Spousal Labor Supply, Caregiving, and the Value of Disability Insurance

Siha Lee*

McMaster University

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Abstract

For married couples, spousal labor supply can act as a household insurance mechanism against one spouse's earnings shock. This paper examines married women's time allocation to market hours and spousal care in the event of their husbands' disability and its implications for evaluating the insurance value of the Social Security Disability Insurance (SSDI) program. Using an event study approach, I find that while there is a sizable increase in wives' working hours after their husbands' job displacement, wives' labor supply responses to their husbands' disability are small, and instead, a considerable amount of time is spent in spousal care. I develop and estimate a dynamic model of married households and find that incorporating time loss due to spousal care increases the insurance value of SSDI relative to its costs. Furthermore, policy reforms such as supplementary caregiving benefits can improve social welfare.

Keywords: disability, social security, added worker effect, caregiving

JEL codes: D13, D15, H53, H55, I38, J22

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*Department of Economics, McMaster University, Hamilton, Ontario, L8S 4M4, Canada. lees223@mcmaster.ca. This paper was previously circulated under the title "Household Responses to Disability Shocks: Spousal Labor Supply, Caregiving, and Disability Insurance." I am deeply indebted to my Ph.D. advisors John Kennan, Ananth Seshadri, and Christopher Taber for their invaluable support and guidance. I also thank numerous seminar participants for helpful comments. I gratefully acknowledge financial support from the Alfred P. Sloan Foundation Pre-doctoral Fellowship on the Economics of an Aging Workforce, awarded through the NBER, and from the Wisconsin Alumni Research Foundation. This paper has benefited from the excellent computing resources at the UW-Madison Center For High Throughput Computing (CHTC) and Compute Canada. All remaining errors are my own. The latest version of the paper can be found [here].

1 Introduction

An important aspect of household labor supply is that idiosyncratic wage shocks of one spouse can be mitigated by an increase in the labor supply of the other spouse. Indeed, previous studies have shown that spousal labor supply acts as an important household insurance mechanism, mainly in the context of husbands' permanent wage shocks or job displacement shocks.[1] However, as I show in this paper, wives' labor supply responses in the event of their husbands' disability are close to zero despite disability shocks being persistent negative shocks to husbands' earnings.

A crucial difference between a job displacement and a disability shock that has not received much attention in previous studies is that disability shocks can reduce the amount of time that spouses can allocate to market work due to time spent in caring for the disabled spouse. This paper studies married women's time allocation to market hours and spousal care when their husbands become disabled and evaluates its implications for measuring the welfare benefits of social disability insurance programs. I focus on the Social Security Disability Insurance (SSDI) program as SSDI is one of the largest social insurance programs in the U.S. with 9 million working-age beneficiaries in 2016. Despite the rapid growth in program size over the past two decades, little is known about the consumption-smoothing benefits of SSDI relative to its costs. Furthermore, most studies have analyzed social disability insurance programs by modelling households as individual workers although married couples consist the majority of the labor force. This paper fills these gaps by quantifying the welfare benefits of SSDI for married households when taking into account that some of the household insurance that spousal labor supply provides is reduced due to time spent in caregiving.

Using data from the Health and Retirement Study (HRS), I perform a set of event study analyses and show that although husbands' job displacement and disability both lead to a persistent drop in husbands' working hours, wives' responses differ considerably. I find that on average, wives' weekly working hours increase by 3 hours (a 12% increase) following their husbands' displacement whereas wives' labor supply responses are close to zero when their husbands become disabled. The most novel finding from the event study analyses is that

[1]Earlier studies on the added worker effect (i.e., the extent to which one spouse's labor supply increases in response to a negative earnings shock of the other spouse) have focused on female labor supply responses to husbands' unemployment shocks and found added worker effects to be small (Mincer, 1962; Heckman and MaCurdy, 1980; Layard et al., 1980; Lundberg, 1985; Maloney, 1987, 1991; Spletzer, 1997; Cullen and Gruber, 2000). In contrast, more recent works have attempted to distinguish between transitory and permanent wage shocks and found that female labor supply plays an important role in insuring against husbands' permanent wage shocks (Hyslop, 2001; Stephens, 2002; Juhn and Potter, 2007; Merkurieva, 2014; Haan and Prowse, 2015; Blundell et al., 2016; Garcia-Perez and Rendon, 2020).

wives increase their time spent in caring for their husbands by 2 to 3 hours per week and that this magnitude is similar to the increase in wives' labor supply responses to their husbands' job displacement.

To measure the welfare benefits of current and counterfactual SSDI policies relative to its costs, I develop and estimate a dynamic model of married households where households are single decision-making units (i.e., unitary household model) and husbands face both job displacement and disability shocks. The model accounts for three crucial mechanisms that affect spousal labor supply responses in the event of a husband's earnings shock: 1) wives' time allocation to caregiving, 2) the interaction with social welfare programs including SSDI, unemployment insurance, and means-tested government transfers, and 3) health state dependent utility where health status enters the utility function in a non-separable way.[2]

The model parameters are estimated by indirect inference. I show that the data patterns from the event study analyses can be used to infer the key preference parameters of the model. By using the results from the event study analyses as data moments, this method allows greater transparency in how the model parameters are identified and provides a tighter connection between the event study analyses and the estimated dynamic model.

Using my estimated model, I perform three counterfactual exercises. First, I show that the extent to which spousal care attenuates wives' labor supply responses varies by husbands' disability severity. In the absence of time lost to spousal care, I find that wives' labor supply responses are still close to zero when husbands become moderately disabled. However, wives of severely disabled husbands would have increased their weekly working hours by 1.8 hours (a 7% increase) and employment rate by 2.6 percentage points.

Second, I find that accounting for time spent in spousal care increases the ex-ante insurance value of SSDI for married households. Using compensating variation measures, I find that married households value each dollar of SSDI benefits as $0.79 when I assume that wives only spend time in leisure and market work. However, the ex-ante insurance value of SSDI increases to $0.83 per each dollar of benefits once wives' time spent in spousal care is

[2] Regarding the third mechanism, the model allows the marginal utility of consumption in the disabled state to differ from that in the healthy state. For example, if consumption goods (such as vacations or recreational activities) are complements to good health, the marginal utility of consumption would be lower in the disabled states. On the other hand, the marginal utility of consumption would be higher in the disabled states if consumption goods (such as household services) are substitutes for good health. While it has been long recognized that health state dependence in the utility function has important economic implications (e.g., the optimal structure of insurance depends on making transfers from the "good" state to the "bad" state such that the marginal utilities of consumption in the two states are equated), there is little empirical consensus on its direction and magnitude. See Finkelstein et al. (2009) for a survey of this literature.

accounted for. In terms of magnitude, this is equivalent to the difference in the insurance value between the current SSDI program and a reformed SSDI program where benefits are 8.3% higher than current levels. This implies that once we take into account that spousal care significantly reduces the insurance role of wives' labor supply, SSDI benefit levels for married households need to be higher compared to when we assume that spouses allocate their time to market work and leisure only.

Finally, I find that it is possible to improve utilitarian social welfare given the same government budget by reducing SSDI benefits but providing a flat amount of supplementary caregiving benefits to eligible SSDI beneficiaries whose spouses provide full-time care. This finding suggests that adjusting benefit generosity based on the degree of required care is one possible modification of the current SSDI system to provide households with the welfare benefits of SSDI while managing the growth of SSDI rolls.

This paper contributes to the large literature on social disability insurance programs (DI) by being the first to explicitly model both the labor supply and caregiving decisions of spouses to quantify the welfare benefits of current and counterfactual SSDI policies. Although this literature has largely evolved around exploring the disincentive effect of the receipt of disability benefits (Parsons, 1980; Bound, 1989; Gruber, 2000; Chen and van der Klaauw, 2008; von Wachter et al., 2011; Maestas et al., 2013; French and Song, 2014), more recent works have focused on the economic consequences of disability and welfare implications of existing or counterfactual disability insurance policies (Bound et al., 2004; Chandra and Samwick, 2005; Bound et al., 2010; Gallipoli and Turner, 2011; Jacobs, 2015; Kostøl and Mogstad, 2015; Low and Pistaferri, 2015; Meyer and Mok, 2019; Autor et al., 2019). Most of these works model households as individual workers and do not explicitly model spouses.[3] This paper extends the models proposed by earlier works. By explicitly accounting for the trade-off between time spent in market work and caregiving, this paper is able to analyze the welfare effects of novel policy reforms such as the introduction of supplementary caregiving benefits.

[3]Studies by Gallipoli and Turner (2011) and Autor et al. (2019) are exceptions. Using Canadian data, Gallipoli and Turner (2011) focus on the role of endogenous marriage and human capital accumulation in explaining the small spousal labor supply responses to husbands' disability. Autor et al. (2019) study the Norwegian DI program and find that households' valuation of DI receipt at appeal is considerably greater for singles than for married couples as spousal labor supply responses offset the loss in household income due to DI denial at appeal. An important caveat of their results is that their analysis is based on DI appellants (i.e., applicants who appeal their initial DI denial) who are more likely to be marginally disabled and thus less likely to require spousal care. My paper focuses on a different mechanism (wives' trade-off between caregiving and market work) and evaluates the full ex-ante insurance value of SSDI prior to the disabilty onset.

Also, this paper is the first to empirically quantify the extent in which caregiving activities attenuate spousal labor supply responses using data on wives' time spent in providing care. My finding that husbands' disability shock has a negligible effect on wives' labor supply is consistent with most studies that examine the effect of health shocks on spousal labor supply responses (Berger and Fleisher, 1984; Haurin, 1989; Coile, 2004; Gallipoli and Turner, 2011; Fadlon and Nielsen, 2017).[4] I add to this literature by utilizing the rich information on caregiving hours in the HRS to measure how much the insurance role of wives' labor supply is reduced due to caregiving for their disabled husbands.

The rest of the paper is organized as follows. Section 2 provides empirical evidence on wives' labor supply and caregiving responses to their husbands' disability shock using an event study framework. Section 3 describes a dynamic model of married households and Section 4 discusses the estimation method of the model parameters. Section 5 reports the parameter estimates of the model and presents the key findings from the welfare analyses using the estimated model. Section 6 concludes.

2 Empirical Evidence

This section provides empirical evidence on how wives' labor market and caregiving hours respond to their husbands' disability and job displacement shocks. All analyses are restricted to the event of husbands' wage shocks since husbands are the "main earners" for most married households in my data sample.[5]

2.1 Background

Before presenting the empirical patterns regarding wives' time allocation to market work and caregiving, I discuss the dataset that is used throughout this paper and how individuals in my sample are categorized as "disabled." I also provide a brief overview of the institutional settings of SSDI and report summary statistics.

[4]Some papers find different results. Parsons (1977) and Charles (1999) find that wives increase their labor supply in response to their husbands' bad health. Jeon and Pohl (2017) finds that individuals decrease their labor supply when their spouses are diagnosed with cancer.

[5]Based on the dataset described in Section 2.1.1, I use various definitions of "main earner" (e.g., the share of total earnings during the marriage, number of years in which one spouse earned more than the other spouse, the share of earnings at a given point in time) and find that 80 ~ 85% of married households can be classified as husbands being the main earner. Also, these measures of "main earner" are highly correlated and therefore robust to how they are defined.

2.1.1 Data

Data from the Health and Retirement Study (HRS) is used for all analyses. The HRS is a biennial panel of a representative sample of Americans ages 50 and over and their spouses. I merge three HRS data products to create a unique panel dataset that contains rich information on respondents' disability status, labor market outcomes, non-market time use, and interactions with disability insurance programs.

First, the Core survey includes data on respondents' health, assets, marital status, labor market outcomes, disability benefits, and caregivers. Twelve survey waves from 1992 to 2014 are used. The caregiver data is especially useful since it reports whether the respondent receives help from someone else to perform a set of (Instrumental) Activities of Daily Living (ADLs/IADLs), the caregiver's relationship to the respondent (e.g., spouse, daughter, son, other relative, non-relative), the number of hours that they provide help, whether they are paid, and if so, the amount that they are paid. Six ADLs (walking across a room, dressing, bathing or showering, eating, getting in and out of bed, and using the toilet) and five IADLs (preparing hot meals, shopping for groceries, making phone calls, taking medications, and managing money) are included. Due to inconsistencies in earlier survey waves, I use information from 2000 to 2014 (8 waves) to identify wives who provide care for their husbands.

