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National Institute of Labour Studies
Flinders University, Adelaide, Australia

NILS working paper series No.226/2016

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* This paper uses unit record data from the Household, Income and Labour Dynamics in Australia (HILDA) Survey. The HILDA Survey project was initiated and is funded by the Australian Department of Social Services (DSS). It is managed by the Melbourne Institute of Applied Economic and Social Research (Melbourne Institute). The findings and views reported in this paper, however, are those of the author and should not be attributed to DSS or the Melbourne Institute. I am grateful to Sue Richardson, Anna Ziersch, and Kostas Mavromaras for valuable comments and suggestions.
JEL Classifications: C33, I1, J24
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Abstract

Maintaining individuals with health limitations in the labour force is a challenge of increasing importance given the ageing of the population. Determining the effect of health on occupation may tell us how people adapt to their limitations, and what types of jobs make this harder or easier. This paper uses the first 14 waves of the Household, Income and Labour Dynamics in Australia Survey (HILDA) to examine the effect of health and changes in health on occupation for the working-age population. We use dynamic panel models which account for selection into employment. Two measures of occupation are used to capture two aspects of occupation highlighted in the literature as being linked to health: physical job demands and status. The results of the analyses provide some evidence that a health shock reduces the likelihood of manual employment for men, suggesting that men may adapt to a health shock by reducing physical job demands. Worsening health and work-limiting long-term conditions are found to have a negative effect on occupational status for men and women, suggesting health selection into lower-status jobs, and an adverse effect of poor health on occupational mobility.

Keywords: Health, occupation, dynamic models, HILDA Survey

I. Introduction

Population ageing increases the share of older persons in the population and this has implications for the health of the working-age population, as well as having consequences for the labour market. This has increased the focus on the work activity of older persons, and the need to encourage labour force participation for working-age people who experience poor health.

Most of the research into the effects of health on labour market outcomes has focused on labour market decisions, in particular on the decision to participate in the labour market (Cai and Kalb 2006; Cai 2010; Oguzoglu 2010; García-Gómez *et al.* 2010; Webber and Bjelland 2015), and on the retirement decision (Disney *et al.* 2006; Lindeboom 2006; Jones *et al.* 2010; Zucchelli *et al.* 2010; Bound *et al.* 2010). These studies show that health has a substantial effect on labour market decisions. In comparison, there has been limited examination of the effects of health on other labour market outcomes, and during working-age years.

It is important to understand how people adapt to health limitations, and what types of jobs make this easier or harder. This is in order to design policies which effectively increase labour force participation and maintain people with health impairments in work. This paper studies the effects of health and changes in health on occupation to determine how health influences the occupations in which people work, and how changes in health might affect the type of job in which they work. Occupation is important, because different occupations are associated with differences in income and varying career prospects (Yamaguchi 2010). Occupations also differ in their exposure to the risk of unemployment and specific health hazards.

A number of studies have investigated the effect of occupation on health (see for example Sindelar *et al.* 2007; Chau and Khlat 2009; Fletcher and Sindelar 2009; Gueorguieva *et al.* 2009). These studies suggest a strong relationship between greater physical job demands and poorer health (especially cumulated physical job demands); that there are occupation-related health differences which persist with age; and that blue-collar work at labour force entry is associated with declining health later in life. There is also some suggestion that status of occupation is associated with health beyond the distinction between work which is physically demanding, and that which is not. A social gradient in health is found when analysing the relationship between occupation status and health (Ferrie *et al.* 2002; Gueorguieva *et al.* 2009; Toivanen 2011; Kjellsson 2013).

The effect of health on occupation is relatively under-examined. Studies which have considered the effects of health and the effects of changes in health on occupation include Pelkowski and Berger (2003), Cohiden *et al.* (2009), De Raeve *et al.* (2009) and Halleröd and Gustaffson (2011). These studies found that health affects occupational mobility (De Raeve *et al.* 2009; Halleröd and Gustaffson 2011); they suggest there is health-based selection into

less-prestigious jobs (Cohiden *et al.* 2009; Halleröd and Gustaffson 2011); and they support the job-change literature, which suggests that people in poor health who are not accommodated in their job will change jobs to adapt to the onset of a health problem (Pelkowski and Berger 2003; De Raeve *et al.* 2009). Differing methodologies were used, with few addressing the issue of endogeneity of health. In all cases, samples were limited to those who were working.

These papers go some way towards understanding the behaviours of those who work after the onset of a health problem, but they do not control for selection into employment. Health-based selection into employment is a key issue. Adverse health can render an individual who is not currently working unable to work at all. Workers who cannot adapt to a health problem (via accommodation or changing jobs) are likely to leave employment.

This paper contributes to the existing literature by using longitudinal data to analyse the effect of health and health changes (both good and bad) on occupation, including dynamics and taking account of selection into employment. The focus of this research is on the working-age population—rather than confining the sample to older workers. The examination of the effect of health differentiates between the effects of general measures of health and work-limiting conditions.

II. Measuring Occupation

The data used in this paper come from the first 14 waves of the HILDA Survey, conducted from 2001 to 2014. The HILDA Survey is a household-based panel survey which interviews all members of the household aged 15 years or older. It collects annual data on economic and subjective well-being, labour market dynamics, and family dynamics. There were 13,969 respondents in 7,682 households in the first wave. Details of the survey, including its rates of attrition, can be found in Summerfield *et al.* (2015). The longitudinal nature of HILDA and the availability of measures of occupation, health, and the major determinants of both make it well-suited for this study.

