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Labour Market Impacts from Disability Onset

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Abstract

In this paper we estimate the causal labour market impacts of disability onset up to four years after onset using longitudinal data from the Household Income and Labour Dynamics Australia (HILDA) survey and difference-in-difference propensity score matching techniques. We find lasting negative impacts on employment, especially full-time employment, which is linked more to reduced movement into full-time employment than to downshifting from full-time to part-time work. Longer-term, impacts on employment and income support reliance are greater for those without post-school qualifications, which points to differential social costs of onset by education. Therefore, to be cost-effective, prevention and vocational rehabilitation measures should be targeted at low-skilled workers.

JEL classification: J20, I10

Keywords: Disability, employment, propensity score matching

1. Introduction

In OECD countries, employment rates for people with a disability are around 60% lower than for people without a disability (OECD 2010). Low employment rates place a significant financial burden on OECD countries, with expenditure on disability benefits at around 2% of GDP, which until the global financial crisis, was twice the expenditure on unemployment benefits (OECD 2010). Disadvantage is not just limited to employment rates, but working conditions as well. Compared to workers without a disability, workers with a disability are more likely to be in low paid and non-traditional jobs, such as part-time employment (DeLeire 2000; Kidd et al. 2000; Wilkins 2004).

To design policy measures to deal with the labour market disadvantage from disability, it is imperative to understand the causal impacts of disability onset during working-age. Analysis of the causal impacts of working-age onset is needed, separate from the causal impacts from early-life onset, because the vast majority of working-age people with disability first experience their condition during adulthood (Burchardt 2003a) and the nature of disadvantage and policy responses required are different (Baldwin and Johnson 2001, Wilkins 2004).[1]

A key issue when estimating causal impacts of onset is dealing with non-random selection. As highlighted in Jenkins and Rigg (2004), people who are disadvantaged in the labour market are more likely to suffer onset than those who are not. Disentangling the impacts of onset from pre-existing disadvantage is important to direct policy responses. If most of the disadvantage is not causally linked to onset, then it may be best to target pre-existing disadvantage; if it is, then to avoid possible scarring from time out of work (Arulampalam 2001; Gregg 2001; Knights et al. 2002) measures should be directed at preventing job loss and returning people to work expeditiously. To be most cost-effective, prevention and rehabilitation measures should be targeted at groups that are likely to be impacted most by onset.

In this paper, we aim to improve the understanding of the causal impacts of working-age disability onset by addressing the following questions: up to four years after disability onset, what are the causal impacts on labour market outcomes, including impacts on full-time and

[1] Because those who experience onset during adulthood have already made human capital investments, they may suffer a career disruption and benefit from rehabilitation programs. In contrast, those who have a disability from a young age may face learning barriers and require extra support in school.

part-time employment, receipt of income support and the chance of living in a low income household? To what extent is any impact on part-time employment driven by a switch from full-time to part-time work? Do the impacts vary by the level of education prior to onset?

To date, much of the literature on the disadvantage faced by people with disability has employed cross-sectional analysis (see for example, DeLeire 2000; Kidd et al. 2000; Wilkins 2004; Jones 2007). Cross-sectional analysis, however, says nothing about how the impacts of onset change over time and whether some individuals are better able to adapt to onset than others. Several studies have investigated the impacts of disability onset including Burkhauser and Daly (1998), Burchardt (2003a, 2003b), Jenkins and Rigg (2004), and Lechner and Vazquez-Alvarez (2012), but the insights from these studies have been limited. In all but one of these studies, the analysis has been limited to estimating short-run impacts on those in employment prior to onset by differencing before and after changes in outcomes.[2] While such an approach controls for time-invariant factors, it does not separate the impacts of onset from the impacts of contemporaneous changes. The exception is the recent study by Lechner and Vazquez-Alvarez (2012), which controls for contemporaneous changes by using propensity score matching (PSM), but the analysis is limited to the impacts of those full-time employed prior to onset.

This paper contributes to the literature in three ways. First, we build on the Lechner and Vazquez-Alvarez (2012) study by estimating impacts on all who experience onset and by comprehensively dealing with non-random selection. We comprehensively deal with non-random selection by combining PSM techniques with difference-in-difference (DID) to control for contemporaneous changes and time-invariant unobservables. Also we use extensive health information in the Household Income and Labour Dynamics Australia (HILDA) survey to control for non-random selection into disability due to poor health.

A second contribution is in examining whether the high rate of part-time work among people with disability is causally linked to disability onset and whether, by conducting separate analysis by pre-onset employment status, it is due to down-shifting (movements from full-time to part-time work). A common finding in the literature is that people with disability are much more likely than those without disability to be employed part-time (Schur 2003; Hotchkiss 2004; Wilkins 2004; Jones 2007). Studies by Schur (2003); Jones et al. (2006); and

[2] Burkhauser and Daly (1998) and Jenkins and Rigg (2004) used before and after onset changes in outcomes for those who experience onset. Analogously, Burchardt (2003a) estimated a fixed effects model on those who experience onset, but without controls for changes in macroeconomic or policy environment.

Jones (2007) on the reasons for the high prevalence of part-time work among people with disability find that it is due to a preference for part-time work and not due to discrimination. While it may be preferred, the freedom in which people can shift from full-time to part-time work to manage their condition is untested. In this context, the use of Australian data is important. Due to flexible labour laws, Australia has the second highest rates of part-time employment in the OECD (Abhayaratna et al. 2008). Recent experiences suggest that the flexibility to switch from full-time to part-time work has been instrumental in helping Australia to maintain low unemployment rates during the global financial crisis (Australian Bureau of Statistics (ABS) 2010). If down-shifting in response to disability onset occurs, it should be observed to occur in Australia.

A third contribution of this paper is to estimate longer-term impacts of disability onset by pre-onset education status. Cross-sectional studies have consistently shown that the labour market disadvantage of those with disability decreases with the level of education (see Kidd et al. 2000; Wilkins 2004; Jones et al. 2006). To date, only two studies that we are aware of have examined differential impacts by education in the first year after onset (Burchardt 2003b; Jenkins and Rigg 2004). We estimate impacts 3-4 years after onset, which is important to properly gauge differential impacts because those with higher qualification levels may be better equipped to adjust in the longer-term.

We find that disability onset negatively impacts employment rates, especially full-time employment rates, increases the chance of being on income support and elevates the risk of belonging to a low-income household up to 3-4 years after onset. Estimated results by pre-onset employment status suggest that the large impacts on full-time employment, relative to part-time employment, is related more to a reduction in the movement into full-time employment than to down-shifting. This finding challenges the notion that flexible labour laws, as found in Australia, facilitate down-shifting and job retention following onset. Importantly, estimates by pre-onset education status show greater impacts on employment and income support reliance for people with low levels of education. These results point to differential social costs from disability onset by education status and the need to target prevention and rehabilitation measures at the low-skilled.

