WHO ARE MINIMUM AND SUB-MINIMUM WAGE WORKERS?

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Abstract

This paper is aimed at providing a comprehensive portrait of who earns the minimum wage, in terms of the characteristics of the individual that are most important in determining this outcome.

New Zealand has substantially increased minimum wages for teenagers and adults since 2000. For example, since the youth minimum was introduced in March 1994, it had increased by 52% in real terms by 2004. Due to past deregulation in this sector, these wage floors represent potentially the most important form of government intervention in the labour market. Consequently, recent New Zealand experience offers a rare opportunity to isolate who earns the minimum wage and which subgroups are more likely to be potentially impacted by a rising minimum.

This study uses individual data from the annual Income Supplements of the Household Labour Force Surveys (HLFS-IS) between June 1997 and June 2004. This unit record data allows isolation of workers earning the minimum wage or close to, rather than relying on anecdotal evidence of who these workers typically are.

A more sophisticated quantitative analysis is also carried out, where the probability of earning at or below the minimum wage is modelled to estimate what individual characteristics are most significant in determining minimum wage status. One of the key findings was that the probability of an individual being affected by the minimum wage increased with the level of the minimum wage and that this increase was disproportionate for different individuals, depending on their characteristics (i.e. age, ethnicity, etc.).

Keywords Labour market, Minimum wage, New Zealand.

JEL: J38

1. Introduction

This research identifies the characteristics of workers who are most likely to be impacted by minimum wage increases. Section 2 begins with background information on the substantial changes to the minimum wage for adults and youth in New Zealand (NZ) over the sample period. In section 3, a brief description of the data sources from Statistics NZ is provided. The quality of these data is one of the main motivating factors for this study. The Household Labour Force Survey (HLFS) provides a range of demographic information about the individuals surveyed, while the Income Supplement (IS) provides detailed wage information. The HLFS-IS is therefore used over the period for which they overlap and are available (June 1997 to June 2004) to conduct a descriptive analysis of the characteristics of workers in section 4. These characteristics are compared for different sub-groups of workers, who are grouped according to their minimum wage status.

This descriptive investigation is then supplemented with a probit regression in section 5, which models the probability of earning at or below the minimum wage. This regression can first be used to predict the probability of an individual being affected by the minimum wage. Secondly, this regression clearly shows how increases in the minimum wage affect an individual's probability of earning the minimum wage, and also how the minimum wage interacts with the individuals' characteristics to also affect the individuals' propensity to be earning at or below the minimum wage. Finally, section 6 summarises the key findings from both the descriptive and quantitative analysis.

2. Background

The Minimum Wage Act was introduced in NZ in 1983 and section 4 stipulates that the Governor General may "by Order in council, prescribe the minimum rates of wages payable to any class or classes of worker". Class is defined as a particular age group in this Act. Initially, the Act set a binding wage for all workers aged 20 years old or above. The minimum wage doesn't apply to those who hold under rate permits[1], and until June 2003, didn't apply to persons undergoing training recognised under the Industry Training Act. This sub-group of employees is now covered by the youth minimum wage. Consequently, exemptions from the minimum wage are few and far between, with close to full coverage for this legislation in this country.

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[1] An under rate permit is granted by Labour Inspectors to a person with a disability that significantly slows their work (Department of Labour, 2006).

Changes to adult and youth minimum wage

Since 1983, the adult minimum wage for those 20 years of age or older has increased fifteen times in nominal terms. It began at $2.50 gross per hour and with the latest change in the time period under study, implemented in March 2004, was $9 gross per hour. In March 1994, a youth minimum wage was introduced for teenagers aged 16 to 19. The youth minimum was initially set at 60% of the adult minimum, but increased to 70% in March 2001. At this time, the minimum eligible age for the adult rate dropped from 20 to 18 years. Hence, the youth rate applied to only 16 and 17 year olds from this point in time onwards. The next significant change was in the following year (March 2002), when the youth rate increased to 80% of the adult rate. Table 1 provides a summary of all the changes to the statutory minimum wage that have occurred by age group until March 2004.

< Insert Table 1 here >

3.   Data

Two data sources have been used in the upcoming empirical analysis. They are the Household Labour Force Survey (HLFS) and the Income Survey (IS). These micro-data were accessed through the use of a secure data laboratory on Statistics NZ premises, under the confidentiality requirements of Statistics Act 1975.

The HLFS is a quarterly data source that began in December 1985, and consists of a sample of between 16,000 to 32,000 households over that time. It is ongoing and includes an array of information on the working-age population in NZ, such as labour force status, educational attainment, etc. The IS is a supplementary survey that has been conducted in the June quarter of the HLFS since 1997. This detailed supplemental questionnaire provides a consistent source of wage information and is therefore used to investigate where the low-wage areas are in the NZ labour market.

4.   Characteristics of all workers affected by the minimum wage

4.1   Construction of the hourly earnings measure

Data are taken from the HLFS and IS from June 1997 to June 2004. Appendix A shows details on the construction of the sample used in this analysis. The sample is initially purged of individuals ineligible for the minimum wage (i.e. individuals under the age of 16 and the disabled). The sample is then restricted to those within the working-age population, not retired, employed and working positive hours and earning positive wages. Next, serious effort

was put into cleaning the data of all possible sources of measurement error. This was done in an attempt to ensure that the earnings sub-groups set up in this analysis truly reflect individuals earning those particular levels. For example, individuals working more than 60 hours a week were removed from the final sample, as preliminary analysis showed that these individuals were much more likely to appear to be earning below minimum wage, and this was probably attributable to them overestimating their hours worked.