There are a number of measures available for classifying occupation. These can be grouped into two commonly used categories: socioeconomic indices and class measures. Socioeconomic indices scale occupations according to the education, income, and other socioeconomic characteristics of population samples. These are a more direct way of tapping

into the human resources and economic rewards associated with occupations (McMillan 2010). Socioeconomic indices include the International Socioeconomic Index (ISEI) and the Australian Socioeconomic Index for 2006 (AUSEI06). The most commonly used measure is the ISEI which allows researchers to assign scores to the International Standard Classification of Occupations (ISCO). In Australia, this same approach was used to form the basis of the AUSEI06. The AUSEI06 was generated from Australian census data and can assign scores to ANZSCO codes (McMillan *et al.* 2009). The scale ranges from 0 to 100, with medical practitioners at the top of the scale and labourers at the bottom.

In terms of class measures, the Erikson-Goldthorpe-Portocarero (EGP) schema—also known as the Goldthorpe class measure—is a commonly used occupational measure in the social sciences. The idea behind the EGP schema is that class categories are produced by similar market and work conditions. It is well-established internationally and forms the basis of the National Statistics Socio-economic Classification in the United Kingdom, which is the official class measure of the UK Office for National Statistics (Rose *et al.* 2005). A version has also been developed for Europe (Rose and Harrison 2009).

Class measures and socioeconomic indices are strongly correlated, with blue-collar workers generally having a low score on the socioeconomic index, and white-collar workers a higher score. This paper analyses a class measure of occupation and a socioeconomic index to examine different relationships. The measures chosen are those previously found in the literature to matter in affecting health and being affected by health: physical job demands and occupational status.[1] The EGP schema can be collapsed into a smaller set of classes to capture physical job demands, and the AUSEI06 is used to examine the effect of health on occupational status.

The EGP schema is generated in HILDA using the ISCO, and variables identifying self-employment and those who are supervisors. Table 1 shows the EGP categories in HILDA. Physical job demands are captured by collapsing the EGP categories into a manual and non-manual classification of occupations, where classes I, II, and III are combined to form a non-

[1] This is not to say that these are the only aspects of occupation which have a relationship with health. Job stress and work schedules are other possibilities, as are other conditions of work which might involve a physical toll. The degree to which these might be subject to reverse relationships, with health affecting these outcomes, is a matter for further research.

manual classification; classes VI, VII, and VIII are combined to form a manual classification.[2]

Table 1: EGP Schema Categories in HILDA Waves 1 to 14

EGP	Frequency	Percent
I Higher controllers	9,073	7.14
II Low controllers	43,625	34.34
III Routine non-manual	19,954	15.71
IV Self-employed with employees	9,202	7.24
V Self-employed without employees	16,348	12.87
VI Skilled manual	18,795	14.79
VII Semi-unskilled manual	6,273	4.94
VIII Self-employed farm workers	3,782	2.98
Total	**127,052**	**100.00**

For the purposes of analysis, the EGP measure in this paper includes a 'not employed' category. This allows modelling of the effects of selection into employment. The EGP and AUSEI06 measures each have advantages and disadvantages. The disadvantage of the EGP measure is that only broad occupational changes are observed. The AUSEI06 measure has a clear assumption about an occupational hierarchy (given that the index is continuous and ranges from 0 to 100), and it captures changes within occupational classes. The main disadvantage of the AUSEI06 is that it is only observed for those who are initially employed. Modelling strategies must take this into account to deal with selection into employment.

This paper, building on previous research by taking into account selection into employment, has two aims. The first is to examine the effect of health and changes in health on occupation: the choice of manual versus non-manual employment, and the effects on occupational status. The second aim is to consider the role of employed versus not employed by examining the effects of health on movement out of employment within the model of occupation. This can go some way towards establishing the degree to which people with health problems adapt or withdraw from work.

III. Measuring Health

[2] Collapsing categories increases the number of observations within each category. Observation numbers on several variables are far too small for reliable estimation, with EGP categories disaggregated to 11 categories.

The HILDA Survey contains a number of measures of health and health behaviours. Individuals were asked if they had a long-term condition which lasted or was likely to last for six months or more, and they were also asked whether this condition limits the amount or type of work they are able to do. The Short Form (SF-36) questions were asked. The SF-36 measures general health and well-being and produces scores for eight dimensions of health (Ware *et al.* 2000). In addition, individuals were asked to compare their current health to their health 12 months ago, with five response categories ranging from much worse health compared with 12 months ago to much better health.