This paper is structured in a traditional way, starting with a discussion of disability policy in Australia (section 2), followed by an overview of the data (section 3), a description of the modelling approach (section 4), a discussion of the results (section 5) and concluding comments (section 6).

2. Disability policy in Australia

Central to interpreting results presented in this study is an appreciation of the Australian policy context that may affect labour market participation and hours of work following disability onset. Flexible labour laws, including deregulated shopping hours and liberal workplace relations arrangements that allow employers to hire staff on a casual and part-time basis, means that the rate of part-time employment in Australia is second among OECD countries behind the Netherlands (Abhayaratna et al. 2008). The flexibility to move from full-time to part-time work in Australia is seen as important in maintaining participation in the workforce. In each of the economic downturns in the last three decades in Australia, there has been a marked fall in full-time employment and a corresponding rise in part-time work (ABS 2010). For people with a disability, the move from full-time to part-time employment is also supported by allowing part-time workers to access income support (under the Disability Support Pension (DSP)).

Like in the United States and the United Kingdom, employment of people with disability in Australia is supported by antidiscrimination legislation — the Disability Discrimination Act (DDA) 1992. The DDA imposes obligations on employers to make 'reasonable adjustments' to the workplace for employees with disability. Adjustments may come in many forms, including time off from work to recuperate, shifts from full-time to part-time work and workplace modifications/additions to plant and equipment. When deciding whether an adjustment is reasonable, employers are entitled to weigh-up the costs against potential benefits, which may depend upon the skills, experience and the duration of tenure of the employee concerned. Therefore, the readiness of employers to make adjustments in practice may vary with the education of employees.

3. Data and key definitions

Our analysis uses data from the first nine annual waves of HILDA, covering the period from 2001-2009. The first wave of the HILDA was a nationally representative sample of Australia living in private households in 2001. In the context of this study, an attractive feature of HILDA is its detailed personal socio-demographic, health and labour market outcomes.[3] Because the analysis is focussed on labour market impacts of onset, we limit the sample to those of working-age: 15-64 years for men and 15-59 years for women.

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[3] For documentation on HILDA and related publications, visit the HILDA website http://www.melbourneinstitute.com/hilda/default.html).

3.1. Disability onset

The definition of disability status used in this study is the reported presence of a specific health condition that restricts everyday functioning. In HILDA, this information is derived by showing the respondent a card containing a list of long-term health conditions, such as sight problems that cannot be corrected by glasses/lenses.[4] Respondents are then asked: *'do you have a long-term health condition, impairment or disability (such as these) that restricts you in everyday activities and has lasted or is likely to last, for 6 months or more?'* Such a measure is less susceptible to justification bias than those based on the self-reported presence of a 'work-limiting condition' (Bound 1991; Cai 2010). Measures of specific conditions are commonly used as exogenous instruments when estimating the impacts of health on employment (see for example Stern 1989; Bound, Schoenbaum and Waidmann 1996; Cai 2010).

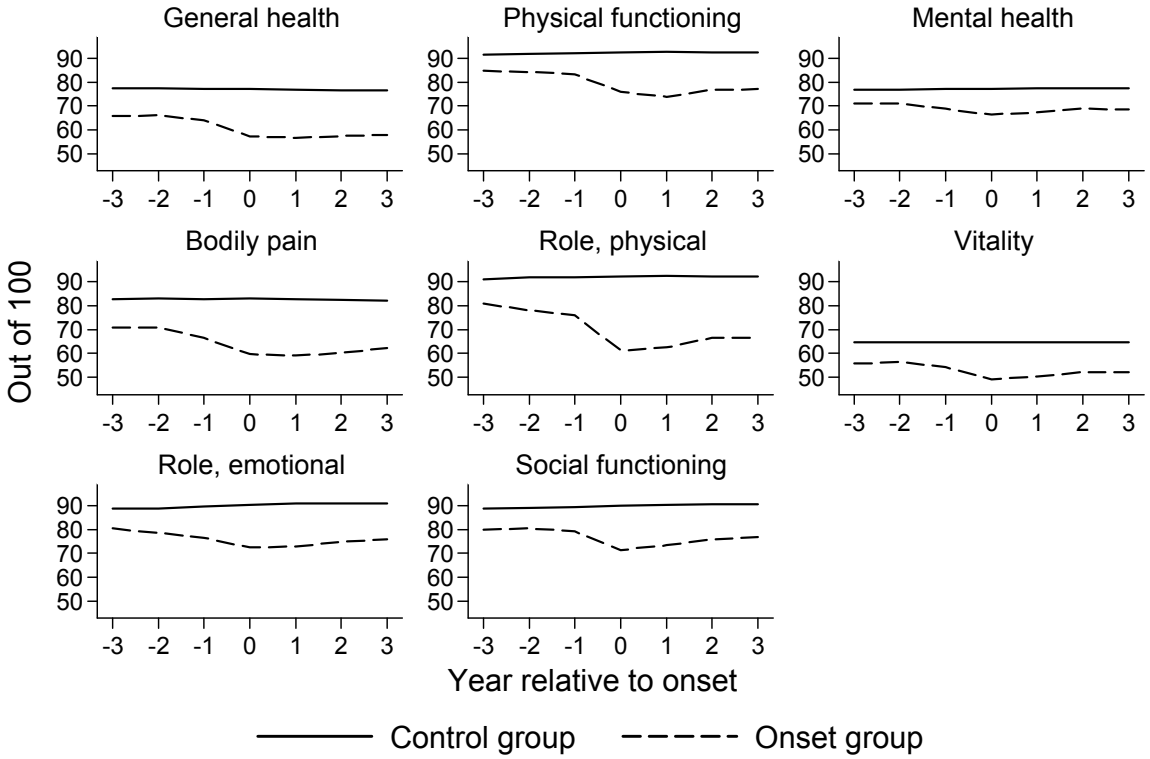
Consistent with Burkhauser and Daly (1998), Burchardt (2003a) and Jenkins and Rigg (2004), we define disability onset in a given period as the commencement of a disability that lasts for at least two consecutive periods in HILDA and was preceded by at least two consecutive periods without disability (identified by the four wave string of disability status 00**1**1). This definition is chosen because it discounts the impacts of transitory disability that may not have longer-term employment impacts (Jenkins and Rigg 2004). To avoid the problem of multiple spells of disability onset for the same individual, we limit our analysis to the first onset observed in the survey. Given the definition of onset used in this study and the data available at the time of analysis, the period of onset in HILDA for which we can observe at least 3 periods (3-4 years) of post-onset outcomes is 2003 to 2006.

