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Use it Too Much and Lose Everything? The Effects of Hours of Work on Health

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【Abstract】
Using data from Wave 1 to Wave 12 of the Household Income and Labour Dynamics in Australia (HILDA) Survey, we examine the causal impact of working hours on various health outcomes of people living in Australia aged 40 years and older. Eight measures of self-assessed health status in SF-36 are employed: physical functioning; role physical; bodily pain; general health; vitality; social functioning; role emotional and mental health. In order to capture the potential non-linear dependence of health status on working hours, the models for health outcome include working hours and its square. We deal with the potential endogeneity of the decision of how many hours to work by using the instrumental variable estimation technique. Our findings show that there is non-linearity in the effect of working hours on health. For working relatively moderate hours (up to 18–23 hours for a week for men and up to 16–17 hours for women), an increase in working hours has a positive impact on health. However, when working hours exceed these thresholds, an increase in working hours has a negative impact on health. These results suggest that compared to not working at all the elderly could maintain or improve their health status by working in a part-time job which requires around 20 hours of work per week.

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Declarations

The authors declare they do not have any actual or potential conflict of interest in relation to this research. No ethic approval was required for this study.

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ABSTRACT

Using data from Wave 1 to Wave 12 of the Household Income and Labour Dynamics in Australia (HILDA) Survey, we examine the causal impact of working hours on various health outcomes of people living in Australia aged 40 years and older. Eight measures of self-assessed health status in SF-36 are employed: physical functioning; role physical; bodily pain; general health; vitality; social functioning; role emotional and mental health. In order to capture the potential non-linear dependence of health status on working hours, the models for health outcome include working hours and its square. We deal with the potential endogeneity of the decision of how many hours to work by using the instrumental variable estimation technique. Our findings show that there is non-linearity in the effect of working hours on health. For working relatively moderate hours (up to 18–23 hours for a week for men and up to 16–17 hours for women), an increase in working hours has a positive impact on health. However, when working hours exceed these thresholds, an increase in working hours has a negative impact on health. These results suggest that compared to not working at all the elderly could maintain or improve their health status by working in a part-time job which requires around 20 hours of work per week.

Keywords: health, working hours, endogeneity, retirement.
JEL Classification Nos: I10, J2

Highlights

- A non-linear causal relationship between working hours and health is observed.
- Health levels peak around 20–25 hours of work for men.
- Health levels peak around 16 hours of work for women.
- For men, working more 50 hours leads to worse health outcomes than not working at all.

1. Introduction

How does work affect health? Is work bad for health? There is an extremely large literature in epidemiology, occupational psychology, and health economics that examines this issue (see Bassanini and Caroli, 2015). Some papers examine extensive margin of work (working or not working), for example, by examining the impact of unemployment and job loss on health outcomes. Using fixed-effect models for Australian, Canadian and UK panel data, Llena-Nozal (2009) shows that the shift from being employed to being unemployed has adverse effects on mental health. On the other hand, using German data, Schmitz (2011) finds no significant effect of plant closures on various health outcomes. Another stream of research on the extensive margin examines whether retirement has any impacts on cognitive functioning and health (Bonsang *et al.* 2012, Coe and Zamarro 2011, Mazzonna and Peracchi 2012, Mazzonna and Peracchi 2017, Rohwedder and Willis, 2010, Blacke and Garriuste 2012, De Grip *et al.* 2012, Kajitani *et al.* 2016). Overall, these studies tend to suggest that retirement has a negative impact on cognitive functioning, but positive impacts on health outcomes.

Others examine intensive margin of work, that is, the number of hours worked. The main focus of these analyses is on the effects of working long hours on various health outcomes. Such studies reveal that working long hours has adverse effects on health (Spurgen *et al.* 1997, Sparks *et al.* 1997, Frijters *et al.* 2009). However, previous studies mostly focus on the effects of long working hours, and do not examine the effects of moderate working hours on health or the optimal number of hours worked. Robone *et al.* (2011) also finds consistent results for self-assessed health with these previous studies. Interestingly, Robone *et al.* (2011) indicate that having a part-time job, as compared to a full-time job, has a positive impact on the health of people who are satisfied with their working hours. This highlights the fact that the relationship between work and health may not be linear. Work can be a double-edged sword in that it can have both positive and negative effects. Interactions with people at work may help maintain an individual's cognitive functions and his/her mental health. Moreover, working individuals have more incentive to invest in health repair activities in order to be 'fit' in the labour market. On the other hand, long working hours can cause fatigue and stress on both physical and mental levels which potentially damage an individual's overall health. Most of the previous studies treat long working hours as a 0–1 dummy variable which defines long working hours as working more than 50 or 60 hours per week. This means that they implicitly assume that long working hours have a constant shift effect on health status, and they do not deal with the potential non-linear effects of working hours on health.

In this paper, we focus on not only labor market participation (the extensive margin), but also working hours (the intensive margin). We examine the causal impact of working hours on the health outcomes of middle-aged and older adults (people aged 40 years and over) in Australia using Wave 1 to Wave 12 of the Household, Income and Labour Dynamics in Australia (HILDA) Survey. One of the issues in estimating the causal relationship between hours worked and health is what is called the 'healthy worker effect' (Bassanini and Caroli, 2015), that is, healthy workers are more likely to be employed and work longer. Thus, the presence of the healthy worker effect implies the existence of reverse causality. We deal with the potential endogeneity of decisions relating to working hours by using the instrumental variable estimation technique. An advantage of using middle-aged and older adults sample is that it enables us to use information related to the eligibility age for pension benefits as an instrument.

Our empirical evidence shows that there is non-linearity in the effects of working hours on self-assessed health status. To be more specific, there is an inverted U shaped relationship. For men, when working hours are less than around 18–23 hours a week, working hours have a positive impact on health. However, when working hours are greater than this threshold, working hours have negative impacts on health. Similarly, for women, when working hours are less than around 16–17 hours a week, working hours have a positive impact on health, but the positive effect becomes negative thereafter. These results suggest that peoples in old age could maintain or improve their health status ability compared to not working by working in a part-time job that requires them to work around 18–23 hours per week for men and 16–17 hours per week for women. The results are consistent with the analysis on cognitive functioning of Kajitani *et al.* (2017). In addition, we observe some statistically significant gender differences in the effects of working hours on health outcomes such as physical functioning, role physical, bodily pain and mental health.

The literature examining the impact of retirement on cognitive function examines the 'use it or lose it' hypothesis, namely that not working (not using your brain) leads to losses of cognitive functioning. Here, we also examine the relevance of this hypothesis for a broader set of health outcomes. In addition, we focus on the 'use it too much and lose everything' hypothesis which means refers to the situation where working too much can lead to not just a loss of cognitive functioning (see Kajitani *et al.* 2017) measures, but declines in health status across the board.

