Online Appendix Not For Publication

1 Further Model Details

1.1 Unemployment Insurance

We assume that unemployment benefits are paid only for the quarter immediately following job destruction. Unemployment insurance is paid only to people who have worked in the previous period, and only to those who had their job destroyed (job quitters are ineligible for UI payments, and we assume this can be perfectly monitored). We assume $B_{it} = b \times w_{it-1}\overline{h}$, subject to a cap, and we set the replacement ratio $b = 75\%$. This replacement ratio is set at this high value because the payment that is made is intended to be of a similar magnitude to the maximum available to someone becoming unemployed. This simplifying assumption means that, since the period of choice is one quarter, unemployment benefit is like a lump-sum payment to those who exogenously lose their job and so does not distort the choice about whether or not to accept a new job offer. Similarly, there is no insurance against the possibility of not receiving a job offer after job loss.

1.2 Universal Means-Tested Program

The universal means-tested program is an anti-poverty program providing a floor to income for all individuals, similar to the actual food stamps program but with three important differences. First, means-testing is on household income rather than on income and assets; second, the program provides a cash benefit rather than a benefit in kind; and third, we assume there is 100% take-up.[1] Gross income is given by

$$y_{it}^{gross} = w_{it} h P_{it} + \left(B_{it} E_{it}^{UI}\left(1 - E_{it}^{DI}\right) + D_{it} E_{it}^{DI}\right)\left(1 - P_{it}\right) \tag{1}$$

giving net income as $y = (1 - \tau_w)\, y^{gross} - d$, where d is the standard deduction that people are entitled to when computing net income for the purpose of determining food stamp allowances. The value of the program is then given by

$$W_{it} = \begin{cases} \overline{T} - 0.3 \times y_{it} & \text{if } E_{it}^{W} = 1 \ \left(\text{i.e., if } y_{it} \leq \underline{y}\right) \\ 0 & \text{otherwise} \end{cases} \tag{2}$$

The maximum value of the payment, $\overline{T}$, is set assuming a household with two adults and two children. The term $\underline{y}$ is the poverty line and so only people with net earnings below the poverty line are eligible.

As we discuss in the main text, this means-tested program interacts in complex ways with disability insurance: the Food Stamps program provides a consumption floor during application for DI, and an alternative mechanism for income support for those of low productivity.

1.3 Taxation on Earnings

We hold the government budget deficit, $\bar{D}$, constant when varying parameters of the social insurance programmes. This is achieved by adjusting the proportional payroll tax, τ_w, such that the present discounted value of net revenue flows is constant:

$$\sum_{i=1}^{N}\sum_{t=1}^{T}\frac{1}{R^t}\left[\left(B_{it}E_{it}^{UI}\left(1-E_{it}^{DI}\right)+D_{it}E_{it}^{DI}\right)\left(1-P_{it}\right)+E_{it}^{W}W_{it}+q\left\{\text{Re}_{it}=1\right\}\right] \tag{3}$$
$$= \sum_{i=1}^{N}\sum_{t=1}^{T}\frac{1}{R^t}\tau_w w_{it} h P_{it} + \bar{D}$$

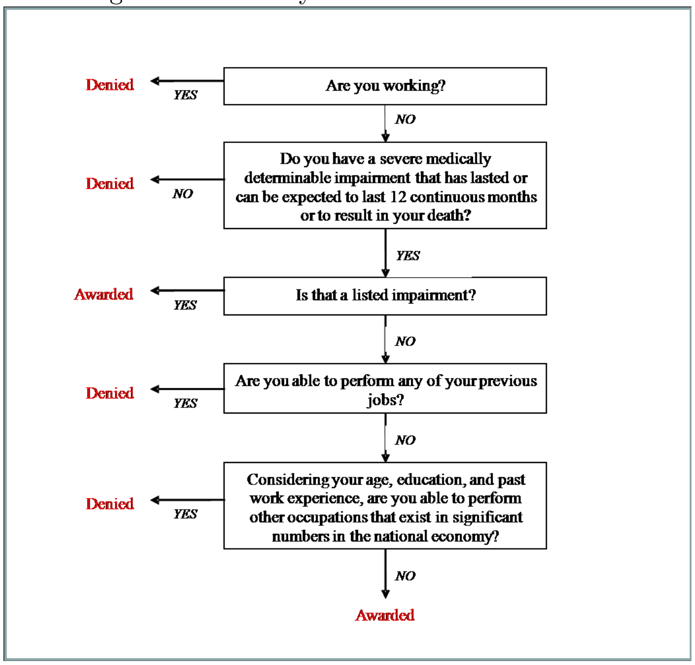
[1] The difficulty with allowing for an asset test in our model is that there is only one sort of asset which individuals use for retirement saving as well as for short-term smoothing. In reality, the asset test applies only to liquid wealth and thus excludes pension wealth (as well as real estate wealth and other durables).