Impacts are estimated for three periods after the year of onset by comparing the outcomes of those who experience onset (onset group) to outcomes, over the same period, of a 'matched' or 'like' control group who do not experience onset. The control group is defined in each period that onset is observed in HILDA (2003 to 2006). In each period an individual is assumed to experience no disability onset if after two periods without disability, they remain

[4] The full list is: sight problems that cannot be corrected by glasses/lenses; hearing problems; speech problems, blackouts, fits or loss of consciousness; slow at learning and understanding things; difficulty gripping things, limited use of feet or legs; nervous or emotional condition that requires treatment; conditions that restricts physical activity or physical work (e.g. back problems, migraines); disfigurement or deformity; mental illness which requires help or supervision; shortness of breath or difficulty breathing; chronic or recurring pain; long-term effects as a result of a head injury, stroke or other brain damage; long-term condition or ailment which is still restrictive even though it is being treated and any other long-term condition such as arthritis, asthma, heart disease, Alzheimers, dementia.

disability free in the current and following three periods (identified by the six period string of disability status 00**0**000). Based on the divergence in health and employment outcomes observed between the onset and control group in the period prior to onset (-1 on the x-axes in Figures 1 and 2), we assume that impacts commence from this time and choose a reference period of two periods prior to onset (-2 on the x-axes) as the starting point from which to measure impacts.

Figure 1: SF-36 health measures

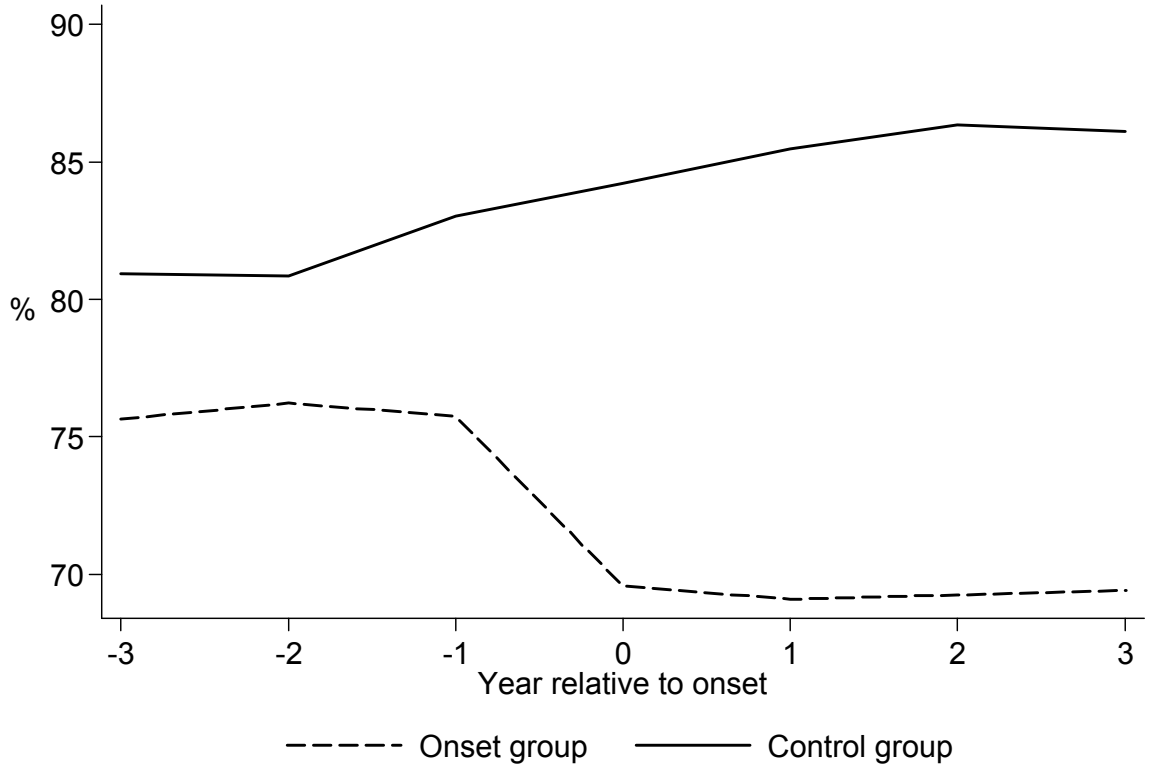


Source: HILDA 2003-09

When analysing impacts by pre-onset employment and education status, we restrict the choice of control group individuals to those who have identical reference period education and employment status (respectively) as members of the onset group. Reference period education status is highest qualification attained and is categorised as either no post-school qualification, vocational education and training (VET) qualification (International Standard Classification of Education (ISCED) 1997 levels 2C, 3C, 4B or 5B) or higher education qualification (ISCED 1997 levels 5A and 6). Reference period employment status is either employed full-time (at least 35 hours on average per week), employed part-time (less than 35 hours on average a week) or not employed.

In all, our final onset sample consists of observe 573 individuals of working age who experience disability onset during the period 2003-06 in HILDA (172 experience onset in 2003, 140 in 2004, 132 in 2005 and 129 in 2006).[5] Of those who experience onset, 136 were out of work in the reference period, 166 were employed part-time and 268 were full-time employed. By education status, 312 had no post-school qualifications, 166 had a VET qualification and 135 had a higher education qualification in the reference period. Descriptive statistics on the type, severity, duration and post-onset health among people who experience onset are reported in Table A.1 in Appendix A. For the control group, our sample consists of 15,000 observations, or around 3750 individuals in each period between 2003 and 2006.

Figure 2: Employment rates



Source: HILDA 2003-09

[5] We exclude 58 working-age individuals who experience disability onset during the period 2003-06 in HILDA, but who do not respond to the SF-36 health questions in HILDA. To explore the sensitivity of dropping these individuals, we also conducted analysis on the full sample (631 treated individuals) by imputing missing values using *the last observed values* and *mean imputation* approaches (see Horton and Kleinman 2007). The results are very similar to those estimated on the restricted sample.

4. Econometric methodology

The aim of this paper is to estimate causal impacts from disability onset. To achieve this end we use a difference-in-difference matching estimator that utilises the longitudinal aspect and richness of the HILDA data to identify causal effects.

Inference about the causal effects from disability onset is based on evaluating the outcomes of those who experience onset relative to the outcomes if onset had not occurred over the same period (counterfactual outcomes). Formally, let $D_{it} \in \{0,1\}$ be an indicator of whether individual i experiences disability onset in period t, and y_{it+s}^{1} be the post-onset outcome at time $t+s, s \geq 0$. The counterfactual outcome y_{it+s}^{0} is the outcome at time $t+s$ if individual i had not experienced disability onset. Thus, the casual effect of disability onset for individual i at time period $t+s$ can be written as:

$$\tau_{is} = y_{it+s}^{1} - y_{it+s}^{0} \tag{1}$$

The fundamental evaluation problem arises because the counterfactual outcome y_{it+s}^{0} is not observed for each treated individual i; which means estimating the individual effect τ_{is} is not possible and one has to estimate average casual effects instead.

