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Jian Z. Yeo
Sholeh A. Maani

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Jian Z. Yeo
University of Auckland

Sholeh A. Maani
University of Auckland
and IZA

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IZA

P.O. Box 7240
53072 Bonn
Germany

Phone: +49-228-3894-0
Fax: +49-228-3894-180
E-mail: iza@iza.org

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ABSTRACT

Educational Mismatches and Earnings in the New Zealand Labor Market*

Mismatch of educational skills in the labor market is an emerging topic in the field of labor economics, partly due to its link to labor productivity. This is the first application of this question to New Zealand data. In this paper we examine the incidence of educational mismatch and its earnings effects. Using micro data drawn from the *Household Labour Force Survey* and the *New Zealand Income Supplement* (HLFS/NZIS) for the years 2004 to 2007, we find a noteworthy incidence of both over- and under-education. We also find that earnings returns to required years of education exceed the returns with over- and under-education, with a greater earnings penalty associated with under-education. We test hypotheses on three alternative models of educational mismatch. As the New Zealand labor market exhibits assignment-type matching, we argue that the higher than average public expenditure on education serves to improve economic performance. We further examine results stratified by age group and for the native-born and immigrants, and find that our results are robust across these groups.

JEL Classification: J24, J31

Keywords: over-education, under-education, educational mismatch, wage effects, productivity

Corresponding author:

Sholeh A. Maani
Graduate School of Management
The University of Auckland
12 Grafton Road
Auckland, 1010
New Zealand
E-mail: s.maani@auckland.ac.nz

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1. Introduction

In a recent economic performance report based on 16 measures, New Zealand ranked 24th out of 32 OECD countries, with sluggish productivity growth (OECD, 2013a). New Zealand was positioned in the bottom third for labor productivity. The average annual hours worked per employee in New Zealand is equal to the average for all OECD countries, which suggests that an increase in labor productivity is vital to an increase in New Zealand's standard of living.

According to the 2013 Education at a Glance report by the OECD (2013b), public spending on education in New Zealand amounted to 20.0% of the total public expenditure on services (OECD average: 13.0%), which is equivalent to 7.2% of total GDP (OECD average: 5.8%.).[1] The combination of low labor productivity and a higher than average rate of spending on public education may raise the question whether this is what the country should be doing.

One of the reasons New Zealand faces low productivity despite having above average investment in education could be a mismatch of skills in the labor market: that is, employee skill sets are wrongly matched to performing a particular job. There is a general consensus that being under-educated or under-skilled will lead to a decline in on-the-job productivity. In a market where only under-educated workers are easily available, firms may be forced to employ low-skilled labor in skilled jobs. A study in the UK found a lower output per worker was associated with firms that experienced a drop in the number of graduate engineers and scientists working for them (Forth & Mason, 2004). Because New Zealand is reported to have the highest brain drain rate of any OECD country (Gibson & McKenzie, 2012), the low productivity caused by a lower-skilled population should be of great concern. Losing a significant amount of educated or skilled labor in the labor market would force firms to hire workers who may be unproductive in high-skilled jobs.[2]

The notion of 'brain drain', however, appears to be a common misconception as New Zealand attracts a large number of skilled workers from other countries. According to Lidgard and Gilson (2002), departing highly skilled New Zealanders are being replaced by highly skilled citizens from other countries, which results in a 'brain exchange' rather than a 'brain drain'. Due to the immigration policies implemented in New Zealand, which favor highly skilled immigrants, citizens of other countries who have obtained higher education in their respective countries are more likely to obtain residency than are those who have not.[3] Despite this exchange of skills, New Zealand's labor productivity does not match that of other countries. This could be attributed to a skills mismatch whereby new skilled migrants are not able to obtain jobs in their respective fields and thus enter the labor market in less-skilled positions; in fact, Maani and Chen (2012), and Maani, et al. (2015) find that highly skilled immigrants sometimes face downward occupational movement upon arrival.[4]

There appears to be some evidence to support the idea that employing workers with more education than their job requires is potentially counterproductive (Tsang & Levin, 1985). Individuals who are over-educated for their jobs may be demotivated when working in a job that does not fully utilize their educational investment and skill set.

Using a four-year micro level (2004 – 2007) 'Household Labour Force Survey (HLFS) and New Zealand Income Supplement' (NZIS) data set, this paper investigates the extent of skills mismatch (over- and under-education) in the New Zealand labor market. We apply empirical methods that have been well developed in prior international literature to analyze the effects and the underlying nature

of the mismatch of skills in New Zealand. To the best of our knowledge, this is the first application of the mismatch analysis to New Zealand data.

The structure of this paper is as follows. Section 2 provides a brief literature review on the causes of skills mismatch; Section 3 describes the empirical approach undertaken in this study. Section 4 identifies commonly used measures for a reference level of education, and Section 5 presents our findings of the incidence of mismatch in New Zealand using those measures. Finally, Section 6 reports the effect of this mismatch. Section 7 is the concluding section.

2. Causes of Skills Mismatch

Studies of returns to education typically relate the log of earnings to years of education attained, potential labor market experience and a range of other personal characteristics (e.g. gender, birth place, and ethnicity). This conventional Mincerian model is regularly expressed as follows:

$$\ln E_i = \beta_0 + \beta_1 S_i + \beta_2 Exp_i + \beta_3 Exp_i^2 + \alpha_i X_i + u_i \quad (1)$$

E_i represents an individual's earnings, S_i is the level of attained education, Exp_i is the post-schooling labor market experience, X_i is a vector of variables that defines the individual (other than education or experience) and u_i is a random error term. This specification reflects labor market outcomes based on employee information and thereby it fully relies on information on educational attainment from the supply side.

In the 1980s the literature on returns to education started distinguishing between an individual's attained education and an adequate level of education. Specifically, Duncan and Hoffman (1982) found that returns to years of required education were higher than returns to years of actual education. Therefore, the importance of distinguishing between under-education, required-education and over-education was recognized.

Required-education is usually defined as a level of education that is adequate or sufficient to meet the requirements of getting or performing a job. Over-education, however refers to the situation when an individual has a surplus of years of education in terms of what is required for a particular job (Duncan & Hoffman, 1982). In contrast, under-education occurs when an individual's attained education is insufficient for the job. Thus, any individual who has obtained education in excess of what is required or that is less than is required would be mismatched to their job. Job requirements can contain many dimensions of worker abilities and aptitudes, and required-education is simply a single variable that necessarily compresses this diverse information. Still, as Hartog (2000) states, it is a step in the right direction. We discuss the empirical derivation of educational mismatches, as developed in the literature, in Section 4.

In this section, we briefly review three alternative economic models of educational mismatches in the labor market.

2.1. Human Capital Model

The standard Becker/Mincer human capital model (Becker, 1964; Mincer, 1974) suggests that earnings are determined by levels of human capital, in particular by years of education and work experience. This model does not distinguish between actual years of education and required years of education. To that effect, any year of education is assumed to increase earnings by as much as any other (and applied equally to under, required, or over-education).

Recently, however, the literature in human capital theory has expanded to recognize that human capital exists in various forms; namely, formal education, job experience and skills acquired through on-the-job training. Results from Sloane et al. (1999) support the hypothesis that workers may substitute one form of human capital for another. According to Hartog (2000), over-education may exist due to a deliberate choice made, because a low-level entry job may be a good investment opportunity.