The rest of this paper is organized as follows: Section 2 presents the empirical framework used in this paper. Section 3 describes the data, and Section 4 reports the results of estimation and discusses their implications. The last section concludes this paper.

2. Estimation model and identification strategy

Our identification strategy exploits the variation in working hours, while controlling for time-invariant individual characteristics. In order to capture the possible non-linear effects of working hours on health status, we consider the following model[1]:

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1 An alternative to the parametric model in equation (1a) to account for the non-linear effect of working hours on health status would be to estimate a semi-parametric or non-parametric

$$y_{it} = \alpha_1 WH_{it}^{\;2} + \alpha_2 WH_{it} + X1_{it}\beta + u_{it},\; i = 1,..N, t = 1,..,T_i \quad \text{(1a)},$$
$$u_{it} = \mu_i + \epsilon_{it} \quad \text{(1b)}$$

where y_{it} denotes various health outcomes (physical functioning, role physical, bodily pain, general health, vitality, social functioning, role emotional and mental health) for individual i at the time of survey t, WH_{it} is working hours, $WH_{it}^{\;2}$ is the square of working hours, and $X1_{it}$ denotes a vector of four time variant control variables: a spouse dummy variable, *Married*, which takes the value one if the respondent has a spouse and zero otherwise; the number of dependent children, *Number of dependent children*; the square of the respondent's age which controls for age-related effects; and a house ownership dummy variable, *Ownhouse*, which indicates whether the respondent owns or is in the process of owning his/her house as a proxy for assets. The variables related to the respondent's marital status and the number of dependent children are included because communication and interaction with other family members may prevent declines in health, particularly in mental health. In addition, the number of dependent children is included since it can be argued that people with dependent children may be likely to invest more in their health capital. The house ownership dummy is included to control for the effects of assets holdings on health. To take account of regional variations, we also include four 0–1 regional dummies. N is the number of individuals and T_i is the number of observations available for individual i indicating that we have an unbalanced panel. As equation (1b) indicates, u_{it} is an error term which consists of a time invariant individual fixed effect, μ_i, and an idiosyncratic error, ϵ_{it}. The coefficients α_1 and α_2 in equation (1a) capture the non-linear effect of working hours on a health outcome. Given the discussion in section 1 that some work is better than no work, and that too much work may be worse than some work, it is expected that $\alpha_1 < 0$ and $\alpha_2 > 0$. Holding everything else constant, it is easy to see that the value of a health score is maximized when $WH_i = -\alpha_2/(2\alpha_1)$, and that for $WH_i = -\alpha_2/\alpha_1$ the level of health is the same as it would be if the respondent is not working.

The possibility of the endogeneity of the respondents' working hours in equation (1a) is a major obstacle to estimating the causal impact of working hours on health. This particular identification problem is called 'healthy worker effect'. Healthy individuals are more likely to be employed and to work longer whereas unhealthy workers may decide to leave the workforce or work short hours. On the other hand, the reverse causality between health and working hours can be more ambiguous. Previous studies in the context of cognitive function

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model. However, such an approach makes it rather difficult to deal with the potential endogeneity between working hours and health status. Here, we put priority on dealing with the potential endogeneity of working hours.

observe that a high wage rate is associated with cognitive skills (for example, Wooden, 2013; Capatina, 2014). In a neoclassical model of consumer behavior where there is a trade-off between consumption and leisure, and leisure is assumed to be a normal good, the impact of the wage rate on working hours depends on whether the substitution effect dominates the income effect or vice versa. Individuals, who are healthier and, therefore, tend to earn a relatively higher wage, could decide to reduce their hours of work even further. The same logic can be applied to health outcomes.

For equation (1a), the standard two stage least squares (2SLS) procedure is to find variables which are related to an individual's labor supply, but that are unrelated to his/her health outcomes. The following equation is assumed to explain an individual's hours worked:

$$WH_{it} = \gamma_1 Interview\ July\ or\ August_{it} + \gamma_2 Over\ Eligibility\ Age_{it} + X2_{it}\delta + e_{it} \quad (2)$$

$$WH_{it} = 0 \quad \text{if} \quad WH_{it}^* \leq 0 \qquad = WH_{it}^* \quad \text{if} \quad 0 < WH_{it}^*, \quad (3)$$

where WH_{it}^* denotes an unobserved latent variable which is connected to the observed working hours WH_{it} through equation (3). $Interview\ July\ or\ August_{it}$ a 0–1 dummy variable which takes the value one if the respondent is interviewed in July or August, and zero otherwise. $Over\ Eligibility\ Age_{it}$ is a 0–1 dummy variable which takes the value unity if the *i*th respondent reached his/her pension eligibility age at time *t*, and zero otherwise. $X2_{it}$ consists of the same vector of control variables as used in equation (1a) and in addition a vector of three control variables: school years dummy variables and the respondent's age, and e_{it} is a disturbance which is assumed to be normally, independently and identically distributed with a zero mean and variance σ^2.

In equation (2), the first instrument, $Interview\ July\ or\ August_{it}$, is used to capture the seasonality of working hours. Interviewers do not randomly choose an interview month for a respondent. The fieldwork for each wave is split into 3 periods - starting end of July–early October (Period 1), end October–early December (Period 2) and early January–early February (Period 3), and the interviewers are allocated households to approach in each of these periods. If a respondent is too busy or away overseas, or temporarily incapable, the interviewer returned at a time that is more appropriate for the respondent. In the second and subsequent waves, although respondents were free to choose when they were interviewed however most respondents were interviewed within 1 month anniversary of their interview in the previous wave[2]. Table 1 in Melbourne Institute (2014, p. 9) provides details of the

[2] Summerfield *et al.* (2016) contains further information on the HILDA's data collection process.

distribution of interviews across months of the year for Waves 1–12, and indicates that this distribution has changed over time. Interviews are never conducted in April, May or June.

The second instrument, $Over\ Eligibility\ Age_{it}$, is closely related to one of the standard instrument used for the analysis of causal relationship between retirement and cognitive functioning (Bonsang *et al.* 2012, Coe and Zamarro 2011, Mazzonna and Peracchi 2012, Mazzonna and Peracchi 2017, Rohwedder and Willis, 2010). It is important to note that the pension related variable we created, $Over\ Eligibility\ Age_{it}$, depends on time because it reflects a major reform of the Australian pension system that was announced by the Australian Government in the 2009/2010 national budget[3]. This reform raised the expected retirement ages for younger generations shifted from 65 to 65.5, 66, 66.5 or 67. A summary of the age pension eligibility ages in Australia and the sample distribution are shown in Table I[4]. In our sample, there is a reasonable amount of variation in the eligibility age is observed. Although the eligibility age for men stayed at the age of 65 until the birth cohort of up to 30 June, 1952, the proportion in Wave 9 (just after the 2009 pension reform) is just 46.3%. the proportion of men whose eligibility age is 67 in Wave 9 consists of 39.5% (Panel A). On the other hand, women show more variation in their retirement age due to continuous policy changes (Panel B).

