Maori disadvantage in the labour market

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Abstract

This paper is a preliminary report on research that is ongoing. Using unit record data from Statistics New Zealand's Income Survey for the June quarters of 1997 to 1999, we estimate wage regressions taking into account the sample selection bias problem which arises from the exclusion from such regressions of those individuals with no market income. Controlling for a set of productivity characteristics including age, household type, marital status, qualifications, occupational class and location, we find evidence of significant ethnic and gender wage differentials. In particular, we find that Maori, Pacific Island and other non-European ethnic groups do suffer labour market discrimination which is not explainable by observable characteristics. We intend to extend this study with Income Survey data from the 2000 year, incorporating useful feedback we have had since first presenting these results last year.

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1. Introduction

It is clear that Maori are economically disadvantaged. The report *Progress Towards Closing Social and Economic Gaps Between Maori and non-Maori* (Ministry of Maori Development 1998), highlights the continuing disparity in income levels, and employment, educational and health status between Maori and non-Maori. The report shows that, although some positive gains have been made, particularly in education, the gaps between Maori and non-Maori are not closing.

Statistics New Zealand (SNZ) (1998) document the same facts as Te Puni Kokiri in one of a series of reports based on the 1996 census. Earlier work which documented the position includes Horsfield and Evans (1988), Whitwell and Thompson (1991) and Economic Development Unit, Manatu Maori (1991).

For the majority of any population, economic status is derived from paid employment and health status may, to a large degree, depend on economic factors, as well might the educational opportunities of the next generation. It would thus seem that labour market status is central to understanding the relative position of any group, including Maori. An individual's labour market status is usually defined in the following qualitative way: not in the labour force, unemployed, working part-time or working full-time. There must be some degree of arbitrariness in these definitions; for example, in the choice of the cut-off in terms of hours worked between part-time and full-time, or in the official definition of unemployed which requires both active seeking of work and availability to start work. Notwithstanding these difficulties, it is clear that Maori fare less well than non-Maori in terms of gaining paid employment. Recent evidence of Maori labour market disadvantage in this qualitative sense is contained in Winkelmann (1999) and Winkelmann and Winkelmann (1997).

A more complete picture emerges if we go beyond qualitative status to consider wage rates. It is possible to seek to determine the effect of ethnicity on wages, holding constant some set of productivity characteristics. The work of Dixon (1996a, 1996b, a998) focuses on wage dispersion throughout the New Zealand work force and finds no significant difference between Maori and non-Maori, once such characteristics as qualifications and age are controlled for.

Overseas, most especially in the United States, there has been considerable research which attempts to explain wage disparities amongst various ethnic groups. On the basis of the hypothesis that there is neither racial discrimination in the labour market nor racial differences in the willingness to supply labour, wage differences between any two ethnic groups ought to be explainable in terms of variables such as age, experience, location and educational attainment.

However, there is a major problem with drawing conclusions about discrimination on the basis of studying wages. The sample used excludes those who have no market income. This sample selection bias problem was first discussed in the economics literature by Heckman (1979) who developed a procedure to take account of the bias. At the first stage of this procedure, the probability of an individual's being employed for income is estimated using data for an entire group, including those who are not employed. The model at this stage is the standard probit for a qualitative dependent variable. From the results of that estimation, a variable is constructed which is then added to a standard wage regression for each observation in the reduced sample. The presence of this variable (known as the inverse Mills ratio) is designed to correct the coefficients of the wage regression for the bias caused by excluding those with no market income.

Our aim is to determine whether Maori fare less well than non-Maori primarily because they possess less human capital in terms of educational attainment and labour market experience or whether they receive smaller labour market rewards for their skills. From a policy perspective it is necessary to understand disadvantage in this sort of detail so that initiatives to address the disadvantage can be undertaken which have the highest probability of success. Given that returns to measurable skills are large and potentially growing in today's labour market (Murnane, Willett and Levy 1995) it is important to understand whether a skill gap is the primary determinant of labour market disadvantage or whether there does exist a significant element of discrimination.

The practical problem which faces this society is that there is a wide disparity in economic status between groups classified by ethnicity. Moreover, this disparity is persistent and is seen by many as inequitable. If indeed discrimination does exist then it is likely that there is more than a distributional issue involved. If the welfare of the minority is compromised with no off-setting gain to the majority then there is an overall loss to society.

To study this issue we use unit record data from the Income Survey (IS) of SNZ which, since 1997, has been conducted as an annual supplement to the quarterly Household Labour Force Survey (HLFS) in the June quarter. Estimating wage regressions, corrected for sample selection bias using Heckman's method, we find statistically significant evidence of wage disadvantage or discrimination in all three years of the sample. The control variables we use also permit conclusions about the relative position of other non-European ethnic groups as well as the relative labour market outcomes of males and females.

The outline of the remainder of this paper is as follows. In section 2 we define economic discrimination and explain how it can be measured. Section 3 examines previous New Zealand evidence, while section 4 discusses the data set used. The details of our econometric models are outlined in section 5. Section 6 presents the results which do show clear evidence of economic discrimination. Section 7 concludes.

2. Economic discrimination

Discrimination defies precise definition, but economic discrimination can be brought more clearly into focus by considering the question:

Under what conditions will essentially identical goods have different prices in competitive markets? (Cain 1986:695)

This moves discrimination away from the labour market to any market but it is helpful in clarifying what we mean by economic discrimination. In the labour market, the "goods" are labour services and the "prices" are wage rates. By "identical" we mean that the goods (labour services) have the same productivity. The notion of productivity is here meant to entail the physical or material production process and does not involve any psychic utility of either employers or co-employees. It can, however, be taken to include various worker characteristics such as skill and dependability. There is a difficulty here. Such characteristics have the potential to raise productivity and, in the presence of discrimination, they may be partly endogenously determined. For example, an ethnic group's participation rate or "willingness-to-produce" may be conditioned on the group's experience of discrimination.