Next, the Consumption and Activities Mail Survey (CAMS) is an off-year supplement on time use surveyed for a subsample of the HRS Core respondents. This survey provides information on non-market time use (including time spent in spousal care) conditional on the severity of spouses' disability, which is generally not available in other datasets. Eight survey waves from 2001 to 2015 are used.[6] In the CAMS survey, spousal care is measured as time spent in treating or managing a spouse's medical condition, whereas in the Core survey, it is measured as helping a spouse perform a set of ADL/IADLs. I utilize both measures in my analyses.

Finally, I merge restricted Social Security data which provides information on respondents' Social Security earnings history and disability benefit claims. Social Security earnings are reported annually and date back to 1954. The disability benefits claims data (Form 831 Disability Records) include detailed information on SSDI applications filed by HRS respondents and their outcomes.

[6]Time spent in caregiving is available from 2007 and onwards as this was not asked in earlier waves.

2.1.2 Definition of "Disability"

Throughout this paper, a respondent is classified as "disabled" if the individual answered 'yes' to the HRS question of "having a health condition that limits the type or amount of work one can do." This is the main disability question available in most public datasets and commonly used in most of the previous works on disability.

HRS has an advantage over other datasets as it allows researchers to determine the severity of the respondent's disability based on a wealth of health information instead of relying on subjective measures of severity (e.g., health condition limits work "somewhat" or "a lot"). As a benchmark, I use a measure of severity proposed by the U.S. Census Bureau where I define individuals as "severely disabled" if they are disabled and satisfy one or more of the following seven criteria (Brault, 2012).

1. Deaf, blind, or unable to see, hear, or have speech understood
2. Unable to perform the following functional activities: walking, using stairs, lifting/carrying, grasping small objects
3. Need to use a wheelchair, cane, crutches, or walker
4. Need assistance of another person to perform the following ADL/IADLs: getting around inside the home, getting in or out of bed or a chair, bathing, dressing, eating, or toileting (ADLs), going outside the home, managing money and bills, preparing meals, doing light housework, taking prescription medicines, using the telephone (IADLs)
5. Has Alzheimer's disease, dementia, or senility
6. Has an intellectual or developmental disability (e.g., autism, cerebral palsy)
7. Had one or more selected symptoms that interfered with everyday activities: was frequently depressed or anxious, had trouble getting along with others, had trouble concentrating, had trouble coping with stress

Those who report being disabled but do not fall into any of the seven criteria listed above are classified as "moderately disabled." Respondents who do not report being disabled are considered as being "healthy."

2.1.3 Background on SSDI

SSDI is designed to replace a worker's income in the event of a work-preventing illness or disability. In 2014, 11 million beneficiaries (9 million working-age beneficiaries and 2 million dependents) received a total of 120 billion dollars in benefit payments. Under SSDI, "disability" is defined as the "inability to engage in substantial gainful activity (SGA) by reason of a medically determinable physical or mental impairment expected to result in death or last at least 12 months." The program is administered by the Social Security Administration (SSA) and individuals must file an application to a local SSA field office.

In practice, the disability determination process consists of multiple stages and applicants can be allowed benefits based on either medical or vocational considerations. If an applicant meets the SSA's listing of qualifying medical conditions (or provides evidence that the applicant's medical condition is "equal" to the that in the SSA's medical listing), then they are accepted into the program under medical allowance. Applicants who are not accepted at this stage are then considered whether their residual functional capacity allows them to work in either their past jobs or any type of work in the national economy based on vocational guidelines (e.g., age, work experience, education). Vocational allowances have grown rapidly over the years such that since the early 2000s, about half of SSDI allowances have been based on vocational considerations (Morton, 2015).

Finally, SSDI beneficiaries receive a monthly benefit in which the amount is based on beneficiaries' past average monthly earnings. The benefit amount does not depend on the severity of the disability since SSDI is designed to be eligible for workers whose impairments are severe enough (i.e., falls under the SSA's definition of "disability").[7] The formula for SSDI benefits is almost identical to that for Social Security Retirement benefits where replacement rates are lower for beneficiaries with higher past earnings.[8] In 2014, the average monthly SSDI payment was $1,145.61 for disabled workers. SSDI benefits automatically convert to Retirement benefits when beneficiaries reach full retirement age.

2.1.4 Summary Statistics

Table 1 provides summary statistics of married men in the HRS by their health status. First, about 20% of husbands are disabled with nearly 10% of husbands classified as being severely disabled. While employment rates drop significantly with the severity of the disability, about 18% of severely disabled husbands still report being employed. Also, disabled husbands are more likely to be less educated and have less wealth. A sizable fraction of disabled husbands receives SSDI benefits, roughly 21% and 46% for the moderately and severely disabled,

[7]This does not imply that SSA can perfectly screen out non-meritorious claims. Since disability status is private information, sizable errors may arise in the screening process. For example, Nagi (1969) finds that 19% of initial allowances were undeserving and 48% of denied applicants were truly disabled. Using the HRS data, Benitez-Silva et al. (2004) conclude that over 40% of recipients of SSDI are not truly work-limited.

[8]Unlike Social Security retirement benefits, however, SSDI benefits are not adjusted for receiving benefits earlier than the full retirement age. Furthermore, up to five years of workers' lowest earnings are excluded when computing past average earnings.

respectively.

The second panel of Table 1 reports heterogeneity in the primary health condition that is associated with the reported disability. For both moderate and severely disabled husbands, musculoskeletal conditions (e.g., arthritis, back/neck/spine problems) and heart, circulatory, and blood conditions (e.g., heart attack, stroke, high blood pressure) are the top two health conditions that are primarily associated with their disabilities. However, moderately disabled husbands are more likely to have musculoskeletal conditions than severely disabled husbands.

The third panel of Table 1 reveals that the Census severity definition aligns well with

Table 1: Summary Statistics of Married Men by Disability Severity

	Healthy	Moderate	Severe
Age (mean)	57.7	58.7	58.3
Years of education (mean)	13.7	12.7	12.0
Employed (in %)	85.64	43.75	18.40
Receives SSDI (in %)	0.28	20.75	45.98
Household wealth (median, in $1,000)	287.66	181.05	91.70
Associated primary health condition (top 3, in %)†			
1) Musculoskeletal system	-	58.26	43.43
2) Heart, circulatory and blood conditions	-	18.52	15.98
3) Neurological and sensory conditions	-	1.30	14.87
4) Respiratory system conditions	-	6.68	4.48
Number of ADLs difficult to perform (mean)§	0.03	0.19	1.19
Number of IADLs difficult to perform (mean)§	0.03	0.04	1.00
Stayed overnight in hospital (last 2 years, in %)	13.03	31.18	43.28
Number of hospital nights (last 2 years, mean)‡	4.82	8.07	14.83
Made any doctor visit (last 2 years, in %)	88.73	95.03	96.53
Number of doctor visits (last 2 years, mean)*	6.20	12.89	21.02
Person-year observations	28,908	3,320	2,860
(%)	78.62	11.48	9.89

Notes: Results are based on a sample of married men from ages 50 to 64 in the HRS (1992-2014). All summary statistics are weighted by HRS sample weights. Dollar values are in 2015 dollars.

† The three most common health condition groups for the moderately (1, 2, and 4) and severely disabled husbands (1, 2, and 3) are reported.

‡ This is conditional on having any overnight hospital stay in the last two years.

* This is conditional on making at least one doctor visit in the last two years.

§ This is out of a total of six Activities of Daily Living (ADLs; walking across a room, dressing, bathing or showering, eating, getting in and out of bed, and using the toilet) and five Instrumental Activities of Daily Living (IADLs; preparing hot meals, shopping for groceries, making phone calls, taking medications, and managing money).

potential caregiving needs. While the average moderately disabled husband does not have any ADLs or IADLs that are difficult to perform, the average severely disabled husband has difficulty in performing one ADL and one IADL. Furthermore, compared to moderately disabled husbands, those who are severely disabled are 40% more likely to stay overnight in a hospital, and once they do, they are hospitalized for a significantly longer period. While both moderately and severely disabled husbands are equally likely to make a doctor visit within a two-year period, severely disabled husbands frequent doctors far more often than moderately disabled husbands do (13 vs. 21 visits in two years). All of these facts suggest that individuals with severe disabilities are more likely to require assistance from another person to perform basic daily activities as well as treat and manage their medical conditions.

Table 2: Share of Wives Providing Care for Their Husbands
(by Husbands' Disability Severity, %)

	Help their husbands perform at least one ADL/IADL[†]		Help treat or manage their husbands' medical condition(s)[‡]	
	Moderate	Severe	Moderate	Severe
$(0, 25]$ hours per week	-	41.76	18.53	35.75
Greater than 25 hours per week	-	14.40	1.53	5.46
Person-year observations	-	1,750	364	271

Notes: Results are based on a sample of wives in the HRS whose husbands are from ages 50 to 64. All summary statistics are weighted by HRS sample weights.
[†] This information is from the HRS Core data (2000-2014, 8 waves). If a disabled husband receives help in performing one or more (Instrumental) Activities of Daily Living (ADL/IADL), then by definition, he is classified as severely disabled (due to the fourth criteria described in Section 2.1.2). Therefore, this information is not available for moderately disabled individuals.
[‡] This information is from the HRS CAMS data (2007-2015, 5 waves). Since the CAMS survey is a supplementary survey which only includes a random subsample of the HRS Core respondents, the sample size is significantly smaller.

Table 2 indicates that both the fraction of husbands receiving care from their wives and the number of hours that they receive increase with the severity of the disability. About 56% of severely disabled husbands receive their wives' help in performing ADL/IADLs with 14% of them receiving help for more than 25 hours per week. Even for moderately disabled husbands, 20% report receiving help from their wives to treat or manage their medical conditions, although the number of hours is smaller. This indicates that wives spend a sizable amount of time in caregiving once their husbands become disabled.

Finally, substantial differences between single and married men in terms of their care-

Table 3: Summary Statistics of Severely Disabled Men Receiving Care

	Single*	Married
Number of caregivers (in %):		
One	61.97	73.60
Two	24.09	16.46
Three or more	13.94	9.94
Caregivers' relationship to respondent‡ (in %)		
Wives	-	97.35
Daughters	18.54	9.95
Sons	8.64	9.62
Other relatives	44.54	11.84
Non-relatives†	51.49	5.02
Has Medicaid coverage (in %)	43.23	16.05
Receives care from Medicaid-covered caregiver(s) (in %)	17.07	1.45
Person-year observations	495	1,152

Notes: Results are based on a sample of severely disabled men from ages 50 to 64 in the HRS Core survey who report receiving help from someone else in performing one or more (Instrumental) Activities of Daily Living (ADL/IADLs) (2000-2014). All summary statistics are weighted by HRS sample weights.
∗ "Singles" include men who are either divorced, separated, widowed or never married.
† Includes caregivers from organizations or institutions, paid helpers, and professional helpers.
‡ Since respondents may have multiple caregivers, this does not necessarily add up to 100%.

givers are reported in Table 3. Here I restrict the sample to severely disabled men aged 50 to 64, conditional on receiving help from someone else to perform ADL/IADLs. The most striking difference between single and married men comes from who they receive care from. For married men, 97% receive care from their wives. Only 5% receive care from non-relative caregivers such as caregivers from organizations or institutions, paid helpers, and professional helpers. Also, while 16% of married men have Medicaid coverage, only 1% of married men utilize caregivers covered by Medicaid. In contrast, more than half of single men receive care from non-relative caregivers and 40% of men with Medicaid coverage receive care from caregivers paid by Medicaid. This implies that for married households, spouses are the primary caregivers despite the existence of alternative market options and coverage through Medicaid.

2.2 Event Study Framework and Results

In this section, I use an event study framework to report changes in wives' labor supply responses and caregiving hours following their husband's earnings shock (job displacement or disability). Job displacements are defined as job separations due to either a business closure or being laid off or let go. All other separation reasons (e.g., quits, health, family, new job, retirement) and separations from a self-employed job are not categorized as job displacements. The estimation sample is restricted to households where both spouses are under age 65.