[Table I around here]

As is clear from equation (3), we have another issue in examining the effects of labor hours on health, that is, labor hours are censored (for example, retirees report zero working hours), so we estimate equations (2) and (3) using a Tobit estimator[5]. Since it is well known that the labor supply behavior of men and women are quite different, both equations (2) and

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[3] On 12 May 2009, Wayne Swan, the Treasurer and Jenny Macklin, the Minister for Families, Housing, Community Services and Indigenous Affairs jointly announced that the Australian government would raise starting in 2017 the qualifying age for the aged pension would be gradually increased from 65 to 67 by 2023. The joint press release is available from URL:
http://ministers.treasury.gov.au/DisplayDocs.aspx?doc=pressreleases/2009/056.htm&pageID=003&min=wms&Year=&DocType=0
Accessed on 4 December 2016.

[4] Prior to the Social Security Legislation Amendment Act 1993 (SSLAA93), women were eligible for an aged pension when they reached the age of 60. With effect from 1 July 1995, SSLAA increased progressively the age pension qualifying age for women from 60 to 65. Further details of SSLAA93 can be obtained from Atalay and Barrett (2015, p.73). This change precedes Wave 1 of the HILDA Survey.

[5] Since we are estimating this model on panel data, it could be argued that we should employ a Tobit estimator with fixed effects. Given the incidental parameter problem, this estimator would not provide a consistent estimator of any of the parameters of the model (see Greene (2004)), so we employ a pooled Tobit estimator.

(3) are estimated for men and women separately.

From equations (2) and (3), the conditional expectation of WH_{it} can be computed as

$$E(WH_{it}\,|Z_{it}) = \Phi\left(\frac{Z_{it}\varepsilon}{\sigma}\right) Z_{it}\varepsilon + \sigma\phi\left(\frac{Z_{it}\varepsilon}{\sigma}\right) \qquad (3),$$

where Z_{it} and ε are the vectors of regressors and parameters in equation (2), respectively, and $\Phi(\cdot)$ and $\phi(\cdot)$ are the cumulative distribution function and probability distribution function of the standard normal distribution, respectively (see Greene 2008, p. 871). Using estimates of the parameters of equation (2), this conditional expectation can be estimated. This estimate is denoted by $\widehat{WH_{it}}$. In estimating equation (1a) using a 2SLS procedure, $\widehat{WH_{it}}$ and $\widehat{WH_{it}}^2$ as instruments for WH_{it} and WH_{it}^2, respectively (see Wooldridge 2010, p. 268).

3. Data: Overview of the HILDA Survey

Our data are drawn from Wave 1 conducted in 2001 to Wave 12 conducted in 2012 of the "Household, Income and Labour Dynamics in Australia (HILDA) Survey." The HILDA Survey which is conducted by the Melbourne Institute of Applied Economics and Social Research is a broad social and economic longitudinal survey. Since 2001, the HILDA Survey has asked Australian respondents about their economic and subjective well-being, family structures, and labor market dynamics. Household included in the survey were selected using a three-stage approach. First, a sample of 488 Census Collection Districts (CDs) were randomly selected from across Australia. Second, within each of these CDs, a sample of dwellings was selected based on expected response rates and occupancy rates. Finally, within each dwelling, up to three households were selected to be part of the sample. In addition, the sample was replenished in Wave 11. One aim of this replenishment was to provide better coverage of migrants for inclusion in the HILDA Survey.[6]

The HILDA survey contains the SF-36 (the 36-Item Short Form Health Survey) which is one of the most widely used self-assessed measures of health status. It consists of eight scaled self-assessed health scores: physical functioning; role physical; bodily pain; general health; vitality; social functioning; role emotional and mental health. The eight categories are scaled by the weighted sums of their questions, and are converted to a 0–100 scale. 0 is equivalent to the highest disability, and 100 is equivalent to the lowest disability[7].

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[6] Detailed information on the sample design of the HILDA Survey is available in Wooden *et al.* (2002) and Watson and Wooden (2013).

[7] Although each self assessed health score is bounded from below by zero and above by 100, and there are individuals who score one of these two boundary values (see Table II), we do

The exact definitions of all the variables used in the analysis in this paper are summarized in the Appendix I. Table II displays descriptive statistics on all the variables used in the analysis. The sample is restricted to individuals who meet the following five criterion: (i) males and females aged 40 and over in the Wave 1 survey or males and females who turn 40 after Wave 1 but are only included for the Waves where they are aged 40 and over; (ii) all eight scores relating to health status are available; (iii) age and working hours are less than age and working hours at the top 1% percentile; (iv) information on all the relevant variables is available and (v) the respondent is not unemployed. Even if we did not have attrition, the second part of criterion (i) means we will not have a balanced panel data set. Table O1 in the online supplementary material indicates the effect of these criterion on the sample size available. In Table II, *Working hours* is the respondent's usual hours of working per week. As a result, the mean values of *Working hours* for males and females are 28.05 and 16.44 hours, respectively.

[Table II around here]

For Wave 1 of the HILDA survey, Table III summarizes the current employment status of respondents by gender and age group. For males aged 40–49, 85.6% work full-time (35 hours and over), 6.5% work part-time (34 hours and less), and 7.9% of them are not working at all. Not surprisingly, as men get older, the proportion working full-time declines, and the proportion not working at all falls. In any age group, the proportion of females working full-time is lower than and the proportion not working at all are higher than for males.

[Table III around here]

4. Estimation results

All regression results reported in this section are estimated using STATA version 14 (StataCorp 2015). Table IV presents the results of estimating equation (2), and indicate that the exclusion restriction variables are individually significant, and the null hypothesis that they are jointly irrelevant in explaining working hours is rejected decisively for both males (F-statistics is 33.20) and females (F-statistic is 31.43).

[Table IV around here]

Table V reports the results of estimating equation (1a) by a Fixed Effect (FE) estimator that ignores the endogeneity of working hours and a Fixed Effect Instrumental Variable method (FEIV) estimator that takes account of the endogeneity of working hours, where the

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not employ a double sided Tobit type estimator when estimating equation (1a).

standard errors have been computed to take account of clustering of the errors. Panel A of Table V reports the results for males, and Panel B reports the results for females. Examining the results for males, we find that, after controlling for the respondent's marital status, the number of dependent children, and the housing variable, the estimated coefficients of *Square of working hours* are all significantly negative and the coefficients of *Working hours* are also all significantly positive when the FE estimator is used (see Columns (1a)–(8a)) and except for bodily pain and general health when the FEIV estimator is used (see Columns (1b)–(8b)).