where q is the cost of undertaking a reassessment of an individual on disability, and Re_{it} is an indicator of whether such a reassessment has been undertaken.[2] This is done iteratively because labor supply and DI application decisions change as a consequence of changes in government policy.

1.4 Disability Insurance Process by the SSA

Figure 1 displays the five steps of the DI determination process.

Figure 1: Disability Insurance Determination



[2] For the period 2004-2008, the SSA spent \$3.985 billion to conduct 8.513 million "continuing disability reviews". This means a review costs on average \$468, and we deflate this back to 1992 prices.

2 Solution Method

There is no analytical solution for our model. Instead, the model must be solved numerically, beginning with the terminal condition on assets, and iterating backwards, solving at each age for the value functions conditional on work status.

We start by constructing the value functions for the individual when employed and when out of work. When employed, the state variables are $\{A_{it}, \varepsilon_{it}, L_{it}\}$, corresponding to current assets, individual productivity and work limitation status. We denote the value function when employed as V^e. When unemployed, there are three alternative discrete states the individual can be: unemployed and not applying for disability (giving a value V^n), unemployed and applying for disability (giving a value V^{App}), and unemployed and already receiving disability insurance (giving a value V^{Succ}). We consider the specification of each of these value functions in turn.

Value function if working:

$$
\begin{aligned}
&V_t^e\left(A_{it}, \varepsilon_{it}, L_{it}\right) = \\
&\max_c \left\{
\begin{array}{c}
U\left(c_{it}, P_{it} = 1; L_{it}\right) + \\
\beta\delta E_t\left[V_{t+1}^n\left(A_{it+1}, \varepsilon_{it+1}, L_{it+1}, DI_{it+1}^{Elig} = 1\right)\right] \\
+\beta\left(1-\delta\right)E_t \max\left\{
\begin{array}{c}
V_{t+1}^n\left(A_{it+1}, \varepsilon_{it+1}, L_{it+1}, DI_{it+1}^{Elig} = 1\right) \\
V_{t+1}^e\left(A_{it+1}, \varepsilon_{it+1}, L_{it+1}\right)
\end{array}
\right\}
\end{array}
\right.
\end{aligned}
$$

where DI_{it+1}^{Elig} is an indicator for whether the individual is eligible to apply for DI.

We consider now the value function for an unemployed individual who is not applying for disability insurance in period t. We need to define as a state variable whether or not an individual has already applied for disability in the current unemployment spell in order to distinguish between those who have the option of applying for disability and those who are ineligible to apply. The value function when eligible for disability is given by:

$$
\begin{aligned}
&V_t^n\left(A_{it}, \varepsilon_{it}, L_{it}, DI_t^{Elig} = 1\right) = \\
&\max_{c, DI^{App}} \left\{
\begin{array}{c}
u\left(c_{it}, P_{it} = 0; L_{it}\right) \\
+\beta\left\{1.App = 1\right\} E_t V_{t+1}^{App}\left(A_{it+1}, \varepsilon_{it+1}, L_{it+1}\right) \\
+\beta\left\{1.App = 0\right\} \\
\left[
\begin{array}{c}
\lambda^n E_t \max\left\{
\begin{array}{c}
V_{t+1}^n\left(A_{it+1}, \varepsilon_{it+1}, L_{it+1}, DI_{t+1}^{Elig} = 1\right) \\
V_{t+1}^e\left(A_{it+1}, \varepsilon_{it+1}, L_{it+1}\right)
\end{array}
\right\} \\
+\left(1-\lambda^n\right)E_t\left[V_{t+1}^n\left(A_{it+1}, \varepsilon_{it+1}, L_{it+1}, DI_{t+1}^{Elig} = 1\right)\right]
\end{array}
\right]
\end{array}
\right.
\end{aligned}
$$