For a married household i at time t, the estimation model is as follows:

$$y_{it} = \alpha_i + \gamma_t + X'_{it}\beta + \sum_{k=-4}^{5} \delta_k \cdot I_{itk} + \epsilon_{it} \tag{1}$$

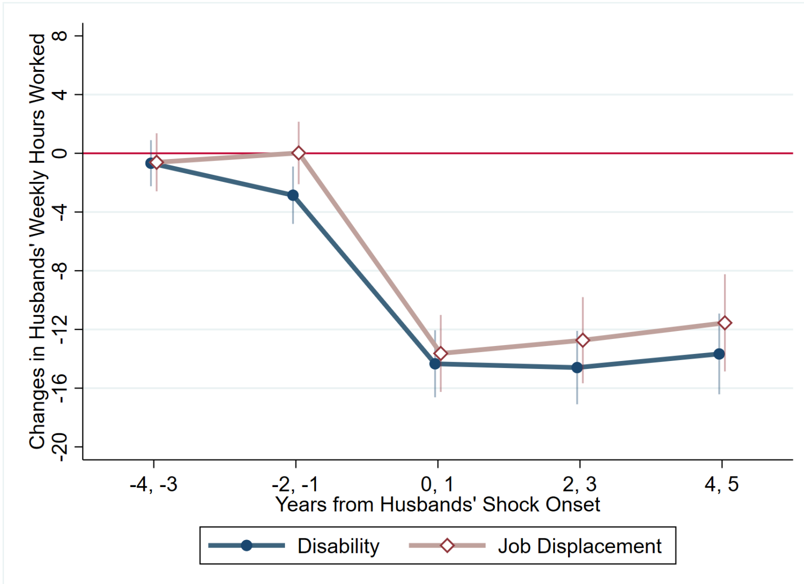
where y_{it} denotes the dependent variable of interest, γ_t are year dummies, and X_{it} is a vector of control variables which includes a quartic in both spouses' ages, census division dummies, household size, and length of the current marriage (in years). Dummy variables for each spouse indicating whether their age is 62 or above are included as well to account for the fact that the early eligibility of Social Security retirement benefits is age 62. Wives' disability severity is also included in X_{it} when the dependent variable corresponds to wives' outcomes. I_{itk} denotes an indicator for being k years since the onset of the wage shock (disability or job displacement). I control for 4 years prior and 5 years after the onset of the wage shock. Therefore, δ_k measures the change in the dependent variable at k years of onset relative to 5 or more years before the onset of the shock. This approach is similar to that of Meyer and Mok (2019), who in turn build upon the approach of Jacobson et al. (1993), Stephens (2001), and Charles (2003).

Figure 1a depicts changes in husbands' weekly working hours pre- and post-onset of the shock. For both job displacements and disability shocks, husbands significantly reduce working hours at the onset of the shock and this persists even after five years since the shock occurred. This implies that disability shocks as well as job displacements are associated with a persistent drop in husbands' earnings.

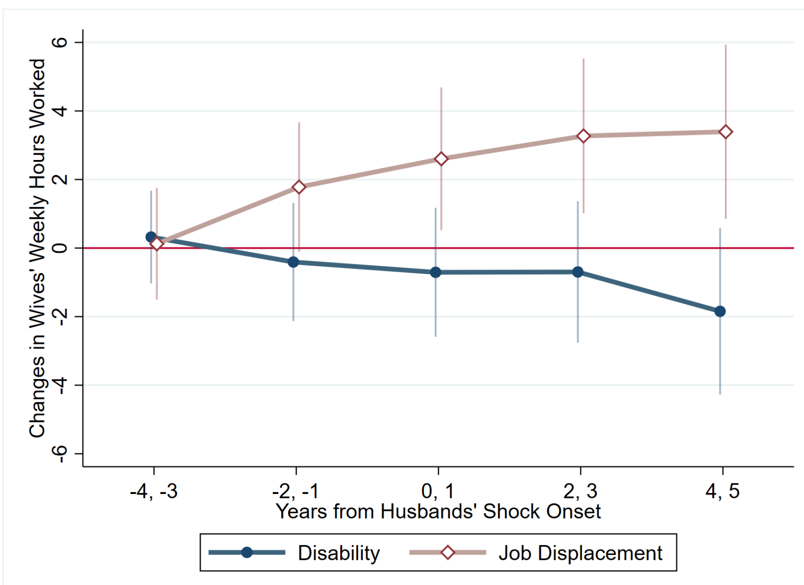
Figure 1b documents how wives adjust their working hours in response to their husbands' wage shocks. First, wives increase their weekly working hours by 3 hours on average following their husbands' displacement and these estimates are statistically significant. Since the average weekly working hours prior to their husbands' displacement is about 25 hours, this

Figure 1: Changes in Weekly Hours Worked by Onset Year

(a) Husbands



(b) Wives



Notes: Results are based on a sample of married households in the HRS (1992-2014) where both spouses are under age 65. All event study regressions control for a quartic in both spouses' ages, dummies for each spouse indicating whether their age is 62 or above, household size, length of current marriage, census division, and year and household fixed effects. Figure 1(b) additionally controls for wives' disability status. The vertical lines through each dot indicate 95% confidence intervals.

is equivalent to a 12% increase in working hours. This is consistent with the findings by Stephens (2002) who used a sample of working-age married women in the Panel Study of Income Dynamics (PSID) and found an 11% increase in annual hours of work after their husbands' job displacement.

In contrast, wives with disabled husbands do not increase their labor supply. Point estimates indicate that wives reduce working hours by 1 hour compared to 5 or more years before their husbands' disability onset and all of the estimates are statistically insignificant. These results are consistent with several previous studies that have also found a small magnitude of added worker effects in response to husbands' health shocks (Charles, 1999; Coile, 2004; Gallipoli and Turner, 2011; Fadlon and Nielsen, 2017). Given that husbands' disability shocks lead to a persistent drop in household earnings (as implied by Figure 1a), the small spousal labor supply responses to husbands' disability shocks imply that wage shocks due to disability shocks elicit household responses that are different from that in the event of job displacements.

Next, columns (1) and (2) of Table 4 report changes in wives' weekly hours spent in providing care for their husbands. As the measures of time spent in caregiving in the Core and CAMS data are different, both results are shown in columns (1) and (2), respectively. Results from both data sources are quantitatively similar where wives spend on average 2 to 3 hours more per week on spousal care. This is comparable to the magnitude of the added worker effect observed in the event of husbands' job displacement (3 hours per week as shown in Figure 1b).

Finally, column (3) of Table 4 shows the difference in spousal caregiving hours by the severity of husbands' disability. A simple OLS regression indicates that even wives of moderately disabled husbands spend a sizable amount of time in caregiving activities (about 2.2 hours per week). As expected, wives of severely disabled husbands spend more than twice the amount of time in caregiving (5.3 hours per week) than those of moderately disabled husbands.

Robustness

While Figure 1 shows that added worker effects in the event of husbands' disability are small and statistically insignificant, it is possible that this may be due to several confounding factors. First, these results may be driven by households that are receiving SSDI benefits. Also, households may have different expectations for different types of disabilities such that it is not surprising to observe small added worker effects if the disability is highly expected.

Table 4: Wive's Weekly Caregiving Hours by Husbands' Disability Onset and Severity

	(1) FE (Core)†	(2) FE (CAMS)‡	(3) OLS (CAMS)
Panel A: By Onset Year			
Year = -4, -3	-0.209	-	
	(0.461)		
Year = -2, -1	0.029	0.845	
	(0.423)	(0.645)	
Year = 0, 1	2.205***	1.930**	
	(0.829)	(0.857)	
Year = 2, 3	3.800***	1.806**	
	(1.216)	(0.868)	
Year = 4, 5	2.108***	-	
	(0.900)		
Panel B: By Severity			
Moderate			2.246**
			(1.109)
Severe			5.277***
			(1.607)
R-sq.	0.016	0.069	0.061
Observations	11,540	1,595	2,849

Notes: Results are based on a sample of married households where both spouses are under age 65. Column (1) is based on data from the HRS Core survey (2000-2014) while columns (2) and (3) are based on the HRS CAMS data (2007-2015). The event study regressions for columns (1) and (2) control for a quartic in both spouses' ages, dummies for each spouse indicating whether their age is 62 or above, household size, length of current marriage, wives' disability severity, census division, and year and household fixed effects. OLS regression for column (3) controls for a quartic in age, education, and race of both spouses, dummies for each spouse indicating whether their age is 62 or above, wives' disability severity, household size, length of current marriage, census division, and year fixed effects. Standard errors in parentheses, clustered at the household level. ***, **, * indicate statistical significance at the 1, 5, and 10 percent levels, respectively.

† Measure of caregiving: time spent in helping the husband in performing (Instrumental) Activities of Daily Living (ADL/IADLs).

‡ Measure of caregiving: time spent in treating or managing the husband's medical condition(s). Due to the CAMS data having a smaller sample size and shorter survey waves, column (2) reports changes in caregiving hours up to 3 years post-onset relative to 3 or more years before the husband's disability.

In addition, one may be concerned that the increase in wives' caregiving hours are driven by wives with weak prior labor force attachment. These concerns are addressed in Appendix A, where I show that 1) spousal labor supply responses to husbands' disability are small even when the first two concerns are accounted for and 2) the sizable increase in wives' caregiving hours are observed regardless of wives' prior labor force attachment.

3 Dynamic Model of Married Households

This section describes a structural model that is estimated and used to compute the insurance value of SSDI relative to its costs and evaluate the welfare implications of counterfactual SSDI policies. The empirical findings in Section 2 are applied to estimate the key preference parameters of the model.

The model is a dynamic model of married households where husbands face the risk of receiving earnings shocks (disability, job displacement, and/or idiosyncratic wage shocks) in each period. The dynamic nature of the model allows it to account for the intertemporal labor supply decisions of both spouses, wives' caregiving choices, household savings, and SSDI application decisions pre- and post-husbands' disability. As a result, the model can be used to compute the ex-ante insurance value of SSDI prior to the husband's disability onset. Additionally, the model incorporates SSDI, unemployment insurance, and means-tested government transfers since differences in policy parameters across various social welfare programs affect household responses to husbands' earnings shocks.

3.1 Model Setup

All households enter the model as married consisting of a husband and a wife denoted as $j \in \{h, w\}$. I assume unitary households where households are single decision-making units. I denote t as the husband's age and set the wife's age as $t - 3$ since this is the average age difference between the two spouses in the HRS data.[9] The model period starts at $t_1 = 50$ and households die with certainty at $t_T = 90$. A period is a year. Households dissolve through (exogenous) death or divorce, and I assume that there is no remarriage.[10]

[9]This is due to computational tractability as separately tracking both spouses' ages substantially increases the state space.

[10]Since the main objective of this paper is to develop and estimate a household model with time allocation to leisure and spousal care and use this model for the welfare analysis of SSDI at the household level, I focus on the unitary model and abstract from endogenous marriage and separation over the life-cycle. Although

Sources of uncertainty – The following exogenous shocks are realized at the beginning of each period t:

1. Mortality and divorce shocks: The husband dies with probability $\delta^h_{m,t-1}(s_{t-1}, f^h)$ which depends on his age t, health status s_{t-1}, and individual type f^h, which is fixed and exogenous in the model. f^h is determined based on the husband's average lifetime earnings and accounts for ex-ante heterogeneity that affects his probability of survival (as well as his health transition probability and wage offers as described below). I discretize f^h to two types: "high" and "low." The wife dies with probability $\delta^w_{m,t-1}$ which is a function of her age. The household dissolves through divorce with probability $\delta_d(s_{t-1})$ which also depends on the husband's health status.

Conditional on the household's survival, the following shocks are realized.

2. Disability shock: The husband's health status $s_t \in \{0, 1, 2\}$ (healthy, moderate, and severe) is realized. The health transition probability is a function of s_{t-1}, t, and his individual type, f^h. I abstract from modeling the wife's health status.

3. Displacement shocks and job arrivals: Husbands who were working in the previous period receive a job displacement shock with probability $\delta_j(s_{t-1})$ which depends on his health status. Jobs arrive at a rate of λ (there is no job search).

4. Wage shocks: The husband's wage offer depends on his age t, health status s_t, and individual type f^h. The wife's wage offer depends on her age, $t-3$. In addition, both spouses receive an idiosyncratic wage shock each period.

Preferences – The household period utility is specified as follows.

$$
\begin{aligned}
u_t(c, l^h, l^w, tc, App; s) = \theta(s) \cdot \frac{c^{1-\gamma} - 1}{1-\gamma} + \psi_h \cdot \frac{(l^h)^{1-\gamma_h} - 1}{1-\gamma_h} + \psi_w \cdot \frac{(l^w)^{1-\gamma_w} - 1}{1-\gamma_w} \\
+ \kappa_t(tc; s) - \iota(s) \cdot App
\end{aligned}
\tag{2}
$$

The household receives utility from household consumption c, leisure of each spouse l^h and l^w, and caregiving provided by the wife's time input tc. The husband's health status is denoted as $s \in \{0 \text{ (healthy)}, 1 \text{ (moderate disability)}, 2 \text{ (severe disability)}\}$.

understanding how disability shocks affect the intra-household allocation of resources and marital formation and dissolution is an interesting question, this is left for future research.

The household can incur a disutility $\iota(s)$ (e.g., "stigma" costs) when applying for SSDI benefits where $App \in \{0, 1\}$ indicates whether the household is applying for SSDI benefits in the given period. For simplicity, I assume that $\iota(2) = 0$.

