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Employment propensity: The roles of mental and physical health

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Abstract

This paper presents an investigation into the impacts of mental and physical health on the propensity to be employed. Health status is parameterised using three physical and three mental health indicators. After controlling for various socioeconomic factors, the application of limited dependent variable regression techniques generates results which indicate that activity-limiting physical health and accomplishment-limiting mental health issues significantly affect the propensity to be employed. Further investigations reveal gender and ethnicity divides and that health is exogenous to employment status.

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1. Introduction

This paper examines the relationship between employment propensity and various indicators of health status. This is an important area of research as poor health diminishes labour productivity, reduces labour force participation and can impose an additional cost on the economy in terms of loss of production. Understanding the relationship between health and employment is complex, not least because there are two potentially non-mutually exclusive categories of health status that should be considered: physical and mental.

The links between employment propensity and either physical or mental health cannot be easily generalised across a population. The mechanisms in which a range of health indicators affect individuals may depend on their gender, ethnicity and other demographic and socio-economic characteristics. There are marked differences across the lines of gender and ethnicity especially with respect to both health and labour market characteristics and, in particular, the narrowing gender gap in labour force participation. Although many studies have focussed on a range of covariates (including education, experience, training and individual characteristics) and their impacts on labour market activity, few have accounted for measures of both physical and mental health. This paper's main contribution aims to address this gap in the literature.

Analysis of the link between health status and labour market activity is strongly influenced by the ability to measure health indicators. Perhaps due to data limitations, much of the past international literature focuses on either physical or mental health,

and does not control for both. For example, Ojeda *et al*. (2010) analyzed the impact of mental health on labour supply in the US, but did little to control for the physical health characteristics of the individuals in their sample.[1] In contrast to many other studies that have used a limited number of health identifiers (Cai and Kalb, 2006; Pelkowski and Berger, 2004; Hamilton *et al*. 1997) that probably capture only one part of the multidimensional health issue, this study makes use of six self-assessed health variables that encompass both physical and mental health status.[2]

Another issue that this research tackles is the endogenous aspect of the relationship between health and employment. Very few previous empirical studies account for the possibility of reverse causality, and consequently the debate regarding the flow of causality between various labour market outcomes and health status is ongoing. Recent developments in this literature include Cai (2009), who confirms that a better health status has a positive and significant impact on wages and finds an insignificant reverse effect from wages to health, and Schmitz (2011), who focuses on the link between unemployment and mental health and finds no evidence of a reverse impact.

The remainder of this paper is organized as follows: Section 2 outlines the rich data source obtained from Statistics New Zealand and in particular details of the six health identifiers that are used in this study, Section 3 explains the econometric strategies undertaken, Section 4 reports the results and Section 5 concludes.

2. Data

[1] Apart from mental illness and mania delusions, the only other health covariate that Ojeda *et al.* (2010) included in their specifications was self-rated health.

[2] It is important to control for both physical and mental health status, as omitting either of these dimensions has the potential to bias the marginal effects estimated for the health variables that are included.

Thus far, and to the knowledge of the authors, there is no study of the effects of mental *and* physical health on employment propensity. Although many studies do analyse one or the other health status in various countries, no study exists that attempts to appreciate fully the multidimensional impacts of health on employment. A prime inhibitor to the initiation of such an analysis is data availability.

New Zealand appears to be similar to many other developed countries in that she has a growing awareness of the importance and consequences of physical and mental illness.[3] For instance, the Mental Health Commission (which is tasked with promoting mental health awareness and advocating the needs of the mentally ill) and the District Health Boards have recently been provided with additional funding from the government with the aim of improving mental health.[4] Despite an array of international studies on this topic, only Gibb *et al*. (2010) have analysed NZ data. Specifically, they made use of the Christchurch Health and Development Study that began in 1997 and they conducted a regression analysis focusing on three outcomes (workforce participation, income and living standard, and educational achievement) dependent on experiencing a psychiatric disorder early in life. Their research had a narrow focus on mental health status and did not control for physical health indicators. As such, the effects of mental *and* physical health on labour market outcomes for the different genders and ethnicities within NZ have not been studied thus far.

[3] Moscone *et al*. (2007) document mental health expenditure in England between 1998 and 2003 and show evidence of spatial interdependence of spending decisions across local authorities.

[4] See, for instance, a description of the mental health priorities and additional funding received by Mid Central District Health Board (2011).

The data used in this study is the New Zealand General Social Survey 2008 (NZGSS), which is a new source of information on physical and mental health characteristics of New Zealanders. It provides data on a wide range of social and economic outcomes of individuals aged 15 years and over. This multidimensional survey was carried out between April 2008 and March 2009 and a total of 8,721 people were interviewed regarding several aspects of their lives, such as education, paid work, income, social relationships and health. Respondents were randomly selected using a multi-stage sample design and interviewed face-to-face.

For the purpose of our study, the outcome variable of interest, and our dependent variable in the upcoming empirical analysis, is the employment status of the individual. This employment variable, the six health status indicators and the other covariates used in our analysis are described in Table 1.[5]

< Insert Table 1 about here >

Broadly speaking there are three physical health indicators (Physical health limiting, Pain and Energy) and three mental health indicators (Depression, Health social, Health accomplishing). All six variables have been coded in an analogous fashion (ordinal categorical variables ordered from one to five) such that the higher the value of the variable, the worse the health of the individual. For example, a value of five for the physical health limiting variable signifies that during the past four weeks, the respondent felt they were limited *all of the time* in their regular daily activities as a result of their *physical* health. Similarly, a value of five for the health social variable

[5] Although not shown in Table 1 for brevity, dummy variables for the age categories 15-19, 20-24, … 60-64 were also included in the analysis, with 30-34 year olds used as the control group.

indicates that during the past four weeks, the respondent felt that emotional problems interfered with their social activities *all of the time*. *A priori* reasoning of the effect of all six health variables on employment propensity suggests that their expected signs should all be negative.