The value function when applying is given by

$$V_t^{App}\left(A_{it},\varepsilon_{it},L_{it}\right)=$$
$$\max_c\left\{\begin{array}{c} u\left(c_{it},P_{it}=0;L_{it}\right) \\ \\ +\beta\pi_L^t E_t V_{t+1}^{Succ}\left(A_{it+1},\varepsilon_{it+1},L_{it+1},D_t=0\right) \\ \\ +\beta(1-\pi_L^t)E_t V_{t+1}^n\left(A_{it+1},\varepsilon_{it+1},L_{it+1},DI_{t+1}^{Elig}=0\right)\end{array}\right.$$

where D_t is a state variable for the duration of the spell on disability insurance and

$$\pi_L^t=\Pr\left(DI_{t+1}=1|\,DI_t^{App}=1,L_t\right)$$

is the probability of a successful application.

Finally, we have to define the value function if an application for disability has been successful.

$$V_t^{Succ}\left(A_{it},\varepsilon_{it},L_{it},D_t\right)= \tag{4}$$
$$\max_c\left\{\begin{array}{c} u\left(c_{it},L_{it},P_{it}=0\right) \\ +\beta\left(1-\pi^R\right)E_t\left[\max\left\{\begin{array}{c} V_{t+1}^{Succ}\left(A_{it+1},\varepsilon_{it+1},L_{it+1},D_{t+1}\right) \\ V_{t+1}^e\left(A_{it+1},\varepsilon_{it+1},L_{it+1}\right)\end{array}\right\}\right] \\ +\beta\pi^R E_t\left[V_{t+1}^n\left(A_{it+1},\varepsilon_{it+1},L_{it+1},DI^{Elig}=0\right)\right]\end{array}\right\} \tag{5}$$

where

$$\pi^R=P^{\mathrm{Re}}\Pr\left(DI_{t+1}=0\,|L_{t+1},DI_t=1\right)$$

is the probability of being reassessed and removed from the program.

Our model has discrete state variables for: Wage productivity, Work limitation status, Participation, Eligibility to apply for DI (if not working), and Length of time on DI (over 1 year or less than 1 year). The only continuous state variable is assets. We use backward induction to obtain policy functions.

Value functions are increasing in assets A_t but they are not necessarily concave, even if we condition on labor market status in t. The non-concavity arises because of changes in labor market status in future periods: the slope of the value function is given by the marginal utility of consumption, but this is not monotonic in the asset stock because consumption can decline as assets increase and expected labor market status in future periods changes. This problem is also discussed in Lentz and Tranaes (2001) and in Low et al. (2010). By contrast, in Danforth (1979) employment is an absorbing state and so the conditional value function will be concave. Under certainty, the number of kinks in the conditional value function is given by the number of periods of life remaining. If there is enough uncertainty, then changes in work status in the future will be smoothed out leaving the expected value function concave: whether or not an individual will work in $t+1$ at a given A_t depends on the realization of shocks in $t+1$. Using uncertainty to avoid non-concavities is analogous to the use of lotteries elsewhere in the literature. In the value functions above, the choice of participation status in $t+1$ is determined by the maximum of the conditional value functions in $t+1$.

3 Further Data Issues

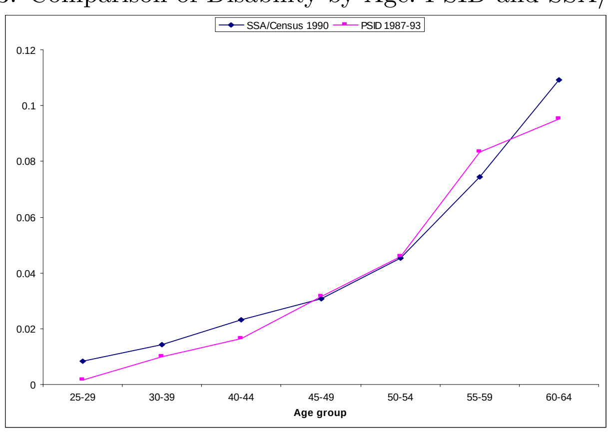
3.1 Comparison of PSID to Alternative Data Sources

Figure 2 and 3 report a comparison of disability rates in different surveys (source: Bound and Burkhauser, 1999) and a comparison of trends in DI rates by age as estimated in the PSID and using aggregate statistics.