Neoclassical theories to rationalise the existence of different wage rates for equally productive workers go back to Becker (1971, second edition of a work first published in 1957). They are almost entirely demand-side theories since it is assumed that all groups of workers have essentially the same tastes for work and, even if they are not equally productive, they at least have equal productive capacity. Becker (1971: 14) claims that if "an individual has a 'taste for discrimination', he must act as if he were willing to pay something, either directly or in the form of reduced income, to be associated with some persons instead of others." A number of different models then emerge, dependent on which agents are doing the discriminating: consumers, workers or employers.

Since most goods do not require customer contact for their production, consumer-based discrimination is thought to play a minor role in differences in average wages, although it is certainly possible that consumer discrimination would lead to a certain amount of job segregation, particularly in the service industries.

In some versions of Becker's models, competitive forces lead to job segregation rather than discrimination per se. In the case of discrimination by workers, it turns out (Cain 1986:712) that, even in the worst case where all "white" workers discriminate (are prejudiced) only segregation, not discrimination in the sense of higher wages for white workers, emerges. It is when impediments to competition are introduced that the potential for discrimination arises. This suggests a testable hypothesis: that there will be more discrimination in industries where firms can exert a degree of market power.

Arrow (1973:10), in a version of a discrimination model in which it is the employers who discriminate, comes to the conclusion that, in the long-run, only "the least discriminatory firms survive." Even when (product market) monopolists can affect wages in the labour market (and it is my no means obvious that this is common) it is unlikely that they will persist in sacrificing profits by discriminating, since they would be open to a takeover by non-discriminating entrepreneurs.

Tests of hypotheses suggested by theories of economic discrimination are quite rare in the literature, principally because of the ambiguity of the models' predictions, most especially with regard to the length of the "short" and "long" runs. An added difficulty is that of matching theoretical variables with available empirical data. As it turns out, most work in this area takes the line of trying to measure the amount of discrimination by estimating, for example, the effect of race on wages, holding constant some set of productivity characteristics.

The type of model we have in mind is:

$$Y_i = X_i'B + AZ_i + u_i \qquad (1)$$

where Y_i is the income, earnings or wages of the i^{th} person; X_i is a vector of productivity characteristics of the i^{th} person that are exogenous; Z_i is 1 if the person is in the "minority" group and 0 otherwise; u_i is a random error term; and A and B are coefficients.

One of the difficulties with the underlying model is that there is little agreement on which productivity variables are appropriate. No doubt we should consider whether the X_i are affected by labour market discrimination but there is no obvious simple way to decide on a variable's exogeneity. For example, years-of-schooling might be thought appropriate to hold constant if we believe that the decision to remain at or leave school is not influenced by discrimination in the labour market, but perhaps Maori perceive smaller labour market rewards for them than non-Maori with equivalent years-of-schooling or qualifications.

Knieser, Padilla and Polachek (1978) consider in detail the issue of "censoring" of data. The most relevant issue here is the position of the unemployed, and how to treat market earnings of zero in the regressions. Usually in wage regressions this problem is ignored. In the context of qualitative labour market status studies, it does not, of course, arise. In the case of the wage distribution, an unemployed person is likely to have faced a wage offer which was less than his/her reservation wage, in the presence of social welfare benefits. In Knieser, Padilla and Polachek's work, they show that an apparent improvement in the wage gap for US blacks is partly driven by the non-neutral racial effect of fluctuations in the unemployment rate. That is, the low earners amongst blacks tend to drop out of the sample.

Chang and Honoré (1998) analyse the black-white male wage differential in the southern states of the US, conditional on the subjects' being employed. They argue that the black-white relative probabilities of being unemployed are very stable over the period of their study. Since their main interest lies in changes in discrimination over time, this allows them to treat observations "censored at zero" as randomly missing data. Given that our focus is on measuring discrimination at a point in time, although potentially we do have three consecutive years of survey data available, we have the choice of studying the wage distribution conditional on being employed, or of finding a way to incorporate those with zero market income. The latter procedure is preferable, since it is clearly unreasonable to treat those not in employment as randomly missing when there is considerable ethnic variation in employment status.

Although the econometric procedures employed in estimating wage regressions, or statistical earnings functions, are straightforward, involving standard estimation procedures with alternative dummy variable specifications, they are subject to what is known as the sample selection problem. This is due to the fact that only individuals who are actually employed form the sample on which the estimation is based. Conceptually, this ignores the possibility of discrimination in hiring (and thus in finding employment) and, statistically, causes biased parameter estimates.

The problem arises because wages are observed only for individuals who are in the labour force. Statistically, this means that the expected value of the random error term is not zero for the observed sample as is normally assumed to be. The statistical earnings functions (where we now subsume all explanatory variables into the vector X_i is actually:

$$Y_i = X_i'\beta + u_i \quad \text{if } X_i\beta + u_i > 0 \quad \text{but}$$

$$Y_i = 0 \quad \text{otherwise.} \qquad (2)$$

If, for example, u_i is assumed to be normally distributed with mean zero and variance σ^2, then the expected value of Y for individuals who are in the labour force is: $E[Y/Y>0]=X\beta + \sigma f(z)/F(z)$, where f(z) is the standard normal probability density function, and F(z) is the cumulative standard normal density function. The quantity f(z)/F(z) is called the inverse Mills ratio. Thus, using ordinary least squares (OLS) only for observations where $Y_i>0$ incorrectly omits the inverse Mills ratio, resulting in a specification error and hence biased estimates of the parameters.