It is important to note that there is the possibility of overlap between these physical and mental health variables. This can best be illustrated with an example: suppose that the interviewee was asked the question relating to the pain variable. Depending on the issues that the respondent had experienced recently, they could mistake the motive for the question as either physical pain or emotional pain.[6] Table 2 presents the correlation coefficients across all six health variables as well as the employment status variable. The highest correlation is between depression and health accomplishing, at 0.600, which can both be considered as mental health issues. As would be expected, all physical health variables are positively correlated, and the same can be stated for mental health variables. Also of interest is that all health variables are negatively correlated with employment status suggesting that, from a non-causal perspective, unemployment is positively correlated with poorer physical and mental health status.

< Insert Table 2 about here >

In terms of the descriptive statistics provided in Table 1, a couple of interesting patterns are immediately evident. First, in comparison to males, females' health perceptions are worse across all facets of physical and mental health (bar the energy variable), which is consistent with several previous studies on the topic of self-rated

[6] Also note, however, that the results presented later do not indicate that the pain variable significantly influences the employment propensity.

health (Green and Pope, 1999; Parslow *et al*., 2004). This gender difference is most visible when investigating self-rated reports of mental health, and particularly psychological distress (Gove and Tudor, 1973; Chesler, 1971). Past research investigating gender differences in physical illnesses show a more convoluted story. For instance, while morbidity rates tend to be higher for women (Marcus and Siegel, 1982), mortality rates and serious incapacitations are found to be higher for men (Verbrugge, 1976; Gove and Hughes, 1979).

While many arguments have been made as to why women report having poorer health, there are two that have become most prevalent in recent debates. First, the perception-reporting hypothesis states that the differences are due to perceptual differences, such as women being more aware of their symptoms and being more likely to recall and report them (Gijsbers van Wijk and Kolk, 1997). On the other hand, the social construction of gender hypothesis suggests that the differences stem from relative social roles and expectations regarding labour force participation patterns (Anson *et al*., 1993). For example, when Verbrugge (1989) accounted for the lower rate of paid labour involvement and the greater stress and unhappiness that women tend to feel, gender differences in morbidity disappeared.

Another pattern which emerges from Table 1 is that while it appears that most New Zealanders rated their different aspects of health status relatively well (evidenced by mean values closer to the value of one, rather than five), the energy variable again seems to stand out as being different. Specifically, all other health variable means range from 1.429 to 1.742, whereas the Energy variable had mean values of 3.682 and 3.501 for males and females, respectively. Reduced energy levels may be a symptom

of fatigued households trying to balance increasing work hours with family commitments.

In terms of the remaining descriptive information in Table 1, the sample is fairly evenly divided along the gender line (46.4% male) and there are three distinct ethnic groupings (Maori, Pacific Islanders and NZ European – also termed Pakeha in much of the NZ literature). Since the early 1990s, Statistics NZ has moved away from prioritising ethnicity data and instead enables respondents the opportunity to co-select a number of ethnicities to describe their background, and consequently, the sum of the ethnic groups is larger than 100%. This is truly reflective of the culturally diverse backgrounds in NZ and is the reason why Statistics NZ continue to emphasize the need to maintain multiple ethnicity responses in many of their surveys (Statistics NZ, 2005).[7]

Also of importance is the percentage of respondents who are employed.[8] Table 3 presents percentage of respondents split by gender and ethnicity. There are asymmetries in employment propensity across ethnicity and gender. The highest employment propensity is for NZ European males, where nearly 86 percent are in employment; this contrasts strongly with Pacific Island females, where fewer than 57 percent are in employment.[9]

< Insert Table 3 about here >

[7] It is important to note that ethnicity groupings in this sample are similar to those obtained on the national level. For instance, in the latest Census (2006), 14% of the population were classed as Maori, and this is in comparison to the 13.1% Maori in this survey.

[8] Note – this includes both full and part-time employment.

[9] Past research has found Maori and Pacific Islanders fare relatively less well compared to other ethnicities in gaining paid employment and there is evidence of these sub-groups bearing a disproportionate burden of unemployment in NZ (Winkelmann, 1997, 1999). Unfortunately taking account of discrimination and other labour market factors which may explain these patterns is beyond the scope of this study.

While these descriptive statistics give us a glimpse into possible health statuses and employment differences, the next section provides an outline of the specific econometric approaches that were used here to investigate the complex relationships that exist between employment propensity and the six health status indicators.

3. Econometric approaches

In its simplest form, whether an individual is in employment or not can be represented by a dichotomous variable taking a value equal to 1 (one) if the individual is employed and a value of 0 (zero) otherwise. Econometric modelling of the determinants of employment in this sense will require a limited dependent variable approach. The probit and logit modelling approaches are based on the assumption that a continuous and unbounded variable, *Z*, is influenced by a set of independent variables, $X_{1..k}$, and a random disturbance term, ε, such that:

$$Z = \alpha + \beta_1 X_1 + \beta_2 X_2 + ... + \beta_k X_k + \varepsilon \quad (1)$$

This is a linear and additive form as the effects of the independent variables are assumed to be identical across all values of *X* and because the effect of each independent variable is the same regardless of the values of other independent variables.