Figure 2: Survey questions on disability and estimated disability rates.

Data	Year	Survey question	Population	% of population with disabilities
PSID	1989	Do you have any nervous or physical condition that limits the type or the amount of work you can do? (Must have responded yes in both 1988 and 1989)	Men 25-61 Women 25-61	9.2 10.6
CPS	1990	Do you have a health problem or disability which prevents you from working or which limits the kind or the amount of work you can do? Or, Main reason did not work in 1989 was ill or disabled; or Current reason not looking for work is ill or disabled (One period)	Men 25-61 Women 25-61	8.1 7.8
SIPP	1990	Do you have a physical, mental, or other health condition which limits the kind or amount of work you can do? (One period)	Men 21-64 Women 21-64	11.7 11.6
SIPP	1990	Do you have a physical, mental, or other health condition which limits the kind or amount of work you can do? (Must have responded yes in wave 3 and wave 6)	Men 25-61 Women 25-61	9.8 9.8
NHIS	1994	Are you limited in the kind or amount of work you can do because of any impairment or health problem? (One period)	Men 25-61 Women 25-61	10.8 11.4
HRS	1992	Do you have any impairment or health problem that limits the kind or amount of paid work you can do? (One period)	Men 51-61 Women 51-61	27.3 29.8

Figure 3: Comparison of Disability by Age: PSID and SSA/Census.



3.2 Receipt of DI

There are important differences by skill level both in terms of probability of disability shocks and disability insurance recipiency rates. In particular, if we proxy skill level by education, we find that individuals with low education (at most high school degree) and high education (some college or more), have very similar DI recipiency rates until their mid 30s, but after that the difference increases dramatically. By age 60, the low educated are four times more likely to be DI claimants than the high educated (16% vs. 4%). In part, this is due to the fact that low educated individuals are more likely to have a severe disability at all ages. Figures 4 and 5 contain the details.

Figure 4: PSID data: Proportions on DI by Education

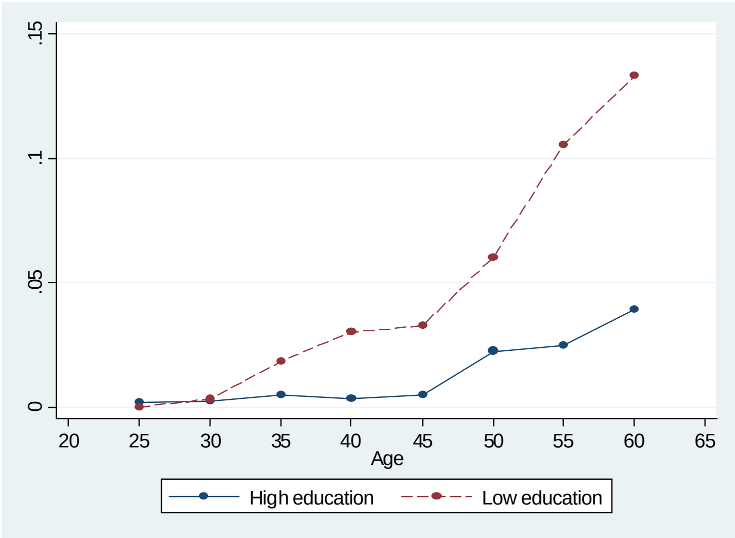
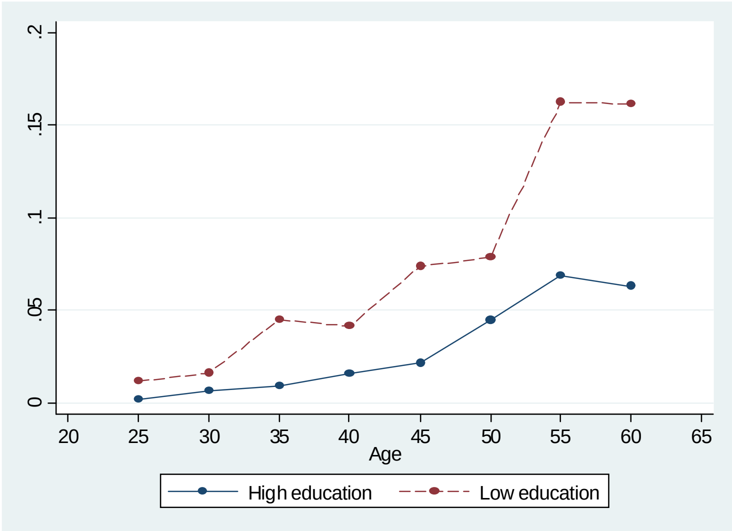
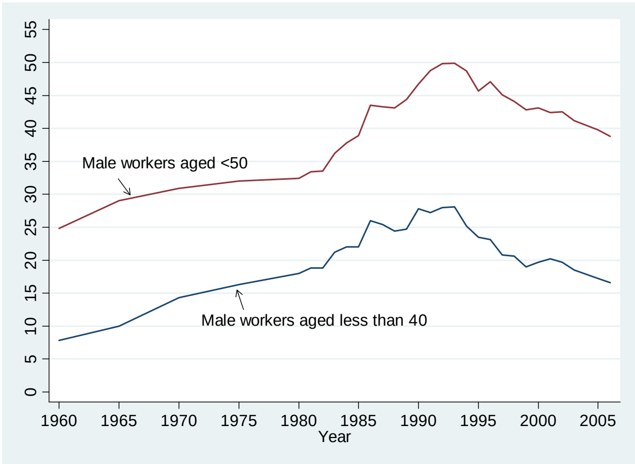