Heckman (1979) develops a procedure for statistically accounting for this omitted variable bias. His procedure involves first estimating the probability of an individual's being in the labour force and then, on the basis of this estimated probability, computing the inverse Mills ratio. This last variable is then added as a regressor to the statistical earnings function equation, whose parameters then can be consistently estimated by OLS. The details of the models we use are set out in section 5 below.

3. Previous New Zealand evidence

Cain (1986:743) summarises many previous overseas results, noting that they are extremely varied and "reveal as much about our ignorance as our knowledge". Overseas work in this area is more useful in formulating a framework for our study than for its measures of discrimination in themselves. The New Zealand econometric evidence is much less abundant. In a series of papers throughout the 1980s, Brosnan (1982, 1984, 1985, 1987, Hicks and Brosnan 1982, Poot and Brosnan 1982, Brosnan and Hill 1984, Revell and Brosnan 1986 and Brosnan and Wilson 1989) uses unpublished tabulations from census data to chart a more detailed picture. For example Brosnan and Wilson (1989), updating Hicks and Brosnan (1982) present descriptive statistics to show that women, young people and Maori bear a disproportionate burden of unemployment in New Zealand and that unemployment is more inequitably distributed here than in the other countries of their study (Australia, Norway, UK, US). The unemployment rates presented are not adjusted for any productivity characteristics such as education.

More recently, since access to unit record data from SNZ has been relaxed, there has been some econometric work undertaken in this area, notably by Dixon (1996a, 1996b, 1998), Winkelmann and Winkelmann (1997), Kirkwood and Wigbout (1999) and Winkelmann (1999).

Winkelmann (1999) draws random samples of the male working-age population from the censuses of 1986, 1991 and 1996. Each individual is classified as in full-time employment, part-time employment, unemployed or not in the labour force. Multinomial logit models are estimated using this unit-record data, controlling for changes in socio-economic and demographic factors. Winkelmann identifies two potential contributors for the declining labour market outcomes of Maori men which he observes from 1986 to 1996; namely an increase in the return to skill and changes in the sectoral composition of the workforce.

Winkelmann adopts the usual SNZ hierarchical definition of ethnicity whereby any person giving "Maori" as one of the responses to the question about ethnicity is classified as Maori. Chapple and Rea (1998: 129) point out that if SNZ's "rule was the equally arbitrary criteria (sic) that anyone who reported any non-Maori ethnic group was non-Maori, a stroke of the statistical pen would currently convert a quarter of the Maori ethnic group in the HLFS into non-Maori." This issue is taken up again when we consider our use of the data.

Winkelmann and Winkelmann (1997) also use the multinomial logit model, finding that the observed individual characteristics to be insufficient to explain all differences in labour force status, except in some years of their study for women. They note a very high premium on qualifications for Maori and raise the issue as to whether University-educated Maori are a "self-selected" group of higher than usual ability for graduates as a whole. This could be bound up with their facing additional obstacles to achieving a high standard of education or with the definition of ethnicity already discussed.

Kirkwood and Wigbout (1999) set out to explore the gender income gap, but since ethnicity is included as one of their possible explanatory factors, there is potential to shed light on the issue of discrimination. They use data from the HLFS supplemented by the IS to apply "tree analysis" to identify sub-groups of the sample each with their own unique characteristics which explain the differing levels of average weekly earnings.

At each branch of the tree analysis, the algorithm used finds the variable and the associated threshold point of that variable which best discriminates between high and low earners. For example, suppose that occupational category is associated with high earnings. Of course, some individuals in a high occupational category will have low earnings (type I error) and some individuals in a low occupational category will have high earnings (type II error). The algorithm (Ghosh and Phillips 1998) searches over all observed values of the occupational category until the number of such errors is minimised.

As it turns out, the most significant factors are occupation, hours worked, age and highest qualification, with sex a distant fifth in importance and ethnicity not rating at all. in the tree analysis.

Dixon (1998), in a recent update of her earlier work (Dixon 1996a, 1996b), uses Household Economic Survey (HES) data to model the log of real hourly earnings as a function of gender, age, education and ethnicity.

Dixon finds no significant difference between Maori and non-Maori, but does raise the issues of the small sample size of the HES and the possibility of systematic measurement bias in the survey, for which she presents some evidence. Overseas validation studies in which self-reports are checked against payroll data, have shown that low earners tend to over-report and high earners under-report. Such studies have not been carried out in New Zealand, but here there is concern about the growth in the numbers of individuals reporting longer hours worked in the HES. For example, from 1984 to 1987 the number of males reporting working over 60 hours per week has risen from 5 to 15%, while the number over 45 hours has risen from 29 to 50%. Surveys other than the HES show less such distortion.

Dixon, too, uses the standard hierarchical definition of ethnicity. Even so (footnote 8, page 93) she admits finding a significant coefficient in an unreported regression using IS data, but offers no explanation for this. Since her primary interest is also in changes over time there was simply insufficient data from the IS to address this.

4. The New Zealand data

Until recently, researchers were unable to access Statistics New Zealand (SNZ) data at the unit record level. In a recent initiative, SNZ has developed a Data Laboratory which is a mechanism for providing access to unit record data. Because of the safeguards and conditions that are in place for the use of the Data Laboratory, use of the facility requires the researchers to access the data in an SNZ office in Auckland, Wellington or Christchurch. No unit-record data can be removed from these secure sites, only the completed statistical analyses. All output is meticulously checked by SNZ staff before release to eliminate the possibility of even inadvertent release of unit record material.