The final sample of 94318 individuals is later divided into sub-groups based on their hourly earnings. Although the IS gives individually provided or survey computed[2] values for hourly earnings, these are inclusive of overtime earnings. Consequently, weekly data in the IS was used to derive regular hourly earnings, exclusive of overtime. This can be derived for both actual earnings (i.e. the individual's latest pay before the survey was taken) and usual earnings. The advantage of actual data is that it refers to a particular reference week, whereas, 'usual' is open to interpretation by the person. However, usual earnings information can possibly be seen as a better average of the individual's earnings, and usual earnings is the standard used in most U.S. research (e.g. Card and Krueger (1995) and DiNardo et al (1996)) which makes use of CPS data. Consequently, the individual's regular usual hourly earnings (r_earn) is calculated in the following way:

r_earn = <u>usual total weekly earnings – usual overtime weekly earnings</u>
    usual total weekly hours – usual overtime weekly hours

4.2   Effectiveness of minimum wage levels

Table 2 segments the final sample along the dimensions of age, gender and qualifications. The minimum wage relative to the median hourly earnings (using r_earn) for each sub-group is provided for each year in the sample to identify any sub-groups experiencing an increasing relative minimum wage ratio.

< Insert Table 2 here >

In Table 2, adults and youth are defined as the minimum wage legislation has defined them (i.e. adults are 20 plus for 1997 to 2000 and 18 plus from 2001 onwards; youth are 16 to 19 for 1997 to 2000 and 16 to 17 from 2001 onwards). The 'no qual' category contains individuals having no qualifications. All summary statistics are weighted using the sampling weights Statistics NZ provided, to increase the representativeness of the sample and take into account sample frame and non-random survey response and individual attrition.

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[2] This implies that the individual provided weekly rather than hourly earning information, which Statistics NZ used to compute a value for the hourly earnings of the individual.

It is immediately apparent that no matter what category is viewed in the above table, all have undergone an increase in their relative minimum. The smallest increases have been experienced by the 20 plus age group. Teenagers on the other hand, have had the largest increases over the 8 years. For example, 18-19 year olds' relative minimum has increased from 0.54 to 0.88.

By 2004, the relative minimum for youth with no school qualifications had increased from 0.60 to 0.84. Surprisingly, the figures for youth and youth without qualifications are very similar and in some cases a little lower for the latter sub-group. This is surprising as we would expect youth without school qualifications to experience a higher relative minimum wage in comparison to youth in general. One explanation for this finding may be that youth with no school qualifications are more likely to be working full-time, while youth in general, may be more likely to be in part-time employment. Information on full/part-time status of employment provided in the HLFS proves this hypothesis to be correct. Over the time period of 1997 to 2004, youth with no qualifications were atleast 1½ times more likely on average to be working full-time. For example, in 1997, the percentage of youth working full-time was 38.5% compared to 60.7% of youth without qualifications.

Overall, Table 2 indicates that the current levels of minimum wage in NZ are more effective, in terms of being set closer to the median earning levels for all the above sub-groups.

4.3   Construction of minimum wage categories

Overseas research on the sub-groups of individuals that are most likely to work for the minimum wage has often pointed to individuals working in the retail industry, female-dominated occupations (e.g. cashiers); non-unionised workers; workers in the fast food industry (See Card and Krueger, 1994; Wimmer, 1996); and younger and less skilled workers (See Neumark, 1999).

Research in Australia by Richardson (1998) showed that low-wage earners in general were found throughout the household income distribution spectrum. They were not only young people just entering the workforce and living at home. She found that the average age of low-wage workers was in the mid-thirties for both genders.

A more detailed analysis was carried out by Card and Krueger (1995), who tabulated wage data against other characteristics of individuals to find sub-group(s) of workers more likely to be at risk when there was a minimum wage increase in the U.S. in 1990. These workers consisted of proportionately more women, non-white individuals, younger workers and individuals living in poverty.

In NZ, "details on who is being paid at the minimum are sketchy" (Luke, 2000, p.5). There is a little informal evidence that the following types of individuals are most at risk when the minimum wage is increased: Maori and unskilled workers; Workers receiving some form of assistance through the tax-benefit system (Hide, 2000); and workers under the age of 25 (CTU Submission, 1998). In an attempt to verify the informal evidence and to provide new and more detailed descriptions of minimum wage workers, information on the earnings of workers from the IS has been cross-tabulated against the characteristics of workers information from the HLFS. This has been conducted in a similar fashion to Card and Krueger (1995), although many more descriptive variables have been identified, such as region.

Three groups were set up, based on the individual's regular usual hourly earnings (r_earn):
- Individuals earning below current minimum wage ("sub-minimum workers").
- Individuals earning more than or equal to the current minimum wage but less than 10% above that minimum ("minimum wage workers").
- Individuals earning 10% or more above their particular minimum wage ("other workers").

Table 3 presents numbers and percentages of the annual and full sample that constitute the sub-minimum and minimum wage workers.

< Insert Table 3 here >

As Table 3 illustrates, there was a general decline in the number of sub-minimum and minimum wage workers from 1997 to 1999. This is due to the erosion of the real minimum wage for both adults and youth during that time. Also evident are the substantial increases after 2001 in the numbers of sub-minimum and minimum wage workers, which coincides with rises in the real minimum wage. By 2004, affected workers, which comprise all workers earning at or below the minimum wage, made up 8.12% of the workers in this sample.

There are several explanations for the size of the sub-minimum group in Table 3. Firstly, it may include individuals working illegally for non-complying employers. The IS data source is annual and takes place in June each year. Any change in the minimum wage is usually enacted in March. Therefore, by June, some employers may still be unaware of any recent changes to the legislated minimum. A second explanation for the sub-minimum group is that it includes individuals exempt from the minimum wage. However, this group should technically be very small due to the limited exemptions there are to the minimum wage in NZ.

The final explanation for this sub-minimum group is salaried workers who misreport their earnings and / or hours worked. However, as explained earlier all individuals reporting their usual weekly total hours to be more than 60 were removed from the final sample. This step

along with the other criteria (shown in Appendix A) used to derive the final sample were aimed at increasing the likelihood that individuals fall into their appropriate earnings category.