The first question in the SF-36 is the standard five item self-reported health measure, scaled from poor to excellent health. This measure is used as the dependent variable in modelling determinants of health for use in predicting the health stock (or health index). This method follows the approach set out by Bound (1991) and Bound *et al.* (1999), where the self-assessed health measure is modelled as a function of demographic characteristics, more objective measures of health, and health behaviours. The health index generated from the predicted values of this model accounts for measurement error in health and the potential endogeneity arising from justification bias. The lag of the health index is used in analysis to deal further with any endogeneity from health affecting labour market outcomes. Table A1 in the Appendix sets out the variables included in the model that was used to construct the index.[3]

Notwithstanding the criticisms of using self-assessed measures, there is some benefit in examining alternative measures for comparison purposes, and to capture different aspects of health. The health index is a stock measure of health and, while it is expected to have an effect on labour market behaviour, it is also desirable to examine the effects of changes in health—both good and bad. Measures of the health shock and of health improvement are used to analyse the effects of worsening and improving health. These are binary variables generated from the question in HILDA comparing current health to health one year ago. The health-shock measure has value 1 if health is somewhat worse or much worse, and value 0 otherwise. The health-improvement measure has value 1 if health is somewhat better or much better, and 0 otherwise.

There are intersections between the different measures of health: self-assessed health, mental health, and work-limiting disability; these intersections are also present between the health

[3] The model of self-assessed health is estimated separately for men and women, and by HILDA wave. Results from estimating the model of self-assessed health are available upon request.

index and other measures of health. Different health measures do, however, have different implications for labour market behaviour. These include, for example, development of a health condition which affects ability to work versus a worsening in health, which is reported as a poor outcome across most health measures, but which does not hinder labour market activity. A measure of work-limiting disability is included in the same model as that including the health shock to identify separately the effects of worsening health and a long-standing condition which affects ability to work (as opposed to less serious health problems which are less likely to prompt changes in behaviour).

This differentiation between health measures and their likely effects on behaviour gives some insight into what effects of health on occupation might be expected. People who develop health problems may be accommodated by employers, depending on the severity of the health condition and the degree to which it affects their ability to work. A number of papers have examined the degree to which workers who develop health problems are accommodated in their current employment (Burkhauser *et al.* 1995; Daly and Bound 1996; Krause *et al.* 1998; Campolieti 2004; Campolieti 2009; Hill *et al.* 2016). Employer accommodation increases the likelihood of remaining in employment (Burkhauser *et al.* 1995; Hill *et al.* 2016). The job-accommodation literature has found that people with health problems who are not accommodated in their current job select into jobs that are less physically demanding (Daly and Bound 1996; Krause *et al.* 2001).

Job change can allow a worker to adapt to their health problem by adjusting the demands of their employment (Daly and Bound 1996; Bound *et al.* 1999; Campolieti 2009). The ability of an individual to adapt to a health problem depends on the type of job in which they are employed at the time of the onset of their poor health. The physical demands of manual jobs suggest that these types of jobs are less likely to be able to accommodate health problems (Krause *et al.* 2001). Workers who cannot adapt to the onset of a health problem by adjusting their job demands are likely to leave employment. Conversely, an improvement in health may enable a person who was not working to gain employment, without having to consider the need for a job which will accommodate their health problems or, likewise, may be able to change jobs to a more demanding occupation. All of these factors illustrate the importance of identifying the effects of different aspects of health, and of taking into account selection into employment.

IV. Methods

The focus of this paper is on determining the effect of health and changes in health on physical job demands and occupational status, taking into account selection into employment and the effects of poor health on the movement out of employment. These aims are pursued by analysing the two specifications of occupation previously set out—the EGP measure and the AUSEI06—and adopting appropriate modelling strategies to deal with the differing nature of the two dependent variables and the way in which they observe occupation.

For both measures, changes in occupation are analysed using dynamic panel data models with random effects. The models incorporate controls for state dependence to account for causal links between past and current labour market status and occupation. The initial-condition problem is accounted for via the Wooldridge approach (Wooldridge 2005).

The categorical EGP outcome is modelled by multinomial multilevel logit models, which include non-employment as an outcome. The dependent variable takes on the value 0 if not employed, 1 if in a manual occupation, and 2 if in a non-manual occupation. This paper looks at transitions over time between these three states: non-manual employment, manual employment, and not employed. The dynamic model of EGP for an individual *i* choosing labour state (or occupation) *j* at time *t* is given by:

$$y_{itj} = \beta_{0\mathrm{j}} + \beta_j' X_{it} + \gamma_j y_{i,t-1} + \xi_j \hat{y}_{i,1} + \lambda_j \bar{x}_{\mathrm{i}} + e_{itj} + u_i \qquad (1)$$

The intercept is composed of a fixed part given by $\beta_{0j}$and a random part given by u_i and $u_i \sim N(0, \sigma_u^2)$. This allows for unobserved heterogeneity, which is given by the u_i. The $\boldsymbol{X}$ are the vector of observed individual characteristics (the explanatory variables). Lagged occupation dummy variables are denoted by the $y_{i,t-1}$, and $\widehat{y_{i,1}}$is initial occupation. The means of time-variant explanatory variables, the $\overline{x_i}$, are also incorporated as a correction to account for relatively fixed underlying differences between individuals (the Mundlak (1978) and Chamberlain (1984) augmentation for random effects models). Selection into employment is dealt with by including not employed (unemployed or not in the labour force) as an outcome. Explicitly modelling economic activity allows examination of movements not only between manual and non-manual employment, but also an estimate of the degree to which health problems cause people to withdraw from employment. It can provide some indication of from which types of occupation they withdraw.