Figure 5: PSID data: Proportions with Severe Disability



The proportions on DI have varied over time, and particularly there has been a marked increase in recipiency numbers from the trough in 1984, as documented in Duggan and Imberman (2009) among others. The age composition of those flowing onto DI is shown in figure 6, which highlights that capturing the behavior of those under 50 is an important part of our understanding of disability insurance.

Figure 6: Proportion of new DI Awards



3.3 Self-Reported Disability Measures

Table 1 shows that our distinction between a severe and moderate disability is correlated with a wide variety of objective measures, including ADLs, hospital stays, extreme BMI values, and mortality.

Table 1: **Validity of Self-Reported Disability Status**

Objective indicator	No disability $L=0$	Moderate $L=1$	Severe $L=2$
Trouble walking/climbing stairs	4%	45%	75%
Trouble bending/lifting objects	7%	58%	79%
Unable to drive car	0%	9%	33%
Trouble with eyesight	2%	5%	16%
Need travel assistance	0%	2%	27%
Need to stay inside	0%	5%	28%
Confined to chair/bed	0%	5%	26%
Limited in physical activity	12%	80%	94%
Spent some time in hospital	5%	24%	35%
Average # of days in hospital	0.36	1.78	14.49
Underweight (BMI $<$ 18.5)	0%	2%	5%
Obese (BMI $\geq$ 30)	11%	25%	20%
Die between 1986 and 2007	8%	19%	23%

Notes: The sample is male heads of household, aged 23-62. Data refer to 1986.

3.4 Sample Statistics

Table 2 reports some sample statistics for individuals by work limitation status and by education (using sampling weights throughout), where low education is defined as high school graduate or less.

Table 2: **Sample Statistics by Work Limitation Status**

	Low Education			*High Education*		
	$L=0$	$L=1$	$L=2$	$L=0$	$L=1$	$L=2$
Age	40.28	44.80	48.81	39.46	42.69	46.07
% Married	0.79	0.84	0.69	0.77	0.72	0.61
% White	0.84	0.90	0.80	0.91	0.92	0.76
Family size	3.01	3.16	2.61	2.92	2.70	2.57
Family income	43,912	39,715	26,416	66,945	51,728	36,098
Income from transfers	1,758	4,667	10,284	1,637	4,700	11,358
% Working now	0.90	0.71	0.15	0.94	0.77	0.44
% Annual wages > 0	0.97	0.81	0.19	0.98	0.89	0.48
Hours|Hours>0	2,140	1,941	1,358	2,228	2,039	1,742
Wages|Hours>0	29,618	24,518	14,718	45,713	33,447	28,365
Hourly wage	12.64	11.78	9.33	19.33	15.60	14.68
% DI recipient	0.01	0.08	0.52	0.00	0.03	0.31
Food spending	5,352	5,223	4,198	6,232	5,738	5,223
N	9,112	784	635	8,003	415	171

Notes: monetary values are in 1992$; the sample is male heads of household, aged 23-62.