4.4 Characteristics of overall sample and wage sub-samples

Table 4 presents characteristics of the whole sample, versus the three earnings groups (sub-minimum, minimum wage and other workers). This information is provided for the entire eight year time period, as averages across the merged data give more consistent and robust results, rather than individual year estimates.

< Insert Table 4 here >

Demographic characteristics

The first column of Table 4 reports average characteristics for the full sample of workers. The average age is 39.41 years and slightly over one-half of the workers (50.95%) are women. Approximately 12% are Maori, while roughly 78% are Pakeha. Most of the individuals in the sample are born in NZ (82.31%), while for those not born in NZ, their average length of time in the country is just over 3 years.

Columns 2 and 3 of Table 4 shows how sub-minimum and minimum wage workers differ from the entire sample. Column 4 shows the characteristics of other workers. To highlight which characteristics are significantly different between the combined group of sub-minimum and minimum wage workers compared to other workers, t-tests were conducted, and the results are shown in column 4. Almost all characteristics are significantly different when comparing affected workers to other workers. Another set of t-tests were also conducted to compare which characteristics were significantly different between the sub-minimum workers and minimum wage workers. The results of these t-tests are shown in column 3. At first glance of the table, it seems fairly obvious that there are much fewer characteristics that are significantly different between the two sets of affected workers, (i.e. sub-minimum versus minimum wage workers), compared to the results of comparing the affected workers to other workers.

Focussing on minimum wage workers, the individuals expected to be directly at risk when the minimum wage rises, this group contains proportionately more women, Maori and Pacific Islanders and employees aged under 25. However, over half of this group (59.53%) are over 25 years old and over three quarters (75.98%) are 20 years old or over. These figures are comparable to Card and Krueger's (1995) findings of 50% of workers affected by the minimum wage increase in the U.S. in 1990 were over the age of 24 and 70% were 20 years or older.

There isn't much of a difference in the percentage of workers NZ born, but individuals not born in this country are likely to have lived here for a shorter time period if they are a minimum wage worker. In terms of education[3], minimum wage workers appear to have much less education. Over a third (34.97%) having no school qualifications, and only 3.57% having a bachelor's or masters qualification. As for region, although most minimum wage workers live in a major urban area (67.04%), they are still more likely to live in a minor urban or rural area in comparison to workers in column 1.

Sub-minimum workers have similar demographic characteristics to the minimum wage workers, except that they are relatively older, have lived in NZ longer and have more education. These characteristics may be the result of this group of workers consisting of both workers who are truly experiencing sub-minimum wages and also some workers whose reported earnings contain measurement error.

Hours of work & Earnings characteristics

Table 4 shows that the average worker in this sample worked 35.46 hours each week and 77.13% of all workers were working full-time. The characteristics of the minimum wage workers in these aspects were vastly different. Only 50.26% of them worked full-time and the average minimum wage worker worked 26.74 hours on average in a usual week (0.20 being overtime).

The average worker in this data sample had real usual regular hourly earnings more than twice that of the minimum wage worker. Table 4 also shows how important the wage workers in this sample are to their household earnings. Sub-minimum and minimum wage workers contribute a much smaller share of their household income in comparison to the rest of the workers in the sample (one-third compared to one-half). This information is enlightening because it tells us that minimum wage workers are not the primary earners of their households. The table also reveals if the individual received any transfer income. Although these figures show that affected workers are more likely to receive any transfer income in comparison to other workers, other workers are still highly likely to receive transfer income. In fact, almost a quarter (23.6%) of other workers received some form of transfer income.

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[3] There are six levels of highest qualification that are consistent across the time period 1997 to 2004: individuals with no school qualifications; school certificate; sixth form or bursary; a diploma; a bachelor's degree; and finally a masters degree.

Household characteristics

Household income level and a variety of household structure variables are produced for the different earnings groups in Table 4. Firstly, the real average household income has a positive relationship with the individuals' level of hourly earnings. This is not necessarily the expected outcome. This is because sub-minimum and minimum wage workers consist of many young workers and workers who, in general, provide a small share of the household income from their earnings. These characteristics potentially indicate that many affected workers could belong to households with high total incomes. However, this is not the case, as affected workers are shown on average to belong to the households with the lowest household income.

It also appears that minimum wage workers are less likely to be married and live alone and more likely to be in a single-parent household with dependents, and on average, in a larger household.

Industry characteristics

The industry affiliations of the different wage sub-groups are also depicted in Table 4. More detailed industry analysis of minimum and sub-minimum wage workers is presented in Pacheco and Naiker (2006) where the focus was on pinpointing types of low-wage employers and analysing the impact of minimum wage increases on their expected profit levels.

Three industries (agriculture, forestry and fishing; retail trade; and accommodation, cafes and restaurants) stand out as containing a disproportionate number of minimum wage workers. They are the only three industries that have a higher representation in the minimum wage workers sub-group compared to the full sample of workers. More than 40% of minimum wage workers are employed in retail trade or accommodation, cafes and restaurants. Additionally, nearly one out of every ten minimum wage workers (9.81%) work in the agriculture, forestry and fishing sector. This is in comparison to just over 5% of the full sample of workers working in this sector. This isn't a surprise as minimum wage workers were found to be more likely to live in a minor urban or rural area in comparison to other workers.

Another large grouping of affected workers is located in the manufacturing industry. However, this figure (12.53% of minimum wage workers) is lower than the sample percentage of manufacturing workers of 17.72%. To further understand which particular sector of the manufacturing industry contains the minimum wage workers, this category was further broken down. The main sector found to contain the bulk of the minimum wage workers was textile and apparel. This finding is backed by informal evidence on research into the collective contracts in the textile industry (Luke, 2000).