The AUSEI06 outcome is continuous and is not observed for individuals who are not initially employed. This paper estimates a panel data Tobit model for the AUSEI06 model which allows for the responses of changing occupation or of leaving employment, and it controls for the bunching of observations with the value 0 for those who do not work at time *t*. The dynamic model of AUSEI06 for an individual *i* at time *t* is given by:

$$y_{it}^{*} = \beta' X_{it} + \gamma y_{i,t-1} + \xi_j \hat{y}_{i,1} + \lambda_j \bar{x}_i + e_{itj} + u_i \qquad (2)$$

$$y_{it} = y_{it}^{*} \; if \; y_{it}^{*} > 0$$

$$y_{it} = 0 \; if \; y_{it}^{*} \leq 0$$

where y_{it}^{*} and y_{it} are latent and observed occupational status, respectively, and the right-hand side of equation (2) accounts for observed individual characteristics, state dependence, initial conditions, and the Mundlak correction in a similar manner to equation (1), but within the framework of a Tobit model. Given that AUSEI06 is not observed for those initially not working, observations are left-censored. The Tobit model controls for this, and it allows for estimation of partial effects which take into account selection into employment.

Estimation of the EGP model uses the glamm procedure in Stata, which is suitable for estimating a multinomial panel data model with a categorical dependent variable. The AUSEI06 model is estimated using the xttobit procedure in Stata, specifying that the data are left-censored at the value 0.

V. Data and Key Variables

The sample used in this paper includes men and women aged 15 to 64 years, excluding full-time students. Models are estimated separately by gender. The final sample for the EGP model consists of an unbalanced panel of 28,327 person-year observations for 4,685 men, and 29,584 person-year observations for 4,934 women. The final sample for the AUSEI06 model consists of an unbalanced panel of 36,185 person-year observations for 5,514 men, and 40,855 person-year observations for 6,052 women.[4,5] Due to the inclusion of lagged occupation variables, the estimating sample comprises data from waves 2 to 14 of HILDA.

[4] Observations are lower for the EGP model due to (i) observations lost in the construction of the EGP measure, and (ii) the exclusion of the self-employed.

[5] Final samples given are those from the model including the health index. Models using other health measures have slightly larger samples due to fewer missing observations.

Summary statistics for the explanatory variables are reported in Table 2. Table A2 in the Appendix contains a description of variables used in the occupation models.

Table 2: Summary Statistics of Variables used in Occupation Models

	Men		Women	
Variables	*Mean*	*Std. dev.*	*Mean*	*Std. dev.*
Post GFC	0.46	0.50	0.47	0.50
Lagged health index	68.96	14.50	71.52	16.09
Initial health	72.83	14.11	71.82	15.26
Health shock	0.12	0.32	0.14	0.35
Work-limiting condition	0.15	0.36	0.18	0.38
Health improvement	0.14	0.35	0.18	0.39
Has children aged 0-4	0.16	0.37	0.18	0.39
Has children aged 5-14	0.26	0.44	0.29	0.45
Married or de facto	0.76	0.43	0.74	0.44
Partner is employed	0.54	0.50	0.61	0.49
Weekly non-labour income ($100's)	2.96	11.10	2.71	9.69
Partner wage	15.84	26.68	19.43	30.24
Rural	0.15	0.36	0.15	0.35
Migrant	0.20	0.40	0.21	0.41
Father's occupation	44.44	22.95	45.59	23.35
Experience	24.46	11.88	18.89	11.09
Economic inactivity	2.59	4.40	8.07	9.16
Unemployment rate	5.91	4.52	5.81	3.85
Degree or above	0.31	0.46	0.37	0.48
Advanced diploma or diploma	0.10	0.30	0.10	0.31
Certificate	0.27	0.45	0.13	0.34
Year 12	0.11	0.31	0.12	0.33
Year 11 or below	0.21	0.41	0.27	0.45

Health

Health is defined by using the constructed health index, health-shock measure, measure of work-limiting long-term condition, and the health-improvement measure described in Section III. The model of self-assessed health is estimated by linear regression as a first stage, assuming that categorical self-assessed health is continuous.[6] The measure of the health index (or health stock) is created using the predicted values from this model. Lagged and initial values of the health index are included in the models to reduce the possibility of endogeneity influencing the results—by using the lag, any change in health occurs before the change in occupation or labour market status.

The measures of health shock and health improvement are included in separate model specifications to estimate the effect of a sudden deterioration in health, and to determine how people might respond to an improvement in their health. These measures are subject to the usual criticisms of self-assessed measures. Nonetheless, analysing measures of more sudden or more serious changes in health allows a fuller understanding of the ways in which individuals may adjust their labour market activities. Likewise, inclusion of the measure of work-limiting long-term condition within the health-shock model specification allows for analysis of the effect of more serious health problems on behaviour, and changes in status or labour market state.

Other Explanatory Variables

Many of the variables included in the analyses are those commonly used in labour supply models (see Table A2). Alongside these, partner characteristics are included, measured by partner wage and partner employment status; these aim to capture interaction between household members' labour supply decisions. Labour market history is accounted for by including years of employment (known to affect occupational mobility) and years of economic inactivity (representing deskilling and strength of attachment to the labour market). A state, gender, and age-group-specific unemployment rate was included to account for the discouraged worker effect which results from a higher unemployment rate. The dummy variable 'Post GFC' reflects the effects of the global financial crisis on the likelihood of employment; a measure of father's occupation is included, as this is a measure of childhood socioeconomic status which is known to affect adult outcomes.