3.5 Consumption Data

The CEX sample we construct to do the imputation of consumption tries to mimic as closely as possible the sample selections we impose in the PSID. Hence, our CEX sample includes only families headed by a male, reporting data between 1986 and 1992, with no missing data on the region of residence, aged 23 to 62, not self-employed, reporting data for all interviews (so an annual measure of consumption can be constructed), with complete income response, non-zero consumption of food, and not living in student housing.

We estimate in the CEX the following regression:

$$\ln c_{it} = \sum_{j=0}^{K} \theta_j \left(\ln F_{it}\right)^j + X_{it}'\mu + \xi_{it}$$

where F is food consumption.

We use a third-degree polynomial in $\ln F$ and control for a cubic in age, number of children, family size, dummies for white, education, region, year, a quadratic in log before-tax family income, labor market participation status, a disability status indicator of whether the head is "ill, disabled, or unable to work", an indicator for whether the head is receiving social security payments (which for workers aged 62 or less should most likely capture DI), and interactions of the disability status indicator with log food, log income, a dummy for white, the DI indicator, and a quadratic in age. The R^2 of the regression is 0.79.

We next define in the PSID the imputed value:

$$\widehat{\ln c}_{it} = \sum_{j=0}^{K} \widehat{\theta}_j \left(\ln F_{it}\right)^j + X_{it}'\widehat{\mu}$$

This is the measure of consumption we use in the analysis that follows.

3.6 Event Study Analysis

We run the regression

Figure 7: Regression Results

```
Fixed-effects (within) regression               Number of obs      =      7385
                                                Number of groups   =      1760

R-sq:  within  = 0.1932                         Obs per group: min =         1
       between = 0.3605                                        avg =       4.2
       overall = 0.3215                                        max =         5

                                                F(33,5592)         =     40.58
corr(u_i, Xb)  = -0.0168                        Prob > F           =    0.0000
```

lcimputed	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
Family size	-.1830035	.0053427	-34.25	0.000	-.1934773	-.1725297
Works	.1964371	.0250665	7.84	0.000	.1472971	.2455771
Mod. Disabl.	-.0563097	.0174924	-3.22	0.001	-.0906016	-.0220179
Sev. Disabl.	-.0389575	.03523	-1.11	0.269	-.1080219	.0301069
Age	-.1256267	.1352946	-0.93	0.353	-.3908567	.1396034
Age sq.	.6852627	.5125973	1.34	0.181	-.3196271	1.690153
Age cub.	-.0001344	.0000836	-1.61	0.108	-.0002984	.0000295
Age quart.	8.68e-07	4.96e-07	1.75	0.080	-1.03e-07	1.84e-06
Dis.onset -5	-.0617191	.1211027	-0.51	0.610	-.2991274	.1756891
Dis.onset -4	-.0673135	.1171309	-0.57	0.566	-.2969356	.1623086
Dis.onset -3	-.0087035	.1124131	-0.08	0.938	-.2290767	.2116697
Dis.onset -2	-.0227198	.1056835	-0.21	0.830	-.2299005	.184460
Dis.onset -1	-.2038358	.1044409	-1.95	0.051	-.4085805	.000909
Dis. onset	-.144337	.1094511	-1.32	0.187	-.3589037	.0702297
Dis.onset +1	-.1645555	.1097674	-1.50	0.134	-.3797422	.0506312
Dis.onset +2	-.1119185	.1096501	-1.02	0.307	-.3268753	.1030383
Dis.onset +3	-.1517696	.1108172	-1.37	0.171	-.3690144	.0654753
Dis.onset +4	-.164069	.1130542	-1.45	0.147	-.3856992	.0575612
Dis.onset +5	-.2313536	.117304	-1.97	0.049	-.4613151	-.0013921
Dis.onset +6	-.325924	.143185	-2.28	0.023	-.6066221	-.0452259
Dis.on.-3*DI	-.1052738	.1722686	-0.61	0.541	-.4429871	.2324395
Dis.on.-2*DI	.2205514	.1701365	1.30	0.195	-.1129822	.554085
Dis.on.-1*DI	-.0828624	.1085452	-0.76	0.445	-.2956531	.1299283
Dis.on.*DI	.1534759	.0609401	2.52	0.012	.0340097	.2729421
Dis.on.+1*DI	.0401161	.0713866	0.56	0.574	-.0998294	.1800615
Dis.on.+2*DI	.0488977	.0683294	0.72	0.474	-.0850544	.1828498
Dis.on.+3*DI	.1286644	.0630564	2.04	0.041	.0050493	.2522795
Dis.on.+4*DI	.0541723	.0682049	0.79	0.427	-.0795357	.1878803
Dis.on.+5*DI	.2042652	.0795741	2.57	0.010	.0482691	.3602613
Dis.on.+6*DI	.312542	.120234	2.60	0.009	.0768366	.5482473
1989	-.0291527	.008779	-3.32	0.001	-.046363	-.0119424
1990	-.0368653	.008833	-4.17	0.000	-.0541814	-.0195491
1991	-.034332	.0093602	-3.67	0.000	-.0526817	-.0159823
Constant	9.643444	1.300309	7.42	0.000	7.094333	12.19255
sigma_u	.35361533					
sigma_e	.26591037					
rho	.63878643	(fraction of variance due to u_i)				

