



Disability, earnings, income and consumption[☆]

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ABSTRACT

We study the well-being of disabled men and the economic benefits of disability insurance. Using longitudinal data for 1968–2015 for male household heads, we determine the prevalence of working-age disability, its association with a wide range of economic outcomes including, earnings, income, poverty, consumption, wealth and time-use. We disaggregate disabled men based on the persistence and severity of work-limiting conditions, and find that disability is common and associated with poor economic outcomes. The outcomes differ sharply by disability group. We then provide the range of behavioral elasticities and preference parameters consistent with current disability compensation being optimal in the Baily–Chetty framework.

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1. Introduction

Disability may be the most significant risk that individuals and their families face. The prevalence of disability is high, its onset and persistence is largely unpredictable, and it is often permanent. These features of disability mean that it is difficult for individuals to take measures to insure themselves against bad outcomes that often include a large decline in their living standards. Balanced against the value of insurance are the distortions and costs of insurance that are high. In 2015, Social Security Disability Insurance (SSDI) payments equaled \$147 billion

and the share of federal Supplementary Security Income (SSI) for the blind and the disabled was \$49 billion. Private spending on the disabled was also high, with about \$64 billion spent on Workers' Compensation in 2013.¹

This paper examines the lifetime prevalence of disability among male household heads and how they and their families fared before and after the onset of disability. Despite high disability rates and high costs, there are major gaps in our understanding of the economic consequences of disability. The dynamic nature of disability calls for longitudinal measures that reflect its prevalence and persistence over an individual's lifetime. To date, however, few studies have examined the lifetime pattern of disability and the long-term economic circumstances of the disabled.² Our study aims to fill this gap in the literature.

The information we report is essential to design and evaluate disability policies. In the framework of Baily (1977) and Chetty (2006), optimal disability benefits depend on the fall in consumption with disability, the

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¹ See U.S. Social Security Administration (2016) and Sengupta and Baldwin (2015). For comparison we spent \$7.8 billion on TANF (Basic Assistance, fiscal year 2015), \$70 billion on SNAP (fiscal year 2015) and \$33 billion on Unemployment Insurance in 2015 according to Administration for Children and Families (2017) for TANF, USDA (2017) for SNAP and Section B1 of U.S. Department of Labor (2017) for UI.

² Important past work on this topic includes Baldwin and Chu (2006) who estimate that the probability of receiving Social Security Disability Insurance by age 67 is 38% for men and 31% for women and Haveman and Wolfe (1990) who study the difference between the incomes and earnings of the disabled and non-disabled using the Current Population Survey. Bound and Burkhauser (1999) also compare earnings of the disabled and the non-disabled, while Bound and Waidmann (2002) look at employment rates among the disabled. Earnings, hours and wages after disability are examined in Charles (2003) with corrections in Mok et al. (2008). Stephens (2001) analyzes some of these outcomes as well as food consumption. There is also related work by Rupp and Davies (2004) and others.

frequency of disability, and the moral hazard effects of disability benefits (as well as utility function parameters).³ This framework, which guides our analyses, also emphasizes that even though disability is endogenously a function of available benefits and the fall in consumption, the *rate* of disability and the accompanying fall in consumption are needed to assess the optimality of disability compensation.

While there is an extensive literature on the moral hazard effects of disability,⁴ we have less information on lifetime disability rates and the fall in consumption with disability. Stephens (2001) is the only published paper we are aware of that examined consumption. This path-breaking paper discussed a single food consumption measure and focused on married men in the first five years after onset. Disabled men as a whole were analyzed, while disaggregation turns out to be crucial here. Our study differs from the literature in several ways. First, by using 48 years of longitudinal data from the Panel Study of Income Dynamics (PSID) we are able to estimate the risk of disability over a household head's lifetime. Second, we comprehensively examine the economic circumstances of disabled men: we investigate changes in earnings, income, public transfer receipt, work hours, employment, food consumption, housing consumption, home production, and leisure time.⁵ In taking this wider view, we obtain a better picture of the well-being of disabled men. Third, our estimates account for public transfer under-reporting, an issue that can lead researchers to overestimate the income decline as well as the poverty rate of the disabled. Fourth, we go beyond a uniform characterization of disabled men by dividing the population based on a disability's duration (persistence) and severity. We then examine the lifetime prevalence of disability and the changes in economic well-being associated with different degrees of disability. To our knowledge, almost all previous economic studies have examined the disabled as a single homogeneous group or only along a single disability dimension – persistence or severity. Fifth, to provide a starting point for a discussion of benefit optimality, we examine the implications of our results in the classic Baily-Chetty model of benefit determination.

This study has many findings. First, disability rates are high. A male household head reaching age 50 has a 36% chance of having been disabled at least once during his working years. We also estimate that by age 50, about 9% of male household heads have begun a chronic and severe disability. By age 56, that number rises to 15%.

Second, disability is associated with poor economic outcomes. Ten years after disability onset, those with a chronic and severe disability condition have on average seen their earnings drop by 77%, their after-tax after-transfer income drop by 28%, their family food and housing consumption drop by 25%, and their consumption of food alone fall by 16%. We also see a less precisely estimated but noticeable decline in wealth. In addition, about two-thirds of these most disabled individuals never return to work in the long run. This pattern of findings indicates the partial but incomplete roles that family support, government and private insurance, and savings play in reducing the consumption drop that follows disability. Despite the various government programs available, the incomes of about one-sixth of families with a chronically and severely disabled head drop below the poverty line in the long term – even after accounting for in-kind transfers and the under-reporting of benefits. We find a noticeable fall in earnings and income prior to the onset of a reported disability. Consumption also falls somewhat prior to reported onset, indicating that future disability is partially but incompletely predictable in the short run.

Third, there are sharp outcome differences across disability groups; those with chronic and severe disabilities often experience a percentage

³ Important research that examines the adequacy of insurance for disability includes Chandra and Samwick (2005) and Low and Pistaferri (2010).

⁴ See for example, Parsons (1980, 1984, 1991), Haveman and Wolfe (1984a, 1984b), Bound (1989, 1991), Gruber (2000), Black et al. (2002), Autor and Duggan (2003), von Wachter et al. (2011), French and Song (2014), and Maestas et al. (2013).

⁵ Our companion paper, Meyer and Mok (2013a), focuses on earnings, income and public benefit receipt.

decline in the above economic outcomes more than twice as large as those of the average disabled. The fall in consumption we find for the large chronic and severe disability group is much larger than the fall found in response to other adverse events including unemployment and retirement.⁶

Furthermore, recent research suggests that the dollar expenditures of the retired may understate their true consumption because they get more for their money through increased shopping and home food preparation (Aguiar and Hurst, 2005). Related to this point, our fourth finding is that time-use surveys do not suggest that disabled men and their spouses do more shopping and cooking. Instead of spending more time on food preparation and other home production, disabled men spend more time using medical services, watching television, relaxing, and sleeping. Together these findings suggest a true decline in material well-being after the onset of disability, especially for those who are severely disabled. We further assess our finding that consumption declines following disability, by examining food surveys and find suggestive evidence that the diet of disabled men is worse than that of the non-disabled.

Fifth, we use our estimates in the Baily-Chetty optimal benefit formula that balances insurance against moral hazard. We calculate the set of behavioral elasticities and utility function parameters consistent with the current compensation for the most disabled being optimal. While several key assumptions must be maintained, our calculation suggests that there is a substantial range over which current compensation for the disabled is lower than is optimal.

The rest of the paper is organized as follows. Section 2 describes our dataset and sample, and how we define and categorize the disabled. This section also discusses lifetime prevalence of disability, and outlines the empirical strategy for the rest of the paper. Section 3 examines the change in earnings and employment following disability onset. Section 4 examines the fall in income following disability onset, the rise in poverty and in public transfer receipt. Section 5 summarizes the changes in consumption of food and housing and in wealth. Section 6 discusses a series of robustness checks, revisits the change in food consumption and considers the time use of the disabled. Section 7 examines the optimality of current programs for the disabled, and Section 8 concludes. The online Appendix includes additional results concerning poverty, the relationship between disability and food quantity and quality, as well as the usage of time.⁷

2. Data, categorizing the disabled and the prevalence of disability

2.1. Data

We use the PSID, a longitudinal dataset begun in 1968 with an initial sample of about 4802 U.S. households. The initial sample had two components, both of which we use: a nationally representative sample (Survey Research Center sample) and a national sample of low-income families (Survey of Economic Opportunity sample) of 1872 households.

Households were interviewed annually between 1968 and 1997, and biannually since then.⁸ Children in sample households are followed as they leave and form their own families. Since the survey's initial focus was the dynamics of poverty, questions are asked about benefits received, work hours, earnings, income, health, and other outcomes. A particularly attractive feature of the PSID is that it collects information on housing and family food expenditures, variables that are available

⁶ Gruber (1997) finds a 7% drop in food consumption that bounces back with reemployment. Browning and Crossley (2001) find a 14% drop in Canadian data. Aguiar and Hurst (2005) review the evidence on the food consumption fall in the PSID for retirees and report estimates that cluster around 10%. Stephens (2001) finds a fall in PSID food consumption of 5–10% for displaced workers.

⁷ The appendices can be accessed online at http://harrisschool.uchicago.edu/directory/faculty/bruce_meyer

⁸ Some data are available for intervening years. For example, the 1999 interviews asked about both 1998 and 1997 earnings.

in few other microeconomic surveys. Many authors have used this particular feature to measure the material well-being of individuals. As of 2015, the PSID had collected information on 77,223 individuals.

In this study, we use the entire PSID panel, beginning with 1968 and continuing through the 2015 wave. Most of our analysis focuses on male household heads who are 22–61 years old in the survey year. We focus on those 22 and older because those below this age are unlikely to be household heads. We focus on male household heads because the PSID did not ask disability questions of spouses until 1981. The PSID defines the household head in a married couple family to be the male, except when he is so severely disabled that he is unable to respond to the survey. In order to assure sufficient information about the variables of interest, we select male household heads who are interviewed for at least six years and who are 22–61 years old for at least four interviews, three of which are consecutive.

2.2. Disability questions, limitations and severity

The main disability question in the PSID is, “Do you have any physical or nervous condition that limits the type or amount of work you can do?” This question is asked of household heads consistently throughout the life of the survey.⁹ After determining the presence of a work-limiting condition, the interviewer asks a severity question to determine the extent to which this condition limits the work capability of the head. We group the responses to this question into two categories: those who respond “can do nothing,” “completely,” “a lot,” or “severely” are classified as *Severely Disabled*, while those who respond “just a little,” “some-what,” “not limiting,” or “not at all” are classified as *Not Severely Disabled*.

Table 1 tabulates the unweighted and weighted disability rates for male household heads aged 22–61 during the 1968–2015 period. These rates are usually between 11 and 15% and are comparable to those found by Burkhauser et al. (2006).¹⁰ The table also reports the share of the disabled with a severe disability. The fraction of disabled men classified as severe is usually about one-third. However, during the 1977–1985 period the possible responses to the severity question in the survey were more limited, apparently leading to a higher fraction of respondents indicating that their condition limited their work capability “A lot.”¹¹ We have investigated the sensitivity of our disability rates and outcomes to reduced reliance on these years, and have found only small impacts given the averaging over time and the classification system we use, as discussed in the online Appendix.

2.3. Self-reported disability and its validity

The distinction between disability defined by disability insurance (DI) receipt and disability defined by self-reports is fundamental. Some authors have questioned the validity of self-reported disability status and focused instead on those who receive benefits such as SSDI or SSI.¹² Several recent papers in this line of work have used clever designs to estimate the causal effect of disability receipt in certain contexts (von Wachter et al., 2011; French and Song, 2014; Maestas et al., 2013; Autor et al., 2017a). However, many researchers have argued that self-reported disability status is the preferred way to define disability given that a large share of disabilities, even those compensated by SSDI, cannot be determined by an explicit physical marker. In 2015, 72% of DI disabling conditions were mental, musculoskeletal, or nervous

⁹ In the period 1973–1975, only new entrants to the survey are asked this disability question. We assume that the disability status of others does not change over this period.

¹⁰ These authors find that PSID disability rates are higher than those in the March CPS, but are generally lower than those found using the Survey of Income Program Participation (SIPP) or the National Health Interview Survey (NHIS).

¹¹ See the Appendix for the exact wording of the question in different periods. No severity question was asked during 1969–1971.

¹² See Bound et al. (2007), Kreider and Pepper (2007), and Kreider (1999) for discussions of the limitations of self-reported disability.

Table 1
Working age male household head disability rates, and shares severely disabled 1968–2015.