[Table V around here]

Examining the estimated results for females in Panel B of Table V we find that when the models are estimated by FE both the negative impacts of *Square of working hours* and the positive impacts of *Working hours* are all statistically significant except for *Square of working hours* for bodily pain (see Columns (1a)–(8a)). On the other hand, when the models are estimated by FEIV in Panel B less than half of the models show significant coefficient estimates for the quadratic term in working hours (see Columns (1b)–(8b)). The only significant results which are consistent with our hypothesis are that of social function (column (6b)) and role emotional (column (7b)). However, in both these cases, working hours are not significant. For both men and women, an examination of the endogeneity tests in Table V which test the joint significance of two residuals added to the model estimated by FE (see Wooldridge 2010, p.354), the results clearly reject the null hypothesis that *Working hours* and *Working hours squared* are exogenously determined. The Cragg-Donald (1993) tests for men and women indicate we do not have a problem of "weak" instruments. Finally, the Hausman tests for choosing between the pooled IV model and FEIV indicate clearly that the FEIV estimator is to be preferred.

The results in Table V indicate that, for all health measures for males and for some measures for females, as working hours increase from zero the magnitude of the positive impact of working hours on their health status is decreasing until working hours reaches a threshold. Above the threshold, further increases in working hours have a negative impact on their self-assessed health status.

Where does the threshold occur? In other words, when does the impact of working hours on health status change from being positive to negative? For men, the peaks occur around 21 hours for physical functioning, 23 hours for role physical, 18 hours for bodily pain, 21 hours for general health, 22 hours for vitality, 23 hours for social functioning, 22 hours for role emotional, and 20 hours for mental health. For women, the peaks occur a little earlier, the peaks occur around 16 hours for social function, and 15 hours for role emotional. These are all slightly lower than the estimated working hours (22–30 hours) for when cognitive abilities peak that are reported in Kajitani *et al.* (2017).

In Figure I, we graph the relationship between impacts of working hours and self-assessed health status after controlling for other variables, using the estimated coefficients presented in Table V. Moreover, Figure I also shows that the health status of those working extremely long hours can be lower than those who are not working at all. This suggests that long working hours can lead to a deterioration of health status across the board for men. For those health statuses where a significant quadratic relationship is observed for women, Figure I suggests that as working hours increase, females reach a peak earlier than men, and their self-assessed health status decline faster compared to their male counterparts.

[Figure I around here]

The results presented in Table V and graphed in Figure I show that there is non-linearity in the causal effects of working hours on self-assessed health status for middle aged and older males and females living in Australia. Even after including retirees, and taking account of the endogeneity and censoring of working hours, our findings are consistent with our hypothesis, that is, work can benefit maintaining health status for middle age and elderly workers, but long working hours have a negative effect. Our results indicate that the part-time work is an effective way to maintain to health in retirement.

5. Concluding remarks

We examine the causal impact of working hours on the self-assessed health status of middle-aged and elderly males and females living in Australia using longitudinal data from the Household Income and Labour Dynamics in Australia (HILDA) Survey. The literature in this area is very limited in that they do not consider a non-linearity in the effect of working hours on health. This study is unique in that we focus on not only labor market participation (the extensive margin), but also the intensive margin of work (working hours) and that we determined the optimal working hours for middle aged and elderly workers in terms of maximizing their health status.

Using eight measures of self-assessed health status in SF-36, it is found that working hours up to 18–23 hours per week have a positive impact on cognition for males depending on the health measure, and up to around 15 hours for females. After that, working hours have a negative impact on health status. Compared to males who do not work, working hours over 40–50 hours will lead to worse health outcomes depending on the measure. This indicates that the differences in working hours is an important factor in explaining differences in the health outcomes of middle aged and elderly adults.

Thus, in middle and old age, adopting part-time work as a pattern of work could be effective in maintaining/improving the health status of individuals compared to when they do not work. Previous studies on retirement and cognitive functioning indicate that increasing the qualifying age for a pension can not only reduce the government social security expenditures but can potentially reduce the risk of cognitive deterioration. However, our study highlights that raising the qualifying age for a pension can reduce the risk of health deterioration, but that too much work can have quite adverse effects on health status.

[Appendix I around here]

Online Supplementary Material

Table O1: Effect of Selection Criterion on Sample Sizes

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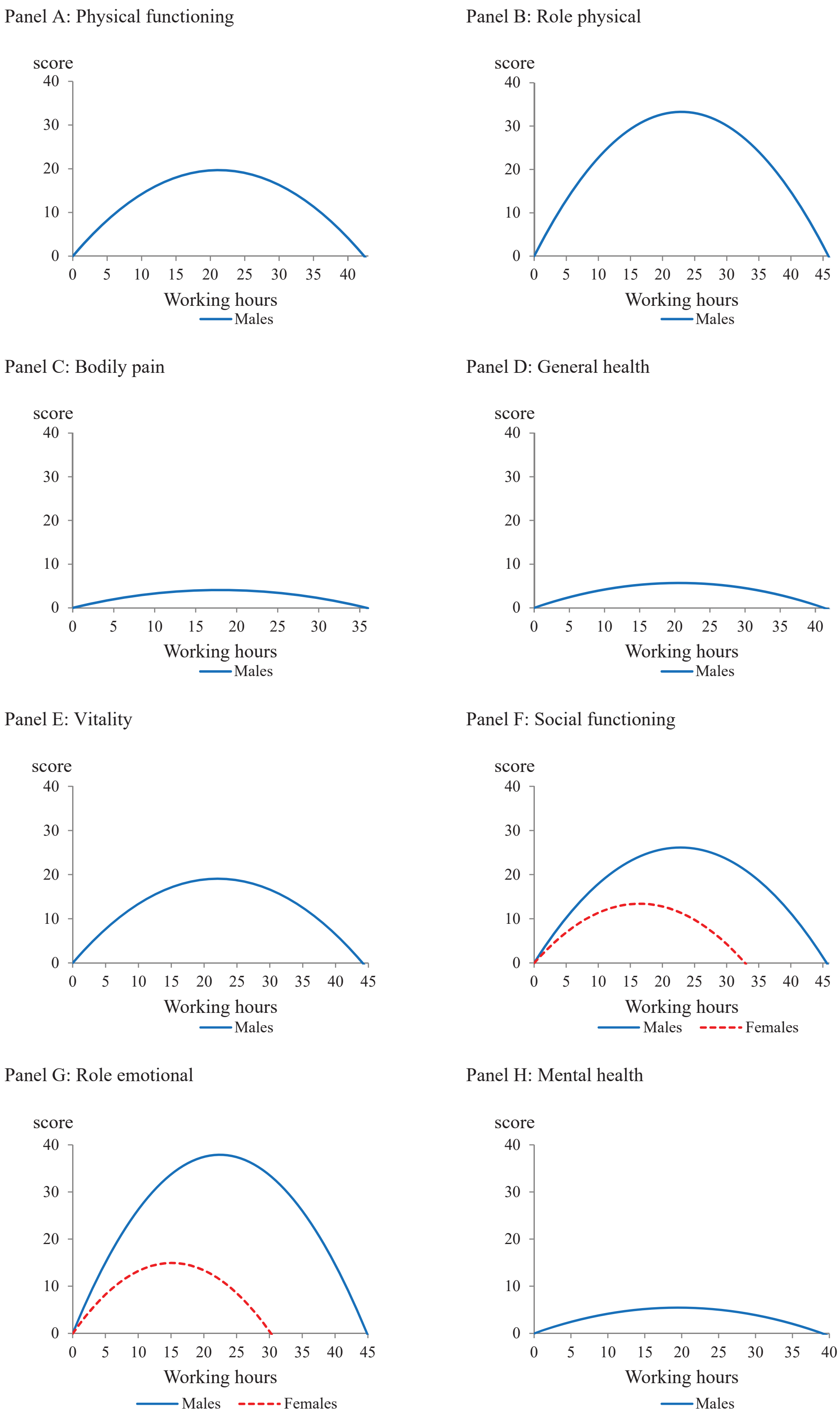
Figure I : Estimated impacts of working hours on health