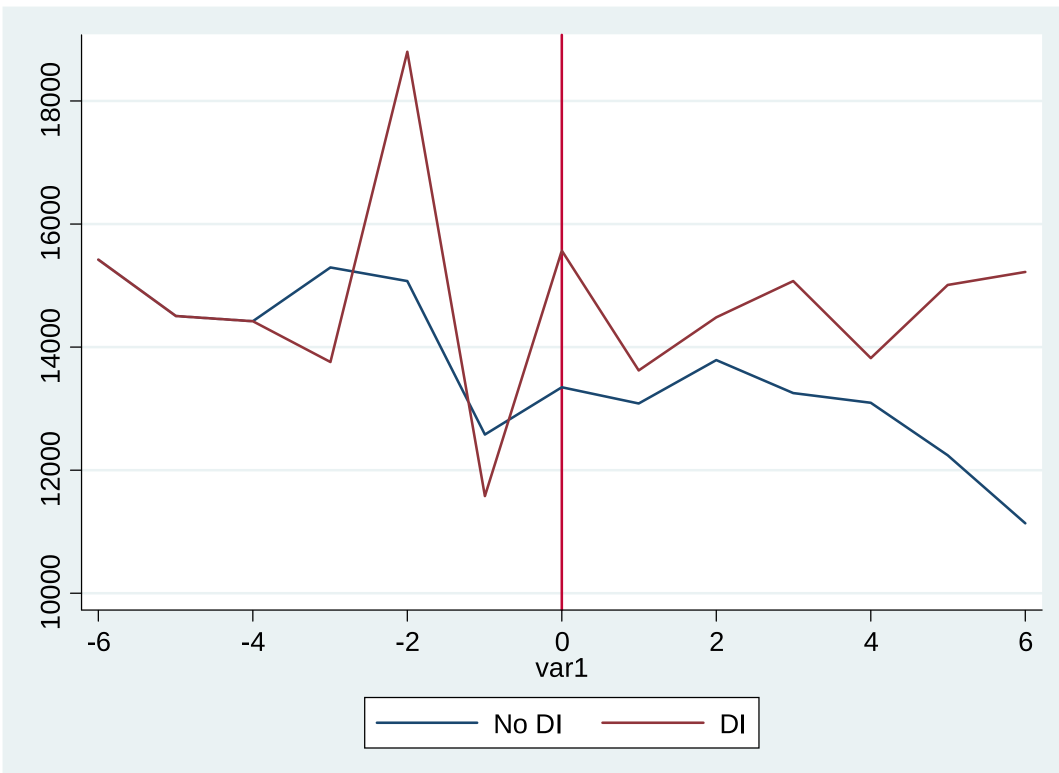
```
F test that all u_i=0:     F(1759, 5592) =     6.35         Prob > F = 0.0000
```

$$\ln c_{it} = f_i + \gamma_t + x_{it}'\beta + \sum_{j=-6}^{6} \delta_j D_{ijt}^{onset} + \sum_{j=-6}^{6} \delta_j D_{ijt}^{onset} DI_{it} + \varepsilon_{it}$$

where f_i is a fixed effect, γ_t are year dummies, x_{it} controls (a quartic in age, family size, dummy for employment, whether severely disabled, whether moderately disabled), $D_{ijt}^{onset} = 1$ if person i in year t is j years away from the onset of severe disability, and $DI_{it} = 1$ if person i is receiving DI in year t.