$\theta(s)$ is included as a tractable way of accounting for health state dependence in consumption utility. Normalizing $\theta(0) = 1$, if $\theta(s)$ is greater than 1 in the disabled states, this implies positive health state dependence since the marginal utility of consumption is multiplied by $\theta(s)$. I do not make any a priori assumption on the direction of the health state dependence in consumption utility.

Conditional on disability status s, husbands have caregiving needs denoted as η. η differs across households and time by assuming that it evolves according the following process.

$$\eta_t(s) = \begin{cases} 0 & \text{if } s = 0 \\ \mu_\eta(s) + \epsilon_t & \text{if } s \in \{1, 2\} \end{cases} \tag{3}$$

$$\epsilon_t = \rho_\eta(s) \cdot \epsilon_{t-1} + \xi_t, \quad \xi_t \sim N(0, \sigma^2_{\xi,s}) \quad \text{if } s \in \{1, 2\} \tag{4}$$

Equations (3) and (4) indicate that disability status s requires caregiving needs of $\mu_\eta(s)$ on average but husbands face an additional idiosyncratic shock ϵ_t which follows a standard AR(1) process. I assume that healthy individuals do not have any caregiving needs by setting $\eta_t(0) = 0$. ϵ_t allows for the fact that there exists (unobservable) heterogeneity in caregiving needs even conditional on disability status s.[11] For example, variation in associated health conditions may lead to differences in caregiving needs.[12] Also, conditional on disability state s, some husbands may use equipment such as wheelchairs and walkers instead of receiving care from their wives.[13] Disability may also worsen or multiple conditions may develop over time such that severely disabled husbands who initially did not receive care and relied on equipment end up requiring help from their spouses. Equations (3) and (4) incorporate these types of heterogeneity in a tractable way since $\rho_\eta(s)$ can capture the persistence in caregiving needs stemming from the nature of the health condition and ξ_t captures any idiosyncratic changes in caregiving needs including the use of equipment or the development of multiple

[11] In the absence of the heterogeneity coming from ϵ_t, it is difficult to match the joint distribution of husbands' employment choices and wives' caregiving choices as observed in the data.

[12] Among severely disabled husbands in the HRS, 58% of those with neurological and sensory conditions (e.g., blind, deaf, multiple sclerosis) report having difficulty in any ADL/IADLs compared to 80% of those with musculoskeletal conditions and 83% of those with heart, circulatory, and blood conditions. This is suggestive of substantial heterogeneity in caregiving needs among severely disabled husbands due to differences in the associated health conditions.

[13] About 60% of severely disabled husbands in the HRS who do not receive spousal care report using equipment or devices including railings, canes, walkers, wheelchairs, or lifts to perform ADLs.

health conditions over time.

Next, l^h, l^w, and tc are chosen subject to the following time constraints,

$$l^h = \bar{L} - \big(\phi(s) + \phi_\eta(s) \cdot g(\eta, s)\big) - \big(\phi^{emp}(s) + \phi_\eta^{emp}(s) \cdot g(\eta, s)\big) \cdot \mathbf{1}(h^h > 0) - h^h \quad (5)$$

$$l^w = \bar{L} - h^w - tc \quad (6)$$

where $\bar{L}$ denotes the time endowment available for each spouse in each period and h^h and h^w denote the husband and wife's hours worked in the labor market, respectively. h^h, h^w, and tc are discretized as zero, part-time, and full-time hours.

Equation (5) indicates that husbands allocate their time to leisure and market hours but incur a time loss[14] of $\phi(s)+\phi_\eta(s)\cdot g(\eta, s)$ and a fixed time cost of working, $\phi^{emp}(s)+\phi_\eta^{emp}(s)\cdot g(\eta, s)$. Both of these time costs depend on health status and the degree of caregiving needs where $g(\cdot, s)$ is a monotonically increasing function of η. In practice, I set $g(\cdot, s)$ to take values 0, 1, and 2 when $\eta(s)$ falls under the first, second, and third tertile of the stationary distribution of $\eta(s)$. This implies that conditional on disability status s, husbands in the top tertile of the caregiving needs distribution incur an additional time cost of $\phi_\eta(s)$ and fixed cost of working $\phi_\eta^{emp}(s)$ compared to the husbands in the middle tertile. Finally, I assume that healthy husbands do not incur additional time costs such that $\phi(0) = \phi_\eta(0) = \phi^{emp}(0) = \phi_\eta^{emp}(0) = 0$. These time costs allow the model to replicate the data pattern in which even conditional on disability status, husbands who receive full-time caregiving are considerably less likely to be employed compared to those who receive part-time or no caregiving.

Wives allocate their time to leisure l_w, market work h_w, and spousal care tc. tc is chosen based on the caregiving utility that it generates, $\kappa_t(tc; s)$. Assume $\kappa_t(tc; s)$ as follows.[15]

$$\kappa_t(tc; s) = \begin{cases} 0 & \text{if } s = 0 \text{ or } tc \leq 1 \\ \eta_t(s) \cdot \log(tc) & \text{if } s \in \{1, 2\} \text{ and } tc > 1 \end{cases} \quad (7)$$

Equation (7) implies that wives will be more likely to allocate time to caregiving when their husbands have a higher degree of caregiving needs $\eta_t(s)$.[16]

[14] This can be thought of as "sick time" which burns some of the husband's leisure time (e.g. experiencing pain, being bedridden, visiting doctors)

[15] Assuming caregiving utility to be zero for $tc \leq 1$ ensures $\kappa_t(tc; s) \geq 0$ for all values of tc. Note that $tc \leq 1$ is a very small number relative to the annual time endowment set as $\bar{L} = 5,696$ hours in Section 4.1.2.

[16] In practice, caregiving can be provided by wives' time input or from household expenditures on hiring professional caregivers (or a combination of both). However, as shown in Table 3, almost all husbands (97%) who receive help in performing ADL/IADLs report that they receive care from their wives. Only 5% of husbands report hiring non-relative caregivers. Also, while 16 % of severely disabled husbands are

Individual behavior after a dissolution of a married household (either through death or divorce) is not explicitly modeled.[17] Instead, the surviving individual j receives a terminal utility $v_t^j(a_t^j, y_t)$ specified as below.

$$v_t^j(a_t^j, y_t) \quad = \quad \psi_v \, \frac{\Big(W_t^j(a_t^j, y_t)\Big)^{1-\gamma}}{1-\gamma}, \quad j \in \{h, w\} \tag{8}$$

$W_t^j(a_t^j, y_t)$ denotes the present discounted value of individual wealth (a_t^j) and future retirement benefits based on the husband's average lifetime earnings at age t, y_t. a_t^j differs between widow/ers and divorcees since widow/ers are assumed to receive all of the household's assets ($a_t^j = A_t$) while divorcees split the household's assets equally ($a_t^h = a_t^w = \frac{1}{2}A_t$). Retirement benefits for single males are computed based on his own average lifetime earnings y_t. For single females, retirement benefits are computed based on the Social Security spousal benefit formula where widows receive 100% of her deceased husband's Primary Insured Amount (PIA) while divorcees receive 50%.[18]

Disability Insurance – Key features of the Social Security Disability Insurance (SSDI) are modeled in order to incorporate the complexities of the program. First, households are required to choose whether to apply for SSDI ($App_t \in \{0, 1\}$). Application is costly since the household incurs a disutility $\iota(s)$ and it requires the husband to be non-employed ($h_t^h = 0$) as well as not being able to receive wage offers during the application period.[19] Conditional on

eligible for Medicaid, only 1% of husbands receive care from Medicaid-paid caregivers. Guided by these data patterns, I assume that caregiving utility is solely produced by the wife's time inputs.

[17] This is because the primary goal of this project is to understand the behavior of married couples who have an additional source of insurance provided by their spouses.

[18] In practice, wives can receive retirement benefits based on their own earnings records (primary benefit) as well as spousal benefits based on their (former) husbands' earnings (secondary benefit). This occurs when entitled spousal benefits are greater than primary benefits since secondary benefits are deducted \$1 to \$1 by primary benefits. For example, a widow may be entitled to \$700 in primary benefits but \$1,000 in spousal benefits based on her deceased husband's earnings. Then she can receive a total of \$1,000 (\$700 as primary benefits and \$300 as secondary benefits) as retirement benefits. Since husbands are the main earners in most married households (roughly 85% in the HRS), wives' entitled spousal benefits are generally greater than their primary benefits. This is one reason why auxiliary beneficiaries (i.e., beneficiaries receiving benefits based on someone else's earning history) are mostly females in the HRS (along with the fact that on average, wives live longer than their husbands). Modeling the wife's retirement benefits to be equivalent to entitled spousal benefits based on her husband's earnings history is a way to keep the model tractable while capturing the main features of the data that the Social Security benefit system generates.

[19] This mimics the first step of SSA's disability determination process where applicants who are working and earning more than the substantial gainful activity (SGA) limit (\$1,070 per month in 2014) are automatically denied of benefits. Average application processing time is roughly 4∼6 months for initial determinations but becomes significantly longer for appeals.

applying, SSDI is awarded with some probability $Pr(DI_{t+1} = 1|s_t, t, App_t)$ which depends on the applicant's current health status and age. This reflects the fact that although the SSA determines whether an applicant is eligible for disability benefits based on medical and vocational considerations, it cannot perfectly observe the true disability status of the applicant. I assume that the probability of receiving SSDI benefits if the applicant is healthy is zero ($Pr(DI_{t+1} = 1|s_t = 0, t, App_t = 1) = 0$) such that husbands never apply for benefits in the healthy state.[20]

Successful applicants who applied in period t start receiving benefits from period $t + 1$. Husbands are not allowed to work while receiving disability benefits.[21] Benefit amount is calculated in the same manner as computing Social Security Retirement benefits which is a monotonic function of average lifetime earnings at age t, y_t.[22] Finally, receiving SSDI is an absorbing state (i.e., husbands continue receiving SSDI benefits each period and do not return to work). This is a standard assumption in the literature, partly motivated by the fact that only a small fraction of SSDI awards are terminated due to recipients returning to work.[23]

Offered Wages, Labor Market Frictions, and Unemployment Insurance – Husbands who are employed face the risk of being displaced with probability $\delta(s_t)$. Non-employed husbands who are neither applying nor receiving SSDI benefits receive wage offers with probability λ. Displaced husbands receive a one-period unemployment insurance (UI) benefit which is set as 23% of previous period's earnings.[24] I assume that wives always receive wage offers each

[20]In my sample from the HRS data, less than 0.5% of healthy husbands report ever applying for SSDI. Also, conditional on being a healthy applicant, the probability of being awarded benefits is similar to that observed for moderately disabled applicants. This is suggestive of "healthy" husbands being only marginally healthy and being more closer to moderately disabled husbands in other dimensions that are unobservable to the researcher. Given the very small fraction of healthy applicants in the data and the fact that the model cannot account for unobservable dimensions that distinguish marginally healthy individuals from moderately disabled individuals, I assume that the probability of a healthy applicant receiving SSDI benefits in the next period is zero.

[21]This reflects the SSDI program rule that earnings above the SGA threshold will lead to the termination of disability benefits.

[22]See Appendix B for details of how benefits are computed. In reality, SSDI benefit calculation differs slightly from that of Retirement benefits as it allows up to five years with the lowest earnings (including zero earnings) to be excluded from the calculation of benefits. I abstract from incorporating this element since a) it requires tracking the five lowest earnings and thus greatly increases the state space and b) the Retirement benefit formula provides a reasonable approximation of SSDI benefit amount.

[23]In 2012, only 5% of SSDI terminations were due to beneficiaries working above the SGA earnings threshold. In contrast, 55% of terminations were due to SSDI benefits rolling over to Retirement benefits once beneficiaries reached full retirement age and 35% due to the death of the recipient (Morton, 2014).

[24]Average UI replacement rates (measured as weekly UI benefits divided by the worker's weekly earnings)

period.

Each household i receives wage offers such that they evolve according to the following process.

$$\begin{aligned}\log w_{it}^h &= \alpha_0 + \alpha_1 \cdot t + \alpha_2 \cdot t^2 + \alpha_3 \cdot \mathbf{1}(f_i^h = \text{high}) + \sum_{s=1}^{2} \varphi_s \cdot \mathbf{1}(s_{it} = s) + \zeta_{it}^h & (9)\\ \log w_{it}^w &= \tilde{\alpha}_0 + \tilde{\alpha}_1 \cdot (t-3) + \tilde{\alpha_2} \cdot (t-3)^2 + \zeta_{it}^w & (10)\\ \zeta_{it}^j &= \zeta_{i,t-1}^j + \nu_{it}^j, \quad \nu_{it}^j \sim N(0, \sigma_{\nu,j}^2),\ Cov(\nu_{it}^h, \nu_{it}^w) = \sigma_{\nu_{h,w}}, \quad j \in \{h, w\} & (11)\end{aligned}$$

For the husband, offered log wages depend on his age t, individual type f^h, and health status s_t. The wife's offered log wages depend only on her age since the model abstracts from tracking the wife's health status. Finally, each spouse receives a permanent wage shock which follows a random-walk process specified as equation (11). I assume that the idiosyncratic wage shock ν_t^j is i.i.d. and correlated between the two spouses with covariance $\sigma_{\nu_{h,w}}$.