Sicherman (1991) finds that workers who are over-educated tend to be younger and are more likely to move to higher-level jobs. These findings support the theory that over-education is transitory and that, with labor market experience, workers move to jobs which match their qualifications, and eventually get employment in a job they match. Groot (1996), however, finds that over-educated male workers tend to stay longer at their current job, reflecting that they might have fewer opportunities to change jobs due to being less productive. However, Groot's negative findings can also be explained by Mendes de Oliveira et al. (2000)'s results, who find that over-educated workers in the Portuguese labor market were those who were desirable to firms. In fact, they were the bulk of those who received training and firm-specific investments, resulting in tenure rewards and not being due to being less productive.

In the human capital model workers who are under-educated can be workers who have accumulated other forms of human capital besides formal education. They may have been promoted from a previously adequately-matched job, or possess more informal human capital. Such skills would in turn give them the ability to perform a job that would usually require more formal education than they have already acquired. Groot (1996) and Mendes de Oliveira et al. (2000) explain that under-education increases with labor market experience, and that it may be persistent, as experience compensates for lack of formal education. Workers who appear to be under-educated for their current job might have had training specific to their job which enabled them to obtain that job in the first place (Hartog, 2000). Therefore, if workers are compensated based on the actual years of formal education obtained, and not based on the years of education required for the job, there should be no difference between returns to years of over-education, under-education and the returns to years of required education.

2.2. Job Competition Model

On the opposing side of the supply and demand equilibrium, a job competition model has been developed to explain demand side labor market factors. This model, developed by Thurow (1975), proposes that the labor market is a market where supplies of trainable labor are matched with jobs (training opportunities) that are in turn associated with the availability of job openings. Jobs only occur when there is a vacancy that creates the demand for the skills required. As most job skills are not acquired before entering the labor market but through on-the-job training, employers face training

costs when hiring. Thus, to minimize training costs, employers rank potential workers based on their training costs using background characteristics as an indirect indicator.

Education is thus used as a signaling device; higher levels of education increase the opportunity to obtain a skilled job but once a job is acquired, returns to marginal education are zero (Muysken & Weel, 1999). The wage effect of having a higher level of education is on the opportunity of getting a better job rather than on directly increasing the wages of an individual. A similar approach is taken by Spence (1973), in which education (up to a certain level where costs of education might outweigh earnings) is used as a signaling tool to obtain skilled jobs. As the lower positioning of skilled workers to unskilled jobs occurs, the job competition model states that the persistence of over-education in the labor market can be attributed to workers' relative educational attainment in the job queue. For example, when employers hire workers whose attributes are associated with low training costs, individuals are more likely to take part in higher education, if a competing worker does so, in order to protect their current position. Though it is difficult to determine how the ceiling of willingness to participate in higher education is achieved, McGuiness (2006) finds that the job competition model provides a clear explanation for over-investments in education, and subsequently for over-education in the labor market.

2.3. Assignment Theory

Assignment theory, proposed by Sattinger (1993), focuses on the assignment of heterogeneous workers to heterogeneous jobs. Within this framework, the earnings function is an equilibrium outcome of the solution of the assignment problem. In general, assignment models specify relevant differences amongst workers, jobs or sectors available to workers, worker characteristics, the technology that relates jobs to output, and the problem of assigning workers to jobs (McGuinness, 2006). Marginal product and thus earnings depends on both workers and the jobs, suggesting an equilibrium based on the supply function found in the human capital model, and the demand determinants in the job competition model. Since the concept of over-education and under-education can be considered within this framework only if the demand side and supply side are separated, Hartog (2000) stated that application of this model is limited because connecting the two requires special assumptions.

We summarize the theories above and their expected outcomes in Table 1. These models provide competing expected outcomes of educational mismatch. We attempt through our estimation methods below to find evidence on the extent and outcomes of educational mismatch. We also consider the model that most closely reflects the source of mismatch based on our results, using a rich micro-level data set on the New Zealand labor market.

Table 1: Theoretical Views of Mismatch

Theory	Main Proponent	Wage Determinants	Predictions of Over-education
Human Capital Model	Mincer (Schooling, Experience and Earnings, 1974)	Supply (personal characteristics)	Return on years of over-education = returns on years of required education
Job Competition Model	Thurow (Generating Inequality: Mechanisms of Distribution in the US Economy, 1975)	Demand (job queues)	No returns on over-education No penalty for under-education
Assignment Model	Sattinger (Assignment Models of the Distribution of Earnings, 1993)	Supply and Demand	Return on required education > return on years of over-education; Penalty for under-education

3. Empirical Approach

Two main specifications have been used throughout the literature to study the returns to mismatched education. Both specifications are modifications of the Mincer earnings function. One utilizes dummy variables for over- and under-education, while the other decomposes years of education into years of over-education, required education and under-education (ORU Specification). Although both specifications are recognized for empirical analysis, the focus in this paper is on the ORU specification (Duncan and Hoffman, 1982), as it uses information more fully, and it also enables formal testing of the three theories of mismatch.[5]

The ORU specification decomposes years of attained education ($actual_i$) into years of required education (req_i), years of over-education ($over_i$), and years of under-education ($under_i$) defined as:

$$actual_i = over_i + req_i - under_i \tag{2}$$

with

$$over_i = \begin{cases} actual_i - req_i, & \text{if } actual_i > req_i \\ 0, & \text{otherwise} \end{cases} \tag{3}$$

and

$$under_i = \begin{cases} req_i - actual_i, & \text{if } actual_i < req_i \\ 0, & \text{otherwise} \end{cases} \tag{4}$$

Using this definition, the standard human capital model above can be written as:

$$\ln E_i = \beta_0 + \beta_1 over_i + \beta_2 req_i + \beta_3 under_i + \beta_4 Exp_i + \beta_5 Exp_i^2 + \alpha_i X_i + u_i \quad (5)$$

where β_1 is the returns to an additional year of over-education, β_2, the returns to an extra year of required education and β_3, the returns to a year of education below the required education. The remaining coefficients are as described above.

Note that the ORU specification in (5) contains two competing theoretical models: the human capital model and the job competition model (Hartog & Oosterbeek, 1988). The human capital model predominantly supports a supply-side theory. Earnings in this model should not be directly affected by job requirements, as job level and related variables are subsumed in the age-earnings profile (Mincer, 1974). Then each year of schooling receives the same earnings return, and the returns to over-education equals the returns to required education, and the penalty of being under-educated ($\beta_1 = \beta_2 = -\beta_3$), and (5) reduces to the conventional Mincerian earnings function in (1). On the other hand, when the returns to over-education and under-education are zero ($\beta_1 = \beta_3 = 0$), (5) reduces to:

$$\ln E_i = \beta_0 + \beta_2 \, req_i + \beta_4 Exp_i + \beta_5 Exp_i^2 + \alpha_i X_i + u_i \quad (6)$$

where earnings are largely determined by the demand side factor of a reference level of education to perform a job; years of over-education and under-education are irrelevant as employers hire workers based on their potential training costs. In general, the literature (see Hartog (2000) for more) surrounding the ORU specification supports the following conclusions:

1. Returns to over-education are positive but smaller than returns to required education ($0 < \beta_1 < \beta_2$).
2. There is a penalty associated with being under-educated, but the penalty is smaller than the returns to required education ($0 < -\beta_3 < \beta_1$).
3. The returns to required education are higher than returns to actual education.

4. Measurement of Required Education

As mentioned above, the main focus of returns to education in recent educational mismatch studies is on the returns to required education instead of just the level of education attained. Thus it is important to measure a required level of education for different jobs.

