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Conference in Memory of Paul Miller

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Special Issue - Conference in Memory of Paul Miller

Phil Lewis, Managing Editor

Paul Miller, one of Australia's most important contributors to the Economics profession, in general, and to Labour Economics, in particular, died on 27 November 2013 after a lengthy battle with cancer. He is sadly missed by all that knew him and those who valued his work.

There have been several tributes to Paul including those of his close friends and colleagues (see, in particular, Bloch, Butler, Chiswick and Tyers 2014, Chiswick 2014; and Leigh 2013). I could do no better than to refer you to these tributes and I could not possibly do better than them in listing and praising Paul's prolific contribution to the profession. I would just like to mention here the immense value he has added to labour economics, particularly in Australia, and his unstinting support of the *AJLE* as a member of the editorial board and a referee since the journal's inception. All connected to the *AJLE*, myself, fellow editors, editorial board, authors and readers, will miss him greatly.

In order to mark the sadness of Paul's passing, but also to celebrate his life's achievements, a number of his friends and colleagues organised a celebration "Honouring Paul Miller". This celebration took place over two days on 11 and 12 November 2014 at The Esplanade Hotel, Fremantle. His long time co-author Barry Chiswick was to deliver the opening address but was unable to attend through ill health. He did, however, provide a few words by way of an opening address in absentia which are included in this issue. Bob Gregory stepped into the role of keynote speaker and provided an excellent presentation based on a chapter on migration policy (Gregory 2014) in Chiswick and Miller (2015). He also looked back on his association with Paul as one of his first students and one of the first in Australia to access census data or regression analysis of immigrant and female labour market outcomes. He particularly pointed out that Paul and Barry were pioneers in developing the world wide interest in language as a means of immigrant labour market integration. Facility in the receiving country language is now widely recognized as being more important than the usual measures of labour market skills.

Bob's address was followed by dinner for friends, family and colleagues – an opportunity to share personal reminiscences of Paul. A program of papers was presented and attendees were invited to present or act as discussants at the sessions.

The best papers have been chosen, after the usual rigorous refereeing process, for publication in this Special Paul Miller Tribute issue of the *Australian Journal of Labour Economics*. They include, fittingly, papers co-authored with Paul himself,

papers by old colleagues and by relative newcomers to the profession. However, they have in common two of the themes for which Paul was best known, namely, the economics of education and of migration. I'm sure Paul would have been pleased to be remembered in this way.

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Negative and Positive Assimilation by Prices and by Quantities

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Abstract

This paper considers the labour market assimilation of immigrants in terms of earnings and employment (employment probability, unemployment probability, and hours worked per week). Using the 2006 Australian Census of Population and Housing, the analyses are performed separately by gender, separately by whether or not the origin is an English-speaking developed country (ESDC), and in comparison to the native-born. Among men in general, 'negative assimilation' is found for immigrants from the ESDC. Among women, the pattern of assimilation in earnings and employment is more positive than among their male counterparts. This may reflect the greater tendency for female immigrants to be tied movers. Among never married immigrant women from the ESDC, who are more likely than married immigrant women from the same countries to be economic migrants, the pattern of negative assimilation is observed.

Keywords: Immigrants, Assimilation, Earnings, Hours worked, Employment, Unemployment

JEL Classification: J61, J31, F22

1. Introduction

Research into the economic adjustment of immigrants has largely had a focus on the changes in their earnings with duration of residence in the destination country (Chiswick, 1978). The typical adjustment profile established in this literature is one of initial earnings disadvantage, followed by a period of relatively rapid increases in earnings, with the rate of increase decreasing over time. This is the stereotype pattern of positive wage assimilation.

Chiswick (1982), Antecol, Kuhn and Trejo (2006) and Miller and Neo (2003) have widened the scope of the labour market outcomes considered in this positive assimilation literature through examination of labour force status: the employment

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probability in the case of Antecol *et al*. (2006), the probability of unemployment in the case of Miller and Neo (2003), and employment, unemployment and weeks worked in Chiswick (1982). Antecol *et al*.'s (2006) study concluded that there was strong evidence of positive employment assimilation among male immigrants. Miller and Neo (2003) reported that male immigrants in Australia experienced relatively high rates of unemployment in the immediate post-arrival period, but this disadvantage dissipated with length of residence. This study also, therefore, finds evidence of positive employment assimilation. Chiswick (1982) found that while recently arrived immigrants in the US worked for fewer weeks than the native born, the weeks worked among established immigrants were generally comparable to those of their native-born counterparts.

Chiswick and Miller (2011)(2012) have recently argued that earnings assimilation patterns should differ between immigrants moving among countries where the skills are highly transferable, such as among the English-speaking developed countries, and those who move between countries where the skills are not highly transferable. They advanced a model where the former group of immigrants would be characterized by 'negative' wage assimilation, in contrast to the 'positive' wage assimilation of the latter group of immigrants.

'Positive Assimilation' refers to the rise in earnings with duration in the destination due to the acquisition of skills, labour market information and networks relevant to the destination. 'Negative Assimilation' refers to the decline in earnings with duration in the destination due to the decline in the economic rent that prompted the migration.

This model was tested using earnings data for male immigrants to the United States and Australia from the major English-speaking immigrant-origin countries. Empirical support for the negative wage assimilation hypothesis was reported.[1] Related to this research, Blau, Kahn and Papps (2011) examine labour market assimilation among immigrants in the United States, using annual hours worked as the index of assimilation. They find that there is positive assimilation for most groups of immigrants, though notable exceptions were immigrants from English-speaking countries and immigrants from countries where English was an official language. This evidence is consistent with the negative assimilation hypothesis (Chiswick and Miller, 2011).

The objective of this paper is to expand the study of Chiswick and Miller (2011) through examination of the patterns of employment, unemployment, hours worked and earnings assimilation for both males and females. The analyses are undertaken for the Australian labour market, a labour market argued by Miller and Neo (2003) and Cobb-Clark and Crossley (2004) to be characterized by considerable wage rigidities that enhanced the prospect of immigrant adjustment occurring through employment rather than earnings. As such it provides a strong testing ground for the negative (employment) assimilation hypothesis. The analyses are based on the 2006 Australian Census of Population and Housing.

[1] In addition to this evidence for immigrants among English-speaking countries, the study by Pedersen *et al*. (2008, 105-6, table 5.8), of immigrants in Sweden, was also consistent with the negative wage assimilation hypothesis for Nordic immigrants and positive assimilation for immigrants from Central and Eastern Europe.

The structure of the study is as follows. Section 2 provides a brief overview of the two models of immigrant economic adjustment: the positive assimilation model and the negative assimilation model. Section 3 describes the data. Section 4 examines the patterns of wage adjustment for immigrants to Australia from the English-speaking developed countries, and contrasts these with the patterns for immigrants from the other countries. Section 5 examines the pattern of change in the probabilities of employment and unemployment for these two groups of immigrants, as well as changes in the hours worked of the employed. A set of sensitivity analyses are presented in section 6, while section 7 concludes.

2. Models of Immigrant Economic Assimilation

The positive immigrant assimilation model of Chiswick (1978), in its simplest form, has three components. First, due to differences across countries in level of economic development, institutions and labour markets, the skills immigrants accumulate in their country of origin are not fully transferable to the destination country. These skills include formal schooling, on-the-job training, language skills, and general knowledge of the functioning of labour markets. Second, due to this less-than-perfect international transferability of human capital skills, and immigrants' response to this through investment in skills relevant for the destination, immigrants will experience considerable wage disadvantages compared to their native-born counterparts immediately after arrival. Third, as investment activity becomes less intense, and as the returns on the post-arrival investments accrue, immigrants' earnings increase, initially quite rapidly, with length of residence in the country of destination, then more slowly. This post-arrival increase in wages is what is now commonly referred to as positive assimilation. Much of the empirical research in the economics of immigration field has been devoted to quantifying aspects of this positive assimilation process.

In contrast, Chiswick and Miller (2011) consider migration between countries with similar labour markets, institutions, languages, and stages of economic development. It is argued that immigration in such situations where skills are highly, if not almost perfectly, transferable is likely to be in response to a favourable draw from the wage distribution in the destination country. An immigrant attracted to Australia to work in the high-wage mining sector at the current time would be an example. Consequently, in the immediate post-arrival period, immigrants would typically initially have higher earnings than their native-born counterparts, because that is what induced the move. The question then is what the future time path of the immigrant's wage will look like? Will they continue to earn relatively high wages, given their human capital skills, or will their position in the wage distribution be subject to a regression to the norm for their skills? Chiswick and Miller (2011) argue that the favourable economic circumstances in sectors of the economy tend not to persist over extended periods of time, and hence a regression to the norm for the immigrant's skills is likely.

Even if such favourable economic conditions in a particular sector could be sustained, if the initial wage offer exceeded the immigrant's true value of marginal product, perhaps because of a high wage draw for random reasons, subsequent wage offers should be more aligned with the immigrant's productivity, in the spirit of the signalling literature. This 'regression to the norm for their skills' in the immigrant's wage, or the decline in the economic rent that stimulated the move, would be expected to occur in terms of real wages, if not in nominal wages. This pattern, whereby the

ceteris paribus wage declines with duration of residence, is what was termed negative assimilation in earnings by Chiswick and Miller (2011).

The negative wage assimilation model of Chiswick and Miller (2011) is based on the incentives for primary movers who are purely economic migrants. The effects under this model would be much weaker, or non-existent, for migrants among the English-speaking developed countries (ESDC) if they are non-economic migrants. Included in this category would be tied movers, refugees, and ideological migrants, though the main group of non-economic migrants among ESDC immigrants in the US or Australia would be tied movers. The best approximation to tied movers is married women, although it needs to be acknowledged that not all married women are tied movers. Accordingly, the analyses below will investigate whether the negative assimilation hypothesis applies to female immigrants as well as male immigrants, and among women does it apply equally to tied movers and economic migrants.

The analyses presented in this paper also examine whether negative assimilation is a characteristic of the probability of employment and the incidence of unemployment, as well as weekly hours worked. The expected patterns of labour quantity adjustment with duration of residence in the destination country have not been explicit in the conceptual frameworks of Chiswick (1978) and Chiswick and Miller (2011). As is apparent from the discussion in Chiswick (1982), Antecol *et al*. (2006) and Miller and Neo (2003), the economic reasoning behind immigrants' positive wage adjustment carries over to the changes in the probabilities of employment and unemployment with duration of residence. In other words, it would be expected that in the immediate post-arrival period, due to the less-than-perfect international transferability of human capital skills, immigrants from non-English-speaking countries will have relatively low probabilities of employment (and high probabilities of unemployment) in an English-speaking developed destination, and that this disadvantage will dissipate with years of residence in the host country. Immigrants from developed English-speaking countries are argued in Chiswick and Miller's (2011) negative assimilation model to be motivated to migrate by a relatively favourable job offer. This implies relatively high (low) probabilities of employment (unemployment) in the immediate post-arrival period. Similar to the wage dynamics, the employment and unemployment experiences of immigrants from developed English-speaking countries are expected to regress to the norm for their set of skills with length of stay in the destination. Trajectories with duration of residence similar to those for the employment probability would be expected in the case of hours worked per week.

The labour market experiences of female immigrants have not been studied to the same extent as those of males, due to the greater selectivity in participating in the paid labour force, and the practical difficulties of accommodating this sample selection in empirical work. Cobb-Clark (1993) is a notable exception. Many female immigrants are likely to experience what Beach and Worswick (1993) have described as a double-disadvantage: they incur a labour market disadvantage because they are immigrants and a further disadvantage because they are female. Then, in the immediate post-arrival period, female immigrants are likely to experience relatively low earnings, employment probabilities (and high unemployment rates), and weekly hours worked. However, with increases in their length of stay in the destination country, they would be expected to experience improvement in their relative economic standing. Moreover, as the typical pattern of economic adjustment reported in the literature is that the speed

of this positive adjustment is inversely related to the extent of the initial disadvantage, it is expected that the improvements in the wage, employment, weekly hours worked, and unemployment positions of female immigrants with duration of residence will be much stronger than those of males.[2]

The general patterns described above for females are likely to match the experiences of immigrants from countries with labour markets, institutions, languages and cultures that differ from those of the host country. In the case of immigrants from countries with highly transferable skills, it would be expected that the immediate post-arrival experience would be more favourable, though as many are likely to be tied movers, the ceteris paribus wage advantage that characterizes their male (primary mover) counterparts is less likely. Instead, the post-arrival experience is likely to be a weakened version of that which characterizes immigrants from non-English-speaking countries. Marital status among female immigrants is used as a proxy for whether they are economic migrants (primary movers) or tied movers.

3. Data

The data for this study are drawn from the 2006 Australian Census of Population and Housing. This census was conducted on 8 August 2006, and a five per cent random sample of records has been made available in the form of a confidentialised unit record file called the '2006 Census Sample File'. This file contains information on labour force status, sector of employment[3], earnings, birthplace, and year of entry into Australia, together with the standard demographic variables that are generally used in studies of labour market outcomes. The birthplace data permit the identification of immigrants from the main English-speaking countries.

The year-of-arrival data for immigrants are presented in categorical form, with the data from 1956 to 2006 divided into five-year arrival cohorts, and the pre-1956 group aggregated into one category. This latter category is, given the time that has elapsed since they came to Australia, of limited importance in studies of labour market activity, where the focus is generally restricted to individuals aged 20-64 years. In the most flexible specification used in the analyses, dichotomous variables for the year-of-arrival cohorts are used in the estimating equation. In other specifications, a continuous 'years of residence in Australia' variable has been formed using the mid-points of the year-of-arrival cohorts, and a value of 56 years for the open-ended, earlier arrivals category. The year of arrival information is also used in combination with the data on chronological age to limit the analyses to those who immigrated as adults (defined as arrival in Australia at or above the 2006 minimum school leaving age of 16 years[4]).

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[2] The family investment model could be used to argue that the female employment rate in the immediate post-arrival period will be relatively high, and hence the post-arrival improvements will be less than otherwise expected. The evidence on this model is, however, mixed: see Baker and Benjamin (1997), Blau, Kahn and Portela-Souza (2003) and Cobb-Clark and Crossley (2004).

[3] Under the Public Service Act 1999, there is the expectation that Australian Public Service workers will be Australian citizens. The citizenship condition can, however, be waived where it is appropriate to do so, such as in cases of a shortage of relevant skills. Appendix A shows that around 11 per cent of male immigrants are in government jobs, as are 15-18 per cent of female immigrants. Approximately 15 per cent of Australian-born male workers and 20 per cent of Australian-born female workers hold government sector jobs.

[4] For earlier arrival cohorts, a younger (15 years) compulsory school leaving age would apply, though this is not used is the analysis.

Most immigrants who arrive as children can be expected to have completed their schooling in Australia, and have superior English language skills, and so their labour market outcomes, and the way these change with duration of residence, may differ from those of the adult immigrants whose economic performance and adjustment is described under the positive assimilation and negative assimilation models. Because of the availability of the year of arrival data only in categories, however, this delineation of the sample will only be approximate. We examine whether the findings are sensitive to this measurement issue in section 6.

Of greater importance to the study of the determinants of earnings is the presentation of the weekly income data in bands. Ten bands are used: (i) $1-$149; (ii) $150-$249; (iii) $250-$399; (iv) $400-$599; (v) $600-$799; (vi) $800-$999; (vii) $1,000-$1,299; (viii) $1,300-$1,599; (ix) $1,600-$1,900 and (x) $2,000 or more. A continuous weekly income figure was computed from these data by using the mid-points of the bands, and a figure of $3,000 for the open-ended upper category. Some previous studies have attempted to accommodate the categorical nature of the income data in the Australian Census by focussing on the weekly income data, analysing these using a grouped regression model, and using supply-side variables as regressors.[5] In the current study, however, the census measure of weekly income was converted to a reasonably continuous hourly measure by dividing through by the hours worked.[6] Descriptions of all variables, along with means and standard deviations, are provided in appendix A.

4. Assimilation by Prices

Consistent with the negative assimilation model, at arrival male ESDC immigrants earned 12 per cent more than the native born, other variables the same, but the male non-ESDC immigrants earned 17.5 per cent less than their native-born counterparts, both differences being statistically significant. (Regressions not shown here.) Table 1 presents the results from the regression analyses of the wages of adult male and female immigrants living in Australia by country of origin, using data from the 2006 Australian Census. A number of specifications of the estimating equation were computed, and these differed in the way in which the Census information on the duration of stay in Australia (YSM) is utilized. As noted in section 3, this information is included in the Census unit record file in categorical form, with eleven year-of-arrival groups being distinguished. This detailed categorical information was used in preliminary estimations, though only the results from models based on a continuous YSM variable are reported.[7] This continuous variable was formed using the mid-points of the intervals in the categorical data. It is used in quadratic form in the table 1, column (i) specification, and in linear form in the column (ii) specification. The first four columns of table 1 are for males, and the final four columns of results are for females.[8] For each gender, the first two

[5] See Barrett (2002) and Lee (2003). The comparisons in Lee (2003) between the estimates he obtained from a grouped regression model and those in studies that use OLS suggest that the two approaches yield similar results.

[6] There are only minor changes in the duration of residence effects recorded when weekly rather than hourly earnings are used as the dependent variable.

[7] The full set of results is presented in a supplementary appendix, available from the authors.

[8] Note that these results are obtained using OLS, without any correction for selectivity in employment. This approach is preferred when there is weak identification of the selection equation. The Census data does not contain variables that we are confident will be valid, strong instruments. The similarities of the conclusions from the study of wages (which may be prone to selection bias) and the study of employment probabilities below (which are not subject to such bias) is reassuring.

columns of results are for immigrants from the non-English-speaking countries and the final two columns of results are for immigrants from the English-speaking developed countries (ESDC).

The estimated effects associated with the control variables, other than years since migration, are broadly consistent with prior research (see, for example, Chiswick and Miller (1985) for Australia, and Ferrer and Riddell (2008) for Canada), and in the interests of brevity they will not be discussed here. Rather, the focus will be on the effects of 'years since migration'. Note that as their associated partial effects are often relatively small, each of the years since migration variables has been scaled (the linear term has been divided by 10 and the squared term has been divided by 100). The effects of the years since migration variables show contrasting outcomes for immigrants from non-English-speaking countries and those from the main English-speaking developed countries. The effects also differ between males and females.

Table 1 - Estimates of Determinants of the Natural Logarithm of Hourly Earnings among Employed Male and Female Immigrants who Arrived as Adults, Australia, 2006

	Males				*Females*			
	non-ESDC		*ESDC*		*non-ESDC*		*ESDC*	
Variable	*(i)*	*(ii)*	*(i)*	*(ii)*	*(i)*	*(ii)*	*(i)*	*(ii)*
Constant	1.993	2.000	1.785	1.785	1.972	1.972	1.922	1.923
	(58.72)	(58.93)	(42.34)	(42.34)	(50.02)	(50.02)	(38.06)	(38.13)
Education	0.058	0.058	0.085	0.085	0.054	0.054	0.076	0.076
	(34.02)	(33.78)	(37.65)	(37.68)	(26.46)	(26.49)	(27.33)	(27.35)
Experience	0.024	0.019	0.024	0.024	0.017	0.017	0.018	0.018
(EXPER)	(13.57)	(12.31)	(9.59)	(10.63)	(8.40)	(10.05)	(6.36)	(7.53
EXPER	-0.038	-0.027	-0.037	-0.037	-0.031	-0.031	-0.034	-0.035
Squared/100	(10.73)	(8.99)	(8.15)	(9.06)	(7.26)	(8.65)	(6.29)	(7.53)
Speaks English	-0.111	-0.118	-0.085	-0.085	-0.048	-0.048	-0.095	-0.096
Very Well/Well	(8.53)	(9.08)	(3.11)	(3.11)	(3.57)	(3.57)	(3.01)	(3.03)
Speaks English Not	-0.251	-0.263	0.100	0.100	-0.193	-0.193	-0.093	-0.097
Well/Not at All	(12.84)	(13.52)	(0.54)	(0.54)	(9.00)	(9.00)	(0.15)	(0.16)
Married	0.076	0.077	0.117	0.117	-0.006	-0.006	-0.032	-0.032
	(6.36)	(6.50)	(8.61)	(8.62)	(0.47)	(0.48)	(2.20)	(2.21)
Government Sector	0.237	0.236	0.074	0.074	0.190	0.190	0.037	0.037
	(14.74)	(14.71)	(4.30)	(4.30)	(12.76)	(12.77)	(2.23)	(2.23)
Years Since	-0.070	0.022	-0.024	-0.024	0.076	0.072	0.040	0.025
Migration	(4.09)	(3.34)	(1.28)	(3.51)	(3.67)	(9.06)	(1.70)	(3.11)
(YSM)/10								
YSM Squared/100	0.025	(a)	0.000	(a)	0.001	(a)	-0.004	(a)
	(5.85)		(0.02)		(0.25)		(0.65)	
Adjusted R^2	0.131	0.129	0.136	0.136	0.104	0.104	0.095	0.095
Sample Size	17,873	17,873	12,388	12,388	14,566	14,566	9,526	9,526

Notes: 't' statistics in parentheses; (a) = Variable not entered; 'Speaks only English at Home' is the benchmark category for the English proficiency variables. This applies to all of the regression equations.
Source: Australian Census of Population and Housing, 2006, Census Sample File.

Consider males. The relationship between earnings and duration of stay in Australia among male immigrants from the non-English-speaking countries is characterized by an atypical pattern, in that the coefficient on the linear years since migration variable is negative (this is usually positive) and the coefficient on the quadratic term is positive (this is usually negative). Examination of the results for the more detailed specification based on the dichotomous immigrant arrival cohorts (see the statistical appendix) shows that this result is driven by the relatively strong labour market performance of those who arrived in Australia since 2000. This could reflect either greater self selection in migration in times of economic downturn, or the progressive tightening over the 1990s of the points system used to select skilled immigrants by Australia (see, Chiswick and Miller, 2006). The summary provided by the linear duration of residence variable in column (ii) indicates that the earnings-duration relationship is positive, with earnings increasing at the rate of one-fifth of a percentage point per year of stay in Australia. Past research in Australia (e.g., Chiswick and Miller, 1985) has similarly reported quite weak price adjustment.

In the case of male immigrants from English-speaking countries (ESDC), a negative association between earnings and duration of stay is observed in both models. This offers evidence in support of the negative assimilation hypothesis (Chiswick and Miller, 2011). Based on the linear duration specification, there is a statistically significant decline in earnings, at the rate of 0.2 of one percentage point per year of residence in Australia. This negative assimilation effect in Australia is smaller than the results based on the 2000 US Census, where the comparative rate is a decline of around 0.7 of one percentage point per year of duration in the US (Chiswick and Miller, 2011).

Hence, the pattern of earnings adjustment of male immigrants in Australia shows weak negative assimilation for immigrants from the English-speaking developed countries and modest positive assimilation for those from the non-English-speaking countries. This is a muted version of the pattern observed in the US. This is consistent with the research by Antecol, Kuhn and Trejo (2006) and Miller and Neo (2003), where it is argued that due to the rigidity of the wage structure, immigrant adjustment in Australia is more through quantity adjustment (employment) than through price adjustment.

In the case of female immigrants from non-English-speaking countries, both the quadratic and linear models indicate significant positive assimilation in earnings. Based on the linear duration variable, their earnings improve at the rate of 0.7 of one percentage point per year. The positive earnings adjustment with duration of residence in Australia for women from non-English-speaking countries is thus much stronger than that observed for men.

The results for the various measures of duration of stay in Australia indicate that there is also positive assimilation for earnings among female immigrants from English-speaking countries. The linear duration variable indicates an improvement of earnings at 0.3 of one percentage point per year in Australia.

Thus, the more positive earnings adjustment for female immigrants from non-English-speaking countries compared to males from those countries carries over to the analyses for women from the English-speaking countries, where the earnings-

duration of residence effect is mildly positive for women and negative for men. A weaker negative earnings effect, or even a positive effect, is what would be expected where the sample of female immigrants from English-speaking countries includes a sizeable proportion of tied movers, for whom, as discussed in section 2, the negative assimilation model is not readily applicable, or is applicable only for the subset who were primary movers. We examine this matter further in section 6.[9]

In summary, these analyses of the earnings data from the 2006 Australian Census provide evidence of weak positive earnings (price) assimilation among male immigrants from non-English-speaking countries, and evidence of modest negative earnings (price) assimilation among male immigrants from English-speaking countries. Analysis of the earnings of female immigrants reveals evidence of stronger positive price assimilation among those from non-English-speaking countries, whereas among female immigrants from English-speaking countries there is weak, positive assimilation. The findings are consistent with female immigrants from the ESDC being more likely to be tied movers than their economic migrant male counterparts.

5. Assimilation by Quantities

The patterns of assimilation by quantities are examined in this section. In the first instance the index of adjustment will be the employment rate. This has previously been studied by Antecol *et al*. (2006), albeit without the distinction between immigrants from English-speaking and non-English-speaking countries. Following this, attention turns to the unemployment rate that formed the basis of the analyses by Miller and Neo (2003). Then the changes with duration of residence in hours worked among the employed will be examined.

(a) Employment Assimilation

Table 2 reports the analysis of the determinants of the probability of being employed (compared to being either unemployed or not in the labour force) among immigrants in Australia in 2006. The structure of this table is the same as that of table 1. While the dependent variable in these analyses is a dichotomous indicator of whether the individual was employed or not at the time of the Census, the analyses are undertaken using Ordinary Least Squares. The findings from this statistical approach do not differ in any material way from those obtained using non-linear binary choice models, and yet are easier to interpret. The results for the control variables, other than duration of residence, have interpretations consistent with those presented for the analyses of the determinants of earnings. The discussion that follows will focus on the estimated effects of duration of residence and country of origin on the probability of being employed.

[9] Of the recent adult immigrants who entered Australia on permanent skilled visas, 77 per cent of males, but only 35 per cent of females, were the primary visa applicant. Alternatively stated, among the main applicants, 70 per cent were males, and among those who were not the main applicant, only 27 per cent were males (see, Australian Bureau of Statistics, 2011).

Table 2 - Estimates of Determinants of Employment among Male and Female Immigrants who Arrived as Adults, Australia, 2006

	Males				*Females*			
	non-ESDC		*ESDC*		*non-ESDC*		*ESDC*	
Variable	*(i)*	*(ii)*	*(i)*	*(ii)*	*(i)*	*(ii)*	*(i)*	*(ii)*
Constant	-0.671	-0.806	0.140	0.045	-0.720	-0.946	-0.499	-0.666
	(18.09)	(23.57)	(2.99)	(1.01)	(18.43)	(26.09)	(8.05)	(11.32)
Education	0.019	0.019	0.009	0.009	0.034	0.035	0.028	0.027
	(21.65)	(22.06)	(8.06)	(7.95)	(36.15)	(36.64)	(18.59)	(18.32)
Age	0.059	0.067	0.033	0.039	0.042	0.057	0.046	0.057
	(31.70)	(41.76)	(14.91)	(19.61)	(21.65)	(33.88)	(15.71)	(22.04)
Age Squared/100	-0.073	-0.083	-0.044	-0.051	-0.053	-0.070	-0.060	-0.073
	(34.47)	(44.45)	(18.05)	(23.04)	(23.35)	(35.21)	(18.35)	(25.07)
Speaks English	-0.043	-0.038	-0.016	-0.019	-0.056	-0.056	-0.048	-0.054
Very Well/Well	(5.75)	(5.19)	(1.14)	(1.35)	(7.35)	(7.33)	(2.61)	(2.90)
Speaks English Not	-0.216	-0.209	-0.192	-0.199	-0.250	-0.247	-0.111	-0.136
Well/Not at All	(21.69)	(21.05)	(2.25)	(2.34)	(25.76)	(25.43)	(0.35)	(0.43)
Married	0.104	0.102	0.080	0.078	-0.009	-0.016	-0.049	-0.052
	(16.31)	(15.98)	(11.96)	(11.67)	(1.54)	(2.57)	(5.72)	(6.05)
Years Since	0.112	0.033	0.054	-0.031	0.185	0.047	0.130	0.029
Migration	(12.19)	(9.36)	(5.80)	(0.95)	(18.75)	(12.52)	(10.08)	(6.34)
(YSM)/10								
YSM Squared/100	-0.020	(a)	-0.014	(a)	-0.036	(a)	-0.026	(a)
	(9.31)		(6.56)		(15.12)		(8.39)	
Adjusted R^2	0.160	0.158	0.106	0.104	0.156	0.150	0.094	0.090
Sample Size	26,475	26,475	15,434	15,434	30,294	30,294	15,036	15,036

Notes: 't' statistics in parentheses; (a) = Variable not entered.
Source: Australian Census of Population and Housing, 2006, Census Sample File.

The table 2 column (i) specification for male immigrants from non-English-speaking countries reveals that there is strong, positive employment assimilation. Thus, in the quadratic specification, the positive coefficient on the linear duration variable is quite sizeable, and the negative coefficient on the squared term is more modest. Using the linear variable as an over-all summary of the employment probability-duration of residence relationship, table 2 column (ii) indicates that there is an improvement in the probability of being employed of around one-third of a percentage point per extra year of residence in Australia.

The findings for the employment adjustment of male immigrants from English-speaking countries diverge from those for their counterparts from non-English-speaking countries. The quadratic specification for the duration of residence information is characterized by a positive coefficient on the linear term (which is one-half of the size of the coefficient for the non-English-speaking immigrants sample), and by a relatively more sizeable negative coefficient on the squared term (which is two-thirds the size of the respective coefficient for the non-English-speaking immigrants sample). When the relationship between the probability of employment and the duration of residence in Australia is summarised using a single linear duration of residence variable, the estimated coefficient is statistically insignificant.

Hence, the general pattern that emerges from the table 2 analyses of the employment probability of adult male immigrants is one of pronounced, positive employment assimilation among immigrants from non-English-speaking countries, and negligible (negative) employment assimilation among immigrants from English-speaking countries. These findings are for a labour market where the relatively high degree of wage rigidity is likely to make positive employment assimilation a more likely outcome (Miller and Neo, 2003; Cobb-Clark and Crossley, 2004).

The findings for female immigrants from non-English-speaking countries are an accentuated version of the results for male immigrants from these countries. Hence, the estimated coefficient on the linear years since migration variable is almost twice the size of that reported for their male counterparts. Thus, in parallel with the study of wage assimilation, the positive employment assimilation is also more intense for females than for males.

Female immigrants from English-speaking countries are also characterized by positive employment assimilation, but this is weaker than is the case for their counterparts from non-English-speaking countries. In particular, the average improvement in the employment probability would only be around one-half as large for female immigrants from English-speaking countries as it is for female immigrants from other countries.

Thus, both groups of female immigrants are characterized by positive employment assimilation, but this assimilation is much weaker among immigrants from English-speaking countries than it is among other female immigrants.

(b) Unemployment Assimilation

Table 3 presents the results from the analysis of the incidence of unemployment among those in the paid labour force. The model used here is the same as that adopted for the study of the employment probability, although the samples for the current sets of analyses are restricted to those in the labour force (i.e., are employed or unemployed).

Among male immigrants from non-English-speaking countries, the unemployment probability declines with length of stay in Australia (see table 3, columns (i) and (ii)). The decline is by about 0.2 of a percentage point per year. In other words, among this group of immigrants, there is positive assimilation by quantities when the incidence of unemployment is used as the index of adjustment. Among male immigrants from English-speaking countries, the incidence of unemployment also declines with length of stay in Australia, though the downward adjustment is negligible in size, and statistically insignificant.

The findings for female immigrants from the study of the probability of being unemployed inform on a, by now, compelling story. Female immigrants from non-English-speaking countries are characterized by more pronounced reductions in the probability of being unemployed with increases in their duration in Australia. That is, the analysis of the determinants of unemployment among female immigrants from non-English-speaking countries reveals evidence consistent with strong, positive employment assimilation. The coefficient on the linear duration variable indicates that the incidence of unemployment declines by 0.3 of a percentage point per year of residence in Australia, an effect 50 per cent greater than the impact among their male counterparts.

Table 3 - Estimates of Determinants of Unemployment among Male and Female Immigrants who Arrived as Adults and who Participate in the Labour Force, Australia, 2006

	Males				*Females*			
	non-ESDC		*ESDC*		*non-ESDC*		*ESDC*	
Variable	*(i)*	*(ii)*	*(i)*	*(ii)*	*(i)*	*(ii)*	*(i)*	*(ii)*
Constant	0.444	0.461	0.162	0.180	0.404	0.459	0.157	0.180
	(15.52)	(17.47)	(6.02)	(7.02)	(11.57)	(14.17)	(4.74)	(5.77)
Education	-0.005	-0.005	-0.003	-0.003	-0.006	-0.006	-0.005	-0.005
	(7.94)	(8.02)	(4.49)	(4.44)	(8.12)	(8.22)	(6.29)	(6.24)
Age	-0.013	-0.014	-0.004	-0.005	-0.007	-0.011	-0.001	-0.003
	(8.97)	(11.14)	(2.90)	(4.23)	(4.11)	(7.08)	(0.68)	(1.88)
Age Squared/100	0.015	0.016	0.005	0.006	0.007	0.012	0.001	0.003
	(9.15)	(11.27)	(3.49)	(4.89)	(3.41)	(6.17)	(0.63)	(1.83)
Speaks English	0.013	0.012	0.002	0.003	0.017	0.016	0.038	0.039
Very Well/Well	(2.47)	(2.36)	(0.28)	(0.35)	(2.88)	(2.73)	(4.05)	(4.12)
Speaks English Not	0.068	0.067	-0.044	-0.043	0.113	0.111	-0.093	-0.088
Well/Not at All	(9.09)	(8.99)	(0.80)	(0.77)	(12.96)	(12.82)	(0.48)	(0.45)
Married	-0.049	-0.049	-0.032	-0.032	-0.025	-0.024	-0.017	-0.017
	(10.74)	(10.69)	(8.26)	(8.18)	(5.08)	(4.88)	(3.92)	(3.88)
Years Since	-0.030	-0.020	-0.013	-0.002	-0.064	-0.030	-0.020	-0.007
Migration	(4.54)	(7.95)	(2.44)	(1.18)	(7.45)	(9.18)	(2.95)	(2.81)
(YSM)/10								
YSM Squared/100	0.003	(a)	0.003	(a)	0.009	(a)	0.004	(a)
	(1.56)		(2.16)		(4.24)		(2.09)	
Adjusted R^2	0.032	0.032	0.010	0.010	0.042	0.041	0.008	0.007
Sample Size	21,056	21,056	13,692	13,692	17,613	17,613	10,732	10,732

Notes: 't' statistics in parentheses; (a) = Variable not entered.
Source: Australian Census of Population and Housing, 2006, Census Sample File.

Turning to the results for female immigrants from English-speaking countries, it is apparent that there are modest reductions in the probability of unemployment with increases in the length of stay in Australia. The summary of the effects of duration of residence on the probability of being unemployed provided by the coefficient on the linear duration of residence variable indicates that this relationship is negative, statistically significant, but quite weak: The estimated coefficient is only -0.001.

(c) Hours Worked Assimilation

The final set of analyses, reported in table 4, cover the determinants of hours worked among employed immigrants. Thus, the sample used here is the same as that used for the study of hourly wages in table 1, and without correction for selectivity in employment. The hourly wage data were constructed by dividing the weekly income by hours worked. Hence, in principle, evidence of minimal hourly wage assimilation among immigrants from non-English-speaking countries could arise from off-setting growth in weekly earnings and in their weekly hours of work with duration in Australia. Similarly, the evidence of negative hourly wage assimilation among immigrants from English-speaking countries could be attributable to either a decline

in their weekly earnings or an increase in their weekly hours of work with duration of residence in Australia.

The evidence in table 4 for males, for the control variables, is consistent with expectations. The better educated, those with more general labour market experience (at least up to around 25 years of labour market activity), those most proficient in English, the married, and workers in the private sector, all supply more labour than their counterparts. Male immigrants from non-English-speaking countries increase their hours of work with duration in Australia; according to the linear specification in table 4 column (ii), hours of work per week increase by around two-fifths of a percentage point per year in Australia. This positive hours of work assimilation occurs simultaneously with the minor hourly wage adjustment documented earlier. In other words, there is a gently upward sloping labour supply (hours worked) curve.

In the case of male immigrants from English-speaking countries, the results for the linear duration of residence specification in table 4 reveal there is negligible hours of work assimilation. This negligible hours of work adjustment occurs simultaneously with the negative hourly wage adjustment that was reported in table 1.