Year	N	Disability rate (unweighted)	Disability rate (weighted)	Share of disabled that are severely disabled (weighted)
	(1)	(2)	(3)	(4)
1968	2865	15.17	14	0.30
1969	2659	17.84	16.25	
1970	2730	16.40	14.76	
1971	2809	16.87	16.01	
1972	2902	14.02	13.16	0.33
1973	3039	12.62	12.24	0.28
1974	3164	11.79	11.41	0.27
1975	3307	10.81	10.60	0.27
1976	3418	10.89	10.43	0.35
1977	3542	11.86	10.95	0.48
1978	3663	12.17	11.39	0.44
1979	3799	13.26	12.79	0.44
1980	3905	14.09	13.60	0.42
1981	3931	12.46	12.38	0.48
1982	3970	11.74	11.99	0.45
1983	4046	11.46	11.25	0.48
1984	4093	12.38	12.86	0.37
1985	4177	11.95	12.14	0.41
1986	4193	10.55	11.25	0.26
1987	4221	12.62	13.64	0.31
1988	4262	12.86	13.71	0.28
1989	4266	12.90	13.49	0.31
1990	5485	13.65	14.42	0.33
1991	5451	13.48	14.09	0.31
1992	5716	13.50	13.99	0.28
1993	5712	13.24	13.46	0.29
1994	6223	13.46	12.80	0.30
1995	5966	13.03	12.98	0.34
1996	4946	12.78	13.19	0.34
1997	4028	11.34	11.75	0.28
1999	4175	12.11	12.29	0.34
2001	4475	12.45	13.02	0.29
2003	4718	12.13	12.58	0.31
2005	4746	11.60	12.07	0.38
2007	4859	12.14	13.22	0.36
2009	5033	11.45	12.03	0.39
2011	5003	11.29	12.60	0.38
2013	5001	11.20	12.53	0.42
2015	4876	11.57	12.55	0.42

Notes: The sample is male household heads ages 22–61 years in the PSID full sample. The disabled in a survey year are those who answer yes to the question: “Do you have a physical or nervous limitation that limits the amount or type of work you can do?” Severely disabled family heads are those who report “Can do nothing,” “Completely,” “A Lot” or “Severely” in response to the follow-up severity question.

system disorders, while only 4% were due to injuries.¹³ The causal effect of disability defined by self-reports cannot truly be estimated since it is endogenous to the degree of material deprivation, its compensation, as well as other factors. Disability defined by self-reports is a larger phenomenon: even our most narrow definition of disability includes about twice as many individuals as those receiving DI or SSI. Examining the larger group of disabled has many advantages over receipt based measures. First, some disabled individuals may not file for SSDI or SSI because of the paperwork and the requirement that the disabling condition is expected to last for at least 12 months. Others may be unwilling to receive government benefits or if they do, they may omit reporting them in surveys. Second, not all disabled individuals will meet these programs' qualifications. For example, SSDI requires the applicant to have worked sufficiently during the years prior to disability,¹⁴ and SSI has a stringent asset limit. SSDI and SSI benefits are also unavailable to those who earn above fairly low amounts despite their disabilities. Third, the denial of an SSDI or SSI application does not necessarily imply that an individual is not disabled (Nagi, 1969; Bound, 1989), as

¹³ See U.S. Social Security Administration (2016).

¹⁴ Only about 80% of working age individuals are insured by SSDI (Autor and Duggan, 2006).

indicated by the high acceptance rates for those who appeal denials (Benítez-Silva et al., 1999 report that in 1993, of the 48% of denied SSDI claimants who requested reconsideration, 50% were accepted).¹⁵

Past research has also pointed out the merits of self-reported disability measures. Benítez-Silva et al. (2004) suggest that self-reported disability responses are an unbiased indicator of SSDI eligibility decisions. Stern (1989) finds that a self-reported disability question is close to exogenous. To the extent self-reported disability was endogenous, the relationship was the opposite of what had been hypothesized in the literature (i.e. health tended to deteriorate when working rather than disability being used to justify not working). In their comparison of the Current Population Survey (CPS) and the National Health Interview Survey (NHIS), Burkhauser et al. (2002) argue that the self-reported work-limitation-based definition of disability may even underestimate disability rates. Given that alternative definitions have their own endogeneity problems or are often too narrow, we believe that self-reported disability status responses, while not perfect, offer the best available method of measurement.¹⁶ While it does not ask such questions regularly, the PSID asked questions about physical limitations and specific medical conditions diagnosed by a health professional in 1986, and the 1999–2015 surveys. In the online Appendix, we provide extensive comparisons of our disability measures to these measures of health limitations. We show that the severely disabled group in our sample has on average much greater numbers of physical and health limiting conditions, as well as more serious forms of these conditions, relative to the non-severe group and the non-disabled.

2.4. Sample construction

Our focus is on disabilities that begin during the working years; accordingly, we exclude those whose onset age is under 18 or above 56. In order to have sufficient information after onset, we require that a disabled individual in our sample be in the survey for a minimum of three years during the ten years after onset. This restriction is parallel to the earlier restriction above that also applies to the non-disabled and is important to determine the disability persistence and severity groups (which we introduce in Section 2.5 below). Due to the restrictions that we impose in selecting our sample, we slightly understate the extent of work limitations, as discussed further below. We replace missing demographic information (age, marital status, years of education, number of family members, number of children and state of residence) by the non-missing value in the nearest wave. We exclude, however, individuals who are missing key demographic variables (education, age and marital status).¹⁷

Determining the year of limitation onset for the disabled requires combining information from multiple years of data. A valuable feature of the PSID is a retrospective question on when a work limitation began that is available for the 1969–1978 waves (except 1976 and 1977). For those disabled on or before 1978, we use the responses to this question to determine their year of onset.¹⁸ For those who first

report having a disability after 1978, we require that such individuals report no limitations in the two consecutive survey years immediately prior to the year in which they first report having a work limitation.¹⁹ The application of these restrictions results in a primary sample of 7433 male household heads, 2098 (28%) of whom are classified as ever disabled.

2.5. Categorizing the disabled

Besides determining how disabled men fare around disability onset, we examine how economic outcomes evolve for different types of disabilities. We divide the extent of disability along two dimensions: persistence and severity. We divide the disabled into three persistence groups, building on Charles (2003). The *One-Time Disabled* are those who report a disability once, but do not report a disability again during the next ten years. The *Temporarily Disabled* are those who have one or two positive limitation reports within the ten years after disability onset. Thus, including the onset report, a temporarily disabled individual will have at most three positive limitation reports through the tenth year after onset. The *Chronically Disabled* are those who have three or more positive limitation reports during the ten years after disability onset. To reduce the dependence of the definition on time in survey, we use all the survey waves and require that a disabled individual be in the survey for at least three years within the ten years after onset.²⁰

The severity questions were asked nearly every year, giving us multiple reports. We rely on average severity throughout the paper.²¹ Specifically, we define the *severity ratio* as the fraction of the time the individual reports he is *Severely Disabled* in the year of onset and the subsequent ten years after onset.

We combine the two disability dimensions in our main analyses by splitting the *Chronically Disabled* into two groups. Hence, this classification yields four groups of interest – *One-time*, *Temporary*, *Chronic-Not Severe* (with a severity ratio under 0.5) and *Chronic-Severe* (with a severity ratio at least 0.5) which we collectively call the *Extent of Disability groups*.

To further motivate the need for a multiyear definition of disability and to summarize the dynamic nature of disability status, Table 2 reports a modified second-order Markov transition matrix for disability group. A given row conditions on disability status (non-disabled, currently *Not Severely Disabled*, currently *Severely Disabled*) during the previous two years. The probability of the various outcomes over the next two years is then reported. The results indicate both patterns of mobility and persistence, depending on past history. We see that there is strong persistence over time in disability status for those who are non-disabled but less persistence for those *Severely Disabled* in two consecutive years. There is a 0.97 probability that someone non-disabled for the past two years will be non-disabled this year, and the probability is 0.95 next year. However, someone who is *Severely Disabled* the past two years has only a 0.80 probability of being *Severely Disabled* this year and a 0.73 probability of being *Severely Disabled* next year. Among those becoming severely disabled who were previously non-disabled, future disability status is fairly uncertain. It is almost equally likely that they will be in any of the three states the following year. This pattern of impairment and recovery is reminiscent of the pattern of entry and exit from long-term care emphasized by Brown and Finkelstein (2008).

¹⁵ Bound (1989) suggests that many rejected SSDI applicants are in fact incapable of work. Citing the study by Nagi (1969), Bound states: “Of the population denied benefits, 35.6% were found incapable of any work, and another 12.3% were only capable of work at home or in sheltered environments.” In addition, Bound cites the study of Treitel (1976), which suggests that many rejected applicants did not work despite the SSDI denials. Using administrative follow-up records, he shows that 13.8% of those denied benefits in 1967 died within the next six years.

¹⁶ Bound (1991) argues that there are biases in both self-reported and objective measures and that the biases from the endogeneity of and measurement error in self-reported health measures tend to cancel each other out.

¹⁷ We exclude 73 individuals (1% of the main estimation sample) because key demographic information is unavailable.

¹⁸ Some individuals may have more than one response due to the panel nature of the data. Because the possible responses to these questions were coded in intervals (except in the 1978 survey, when the exact number of years is given), we determine the intersection of the intervals given by these questions and take the earliest year within the intersection as the year of disability onset.

¹⁹ For example, if an individual first reports having a limitation in 1980, then the year of onset would be 1980 if he has no limitations in 1978 and 1979. Since there is only one interview per year, we also choose the year of onset to be the year including the midpoint in time of adjacent interviews. See the Appendix.

²⁰ If we require more than three (four to six) post-onset positive limitation reports to be in the chronic group, the results are very similar.

²¹ The results are similar if we use only the initial severity report.

Table 2
Disability transition matrix.

t – 1	t	t + 1			t + 2		
		Non-disabled	Not severe	Severe	Non-disabled	Not severe	Severe
Non-disabled	Non-disabled	0.966	0.023	0.007	0.954	0.030	0.011
Non-disabled	Not Severe	0.586	0.336	0.075	0.619	0.300	0.074
Non-disabled	Severe	0.309	0.255	0.431	0.345	0.253	0.388
Not severe	Non-disabled	0.752	0.203	0.041	0.726	0.202	0.067
Not severe	Not Severe	0.252	0.647	0.094	0.323	0.546	0.118
Not severe	Severe	0.124	0.314	0.552	0.173	0.309	0.514
Severe	Non-disabled	0.647	0.196	0.145	0.609	0.211	0.165
Severe	Not Severe	0.194	0.464	0.342	0.212	0.397	0.386
Severe	Severe	0.066	0.129	0.796	0.099	0.160	0.728

Notes: The sample is male household heads ages 22–56. See the text for further details.

Table 3 reports descriptive statistics for the *Extent of Disability groups*. Of the 2098 disabled individuals, 525 (25%) are *One-Time* disabled, 640 (31%) are *Temporary* disabled, 575 (27%) are *Chronic-Not Severe* and 358 (17%) are *Chronic-Severe*. The average age at disability onset is highest for the *Chronic-Severe* group (42 years), followed in descending order by the *Chronic-Not Severe* group (37 years), the *Temporary* group (36 years) and the *One-Time* group (36 years). The *Chronic-Severe* group is also the least educated group – only 23% have ever attended college; by comparison, 50% of the *One-Time* group have

attended college. The *Chronic-Severe* group members are much less likely to be white, but only slightly less likely to be married than the other *Extent of Disability* groups and the non-disabled.

Members of each of the four disabled groups have participated on average in the survey for at least 10 years after disability onset, though the *Chronic-Not Severe* participated on average six more years than the *One-Time* group. It is also encouraging to see that all four disabled groups have participated in a similar total number of interviews, at least 17 on average. This similarity in years in the survey, especially

Table 3
Sample means and standard deviations, non-disabled and the extent of disability groups.