In this paper, we are interested in the average causal effects of disability onset among those who actually experience onset. Following the standard micro-economic evaluation literature (for example, see Rosenbaum and Rubin 1985), the casual average effect of disability onset can be written as:

$$E\{\tau_{is}|D_{it}=1\} = E\{y_{it+s}^{1}|D_{it}=1\} - E\{y_{it+s}^{0}|\mathrm{D_{it}}=1\} \tag{2}$$

where causal inference relies on the estimation of the counterfactual for the last term in equation (2). This term is approximated using outcomes of those from a 'like' or 'matched' control group, which is constructed using matching techniques. The basic idea of matching is to generate a counterfactual outcome for each individual *i* by averaging outcomes from select control group members who are similar in all relevant observed characteristics prior to onset.

In practice, finding exact matches across multiple dimensions is almost impossible, which is why most studies deploy a propensity score matching (PSM) approach, as suggested by Rosenbaum and Rubin (1985). PSM simplifies the task by selecting counterfactual outcomes on the basis of a function of all relevant covariates. In this study, the propensity score function is the predicted probability of disability onset estimated using a binary probit model.

Let p_i denote the predicted probability for individual i from the onset group (denoted as O) at time t and let p_j denote the predicted probability for individual j in the control group (denoted as C). A matching estimator of the causal effect of disability onset can be written as:

$$\hat{t}_s = \frac{1}{O}\sum_{i \in O}\left(y_{it+s} - \sum_{j \in C} g(p_i, p_j) y_{jt+s}\right) \tag{3}$$

where $g(.)$ is a function that assigns weights to the counterfactual outcome for control group member j in the construction of the counterfactual for onset group member i.

Different matching algorithms can be used to generate the weights for the matched control groups (see Smith and Todd 2005 for a review of different matching methods). The most straight forward matching algorithm is Nearest Neighbour Matching (NNM), which for each *i* assigns a weight of 1 for the counterfactual with the identical or most similar propensity score and 0 otherwise. Commonly used alternative methods, Kernel Matching (KM) and Local Linear Matching (LLM) are nonparametric estimators that use a weighted average of many control group members for each *i* onset group member. Specifically, KM weights are given by:

$$g(p_i, p_j) = \frac{\mathrm{G}((p_i - p_j)/a_n)}{\sum_{\mathrm{j} \in \mathrm{C}} \mathrm{G}((p_i - p_j)/a_n)} \tag{4}$$

where $G(.)$ is a kernel function and a_n is a bandwidth parameter, which are both specified by the researcher (see Heckman et al., 1997). Local linear matching proposed by Heckman et al (1997) is a generalised version of KM, with the weighting function being given by:

$$g(p_i, p_j) = \frac{G_{ij}\sum_{k \in C} G_{ik}(p_k - p_i)^2 - \left[G_{ij}(p_j - p_i)\right]\left[\sum_{k \in C} G_{ik}(p_k - p_i)\right]}{\sum_{j \in C} G_{ij}\sum_{k \in C} G_{ik}(p_k - p_i)^2 - \left(\sum_{k \in C} G_{ik}(p_k - p_i)\right)^2} \tag{5}$$

where $G_{ij} = \mathrm{G}((p_i - p_j)/a_n)$. LLM differs from KM in that it includes a linear term in the propensity score of the treated individual. Inclusion of the linear term is advantageous whenever control groups are distributed asymmetrically around the treated observations. In other words, LLM is superior to KM in generating counterfactual outcomes for treated observations at boundary points of the propensity score.[6]

[6] For more discussion on the advantages of the local linear regression over the kernel regression, see Fan (1992a; 1992b).

The estimation methods discussed above assume that after conditioning on a set of observable characteristics, outcomes are mean independent of treatment status. This conditional independence assumption (CIA) is plausible when all covariates that affect both selection and outcomes are observed. Thus, the richness of the data is crucial to the performance of the matching methods. As described below (section 4.1), the richness of HILDA allows us to control for many important variables that may affect both disability onset and labour market outcomes.

Besides the CIA, a further requirement is the common support or overlap condition. In essence, this condition requires that for each onset group member, there are control group members with similar propensity scores. While the violation of the common support is less of a concern due to the large number of control group members relative to onset group members, we still impose the common support condition in all estimations. In particular, we follow the minima and maxima approach (Dehejja and Wahba 1999), deleting all onset group observations whose propensity score is smaller/larger than the minimum/maximum in the control group.

Asymptotically under the CIA and common support conditions these different estimators should yield similar results; however, in small samples there is generally a trade-off between bias and efficiency (Smith and Todd, 2005). Notably, NNM estimators are less biased while nonparametric estimators are more efficient. In this paper, we use LLM as our main estimator and use a Gaussian kernel with a standard bandwidth of 0.06.[7] We choose LLM over KM because it is less sensitive to different propensity score distributions. For sensitivity analysis, we also estimate results using NNM.

To fully exploit the longitudinal nature of our data, we combine the LLM and NNM matching estimators with the difference-in-differences (DID) approach, by estimating impacts on before and after onset changes in labour market outcomes. Formally, the differences-in-difference matching estimator can be written as:

$$\hat{t}_s = \frac{1}{O} \sum_{i \in O} \left(\Delta y_{is} - \sum_{j \in C} g(p_i, p_j) \Delta y_{js} \right) \tag{6}$$

[7] Results are robust to the use of alternative bandwidth assumptions and these results are available upon request from the corresponding author.

where Δy_s denotes the change in labour market outcomes from the reference period (two periods prior to the year of onset or $t-2$) to post-onset period $t+s$. The use of this DID matching estimator, which was first proposed by Heckman et. al. (1997), is motivated by the fact that DID matching has the additional advantage of eliminating unobserved time-invariant differences in the outcomes between the onset and matched control group. In their analysis of different matching estimators, Smith and Todd (2004) conclude that difference-in-difference matching estimators perform much better than cross-sectional methods.

4.1. Specification of the propensity score function

The difference-in-difference matching method rests on the assumption that the time effects for the onset and matched control groups are the same. To ensure consistent time effects, we restrict the matching to control group members whose period of *no* disability onset (as defined previously) corresponds to the onset group member's period of onset. To reduce the chance that common time trends may affect the matched control group and onset group in different ways, we utilise the rich health, education, labour market and personal information in HILDA to ensure that the characteristics of those in the matched control group closely resemble those in the onset group prior to onset.

This is the first study to control for non-random selection into disability due to poor health (refer to Figure 1). In controlling for prior health, we use the 8 derived SF-36 indices (positively scaled from 0-100) available in HILDA, which have been proven to be reliable measures of mental and physical health (Ware et al. 1993; Ware et al. 1994; Ware 2000).[8] Other health related controls such as intensity of smoking, alcohol consumption and exercise were trialled, but were found to be insignificant and were omitted. To avoid reverse causation, we use health information from the reference period in the propensity score matching.