Sample characteristics

Table 4 provides information on the relative size of the whole sample and the sub-groups of different workers. Also shown is the percentage of data in each sub-group that is imputed or proxy information. Because the HLFS survey is often conducted by proxy interview, Statistics NZ sometimes needs to impute missing responses in the IS. It is important to note that the level of proxy information for the sub-minimum group is double the sample average. This is an indication that the figures within this group maybe less reliable compared to the minimum wage workers sample. However, the t-test shows that there isn't a significant difference, and as Hyslop and Stillman (2004) note in their analysis of the youth minimum in NZ, there will be significant potential for large sample selection bias caused by excluding the number of imputed or proxy responses from this analysis.

5. Probability of earning minimum wage

This study has so far found several useful descriptors of sub-minimum and minimum wage workers. These characteristics are the focus of the following regression analysis, which estimates the probability of a worker earning at or below the minimum wage. A probit model is set up (equation 1) to predict someone's probability of being affected by the minimum wage, conditional on their observed characteristics.

$$P_i = P(MW_i = 1 | X_i, EMP_i = 1) \tag{1}$$

$MW_i = 1$ if the individual is a sub-minimum or minimum wage worker. This combined group is used under the assumption that any measurement error in the sub-minimum group and hence in the dependent variable is unrelated to the demographic characteristics of these workers. The regression is run for only those employed in the data sample. X is a vector of characteristics expected to influence the probability of the worker earning at or below the minimum wage. These are explained in further detail when interpreting the marginal effects obtained from this analysis in Table 5.

Three alternative specifications are trialled. The simplest is specification 1, where X includes general demographic characteristics of the worker such as their individual, educational, regional, household and industry information. Specifications 2 and 3 sequentially add more independent variables.

$$P_i = P(MW_i = 1 | X_i, \ln RMW_i, EMP_i = 1) \tag{2}$$

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In specification 2, $\ln RMW_i$ is a policy variable - the log of the real minimum wage. This variable is added as it is expected that the higher the applicable real minimum wage for the individual at the time, the higher the probability of being employed at or below that minimum wage.

$$P_i = P(MW_i = 1 | X_i, \ln RMW_i, \ln RMW_i * Z_i, EMP_i = 1) \qquad (3)$$

Specification 3 includes a set of interaction variables, where the log of the real minimum wage ($\ln RMW_i$) is individually interacted with a set of characteristics of the individual - age, gender, ethnicity, education, region and industry (Z_i)[4]. The expectation is that the probability of earning the minimum wage varies by the level of the real minimum wage and at the same time varies by these particularly important individual characteristics.

< Insert Table 5 here >

The regression results provided in Table 5 make use of similar characteristics to those used in the descriptive analysis in section 4 of this paper. In terms of age, gender, ethnicity and whether the individual was born in NZ, the estimated marginal effects are all significant and in the expected direction. For example, in specifications 1 and 2, a positive influence on the probability of earning at or below the minimum wage is estimated if the individual is Maori. This becomes a statistically significant negative effect in specification 3 when the lnRMW*Maori variable is introduced, along with other real minimum wage variables. This is because the marginal effect on the lnRMW*Maori variable captures some of the positive influence of being Maori on the individual's probability of earning minimum wage. In specification 3, the total impact of being Maori is made up of the following two components:

$\dfrac{\partial P_i}{\partial Maori_i} = -0.0487 + \overline{\ln RMW} * 0.0571 = 0.06219$ where $\overline{\ln RMW}$ is the mean of lnRMW (1.942).

Hence, in this specification, being Maori, relative to the excluded group of Non-Maori and Non-Pacific Islanders, increases the probability of earning at or below the minimum wage by 6.22% points. More importantly, the marginal effect on the variable lnRMW*Maori illustrates how the ethnic sub-group of Maori are more affected by a rise in the real minimum wage relative to non-Maori and non-Pacific Islanders.

In terms of educational attainment, the likelihood of earning the minimum wage is less for all levels of education, in comparison to the control group (those with no school qualifications). Also, in general, the likelihood of earning at or below the minimum wage steadily decreases with higher educational qualifications.

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[4] Z is essentially a subset of the characteristics contained within the vector X.

Household characteristics represent the next subsection of Table 5. Figures in this section imply that the real average other household income has an insignificant effect (in specification 3, and extremely small and barely significant in specifications 1 and 2) on the likelihood of the individual earning the minimum wage. This indicates that the earning levels of other household members do not seem to have a significant effect on the individual earning at or below minimum wage and hence that it is the individual's own characteristics (such as their age especially) that result in them earning minimum wage or lower.

In the industry characteristics analysis, the excluded group consisted of those working in Mining, Electricity, Defence and Other services. Four key sectors stand out in specifications 1 and 2, as strongly increasing the individual's probability of earning at or below the minimum wage - agriculture, forestry and fishing, retail trade, accommodation, cafes and restaurants, and personal and other services. Besides industry, no other employment-related variables were included in this analysis, due to the risk of these variables being endogenous. For example, although minimum wage workers are more likely to be working part-time, it is difficult to know whether the individual is earning minimum wage because they are working part-time or whether because they are earning minimum wage, they are only receiving part-time hours. Another motivation for the exclusion of the employment related variables such as full/part-time status, is that other variables in the model should already capture this effect (e.g. household and individual characteristics are variables that could be used to determine part/full-time status of the worker).

From specification 2 onwards, real minimum wage variables are added to the probit analysis. Specifically, the level of the real minimum wage the individual faces, and then that interacted with the gender, ethnicity, age, education, region and industry variables. The findings are clear, the higher the real minimum wage, the higher the probability the individual will be earning at or below the minimum wage. Specifically, if the real minimum wage increases by 10%, the probability of earning at or below the minimum wage increases by 1.438% points. This is large relative to the sample mean of the dependent variable (5.75%). Adding another 1.438% points to this sample mean, for a 10% rise in the real minimum wage, is essentially a 25% increase.