	Extent of disability groups					
	Non-disabled	All disabled	One-time	Temporary	Chronic not severe	Chronic severe
	(1)	(2)	(3)	(4)	(5)	(6)
Age at disability onset		37.4 (10.3)	36.0 (9.1)	36.1 (10.5)	37.3 (10.4)	42.0 (10.2)
Age	36.0 (7.7)	40.8 (8.4)	37.6 (6.6)	40.0 (8.2)	42.2 (8.3)	44.7 (8.9)
White	0.666 (0.472)	0.664 (0.472)	0.714 (0.452)	0.644 (0.479)	0.748 (0.435)	0.494 (0.501)
Married	0.784 (0.329)	0.788 (0.321)	0.778 (0.325)	0.782 (0.318)	0.812 (0.304)	0.773 (0.344)
Number of years in survey	13.2 (7.8)	19.5 (8.3)	19.3 (8.3)	19.4 (8.4)	20.7 (8.1)	17.8 (8.2)
Highest level of educ-high school	0.319 (0.466)	0.305 (0.461)	0.319 (0.466)	0.308 (0.462)	0.334 (0.472)	0.265 (0.442)
Highest level of educ-college	0.506 (0.500)	0.387 (0.487)	0.501 (0.500)	0.394 (0.489)	0.374 (0.484)	0.229 (0.421)
Years in survey after onset		13.9 (8.8)	10.7 (7.1)	14.1 (9.5)	16.7 (8.9)	13.6 (8.4)
Number of consecutive positive limitation reports		1.772 (4.092)		0.413 (0.619)	3.183 (5.118)	4.534 (6.063)
Number of non-missing reports of disability status from onset to the 10th year after onset		7.273 (2.494)	6.573 (2.523)	7.066 (2.512)	8.056 (2.254)	7.413 (2.435)
Number of positive limitation reports from onset to the 10th year after onset		2.899 (2.858)		1.406 (0.492)	5.292 (2.095)	5.975 (2.333)
Severity ratio		0.279 (0.372)	0.135 (0.343)	0.208 (0.311)	0.125 (0.165)	0.831 (0.169)
Age in the last interview	45.8 (12.2)	56.3 (13.7)	52.4 (12.7)	55.4 (14.1)	59.0 (13.4)	59.2 (13.4)
Number of observations	5335	2098	525	640	575	358
<i>Economic outcomes (in 2016 dollars) in the years prior to the fifth year before disability (overall average for the non-disabled)</i>						
Earnings	60,007 (76,845)	47,592 (38,794)	49,423 (27,983)	50,315 (51,442)	47,457 (39,683)	39,718 (25,250)
After-tax, after transfer family income	78,237 (77,419)	58,277 (37,491)	60,584 (30,409)	60,359 (49,856)	57,034 (33,718)	52,247 (26,834)
Consumption	22,792 (17,023)	17,731 (9558)	18,427 (9436)	18,183 (10,898)	17,406 (8357)	16,126 (8550)

Notes: Standard deviations are in parentheses. The variables Age and Married are averages over the sample years during which the individual is the head and ages 22–61. Individuals are classified by their first observed disability. See the text and Appendix for sample restrictions and the text for group definitions.

after onset, should reduce any concerns that the *One-Time* group members are categorized as such because they are more likely to have exited the survey after disability.

In much of the paper, we focus on the *Chronic-Severe* group. While this group is defined in a restrictive way, it still includes a much larger share of a given age group than is receiving Social Security disability payments as we will see shortly. Members of the *Chronic-Severe* group have slightly more persistent disabilities on average than the *Chronic-Not Severe* group. The *Chronic-Severe* group reports a mean of 6.0 years of positive limitation reports within ten years after disability, while the *Chronic-Not Severe* group reports a mean of 5.3. The average severity ratio of the *Chronic-Severe* group (0.83) is over six times that of the *Chronic-Not Severe* group (0.13).

2.6. Disability rates and lifetime prevalence

We saw in Table 1 that roughly one in seven male household heads experiences a work limitation in a given year. However, the statistic that more naturally feeds into calculations of the insurance value of disability insurance is the probability that a person becomes disabled some time during his working life.²² With data currently spanning 48 years, the PSID is ideally suited for this calculation. We define the *lifetime prevalence of disability* as the probability that an individual becomes disabled during his working years by a given age. We calculate this measure for all ages 28–64. For this purpose we use the information on disability reports and severity in a rolling ten-year-ahead window to classify an individual's current disability for each survey year. Accordingly, this measure fully accounts for the potential worsening of a condition over time. We then classify individuals by the most serious form of disability ever experienced, ranking the disability types in increasing order of seriousness as follows: *One-Time*, *Temporary*, *Chronic-Not Severe* and *Chronic-Severe*. In these analyses, we use sample weights to better approximate U.S. averages.²³

As the number of years after 1968 increases, so does the number of years of past information in the PSID. In addition, we use up to ten years of future information on persistence and severity to classify a person's current condition. Thus, in order to have the best data to summarize disability histories, we focus on those individuals in the survey's middle years (1980–1992) who have been in the survey for at least ten prior years. Using the survey's initial waves would understate the prevalence rate because we do not have information about the individual prior to 1968 and many will have had a disabling condition well before the PSID began.²⁴ By contrast, using the most recent years would not give us the full ten years of data after onset to classify a given disability.

We first report the chance of experiencing disability by the time an individual reaches a given age in Table 4 for the 1980–1992 subsample.²⁵ Not surprisingly, the chance of experiencing disability rises with age, though the estimates do not rise monotonically given the unbalanced panel. By the time a person reaches age 50, there is a 36% chance that he has experienced some kind of disability during his working years. In particular, there is a 9% chance that an individual has ever experienced a *Chronic-Severe* disability by that age. The corresponding rates for *One-Time*, *Temporary* and *Chronic-Not Severe*

²² The information relevant in a full life-cycle model of insurance might be more extensive, including probabilities of disability at each age, the duration of the disability or the probability of recovery, the change in consumption, and any effects on the mortality rate.

²³ We use the current year weights in these analyses. Using the initial year weights (the first observed weight in the 1980–90 window) yields almost identical percentages.

²⁴ Recall that the retrospective question was asked only if an individual was disabled at the time of the interview.

²⁵ These prevalence rates may still be understated because of sample attrition and because the PSID does not interview the head if he is totally incapacitated. We have examined the reasons for attrition and find that the main causes are refusal and death, with total incapacitation accounting for less than 5% of all attrition. See the Appendix for further discussion.

disabling conditions are 6%, 8% and 13%. The rise in the prevalence of *Chronic-Severe* disability with age is steep. The chance of ever experiencing a *Chronic-Severe* disability approximately triples between age 40 and age 50. Between age 50 and age 60 the probability nearly doubles again. The rates of *Chronic-Severe* disability tend to be about twice as high as the SSDI receipt rates by age indicated in SSA data. Despite a broader definition than SSDI eligibility, we will see that the *Chronic-Severe* group fares very poorly.

We also report changes in disability prevalence over time (see the online Appendix). Our most sophisticated analyses that account for definitional and sample changes, suggest only a modest decline in disability rates over time.

2.7. Empirical methodology

To measure the change in economic outcomes associated with disability, consider the following fixed effect model for person i in year t :

$$y_{it} = \alpha_i + \gamma_t + X_{it}\beta + \sum_g \sum_k \delta_k^g A_{kit}^g + \varepsilon_{it}, \quad (1)$$

where y_{it} is the outcome of interest (such as hours worked) for person i in year t , α_i is an individual fixed effect and γ_t is an indicator variable for year t . X_{it} is a set of time-varying explanatory variables including marital status, state of residence, age and age-squared, education, and number of children. Additional controls are included, depending on the dependent variable.²⁶ A_{kit}^g is an indicator variable that equals one if in year t , individual i belongs to disability group g and he is k years from the year of onset, and ε_{it} is a potentially serially correlated error term.

The sample for our analyses consists of nondisabled and disabled men during all years prior to disability onset through the ten years after onset. Throughout this study, we focus on a set of outcomes five years before and ten years after the year of disability onset, thus $k \in \{-5, 10\}$. Given the inclusion of individual fixed effects, δ_k^g measures the change in the dependent variable k years away from the year of onset for those in disability group g relative to the value of their dependent variable more than five years prior to disability. The inclusion of these time invariant individual fixed effects also alleviates the concern that those who begin their disability spell later in their lifetime may exhibit different patterns of outcomes compared with those who become disabled at a younger age. The non-disabled are included to improve the precision of the estimated coefficients on age, education and the other control variables. This way of modeling the time pattern of economic outcomes is similar to the approach of Jacobson et al. (1993), Stephens (2001) and Charles (2003).

Specification (1) is attractive for some dependent variables, but in other cases we may be interested in percentage changes in the dependent variable and may believe proportional effects of explanatory variables are more natural than additive effects. Although one can transform specification (1) into a log-linear form, by replacing the dependent variable y_{it} by $\log(y_{it})$, this method however is not suitable if a large number of observations on the dependent variable are zero. As we will show, many disabled men have zero earnings because they do not work at all. Defining a lower cutoff (that is, $\log(y) = \log(a)$ for $y < a$) is also not ideal, as the estimates may be sensitive to this cutoff. We therefore consider the Poisson fixed effect regression model:

$$y_{it} = \exp\left(a_i' + \gamma_t' + X_{it}\beta' + \sum_g \sum_k \delta_k^g A_{kit}^g\right) + \varepsilon_{it} \quad (2)$$

²⁶ The number of members in the family is included in the income regressions. For earnings, hours, and income, we also include interactions of education with age, age-squared and time since 1968 and its square. For the food and housing consumption regressions, variables for the numbers of family members of different genders and ages are also included. For more details, see the online Appendix.

Table 4
Prevalence of disability by age.

Age	N	Any disability	Currently disabled	One-time	Temporary	Chronic-not severe	Chronic-severe
30	602	0.2195 (0.0203)	0.0872 (0.0148)	0.0432 (0.0090)	0.0657 (0.0121)	0.0745 (0.0125)	0.0361 (0.0103)
32	1005	0.2168 (0.0157)	0.0772 (0.0103)	0.0424 (0.0077)	0.0647 (0.0090)	0.0775 (0.0101)	0.0323 (0.0071)
34	1203	0.2472 (0.0152)	0.0909 (0.0103)	0.0577 (0.0080)	0.0597 (0.0080)	0.0913 (0.0099)	0.0386 (0.0079)
36	1255	0.2490 (0.0145)	0.1004 (0.0099)	0.0594 (0.0077)	0.0581 (0.0076)	0.0980 (0.0103)	0.0334 (0.0058)
38	1106	0.2708 (0.0162)	0.0832 (0.0099)	0.0641 (0.0085)	0.0699 (0.0093)	0.1080 (0.0119)	0.0289 (0.0057)
40	997	0.2715 (0.0169)	0.0901 (0.0107)	0.0548 (0.0083)	0.0727 (0.0098)	0.1142 (0.0124)	0.0298 (0.0063)
42	896	0.2864 (0.0180)	0.1093 (0.0128)	0.0619 (0.0093)	0.0719 (0.0100)	0.1220 (0.0133)	0.0306 (0.0068)
44	736	0.3041 (0.0201)	0.1221 (0.0143)	0.0491 (0.0089)	0.1008 (0.0133)	0.1217 (0.0145)	0.0325 (0.0071)
46	583	0.3296 (0.0231)	0.1317 (0.0169)	0.0507 (0.0108)	0.1061 (0.0152)	0.1129 (0.0155)	0.0599 (0.0116)
48	555	0.3417 (0.0237)	0.1277 (0.0165)	0.0471 (0.0101)	0.0911 (0.0144)	0.1397 (0.0175)	0.0638 (0.0117)
50	534	0.3640 (0.0248)	0.1648 (0.0193)	0.0565 (0.0118)	0.0800 (0.0136)	0.1348 (0.0172)	0.0927 (0.0153)
52	544	0.3638 (0.0244)	0.1732 (0.0195)	0.0621 (0.0122)	0.0740 (0.0125)	0.1232 (0.0169)	0.1045 (0.0156)
54	535	0.3835 (0.0243)	0.1915 (0.0199)	0.0609 (0.0122)	0.0761 (0.0127)	0.1285 (0.0165)	0.1181 (0.0161)
56	536	0.4262 (0.0247)	0.2217 (0.0210)	0.0656 (0.0131)	0.0756 (0.0128)	0.1350 (0.0169)	0.1500 (0.0177)
58	361	0.6609 (0.0298)	0.3315 (0.0300)	0.0920 (0.0186)	0.1138 (0.0195)	0.2299 (0.0269)	0.2252 (0.0263)
60	338	0.6508 (0.0310)	0.3220 (0.0302)	0.0856 (0.0190)	0.1066 (0.0191)	0.1989 (0.0263)	0.2597 (0.0281)

Notes: This table reports for each age the fraction of the sample members who have had a disability by the specified age, the fraction of individuals who are currently disabled, and the fraction for whom a given disability type is their most severe disability to date. For this table we only use data from 1980 to 1992. The fractions are weighted. Standard errors are in parentheses. We restrict the sample to individuals with at least 10 years of data prior to the specified age. See text for details.

where the coefficients of interest can be estimated by conditional maximum likelihood methods. Estimated percentage change in the outcome of a one-unit change in the dependent variable can be obtained simply as $\exp(b)-1$, where b is the estimated coefficient of interest. We estimate model (1) if our interest is how disability affects the *level* of the outcome (such as hours of work, receipt of public transfers), whereas we estimate model (2) if we are interested in knowing how disability affects the *percentage change* of the outcome (such as earnings, income, food and food plus housing consumption). Standard errors are clustered by person.²⁷ In our analysis, all monetary values are reported in 2016 dollars, adjusting for inflation using the CPI Research Series using Current Methods (CPI-U-RS).