The limited dependent variable approach builds on the assumption that *Z* cannot be observed directly and that a dichotomous indicator, *Y*, can be used instead where:

$$\begin{matrix} Y = 0 \\ Y = 1 \end{matrix} \quad if \quad \begin{matrix} Z \leq 0 \\ Z > 0 \end{matrix}$$

Thus, probit and logit modelling approaches assume no interaction among the independent variables in influencing the unmeasured continuous Z. However, in the probit model (often favoured by economists):

$$\Pr(Y = 1) = \Phi(Z) = \Phi(\alpha + \beta_1 X_1 + \beta_2 X_2 + ... + \beta_k X_k) \tag{2}$$

where $\Pr(Y = 1)$ denotes the probability that *Y* equals 1 and Φ is the cumulative normal distribution, and in the logit model where:

$$\Pr(Y = 1) = \frac{e^{(\alpha + \beta_1 X_1 + \beta_2 X_2 + ... + \beta_k X_k)}}{(1 + e^{(\alpha + \beta_1 X_1 + \beta_2 X_2 + ... + \beta_k X_k)})} \tag{3}$$

both functional forms are nonlinear and nonadditive because of the nonlinear relationships between each *X* and $\Pr(Y = 1)$ and the independent variables that interact when influencing this probability; nevertheless they retain the underlying assumption that the independent variables have a linear and additive effect on the unmeasured and unbounded *Z*.

Standard econometric textbooks illustrate that the probit and logit approaches assume that when $\Pr(Y = 1)$ is equal to 0.5 then it is most sensitive to changes in the values of the independent variables. However if the probabilities under scrutiny are likely to be slightly different, as are the probabilities of being employed across ethnicities and

gender, then a skewed limited dependent variable approach may be more appropriate. The scobit (sometimes called skewed logit) approach, which can be seen as a generalization of the logit approach, does not constrain the value of $\Pr(Y=1)$ to be equal to 0.5 when it is most sensitive to changes in the independent variables (*X*s) and may be favourable in this case.[10]

The underlying theoretical model that we estimate is:

$$E = \alpha + \beta_1 PH + \beta_2 MH + \beta_3 Ed + \beta_4 Eth + \beta_5 G + \beta_6 SE + \varepsilon$$

where *E* is our dichotomous variable equal to 1 (one) if the respondent is employed and equal to 0 (zero) otherwise, *PH* is a set of physical health variables, *MH* is a set of mental health variables, *Ed* are education dummies according to the level of achievement, *Eth* is a set of ethnicity dummy variables, *G* is a gender dummy variable and *SE* represents a set of other socioeconomic control variables which include parental status, marital statuses and age.

All three limited dependent variable approaches will be applied in the econometric estimation process presented below. Probits will be employed because of the useful underlying assumption that the cumulative distribution is normal. Logits will be employed because, although the underlying distribution assumes a logistic distribution, this approach permits greater interpretation through the use of odds-ratios.[11] Scobits are also employed because of the potential for the effects of the variables to be more sensitive at different points in the distribution for different

[10] See Nagler (1994) for details of this econometric approach.
[11] Calculated by estimating e^{β} (Tarling, 2009).

ethnicities and gender; applications of scobits also permit the interpretation of odds-ratios. Although the application of probit estimations may seem slightly constraining due to its underling cumulative normal distribution, tests for exogeneity through the use of instrumental variables can be easily executed with probits and be used to inform us whether the assumption that health is exogenous to employment status can be rejected. Additionally, application of all three approaches (probits, logits and scobits) can be seen as an attempt to identify whether the effects of explanatory variables on the employment decision are sensitive to functional form.

4. Results

Throughout this paper we present the coefficients for probit estimates and the odds-ratios for both the logit and scobit models. Table 4 presents the results of all three econometric approaches (probit, logit and scobit) for the full sample, as well as the sub-samples of males and females. It is important to recognise the stability of results across all three specifications and sub-samples; see, for example, the positive impact on employment propensity if the individual is male, the inverted U shaped effect of age, and the negative impact of all ethnicities (Maori, Pacific Islanders and others) relative to the control group of NZ European. Specifically, the logit model illustrates that Maori are approximately 53% less likely to be employed (odds-ratio of 0.654) relative to NZ European. This negative and highly significant effect is also stronger for male versus female Maori (odds-ratios of 0.562 versus 0.674, respectively).

< Insert Table 4 about here >

Many of the other covariates also yield expected results. For example, the presence of children in the household significantly reduces the employment propensity of the individual, and this impact is much stronger for females versus males. Having a partner increases the probability of being employed and in general, the higher the educational attainment, the better chance of being employed.

Turning our attention to the health variables and visually inspecting the results presented in Table 4, as expected all six variables have a negative effect on employment status, in terms of the whole sample. However, not all health related variables have an impact on employment status when referring solely to their statistical significance. The two variables with the strongest effects are physical health-limiting and health-accomplishing, which are both statistically significant at the 1% level. According to the odds-ratios that are the result of our fitted model, a one-unit increase in the health-accomplishing variable results in a reduction of employment propensity by 18% on average for the whole sample (approximately 11% and 22% for males and females, respectively). Similar results for physical health-limiting are obtained where a one-unit increase in this variable results in a reduction of employment propensity by 38% on average for the whole sample (approximately 61% and 25% for males and females, respectively). These results indicate the importance of both physical and mental health issues on employment status.