[6] This produces residuals which are not correlated with fitted values and covariates. The resulting fitted values were compared to those obtained by ordered probit (the usual approach) and were found to be extremely similar. This suggests that the assumption of health being continuous is not unreasonable for the purposes of constructing the health index.

Table 3 documents the total number of year-on-year transitions for men and women for the estimating sample between the categories of the EGP measure over waves 2 to 14 of HILDA.[7] The low rate of transitions illustrates a high degree of state dependence (persistence) in occupation, particularly for non-manual employment. This supports the inclusion of the variables to capture state dependence.[8]

Table 3: Number (and percentage) of Transitions over Waves 2 to 14 of the HILDA Survey

	Not employed	Manual	Non manual	Total
Not employed	9,105	465	997	10,567
	(86.2)	(4.4)	(9.4)	(100.0)
Manual	520	6,688	749	7,957
	(6.5)	(84.1)	(9.4)	(100.0)
Non-manual	1,307	652	22,795	24,754
	(5.3)	(2.6)	(92.1)	(100.0)
Total	10,932	7,805	24,541	43,278
	(25.3)	(18.0)	(56.7)	(100.0)

VI. Results

EGP Results

Key results from the first specification of the EGP model (using the health index to measure health) are presented in Table 4.[9] It contains parameter estimates for key variables, as well as estimated between individual variances.[10] Positive values for the parameter estimates represent an increased likelihood of not being employed, or of manual employment relative to non-manual employment.

For both men and women, the estimate on the lag of the health index is negative for the 'not employed' outcome. A higher value of the health index (representing better health) lowers the likelihood of not being employed. This suggests that those who experience poorer health (lower values of the health index) are more likely to leave employment. The estimate for manual employment is very small, almost zero, and is only statistically significant for men.

[7] Separating by gender shows little difference in the pattern of transitions.
[8] The small number of transitions may be somewhat indicative of the EGP measure only capturing broad occupational changes.
[9] For each results table, statistical significance of the results is reported at three levels: ***statistically significant at the 1% level; **statistically significant at the 5% level; *statistically significant at the 10% level. Standard errors are reported in parentheses.
[10] Complete tables of results are too lengthy to include in the paper, but are obtainable upon request.

This suggests that there is no impact from health deteriorations on occupational choice between non-manual and manual employment.

Table 4: Key Multinomial Logit Parameter Estimates (and Standard Errors) for Outcomes of Not Employed and Manual Relative to Non-manual Employment

	Men		Women	
	Not Employed	**Manual**	**Not Employed**	**Manual**
Not Employed at t-1	2.503***	1.602***	2.646***	1.520***
	(0.119)	(0.116)	(0.078)	(0.131)
Manual at t-1	0.953***	2.802***	1.221***	3.726***
	(0.120)	(0.108)	(0.132)	(0.163)
Not Employed t=1	3.003***	2.178***	2.253***	1.691***
	(0.147)	(0.148)	(0.083)	(0.138)
Manual at t=1	2.707***	3.806***	1.969***	3.683***
	(0.169)	(0.149)	(0.149)	(0.167)
Health index	-0.027***	-0.008**	-0.014***	-0.002
	(0.004)	(0.004)	(0.003)	(0.004)
Initial health	-0.003	0.003	-0.007**	-0.004
	(0.004)	(0.004)	(0.003)	(0.005)
Btwn ind variance	1.658***		0.825***	
	(0.159)		(0.092)	
Sample	28,327		29,584	
Individuals	4,685		4,934	

There is strong evidence of state dependence and cross-dependencies. The parameter estimate on lagged manual employment and not employed is positive and very large for both outcomes. Previous manual employment and economic inactivity greatly increase the likelihood of current manual employment and economic inactivity. Initial outcomes are also an important determinant of current occupation, adding to the overall picture of persistence.

The variance for the individual random effect is statistically significant in results for both men and women, showing that the models are subject to unobserved heterogeneity, and supporting the use of a random effects model. The test statistic from conducting a likelihood ratio test also found very strong evidence of individual effects. The overall estimation results for the other explanatory variables accord with intuition, having the expected effects. They are robust to the inclusion of different health measures.

The parameter estimates presented in Table 4 do not have a straightforward interpretation in terms of magnitude. Average predicted probabilities enable quantitative estimates of the magnitude of findings, and they are presented for the EGP model, including the health index, in Figure 1. These predicted probabilities use health index quintiles to determine the effects of health, with the lowest quintile reflecting the poorest health. They represent counterfactuals, with all observations by gender set to have the same health (the mean of each health quintile), and probabilities averaged across all observations.