3. Employment and earnings following disability

We first examine labor supply and annual hours worked, the probability of working, and annual earnings during the five years before and ten years after disability onset.

3.1. Hours of work and employment

We estimate model (1) for hours since the estimated coefficients represent changes in the level of annual hours which are easily interpreted. Column 1 of Table 5 shows the changes in annual hours of work of the average disabled, and Fig. 1 depicts these changes. Similarly, column 2 reports the percentage of the average disabled working zero hours; these results are displayed in Fig. 2. By the year of onset, annual hours of work are estimated to decline about 270 h for the average disabled, with about 6% of this population not working during the

year. This decline is relative to the period more than five years prior to onset (that is, $k < -5$, where $k = 0$ in the year of disability onset). By the following year, the drop increases to 400 h with about 14% of disabled men not working. From then on, the change in annual hours of work remains roughly flat, but the percentage of the disabled who work zero hours continues to rise. In the long term (six to ten years after disability onset), almost one-fifth of the average disabled do not work at all during the year.

Figs. 1 and 2 also show the hours and employment changes for the *Extent of Disability* groups. We see relatively small changes in annual work hours for the *One-Time* group; they are estimated to drop by only about 120 h on average during disability onset and by an additional 13 h the following year. From then on, the fall diminishes. An F-test that all estimates of the fall in hours are zero after $k = 5$ fails to reject the null hypothesis (p -value = 0.14) for our *One-Time* group. We observe a similar pattern for the *Temporary* group. By the tenth year after onset, about 7 to 8% of people in the *One-Time* and *Temporary* groups work zero hours.

Changes in yearly hours of work are much larger for the *Chronic-Not Severe* group, with an estimated decline of about 240 h by the year of onset. By the fifth year after onset, this group's work hours are estimated to decline by about 390 with about 12% of these individuals not working at all. In the long run (six to ten years after disability onset), yearly work hours are estimated to decline by about 350 with about 10% of these household heads not doing any work during the year. Although these declines are large, they are much smaller than those of the *Chronic-Severe* group (columns 1 and 2 of Table 6), whose annual hours of work are estimated to plummet by over 700 by the year of onset. By the following year, we estimate annual hours to decline by over 1100, and about 40% of this group is doing no work during the year. In the long run (six to ten years after onset), annual hours of work for the *Chronic-Severe* group are estimated to decline by about 1470. We also

²⁷ Note that we do not impose the Poisson variance assumption.

Table 5
Changes in economic outcomes before and after disability onset, all disabled.

Year from onset	Implied percentage change					Consumption		
	Hours of work (1)	% working zero hours (2)	Earnings (3)	Pre-public transfer income (4)	Post-public transfer income (5)	Food (6)	Housing (7)	Food plus housing (8)
-5	-2 (20)	2.53%	-5.36** (1.93)	-2.18 (1.30)	-1.96 (1.28)	0.57 (1.38)	-4.15** (1.48)	-2.36* (1.11)
-4	-37 (23)	2.62%	-4.51 (2.56)	-2.21 (1.48)	-1.84 (1.49)	-2.25 (1.15)	-3.98* (1.66)	-3.83** (1.17)
-3	-46* (22)	3.67%	-6.94** (2.38)	-3.86* (1.68)	-3.76* (1.66)	-2.33 (1.28)	-4.49* (1.76)	-4.21** (1.24)
-2	-95** (25)	2.81%	-9.67** (1.94)	-5.76** (1.43)	-5.43** (1.38)	-0.68 (1.29)	-4.42* (1.91)	-3.53** (1.33)
-1	-173** (25)	5.91%	-12.68** (2.03)	-7.09** (1.53)	-5.17** (1.53)	-2.80* (1.28)	-2.62 (2.20)	-3.59* (1.44)
0	-271** (27)	6.21%	-15.69** (2.06)	-10.25** (1.50)	-6.29** (1.50)	-2.86* (1.23)	-6.39** (2.00)	-5.74** (1.39)
1	-399** (28)	14.37%	-22.50** (2.24)	-15.22** (1.57)	-9.15** (1.61)	-2.51 (1.53)	-5.00* (2.09)	-4.89** (1.51)
2	-377** (29)	13.50%	-22.36** (2.24)	-14.32** (1.61)	-9.39** (1.65)	-6.25** (1.27)	-6.81** (2.15)	-7.86** (1.48)
3	-361** (29)	16.62%	-21.28** (2.67)	-13.84** (2.01)	-9.83** (2.07)	-5.40** (1.39)	-6.20** (2.35)	-7.23** (1.61)
4	-402** (30)	15.23%	-23.17** (2.41)	-13.16** (2.19)	-7.90** (2.26)	-6.21** (1.35)	-6.92** (2.47)	-7.99** (1.69)
5	-384** (31)	19.03%	-24.11** (2.82)	-15.84** (1.89)	-10.43** (1.92)	-6.65** (1.39)	-5.97* (2.74)	-8.00** (1.83)
6	-363** (32)	16.16%	-22.82** (2.67)	-14.51** (1.97)	-10.19** (2.00)	-4.87** (1.40)	-6.35 (3.32)	-7.37** (2.17)
7	-370** (32)	19.63%	-24.75** (2.90)	-13.32** (2.71)	-8.29** (2.78)	-7.84** (1.39)	-10.12** (2.62)	-10.95** (1.79)
8	-338** (34)	16.40%	-24.91** (2.72)	-16.09** (2.08)	-12.20** (2.07)	-4.63** (1.48)	-9.09** (3.00)	-9.13** (2.04)
9	-375** (35)	19.90%	-23.55** (3.02)	-15.85** (2.15)	-10.98** (2.17)	-7.04** (1.51)	-8.63** (3.18)	-10.02** (2.10)
10	-413** (37)	18.40%	-24.62** (3.20)	-15.07** (2.37)	-9.15** (2.46)	-6.39** (1.60)	-9.62** (3.04)	-10.04** (2.12)

Notes: The numbers reported are, for each variable of interest, the coefficient estimates of the time from onset indicator variables in fixed effect regressions or the implied percentage changes. The omitted period is more than 5 years before onset. Standard errors clustered by person are in parentheses. Statistical significance of each estimate is denoted as follows: **Significant at 1% level, *Significant at 5% level. See the text and Appendix for variable definitions and the text for further details.

see that about 65% of this group will do no work in a year in the long run. Note, however, that the rise in this zero-work percentage is not instantaneous; it rises gradually from about 40% in the year after

onset to about 65% by the tenth year after onset. It appears that many individuals' disabilities worsen over time or their skills decline, and eventually they do not do any work.

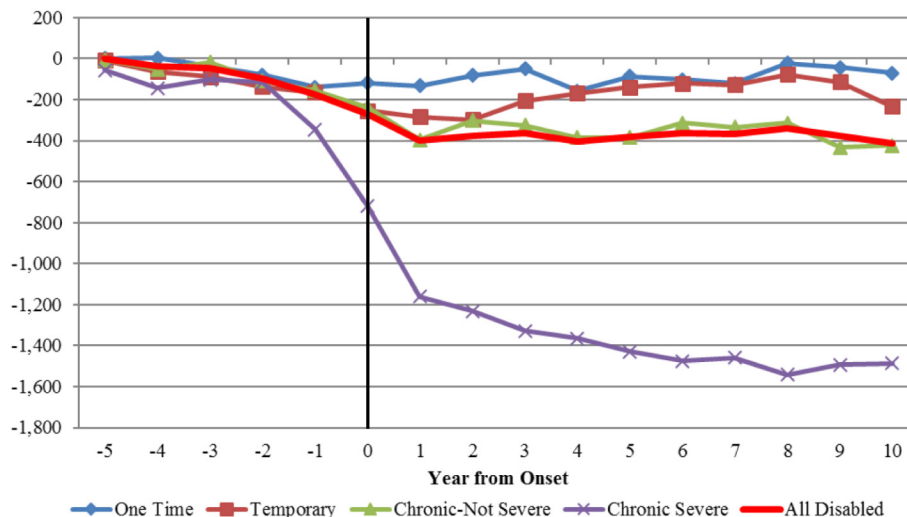


Fig. 1. Change in annual hours of work before and after disability onset, extent of disability groups and all disabled. Note: The estimates in this figure are from a fixed effects linear model.

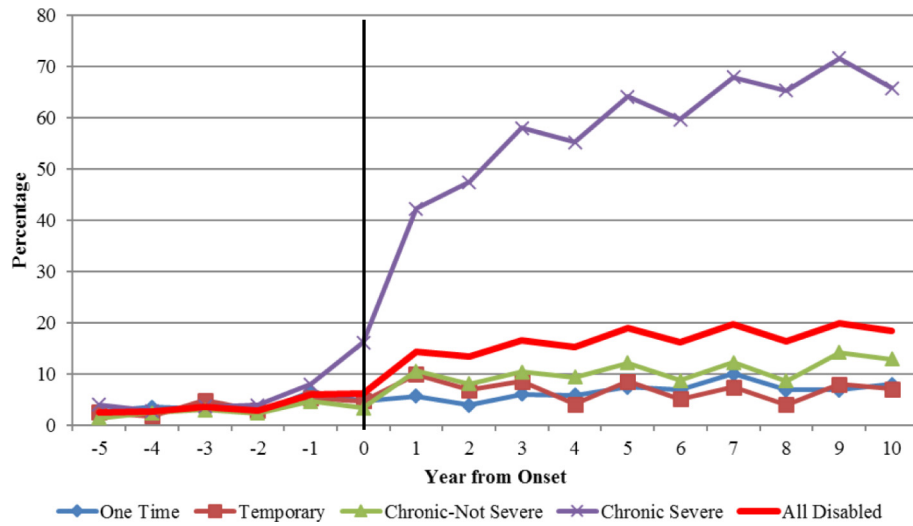


Fig. 2. Percentage of disabled with zero hours of work before and after disability onset, extent of disability groups and all disabled (without controls).

3.2. Earnings

With many disabled having zero earnings and zero hours of work following disability, we use Poisson regression to estimate the relationship of disability with earnings. Column 3 of Table 5 shows the results

for disabled men as a whole. Here, we report the implied percentage changes and their corresponding standard errors. These percentage changes are also displayed in Fig. 3. Annual earnings decline rapidly around the year of disability onset, falling about 12.7% on average by the year prior to onset and 15.7% by the year of onset. This decline

Table 6
Changes in economic outcomes before and after disability onset, chronic-severe disabled.

Year from onset	Implied percentage change								
	Hours of work (1)	% working zero hours (2)	Earnings (3)	Pre-public transfer income (4)	Post-public transfer income (5)	Consumption			
						Food (6)	Housing (7)	Food plus housing (8)	
-5	-57 (57)	3.97%	-11.55** (3.72)	-8.13** (2.90)	-6.72* (2.67)	-0.16 (2.63)	-9.77** (2.83)	-5.66** (2.10)	
-4	-144** (51)	2.82%	-12.49** (3.54)	-6.44* (3.13)	-8.08** (2.90)	-5.03 (2.60)	-7.53* (3.15)	-8.14** (2.29)	
-3	-102 (52)	3.65%	-14.29** (3.72)	-7.29* (3.24)	-6.92* (2.93)	-5.91* (3.01)	-5.23 (4.13)	-7.90** (2.61)	
-2	-117 (62)	3.90%	-16.12** (4.45)	-9.67** (3.42)	-9.98** (3.02)	-7.98** (2.90)	-10.79** (4.12)	-11.77** (2.86)	
-1	-346** (61)	7.99%	-24.43** (4.45)	-12.42** (3.43)	-9.48** (3.25)	-9.74** (3.17)	-11.68** (4.19)	-12.77** (2.85)	
0	-720** (71)	16.18%	-38.83** (4.70)	-23.49** (3.81)	-12.31** (3.42)	-9.28** (2.76)	-12.84** (4.09)	-13.21** (2.69)	
1	-1161** (68)	42.33%	-60.91** (3.95)	-38.15** (3.41)	-18.36** (3.48)	-8.25 (4.45)	-16.78** (4.12)	-14.84** (3.25)	
2	-1231** (72)	47.49%	-63.97** (3.94)	-40.97** (3.37)	-23.58** (3.16)	-16.92** (2.65)	-18.95** (3.66)	-20.95** (2.50)	
3	-1328** (65)	58.09%	-67.47** (3.99)	-44.77** (3.50)	-24.04** (3.89)	-15.62** (3.20)	-18.27** (3.67)	-19.68** (2.65)	
4	-1365** (69)	55.26%	-68.38** (4.00)	-43.26** (5.24)	-19.22** (5.10)	-18.83** (2.55)	-18.09** (4.09)	-21.70** (2.63)	
5	-1430** (64)	64.19%	-74.98** (3.26)	-48.62** (3.30)	-24.84** (3.24)	-18.92** (2.84)	-18.42** (4.06)	-22.17** (2.68)	
6	-1474** (71)	59.75%	-74.72** (3.61)	-48.77** (3.56)	-25.24** (3.70)	-14.82** (3.09)	-21.37** (4.60)	-21.83** (2.94)	
7	-1460** (70)	67.98%	-79.99** (2.98)	-50.43** (3.64)	-26.53** (3.58)	-19.33** (3.14)	-24.55** (5.37)	-25.90** (3.01)	
8	-1542** (73)	65.35%	-80.67** (3.52)	-56.69** (3.29)	-34.43** (3.28)	-19.47** (2.58)	-28.15** (4.72)	-28.08** (2.73)	
9	-1493** (80)	71.64%	-79.72** (3.60)	-56.55** (3.39)	-30.46** (3.35)	-20.62** (2.75)	-20.59** (7.07)	-25.05** (3.76)	
10	-1487** (83)	65.82%	-77.23** (4.39)	-53.09** (4.31)	-28.12** (4.36)	-16.18** (3.49)	-24.22** (4.50)	-25.05** (2.94)	

Notes: The numbers reported are, for each variable of interest, the coefficient estimates of the time from onset indicator variables in fixed effect regressions or the implied percentage changes, for the Chronic-Severe disability group. The omitted period is more than 5 years before onset. Standard errors clustered by person are in parentheses. Statistical significance of each estimate is denoted as follows: **Significant at 1% level, *Significant at 5% level. See the text and Appendix for variable definitions and the text for further details.