Table 4 - Estimates of Determinants of the Natural Logarithm of Hours Worked among Employed Male and Female Immigrants who Arrived as Adults, Australia, 2006

	Males				*Females*			
	non-ESDC		*ESDC*		*non-ESDC*		*ESDC*	
Variable	*(i)*	*(ii)*	*(i)*	*(ii)*	*(i)*	*(ii)*	*(i)*	*(ii)*
Constant	3.144	3.140	3.502	3.502	2.929	2.928	3.291	3.292
	(124.13)	(124.03)	(118.92)	(118.91)	(76.43)	(76.35)	(67.11)	(67.20)
Education	0.008	0.008	0.004	0.004	0.017	0.017	0.015	0.015
	(6.21)	(6.37)	(2.75)	(2.67)	(8.42)	(8.60)	(5.50)	(5.48)
Experience	0.024	0.027	0.015	0.016	0.012	0.018	0.005	0.006
(EXPER)	(18.30)	(23.62)	(8.55)	(10.51)	(6.27)	(10.58)	(1.86)	(2.35)
EXPER	-0.046	-0.051	-0.033	-0.036	-0.022	-0.033	-0.015	-0.016
Squared/100	(17.36)	(22.68)	(10.41)	(12.64)	(5.41)	(9.46)	(2.86)	(3.52)
Speaks English	-0.062	-0.059	0.018	0.017	-0.013	-0.008	0.026	0.026
Very Well/Well	(6.40)	(6.08)	(0.95)	(0.88)	(0.96)	(0.63)	(0.85)	(0.83)
Speaks English	-0.119	-0.114	-0.365	-0.368	-0.064	-0.058	0.340	0.338
Not Well/Not at All	(8.19)	(7.83)	(2.81)	(2.84)	(3.09)	(2.76)	(0.58)	(0.57)
Married	0.091	0.091	0.053	0.053	0.015	0.012	-0.131	-0.131
	(10.29)	(10.20)	(5.61)	(5.54)	(1.24)	(1.06)	(9.31)	(9.32)
Government Sector	-0.024	-0.024	-0.056	-0.056	0.019	0.020	0.051	0.051
	(2.02)	(2.01)	(4.62)	(4.62)	(1.34)	(1.39)	(3.14)	(3.14)
Years Since	0.082	0.038	0.024	-0.003	0.113	0.017	-0.003	-0.013
Migration	(6.40)	(7.61)	(1.80)	(0.56)	(5.60)	(2.19)	(0.15)	(1.69)
(YSM)/10								
YSM Squared/100	-0.012	(a)	-0.007	(a)	-0.027	(a)	-0.003	(a)
	(3.73)		(2.15)		(5.15)		(0.47)	
Adjusted R^2	0.066	0.065	0.029	0.029	0.018	0.017	0.023	0.023
Sample Size	17,873	17,873	12,388	12,388	14,566	14,566	9,526	9,526

Notes: 't' statistics in parentheses; (a) = Variable not entered.
Source: Australian Census of Population and Housing, 2006, Census Sample File.

Table 4 also reports the findings from the companion set of analyses for female immigrants. Among female immigrants from non-English-speaking countries, the coefficients on the arrival cohort variables in the table 4 column (i) specification indicate positive hours of work adjustment for the first 20 years in Australia. Beyond this threshold, however, hours worked per week decline with residence in Australia. The linear years since migration variable has a positive, statistically significant, coefficient of 0.002. In comparison to negatively-sloped pattern, the hours worked per week by female immigrants from the English-speaking countries tend to decline with duration in Australia, though the 't' statistic on the negative coefficient is only 1.69.

Overall, the study of the determinants of hours of work for females shows that the pattern for immigrants from non-English-speaking countries is consistent with the conventional positive assimilation trajectory, whereas that for immigrants from English-speaking developed countries shows that hours worked decline with duration in Australia.

6. Sensitivity Analysis

Three issues are investigated in this section. The first is a comparison of analyses for hourly earnings and weekly earnings. The second is whether the findings for female immigrants are sensitive to the use of the limited information available on whether they are tied movers or economic migrants. The third issue relates to the sensitivity of the findings to the age threshold used to define adult immigrants.

(a) Hourly Earnings vs. Weekly Earnings

Given these patterns in the hours of work adjustment with duration of residence in Australia, the hourly earnings analyses presented earlier were repeated using the natural logarithm of weekly earnings as the dependent variable. When the natural logarithm of hours worked was included as an explanatory variable, it had a coefficient of around 0.6, and the findings are very similar to those reported in table 1.[10] In the supplementary appendix, results from regressions estimated on weekly earnings without the hours worked regressor are reported. Table 5 presents the estimated coefficient from the linear years since migration variable from the separate estimations of the determinations of usual weekly earnings, together with the estimates for this variable from the analyses of hourly earnings and hours worked per week.[11] Presenting the estimates from these three models together seems to be informative. For comparison purposes, the coefficients for the education variable are also presented.

Among male immigrants from non-English-speaking countries (table 5), some minor price adjustment occurs via hourly earnings, and is reinforced by a labour supply effect on hours worked. As a result positive price adjustment is more apparent when weekly earnings are examined than when the focus in on hourly earnings. Among male immigrants from English-speaking countries, there is negative price adjustment when hourly earnings are examined, and trivial negative adjustment via

[10] The low coefficient on the natural log of hours worked (elasticity of 0.6) is consistent with substantial measurement error in the hours variable.
[11] Recall that the three dependent variables are related: ln(hourly earnings) = ln(weekly earnings) – ln(hours per week).

hours worked. Consequently, when weekly earnings are examined, there remains the evidence of negative adjustment.

Among female immigrants, there is evidence of positive price adjustment among those from English-speaking countries and those from non-English-speaking countries when the index of adjustment is the hourly rate of pay. The table 5 evidence shows that the hours worked by female immigrants from non-English-speaking countries increase slightly with increases in the length of time they have resided in Australia, whereas the hours worked by female immigrants from English-speaking countries decline slightly with length of residence in Australia.

Table 5 - Selected Estimates of Determinants of the Natural Logarithm of Weekly Earnings, Natural Logarithm of Hourly Earnings and the Natural Logarithm of Weekly Hours Worked among Employed Immigrants who Arrived as Adults, by Gender, Australia, 2006

	non-English-speaking countries			*English-speaking developed countries*		
Variable	*Weekly Earnings*	*Hourly Earnings*	*Hours Worked*	*Weekly Earnings*	*Hourly Earnings*	*Hours Worked*
Males						
Education	0.066	0.058	0.008	0.090	0.085	0.004
	(36.58)	(33.78)	(6.37)	(38.40)	(37.68)	(2.67)
Years Since Migration (YSM)/10	0.060	0.022	0.038	-0.027	-0.024	-0.003
	(8.56)	(3.34)	(7.61)	(3.79)	(3.51)	(0.56)
Females						
Education	0.071	0.054	0.017	0.090	0.076	0.015
	(31.73)	(26.49)	(8.60)	(29.05)	(27.35)	(5.48)
Years Since Migration (YSM)/10	0.088	0.072	0.017	0.012	0.025	-0.013
	(10.19)	(9.06)	(2.19)	(1.30)	(3.11)	(1.69)

Note: 't' statistics in parentheses.
Source: Australian Census of Population and Housing, 2006, Census Sample File.

The negative labour supply effect combines with the modest nature of the positive hourly wage effect to result in a statistically insignificant relationship between the weekly earnings and duration in Australia for female immigrants from English-speaking countries. In contrast, the relationship between the weekly earnings and duration of residence in Australia for female immigrants from non-English-speaking countries is positive.

Hence, when the focus is on weekly rather than hourly earnings, there is evidence of negative earnings assimilation among male immigrants from English-speaking countries, and negligible price adjustment among female immigrants from these countries. This sits side-by-side with the strong positive earnings adjustment of both male and female immigrants from non-English-speaking countries.

(b) Motive for Migration among Females

Differences in findings for male and female immigrants could reflect a greater proportion of tied immigrants among females. The census data does not, however, contain information on the motive for migration. Nevertheless, it is possible that some insight into this can be gained through the use of the census marital status information, in conjunction with information on the birthplace of the oldest child in the family home. Hence, foreign-born females who arrived in Australia as an adult and who were listed as never married at the time of the census were categorized as economic immigrants. Foreign-born females who were, or had been, married at the time of the census and whose oldest child (still living at home) was born abroad were categorized as tied immigrants.[12] These two groups comprise, respectively, 17 per cent and 19 per cent of the sample of adult female immigrants from non-English-speaking countries, and 20 and 19 per cent of those from English-speaking countries. All other foreign-born female immigrants have their motive for migration categorized as 'unsure'. Dichotomous variables for 'unsure' and 'tied' were entered into the earnings equation (the reference group is 'economic' immigrants), together with interaction terms between these dichotomous variables and the linear years since migration variable. Selected results are presented in table 6.

Among female immigrants from non-English-speaking countries, the ranking of earnings at the time of arrival, from highest to lowest, is 'unsure', 'tied' and 'economic'. Economic immigrants are characterized by strong earnings growth with length of residence in Australia, whereas the earnings growth for the other two groups, whilst positive, is much more modest.

Table 6 - Selected Regression Coefficients of Model of Earnings Determination for Adult Female Immigrants with Motive for Migration Variables[(a)]

Variable	*non-English Speaking Countries*	*English-Speaking Countries*
Years Since Migration	0.242	-0.023
(YSM)/10	(11.87)	(1.13)
Tied Immigrant	0.088	-0.350
	(2.54)	(8.62)
Unsure of Motive for Migration	0.200	-0.148
	(7.19)	(4.35)
YSM/10 * Tied	-0.132	0.100
	(5.38)	(3.64)
YSM/10 * Unsure	-0.186	0.013
	(9.26)	(0.62)

[(a)] Benchmark is 'economic migrants', as defined in the text.
Source: Australian Census of Population and Housing, 2006, Census Sample File.

[12] There is no information available in the census on year or age at current or first marriage or on children who do not live with their parents.

This suggests that the initial earnings disadvantage of economic immigrants is a result of their post-arrival investment in destination-specific human capital. As a result of this investment, after around 11 years of residence in Australia, the female economic immigrants have higher earnings than the other two motive-for-migration groups of women.

In contrast, among female immigrants from English-speaking countries, the ranking of earnings at the time of arrival, from highest to lowest, is 'economic', 'unsure' and 'tied'. The earnings of economic immigrants are characterized by a decline, albeit insignificant, with duration of residence in Australia, whereas the 'tied' group, which has the lowest earnings at arrival, is characterized by significant earnings growth with duration in Australia.

Hence, although the categorization of female immigrants according to motive for migration is crude, the findings for the economic immigrants are more aligned with the predictions of the positive (for immigrants from non-English-speaking countries) and negative (for immigrants from English-speaking countries) assimilation models than the analyses conducted using the data pooled across all female migrants. The collection of data on visa status at entry and motive for migration would assist further research endeavours.

(a) Sensitivity to Age at Migration

Turning to the third test of robustness, it is noted that the sample of immigrants who arrived in Australia as adults may be defined imprecisely, due to the fact that an age at migration has to be inferred from the census self reports on age and year of arrival in Australia, and the year of arrival information is presented only in five-year bands. To examine the effect that this coarse nature of the measure of age at migration might have on the analyses, the analyses of hourly and weekly earnings, employment, unemployment and hours worked were undertaken on two further populations: the sub-set of immigrants who arrived in Australia at age 18 or more, and the sample of all immigrants (that is, those who arrived as children as well as those who arrived as adults). The immigrants who arrived in Australia aged more than 18 years comprise around 58 per cent of the total sample, whereas those who arrived in Australia aged more than 15 years are about 64 per cent of the initial sample. Relevant findings in relation to the linear years since migration variables for the three samples are reported in table 7. These results relate to the five labour outcomes: hourly earnings, employment, unemployment, hours worked and weekly earnings.

The estimated coefficients indicate that there is only one outcome for immigrants from non-English-speaking countries which appear to be sensitive to the composition of the sample. Thus, among adult male immigrants from non-English-speaking countries who were more than 18 years at the time of arrival, the years since migration effect is statistically insignificant in the hourly earnings equation. It remains statistically significant in the weekly earnings equation, and the labour supply indices are also characterized by strong positive assimilation. One would therefore conclude from the complete set of results for adult immigrants from non-English-speaking countries that their labour market outcomes are characterized by positive assimilation, and that this adjustment profile is stronger for females than for males.

Among immigrants from English-speaking countries, the main change observed as the sample is narrowed from all immigrants to adult immigrants is a weakening of the negative quantity assimilation that characterizes the adjustment of males with increases in their length of residence in Australia. To generate this change, compared to adult immigrants, those who arrived as children must have either high hours worked/employment probabilities among recent arrivals, or low hours worked/employment probabilities among longer-term settlers. This would also appear to be the case among female immigrants from English-speaking countries. As immigrants who arrived as children should, given the age restriction on the sample (20-64 years), not greatly impact the results for recent arrivals, the change in the table 7 results between all immigrants and adult immigrants must imply that immigrants who arrived as children and who are in the longer duration of residence categories have relatively low weekly hours worked.

Table 7 - Estimated Relationship Between Labour Market Outcomes and Linear Duration of Residence Variable(a), All Immigrants and Adult Immigrants By Gender, Australia 2006

	non-English-speaking countries			*English-speaking developed countries*		
Dependent Variable	*All Immigrants*	*Adult Immigrants (> 15)*	*Adult Immigrants (> 18)*	*All Immigrants*	*Adult Immigrants (> 15)*	*Adult Immigrants (> 18)*
A. Males						
1. Hourly Earnings	0. 039	**0.022**	0.007	-0.016	**-0.024**	-0.023
	(10.87)	**(3.34)**	(0.98)	(4.83)	**(3.51)**	(3.04)
2. Employment	0.027	**0.033**	0.029	-0.009	**-0.003**	0.001
	(13.68)	**(9.36)**	(7.44)	(5.30)	**(0.95)**	(0.22)
3. Unemployment	-0.013	**-0.020**	-0.019	0.000	**-0.002**	-0.004
	(9.21)	**(7.95)**	(6.45)	(0.12)	**(1.18)**	(1.93)
4. Hours Worked	0.034	**0.038**	0.032	-0.006	**-0.003**	-0.000
	(12.64	**(7.61)**	(5.82)	(2.51)	**(0.56)**	(0.05)
5. Weekly Earnings	0.074	**0.060**	0.040	-0.022	**-0.027**	-0.023
	(19.46)	**(8.56)**	(4.99)	(6.42)	**(3.79)**	(2.99)
Sample Size	26,716	**17,873**	15,953	19,823	**12,388**	11,509
B. Females						
1. Hourly Earnings	0.063	**0.072**	0.059	0.014	**0.025**	0.034
	(15.35)	**(9.06)**	(6.62)	(3.42)	**(3.11)**	(3.19)
2. Employment	0.046	**0.047**	0.050	0.012	**0.029**	0.035
	(21.17)	**(12.52)**	(11.84)	(5.19)	**(6.34)**	(6.96)
3. Unemployment	-0.020	**-0.030**	-0.031	-0.003	**-0.007**	-0.010
	(12.59)	**(9.18)**	(8.16)	(2.72)	**(2.81)**	(3.69)
4. Hours Worked	0.006	**0.017**	0.012	-0.024	**-0.013**	-0.014
	(1.41)	**(2.19)**	(1.37)	(5.96)	**(1.69)**	(1.66)
5. Weekly Earnings	0.068	**0.088**	0.071	-0.010	**0.012**	0.014
	(15.19)	**(10.19)**	(7.27)	(2.30)	**(1.30)**	(1.40)
Sample Size	21,851	**14,566**	12,985	15,930	**9,526**	8,681

Notes: (a)=duration of residence variable divided by 10; numbers of observations listed in the table are based on the samples for the earnings regressions. Regression results in columns in bold are from tables 1 to 5 for those who immigrated at more than 15 years of age.
Source: Australian Census of Population and Housing, 2006, Census Sample File.

7. Conclusion

Among economic migrants, immigrant adjustment with duration in a destination is expected to differ depending on whether the immigrants are from countries where skills are highly transferable to the destination or from low-skill transferability countries. Among immigrants from low skill transferability countries, positive economic adjustment is expected. The hypothesis is that there will be improvements with duration in the destination in hourly and weekly earnings, increases in the employment probability and hours worked per week, and decreases in the probability of unemployment. Among economic migrants from very high skill transferability countries, however, negative economic adjustment is hypothesized. For these immigrants it is expected that with increases in duration their hourly and weekly earnings will decline, their probability of being employed and hours worked per week will decline, and the probability of being unemployed will increase. These hypotheses should generally apply to male non-refugee immigrants who as primary movers are predominantly economic migrants. The extent to which they apply to female immigrants, who are likely to include a sizeable proportion of tied movers, is unclear.

The statistical tests are performed on the microdata from the 2006 Census of Australia for whom immigrants from the English-speaking developed countries (ESDC) have highly transferable skills. A summary of the evidence is presented in table 8.

The results for male immigrants match these expectations. Male immigrants' economic outcomes are characterized by both price and quantity adjustment, and the two dimensions of adjustment display highly consistent patterns. The ESDC male immigrants exhibit negative earnings and employment assimilation, while other male immigrants exhibit positive assimilation.

Among female immigrants from non-English-speaking countries, the dominant post-arrival profile is one of positive economic adjustment, according to both the price and quantity dimensions. This adjustment is generally even more positive than that which characterized their male counterparts. The post-arrival path of economic adjustment for female immigrants from English-speaking developed countries is generally (though certainly not always) positive, but far weaker than that for female immigrants from non-English-speaking countries. The analyses conducted on a group of female immigrants who were likely to be economic immigrants (adult females who were never married at the time of the census) generated results that were consistent with the positive assimilation model for those from non-English-speaking countries, and with the negative assimilation model for those from English-speaking countries.

For these findings to be a consequence of changes over time in the unmeasured dimensions of immigrant quality would require that quality increased in more recent cohorts from the EDSC but decreased in more recent non-EDSC cohorts. It was not possible to test this hypothesis with these data, but a divergent pattern of sufficient magnitude is highly unlikely.

Hence, in Australia there is negative assimilation among immigrants with highly transferrable skills and positive assimilation for immigrants with low transferable skills via both price (earnings) and quantity (employment) adjustments, and the two processes are highly consistent and robust.

Table 8 - Summary of Assimilation Profiles by Prices and Quantities

	Males		*Females*	
Type of Assimilation	*non-English-speaking countries*	*English-speaking developed countries*	*non-English-speaking countries*	*English-speaking developed countries*
Assimilation by Prices				
Wage	Modest positive	Modest negative	Stronger positive	Weak positive
Assimilation by Quantities				
Employed	Strong positive	Weak negative	Stronger positive	Weak positive
Unemployed	Strong positive	Negligible or Modest negative	Stronger positive	Weak positive
Hours Worked Per Week	Traditional inverted 'U' shape or modest positive	Modest negative	Traditional inverted 'U' shape or modest positive	Modest negative

Appendix

Appendix A – Definitions of Variables

The variables used in the statistical analysis of the 2006 Australian Census of Population and Housing are defined below. The main set of analyses is restricted to foreign-born workers aged 20-64 years. Additional restrictions to the sample are discussed in the text.

Dependent Variables	
Log of Weekly Earnings	Natural logarithm of weekly earnings (where earnings are defined as gross earnings from all sources). As weekly earnings were coded in intervals, midpoints of intervals were used to construct a continuous measure. The open-ended upper category was assigned a value of 1.5 times the lower threshold level.
Log of Hours Worked	Natural logarithm of hours worked. Hours worked were recorded in individual hours up to 59, followed by an open-ended upper category of 60 or more. A value of 70 was assigned to this final upper interval.
Log of Hourly Earnings	Natural logarithm of hourly earnings, defined as weekly earnings divided by hours worked.
Employment Indicator	A dichotomous variable, set equal to one where the individual was employed at the time of the census, and set equal to zero for the unemployed and for those who were not in the labour force.
Unemployment Indicator	A dichotomous variable relevant only for labour force participants, defined to equal 1 where the individual's labour force status was recorded as unemployed, and set equal to zero for individuals who were employed.

Explanatory Variables	
Years of Education	This is a continuous variable that records the equivalent years of full-time education completed by the individual. Individuals holding a Postgraduate degree are assigned 19 years of education, Graduate Diploma and Graduate Certificate holders are assumed to have 17 years, Bachelor degree holders have the equivalent of 15.5 years of education, advanced Diploma and Diploma holders are coded as having 14 years, holders of Certificates are assigned 13 years, those who have completed either Year 9 or any years through to Year 12 are coded as 9, 10, 11 and 12 years of education, respectively, and those who did not go to school or attained Year 8 or below are assumed to have 7 years of education.
Experience	The experience variable was derived using the Mincer (1974) proxy; Age – Years of Education – 5.
Marital Status	Dichotomous variable set to one if an individual is married at the time of the census and set to zero otherwise. Social marital status is used in this definition, so marriage refers to both registered and de facto marriages.
English Proficiency	Five English skills categories are distinguished in the data set: (i) speaks only English at home; speaks a language other than English at home and speaks English (ii) very well; (iii) well; (iv) not well; (v) not at all. Dichotomous variables are included in the estimating equation that group those in the 'very well' and 'well' categories, and those in the 'not well' and 'not at all' categories, with the 'speaks only English at home' group being the benchmark group.
Government Employment	This is a dichotomous variable that distinguishes between those working in government organizations and those working in the private sector.
Birthplace of individual	Individuals who were born overseas in the main English-speaking developed countries (ESDC) are distinguished from those born abroad in other countries (non-ESDC). The English-speaking developed countries of birth identified in the Australian census microdata file are New Zealand, England, Scotland, other United Kingdom and Ireland, the United States, and South Africa
Duration of Residence in Australia	This records the number of years an individual born overseas has lived in Australia. Both dummy variables based on the 11 year-of-arrival categories identified in the data (see text), and a continuous duration of residence variables constructed using the mid-points of the arrival periods are used in the estimations.

Table A1 - Descriptive Statistics of Variables by Gender and Birthplace Groups

Variable	*non-English-speaking Countries*	*English-speaking Developed Countries*
Males:		
Log Hourly Income	3.045	3.285
	(0.646)	(0.632)
Log Hours Worked	3.601	3.718
	(0.465)	(0.416)
Employment Rate	0.738	0.858
Unemployment Rate	0.072	0.033
Years of Education	13.540	13.084
	(3.250)	(2.535)
Years of Experience	24.715	27.550
	(12.206)	(11.307)
Duration of Residence	15.447	16.609
	(10.880)	(11.841)
Marital Status	0.778	0.806
Government Sector	0.092	0.109
English Only	0.148	0.960
English Very Well/Well	0.753	0.039
English Not Well/Not at All	0.099	0.001
Females:		
Log Hourly Income	2.977	3.134
	(0.649)	(0.636)
Log Hours Worked	3.375	3.389
	(0.603)	(0.595)
Employment Rate	0.527	0.686
Unemployment Rate	0.094	0.040
Years of Education	13.595	13.153
	(3.072)	(2.528)
Years of Experience	23.465	26.775
	(11.681)	(11.249)
Duration of Residence	14.687	16.863
	(9.992)	(11.547)
Marital Status	0.735	0.749
Government Sector	0.145	0.176
English Only	0.182	0.959
English Very Well/Well	0.723	0.041
English Not Well/Not at All	0.095	0.0001

Note: Standard errors in parentheses for continuous variables, and not reported for dichotomous variables.

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Skills Deepening or Credentialism? Education Qualifications and Occupational Outcomes, 1996-2011

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Abstract

We look at the changes to the 'quality' of jobs obtained by persons with particular qualifications over the period 1996 to 2011, where quality is based on an index which ranks 400 or so occupations by the level of qualifications in the occupation, average income of those who are full-time employed or occupational status. The occupational structure has changed in a way to favour the 'better jobs', but this has been swamped by the expansion in educational qualifications with the result that the average quality of the job obtained by a person with a particular qualification is lower in 2011 than in 1996. The census data allow a detailed characterisation of qualifications with four levels – higher degrees, degrees, diplomas and certificates III/IV – and nine fields of study. The groups most affected by the decline in the quality of jobs obtained are those with a higher degree (particularly business and administration) and diploma (particularly education and health).

Keywords: Human capital, Skills; Occupational choice, Labor productivity

JEL classification: J21, J24

1. Introduction

The lynch-pin of public education policy over the last 50 years (or longer) has been ever increasing education levels. This policy direction is firmly entrenched (see, for example, Australian Workplace Productivity Agency, 2013) and has been based on demonstrable returns to education. For example, Coelli and Wilkins (2008) provide a comprehensive set of estimates of average returns for Australia and show that the labour market has remained pretty friendly to (university) graduates. Karmel (2013) also shows that relative hourly wage rates for individuals with varying educational qualifications have been quite stable for the period 1997-2009, despite the substantial

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increase in the proportion of the workforce with qualifications. However, logically at least, an expansion will eventually lead to a decrease in the return to education for some people – if everyone has a PhD then inevitably some will end up driving taxis. Concerns that the expansion of education can lead to a surplus of graduates were aired 40 years ago with Freeman (1976) arguing that there were too many graduates in the Unites States in the 1960s, and the production of too many graduates would lead to underutilisation of graduates' skills. More recently, the concept of credentialism – by which is meant the acquisition of credentials not needed for a job- has received attention (for example, Dockery and Miller, 2012).

The purpose of this paper is to explore further one particular aspect of the pay-off to education – the type of job an individual with a particular level of education is likely to get. The general idea has been presented earlier (Karmel, 2011). We use occupations as a device to rank jobs and then compare the distributions of jobs across time for individuals with particular education levels. In that paper, for example, we found that between 1996 and 2006, individuals with a diploma became considerably less likely to have a job in the top two deciles of skilled jobs (based on an index which ranked occupations depending on their qualification profile).

This way of looking at the pay-off to education is related to the concept of over education (see, Mavromaras and McGuinness (2007) for an overview). Graduates are said to be overeducated if they are in jobs which typically do not require that level of education. Similarly, graduates are mismatched if they are in a job which does not require the particular level of education. Typically, it has been found that overeducation is associated with poorer labour market outcomes such as lower wages and job satisfaction. Miller (2007) found that in Australia around a half of workers with university degrees could be categorised as overeducated and argued that this was of some concern because of the high cost of the acquisition of a degree. Sloane (2007) points to over education increasing in the United Kingdom with the extent of overeducation rising to 30 per cent in 2006. Mavromaras and McGuinness point to over education being an issue in numerous countries, including the United States, Denmark, France, Ireland, Italy, Spain, Greece, Portugal and Australia.

In our analysis we focus on how the job distribution has changed for a given level of education rather than a change in the proportion of graduates who are over educated. There will be a relationship between the two – if the distribution of persons with a certain qualification shifts toward less desirable jobs then we can expect the proportion of over educated persons to have increased. The distributional approach we have adopted has the advantage of not requiring a definition of specific education requirements for an occupation, noting that education requirements for an occupation tend to change over time.

The extension in this paper is four fold. First, the data are updated to 2011, taking advantage of the Census of that year.[1] Second, the analysis considers two

[1] In using the 1996 and 2011 Census data we had to contend with the Australian Standard Classification of Education (ASCED) replacing the ABS Classification of Qualifications (ABSCQ) and ANZSCO replacing the earlier occupational standard ASCO. Details of the methodology handling these changes can be found in Karmel, Stanwick and Moore (forthcoming).

additional alternative indexes, with occupations ranked on the basis of income and also by socioeconomic status, as well by the qualifications profile. Third, changes in the occupational structure of the labour market are isolated, by using the 1996 distribution of jobs as the benchmark. Finally, the analysis is undertaken at a broad field of study, to emphasise the point that averages mask considerable variation in people's experiences. We also note that the Census allows a fine grained approach with the occupational distributions created from around 400 individual occupations.

The structure of the paper is as follows. In the next section we consider the three indexes used to rank occupations. In section three we show how educational qualifications have increased and how the occupational distribution of jobs has changed between 1996 and 2011. This is followed by an analysis of the occupational distributions, focussing first on the relationship between educational qualification and occupational distributions in 1996 and then the changes between 1996 and 2011. Section 4 repeats the analysis by field of study. We end with a short discussion.

Our main finding is that, despite the occupational structure changing to favour the better jobs, that the expansion in the proportion of persons with qualifications has far out-stripped the change in the employment structure. This means that in general the average job for persons with a particular qualification in 2011 is of lower quality than in 1996. Persons with higher degrees (particularly those in business and administration) and diplomas (particularly education and health) have been the most affected. The former most likely reflects the rapid expansion in supply of persons with higher degrees, while the latter is largely a consequence of changes in minimum job requirements – for example, degrees are now required for nursing and teaching.

2. Occupational Indexes

The main point of this paper is to look at how the likelihood of getting a 'good' job has changed for individuals with a particular level of qualification. This requires an ordering of occupations from the best to the worst. Previously (Karmel, 2011) we ordered occupations by means of a skills index, which assigned a ranking to four digit ASCO2 occupations on the basis of the distribution of qualifications in the occupation. According to that index the most skilled occupation was 2421 University lecturers and tutors (with a high proportion of individuals with post-graduate qualifications) and the least skilled occupation was 9932 Fast food cooks.

An alternative ranking of occupations is by income. This index was constructed using full-time employment by occupation by income data from the 2006 Census. The precise method can be found in Karmel, Stanwick and Moore (forthcoming). The highest ranked occupation according to this index is *2312 Specialist Medical Practitioners*.

A third ranking is available from an index constructed at the ANU. The ASCO version of this index (Jones and McMillan, 2001) is labelled ANU 4[2] and is described as an index of socio-economic status. It reflects qualification levels, income and occupational prestige.

[2] The latest version is AUSEI06 (Macmillan *et al*. 2009).

The essential feature of these indexes is that they can be used to rank occupations.

All of these measures have their limitations. For example, the skills measure can be criticised for being self-referential if we are particularly interested in the outcomes of people with qualifications. Why does working in an occupation where there are few with a degree make the job less desirable? Also the skills index does not account for skills learnt on the job (although the returns to experience tend to be higher in professional jobs relative to trade or unskilled jobs). Nevertheless, it is intuitively attractive that occupations typically performed by individuals who have invested in high levels of education are highly desirable. Similarly, average income does not capture many important attributes of wages, such as the level of entry level wages, income volatility, and likely wage progression. The socioeconomic status index sounds broader conceptually but in practice builds primarily on levels of qualifications and wages.

Thus, there is no single measure of what makes a good job. That said, the three rankings are highly correlated. If we map the index rankings on the 2006 full-time employment data to obtain percentiles (a value of 10, for example, indicates that the occupation is in the top 10 per cent of jobs according to that index), then we can calculate the correlations between the three possibilities (table 1).[3]

Table 1 - Correlations between Occupations according to the Skills Index, the Income Index and Occupational Status (ANU4)

	Skills	*Income*	*Status*
Skills	1.00	0.72	0.92
Income		1.00	0.76
Status			1.00

The correlations are high, suggesting that the precise way occupations are ordered is not a great issue.

The most similar indexes are the skills index and the occupational status index. The least similar are the skills index and the income index. It appears that the ANU4 occupational index lies between the other two, although it is very closely related to the skills index. To keep the analysis tractable, we restrict the ensuing analysis to the skills and income indexes – the two which differ the most. If the results of the analysis are robust to the choice of index then we do not need to particularly concerned about precisely how the occupations are ranked.

To give some flavour of the occupational rankings we present in table 2 the highest and lowest ranked occupations according to the skills and income indexes. The highest ranked occupation is at the top of the table and the lowest at the bottom. Those occupations that are in the top (bottom) 20 occupations according to the two indexes are bolded.

[3] The three rankings for each occupation can be found in Karmel, Stanwick and Moore (2014) (noting that occupations with less than 500 employed persons in 2006 were deleted because of doubts about reliability).

Table 2 - Highest and Lowest Ranked Occupations According to Skills and Income Occupational Indexes

Highest paid occupations	*Highest skilled occupations*
2312 Specialist Medical Practitioners	2421 University Lecturers and Tutors
1111 Legislators and Government Appointed Officials	2110 Natural and Physical Science Professionals, nfd
2311 Generalist Medical Practitioners	2514 Psychologists
2381 Dental Practitioners	2387 Chiropractors and Osteopaths
1212 Company Secretaries	**2312 Specialist Medical Practitioners**
2127 Mining and Materials Engineers	**2522 Economists**
2213 Corporate Treasurers	2113 Life Scientists
1221 Engineering Managers	**2112 Geologists and Geophysicists**
1112 General Managers	2119 Other Natural and Physical Science Professionals
1224 Information Technology Managers	2115 Medical Scientists
2521 Legal Professionals	1293 Education Managers
4988 Power Generation Plant Operators	2420 University and Vocational Education Teachers, nfd
2112 Geologists and Geophysicists	2393 Dietitians
3210 Finance Associate Professionals, nfd	**2311 Generalist Medical Practitioners**
1291 Policy and Planning Managers	2492 English as a Second Language Teachers
2295 Property Professionals	2386 Speech Pathologists
1293 Education Managers	**2381 Dental Practitioners**
2522 Economists	2293 Mathematicians, Statisticians and Actuaries
1213 Human Resource Managers	2322 Nurse Educators and Researchers
2541 Air Transport Professionals	2385 Physiotherapists
Lowest paid occupations	*Lowest skilled occupations*
9200 Factory Labourers, nfd	9915 Railway Labourers
8313 Domestic Housekeepers	9913 Paving and Surfacing Labourers
4931 Hairdressers	9213 Meat and Fish Process Workers
6131 Receptionists	9912 Earthmoving Labourers
4513 Cooks	7297 Clay, Stone and Concrete Processing Machine Operators
6391 Dental Assistants	8115 Betting Clerks
8296 Service Station Attendants	**6324 Hospitality Trainees**
9921 Farm Hands	**8116 Office Trainees**
9931 Kitchenhands	**7211 Sewing Machinists**
9932 Fast Food Cooks	9931 Kitchenhands
8291 Checkout Operators and Cashiers	9000 Labourers and Related Workers, nfd
9221 Hand Packers	**9221 Hand Packers**
6323 Waiters	7112 Forklift Drivers
8315 Laundry Workers	**9933 Food Trades Assistants**
9933 Food Trades Assistants	**8291 Checkout Operators and Cashiers**
6312 Children's Care Workers	9219 Other Process Workers
7211 Sewing Machinists	4612 Shearers
6392 Veterinary Nurses	9215 Wood Products Factory Hands
6324 Hospitality Trainees	9991 Garbage Collectors
8116 Office Trainees	**9932 Fast Food Cooks**

While the correlation between these two indexes is high at 0.72, there are considerable numbers of occupations for which the income ranking is well above the skills ranking, and vice versa. To give some insight into these differences, we show the 10 occupations for which the income percentile is much more favourable than the skills percentile, the 10 occupations for which the income and skills percentiles have the greatest degree of concordance, and the 10 occupations for which the skills percentile is much more favourable than the income percentile.

Table 3 - Selected Occupations and Index Values

Occupation	*2006 full-time emp.*	*Income per cent*	*ANU4 per cent*	*Skills per cent*	*Difference between income and skills per cent*
Occupations in which income >skill ranking					
7911 Miners	20,667	8.1	82.1	83.4	-75.3
4986 Drillers	4,692	11.6	77.3	80.3	-68.7
7912 Blasting Workers	757	9.3	82.1	74.6	-65.3
7315 Train Drivers and Assistants	7,171	20.1	83.3	80.2	-60.1
7122 Crane, Hoist and Lift Operators	6,868	30.3	83.9	82.2	-51.9
9915 Railway Labourers	2,727	46.5	98.4	97.1	-50.6
9911 Mining Support Workers and Driller's Assistants	2,765	33.0	87.0	83.6	-50.6
7124 Pulp and Paper Mill Operators	1,512	34.5	84.0	81.9	-47.5
4987 Chemical, Petroleum and Gas Plant Operators	5,013	12.1	48.2	58.8	-46.7
7913 Structural Steel Construction Workers	10,990	31.7	82.3	77.8	-46.1
7111 Mobile Construction Plant Operators	31,696	47.2	93.8	91.8	-44.6
3393 Transport Company Managers	9,076	36.8	38.6	81.0	-44.2
Occupations in which income=skill ranking (a)					
9111 Cleaners	59,001	92.3	91.5	92.8	-0.5
3291 Office Managers	66,261	53.4	42.2	53.5	-0.1
9931 Kitchenhands	18,131	97.9	89.0	98.0	-0.1
9933 Food Trades Assistants	1,467	99.1	87.8	99.2	-0.1
9221 Hand Packers	23,832	98.6	98.2	98.6	0.0
3120 Building and Engineering Associate Professionals, nfd	8,961	34.6	32.3	34.5	0.1
8211 Sales Assistants	156,772	90.5	81.8	90.3	0.2
4000 Tradespersons and Related Workers, nfd	12,306	44.2	50.0	44.0	0.2
6213 Retail and Checkout Supervisors	15,927	80.9	85.6	80.6	0.4
2521 Legal Professionals	41,167	3.7	1.4	3.3	0.4
Occupations in which income <skill ranking					
3111 Medical Technical Officers	10,012	80.3	32.8	35.2	45.1
6392 Veterinary Nurses	2,820	100.0	73.2	51.9	48.1
6312 Children's Care Workers	36,943	99.8	66.2	51.4	48.3
3997 Library Technicians	3,072	79.8	36.5	29.8	50.0
3411 Enrolled Nurses	8,289	82.1	34.5	30.4	51.7
4931 Hairdressers	27,656	95.4	70.7	42.5	52.9
2394 Natural Therapy Professionals	1,998	69.7	10.8	13.2	56.5
3494 Massage Therapists	1,931	82.7	34.6	24.6	58.2
2515 Ministers of Religion	10,975	69.4	21.1	10.3	59.1
6395 Personal Care Consultants	8,817	93.8	45.2	34.7	59.2

Note: (a) within +/- 0.5per cent.