As well as having poorer health, people who experience disability onset have poorer labour market outcomes prior to onset (Jenkins and Rigg 2004). To deal with selection by prior labour market disadvantage, we control for a range of labour market variables from the

[8] SF-36 is a short-form health survey within HILDA that asks specific questions about physical and mental functioning, such as, "whether or not you have difficulty climbing stairs?" and "whether you felt so down in the dumps that noting could cheer you up?" There are numerous studies that have used SF-36 scales to measure physical and mental health. See Glassman et al. (2006); Syddall et al. (2009); Carreon et al. (2010) for examples using SF-36 to measure physical health and Strand et al. (2003); Prochaska (2008); Chang et al. (2007) for examples measuring mental health.

reference period, including industry of employment, labour market status, real labour earnings ($'000s, 2009 prices) and percentage of time in employment since left full-time education for the first time. To control for the effect of labour market conditions, we also include regional unemployment rates from the year of onset. Other labour market variables that may affect both selection and outcomes of interest, such as reported job satisfaction, satisfaction with job security, type of employment contract, years worked in the same occupation, employer size and years worked with the same employer were also trialled, but were found to be insignificant and were omitted.

Personal information used in the matching includes gender, marital status, the presence of dependent children, immigrant status, age, state and region of residence (urban, rural, remote), equivalised real household income excluding own earnings ($'000s, 2009 prices) and highest education level.[9] To control for time effects, we include wave dummies. All personal information used in the matching is from the period prior to onset. Other personal variables including age dummies for dependent children, socio-economic status of region of residence and homeownership were also trialled, but were omitted because they were insignificant.

To ensure that the CIA is met, post-match balancing tests are used, as proposed by Rosenbaum and Rubin (1985). The balancing tests check for differences (using t-tests) in the variable means of the treatment and matched control groups. Significant differences suggest that the conditional independence assumption is violated. In the final specification of the probit model of disability onset used in the matching, there were no significant differences in mean characteristics between the onset and matched control group.[10]

Descriptive statistics of all variables used in the matching along with the estimated coefficients from the probit model of onset used in the matching are presented in Table B.1 of Appendix B.

[9] Real household income is equivalised to adjust for differences in the number of household members using the OECD square root scale (OECD 2008), which is derived by dividing real household income by the square root of the number of people living in the household.

[10] Post-onset balancing tests were used to help derive the best cut-off points for continuous variables age and proportion of time in employment since first left full-time education, which were treated as dummy variables for greater flexibility in estimation. Post-matching balancing test results for the final specification are available upon request from the corresponding author.

5. The estimated effects of disability onset

In this section we present the estimated labour market impacts of disability onset using the LLM with difference-in-difference (LLM-DID) estimator. The estimated impacts are measured as average treatment effects on the treated (ATET). Accompanying standard errors are estimated using a 500 draw bootstrap procedure. Results for NNM with difference-in-difference (NNM-DID) are presented in Tables B.2, B.3 and B.4 in Appendix B. NNM-DID estimates are generally consistent with those from the LLM-DID estimator, suggesting that results are robust to the choice of matching algorithms.

5.1. Overall impacts

Overall, the onset of disability is estimated to reduce employment by 9.4 percentage points in the year of disability onset (Table 1). Given that there is no significant increase in the chance of looking for work (unemployment), this means that supply-side factors, and not demand-side factors, are the cause. It is important to note however; of the 9.4 percentage point reduction in employment in the year of onset, only 2.4 percentage points is due to people stopping work, but retaining their job (Not in the Labour Force (NLF) and has a job).[11] This result suggests that most people who stop working do not have a job kept open for them for an extended period.

Table 1: Estimated effects of disability onset, LLM-DID

	Year of onset (less than one year since time of onset)		1st year after (1-2 years since time of onset)		2nd year after (2-3 years since time of onset)		3rd year after (3-4 years since time of onset)	
	ATET	s.e.	ATET	s.e.	ATET	s.e.	ATET	s.e.
Employed	-0.094***	0.016	-0.110***	0.018	-0.116***	0.018	-0.107***	0.017
Full-time employed	-0.058***	0.016	-0.076***	0.018	-0.075***	0.017	-0.119***	0.018
Part-time employed	-0.035**	0.016	-0.033**	0.016	-0.041**	0.016	0.012	0.017
Unemployed	-0.005	0.010	0.006	0.012	0.013	0.011	0.014	0.011
Labour market participation	-0.099***	0.016	-0.103***	0.018	-0.104***	0.018	-0.093***	0.017
NLF has a job	0.024*	0.014	0.030**	0.013	0.026*	0.014	0.032**	0.014
NLF doesn't have a job	0.075***	0.016	0.073***	0.016	0.077***	0.016	0.062***	0.017
Low income household	0.025	0.017	0.039**	0.019	0.062***	0.020	0.070***	0.018
Income support	0.037**	0.016	0.074***	0.017	0.057***	0.017	0.074***	0.017

*** is significant at 1%, ** is significant at 5%, * is significant at 10%.

[11] Employment in HILDA is defined by whether or not an individual responds working in a job, a business or farm at any time at all in the last 7 days. NLF is not employed and not looking for work, whether or not NLF individuals have a job is based on whether NLF respondents report not looking for work because they already have a job.

Significant employment impacts are estimated to persist for at least 3 periods after the onset year, or at least 3-4 years after the time of onset. Longer-term employment impacts translate into significant increases in the chances of receiving income support, especially from 1-2 years after onset. Those who are displaced from work at disability onset may initially be less reliant on income support because of the receipt of lump-sum compensation payments for loss of income from an injury sustained at work.[12] Compensation for loss of earnings is considered as income under DSP arrangements, which means that compensation holders may initially be ineligible. Compensation may also explain why disability onset is estimated to have a delayed effect on the chances of becoming a low-income household, defined as having equivalised real household income in the bottom quintile of all working-age households.[13]

Importantly, we find that the high prevalence of part-time work that is commonly associated with people with disability (Schur 2003; Hotchkiss 2004; Wilkins 2004; Jones 2007) can be explained by greater impacts on full-time employment relative to part-time employment following onset. A key question posed in this study is whether any reduction in the rate of full-time employment relative to part-time employment is due to workers down-shifting from full-time to part-time work?

5.2. Impacts by employment status prior to onset

Estimated impacts on employment status, conditional on employment status in the reference period, are presented in Table 2. Results suggest that the impacts on full-time employment are due more to large reductions in transitions into full-time work among those who were previously part-time employed or out of work than due to down-shifting from full-time to part-time employment. For those in part-time work and out of work in the reference period, disability onset is estimated to lead to a 12.1 percentage point and a 14.2 percentage point reduction respectively in the chances of full-time work by 3-4 years after onset. There is some evidence that those full-time employed prior to onset move to part-time work after onset, but not until 3-4 years after onset. We find no evidence that part-time work helps buffer against the impacts of disability onset, with those employed part-time prior to onset at least as likely to exit employment as those who were employed full-time.