The main sources of microdata possibly relevant for the sort of study we propose are: the Census, Household Economic Survey (HES), Household Labour Force Survey (HLFS) and Income Survey (IS). The latter is a recently introduced annual supplement to the quarterly HLFS.

The problem with Census data has to do with income. Total income from all sources is reported in bands of $5000 to $30 000 except for the open-ended, $100 001 or more. In addition, individuals are asked to report all sources of income, but the total income is not able to be broken down by source. Income is pre-tax and includes welfare benefits.

The HES does give much better income data, breaking down the amounts of income received by source. The main difficulty, however, is the quite small sample size. The HLFS has a sample size about five times that of the HES, at 15 000 households and approximately 30 000 individuals. Its drawback is that no income questions are asked. However, the New Zealand Income Survey (IS) was run for the first time in the June 1997 HLFS quarter (April to June) as a supplement to the HLFS and is planned to be run in all subsequent HLFS June quarters. According to the June 2000 HLFS the "survey collects recent gross income data on wages and salaries (up to three jobs), self-employment, government transfers and other transfers which includes private superannuation and annuities."

Some of the difficulties of drawing conclusions from the descriptive data from such surveys are illustrated by the following extracts from SNZ's commentary on the June 2000 HLFS:

"The unemployment rate for the Maori ethnic group is at the lowest level since the June 1988 quarter when it was 12.1 percent."

"In the June 2000 quarter the unadjusted unemployment rates stood at 4.7 percent for European/Pakeha, 13.0 percent for Maori, 10.8 percent for Pacific Islands people and 11.6 percent for the 'Other' ethnic group. The order of unemployment rates for ethnic groups has been largely the same for the last several years."

There would then seem to be little doubt that non-European ethnic groups suffer higher rates of unemployment than European, but this does not account for age structure of the differing populations, nor their quailification mix or geographic location. In relation to the IS, SNZ's commentary adds:

"When making income comparisons between different ethnic groups, it is important to note the different age structures. The Maori, Pacific Islands and 'Other' ethnic groups are over represented in the younger age groups, which have lower average earnings. The European/Pakeha ethnic group is over represented amongst those aged 65 years and over, for whom the major source of income is New Zealand Superannuation.

All ethnic groups had an increase in average weekly income between the June 1998 and June 1999 quarters. The only statistically significant change was for the European/Pakeha ethnic group which had an increase of $19.

A higher proportion of the European/Pakeha ethnic group are in paid employment when compared with the other three ethnic groups."

To what extent the argument about age structure explains the differences in income is not quantified.

SNZ made available to us, at the Christchurch DataLab, data from the 1997, 1998 and 1999 IS and HLFS. The most important difference in our data set to those used by other researchers is that we asked SNZ to classify separately those respondents who ticked only "Maori" and those who ticked both "Maori" and some other ethnic group in answering the ethnicity question. Accordingly we were able to identify separately those individuals who identify solely with the Maori ethnic group and those (whom we call "mixed") who identify themselves as Maori as well as at least one other classification. This enables us to address the criticism made by Chapple and Rea (1998) and to avoid conclusions that are driven by a changing proportion of the sample identifying as Maori over time.

More detailed descriptive data that we were able to extract shows that, amongst the waged, Maori males in most qualification groups actually outperform European males, certainly in the 1997 and 1998 samples. Tables 1 to 3 present data for average usual hourly rates for men. What needs to kept in mind here is that only those who have paid employment are represented in the sample, and that some of the sample sizes in various qualification groups (especially amongst Maori) are quite small. We do not mean to suggest that the figures in tables 1 to 3 suggest that Pakeha males are discriminated against. Rather, the figures hint strongly at the existence of a sample selection bias problem.

5. The models

At the first stage of the analysis, for each of the annual data sets, a probit analysis was undertaken. In each case the dependent variable was EMPLC which is defined as 1 if the individual is employed and 0 otherwise. The independent variables, with brief definitions are listed in table 4.

Age and its square are entered in the regressions as proxies for experience. This does fail to account for the details of individuals' differing labour market experiences; for example, that females will often have time out of the work force for child rearing. It may be true that Maori and non-Maori males, for instance, have differing labour market experiences. But, it is hard to imagine any supply side explanation for this (such as the child-bearing argumemt in the case of the female-male differential) unless such explanation were related to feedback from individuals' difficulties in obtaining employment. In this case the difference is likely to be associated with some form of discrimination anyway. In any case, we simply do not have access to detailed labour market profiles on the people in our samples.

The effect of age on wage is likely to be positive but diminishing, hence the use of the squared term.

Household type dummies, with a couple with no dependent children as the reference class, are included to account for the possibly differing opportunities and incentives facing those with and without children, as well as those living alone. Marital status dummies are included for much the same reason, with a greater expectation of finding a significant effect for those "living as married" than those who are "widowed, separated or divorced", the reference class being "never married".

A set of qualification dummies, ranging from a person's highest qualification being at secondary school level to university level, is used to capture the positive effect of increasing educational qualifications. The reference class is "no qualifications" and one of the qualification groups (containing relatively few observations) is "unspecified" to allow for completeness in treating the sample.

A regional dummy, taking the value 1 for survey participants who reside in one of the three main urban centres, is used to account for relatively lower wages in the provincial areas. A more complete set of regional dummies, based on thirteen regional council areas (using the principal urban area, Auckland, as reference class) was also tried. The etxra results, which we do not present here but which are available on request, are quite robust to this change in specification, although the regions which show up as negative vary from sample to sample.

Ethnicity and gender dummies are included, not for any supposed productivity effect, but to test for discrimination.