Retirement Period – The household retires (i.e., both spouses do not work) when the husband reaches age 65 (and age 62 for the wife). Therefore, household consumption and savings are the only choices during this period. The household receives Social Security Retirement benefits which is the sum of the husband's benefit and the wife's spousal benefits.[25] As per the SSDI program rules, SSDI benefits are automatically converted to retirement benefits once the husband enters the retirement period.

Budget Constraint – The household faces the following budget constraint each period.

$$\begin{aligned}A_{t+1} = (1+r)A_t + \sum_{j \in \{h,w\}} w_t^j h_t^j + UI_t + b_t(y, DI_t) - \tau(A_t, w_t^h h_t^h, w_t^w h_t^w)\\ - m(t, s_t, f^h) + T_t - c_t\end{aligned} \quad (12)$$

UI_t denotes a one-period UI benefit when husbands are displaced. b_t denotes Social Security benefits as a function of the husband's average lifetime earnings y_t and whether the household is receiving disability benefits ($DI_t = 1$) or retirement benefits ($t \geq 65$). $\tau(A_t, w_t^h h_t^h, w_t^w h_t^w)$

were about 0.46 during the period of year 2011 to 2017. Since UI benefits are provided for (a maximum of) 26 weeks and my model period is a year (52 weeks), I set the UI replacement as 0.23.

[25]See footnote 18 regarding the use of husbands' average lifetime earnings to compute wives' retirement benefits. See Appendix B for details on how benefits are computed.

denotes payroll and federal income taxes.[26] $m(t, s_t, f^h)$ denotes exogenous out-of-pocket medical expenses which depends on the husband's age, health status, and productivity type.

For low-income households, government transfers T_t provides a minimum consumption level $\underline{c}$ which satisfies the following equation.

$$T_t = \max \Big\{ 0,\ \underline{c} - \big((1+r)A_t + \sum_{j \in \{h,w\}} w_t^j h_t^j + UI_t + b_t(y_t, DI_t) - \tau(A_t, w_t^h h_t^h, w_t^w h_t^w) - m(t, s_t, f^h) \big) \Big\} \tag{13}$$

$\underline{c}$ is a tractable of way of incorporating the minimum standard of living guaranteed by means-tested programs such as the Supplemental Security Income (SSI), the Supplemental Nutrition Assistance Program (SNAP), Medicaid, and Section 8 housing assistance vouchers. This is an aggregate approximation of all available means-tested programs following the influential work of Hubbard et al. (1995).[27]

Finally, households are not allowed to borrow such that $A_t \geq 0$ holds for each period. This is partly due to the fact that it is illegal to borrow against future SSDI/retirement benefits and means-tested program benefits.

Model Solution – Define the vector of state variables at period t as $\boldsymbol{X}_t = \big\{ A_t, s_t, y_t, \vartheta_t, DI_t, f^h, \zeta_t^h, \zeta_t^w, \epsilon_t \big\}$ which consists of household assets (A_t), the husband's health status s_t, the husband's average lifetime earnings at age t (y_t), whether the husband is displaced ($\vartheta_t \in \{0,1\}$), whether the husband is receiving SSDI benefits ($DI_t \in \{0,1\}$), the husband's individual type ($f^h \in \{\text{high, low}\}$), idiosyncratic wage shocks of both spouses (ζ_t^h, ζ_t^w), and the idiosyncratic shock to caregiving needs (ϵ_t). For each period t, households solve the following problem

[26] State income taxes are not modeled due to wide variation in state tax codes. See Appendix C for details on how taxes are computed.

[27] Although the disability determination process is the same for both SSDI and SSI, SSI requires married applicants to hold less than \$3,000 in assets to be eligible for benefits. However, many forms of assets are excluded from this \$3,000 limit including an individual's home and adjacent land, and one car (Morton, 2014). This makes it difficult to precisely model SSI since it requires modeling different types of assets and imposing assumptions regarding how these different types of assets are consumed. Also, SSI benefits are a flat monthly amount which is deducted by both unearned (including SSDI benefits which are deducted \$1 to \$1) and earned income (including own and spouse's earnings). Given that the purpose of SSI is to provide households a minimum standard of living and thus benefits are deducted accordingly if the household has additional resources through unearned/earned income, equation (13) incorporates the nature of SSI while maintaining tractability.

subject to time and budget constraints (5), (6), and (13).

$$
\begin{aligned}
V_t(\boldsymbol{X}_t) = \max_{\substack{c_t, h_t^h, h_t^w, \\ tc_t, App_t}} & \; u(c_t, l_t^h, l_t^w, tc_t, App_t; s_t) \\
& + \beta \Big\{ \big(1 - \delta_{m,t}^h(s_t)\big)\big(1 - \delta_{m,t}^w\big)\big(1 - \delta_d(s_t)\big) E_t\big[V_{t+1}(\boldsymbol{X}_{t+1} | \boldsymbol{X}_t)\big] \\
& \quad + \big(1 - \delta_{m,t}^h(s_t)\big)\big(1 - \delta_{m,t}^w\big)\; \delta_d(s_t) \Big(\sum_{j \in \{h,w\}} v_{t+1}^j\big(\tfrac{1}{2} A_{t+1}, y_{t+1}\big)\Big) \\
& \quad + \big(1 - \delta_{m,t}^h(s_t)\big) \cdot \delta_{m,t}^w \cdot v_{t+1}^h(A_{t+1}, y_{t+1}) \\
& \quad + \delta_{m,t}^h(s_t) \cdot \big(1 - \delta_{m,t}^w\big) \cdot v_{t+1}^w(A_{t+1}, y_{t+1}) \Big\}
\end{aligned} \tag{14}
$$

The model requires to be solved numerically as there is no analytical solution. This is done by solving the value functions at the terminal period t_T and iterating backwards such that I solve for the value functions and the decision rules for each period.

3.2 Discussion of the Model

This section discusses some of the key model mechanisms and their implications for evaluating the welfare benefits of SSDI. First, health state dependence in consumption utility, $\theta(s)$, has important implications for determining the insurance value of SSDI benefits. This is because ideally, transfers should be made from the healthy state (in the form of taxes) to the disabled state (in the form of disability benefits) such that the marginal utilities of consumption in both states are equal. Therefore, if $\theta(s) > 1$ in the disabled state (i.e, positive health state dependence), this increases the insurance value of SSDI given the SSDI benefit amount since the marginal value of \$1 of consumption is higher in when husbands are disabled compared to when they are healthy. The opposite logic holds if $\theta(s) < 1$ in the disabled state (i.e., negative health state dependence).

Empirically, it is well recognized in the literature that the direction and magnitude of $\theta(s)$ are ambiguous a priori. For example, expenditures on vacations would drop when one becomes disabled which implies that $\theta(s)$ is less than one for expenditures on vacations. On the other hand, it is likely that consumption for taxis and household services would increase in the disabled state such that $\theta(s)$ is greater than one for those consumption goods. Notice that $\theta(s)$ in the model is a catch-all measure that averages over all types of consumption goods at the household level.

Next, wives' time allocation to market work and spousal care in the event of their husbands' disability has implications for the household insurance mechanism against disability shocks. Compared to a job displacement, a disability shock is an earnings shock that also entails caregiving needs. This implies that while wives would insure against their husbands' job displacement by increasing working hours, this is not necessarily true in the event of their husbands' disability since wives' time endowment can also be used in spousal care to generate utility $\kappa_t(tc; s)$.[28]

Another implication of wives' time allocation to market work and spousal care is that it provides inference for $\theta(s)$. For the purpose of illustration, consider a static environment where the period utility is specified as equation (2). First order conditions indicate a direct link between household consumption and wives' leisure since the following holds (i.e., the marginal utility of wives' leisure per dollar equals the marginal utility of household consumption).

$$\theta(s) \cdot c^{-\gamma} \;=\; \frac{\psi_w \cdot l_w^{-\gamma_w}}{w_w}, \qquad \forall s \tag{15}$$

Notice that if the model ignores caregiving such that wives allocate all of their time to leisure and market work only, wives' market hours can be mapped into the marginal utility of consumption in each health state since equation (15) can be expressed as follows.

$$\theta(s) \cdot c^{-\gamma} \;=\; \frac{\psi_w \cdot (\bar{L} - h_w)^{-\gamma_w}}{w_w}, \qquad \forall s \tag{16}$$

This implies that conditional on the realization of each health state, h_w is chosen such that it reveals how much consumption is valued in the form of spousal earnings, allowing one to use the changes in spousal labor supply responses across husbands' health states to recover $\theta(s)$. This is extremely useful since $\theta(s)$ is empirically challenging to estimate in the absence of panel data that provides a comprehensive measure of household consumption in each health state. The mapping between wives' market hours and the marginal utility of consumption circumvents this issue and provides inference for $\theta(s)$ which is the key parameter of interest.

However, a crucial point is that wives' time endowment is not solely used for market work and leisure when their husbands become disabled. If wives also spend their time in

[28]If caregiving utility could also be produced by expenditures on professional caregivers, then this would be a form of health state dependence in consumption utility since the demand for professional caregivers would be higher in the disabled state. Then, wives may choose to increase their working hours so that they can hire professional caregivers. However, as shown in Table 3, almost all of the care that husbands receive is provided by wives despite the existence of alternative market options (either because hiring professional caregivers is more expensive than wives' forgone earnings or husbands prefer to receive care from their wives rather than from professional caregivers).

spousal care, their choice of h_w cannot fully capture the marginal utility of consumption in the disabled states. This can be shown from the following,

$$\theta(s) \cdot c^{-\gamma} \quad = \quad \frac{\psi_w \cdot (\bar{L} - h_w - tc)^{-\gamma_w}}{w_w}, \qquad \forall s \in \{1, 2\} \tag{17}$$

which indicates that the marginal disutility of h_w is higher in the disabled state since tc reduces the time endowment that can be allocated to leisure. Since the direct mapping between wives' market hours and the marginal utility of consumption in the disabled state does not hold, the key implication is that wives' time allocation to both market work *and* spousal care needs to be considered in order to correctly infer $\theta(s)$.

4 Estimation

4.1 Estimation Method

To estimate the parameters of the model, I employ a two-step estimation method which is similar to the one used by Gourinchas and Parker (2002), De Nardi et al. (2010), and French and Jones (2011). In the first step, I estimate or calibrate certain parameters that can be identified without explicitly using the model. Given the parameter values from the first step, the remaining preference parameters are estimated by indirect inference. First, I numerically solve the model for a given initial guess of the parameter values and simulate forward to generate simulated moments. Based on the fit between the simulated moments and the data moments, I update the parameter guess and repeat this process until I find the parameter values that generate the closest fit between the simulated moments and the data moments.

Formally, denote the vector of model parameters that are estimated in the first stage as $\boldsymbol{\theta_f}$ and those that are estimated in the second stage as $\boldsymbol{\theta_s}$. Then, the estimate $\hat{\boldsymbol{\theta}}_{\boldsymbol{s}}$ is chosen such that it minimizes the weighted distance between the vector of data moments $\boldsymbol{m_d}$ and the vector of simulated moments $\boldsymbol{m_s}(\hat{\boldsymbol{\theta}}_{\boldsymbol{f}}, \boldsymbol{\theta_s})$ where the weight is specified by the matrix $\hat{W}$.

$$\hat{\boldsymbol{\theta}}_{\boldsymbol{s}} \quad = \quad \underset{\boldsymbol{\theta_s}}{\arg\min} \left(\boldsymbol{m_d} - \boldsymbol{m_s}(\hat{\boldsymbol{\theta}}_{\boldsymbol{f}}, \boldsymbol{\theta_s})\right)' \, \hat{W} \, \left(\boldsymbol{m_d} - \boldsymbol{m_s}(\hat{\boldsymbol{\theta}}_{\boldsymbol{f}}, \boldsymbol{\theta_s})\right) \tag{18}$$

Following Pischke (1995), I use a diagonal weighting matrix $\hat{W}$ which uses the inverse of the variance-covariance matrix of the data along the diagonal and zero elsewhere.[29]

4.1.1 Estimation Sample and Initial Conditions

When simulating households, I control for initial conditions by using the first observation of each married household in the HRS sample as the state vector and simulate forward. Table 5 provides a summary of this initial distribution. I make the additional sample restriction where I focus on households in which husbands are white and hold less than a bachelor's degree. This is because even after controlling for average lifetime earnings, mortality and disability processes differ significantly for non-whites and four-year college degree holders. In my data sample, 85% of married households have husbands who are white and 70% of married white men hold less than a bachelor's degree. Therefore, the additional sample cut still covers the majority of the population of interest.