Additionally, based on the generalised results for the whole sample, it appears that poor mental health has a greater impact on labour market outcomes, in comparison to physical health. There is statistical evidence via the scobit results which indicate that all three mental health variables (depressed, health-social and health-accomplishing)

have statistically significant effects on employment propensity, and the same cannot be said for the physical health variables. These results therefore suggest that from a policy perspective improving mental health awareness is of vital importance when attempting to improve productivity via increased labour force participation.[12]

There are some results that are worthy of further investigation. For instance, although physical health-limiting is consistently statistically significant across all results, health-accomplishing appears to be less important for males. Also, there is evidence that pain influences female employment propensity though not males, and there appears to be no statistically significant role of energy. In general, males' employment propensity appears to be hindered significantly by only one of the health variables: physical health-limiting. In contrast, the probability of being employed for women is significantly negatively influenced by three health aspects: physical health-limiting, pain and health-accomplishing. These findings illustrate the importance of investigating gender differences with respect to the relationship between health and labour market activity. Research by Pelkowski and Berger (2004), which focussed on wages rather than employment propensity in the United States, also found evidence to suggest that poor health conditions had a larger negative impact on females rather than males. Research from Europe by Gambin (2005) concentrated on physical health and their results showed self-assessed general health having a greater impact on men's wages, while chronic health conditions in particular had more of an effect on women's wages. Similarly, an Australian study by Cai and Kalb (2006) also found better health increased labour market participation more for women and older age groups.

[12] Increased funding is not necessarily the immediate response here. Rather, future research should delve into the mechanics of how mediating factors can lead poor mental health to a reduced employment propensity.

Tables 5 and 6 present results further disaggregated by ethnicity and split between males and females, respectively.[13] Table 5 illustrates that there is an asymmetry across ethnic backgrounds in terms of the effect of health variables on employment propensity. The empirical evidence suggests that Maori and European males' employment propensity is adversely affected by health-limiting physical issues. Although similar coefficients and odd-ratios are found for Pacific Island males, the results are not statistically significant; more research is recommended in this specific area.[14]

Of particular interest is the mental health variable indicating depression. While it was weakly significant for the whole sample, it was not significant when looking at the gender sub-samples in Table 3, even though it was more negative for males relative to females. However, Table 5 reveals the individual characteristic that was driving the negative impact of depression on males' employment status: Pacific Island ethnicity. Specifically, for male Pacific Islanders, the logit and scobit odds-ratios indicate that a one-unit increase in the depression variable results in 114% and 72% increases in their propensity not to be employed, respectively. Jensen *et al*. (2005) also notably found that the likelihood of employment of people within the Pacific ethnicity category was more affected by disabilities (which included experiencing mental illness) than either Maori or NZ European.[15] In terms of international evidence on

[13] Note that the possibility of multiple ethnicity responses by an individual is controlled for in all regression tables.

[14] It is necessary to note that a limitation of our results with regard to the Pacific Island ethnic group is the small sample size our study faced.

[15] Oakley Browne *et al*. (2006) find that Pacific peoples are less likely to access *Child and adolescent mental health services* in NZ due to a number of cultural barriers. These include a lack of culturally appropriate specialists and/or resources, and possibly culturally different definitions of health (Ramage *et al*., 2005). Plausible reasons for this include Pacific Islanders being less likely to accept

mental health issues impacting employment propensity dissimilarly across ethnicities, the limited evidence available is mixed. While Chatterji *et al*. (2007) found significant negative associations between being employed and psychiatric disorders for Latinos, their figures were comparable to similar studies conducted in the United States on mostly white samples. However, the impact on the probability of employment was found to be larger for Latinos in comparison to Asians. Research by Ojeda *et al*. (2010) also focussed on the impact of mental distress on employment (namely, labour supply) and although their results were not strictly ethnic based, they compared immigrants with U.S. born citizens and found that there was an insignificant difference in the likelihood of being employed between healthy immigrants and those affected by mental illness. Future research should further investigate the likelihood of ethnic minorities being more at risk of being affected by mental health issues, and in particular the mechanisms in which this then impacts on their labour market activity.

< Insert Table 5 about here >

Table 6 presents comparable results for females. They corroborate the effect of the health-limiting physical issue on employment propensity, and with it having different strengths across ethnicities, albeit with a smaller negative effect for females than for males. There is no statistically strong evidence that depression has an adverse effect on employment propensity for females. However, there is evidence that female employment propensities are significantly influenced by the limiting effects of mental health for different reasons across ethnicities. For instance, the social-limiting health effect is particularly strong for Pacific Island females and non-existent for Maori.

mental health issues as a significant factor and/or less likely to seek professional help at a later stage of their depression, relative to other ethnicities.

Although the odds-ratios suggest similar effects of health-accomplishing on employment propensity, they are only highly-statistically significant for Maori and Europeans. Further research should investigate whether similar effects are present across different ethnicities in other countries.

< Insert Table 6 about here >

Endogeneity

The results presented above implicitly assume that the direction of causality is from health to employment status. This assumption may be incorrect if being in employment reduces the severity of mental and physical health issues or if being unemployed accentuates an individual's physical or mental health status. Although this issue has not been the focus of a substantial amount of empirical research, three recent contributions to this literature are noteworthy. Cai's (2009) results illustrates that better health status positively impacts on wages and he finds no evidence of a reverse effect from wages to health. In contrast, when Cai (2010) conducts similar research in terms of labour force participation, he finds that the reverse effect from labour force status to health was different by gender. In particular, his results indicate that there is a negative and strong reverse effect for males, and a positive and weakly significant reverse effect for females. Schmitz (2011) also attempts to investigate the causal effect of labour force status (specifically, unemployment) on health and finds no evidence of the reverse impact that unemployment influences mental health.