Three measures can be drawn from Hartog (2000), Verdugo and Verdugo (1989) and Mendes de Oliveira et al. (2000): 'worker self-assessment', 'job analysis', and 'realized matches'. Because worker self-assessments and job analysis reports are not available in New Zealand, a more objective realized matches approach is used in this paper. A realized matches approach uses available data (such as years of attained education) to measure the required level of education for a particular job (Mendes

de Oliveira, Santos, & Kiker, 2000; Verdugo & Verdugo, 1989). One way to do so is to use the *mean* educational attainment for each occupation for full-time workers. Workers whose skills match the job comprise the middle range of the educational distribution, having between plus and minus one standard deviation of the mean. Workers who are over-educated have educational attainment more than one standard deviation above the mean while under-educated workers have less education than one standard deviation below the mean. The attractiveness of this approach is its relative ease; it does not require specific questions to be asked of workers in surveys.

Using the mean level of education +/- one standard deviation usually leads to symmetrical incidence of over and under-education; which is what one would normally find beyond the one standard deviation tails of a normal distribution (Hartog, 2000). This mean specification is also sensitive to outliers in the data. If an occupation has above average numbers of over-educated workers, the level of adequate education will be pushed upwards, resulting in a smaller incidence of over-education, and vice versa for occupations with above-average numbers of under-educated workers.

Nevertheless, Hartog (2000) warned that using the RM approach should be interpreted differently from the other two approaches as it contains observations that are the result of the supply and demand of the labor market (assignment theory) rather than just the demand or supply side.

Kiker et al. (1997) proposed using the modal value of educational attainment for each occupation to reduce sensitivity to outliers, and year-to-year variation in data sets, and to provide a more accurate measure of adequate education. Using the modal value, workers are over-educated if their attained education is above the modal value, and under-educated if it is below the modal value of education. Another advantage of the method is that required years of education refers to actual education levels held by employees in jobs, rather than to made-up fractions of years of education. In this paper, we focus on the mode method.

4.1. Data and Measurement Choice

The sample used for this study has been drawn from the 'Household Labour Force Survey and the New Zealand Income Supplement' (HLFS/NZIS) provided by Statistics New Zealand (CURF: Confidentialized Unit Record File, data). The HLFS/NZIS is a cross-sectional data set that provides micro-level data on variables such as earnings, qualifications, ethnicity and occupation for the years 2004 to 2007. The HLFS is a quarterly survey of approximately 15,000 private households (approximately 29,000 individuals) sampled on a statistically representative basis from rural and urban areas throughout New Zealand. The NZIS runs as a supplement to the HLFS during the June quarter of each year. All full-time employed, prime-aged males and females were selected. To obtain a better approximation of actual years of education, we excluded those whose educational qualifications were not specified. Finally, we selected individuals between the ages of 25 to 59 to be consistent with prior study on returns to higher education by Maani and Maloney (2004). This leaves us with 41,234 individual observations, (24,303 males and 16,931 females) pooled across the four years. The variables that we have used in this paper are listed in Appendix A (Table A1).

Years of education were approximated using both the results from HLFS/NZIS and the New Zealand Education System Overview. A complete description of the years of education attained is

available in Appendix B. Measurements of the educational requirements of each occupation were calculated using the realized matches approach described above.

The variable for required years of education (req_i) across the analyses in our paper is created at the occupation level, across the pooled four years of data and pooled across gender. Therefore, it is fixed across the four years of data. This approach is used within both the mean and the mode methods applied. As such, it provides a better indication of required education that is not influenced by year-to-year variation in the data. In addition, the advantage of measurement of required years of education across pooled samples by gender is that educational requirements are not guided by gender.

Due to the specific nature of the CURF data, which are designed to maintain anonymity, no individually identifiable variables were available. Hence, panel data analysis is not possible. To increase the accuracy of the analysis, the data are pooled together for the four years. Given the pooled nature of our data, the objective of our study is limited to identifying whether individuals can be broadly identified in jobs where they are over- or under-educated, compared to the rest of the workforce in their profession in New Zealand at any time. But our analyses cannot show why individuals are over-, or under-educated. Likewise, we show the association of earnings with each year of adequate education, over-education, and under-education, but we cannot separate individual heterogeneity (e.g. individual unobserved traits, or specifics of degrees) from job characteristics. One of the implications of this is that our results do not show what the earnings penalty to over-education is, should a person change jobs. But they show the extent of educational mismatch classification, and the potential earnings differentials associated with it, for individuals who are in mismatched jobs. Nevertheless, our analyses use the same modelling approach as do the Australian and other studies reviewed and used for comparison in this paper.[6]

5. Incidence of Mismatch

Using the realized matches approach, with both mode and mean indices, we report the incidence of mismatch. We report our summary results for New Zealand in Table 2.

Our results show evidence of significant mismatch of both over- and under-education, with under-education being the more pronounced mismatch. Our results show that for both men and women under-education is more prevalent than over-education, but both are prominent. Based on the mode method, which as discussed above is our preferred method, close to 60% of men in New Zealand are in jobs that can be categorized as mismatched, with 33.4% being under-educated, and 26.1% over-educated. For women the proportion of mismatches is higher, with 42.8% categorized as under-educated and 33.4% over-educated.

The incidence of both males and females being under-educated was significantly higher in the mode than in the mean index (from the mode index, close to half of the labor market for some age groups appears to be under-educated). The difference between the two measures reflects the different computation of the two indices.

We found that under both the mode and mean indices, males tend to be more over-educated than do females. This finding is in contrast with in the findings of Groot and van den Brink (2000)'s meta-analysis of 25 studies, which report more frequent over-education amongst female workers,

while male workers were more likely to be under-educated. One reason for this occurrence could be female workers having to compensate for certain labor market biases and requirements by having more years of formal education. This does not seem to be the case in New Zealand and our results are in line with the findings by both Linsley (2005) and Voon and Miller (2005) in Australia, in which male workers seem to have to compensate by having more years of education, or female workers have unquantifiable skills that are desirable to both New Zealand and Australian employers.

Our findings using the mean index show that 68.9% of male workers and 72.2% of female workers are adequately educated. Using the mode index, however, the proportion adequately matched to their jobs falls to 40.5% and 37.8% respectively. This should come as no surprise since using the mean level of education qualifies more workers to be classified as being adequately educated. Prior research using the Adult Literacy and Life Skills (ALL) survey in Earle (2011) estimated that only 41% of workers in New Zealand were well matched to the literacy and numeracy skill practices in their jobs. [7] Further, a study by Quintini (2011) also found that in the year 2005 approximately 40% of the New Zealand workforce was classified as under-educated. These two studies provide some support for the view that the mode index presents a more accurate picture of the New Zealand incidence of skills mismatch. In the UK, Green and McIntosh (2007), using the 2001 Skills Survey data, report that 37% of employees are over-educated, while also mentioning that 35% of UK employees are over-skilled.

Table 2 also shows comparable estimates of educational mismatches for Australia. We find that the Australian labor market is also affected by mismatches, with slightly higher reported measures of over-education in Australia. The higher measures of over-education for both males and females in Australia relative to New Zealand workers may be partly attributed to the inclusion of the age group 20-24 in the Australian studies reported. The incidence of over-education reduces with labor market experience (and hence with age); thus we can expect a higher incidence in the Australian studies based on the age categories, using the mean as an index.