It is interesting to note that the top group, with very high income rankings, tend to be in male dominated occupations in industries where there is considerable union power. By contrast, the bottom group of occupations – where income rankings are much lower than skills rankings -is largely female dominated, where qualifications are expected but pay is poor.

3. Changes in Education Levels and Occupations 1996 to 2011

The crux of the paper is that the relationship between occupation and educational qualifications has been changing, with the increase in education levels occurring faster that that 'required' by changes in the occupation structure. This implies that - in the terminology of the Skills Australia (2009) – 'skills deepening' has occurred, with the levels of qualification increasing within occupations. Table 4 shows that the fifteen years 1996 to 2011 have seen considerable increases in the proportion of the workforce with qualifications.

Table 4 - Proportion of Employed Persons by Highest Qualification, 1996, 2006 and 2011, Per Cent

	1996	*2006*	*2011*	*Per cent point change 1996 to 2011*
Higher degree	2.1	3.8	5.1	3.0
Bachelor degree	13.6	18.4	20.9	7.3
Diploma/advanced diploma	8.2	9.0	10.1	1.8
Certificate III & IV level	14.3	18.2	19.5	5.2
Other certificates	10.7	8.6	7.1	-3.6
No non-school qualification	51.0	41.9	37.3	-13.7
Total	100	100	100	

Notes: Higher degree includes doctorates, masters and post-graduate degree level (not further defined); bachelor degrees include bachelor degrees and graduate diploma/graduate certificates; other certificates include certificates I/II, certificates not further defined, and level inadequately described or not stated. Four digit occupations with less than 500 persons in the 2006 census have been excluded from the analysis in this and the following three tables to be consistent with the rest of the analysis in this paper, but they only account for a very small proportion of all occupations anyway. When originally constructing the skills index, occupations with less than 500 people were excluded (see, Karmel, 2011).
Source: Derived from the Census of Population and Housing, 1996, 2006 and 2011.

We see that the proportion of the workforce with qualifications has increased quite dramatically over the period. The greatest increase has been in the proportion with a bachelor degree and certificate III/IV.

There has been substantial change in the occupational structure of the workforce (table 5), reflecting the impact of technological and other structural changes (Kelly and Lewis, 2010), but the increase in levels of qualifications has been much greater than that needed to maintain the status quo. Thus we see in table 6 that in every occupation there has been an increase in the proportion of workers with post-graduate, bachelor degree, diploma and certificate III/IV qualifications, and a decline

in the proportion with no qualification. The table also shows an element of upgrading in qualifications with the proportion with a certificate other than at the III/IV level declining.

Table 5 - Employment Growth 1996 to 2011, by ASCO2 Major Groups (Per Cent)

	1996	*2011*	*Per cent change*
1 Managers and administrators	708,626	877,325	23.8
2 Professionals	1,306,709	2,091,565	60.1
3 Associate professionals	860,501	1,237,677	43.8
4 Tradespersons and related workers	995,523	1,174,805	18.0
5 Advanced clerical and service workers	329,673	272,064	-17.5
6 Intermediate clerical, sales and service workers	1,222,762	1,763,988	44.3
7 Intermediate production and transport workers	660,330	784,406	18.8
8 Elementary clerical, sales and service workers	677,190	912,194	34.7
9 Labourers and related workers	666,221	741,896	11.4
Total	**7,427,535**	**9,855,920**	**32.7**

Source: Derived from the Census of Population and Housing, 1996 and 2011.

Table 6 - Changes in the Proportion of Occupations (ASCO 2 Major Groups) with Qualifications, 1996 and 2011 (Percentage Points)

	Higher degree	*Bachelor degree*	*Diploma/ advanced diploma*	*Certificate III & IV level*	*Other certificates*	*No non-school qualification*
1 Managers and administrators	5.9	10.3	2.5	2.5	-4.2	-17.1
2 Professionals	6.3	7.8	-6.8	2.0	-3.5	-5.8
3 Associate professionals	2.6	8.3	5.2	4.7	-5.8	-15.0
4 Tradespersons and related workers	0.2	1.5	1.9	6.1	-3.5	-6.3
5 Advanced clerical and service workers	1.7	8.0	6.4	9.0	-9.7	-15.4
6 Intermediate clerical, sales and service workers	1.6	5.5	4.5	12.0	-3.9	-19.6
7 Intermediate production and transport workers	0.6	2.0	2.1	7.7	-1.0	-11.5
8 Elementary clerical, sales and service workers	1.1	3.6	2.7	5.4	-1.7	-11.2
9 Labourers and related workers	0.6	2.4	2.0	7.2	-0.5	-11.7
Total	**3.0**	**7.3**	**1.8**	**5.2**	**-3.6**	**-13.7**

Source: Derived from the Census of Population and Housing, 1996 and 2011.

Thus we see that people with higher degrees increased their share of employment by three percentage points between 1996 and 2011, but increased their share of employment in *managers and administrators* and *professionals* by 5.9 and 6.3 percentage points respectively. We also see that the proportion of people with qualifications has increased even in occupations where there is unlikely to be a link between the qualification and the work. For example, we see increases in the proportion of workers with a higher degree in *intermediate clerical, sales and service workers; intermediate production and transport workers; elementary clerical, sales and service workers;* and *labourers and related workers*.

Finally, we note that the growth of qualifications has been uneven across fields of study (table 7).

Table 7 - Average Annual Growth 1996-2011 (Per Cent)

	Higher degree	*Bachelor degree*	*Diploma and advanced diploma*	*Cert III & IV*	*Other quals*	*Total*
Agriculture, Environmental and Related Studies	8.9	7.6	2.9	5.7	2.3	4.3
Architecture and Building	14.3	6.4	3.9	2.8	1.3	2.7
Management and Commerce	12.2	6.5	5.0	17.6	2.0	5.1
Education	7.9	3.2	-2.3	n.a.	3.8	3.0
Engineering and Related Technologies	6.8	4.7	2.0	1.1	1.7	1.8
Health	6.4	5.8	-0.5	19.0	1.1	3.3
Natural and Physical Sciences + Information Technology	6.6	4.4	4.8	12.3	3.8	4.8
Society and Culture + Creative Arts	6.6	4.0	7.0	14.7	5.2	5.8
Food, hospitality and personal services + mixed fields	9.3	5.9	4.3	3.9	-0.7	0.2
Total	8.3	5.1	3.4	3.9	-0.1	1.5

Source: Derived from the Census of Population and Housing, 1996 and 2011.

The growth in higher degrees has been particularly high in *architecture and building* and *management and commerce*. The growth in degrees has been relatively uniform while the growth in diplomas was highest in *society and culture and creative arts* and *management and commerce* but negative in a couple of areas (presumably degrees are edging out diplomas). The growth in certificates III and IV is quite concentrated: *management and commerce, health, natural and physical sciences and information technology,* and *society and culture and creative arts* all have annual growth rates exceeding 10 per cent per annum.

4. Occupational Distributions

We now analyse the change in the relationship between education level and occupation in a rather more sophisticated way, by looking at the occupational distribution of jobs for those with a particular level of qualification.

Before looking at the occupational distributions at the qualification level we show how the occupational distributions have changed between 1996 and 2011. The distributions are represented by Lorenz style curves, with the cumulative share of employment in 2011 on the y axis and the cumulative share of employment in 1996 on the x axis (each point is an occupation). If there had been no change in the distribution of jobs by occupation across the two periods then the curve would be a 45 degree line.

Figure 1 shows the change based on the distribution in which jobs are ranked by skill levels, figure 2 by income levels.

We see that both curves are to the left of the 45 degree line, indicating that employment growth has been biased toward the better jobs, irrespective of which ordering of occupations is used. For example, if we take the occupation corresponding to the 40th percentile in 1996 according to the skills index (figure 1), we see that around 45 per cent of jobs in 2011 were at this skills level or higher. That is, the 'better' occupations grew faster than the lower skill occupations.

We now consider the occupation distributions at the qualification level. In figure 3, we show the Lorenz style curves for 1996 for each of the qualification levels, based on the skills index. On the x axis is the cumulative distribution of all jobs, with the 'best' job at the zero point. On the y axis is the cumulative distribution of the jobs for individuals possessing a particular qualification. Rather than present this for all persons we look at 25-44 year olds – this age group best reflects the job prospects of young people once they have completed their education.[4] Figure 4 shows the curves for the income index.

The above figures map out the cumulative distributions of the employment level for each qualification; one can read off the proportion of employment for each qualification that corresponds to any point in the overall employment distribution. So, taking the skill index for example (figure 3), we see that around 55 per cent of those with a higher degree had jobs in the top decile of jobs, with the corresponding figure for bachelor degrees around 40 per cent, for diplomas 15 per cent and close to zero for those with a certificate III/IV. Similar statistics can be extracted at any percentile of the overall job distribution. There is a clear hierarchy of qualifications, and this pattern is quite robust in respect of the choice of occupational index.

[4] The analysis was also done for all persons aged 15-64 years.

Figure 1 - Cumulative Shares of Employment (15-64 year olds) for Each Occupation, 1996 and 2011, Occupations Ordered by Skill Levels

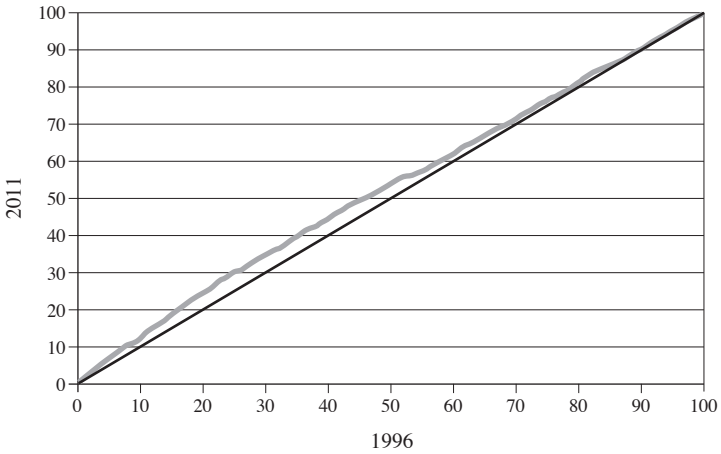


Figure 2 - Cumulative Shares of Employment for Each Occupation (15-64 year olds), 1996 and 2011, Occupations Ordered by Income Levels

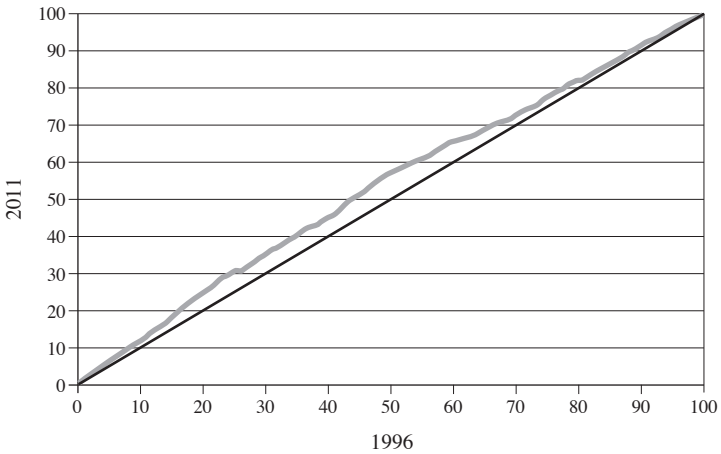


Figure 3 - Cumulative Shares of Employment by Qualifications, 1996, 25-44 years, Occupations Ranked by Skill Level

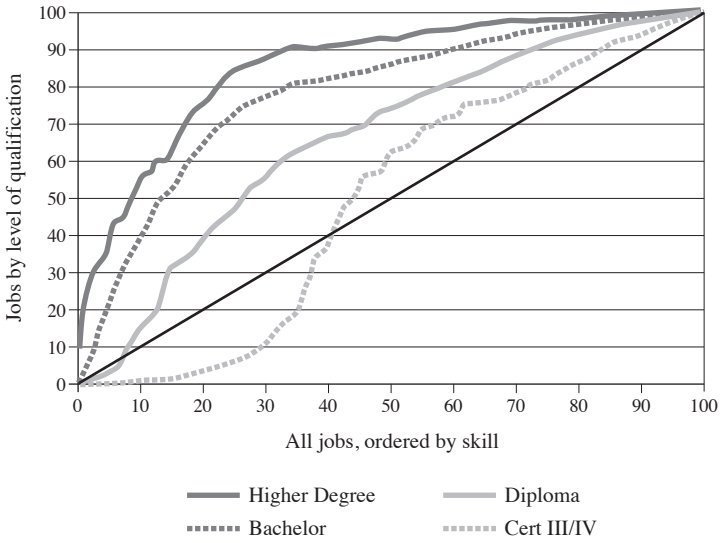
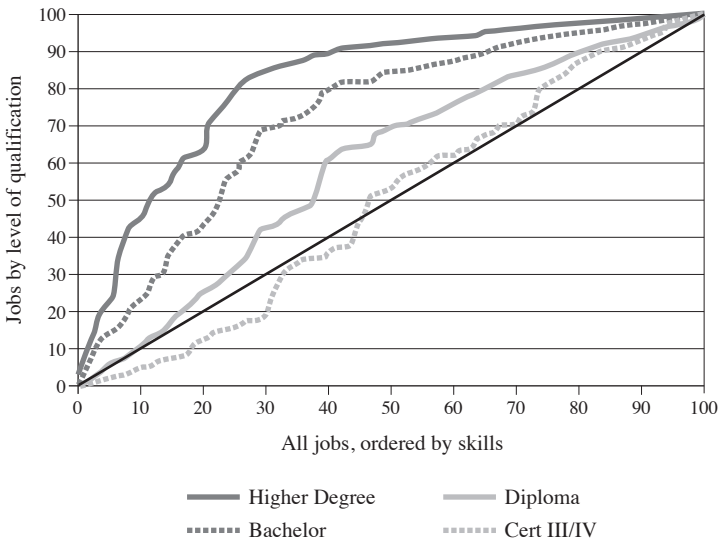


Figure 4 - Cumulative Shares of Employment by Qualifications, 1996, 25-44 years, Occupations Ranked by Income Level



When we start considering changes over time and the various fields of study we end up with a very large number of graphs. This becomes a little overwhelming and thus it is expedient to have a single summary statistic to summarise the distributions. The simplest single statistic to capture the shape of the curve is its mean or expected value, with the units being the percentile of the overall distribution of jobs as displayed on the x axis.[5] This has a simple interpretation: for example a value of 35 for a particular curve means that the average job (or expected job) is at the 35th percentile of all jobs (with 0 representing the best job).

Calculating this 'mean percentile', gives the following table.

Table 8 - Mean Percentile of Jobs by Qualification Level, Persons Aged 25-44 Years, 1996

	Income	*Skills*
Higher degree	18	15
Bachelor degree	28	22
Diploma	41	34
Certificate III/IV	51	51

Source: ABS 1996 census data.

We see the same general pattern, irrespective of the index used to rank occupations. The 'average job' for persons with a higher degree is in the top 15-18th percentile of jobs, depending on which occupational index and which age group is used. By contrast, those with a certificate III/IV can expect on average to get a job in the middle of the distribution (51st percentile).

We now move to the changes in the distributions by qualification level. Figures 5(a) to 5(d) present three Lorenz style curves for each of the four qualification levels, based on the skills index (i.e. occupations are ranked from the most highly skilled (qualified) to the least). Each of these figures has three curves:

- The 1996 distribution of jobs for the qualification plotted against the 1996 distribution of all jobs.
- The 2011 distribution of jobs for the qualification plotted against the 2011 distribution of all jobs.
- The 2011 distribution of jobs for the qualification plotted against the 1996 distribution of all jobs.

In making an assessment of whether in 2011 individuals with a certain qualification are obtaining similar jobs to the situation in 1996, it is the first and third of these curves that are relevant. This is because the 2011 job distribution has shifted to the left of the 1996 distribution because the better jobs have grown relatively quickly (as illustrated earlier in figures 1 and 2). To compare the first and second of these curves would 'move the goal posts', because the definition of, say, the top decile of jobs in 2011 is a more restrictive set of occupations than in 1996.

We see that for each qualification, the share of 'good' jobs declines, reflecting the fact that the increase in people with each of the qualifications has been greater

[5] In fact, the mean percentile of a Lorenz curve is approximately equal to the area above the curve. So the summary measure is closely related to the Gini coefficient (a measure often used to measure inequality) which can be calculated as twice the area between the curve and the 45 degree line.

than the expansion in good jobs. However, the higher degrees and diplomas have been particularly affected. For example, in figure 5(a) we see that in 1996 almost 80 per cent of higher degree graduates had a job in the top 20 per cent of jobs, while in 2011 this had dropped to around 65 per cent (keeping the 1996 definition of the top 20 per cent of jobs).

Figure 5(a) - Cumulative Shares of Employment for those with a Higher Degree Qualification, 1996 and 2011, 25-44 years, Occupations Ranked by Skill Level

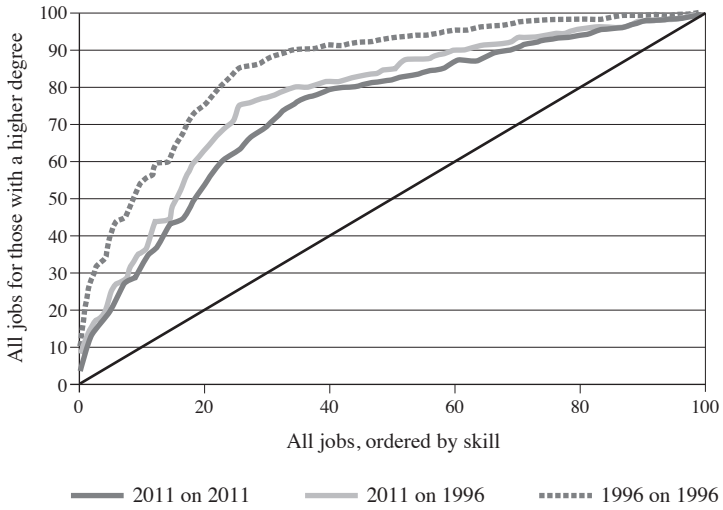


Figure 5(b) - Cumulative Shares of Employment for Those with a Bachelor Degree Qualification, 1996 and 2011, 25-44 years, Occupations Ranked by Skill Level

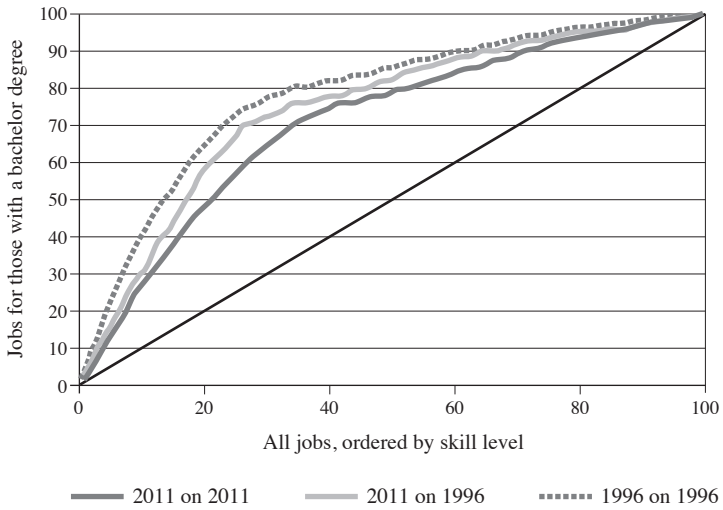


Figure 5(c) - Cumulative Shares of Employment for Those with a Diploma Qualification, 1996 and 2011, 25-44 years, Occupations Ranked by Skill Level

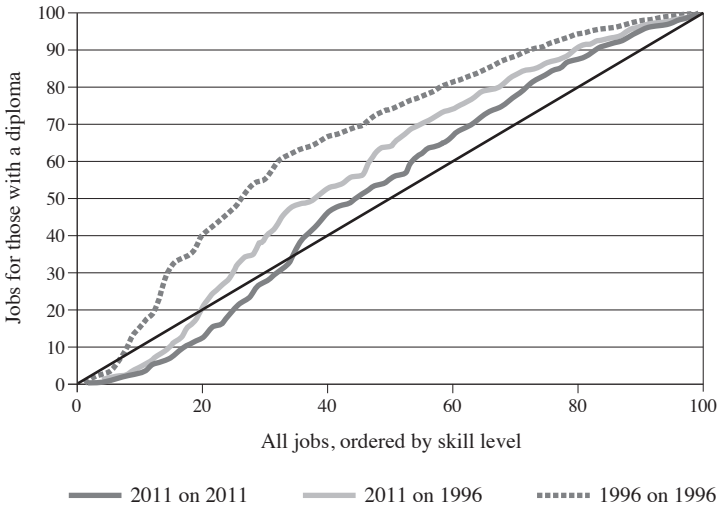
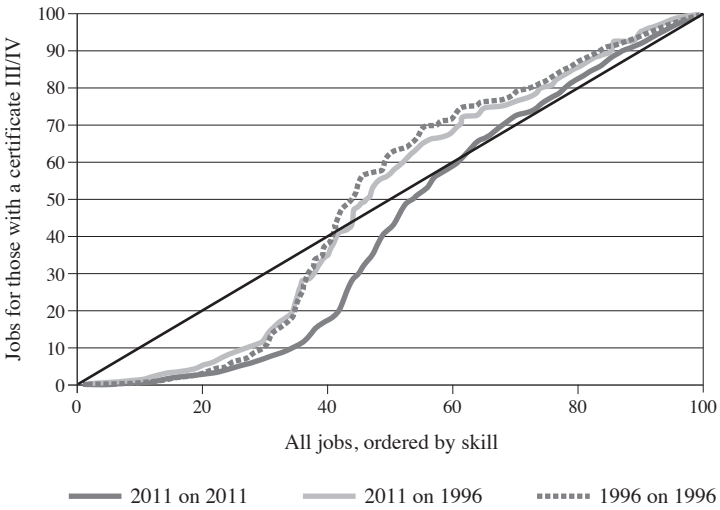


Figure 5(d) - Cumulative Share of Employment for Those with a Certificate III/IV Degree Qualifications, 1996 and 2011, 25-44 years, Occupations Ranked by Skill Level



Similar patterns emerge for the income index. Rather than present another set of graphs we summarise the changes through the change in the average job (table 9).

Table 9 - Changes in the Average Job, 1996 to 2011, 25-44 Years, Percentile of 1996 Job Distribution

	Jobs ordered by skill			*Jobs ordered by income*		
	Mean 1996	*Mean 2011 (1996 base)*	*Increase in mean percentile (percentile points)*	*Mean 1996*	*Mean 2011 (1996 base)*	*Increase in mean percentile (percentile points)*
Higher degree	15	23	8	18	26	8
Bachelor degree	22	26	4	28	30	2
Diploma	34	43	9	41	48	7
Certificate III/IV	51	52	1	51	54	3

Note: 1 represents the best job, 100 the worst.

We see a robust pattern. There has been a decline in all qualification levels, but that those with a higher degree or a diploma have been more affected than those with a certificate III/IV or a bachelor degree.

5. Occupational Distributions by Field of Study

We complete our analysis by looking at the distributions of jobs and their changes by field of study. We first present the mean job for each qualification and field of study for 1996, based on the skills index (table 10) and the income index (table 11).

Table 10 - Mean Job, by Qualification and Field of Study, Persons 25-44 years, 1996 (1996 Job Distribution Percentiles Based on Skills Index)

1996 Skill 1996 base	*Cert III/IV*	*Diploma*	*Bachelor*	*Higher degree*
Engineering	49	35	24	16
Education	**	24	16	11
Health	43	24	13	7
Agriculture	65	57	37	26
Architecture and Building	52	38	21	15
Business and Administration	47	44	29	22
Natural and Physical Science	46	36	24	13
Society and Culture	48	40	27	15
Miscellaneous fields	56	41	49	22
Total	51	34	22	15

** There was no one recorded as having a certificate III/IV in the field of education in the 1996 census data provided to us.

Note: In this table and table 11 below the 1996 fields have been used as the tables pertain solely to 1996 data. To reiterate though, Natural and Physical Sciences also largely incorporates Information Technology, Society and Culture also largely incorporates Creative arts, and Miscellaneous fields also largely incorporates Food, Hospitality and Personal Services.

Table 11 - Mean Job, by Qualification and Field of Study, Persons 25-44 Years, 1996 (1996 job Distribution Percentiles Based on Income Index)

1996 Income 1996 base	*Cert III/IV*	*Diploma*	*Bachelor*	*Higher degree*
Engineering	47	31	20	15
Education	**	39	31	23
Health	54	42	26	13
Agriculture	62	53	37	32
Architecture and Building	47	33	23	19
Business and Administration	40	41	25	16
Natural and Physical Science	51	38	25	19
Society and Culture	67	54	32	22
Miscellaneous fields	72	38	42	14
Total	51	41	28	18

** There was no one recorded as having a certificate III/IV in the field of education in the 1996 census data provided to us.

A clear hierarchy emerges; the qualifications 'pecking order' is maintained in each field of study, irrespective of which index is used: the mean job for someone with a higher degree is better than for a bachelor degree, which in turn is better than someone with a diploma, which in turn is better than someone with a certificate III/IV (with the exception of 'mixed fields for which the position of diplomas and degrees are reversed, noting that that the mixed field category is difficult to understand). However, the rankings of fields within each qualification level do depend to some extent by which index is used.

Some fields stand out. Among higher degrees the field with the best average job irrespective of the index is *health*. But among those with a bachelor degree, according to the skills index the field with the best average job is *health* (13th percentile) while according to the income the index the field with best average job is *engineering* (20th percentile). Similarly, among those with a diploma, the fields with the best average job according to the skills index are *health* and *education* (24th percentile), while the field with the best average job according to the income index is *engineering* (31st percentile). Irrespective of which index is used *agriculture* fares poorly.

We also see some overlap between qualifications. For example, according to the income index, a diploma in engineering on average will provide a better job than a degree in *education, society and culture* and *agriculture*.

We now look at the changes in the style curves between 1996 and 2011 by field of study. Again we use the mean to summarise the distribution.

Table 12 - Change in Mean Percentile Job, 1996 to 2011, by Qualification and Field of Study, Persons 25-44 years, 1996 (1996 Job Distribution Percentiles Based on Skills Index)

	Cert III/IV	*Diploma*	*Bachelor*	*Higher degree*
Engineering	0	4	-1	4
Education	**	10	0	4
Health	1	7	2	2
Agriculture	1	0	-2	-4
Architecture and Building	0	2	2	0
Business, Administration	7	2	4	11
Natural and Physical Science and Information Technology	-3	1	4	10
Society and Culture and Creative Arts	3	3	3	5
Food, hospitality and personal services + mixed fields	0	14	6	4
Total	1	9	4	8

** There was no one recorded as having a certificate III/IV in the field of education in the 1996 census data provided to us.

Table 13 - Change in Mean Percentile Job, 1996 to 2011, by Qualification and Field of Study, Persons 25-44 years, 1996 (1996 Job Distribution Percentiles Based on Income Index)

	Cert III/IV	*Diploma*	*Bachelor*	*Higher degree*
Engineering	-2	2	-1	3
Education	**	14	2	7
Health	12	8	3	7
Agriculture	1	2	0	-5
Architecture and Building	-2	2	1	1
Business, Administration	13	3	5	13
Natural and Physical Science and Information Technology	-8	-1	3	6
Society and Culture and Creative Arts	2	1	2	4
Food, hospitality and personal services + mixed fields	0	31	20	21
Total	3	7	2	8

** There was no one recorded as having a certificate III/IV in the field of education in the 1996 census data provided to us.

What is interesting about these results by field of study is the variation in the change in the mean percentile:

Engineering: according to the income index those with engineering qualifications have largely maintained the quality of their jobs. According to the skills index, there have been small declines in the average quality of higher degrees (four percentile points) and diplomas (three percentile points).

Education: those with a diploma or a higher degree have seen a significant decline in the quality of their jobs.

Health: diplomas have been badly affected irrespective of which index is used (declines of eight to nine percentile points). However, according the income index, there have also been declines within the other qualifications – 13 percentile points (certificate III/IV), five percentile points (bachelor degree) and 13 percentile points (higher degree).

Agriculture: this field is one which has seen little decline in the quality of jobs obtained. In fact there are examples where there has been a modest improvement in the quality of jobs, notably a four to five percentile improvement for those with a higher degree.

Architecture and building: this field has seen little change in the quality of jobs obtained.

Business and administration: persons with a certificate III/IV or a higher degree have seen large declines in the quality of jobs (of between eight and 13 percentile points). Persons with a degree have seen a more modest decline (five percentile points).

Natural and physical sciences and information technology: persons with a higher degree have seen a large decline in the quality of their jobs (nine percentile points on the skills index and six percentile points on the income index). Persons with a bachelor degree have seen a lesser decline, and those with a diploma have been little affected. Against the overall trend those with a certificate III/IV have seen an improvement, but it should be noted that there are relatively few certificates delivered in the physical sciences - this field is dominated by higher level qualifications.

Society and culture and creative arts: as with many of the fields the group that has seen the largest decline in the mean occupation is persons with a higher degree (four to five percentile points). Those with a bachelor degree have seen a more modest decline (three percentile points).

Food, hospitality and personal services, and mixed fields: the results for this field grouping needs to be treated with caution (a) because there are hardly any higher degrees and few bachelor degrees in this grouping, and (b) because of the disparate nature of occupations this grouping of fields is ill-defined.

One point to emerge from the above analysis is that at this level of disaggregation the choice of index does not make a huge difference. It certainly affects the magnitude of the changes but not the broad patterns. The overall picture is that there have been declines in the average quality of jobs particularly for those with a diploma or a higher degree. And particular qualifications have been affected, notably: higher degrees in *business, administration*, diplomas in *education* and *health* and certificates III/IV in *business, administration*. The only specific qualification which shows a completely different picture depending on the choice of index in certificates III/IV in *health*: according to the skills index there was virtually no change, while according to the income index there was a decline of 12 percentile points in the average quality of the job.

6. Concluding Comments

The conventional way of looking at the return to education is to focus on employment rates and relative wages. However, in this paper we have taken a different approach and looked at the return in terms of the 'quality' of the job that an individual obtains. Quality is defined by occupation (some 400 of them) with the occupations ranked by skill level (proxied by the qualification profile of the occupation) and average income (of a full-time worker). Our approach was to look at how the distribution of jobs for individuals with particular qualifications has changed between 1996 and 2011, with the benchmark distribution being the one in 1996. We focused on the age group 25-44 years, that being the most relevant group for young people embarking on their post-school education.

On a methodological note, one might quibble with the whole concept of job 'quality'; what is a good job for one person is a bad one for someone else and our indexes of occupational quality capture only certain attributes of a job. However, at an intuitive level, all would acknowledge that some jobs are better than others. Our use of two indexes provides a test of robustness to the analysis. As an aside, the two indexes we use are highly correlated but there are differences and many of those differences appear to reflect industrial history and the degree of feminisation of occupations.

What has emerged is that over this 15 year time period, the distribution of jobs has changed in way to favour the better jobs. That is, any technological change over this period has been, at least to some extent, skills-biased. However, the expansion in the proportion of persons with qualifications has far out-stripped the change in the employment structure. This means that within occupations there has been 'skills deepening', with a higher proportion of individuals having qualifications (or a qualification at a higher level). An alternative way of looking at the same data, and the one adopted in this paper, is to look at the distribution of jobs for people with a certain qualification. In general the average job for persons with particular qualification in 2011 is of lower quality than in 1996. Persons with higher degrees (particularly those in *business and administration*) and diplomas (particularly *education* and *health*) have been the most affected.

In trying to make sense of these findings, there seem to be a number of forces at work. First, there is no doubt that the labour market is changing in a way that favours persons with qualifications, but there is equally no doubt that the supply of people with qualifications has grown more than commensurately. One element that must be taken

into account is the role of regulation. An obvious example is the decline in average job quality of those with a diploma in education or health. Changes in mandatory qualifications have meant that a diploma in those areas no longer allows entry into the same types of jobs as it once did. Other areas which have been affected are those occupations which have become more highly regulated. Examples here are financial services, childcare and aged care. To operate in these occupations is requiring the possession of very specific qualifications. An example of where there has been a 'de facto' change in required qualifications is in the university sector where a doctorate has become virtually an entry requirement for most academic jobs.

However, not all qualifications have been affected by changes in regulation or entry requirements to the same extent. Much of the decline in the average quality of the job held by persons with a higher degree can simply be explained by the interaction of supply and demand. Relatively few jobs 'require' a higher degree, implying that the expansion in those with a higher degree has increased the competition for good jobs. Persons with a higher degree in business administration are a case in point, and there is certainly considerable anecdotal evidence pointing to an MBA no longer being a fast track into a top job.

The two qualifications where there has been the smallest change have been bachelor degrees and certificates III/IV. Overall, there has been some decline in the average quality of the job but these declines have generally been small.

Are there any policy implications from the analysis? First, from a young person's point of view the changing relationship between qualifications and the labour market is very relevant to educational choice. Particular qualifications on the whole will not guarantee the same sort of job as held by earlier cohorts with that qualification. At this level there has been credential creep. Nevertheless the relationship between level of qualification and the distribution of jobs is still strong. While a higher degree has seen the greatest decline in the average quality of jobs, it is still the case that on average those with higher degrees obtain better jobs than those with a bachelor degree, and the pecking order – higher degree, bachelor degree, diploma, certificate III/IV- has not changed. Thus while a higher degree, for example, may not provide the same job prospects as it did previously, it is still ranks well ahead of an ordinary degree. Credentialism may have occurred but that is the labour market in which young people have to compete. While credentialism may reflect over investment in education from society's point of view, it may still be optimal from an individual's perspective to invest in that additional qualification, even if employers are seeking higher qualifications as a sorting device or believe that academic standards have been declining. The other point to note from an individual's perspective is that some fields have been more affected than others. In particular, higher degrees in *business and administration* have seen a very large decline in the average quality of job. Finally, the analysis brings home the point that while the average return to a qualification might be high, not everyone will get that average; for any particular qualification there will be a distribution of jobs and some will do better than the average and others worse.

The analysis could be extended by breaking down the supply side into domestic and foreign born graduates, perhaps splitting the latter into whether they come from a non-English speaking background or not. It may be the case, for example, that

Australian born graduates have fared better than those born overseas. Of particular interest would be the role in increasing the supply of graduates of skilled migration and international higher education students who remain in Australia after graduation. However, such analysis is beyond the scope of this paper.

From governments' perspective the issues are a little different. On the labour demand side, part of the story is the increased regulation of the labour market. Degrees rather than diplomas in health jobs (education went through this change before the time period we are considering), and the introduction of mandatory credentials in financial services and community services have naturally been addressed through an increase in people training in and obtaining these credentials. Whether this has led to an improvement in the quality of these services is an important policy question in its own right. However, only part of the expansion in the proportion of people with qualifications can be attributed to regulatory changes. In unregulated parts of the labour market, the question is whether the educational expansion, or 'skills deepening' is providing any real benefit (noting that the balance between public and private benefits goes to the issue of public/private financing of the expansion). One can argue that the 'skills deepening' might lead to improved productivity within occupations; if this is the case then the decline in the average 'job quality' as measured by occupation would be less of a concern. However, there must be a nagging feeling that part of what we have observed is credentialism, with individuals requiring higher level qualifications to obtain a job in an occupation without an impact on productivity. The uncapping of university places over recent years implies that increasing education levels will be a feature of the emerging labour market, and the job prospects of new higher education graduates since 2008 have been worsening (Graduate Careers Australia, 2013). Whether this is a cyclical phenomenon or reflects longer term structural changes will become clearer with the passage of time. The match between the labour market and education is certainly a concern of the OECD (2012), asking how the world economies are going to absorb the increasing number of well-educated young people. Of course, if individuals were paying for the full cost of qualifications then that would be an issue for private concern but the very significant public contribution to the costs of qualifications means then it must be a public policy concern.

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Externalities and the Social Return to Education in Indonesia

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Abstract

It is widely known that education provides economic benefits to individuals. However, education also has the potential to generate significant externalities. These external effects of education, in Indonesia, are the focus of the current paper. They are investigated using a local labour market (the province) approach. Significant externalities, as high as, or even much higher than, the private return to schooling, are documented, using both OLS and IV estimations. Sensitivity tests involving separate analyses for skill groups along the lines of Moretti (2004a) and Muravyev (2008), indicate that this finding is robust. The results thus strongly support the view that investing in education is more important for aggregate economic outcomes than it is for the individuals who do so. It appears that there is a clear role for the government fostering further expansion of education opportunities in Indonesia.

Keywords: Externality, Earnings, Experience, Returns to schooling, Instrumental variables

JEL Classification: I210, I220, J240, J310

1. Introduction

Studies of the return to education in Indonesia have shown that this is much lower than in comparator countries.[1] For example, Duflo (2001) reported that the return to

[1] The Indonesian economy shifted from a controlled economy to a market driven economy in 1966 (Ananta and Arifin, 2008). Referring to the general pattern of the return to schooling in economic transition countries, the low return to schooling in Indonesia in the late 2000s invites a question. At this period, where the economic reform process had already reached the market driven economy stage, the return to schooling is expected to be higher than the estimates described in this section.