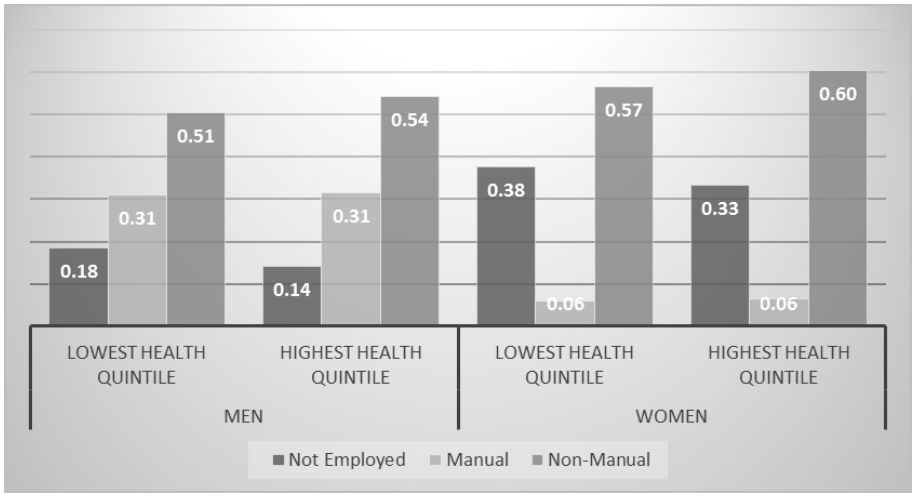

Figure 1: Average Predicted Probability of EGP by Health Index Quintile and Gender

The predicted probabilities can be interpreted as a change in health, holding all other characteristics constant. The relationships found in the parameter estimates are reflected in the predicted probabilities in Figure 1. Poorer health increases the probability of economic inactivity for both men and women (by 4 and 5 percentage points, respectively), with people either unable to work or leaving employment. This illustrates the importance of accounting for health selection out of employment for those experiencing poor health. The results using the health index do not support the findings in the literature that poor health induces job change. It must be acknowledged that not all cases of poorer health affect the ability to work; hence, EGP models are estimated using other measures of health.

Table 5 presents the key results from the EGP models including the alternative measures of health. There are minimal differences in the effects of the explanatory variables in each EGP model specification. In order to avoid repetition, Table 5 only contains parameter estimates for the effects of the health variables on the EGP outcomes.

Table 5: Key Multinomial Logit Parameter Estimates (and Standard Errors), Alternative Health Measures

	Men		Women	
	Not Employed	**Manual**	**Not Employed**	**Manual**
Health shock model				
Health Shock	0.427***	-0.239**	0.325***	0.0234
	(0.116)	(0.114)	(0.0887)	(0.144)
Work limit	1.009***	0.150	0.738***	-0.131
	(0.110)	(0.118)	(0.0835)	(0.142)
Health improvement model				
Health improvement	-0.130	0.002	0.055	0.003
	(0.120)	(0.098)	(0.078)	(0.131)
Sample	28,770		30,331	
Individuals	4,615		4,874	

The estimates show that a health shock has a negative effect on the likelihood of manual employment for men. This suggests that men who experience a health shock are more likely to transition from manual to non-manual employment. Worsening health has a greater impact on occupational choice for men than work-limiting conditions have. A work-limiting condition greatly increases the likelihood of not being employed, but has no significant effect on manual versus non-manual employment.

For women, the estimates for manual employment are small and they are not statistically significant for the health shock and for work-limiting conditions. This suggests that there is no impact from a health shock or a work-limiting condition on occupational choice. An improvement in health has no significant effect for men or women on any outcomes in the model.

The large estimates for both men and women for the 'not employed' outcome—most glaringly for the health-shock measure and for the work-limiting condition, but also evident in the effect of the health index—is perhaps not surprising, given that theory and previous empirical findings support the conclusion that poor health reduces the probability of being employed. This suggests that the selection effect dominates any effect of health on occupation.

Predicted probabilities for the effect of a health shock appear in Figure 2. These predicted probabilities show that men who experience a health shock have a higher probability of not being employed (by 3 percentage points) and a lower probability of manual employment (by 2 percentage points). Interpreting these probabilities in the light of the parameter estimates suggests that there is some evidence that men change jobs after a health shock in order to adapt and keep working. Those who are unable to work or who are unable to find a job which accommodates their worsened health withdraw from employment. For women, there is no evidence supporting job change, suggesting that withdrawal from employment is the primary response to a health shock, even more so than it is for men.

Figure 2: Average Predicted Probability of EGP by Health Shock and Gender

As previously acknowledged, the EGP measure of occupation represents a broad measure of physical job demands. The low number of transitions between broad occupational categories could explain the limited significant effects of the health measure on occupational choice when using the EGP schema. The AUSEI06 assumes a less rigid occupational hierarchy than the EGP (ranging from 0 to 100) and this wider range is more likely to capture changes within occupational classes and to identify effects of health on occupational status.

AUSEI06 Results

Table 6 and Table 7 present key results from the Tobit models for men and women, respectively. Three specifications are separately estimated using the different health measures as was done for the EGP models: (1) includes the health index, (2) includes health shock and work-limiting long-term condition, and (3) includes health improvement. Average marginal effects are reported and these take into account the censored nature of the dependent variable,

as illustrated by the number of censored observations in tables 6 and 7 which represent the individuals who were not employed.