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[12] Workers compensation in Australia is a 'no fault' scheme, covers around 90% of all workers and is funded by employers through a compulsory levy to cover the costs of work related injuries (Safe Work Australia 2011).

[13] The bottom quintile of real equivalised household income (including own earnings) is calculated each year.

Table 2: Estimated employment effects of disability onset, conditional on employment status in the reference period, LLM-DID

Employment status in reference period	Year of onset (less than one year since time of onset)		1st year after (1-2 years since time of onset)		2nd year after (2-3 years since time of onset)		3rd year after (3-4 years since time of onset)	
	ATET	s.e.	ATET	s.e.	ATET	s.e.	ATET	s.e.
				Employment				
Full-time	-0.062***	0.019	-0.089***	0.020	-0.069***	0.019	-0.059***	0.020
Part-time	-0.052	0.038	-0.080**	0.039	-0.077*	0.038	-0.084**	0.042
Out of work	-0.173***	0.037	-0.161***	0.041	-0.198***	0.040	-0.215***	0.042
				Full-time employment				
Full-time	-0.048**	0.023	-0.080***	0.024	-0.073**	0.025	-0.108***	0.026
Part-time	-0.063	0.039	-0.050	0.044	-0.080	0.044	-0.121***	0.041
Out of work	-0.093***	0.023	-0.088***	0.029	-0.108***	0.028	-0.142***	0.028
				Part-time employment				
Full-time	-0.014	0.016	-0.009	0.017	0.003	0.018	0.048**	0.021
Part-time	0.012	0.047	-0.030	0.050	0.003	0.052	0.036	0.048
Out of work	-0.080**	0.036	-0.072*	0.037	-0.090**	0.036	-0.073*	0.040

*** is significant at 1%, ** is significant at 5%, * is significant at 10%.

A new and important finding is that the labour market disadvantage of those out of work is compounded by the onset of disability. For those out of work, disability onset is estimated to reduce the chances of being in employment by 21.5 percentage points after 3-4 years. This compares to a 5.9 percentage point and a 8.4 percentage point reduction in employment rates for those previously employed full-time and part-time respectively. Those out of work prior to onset are likely to face a number of factors that pre-dispose them to labour market disadvantage, such as poor employment history and low qualifications, relative to those in employment, which makes it more difficult for them to adjust to onset. Impacts from difficulty adjusting to onset are likely to be greater for those out of work during periods of strong economic growth, which prevailed during the period of analysis in Australia.[14] Under weak economic conditions, the opportunity cost of disability onset for those out of work is likely to be lower because, with or without onset, their employment prospects are limited.

5.3. Impacts by education qualification prior to onset

Unlike Jenkins and Rigg (2004) who find no significant difference in the chance of losing employment by education in the year of onset, we find marked differences in initial employment impacts by education status (Table 3). In the year of onset, we estimate a 6

[14] Evidence of the effect of strong economic conditions on employment can be found by the increasing rates of control group employment in Figure 2.

percentage point, a 6.6 percentage point and a 12.2 percentage point reduction in the rates of employment for those with higher education qualifications, VET qualifications and no qualifications respectively.[15] A possible explanation for the discrepancy in findings is that Jenkins and Rigg (2004) limit their analysis to those employed prior to onset. As discussed in the previous section, the impacts of onset are estimated to be much larger for those out of work prior to onset. Because a high proportion of people out of work prior to onset have no post-school qualifications, the estimates from Jenkins and Rigg (2004) are likely to underestimate the overall impacts on those without secondary school qualifications. This explanation is supported by much smaller relative impacts by education estimated in the year of onset when the analysis is limited to the sub-sample who were employed prior to onset.[16]

Differences in initial employment impacts by pre-onset education levels appear to be accentuated over time. For those without qualifications, impacts 3-4 years after onset are greater than initial impacts, whereas for those with post-school qualifications, the impacts are on par or have declined relative to their initial levels. Along with longer-term differences in employment impacts by education, there are clearly differences in income support reliance. In particular, 3-4 years after onset, there is an estimated 12.6 percentage point increase in the number of income support recipients among people without post-school qualifications, compared to 3.5 and 1.8 percentage point increases among people with VET and higher education qualifications respectively.

Access to income support does not prevent an increase in the likelihood that those with VET and no post-school qualifications will become low-income. While initially protected from financial disadvantage in the year of onset, in subsequent years the rates of disadvantage are estimated to rise steeply for these groups. Those with VET qualifications are more vulnerable than those without qualifications to financial disadvantage following a job loss because they are more likely to be the main income earner in the household.

[15] Although 90% confidence intervals for all three intersect, which suggests that none of the estimated ATET are significantly different from each other, which is mainly because of the small sample sizes involved.

[16] Results available upon request from the authors.

Table 3: Estimated employment effects from disability onset, conditional on education status in the reference period, LLM-DID

Education status in reference period	Year of onset (less than one year since time of onset)		1st year after (1-2 years since time of onset)		2nd year after (2-3 years since time of onset)		3rd year after (3-4 years since time of onset)	
	ATET	s.e.	ATET	s.e.	ATET	s.e.	ATET	s.e.
				Employment				
Higher education	-0.060**	0.030	-0.100***	0.033	-0.065*	0.032	-0.051	0.032
VET	-0.066**	0.029	-0.085***	0.032	-0.076**	0.032	-0.070**	0.034
No qualifications	-0.122***	0.025	-0.116***	0.025	-0.135***	0.026	-0.147***	0.028
				Full-time employment				
Higher education	-0.062**	0.029	-0.063*	0.035	-0.048	0.036	-0.043	0.038
VET	-0.076**	0.032	-0.076**	0.035	-0.088*	0.035	-0.149***	0.038
No qualifications	-0.056**	0.023	-0.088***	0.026	-0.098***	0.024	-0.136***	0.026
				Part-time employment				
Higher education	0.002	0.029	-0.037	0.029	-0.017	0.031	-0.008	0.034
VET	0.010	0.029	-0.009	0.030	0.013	0.033	0.079**	0.038
No qualifications	-0.065**	0.026	-0.028	0.028	-0.037	0.027	-0.011	0.028
				Labour force participation				
Higher education	-0.056*	0.030	-0.082***	0.030	-0.057*	0.031	-0.051*	0.031
VET	-0.066**	0.030	-0.095***	0.034	-0.071*	0.036	-0.052	0.035
No qualifications	-0.141***	0.026	-0.110***	0.027	-0.132***	0.027	-0.133***	0.028
				Not in labour force and does not have a job				
Higher education	0.028	0.025	0.053*	0.029	0.027	0.029	0.023	0.029
VET	0.050*	0.029	0.074**	0.030	0.051	0.030	0.035	0.031
No qualifications	0.117***	0.027	0.089***	0.028	0.110***	0.028	0.098***	0.029
				Income support				
Higher education	0.011	0.023	0.043*	0.025	0.025	0.019	0.018	0.019
VET	0.048	0.031	0.061*	0.032	0.050	0.030	0.035	0.032
No qualifications	0.045*	0.025	0.100***	0.029	0.086**	0.029	0.126***	0.033
				Low income household				
Higher education	0.022	0.023	0.015	0.027	0.038	0.031	0.064**	0.032
VET	0.015	0.034	0.061*	0.036	0.053	0.038	0.062*	0.033
No qualifications	0.036	0.032	0.052*	0.030	0.061*	0.032	0.085***	0.032

*** is significant at 1%, ** is significant at 5%, * is significant at 10%.

6. Conclusion

Using propensity score matching difference-in-difference and longitudinal data, we show that the onset of disability has lasting negative causal impact on employment, especially full-time employment, and on the risk of belonging to a low income household. An important finding is that people who cease employment generally do not retain their job and do not spend time unemployed longer-term. From these findings, we can conclude that measures to maintain connection to the labour market following onset, such as incentive schemes to encourage

employers to retain workers (as outlined in Stapleton et al. 2008) and early vocational rehabilitation may be cost effective.