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education ranged from 6.8 to 10.6 per cent, based on data from the 1995 inter-census survey of Indonesia. Similarly, Comola and Mello (2010), using data from the 2004 Indonesian labour market survey, found that the return to education estimated by ordinary least squares ranged from 9.49 per cent to 10.32 per cent. It was similar to these figures when sample selectivity correction methods of estimation were employed. Both Duflo (2001) and Comola and Mello (2010) have a focus on a single average return to years of education. Other studies have examined variations in the return to education according to the level of schooling. Thus, Deolalikar (1993), based on data from the 1987 round of the National Socioeconomic Survey and the Village Potential module of the 1986 Economic Census, reported that the returns to schooling ranged from around 10 per cent for workers with some primary schooling, to close to 20 per cent for workers with secondary or higher education. In comparison, Psacharopoulos (1981, 1985 and 1994) reported that the returns to schooling for Asian countries are 31 to 39 per cent, 15 to 18.9 per cent and 18 to 19.9 per cent for primary, secondary, and tertiary education, respectively. Hence, not only is the return to schooling relatively low in Indonesia, but it also exhibits a pattern across levels of education that is different from that in most other comparator countries.

Moreover, there is evidence that the returns to schooling in Indonesia have fallen in recent years. Thus, Purnastuti, Miller and Salim (2013a) reported that the payoff to schooling in Indonesia in 2007/2008 was several percentage points lower than in 1987. They argue that this may be linked to the large-scale expansion of the education sector in that country.

Investment in education by the government is in part due to the benefits to the economy of a highly educated workforce. The main measure of these benefits is the private return discussed above. Indeed, for Indonesia, this appears to be the only measure of the benefits of education. From this perspective, the picture of relatively low rates of return, rates of return that are relatively modest at the primary and secondary level, and of falling rates of return, might call into question the recent, and planned, rapid expansion of the education sector in Indonesia.

However, the private monetary gains associated with additional years of schooling are only one part of the potential benefits of education. Another potentially important component of the benefits to society as a whole is the external effects of education. These external effects are the focus of the current paper.

The rest of the paper proceeds as follows. Section 2 outlines the conceptual framework and related empirical evidence for this study. This framework is based on the idea that education can have external effects in local labour markets. Section 3 outlines the data sets used. Empirical results are presented and discussed in section 4. Both ordinary least squares and instrumental variables methods of estimation are used. Some sensitivity analyses are presented in section 5, and these are followed by a conclusion in section 6.

2. Conceptual Framework and Empirical Evidence

It is widely accepted that an individual's educational attainment affects not only the individual's productivity but also that of others in society. Workers, for example, may benefit from being close to a dense, skilled, labour market where, through different

channels, they can learn from others, and hence enhance their productivity and earnings, without cost. Education externalities need not be limited to market externalities of this type. A wide range of other potential externalities have been discussed in the literature (see, for example, McMahon, 2007), such as more informed voting and better parenting practices. However, most empirical research has focussed on local labour market monetary externalities using the Mincerian equation.[2] Acemoglu (1997) and Acemoglu and Angrist (2000) develop theories about monetary externalities of education, whereas Jacobs (1970) discuss nonmonetary externalities of education.

Recently Fu (2007) proposes that human capital externalities penetrate through four channels. Workers can learn from their occupational and industrial peers, who are in the same local labour market, through the depth (quality) of the human capital stock in the local labour market; Marshallian labour market externalities, or specialisation and peer competition effects; Jacobs labour market externalities or the diversity of the local labour market in terms of occupations and industries; and the thickness (density) of the local labour market, or labour market pooling effects. The depth of human capital stock captures the vertical difference of knowledge i.e. workers with better human capital in their fields can learn more and faster than those with lower human capital levels in their fields. Marshallian labour market externalities emphasize technological spillovers. According to this phenomenon workers can learn from the local concentration of same-occupation and same-industry peers. While Jacobs labour market externalities consider the benefit from urban diversity which results from the variety and diversity of geographical proximate industries that promote innovation and growth. The thickness of a labour market considers how workers benefit from the thickness or density of a local labour market. The higher the thickness of a local labour market the higher the possibility that worker can socialize more frequently and build social networks more easily to exchange information.

Acemoglu and Angrist (2000) and Rudd (2000) study human capital externalities in the US at the state level, whereas Rauch (1993) and Morreti (1998, 2004a) investigate human capital externalities in that country at the metropolitan area (cities) level. A study for Canada by Rakova and Vaillancourt (2005) also has a focus on metropolitan area-level data. Similarly, two studies of less developed countries are based on disaggregated data, namely Kenya (district level), and China (city level).

Acemoglu and Angrist's (2000) research was based on a panel of US states, and accounted for state-fixed effects as well as for the endogeneity of the average and individual schooling variables. The focus was on white men aged 40-49, using data from the 1960-1980 US Censuses. Acemoglu and Angrist (2000) measured aggregate human capital by the average years of schooling at the state level. The main findings of this research suggest that a small external return, of about one per cent (mostly ranging from one to three per cent), is possible, though the effect was statistically insignificant in the IV estimations.

[2] Moretti (2004a) argues that there are two separate reasons why an increase in the share of educated workers may increase total wages over and above the private return to schooling. First, if educated workers and uneducated workers are imperfect substitutes, an increase in the share of educated workers will raise the productivity of uneducated workers. Second, the human capital externality raises the productivity of uneducated workers through the learning effects noted above. This matter is investigated in section 5.

Turning to developing countries, Kimenyi *et al*. (2006) applied the augmented Mincer equation to analyse returns to education and the social externality of education at the district level in Kenya. The data used were derived from the Welfare Monitoring Survey of 1994 undertaken by the Central Bureau of Statistics in Kenya. The results of this study provided evidence of significant human capital externalities in urban areas.

Liu (2007) investigated the external returns to education associated with a measure of city average education in China. This study was based on the 1988 and 1995 waves of the Chinese Household Income Project. Several approaches to estimate the impact of human capital externalities were employed, such as OLS estimation using city average education for city-level education, OLS estimation using the fraction of college-educated workers for city-level education, IV estimation, and estimation of the external returns by education group. The OLS estimates indicate that a one-year increase in city average education could raise the earnings of individuals by 4.9 per cent to 6.7 per cent. The IV estimates of the external returns range from 11 per cent to 13 per cent. As such the social returns to education, which consist of the private and external returns, were as high as 16 per cent in the mid-1990s in urban China.

Turning to the case of Indonesia, McMahon, Jung and Boediono (1992), and Behrman and Deolalikar (1993) analysed the rate of return to education. McMahon, Jung and Boediono (1992) compared the social return between general and vocational schools in major regions of Indonesia and found that rate of return varies from five to 22 per cent on average for all regions but narrows to nine to 14 per cent in case of the most densely populated area of Central Java. Considering the gender difference on the rate of return to schooling, Behrman and Deolalikar (1993) found that private rates of return to schooling investments in females are higher than are those to males. Sohn (2013) analysed both the monetary and nonmonetary returns to education in Indonesia using Mincerian specification and quintile regression approach. He found that monetary rate of return is lower for self-employment than for paid employment for person- and- sector specific reasons. He also found positive, substantial and robust non-monetary effects of returns to education above and beyond absolute and relative level of monetary returns to education.

Thus, the literature indicates that the importance of human capital externalities depends on the level of disaggregation. Significant results are obtained when the aggregate human capital is measured at the city or district level. In studies where the level of analysis is extended to a wider geographical area, such as the state level, the human capital externalities are generally not significant. The literature also has two other features. First, the measures of human capital that are commonly utilised are the average of the years of schooling, and the proportion of workers with college or higher degrees. However, the studies indicate that where human capital externalities are important they are important regardless of the aggregate human capital measure employed. Second, most of the studies suggest that when estimating human capital externalities there should be consideration of a potential endogenity problem.

3. Empirical Conceptualisation and Data

The augmented Mincerian earnings equation in the current application to the Indonesian labour market can be written as:

$$\ln(E_i) = \beta_0 + \beta_1 S_i + Z_i\beta_2 + X_i\beta_3 + \varepsilon_i \quad (1)$$

Where $\ln(E_i)$ is natural logarithm of monthly earnings of individual *i*. These monthly earnings include the value of all benefits secured by an individual in their job. The variables for individual characteristics employed in the estimations are years of schooling (S_i), job experience and its square, job tenure and its square, marital status, urban area of residence, and gender (X_i). These are standard control variables in an estimation of this type.

The external effect of human capital (Z) can be internalised within a small group, such as a firm, or a bigger group, such as a city, province, or state. Consequently, two approximations for the aggregate-level human capital measure are used. The first aggregate-level human capital measure is based on the province of residence. The second aggregate-level human capital measure is based on the industrial sector of employment within the province. Within each of these aggregate-level human capital measures two types of variables are constructed, based on the average years of schooling of workers and on the percentage of workers with higher education qualifications. Thus, the aggregate-level human capital measures for each province are: (i) the average years of schooling among all the workers in the province (*AveSchool*); (ii) the province-specific average years of schooling in the industrial sector in which the worker is employed (*AveSchool-Ind*); (iii) the percentage of college or higher-degree holders among all the workers in the province (*PerHE*); and (iv) the province-specific percentage of college or higher-degree holders in the industrial sector in which the worker is employed (*PerHE-Ind*).[3]

Estimating external returns to schooling using the OLS approach invites the question of whether the estimation results will suffer from omitted variables bias. As noted by Acemoglu and Angrist (2000) and Moretti (2004a), among others, the unobserved characteristics of individuals and provinces could be correlated with the average years of schooling or the percentage of higher education graduates, and this could raise individuals' earnings, biasing the coefficient on the aggregate human capital measure. An IV approach is used to address this potential source of bias. Two instruments are considered, namely the ratio of higher education institution per 1,000 people (HE1000), and the percentage of household use clean water (CW).

While both the *HE1000* and electricity variables are available for use as instruments for the province-level variables, suitable variables are not available for their industry-level counterparts. However, we are instrumenting *AveSchool-Ind* and *PerHE-Ind* using internal instruments following Lewbel (2012).[4] This approach is based on the use of the product of heteroscedastic residuals from a first-stage

[3] The externalities estimated using these variables are those which Choi (2011) describes as static externalities, as distinct from the learning externalities examined in his calibrated (using US data) growth model.

[4] We are grateful to Christopher F. Baum and Mark E. Schaffer for access to their Ivreg2h Stata module that implements Lewbel's (2012) heteroskedasticty-based procedure.

equation explaining variation in the endogenous regressor and each of the exogenous regressors as generated or internal instruments. In general, the greater the degree of heteroscedasticity in the first-stage regression the better (that is, the higher the correlation of the generated instruments with the endogenous variable) the instruments.

The data used are taken from four sources. Individual-level data are taken from the Indonesian Family Life Survey 4 (IFLS4). IFLS4 is a nationally representative sample comprising 13,536 households and 50,580 individuals, spread across provinces on the islands of Java, Sumatra, Bali, West Nusa Tenggara, Kalimantan, and Sulawesi. Together these provinces encompass approximately 83 per cent of the Indonesian population and much of its heterogeneity. IFLS4 was fielded in late 2007 and early 2008. It was a collaborative effort by RAND, the Center for Population and Policy Studies of the University of Gadjah Mada, and Survey Meter. Average provincial-level data are taken from the BPS - Statistics Indonesia and the Ministry of Manpower and Transmigration (MoMT). The variables to instrument the average years of schooling and the percentage of workers with higher education variables are based on data from the BPS - Statistics Indonesia and the Ministry of National Education (MoNE).

Table 1 shows the summary statistics for the variables. The mean total monthly earnings in log form are 5.908 across the workers. The mean years of schooling is relatively low, specifically 10.67 years, and so exceeds the nine years of compulsory study by slightly less than two years. The workers in the sample have mean work experience of approximately 17.87 years. The mean length of job tenure is 7.89 years.

Table 1 - Summary Statistics of Variables

Variables	*Mean*	*Standard Deviation*	*Variables*	*Mean*	*Standard Deviation*
Monthly earnings (IDR)	1,339,521	1,961,290	Average years of schooling	8.744	0.770
Years of schooling	10.669	3.751	Average years of schooling based on industrial sector	9.370	1.493
Experience	17.869	10.604	Percentage of workers with higher education	7.731	3.139
Tenure	7.890	8.142	Percentage of workers with higher education based on industrial sector	12.348	12.406
Married	0.868	0.339	The number of higher education institution per 1000 people	0.0158	0.010
Urban	0.674	0.469	Percentage of household use clean water	53.649	12.099
Female	0.334	0.472			

Source: Authors' calculation based on IFLS4, BPS's, MoMT's and MoNE's databases.

Table 2 presents some characteristics of the provincial-level data. It shows a substantial variation in the number of people - between 1.1 and 40.6 million – across the provinces. There are four provinces in the sample with a population of over 10 million. Three of these provinces are located in Java Island, namely Jawa Barat, Jawa Tengah,

and Jawa Timur. Jawa Barat is the most populated province among these (population of 40.6 million), followed by Jawa Timur, Jawa Tengah, and Sumatera Utara, which have populations of 37 million, 32.5 million, and 12.9 million, respectively. The province with the smallest population is Kepulauan Bangka Belitung, with 1.1 million inhabitants.

In terms of the average years of schooling for workers in each province, Daerah Istimewa Yogyakarta (DIY) has the highest average years of schooling, with 12.22 years of schooling. However, this figure is just equal to an individual who completed senior high school (grade 12). The province with the lowest average years of schooling for its workers is Riau, 9.42 years of schooling, and this is just equal to an individual who completed basic education (grade 9).

Table 2 - Characteristics of Provincial-Level Data

Province	*2007/2008 population (thousands)*	*Per cent of workers with higher education*	*The number of higher education institution per 1,000 people*	*Per cent HH use clean water*
Sumatera Utara	12,938.35	6.38	0.018	47.82
Sumatera Barat	4,730.45	8.46	0.023	46.29
			0.0026	40.11
Lampung	7,289.8			
Kepulauan Riau	1,423.00	10.71	0.0026	69.33
Riau	5,130.10	7.75	0.0096	34.90
DKI	9,105.40	16.20	0.037	80.36
Jawa Barat	40,623.70	7.31	0.011	41.97
Jawa Tengah	32,503.35	5.68	0.0084	50.71
DIY	3,451.50	10.43	0.039	66.93
Jawa Timur	36,995.20	5.49	0.011	57.63
Banten	9,512.90	7.89	0.012	45.05
Bali	3,497.90	8.64	0.012	63.76
NTB	4,328.15	5.04	0.012	46.72
Kalimantan Selatan	3,421.65	5.50	0.012	53.89
Sulawesi Selatan	3,421.65	7.80	0.021	48.26

Source: Authors' calculation based on IFLS4, BPS's, MoMT's and MoNE's databases.

The percentage of the workers with higher education is low. Only three provinces in the sample have a percentage of their workers with higher education of more than 10 per cent, namely Daerah Khusus Ibukota (DKI), Kepulauan Riau, and DIY, with 16.20, 10.71 and 10.43 per cent, respectively. Nusa Tenggara Barat (NTB) is the province with the lowest percentage of workers with higher education, with only 5.04 per cent. The largest ratio of the number of higher education institution per 1,000 people is for the province of DKI, with a ratio of 0.037. The province with the lowest ratio is Kepualuan Riau, with a ratio of 0.0026.

4. Statistical Analyses

The discussion in this section commences with the analysis based on the OLS approach. Following this the IV analyses are considered.

(i) OLS Analyses

Table 3 shows the results from the estimation of the augmented Mincerian model. The findings in the two left-hand columns are for when the average years of schooling and the average years of schooling based on the industrial sector within each province are utilised as the aggregate-level human capital measures. The findings in the final two columns are based on the percentage of workers with higher education as the aggregate-level human capital measures. In each instance the first model presented contains only the aggregate-level variable that is based solely on the province of residence, while the second model contains this variable together with the corresponding variable based on the worker's industry of employment within the province. This sequential approach to estimation will inform on whether there are collinearities between the two measures of external effects. It also provides a tractable approach for the IV estimations that follow. Two sets of standard errors are listed for each variable. The first standard error is the conventional robust one. The second reflects the clustering of the measures of the external effects at the provincial level. The presentation of both types of standard errors follows Hyytinen, Ilmakunnas and Toivanen (2013). It is noted that variables which are statistically significant have this status in this instance regardless of the standard error used. In subsequent presentations, only clustered standard errors are listed.

The results reported in table 3 can be considered satisfactory, as close to 30 per cent of the variance in earnings is explained. The findings associated with the non-education variables conform to conventional wisdom, and will not be discussed here (see, Purnastuti, Miller and Salim (2013a) for relevant analysis). Rather the discussion will focus on the individual and aggregate-level education variables.

The estimates of the private returns to education are comparable for the two sets of results. Each additional year of schooling is expected to increase individual earnings by between four and five per cent.[5]

The estimates of the human capital externalities are all positive and statistically significant at the five per cent level of significance or better. In the model of column (i), where only the provincial average years of schooling is included in the estimating equation, the estimated effect indicates that an increase by one in the average years of schooling in the province is expected to be associated with an increase in the individual worker's wage of 5.8 per cent.[6] This finding is in line with those reported by Liu (2007) in China, where an increase in the average years of schooling by one

[5] The estimates of the private return to schooling using levels of education show that the payoff to schooling increases as higher levels of education are considered. As noted in section 1, this pattern, which is the same as reported by Deolalikar (1993), contrasts with the pattern typically found in developing countries (Psacharopoulos, 1981, 1985 and 1994).

[6] Similar estimates of the external effects are obtained when variables for the level of education for the individual are used in the estimations. This contrasts with Rudd's (2000) finding. Rudd (2000) reported that there was no evidence of human capital spillovers when a years' of schooling variable was used in the estimation, while such spillovers were evident when dummy variables for educational attainment were utilised in the model.

year led to an increase in individual earnings by 4.90 to 6.67 per cent. The external effect associated with an expansion of the education sector in Indonesia is almost one percentage point higher than the internalised effect associated with the individual's years of schooling variable.

Table 3 - OLS Estimates of Augmented Mincerian Earnings Equation

	(i)	*(ii)*	*(iii)*	*(iv)*
	Externality measure			
Variable	*Average years of schooling*		*Percentage of workers with higher education*	
Constant	4.7118 ***	4.4942 ***	5.1434 ***	5.1545 ***
	(0.137)	(0.148)	(0.068)	(0.068)
Years of schooling	0.0492 ***	0.0439 ***	0.0491 ***	0.0460 ***
	(0.003)	(0.003)	(0.003)	(0.003)
Experience	0.0076 **	0.0074 **	0.0078 **	0.0077 **
	(0.003)	(0.003)	(0.003)	(0.003)
Experience^2/100	-0.0129 *	-0.0128 *	-0.0135 *	-0.0134 *
	(0.007)	(0.007)	(0.007)	(0.007)
Tenure	0.0162 ***	0.0161 ***	0.0160 ***	0.0158 ***
	(0.003)	(0.003)	(0.003)	(0.003)
Tenure^2/100	-0.0283 ***	-0.0284 ***	-0.0281 ***	-0.0281 ***
	(0.008)	(0.008)	(0.009	(0.009)
Marital status	-0.0073	-0.0018	-0.0076	-0.0053
	(0.019)	(0.020)	(0.019)	(0.020)
Urban	0.0950 ***	0.0760 ***	0.0942 ***	0.0904 ***
	(0.022)	(0.023)	(0.021)	(0.021)
Female	-0.1909 ***	-0.2008 ***	-0.1917 ***	-0.1961 ***
	(0.018)	(0.019)	(0.019)	(0.020)
AveSchool	0.0580 ***	0.0524 ***		
	(0.014)	(0.012)		
AveSchool-Ind		0.0361 ***		
		(0.009)		
PerHE			0.0098 **	0.0096 **
			(0.005)	(0.004)
PerHE-Ind				0.0024 ***
				(0.001)
Adj-R^2	0.2847	0.2965	0.2791	0.2829
Observations	4528	4528	4528	4528

Notes: Heteroscedasticity-consistent standard errors in parentheses; *, ** and *** denote statistical significance at the 10 per cent, five per cent and one per cent levels, respectively.

The model of column (ii) is distinguished by the addition of the depth of the same industrial sector human capital stock. The inclusion of this variable is associated with a small reduction in the coefficient on the overall human capital stock variable, from 0.0580 to 0.0524. The *AveSchool-Ind* variable has a coefficient of 0.0361, indicating that an increase by one in the average years of schooling in each worker's industrial sector is associated with an increase in the worker's monthly earnings by around 3.6 per cent. It therefore appears that the effects of human capital depth within the worker's industrial sector of employment are slightly smaller than the effects of the

overall human capital depth, though both sources of externality are important. This is in agreement with Fu's (2007) finding using Boston metropolitan data.

The social return[7] to schooling consists of both the private and external returns to schooling. Thus, social return to schooling in this article is measured as (Years of schooling + Average Schooling)/Private Return to school. Then, based on the results in column (i) of table 3, it can be seen that the social return exceeds the private return by a factor of (0.0492 + 0.0580)/0.0492, or by about 2.2. This figure is higher than the finding of Rauch (1993), based on US data. Rauch (1993) found that the social return exceeded the private return by a factor of 1.7.

To check the robustness of the OLS estimates considered above, the models of columns (i) and (ii) were re-estimated using the alternative measure for the provincial level education, namely the percentage of workers with higher education. The results are reported in columns (iii) and (iv) of table 3. It is apparent that the results for the variables other than the aggregate-level variables are unaffected by this change to the specification.

Including an aggregate-level human capital measure based on the percentage of workers with higher education leads to lower estimated coefficients compared to those obtained using the average years of schooling. Using this new variable, the estimated coefficient is around 0.01 in each specification, implying that an increase in the percentage of workers with higher education by one percentage point can be expected to increase an individual's monthly earnings by about one per cent. These results are very similar to the OLS estimates of 1.02 per cent to 1.42 per cent reported by Morreti (2004a) based on US data, the 1.10 per cent to 1.45 per cent reported by Liu (2007) based on Chinese data, and the recent estimates of 0.6 per cent to 1.8 per cent for Germany by Heuermann (2011). Comparison with the estimates presented in the first two columns of table 3 suggest the externalities associated with education in Indonesia seem to derive more from expansion of the pre-tertiary levels of schooling rather than from the higher education sector.[8]

The estimates based on the variables constructed using the percentage of workers with higher education based on the industrial sector within each province are consistent with the above conclusion. These results show that an increase in the percentage of workers with higher education in each industrial sector by one percentage point is associated with an increase in an individual's monthly earnings by approximately 0.2 per cent. Similar to the results in columns (i) and (ii), the external returns to schooling associated with the aggregate-level human capital in the same industrial sector within the province are lower than those from the overall-level of human capital within the province. The social returns to education associated with the

[7] Private and social returns to education may differ in the presence of externalities.

[8] Note that the *PerHE* and *PerHE-Ind* variables are measured as a per cent whereas *AveSchool, AveSchool-Ind* and years of schooling are in years. Comparisons of estimated impacts might be more useful if undertaken using an elasticity measure. In the semi-logarithmic specification of the earnings equation, the elasticity is found by multiplying the regression coefficient by the mean of the variable of interest. However, as the means are comparable (for example, the mean of *AveSchool* is 8.74 and the mean of *PerHE* is 7.73), the regression coefficients provide a good basis for comparisons from this perspective. For this reason also, the discussion of the social return using the *PerHE* variables is based simply on the summation of the estimated coefficients.

percentage of workers with higher education (columns (iii) and (iv)) exceed the private returns by a factor of at least 1.2. This is lower than that recorded on the basis of the specifications listed in columns (i) and (ii).

Summing up, these OLS estimates reveal four points of interest. First, the estimates of the private returns to schooling are stable across all specifications. Second, all estimates of the external returns to schooling are positive and statistically significant, both for the overall level and for the industrial sector level variables. Third, the externalities associated with education in Indonesia appear to be associated mainly with expansion of schooling at the pre-tertiary level. Fourth, the social return to schooling could be more than double the conventionally estimated private return. If this is the case the policy implications in relation to the potential for further expansion of the education sector would be altered considerably. Before pursuing these policy implications, however, the IV estimates will be discussed.

(ii) IV Approach

In this sub-section an IV approach is adopted to address the issue of potential bias that may arise because of unobserved factors being correlated with the provincial level human capital. Tables 4 reports the results. The column (i) and (ii) of this table are based on the use of the *AveSchool* variables as the measure of aggregate-level human capital. Of these columns of results, the first is for where the Number of higher education institution per 1000 people is employed as an instrument (*HE1000*), and the second covers the results from the IV estimations using the percentage of household use clean water as an instrument (*CW*). The results contained in the final two columns are based on the *PerHE* variable as the aggregate-level human capital measure, with the *HE1000* and *CW* as instruments.

Ideally the bias that may arise because of unobserved factors being correlated with the human capital measure based on the industrial sector within each province should also be evaluated. Unfortunately, as noted above, there is no suitable instrument for this disaggregated measure of the human capital stock within each province. The model was, however, estimated with internal instruments along the lines of Lewbel (2012). While the error structure in the first-stage regression was heteroscedastic, suggesting the approach may have merit, the industrial sector human capital measure was statistically insignificant in the earnings equation, indicating the internal instruments are weak. For this reason, the IV estimations reported here are based only on one aggregate-level human capital measure per equation, as per columns (i) and (iii) of table 3.

Table 4 - Instrumental Variables Estimates of the Augmented Mincerian Model[9]

	(i)		*(ii)*		*(iii)*		*(iv)*	
	Externality Measure							
	Years of schooling				*Per cent of workers with higher education*			
	Type of Instrument							
	Number of higher education institution per 1,000 people		*Per cent household use clean water*		*Number of higher education institution per 1,000 people*		*Per cent household use clean water*	
Variable	*1st stage*		*1st stage*		*1st stage*		*1st stage*	
Constant	8.2423 ***	4.1957 ***	7.5336 ***	4.3383 ***	4.6747 ***	5.1727 ***	3.4880 ***	5.0532 ***
	(0.0578)	(0.2685)	(0.0729)	(0.22154)	(0.2243)	(0.0430)	(0.2996)	(0.0662)
Years of schooling	0.0011	0.0408 **	0.0031 ***	0.0409 ***	0 .0204 *	0.0405 ***	0.0276 **	0.0401 ***
	(0.0031)	(0.0016)	(0.0031)	(0.0016)	(0.0121)	(0.0016)	(0.0126)	(0.0016)
Experience	0.0103 **	(0.0053) ***	0.0118 ***	0.0054 ***	0.0331 **	0.0059 ***	0.0384 ***	0.0052 **
	(0.0041)	(0.0021)	(0.0041)	(0.0021)	(0.0161)	(0.0021)	(0.0168)	(0.0022)
Experience^2/100	-0.0211 **	-0.0088 ***	-0.0236 ***	-0.0092 **	-0.0662 *	-0.0101 **	-0.0772 ***	-0.0086 *
	(0.0090)	(0.0046)	(0.0089)	(0.0046)	(0.0348)	(0.0046)	(0.0363)	(0.0047)
Tenure	-0.0011	0.0173 **	-0.0037 **	0.0173 ***	0.0090	0.01670 ***	-0.0024	0.0170 ***
	(0.0040)	(0.0020)	(0.0039)	(0.0020)	(0.0155)	(0.0020)	(0.0161)	(0.2079)
Tenure2/100	-0.0068	-0.0301 ***	0.0010 ***	-0.0301 ***	-0.0521	-0.0298 ***	-0.0162	-0.0293 ***
	(0.01300)	(0.0066)	(0.0128)	(0.0066)	(0.0504)	(0.0066)	(0.0527)	(0.0068)
Marital status	0.0486	-0.0032	0.0417 **	-0.0027	0.3017 **	-0.0036	0.23487	-0.0077
	(0.0357)	(0.0182)	(0.0352)	(0.0181)	(0.1384)	(0.0182)	(0.1446)	(0.0187)
Urban	0.1480 ***	0.0876 ***	0.1482 *	0.0914 ***	0.9427 ***	0.0861 ***	1.2034 ***	0.0580 ***
	(0.0255)	(0.0145)	(0.0248)	(0.0139)	(0.0981)	(0.0147)	(0.1019	(0.0190)
Female	-0.0274	-0.1880 ***	-0.0236 *	-0.1883 ***	-0.0804	-0.1898 ***	-0.0412	-0.1892 ***
	(0.0237)	(0.0120)	(0.0233)	(0.0120)	(0.0918)	(0.0120)	(0.0959)	(0.0124)
AveSchool		0.1311 ***		0.1143 ***				
		(0.0315)		(0.0259)				
PerHE						0.0222 ***		0.0419 ***
						(0.0053)		(0.0098)
HE1000	17.8576 *				05.6164 ***			
	(1.1057)				(4.2888)			
CW			0.0181 ***				0.0493 ***	
			(0.0009)				(0.0037)	
F-test of exogeneity		5.3290 **		4.6249 **		5.6940 **		11.5154 ***
Observations	4528	4528	4528	4528	4528	4528	4528	4528

Notes: Standard errors in parentheses. *, ** and *** denote statistical significance at the 10 per cent, five per cent and one per cent levels, respectively.

The identifying instrument is statistically significant, and has the expected sign in each estimation. The F-test of the endogeneity of the aggregate-level human capital measure rejects the null hypothesis of exogeneity in all the models. Attempts to instrument using both the external instruments and generated instruments, in line with Lewbel's (2012) approach, was not associated with any quantitative improvement in the results. Hence only the findings based on the external instruments, and in particular the estimations using the HE1,000 variable as the instrument, are discussed.

There are no material changes to the results presented in table 4 for the variables other than the aggregate-level human capital measures. Each of the aggregate-level human capital measures is associated with the same positive impact on individual's wages that characterised the OLS estimates. However, there are important changes in magnitude. Applying the IV approach leads to much higher (by a factor of four) estimated external returns to schooling compared to those obtained using the OLS approach. Thus, according to the column (i) results, an increase by one in the average years of schooling in the province is associated with an increase in the individual's monthly earnings by about 13 per cent. These results are lower than the study using 1990 Canadian data conducted by Rakova and Vaillancourt (2005). They found that an increase by a year in their average education variable had an effect on labour productivity of 23 per cent.

When the *AveSchool* variable is replaced by *PerHE* the IV findings are consistent with those obtained using OLS, in that the use of this alternative measure of aggregate-level human capital is associated with a much lower estimate of the human capital externality. In particular, the estimated coefficient on the *PerHE* variable is 0.0222 in the column (iii) results. However, even this lower estimate of the external return to schooling exceeds the estimated private return to schooling.

Summing up the patterns of these IV estimates results, there are two points that need to be highlighted. First, the findings from the IV analyses are sensitive to the choice of instrument, including whether external or internal instruments are employed. This is consistent with research on the IV estimation of the private return to schooling, such as Levin and Plug (1999). Second, the estimated external returns to schooling associated with both the average years of schooling and the percentage of workers with higher education obtained using the IV approach are larger than that obtained using OLS. Hence, it appears that education externalities are an important issue for public policy makers to consider in Indonesia.

[9] (Table 4) To evaluate whether the instruments used in this analysis are appropriate the quality and relevance criteria of the instruments are introduced. The test for the quality of the instruments by examining the F-test of the joint significant of the respective instrument sets in their first stage equation has been undertaken. The second criterion is relevance. The relevance of the instrument is to answer the most essential question, whether instrumenting the schooling variable is necessary or not? To answer this question, the Hausman test can be applied (Hausman, 1978).

5. Sensitivity Analyses

In this section the results of two extensions of the above set of analyses are presented.[10] First, results from estimations undertaken for samples disaggregated by level of education are presented. This approach provides a test of the substitution hypothesis of Moretti (2004b) and Muravyev (2008). Second, the variable for each worker's years of schooling, which captures the private return to education, is instrumented at the same time that the aggregate-level measure is instrumented. Acemoglu and Angrist (2000) argue that this is an important consideration. Parents' educational attainments are used as instruments for the individual-level schooling variable.

(i) Human Capital Spillovers vs. Substitutability

Moretti (2004b, 2004a) argued that the correlation between aggregate-level human capital and earnings is not always associated with human capital externalities. Rather, it could arise from imperfect substitution between low-skilled and high-skilled workers.[11] Specifically, in a conventional demand and supply model with imperfect substitution between high-skilled and low-skilled workers, an increase in the number of high-skilled workers will tend to decrease the earnings of the high-skilled workers and, at the same time, the earnings of low-skilled workers will tend to increase. In other words, although there are no human capital externalities, low-skilled workers receive benefit from an increase in the number of high-skilled workers under imperfect substitution between these types of workers. However, at the same time, human capital externalities may increase the earnings of both low- and high-skilled workers. Putting these two effects together, an increase in the ratio of workers with higher education should have a positive effect on the earnings of low-skilled workers. The effect for high-skilled workers will be positive only where the spillover effect is sufficient to offset the supply effect. Hence, externalities can be said to be present when an increase in the average-level of education translates into an increase in the earnings of high-skilled workers.

To examine which of these explanations is more credible for Indonesia we follow Moretti (2004b, 2004a) and Muravyev (2008), and estimate the education spillover effect separately for low-skilled and high-skilled workers.[12] Table 5 shows the results for the OLS estimations, separately for workers who obtained higher education (columns (iii) and (iv)) and for all other (less-skilled) workers (columns (i) and (ii)). These equations were also estimated using an IV approach, and with the industry-level variables as well (results are available from the authors upon request).

The results reported in table 5 show that the coefficient of the AveSchool variable for workers without higher education is 0.058, whereas the coefficient of this variable for workers with higher education is 0.074. Each of these coefficients is statistically significant. These results thus show that the average years of schooling in each province has a two percentage points larger effect on the earnings of high-

[10] As an additional test of robustness the models were estimated separately by gender. Broadly similar results were obtained for males and females.
[11] See, for example, the theoretical exposition in Heuermann (2011).
[12] Low-skilled workers are defined as workers with education lower than higher education. High-skilled workers are defined as workers with higher education.

skilled workers than they have on the earnings of low-skilled workers. Hence, these findings appear to confirm the presence of human capital externalities, since both of the aggregate-level human capital variables are associated with increases in the earnings of high-skilled workers. This result is similar to Moretti (2004a), though in Moretti's analyses for the US an increase in the proportion of high-skilled workers had a larger positive effect on the wages of low-skilled workers than it had on the wages of the high-skilled workers. The relativity in the current paper between the effects for high-skilled and low-skilled workers is, however, consistent with Heuermann's (2011) recent findings for Germany.

The coefficient of the *PerHE* variable for workers without higher education is 0.0088, whereas the coefficient of this variable for workers with higher education is 0.0170. These estimates for the *PerHE* variable indicate that a one percentage point increase in the percentage of workers with higher education in each province is associated with increases in the earnings of low-skilled workers of 0.88 per cent, and increases in the earnings of high-skilled workers of 1.70 per cent. These results support the finding discussed earlier in this sub-section.

In conclusion, these estimates on the samples disaggregated by skill level give further assurance in relation to the existence of human capital externalities.

Table 5 - Test for Imperfect Substitutability of Workers with and without Higher Education (OLS Estimation)

	(i)	*(ii)*	*(iii)*	*(iv)*
	Skill level			
Variable	*Low Levels of Education*		*Higher Education*	
Constant	4.8505 ***	5.2830 ***	3.6941 ***	4.2123 ***
	(0.1720)	(0.073)	(0.318)	(0.211)
Years of schooling	0.0379 ***	0.0381 ***	0.1002 ***	0.1004 ***
	(0.004)	(0.004)	(0.014)	(0.014)
Experience	0.0046	0.0051	0.0201 ***	0.0202 ***
	(0.003)	(0.003)	(0.007)	(0.007)
Experience^2/100	-0.0091	-0.0099	-0.0428 **	-0.0432 **
	(0.007)	(0.007)	(0.018)	(0.018)
Tenure	0.0156 ***	0.0155 ***	0.0157 ***	0.0142 ***
	(0.003)	(0.003)	(0.003)	(0.004)
Tenure^2/100	-0.0272 ***	-0.0274 ***	-0.0270 ***	-0.0215 *
	(0.009)	(0.010)	(0.010)	(0.011)
Marital Status	-0.0019	-0.0031	-0.0336	-0.0310
	(0.016)	(0.016)	(0.053)	(0.055)
Urban	0.0955 ***	0.0953 ***	0.1424 ***	0.1358 ***
	(0.024)	(0.023)	(0.025)	(0.022)
Female	-0.2168 ***	-0.2172 ***	-0.1297 ***	-0.1293 ***
	(0.024)	(0.026)	(0.016)	(0.015)
AveSchool	0.0577 ***	0.0740 ***		
	(0.018)	(0.026)		
PerHE		0.0088 *		0.0170 ***
		(0.005)		(0.005)
Adjusted R^2	0.2112	0.2043	0.2115	0.2101
Observations	3680	3680	848	848

Notes: Clustered (at level of province) standard errors in parentheses. *, ** and *** denote statistical significance at the 10 per cent, five per cent and one per cent levels, respectively.

(i) Endogeneity of Individual and Average Schooling

Following Acemoglu and Angrist (2000), we further address the endogeneity of both the individual and average schooling variables. The levels of education of parents and the number of higher education institution per 1,000 people are used as instruments. The variation in the parental education variables across individuals in a given age group appears to provide a superior basis for the IV framework than variables that have minimal variation across groups (see, Purnastuti, Miller and Salim, 2013b).