Instrumental variable probit regression is an econometric method that permits the investigator to empirically identify whether there is the statistical presence of endogeneity of specific explanatory variables. The statistical validity of the results from instrumental variable regressions rest, at least in part, on the appropriateness of the instrument. While the NZGSS does provide a wide range of variables, unfortunately our inspection did not provide us with a variable that would be convincingly correlated with physical health status and, at the same time, not correlated with employment status. Nevertheless, our examination of the data did provide us with a variable that could be employed as an instrument for mental health, called *Calm*, as described in Table 1.

Our selected instrumental variable for mental health corresponds to whether the respondent felt relatively calm and peaceful during the last four weeks. In order to examine this endogeneity issue a new variable was created with a value equal to 1 (one) if there was at least one mental health issue indicated by the respondent, and equal to 0 (zero) otherwise. This variable was then instrumented by *Calm*. Note from Table 2 that the absolute values of the correlations between *Calm* and the mental health related variables rest between 0.37 and 0.41, but that the correlation between *Calm* and Employment is 0.07.[16]

Application of the instrumental variable probit regression allowed the calculation of Wald statistical tests (see Wooldridge, 2002, pp. 472-477). The null hypothesis with these tests is that the mental health variable is exogenous to employment. The results

[16] We are implicitly assuming that *Calm* is related to employment only through its relation with mental health, as could be the case with these correlation coefficients. However the weak correlation between *Calm* and Employment may be the product of a positive association for some jobs and a negative association for others.

of these Wald tests are presented in Table 7 and are never statistically significant at the 5% confidence level, indicating that we cannot reject this null hypothesis at traditional levels of statistical confidence. It is also reassuring to note from Table 7 that these results hold across all the sub-groups demarcated by gender and ethnicity. Thus, the empirical evidence presented here suggests that mental health is not endogenous to employment. Such evidence corroborates similar results of Cai (2009) and Schmitz (2011) that health status is not endogenous to wage and unemployment status, respectively.

< Insert Table 7 about here >

5. Conclusions

This paper presented an investigation into the impacts of mental and physical health issues on employment propensity across gender and ethnicity. This is the first paper to explore the effects on employment of both health issues simultaneously.

Results from this study illustrate that both mental and physical health issues significantly affect employment propensity. The results were consistent across different limited dependent variable probits, logits and scobits specifications. The latter functional form was particularly important given the potential for the effects of the core health variables to be more sensitive at different points in the distribution for different ethnicities and gender.

In general the results emphasise three important themes. First, across all the ethnicities, there is a substantial impact of the physical health-limiting variable for males. Future research should focus on what specific type of physical health problems this variable encompasses and the severity of them. For example, it would be useful to know whether this variable signifies more short or long term physical ailments and consequently the likely barriers to participating in the labour market for males. Second, there is a considerable impact of mental health issues (in particular, health-accomplishing) on employment of females. Again, the direction for future work is to investigate the mechanisms by which females' labour market activity are more affected by mental health problems in comparison to males. Third, depression has a sizeable negative effect on employment propensity, and is especially statistically significant in our sample for Pacific Island males.

Our results strongly suggest that health status influences employment status, but there is also the theoretical possibility that causality in only this direction is misleading. Instrumental variable probit regression was applied to test for this endogeneity, and the results indicate that the direction of causality, at least for mental health status, is from health to employment. Awareness that mental and physical health issues influence different groups in society in different ways should enhance the appropriateness of future policy directions.

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Table 1: Descriptive statistics