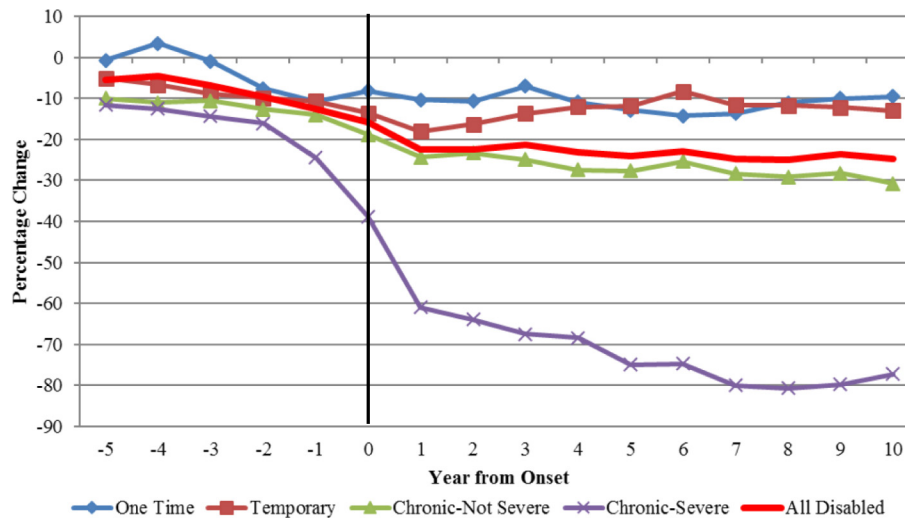


Fig. 3. Percent change in annual earnings before and after disability onset, extent of disability groups and all disabled. Note: The estimates in this figure are from a fixed effects Poisson model.

continues over the next two years, reaching about 20%. The earnings drop remains at around this level through the ten years after onset. These results for disabled men as a whole are very similar to those of Stephens (2001).²⁸

The change in average earnings for all disabled heads hides great heterogeneity across the *Extent of Disability* groups. Fig. 3 also shows each disability group's implied percentage change in annual earnings (the full set of estimates are shown in Appendix Table 4). Not surprisingly, earnings drop the least after disability for the *One-Time* and *Temporary* groups. For the *One-Time* group, they fall 8.1% by the year of onset. By the fifth year after onset, the decline reaches about 12.8%. Six to ten years after disability onset, annual earnings have fallen about 11%.

A slightly different pattern emerges for the *Temporary* group. Earnings have dropped 14% by the year of onset and 18% by the year after onset. By the third year after onset, the earnings drop has shrunk to about 14%. The estimated percentage decline in later years are about 8–12% but many estimates are statistically indistinguishable from zero. For the *Chronic-Not Severe* group, earnings drop about 17.3% by the year of disability onset. This decline in earnings continues through the following ten years; by the tenth year after disability onset, it reaches above 30%.

In contrast, the decline in the earnings of the *Chronic-Severe* group is especially large. The coefficient estimates and the corresponding implied percentage changes are reported in columns 3 and 4 of Table 6 respectively. By the year of onset, earnings fall 38.8%. In the following year, they fall an additional 22 percentage points, resulting in a cumulative loss of about 60.9%. This downward trend continues, and by the tenth year after onset, earnings have dropped by a fairly precisely estimated 77% on average, with the 95% confidence interval being (–85.8, –68.6). Such a drop is more than triple that of the average disabled. As we saw earlier, this pronounced drop is due to the high fraction of people who work zero hours after disability.

A closer examination of the two chronic groups suggests that they both experience a decline in earnings prior to recorded disability onset. By the year before onset, earnings of the *Chronic-Not Severe* group and the *Chronic-Severe* group drop 14.0% and 24.4%, respectively. As mentioned in Section 2.3, most disabling conditions are types that evolve over time. This evolution was also seen in the transition matrix

²⁸ Stephens (2001) finds that disabled individuals experience a decline in annual earnings of about 10% during the year of onset and experience a long-term loss in annual earnings of about 22%. Both our results and those of Stephens's are not comparable with those of Charles (2003) because the analyses in Charles exclude those with zero earnings. See also Mok et al. (2008) for corrections to some of the results in Charles (2003).

of Table 2, suggesting that many individuals may hesitate to call themselves disabled initially, but are willing to do so after a condition persists.²⁹ We will later see evidence of worsening health prior to onset.

4. Changes in income and transfers with disability

4.1. After-tax income

Our results in the previous section suggest that earnings decline after disability, especially for the *Chronic-Severe* group. It would be premature to conclude, however, that these large declines translate into large reductions in economic well-being. The effects of lowered earnings may be cushioned by many factors, including 1) public benefits, 2) intra-family risk-sharing through earnings of a spouse or children, 3) inter-family transfers such as support from friends and relatives and 4) reductions in taxes or increases in tax credits from programs such as the Earned Income Tax Credit that supplement income for the working-poor. In this section, we examine changes in family income after disability.

Using the summary family income variable provided by the PSID, which is the sum of labor, asset and transfer income, may be unsatisfactory even after we account for federal income tax liabilities.³⁰ First, this measure does not include in-kind transfers such as Food Stamps and subsidized housing. Second, public transfer income is generally under-reported in household surveys, and transfers to the disabled in the PSID are no exception.³¹

We use two income measures when examining the material well-being of disabled men. First, after-tax pre-transfer income is family income after federal income taxes but excluding public benefits.³² This income measure enables us to see how much non-labor earnings, and

²⁹ As Meyer and Mok (2013a) shows, about 4.4% of the *Chronic-Severe* disabled received OASDI and an additional 1% received SSI before disability onset. The drop in earnings prior to onset is also documented in Singleton (2012) using Survey of Income and Program Participation (SIPP) data. With annual data, there is rounding onset date, but these errors are small and cannot explain the differences across disability groups.

³⁰ We use TAXSIM to generate tax liability estimates. See the Appendix for details. A technical appendix discussing how we deal with the family issues in estimating federal tax liabilities via TAXSIM is available upon request.

³¹ See Meyer et al. (2009) for evidence of under-reporting of public transfers in several datasets including the PSID.

³² Public benefits are Social Security, Supplemental Security Income, unemployment insurance, workers' compensation, Aid to Families with Dependent Children/Temporary Assistance for Needy Families, Veterans (VA) pensions and other welfare.

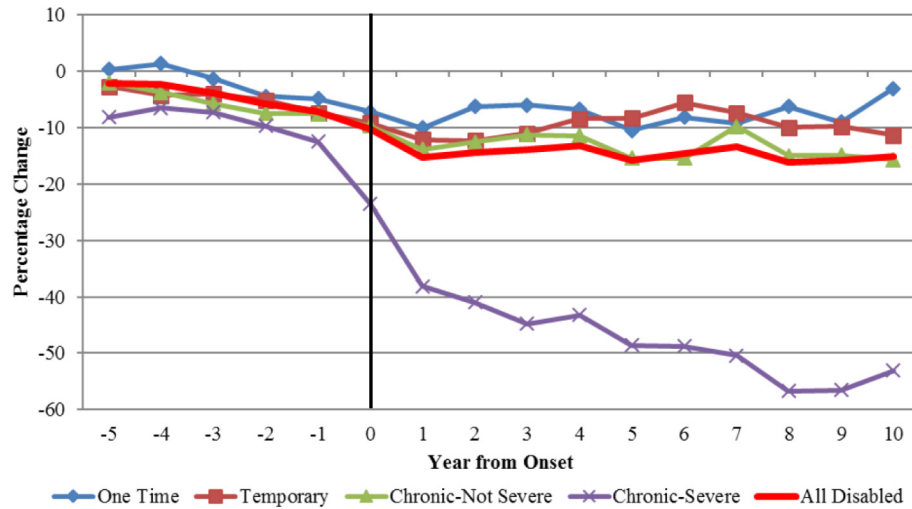


Fig. 4. Percentage change in after-tax pre-public transfer income before and after disability onset, extent of disability groups and all disabled. Note: The estimates in this figure are from a fixed effects Poisson model.

intra- and inter-family transfers mitigate the income loss due to the lowered earnings of the head that result from disability. Second, after-tax post-transfer income is the sum of after-tax family income, Food Stamps and the amount of any housing subsidy received.³³ In addition, we account for under-reporting in the main public benefit programs by scaling the benefits received using the program-specific reporting rates following Meyer et al. (2009). These reporting rates are calculated by comparing the weighted sum of the benefits received by the entire PSID sample with those reported to have been paid out by government agencies. We assume that all reporters are under-reporting by the same ratio. By scaling up benefits in this way, we implicitly assume that non-reporting recipients share the same characteristics as reporting recipients. The group means that we report are unaffected by the allocation of benefits across specific individuals with given characteristics. The difference between our two income measures will enable us to see how the receipt of benefits from various public programs affects the drop in income after disability. Column 4 of Table 5 reports the Poisson regression implied percentage change estimates for after-tax pre-transfer income received for disabled men as a whole and we display these estimates in Fig. 4. For disabled men as a whole, after-tax pre-transfer income drops about 10% by the year of disability onset. The decline continues and the drop by the tenth year after onset is about 15%.

Before examining the changes for the other disability groups, let us consider how public transfers mitigate the income drop for the average disabled. Column 5 reports the estimates for after-tax post-transfer income, and the implied percentage changes we display in Fig. 5. Including public transfers reduces the income drop for the average disabled by almost a half, to about 6% by the year of onset and about 9% by the tenth year after onset.³⁴

Changes in family income vary considerably across the disabled groups (Appendix Tables 7 and 8). For the *Chronic-Not Severe* group, pre-transfer income drops an estimated 9.7% by the year of onset. Public transfers reduce this drop to under 5%. Income continues to fall through the ten years after disability. By the tenth year after onset, pre-transfer income has fallen by almost 16%. With public transfers, the income drop is reduced to about 9.5%. A similar pattern is apparent for the *Temporary* group. For the *One-Time* group, the pre-transfer income change by the tenth year after disability onset is small and statistically insignificant and the effect of moving to post-transfer income is small.

Columns 4–5 in Table 6 report the income changes for the *Chronic-Severe* group, and we also display them in Figs. 4 and 5. There is significant evidence of a pre-onset fall in both income measures which, as we saw earlier, is primarily due to a fall in earnings prior to disability. By the year of onset, the drop in after-tax pre-transfer income is about 23%, but only 12% when public transfers are included. The role of public transfers in alleviating the post-onset income drop is evident throughout the *Chronic-Severe* group's disability history. By the tenth year after onset, we estimate that pre-transfer income has dropped 53%, with the 95% confidence interval being (−61.5, −44.7); when public transfers are included, we estimate the income drop to be reduced to 28% on average.

4.2. Public transfer income and spousal earnings

Our estimates above reveal that the *Chronic-Severe* group suffers the largest average decline in earnings and income. A comparison of the changes in our two income measures also suggests that the *Chronic-Severe* group receives substantial public transfers. To see this result, we estimate specification (1) with public transfers received as the dependent variable (adjusted for benefit under-reporting, including Food Stamps and subsidized housing). Fig. 6 shows these estimates for various disabled groups. The *Chronic-Severe* group receives by far the largest amount of public transfers; total benefits increase \$7300 by the year of onset then rise sharply in the next year. Benefits received then rise slowly, reaching about \$15,000 per year ten years after onset. In contrast, members of the *Chronic-Not Severe* group receive only about \$3200 ten years out.