The results from the first-stage estimation reveal that father's years of schooling and mother's years of schooling both have highly significant positive influences on the individuals' years of schooling. At the aggregate level, it is apparent that father's and mother's years of schooling do not impact the average schooling variable, measured using either *AveSchool* or *PerHE*. The number of higher education institution per 1,000 people continues to have a marked impact on the provincial-level human capital measures. An F-test, robust to the clustering in the data, of the null hypothesis that both variables are exogenous was rejected, suggesting that an IV approach to accommodate endogeneity is appropriate.

The results reported in table 6 are distinguished by an increase in the private return to schooling of about three percentage points compared to the estimations where the worker's individual years of schooling was treated as exogenous. Nevertheless, the estimated external returns are as least as large as the private returns, and typically much larger for the model using AveSchool. For example, in the column (i) specification, the private return to schooling is 7.47, and the externality effect is close to 10.84 per cent. These results support the conclusion of the analyses in the previous sub-sections, to the effect that the education externalities in Indonesia are sizeable, and as such warrant consideration in public decision making over expenditure levels on education.

Thus our results suggest that the most obvious outcome of the private returns to schooling is higher earnings. However, an additional year of schooling raises the level of economic activity more than its private return. The results of the study of imperfect substitutability between low-skilled and high-skilled workers strengthen reveals that human capital spillovers exist in Indonesia. Provinces with higher amount high-skilled workers have higher human capital externalities. This finding supports the Marshallian propositions of labour market externalities. This can be explained by the channel that the concentration of skilled workers creates competition, which in turn provides a strong motivation for other to learn which is ultimately conducive to the creation and diffusion of knowledge.

Table 6 - Estimates of External Return to Schooling when Individual and Average Schooling are treated as Endogenous Variables

	(i)	*(ii)*
	Externality Measure	
	Years of schooling	*Percentage of workers with higher education*
	Type of Instrument	
Variable	*Parental education and number of HE institution per 1,000 people*	*Parental education and number of HE institution per 1,000 people*
Constant	4.0075 ***	4.8007 ***
	(0.2667)	(0.0593)
Years of schooling	0 .0747 ***	0.0759 ***
	(0.0045)	(0.0044)
Experience	0.0111 ***	0.0118 ***
	(0.0023)	(0.0022)
Experience^2/100	-0.0099 **	-0.0109 **
	(0.0047)	(0.0046)
Tenure	0.0128 ***	0.0123 ***
	(0.0021)	(0.0021)
Tenure^2/100	-0.0251 ***	-0.0247 ***
	(0.0067)	(0.0067)
Marital status	-0.0302	-0.0316 *
	(0.0186)	(0 .0187)
Urban	0.0334 **	0.0296 *
	(0.0159)	(0.0164)
Female	-0.1908 ***	-0.1924 ***
	(0.01215)	(0.0122)
AveSchool	0.1084 ***	
	(0.0320)	
PerHE		0.0182 ***
		(0.0054)
Observations	4528	4528
F-test of exogeneity	26.5235 ***	27.6468 ***

Notes: Clustered (at level of province) standard errors in parentheses. *, ** and *** denote statistical significance at the 10 per cent, five per cent and one per cent levels, respectively.

6. Conclusion

Using IFLS4 data, this paper has analysed whether a relationship exists between the aggregate-level of human capital and individual earnings in Indonesian provinces, and also whether this relationship reflects the presence of human capital externalities. The estimations are based on Mincerian earnings regression augmented with measures of the aggregate-level human capital in each province and in the industrial sector within each province. Specifically, four alternative measures of aggregate-level human capital are used, namely the average years of schooling, the percentage of workers with higher education, the average years of schooling based on the industrial sector within each province, and the percentage of workers with higher education based on the industrial sector within each province. A potential endogeneity problem is addressed, and the possibility of imperfect substitutability between low-skilled and high-skilled workers is also examined.

The main set of analyses suggests that human capital externalities are economically important in Indonesia. The OLS estimate of these is typically as large as the private return to schooling, which means that the social return is about double the private return to schooling. The IV estimates are associated with even higher values of the externalities, of over two times the magnitude of the private return to education. These sizeable externalities are also a feature of the labour market outcomes of both males and females.

The results of the study of imperfect substitutability between low-skilled and high-skilled workers strengthen our conclusion that human capital spillovers exist in Indonesia. Hence, the results of this study strongly support the view that investing in education is even more important for aggregate economic outcomes than it is for the individuals who do so. This study also provides evidence of the existence of human capital externalities as high as, or even much higher than, the private return to schooling. Thus, there would appear to be a clear role for the public sector fostering education and human capital development in order to seize the benefit of these externalities.

Appendix

Table A1 - IV with External Instruments plus Lewbel's Generated Instruments (AveSchool as Aggregate Human Capital)

	Standard IV		*IV with Generated Instruments*		*IV with Generated Instruments and External Instruments*	
Variable	*Number of higher education institution per 1,000 people*	*Per cent household use clean water*	*Number of higher education institution per 1,000 people*	*Per cent household use clean water*	*Number of higher education institution per 1,000 people*	*Per cent household use clean water*
Constant	4.8109 ***	4.7990 ***	4.8154 ***	4.8154 ***	4.8140 ***	4.8023 ***
	(0.0737)	(0.0733)	(0.2970)	(0.2970)	(0.0733)	(0.0730)
Years of schooling	0.0409 ***	0.0409 ***	0.0410 ***	0.0410 ***	0.0410 ***	0.0409 ***
	(0.0016)	(0.0016)	(0.0016)	(0.0016)	(0.0016)	(0.0016)
Experienc	0.0060 ***	0.0060 ***	0.0061 ***	0.0061 ***	0.0061 ***	0.0060 ***
	0.0021)	(0.0021)	(0.0021)	(0.0021)	(0.0021)	(0.0021)
Experience^2/100	-0.0001 **	-0.0001 ***	-0.0104 **	-0.0104 **	-0.0104 **	-0.0104 **
	(0.0045)	(0.0045)	(0.0046)	(0.0046)	(0.0045)	(0.0045)
Tenure	0.0171 ***	0.0171 ***	0.0171 ***	0.0171 ***	0.0171 ***	0.0171 ***
	(0.0020)	(0.0020)	(0.0020)	(0.0020)	(0.0020)	(0.0020
Tenure^2/100	-0.0302 ***	-0.0302 ***	-0.0302 ***	-0.0302 ***	-0.0302 ***	-0.0302 ***
	(0.0065)	(0.0065)	(0.0065)	(0.0065)	(0.0065)	(0.0065)
Marital status	-.0008	-.0009 ***	-.0008	-.0008	-.0008	-.0008
	(0.0180)	(0.0180)	(0.0180)	(0.0180)	(0.0180)	(0.0180)
Urban	0.1042 ***	0.1039 ***	0.1043 ***	0.1043 ***	0.1043 ***	0.1040 ***
	(0.0126)	(0.0126)	(0.0149)	(0.0149)	(0.0126)	(0.0126)
Female	0.1893 ***	-0.1893 ***	-0.1893 ***	-0.1893 ***	-0.1893 ***	-0.1893 ***
	(0.0119)	(0.0119)	(0.0119)	(0.0119)	(0.0119)	(0.0119)
AveSchool	0.0585 ***	0.0599 ***	0.0580 *	0.0580 *	0.0582 ***	0.0595 ***
	(0.0080)	(0.0080)	(0.0349)	(0.0349)	(0.0080)	(0.0079)
F test (weak identification est.)	5,147.711	1.1e+04	25.710	25.710	2,247.346	2,395.848
Observations	4,528	4,528	4,528	4,528	4,528	4,528

Notes: Clustered (at level of province) standard errors in parentheses. *, ** and *** denote statistical significance at the 10 per cent, five per cent and one per cent levels, respectively.

Table A2 - IV with External Instruments plus Lewbel's Generated Instruments (PerHE as Aggregate Human Capital)

	Standard IV		*IV with Generated Instruments*		*IV with Generated Instruments and External Instruments*	
Variable	*Number of higher education institution per 1,000 people*	*Per cent household use clean water*	*Number of higher education institution per 1,000 people*	*Per cent household use clean water*	*Number of higher education institution per 1,000 people*	*Per cent household use clean water*
Constant	5.2670 ***	5.2628 ***	5.2079 ***	5.2079 ***	5.2587 ***	5.2579 ***
	(0.0313)	(0.0312)	(0.0363)	(0.0363)	(0.0310)	(0.0310)
Years of schooling	0.0409 ***	0.0409 ***	0.0407 ***	0.0407 ***	0.0409 ***	0.0409 ***
	(0.0016)	(0.0016)	(0.0016)	(0.0016)	(0.0016)	(0.0016)
Experience	0.0064 ***	0.0064 ***	01.0061 ***	01.0061 ***	0.0064 ***	0.0064 ***
	(0.0021)	(0.0021)	(0.0021)	(0.0021)	(0.0021)	(0.0021)
Experience^2/100	-0.0112 ***	-0.0112 **	-0.0105 **	-0.0105 **	-0.0111 **	-0.0111 **
	(0.0045)	(0.0045)	(0.0046)	(0.0046)	(0.0045)	(0.0045)
Tenure	0.0170 ***	0.0170 ***	0.0170 ***	0.0170 ***	0.0170 ***	0.0170 ***
	(0.0020)	(0.0020)	(0.0020)	(0.0020)	(0.0020)	(0.0020)
Tenure^2/100	-0.0302 ***	-0.0302 ***	-0.0299 ***	-0.0299 ***	-0.0301 ***	-0.0301 ***
	(0.0066)	(0.0066)	(0.0066) ***	(0.0066)	(0.0066)	(0.0066)
Marital status	-0.0002	-0.0004	-0.0023	-0.0023	-0.0005	-0.0006
	(0.0181)	(0.0180)	(0.0181)	(0.0181)	(0.0180)	(0.0180)
Urban	0.1082 ***	0.1073 ***	0.0943 ***	0.0943 ***	0.1063	0 .1061 ***
	(0.0129)	(0.0129)	(0.0136)	(0.0136)	(0.0129)	(0.0129)
Female	-0.1902 **	-0.1902 ***	-0.1899 ***	-0.1899 ***	-0.1902 ***	-0.1901 ***
	(0.0120)	(0.0120)	(0.0120)	(0.0120)	(0.0120)	(0.0120)
PerHE	0.0066 ***	0.0073 ***	0.0164 ***	0.0164 ***	0.0080 ***	0.0081 ***
	(0.0022)	(0.0022)	(0.0037)	(0.0037)	(0.0021	(0.0021)
F test (weak identification test)	5,147.711	5,577.561	176.793	176.793	1,427.088	3,454.474
Observations	4,528	4,528	4,528	4,528	4,528	4,528

Notes: Clustered (at level of province) standard errors in parentheses. *, ** and *** denote statistical significance at the 10 per cent, five per cent and one per cent levels, respectively.

Table A3 - First Stage Regression of The Estimates of External Return to Schooling when Individual and Average Schooling are treated as Endogenous Variables

	(i)		*(ii)*	
	Externality Measure			
	Years of schooling		*Per cent workers with higher education*	
	Type of Instrument			
	Parental education and number of HE institution per 1,000 people		*Parental education and number of HE institution per 1,000 people*	
Variable	*Partial*	*Aggregate/ Provincial*	*Partial*	*Aggregate/ Provincial*
Constant	7.4974 ***	8.1745 ***	7.4974 ***	4.6354 ***
	(0.21487)	(0.0554)	(0.2149)	(0.2150)
Experience	-0.1063 ***	0.0114 ***	-0.1064 ***	0.0340 **
	(0.0160)	(0.0041)	(0.0160)	(0.0161)
Experience^2/100	-0.0011 ***	-0.0011 ***	-0.1142 ***	-0.0727 *
	(0.0347)	(0.0347)	(0.0347)	(0.0348)
Tenure	0.1187 ***	0.1187 ***	0.1187 ***	0.0105
	(0.0154)	(0.0154)	(0.0154)	(0.0154)
Tenure^2/100	-0.0847 *	-0.0847 *	-0.0847 *	-0.0516
	(0.0504)	(0.0504)	(0.0504)	(0.0504)
Marital status	0.6727 ***	0.6727 ***	0.6727 ***	0.3113 **
	(0.1381)	(0.1381)	(0.1381)	(0.1382)
Urban	1.3175 ***	1.3175 ***	1.3175 ***	0.9396 ***
	(0.0968)	(0.0968)	(0.0968)	(0.0968)
Female	-0.0856	-0.0856	-0.0856	-0.0883
	(0.0918)	(0.0918)	(0.0918)	(0.0919)
Father's education	0.2894 ***	0.2894 ***	0.2894 ***	0.0079
	(0.0172)	(0.0172)	(0.0172)	(0.0172)
Mother's education	0.1742 ***	0.1742 ***	0.1742 ***	0.0298
	(0.0198)	(0.0198)	(0.0198)	(0.0198)
HE1000	0.3392	17.6602 ***	0.3392	105.0362 ***
	(4.2945)	(1.1071)	(4.2945)	(4.2967)
Observations	4528			4528
F test (weak identification TEST)	83.797	83.797	194.549	194.549
F-test of exogeneity	26.5235 ***	26.5235 ***	27.6468 ***	27.6468 ***

Notes: Clustered (at level of province) standard errors in parentheses. *, ** and *** denote statistical significance at the 10 per cent, five per cent and one per cent levels, respectively.

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Does School Socio-economic Status Influence University Outcomes?

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Abstract

This study explores the role of schools' socioeconomic status in determining academic performance at university. Data for first year domestic undergraduates at an Australian university in 2011 to 2013 are linked to schools' data to examine the role of student- and school-level characteristics in influencing university marks. Schools' socioeconomic status is found to have moderate impacts on university performance, with students from lower socioeconomic status schools faring better. Prior academic achievement, as proxied by ATAR scores, is found to be a strong determinant of university grades. School sector and resources are found to have negligible impacts on students' academic performance at university. The results suggest that equity measures to increase university access for low SES students and those from lower-SES schools could be expanded without compromising academic standards.

Keywords: Analysis of education; Education and inequality; Government policy

JEL classification: I21, I24, I28

1. Introduction

The Australian university sector has undergone a number of reforms in recent years. The Bradley Review of Australian Higher Education (Bradley, 2008) recommended an ambitious university degree attainment target of 40 per cent for Australians aged 25 to 34 years by 2025, which was adopted formally by the Australian Labor government under the prime ministership of Kevin Rudd. Since then, Australia's higher education sector has undergone an expansion in university student numbers, particularly after the uncapping of Commonwealth funded undergraduate student places in 2012. At the same time, the Bradley Review had also recommended that the representation of

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students from low socioeconomic status (SES) be increased to 20 per cent of higher education enrolments by 2020. Student statistics from the Department of Education (2014) indicate, however, that the proportion of low SES students in undergraduate courses in Australia was stable at around 16 per cent between 2000 and 2011. The uncapping of Commonwealth supported student places at Australian universities under the demand-driven system in 2012 saw the share of low SES students at university rise to 17 per cent in 2012 and 17.5 per cent in 2013 (Department of Education, 2014; Parliament of Australia, 2014).

One issue with raising the proportion of low SES university student enrolment lies in the strategies available for universities to increase the proportion of low SES students they admit, while not compromising student quality in terms of academic performance and degree completion. In addition, it is desirable that university admission pathways for low SES students be done in a transparent and objective manner. In terms of achieving equity in labour market outcomes, the efficacy of the policy of expanding university places for students from low SES backgrounds requires that the low SES students brought into the university sector will be successful in their studies and receive positive returns from gaining those qualifications. In this paper, the nexus between SES background and university success are investigated, with a particular focus on schools' SES and resources, and the intermediary role of the Australian Tertiary Admission Rank (ATAR) as the main criterion for gaining entry to university. More specifically, the research questions to be addressed are: i) is there a link between school SES and university performance?, ii), are there individual schools or school sectors which provide a better platform for university success?, iii) are SES and school effects primarily embodied in students' ATAR scores, or are there other school-related effects that shape university outcomes beyond students' leaving results?, and iv) can any school or sector effects identified be explained by the level of school resourcing?

The paper is structured in the following manner. Section 2 reviews some of the existing literature, with a focus on more recent Australian studies. Section 3 discusses the data and variables that will be used for the study, as well as summary statistics for selected variables, disaggregated by school sector. The methodological approach and estimating equations are discussed in section 4. Empirical results are presented and discussed in section 5. Section 6 concludes.

2. Literature Review

For young Australians seeking to study at university, eligibility is generally determined through high school leaving grades, upon which their ATAR is calculated. Based on a combination of school assessment and marks in leaving examinations, the ATAR ranks school leavers relative to other school leavers of the same year. For example, an ATAR score of 85 indicates that the student is ranked higher than 85 per cent of that students' cohort. For school leavers (as opposed to mature age entrants) universities use ATAR as the main basis for deciding between applicants, and institutions typically advertise minimum ATARs for acceptance into different courses. Thus, the ATAR is accepted as a robust indicator of school leavers' likely success at university.

If students are considered to be endowed with a given level of natural academic ability, the school they attend may still potentially play an important role in a young person's higher educational achievement in a number of ways. First, for any given level of ability, different schools may provide a higher probability of an individual gaining access to university. This may be because the school environment shapes their career aspirations and increases the chance they will seek to qualify for an ATAR and apply to enter university; or because some schools are more effective in raising students' leaving grades, and hence raise their ATAR scores given their ability. Second, for those students who do enter university, some schools may be more effective in preparing students for university studies.

Whether such school effects exist and, if so, the magnitude of those school effects, are significant issues. Parents will want to know whether their children are receiving a 'good education', and if the school they attend boosts their opportunity to progress to university. In particular, parents have to make the choice between sending their children to an Independent or Catholic school for which parental monetary contributions are substantially higher as opposed to public schools. Education departments need to know how schools are performing for the purposes of performance management, and identifying what factors contribute to school performance has clear implications for efforts to improve the education system. Further, equality of opportunity among children requires that certain demographic or socio-economic groups are not systematically excluded from the better performing schools.

The introduction of the low-SES equity target for university enrolments further kindles interest in the influence of schools' SES on student performance. School effects may stem from what the school does, but also the family background of who attends. Beyond the classroom, neighbourhood, family, peer and other role model effects may all influence academic emphasis and shape non-cognitive skills, making it likely that attendance at a school where students have a higher average SES background will contribute to improved student outcomes.

Previous Australian literature on school effects has concentrated on the role of schools and/or school sector on leaving grades (Houng and Justman, 2014; Marks, 2010; Ryan, 2013) and school completion rates (Le and Miller, 2003a; Marks, 2007; 2013; Cardak and Vecci, 2013). This is relevant because the interpretation of school effects on university performance hinges critically on how schools impact upon individuals' ATARs and their probability of entering university. Hence we summarise the key findings from that literature, before reviewing the more limited literature investigating school effects on university performance (Birch and Miller, 2007; Cardak and Vecci, 2013; Dobson and Skuja, 2005; Mills *et al*. 2009; Win and Miller, 2005).

Student academic achievement at school

Results from the OECD's Programme for International Student Assessment (PISA) indicate that a significant proportion of the variation in student performance on standardised tests occurs at the school level – on average around one-third across OECD countries (OECD 2005). For the 2009 Australian PISA, Mahuteau and Mavromaras (2014) attribute 75 per cent of the variance in results to differences between students and 25 per cent to differences between schools. However, a landmark

study into educational opportunity commissioned by the US Department of Education in the 1960s (the 'Coleman Report' – Coleman *et al*. 1966) highlighted the limited role of school funding and other school-level effects in the US after allowing for the composition of the student population. Studies with rigorous controls for student background and prior academic achievement have since consistently found no or minimal effects of measures of school quality that might have been expected to impact upon student performance, such as school resourcing, class sizes or teaching practices (Card and Krueger, 1992; Fertig and Wright, 2005; Marks, 2010). The recent empirical literature suggests that much the same conclusion holds for Australia (Marks, 2014; Ryan, 2013). There is evidence that compositional effects do affect outcomes. In other words, it is not so much what schools do that matters, as opposed to who it is goes to schools. McConney and Perry (2010, p. 429), note OECD research based on PISA data shows that in most countries mean school SES has a stronger association with student achievement than the students' own SES background.

Measures of prior academic performance, such as PISA scores (Marks 2007) and NAPLAN scores (Marks, 2014, Houng and Justman, 2014) are strong predictors of school retention, completion and leaving grades.[1] Using data from the 2003 cohort of the Longitudinal Survey of Australian Youth (LSAY) Marks (2007) found school-level measures of SES, academic environment and student-teacher ratios have no significant impact on school completion, however students at Independent schools were substantially less likely to leave school before completing Year 12. In a later study of administrative data for a large sample of Victorian high-school students, Marks (2014) found that most of the between-school variation in retention rates to Year 12 could be accounted for by an elementary set of individual controls, notably NAPLAN scores. However, SES gradients persisted after controlling for student performance (Marks, 2014, p. 345). Huong and Justman (2014) similarly find that given Year 9 NAPLAN scores, Victorian students from high SES backgrounds achieve markedly higher ATARs than those from low SES backgrounds.

The potential effect of school sector (i.e. government, Catholic or Independent) on student performance has received considerable attention (Cardak and Vecci, 2013; Le and Miller, 2003a; Mahuteau and Mavromaras, 2014; Marks, 2007, 2014; Ryan, 2013). However, the findings remain inconclusive, in part because of uncertainty over the selection effects into the different sectors (Cardak and Vecci, 2013; Le and Miller, 2003a). It is also possible that the effects of sectors have changed over time due to the rapid expansion of the private school sector (Ryan, 2013, p. 237) or the very large increase in overall school completion rates (Cardak and Vecci, 2013).

Few studies have been identified that specifically address the relationship of most interest to this current paper, the link between school SES and student performance, other than to the extent that school sector is associated with SES. Independent schools and Catholic schools have higher mean SES than government schools, but the Independent schools are more elite (Ryan, 2013; Mahuteau and

[1] The National Assessment Program - Literacy and Numeracy was introduced in 2008 and tests students in the domains of reading, writing, language conventions and numeracy in Years 3, 5, 7 and 9 (see www.nap.edu.au). PISA assesses reading, mathematical and scientific literacy and can be undertaken in Years 9, 10 or 11 depending upon jurisdiction (Ryan, 2013, p. 228).

Mavromaras, 2014). As noted, Marks (2007) found the average SES of a school's student body to be unrelated to school leaving after controlling for individual factors. In contrast, McConney and Perry (2014) examined 2006 Australian PISA results for both mathematics and science literacy, and find a strong school-level SES gradient within each quintile of students when ranked by individual SES. Furthermore, the gradient is steeper for students in the top half of the distribution by individual SES. Based on multilevel modelling, Mahuteau and Mavromaras (2014) also find evidence of substantial school-level SES effects for the Australian 2009 PISA results for reading, mathematics and science literacy. While McConney and Perry (2013, p. 431) argue such findings of strong school-level SES effects are consistent with existing studies from overseas, Marks' (2010, p. 269) assessment of the literature is that the evidence for such effects is inconclusive.

Schools and university performance

The effects of school attended and prior academic achievement on university entrance, completion and university grades have been studied using data from the LSAY (Cardak and Vecci, 2013) and from datasets matching students' university academic record to their university application data (Birch and Miller, 2007; Dobson and Skuja, 2005; Mills *et al*. 2009; Win and Miller, 2005). Le and Miller (2003b) and Cardak and Vecci (2013) also studied access to university. A clear finding is that school achievement as measured by academic grades is the most important predictor of entry to and subsequent success at university.

Win and Miller (2005) accessed administrative data containing the grades of first-year students at The University of Western Australia in 2001, along with their Tertiary Entrance Rank (similar to an ATAR score), limited demographic information and data on the school they attended drawn from their tertiary applications. The school data included location, size, school sex status (single-sex versus co-educational), and school sector. Further school level data were included from external sources, including the proportion of full-time students that graduated from each school and the proportions that attained certain leaving grades. Weighted average marks in first year university were regressed using a standard ordinary least squares regression (what Win and Miller describe as a 'first generation' model) and random coefficients models in which variables are standardised within schools and the school effects captured through school-specific intercept terms (or 'second generation' models). The results suggest that students from Catholic and Independent schools achieve lower university results than students from government schools after controlling for high school leaving grades and other background variables. Other school effects identified include lower university performance for students from rural schools and single-sex schools, and higher university performance for students from high schools with a large proportion of students with high leaving grades. Win and Miller (2005, p. 12) describe this latter result as an 'immersion effect', a positive externality in which students who attend high schools with many strong academic students, perform better at university in turn.

With respect to the finding of lower university performance for students from non-government schools, Win and Miller (2005, p. 12) suggest that this may arise because Catholic and Independent schools 'artificially inflate' students' high school

leaving grades given their ability. The evidence on school effects as presented above casts doubt on whether such inflation really occurs, at least for recent school leavers. In all specifications tested, the strong positive effect of the Tertiary Entrance Rank (high school leaving) score persisted, with its magnitude insensitive to the many controls added to the models: essentially one additional place in a student's rank in leaving grades translated to one additional mark in their weighted average university marks in first-year. In a descriptive analysis of marks for full-time first year students at Monash University between 2000 and 2003, Dobson and Skuja (2005) also find that students from government schools outperform those from Catholic and Independent schools conditional on gender and entry scores. However, they note the correlation between the entry score and first-year university marks is negligible for the lower end of the distribution of entry scores and varies substantially by field of study.

Birch and Miller (2007) largely confirm Win and Miller's (2005) results via quantile regressions for WAMs for first year students at UWA in 2001, 2002, 2003 and 2004, but with more limited school information. The school level variables included were school size, sector and co-ed status. The quantile regressions show the gradients associated with high school leaving grades (positive), having attended a co-ed school (positive) and a non-government school (negative) to be steeper among students at the lower end of the university marks distribution. The fact that many non-government schools are all-boys or all-girls schools accounted for around two thirds of the estimated penalty associated with attendance at a non-government school that is observed, when co-ed status is not controlled for. The results observed in Win and Miller (2005) and Birch and Miller (2007) relating to the importance of leaving grades and school sector were reinforced in a study of 381 first-year Health Science students at UWA in 2000 (Mills *et al*. 2010).

In the study by Cardak and Vecci (2013) noted above, estimates of the effect of attending a Catholic school (assessed against attendance at a government school) on university entrance and university completions rates range from around minus 4 per cent to plus seven per cent, depending upon the assumption regarding selection on unobservables in attendance at Catholic school. Again, however, there are no clear grounds upon which to choose between these various assumptions.

As with the effect of school characteristics on student performance at school, a gap in the literature exists with regard to the effect of the SES of schools on students' performance at university, other than what can be inferred about differences in SES between school sectors. A consistent result is that the socio-economic background of students' own families does influence results over and above measures of prior academic achievement. Cardak and Ryan (2009) find that conditional upon high school leaving grades, students are equally as likely to enter university irrespective of SES background (p. 444). That is, the SES gradient in university access is attributable to differences in school achievement prior to the school-to-university transition. Moreover, they find that much of the SES effect has materialised by Year 9, arguing that improving educational outcomes in primary school and the early years of high school is needed to address the SES imbalance in higher education participation (Cardak and Ryan, 2009, p. 444).

3. Data

This study uses linked data from three sources. Confidentialised unit record data on domestic undergraduates commencing in 2011 to 2013 at an anonymous Australian university are obtained via the National Centre for Student Equity in Higher Education. Only students who were admitted to their university course on the basis of completing Year 12 at high school and for whom information on the school they attended are available, are included in the sample. The total number of observations in the sample population for the study consists of 8,417 undergraduates.

The de-identified university student record data contains demographic characteristics such as the students' age, gender, English-speaking background, residential postcode, and university study characteristics, such as the primary field of university study, ATAR score for university admission and Weighted Average Marks obtained in their first year of university study (WAM). Information on the students' socio-economic status are also obtained by linking their residential postcodes to indices which indicate socio-economic (dis)advantage, namely, the Index of Economic Resources and the Index of Education and Occupation. Both of these indices are constructed by the Australian Bureau of Statistics. Briefly put, the Index of Economic Resources looks at measures of access to economic resources, while the Index of Education and Occupation reflects the educational attainment and occupational levels of the community living in each geographic area. Further information on the construction of these indices can be obtained at ABS (2011).

The student record data are linked to school data based on the high school at which they completed their Year 12 studies. Australian schools' data are sourced from the Australian Curriculum, Assessment and Reporting Authority (ACARA). The undergraduate sample in this study came from 186 schools. The school data includes information on schools' funding, co-educational status, education sector, institution type, religious denomination, location, size (number of student enrolments), full-time equivalent staff numbers (teaching and non-teaching) and socioeconomic status as measured by the Index of Community Socioeconomic Advantage (ICSEA).

The ICSEA was developed by ACARA in order to compare educational achievements of students from socio-educational statistically similar backgrounds, making use of both student and school-level information. Calculation of the ICSEA for each school used student level information on parental education, parental occupation, geographical remoteness, as well as aggregated school level data on the percentage of Indigenous student enrolment and the percentage of students from a non-English language background. In addition, the ICSEA also incorporates other indirect measures of socio-educational advantage by matching data from the ABS's Census Collection Districts to addresses from schools' enrolment records. The Census Collection Districts data covers information such as percentage of people with no post-school qualification, proportion of employed people with higher skill level occupations, percentage of single parent families with dependent offspring only and percentage of occupied private dwellings with no internet connection. Further details on how the ICSEA is developed can be found at ACARA (2012).

Descriptive statistics by school sector

Descriptive statistics for the full sample are presented in the first column of table 1, with separate statistics for the school sectors presented in the remaining columns. The discussion of the descriptive statistics will be focussed on variables of interest, such as the measures of academic performance, school resources and ICSEA. Nevertheless, it can be noted that for most variables, there does not appear to be much variation by school sector.[2]

Table 1 - Descriptive statistics, full sample and by school sector

Variable	*All*	*Independent*	*Catholic*	*Government*
Weight Average Mark	63.7	63.3	63.1	64.3
ATAR score	82.3	82.7	82.6	81.7
Demographics				
Age	17.6	17.6	17.5	17.7
Female	0.563	0.584	0.551	0.559
Foreign-born	0.189	0.187	0.112	0.248
NESB	0.088	0.047	0.058	0.139
Index of Economic Resources	1050	1054	1043	1052
Index of Education and Occupation	1030	1039	1029	1025
Field of study				
Natural and physical science	0.130	0.115	0.118	0.149
Information technology	0.012	0.011	0.012	0.012
Engineering	0.108	0.087	0.109	0.123
Architecture and building	0.065	0.066	0.075	0.058
Health and related fields	0.234	0.249	0.239	0.220
Education	0.030	0.031	0.028	0.031
Management and Commerce	0.173	0.174	0.184	0.165
Society and culture	0.222	0.234	0.214	0.220
Media and Others	0.025	0.032	0.022	0.022
School sector				
Independent	0.280	(a)	(a)	(a)
Catholic	0.307	(a)	(a)	(a)
Government	0.413	(a)	(a)	(a)
School sex status				
Boy's school	0.073	0.089	0.158	(a)
Girl's school	0.080	0.127	0.143	(a)
Co-educational school	0.847	0.784	0.698	(a)
School resources				
School income per student	15,740.8	18,360.3	14,880.0	14,602.8
Teacher-student ratio	0.078	0.084	0.075	0.076
Non-teaching staff-student ratio	0.033	0.044	0.033	0.026
ICSEA	1,070	1,117	1,065	1,041
Number of students	8,417	2,359	2,580	3,478
Number of schools	186	55	34	97

Note: (a) denote non-applicability. School income per student takes into account all funding sources, including governmental, parental and all other contributions.

[2] One exception is school sex status. Most government schools in Australia are co-educational schools, and only the Catholic and Independent sectors have same sex schools.

The 8,417 students in the data had an average ATAR score of 82.3 and achieved a mean WAM of 63.7 in their first year. As may be expected, there is a positive and highly significant correlation between the socio-economic status of schools and students' raw ATAR of +0.18, and a much stronger correlation between ATAR and WAM (+0.42). Less expected, however, is a small but significant negative correlation between school ICSEA and students' WAM (-0.05).

The mean ATAR scores for students from Catholic and other private schools, are similar at around 82.6, and are slightly higher than the mean for students from government schools (81.7), and the difference in the means are highly significant by the standard 't'-test in both cases. However, there are no significant differences between sectors in the mean of the weighted average marks achieved at university. Hence, students from private schools entered the university with higher average leaving grades than those from government schools, but this does not appear to have conferred any advantage in their early performance at university.

On average, the private sector schools are of higher socio-economic status background by the ICSEA measure. Independent schools received more funding per student and had higher teacher to student ratios, compared to the Catholic and government schools. There are differences in the non-teaching staff to student ratios, with Independent schools having more non-teaching staff compared to Catholic and government schools, and Catholic schools having more non-teaching staff compared to government schools. Thus, there are resourcing differences between school sectors, with Independent schools being better resourced than both Catholic and government schools.

4. Methodology and estimating equations

Statistical framework

Studies of university academic outcomes have been largely based on a simple education production function, where a student's university academic performance (AP_i) is modelled as a function of their background characteristics (BC_i), the characteristics of the secondary school attended (S_i), and their previous academic achievement (PAA_i). The production function for the ith student may be written as:

$$AP_i = f(BC_i, S_i, PAA_i), \qquad i = 1,\ldots,\text{n} \tag{1}$$

The background characteristics (BC_i) of the individual considered in the present study are age, gender, birthplace, socioeconomic status and English-speaking background, while the school characteristics (S_i) covered include school sector, size (number of students), remoteness and socio-economic status. The university academic outcome that will be examined is the WAM acquired in the first year of university study.

The ATAR score obtained by the students is used as the measure of students' previous academic achievements (PAA_i). As noted above, most studies suggest that there is a strong positive relationship between such scores upon which university admission is based and marks at university, with findings of a one percentage point increase in students' university entrance scores being associated with an increase in marks at university by three-quarters to one percentage point being typical (see, for instance, Win and Miller, 2005).

Whether there are specific schools that are over- or under-performing can be assessed through accounting for school fixed effects in an analysis of student first-year (or later year) academic performance. This amounts to having a separate intercept term in the regression analysis for each *j*th school, and can be written as:

$$AP_i = \alpha_{0j} + \alpha_1 BC_i + \alpha_2 PAA + \varepsilon_i \quad (2)$$

A more systematic analysis of these issues may be able to be gained using the varying coefficients model (two-level hierarchical model) used by Win and Miller (2005) and discussed in Kreft (1993). This is depicted in model (3).

$$AP_i = \alpha_0 + \alpha_{1j} BC_i + \alpha_{2j} PAA + \varepsilon_i \quad (3)$$
$$\alpha_{1j} = f(S_i)$$
$$\alpha_{2j} = f(S_i)$$
$$i = 1, \ldots n.$$

In model (3), the way in which prior academic achievement is transformed into university success is allowed to vary according to the characteristics of the school attended.

Standardisation of continuous variables

Some of the continuous variables of interest were standardised to a mean of zero and a standard deviation of one, in keeping with the practice of most studies utilising random effects models in the study of educational performance. As Marks (2010) points out, this allows for greater ease in the interpretation of the relative impact of these variables, and is also useful in the estimation of random effects (Kreft, 1993). As the main interest of the present study lies in exploring the effect of between-school variations, the grand or population means are used in standardising continuous variables. The impact of standardising means for student-level characteristics according to the mean characteristics in each school attended (the approach taken by Win and Miller, 2005; Marks, 2010) is also explored in a later section.

5. Results

Influence of ICSEA on WAM

The results from various random intercept models (based on equation 2 above) are presented in table 2.[3] The discussion will first focus on the results of models 1 and 2. Model 1 examines the links between the ICSEA and WAM, and includes controls on the students' exogenous demographic characteristics and field of study at university. Model 2 includes controls for school type, school sex, and resource characteristics in addition to the regressors in model 1. Note that student ATAR scores are not included among the explanatory variables in these two models. Hence the estimated effects of background characteristics and school characteristics are total effects that include any intermediary effect that these variables may have upon ATAR scores.

[3] The reader is reminded that the random effects models in this study use two levels of hierarchy, first of the students, who are then treated as being clustered within schools.

A number of observations can be made with regards to the estimates in models 1 and 2. First, likelihood tests (not reported in the table) for all the models are conducted to compare the statistical validity of fitting a random intercept model as compared to fitting an ordinary linear regression. For all models, the likelihood ratio tests are statistically significant and indicate that the use of a random intercept specification of the model is valid.