Table 6: Marginal Effects for Key Results from Tobit AUSEI06 Estimations, Men

	Health Index	Health Shock	Health Improv
AUSEI06 at t-1	0.341***	0.339***	0.338***
	(0.006)	(0.006)	(0.006)
AUSEI06 at t=1	0.345***	0.342***	0.347***
	(0.007)	(0.007)	(0.007)
Health Index	0.069***		
	(0.011)		
Work limit		-4.171***	
		(0.321)	
Health shock		-1.026***	
		(0.317)	
Health Improv			0.116
			(0.267)
Sample	36,185	36,733	36,738
Individuals	5,514	5,422	5,422
Censored	4,912	5,069	5,070

Table 7: Marginal Effects for Key Results from Tobit AUSEI06 Estimations, Women

	Health Index	Health Shock	Health Improv
AUSEI06 at t-1	0.361***	0.355***	0.355***
	(0.006)	(0.005)	(0.005)
AUSEI06 at t=1	0.301***	0.299***	0.304***
	(0.006)	(0.006)	(0.006)
Health Index	0.067***		
	(0.011)		
Work limit		-5.083***	
		(0.344)	
Health Shock		-1.180***	
		(0.327)	
Health Improv			-0.048
			(0.265)
Sample	40,855	41,826	41,835
Individuals	6,052	5,977	5,977
Censored	11,596	12,000	12,008

The estimate on the lag of the health index is positive and highly significant for both men and women—those with a higher value on the health index (better health) have higher occupational status. The estimate appears small, just under 0.07, but if we compare somebody with a health index score of 85 (the approximate average score in the highest health quintile) against somebody with a health index score of 45 (the average score in the lowest health quintile), this leads to an average 2.8 point difference on the occupational status index.

Estimates of the effect of a health shock are negative and significant for both men and women, as are the estimates of the effect of a work-limiting long-term condition. Inclusion of both measures within the one model separately identifies the effect of worsening health, and the effect of a long-standing condition which affects the ability to work. As would be expected, a work-limiting condition has a larger effect, resulting in a 4.2 index points lower occupational status for men and 5.1 index points lower occupational status for women. A health shock results in a 1 point lower occupational status for men and 1.2 points lower occupational status for women. A health improvement has no significant effect on occupation using the AUSEI06 measure, as was the case in the EGP results. Other explanatory variables (not reported) have the expected effects with higher education, in particular, having a large positive effect on occupational status.

The results offer support for the previous finding that people in poor health select into less-prestigious jobs (Cohiden *et al.* 2009; Halleröd and Gustaffson 2011), or in the case of those who are working, their health problems adversely affect occupational mobility (De Raeve *et al.* 2009; Halleröd and Gustaffson 2011). The effect of occupational status in the previous year is highly significant, providing evidence of state dependence. Initial occupational status has a significant effect on current occupational status. This suggests that health-related disadvantage may be amplified, with any adverse effects of health on occupational status potentially having a persistent effect on future occupational status.

VII. Discussion and Conclusions

This paper examined the effects of health and changes in health on occupation. It aimed to provide some evidence on the degree to which people with health problems adapt or withdraw from work, and to determine how health and changes in health may influence the occupations in which people work. The empirical analysis accounts for selection into employment, state dependence, and unobserved heterogeneity.

The results show that movement out of employment is the dominant response to adverse health, especially for women. This illustrates the importance of controlling for selection bias when analysing determinants of occupation. There is, however, a statistically significant effect of health on occupational choice for men, even after accounting for selection. Results show that there may be some degree of choosing work to enable continued employment, with men being less likely to work in physically demanding manual occupations after a health shock. The gender differences in response to poor health mirror the finding of Daly and Bound (1996), with women being more likely to leave employment than men are after the onset of health impairment. Worsening health and work-limiting health conditions have a negative effect on occupational status, suggestive of selection into lower-status jobs and adverse effects of poor health on occupational mobility.

The lack of a significant effect of a health improvement may be explained by voluntary versus involuntary labour market activity. An improvement in health just makes it possible to shift into employment or to a more desired occupation. Any positive shift will be likely to occur at a more leisurely pace than responses to adverse health do. The results on the effects of poor health offer support to the limited evidence to date on the effects of health on occupation, extending this to account for selection into employment and, in addition, providing evidence on the persistence of occupation which has implications for the adverse effects of poor health.

State dependence and the findings on the effect of initial occupation suggest that past outcomes have the potential to amplify adverse effects of poor health, particularly the disadvantage resulting from withdrawal from employment. Withdrawal from employment is a powerful source of disadvantage from poor health, not only affecting current earnings but also future employment and earnings outcomes. This is particularly so if the spells out of employment are prolonged.

It is acknowledged that the analysis was not able to identify employer accommodations which assist in enabling individuals to remain employed after the onset of health impairment. The measure of physical job demands is a broad measure, and it may mask other characteristics of jobs which may make it easier or harder to keep on working. Nonetheless, the results do support the existing job-accommodation literature. They contribute to understanding the effect of health on occupational choice by examining, within the model of occupation, the effects of health on the movement out of employment.

The findings from this paper have important implications for policy efforts to deal with negative employment outcomes for those in poor health, and to increase the employment rates of those with a disability. The effect of health on occupation shows that the type of job, and the physical demands involved can play a role in whether individuals adapt or withdraw in response to health impairment. The need to match job demands to individual needs and specific health limitations poses a challenge to policies aimed at increasing employment—but efforts to find employment which accommodates health limitations will ensure that these policies have a greater positive impact.

Examining the effects of poor health on outcomes beyond participation, such as occupation, shows that there is still likely disadvantage for those with a health impairment who do participate in employment compared with individuals who do not experience poor health. Even if they can adapt to a health problem and continue in work, negative effects of poor health on status have implications for income and career prospects.