The similarities across our study and the Australian studies in Table 2 show that the incidence of over-education in New Zealand also decreases with labor market experience (and hence, with age). This could be the result of workers getting more information on the jobs available in the market and thus of their movement to different jobs in which their levels of education match the requirements of the job. It is also possible that workers gain other forms of human capital while working (which compensates for having less formal education initially). In such cases they may be promoted to higher job levels within the same firm, which explains the decreasing incidence of under-education. This latter pattern of decreasing incidence of over-education and increasing incidence of under-education is consistent across all occupational groups in Table 2.

The incidence of under-education is higher among mature age groups. This effect reflects the general increase in the education levels of the younger cohorts, such that mature workers in both Australia and New Zealand are more likely to have fewer years of education than younger cohorts have. Nevertheless, both over-education and under-education are prevalent across all age groups, and therefore they are not specific to mature workers.

Table 2: Incidence of Mismatch

Region/Author	Measure	Age	Exp	Over-educated (%)		Under-educated (%)	
				Male	Female	Male	Female
New Zealand (This study)							
	RM (mode)	25-59		26.1	19.4	33.4	42.8
			1-5	35.4	29.4	4.3	6.7
			11-15	30.1	20.3	27.0	37.7
			21-25	26.2	20.3	32.0	41.9
			31-35	23.7	14.2	39.3	51.3
			41-45	12.3	4.7	54.0	70.7
	RM (mean)	25-59		11.6	7.4	19.6	20.4
			1-5	31.5	24.8	0.0	0.0
			11-15	15.1	8.7	11.2	13.0
			21-25	12.3	7.1	17.2	17.4
			31-35	8.5	3.1	24.5	27.0
			41-45	0.0	0.0	56.7	67.2
Australia							
Linsley (2005)	WSA (Worker Self-assessment)	18-54		28.7	25.7	17.1	21.0
		18-24		40.7	40.0	17.1	21.0
		25-34		30.0	29.3	12.0	17.7
		35-44		28.5	23.7	21.6	22.0
		44-54		21.8	17.1	21.8	29.0
Voon & Miller (2005)	RM (mean)	20-64		15.8	13.6	13.7	18.5
			1-5	26.2	26.8	2.4	1.6
			11-15	17.7	14.8	7.0	11.5
			21-25	16.4	12.6	11.3	17.8
			31-35	9.5	5.2	22.9	38.1
			41-45	4.3	2.4	47.8	58.3

An examination of the average incidences of over-education and under-education across individual groups and industries shows that both mismatches are prevalent across these categories. Notably, there is a higher incidence of over-education among immigrants in our sample (at 26.1%, compared to 22.7% among the native-born (mode method). In addition, over-education is significantly more prevalent in the agriculture industry (63.9% are classified as over-educated, compared to the national average of 23.4%). Over-education is, in turn, significantly less prevalent in the education and construction industries (11.3% and 17.2% are respectively classified as over-educated in the education and construction industries, compared to the national average of 23.4%). Under-education is significantly more prevalent in the Wholesale, Retail Trade and Accommodation industry, and health and Community Services (52.2% and 52.8% are respectively classified as over-educated in these industries, compared to the national average of 37.1%).[8] These averages do not control for factors such as age; they do, however, provide a general indication of where mismatch is more prevalent.

We report the incidence of mismatch for each occupational class by gender in Table 3. Consistent with our findings when tabulating incidence with all occupations, the mean index provides a far higher incidence of workers who were adequately matched with their jobs. Using the mode and the mean indices for different occupational groups continues to show that male workers are consistently more over-educated than female workers while the opposite holds true for under-educated workers.

From the mode index, occupations that require lower levels of education seem to have a higher incidence of over-educated workers; the highest incidence of over-education (71.3% and 68.2% for male and female Agriculture & Fisheries workers) requires the lowest level of education (10 years). Workers in this occupation might undertake more formal education without the intention of working in this occupation when they finish studying.

An interesting observation at the one digit occupational classification is that in the category of Professional, Technicians and Associated Professionals, workers report one of the higher rates of adequately matched jobs. This indicates that workers in this professional category have a clearer path from the start of their education to the beginning of their working career. Also, it is possible that this category of workers, and the employers who hire them, have more information about the jobs and workers that are available in the market.[9] Descriptions of jobs in the category seem to be more specific and clear about the requirements of hire. More examples of jobs in this category are listed in Appendix C.

In the first part of this study we do not separate New Zealand workers into foreign and domestic born sub-samples, but we control for country of birth heterogeneity in our models by including dummy variables for immigrant status. Poot and Stillman (2010) provide a comprehensive discussion of the importance of heterogeneity when examining immigrant education-occupation mismatch, though they left the calculations of private cost of over- and under-education to a later date. In a later section (Section 6.3), we contribute to filling that gap by providing results that are stratified by immigrant and NZ-born groups.

Table 3: Incidence of Mismatch by Occupation

Occupational group	Required years of education	Over-educated (%)		Under-educated (%)		Adequate (%)	
	Mode/ Mean (sd)	Male	Female	Male	Female	Male	Female
RM (mode)							
Legislators, Administrators & Managers	15	25.8	22.5	41.7	44.8	32.5	32.7
Professionals, Technicians & Associated Professionals	18	0.0	0.0	55.1	57.5	44.9	42.5
Clerks	13	40.7	40.4	25.0	23.9	34.3	35.6
Service & Sales Workers	15	9.1	4.1	54.2	67.5	36.6	28.4
Agriculture & Fisheries Workers	10	71.3	68.2	0.0	0.0	28.7	31.8
Trades Workers	15	2.9	3.3	48.4	69.6	48.7	27.1
Plant & Machine Operators and Assemblers	10	59.5	51.1	0.0	0.0	40.5	48.9
Elementary Occupations	10	55.9	47.8	0.0	0.0	44.1	52.2
All Occupations*		26.1	19.4	33.4	42.8	40.5	37.8
RM (mean)							
Legislators, Administrators & Managers	14.4 (2.6)	25.8	22.5	19.8	17.9	54.4	59.6
Professionals, Technicians & Associated Professionals	15.7 (2.4)	0.0	0.0	20.0	19.2	80.0	80.8
Clerks	13.5 (2.3)	14.4	9.6	24.2	23.1	61.5	67.3
Service & Sales Workers	12.9 (2.4)	9.1	4.1	19.0	30.2	71.9	65.7
Agriculture & Fisheries Workers	12.7 (2.4)	6.9	5.6	28.7	31.6	64.5	62.8
Trades Workers	13.2 (2.2)	2.9	3.3	36.9	39.2	60.1	57.5
Plant & Machine Operators and Assemblers	12.0 (2.3)	24.3	17.4	0.0	0.0	75.7	82.6
Elementary Occupations	11.9 (2.2)	21.6	14.9	0.0	0.0	78.4	85.1
All Occupations*		11.6	7.4	19.6	20.4	68.9	72.2

Note: * Excluding workers with unspecified occupations.

6. Returns to Over and Under-education

Before examining the returns to a mismatch, we examine the base model of returns to education attained in New Zealand for both male and female workers. The results can be seen in Table 4, where we report both models without (columns 1 and 2) and with (columns 3 and 4) control fixed effects. The definition of the variables used in these models is available in Table A1 in Appendix A.