Table 2 - Random Intercept Models' Estimates of School Socio-economic Status on University Academic Performance

Variable	*Model 1*	*Model 2*	*Model 3*	*Model 4*
Age (at commencement)	0.392 ***	0.403 ***	0.156 *	0.161 *
	(0.087)	(0.084)	(0.086)	(0.084)
Female	4.821 ***	4.651 ***	4.094 ***	3.960 ***
	(0.326)	(0.348)	(0.349)	(0.367)
Foreign born	0.348	0.278	0.777 **	0.691 **
	(0.361)	(0.366)	(0.304)	(0.310)
NESB	-0.536	-0.479	-0.472	-0.398
	(0.582)	(0.598)	(0.539)	(0.556)
IER+	0.414 ***	0.318 *	0.285 **	0.202
	(0.153)	(0.166)	(0.139)	(0.148)
IEO+	-0.120	0.059	-0.267	-0.075
	(0.200)	(0.203)	(0.171)	(0.168)
Natural and physical science	0.080	0.076	0.022	-0.015
	(0.646)	(0.645)	(0.592)	(0.590)
Information technology	-3.941 **	-4.070 **	-3.671 **	-3.794 **
	(1.952)	(1.943)	(1.839)	(1.832)
Engineering	7.640 ***	7.537 ***	1.733 ***	1.622 ***
	(0.664)	(0.669)	(0.618)	(0.626)
Architecture and building	2.408 ***	2.435 ***	2.718 ***	2.738 ***
	(0.662)	(0.671)	(0.594)	(0.600)
Health and related fields	7.000 ***	6.970 ***	4.561 ***	4.530 ***
	(0.471)	(0.471)	(0.452)	(0.455)
Education	2.367 ***	2.302 ***	3.533 ***	3.448 ***
	(0.880)	(0.880)	(0.847)	(0.846)
Society and culture	2.800 ***	2.790 ***	3.027 ***	3.015 ***
	(0.499)	(0.506)	(0.465)	(0.472)
Media and others	0.804	0.994	2.053 **	2.002 **
	(1.006)	(0.976)	(0.920)	(0.929)
Independent school		0.909		0.850
		(0.637)		(0.606)
Catholic school		-0.084		-0.703
		(0.602)		(0.532)
Rural school		0.796		0.624
		(0.609)		(0.599)
Boy's school		-2.127 **		-2.048 **
		(1.064)		(0.800)
Girl's school		-1.106 *		-1.823 ***
		(0.668)		(0.703)
School income per student+		-1.267 **		-1.166 **
		(0.560)		(0.491)
Teaching staff per student+		0.694 *		16.649
		(32.473)		(32.030)
Non-teaching staff per student+		-0.095		38.681
		(24.945)		(26.093)

Table 2 - Random Intercept Models' Estimates of School Socio-economic Status on University Academic Performance (continued)

Variable	*Model 1*	*Model 2*	*Model 3*	*Model 4*
ATAR+			5.924 ***	5.944 ***
			(0.247)	(0.247)
ICSEA+	-0.729 ***	-0.426	-1.744 ***	-1.506 ***
	(0.236)	(0.310)	(0.224)	(0.277)
Constant	50.016 ***	45.126 ***	55.362 ***	52.705 ***
	(1.485)	(3.044)	(1.445)	(2.947)
Prob > χ^2	0.000	0.000	0.000	0.000

Notes: Robust standard errors are presented in parentheses. ***, ** and * denote statistical significance at the one, five and ten per cent levels, respectively. + indicates that the variable is standardised. Log likelihood tests for the random intercept models reported in this table indicated that they are statistically different from an ordinary linear regression. The models estimated included two dummy variables for cohort year. There are 8,417 students and 186 schools in the sample.

Second, students' individual socioeconomic status has a very mild impact on their academic performance. The measure of students' access to economic resources, IER, is statistically significant but has very low estimates of less than half a percentage point. This means that every standard deviation shift along the IER distribution only results in a gain (or loss) of less than half a percentage point in WAM. Estimates on community occupational or educational attainment (IEO) are very small in magnitude, and not statistically significant.

Third, it is noteworthy that statistically significant estimates are not present for some characteristics that have been found to influence educational achievement at the secondary school and university level in the studies reviewed in section 2. For example, the students' school sector (Independent or Catholic), migrant status and English background are found to be statistically insignificant. These results suggest that high school attended has no discernible impacts on students' university academic performance.[4] On this basis, it might be argued that the university admission process has worked well, and students' academic performances are not influenced by their migrant background or high school characteristics. The only school effect which is statistically significant is the estimate for school sex (boy's or girl's school). In particular, students who attended a boy's or girl's school scored about two percentage points lower in their first year studies, as compared to students who attended a co-educational school.[5]

[4] It might have been possible that the school sector effects are being masked by the inclusion of schools' SES in the estimating equation. Hence, model 2 is estimated again, but without the ICSEA variable. The results of this estimation (not presented) had little impact on the size and statistical robustness of the estimates presented for model 2.

[5] Recall from the discussion of summary statistics (see table 1) that government schools in the sample are all co-educational. It is thus possible that the impacts of school sector are being muted by estimated effects of school sex status. To investigate this further, the sample is restricted to just co-educational schools, and model 2 is re-estimated (with the exclusion of the school sex dummy variables). The estimates on school sector remained negligible, and estimated effects of other variables are qualitatively identical to those presented in model 2 of table 2. The only difference of note is for the estimate on ICSEA, which is statistically significant at the one per cent level and had its effect size tripled to around -1.5 percentage points, which is similar to the effects found and discussed for subsequent models.

Fourth, school resourcing characteristics are found to have very modest influences on university academic performance. Model 2 contained three variables for school resourcing: income per student, and staff ratios (teaching and non-teaching). The amount of income received per student by the school is found to have a small, negative impact on academic performance, by about 1 WAM score for each standard deviation of the income per student distribution. While the estimated coefficient on teacher-student ratios is significant at the 10 per cent level, the estimated impact is, once again, very modest, and indicates only a 0.7 percentage point improvement in WAM for a standard deviation increase in the teacher-student ratio. The estimated impact of non-teaching staff to student ratio is statistically insignificant. These findings are complementary to other studies which found no meaningful association between class sizes and academic scores (Mahuteau and Mavromaras, 2014). Mahuteau and Mavromaras (2014) concluded that the lack of association between staffing resources and scores could potentially be due to the similarity in teacher-student ratios across schools, due to governmental regulation. The summary statistics reported above add credence to this, with the presented mean staff to student ratios indicating that staffing ratios are similar across school sectors and have little variation. The OECD's Education Policy Outlook (OECD, 2013) notes though, that the funding model for Australia's schools is not transparent and lacks coherence. This had also been highlighted in the Gonski Review of Funding for Schooling, which noted the extensive number of programs and funding streams, at different levels of government (Gonski, 2011, p. 48).

Fifth, estimated coefficients on gender and some fields of study are consistently statistically significant, often at the one per cent level, across models 1 and 2. Female students consistently outperform their male counterparts, by almost five percentage points in their WAM. Students in the engineering, architecture and building, health, education and society and culture disciplines have higher WAMs than their peers in the benchmark category of management and commerce.

Lastly, the estimated coefficient on the variable, ICSEA, has a value of around negative 0.7 in model 1. For model 2, however, the estimated coefficient on ICSEA is smaller and statistically insignificant. Regardless of statistical significance, the magnitude of the effect is modest, and can be interpreted as only a less than one percentage point decrease in WAM when students move by one standard deviation across the school SES distribution (towards higher SES). This indicates that schools with lower SES are associated with positive impacts on university academic performance, but that the magnitude of the relationship is minimal.

Impact of Prior Academic Achievement on WAM

In order to assess the impact of prior academic achievement (ATAR) on university academic performance, as well as any differences in the way schools' SES are translated into academic scores, models 1 and 2 are estimated again, with a standardised ATAR variable.[6] These models are presented in table 2 as models 3 and 4, respectively. There are five observations that can be made regarding the addition of the ATAR variable into the estimating equations. First, prior academic achievement has large impacts

[6] Specifically, the ATAR variable is standardised across the sample population, with a mean of zero and a standard deviation of one.

on performance at university. Specifically, the estimated coefficients on ATAR have values of around 6 percentage points for models 3 and 4, indicating that having ATAR scores of one standard deviation above or below the mean ATAR score impacts on first year WAM by 6 marks. In most universities, this is equivalent to moving more than half a grade band, and hence the impact of ATAR can be said to be rather substantial. This reinforces findings of earlier studies such as Win and Miller (2005) which found prior academic achievement to be a good predictor of academic success at university. Second, in model 4, the estimates on school types (Independent and Catholic) are still statistically insignificant. Thus, no school sector appears to provide a better platform in preparing their students for university study.

Third, the estimates on schools' SES remain statistically significant at the one per cent level, and have also doubled in magnitude, when compared with earlier estimates in models 1 and 2. This indicates that low SES schools prepare their students better for university study compared to high SES schools, and this effect is more pronounced when controls for students' ATAR are added. Put another way, higher SES schools appear to provide an 'inflation' of ATAR scores that does not translate to improved academic performance at university. From an equity perspective, this finding is positive, and indicates higher education policy and university admission processes to encourage students from low SES schools to participate in higher education could be expanded with no compromise in standards or academic achievement.

Fourth, the estimated impact of students' access to economic resources (IER) remained small across models 3 and 4, but is statistically insignificant in model 4. Hence, it appears that after prior academic achievement is controlled for, individual level SES (or access to economic resources) does not enhance academic performance in university. This is, once again, encouraging from an equity perspective.

Fifth, the estimated impact of teacher-student ratio is found to be statistically insignificant. The estimated coefficient has a very large value of almost 17 percentage points, but also has very large standard errors for this estimate. There is thus no clear relationship between teaching staff to student proportions and student performance at university. As earlier studies argue, teacher quality can be heterogeneous, and a measure of teacher quality would be required to explore the impact of teaching staff on student academic outcomes.

Table 3 - Random effects models, school-level standardised means

Variables	*Model 5*	*Model 6*
Age (at commencement)	0.143 *	0.139 *
	(0.083)	(0.084)
Female	4.024 ***	4.005 ***
	(0.368)	(0.366)
Foreign born	0.693 **	0.664 **
	(0.312)	(0.313)
NESB	-0.500	-0.483
	(0.550)	(0.545)
IER (standardised within schools)	-0.042	-0.041
	(0.136)	(0.135)
IEO (standardised within schools)	0.135	0.141
	(0.128)	(0.129)
Natural and physical science	-0.085	-0.084
	(0.590)	(0.589)
Information technology	-3.753 **	-3.832 **
	(1.841)	(1.837)
Engineering	1.600 ***	1.504 **
	(0.596)	(0.596)
Architecture and building	2.767 ***	2.752 ***
	(0.598)	(0.599)
Health and related fields	4.447 ***	4.382 ***
	(0.444)	(0.443)
Education	3.640 ***	3.617 ***
	(0.858)	(0.862)
Society and culture	2.967 ***	2.915 ***
	(0.472)	(0.475)
Media and others	1.832 **	1.735 *
	(0.916)	(0.923)
Independent school	0.804	0.791
	(0.653)	(0.643)
Catholic school	-0.212	-0.035
	(0.613)	(0.596)
Rural school	0.987	0.675
	(0.609)	(0.609)
Boy's school	-2.598 **	-2.635 **
	(1.117)	(1.090)
Girl's school	-1.078 *	-1.381 **
	(0.641)	(0.661)
School income per student+	-1.148 **	-1.166 **
	(0.561)	(0.525)
Teaching staff per student+	40.673	44.400
	(33.140)	(32.059)
Non-teaching staff per student+	2.617	5.591
	(21.834)	(21.808)
ATAR (standardised within schools)	5.870 ***	5.693 ***
	(0.171)	(0.176)
ICSEA+	-0.370	-0.386
	(0.313)	(0.309)
Constant	51.983 ***	51.777 ***
	(3.154)	(3.052)
Prob > χ^2	0.000	0.000

Notes: Robust standard errors are presented in parentheses. ***, ** and * denote statistical significance at the one, five and ten per cent levels, respectively. + indicates that the variable is standardised at the population level. Log likelihood tests for the random effects models reported in this table indicated that they are statistically different from an ordinary linear regression. The models estimated included two dummy variables for cohort year. There are 8,417 students and 186 schools in the sample.

Random Coefficients Models and Within-school Variation in Student Characteristics

Further analyses are conducted to explore two further issues. The first relates to whether differences exist in the way within-school variation in student characteristics impact on the determinants of university performance, particularly, the role of ATAR on influencing university scores. This can be explored by standardising student-level continuous variables according to the mean values of those variables within each school. That is, variables for students' SES (IER and IEO) as well as ATAR scores are standardised using mean values for those characteristics within each school the student attended.[7] As Marks (2010) and Win and Miller (2005) point out, standardisation of variables in such a way will permit the assessment of within-school effects, and highlight the importance of those individual characteristics on university performance. The estimation results from using these school-standardised variables in a random intercept model are presented in table 3 (model 5).

The second issue relates to whether the determinants of university performance have differing impacts by schools with varying SES or mean ATAR performance. To explore this issue further, a random coefficients model is estimated. In this random coefficients model (model 6), the slope coefficients on ICSEA and ATAR are allowed to vary by school. Estimation results from model 6 are also presented in table 3.

Comparisons of the estimates from model 5 with results from model 4 (table 2) indicate that there are negligible changes to the estimated influences on university performance in model 5 from employing the estimation strategy described above. The only difference of note is that the estimated impact of schools' SES in model 5 is now negligible and statistically insignificant. Specifically, the variables for students' individual SES and ATAR are standardised using the schools' mean, and the impact of those variables should be interpreted as the impact of individual students having characteristics more or less than the mean characteristic in the school attended. The estimates in model 5 indicate that individual or schools' SES do not affect university academic performance, and that ATAR holds as a strong predictor of WAM at university.

Finally, estimates from model 6 confirm that ATAR is a strong predictor of university academic performance. Further, the utilisation of a random coefficients model where the slope coefficients for ATAR and ICSEA are allowed to vary reveal that there are no substantial differences in the way schools transform these into university academic performance.[8]

[7] School-level characteristics that are standardised, such as school income and ICSEA, are still standardised according to the grand or population mean.

[8] A separate random coefficients model (not reported) using population means for standardisation of the ATAR variable shows two findings. First, the estimate on ICSEA is statistically significant and of comparable magnitude in comparison to previous models. Second, the slopes of estimated impacts of ATAR and ICSEA by schools are still very similar. Hence, no school comes across as being superior conduits of prior ability or SES into academic success.

6. Conclusion

This study examined the student- and school-level characteristics that impacted on university marks in the first year of study for Australian undergraduates. Note, however, that there are some limitations to the study and hence the findings of the study should be viewed with these caveats in mind. First, the sample population consists of first-year undergraduates in a single university who were admitted on the basis of their ATAR. As such, any interpretation of the findings of the study needs to consider sample bias, specifically, that these are students who have already been admitted into university, while some of the characteristics used in the study (such as prior academic achievement and SES) are also determinants of participation in higher education (see, for example, Le and Miller, 2005). In particular, the effect of schools on their students' access to university is unable to be assessed and all results from the study need to be interpreted as applying within a pool of successful university entrants.

Further, while the study covers students from 186 schools, the data used is only for one university. This matters because universities typically have listed cut-off ATAR scores for entry into undergraduate courses and these minima vary considerably across institutions.[9] Therefore, there may be further selection processes at work, relating to selection into this particular university or this type of university, with consequences for the distribution of prior ability of the sample, as proxied by ATAR.

Notwithstanding the caveats above, this study makes important contributions to the literature. As noted, the literature remains divided on the importance or otherwise of school level SES effects. Of the handful of Australian studies identified that utilised linked student records and schools data to analyse performance at university, Birch and Miller (2007), Mills *et al*. (2009) and Win and Miller (2005) relate to students who graduated from high school more than a decade ago, while Dobson and Skuja (2005) condition only on leaving grades, gender and school sector. There is clear evidence in the literature that school effects may have changed substantially over time, notably with respect to the benefits of attending Catholic and Independent schools, and therefore there is a need for updated estimates. Moreover, those previous four studies are based on data for students at just two universities, three using data from The University of Western Australia and one from Monash. A further innovation of the present study is that it uses a rich array of previously unavailable data on Australian schools' characteristics, including a robust measure of school SES.

Some important findings have been uncovered. First, schools' SES has been found to have modest impacts on university performance, and students from lower SES schools have been found to perform marginally better than their peers from higher SES schools. This suggests that higher SES schools inflate their students' ATAR scores and improve their access to university. From an equity perspective, however, it is encouraging that the university system appears to level the playing field in terms of academic achievement for students entering from more privileged and less privileged schools. Furthermore, the individual students' SES background had

[9] For example, Central Queensland University has an indicative ATAR cut-off of 39.75 for entry into their Bachelor of Arts for 2013, while Curtin University and the Australian National University have ATAR cut-offs of 70.00 and 80.00 for the same course, respectively (Universities Admissions Centre, 2014; Tertiary Institutions Service Centre, 2014).

no discernible impact on university performance. From this viewpoint, participation in higher education for students from lower SES background should be encouraged, particularly as they are under-represented. At the university level, admission regimes could take into account the relatively good performance of students from schools of lower SES, and restructure their admission regimes to advantage them accordingly.

Another finding of importance, and which needs to be investigated further in future research, lies in the fact that most school characteristics and school resourcing measures do not appear to have any substantial or meaningful impact on students' performance in university. While this finding may go against the expectations of many, it is not inconsistent with previous international and Australian findings of limited school effects on high school leaving grades (Marks, 2010). This has important implications for strategies to achieve equity in higher education participation and on school resourcing. The results indicate that school sector does not confer any advantage on performance at university, and that larger or smaller amounts of funding per student do not translate into better outcomes at university. It may be possible that the quality rather than level of school resources, notably teacher quality, is more important for shaping student achievement, a hypothesis that could not be tested with the current data.

There are also outstanding issues which fall beyond the scope of this study, but which warrant investigation. First, from an equity perspective, a priority for future research should be the assessment of school effects on access to university, an issue that could not be addressed with this dataset. Second, the university academic outcome addressed in this study is the WAM in the first year of university study. It would be useful to have an assessment of university academic outcomes in later years to see if the effects of schools' SES and ATAR hold. Third, due to data unavailability, it was also not possible to assess other academic outcomes, such as degree course dropout. An examination of the effect of school and individual attributes on the likelihood of university degree completion would add a further dimension and richness to the evidence base for higher education policy. And finally, it would be of interest to evaluate the post-graduation activities of the graduates. Higher education policy aimed at increasing the university participation and completion of lower SES students assumes that university education will generate returns in the form of labour market employment and better earnings, and an evaluation of these outcomes will aid in policy decision marking.

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Occupational Attainment and Earnings among Immigrant Groups: Evidence from New Zealand

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Abstract

This paper concerns the prediction of career success among migrants. We focus specifically on the role of occupation as a mediating variable between the predictor variables education and time since migration, and the dependent variable career success as denoted by occupational status, linked to earnings. Following a review of the literature specifically focused on occupation, we apply Ordered Probit analysis to a sample of over 37,900 employed males surveyed in New Zealand. New Zealand provides an interesting case, as a country where migrants from diverse ethnic groups comprise a significant part of the population. We focus on the occupational attainment of immigrants and the native-born populations and provide evidence on the mediating effect of occupational attainment on earnings. Our analyses show the interplay of factors leading to occupational attainment: for example, education level is of greatest importance, and much of its effect on earnings is through occupational attainment; different immigrant groups have differentiable outcomes, and years of experience in the host country enable gradual occupational advancement. This is the first application of this analysis to New Zealand data. Our results highlight the significant mediating role of occupational attainment in explaining earnings across immigrant and native-born groups.

Keywords: Occupational attainment, earnings, immigrants, ethnic group

JEL classification: J30, J31

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1. Introduction

A large and increasing proportion of the world's population, particularly those living in developed countries, are nowadays migrants, i.e. resident in a country other than the one they were born in: an estimated 214 million people, or nearly 3.1 per cent of the world's population (IOM, 2012).

Globally, countries and organizations have become involved in attracting skills (OECD, 2002). An increasing number of countries rely on immigrants as part of their human resources and economic growth strategies. Among English-speaking countries, immigrants have played and continue to play an important role in the USA, Canada, Australia and New Zealand. An important expectation in the immigration policies of these countries is an economic assimilation (integration) model in which immigrants enjoy similar economic and social benefits as the rest of the population. The economic assimilation hypothesis broadly refers to the idea that while immigrants may initially be disadvantaged either due to characteristics that distinguish them from the mainstream population such as in language proficiency, or due to fewer opportunities and lack of networks, over time they adopt characteristics that lead to economic integration, making them comparable to the native-born population in economic terms.

A number of studies have verified that immigrants may initially experience lower earnings compared to the native-born population (e.g. Chiswick, 1978; Borjas, 1985; Orrenius and Zavodny, 2007; Amuedo-Dorantes and De La Rica, 2007; Chiswick and Miller, 2008b; and Elliott and Lindley, 2008). According to Orrenius and Zavodny (2007) high-skilled immigrants to the US suffer a larger earnings penalty than do less-skilled immigrants. This effect has also been verified for New Zealand (Winkelmann and Winkelmann, 1998; and Stillman and Maré, 2009).

Migrants typically migrate with specific labour resources. In seeking jobs in the host country they may have advantages such as educational qualifications, work experience, bilingualism, high motivation, and lower expectations in respect of wages. Countering these, however, are initial potential disadvantages such as less language proficiency and non-recognition of foreign qualifications and experience; and deficits in host country labour market information, firm-specific training, and social networks (Chiswick, 1978). In addition, immigrants may typically experience disruption to their careers.

One of the important indicators of immigrant economic integration in their host country is the degree to which their occupational attainment reaches levels that match those of the rest of the population. In addition, since education and skills are generally the most significant assets that immigrants bring with them, the degree to which their education leads to occupational attainment in the host country is a key factor of interest.

In spite of the importance of this effect, relatively few economics studies to date have examined the role of occupational attainment of immigrants in explaining their economic success, in terms of both economic opportunity and access, and as a pathway to higher earnings. However, it is increasingly recognised that the information on the occupational distribution of immigrants in a host country is central

to understanding how immigrants affect economic growth and how they adjust to the host country (Green, 1999; Orrenius and Zavodny, 2007; Elliott and Lindley, 2008; Chiswick and Miller, 2009a, 2009b; Orrenius and Zavodny, 2007).[1]

In this paper we examine the occupational attainment of immigrants in New Zealand, a major immigrant-receiving country, and the link between occupational attainment and earnings. We use micro-data pooled across six years for a large random sample consisting of immigrants and native-born populations to examine the relative chances of immigrants to be engaged in higher-level occupations.

The main objective of our analyses in this paper is to examine the mediating effect of occupational attainment on the earnings of immigrants relative to the native-born population. Following the approach in Chiswick and Miller (2008a, and 2009a) in our analysis, we first examine the relative chances of immigrants being engaged in higher-level occupations, after controlling for education, years of experience and years of residence in the host country. We also consider effects relative to the native population. To the data we apply an Ordered Probit modelling approach (Aitchison and Silvey, 1957) to examine the effect of human capital variables on occupational attainment and earnings, and we incorporate the hierarchical nature of occupational attainment in the analysis. We augment our analysis through additional multinomial-logit estimations.

We then verify the effect of occupational attainment on earnings. For this analysis, we first estimate standard earnings models based on the main human capital variables widely used in economics and related fields (based on semi-logarithmic multivariable regression analyses). We then augment our earnings models by adding each person's occupational category of employment. Thus a comparison of our models, with and without occupation of employment, can verify and quantify the extent to which occupational attainment contributes to the relative earnings of immigrant groups.

The context for our research is New Zealand, an immigrant-receiving country, and a nation of immigrants. According to the 2013 Census immigrants made up 25.2 per cent of the total population (over six times the world average).[2] Attitudes toward immigrants in New Zealand are generally positive (Ward and Masgoret, 2008). There appear to be outcome differences between immigrant ethnic groups, but educational qualifications also vary across these groups, and these comparative measures do not control for education and skills.

New Zealand's general history and its immigration history are closely related. In its very earliest years, Maori immigrants settled in New Zealand. In the nineteenth century, large numbers of European immigrants arrived. In recent decades, New Zealand has become a country with multiple ethnicities and cultural backgrounds. Immigration has generally become the greater mechanism for population growth in New Zealand. Both immigrants with high technical and academic qualifications and immigrants with the ability to establish business or financial investments are welcomed, to contribute to the 10,000 annual population growth net goal of New Zealand.

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[1] An earlier literature on occupational attainment in general, and not specific to immigrants, includes, for example, studies by Duncan (1961), Schmidt and Strauss (1975), Solomon (1981), Nickell (1982), and Grossman (1984).

[2] Immigrants comprised 23 per cent of the New Zealand population in the 2006 Census (and 19 per cent of the population in the 2001 Census).

New Zealand immigration policy is principally focussed on skilled migration. Since the immigration policy reform of 1987 and its extensions in 1991, the 'points system' which rewards educational qualifications, work experience and younger working age adults is a major feature of New Zealand immigration policy. For example, 59 per cent of permanent resident visas granted in 2007 were based on the skilled migration/business category.[3]

Among immigrants the largest group has traditionally been from (a) European background (Europe, South Africa and North America). Other substantial groups of migrants are from (b) Asia, particularly China, Honk Kong, Taiwan, South Korea and India; and (c) the Pacific Islands, especially Samoa, Tonga, and the Cook Islands.[4] This feature of New Zealand data allows us to examine the effects of interest across immigrant groups from diverse country of origin groups.

A high proportion of recent immigrants from the Pacific Islands and Asia tend to work in 'elementary' occupations compared to the immigrants from a European background (Ward and Masgoret, 2008). This general analysis highlights differences across immigrant groups by ethnic group, but average educational qualifications also vary across immigrant ethnic groups, and the above comparative measures do not control for education and skills.

In the analytical section of our paper we show the determinants of occupational attainment and the mitigating effect of occupation on earnings. We incorporate disaggregated data and account for education, experience and skill. We further show evidence on ethnic occupational attainment for controlled educational groups.

We examine the relative occupational attainment and earnings of three important immigrant groups in New Zealand: from European backgrounds, Pacific Island backgrounds, and the group consisting mainly of Asian immigrants. Immigrant enclaves vary in available resources and established networks, and even years after immigration there are marked differences across immigrant ethnic groups in earnings and employment in certain occupations associated with higher earnings. We examine the relative chances of these immigrant groups to be engaged in higher-level occupations, based on controlled analyses that account for education, years of experience and years of residence in the host country.

This is the first application of occupational attainment analysis for immigrants, with impacts on earnings, based on the Chiswick and Miller (2009) method to New Zealand data. We also extend the international literature by examining effects across immigrant ethnic groups.

The plan of this paper is as follows. In section 2 we provide a review of the main questions and findings of the economics literature on occupational attainment. In section 3 we discuss our data and methodology. In section 4 we discuss our analytical methods and findings on occupational attainment, and earnings. In section 5 we present our conclusions.

[3] The family reunion category contributed to 32 per cent of permanent resident visas, and the humanitarian category contributed to the remaining nine per cent in 2007 (Source: New Zealand Ministry of Business, Innovation, and Employment, Migration Trends (http://dol.govt.nz/research/migration).

[4] In the 2013 Census of the resident New Zealand Population, 35.7 per cent of immigrants were born in the United Kingdom and Ireland, Australia, U.S. and South Africa accounted for. Those born in China, India, South Korea, and Philippines accounted for 24.7 per cent of immigrants. Immigrants born in Samoa and Fiji accounted for 10 per cent of the immigrant population.

2. Review of the Literature and Hypotheses

Occupational Attainment

According to Green (1999), knowing the occupational distribution of immigrants and its changes over time is the key to understanding immigrants' social and economic adjustment to a host country. To determine whether immigrants facilitated growth in Canada in the 1980s by filling gaps in occupational structures, Green used a multinomial logit model of occupational distribution, estimated separately for immigrant and native-born census samples. The multinomial logit model allows estimation of the effects of various personal characteristics on individuals' occupational status as professionals (including managers), white collar, blue collar, or people who did not work. To explain outcomes he used variables such as education, age, country of origin, location, entrance cohorts, and language proficiency. He applied the model to natives and immigrants in Canada at the 1981, 1986 and 1991 censuses. He compared immigrants and native-born at each census, tested changes in both groups' occupational distribution over time, and estimated the economic assimilation effects.

Green's results indicated that immigrants were over-represented in professional and blue-collar occupations and under-represented in white-collar occupations. Comparisons of occupational distributions across censuses for immigrants and natives indicated greater mobility among immigrants, and reflected assimilation to the host country. Moreover, the logit estimates suggested that immigrant adjustment and professional status were related to immigrants' education, skills, and independence.

An important indicator of immigrants' access to opportunities is their level of occupational attainment relative to the native population, and we make this variable key in the present paper. Since education and skills are generally immigrants' most significant assets, the degree to which their education leads to occupational attainment is the focus of this paper. Few studies have examined the relationship of immigrants' occupational attainment to their economic success. However, it is increasingly recognised that the occupational distribution of immigrants and its changes over time are central to understanding immigrants' adjustment and social development (Green, 1999; Orrenius and Zavodny, 2007; Elliott and Lindley, 2008; Chiswick and Miller, 2009b).

Chiswick and Miller (2009a) highlighted that previous research failed to fully understand the 'catch-up' effect of immigrants' labour market adjustment, and argued that insights into such adjustment can be gained from earnings equations that take account of occupational status. They used the US Census to examine the determinants of occupational attainment and the impact of occupation on immigrant earnings. They characterised the desirability of occupations by their earnings, employing in the ordinary least squares analysis a continuous quantitative measure of occupation. They estimated typical human capital earning functions for immigrants both with and without occupational variables as predictors, relating the natural logarithm of annual earnings to educational attainment, potential labour market experience, the natural log of weeks worked, foreign birth, ethnicity, marital status, location, and veteran status.

On this basis, Chiswick and Miller (2009a) found that most of the increase in migrants' earnings associated with education resulted from access to higher-paying occupations. For a given level of education, there was a negative relationship between occupational attainment and pre-immigration work experience, which suggests that

for occupational attainment, and with education controlled for, it is better to have immigrated upon leaving school than to have foreign labour market experience.

Our study enables us to go beyond the work of Chiswick and Miller (2008a, 2009a) in the following ways:

1. We extend data over a wider time-span during which employment outcomes may be affected;
2. We examine effects in New Zealand, which has immigration policies which favour skill as a criterion and may therefore be a model for others who may adopt such policies in the future. This is the first application of the occupational attainment and earnings effects model above to New Zealand data;
3. We differentiate effects by immigrant ethnic groups.

Hypothesis 1:
Occupational attainment substantially affects earnings, especially for immigrants. We seek to quantify such effects.

Hypothesis 2:
Human capital factors of educational qualifications, years of general work experience, and years in the host country influence occupational attainment. We seek to quantify such effects for immigrants.

Hypothesis 3:
The effect of human capital variables on earnings is partially through occupational attainment. We seek to quantify such effects.

While our interest in these hypotheses is in the occupational attainment and economic success of immigrants, we report parallel results for native-born individuals, and where appropriate, we draw attention to differences.

Variables of Interest

Education

Educational attainment is a primary determinant of immigrants' socioeconomic status (Becker, 1993), and has both direct and indirect impacts on earnings, with the indirect impacts operating, we suggest, through occupational attainment (Chiswick and Miller, 2009a). Educational attainment reflects prior learning and creates the expectation of a more skilled occupation or easier access to jobs. Chiswick and Miller (2009b) found that most of the increase in earnings associated with education comes through access to higher-paying occupations, but that immigrants' payoff for educational qualifications is generally less than that obtained by natives. Lalonde and Topel (1997) indicated that the value of education abroad is always less than that of education in the host country.

Experience

Labour market experience includes both pre- and post-migration experience. As with educational qualifications, pre-migration experiences appear relatively difficult to transfer to host country labour markets (Chiswick, 1978). However, Chiswick and Miller (2009a) observe that once occupation is taken account of, the payoff to pre-immigration labour market experience rises: thus, pre-migration labour market experience has a negative impact on occupational status, especially among those who seek to enter high-paying occupations.

Years since migration

Labour market experience gained post-immigration has a positive and more significant effect on occupational attainment (Chiswick and Miller, 2009b). Longer residence enables immigrants to assimilate more deeply, and to advance occupationally, in the host country. However, for higher-paid and more professional occupations, which require more complex skills that might not be accumulated in longer host-country residency, the influence of duration of residence may be less. Moreover, Duleep and Regets (1997) indicate that the greatest post-arrival gains in relative earnings are recorded by immigrants with low earnings at arrival, because they make greater destination-specific investments in human capital.

Ethnicity

Blackaby, Leslie, Murphy and O'Leary (1998) demonstrated an earnings disadvantage of non-European immigrants in the U.K. that remains unexplained after controlling for an extended number of human capital factors, a result supported by Blackaby, Carlin and Murphy (2007), and by Chiswick (1978) in the U.S. Elliott and Lindley (2008), in a U.S. study, also found immigrant ethnic minorities were disadvantaged in gaining employment in higher-paying occupations.

Other research focuses on how immigrant ethnic enclaves can provide labour market information and access to jobs (Borjas, 1992; Wang and Maani, 2014). These studies highlight the added role of immigrant group resources, information and networks (ethnic capital) on facilitating immigration group economic success in the host country. Both groups of studies (focusing on employer behaviour and ethnic group resources) indicate the existence of differential labour market effects for immigrants of differing ethnicities. However, the second group of studies highlights the positive (or negative) impact of group resources (or lack of them) on ethnic group economic outcomes.

Marital status

Other variables predicting immigrant occupational attainment are marital status and family circumstances (number of young children). Differences in these variables are important, and measures of these variables were available to us in our study. In particular, in home countries where gender roles are more distinct, influences may persist post-migration, resulting in differential occupational and earnings effects of marital status across immigrant groups. (Grossman, 1984; Blau, Kahn, Liu and Papps, 2013).

3. Data

We use individual-level data from the Household Labour Force Survey conducted by Statistics New Zealand, from the June quarter of each year, pooled across six years, 2002 to 2007. The Household Labour Force Survey and its annual supplement, the New Zealand Income Survey, provide information on the labour force experience and earnings of a representative sample of approximately 30,000 individuals collected each year. We select all employed males aged 24-65. The resulting sample of males in our expanded models based on available data on all variables is 37,949 observations. The combined data sets provide disaggregated information on immigrant or native-born status, education, occupation of employment, marital status, number of young children, and, for immigrants, number of years since migration.

In this paper we focus on the age group 24 to 65 years. The data set distinguishes between immigrants (born overseas) and the native-born males, those of different marital status, and ethnic groups: those from a European background, indigenous Maori, Pacific Islands birth place, an 'others' group mainly consisting of Asian immigrants, and a remaining group consisting of other ethnicities.

4. Methodology

Using an Ordered Probit estimation methodology originally considered by Aitchison and Silvey (1957) we first examine the effects of variables including educational qualifications and years since migration on occupational attainment. We then verify the effects of occupational attainment on earnings, and extend the conventional human capital earnings model with controls for major occupational groups. By comparing the results, we show the role of occupation in determining the earnings of immigrants. The Ordered Probit model used is our preferred modelling approach because it enables us to incorporate the hierarchical nature of occupational attainment in this analysis.

Mean occupational earnings are used as the measure of the desirability or attractiveness of an occupation. Hence the average hourly wage of each occupational group as reflected by the data is used to rank the occupations by order of attractiveness.

For a clear hierarchy for our Ordered Probit Model, we define five distinct occupational categories based on mean hourly earnings. The resulting occupational groups from the lowest to the highest are: 1. Elementary occupations; and Service and Sales workers; 2. Agriculture and Fisheries workers; 3. Trade workers; and Plant and Machine Operators and Assemblers; 4. Clerks; 5. Professionals, Technicians and Associate Professionals; and Legislators, Administrators and Managers. Based on this specification, each occupational category represents a clear differential category in terms of the hourly wage as demonstrated by the data (table 1).

Table 1 shows the occupational ranking based on mean hourly earnings for our samples across all six years. The highest earnings ranking occupations are those held by professionals, technicians and associate professionals, while the least ranking in terms of earnings are elementary occupations and agriculture and fishery jobs. Table 1 is useful in highlighting a hierarchy of occupational categories based on hourly earnings. This hierarchy corresponds with higher educational requirements across these occupations, and higher wages.

Table 1 - Average Occupational Hourly Wage

Occupation	*Hourly Wage **
Professional, Assoc. Professionals; and Legislators, Administrators, Technicians, and Managers	29.80
Clerks	19.30
Plant and Machine Operators and Assemblers; and Trade Workers	18.76
Agriculture and Fisheries Workers	17.66
Elementary Occupations; and Service and Sales Workers	15.68

Note: * Means (in constant, 2007 NZ dollars) for males, based on the Household Labour Force Survey (HLFS)/Income Survey (IS) pooled across for six years (2002-2007) utilised in this study.
1. Sample of employed males.
2. Standard deviations are respectively 30.08, 9.32, 11.37, 19.56, and 9.56).
3. Sample size: 37,949 observations.

Using the Ordered Probit model, we provide estimated probabilities of overall occupational attainment based on a unit change in each of our explanatory variables. For example, our analyses provide probabilities for an average immigrant to move up by one occupational category. The analyses further provide variations by educational qualification, each year since immigration, and by gender and ethnic group. In addition, the approach is flexible in allowing differential impacts for the explanatory variables for attainment of different occupational categories, which is important for precise estimations (e.g. different educational qualification levels can realistically have different effects on the probability of belonging to the professional occupations, as compared to clerical occupations).