Six to ten years after disability onset most of the disabled in the *Chronic-Severe* group receive benefits – 49% receive Social Security retirement or disability benefits (42% receive SSDI), 10% receive SSI (and about 50% receive SSDI or SSI), and 25% receive food stamps.³⁵ These rates are considerably higher than those of the *Chronic-Not Severe* and *Temporary* groups. In the case of SSDI, the receipt rate of the *Chronic-Severe* group is about ten times that of the *Chronic-Not Severe* group. But as we will see in our next section, those in the *Chronic-Severe* group still suffer on average from a large drop in living standards despite these relatively high benefit receipt rates. Despite the various government programs available, the incomes of about one-sixth of families with a chronically and severely disabled head drop below the poverty line in

³³ See the online Appendix for how we estimate the value of housing subsidies.

³⁴ Stephens (2001) finds that family income falls about 7.4% by the year of onset and 15.5% by the fifth year after onset. He does not, however, account for benefit under-reporting.

³⁵ See Appendix Table 10 in the Online Appendix and Meyer and Mok (2013a). The SSDI receipt rate is based on 1984–1992 surveys, as these are the only years when the type of Social Security payments received was recorded for the household head.

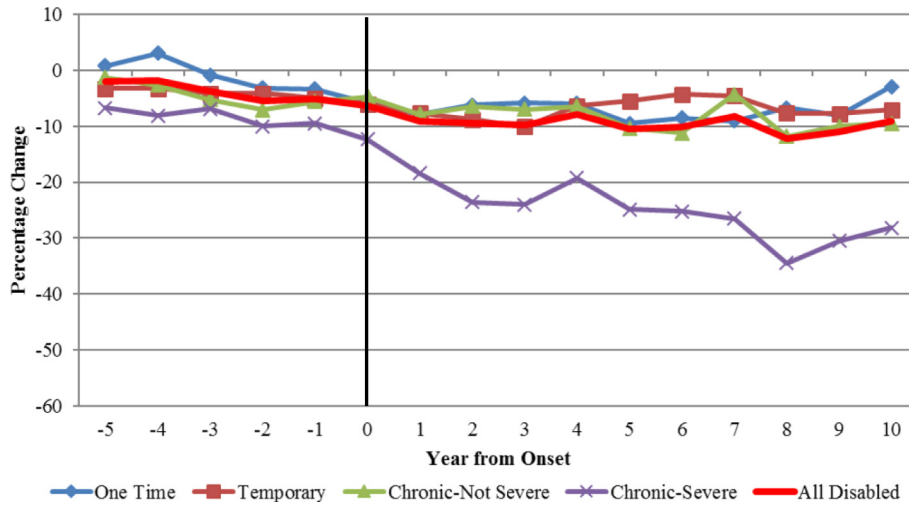


Fig. 5. Percentage change in after-tax post-transfer income before and after disability onset, extent of disability groups and all disabled. Note: The estimates in this figure are from a fixed effects Poisson model.

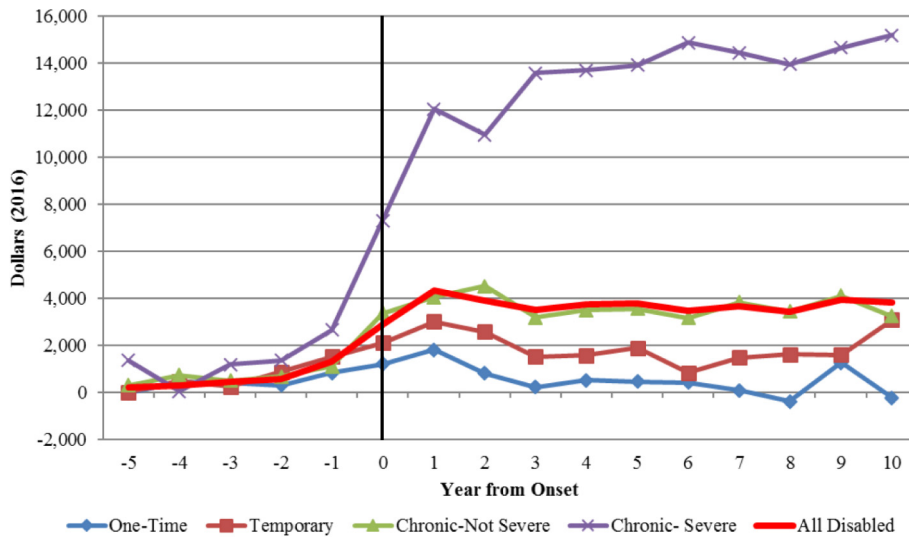


Fig. 6. Change in under-reporting adjusted public transfer income before and after disability onset, extent of disability groups and all disabled. Note: The estimates in this figure are from a fixed effects linear model.

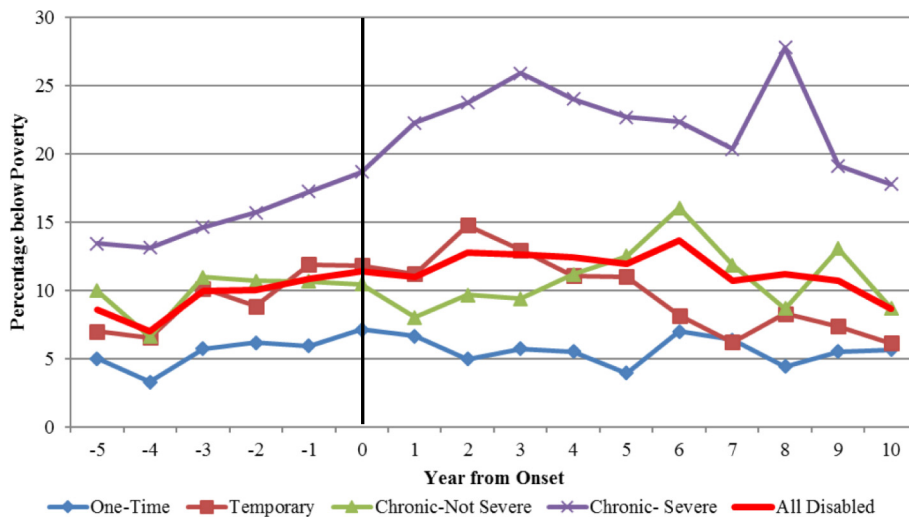


Fig. 7. Percentage of families with after-tax post-transfer income below the poverty line, extent of disability groups and all disabled (without controls).

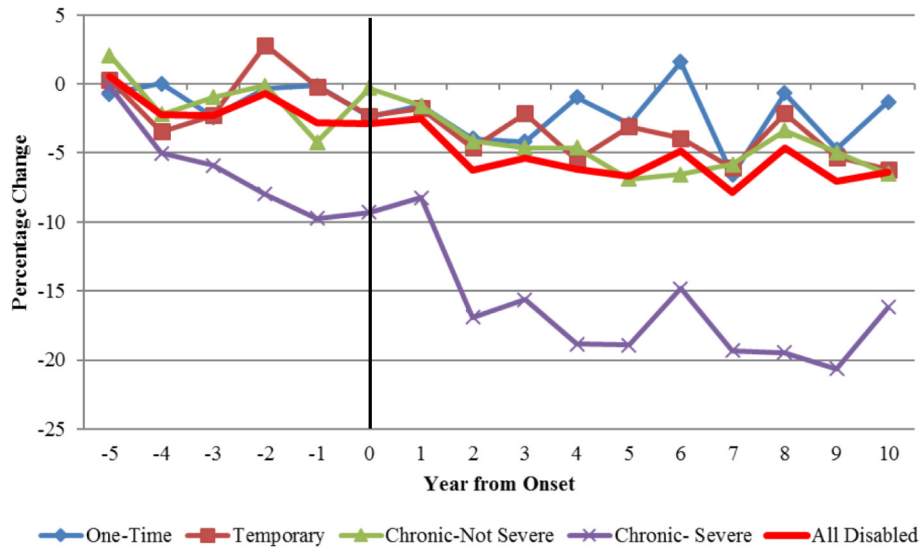


Fig. 8. Percentage change in food consumption before and after disability onset, extent of disability groups and all disabled. Note: The estimates in this figure are from a fixed effects Poisson model.

the long term – even after accounting for in-kind transfers and the under-reporting of benefits (see Fig. 7 and the Appendix for these results). We also calculate the share of each disability group that neither receives benefits nor works in the long run. This fraction is especially high for the *Chronic-Severe* group of which 14% does not have an obvious means of nonpublic support besides family member earnings or asset income.³⁶

Spousal earnings reduce the percentage fall in family income simply through income pooling. While pooling is the main influence, an additional factor is the change in annual hours of work by wives of disabled heads.³⁷ The general pattern suggests a decline in hours worked by the wife, particularly for those with a chronically and severely disabled husband; the estimates are not precise, however.³⁸ Although not reported, we have also examined changes in marital status of disabled men over time. We find that the share of disabled male heads that report their marital status as “Divorced” or “Separated from Spouse” rises sharply over time relative to the nondisabled, after accounting for age, education, children and other characteristics. The rise is especially sharp for the more seriously disabled groups.³⁹ These findings suggest that badly disabled men often lose support from their wives as well.

5. Consumption and wealth changes surrounding disability

We now focus on consumption changes surrounding disability onset because consumption has advantages over income when measuring well-being and can be used to assess the optimality of current disability compensation. Economic theory suggests that material well-being is more directly tied to current consumption than to current income (Poterba, 1991; Cutler and Katz, 1991). Consumption may also lend itself to more accurate reporting than after-tax income for those who are disadvantaged given transfer under-reporting and inaccurate

tax imputation (Meyer et al., 2009). Furthermore, consumption is more closely associated with other measures of well-being for the disadvantaged (Meyer and Sullivan, 2003, 2011).

The life-cycle model is the canonical model of income shocks and consumption. The model predicts that in the absence of uninsured shocks to income, the marginal utility of consumption should change slowly over time leading consumption to have a roughly constant or slowly trending time pattern (Dynan, 1993; Bernheim et al., 2001).

A few comments on the assumptions and applicability of the model to the disabled are in order. First of all, the model only implies small consumption changes if the interest rate is not too far from the discount rate adjusted for mortality and if precautionary saving motives are small. In general, we expect these conditions to hold for most households. Second, the marginal utility of consumption must not fall sharply with disability. In principle, the marginal utility of consumption could rise or fall. Marginal utility might rise if disability sufficiently increases demand for uncovered medical or nursing care, wheelchairs, scooters, elevator buildings, and ranch houses. It might fall if travel, eating out, and recreation demand fall.⁴⁰ Third, and most importantly, disabled men are embedded in households that in our data have on average about 4 members, falling to about 3.5 ten years after disability onset. Thus, it seems reasonable to assume that the household level marginal utility of consumption does not change appreciably with the head's disability.

5.1. Food and housing consumption

We focus on the two components of consumption that can be measured well in the PSID: food and housing.⁴¹ Food consumption is defined as the sum of family food consumption expenditure at home, family food consumption expenditure outside the home and the face value of Food Stamps received.⁴² Housing consumption is the sum of owned

³⁶ This statistic is likely overstated (and the earlier program receipt rates understated) because of the under-reporting of transfers mentioned earlier.

³⁷ A priori, there is no reason to believe that the wife of a disabled husband will unequivocally work more, as she may prefer to spend less time working and instead care for her husband.

³⁸ Appendix Table 6 of the Online Appendices shows these results. Although not reported, we have also studied the degree of intra-family risk sharing by examining the changes in earnings of other family members during the head's period of disability; we find that they are generally small and insignificant, consistent with the findings of Nagi and Hadley (1972).

³⁹ A study by Charles and Stephens (2004) finds no change in the divorce hazard after disability. Using the Survey of Income and Program Participation, Singleton (2012) finds an increase in divorce probability after disability for a sample of men.

⁴⁰ For recent empirical evidence on the effect of bad health on the marginal utility of consumption see Finkelstein et al. (2013) and the discussion and references there.

⁴¹ Many authors have used the food and housing variables in the PSID to impute total consumption expenditures (Skinner, 1987; Meyer and Sullivan, 2003; Blundell et al., 2005) via the use of the Consumer Expenditure Survey (CE Survey). A potential problem in predicting consumption for the disabled is that the relationship between characteristics and consumption differs between the disabled and non-disabled, and the CE Survey question on disability is very different from the PSID question. In the CE Survey the question is only asked of those who have not worked in the past 12 months, and includes disability along with other reasons for not working.