In equation 3, results suggest that the probability of facing a minimum wage increases with a change in its real level and varies by certain 'at risk' demographic characteristics (being female, Maori or Pacific Islander, aged 16-24, having a low level of educational qualifications). Being young definitely seems to be a key 'at risk' individual characteristic. For example, when the youth minimum wage was introduced for 16-19 year olds in March 1994, (relative to the

control group of 60-64 year olds), being aged 16 increased the estimated[5] probability of earning the minimum wage or below it, by 12.15% points. This effect decreases as age increases, becoming 10.10, 9.29 and 7.97% points for 17,18 and 19 year olds respectively. Using the latest level of the real minimum wage in the sample period under study (March 2004), increasing the minimum wage now increases the probability of 16 year olds earning the minimum wage by 16.48% points, relative to 60-64 year olds.

Other particularly interesting results from specification 3 are the interactions between industry sectors and the level of the real minimum wage. Previously, under specifications 1 and 2, individuals were strongly and significantly more likely to be earning the minimum wage if in four key industry sectors. Under specification 3, this picture changes, with agriculture, forestry and fishing being the only industry out of the four that still has a large and significant positive marginal effect on the probability that the individual is earning at or below minimum wage. The reduced likelihood of earning the minimum wage in the third specification, if in the sectors of retail trade, accommodation, cafes and restaurants and personal and other services, is probably due to the marginal effects indirectly indicating the impact of being a youth, since youth are more prevalent in these industries. To test this hypothesis, specification 3 was rerun with no variables interacted with the log of the real minimum wage besides the industry sectors. Under this specification, the marginal effects on the probability of earning the minimum wage became positive for all industry sectors again, relative to the control group. This is more than likely due to the predominance of the types of individuals that are at risk to the minimum wage in these industries (i.e. youth, females, individuals with low levels of education). Consequently, with the removal of these variables interacted with the level of the real minimum wage – the positive marginal effect of these individuals' characteristics as the minimum wage rises was exhibited through the industries these individuals are affiliated with.

Lastly, fit measures for specifications 1 to 3 indicate an increase in goodness of fit as you move from the first specification forward, and a Wald test conducted in specification 3 rejected the joint hypothesis that all the coefficients on the set of independent variables $\ln RMW_i * Z_i$ were equal to zero. Hence, specification 3 adds further explanation to the probability of an individual earning at or below the minimum wage, compared to specification 2.

The coefficient estimates from these three specifications are next used to create a probability of the individual earning the minimum wage for all individuals in the HLFS-IS data (i.e. no longer restricting analysis to only those employed).

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[5] The introduction of the minimum wage for 16-19 year olds in March 1994 happened outside the sample period under study. Hence, these calculations are based on the assumption that the estimated marginal effect found in the sample time period can also be applied to changes to the minimum wage three years prior.

$$\hat{P}(MW_i = 1) = \Phi(\hat{\beta}'X) \tag{4}$$

Equation 4 returns the probability from the standard cumulative normal distribution of the individual earning at or below the minimum wage. The mean of this probability under all three specifications is compared between the employed sub-sample of 94318 individuals and the full HLFS–IS sample (only removing individuals not employed if under 16 or over 64, or disabled, or retired, or with no household income information; and applying the same criteria as shown in Appendix A if the individual is employed) of 134,884 individuals. In conducting this comparison, the assumption of no sample selection bias is being made (i.e. that non-workers and workers with the same X characteristics face the same probability of working at the minimum wage).

Because all three specifications include industry affiliation information on individuals, sample means of these industry characteristics are imputed for the non-employed individuals in the full sample. The comparison of the means of the probability of earning at or below the minimum wage between the employed and full data samples is shown in Table 6.

< Insert Table 6 here >

Table 6 shows that the probability of earning at or below the minimum wage, is always higher for the full sample, no matter what specification is used. For example, using specification 1, 5.74% of the employed sub-group earn at or below the minimum wage. This proportion increases to 6.92% for the full sample, and consequently indicates that the risk factor for the non-employed group is higher than the employed group (9.66% versus 5.74%). This is interesting as it shows that the current estimates of the percentage of at risk individuals are probably an understatement of the true value. This is because non-workers who may face wages around the minimum wage are not counted in the incidence measure. This understatement is enlarged if minimum wage increases reduce the employment opportunities for these individuals.

To further illustrate the impact of the rising minimum wage in recent years, the same predicted probabilities of earning at or below the minimum wage were done for each year between 1997 and 2004 inclusive under the preferred specification 3.

< Insert Figure 1 here >

Figure 1 shows that the estimated proportion of non-workers at risk of earning at or below the minimum wage is always higher than the proportion of workers receiving the minimum wage. The trends for all three sub-groups 'at risk' status is an increasing one. The proportion of the employed group earning at or below the minimum wage in 1997 is 4.5%, and the

corresponding estimated figure for the non-employed group is 7.6% (estimated proportion if these individuals were working). These figures increase to 8.9% and 17.3% respectively by 2004. This is essentially a doubling of the proportion of affected individuals in the employed group and a more than double increase in the estimated proportion of affected individuals in the non-employed group. The gap between the employed and non-employed proportions is definitely increasing and this may be an indication that as the minimum wage rises, those most affected are forced from the employed into the non-employed sub-group.

6.   Conclusion

The initial contribution of the paper was to show the rise in the incidence of the minimum wage. This was done by looking at the relative minimum wage for different sub-groups and finding that although this has increased across the board for all groups, it has increased at a faster speed for some groups – specifically youth, females, individuals with no qualifications and part-time workers. The minimum wage has clearly become more binding for these individuals over the time period 1997 to 2004.

This study then described the key demographic, household, educational, regional and industry characteristics of both sub-minimum and minimum wage earners. Workers affected by the minimum wage, and hence likely to be at risk to further minimum wage increases tend to be: younger (aged 16-24), female, Maori or Pacific Islander, have lower educational qualifications, live in a minor urban or rural area, work part-time, live in a larger household and work in the industries of retail trade, accommodation, cafes and restaurants, textile and apparel or agriculture, forestry and fishing.