Table 5: Summary Statistics of the Initial Distribution by Husbands' Health Status

	Husbands' Health Status		
	Healthy	Moderate	Severe
Husbands' age (mean)	55.33	55.98	55.84
Wives' age (mean)	52.14	52.38	52.63
Husbands' average lifetime earnings (mean, in $)	29,719	25,416	22,504
Household assets (median, in $1,000)	198.33	160.59	91.85
Fraction of "high type" husbands†	0.48	0.40	0.30
Husbands' hourly wages (mean)‡	24.71	23.30	21.89
Wives' hourly wages (mean)‡	22.93	19.98	19.30
Observations	1,551	178	169

Notes: This table reports summary statistics of the initial sample that is used in the simulation. The first observation of married households in the HRS are used. Sample consists of married households in which husbands are white and hold less than a bachelor's degree. Dollar values are in 2015 dollars.
† Hubands' individual type f^h is measured using their average lifetime earnings. "High type" refers to husbands whose average lifetime earnings is greater than $30,223 (median average lifetime earnings of males in the HRS).
‡ For non-employed respondents whose hourly wages are unobserved, their most recent wage in their last job is used as a proxy.

[29] This is because although the inverse of the variance-covariance matrix is asymptotically efficient, in practice it can be severely biased in small samples as shown by Altonji and Segal (1996).

4.1.2 First Stage Parameters

Annual time endowments, and part- and full-time hours – Annual time endowment $\bar{L}$ is set as 5,696 hours (16 hours × 365 days). For both spouses' market hours (h^h, h^w), I define annual full- and part-time labor market hours as 2,000 hours (40 hours × 50 weeks) and 1,000 hours (20 hours × 50 weeks), respectively. Annual full- and part-time caregiving hours are defined as 2,000 hours and 350 hours (7 hours × 50 weeks), respectively. This is because the average weekly caregiving hours of wives in the HRS who spend more than zero but 25 hours or less to care for their husbands is roughly 7 hours.

Coefficient of relative risk aversion – Following Low and Pistaferri (2015), γ is set as 1.5. I set $\gamma_h = 1$ and $\gamma_w = 1$ such that both spouses' utility from leisure is specified as a log function.[30]

Rate of return and discount factor – Real interest rate for assets is set as $r = 0.03$ and the discount factor is set as $\beta = \frac{1}{1.03}$, which are commonly assumed values in the literature (Gourinchas and Parker, 2002; Cagetti, 2003; Brown and Finkelstein, 2008; Low and Pistaferri, 2015; Autor et al., 2019).

Job displacement and job arrival rates – Annual job displacement rates $\delta_j(s)$ are calculated from the HRS by measuring the fraction of workers that become displaced in the next 12 months, conditional on current disability status. These values are reported in the second column of Table A.4. I use self-reported dates on when respondents left their previous employer due to either a business closure or being laid off or let go. The job arrival rate is set to $\lambda = 0.99$ which is similar to job arrival rates estimated in previous works when converted to an annual basis.[31]

Divorce rates – Biennial divorce rates $\tilde{\delta}_m(s)$ are computed as the fraction of married cou-

[30] Assuming certainty and interior conditions, γ_h and γ_w govern the Frisch labor supply elasticities of the husband and wife. However, in the model, labor market hours are discretized to three choices (non-employment, part-time and full-time employment). I measure labor supply elasticities for husbands and wives respectively by introducing a 20% increase in simulated wages at the beginning of the simulation period and computing the change in total hours worked in this period. This labor supply elasticity will be smaller than the Frisch labor supply elasticity due to wealth effects. Given the estimated model parameter values, the resulting labor supply elasticities are 0.16 and 0.63, which is within the range labor supply elasticities reported by previous studies (Keane, 2011; Chetty et al., 2011; Chetty, 2012; Blundell et al., 2016).

[31] Low et al. (2010) estimate a quarterly job arrival rate of 0.73 from the PSID. Merkurieva (2019) reports a monthly job arrival rate of 0.24 based on the CPS data.

ples in the HRS that divorced in the next survey wave, conditional on husbands' disability status. In order to get annual divorce rates $\delta_m(s)$ from the biennial rates $\tilde{\delta}_m(s)$, I assume that annual divorce rates between the survey waves are equal and use the relationship $1-\tilde{\delta}_m(s) = (1-\delta_m(s))^2$. The resulting parameter values are reported in the third column of Table A.4. Notice that annual divorce rates for healthy and moderately disabled husbands are the same but higher for severely disabled husbands.

Mortality rates – Husbands' annual survival rates are estimated from a logit regression model using reported death dates in the HRS data. Covariates include a quartic in age, disability status, and a dummy for whether average lifetime earnings are above the median of the distribution. Wives' annual survival rates are taken from the SSA Life Tables (Bell and Miller, 2005) since the model tracks neither wives' health status nor their average lifetime earnings. I use the reported survival rates for females born in 1930 since most wives in the estimation sample are born between the years 1930 and 1940.

Disability transition probabilities – Husbands' biennial disability transition probabilities are estimated from the HRS data using a multinomial logit regression model. Covariates include a quadratic in age, a dummy for whether average lifetime earnings are above the median of the distribution, and current disability status. Conditional on age and average lifetime earnings, I obtain a three by three matrix of annual transition probabilities Π_a from the matrix of biennial transition probabilities Π_b using the relationship $\Pi_a^2 = \Pi_b$.

Wage offer function – I follow the estimation method used by Low and Pistaferri (2015) to estimate the parameters of the wage offer equations (9) through (11). These estimates are reported in Table A.5. In order to correct for selection into employment, a two-step Heckman estimation procedure is employed. Following Low and Pistaferri (2015), I use state and year variation in potential UI benefits and potential SNAP benefits as exclusion restrictions.[32] For husbands, I generate interactions of the exclusion restriction variables with disability status, and use these interaction terms as additional exclusion restrictions. The variance of the idiosyncratic wage shocks $(\sigma^2_{\nu,h}, \sigma^2_{\nu,w})$ and their covariance between the two spouses $(\sigma_{\nu_{h,w}})$ are estimated by GMM.

[32]Refer to Appendix D for details on the construction of the exclusion restrictions. Potential UI and SNAP benefits are computed based on formulae coded in federal and state legislation. By using potential benefits based on legislative formulae, only exogenous characteristics (state and year) are exploited.

SSDI award probabilities – Using the merged administrative data on respondents' disability benefit claims, I compute the annual SSDI award probabilities of husbands who apply for benefits. These results are reported in Table A.6.

Annual medical expenses – $m(t, s_t, f^h)$ is estimated by performing a linear regression of log out-of-pocket medical expenses on husbands' age, productivity type, and disability status. Table A.7 reports the estimated coefficients.

4.1.3 Second Stage Parameters and Targeted Data Moments

Given the parameter values estimated in the first stage, the remaining model parameters are estimated using indirect inference. There are a total of 21 parameters including the health state dependence in consumption utility ($\theta(s), s \in \{1, 2\}$), the husband and wife's weight on leisure utility ($\psi_j,\ j \in \{h, w\}$), the husband's time costs by his disability status ($\phi(s), \phi_\eta(s), \phi^{emp}(s), \phi_\eta^{emp}(s), s \in \{1, 2\}$), the weight on terminal utility (ψ_v), the parameters that govern the husband's caregiving needs ($\mu_\eta(s), \rho_\eta(s), \sigma_{\xi,s}, s \in \{1, 2\}$), the minimum consumption level provided by government transfers ($\underline{c}$), and the disutility of applying for SSDI when moderately disabled ($\iota(1)$). This section discusses how certain targeted moments are informative of the second stage parameters.

First, *jointly* matching wives' labor supply responses and caregiving choices following their husbands' disability is informative of the health state dependence in consumption utility, $\theta(s)$. As discussed in Section 3.2, this is because the direct mapping between wives' marginal disutility of working and the marginal utility of consumption in each health state does not hold in the presence of spousal care since time spent in caregiving increases wives' marginal disutility of working by reducing the time endowment that can be allocated to leisure and market work.

The husband's weight on leisure utility (ψ_h) and his time costs in the disabled states ($\phi(s), \phi_\eta(s), \phi^{emp}(s), \phi_\eta^{emp}(s), s \in \{1, 2\}$) are pinned down by matching husbands' average employment rates and part-time employment rates. I not only match these moments by husbands' health status but also jointly by husbands' health and wives' caregiving choices. In particular, husbands' employment rates by their health status and wives' caregiving choices are informative of $\phi_\eta(s)$ and $\phi_\eta^{emp}(s)$ since husbands with greater caregiving needs are more likely to receive care from their wives as well as less likely to work. The wife's weight on leisure utility (ψ_w) can be recovered by matching wives' average employment rates.

Next, median household asset profiles by age are matched to infer the weight on terminal utility, ψ_v, as this parameter governs the household's wealth holdings over the remaining life-cycle given γ. The minimum household consumption floor $\underline{c}$ can be recovered by matching household asset profiles by age at the 25th percentile since $\underline{c}$ affects the savings decisions of households with low levels of assets.

Parameters related to the husband's caregiving needs $(\mu_\eta(s), \rho_\eta(s), \sigma_{\xi,s})$ are pinned down by matching various data moments regarding wives' caregiving choices. Specifically, $\rho(s)$ governs the persistence in wives' caregiving choices and $\sigma_{\xi,s}$ affects the fraction of part- and full-time caregivers since wives will be more likely to choose full-time caregiving when their husbands receive a higher idiosyncratic shock in caregiving needs.

Finally, the disutility of applying for benefits when moderately disabled, $\iota(1)$, is inferred by matching the percentage of SSDI applicants by health status. Since the SSDI award probability conditional on applying is given in the first stage, $\iota(1)$ directly affects the number of husbands who decide to apply for benefits. This ensures that both the award probabilities and the flow into the SSDI program are consistent with what is observed in the data.

5 Results

5.1 Model Fit and Parameter Estimates

Tables 6 through 8 report the estimated parameter values and model fit of the targeted moments. Parameter estimates of the baseline model specified in Section 3 are reported in column (a) of Table 6. Next, I re-estimate the model where caregiving utility $\kappa_t(tc; s)$ is set to be zero in all states such that wives never choose caregiving and only allocate their time between leisure and market hours (referred as the "no-caregiving" model). The corresponding parameter estimates are reported in column (b) of Table 6 and the model fit is reported in Appendix A.8. The goal of this exercise is to highlight the potential bias in the estimates of key preference parameters when wives' time allocation to spousal care is not considered. When I estimate the "no-caregiving" model, I use the same moments as described in Section 4.1.3 except for moments that involve wives' caregiving choices.

The key preference parameter that has significant implications for evaluating the welfare benefits of SSDI is the health state dependence in household consumption utility, $\theta(s)$. For the moderately disabled state, both the baseline and "no-caregiving" model estimates indicate that the marginal utility of consumption is slightly lower (8.6% and 4%, respectively) than in the healthy state. However, compared to the baseline model, $\theta(2)$ is significantly underestimated under the "no-caregiving" model. While the baseline model suggests that the marginal utility of consumption in the severely disabled state is 44.6% higher than in the healthy state, the "no-caregiving" model indicates that it is only 8% higher. This implies that in the context of disability shocks, changes in wives' labor supply responses across their husbands' health states are not sufficient to recover key preference parameters. By omitting the fact that wives of severely disabled husbands are spending a significant amount of time in caregiving, the "no-caregiving" model incorrectly interprets the small spousal labor supply responses as households' valuation of consumption in the severely disabled states being lower than it actually is. Panel A of Table 7 and Panels A and B of Table 8 show that the model can replicate wives' labor supply and caregiving choices in response to their husbands' disability shocks as observed in the data.

The extent to which spousal labor supply responses to husbands' disability shocks are attenuated due to caregiving needs are quantified and reported in Table 9. I estimate the simulated added-worker effects using the baseline model estimates (column (a) of Table 6) but set caregiving utility κ_t to be zero such that wives do not need to spend time in spousal care. Columns (2) and (4) of Table 9 indicate that in the absence of time spent in caregiving, wives of severely disabled husbands would increase weekly working hours by 1.8 hours (a 7% increase from a base of 26 hours) and employment rate by 2.6 percentage points, which is a substantial magnitude.