Table 4: Returns to Education (Wage Effects): Mincer Model by Gender

	(1)	(2)	(3)	(4)
Earnings (natural log)	Male	Female	Male	Female
actual years of education	0.069***	0.065***	0.038***	0.038***
	(0.005)	(0.002)	(0.003)	(0.003)
exp	0.024***	0.016***	0.021***	0.014***
	(0.002)	(0.002)	(0.002)	(0.002)
exp^2	-0.0004***	-0.0003***	-0.0003***	-0.0002***
	(0.00004)	(0.00004)	(0.00004)	(0.00004)
Immigrant (binary)	-0.071**	-0.064**	-0.025**	-0.034*
	(0.017)	(0.015)	(0.008)	(0.014)
married (binary)	Yes	Yes	Yes	Yes
child (binary)	Yes	Yes	Yes	Yes
ethnicity effects	No	No	Yes	Yes
industry effects	No	No	Yes	Yes
occupation effects	No	No	Yes	Yes
locality effects	No	No	Yes	Yes
year effects	No	No	Yes	Yes
_constant	1.684***	1.791***	1.811***	1.860***
	(0.081)	(0.060)	(0.086)	(0.073)
R^2	0.177	0.178	0.303	0.312
p	0	0	0	0
Sample size	19668	15021	19668	15021

Notes:
1. Robust standard errors clustered by industry are reported in parentheses.
2. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

To account for potential unobserved heterogeneity in the data, all standard errors are robust standard errors, clustered by industry (9 industry categories). This adjustment allows for some correlation across unobserved characteristics by industry.

On average, male workers make 0.42% more than females for each year of additional education. However, including control variables in our wage equation shows that female workers have slightly higher rates of return to education (3.81% for males compared to 3.84% for females). The findings here are consistent with the findings in Maani (1999), which found that across all levels of education

in New Zealand, females have slightly higher rates of return to education. Females who have dependent children make 2.7% less (though this becomes not significant when control variables such as occupation effects are introduced), while males earn 2.67% more when control variables are added, indicating that they have to work more to support a child. Both males and females earn more when married. Migrant male and female workers earn less, in particular female migrant workers.

6.1 ORU Specification

The ORU specification allows us to differentiate between returns to years of adequate education as well as the returns of any mismatched years. An interesting feature of this specification is that it allows us to conduct hypothesis testing of the human capital, job competition and assignment models described in Section 2. In particular, the null hypotheses are as follows:

$$H1: \beta_1 = \beta_2 = -\beta_3 \quad (7)$$

$$H2: \beta_1 = \beta_3 = 0 \quad (8)$$

$$H3: \beta_1 = \beta_2 = \beta_3 = 0 \quad (9)$$

The first hypothesis H1 (7) is consistent with the human capital theory, which implies that educational attainment alone determines earnings; and failure to reject the null hypothesis provides evidence that the human capital model holds. The second hypothesis H2 (8) is based on the job competition model, where earnings are determined only by required education. Failure to reject this hypothesis provides evidence to support this theory. Finally, the third hypothesis H3 (9) tests that both educational attainment and job requirements determine earnings as indicated by the assignment model. Human capital, and the job competition model may be considered as extreme cases of the assignment model. Hence, if H1, H2 and H3 are all rejected, the results provide support for the assignment model of the labor market. These tests have been used in Allen and Van der Velden (2001), Bauer (2002) and Linsley (2005), and Hartog and Oosterbeek (1988) in this context.

Table 5 presents the results obtained using the ORU specification. Throughout our analyses we apply the mode method. [10] Our first set of results is provided in Table 5. Robust standard errors, clustered by industry are applied, and adjusts for potential heterogeneity and correlation across unobserved characteristics by industry.[11]

The models in columns 1 and 2 have the base explanatory variables. They include the years of potential experience, and experience squared, binary variables for immigrants, marital status (married), and presence of one or more dependent children, and it includes year fixed effects. Fixed effects for ethnicity, locality, and industry are added to the models in columns 3 and 4. The earnings effects of each year of over- and under-education in columns 3 and 4 reflect general average effects of educational mismatches across and within occupations.

Across the two variations of the ORU specification in Table 5, returns to years of required education were significantly higher than years of over-education (more than double in most cases). In addition, there is a lower earnings return (a negative coefficient) for each year of under-education. The results in Table 5 are closely compatible with the results of the survey of studies (Leuven & Oosterbeek, 2011), where they estimate the average wage effect for a year of required education across European studies at 7.6%; of over-education at 3.8%; and of under-education at -3.5%. Indeed,

the results in columns 3 and 4 are very similar to their average estimates for Europe, except that their average effect of the penalty for a year of under-education of -3.5% is relatively lower than the effect (-4.8% (for males) and -5.1%(for females)) in the New Zealand setting.

The results in columns 3 and 4 of Table 5 reveal that years of required education provide significantly more earnings, compared to just having more years of education as previously shown in Table 4. Returns to required years of education for male workers were 7.3%, (column 3, Table 5), compared to 3.81% in the standard Mincerian earnings function (Column 3, Table 4). For female workers the returns to each year of required education is also rewarded at 7.5%, compared to 3.85% in the Mincerian model. This higher return for required education that follows from a comparison between the standard Mincerian earnings function and the ORU specification holds for Australia (Voon & Miller, 2005), the US (Duncan & Hoffman, 1982), and the UK (Sloane, Battu, & Seaman, 1999).

Table 5: Returns to Education (Wage Effects): ORU Specification by Gender (Mode)

	(1) Male	(2) Female	(3) Male	(4) Female
over (years)	0.045***	0.041***	0.037***	0.035***
	(0.005)	(0.002)	(0.003)	(0.005)
required education (years)	0.084***	0.078***	0.073***	0.075***
	(0.006)	(0.004)	(0.004)	(0.006)
under (years)	-0.054***	-0.057***	-0.048***	-0.051***
	(0.003)	(0.002)	(0.004)	(0.003)
exp	0.024***	0.015***	0.022***	0.015***
	(0.0002)	(0.002)	(0.002)	(0.002)
exp^2	-0.0004***	-0.0003***	-0.0004***	-0.0003***
	(0.00004)	(0.00004)	(0.00004)	(0.00004)
immigrant (binary)	-0.072***	-0.052***	-0.031**	-0.042**
	(0.012)	(0.011)	(0.008)	(0.013)
married (binary)	Yes	Yes	Yes	Yes
child (binary)	Yes	Yes	Yes	Yes
ethnicity effects	No	No	Yes	Yes
industry effects	No	No	Yes	Yes
locality effects	No	No	Yes	Yes
year effects	No	No	Yes	Yes
_constant	1.489***	1.610***	1.463***	1.529***
	(0.107)	(0.090)	(0.109)	(0.083)
R^2	0.218	0.203	0.274	0.274
p	0	0	0	0
Sample size	19668	15021	19668	15021
H1 (hypothesis 1)	39.04***	37.46***	44.05***	39.33***
H2 (hypothesis 2)	109.24***	366.97***	116.54***	180.47***
H3 (hypothesis 3)	76.34***	326.04***	108.78***	124.39***

Notes:
1. Robust standard errors clustered by industry are reported in parentheses.
2. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

However, as discussed earlier, our analysis cannot distinguish the extent to which the lower relative earnings return to each year of over-education is due to individual unobserved characteristics that are valued less in the labor market, and the extent to which each year of over-education is less productive. Likewise, we cannot distinguish the extent to which under-educated individuals receive a negative earnings penalty due to lower productivity, and to what extent such a penalty is due to individual unobserved characteristics. In the latter case, since individual characteristics for under-educated employees are likely to be positive traits that can compensate for less-than-required education, the negative returns to each year of under-education may well represent lower productivity.