We find little evidence that the high rate of part-time employment amongst people with disability is due to downshifting from full-time to part-time work. Instead, the reduction in full-time employment following disability onset is found to be driven more by people out of work and in part-time employment foregoing, or having reduced opportunities, to move to full-time work. This finding challenges the notion that flexible working conditions, as found in Australia, help workers down-shift to manage their condition and remain engaged in work. There may be several explanations for the limited down-shifting following onset, despite such movements observed in response to the global financial crisis in Australia. First, employers may have to shoulder additional costs to retain employees with disability on a part-time basis, especially if they have to make workplace modifications. Second, employers are uncertain of the long-term effects of any adjustments on worker productivity. Third, the nature of many jobs means that it may be difficult to move from a full-time to a part-time schedule, for example, jobs that involve highly specialised skills for operating expensive capital equipment. Fourth, the nature of a longer-term disability may severely restrict the capacity of an individual to continue in an existing job even in a part-time capacity. Finally, moving to part-time work may signal a capacity to work full-time, which may jeopardise access to disability-related income support (DSP).

We find that the labour market impacts from disability onset are greater for those without post-school qualifications. Not only are those without qualifications more likely to end up outside of employment, but they are much more likely to be on income support 3-4 years after onset. These results point to differential social costs from disability onset across people from different education backgrounds.[17] An implication is that measures to maintain connection to the labour market following onset, such as employer incentive schemes and early vocational rehabilitation, will be more cost-effective if targeted at those with low qualification levels. For incentive schemes, this means better aligning the private cost to the employer with the avoided social cost of onset by offering greater incentives to retain employees with low levels of education. Failure to do so would mean that in many cases, incentive payment to employers of highly educated workers would amount to nothing but a windfall.

[17] In terms of reduced well-being from losing employment and the associated financial hardship and the fiscal burden of income support.

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Appendix A: Descriptive statistics

Table A.1: Characteristics of those who experience disability onset by education status

	Higher education	VET	No qualifications
Disability type in year of onset (%)[a]			
Sensory	9	9	10
Physical	30	27	23
Mental	9	6	9
Health conditions	33	31	34
Multiple	19	28	25
Duration of disability (%)			
Has a disability in the 2-3 years after onset	55	62	65
Has a disability in the 3-4 years after onset	45	54	56
Change in SF-36 health measures between year of onset and reference period (% diff.)			
General health	-13	-11	-15
Physical functioning	-9	-9	-9
Bodily pain	-17	-17	-13
Role, physical	-26	-24	-17
Vitality	-11	-13	-12
Social functioning	-10	-12	-10
Role, emotional	-9	-8	-8
Mental health	-6	-6	-6
Change in SF-36 health measures between year of onset and 3-4 years after onset (% diff)			
General health	2	-1	2
Physical functioning	3	-1	-1
Bodily pain	4	1	4
Role, physical	2	8	1
Vitality	3	18	0
Social functioning	5	5	3
Role, emotional	3	8	4
Mental health	0	0	0
Disability limits amount of work you can do in the year of onset (%)			
No work limitation (0 out of 10)	48	45	41
Mild limitation (1-3 out of 10)	28	18	17
Moderate limitation (3-6 out of 10)	10	16	22
Severe limitation (7-9 out of 10)	13	17	17
Can't work (10 out of 10)	1	4	3
Average age in year of onset	44	46	41

[a] Sensory: sight, hearing and speech problems. Physical: limited use of legs, feet, arms or legs; difficulty gripping; disfigurement or deformity; other conditions that affect physical work (e.g. back pain). Mental: Learning disorder; intellectual disability; mental illness; emotional or nervous disorder and acquired brain damage. Health conditions: shortness of breath; fits; chronic pain; other long-term conditions requiring treatment (e.g. arthritis, heart disease, asthma).

Appendix B: Full results

Table B.1: Sample statistics and estimated coefficients for the binary probit model of disability onset model (coded 1 for onset group member; 0 for control group member)

	Model estimates		Sample statistics	
	coeff.	s.e.	mean	std. dev.
Male	-0.018	0.050	0.455	0.498
Married/defacto	-0.078	0.053	0.675	0.468
Has dependent children less than 25	-0.074	0.052	0.471	0.499
Immigrant	-0.117**	0.053	0.203	0.402
Highest education qualification in reference period (ref. case: Higher education)				
VET	-0.039	0.060	0.276	0.447
No qualification	-0.046	0.058	0.467	0.499
Age (ref. case: 15-24)				
25-29	0.149	0.102	0.097	0.296
30-34	0.246**	0.096	0.130	0.336
35-39	0.252**	0.098	0.142	0.350
40-44	0.511***	0.092	0.148	0.355
45-49	0.471***	0.094	0.127	0.332
50-54	0.541***	0.095	0.090	0.286
55-64	0.700***	0.090	0.098	0.298
Year (ref. case: 2003)				
2004	-0.079	0.056	0.246	0.431
2005	-0.101*	0.061	0.245	0.430
2006	-0.136**	0.062	0.253	0.435
State of residence (ref. case: NSW)				
Victoria	-0.160***	0.056	0.256	0.437
Queensland	-0.181***	0.060	0.212	0.408
South Australia	0.007	0.075	0.086	0.280
Western Australia	-0.183**	0.076	0.104	0.306
ACT/NT	0.003	0.089	0.060	0.237
Live outside of a major city	-0.071	0.050	0.366	0.482
Own real earnings ($'000s, 2009 prices)	-0.053	0.041	0.673	0.708
Equivalised real household disposable income, excluding own in reference period ($'000s, 2009 prices)	-0.001	0.001	21.502	20.460
SF-36 health scores in reference period (0-100)				
Physical functioning	-0.006***	0.001	92.943	14.048
Role, physical	-0.003***	0.001	92.542	21.346
Bodily pain	-0.007***	0.001	83.400	18.121
Mental health	0.001	0.002	76.872	14.607
Emotional health	-0.002**	0.001	89.588	25.087
General health	-0.012***	0.001	77.756	15.602
Social functioning	0.001	0.001	88.939	17.526
Vitality	-0.001	0.002	64.690	17.205
Current regional unemployment rate (%)	-0.009	0.025	5.301	1.016