⁴² The PSID food-spending question is “How much do you (family) spend on food in an average week?” We assume that the question refers to the time of interview rather than the previous year.

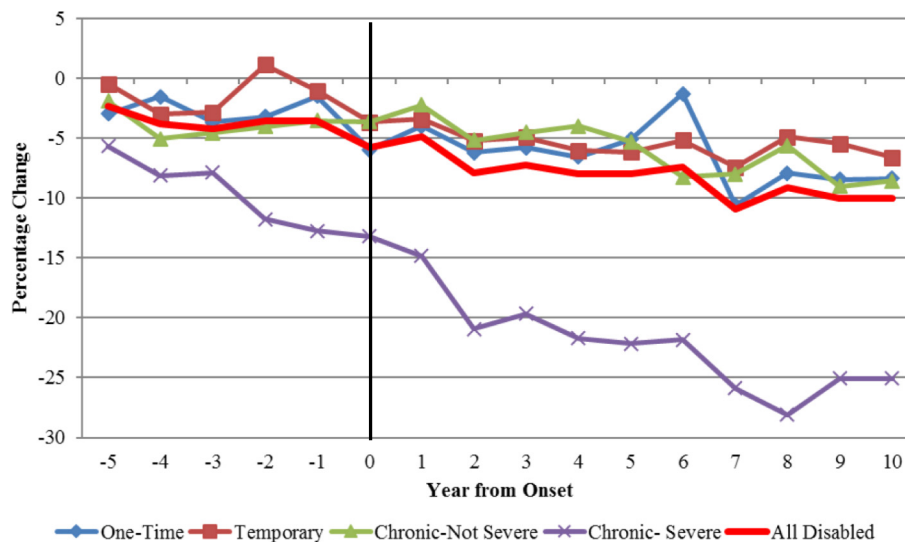


Fig. 9. Percentage change in food plus housing consumption before and after disability onset, extent of disability groups and all disabled. Note: The estimates in this figure are from a fixed effects Poisson model.

dwelling service flows calculated as 8% of current housing value, rent payments and the rental subsidy for those with free or subsidized housing.⁴³ Note, that consumption is measured at the household level, so in most cases a fall in consumption reflects a decline in living standards for more than the disabled head.

Columns 6 and 8 of Table 5 report the estimated percentage changes from the Poisson regressions for food consumption and food plus housing consumption, respectively, for the average disabled. We display the results in Fig. 8 (food) and Fig. 9 (food plus housing). For disabled men as a whole, food consumption falls 3% by the year of onset while food plus housing drops about 6%. Consumption continues to fall: our estimates imply that by the tenth year after disability onset, the average disabled man faces a decline in earnings of 25%, in after-tax post-transfers income of 9%, in food plus housing consumption of 10% and in food consumption of 6%.

Across the *Extent of Disability* groups, we again see that the decline in consumption is most dramatic for the *Chronic-Severe* group (columns 6 and 8 of Table 6).⁴⁴ By the year of onset, food consumption has fallen an estimated 9% and food plus housing consumption has fallen by 13%. Consumption continues to decline through the next ten years – by the tenth year after disability onset, food consumption has fallen by about 16% and food plus housing by about 25%.⁴⁵ These large declines are about triple those of the *Temporary* and *Chronic-Not Severe* groups, for whom food consumption drops about 6–7%. Compared with our previous estimates for the *Chronic-Severe* group, earnings fall 77%, after-tax post-transfers income falls 28%, food plus housing falls 25% and food falls 16%. These declines are close to triple those of the average disabled. The pattern also reflects the incomplete roles that savings, family support and social insurance play in reducing the consumption drop following disability for the *Chronic-Severe* group. The smaller decline found for disposable income than for earnings and the even smaller decline in consumption is plausible given other sources of income and the drawing down of savings by some households.

We also note that food consumption has fallen by about 9.7% the year before onset for the *Chronic-Severe* disabled. As noted in our discussion of earnings changes, a person may not immediately report he has a disability even when his productivity has fallen. During this period of

decreased productivity, however, he might suspect that his future income will be lower. Consequently, such a person may adjust his consumption downwards as suggested by the Permanent Income Hypothesis. This finding is similar in some respects to Hendren's (2017) finding of anticipation of future unemployment.

When we split food into food eaten at home and food away, we find a larger percentage decline for food away, but food at home is responsible for most of the overall decline given its larger share. Thus, the overall decline is not principally due to a shift away from higher cost restaurant meals.

5.2. Housing consumption

We saw in Table 6 that food and housing consumption fall after disability. In Table 6 and Fig. 10 we see that housing consumption alone falls even more in percentage terms. Exactly how the fall in housing consumption occurs is unclear because on the surface housing consumption seems hard to adjust. To understand the change in housing consumption, we analyzed the change in housing type (rent, public housing, private housing) and the change in housing consumption conditional on type. For brevity, we report the full results in the online Appendix. For the *Chronic-Not Severe* and the *Chronic-Severe* group, the likelihood of living in public housing increases in the long run by 2 and 3.7 percentage points, respectively, though they are quite imprecisely measured.⁴⁶ The likelihood of the *Chronic Severe* group owning a home has also declined by almost 7 percentage points in the long run. For housing consumption, the *Chronic-Severe* group again displays some pronounced patterns. The estimated decline in homeowners' housing consumption in the long run is more than \$4700 a year; this corresponds to a drop in home value of more than \$58,000. For those who rent private housing units, estimated annual rent paid declines about \$1500 (\$125 per month) in the long run. Both results suggest that members of the *Chronic-Severe* group who do not receive public housing decrease their housing consumption to accommodate an overall decline in resources by moving to less costly dwelling units.

5.3. Consumption after social security eligibility

Up to now, we have investigated how the working age disabled fare after their disability onset. However, after a disabled person becomes

⁴³ Details on how we construct the rental subsidy are included in the data appendix (Appendix 3).

⁴⁴ We report the full set of estimates in Appendix Table 8 in the Online Appendix.

⁴⁵ The average decline in Food plus housing consumption in the six to ten years for the *Chronic-Severe* group is 24.7%.

⁴⁶ In the years prior to $t = -5$, 60.5% of the *Chronic-Severe* owned their home, 36.2% rented their home and 3.2% were in subsidized housing.

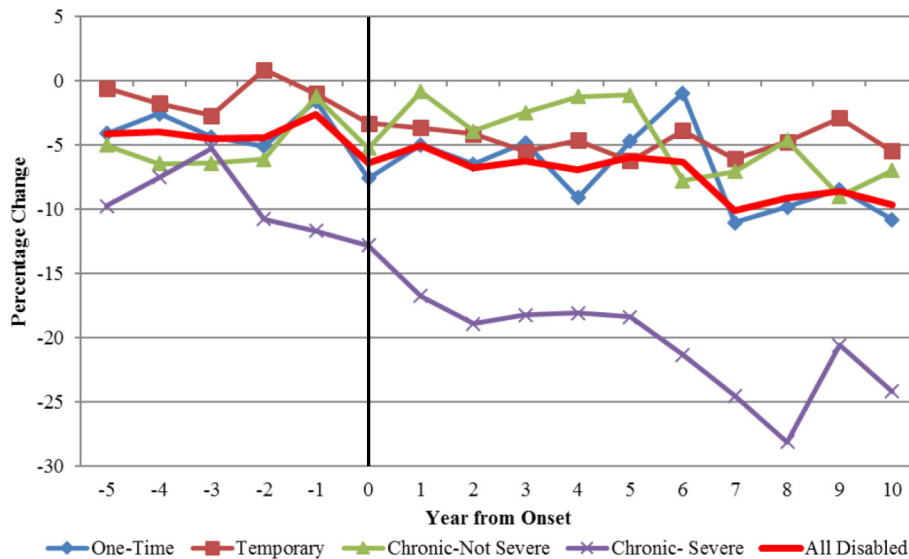


Fig. 10. Percentage change in housing consumption before and after disability onset, extent of disability groups and all disabled. Note: The estimates in this figure are from a fixed effects Poisson model.

eligible for social security retirement benefits, his income and consequently consumption may rise. To examine this issue, we retain observations after age 61 and regress consumption on age indicator variables. Specifically, we regress consumption (food plus housing) on a set of age indicator variables (62–64, 65–69, 70–74), year indicator variables, individual fixed effects and a set of non-age demographic variables. We find that food and housing consumption for the average *Chronic-Severe* disabled is not significantly different during all periods after social security eligibility than it was earlier, though the point estimates suggest that consumption falls slightly relative to the pre-eligibility years. The change with age is not significantly different for those who receive SSDI prior to age 62, and those who do not.

5.4. Wealth and how the changes fit together

The last primary outcome associated with disability that we examine is changes in wealth. So far, we have seen that the changes in outcomes have the expected patterns and relationship to each other. Family income falls less than household head earnings reflecting mostly pooling of income. After we account for government transfers the fall is even lower. There is a sharp rise in transfers that accounts for this difference. The fall in food plus housing consumption is even lower than the fall in income. We have also seen that the fall in food consumption is lower than that for housing, and the fall in food at home is even lower than overall food decline. The missing connection so far is the identity connecting changes in income and consumption to changes in wealth. The change in consumption can only be smaller than the change in income if wealth is declining. In this section we examine this missing link. We might also be independently interested in changes in wealth as an indicator of the well-being of the disabled.

The wealth data available in the PSID are more limited than the income and consumption data. The wealth data are also highly skewed, complicating statistical analysis. Thus, the estimates are less precise and differ depending on the measure of wealth examined. However, these data are consistent with the decline in wealth for the *Chronic-Severe* disabled that we expect. Wealth is only available every five years beginning in 1984 and every two years beginning in 1997. We linearly interpolate between reports when possible or use a report from up to two years away. Given the skewness of the wealth data, we focus on medians and censored means that are less sensitive to outliers than ordinary means. We first look at median wealth without demographic controls or fixed effects. The median net wealth of the *Chronic-Severe* disabled falls

over time approximately one thousand dollars per year, while it generally rises for the other disabled groups by roughly two thousand dollars per year (Appendix Table 10). We then estimate mean regressions with fixed effects. Our estimates suggest a highly significant decline in net wealth on the order of four to seven thousand dollars per year for the *Chronic-Severe* relative to the non-disabled. This dissaving estimate is more than sufficient to account for the lower fall in consumption than in income that we find. Given the small number of observations and the difficulty of estimating changes in wealth, we think of this as only a rough estimate of the degree of dissaving.

6. Robustness checks, nutrition, and time use

In this section we report several additional results: a) changes in other behaviors prior to onset, b) the effects of accounting for unobserved differences between disabled men and the nondisabled through fixed effects, c) results for subsamples defined by program receipt and cohort, d) changes in nutrition, and e) the time-use of disabled men. The details of these analyses can be found in the online Appendix.

6.1. Differences in unemployment, illness and health prior to the onset of disability

While our approach treats disability as endogenous, one might wonder if a period of unemployment or bad health leads a person to say he is disabled. An individual's decision on when he is disabled is likely a function of his time-varying productivity, disutility of work, and other factors. We present suggestive evidence for this view by looking at how unemployment, illness and health change prior to when an individual reports a condition that limits work. We estimate a series of regressions for the period prior to onset, controlling for demographic variables as in Eq. (1). We first examine the number of working days lost due to unemployment in the five years before disability onset. For the average disabled, there is virtually no change over time. For the chronic groups, however, there is a dip in days of unemployment during the third and fourth years before onset, compared to earlier or later years, but no clear evidence of a prolonged rise in unemployment leading up to onset.

Next, we examine the number of workdays lost due to illness. The results suggest that the number of workdays lost due to illness rises as we approach the year of onset; the changes are similar for all disabled groups. Finally, we examine health status where the dependent variable equals one if an individual is in poor or fair health. Again, we see

suggestive evidence that a decline in health is an important reason for reporting a disability. This change is particularly noticeable for our *Chronic-Severe* group; the fraction of those reporting fair or poor health increases over 10 percentage points just prior to disability onset. Overall, the results suggest that declining health, but not unemployment, is a key reason for reporting a disability.

6.2. Underlying permanent differences between disabled and non-disabled men⁴⁷

We compare the association of disability with various outcomes with and without fixed effects to examine how disabled men differ in terms of unobservable permanent characteristics. These estimates indicate whether it is important to estimate fixed effects models, which account for these unobserved differences. In both sets of specifications we include the non-disabled. When we include fixed effects, the estimates for outcomes are relative to those for the disabled more than five years before onset. When we do not include fixed effects, the estimates for outcomes are relative to the disabled more than five years before onset and the non-disabled with similar age, education, etc. Thus, a comparison of the estimates with and without fixed effects tells us how the unobserved characteristics of the disabled that affect the outcome in question compare to those of the non-disabled with similar observed characteristics.