The choice of five occupation groups is close to the study by Green (1999), which had four broad categories. Using the broad occupational categories in our study is constrained by our data, but it has two advantages. One advantage is that it provides clear occupational hierarchies for Ordered Probit analyses. A second advantage is that it allows us to clearly check whether, controlling for education and experience, a higher proportion of immigrants are engaged in lower-ranked occupations (e.g. elementary occupations or services), and whether we observe improvements in occupational advancement with years since migration. This categorisation allows us, for example, to capture movements of skilled immigrants who initially start work in less-skilled occupations or trades, and move to higher level occupations with time lived in the host country. A potential drawback of the use of broad categories is that occupational advancement effects may not be observed as often, or it may result in statistically insignificant effects for occupational movements. Nevertheless, as we show in our analytical section, this concern does not seem to be a major one, as we observe highly significant coefficients.

We further calculate and provide marginal probability effects, reflecting the change in the probability of belonging to each occupational category, for a one-unit change in each explanatory variable, keeping other characteristics constant. Marginal

probability measures are especially useful for summarising the results in easily interpreted percentage terms for belonging to each occupational category.[5]

We then verify the effect of occupational attainment on earnings, and extend the conventional human capital earnings model with controls for major occupational groups. By comparing both results the importance of the role of occupation when determining the earnings for immigrants is identified.

For this analysis, we first estimate standard earnings models based on the main human capital variables widely used in economics and related fields. These variables include educational qualifications, potential work experience (age minus years of study) and time in the host country for immigrants. These three sets of variables reflect the effect of human capital, which is expected to result in higher productivity and earnings in the labour market. We then augment our earnings models by adding each person's occupational category of employment. Thus a comparison of our models with and without occupation of employment can quantify the extent to which occupational attainment contributes to the relative earnings of each immigrant group.

We consider both occupational attainment and earnings effects across immigrant ethnic groups. Since we obtain parallel results for the native-born from the same ethnic groups, our results allow us to draw comparisons on effects for second and higher generation immigrants, compared to first generation immigrants in our immigrant groups' analyses.

The combination of our analyses of occupational attainment and earnings effects provides a more comprehensive exposition of the labour market experience of the immigrant groups of interest in our analysis.

Table A1 (Appendix) provides the definition of variables used in our occupational attainment and earnings models.

5. Results

Hypothesis 1: Occupational Attainment Affects Earnings

Table 1 indicates mean hourly earnings for our samples across all six years, and shows marked differences between professional and elementary occupations. For example, the hourly wage in the top occupational category is more than double that of the lowest, highlighting a clear hierarchy of occupational categories.

As noted earlier, these statistics do not control for factors such as education and skills and years of experience, and years since migration. In our analytical section we provide estimates that carefully control for these factors at the disaggregated level.

Hypothesis 2: Human Capital Factors Affect Occupational Attainment

Table 2 provides the comprehensive set of Ordered Probit results (based on maximum-likelihood estimation) and derived marginal effects for belonging to each occupational category for the immigrant and the native-born populations (see, e.g. Newell and Anderson (2003) on the derivation of marginal effects). In these tables we summarize the effects and the significance of each explanatory variable on the probability of moving from a lower occupation to the next higher level occupation, for male immigrants, and native-born, respectively (across years 2002 to 2007).

[5] We augmented our analysis through additional estimates based on multinomial-logit estimations. The multinomial-logit approach assumes no particular order across the occupational categories. The results based on this added method support our findings based on the main analyses.

Table 2 - Ordered Probit Model of Occupational Attainment

Variable	*Coefficients*		*Marginal effects (change in the probability of belonging to selected occupational category for 1 unit change in X)*			
Occupation Category			*Elementary occupations and services (lowest rank)*		*Professional and Managerial (highest rank)*	
	Immigrants	*Native-born*	*Immigrants*	*Native-born*	*Immigrants*	*Native-born*
High-school degree	0.256***	0.386***	-0.057***	-0.081***	0.100***	0.142***
Post-school qualification	0.589***	0.512***	-0.132***	-0.116***	0.228***	0.182***
University degree	1.575***	1.925***	-0.270***	-0.215***	0.566***	0.653***
Experience (in years)/10	0.474***	0.535***	-0.115***	-0.125***	0.183***	0.189***
Experience (in years)2/100	-0.096***	-0.100***	0.023***	-0.024***	-0.037***	-0.035***
Years since migration/10	0.268***	-	-0.065***	-	0.104***	-
Years since migration2/100	-0.063***	-	0.015***	-	-0.024***	-
European ethnicity	0.350***	0.128***	-0.083***	-0.031***	0.135***	0.044***
Maori ethnicity	-	-0.088***	-	0.021**	-	-0.031**
Pacific ethnicity	-0.178***	-0.007	0.045***	-0.001	-0.067***	0.003
Other ethnicity (mainly Asian)	-0.091	0.174**	0.023	-0.037**	-0.035	0.064**
Married	0.209***	0.118***	0.022***	-0.045 ***	0.079***	0.065***
Log of Likelihood	-9009.0	-38520.2				
Prob>chi^2	0.0000	0.0000				
Probability of belonging to the category			0.159	0.151	0.402	0.310
Number of observations	7642	30307				

Notes: 1. Sample of employed males.
2. *p<.10,**p<.05,***p<.01; - (Not Applicable)
3. Experience and Years since migration are measured in years (coefficients are reported in decades).
4. All models include fixed effects for each year of data; Base category for Ethnicity is 'all other immigrant ethnicities'.

The first two columns of each table show the coefficients of the Ordered Probit model with five occupational categories, and significance levels of each variable. In columns 3 to 6 we report derived marginal effects of a unit change in explanatory variables on the probability of belonging to particular occupational categories. For brevity, we provide information on two major occupation rank categories: elementary and service occupations (lowest rank); and professional, administrative and managerial occupations (highest rank), which represent, respectively, lower-level and higher-level occupations.[6]

Positive marginal effect signs reflect an increased probability of belonging to the category in association with a one-unit increase in the explanatory variable, and negative effects reflect a decreased probability. Note that the same variable may have different effects in differently ranked occupation categories.

Our model performs well in explaining occupational attainment, and allows us to control for educational qualifications, work experience and, for immigrants, years since immigration.

[6] These results are available from the authors.

We find that occupational attainment is affected most significantly by educational qualifications, but that other factors also have influence. For example, as column 1 of table 2 shows, male immigrants' probability of belonging to a higher category is increased by 25.6 per cent of a standard deviation from having a High-school qualification, and by 157.5 per cent from a University degree.

The results show that, as predicted, 'Years since migration' increases the probability of moving from a lower-paid occupational category to a higher-paid one, indicating that although immigrants may initially be penalised by the imperfect transferability of qualifications or other disadvantages, over time they tend to move to better occupations. The negative sign of the quadratic term coefficient indicates the increases occur at a decreasing rate with increased years since migration. We estimate the additional chances of belonging to a higher-ranking occupation to be about 14.6 per cent of a standard deviation (of the spread of population across occupational categories) higher after a decade since immigration, and about 29.2 per cent of a standard deviation in two decades.[7]

Immigrants from a European country background have about a third (35.0 per cent) higher probability of engagement in a higher-ranked occupation, compared to the base category of other non-Asian and not specified immigrants. In contrast, immigrants from the Pacific Island countries have a 17.8 per cent lower probability. When educational and other relevant factors are controlled for in the model, these effects are weaker, but remain, compared to other immigrant groups. When considering each occupation category, immigrants from European countries have a 13.5 per cent higher probability of belonging to the highest of the five categories in our study, i.e. professionals. In contrast, immigrants from the Pacific Islands have a 6.7 per cent lower probability of belonging to that category. The statistically significant effects for immigrants, for example, the negative effects for the Pacific Island ethnic group compared to the positive effect for European immigrants of over 20 per cent, are in magnitude equivalent to occupational attainment gains expected on average within a decade and a half since migration for the overall sample.

Since our analysis of the native-born workforce in table 3 reflects occupational movement for second and higher generation immigrants, it complements our analysis of immigrants. The following results are noteworthy. A comparison of results across immigrants and the native-born shows that while the effect of all explanatory variables is compatible across the immigrant and native-born groups, educational qualifications and years of experience generally make larger positive impacts on occupational attainment for the native born, compared to immigrants. This effect as noted earlier is likely to reflect potential disadvantages of immigrants, partly due to incomplete transferability of educational skills or work experience, as noted earlier.

We further find that among the native-born population, when educational qualifications are controlled for, the probability of belonging to a higher occupational category for the Pacific Island population is no longer statistically significant, compared to the other native-born groups. In addition, compared to other native-born workers the positive differential probability of belonging to highest occupational category (i.e. professionals) is smaller for the native-born workforce with a European background

[7] We use the coefficients and their quadratic in table 2, column 1, for marginal effects setting the values of Years since migration, to one and two decades respectively (0.272- 2(0.063) = 0.146 for one decade; and 0.272(2) – 2(0.063)(2) = 0.292 for two decades).

(4.4 per cent compared to 13.5 per cent for immigrants from a European background). The results for the native-born population of Pacific Island and European ethnic backgrounds provide complementary analyses, which generally signal regression to the mean and economic opportunity for the second and higher generations of immigrants.

Hypothesis 3: The Effect of Human Capital Variables on Earnings is Partially through Occupational Attainment

Here, we examine the extent to which educational qualifications, years since migration and ethnic group influence earnings through occupational attainment. The results from standard earnings models and expanded models which also control for the five occupational categories are summarised in table 3. The dependent variable is the natural logarithm of the hourly wage. The explanatory variables include educational qualifications, years of experience, and years since migration. As the dependent variable in these models is the natural logarithm of hourly earnings, the coefficients (x100) are interpreted as reflecting percentage effects on hourly earnings.[8]

Table 3 - The Mediating Effect of Occupational Attainment on Hourly Wage

	Immigrants			*Native-born*		
Variable	*Standard Model*	*With Occupational Attainment*	*Percentage Change from Standard the Model*	*Standard Model*	*With Occupational Attainment*	*Percentage Change from Standard the Model*
High-school degree	0.121***	0.084***	-30.6	0.137***	0.088***	-35.8
Post-school qualification	0.240***	0.157***	-34.6	0.232***	0.172***	-25.9
University degree	0.488***	0.305***	-37.5	0.549***	0.374***	-31.9
Experience (in years)/10	0.323***	0.270***	-16.4	0.375***	0.330***	-12.0
Experience (in years)2/100	-0.066***	-0.055***	-16.7	-0.073***	-0.065***	-10.9
Years since migration/10	0.106***	0.076***	-28.3	-	-	
Years since migration2/100	-0.023***	-0.016***	-30.4	-	-	
European ethnicity	0.156***	0.106***	-32.0	0.061***	0.045***	-26.2
Maori ethnicity	-	-	-	-0.020*	-0.008	-
Pacific ethnicity	-0.101***	-.066***	-34.6	-0.007	-0.007	0.0
Other ethnicity (mainly Asian)	-0.051**	-0.046**	-9.8	0.011	-0.010	0.0
Married	0.085***	0.063***	-25.9	0.119***	0.099***	-16.8
Constant	2.172***	2.167***	-0.2	2.218***	2.200***	-0.8
R^2	0.316	0.388		0.328	0.379	
F-value	298.1	260.5		1364.3	1002.3	
Prob>F	0.0000	0.0000		0.0000	0.0000	
Number of observations	7642	7642		30307	30307	

Notes: 1. Sample of employed males.
2. *P<.10,**P<.05,***P<.01; - - (Not Applicable)
3. Experience and Years since migration are measured in years (coefficients are reported in decades).

[8] For example a coefficient of 0.10 for a continuous variable such as years since migration represents approximately a 10.5 per cent increase in hourly earnings associated with a one unit change in the explanatory variable. For binary variables, e.g. Post-school or University degree, the percentage effect is: (the anti-log of the coefficient- 1)(x100), which is slightly larger than the above calculation).

The results confirm the significance of occupation in explaining immigrant earnings differentials. For example, when occupation is controlled for, as columns 3 and 6 of table 3 show, the coefficient for a University degree decreases by 37.5 per cent for immigrant men, and by about 32 per cent for native-born men, suggesting that a significant part of the increase in earnings associated with a University degree occurs through entrance into higher-paid occupation. Results for Post-school and school qualifications are almost as strong.

Table 3 column 3 further shows that 28.3 per cent of the effect of years since migration for immigrant men is through occupation. We have obtained these results despite using broad occupational categories, which can result in insignificance of coefficients.

Some differentiable results occur for different ethnic groups. For example, with occupation controlled for, among the native-born and immigrants approximately a quarter to a third (26.2 per cent and 32.1 per cent, respectively), of the increase in earnings associated with being in the European group occurs through entrance into higher-paid occupations. The opposite effect applies for the impact of Pacific group and others on earnings for immigrants: a reduction of the estimated coefficient value for the Pacific group immigrants by about a third (33.7 per cent), indicating the importance of occupational attainment in explaining earnings for the group, whereas for the 'others' (mainly Asian) group the reduction is more modest at 9.8 per cent.[9] These results indicate that occupational attainment plays a greater role in explaining earnings effects in immigrant groups from both European and Pacific countries, compared to the other groups of immigrants.

An implication of these results for econometric modelling is that when occupation is not included in earnings models, the coefficients for other important and correlated variables, such as educational attainment and ethnicity, combine their direct effects on earnings with omitted indirect effects through occupational attainment. We find that the indirect effects through occupational attainment are very significant.

We further find that among the native-born population, when educational qualifications are controlled for, for the Pacific Island population earnings is no longer statistically significant, compared to the other native-born groups. In addition, compared to other native-born workers, the positive earnings effect for the native-born workforce of European background is smaller than for immigrants of European background (6.1 per cent compared to 15.6 per cent, respectively). These results further indicate regression to the mean and economic opportunity for the second and higher generations of immigrants.

In summary, the return to having a University degree for immigrants achieved through occupational earnings mobility is more than a third of the returns reported for the conventional earnings function. The added effect of return to Years since

[9] We also examined occupational attainment and earnings for women based on the same data set. While we are not reporting those results here for brevity and given the different focus of the two analyses, those results show that for female immigrants the advantages of having higher qualifications for entering into higher-paid occupations are relatively greater than for males and for native-born women. Compared to immigrant men, the mediating 'occupation effect' is also larger for immigrant women from a European background, and the negative impact for the Pacific island group is also larger.

migration through occupational effects is more than a quarter of the return reported for the conventional earnings function for immigrants. In addition, a major part of the remaining effect of ethnicity on earnings is through occupational attainment. Our results confirm that for both immigrants and native-born workers occupation is indeed closely connected to earnings outcomes.

6. Conclusion

Some of our key results are as follows. We find that the probability of engagement in higher occupational categories is most significantly affected by educational qualifications, and that occupational attainment is an important mechanism through which education and skills result in higher earnings.

Our results highlight the importance of possessing a higher education (a Post-school qualification, or a University degree) in accessing highly ranked occupations. This effect is large but not uniform across the immigrant and native-born groups: for immigrants who seek to attain the highest occupational categories, there is some disadvantage compared to the native-born workforce with similar educational qualifications.

For immigrants, having a University degree is associated with a significant return achieved through occupational earnings mobility, at more than a third (37.5 per cent) of the return reported for the conventional earnings function. The effect of return from years since migration through occupational effects is also high, at approximately over a quarter (28.3 per cent) of increased earnings reported for the conventional earnings function. Our results therefore confirm that occupation indeed plays a key role in determining the earnings outcomes for both immigrants and natives.

In addition, we find that once educational qualifications are controlled for, progress to higher occupation categories for immigrants takes place with both increased work experience and years of residence in the host country. Based on our results it would take the average immigrant a decade and a half to progress to a higher occupational category. These effects vary significantly for different ethnic groups. Such results have implications for various 'end-users' of migration. For government, public service agencies and migrants themselves they draw attention to the importance of occupation as well as education as a means of climbing local 'earnings ladders' following migration.

We further show that accounting for occupational attainment significantly improves the explanatory power of immigrant earnings regressions, and our results across both Ordered Probit models of occupational attainment and earnings regression models highlight the significant mediating role of occupational attainment in explaining earnings across immigrant and native-born groups.

Finally, the results indicate that immigrant opportunities for occupational progress in New Zealand are strong. The skilled migration policy feature of the New Zealand immigration policy may be related to this positive outcome.

Appendix

Table A1- Definition of Variables

Variable	*Definition*
Experience (in years)	Years of potential experience measured as age minus age at completion of education
Years since migration	Years since migration to host country in years
High-school degree	Binary variable = 1 if highest degree is a High-school degree, =0 otherwise
Post-school qualification	Binary variable = 1 if highest degree is a Post-school qualification, =0 otherwise
University degree	Binary variable = 1 if highest qualification is a Bachelor degree or higher, =0 otherwise
European ethnicity	Binary variable = 1 if ethnic background is specified as from Europe or European descent, = 0 otherwise
Pacific ethnicity	Binary variable = 1 if ethnic background is specified as from Pacific Islands or Pacific Island descent, = 0 otherwise
Maori ethnicity	Binary variable = 1 if ethnic background is specified as Maori or Maori descent, =0 otherwise
Other ethnicity (mainly Asian)	Binary variable = 1 if ethnic background or descent is specified as from Other source countries (mainly Asian), = 0 otherwise
Married	Binary variable = 1 if currently married, = 0 otherwise
Year	Binary variable for year of data
Hourly Earnings	Natural logarithm of hourly earnings
Occupation Category 5:	Professionals, technicians, associate professionals, legislators, administrators, and managers
Occupation Category 4:	Clerks
Occupation Category 3:	Plant and machine operators, assemblers, and trade workers
Occupation Category 2	Agriculture and fisheries workers
Occupation Category 1:	Elementary occupations, and services and sales workers

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The Employment and Occupational Outcomes of Indian Male Migrants in the Australian Labour Market

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Abstract

This paper builds on the earlier work by Rafi and Lewis (2014) and analyses the employment and occupational outcomes of Indian born male migrants relative to other male cohorts in Australia. The findings indicate that the employment outcomes for Indian born males are similar to that of Australian males and foreign born males from both English speaking and non-English speaking backgrounds. However, as measured by hours worked per week, Indian born male migrants do have a lower engagement with the labour market. The results also indicate that tertiary qualifications make a very modest contribution to increasing the likelihood of an individual being employed. Analysis of the sample data also illustrates that Indian born male migrants in the Australian labour market are correctly matched with occupations relative to their formal training. Taken together with the migrant earnings results presented in Rafi and Lewis (2014) this indicates that while Indian born males do not face difficulty in finding suitable employment, they are still not as successful at generating higher returns to their tertiary education relative to the other male cohorts.

Keywords: Indian migrants, Labour market outcomes, Skilled occupation, Australia

JEL classification: J15, J24, J61

1. Introduction

As a net importer of labour, Australia relies on immigrants, particularly skilled immigrants to maintain its economic momentum. Australia's skilled migration program has attracted skilled overseas migrants and has offered incentives and expedited processing of applicants, especially former international students who possessed skills and locally obtained qualifications that were deemed desirable for the Australian economy. Over the years the composition of Australia's migrant intake has also shifted from migrants originating from English-speaking developed nations

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to migrants from Non-English backgrounds originating from developing countries, especially in Asia (Antecol, Cobb-Clark and Trejo, 2003)

In the last few years concerns have been raised about the efficacy of Australia's skilled migration program and the labour market outcomes (in terms of earnings and employment) and integration of skilled Indian migrants in the Australian economy. Baas (2007); Birrell and Healy (2008, 2010) and McCann (2010) offer an overview of this debate. The cited authors highlighted the link between the tertiary sector in Australia and Australia's migration policies, and also voiced concern about the skillset of recent Indian graduates and migrants in the Australian economy and their perceived inability to secure skilled employment. The first labour market outcome (earnings) was discussed in an earlier work by Rafi and Lewis (2014) which analysed the returns to qualifications for migrants in Australia and noted that Indian born male migrants were not as successful as the other male cohorts in terms of leveraging their tertiary qualifications to increase their earnings.

This paper builds on the earlier work by Rafi and Lewis (2014) and assesses the employment and occupational outcomes for an important migrant cohort, namely, Indian males in the Australian economy. As stated by Lane (2012) in recent years India has leapfrogged the United Kingdom and China to become the largest source of permanent migrants to Australia. This fact is supported by data provided by the Australian Bureau of Statistics (ABS); in 2011 there were 295,362 Indian born migrants in Australia, positioning them as the fourth largest aggregate cohort of migrants in Australia behind the United Kingdom (1.1 million), New Zealand (483,400) and China (319,000). ABS (2014) also highlighted that Indian migrants in Australia are the most recently arrived cohort having a median duration of residency of just 5 years, compared to 37 years for immigrants from the UK, 14 years for immigrants from New Zealand and 8 years for immigrants from China. Thus analysing the employment and occupational outcomes for this recently arrived cohort is of academic and social interest. The remainder of the paper will discuss these issues and is structured as follows; section 2 discusses some brief themes from the literature on migrant employment outcomes. Section 3 outlines the methodology and data sources used for this research; this is followed by the presentation and discussion of empirical results in section 4, finally followed by some concluding remarks in section 5.

2. Themes from the Literature

The literature on migrant employment outcomes and earnings was discussed in Rafi and Lewis (2014) and is not repeated in whole for the sake of brevity. In summary the work of authors such as Slater (1079), Maxwell (1988), Cellini (2007) and Bradford (2013) illustrated that migration can provide net benefits to both the home and host country and the decision to migrate and the destination of migration are influenced by the relative wage structure and prospects of employment in the home and host economies. The more robust Australian labour market relative to the Indian labour market therefore helps to explain the migrant flows from India as the literature identifies that the Indian economy is characterised by large scale informal employment, heterogeneous and in some cases quite stagnant wage and productivity growth and increasing income inequality (Kijima, 2006; Glinskaya and Lokshin, 2007; Kumar and Mishra, 2008; Majumdar, 2010; and Sidhu, 2010).

In terms of migrant employment outcomes authors such as Kossudji (1989), Miller and Neo (2003), Chiswick and Miller (2008), and Parasnis, Fausten and Cheo (2008) discussed migrant assimilation in host economies. In the Australian context, Miller and Neo and (2003) and Chiswick and Miller (2008) noted that migrants face initial difficulties in assimilating in the Australian labour market and are more likely to accept menial and low skilled jobs when they first enter the labour market. However migrant outcomes do improve with time in Australia but the rates of convergence are slow due to the inflexibility of the Australian labour market. The findings of these authors and the OECD (2007) also suggested that there is mixed evidence of whether qualifications acquired in Australia assist in migrants securing better paying and high skilled jobs.

3. Methodology and Data Sources

The theoretical framework used for this study draws inspiration from the work of Chiswick and Miller (Miller and Neo, 2003; Chiswick and Miller, 2008) and Parasnis, Fausten and Cheo (2008). This study analyses the impact of educational attainment and other demographic variables on the employment outcome of Indian born males compared to native born males and foreign born males from English speaking backgrounds (ESB) and non-English speaking backgrounds (NESB).

The binary employment outcome (1 for employed, 0 for unemployed) is modelled using a binary logit model of the form

$$p + pr[y = 1\ [x] = F(x'\beta)]$$

Where $F(x'\beta)$ has the functional form

$$F(x'\beta) = \frac{e^{x\prime\beta}}{1 + e^{x\prime\beta}}$$

And the marginal effects for the *j'th* regressor is given by

$$\frac{\partial p}{\partial xj} = F'(x'\beta)\beta_j$$

The employment status of an individual *EMPi* is regressed on a number of educational and demographic variables

$$EMP_i = \beta 0 + \beta 1Y12_i + \beta 2CER_i + \beta 3DIP_i + \beta 4UG_i + \beta 5PG_i + \beta 6EXP_i + \beta 7EXP_i^2$$
$$+ \beta 8SMS_i + \beta 9DR5_i + \beta 10FESB_i + \beta 11FNESB_i + \beta 12INB_i + u_i$$

Where *Y*12, *CER*, *DIP*, *UG*, *PG* are highest educational attainment dummies for each individual i, namely, year 12, certificate, diploma, undergraduate degree and postgraduate qualifications respectively. *EXP* denotes the years of labour market experience of each individual which is calculated using the Mincer proxy (age of an individual minus their years of training minus the age at which they started school, usually at five years of age). To allow for the possibility of diminishing returns to

experience a quadratic term EXP^2 is also included. *SMS* is a dummy variable that denotes social marital status (civil or de facto), *FESB, FNESB* and *INB* are dummies that are equal to 1 if an observation is foreign born English speaking background, foreign born non-English speaking background or Indian born respectively. It should be noted that Indian born observations are not included in either of the two foreign born cohorts, which is to say for an Indian born observation *FESB* and *FNESB* are equal to 0.

To capture duration of residence effects, *DR5* denotes a dummy variable which is equal to 1 if a migrant arrived in Australia more than five years ago and 0 otherwise. The observations for the different cohorts were pooled together for estimation as cohort specific auxiliary regressions did not illustrate significant differences in the slope parameters. Therefore the observations were pooled to provide the greatest possible variability with cohort effects controlled through the use of dummy variables. The employment sample only includes individuals who are in the labour force (employed or unemployed but looking for work), the sample excludes males under the age of 21 and full time students as the employment outcomes of such individuals are likely to be influenced by educational participation.

The above specification offers a very broad indicator of an individual's engagement with the labour market. To test for varying levels of engagement with the labour market the hours worked per week by an individual (*HWP*) is expressed as a function of the explanatory variables plus some additional dummies for family composition.

$$\begin{aligned} HWP_i = {} & \alpha 0 + \alpha 1Y12_i + \alpha 2CER_i + \alpha 3DIP_i + \alpha 4UG_i + \alpha 5PG_i + \alpha 6EXP_i + \alpha 7EXP_i^2 \\ & + \alpha 8SMS_i + \alpha 9DR5_i + \alpha 10FESB_i + \alpha 11FNESB_i + \alpha 12INB_i \\ & + \alpha 13CPND_i + \alpha 14CPD15_i + \alpha 15SPD15_i + u_i \end{aligned}$$

Where *HWP* is a continuous variable equal to the number of hours worked per week by an individual. Along with the previously defined set of explanatory variables and controls, the labour market engagement model controls for family composition through the use of additional binary variables. *CPND* is a dummy variable that is equal to one if an individual is part of a family unit that does not have any dependents and 0 otherwise, *CPD15* is 1 if an individual is in a family unit with dependents under the age of 15 and 0 otherwise, *SPD15* is equal to 1 if an individual is a single parent with dependents under the age of 15 and 0 otherwise. The hours worked per week sample is constructed using the same criteria as the employment sample, but also excludes individuals that do not report their weekly hours worked.

Data Sources and Sample Summary Statistics

This study utilises cross sectional confidential unit record data from the Census of Housing and Population conducted by the Australian Bureau of Statistics (ABS). In recent rounds the ABS has provided access to confidential unit record data files (CURFs) as a one per cent and five per cent sample of the Australian population (ABS 2009; ABS 2013). These CURFs contain information on a wide range of demographics variables, such as age, ethnic background, employment status, weekly income, level of

post-secondary qualifications and year of arrival in Australia. This study primarily utilizes CURF data from the five per cent sample from the 2006 and 2011 Census. Data from the 2001 Census is not included in the analysis due to the unavailability of a five per cent CURF sample, and an insufficient number of valid observations for Indians in the one per cent sample.

Selected summary statistics from the data are reported in this section for the sake of illustration and to assist in later analysis.

Table 1 - Sample Unemployment Rate – Per Cent

	2006	*2011*
Australian	4.26	4.16
ESB	3.67	3.87
NESB	5.82	5.38
INB	3.92	3.27

Table 2 - Sample Distribution of Number of Weekly Hours Worked

	AUS	*ESB*	*NESB*	*INB*
		2006		
25th Percentile	40	40	38	38
Median	42	43	40	40
75th Percentile	50	50	50	45
Mode	40	40	40	40
60 hours or more	15%	14%	11%	7.5%
		2011		
25th Percentile	40	40	38	38
Median	42	42	40	40
75th Percentile	50	50	48	42
Mode	40	40	40	40
60 hours or more	15%	14.00%	10.30%	5%

Tables 1 and 2 report that the various sample cohorts are quite similar in terms of the unemployment rate. However foreign born males with a non-English background fare the worst in terms of employment. It must be reemphasised that Indian born males are not included in the non-English background cohort and are reported separately, the sample unemployment statistics show Indian born males as faring better than all the other cohorts in 2011 with the sample unemployment rate at 3.27 per cent. In terms of labour market engagement as measured by hours worked per week, again there is considerable similarity between the cohorts, however, the Indian born cohort has a much lower percentage of individuals who work sixty hours or more in a week.

Table 3 reports the tertiary qualifications possessed by the sample cohorts, Indian born males in the sample had a much higher incidence of higher education qualifications with nearly sixty three per cent of the cohort possessing a university qualification in 2006 and 2011. Generally table 3 illustrates that certificate qualifications

(vocational qualifications) were more prevalent within the Australian and foreign born English speaking background (ESB) cohorts, whereas university degrees had a higher representation in the foreign born non- English background (NESB) and Indian cohorts.

Table 3 - Tertiary Qualifications[2] – Per Cent of Sample Cohort

	Australian	*ESB*	*NESB*	*INB*
		2006		
PG	3	6	8.7	28.53
GD	1.64	1.7	1.28	2.74
UG	13.78	16.17	22.3	30.98
DIP	7.57	8.8	9.5	8.65
CER	31.65	30.67	19.58	12.01
		2006		
PG	3.58	6.84	11.37	29.6
GD	1.77	2.1	1.64	3.5
UG	15	18.07	25.39	30.26
DIP	8.26	10	9.72	12.97
CER	33.43	29.47	18.57	9.72

Table 4 reports the age distribution of the sample cohorts, at the median it can be seen that the two foreign born cohorts are older than both the Australian and Indian cohorts. It should also be noted that the Indian born male cohort has gotten markedly younger between 2006 and 2011, with the age difference at the median between Australian and Indian born males widening from 2 years in 2006 to 7 years in 2011. The widening of this gap between Australian males and Indian born males highlights the increasing influx of younger Indian migrants especially former international students that is discussed in Rafi and Lewis (2013).

Table 4 - Age Distribution of Sample Cohorts

	AUS	*ESB*	*NESB*	*INB*
		2006		
25th Percentile	29	36	34	30
Median	39	44	44	37
75th Percentile	49	53	52	46
90th Percentile	56	59	59	56
		2011		
25th Percentile	30	35	33	29
Median	40	45	43	33
75th Percentile	50	53	52	41
90th Percentile	58	60	59	52

[2] PG denotes post graduate qualifications such as Masters and Doctorate degrees, GD denotes graduate diplomas, UG denotes undergraduate (bachelors) degrees and DIP and CER denote vocational diplomas and certificate qualifications.

Table 5 - Social Marital Status of Sample Cohorts – Per Cent

	AUS	*ESB*	*NESB*	*INB*
		2006		
Unmarried	36.37	27.2	26.43	25.94
Married	63.63	72.8	73.57	74.06
		2011		
Unmarried	36.66	28.33	27.44	28.88
Married	63.34	71.67	72.56	71.12

Finally, table 5 illustrates that marriage (civil or de facto) is an important facet of Australian society and the lives of labour market participants in general. While the proportion of married males is high across all the cohorts, Australian males had a noticeably higher proportion of unmarried males relative to the other cohorts.

4. Empirical Results

The empirical results are summarised and discussed in this section. The results are robust from heteroskedasticity and show that there is very little difference in the employment outcome of the four cohorts and that a tertiary qualification only makes a very modest contribution to increasing the likelihood of an individual being employed. However, in terms of labour market engagement, Indian born males work less hours per week compared to the other cohorts.

Table 6 reports the results from the pooled binary logit model of employment and unemployment. The first important finding of the results highlights that the possession of tertiary qualifications only makes a very modest contribution to an individual's likelihood of being employed; this is reflected in the odds ratios for the educational dummies which are quite modest and similar. Secondly, it can be noted that there has been a slight deterioration in the ability of undergraduate and post graduate degrees to assist in employment with the odds ratios for those variables recording a very modest decline.

The results indicate that migrants are at a slight disadvantage in the labour market in terms of employment; this disadvantage is modest for ESB males, but more noticeable for NESB and Indian males. In 2006 Indian born males fared worse than Australian and ESB male migrants in terms of employment but better than NESB male migrants. In 2011 the non-significant coefficients for ESB and Indian born males suggests that in terms of being employed there was no statistically significant difference between Australian, ESB male migrants and Indian born males. The results therefore suggest that the language background of an individual remains an important factor in terms of explaining employment. The results also suggest that migrants who have resided in Australia for longer than five years (as captured by the DR5 dummy) enjoy a modest advantage in being able to secure employment, however this duration of residence effect as quantified by the odds ratio is not very strong. Finally the results from the pooled logit model illustrate that age (and by extension experience) play a very limited role in terms of facilitating employment in the Australian labour market, and that by far the largest determinant of being employed was an individual's marital status.

At face value the results presented in table 6 suggest that differences in the employment outcomes of Australian, foreign born and Indian born males are quite trivial. However the logit model offers a very broad indicator of the labour market engagement of an individual. To test for differences between the labour market engagements of the various cohorts, the continuous variable hours worked per week by an individual is regressed on the original explanatory variables in addition to some new family composition dummies. These results are presented in table 7, and illustrate that the possession of tertiary qualifications, especially a university degree does increase the engagement of an individual with the labour market, however the slight deterioration with respect to the contribution of educational qualifications observed in the logit model is also apparent in the OLS results. The results presented in table 7 do indicate that Indian born males have the lowest engagement with the labour market of all the cohorts, followed by NESB and ESB male migrants respectively.

Table 6 - Binary Logit Employment Model Estimates

	2006				*2011*			
EMP	*Coefficient*	*Odds Ratio*	*Marginal Effect*		*Coefficient*	*Odds Ratio*	*Marginal Effect*	
Y12	0.546	1.726	1.81%	***	0.473	1.604	1.68%	***
CER	0.638	1.894	1.86%	***	0.482	1.620	1.52%	***
DIP	0.443	1.557	1.22%	***	0.466	1.593	1.34%	***
UG	0.645	1.905	1.73%	***	0.504	1.655	1.49%	***
PG	0.571	1.771	1.47%	***	0.353	1.423	1.05%	***
ESB	-0.333	0.717	-1.23%	***	-0.036	0.965	-0.12%	
NESB	-0.862	0.423	-3.78%	***	-0.421	0.656	-1.65%	***
INB	-0.556	0.574	-2.35%	***	0.121	1.129	0.39%	
AGEP	0.030	1.031	0.10%	***	0.024	1.024	0.08%	***
$AGEP^2$	0.000	1.000	0.00%	***	0.000	1.000	0.00%	***
DR5	0.288	1.334	0.88%	***	0.228	1.257	0.86%	***
SMS	1.092	2.981	4.37%	***	1.042	2.835	4.34%	***
	n	220,697			n		250,598	
	R^2	6.50%			R^2		5.30%	
	Correctly Classified	95.70%			Correctly Classified		95.60%	

The dependent variable in this case is employment status (EMP) which is a binary variable (1 if employed, 0 if unemployed). *** Significant at 1 per cent, ** significant at 5 per cent, * significant at 10 per cent.

Table 7 - OLS, Hours Worked Per Week Model Estimates

HWP	*2006*		*2011*	
Y12	1.589	***	1.222	***
CER	2.004	***	1.826	***
DIP	1.131	***	1.177	***
UG	2.030	***	1.801	***
PG	2.618	***	2.076	***
ESB	-1.754	***	-0.019	
NESB	-4.389	***	-2.872	***
INB	-4.531	***	-3.164	***
AGEP	0.832	***	0.855	***
$AGEP^2$	-0.010	***	-0.011	***
DR5	1.429	***	1.546	***
SMS	4.571	***	4.302	***
CPND	-1.426	***	-1.462	***
CPD15	-0.761	***	-0.905	***
SPD15	-3.072	***	-2.806	***
n	220,697		250,598	
R^2	5.00%		4.90%	

The dependent variable in this case is hours worked per week (HWP) which is a continuous variable. *** Significant at 1 per cent, ** significant at 5 per cent, * significant at 10 per cent.

The results in table 7 indicate that in 2006, Indian born males in the sample worked four and a half hours less per week compared to Australian males and approximately three hours less in 2011. The reason for this lower engagement needs to be investigated further; most notably it needs to be investigated whether this lower engagement per week with the labour market is by choice or whether due to the inability of NESB and Indian born males to secure more hours of employment. The results also reaffirm the very limited role played by age (and by extension experience) in terms of employment outcomes. In terms of duration of residence effects the results in table 7 indicate that migrants who have resided in Australia for longer than five years had a higher labour market engagement and worked on average an hour and a half more per week than more recently arrived migrants. It would appear that marital status and family composition are more important determinants of labour market engagement. The results illustrate that married males worked nearly four and a half hours more in 2006 and 2011 than unmarried males. The empirical results also indicate that family composition is an important influence on labour market engagement. Table 7 illustrates that males in a relationship with no dependents and males that were single parents worked less hours per week compared to males in a relationship with dependents under the age of 15. The significant influence of family composition on labour market engagement is a possible area for future research that will be considered in greater detail in later work.