The results are reported in Figure 7. The graphical representation of consumption levels evolution over the event study is in Figure 8. We test whether the two groups (DI and no DI) have similar consumption levels *before* the onset of disability. The p-value is 40%. We then test whether the two groups have similar consumption level *after* the onset of disability. The p-value of the two-sided test is 4.75% (2.8% if we also include the.year of onset), so the one sided test that the consumption in the DI group is higher has p-value of 2.4%. The two groups experience similar falls in consumption due to disability (the largest drop occurs the year before onset - note that the DI group exhibits more noise); however, the DI group then stabilizes. In fact, starting from the rather large fall in the period before onset, this group experiences an *increase* in consumption, consistent with the results reported in Table 3 section B in the main text. For the no DI group, after the fall in the period before onset there is some stability before a further decline.

Figure 8: Event study



4 Further Details of the Estimation Process

4.1 The variance of productivity shocks

Assuming for simplicity of notation that the measurement error ω_{it} is i.i.d., we can identify the variance of productivity shocks and the variance of measurement error using the following moment restrictions:

$$\begin{aligned} E\left(g_{it}|P_{it}=1,P_{it-1}=1\right) &= \rho_{\zeta\vartheta}\sigma_{\zeta}\lambda\left(s_{it}\right) & (6)\\ E\left(g_{it}^{2}|P_{it}=1,P_{it-1}=1\right) &= \sigma_{\zeta}^{2}\left(1-\rho_{\zeta\vartheta}^{2}s_{it}\lambda\left(s_{it}\right)\right)+2\sigma_{\omega}^{2} & (7)\\ -E\left(g_{it}g_{it+1}|P_{it}=1,P_{it-1}=1\right) &= \sigma_{\omega}^{2} & (8)\end{aligned}$$

(see Low et al., 2010). Here $\rho_{\zeta\vartheta}$ denotes the correlation coefficient between ζ and ϑ (which is not of direct interest).

4.2 Indirect Inference

The Indirect Inference statistical criterion that we use is:

$$\hat{\phi}=\arg\min_{\phi}\left(\widehat{\alpha}^{D}-S^{-1}\sum_{s=1}^{S}\widehat{\alpha}^{S}\left(\phi\right)\right)'\Omega\left(\widehat{\alpha}^{D}-S^{-1}\sum_{s=1}^{S}\widehat{\alpha}^{S}\left(\phi\right)\right)$$

where $\widehat{\alpha}^{D}$ are the moments in the data, $\widehat{\alpha}^{S}(\phi)$ are the corresponding simulated moments (which we average over S simulations) for given parameter values ϕ. The function $\alpha(\phi)$ is the binding function relating the structural parameters to the auxiliary parameters, and Ω is the weighting matrix. The optimal weighting matrix is the the inverse of the covariance matrix from the data, $\widehat{\Omega}=var\left(\widehat{\alpha}^{D}\right)^{-1}$.[3]

Standard errors of the structural parameters can be computed using the formula provided in Gourieroux et al. (1993),

$$var\left(\widehat{\phi}\right)=\left(J'\mathbf{\Omega}J\right)^{-1}J'\mathbf{\Omega}\mathbf{V}\mathbf{\Omega}J\left(J'\mathbf{\Omega}J\right)^{-1}$$

where $J=\frac{\partial\widehat{\alpha}^{S}(\phi)}{\partial\phi}$, and $V=var\left(\widehat{\alpha}^{D}-\widehat{\alpha}^{S}\left(\widehat{\phi}\right)\right)$. Asymptotically, V reduces to $\left(1+\frac{1}{S}\right)var\left(\widehat{\alpha}^{D}\right)$, but when we present standard errors, we calculate V using the simulated moments explicitly. We calculate J by finite difference.

References

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[3] To reduce computational issues, we use $diag\left(\widehat{\Omega}\right)$. We compute standard errors using a formula that adjusts for the use of the non-optimal weighting matrix.