Next, the parameter estimates for husbands' leisure time costs indicate that both sick time and fixed cost of working increase with disability severity and the degree of caregiving needs. Panels C and D of Table 8 show that the model can replicate the negative correlation between husbands' caregiving needs and labor supply.

Parameter estimates of the baseline model indicate that on average, caregiving needs are higher and exhibit greater persistence for severely disabled households compared to moderately disabled households. As wives of severely disabled husbands are more likely to spend time in caregiving, this increases the marginal disutility of wives' market hours and discourages wives from choosing market work to make up for the loss in their husbands' earnings. Panels A and B of Table 8 show that the model does a good job of replicating wives' caregiving choices.

Finally, given that the SSDI award rate for moderately disabled husbands in the data can be as high as 62% (see Table A.6), the disutility of applying when moderately disabled is estimated to be strictly positive in order to match SSDI application rates. Although the

Table 6: Second Stage Estimates of the Model Parameters

Parameters (by disability $s \in \{1(\text{moderate}), 2(\text{severe})\}$	(a) Baseline		(b) "No-caregiving"†	
	$s=1$	$s=2$	$s=1$	$s=2$
Health state dependence in consumption utility, $\theta(s)$	0.914 (0.009)	1.446 (0.011)	0.960 (0.012)	1.083 (0.008)
Husbands' leisure time costs (in hours)				
$\phi(s)$	1,536 (145.2)	1,838 (140.1)	1,631 (140.7)	1,787 (97.97)
$\phi_\eta(s)$	32.80 (42.37)	38.49 (38.32)	-	-
$\phi^{emp}(s)$	173.8 (76.57)	371.0 (25.03)	176.3 (11.70)	288.4 (16.16)
$\phi^{emp}_\eta(s)$	40.13 (14.46)	181.2 (73.06)	-	-
Caregiving needs				
$\mu_\eta(s)$ Average ($\times 10^{-5}$)	4.008 (0.097)	19.01 (3.433)	-	-
$\rho_\eta(s)$ Auto-regressive persistence	0.125 (0.130)	0.811 (0.049)	-	-
$\sigma_{\xi,s}$ Variance of white noise ($\times 10^{-4}$)	0.009 (0.009)	6.040 (0.857)	-	-
Husbands' weight on leisure utility ($\times 10^{-3}$), ψ_h	3.162 (0.148)		2.979 (0.179)	
Wives' weight on leisure utility ($\times 10^{-3}$), ψ_w	2.846 (0.077)		2.814 (0.092)	
Weight on terminal utility, ψ_v	4.081 (0.223)		6.115 (0.450)	
Minimum consumption floor ($2015), $\underline{c}$	25,375 (1,043)		26,658 (748.7)	
Disutility of SSDI application when moderately disabled ($\times 10^{-4}$), $\iota(1)$	3.692 (1.736)		2.912 (1.530)	

Notes: Standard errors in parentheses. Refer to Appendix E on how standard errors are computed.
† Parameter estimates when caregiving is omitted (i.e., caregiving utility $\kappa_t(tc; s)$ is always zero such that wives allocate their time to leisure and market work only).

Table 7: Targeted Moments I

	Model	Data	Model	Data
Panel A: Changes in Wives' Labor Supply by Husbands' Disability[†]				
	Wives' Employment Rate		Wive's Weekly Hours (in hours)	
Moderate	-0.023	-0.021 (0.014)	-0.301	-0.223 (0.540)
Severe	-0.012	-0.009 (0.018)	0.012	-0.213 (0.644)
Panel B: Husbands' Employment Rates by Health Status				
	Employment Rate		Part-time Employment Rate	
Healthy	0.837	0.839 (0.006)	-	-
Moderate	0.437	0.436 (0.018)	0.106	0.109 (0.011)
Severe	0.192	0.200 (0.014)	0.044	0.043 (0.006)
Panel C: Wives' Employment Rate				
	0.723	0.716 (0.009)		
Panel D: Household Assets (by husbands' age, in $1,000)				
	50th Percentile		25th Percentile	
Ages 50 - 54	175.34	170.52 (5.803)	85.94	70.95 (3.317)
Ages 55 - 59	197.10	205.03 (4.749)	87.53	81.56 (2.825)
Ages 60 - 64	233.08	232.00 (5.373)	95.05	91.37 (3.525)
Panel E: SSDI Application Rates by Husbands' Disability				
	Moderate		Severe	
	0.083	0.083 (0.007)	0.139	0.142 (0.009)

Notes: Standard errors in parentheses. All moments are computed conditional on both spouses being younger than age 65. Dollar values are in 2015 dollars.

[†] Based on fixed effect regressions of labor supply variables on indicators of husbands' disability severity, a quartic in both spouses' ages, and household fixed effects. The reported moments are the regression coefficients for the indicators of husbands' disability severity.

Table 8: Targeted Moments II – Caregiving Choices by Husbands' Disability

	Model	Data	Model	Data
	Moderate		Severe	
Panel A: Fraction of Wives Providing Care				
Part-time	0.200	0.203 (0.040)	0.440	0.430 (0.024)
Full-time	0.000	0.000 (0.000)	0.139	0.131 (0.017)
Panel B: Caregiving Transition Rates (year $t \rightarrow t+2$)				
No Care → No Care	0.884	0.910 (0.045)	0.634	0.629 (0.046)
Care → Care	0.466	0.420 (0.171)	0.717	0.732 (0.036)
Panel C: Husband's Employment Rates by Wives' Caregiving Choices				
No Care	0.464	0.447 (0.049)	0.272	0.253 (0.022)
Part-time Care	0.348	0.314 (0.097)	0.145	0.156 (0.022)
Full-time Care	-	-	0.070	0.024 (0.040)
Panel D: Husband's Part-time Employment Rates by Wives' Caregiving Choices				
No Care	0.119	0.116 (0.031)	0.047	0.055 (0.011)
Part-time Care	0.064	0.074 (0.061)	0.039	0.035 (0.011)
Full-time Care	-	-	0.025	0.007 (0.021)

Notes: Standard errors in parentheses. All moments are computed conditional on both spouses being younger than age 65.

Table 9: Simulated Added-Worker Effects Under Baseline Estimates

	Wives' Weekly Hours		Wives' Employment Rate	
	(1) With spousal care	(2) Without spousal care	(3) With spousal care	(4) Without spousal care
Husbands' Disability				
Moderate	-0.301	-0.257	-0.023	-0.019
Severe	0.012	1.821	-0.012	0.026

Notes: This table reports results from fixed effect regressions of wives' labor supply on indicators of husbands' disability severity, a quartic in both spouses' ages, and household fixed effects using model simulated data. Columns (1) and (3) are equivalent to simulated moments reported in Panel A of Table 7. Columns (2) and (4) report simulated added-worker effects using baseline model estimates but when caregiving utility $\kappa_t(tc; s)$ is always zero such that wives do not need to spend time in spousal care.

disutility of applying in the severely disabled state is assumed to be zero, the model can match the SSDI application rates for both moderately and severely disabled households as shown in Panel E of Table 7.

5.2 Evaluating the Welfare Benefits of SSDI Policies

Building on parameter estimates that generate good model fit, I use the model to analyze the welfare benefits of the current and counterfactual SSDI policies relative to their costs. First, the ex-ante insurance value of SSDI is calculated using a compensating variation measure, x. I define x as the lump sum amount of asset that needs to be given at the start (i.e., age 50) under the counterfactual economy where SSDI does not exist such that the expected utilities under the baseline world with SSDI and the counterfactual world with no SSDI are equal. Therefore, x is the monetary value that each household places on the insurance value of SSDI. This can be formally expressed as follows,

$$V_{50}(A_t, \mathbf{\Theta}_t | \text{economy with SSDI}) = V_{50}(A_t + x, \mathbf{\Theta}_t | \text{economy with no SSDI}) \tag{19}$$

where $\mathbf{\Theta}_t$ denotes the vector of state variables excluding assets (A_t).

I calculate x for each simulated household of ages 50 to 54 in my initial sample and divide the average compensating variation by the average present discounted value of SSDI benefits to get a measure of how much a dollar of SSDI benefits is valued ex-ante. This exercise is done using the baseline model as well as the "no-caregiving" model which ignores wives' time allocation to spousal care (using corresponding parameter estimates reported in column (b) of Table 6). The goal of this exercise is to quantify the difference in the ex-ante insurance value of SSDI that each model predicts. These results are reported in Table 10.

Row (2) of Table 10 reports that under the baseline model where an additional dollar of consumption is valued significantly higher in the severely disabled states than in the healthy states, households value each dollar of SSDI benefits as 83 cents. In contrast, the "no-caregiving" model predicts the insurance value relative to a dollar of SSDI benefits as 79 cents per SSDI benefit payments. This implies that SSDI benefits for married households need to be higher when we take into account that the insurance role of spousal labor supply is reduced due to time spent in caregiving. In terms of magnitudes, row (3) reports the required percentage change in SSDI benefits such that the insurance value of SSDI equals

Table 10: Ex-ante Insurance Value of SSDI for Married Households

	Model	
	Baseline	"No-caregiving"*
Health state dependence estimates $(\theta(1), \theta(2))$	(0.91, 1.45)	(0.96, 1.08)
(1) Ex-ante insurance value of SSDI (in \$)†		
Mean	7,760	6,998
Median	6,800	5,894
25th percentile	3,794	3,166
75th percentile	10,375	9,341
(2) Ex-ante insurance value of SSDI per dollar of SSDI benefits (in \$)‡	0.83	0.79
(3) Required % change in SSDI benefits such that (2) equals 0.79	+8.27%	-
(4) Required % change in SSDI benefits such that (2) equals 1	-20.95%	-

Notes: Reports the ex-ante insurance value of SSDI for married households that are first observed at ages 50 to 54. Nominal dollar amounts are in 2015 dollars.

* Alternative model that omits wives' time allocation to spousal care (i.e., caregiving utility κ_t is always zero) using the corresponding parameter estimates reported in column (b) of Table 6.

† For each simulated household, the ex-ante insurance value is measured as the lump sum amount of asset which should be given upon entering the counterfactual economy where SSDI does not exist such that the expected utilities at the beginning of the model under the economies with and without SSDI are equal. Refer to equation (19) for a formal definition.

‡ Computed as the average ex-ante insurance value over the average present discounted value of SSDI benefits.

to the value predicted by the "no-caregiving" model. Note that an increase in benefits will decrease the insurance value of SSDI relative to its costs as it creates work disincentives for both husbands and wives. Row (3) indicates that SSDI benefits need to be 8.27% higher for the insurance value of SSDI per dollar of benefits to be decreased to \$0.79, which is a non-negligible magnitude.

Also, given the degree of moral hazard in the model, the welfare benefits (i.e., ex-ante insurance value) of SSDI are smaller than its costs even under the baseline model. Row (4) shows that under the baseline model, SSDI benefits needs to be decreased by about 21% in order for the cost of SSDI to be equal to the insurance value that married households place on SSDI.

Next, I consider whether a government-budget-neutral policy reform that reduces SSDI benefit levels by x% but provides a flat amount of annual caregiving benefits b_{care} to eligible SSDI beneficiaries can improve utilitarian social welfare. Providing a supplementary caregiving benefit for disability beneficiaries is a common feature in many OECD countries but not in the U.S. Instead of mimicking specific policies, I consider a hypothetical policy where SSDI beneficiaries receive a flat amount of b_{care} in the periods when their caregiving needs $\eta_t(s)$ are greater than some threshold z and they receive full-time care from their spouses. In my data sample, about 3% of severely disabled men are completely unable to perform one or more ADLs. Since one can expect that this subgroup would require a greater degree of caregiving and be more easily identifiable as being "severely disabled," I set z such that 3% of severely disabled households are eligible for this caregiving benefit.

Table 11 reports that reducing benefits for everyone by 7.6% but providing an annual caregiver allowance of \$35,668 for eligible beneficiaries can maximize utilitarian social welfare while keeping the government budget the same as under the current SSDI policy. Furthermore, this policy reform is largely favored by households in the bottom quintiles of husbands' lifetime earnings.

Tables 10 and 11 point toward a couple of important conclusions. First, Table 10 shows that the consumption smoothing benefits of SSDI relative to the government expenditures on benefits increase to a sizable extent when we take into account that the insurance role of wives' labor supply is reduced due to time allocated to spousal care. Furthermore, Tables 10 and 11 imply that although the insurance value of SSDI is lower than the government expenditures on SSDI benefits on average, utilitarian social welfare can be improved given the same government budget level by targeting resources to a certain population (in this case, disabled beneficiaries requiring a significant degree of care from others).