From the results of the probit analyses, inverse Mills ratios were calculated for each observation and used in wage regressions. The wage regressions included all of the variables from the original probits along with occupational class and part-time dummies as defined in table 5.

Part-time work in the survey is defined as less than thirty hours per week and this dummy is included to allow for the possibility that part-time and full-time work are differently rewarded.

Occupational class dummies allow for the obvious wage structure of professional against skilled, semi-skilled and unskilled occupations.

Heckman (1979: 157) outlines the procedure to be followed. First, the parameters of the probit model are estimated using the full sample. From these estimates the inverse Mills ratio is calculated for each observation. Then, the wage regression is run, using the subsample of individuals who are employed and have positive wage data.

The dependent variable in the wage regressions presented here is the natural logarithm of the actual hourly rate. Both usual and actual hourly rates were collected for each person in the sample and it is debatable as to which is the more appropriate measure. We repeated the estimations using the usual hourly rates and found that the results from each of the variables LNUSHRLY and LNACHRLY turn out to be very similar. The full set of results is available on request.

6. Results

The results of the probit estimates for the 1997 data set are presented in table 6. They are very much as expected, with all explanatory variables showing the expected signs and almost all significant at the 1% level. The only insignificant variables were NSQAL, which represents "unspecified" qualifications, and the two marital status variables, although the variable MARR, indicating currently married or living as such, is significant at the 10% level. No effect is detected for those who are widowed, separated or divorced, against the reference group of those never married.

As expected AGE is positively related to employment, but its square is negatively related.

The reference class for the ethnicity variables is European. All other ethnic groups have significantly negative coefficients. The magnitude of the coefficient on MAOR is twice that on MIXD and very comparable with that on PACI. Other ethnic groups, covering for the most part various Asian ethnicities, shows the largest negative effect. Thus, all non-European ethnic groups are under-represented in employment, even accounting for the obvious productivity characteristics.

The reference class for household type is a couple without children. All other household types, from couples with children to sole person households show up as significantly negative.

All qualification types (except unspecified) are positive against the reference class of "no qualifications", with the strength of the effect greatest for university qualifications, as expected.

The gender coefficient is of similar magnitude to those on MAOR and PACI and is also negative, indicating that female employment is lower than male employment.

Tables 7 and 8 are the corresponding probit estimates for the 1998 and 1999 data sets. These results, for the most part, closely parallel the 1997 results. The main differences are that the regional dummy is not as significant in the later samples and that the marital status dummies vary somewhat in their magnitudes and significances. The "unspecified qualification" dummy is sometimes significant. The ethnic and gender conclusions vary very little from sample to sample.

We present the results of the wage regressions (both without and with a Mills ratio variable) with LNACHRLY as the dependent variable in tables 9 to 11. We first focus on the results in table 9 (the wage regression for the 1997 sample using the actual hourly rate as the dependent variable) and later highlight some points of similarity and difference amongst the results from different years.

The inverse Mills ratio is different from zero at a high level of significance. This indicates that the estimates from the regression without the MILLS variable are indeed biased by the sample selection problem. That the model with MILLS performs better is also evidenced by the higher adjusted R-squared and confirmed by an F-test for nested models, which takes the value 36.2 in this case. The INTERCEPT term changes very substantially and drastically reduces in significance once MILLS is entered into the regression, indicating that it had been capturing the omitted variable.

On comparing the coefficients on the other variables before and after the introduction of MILLS we find that there are many substantial changes in magnitude and significance. Taking the variable MAOR, we find it more than doubles in magnitude and its t-ratio nearly doubles. The coefficient on MIXD triples and increases in significance. There is also a very sizeable increase in the magnitude of the coefficients on PACI and OTHRETH. The importance of higher qualifications is brought out even more strongly once the selection bias problem has been addressed. Female wage disadvantage becomes more evident. The occupational class dummies are quite robust to the inclusion of MILLS.

These results from the 1997 sample indicate that Maori receive 13% lower actual hourly wages than non-Maori, even when they have the same productivity characteristics. This figure of 13% is arrived at by noting that the ratio of Maori to non-Maori wages is given by e^{β} where β is the coefficient on the variable MAOR. Other wage differentials are calculated in a similar manner. Pacific Island people are even more affected, losing out by nearly 17%. Other ethnicities (than European/Pakeha) receive 20% lower hourly rates. Even what we have called the "mixed" group lose out by about 6%.

Females earn 18% less than comparable males. The gaining of formal qualifications adds 25%, 34% or 61% to the hourly wage, according as the level of the qualification is school, tertiary (other than university) or university.

In the case of other two annual samples the regression with MILLS is preferred by a nested F-test (1998 F-value is 47.9 and 1998 F-value is 80.3). There is also a good deal of robustness of the estimated coefficients across the three different years. For example the respective coefficients on MAOR are all -0.1 to one significant figure and on PACI and GNDR are both -0.2 to one significant figure.

7. Conclusion

This is the first time, to our knowledge, in the New Zealand literature that this method of correction for sample selection bias has been used in estimating wage regressions. Our results indicate both disadvantage in getting employment and wage discrimination, with respect to all non-European ethnic groups. The reasons for the continued existence of wage discrimination are beyond the realm of economics which would claim that such discrimination was irrational. Yet we have quantified this discrimination and would point out that improving the productivity characteristics of individuals will not remove it.