Proportion of time in employment since first left full-time education in reference period (ref. case: less than a third)				
One to two-thirds	-0.219**	0.091	0.134	0.341
More than two-thirds	-0.279***	0.084	0.812	0.390
Employment status in reference period (ref. case: out of work)				
Full-time	-0.083	0.087	0.550	0.498
Part-time	-0.161*	0.084	0.257	0.437
Industry of employment in reference period (ref. case: Business)				
Agriculture	-0.076	0.142	0.032	0.176
Manufacturing	0.140	0.086	0.085	0.279
Construction	0.083	0.099	0.068	0.251
Retail trade	0.151*	0.080	0.130	0.337
Hospitality	0.217*	0.114	0.038	0.192
Education	-0.084	0.094	0.089	0.284
Health	0.087	0.085	0.097	0.296
Other	0.159*	0.081	0.097	0.295
Constant	0.862***	0.228		
Sample (N)	15,476		15,476	

*** is significant at 1%, ** is significant at 5%, * is significant at 10%.

Table B.2: Estimated effects from disability onset, NNM-DID

	Year of onset (less than one year since time of onset)		1st year after (1-2 years since time of onset)		2nd year after (2-3 years since time of onset)		3rd year after (3-4 years since time of onset)	
	ATET	s.e.	ATET	s.e.	ATET	s.e.	ATET	s.e.
Employed	-0.111***	0.027	-0.100***	0.029	-0.118***	0.031	-0.104***	0.031
Full-time employed	-0.067**	0.028	-0.072**	0.032	-0.081**	0.032	-0.137***	0.035
Part-time employed	-0.044	0.029	-0.028	0.031	-0.037	0.032	0.033	0.035
Unemployed	-0.002	0.017	0.002	0.018	0.005	0.017	0.004	0.017
Labour market participation	-0.112***	0.025	-0.098***	0.028	-0.112***	0.029	-0.100***	0.028
NLF has a job	0.040*	0.021	0.042**	0.021	0.047**	0.022	0.044**	0.022
NLF doesn't have a job	0.072***	0.023	0.056**	0.025	0.065***	0.024	0.056**	0.026
Low income household	0.026	0.029	0.028	0.030	0.065**	0.032	0.070**	0.031
Income support	0.033	0.022	0.067***	0.024	0.058**	0.024	0.069***	0.023

*** is significant at 1%, ** is significant at 5%, * is significant at 10%.

Table B.3: Estimated employment effects of disability onset, conditional on employment status in the reference period, NNM-DID

Employment status in reference period	Year of onset (less than one year since time of onset)		1st year after (1-2 years since time of onset)		2nd year after (2-3 years since time of onset)		3rd year after (3-4 years since time of onset)	
	ATET	s.e.	ATET	s.e.	ATET	s.e.	ATET	s.e.
				Employment				
Full-time	-0.049*	0.025	-0.078***	0.027	-0.065**	0.027	-0.075***	0.029
Part-time	-0.092	0.056	-0.143**	0.059	-0.109*	0.059	-0.084	0.061
Out of work	-0.167**	0.065	-0.136*	0.072	-0.187**	0.070	-0.197***	0.072
				Full-time employment				
Full-time	-0.029	0.035	-0.036	0.037	-0.050	0.038	-0.101**	0.042
Part-time	-0.092	0.063	-0.050	0.068	-0.105	0.070	-0.151**	0.074
Out of work	-0.076	0.048	-0.091	0.056	-0.104*	0.058	-0.167***	0.058
				Part-time employment				
Full-time	-0.019	0.027	-0.042	0.029	-0.015	0.030	0.026	0.035
Part-time	0.000	0.076	-0.092	0.080	-0.004	0.079	0.067	0.081
Out of work	-0.091	0.061	-0.045	0.065	-0.083	0.063	-0.030	0.069

*** is significant at 1%, ** is significant at 5%, * is significant at 10%.

Table B.4: Estimated employment effects from disability onset, conditional on education status in the reference period, NNM-DID

Education status in reference period	Year of onset (less than one year since time of onset)		1st year after (1-2 years since time of onset)		2nd year after (2-3 years since time of onset)		3rd year after (3-4 years since time of onset)	
	ATET	s.e.	ATET	s.e.	ATET	s.e.	ATET	s.e.
				Employment				
Higher education	-0.045	0.049	-0.082	0.053	-0.047	0.054	-0.015	0.057
VET	-0.024	0.049	-0.054	0.054	-0.041	0.054	-0.036	0.057
No qualifications	-0.120***	0.044	-0.128***	0.048	-0.146***	0.050	-0.158***	0.056
				Full-time employment				
Higher education	-0.097*	0.055	-0.067	0.061	-0.067	0.066	-0.045	0.068
VET	0.000	0.052	-0.030	0.058	-0.042	0.061	-0.127**	0.064
No qualifications	-0.011	0.041	-0.090**	0.044	-0.090*	0.044	-0.124**	0.050
				Part-time employment				
Higher education	0.052	0.053	-0.015	0.057	0.021	0.059	0.030	0.063
VET	-0.024	0.049	-0.024	0.056	0.002	0.060	0.090	0.060
No qualifications	-0.109**	0.049	-0.038	0.051	-0.055	0.053	-0.034	0.054
				Labour force participation				
Higher education	-0.037	0.045	-0.037	0.047	-0.015	0.050	0.015	0.057
VET	-0.066	0.047	-0.072	0.054	-0.056	0.055	-0.024	0.057
No qualifications	-0.128***	0.043	-0.109**	0.049	-0.131***	0.051	-0.139***	0.053
				Not in labour force, does not have a job				
Higher education	0.037	0.036	0.015	0.044	0.006	0.045	-0.015	0.049
VET	0.072*	0.041	0.084*	0.044	0.065	0.046	0.042	0.049
No qualifications	0.154***	0.040	0.113***	0.043	0.144***	0.046	0.128**	0.050
				Income support				
Higher education	0.000	0.035	0.052	0.036	0.034	0.035	0.045	0.035
VET	0.036	0.041	0.054	0.044	0.045	0.043	0.060	0.045
No qualifications	0.015	0.039	0.102**	0.041	0.068	0.042	0.098**	0.047
				Low income household				
Higher education	0.022	0.042	-0.022	0.046	0.028	0.048	0.075	0.052
VET	0.024	0.052	0.024	0.054	0.039	0.057	0.048	0.057
No qualifications	0.071	0.049	0.060	0.048	0.075	0.052	0.105**	0.050

*** is significant at 1%, ** is significant at 5%, * is significant at 10%.