Next, section 5 showed that the probability of an individual being affected by the minimum wage increased with the level of the minimum wage and that this increase was disproportionate for different individuals, depending on their characteristics. Results showed that there was an unequal minimum wage incidence associated with rises in the real minimum wage, especially for youth and Maori and Pacific Islanders. Results also indicated that it was the individual characteristics of the person, such as age, which were much more important and significant than the household circumstances or industry affiliations of the individual. The analysis in section 5 ended by showing that the observed minimum wage incidence over the period 1997 to 2004 is significantly lower than the estimated minimum wage incidence if non-workers are included in the sample. Importantly, the gap between the groups is significantly increasing over time as well.

Appendix A   **Construction of the sample**

The data used in this analysis is taken from the HLFS-IS: 1997 to 2004. The following sequential criteria was used to select the sample.

Selection criteria	Number of observations deleted
Total observations = 299026	
Removing individuals:	
1. Aged under 16 or over 64	117502
2. That are disabled or retired	12892
3. Who don't work positive weekly hours (usual)	68495
4. Who don't earn positive weekly wages (usual)	26
5. Who are not employed	122
6. Who reported usual overtime weekly earnings / hours to be larger than usual total weekly earnings / hours	32
7. With usual regular hourly wage less than $1 per hour	101
8. With usual regular hourly wage more than $1000 per hour	1
9. With no information on household income	764
10. Who report income from self-employment	1130
11. Who report usual total weekly hours > 60	2150
12. Who report usual earnings from all their wage and salary jobs more than total household income	1493
Remaining observations in June 1997 – June 2004 sample =	94318

Source: HLFS - IS data. Author's compilation.

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Table 1
Nominal hourly minimum wage changes: 1984 - 2004

Date of change	Age groups			
	15 years	**16-17 years**	**18-19 years**	**20 years +**
Pre February 1985	No minimum applies	No minimum applies	No minimum applies	2.500
February 1985				2.800 (12.0)
September 1985				4.250 (51.8)
February 1987				5.250 (23.5)
February 1988				5.625 (7.1)
May 1989				5.875 (4.4)
September 1990				6.125 (4.3)
March 1994		3.68	3.68	6.125 (---)
March 1995		3.75 (1.9)	3.75 (1.9)	6.250 (2.0)
March 1996		3.83 (2.1)	3.83 (2.1)	6.375 (2.0)
March 1997		4.20 (9.7)	4.20 (9.7)	7.000 (9.8)
March 2000		4.55 (8.3)	4.55 (8.3)	7.550 (7.9)
March 2001		5.40 (18.7)	7.70 (69.2)	7.700 (2.0)
March 2002		6.40 (18.5)	8.00 (3.9)	8.000 (3.9)
March 2003		6.80 (6.3)	8.50 (6.3)	8.500 (6.3)
March 2004	7.20 (5.9)	7.20 (5.9)	9.00 (5.6)	9.000 (5.6)

Source: Department of Labour. All figures for nominal gross hourly wages ($). The statistics in parenthesis are the percentage change in the nominal hourly wage.

Table 2
Minimum wage relative to median hourly earnings: June 1997 to June 2004

Minimum wage / median wage	1997	1998	1999	2000	2001	2002	2003	2004
Female adults	0.58	0.58	0.56	0.61	0.58	0.60	0.62	0.61
Male adults	0.48	0.47	0.47	0.50	0.50	0.50	0.53	0.53
Female youth	0.56	0.56	0.55	0.52	0.68	0.80	0.85	0.85
Male youth	0.56	0.58	0.51	0.58	0.73	0.80	0.80	0.85
16,17 year olds	0.60	0.65	0.65	0.65	0.69	0.80	0.85	0.85
18, 19 year olds	0.54	0.50	0.48	0.51	0.81	0.84	0.89	0.88
20+ year olds	0.54	0.52	0.51	0.54	0.52	0.54	0.57	0.56
No qual adult[6]	0.67	0.61	0.64	0.69	0.63	0.67	0.68	0.72
No qual youth	0.60	0.67	0.50	0.54	0.64	0.80	0.91	0.84

Source: HLFS - IS data for median hourly earnings. Minimum wage levels are supplied by the labour market policy group. Author's compilation.

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[6] No qual = Individuals with no school qualifications.

Table 3
Number of sub-minimum and minimum wage workers: June 1997 to June 2004

Year	Number of workers (Percentage of sample)	
	Sub-minimum workers	Minimum wage workers
1997	311 **(3.08)**	245 **(2.43)**
1998	275 **(2.48)**	144 **(1.30)**
1999	262 **(2.38)**	161 **(1.46)**
2000	282 **(2.41)**	252 **(2.16)**
2001	313 **(2.60)**	284 **(2.36)**
2002	368 **(2.84)**	517 **(3.99)**
2003	430 **(3.34)**	557 **(4.33)**
2004	381 **(3.03)**	639 **(5.09)**
1997-2004	2622**(2.78)**	2799**(2.97)**

Source: HLFS - IS data. In parentheses is the percentage of workers in the sample that fall into the particular category. Author's compilation.