Given the controversial nature of this result it is our intention to repeat our study with the now available June 2000 IS survey data. We will also take this opportunity to address a number of econometric refinements to the model. First, the standard errors reported in the regressions containing the inverse Mills ratio ought to be corrected for possible heteroscedasticity (White 1980). While heteroscedasticity does not bias the coefficients it does lead to incorrect standard errors and therefore incorrect t-statistics. Second, it is often argued in the literature (Puhani 2000:57) that the wage regression "is only identified through the nonlinearity of the inverse Mills ratio" if all variables in the probit analysis also appear in the wage regression. To overcome this problem we could omit the household type variables from the wage regression, as they are much more plausibly likely to affect employment rather than wages. Third, the wage equations could have additional slope dummies added to them to account, for example, for possibly differing effects of education by ethnicity. As an alternative, on the basis of running separate regressions for different ethnic groups, it is possible to decompose gross wage differentials into discrimination and productivity components. Oaxaca and Ransom (1994) present four different methods for doing this. Finally, Puhani (2000:65) points out that in the absence of collinearity problems, full-information maximum likelihood is preferable to Heckmans's two-step method, and gives practical advice on which estimation method should be used, which can only "be decided upon case by case."

Table 1 Average usual hourly wages - males (1997)

Qualification group	Pakeha	Maori
1	7.57	8.46
2	8.90	10.79
3	10.62	9.40
4	9.94	12.89
5	8.89	14.06
6	10.54	11.76
7	16.07	20.95
8	10.67	11.22

Table 2 Average usual hourly wages - males (1998)

Qualification group	Pakeha	Maori
1	9.51	11.50
2	10.23	11.38
3	11.54	12.04
4	12.48	15.34
5	8.50	12.84
6	12.08	12.82
7	17.34	18.32
8	13.81	14.35

Table 3 Average usual hourly wages - males (1999)

Qualification group	Pakeha	Maori
1	9.06	12.60
2	11.39	12.32
3	12.57	13.03
4	11.81	9.18
5	9.68	7.81
6	12.13	12.50
7	18.13	15.62
8	13.04	13.46

Note: the qualification groups are 1 (no qualification), 2 (School certificate), 3 (Sixth form certificate), 4 (Higher school qualification), 5 (Other school qualification), 6 (Vocational or trade qualification), 7 (Bachelor or higher degree), 8 (Other post-school qualification).

Table 4 Independent variables in probit analysis

Variable	Definition
age variables	
AGE	age in years
AGESQ	square of AGE
ethnicity variables	
MAOR	1 if Maori, 0 otherwise
MIXD	1 if Maori and other ethnic group, 0 otherwise
PACI	1 if Pacific Islander, 0 otherwise
OTHRETH	1 if other ethnic group (except European), 0 otherwise
household type variables	
CWCH	1 if a couple with dependent children, 0 otherwise
SWCH	1 if a single parent with dependent children, 0 otherwise
SOLO	1 if a single parent with no dependent children, 0 otherwise
ONEP	1 if a sole person household, 0 otherwise
OTHRHH	1 if another household type (except couple with no dependent children), 0 otherwise
regional variable	
MCNT	1 if resident in Auckland, Wellington or Canterbury regions, 0 otherwise
marital status variables	
MARR	1 if living as married, 0 otherwise
SEP	1 if separated, divorced or widowed, 0 otherwise
qualification variables	
UNIQ	1 if highest qualification a first degree or higher degree, 0 otherwise
PSCQ	1 if highest qualification post-school but not university, 0 otherwise
SCHQ	1 if highest qualification is school level, 0 otherwise
NSQAL	1 if highest qualification is not specified (but not none), 0 otherwise
gender variable	
GNDR	1 if female, 0 if male

Table 5

Variable	**Definition**
occupational variables	
OCCT	1 if in top two occupational groups, 0 otherwise
OCCM	1 if in middle three occupational groups, 0 otherwise
part-time status	
PT	1 if part-time, 0 if full-time
Variable to correct for sample selection bias	
MILLS	Inverse Mills ratio

Table 6: Probit results 1997

sample size 28292

Variable	Estimate	Std Err	Chi Square	Pr>Chi
INTERCPT	-1.8351911	0.06831	721.7624	0.0001
AGE	0.15942304	0.003626	1933.025	0.0001
AGESQ	-0.0021521	0.00004	2957.527	0.0001
MAOR	-0.4173216	0.030759	184.0801	0.0001
MIXD	-0.2035	0.048785	17.40024	0.0001
PACI	-0.3929083	0.03841	104.6374	0.0001
OTHRETH	-0.691715	0.039221	311.0396	0.0001
CWCH	-0.3155454	0.024617	164.3108	0.0001
SWCH	-0.7722192	0.041092	353.1489	0.0001
SOLO	-0.1810237	0.056671	10.20351	0.0014
ONEP	-0.180683	0.044566	16.43711	0.0001
OTHRHH	-0.2331573	0.036347	41.14895	0.0001
MCNT	0.07141938	0.018392	15.07905	0.0001
MARR	0.05664533	0.034274	2.731547	0.0984
SEP	-0.0324694	0.038372	0.716013	0.3975
UNIQ	0.6198082	0.03777	269.2868	0.0001
PSCQ	0.48796675	0.022005	491.7369	0.0001
SCHQ	0.3137189	0.023488	178.4001	0.0001
NSQAL	0.21445113	0.323264	0.440091	0.5071
GNDR	-0.4475861	0.018056	614.4507	0.0001