Note: The fitted values of these scores are computed using the estimated coefficients of *Working hours-squared* and *Working hours* reported in Columns (1b)–(8b) in Table V.

Table I: Australian Age Pension Eligibility Ages and the Sample Distribution by Gender

Panel A: Males

	Before April 2009 Pension eligibility age	Sample (%)								After May 2009 Pension eligibility age	Sample (%)			
		wave1	wave2	wave3	wave4	wave5	wave6	wave7	wave8		wave9	wave10	wave11	wave12
Up to 30 June, 1952	65	65.5	61.6	59.4	56.8	55.3	52.2	51.2	48.8	65	46.3	44.2	42.4	41.0
1 July 1952 to 31 December 1953	65	7.4	7.1	6.9	6.8	6.2	6.3	6.0	6.0	65.5	5.8	5.8	5.7	5.6
1 January 1954 to 30 June 1955	65	3.7	3.4	3.3	2.9	2.8	2.6	2.5	2.4	66	2.7	2.4	2.3	2.3
1 July 1955 to 31 December 1956	65	7.6	7.3	6.8	6.7	6.6	6.5	6.3	6.0	66.5	5.7	5.9	6.0	5.5
From 1 January 1957	65	15.8	20.5	23.7	26.8	29.1	32.5	34.0	36.8	67	39.5	41.7	43.6	45.7
Total		100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0		100.0	100.0	100.0	100.0
Observations		2979	2862	2831	2822	2841	2878	2793	2803		2826	3034	3876	3885

Panel B: Females

	Before April 2009 Pension eligibility age	Sample (%)								After May 2009 Pension eligibility age	Sample (%)			
		wave1	wave2	wave3	wave4	wave5	wave6	wave7	wave8		wave9	wave10	wave11	wave12
Before 1 July, 1935	60	23.9	22.3	20.9	19.5	18.7	17.4	16.0	14.6	60	13.1	11.8	10.0	9.1
1 July, 1935 to December 31, 1936	60.5	3.6	3.4	3.4	3.4	3.1	3.2	2.9	2.9	60.5	2.7	2.7	2.4	2.2
1 January, 1937 to 30 June, 1938	61	2.0	2.1	1.8	1.7	1.7	1.7	1.8	1.7	61	1.5	1.5	1.5	1.6
1 July, 1938 to December 31, 1939	61.5	3.8	3.4	3.3	3.4	3.2	3.2	3.1	3.1	61.5	3.0	2.8	2.8	2.8
1 January, 1940 to 30 June, 1941	62	2.2	2.2	2.1	2.1	2.1	2.2	2.2	2.1	62	2.0	2.2	1.8	1.8
1 July, 1941 to December 31, 1942	62.5	4.0	4.2	3.9	3.8	3.5	3.6	3.7	3.5	62.5	3.4	3.1	3.3	3.1
1 January, 1943 to 30 June, 1944	63	2.8	2.3	2.4	2.5	2.3	2.2	2.3	2.4	63	2.3	2.2	2.2	2.1
1 July, 1944 to December 31, 1945	63.5	4.8	4.7	4.5	4.5	4.4	4.0	4.0	4.1	63.5	3.8	3.8	4.0	3.9
1 January, 1946 to 30 June, 1947	64	3.5	3.4	3.3	3.3	3.1	3.1	2.9	2.8	64	2.7	2.7	2.8	2.9
1 July, 1947 to December 31, 1948	64.5	6.2	5.8	5.9	5.6	5.4	5.2	5.1	4.9	64.5	5.1	4.8	4.7	4.6
1 January, 1949 to 30 June, 1952	65	8.8	8.5	8.1	7.9	7.8	7.5	7.6	7.3	65	7.3	7.2	7.6	7.4
1 July 1952 to 31 December 1953	65	7.0	6.7	6.1	6.1	5.9	5.8	5.6	5.2	65.5	5.1	5.3	5.1	5.0
1 January 1954 to 30 June 1955	65	3.6	3.2	3.4	2.9	3.0	2.8	2.9	2.9	66	2.9	2.7	2.8	2.7
1 July 1955 to 31 December 1956	65	7.8	7.9	7.5	6.8	7.0	6.5	6.4	6.5	66.5	6.5	6.4	6.0	5.8
From 1 January 1957	65	16.1	20.2	23.4	26.5	28.7	31.7	33.7	36.0	67	38.6	40.9	42.9	45.1
Total		100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0		100.0	100.0	100.0	100.0
Observations		3302	3160	3195	3220	3217	3255	3247	3220		3247	3447	4435	4490

Source: For pension eligibility ages: Atalay and Barrett (2015), p. 73, Table 1, and Commonwealth of Australia (2009), p. 9. Sample proportions in each group are authors' calculations using data from the HILDA Survey.