Table 4
Characteristics of workers: June 1997 to June 2004

	Full sample of workers	Sub-minimum workers	Minimum wage workers	Other workers
Total (%)	100	2.78	2.97	94.25
Demographic characteristics:				
Average age (years)	39.41	35.29	32.74[+++]	39.74***
Percentage aged 16 – 17	2.20	10.35	9.89	1.72***
Percentage aged 18 – 19	2.54	9.80	14.12[+++]	1.96***
Percentage aged 20 – 24	8.16	10.29	16.45[+++]	7.83***
Percentage aged 25 +	87.10	69.56	59.53[+++]	88.49***
Percentage female	50.95	60.87	67.84[+++]	50.12***
Percentage Maori	11.55	18.42	15.34	11.23***
Percentage Pacific Islander	4.90	4.99	6.66[+++]	4.84***
Percentage Pakeha	78.05	68.99	69.35[++]	78.59***
Percentage NZ born	82.31	82.52	82.05	82.31
Average years in NZ[7]	3.05	2.54	1.87[+]	3.10***
Education (highest qualification):				
Percentage with no school qualifications	23.65	35.58	34.97	22.95***
Percentage with school certificate	14.14	18.57	21.59	13.77***
Percentage with Sixth Form or Bursary	13.67	15.84	20.35[+++]	13.39***
Percentage with diploma	35.47	24.43	19.52[+++]	36.30***
Percentage with bachelor's degree	9.26	4.26	2.96[+]	9.60***
Percentage with masters degree	3.80	1.32	0.61	3.98***
Regional information:				
Percentage living in a major urban area	73.03	65.98	67.04	73.42***
Percentage living in a minor urban area	17.60	19.23	23.41[++]	17.37***
Percentage living in a rural area	9.37	14.80	9.56[+++]	9.21***
Hours of work & Earnings characteristics:				
Percentage working full-time[8]	77.13	47.98	50.26	78.82***
Usual total weekly hours	35.46	27.22	26.74	35.97***
Usual overtime weekly hours	0.34	0.11	0.20	0.35***
Real average usual hourly earnings ($)	15.23	5.69	7.64[+++]	15.74***
Share of household income from earnings of main job (%)	54.51	28.16	31.75[+++]	55.99***
Percentage receiving any transfer income	23.68	25.40	25.22	23.58
Household characteristics:				
Real average weekly household income ($)	1142.98	839.82	934.28[+++]	1158.3***
Percentage married	68.31	50.30	46.77[+++]	69.52***
Percentage one person households	8.14	7.00	4.73[++]	8.28***
Percentage single-parent households with dependents	10.31	15.37	16.72[++]	9.96***
Percentage two-parent households with dependents	45.11	49.20	47.34[++]	44.92***
Average number of people in household	3.06	3.29	3.37	3.04***
Industry characteristics:				

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[7] This statistic is only calculated for people not born in NZ.
[8] The HLFS defines full-time employment as persons who usually work 30 or more hours per week, while part-time employment is those who usually work less than 30 hours.

Percentage in each earnings category working in:

Agriculture, Forestry and Fishing	5.05	10.96	9.81[++]	4.73***
Manufacturing	17.72	9.10	12.53[+++]	18.13***
Construction	5.13	3.80	2.71	5.25***
Wholesale trade	4.94	2.24	2.26	5.10***
Retail trade	12.41	19.22	29.33[+++]	11.67***
Accommodation, Cafes and Restaurants	4.53	7.97	13.35[+++]	4.15***
Transport and Storage	3.94	3.50	1.65[+++]	4.03***
Finance and Insurance and Communication Services	5.08	3.38	1.52[+++]	5.24***
Property and business Services	8.34	8.45	4.58[+++]	8.46***
Education	9.75	7.71	5.35[+++]	9.95***
Health and Community Services	10.39	10.67	9.78[++]	10.40***
Cultural and Recreational Services	1.91	2.57	1.71	1.90
Personal and Other Services	3.98	7.88	3.92[+++]	3.88***
Other Services	6.41	2.36	1.24[+++]	6.69***

Sample characteristics:

Percentage imputed data	14.05	17.16	13.24[+]	13.99
Percentage proxy data	1.81	3.63	2.49	1.74***
Sample size	94318	2622	2799	88897

Source: HLFS - IS data. Author's compilation.
Note: [+] 10%, [++] 5%, [+++] 1% significance level difference in characteristics of sub-minimum workers compared to minimum wage workers.
* 10%, ** 5%, *** 1% significance level difference in characteristics of the combined group of sub-minimum and minimum wage workers compared to other workers.

Table 5 **Estimated marginal effects for the probability of earning at or below the minimum wage**

	(Partial derivatives computed at the means of Xs)		
	Specification		
	1	**2**	**3**
Demographic characteristics:			
Age	-0.0078***	-0.0111***	-0.0022
Age squared	0.0009***	0.0001***	0.0004*
Female	0.0083***	0.0089***	-0.0683***
Maori	0.0119***	0.0095***	-0.0487***
Pacific Islander	0.0154***	0.0103***	-0.0360***
NZ born	-0.0475***	-0.0468***	-0.0459***
Time spent in NZ	-0.0013***	-0.0012***	-0.0012***
Education (highest qualification):			
School certificate	-0.0141***	-0.0126***	-0.0267*
Sixth form or Bursary	-0.0182***	-0.0178***	-0.0315**
Diploma	-0.0281***	-0.0285***	-0.0142
Bachelors	-0.0336***	-0.0334***	0.1282
Masters	-0.0328***	-0.0317***	0.9266***
Household characteristics:			
Real average other household income ($000)	0.0161*	0.0160*	0.0049
Married	-0.0325***	-0.0331***	-0.0281***
Married * Female	0.0195***	0.0185***	0.0142***
Single-parent household	0.0046**	0.0052**	0.0025
Two-parent household	0.0054***	0.0086***	0.0048***
Average number of children under 5 in the household	0.0008	-0.0001	0.0017
Average number of children under 5 * Female	0.0067***	0.0058**	0.0073***
Average number of dependents above 4 and below 18 in the household	0.0040***	0.0073***	0.0028***
Average number of dependents above 4 and below 18 * Female	0.0010	0.0003	0.0025**
Industry characteristics:			
Agriculture, Forestry and Fishing	0.0871***	0.0809***	-0.0613***
Manufacturing	0.0131***	0.0111***	-0.0784***
Construction	0.0226***	0.0166***	-0.0494***
Wholesale trade	0.0120**	0.0100*	-0.0434***
Retail trade	0.0600***	0.0588***	-0.0853***
Accomodation, Cafes and Restaurants	0.0612***	0.0556***	-0.0617***
Transport and Storage	0.0245***	0.0210***	-0.0488***
Finance and Insurance and Communication Services	0.0038	0.0024	-0.0368**
Property and Business Services	0.0295***	0.0285***	-0.0456***
Education	0.0313***	0.0286***	-0.0582***
Health and Community Services	0.0302***	0.0277***	-0.0940***
Cultural and Recreational Services	0.0362***	0.0331***	-0.0398***
Personal and Other Services	0.0833***	0.0790***	-0.0376***
Regional dummies included	Yes	Yes	Yes
Real minimum wage variables			