Table 7: Probit results 1998

sample size **28075**

Variable	Estimate	Std Err	Chi Square	Pr>Chi
INTERCPT	-1.8953295	0.068209	772.1155	0.0001
AGE	0.16022417	0.003594	1987.994	0.0001
AGESQ	-0.0021367	0.000039	2971.68	0.0001
MAOR	-0.4123344	0.030692	180.4926	0.0001
MIXD	-0.1283051	0.048915	6.880265	0.0087
PACI	-0.3554484	0.039585	80.63043	0.0001
OTHRETH	-0.7172287	0.038017	355.9318	0.0001
CWCH	-0.3251955	0.024517	175.9309	0.0001
SWCH	-0.806279	0.041177	383.4108	0.0001
SOLO	-0.3440012	0.057448	35.85625	0.0001
ONEP	-0.2523382	0.043143	34.20945	0.0001
OTHRHH	-0.3154003	0.036646	74.07495	0.0001
MCNT	0.03304836	0.01833	3.250535	0.0714
MARR	0.01360134	0.034045	0.159604	0.6895
SEP	-0.0218757	0.037883	0.33345	0.5636
UNIQ	0.72751896	0.037764	371.128	0.0001
PSCQ	0.49795178	0.021963	514.0451	0.0001
SCHQ	0.29762125	0.023551	159.7068	0.0001
NSQAL	0.42860386	0.152876	7.860219	0.0051
GNDR	-0.4175043	0.017968	539.9094	0.0001

Table 8: Probit results 1999

sample size 26651

Variable	**Estimate**	**Std Err**	**Chi Square**	**Pr>Chi**
INTERCPT	-1.7342393	0.067873	652.875	0.0001
AGE	0.14644005	0.003472	1778.578	0.0001
AGESQ	-0.0019593	0.000037	2773.324	0.0001
MAOR	-0.4198903	0.031774	174.639	0.0001
MIXD	-0.177881	0.049025	13.16501	0.0003
PACI	-0.3906798	0.038474	103.1132	0.0001
OTHRETH	-0.5987454	0.037955	248.856	0.0001
CWCH	-0.2642238	0.024836	113.1849	0.0001
SWCH	-0.7813419	0.042027	345.6396	0.0001
SOLO	-0.3072628	0.058074	27.99362	0.0001
ONEP	-0.2405283	0.043309	30.84464	0.0001
OTHRHH	-0.3112492	0.037752	67.97402	0.0001
MCNT	0.03384708	0.018832	3.230295	0.0723
MARR	0.09287444	0.034115	7.411352	0.0065
SEP	0.11345143	0.038519	8.675085	0.0032
UNIQ	0.69631286	0.03806	334.7054	0.0001
PSCQ	0.46763688	0.022501	431.9119	0.0001
SCHQ	0.26215298	0.024145	117.8848	0.0001
NSQAL	0.25924822	0.124648	4.325744	0.0375
GNDR	-0.3973974	0.018399	466.5024	0.0001

Table 9: 1997 wage regressions: actual hourly rate as dependent variable

	Regression inverse	**without Mills ratio**	**Regression inverse**	**with Mills ratio**	**exp(β)-1**
Variable	**Estimate**	**t**	**Estimate β**	**t**	
INTERCEP	1.369307	38.250	0.678311	5.641	
AGE	0.044554	22.094	0.077606	13.267	
AGESQ	-0.000495	-20.161	-0.000940	-12.081	
MAOR	-0.061515	-4.370	-0.140451	-7.306	-.131
MIXD	-0.025038	-1.178	-0.061001	-2.767	-.059
PACI	-0.115524	-6.669	-0.186238	-8.907	-.17
OTHRETH	-0.098908	-5.378	-0.225667	-8.076	-.202
CWCH	-0.014031	-1.525	-0.073006	-5.436	-.07
SWCH	-0.001595	-0.082	-0.162763	-4.917	-.15
SOLO	-0.032547	-1.399	-0.066012	-2.764	-.064
ONEP	0.045807	2.493	0.005254	0.269	.005
OTHRHH	0.033639	2.371	-0.007561	-0.481	-.008
MCNT	0.072875	9.798	0.082964	10.897	.087
MARR	0.122509	8.944	0.126823	9.260	.135
SEP	0.047671	2.768	0.038730	2.244	.039
UNIQ	0.376215	25.509	0.478575	21.273	.614
PSCQ	0.203981	20.192	0.290922	16.512	.338
SCHQ	0.160639	14.844	0.221637	14.960	.248
NSQAL	-0.129507	-1.067	-0.087252	-0.718	-.084
GNDR	-0.129647	-16.688	-0.203453	-14.021	-.184
OCCT	0.224126	17.901	0.221287	17.689	.248
OCCM	0.091909	9.121	0.090557	8.999	.095
PT	-0.151536	-15.558	-0.152792	-15.708	-.142
MILLS			0.367203	6.018	

Note: For dummy variables the rightmost column above shows the percentage difference in the wage when the dummy is 1 as opposed to 0.

ANOVA	**without**	**MILLS**			
Source	**DF**	**SumofSqs**	**MnSquare**	**FValue**	**Prob>F**
Model	22	845.41158	38.42780	262.534	0.0001
Error	11401	1668.79738	0.14637		
CTotal	11423	2514.20896			
	RootMSE	0.38259	**R-square**	0.3363	
	DepMean	2.54483	**AdjR-sq**	0.3350	
	C.V.	15.03392			
ANOVA	**with**	**MILLS**			
Source	**DF**	**SumofSqs**	**MnSquare**	**FValue**	**Prob>F**
Model	23	850.69675	36.98682	253.470	0.0001
Error	11400	1663.51221	0.14592		

CTotal	11423	2514.20896		
	RootMSE	0.38200	**R-square**	0.3384
	DepMean	2.54483	**AdjR-sq**	0.3370
	C.V.	15.01075		