An important finding is that the joint F-test for the three hypotheses H1, H2 and H3 ((7), (8), and (9)) reveals that there is evidence to reject all the hypotheses. The null hypothesis H1 is rejected at the 0.001% level of significance for all variations: thus, earnings are not determined by actual education levels alone. Similarly, the nulls H2, and H3 are rejected at the 0.001% level of significance, in favor of an encompassing assignment model. Our findings here are in line with most studies that tend to reject the hypothesis that the coefficients are equal (see Alba-Ramirez, (1993); Bauer (2002); Hartog and Ooesterbeek, (1988); Kiker et al. (1997); Sloane et al. (1999)), which suggests that the assignment model most accurately reflects the dynamic nature of the New Zealand labor market.

Certain inferences can be drawn from this result. Firstly, the distribution of earnings rises from the labor market's solution when assigning heterogeneous workers to heterogeneous jobs and not exclusively due to one or the other side of the matching process. This is different to what we find in Australia, where workers' productivity levels (and hence wages) are determined by the job alone rather than by a worker's educational attainment or a combination of both (Linsley, 2005). Investments in public education greater than what is formally required may be more productive for the economy in New Zealand than they are for Australia. Given that New Zealand spends a higher than average proportion of public expenditure on education among the OECD, and it receives immigrants with higher education, it is important to realize that this cost bears positive externalities for the economy.

Secondly, the assignment model specifies that over-education (and under-education) is the result of inefficient allocation of workers to jobs in the economy (Sattinger, 1993). As we have determined from Section 5 above, the incidence of mismatch is especially high in New Zealand, which gives reason to believe that lower returns to over- and required-education are due to allocation of workers to jobs for which they are not well suited. This may extend into underutilization of skilled workers[12] and productivity losses from less-skilled workers. It is important to note that the effect of educational mismatches and skills mismatches[13] might not be the same, as Allen and Van der Velden (2001) find the former to have a strong negative effect on earnings while the latter does not.

Finally, under-education increases as workers compensate for lower years of education by having more labor market experience, while over-education remains a persistent occurrence in the labor market due to inefficient job allocation. As the assignment model argues that workers choose jobs to maximize their income and/or utility, this explains why New Zealand workers might choose to work in a foreign country such as Australia instead of in their home country.

The ORU models examined provide us with a picture of the effects of having skills that are accurately matched to jobs. Nevertheless, it appears that the effect of a mismatch is drastically affected by current occupation, given the significant difference in results when including occupational control variables.

As, due to the nature of the data, we are constrained from using individual identifiers from one year to the next, future research in this area should look towards richer data sets for panel estimation techniques to address heterogeneity of workers and job characteristics. Finally, more concrete distinction between educational mismatch and skills mismatch might provide additional insight into increasing labor market productivity.

In the next sections we provide auxiliary analyses to examine three sets of the ORU model, based on sample stratifications by age groups (25-29, 30-44, 45-59) in Section 6.2; for the domestic born and immigrants in Section 6.3; and by required years of education (mode method; i.e. higher (15-18) and lower (10-13) years of required education) in Section 6.4. These analyses provide useful information by allowing us to examine variations in estimates, and to check the robustness of our results across different worker groups, and diverse job requirements.

6.2 Results by Age Group

A question that is worth further consideration is the impact of educational mismatch for various age groups. In particular, since for our samples for the younger generation the prevalence of higher education has increased, a question that arises is whether or not returns to years of over- and under-education vary across generations. For example, if younger persons are more likely to be over-educated, and mature workers are more likely to be under-educated, how do our results hold up when we consider models for separate age groups? We examine this question by considering three separate age groups of 25-29, 30-44, and 45-59 years. The results are presented in Table 6. The model specifications in Table 6 (and the remainder of the paper) are equivalent to the general specification in columns 3 and 4 of Table 5, with all control variables included, including potential years of experience, except for occupation.

Table 6: Returns to Education (Wage Effects) Coefficients: ORU Specification by Age Group (Mode)

Age Group:	25-29		30-44		45-59	
	(1) Male	(2) Female	(3) Male	(4) Female	(5) Male	(6) Female
over (years)	0.032**	0.041***	0.042***	0.028**	0.033***	0.041**
	(0.009)	(0.005)	(0.003)	(0.007)	(0.005)	(0.009)
required education (years)	0.062***	0.070***	0.077***	0.071***	0.074***	0.079***
	(0.007)	(0.006)	(0.004)	(0.008)	(0.006)	(0.006)
under (years)	-0.045***	-0.055***	-0.055***	-0.049***	-0.045***	-0.053***
	(0.007)	(0.005)	(0.005)	(0.004)	(0.006)	(0.003)
R^2	0.238	0.283	0.283	0.287	0.252	0.270
Sample size	2403	1991	9459	6758	7806	6272

Notes:

1. Robust standard errors clustered by industry are reported in parentheses.
2. The control variable specification in this table is equivalent to the full model in columns 3 and 4 in Table 5. All equations estimated include a constant, controls for years of experience and experience squared; binary variables for immigrant (born overseas), married, the presence of one or more children; and ethnicity, locality, industry, and year fixed effects.
3. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$
4. The three hypotheses of interest (H1, H2 and H3) are rejected for all models in columns 1-6 of this table, at the 0.001 level of statistical significance.

Consistent with our findings in the previous section, the results in Table 6 show that each year of over-education results in marginal wage returns that are about half of the returns to each year of required education. In addition, our three hypotheses of interest are all significant for each age group, indicating that our major results are not sensitive to the generational effect considered, and that our findings are robust across distinct age groups.

6.3 Results for Migrants and the New Zealand-Born

Given that New Zealand's skill-based immigration policy is designed to select candidates with higher education, a second question of interest is whether or not labor market rewards to years of over-education, and under-education vary among immigrants and the NZ-born in mismatched jobs. As noted earlier, the incidence of over-education in our sample is greater among immigrants at 26.1%, compared to 22.7% among the native-born (mode method). In addition, 31.9% of immigrants are classified as under-educated, compared to 38.6% of the domestic born.

To further examine this question, we estimate our ORU model for the sub-samples of the New Zealand-born and immigrants (born overseas). The results are presented in Table 7.

Table 7: Returns to Education (Wage Effects) Coefficients: ORU Specification for New Zealand-born and Migrants (Mode)

	NZ born		Immigrant	
	(1)	(2)	(3)	(4)
	Male	Female	Male	Female
over (years)	0.041***	0.043***	0.030***	0.025**
	(0.003)	(0.005)	(0.005)	(0.006)
required education (years)	0.073***	0.074***	0.074***	0.079***
	(0.004)	(0.006)	(0.004)	(0.007)
under (years)	-0.047***	-0.051***	-0.053***	-0.051***
	(0.004)	(0.004)	(0.004)	(0.004)
R^2	0.267	0.264	0.316	0.339
Sample size	15170	11755	4481	3256

Notes:

1. Robust standard errors clustered by industry are reported in parentheses.
2. The control variable specification in this table is consistent with the full model in columns 3 and 4 in Table 5. All equations estimated include a constant, controls for years of experience and experience squared; binary variables for and immigrant (born overseas), married, the presence of one or more children; and ethnicity, locality, industry, and year fixed effects.
3. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$
4. The three hypotheses of interest (H1, H2 and H3) are rejected for all models in columns 1-4 of this table, at the 0.001 level of statistical significance.