Variable	Definition	Mean (Standard deviation)		
		All	Males	Females
Employed	Dummy variable: 1 for employed; 0 otherwise.	0.775 (0.418)	0.839 (0.367)	0.718 (0.450)
Physical Health limiting	Question: During the past four weeks, how much of the time were you limited in the kind of work or other regular daily activities you do as a result of your physical health? Categorical variable: 1 = none of the time; 2 = a little of the time; 3 = some of the time; 4 = most of the time; and 5 = all of the time.	1.521 (0.967)	1.474 (0.936)	1.563 (0.991)
Pain	Question: During the past four weeks, how much did pain interfere with your normal work including both work outside the home and housework? Categorical variable: 1 = not at all; 2 = a little bit; 3 = moderately; 4 = quite a bit; 5 = extremely.	1.729 (1.134)	1.713 (1.118)	1.742 (1.147)
Energy	Question: How much of the time during the past four weeks did you have a lot of energy? Categorical variable: 1 = all of the time; ….; 5 = none of the time.	3.586 (0.912)	3.682 (0.881)	3.501 (0.930)
Depressed	Question: How much of the time during the past four weeks have you felt downhearted and depressed? Categorical variable: 1 = none of the time;…..; 5 = all of the time.	1.680 (0.902)	1.620 (0.876)	1.733 (0.920)
Health social	Question: During the past four weeks, how much time has your physical health or emotional problems interfered with your social activities, such as visiting friends, relatives, etc. Categorical variable: 1 = none of the time;,,,,,; 5 = all of the time.	1.487 (0.917)	1.429 (0.875)	1.538 (0.948)
Health accomplishing	Question: During the past four weeks, how much of the time have you accomplished less than you would like as a result of any emotional problems, such as feeling depressed or anxious? Categorical variable: 1 = none of the time; …; 5 = all of the time.	1.541 (0.887)	1.490 (0.860)	1.585 (0.906)
Maori	Dummy variable: 1 = Maori; 0 otherwise	0.131 (0.337)	0.121 (0.326)	0.139 (0.346)
Pacific Islanders	Dummy variable: 1 = Pacific Islander; 0 otherwise	0.053 (0.224)	0.055 (0.228)	0.051 (0.219)
NZ European	Dummy variable: 1 = NZ European; 0 otherwise	0.812 (0.391)	0.818 (0.386)	0.806 (0.396)
Other ethnicities	Dummy variable: 1 = Ethnicities other than Maori, Pacific Islander and NZ European; 0 otherwise	0.072 (0.259)	0.067 (0.250)	0.077 (0.267)
Male	Dummy variable: 1 = Male; 0 = Female	0.464 (0.499)	-	-
Children	Dummy variable: 1 = presence of children in household; 0 otherwise	0.433 (0.496)	0.406 (0.491)	0.457 (0.498)
Older children	Dummy variable: 1 = presence of adult children in household; 0 otherwise	0.076 (0.265)	0.078 (0.268)	0.075 (0.263)
Partnered	Dummy variable: 1 = non-partnered; 0 = partnered	0.586 (0.493)	0.617 (0.486)	0.559 (0.497)
Qual Cert	Dummy variable: 1 = highest educational qualification is a school certificate; 0 otherwise	0.458 (0.498)	0.490 (0.500)	0.429 (0.495)
Qual Diploma	Dummy variable: 1 = highest educational qualification is a post-school Diploma; 0 otherwise	0.132 (0.338)	0.106 (0.308)	0.154 (0.361)
Qual Degree plus	Dummy variable: 1 = highest educational qualification is at least a degree; 0 otherwise	0.082 (0.274)	0.077 (0.267)	0.085 (0.279)
Calm	Dummy variable: 1 = if the respondent has felt calm and peaceful in the last four weeks some, most or all of the time; 0 = otherwise	0.650 (0.477)	0.684 (0.465)	0.620 (0.485)
Sample size		*6737*	*3130*	*3607*

Table 2: Health variables correlations

	Physical Health Limiting	Pain	Energy	Depression	Health Social	Health Accomplishing	Employed	Calm
Physical Health Limiting	–	–	–	–	–	–	–	–
Pain	0.463	–	–	–	–	–	–	–
Energy	0.396	0.272	–	–	–	–	–	–
Depression	0.269	0.189	0.344	–	–	–	–	–
Health Social	0.481	0.332	0.403	0.496	–	–	–	–
Health Accomplishing	0.351	0.204	0.350	0.600	0.534	–	–	–
Employed	-0.202	-0.112	-0.128	-0.144	-0.172	-0.177	–	–
Calm	-0.188	-0.148	-0.383	-0.409	-0.324	-0.373	0.070	–

Table 3: Percentage employed

	All	Males	Females
All	77.46	83.94	71.83
NZ European	80.14	85.92	75.05
Maori	65.99	72.63	60.99
Pacific Islanders	65.27	74.14	56.83