Table II: Descriptive Statistics

	Males (Obs.=36430)				Females (Obs.=41435)			
	Mean	Std. Dev.	Min	Max	Mean	Std. Dev.	Min	Max
Physical functioning	79.98	23.56	0	100	75.87	25.08	0	100
Role physical	74.27	38.84	0	100	71.00	40.36	0	100
Bodily pain	70.30	24.51	0	100	67.54	25.56	0	100
General health	65.27	21.53	0	100	66.62	22.21	0	100
Vitality	61.63	19.62	0	100	58.60	20.45	0	100
Social functioning	82.56	23.68	0	100	80.31	24.93	0	100
Role emotional	83.08	33.26	0	100	81.00	34.74	0	100
Mental health	76.33	16.56	0	100	74.44	17.42	0	100
Working hours-squared/100	13.31	13.62	0	70.56	6.17	8.76	0	49
Working hours	28.05	23.32	0	84	16.44	18.63	0	70
Age-squared/100	33.49	14.09	16	75.69	34.02	14.83	16	79.21
Age	56.66	11.75	40	87	57.03	12.23	40	89
School years 7–10	0.48	0.50	0	1	0.50	0.50	0	1
School years 11 and over	0.49	0.50	0	1	0.46	0.50	0	1
Married	0.79	0.40	0	1	0.67	0.47	0	1
Number of dependent children	0.64	1.07	0	9	0.55	0.98	0	10
Ownhouse	0.83	0.38	0	1	0.81	0.39	0	1
Inner regional	0.27	0.44	0	1	0.27	0.44	0	1
Outer regional	0.13	0.33	0	1	0.12	0.32	0	1
Remote	0.02	0.12	0	1	0.01	0.12	0	1
Very remote	0.00	0.06	0	1	0.00	0.06	0	1
Over pension eligibility age	0.26	0.44	0	1	0.31	0.46	0	1
Interview July or August	0.15	0.36	0	1	0.16	0.37	0	1

Source: Authors' calculations using data from Waves 1–12 of the HILDA Survey

Table III: Current Employment Status in Wave 1 by Age and Gender

	Full-time 35 hours and more	Part-time 34 hours and less	Non participants	Observations
Males				
Aged 40–49	85.6%	6.5%	7.9%	1115
Aged 50–59	68.2%	9.9%	22.0%	820
Aged 60–69	22.6%	14.4%	62.9%	561
Aged 70 and over	2.9%	4.3%	92.8%	483
Total	55.5%	8.6%	35.9%	2979
Females				
Aged 40–49	38.4%	38.0%	23.6%	1238
Aged 50–59	32.9%	28.6%	38.5%	893
Aged 60–69	6.4%	12.1%	81.5%	595
Aged 70 and over	0.7%	1.7%	97.6%	576
Total	24.6%	24.4%	51.0%	3302

Source: Authors' calculations using data from Wave 1 of the HILDA Survey.

Table IV: Model for Working Hours Estimated Using the Tobit Estimator

	(1) Males		(2) Females	
Over pension eligibility age	-14.586	***	-13.483	***
	[1.842]		[1.843]	
Interview July or August	-1.328	***	-1.680	***
	[0.479]		[0.470]	
Age-squared/100	-3.996	***	-4.993	***
	[0.604]		[0.653]	
Age	2.986	***	4.100	***
	[0.628]		[0.674]	
School years 7–10	6.336	*	26.599	***
	[3.515]		[3.732]	
School years 11 and over	10.705	***	35.525	***
	[3.488]		[3.729]	
Married	7.631	***	-4.773	***
	[0.966]		[0.774]	
Number of dependent children	0.467		-3.337	***
	[0.296]		[0.322]	
Ownhouse	5.922	***	7.425	***
	[0.898]		[0.904]	
Inner regional	-1.085		-1.729	**
	[0.782]		[0.776]	
Outer regional	2.036	*	-0.388	
	[1.180]		[1.150]	
Remote	11.423	***	1.239	
	[2.510]		[2.752]	
Very remote	13.651	***	2.959	
	[4.410]		[5.031]	
Constant	-32.024	**	-89.676	***
	[16.306]		[17.677]	
F-test H_0: the coefficients on the two exclusion variables, *Over pension eligibility age* and *Interview July or August*, are jointly zero	33.20	***	31.43	***
F-test H_0: all the coefficients except the constant are jointly zero	269.92	****	195.19	***
Observations	36430		41435	
Left-censored observations	12679		19862	

Notes

1) *, ** and *** indicate statistical significance at the 10%, 5% and 1% levels, respectively.

2) Figures reported in square brackets are robust standard errors adjusted for clustering.

Table V: The impacts of working hours on health

Panel A: Males

	Fixed Effect (FE) Estimates							
	(1a)	(2a)	(3a)	(4a)	(5a)	(6a)	(7a)	(8a)
	Physical functioning	Role physical	Bodily pain	General health	Vitality	Social functioning	Role emotional	Mental health
Working hours-squared/100	-0.087 ***	-0.399 ***	-0.103 ***	-0.068 **	-0.127 ***	-0.152 ***	-0.185 ***	-0.060 **
	[0.031]	[0.062]	[0.036]	[0.027]	[0.030]	[0.037]	[0.056]	[0.025]
Working hours	0.117 ***	0.440 ***	0.146 ***	0.096 ***	0.062 ***	0.170 ***	0.241 ***	0.052 ***
	[0.025]	[0.048]	[0.027]	[0.021]	[0.022]	[0.028]	[0.044]	[0.018]
Age-squared/100	-0.517 ***	-0.684 ***	-0.484 ***	-0.476 ***	-0.253 ***	-0.241 ***	-0.258 ***	0.007
	[0.032]	[0.059]	[0.034]	[0.027]	[0.026]	[0.035]	[0.054]	[0.022]
Married	0.402	0.341	-0.805	-0.764	0.617	3.841 ***	5.616 ***	2.650 ***
	[0.614]	[1.137]	[0.701]	[0.555]	[0.537]	[0.765]	[1.125]	[0.529]
Number of dependent children	-0.411 *	-0.835 **	-0.102	-0.031	-0.669 ***	-0.505 **	-0.791 **	-0.391 **
	[0.222]	[0.414]	[0.242]	[0.192]	[0.195]	[0.248]	[0.368]	[0.171]
Ownhouse	0.318	-1.087	0.171	-0.239	0.152	0.416	1.673 *	0.514
	[0.517]	[0.931]	[0.545]	[0.441]	[0.448]	[0.614]	[0.991]	[0.411]
Inner regional	-0.868	-0.098	0.004	0.190	0.056	0.247	1.505	1.092 *
	[0.837]	[1.425]	[0.876]	[0.702]	[0.687]	[0.899]	[1.311]	[0.643]
Outer regional	-0.511	0.049	0.902	-0.561	0.493	1.169	1.789	1.785 *
	[1.184]	[1.956]	[1.268]	[0.999]	[0.904]	[1.328]	[1.874]	[0.990]
Remote	-0.810	-3.148	1.645	-1.480	-2.064	-0.556	-3.898	-0.616
	[1.785]	[4.118]	[2.041]	[1.545]	[1.671]	[2.080]	[4.253]	[1.568]
Very remote	-3.212	-10.773 *	-0.121	-2.195	-2.060	-3.939	-2.804	0.111
	[4.586]	[6.511]	[4.291]	[2.188]	[2.791]	[2.746]	[6.283]	[2.576]
Constant	95.185 ***	91.433 ***	84.203 ***	80.316 ***	69.844 ***	84.610 ***	81.525 ***	72.634 ***
	[1.338]	[2.535]	[1.471]	[1.168]	[1.137]	[1.504]	[2.285]	[0.997]
F-test H_0: all the coefficients. except the constant are jointly zero	36.50 ***	31.19 ***	35.24 ***	42.03 ***	12.90 ***	15.20 ***	12.26 ***	4.532 ***
Observations	36430							
Number of individuals	6218							