Our results in Table 7 show that the returns to each year of required education is comparable for the NZ-born and immigrant groups. However, the returns to a year of over-education is rewarded at a lower rate for immigrants (a coefficient of 0.03 for males and 0.025 for females), compared to the NZ-born (rewarded at 0.04% for males and females). The difference between the coefficients for

returns to over-education for immigrants and the NZ-born is statistically significant at better than 0.01 significance level. One hypothesis with which this result is compatible is that over-education may assist recent immigrants in obtaining employment, but at the expense of a lower wage reward for over-education.

The results in this section further show that our findings in the previous sections are robust across the two major groups of the New Zealand-born and immigrants. Notably, the three hypotheses of interest are rejected for all sub-samples in Table 7.

6.4 Estimates by Required Years of Education

We finally examine whether the earning returns to over- and under-education varies for employment in occupations that require higher education (such as in professional occupations), compared to lower required years (such as in clerical work or trades). In Table 8, we report estimates that are stratified for two sub-samples: in occupations with *mode* required years of education of 10-13 and 15-18 years of education. Each sub-sample group contains four occupation groups. [14]

Table 8 Returns to Education (Wage Effects) Coefficients: ORU Specification by Required Education (Mode)

Years of required education:	10-13		15-18	
	(1) Male	(2) Female	(3) Male	(4) Female
over (years)	0.028***	0.019**	0.081***	0.098***
	(0.002)	(0.005)	(0.010)	(0.015)
required education (years)	0.064***	0.091***	0.066***	0.095***
	(0.010)	(0.011)	(0.007)	(0.021)
under (years)	-0.020**	-0.035***	-0.044***	-0.048***
	(0.006)	(0.004)	(0.004)	(0.003)
R^2	0.133	0.222	0.238	0.278
Sample size	7099	5232	12569	9789

Notes:

1. Robust standard errors clustered by industry are reported in parentheses.
2. The control variable specification in this table is equivalent to the full model in columns 3 and 4 in Table 5. All equations estimated include a constant, controls for years of experience and experience squared; binary variables for and immigrant (born overseas), married, the presence of one or more children; and ethnicity, locality, industry, and year fixed effects.
3. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$
4. The three hypotheses of interest (H1, H2 and H3) are rejected for all models in columns 1-4 of this table, at the 0.001 level of statistical significance.

The results stratified by 'required years of education' highlight an interesting new finding. As Table 8 shows, while in the occupations that require 10-13 years of education the years of over-education receive lower wage rewards than do adequate years of education, a similar pattern of penalty to over-education is not observed in occupations that require higher education (15-18 years). This result suggests that the group of occupations that require higher education may have the capacity to absorb higher levels of education in productive ways. This result is also consistent with a skill

shortage of highly educated individuals, such that firms may wish to hire more qualified individuals than their mode worker, but constrained from doing so. Vahey (2000) similarly finds, based on Canadian data, that over-educated males were not penalized in occupations that require a university education. In the New Zealand case, this result pertains to both males and females.

In addition, the results in Table 8 show that the wage penalty to over-education is present and significant in occupations that require less education (10-13 years). Under-education, in contrast, has a greater penalty in occupations that require more education (15-18 years). These results are consistent across genders. The combination of these results further suggests that lower productivity issues due to job mismatches are potentially of concern both when workers with higher education find employment in jobs that require significantly less education than they have, and when under-educated workers are engaged in occupations that require higher education.

The results for these two sub-samples further confirm the rejection of the three main hypotheses of interest (H1, H2 and H3). These results are again compatible with the assignment model of job allocations, where both demand and supply play a role.

7. Conclusion

This paper addresses the void in the existing mismatch of skills literature by offering an empirical evaluation of over- and under-education in New Zealand. We do so in light of recent reports of low labor productivity in the New Zealand labor market. The results we have obtained using the HLFS/NZIS survey data provide insight into the incidence of mismatch as well as the effects of this incidence. Using the mode index in the specification, as adopted in this paper, we find evidence of both over-education and under-education in New Zealand.

We find that under-education is associated with significant earnings penalties in New Zealand of around 4.5% for each year of under education compared to the required level for the job. In addition, we find that each year of over-education results in positive earnings, but each year of over-education results in lower returns by about 3-4% per year of over-education compared to each year of required education. Both of these effects are expected to have contributed to New Zealand's lower relative earnings compared to other OECD countries.

Our auxiliary analyses stratified across sub-samples by age groups and for immigrants and the New Zealand-born have returned results that are robust in relation to our major findings. These results indicate that the effects of over- and under-education on earnings are not specific to certain age groups, and that while wage returns to over-education are rewarded at a lower rate for immigrants than for the NZ-born, all our results stand across the groups.

In addition, our analyses that are stratified by the two sub-sets of occupations that require significantly different levels of education show that, controlling for individual characteristics, the group of occupations that require higher education do not demonstrate a penalty for over-education. However, a greater penalty to over-education, than our average results indicate, is observed in the occupations that require less education. In contrast, under-education has a greater penalty in occupations that require higher education, than in occupations that require less education. These results indicate that loss of productivity is potentially greater when workers are employed in jobs that require significantly less (or more) education than they have.

Certain studies have pointed out that having workers who were over-educated could imply lower job satisfaction and ultimately lower worker productivity. This suggestion gives reason to believe that the low productivity experienced in the New Zealand economy may be due in part to this mismatch. Classification of low productive over-educated and under-educated workers, however, is largely sensitive to occupational characteristics. Certain jobs rewarded workers who had acquired more years of formal education than what was required for their job. This could be an indication that workers in such cases had obtained productive human capital that was recognized by their employers.

Our results are in line with the assignment model of incorporating supply and demand side factors to explain the disparity in earnings, rather than being dependent on human capital or job characteristics exclusively. As the New Zealand labor market exhibits assignment-type matching, we argue that the higher than average public expenditure on education serves to improve economic performance. However, while productivity is affected by a variety of factors, inefficient allocation of these skills could be a factor that hinders the economy experiencing the full benefits of such spending.

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Appendix A: Definition of Variables

Table A1: Description of Variables and Sample Means

Variable	Description	Mean (sd)
earnings	Log of actual total earnings per hour from wage or salaried job	2.95 (0.44)
actual years of education	Years of actual formal education attained	13.87(2.74)
required education	Years of formal education normally required by an occupation, obtained across four years of data	14.46(2.95)
over	Years of formal education obtained above what is normally required by an occupation (mode method)	0.78(1.62)
under	Years of formal education obtained below what is normally required by an occupation (mode method)	1.37(2.00)
exp	Years of presumed labor market experience (age-yearsactual-5)	23.38(10.19)
exp^2	exp squared	
child	Dummy variable, 1 if 1 or more dependent children	0.46
immigrant	Dummy variable, 1 if foreign born	0.21
ethnicity1	Dummy variable, 1 if European background	0.75
ethnicity2	Dummy variable, 1 if Maori	0.08
ethnicity3	Dummy variable, 1 if Pacific Peoples	0.05
married	Dummy variable, 1 if married	0.75
locality1	Dummy variable, 1 if North of North Island	0.18
locality2	Dummy variable, 1 if Auckland	0.24
locality3	Dummy variable, 1 if Central North Island	0.17
locality4	Dummy variable, 1 if Wellington	0.11
locality5	Dummy variable, 1 if South Island (excluding Canterbury)	0.18
locality6	Dummy variable, 1 if Canterbury	0.12
industry1	Dummy variable, 1 if Agriculture, Forestry and Fishing	0.07
industry2	Dummy variable, 1 if Manufacturing	0.17
industry3	Dummy variable, 1 if Construction	0.09
industry4	Dummy variable, 1 if Wholesale & Retail Trade & Accommodation etc.	0.18
industry5	Dummy variable, 1 if Transport, Storage and Communications	0.06
industry6	Dummy variable, 1 if Business & Financial Services	0.14
industry7	Dummy variable, 1 if Education	0.08
industry8	Dummy variable, 1 if Health & Community Services	0.09
industry9	Dummy variable, 1 if Other Services	0.12
occupation1	Dummy variable, 1 if Legislators, Administrators and Managers	0.15
occupation2	Dummy variable, 1 if Professionals, Technicians, and Associated Professionals	0.29
occupation3	Dummy variable, 1 if Clerks	0.11
occupation4	Dummy variable, 1 if Service & Sales Workers	0.10
occupation5	Dummy variable, 1 if Agriculture & Fisheries Workers	0.07
occupation6	Dummy variable, 1 if Trade Workers	0.11
occupation7	Dummy variable, 1 if Plant & Machine Operators	0.12
occupation8	Dummy variable, 1 if Elementary Occupations	0.05