Table 4: Regression results

Variable	Probit			Logit						Scobit					
	All	Males	Females	All	OR	Males	OR	Females	OR	All	OR	Males	OR	Females	OR
N	*6737*	*3130*	*3607*	*6737*		*3130*		*3607*		*6737*		*3130*		*3607*	
Physical health limiting	**-0.190**** **(0.022)**	**-0.269**** **(0.036)**	**-0.137**** **(0.049)**	**-0.322**** **(0.038)**	0.725	**-0.476**** **(0.064)**	0.621	**-0.227**** **(0.049)**	0.797	**-0.220**** **(0.035)**	0.803	**-0.344**** **(0.081)**	0.709	**-0.182**** **(0.048)**	0.833
Pain	-0.022 (0.018)	0.024 (0.030)	**-0.051*** **(0.039)**	-0.041 (0.032)	0.961	0.044 (0.055)	1.045	**-0.088*** **(0.039)**	0.916	-0.021 (0.021)	0.979	0.033 (0.040)	1.033	-0.065 (0.034)	0.937
Energy	-0.028 (0.023)	-0.035 (0.037)	-0.024 (0.050)	-0.056 (0.040)	0.946	-0.069 (0.067)	0.933	-0.047 (0.050)	0.954	-0.026 (0.026)	0.975	-0.044 (0.049)	0.957	-0.027 (0.040)	0.973
Depressed	-0.049 (0.026)	-0.054 (0.043)	-0.044 (0.056)	-0.082 (0.044)	0.922	-0.088 (0.076)	0.916	-0.072 (0.056)	0.930	**-0.060*** **(0.030)**	0.941	-0.074 (0.056)	0.929	-0.060 (0.044)	0.942
Health social	-0.045 (0.025)	-0.067 (0.042)	-0.033 (0.054)	-0.074 0.043)	0.929	-0.120 (0.073)	0.887	-0.053 (0.054)	0.949	**-0.053*** **(0.029)**	0.948	-0.087 (0.056)	0.917	-0.045 (0.043)	0.956
Health accomplishing	**-0.095**** **(0.026)**	-0.060 (0.044)	**-0.118**** **(0.057)**	**-0.165**** **(0.045)**	0.848	-0.107 (0.078)	0.898	**-0.196**** **(0.057)**	0.822	**-0.100**** **(0.033)**	0.904	-0.077 (0.058)	0.926	**-0.152**** **(0.052)**	0.859
Male	0.418** (0.039)	-	-	0.709** (0.068)	2.033	-	-	-	-	0.475** (0.068)	1.608	-	-	-	-
Age: 15-19 years	-0.610** (0.087)	-1.146** (0.157)	-0.318** (0.190)	-1.006** (0.149)	0.366	-1.930** (0.292)	0.145	-0.518** (0.190)	0.596	-0.743** (0.118)	0.476	-1.474** (0.299)	0.229	-0.430** (0.163)	0.651
20-24 years	-0.091 (0.090)	-0.402* (0.160)	0.028 (0.195)	-0.144 (0.157)	0.866	-0.706* (0.394)	0.494	0.042 (0.195)	1.042	-0.105 (0.100)	0.900	-0.514* (0.225)	0.598	0.047 (0.150)	1.049
25-29 years	-0.039 (0.084)	-0.306 (0.160)	0.023 (0.173)	-0.066 (0.146)	0.936	-0.522 (0.311)	0.593	0.021 (0.173)	1.021	-0.041 (0.092)	0.960	-0.385 (0.214)	0.680	0.045 (0.135)	1.046
30-34 years	*Control variable*			*Control variable*						*Control variable*					
35-39 years	0.276** (0.079)	0.085 (0.158)	0.320** (0.162)	0.496** (0.139)	1.642	0.175 (0.312)	1.191	0.544** (0.162)	1.723	0.294** (0.095)	1.342	0.109 (0.203)	1.115	0.415** (0.147)	1.515
40-44 years	0.339** (0.080)	-0.080 (0.154)	0.471** (0.170)	0.599** (0.143)	1.820	-0.165 (0.299)	0.848	0.807** (0.170)	2.241	0.368** (0.100)	1.445	-0.101 (0.197)	0.904	0.614** (0.175)	1.848
45-49 years	0.305** (0.081)	-0.118 (0.153)	0.453** (0.177)	0.543** (0.145)	1.722	-0.276 (0.291)	0.759	0.800** (0.178)	2.225	0.330** (0.100)	1.392	-0.139 (0.202)	0.870	0.588** (0.187)	1.801
50-54 years	0.105 (0.085)	-0.126 (0.162)	0.085 (0.179)	0.185 (0.149)	1.204	-0.223 (0.316)	0.800	0.138 (0.179)	1.148	0.114 (0.093)	1.121	-0.151 (0.209)	0.860	0.111 (0.136)	1.118
55-59 years	-0.131 (0.088)	-0.456** (0.0.158)	-0.120 (0.194)	-0.209 (0.155)	0.811	-0.838** (0.303)	0.432	-0.189 (0.194)	0.828	-0.158 (0.096)	0.854	-0.572* (0.238)	0.564	-0.160 (0.147)	0.852

60-64 years	-0.535** (0.084)	-0.868** (0.152)	-0.528** (0.182)	-0.925** (0.145)	0.397	-1.597** (0.289)	0.203	-0.899** (0.182)	0.407	-0.589** (0.119)	0.555	-1.102** (0.312)	0.332	-0.669** (0.199)	0.512
Children	-0.480** (0.047)	-0.211** (0.081)	-0.676** (0.107)	-0.854** (0.083)	0.426	-0.446** (0.151)	0.640	-1.148** (0.107)	0.317	-0.525** (0.091)	0.592	-0.272* (0.136)	0.762	-0.878** (0.186)	0.415
Older children	-0.003 (0.075)	0.023 (0.115)	-0.045 (0.174)	-0.027 (0.132)	0.974	-0.023 (0.207)	0.978	-0.092 (0.174)	0.912	0.006 (0.081)	1.006	0.026 (0.148)	1.027	-0.058 (0.129)	0.944
Partnered	0.322** (0.042)	0.638** (0.075)	0.103* (0.088)	0.560** (0.073)	1.751	1.213** (0.140)	3.365	0.184* (0.088)	1.202	0.356** (0.064)	1.428	0.808** (0.219)	2.243	0.131* (0.074)	1.140
Smoker	-0.099* (0.045)	-0.093 (0.072)	-0.114 (0.059)	-0.170* (0.078)	0.844	-0.158 (0.130)	0.854	-0.193 (0.100)	0.825	-0.116* (0.052)	0.891	-0.128 (0.096)	0.881	-0.156 (0.084)	0.856
NZ European	*Control variable*			*Control variable*						*Control variable*					
Maori	-.0253** (0.054)	-0.333** (0.089)	-0.234** (0.116)	-0.425** (0.092)	0.654	-0.576** (0.158)	0.562	-0.394** (0.116)	0.674	-0.281** (0.068)	0.755	-0.435** (0.137)	0.648	-0.295** (0.109)	0.744
Pacific Islanders	-0.315** (0.078)	-0.452** (0.124)	-0.328** (0.172)	-0.558** (0.132)	0.572	-0.831** (0.218)	0.435	-0.551** (0.172)	0.577	-0.347** (0.101)	0.706	-0.568** (0.207)	0.556	-0.438** (0.155)	0.645
Other ethnicities	-0.435** (0.069)	-0.365** (0.118)	-0.481** (0.149)	-0.751** (0.120)	0.472	-0.662** (0.218)	0.516	-0.799** (0.174)	0.450	-0.487** (0.098)	0.614	-0.481** (0.181)	0.618	-0.640** (0.154)	0.527
No school qualifications	*Control variable*			*Control variable*						*Control variable*					
Qual Cert	0.170** (0.042)	0.274** (0.068)	0.104* (0.092)	0.298** (0.072)	1.347	0.470** (0.122)	1.599	0.197* (0.092)	1.217	0.178** (0.053)	1.195	0.351** (0.107)	1.420	0.122 (0.084)	1.129
Qual Diploma	0.356** (0.064)	0.583** (0.133)	0.277** (0.132)	0.634** (0.115)	1.886	1.123** (0.266)	3.075	0.500** (0.132)	1.648	0.376** (0.088)	1.457	0.742** (0.253)	2.099	0.345* (0.136)	1.412
Qual Degree plus	0.435** (0.083)	0.349* (0.146)	0.446** (0.183)	0.779** (0.154)	2.180	0.696* (0.294)	2.007	0.767** (0.183)	2.153	0.458** (0.111)	1.581	0.443* (0.221)	1.558	0.559** (0.181)	1.749
Constant	1.344** (0.097)	1.824** (0.168)	1.500** (0.124)	2.293** (0.170)	-	3.200** (0.318)	-	2.501** (0.212)	-	-0.139 (0.912)	-	1.348 (1.140)	-	1.007 (1.178)	-