In the case of the *Chronic-Severe* group, we notice a number of patterns. The most striking pattern is a lack of difference between the estimates with and without fixed effects in most of the outcomes. These results suggest that cross-sectional methods may do a fairly good job of approximating panel data methods in some cases, though our definition of disability requires panel data.

6.3. Social security and outcomes

Since Social Security disability or SSI payments are the main safety net for the permanently disabled, it is natural to ask how recipients fare relative to non-recipients. We split the *Chronic-Severe* group into those who receive SSDI or SSI benefits more than half of the time over the ten years after disability onset (SSA recipients) and those who do not (SSA non-recipients). We find that those who receive Social Security payments stop working earlier than those who do not. Nonetheless, the fall in income and consumption is very similar for the two groups (Appendix Figs. 4 through 7). The results suggest that those with low pre-transfer income are more likely to be recipients, with the benefits raising these worst off recipients to the level of the other disabled.

6.4. Cohort differences

We examine whether the material circumstances of disabled men have changed over time. To do so, we split the disabled into two samples: those who were first disabled before 1985, and those disabled later. We estimate the outcome regressions on these two samples separately and find that the two sets of results for the *Chronic-Severe* group are very similar. Results for earnings and income can be found in Meyer and Mok (2013a).

6.5. Nutrition and time-use data

The fall in food consumption we observe for the disabled may be a result of disabled men: 1) spending more time shopping and searching for lower prices for the goods they purchase and/or 2) spending more time on food preparation, which may turn cheaper ingredients into better food. Our findings do not support these effects being important, as

we find further evidence that the drop in consumption reflects a lower living standard as indicated by worse nutrition (see the Appendix for details). To examine time use, we employ the American Time Use Survey (ATUS). Major uses of the additional non-work time of the disabled are time spent watching TV – 15.1 h per week, obtaining medical care – 1.3 h per week, sleeping – 6.6 h per week, and “relaxing” – 2.5 h per week. Given that the household production function employs time inputs of both the husband and the wife, we also investigate the time-use of wives of disabled men. On average, wives of disabled men do not spend more time working than those whose husbands are not disabled; this is consistent with the PSID results discussed earlier.

7. Optimal disability benefits

7.1. Theoretical results

We have emphasized that social insurance reduces material deprivation by smoothing an individual's consumption, while past work has emphasized its labor supply distortions. Models of optimal social insurance balance these two effects, with the classic reference being Baily (1977) who examines the optimality of unemployment insurance. Chetty (2006) generalizes his results emphasizing that the model holds under very general conditions, and applies to disability insurance as well. The essence of the model is that there are two states of the world, good and bad (bad being when unemployed or disabled) and that the length of time in the bad state is determined by the individual, i.e. is endogenous. The optimality condition is simply a first-order condition, exploiting envelope conditions, for a policy giving benefits b in the bad state paid for by a proportional tax on earnings in the good state of the world. The first order welfare effects of a marginal change in benefits are captured by 1) the fiscal externality of this change in benefits as measured by the elasticity of the probability of being in the bad state and receiving benefits w.r.t. the level of benefits and 2) the difference in the marginal utility of individuals receiving the benefits and that of individuals in the good state. The fiscal externality is usually dubbed the moral hazard cost of the policy, which needs to be balanced against the consumption smoothing benefits (the wedge in marginal utility of consumption across states). This marginal condition can be written as

$$\gamma \frac{\Delta c}{c}(b^*) = \varepsilon_{D,b} \quad (3)$$

where $\frac{\Delta c}{c}(b^*)$ is the drop in mean consumption with disability benefits as a function of the benefit level b evaluated at its optimal level, γ is $-u''c_d/u'$, the coefficient of relative risk aversion, and $\varepsilon_{D,b}$ is the elasticity of time receiving disability benefits with respect to b .

The relationship in Eq. (3) provides a way of checking whether current benefits are optimal. If the left hand side is greater than the right hand side then benefits are too low; if the reverse is true then benefits are too high. This equation highlights the importance of knowing the consumption fall with disability benefits when designing disability policy.

It is important to note that the Baily-Chetty model applies to those who receive benefits not those who are disabled. As reported in Section 4, only about half of the *Chronic-Severe* disabled report receipt of DI or SSI within a few years of onset. Though, we should emphasize that there is substantial under-reporting of receipt in the PSID as in other datasets (Meyer et al., 2009, 2015). This measurement error is even pronounced for DI in longitudinal data from what is thought to be the most accurate survey with program receipt information (Gathright and Crabb, 2014).

We apply Eq. (3) to disability benefit recipients (whether or not they are *Chronic-Severe* disabled). There is a close relationship between DI and non-aged SSI recipients and the *Chronic-Severe* group, though examining the relationship is complicated by the dynamics of disability and benefit receipt and measurement error in the data. In the ten

⁴⁷ These results are not reported, but are available from the authors upon request.

years after onset, a little more than half of the Chronic-Severe report benefit receipt for a majority of the years. However, since many disabilities become Chronic-Severe later, 84% of long-time (5 or more year) DI or SSI recipients are eventually Chronic-Severe and 75% of DI receipt years are by those who are eventually Chronic-Severe.

7.2. Empirical implementation

To implement the optimality rule implied by Eq. (3), we first take the proportional drop in consumption to be 0.18, based on the estimate of the change in food plus housing consumption after the start of DI or SSI receipt (for those under 65) compared to the period more than five years before the start of receipt in an equation analogous to Eq. (2). We ignore the years just prior to receipt as they are a period without compensation but earnings have already fallen. It is an abstraction from the strict two state model of Chetty to skip the transition years, but as we have emphasized disability is not turning on a switch but a process that evolves over time for most individuals and the application process also frequently takes several years.⁴⁸ During this period earnings are low so little taxes are paid and little compensation is received as well.

We further assume that the marginal utility of consumption (at a given consumption level) is the same before and after disability, though as discussed earlier, the direction of any change is uncertain. Particularly since, as mentioned earlier, it is the marginal utility of consumption for a household of 3 to 4 members on average not just one disabled individual, the assumption of constancy seems reasonable. If γ ranges from 1 to 5, the elasticity $\varepsilon_{D,b}$ consistent with optimality ranges from 0.18 to 0.90. If we focus on an estimate of γ of at least three as assumed typically,⁴⁹ benefits are optimal or higher than optimal if the true elasticity of time spent disabled is at least 0.54, but lower than optimal if the elasticity is lower. The elasticity cutoff for a coefficient of relative risk aversion of two is 0.36, and for one it is 0.18.

We focus on DI for the elasticity of receipt with respect to benefits as it is the largest program available to the disabled. Estimates of the elasticity of receipt with respect to benefits are not available in the literature but estimates of the elasticity with respect to earnings are. If we take the disability enrollment decisions to be a function of $b-E$, where b is the benefits and E is earnings, the elasticity with respect to b is just the elasticity with respect to E times the mean replacement rate.⁵⁰ We start from the recent estimate of Charles et al. (2018) for the earnings elasticity of -0.29 (which they report is similar to past estimates)⁵¹ and multiply by the replacement rate for men at the 25th percentile of the earnings distribution from Autor and Duggan (2003) of 0.6.⁵² This calculation yields receipt elasticity with respect to benefits of 0.174, suggesting that the current compensation for disability appears to be lower than is optimal based on Eq. (3), if we believe that the coefficient of relative risk aversion is one or higher.

A number of qualifications and limitations of the model should be mentioned. There is a substantial consumption fall for Chronic-Severe disabled who are not recipients (reported in Appendix Fig. 7) so there may be a substantial welfare improvement from providing some

support for this group. Kroft (2008) generalizes Baily–Chetty to allow incomplete takeup or a screening mechanism for recipients. The screening mechanism is not optimally chosen in his model and extending this model to allow an optimally chosen screening mechanism is beyond the scope of the paper, but would be an interesting extension.

Another qualification worth noting is that the implicit assumption when estimating the consumption fall is that benefit recipients would have wanted their consumption to change with age and time in the same way as the nondisabled if not for their disability.

The optimality condition is robust to a number of extensions: private insurance arrangements (such as spousal supply of labor), a leisure value of nonemployment, dynamic search and saving behavior, borrowing constraints, and heterogeneity in the consumption fall.⁵³ Eq. (3) does not hold under heterogeneity in risk aversion as Andrews and Miller (2013) emphasize. They note that optimal benefits will be lower if risk aversion and the consumption fall are negatively correlated and higher if the reverse is true. Andrews and Miller also generalize the model to allow a benefit that is proportional to a person's wage. Chetty (2006) does generalize the Baily result to incorporate in the first order condition higher order derivatives of the utility function and the length of time spent in the bad state. See Meyer and Mok (2013b) for a discussion of these issues in an earlier version of the paper.

8. Discussion and conclusions

This paper studies the prevalence of working-age disability, changes in household material well-being surrounding disability onset, and the optimality of current benefits for the disabled. We use longitudinal data for the period 1968–2015 from a sample of male household heads to determine the prevalence of disability and examine how it affects a comprehensive range of outcomes, including earnings, income, and consumption. This paper has several key findings. First, disability rates are high. We estimate that by age 50, about 9% of male household heads have begun an enduring and severe disability. By age 56, that share rises to 15%. An even larger proportion of men have experienced some type of disability.

Second, disability is associated with poor economic outcomes. Ten years after disability onset, those with a chronic and severe disability condition have on average experienced a 77% decline in earnings, a 28% decline in after-tax after-transfer income, a 25% decline in food and housing consumption and a 16% decline in consumption of food alone. In addition, about two-thirds of these most disabled individuals do not return to work in the long run. Third, there are sharp outcome differences across disability groups; the outcome declines for those with chronic and severe disabilities are often more than twice those for the average disabled.

Our findings indicate the partial but incomplete roles that individual savings, family support, and government and private insurance play in reducing the consumption drop that follows disability. Despite the various government programs available, the incomes of about one-sixth of families with a chronically and severely disabled head drop below the poverty line in the long term – even after accounting for in-kind transfers and the under-reporting of benefits. We also find a noticeable fall in earnings and income prior to the onset of a reported disability. Consumption also falls somewhat prior to reported onset, indicating that future disability is partially but incompletely predictable in the short run.

Fourth, evidence from time-use surveys does not suggest that disabled men do more shopping, which might enable them to enjoy lower prices through greater search effort. We also find that instead of working more on home and food production, disabled men spend more time watching television, relaxing, sleeping and using medical services. Together these findings indicate a real decline in material

⁴⁸ Autor et al. (2017b) reports that while the average processing time for an approved DI applicant was about 14.5 months, those DI recipients who were initially denied but pursued an appeal or reapplication had experienced an average processing time of almost 28 months.

⁴⁹ See Chandra and Samwick (2005) who also take γ to be 3, or Cohen and Einav (2007) who suggest that a widely used estimate is “a low single-digit coefficient”.

⁵⁰ To see this, the elasticity of disability benefits receipt with respect to earnings $\varepsilon_{D,E}$ is $\frac{dD}{dE} \frac{E}{D}$, where D is disability benefit receipt. By the assumption that DI enrollment is a function based on $b-E$, then $\frac{dD}{dE} = -\frac{dD}{db}$ and hence $\varepsilon_{D,E} = -\varepsilon_{D,b} \times \frac{b}{E}$.

⁵¹ Their SSI receipt elasticity is lower at 0.16.

⁵² We use the 25th percentile given the low skill of most DI recipients. Table 1 of Autor and Duggan reports DI replacement rates of men of various age groups and earnings percentiles. In 1999, the number ranges from 0.22 (age 50–54, 90th percentile) to 1.04 (age 55–61, 10th percentile). The typical social security replacement for a DI beneficiary is less than 0.6 in 2000 (U.S. Social Security Administration, 2006).

⁵³ Interested readers can refer to pp.1895–96 in Chetty (2006).

well-being after the onset of disability, especially for those who are more disabled. To further substantiate our claim that consumption declines following disability, we examine food surveys and find that the diet of disabled men is worse than that of the non-disabled.

Fifth, we employ the Baily–Chetty optimal benefit formula, which balances the consumption fall we find against the large labor supply disincentives found in past research. We find that for a substantial range of plausible parameter values current compensation for the most disabled appears to be lower than this standard model suggests is optimal. This optimal benefit calculation accounts for the moral hazard effects of disability, but assumes that the marginal utility of consumption at the household level is not state dependent.

There are several important limitations to our research. We have not examined the prevalence and circumstances of disabled women since the lack of information on disability for women in the early years of the PSID prevents a parallel treatment. Recent evidence from other sources suggests that disability is rising for women (Baldwin and Chu, 2006). We should also emphasize that we only focus on disability during the working years, not earlier or later ages. We hope that future work will address these limitations.

Appendix A. Appendices to disability, earnings, income and consumption

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