	Fixed Effect Instrumental Variable (FEIV) Estimates							
	(1b)	(2b)	(3b)	(4b)	(5b)	(6b)	(7b)	(8b)
	Physical functioning	Role physical	Bodily pain	General health	Vitality	Social functioning	Role emotional	Mental health
Working hours-squared/100	-4.384 ***	-6.331 ***	-1.273	-1.342 **	-3.921 ***	-5.034 ***	-7.535 ***	-1.438 **
	[1.099]	[1.737]	[0.774]	[0.656]	[0.931]	[1.221]	[1.847]	[0.572]
Working hours	1.858 ***	2.903 ***	0.456	0.553	1.730 ***	2.295 ***	3.380 ***	0.561 *
	[0.583]	[0.922]	[0.409]	[0.346]	[0.496]	[0.650]	[0.979]	[0.303]
Age-squared/100	-0.983 ***	-1.277 ***	-0.745 ***	-0.662 ***	-0.557 ***	-0.649 ***	-0.921 ***	-0.182 ***
	[0.076]	[0.124]	[0.062]	[0.052]	[0.059]	[0.080]	[0.125]	[0.041]
Married	1.170	1.374	-0.519	-0.509	1.235	4.646 ***	6.855 ***	2.920 ***
	[1.021]	[1.598]	[0.770]	[0.628]	[0.851]	[1.194]	[1.755]	[0.595]
Number of dependent children	0.613	0.599	0.121	0.253	0.279	0.707	1.015	-0.079
	[0.529]	[0.808]	[0.342]	[0.287]	[0.456]	[0.591]	[0.890]	[0.264]
Ownhouse	-0.816	-2.626 *	-0.208	-0.600	-0.793	-0.810	-0.196	0.129
	[0.894]	[1.358]	[0.607]	[0.501]	[0.730]	[0.991]	[1.493]	[0.479]
Inner regional	-2.586 *	-2.225	-1.122	-0.554	-0.932	-1.114	-0.780	0.343
	[1.451]	[2.222]	[0.992]	[0.851]	[1.212]	[1.575]	[2.358]	[0.768]
Outer regional	0.704	1.879	0.818	-0.348	1.897	2.920	4.276	2.050 *
	[2.219]	[3.094]	[1.504]	[1.266]	[1.744]	[2.311]	[3.541]	[1.195]
Remote	6.194	6.303	4.144	0.808	3.645	6.871	7.495	1.809
	[4.618]	[6.486]	[2.643]	[2.264]	[3.812]	[4.663]	[8.094]	[2.221]
Very remote	9.046	5.494	4.988	2.070	7.343	8.400	16.406	4.577
	[8.584]	[14.277]	[6.119]	[3.597]	[8.367]	[9.779]	[14.137]	[3.632]
Constant	118.951 ***	120.788 ***	100.011 ***	90.686 ***	83.350 ***	103.247 ***	112.922 ***	83.071 ***
	[5.145]	[8.148]	[3.818]	[3.199]	[4.137]	[5.527]	[8.370]	[2.639]
Wald-test H_0: all the coefficients. except the constant are jointly zero	232.1 ***	170.2 ***	280.5 ***	347.8 ***	117.5 ***	97.62 ***	83.31 ***	57.83 ***
Cluster-Robust Hausman Test: Pooled-OLSIV vs FEIV	106.05 ***	78.31 ***	128.58 ***	150.87 ***	94.23 ***	84.64 ***	53.54 ***	86.44 ***
Endogeneity test (F-statistic)	59.74 ***	31.43 ***	15.28 ***	12.23 ***	49.90 ***	46.34 ***	48.58 ***	21.86 ***
Cragg-Donald Wald F statistic for weak instruments	43.94							
Observations	36430							
Number of individuals	6218							

Notes

1) *, ** and *** indicate statistical significance at the 10%, 5% and 1% levels, respectively.

2) Figures reported in square brackets are robust standard errors adjusted for clustering. The Cragg-Donald Wald F statistic reported is computed using the "xtivreg2" command in STATA 14.

3) The estimated significance of the Hausman chi-squared statistic is based on 500 bootstrap repetitions using the "rhausman" command in STATA 14.

Table V: The impacts of working hours on health (*continued*)

Panel B: Females

	Fixed Effect (FE) Estimates							
	(1a)	(2a)	(3a)	(4a)	(5a)	(6a)	(7a)	(8a)
	Physical functioning	Role physical	Bodily pain	General health	Vitality	Social functioning	Role emotional	Mental health
Working hours-squared/100	-0.080 *	-0.307 ***	-0.024	-0.071 *	-0.148 ***	-0.183 ***	-0.399 ***	-0.099 **
	[0.047]	[0.088]	[0.051]	[0.040]	[0.044]	[0.055]	[0.082]	[0.038]
Working hours	0.114 ***	0.327 ***	0.065 **	0.101 ***	0.044 *	0.180 ***	0.345 ***	0.079 ***
	[0.028]	[0.051]	[0.029]	[0.024]	[0.025]	[0.032]	[0.048]	[0.022]
Age-squared/100	-0.745 ***	-0.997 ***	-0.591 ***	-0.490 ***	-0.296 ***	-0.381 ***	-0.384 ***	-0.004
	[0.031]	[0.057]	[0.032]	[0.026]	[0.025]	[0.034]	[0.050]	[0.021]
Married	0.136	1.196	-0.833	-0.690	1.120 **	2.485 ***	3.631 ***	2.639 ***
	[0.557]	[1.061]	[0.633]	[0.467]	[0.498]	[0.714]	[1.052]	[0.466]
Number of dependent children	0.011	-0.862 **	0.430 *	0.126	-1.231 ***	-0.565 **	-0.669	-0.180
	[0.236]	[0.426]	[0.258]	[0.213]	[0.222]	[0.281]	[0.408]	[0.195]
Ownhouse	-0.162	-0.906	-0.095	-0.818 *	-0.148	-0.658	-0.544	-0.135
	[0.535]	[0.985]	[0.590]	[0.462]	[0.461]	[0.579]	[0.934]	[0.397]
Inner regional	-0.405	-2.033	-1.189	0.894	-0.037	0.100	1.298	0.533
	[0.756]	[1.582]	[0.893]	[0.748]	[0.804]	[0.940]	[1.322]	[0.660]
Outer regional	-0.865	-2.167	-1.604	-0.510	-2.546 **	-0.365	-2.116	-0.928
	[1.247]	[2.113]	[1.338]	[1.165]	[1.185]	[1.385]	[1.858]	[1.013]
Remote	-1.570	-4.741	-4.883 **	-2.332	-5.483 ***	-0.203	-1.087	-3.490 **
	[1.802]	[3.099]	[1.913]	[2.133]	[1.994]	[1.984]	[3.229]	[1.706]
Very remote	0.382	-2.170	4.352	-2.867	-1.818	-6.324	-0.397	-5.336 **
	[4.220]	[6.128]	[3.074]	[2.269]	[3.751]	[3.943]	[9.053]	[2.134]
Constant	100.112 ***	102.718 ***	87.699 ***	82.987 ***	69.281 ***	90.674 ***	89.128 ***	72.354 ***
	[1.362]	[2.534]	[1.398]	[1.144]	[1.126]	[1.463]	[2.240]	[0.958]
F-test H$_0$: all the coefficients. except the constant are jointly zero	70.61 ***	42.87 ***	43.97 ***	46.14 ***	18.49 ***	21.96 ***	16.29 ***	5.54 ***
Observations	41435							
Number of individuals	6969							