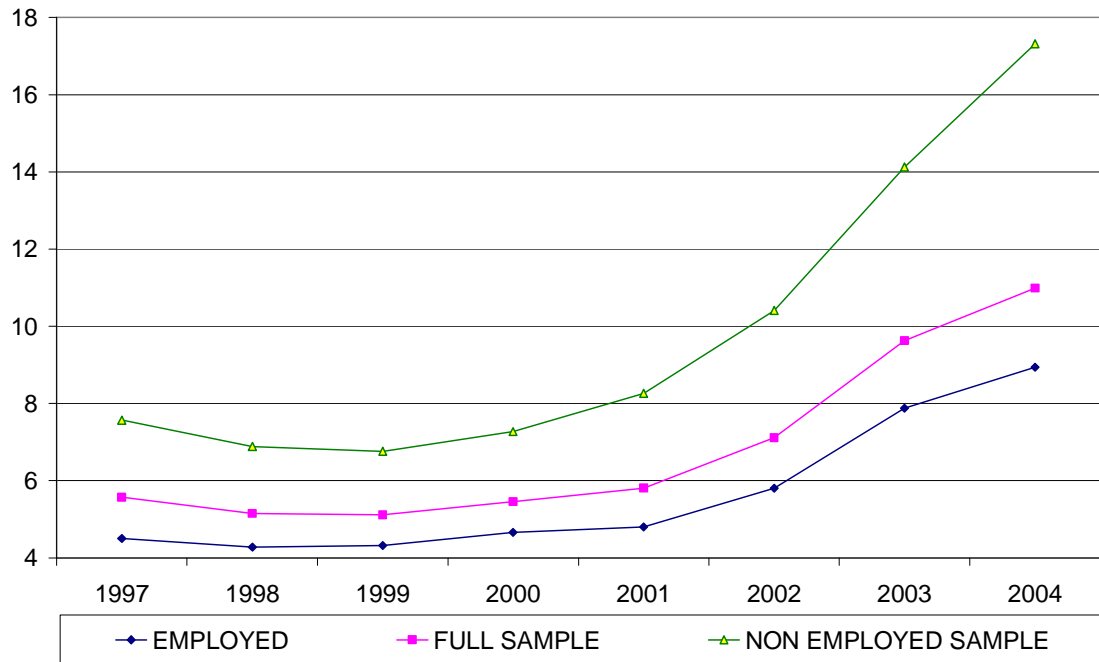|			
Log of real minimum wage(LnRMW)	-	0.1438***	-0.0081
LnRMW * Female	-	-	0.0379***
LnRMW * Maori	-	-	0.0571***
LnRMW * Pacific Islander	-	-	0.0407
LnRMW * Age16	-	-	0.0912***
LnRMW * Age17	-	-	0.0758***
LnRMW * Age18	-	-	0.0697***
LnRMW * Age19	-	-	0.0598***
LnRMW * Age 20	-	-	0.0408***
LnRMW * Age 21	-	-	0.0330***
LnRMW * Age22	-	-	0.0291***
LnRMW * Age23	-	-	0.0302***
LnRMW * Age24	-	-	0.0270***
LnRMW * Age25	-	-	0.0211**
LnRMW * Age26	-	-	0.0252***
LnRMW * Age27	-	-	0.0223**
LnRMW * Age28	-	-	0.0240***
LnRMW * Age29	-	-	0.0205**
LnRMW * Age3034	-	-	0.0169**
LnRMW * Age3539	-	-	0.0138*
LnRMW * Age4044	-	-	0.0098
LnRMW * Age4549	-	-	0.0076
LnRMW * Age5054	-	-	0.0028
LnRMW * Age5559	-	-	0.0008
LnRMW * School certificate	-	-	0.0094
LnRMW * Sixth form or Bursary	-	-	0.0122
LnRMW * Diploma	-	-	-0.0070
LnRMW * Bachelors	-	-	-0.0595
LnRMW * Masters	-	-	-0.1783*
LnRMW*Agriculture, Forestry and Fishing	-	-	0.0789*
LnRMW*Manufacturing	-	-	0.0667*
LnRMW*Construction	-	-	0.0178
LnRMW*Wholesale trade	-	-	0.0265
LnRMW*Retail trade	-	-	-0.0091
LnRMW*Accomodation, Cafes and Restaurants	-	-	0.0013
LnRMW*Transport and Storage	-	-	-0.0192
LnRMW*Finance and Insurance and Communication Services	-	-	-0.0299
LnRMW*Property and Business Services	-	-	0.0132
LnRMW*Education	-	-	0.0045
LnRMW*Health and Community Services	-	-	-0.0493*
LnRMW*Cultural and Recreational Services	-	-	-0.0171
LnRMW*Personal and Other Services	-	-	-0.0310
LnRMW*each regional dummy included			Yes
Fit Measures			
Rsqrd_ML[9]	0.05196	0.05909	0.06619
Akaike I.C.	0.38755	0.38002	0.37354
Sample size	94318	94318	94318

Source: HLFS - IS data. Note: *10% significance level, ** 5% significance level, *** 1% significance level, two-tailed test. Author's compilation.

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[9] Rsqrd_ML is the maximum likelihood method of calculating the modified R squared in probit regression.

Table 6	Probability of facing the minimum wage		
Specification	Employed sample	Full sample	Non-employed sample
1	5.74	6.92	9.66
2	5.75	6.80	9.25
3	5.74	6.89	9.57
Sample size	94318	134884	40566

Source: HLFS – IS data. Author's compilation.

Figure 1
Estimated proportion of workers and non-workers at risk of earning at or below the minimum wage

Source: HLFS – IS data. Author's compilation.