Notes: OR = odds ratios; Standard errors in parentheses; * and ** signify statistical significance at the 5% and 1% confidence level, respectively.

Table 5: Regression results: Males only

	Maori *N* = 376			**Pacific Islander** *N* = 169			**NZ European** *N* = 2565		
	Probit	Logit OR	Scobit OR	Probit	Logit OR	Scobit OR	Probit	Logit OR	Scobit OR
Physical health limiting	**-0.346**** **(0.103)**	**0.549**** **(0.101)**	**0.719**** **(0.073)**	-0.370 (0.212)	0.530 (0.196)	0.651 (0.145)	**-0.261**** **(0.040)**	**0.624**** **(0.045)**	**0.620**** **(0.079)**
Pain	0.141 (0.079)	1.293 (0.185)	1.152 (0.084)	0.150 (0.133)	1.276 (0.289)	1.250 (0.188)	-0.009 (0.035)	0.984 (0.062)	0.984 (0.063)
Energy	0.029 (0.103)	1.036 (0.183)	1.055 (0.108)	-0.077 (0.191)	0.890 (0.301)	0.986 (0.196)	-0.028 (0.043)	0.947 (0.074)	0.946 (0.077)
Depressed	0.023 (0.112)	1.039 (0.203)	1.011 (0.113)	**-0.428*** **(0.182)**	**0.467*** **(0.153)**	**0.583*** **(0.132)**	-0.062 (0.050)	0.895 (0.080)	0.894 (0.084)
Health social	0.047 (0.109)	1.074 (0.206)	1.052 (0.109)	0.040 (0.202)	1.133 (0.396)	1.031 (0.247)	-0.086 (0.048)	0.855 (0.074)	0.853 (0.080)
Health accomplishing	-0.080 (0.106)	0.903 (0.172)	0.878 (0.095)	-0.214 (0.198)	0.692 (0.236)	0.843 (0.182)	-0.052 (0.052)	0.914 (0.087)	0.913 (0.089)

Notes: OR = odds ratios; Standard errors in parentheses; * and ** indicate statistical significance at the 5% and 1% confidence level, respectively.
All control variables included in Table 3 are also used here but not reported for brevity.

Table 6: Regression results: Females only

	Maori			**Pacific Islander**			**NZ European**		
	N = 485			*N* = 180			*N* = 2907		
	Probit	Logit OR	Scobit OR	Probit	Logit OR	Scobit OR	Probit	Logit OR	Scobit OR
Physical health limiting	-0.075	0.878	0.868	-0.083	0.861	0.901	**-0.153****	**0.776****	**0.830****
	(0.080)	(0.119)	(0.150)	(0.122)	(0.176)	(0.125)	**(0.033)**	**(0.043)**	**(0.044)**
Pain	-0.012	0.968	0.924	0.193	1.388	1.238	-0.044	0.925	0.950
	(0.067)	(0.109)	(0.155)	(0.120)	(0.293)	(0.157)	(0.026)	(0.042)	(0.032)
Energy	-0.083	0.868	0.830	0.066	1.120	1.092	-0.026	0.949	0.976
	(0.078)	(0.112)	(0.153)	(0.137)	(0.258)	(0.171)	(0.034)	(0.056)	(0.041)
Depressed	-0.031	0.952	0.925	-0.031	0.946	0.924	-0.046	0.928	0.948
	(0.084)	(0.134)	(0.172)	(0.150)	(0.241)	(0.176)	(0.038)	(0.059)	(0.043)
Health social	-0.005	0.999	1.009	**-0.438****	**0.482****	**0.626***	-0.035	0.944	0.958
	(0.080)	(0.132)	(0.169)	**(0.167)**	**(0.135)**	**(0.125)**	(0.037)	(0.058)	(0.043)
Health accomplishing	**-0.261****	**0.641****	**0.580***	-0.158	0.785	0.799	**-0.113****	**0.827****	**0.876***
	(0.085)	**(0.091)**	**(0.151)**	(0.152)	(0.201)	(0.136)	**(0.039)**	**(0.054)**	**(0.048)**

Notes: OR = odds ratios; Standard errors in parentheses; * and ** indicate statistical significance at the 5% and 1% level, respectively.
All control variables included in Table 3 are also used here but not reported for brevity.

Table 7: Wald exogeneity tests

	Maori	Pacific Islander	NZ European
Males	0.1	3.02	0.75
Females	0.62	0.03	1.39

Note: * and ** signifies statistical significance at the 5% and 1% confidence level.