Note: Industry dummy variables are based on The Australian and New Zealand Standard Industrial Classification (ANZSIC); Occupation dummy variables are based on New Zealand Standard Classification of Occupations 1999 (NZSCO99)

Appendix B: Approximation of Years of Education

In approximating the years of education, the particular survey questions of interest that were drawn from the HLFS/NZIS were QAL (highest degree (qualification)) and QALTYPE (degree (qualification) type), where coding is displayed in able B1. Since we have a sufficiently large data set, individuals who were classified as having qualifications that were unspecified (QAL=6 and/or QALTYPE=5) were dropped from the analysis. Finally, as actual years of education were unavailable, it is approximated using the matrix listed in Table B2, using The New Zealand Education System Overview.

Table B1: Coding of Qualifications as per the HLFS/NZIS Manual

QAL	QALTYPE
1 No qualification (No High-school degree)	1 No qualification (No High-school degree)
2 High-school degree	2 High-school but no post school degree
3 Vocational or trade degree	3 Post school but no High-school degree
4 Bachelor or higher degree	4 High-school and post school degrees
5 Post-school degree	
Qualifications in the data were collapsed from 10 categories to 6 categories by Statistics New Zealand.	

Table B2: Approximation of Years of Education

QAL	QALTYPE	Years of Education
1	1	10
2	2	13
3	3	11
3	4	15
4	3	17
4	4	18
5	3	12
5	4	15

Notes:

1. The NZ Education System Overview can be retrieved from: http://www.minedu.govt.nz/NZEducation/EducationPolicies/InternationalEducation/

2. School is compulsory in New Zealand up to the age of 16. School starts at age 5 with a kindergarten type year 1 and it continues to year 13. No qualification refers to having left school without passing, or prior to completing year 11. High-school degree/qualification (QAL2) is equivalent to the completion of High-school (year 13).

Appendix C: Definition of Variables Occupational Classification

Table C1: Major Group Skill Level Classification Based on HLFS and NZSCO99

	Major Group	Example	Skill Level
1	Legislators, Administrators & Managers	Legislators, government or business administrators, corporate managers	Experience and/or formal qualifications
2	Professionals, Technicians & Associated Professionals	Science, health, legal, and business professionals	University degree, NZ Certificate or other advanced vocational qualifications
3	Clerks	Office clerks, customer service clerks	On-the-job training
4	Service & Sales Workers	Travel attendants, housekeepers, cooks, police, salespersons, street vendors	On-the-job training
5	Agriculture & Fisheries Workers	Farmers, loggers, animal welfare workers	University degree, on-the-job training, experience
6	Trades Workers	Bricklayer, blacksmith, mechanic, locksmith, baker	Trade Certificate or other vocational qualification
7	Plant and Machine Operators and Assemblers	Industrial plant operators, drivers	On-the-job training
8	Elementary Workers	Caretakers, cleaners, laborers, packer	On-the-job training

For full list, see New Zealand Classification of Occupations 1999.

Notes

[1] Surpassed only by Belgium (6.6%), Denmark (8.8%), Iceland (7.6%), and Norway (8.8%).

[2] The New Zealand government has taken a pro-active approach in addressing productivity in the economy with the establishment of the New Zealand Productivity Commission in 2011 (http://www.productivity.govt.nz/about-us/the-commission). The mandate of this commission is to provide advice to the government on increasing productivity in a way that directly supports the overall well-being of New Zealanders.

[3] Because the highly-skilled immigration policy leads to a migrant workforce that is, on average, more educated, the focus of this paper is on the effects of over-education and to a lesser extent, on under-education.

[4] See for example, http://www.stats.govt.nz/browse_for_stats/population/mythbusters/brain-drain.aspx

[5] Empirical analysis utilising the dummy variable specification is available from the authors.

[6] CURF data employed reports the occupation of employment for each respondent based on the one-digit New Zealand Standard Classification of Occupations 1999 (NZSCO99). Wen and Maani (2014) have examined the effect of one-digit versus two-digit occupational classification, based on Australian data. They find that interestingly the incidence of over-education is not sensitive to this choice of the classification.

[7] The results from this study allow us to approximate job skills using years of formal education, as actual skill matrices were not available from the HLFS/NZIS survey.

[8] There are some minor differences across localities, but these are not as notable as the above. For example, there are slightly lower rates of over-education, and higher under-education in Wellington and Canterbury (22.7% and 21.8% are respectively classified as over-educated in the two localities (compared to the national average of 23.4%); and 39.4% and 37.0% are respectively classified as under-educated (compared to the national average of 37.1%).

[9] For an example of such information, we look towards New Zealand job search websites with emphasis on professionals: http://www.gradconnection.co.nz/, http://www.seek.co.nz/, http://www.auckland.ac.nz/uoa/auckland-careerhub

[10] The mode method adopted, as discussed, is the preferred method across studies. Results based on the mean method are also available from the authors. These results are qualitatively compatible with the results based on the mode method reported, in finding higher wage returns to required education, compared to each year of over- and under-education. The three hypotheses (H1, H2 and H3) are also rejected across the models, providing support for the assignment model.

[11] We also examined clustering by locality, which resulted in qualitatively similar results. The standard errors became slightly larger, but coefficient significance levels did not change. We find that adjustment by industry is more appropriate in this setting, by allowing error correlation due to specific industry characteristics.

[12] Although skilled workers were underutilized, the prior paragraph notes that workers in New Zealand who had more than the required education were still slightly more productive than their peers who were adequately educated. However, the marginal compensation that they receive from more years of education was not as high as the marginal compensation from a year of adequate education.

[13] In this study, we are unable to differentiate between an educational mismatch and a skill mismatch due to the data set not containing approximations of skills needed for particular jobs. Mavromaras, et al. (2009), for example, focus on skill mismatches.

[14] Occupation group one (10-13 years of required education (mode)) consists of the occupations: Legislators, Administrators & Managers; Professionals, Technicians & Associate Professionals; Service & Sales Workers; and Trade Workers (See Table 3). Group two (15-18 years of required education (mode)) consists of: Clerks; Agriculture & Fisheries Workers; Plant & Machine Operators and Assemblers; and Elementary Occupations.