Table 10: 1998 wage regressions: actual hourly rate as dependent variable

	Regression inverse	without Mills ratio	Regression inverse	with Mills ratio	exp(β)-1
Variable	**Estimate**	**t**	**Estimate β**	**t**	
INTERCEP	1.494549	46.553	0.840614	8.019	
AGE	0.041655	23.353	0.073011	14.298	
AGESQ	-0.000449	-20.807	-0.000865	-12.909	
MAOR	-0.020042	-1.545	-0.090937	-5.388	-.087
MIXD	0.002555	0.135	-0.016754	-0.874	-.017
PACI	-0.100165	-6.243	-0.158173	-8.642	-.146
OTHRETH	-0.098720	-5.904	-0.218577	-8.826	-.196
CWCH	-0.004809	-0.569	-0.060840	-5.065	-.059
SWCH	0.012357	0.707	-0.139296	-4.806	-.13
SOLO	-0.010230	-0.463	-0.066564	-2.812	-.064
ONEP	0.062733	3.808	0.013429	0.742	.014
OTHRHH	0.025197	1.875	-0.024796	-1.606	-.024
MCNT	0.080242	11.573	0.084291	12.130	.088
MARR	0.114127	9.125	0.109843	8.785	.116
SEP	0.015494	1.000	0.009097	0.587	.009
UNIQ	0.351397	25.431	0.457870	21.480	.581
PSCQ	0.167348	18.067	0.247951	16.111	.281
SCHQ	0.104905	10.390	0.158443	12.211	.172
NSQAL	0.099740	1.867	0.176081	3.225	.193
GNDR	-0.143828	-19.902	-0.207343	-17.158	-.187
OCCT	0.239752	20.875	0.237023	20.659	.267
OCCM	0.067729	7.495	0.065644	7.272	.068
PT	-0.138758	-15.947	-0.137588	-15.835	-.129
MILLS			0.324877	6.552	

Note: For dummy variables the rightmost column above shows the percentage difference in the wage when the dummy is 1 as opposed to 0.

ANOVA	**without**	**MILLS**			
Source	**DF**	**SumofSqs**	**MnSquare**	**FValue**	**Prob>F**
Model	22	922.01304	41.90968	304.049	0.0001
Error	12507	1723.94951	0.13784		
CTotal	12529	2645.96255			
	RootMSE	0.37127	**R-square**	0.3485	
	DepMean	2.58586	**AdjR-sq**	0.3473	
	C.V.	14.35757			
ANOVA	**with**	**MILLS**			
Source	**DF**	**SumofSqs**	**MnSquare**	**FValue**	**Prob>F**
Model	23	927.91030	40.34393	293.670	0.0001
Error	12506	1718.05225	0.13738		
CTotal	12529	2645.96255			

RootMSE	0.37065	**R-square**	0.3507
DepMean	2.58586	**AdjR-sq**	0.3495
C.V.	14.33356		

Table 11: 1999 wage regressions: actual hourly rate as dependent variable

	Regression inverse	without Mills ratio	Regression inverse	with Mills ratio	exp(β)-1
Variable	**Estimate**	**t**	**Estimate β**	**t**	
INTERCEP	1.539156	46.913	0.610832	5.621	
AGE	0.036476	20.656	0.080202	15.458	
AGESQ	-0.000386	-18.400	-0.000965	-14.204	
MAOR	-0.024268	-1.756	-0.130624	-7.184	-.122
MIXD	-0.016780	-0.833	-0.058013	-2.815	-.056
PACI	-0.106575	-6.603	-0.198482	-10.402	-.18
OTHRETH	-0.067219	-3.898	-0.209753	-8.956	-.189
CWCH	-0.010700	-1.198	-0.080449	-6.801	-.077
SWCH	0.026197	1.426	-0.192390	-6.307	-.175
SOLO	0.023063	0.992	-0.055727	-2.247	-.054
ONEP	0.039420	2.313	-0.030866	-1.650	-.03
OTHRHH	0.043843	3.001	-0.033867	-1.998	-.033
MCNT	0.104891	14.236	0.110661	15.011	.117
MARR	0.144706	11.052	0.149423	11.441	.161
SEP	0.036365	2.261	0.057468	3.547	.059
UNIQ	0.375094	25.905	0.520892	23.947	.684
PSCQ	0.194508	19.708	0.304132	19.371	.355
SCHQ	0.148314	13.822	0.216198	16.494	.241
NSQAL	0.205653	4.010	0.275116	5.322	.317
GNDR	-0.114315	-14.922	-0.202410	-16.258	-.183
OCCT	0.245052	20.173	0.242522	20.026	.274
OCCM	0.059003	6.116	0.057330	5.961	.059
PT	-0.191542	-21.198	-0.187143	-20.749	-.171
MILLS			0.467394	8.959	

Note: For dummy variables the rightmost column above shows the percentage difference in the wage when the dummy is 1 as opposed to 0.

ANOVA	**without**	**MILLS**			
Source	**DF**	**SumofSqs**	**MnSquare**	**FValue**	**Prob>F**
Model	22	977.22188	44.41918	299.246	0.0001
Error	11940	1772.34037	0.14844		
CTotal	11962	2749.56225			
	RootMSE	0.38528	**R-square**	0.3554	
	DepMean	2.59045	**AdjR-sq**	0.3542	
	C.V.	14.87292			
ANOVA	**with**	**MILLS**			
Source	**DF**	**SumofSqs**	**MnSquare**	**FValue**	**Prob>F**
Model	23	989.05630	43.00245	291.624	0.0001
Error	11939	1760.50595	0.14746		
CTotal	11962	2749.56225			

RootMSE	0.38400	**R-square**	0.3597
DepMean	2.59045	**AdjR-sq**	0.3585
C.V.	14.82380		

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