	Fixed Effect Instrumental Variable (FEIV) Estimates							
	(1b)	(2b)	(3b)	(4b)	(5b)	(6b)	(7b)	(8b)
	Physical functioning	Role physical	Bodily pain	General health	Vitality	Social functioning	Role emotional	Mental health
Working hours-squared/100	-1.813	-6.898	-1.811	0.319	-2.277	-4.979 *	-6.554 *	0.120
	[2.015]	[4.248]	[2.062]	[1.615]	[1.835]	[2.669]	[3.831]	[1.337]
Working hours	0.375	2.282	0.589	-0.355	0.477	1.636	1.981	-0.303
	[0.863]	[1.813]	[0.881]	[0.688]	[0.783]	[1.137]	[1.634]	[0.573]
Age-squared/100	-0.925 ***	-1.300 ***	-0.675 ***	-0.606 ***	-0.472 ***	-0.589 ***	-0.741 ***	-0.118 ***
	[0.046]	[0.089]	[0.046]	[0.036]	[0.038]	[0.054]	[0.081]	[0.029]
Married	-0.335	0.014	-1.157 *	-0.834 *	0.613	1.646 *	2.407 *	2.479 ***
	[0.652]	[1.308]	[0.688]	[0.503]	[0.608]	[0.901]	[1.323]	[0.506]
Number of dependent children	-1.276 ***	-3.532 ***	-0.306	-0.502	-2.553 ***	-2.431 ***	-3.600 ***	-0.821 ***
	[0.404]	[0.850]	[0.402]	[0.320]	[0.375]	[0.536]	[0.774]	[0.272]
Ownhouse	0.016	-0.704	-0.038	-0.662	0.015	-0.527	-0.261	0.014
	[0.628]	[1.294]	[0.636]	[0.483]	[0.554]	[0.824]	[1.232]	[0.424]
Inner regional	-1.662 *	-3.985 *	-1.734 *	0.011	-1.250	-1.222	-1.081	-0.330
	[0.993]	[2.201]	[1.026]	[0.803]	[0.982]	[1.441]	[2.093]	[0.722]
Outer regional	-0.785	-0.950	-1.279	-0.903	-2.341	0.552	-1.159	-1.266
	[1.522]	[2.970]	[1.533]	[1.282]	[1.471]	[2.038]	[2.747]	[1.169]
Remote	1.628	3.781	-2.552	-1.550	-1.979	5.871	7.587	-2.579
	[2.825]	[6.936]	[2.892]	[2.412]	[2.741]	[4.552]	[6.688]	[2.077]
Very remote	0.924	-1.433	4.560	-2.442	-1.306	-5.834	0.553	-4.926
	[6.239]	[11.536]	[4.544]	[3.215]	[5.817]	[8.253]	[11.898]	[3.009]
Constant	113.780 ***	123.913 ***	93.619 ***	92.610 ***	82.473 ***	105.024 ***	114.975 ***	81.748 ***
	[3.378]	[6.673]	[3.403]	[2.617]	[2.842]	[4.190]	[6.129]	[2.165]
Wald-test H$_0$: all the coefficients. except the constant are jointly zero	612.1 ***	311.1 ***	404.3 ***	437.5 ***	207.6 ***	177.7 ***	124.4 ***	68.62 ***
Cluster-Robust Hausman Test: FEIV vs. Pooled-OLSIV	174.16 ***	103.82 ***	203.03 ***	280.52 ***	120.33 ***	155.81 ***	97.76 ***	128.62 ***
Endogeneity test (F-statistic)	26.57 ***	25.65 ***	6.12 ***	13.93 ***	41.82 ***	34.10 ***	43.86 ***	20.62 ***
Cragg-Donald Wald F statistic for weak instruments	15.28							
Observations	41435							
Number of individuals	6969							

Note

1) As for Panel A.

Appendix I: Definitions of Variables

Name	Definition
Physical functioning	The SF-36 physical functioning scare (0–100)
Role physical	The SF-36 role physical scare (0–100)
Bodily pain	The SF-36 bodily scare (0–100)
General health	The SF-36 general health scare (0–100)
Vitality	The SF-36 vitality scare (0–100)
Social functioning	The SF-36 social functioning scare (0–100)
Role emotional	The SF-36 role emotional scare (0–100)
Mental health	The SF-36 mental health scare (0–100)
Working hours	The number of usual or average working hours per week the respondent works.
Working hours-squared	$(\text{Working hours})^2$
Age	Respondent's age in years at the time of the survey
Age-squared/100	$\text{Age}^2/100$
School years 7–10 (benchmark: the respondent's highest years of school completed are under 7)	0–1 dummy variable taking the value of unity if the respondent's highest years of school completed are between 7 and 10, and 0 otherwise.
School years 11 and over (benchmark: the respondent's highest years of school completed are under 7)	0–1 dummy variable taking the value of unity if the respondent's highest years of school completed are 11 and over, and 0 otherwise.
Married	0–1 dummy variable taking the value of unity if the respondent is currently married, and 0 otherwise.
Number of dependent children	The number of the respondents' children who reside with him/her who are aged under 15 years or aged 16–24 years and are enrolled in full-time education.
Ownhouse	0–1 dummy variable taking the value of unity if the respondent owns his/her own house or currently paid off mortgage, and 0 otherwise.
Inner regional	0–1 dummy variable taking the value unity if the respondent lives in inner regional Australia, and 0 otherwise.
Outer regional	0–1 dummy variable taking the value unity if the respondent lives in outer regional Australia, and 0 otherwise.
Remote	0–1 dummy variable taking the value unity if the respondent lives in remote Australia, and 0 otherwise.
Very remote	0–1 dummy variable taking the value unity if the respondent lives in very remote Australia, and 0 otherwise.
Over pension eligibility age	0–1 dummy variable taking the value unity if the respondent's age is at or above the Aged pension eligibility age, and 0 otherwise.
Interview July or August	0–1 dummy variable taking the value of unity if the respondent was interviewed in July or August, and 0 otherwise.