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Appendix

Table A1: Variables used in Model of Self-assessed Health

Variable	Description of Variable
Age	Age in years
Age squared	Age in years, squared
Married or de facto	1 if married or has partner, 0 otherwise
Household size	Number of people residing in the household
Owns home	1 if owns home, 0 otherwise
Degree or above	1 if has degree or above, 0 otherwise
Advanced diploma or diploma	1 if has advanced diploma or diploma, 0 otherwise
Certificate III or IV	1 if has certificate III or IV, 0 otherwise
Year 12	1 if has year 12, 0 otherwise
Year 11 or below	Reference category, 1 if has year 11 or below
SF-36 mental health	Score on the SF-36 mental health scale, 0-100
SF-36 physical functioning	Score on the SF-36 physical functioning scale, 0-100
Long-term condition not limiting work	1 if has a long term condition which does not limit work
Condition such as arthritis, asthma, heart disease, Alzheimer's, dementia	1 if has condition, 0 otherwise
Condition restricting physical activity	1 if has condition, 0 otherwise
Shortness of breath or difficulty breathing	1 if has condition, 0 otherwise
Effects as a result of stroke, head injury or other brain damage	1 if has condition, 0 otherwise
Sight problems not corrected by glasses	1 if has condition, 0 otherwise
Social support	Social support, scale 1-7 (7 is more support)
Smoker	1 if currently smoking or ever smoked, 0 otherwise
Heavy drinker	1 if a heavy drinker, defined as drinking more than 6 standard drinks a day when drinking, 0 otherwise
Lack of physical activity	1 if lack of physical activity, defined as no physical activity at all or less than once per week, 0 other wise
Has lived in Australia 0-4 years	1 if has lived in Australia 0-4 years, 0 otherwise
Has lived in Australia 5-9 years	1 if has lived in Australia 5-9 years, 0 otherwise
Has lived in Australia 10-19 years	1 if has lived in Australia 10-19 years, 0 otherwise
Has lived in Australia 20+ years	1 if has lived in Australia 20 years or longer, 0 otherwise
Reference category	Reference category, 1 if born in Australia
Capital income ($1000's)	Capital income, divided by 1000
Weekly non-labour income ($100's)	Weekly non labour income, divided by 100
State dummies for each State	1 if lives in State or Territory, 0 otherwise

Table A2: Description of Variables used in Occupation Models

Variable	Description of Variable
Dependent variables	
EGP	0 if not employed, 1 if employed in a manual occupation, 2 if employed in a non-manual occupation
AUSEI06	Australian Socioeconomic Index scaled from 0 to 100
Variables Appearing in Both Specifications of Occupation	
Post GFC	1 if observation is from 2008 or later, 0 otherwise
Lagged health index	Health index score from previous year
Initial health	Health index score from initial wave of data
Health shock	1 if health somewhat worse or much worse than last year, 0 otherwise
Work limiting condition	1 if has work limiting condition, 0 otherwise
Health improvement	1 if health somewhat better or much better than last year, 0 otherwise
Has children aged 0-4	1 if has children aged 0-4, 0 otherwise
Has children aged 5-14	1 if has children aged 5-14, 0 otherwise
Married or De Facto	1 if married or has partner, 0 otherwise
Partner is employed	1 if has partner in employment, 0 otherwise
Weekly non-labour income ($100's)	Real weekly non labour income divided by 100
Partner wage	Real hourly wage of partner, takes value 0 if has no partner
Rural	1 if lives in rural area, 0 otherwise
Migrant	1 if migrant, 0 if Australian-born
Migrant*lagged health index	Interaction term between health index score from previous year and migrant
Father's occupation	AUSEI06 occupational status scale, father's occupation when respondent was aged 14
Experience	Years in employment since leaving full time education
Experience squared	Years in employment since leaving full time education squared
Economic inactivity	Years not employed since leaving full time education
Economic inactivity squared	Years not employed since leaving full time education squared
Unemployment rate	Unemployment rate calculated by age, sex, state of residence and year
Education	Measured by dummy variables reflecting highest educational attainment
Degree or above	1 if has degree or above, 0 otherwise
Advanced diploma or diploma	1 if has advanced diploma or diploma, 0 otherwise
Certificate	1 if has certificate I, II or III or IV, 0 otherwise
Year 12	1 if has year 12, 0 otherwise

Variable	Description of Variable
Year 11 or below	Reference category, 1 if has year 11 or below
Variables appearing only in model using EGP schema	
Not employed at t-1	1 if not employed in previous year, 0 otherwise
Manual at t-1	1 if employed manually at t-1, 0 if not employed or employed in a non-manual occupation
Not employed at t=1	1 if not employed in initial wave of data, 0 otherwise
Manual at t=1	1 if employed manually in initial wave of data, 0 if not employed or employed in a non-manual occupation
Variables appearing only in model using AUSEI06	
AUSEI06 at t-1	Australian Socioeconomic Index ranged from 0 to 100, value from previous year
AUSEI06 at t=1	Ranking on Australian Socioeconomic Index in initial wave of data

Note: Partner wage rate and non-labour income are inflated to the value in the year 2014 by the RBA annual inflation rate over the period (2001–2014) derived from the ABS Consumer Price Index