The Quality and Nature of Employment

So far the empirical results have established that Indian born male migrants are quite similar to Australian born males and other male migrant cohorts in terms of their

ability to secure employment. The results have also indicated that Indian male migrants (as well as NESB male migrants) have lower labour market engagement relative to Australian males and ESB males as measured by the hours worked per week.

The question arises whether the differences between Indian male migrants and other male cohorts arise not so much in the broad aggregates of employment status and hours worked but rather in the quality and nature of employment. This section of the paper reports summary extracts from cross tabulations of occupations by field of study and level of study from the estimation sample and offers some clarity on the nature of employment of Indian male migrants.

Table 8 - Top 5 Occupations of sample Cohorts

	2006	*2011*
Australian	Specialist Managers (8.4%) Construction Trade Workers (6%) Business, HR and Marketing Professionals (5.1%) Hospitality Retail and Services Managers (4.8%) Road and Rail Drivers (4.6%)	Specialist Managers (8.9%) Automotive and Engineering Trades Workers (7.1%) Construction Trades Workers (6.2%) Business, Human Resource and Marketing (5.2%) Hospitality, Retail and Service Managers (4.7%)
ESB	Specialist Managers (10.9%) Business, HR and Marketing Professionals (6.2%) Automotive and Engineering Trade Workers (5.9%) Design, Engineering, Science and Transport Professionals (4.7%) Hospitality Retail and Services Managers (4.4%)	Specialist Managers (11.1%) Automotive and Engineering Trades Workers (5.7%) Construction Trades Workers (5.5%) Design, Engineering, Science and Transport Professionals (5.4%) Hospitality, Retail and Service Managers (4.4%)
NESB	Specialist Managers (7.7%) Business, HR and Marketing Professionals (5.9%) Automotive and Engineering Trade Workers (5.5%) Design, Engineering, Science and Transport Professionals (5.2%) ICT Professionals (5.1%)	Specialist Managers (7.9%) Business, HR and Marketing Professionals (6.6%) Design, Engineering, Science and Transport Professionals (5.7%) ICT Professionals (5.6%) Automotive and Engineering Trades Workers (5.1%)
INB	ICT Professionals (11%) Business, HR and Marketing Professionals (10.3%) Specialist Managers (8.7%) Design, Engineering, Science and Transport Professionals (6.7%) Road and Rail Drivers (4.9%)	ICT Professionals (12.4%) Business, HR and Marketing Professionals (8.2%) Specialist Managers (7.7%) Road and Rail Drivers (6.9%) Design, Engineering, Science and Transport Professionals (5.5%)

Table 8 reports the top five occupations of each male cohort from the estimation sample from 2006 and 2011. The percentages in brackets denote the proportion of each sample cohort engaged in a particular occupation. Table 8 shows that apart from 'Road and Rail Drivers' Indian born males were engaged in highly specialised

occupations in 2006 and 2011 with a high proportion ICT professionals, Business, HR and Marketing Professional and specialist managers. In general the three migrant cohorts were all engaged in specialised occupations, suggesting good matching of skills with occupations. Table 9 further shows that all cohorts were highly skilled in terms of their fields of study with the Indian born male cohort having the highest relative proportions of males with engineering and IT qualifications. Tables 8 and 9 illustrate that in terms of skills, and skilled occupations, Indian born male migrants in the sample are not dissimilar to the other cohorts.

Table 9 - Top 3 Fields of Study of Sample Cohorts

	2006	*2011*
Australian	Engineering and Related Technologies (21%) Management and Commerce (9.5%) Architecture and Building (7.6%)	Engineering and Related Technologies (21.7%) Management and Commerce (10.7%) Architecture and Building (8.4%)
ESB	Engineering and Related Technologies (23.4%) Management and Commerce (10%) Architecture and Building (8.3%)	Engineering and Related Technologies (22.4%) Management and Commerce (11.8%) Architecture and Building (8.54%)
NESB	Engineering and Related Technologies (22.1%) Management and Commerce (12.1%) Information Technology (6%)	Engineering and Related Technologies (21.3%) Management and Commerce (15.1%) Information Technology (7.1%)
INB	Engineering and Related Technologies (26.7%) Management and Commerce (21.6%) Information Technology (16.3%)	Engineering and Related Technologies (24.6%) Management and Commerce (24%) Information Technology (17%)

Table 10 also illustrates that Indian male migrants with post graduate and undergraduate qualifications were employed in occupations that required specialised skillsets although there has been some deterioration between 2006 and 2011, for example for Indian born males with post graduate qualifications as shown by a notable proportion (5.4 per cent) of Indian postgraduates working as numerical clerks. There is also a higher incidence of trade and semi-skilled occupations for Indians with diploma qualifications however this pattern is not dissimilar from that of the other male cohorts in the estimation sample[1].

Tables A1 and A2 reported in the appendix of this paper report the top three occupations by field of study, again apart from a few idiosyncratic results (17.4 per cent of males with Architecture and Building qualifications working as road and raid drivers in 2006) the skillsets of Indian males are well matched with occupations in the Australian labour market. However, there is some evidence of deteriorating employment opportunities in terms of correctly matched occupations for Indian born males in 2011 for certain fields of studies such as education and society and culture.

[1] The cross tabulations and summary extracts for the other male cohorts are not reported in this paper for the sake of brevity but exhibit similar patterns to Indian born males. These extracts are available from the author upon request

Table 10 - Indian Born Males, Top 5 Occupations by Level of Study

	2006	*2011*
PG	ICT Professionals (15.3%) Business, HR and Marketing Professionals (14%) Specialist Managers (12.1%) Design, Engineering, Science and Transport Professionals (11.8%) Health Professionals (5.9%)	ICT Professionals (20.5%) Business, HR and Marketing Professionals (12.9%) Specialist Managers (10.8%) Design, Engineering, Science and Transport Professionals (8.9%) Numerical Clerks (5.4%)
UG	ICT Professionals (16.2%) Business, HR and Marketing Professionals (12.1%) Specialist Managers (9.1%) Design, Engineering, Science and Transport Professionals (6.9%) Health Professionals (6.9%)	ICT Professionals (15.9%) Business, HR and Marketing Professionals (10%) Specialist Managers (8.5%) Design, Engineering, Science and Transport Professionals (7.0%) Health Professionals (6.5%)
DIP	Hospitality Retail and Services Managers (9.4%) Automotive and Engineering Trade Workers (9.4%) ICT Professionals (7.2%) Specialist Managers (6.7%) Business, HR and Marketing Professionals (6.1%)	Road and Rail Drivers (13.6%) Food Trade Workers (12.9%) Hospitality Retail and Services Managers (5.7%) Machine and Stationary Plant Operators (5.4%) Automotive and Engineering Trade Workers (5.1%)
CER	Automotive and Engineering Trade Workers (22.4%) Machine and Stationary Plant Operators (10%) Factory Process Workers (7.6%) Electro Technology and Telecomm Trade Workers nfd (6.8%) Food Trade Workers (6%)	Automotive and Engineering Trade Workers (17.7%) Food Trade Workers (9.3%) Road and Rail Drivers (8.1%) Machine and Stationary Plant Operators (7.7%) Electro Technology and Telecomm Trade Workers nfd (6.7%)

As shown in table A2, in 2011, 7.4 per cent of Indian males with qualifications in natural and physical sciences were working in hospitality and retail services. A large proportion of Indian males with qualifications in education, society and culture (17.5 and 11.1 per cent respectively) were working as road and rail drivers, suggesting that by 2011 employment opportunities for some Indian males in their nominated field of training were shrinking. Overall, Indian male migrants in the sample do not display any strong evidence of occupational and skills misclassification in term of employment patterns when cross tabulated against their level and field of study.

However, as established in Rafi and Lewis (2014) Indian born male migrants were the least successful of all the male cohorts in terms of leveraging their tertiary qualifications to increase earnings, especially at the undergraduate and post graduate level. Taken together the findings of this paper and Rafi and Lewis (2014) imply that while Indian born males do not face difficulty in finding suitable employment, they are not as successful at generating higher returns to tertiary education. There could be a number of reasons for this, firstly, language and cultural barriers may be preventing

Indian born males from climbing organisational hierarchies, they may be correctly matched with occupations but may be unable to secure promotions or senior positions due to language or cultural difficulties as they are crowded out by more naturalised employees. Secondly, the lower returns to earnings could be a result of the relatively poor quality of qualifications held by Indian born males. A limitation of the census data utilised in this research is that it does not identify whether qualifications were obtained in Australia or overseas, nor is it possible to identify the institution attended by an individual. These issues remain important and warrant further attention and are potential areas for future research.

5. Conclusion

This paper utilised unit record data from the 2006 and 2011 Census of Housing and Population to analyse the employment and occupational outcomes of Indian born males relative to Australian and other foreign born male migrants in the Australian labour market. The findings from this paper indicate that Indian born males are not dramatically dissimilar to Australian males and foreign born males from both English speaking and non-English speaking backgrounds in terms of their ability to secure employment. Furthermore, the results indicate that tertiary qualifications only make a very modest contribution to increasing the likelihood of an individual being employed. However, in terms of labour market engagement, as measured by hours worked per week, Indian born male migrants do have a lower engagement with the labour force. The empirical results of this paper and the summary extracts from the sample cross tabulations highlight that despite lower labour market engagement there is no strong evidence of a mismatch of skills and occupations for Indian born male migrants. Cross tabulations from the sample data illustrate that the Indian born male migrants are largely engaged in occupations that complement their formal training and level of study. This makes the lower earnings for Indian male migrants that were discussed in Rafi and Lewis (2014) perplexing, it is hypothesised that cultural and language barriers and the lower quality of their tertiary qualifications may be holding Indian male migrants back in terms of earnings.

Appendix

Tables A1 and A2 provide summary information from cross tabulation of the sample data. The occupation of each observation was cross tabulated against their field of study to determine whether there was any mis-match between formal training and occupations. The patterns displayed by Indian born males are largely consistent with those of other male cohorts in the estimation sample. Summary information from the cross tabulations for the other male cohorts are not reported in this paper for the sake of brevity but is available from the author on request.

Table A1 - Indian Born Males, Top 3 Occupations by Field of Study

	2006
Natural and Physical Sciences	Design, Engineering, Science and Transport Professionals (16.7%) Specialist Managers (11.1%) ICT Professionals (11.1%)
Information Technology	ICT Professionals (37.5%) Engineering, ICT and Services Technicians (7.4%) Specialist Managers (6.5%)
Engineering and Related Technologies	Design, Engineering, Science and Transport Professionals (15.8%) Automotive and Engineering Trade Workers (15.8%) ICT Professionals (10.4%)
Architecture and Building	Design, Engineering, Science and Transport Professionals (39.1%) Road and Rail Drivers (17.4%) Specialist Managers (13.04)
Health	Health Professionals (87%) Design, Engineering, Science and Transport Professionals (4%) Managers nfd (1%)
Education	Education Professionals (46.1%) Specialist Managers (11.5%) Other Clerical and Admin (7.7%)
Management and Commerce	Business, HR and Marketing Professionals (31.3%) Specialist Managers (14.7%) Numerical Clerks (6.9%)
Society and Culture	Legal, Social and Welfare Professionals (9%) Protective Services Workers (7.9%) Business, HR and Marketing Professionals (6.4%)
Creative Arts	Design, Engineering, Science and Transport Professionals (14.29%) Inquiry Clerks and Receptionists (14.29%) Arts and Media Professionals (7.14%)
Food, Hospitality and Personal Services	Food Trade Workers (57.9%) Hospitality Retail and Services Managers (10.5%) Specialist Managers (5.2%)

Table A2 - Indian Born Males, Top 3 Occupations by Field of Study

	2006
Natural and Physical Sciences	Design, Engineering, Science and Transport Professionals (15.6%) Engineering, ICT and Services Technicians (8.2%) Hospitality Retail and Services Managers (7.4%)
Information Technology	ICT Professionals (44%) Specialist Managers (7.6%) Engineering, ICT and Services Technicians (6.8%)
Engineering and Related Technologies	Design, Engineering, Science and Transport Professionals (15.5%) Automotive and Engineering Trade Workers (11.4%) ICT Professionals (10.5%)
Architecture and Building	Design, Engineering, Science and Transport Professionals (28.1%) Engineering, ICT and Services Technicians (18.8%) Specialist Managers (12.5%)
Health	Health Professionals (84.2%) Carers and Aides (1.9%) Specialist Managers (1%)
Education	Education Professionals (32.5%) Road and Rail Drivers (17.5%) Specialist Managers (7.5%)
Management and Commerce	Business, HR and Marketing Professionals (22.3%) Specialist Managers (11.5%) Numerical Clerks (8.5%)
Society and Culture	Legal, Social and Welfare Professionals (11.1%) Road and Rail Drivers (11.1%) Specialist Managers (8.2%)
Creative Arts	Arts and Media Professionals (13.3%) Design, Engineering, Science and Transport Professionals (13.3%) Machine and Stationary Plant Operators (10%)
Food, Hospitality and Personal Services	Food Trade Workers (41%) Road and Rail Drivers (16.2%) Hospitality Retail and Services Managers (7.7%)

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The Determinants of Academic Achievement Among Primary School Students: A Case Study of the Australian Capital Territory

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Abstract

This paper uses a unique opportunity of access to unit record data held by the ACT Education and Training Directorate to estimate the determinants of outcomes for primary students in the NAPLAN reading and numeracy tests. The results show that individual characteristics such as gender, educational background of parents, Indigeneity and non-English speaking background have a significant influence on outcomes. The average level of socio-economic advantage of the school and the size of the school were also important. The results add to our existing knowledge of the determinants of academic achievement at the primary level in Australia.

Keywords: Educational achievement, Primary school, NAPLAN, Socio-economic status

JEL classification: I24, I21, I25

1. Introduction

Educational attainment has long been recognised as an important determinant of labour market outcomes. Australian figures show that there is a strong link between educational attainment and employment. Those with a low level of education are less likely to be participating in the labour force; almost 30 per cent of those with less than a Year 12 level of education did not participate in the labour force in 2014 compared to 19 per cent of those with a bachelor degree. Sixty per cent of those holding a Bachelor Degree were employed on a full-time basis compared to just 40 per cent of those with less than a Year 12 level of education (Australian Bureau of Statistics (ABS), 2014). The higher rates of participation in conjunction with higher hourly pay rates mean that people who have at least completed year 12 have higher incomes than those who have not.

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There is considerable evidence that poor performance by students in national and international tests in the high school years is associated with a lower propensity to complete secondary schooling (Curtis and McMillan, 2008; Mahuteau and Mavromaras, 2014; Marks, 2007 and Marks, 2014a) and to have problems gaining full-time employment (Carbonaro, 2006; Jensen and Seltzer, 2000 and Marks, 2006). Outcomes during secondary education are in turn strongly correlated with primary school performance (Marks, 2014b). Heckman (2002) emphasised the importance of early intervention strategies for promoting better outcomes for children from disadvantaged backgrounds in the US. Researchers in the UK (Anders *et al*., 2011) and Australia (Hilferty and Redmond, 2010) have also advocated for early intervention strategies for children at risk of low levels of academic achievement. The determinants of student performance at primary school are therefore important for their future engagement with the labour force.

The aim of this paper is to examine determinants of outcomes for primary school students in the National Assessment Program- Literacy and Numeracy (NAPLAN) tests for reading and numeracy, including the impact of the level of educational advantage/ disadvantage of the school and parental education. This study offers a unique opportunity to examine the relationship between parents' education, school-level variables and academic outcomes for primary school students in an Australian jurisdiction, the Australian Capital Territory (ACT), as the authors have been granted access to de-identified unit record data available at the ACT Education and Training Directorate. These data have been linked to data from the *MySchool* website to create a dataset with both individual and school-level variables relevant to academic achievement.

The Australian Capital Territory (ACT) is a small Australian jurisdiction with particular features arising from its role as the seat of the Government of Australia. It has the highest median income and educational attainment among Australian States and Territories. According to the 2011 Population Census conducted by the Australian Bureau of Statistics (ABS), almost three-quarters of the population aged 15 years and older had completed Year 12 or equivalent and over half of that population held a post school qualification (ABS, 2013). Almost 60 per cent of those with post school qualifications held a bachelor degree or higher. Given the association between parents' education and child's education (Alon, 2009; Chesters and Watson, 2013; Pfeffer, 2008 and Stadelmann-Steffen, 2012), it is not surprising to find that ACT students perform well in the NAPLAN tests.

The ACT has advantages as the focus of this study as it is a relatively small homogeneous jurisdiction, reducing the effects of confounding influences such as urban/rural location of schools on results. In addition, most Australian studies have focused on secondary school results while this one examines the results for students attending government primary schools. A third reason why these results are of wider interest is that they add to the accumulated knowledge on the determinants of test performance in Australia. Education is a State and Territory responsibility in Australia so each jurisdiction has its own particular characteristics. While analysis of Australia-wide data through testing under the OECD Programme for International Student Assessment (PISA) and surveys such as the Longitudinal Survey of Australian Youth

(LSAY) offer an aggregate picture, a detailed examination of outcomes at the State/Territory level require analysis of State/Territory level data. This study will contribute to the development of this evidence base.

2. Determinants of Test Performance

There are a number of variables which have been shown in the international and Australian contexts to have an important influence on the academic achievements of school-aged children. However, the choice of variables used in this analysis has been limited by the availability of data. The variables used in this study include characteristics of the individual student such as their parents' educational attainment, language background (NESB), Indigenous status and sex. Characteristics of the school have also been shown to have a significant impact on academic outcomes including the average socio-economic status (SES) of the school and its location. The following section presents the key findings of earlier studies of the determinants of student performance relevant for this study.

There is considerable evidence that the socio-economic background of fellow students has a significant influence on educational outcomes for students and may even be more important than an individual's background in determining outcomes (see for example, Buckingham *et al*., 2013; Lim *et al*., 2013; McConney and Perry, 2010; OECD, 2010; Perry and McConney, 2010; Rothman and McMillan, 2003 and Sirin, 2005). The interaction between students, the school environment and community support all contribute significantly to individual performance in academic tests.

Researchers examining the effects of parental education and socio-economic status on child's educational achievement and attainment largely agree that high SES parents are able to facilitate the development of their children's cognitive abilities and provide them with the necessary cultural capital required for success at school (Ball, 2010; Bourdieu, 1984; Breen *et al*., 2009; Roska and Potter, 2011; van de Werfhorst and Hofstede, 2007). Furthermore, they are able to provide a home environment conducive to intellectual development and encourage their children's participation in appropriate extracurricular activities (Lareau, 2011).

The OECD (2010) emphasised the importance of the SES of schools in their analysis of reading results for 15 year olds in 65 participating countries under the Programme for International Student Assessment (PISA). The study concluded that students attending schools with socio-economically advantaged peers tended to perform better on the tests regardless of their own SES. The results for Australia show that while the dispersion of reading results according to the socio-economic status of individual students was less than the average for OECD countries, the socio-economic gradient was steeper than the OECD average, that is, there was a significant increase in scores as SES rose.

In a more detailed examination of the 2012 PISA results for mathematical literacy Thomson, De Bortoli and Buckley (2013) show that the socioeconomic gradient was steeper in the ACT than for Australia as a whole. Students from low socioeconomic backgrounds in the ACT performed less well than their counterparts in all states except Tasmania and the Northern Territory whereas those from more advantaged socioeconomic backgrounds performed better than the Australian average.

This has implications for employability with the types of jobs available in the ACT typically requiring higher levels of education and skills. Of those employed in the ACT, 45 per cent held a bachelor degree or higher qualification compared 29 per cent nationally (Department of Education, 2015).

Gender, English speaking background and Indigenous status have also been found to have an effect on test scores. Girls tend to perform better than boys on reading tests while this is reversed for mathematical tests. The effect of migrant status on achievement is mixed with Marks (2014b) finding that students from language backgrounds other than English (LBOTE) scored lower, on average, on numeracy and reading in Year 3 than their English-speaking peers but higher, on average, on both domains in Year 5. By Year 7, LBOTE students achieved higher scores for numeracy and lower scores for reading. According to the OECD (2010) students in Canada and Australia who spoke a language other than the assessment language at home performed as well as the average.

The differences in educational outcomes for Indigenous Australians have been well documented. The results for NAPLAN tests provide evidence of the raw gap in performance between Indigenous and non-Indigenous students (ACARA, 2012; Marks, 2014b). The poorer academic outcomes of Indigenous students have been the focus of considerable policy concern. One of the Closing the Gap goals is to 'halve the gap for Indigenous children in reading, writing and numeracy within a decade (by 2018)' (CoAG, 2008: p. 6).

A final variable included in this study that has not appeared in many other Australian studies is the size of the school. The effect of school size on academic achievement has been contested in the literature. Economies of scale might be expected to improve the range and availability of resources for students in larger schools and therefore their academic outcomes while smaller schools might have the advantage of a less bureaucratic environment and reduced social stratification among students and teachers (Huang and Howley, 1993). A series of studies based on data from seven US states, referred to as the Matthew Project, found that the negative effect of social disadvantage on student academic performance was reduced in small schools compared to large schools (Howley and Bickel, 1999). However, Australian research on Higher School Certificate performance in Catholic schools in NSW from the same period found that after controlling for school and individual characteristics, students at larger schools outperformed those at smaller schools (Mok and Flynn, 1996).

In summary, previous research shows that individual measures of social background, gender, language background, Indigenous status and school-level measures such as school size have an effect on students' performance in academic tests. Levels of academic achievement at school are correlated with educational attainment which in turn is subsequently correlated with labour force status. Therefore, recognising the importance of the primary school years for employment outcomes over the life course, this paper examines the links between individual and school-level characteristics and levels of academic achievement in primary school. It adds to the existing literature on this topic by presenting results for one Australian jurisdiction, the ACT.

3. Method

We analyse data from two sources: the ACT ETD (Australian Capital Territory, Education and Training Directorate); and the *MySchool* website. The ACT ETD provided de-identified data from 45 primary schools and seven combined primary and secondary schools on NAPLAN scores for reading and numeracy in Years 3 and 5; parents' education; Indigenous (Aboriginal and/or Torres Strait Islander) status; NESB (language other than English spoken at home) status; and sex. We analyse data pertaining to one cohort of students who were in Year 3 in 2010 and Year 5 in 2012. Rather than focus on change in individual scores between Year 3 and Year 5, we conduct separate analysis of the two cohorts to examine whether school effects mediate family effects in Year 3 and 5.

NAPLAN is a national testing of achievement across five educational domains: reading; writing; spelling; grammar and numeracy at Year 3, 5, 7, and 9 levels which has been conducted annually since 2009. There is a common scale across all years ranging from 0 to 1000 in each domain so a score, for example, of 500 indicates the same level of achievement regardless of the year of study for the student but the average national score and minimum standards increases at higher levels of schooling.

In 2010, the national average reading score for Year 3 was 414.3 and the numeracy score, 395.4. The ACT averages were higher in each category, 439.1 for reading and 412.6 for numeracy (ACARA, 2010). The percentage of students tested who did not achieve the national minimum standard in reading and numeracy in the ACT was less than half for Australia as a whole, 2.1 per cent for reading compared to 4.0 per cent for Australia as a whole and 1.2 per cent compared to 3.7 per cent in the numeracy test. In 2012 the average reading score for Year 5 in the ACT was 519.0 compared to the national average of 493.0 and in numeracy, 504.4 compared to the national average of 488.7. Once again the percentage of students who did not achieve the national minimum standards in Year 5 in the ACT was less than half the Australian average (ACARA, 2012). These figures relate to all students in the ACT including both public and private schools.

We use the raw NAPLAN scores for each student attained in Year 3 (in 2010) and Year 5 (in 2012). Parents' education is an indicator of individual socio-economic status (Lim and Gemici, 2011; Pfeffer, 2008) and is derived from the highest level of school education of either parent. Unfortunately, a more refined categorisation of education level was not available, therefore, the parents' education variable has three categories: less than Year 12; Year 12; missing. Indigenous status is coded 1 = either Aboriginal or Torres Strait Islander. NESB status is coded 1 = language other than English spoken at home. The data also include information on whether the child is from a non-English-speaking background (LBOTE), however, we chose to use the information regarding the language spoken at home as this is a more precise measure of the first language spoken. Sex is coded 1= female.

The *MySchool* website data provide school level data on size of school and the school mean ICSEA (Index of Community Socio-Educational Advantage). The ICSEA mean variable has five categories: <1001; 1001 -1050; 1051- 1100; 1101 -1150 1151 -1200. To identify the schools with both primary and secondary school students, we include a dummy variable coded 1= combined school. When we allocated

combined schools into categories of the school size variable, we used the number of students enrolled from Preschool to Year 6. The school size variable has seven categories: <251; 251 -300; 301 - 350; 351- 400; 401 -450; 451- 500; 501+ students. The descriptive statistics of the sample are provided in table 1.

Table 1 also provides the mean scores and standard deviations for Year 3 and Year 5 reading and numeracy scores. The mean scores of students attending government schools are somewhat lower than those for the entire cohort of the ACT students. The mean score for reading in Year 3 of 435.6 is 3.5 points lower than the ACT mean (439.1) and the mean score for reading in Year 5 of 515.3 is 4.7 points lower than the ACT mean (519). The mean score for numeracy is just half a point lower in Year 3 (412.1 compared to 412.6) and 2.4 points lower in Year 5 (502 compared to 504.4). These differences are not surprising given that students with highly-educated parents are more likely to have higher levels of academic achievement (Jaeger, 2011; Roska and Potter, 2011); and that highly-educated parents tend to send their children to non-government schools (Chesters, 2015).

Table 1 - Characteristics of the Sample

	n=	*Per cent*
Male	927	49
Female	962	51
Parents' education		
<Year 12	236	12
Year 12	1265	67
Missing	388	21
Indigenous status		
non- Indigenous	1838	97
Indigenous	51	3
NESB Status		
Non NESB	1531	81
NESB	358	19
School ICSEA mean		
<1001 (10 schools)	283	15
1001 to 1050 (10 schools)	300	16
1051 to 1100 (8 schools)	386	20
1101 to 1150 (16 schools)	555	29
1151+ (8 schools)	365	19
School size		
<251 (9 schools)	148	8
251 to 300 (12 schools)	329	17
301 to 350 (4 schools)	147	8
351 to 400 (10 schools)	438	23
401 to 450 (5 schools)	233	12
451 to 500 (4 schools)	181	10
>500 (8 schools)	413	22
NAPLAN scores	**mean**	**Std dev.**
Year 3 reading	435.6	91.9
Year 5 reading	515.3	87.5
Year 3 numeracy	412.1	77.1
Year 5 numeracy	502.0	73.0

4. Analytical Strategy

To simultaneously analyse the effects of individual and school characteristics on NAPLAN scores, we estimate a series of nested multi-level models for each of the four outcome variables: reading score in Year 3, reading score in Year 5, numeracy score in Year 3 and numeracy score in Year 5. At this stage we do not have access to the unique student identifier which would enable an analysis of changes in performance between Years 3 and 5. Nevertheless, our results enable a comparison of the average effect of the independent variables on NAPLAN outcomes between Years 3 and 5. Our analyses are performed on data pertaining to an entire cohort of ACT students rather than a sample taken from the cohort, therefore, levels of statistical significance are not reported in this paper. Levels of statistical significance provide an indication of whether the results obtained from the analysis of a sample of the population reflect the results that would be obtained if data from the whole population were analysed.

5. Results

The analyses presented here are derived from a series of hierarchical linear models examining the effects of parents' education on NAPLAN reading and numeracy scores. In the first set of models, presented in table 2, the outcome variables are Year 3 reading scores and Year 5 reading scores. In Model 1, when only individual factors: parents' education; sex; Indigenous status; and NESB status; are included, between-school variance accounts for 10 per cent of the unexplained variation in Year 3 indicating that differences between students within schools were a far more important factor in overall variance than differences between students attending different schools. The coefficients for Model 1 indicate that even after controlling for the effects of sex, Indigenous status and NESB status, parents' education has a positive effect on Year 3 reading scores. Having at least one parent who completed Year 12 is associated with an increase of 48 points, on average. Indigenous students' scores were, on average, 43 points lower than those of non-Indigenous students and NESB students' scores were, on average, 10 points lower than those of non-NESB students, net of other factors.

When the school level effects are included in Model 2, the proportion of unexplained variance attributable to school factors not measured in the model, such as teacher quality and class size is just 0.01. School ICSEA mean has a positive association with Year 3 reading score, net of the effects of the other factors with students attending schools with higher ICSEA means recording higher, on average, reading scores than students attending schools with the lowest ICSEA means. Students attending schools with more than 250 students had, on average, lower reading scores in Year 3 compared to students in smaller schools. Parents' education has a strong positive effect on achievement, as measured by the NAPLAN reading test, in Year 3 even after controlling for school effects.

Table 2 - Effect of Parents' Education on Reading Score in Year 3

	Year 3		*Year 5*	
	Model 1 Coef.	*Model 2 Coef.*	*Model 3 Coef.*	*Model 4 Coef.*
Individual level characteristics				
Female =1	13.90	13.60	12.97	12.96
Parents' education				
<Year 12 (ref.)				
Year 12	48.11	46.10	50.20	48.65
Missing	32.08	29.33	39.46	37.22
Indigenous =1	-42.70	-38.55	-29.80	-26.45
NESB =1	-10.73	-11.70	-17.66	-17.26
School-level variables				
School ICSEA mean				
<1001 (ref.)				
1001 to 1050		25.59		15.48
1051 to 1100		34.98		30.75
1101 to 1150		55.69		60.77
1151+		77.67		81.02
School size				
<251 (ref.)				
251 to 300		-31.59		-12.44
301 to 350		-32.97		-22.41
351 to 400		-31.13		-14.38
401 to 450		-21.56		-19.18
451 to 500		-9.59		2.17
501+		-20.96		-17.64
Combined school =1		9.58		13.49
constant	390.54	374.30	468.17	440.96
Random effects				
Between school variance proportion	0.10	0.01	0.13	0.02
Within school variance proportion	0.90	0.99	0.87	0.98
Chibar2 a	103.35	10.29	165.38	11.60

level 1 n= 1870 Year 3 students; n= 1888 Year 5 students; level 2 n= 52 school. a. The Chi Bar squared test takes into account the restrictions imposed in estimating this multi-level model.

The results presented in Model 3 indicate that between-school variance accounts for 13 per cent of the unexplained variation in Year 5 reading scores. The coefficients indicate that even after controlling for the effects of sex, Indigenous status and NESB status, parents' education has a positive effect on Year 5 reading scores. Having at least one parent who completed Year 12 is associated with an increase of 50 points, on average. Indigenous students' scores were, on average, 30 points lower than those of non-Indigenous students and NESB students' scores were, on average, 18 points lower than those of non-NESB students, net of other factors.

When we include school level characteristics in Model 4, we find that between-school variance accounts for two percent of the unexplained variation in Year 5 reading scores. School ICSEA mean has a positive association with Year 5 reading score, net of the effects of the other factors. Students attending schools with more than 250

students have lower reading scores in Year 5 compared to students attending smaller schools. Parents' education has a strong positive effect on achievement, as measured by the NAPLAN reading test, in Year 5 even after controlling for school effects. The average negative effect associated with Indigenous status declined between Year 3 and Year 5 whereas the average negative effect associated with NESB status increased between Year 3 and Year 5.

Next we examine the association between Year 3 and Year 5 numeracy scores and parents' education and present the results in table 3. The results for Model 1 indicate that even after controlling for the effects of sex, Indigenous status and NESB status, parents' education has a positive effect on Year 3 numeracy scores. Having at least one parent who had completed Year 12 is associated with an increase of 42 points, on average. Indigenous students' scores were, on average, 46 points lower than those of non-Indigenous students, net of other factors. NESB status had a small negative effect on numeracy scores.

Table 3 - Effect of Parents' Education on Year 3 and Year 5 Numeracy Scores

	Year 3		*Year 5*	
	Model 1 Coef.	*Model 2 Coef.*	*Model 3 Coef.*	*Model 4 Coef.*
Individual characteristics				
Female =1	-7.55	-7.87	-11.23	-11.28
Parents' education				
<Year 12 (ref.)				
Year 12	42.20	40.20	45.25	44.30
Missing	34.02	30.18	37.88	36.64
Indigenous =1	-46.01	-41.40	-30.20	-27.77
NESB =1	-5.51	-6.23	-6.10	-6.11
School level characteristics				
School ICSEA mean				
<1001 (ref.)				
1001 to 1050		21.14		28.09
1051 to 1100		26.43		37.31
1101 to 1150		40.21		56.77
1151+		56.40		64.11
School size				
<251 (ref.)				
251 to 300		-12.21		-12.84
301 to 350		-12.36		-26.70
351 to 400		-15.57		-16.60
401 to 450		-12.83		-20.47
451 to 500		1.60		5.12
501+		-9.82		-17.26
Combined school =1		13.91		16.89
constant	381.64	361.77	468.72	441.79
Random effects				
Between school variance proportion	0.07	0.01	0.13	0.03
Within school variance proportion	0.93	0.99	0.87	0.97
Chibar2 a	61.94	2.51	136.84	14.86

level 1 n= 1838 Year 3 students; n= 1855 Year 5 students; level 2 n= 52 schools. a. The Chi Bar squared test takes into account the restrictions imposed in estimating this multi-level model.

When the school level variables are included in Model 2, school ICSEA mean has a positive effect on Year 3 numeracy score, net of the effects of the other factors. Students attending schools in the second ICSEA mean group scored, on average, 21 points higher than students attending schools in the lowest ICSEA mean group. The average increase for students attending schools in the third, fourth and fifth ICSEA mean group are 26 points, 40 points and 56 points, respectively.

Students attending schools with more than 250 students had lower, on average, numeracy scores in Year 3 than students attending smaller schools, net of the effects of the other factors. Parents' education continues to have a strong positive effect on achievement in Year 3 even after controlling for school effects.

The coefficients reported in Model 3 indicate that after controlling for the effects of sex, Indigenous status and NESB status, parents' education has a positive effect on Year 5 numeracy scores. Having at least one parent who had completed Year 12 is associated with an increase of 45 points, on average. Indigenous students' scores are, on average, 30 points lower than those of non-Indigenous students, net of other factors. NESB status has a small negative effect on numeracy scores.

When the school level variables are included in Model 4, we find that between-school variance now accounts for three per cent of the unexplained variance. School ICSEA mean has a positive association with Year 5 numeracy score, net of the effects of the other factors. Students attending schools in the highest ICSEA group score, on average, 64 points higher than students attending schools in the lowest ICSEA group, net of the effects of the other variables. School size has a negative effect on numeracy scores in Year 5, net of the other factors. Parents' education continues to have a strong positive effect on achievement, as measured by the NAPLAN numeracy test, in Year 5 even after controlling for school size and school ICSEA mean.

6. Discussion and Conclusion

The analyses presented in this paper show that both individual socio-economic status as measured by parents' education and average level of educational advantage of the school population have a positive effect on child's academic achievement, as measured by NAPLAN literacy and numeracy tests, thus confirming the findings of the majority of previous research. Perry and McConney (2010) found that academic achievement was positively correlated with socio-economic status at both an individual and school level. Their measure of socio-economic status was based on the economic, social and cultural status (ESCS) measure calculated by the PISA project team. After conducting a comprehensive meta-analysis of existing research, Buckingham *et al*. (2013) also concluded that individual and school socioeconomic status were positively correlated with academic achievement as did Sirin (2005).

Holding everything else constant, in three of the four final models, shifting a student from a school at the bottom of the ICSEA distribution to one in the top two ICSEA bands is estimated to increase their NAPLAN score in literacy and numeracy by a larger margin than a shift in their parental education to the completion of Year 12. This result however, did not hold for Year 3 numeracy. In this model (table 3, model 2) it is estimated that the student would need to move to a school in the top ICSEA band in order to have a larger effect on their numeracy result than an increase in parental education would provide, holding everything else constant.

Our results show that girls perform better, on average, than boys in literacy tests but worse, on average, than boys in numeracy confirm the findings of previous research (Marks, 2014b). The finding that Indigenous students had lower scores than non-Indigenous students provides more evidence that the achievement gap between Indigenous and non-Indigenous students appears early in the academic career. Although the gap appears to narrow over time, it is unlikely that Indigenous students will achieve at similar levels as their non-Indigenous peers. For NESB students, reading scores were, on average, substantially lower than for non-NESBB students, however, there was little difference in numeracy scores. Although previous research suggests that NESB students tend to achieve at similar or higher levels as non-NESB students by Year 12 (Considine and Zappala, 2002; Gemici *et al*., 2013 and Marks, 2014b), our results indicate that after controlling for parents' education, the achievement gap increases between Years 3 and 5 in the ACT. Students in smaller schools performed better on NAPLAN tests than students in large schools, particularly in Year 3 literacy tests.

These results have important implications for longer terms outcomes for these students and their ability to complete school and transition successfully into the labour market. It has highlighted some key variables in determining educational outcomes at the primary level which can be identified in policy development. For example, attention should be directed to the determinants of Indigenous disadvantage and that of NESB students highlighted here given the longer term implications of outcomes for schooling and labour market performance.

Previous research confirms that negative effects identified in primary school do not dissipate over the educational career, therefore, interventions designed to alleviate inequality in educational attainment may have more of an effect if enacted in the early stages of schooling, particularly in the first three years.

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The Centre is a consortium of Curtin University, Murdoch University, the University of Canberra and the University of Western Australia.

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