Table 11: Policy Reform: Supplementary Caregiver Benefits

(1) Baseline policy: Current SSDI policy

(2) Government budget-neutral reform that maximizes social welfare*: Reduce SSDI benefits by 7.6% but provide annual caregiver benefits of $35,668 to eligible beneficiaries†

Quintiles of husbands' lifetime earnings at age 50	Fraction that prefers (2)	Insurance value of policy (1)‡	Insurance value of policy (2)‡
Q1 (bottom)	0.98	$4,047	$4,487
Q2	0.96	$6,797	$7,000
Q3	0.50	$9,307	$9,214
Q4	0.16	$10,802	$10,424
Q5 (top)	0.04	$10,171	$9,336

* A utilitarian social welfare function is assumed.
† In this policy experiment, I assume that SSDI beneficiaries can receive supplementary caregiver benefits if husbands have caregiving needs $\eta_t(s)$ above some threshold z and their wives provide full-time spousal care. As a benchmark, I set z such that 3% of severely disabled households are eligible for this caregiving benefit since about 3% of severely disabled men in my data are completely unable to perform one or more ADLs.
‡ For each simulated household, the ex-ante insurance value is measured as the lump sum amount of asset which should be given upon entering the counterfactual economy where SSDI does not exist such that the expected utilities at the beginning of the model under the economies with and without SSDI are equal (refer to equation (19) for a formal definition). Each cell reports simple averages taken within each quintile group.

6 Conclusion

This paper provides empirical evidence that spousal care plays an important role in understanding married women's labor supply responses to their husbands' disability and evaluating the welfare benefits of current and counterfactual SSDI policies. The key results of this paper can be summarized as follows. First, while spousal labor supply responses to husbands' disability are small, there is a significant increase in wives' time spent in spousal care. Second, the insurance value of SSDI relative to its costs is underestimated to a sizable degree when we do not consider the fact that caregiving needs substantially reduce the insurance role of spousal labor supply. Lastly, counterfactual policy experiments indicate that for the same government budget level, it is possible to improve utilitarian social welfare by reducing overall SSDI benefit levels but introducing a supplementary caregiving benefit to eligible SSDI beneficiaries with significant caregiving needs.

When interpreting these results, an important caveat is that this paper's findings are based on the analysis of married households and the disability shock to the husband. In the HRS, the majority of SSDI beneficiaries are married and the primary earner for most married households is the husband. Therefore, this paper's results still apply to a large fraction of the population that SSDI covers. However, the results of this paper may not be generalizable to disabled singles as they are significantly more likely to receive help from formal caregivers (as shown in Table 3) and this may affect the insurance value of SSDI for single households. In addition, spousal responses (in terms of labor supply, caregiving, and marital stability) and their implications for the welfare analysis of SSDI policies may differ when considering the disability shock to the wife. Accounting for further heterogeneity in household structure and enriching this paper's model accordingly are important directions for future work.

Between 1980 to 2013, the number of SSDI beneficiaries and their eligible dependents rose from 4.7 million to 11 million. During the same period, spending on benefits increased from 0.54% to 0.84% of US GDP, putting a significant strain on the DI trust funds (Morton, 2015). This has raised concerns among policymakers and subsequently, various reforms to the current SSDI program have been proposed. Given that SSDI benefit amounts are computed based on individuals' past earnings and do not vary by severity under the current system, these results imply that further adjusting benefit generosity based on the degree of required care may be an effective method to address the rapid growth of SSDI while providing households with consumption smoothing benefits.

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Appendix

A Robustness of Spousal Responses to Husbands' Disability Onset

This section provides additional analyses regarding wives' labor supply and caregiving responses to their husbands' disability. Table A.1 reports the effect of husbands' disability onset on their wives' weekly working hours. All event study regressions are based on equation (1) but with additional control variables. Column (1) reports the baseline result that is documented in Figure 1b for comparison. Column (2) additionally controls for whether a household is receiving SSDI benefits or Supplemental Security Income (SSI). The coefficients in column (2) imply that indeed wives with husbands who are receiving disability benefits are more likely to reduce working hours but the estimates are statistically insignificant. Moreover, spousal labor supply responses are still small and statistically insignificant even after controlling for disability benefit receipt. Therefore, the small spousal labor supply responses shown in Figure 1b are not mainly driven by households whose husbands are receiving SSI/DI benefits.

Another concern is that disabilities that are highly expected would not elicit substantial spousal responses and these disabilities may be the reason why added worker effects in response to disability shocks are small. I explore this issue by distinguishing whether a disability is a result of an accident or not. Arguably, disabilities caused by accidents are less likely to be expected and therefore more likely to be regarded as an unexpected shock. Formally, the estimation model is as follows:

$$y_{it} = \alpha_i + \gamma_t + X_{it}'\beta + \sum_g \left(\sum_{k=-4}^{5} \delta_k^g \cdot I_{itk}^g \right) + \epsilon_{it} \tag{20}$$

where g indicates the disability group (whether the disability is due to an accident or not). Column (3) reports δ_k^g for both disability groups. Again, added worker effects are not observed for both groups. Although there exists heterogeneity in the degree in which disabilities are expected, this does not seem to be the main driving force given that households cannot perfectly predict the timing that disabilities occur.

Finally, one might be concerned that the increase in wives' time spent in spousal care is driven by those with weaker labor force attachment (and hence are less capable of increasing their working hours in response to their husbands' earnings shock). The results shown in

Table A.1: The Effect of Husbands' Disability Onset on Wives' Weekly Hours Worked

	(1)	(2)	(3)	
			Cause of disability	
			Non-Accident	Accident
Year = -4, -3	0.321	0.332	0.601	-0.717
	(0.691)	(0.690)	(0.785)	(1.384)
Year = -2, -1	-0.407	-0.370	0.106	-2.001
	(0.878)	(0.877)	(0.974)	(1.844)
Year = 0, 1	-0.706	-0.565	-0.640	-0.611
	(0.959)	(0.957)	(1.057)	(1.940)
Year = 2, 3	-0.697	-0.440	-0.230	-1.279
	(1.052)	(1.068)	(1.183)	(1.966)
Year = 4, 5	-1.845	-1.526	-1.309	-2.370
	(1.238)	(1.267)	(1.372)	(2.380)
Receiving SSDI	-	-1.625	-1.644	
		(1.479)	(1.485)	
Receiving SSI	-	-1.346	-1.390	
		(2.630)	(2.639)	
Observations	23,424	23,424	23,424	
R-sq	0.108	0.108	0.109	

Notes: This table reports results from fixed effect regressions of wives' weekly working hours on husbands' disability onset years. The estimation sample is restricted to married households where both spouses are under age 65 in the HRS Core survey (1992-2014). All event study regressions control for a quartic in both spouses' ages, dummies for each spouse indicating whether their age is 62 or above, wives' disability status, household size, length of current marriage, census division, and year and household fixed effects. Standard errors in parentheses, clustered at the household level.

Table A.2 aim to address this concern by dividing households into two groups based on wives' labor force attachment prior to their husbands' disability. I use the same specification as equation (20) and categorize group g based on whether wives report working in at least one survey wave during the 4 years prior to their husbands' disability. Both columns (1) and (2) indicate that even for wives with stronger labor force attachment, there is a sizable increase in time spent in spousal care.

Table A.2: The Effect of Husbands' Disability Onset on Wives' Caregiving

	(1) Provides care (0/1)		(2) Weekly caregiving hours	
	Wives' prior labor force attachment†			
	High	Low	High	Low
Year = -4, -3	0.003	-0.010	-0.333	-0.010
	(0.014)	(0.011)	(0.624)	(0.368)
Year = -2, -1	0.008	0.028	-0.153	0.402
	(0.017)	(0.022)	(0.487)	(0.783)
Year = 0, 1	0.101***	0.104***	1.874*	3.423**
	(0.025)	(0.034)	(0.978)	(1.472)
Year = 2, 3	0.103***	0.142***	2.270*	7.235***
	(0.029)	(0.045)	(1.184)	(2.803)
Year = 4, 5	0.109***	0.182***	2.115**	3.233
	(0.029)	(0.058)	(0.929)	(2.031)
Observations	11,540		11,540	
R-sq	0.042		0.019	

Notes: This table reports results from fixed effect regressions of wives' caregiving on husbands' disability onset years. The estimation sample is restricted to married households where both spouses are under age 65 in the HRS Core survey (2000-2014). Caregiving is defined as the amount of time spent in helping a spouse in performing ADL/IADLs. All event study regressions control for a quartic in both spouses' ages, dummies for each spouse indicating whether their age is 62 or above, wives' disability status, household size, length of current marriage, census division, and year and household fixed effects. Standard errors in parentheses, clustered at the household level. *, **, and *** indicate statistical significance at the 10, 5, and 1 percent level, respectively.
† As a proxy for wives' labor force attachment, households are divided into two groups based on whether wives report working in at least one survey wave during the 4 years prior to their husbands' disability onset. 64% of wives in this estimation sample are categorized as having "high" labor force attachment according to this classification.

B Social Security Benefit Computation

This section describes how Social Security Disability Insurance and (household) retirement benefits are computed in the model. Denote the age that the husband first receives Social Security benefits (either SSDI or retirement) as t_b. In reality, the individual's 35 highest years of earnings (including zero earnings) are used in computing benefits. Since keeping track of husbands' entire earnings histories is computationally infeasible, I approximate average lifetime earnings at age t_b as follows:

$$y_{t_b} = \frac{\sum_{t=t_0}^{t_b} e_t^*}{35} \quad (21)$$

where t_0 denotes the first year of earnings. e_t^* denotes period earnings subject to the maximum taxable earnings e^{max}:

$$e_t^* = \min\{w_t^h h_h^h, e^{max}\} \quad (22)$$

I set $e^{max} = \$118,500$ based on the Social Security maximum taxable earnings in 2015.

The husband's Average Indexed Monthly Earnings (AIME) is computed as his average lifetime earnings (measured at age t_b) y_{t_b} divided by 12.

$$AIME(y_{t_b}) = \frac{y_{t_b}}{12} \quad (23)$$

In reality, indexed nominal earnings are used when computing the AIME in order to ensure that benefits reflect the general rise in the standard of living that occurred during the worker's working lifetime. Since all dollar values in the model are in 2015 dollars, equation (23) provides a reasonable approximation of the AIME without the need of introducing a wage index for each calendar year.

Next, the Primary Insurance Amount (PIA) is computed from the AIME based on the following Social Security benefit formula.

$$\begin{aligned} PIA(y_{t_b}) = \; & 0.90 \times \min\{AIME(y_{t_b}), b_1\} \\ & + 0.32 \times \min\Big\{\max\{AIME(y_{t_b}) - b_1, 0\}, b_2 - b_1\Big\} \\ & + 0.15 \times \max\{AIME(y_{t_b}) - b_2, 0\} \end{aligned} \quad (24)$$

b_1 and b_2 denote bend points which reflect the three progressive replacement factors (90%, 32%, and 15%) that are applied to the three brackets of AIME. I use $b_1 = \$826$ and $b_2 = \$4{,}980$ based on the policy parameters for 2015.

Since the model period is annual, disability benefits are set as follows.

$$b_t(y_{t_b}, DI_t = 1) = 12 \times PIA(y_{t_b}) \quad (25)$$

Household retirement benefits are computed as the sum of both spouses' retirement benefits based on the husband's average lifetime earnings.[33] I use the fact that wives are eligible for 50% of their husbands' PIA and calculate household retirement benefits as below.[34]

$$b_t(y_{t_b}, DI_t = 0) \quad = \quad 12 \times (1.5 \times PIA(y_{t_b})) \tag{26}$$

C Taxes

Household taxes $\tau(A_t, w_t^h h_t^h, w_t^w h_t^w)$ are computed as the sum of payroll taxes of both spouses and federal income tax.

Payroll tax – Payroll tax consists of Social Security and Medicare tax. Social Security tax is 6.2% of earnings capped at the maximum taxable earnings while the Medicare tax rate is 1.45% and earnings are uncapped. Therefore, each spouse's payroll tax $\tau_{P,t}^j$ is specified as follows.

$$\tau_{P,t}^j \quad = \quad 0.062 \times \min\{w_t^j h_t^j, e^{max}\} + 0.0145 \times w_t^j h_t^j, \quad j \in \{h, w\} \tag{27}$$

Federal income tax – Federal income tax is a progressive tax on labor and non-labor income. Define the taxable household income as follows

$$I_t \quad = \quad \max\{rA_t + w_t^h h_t^h + w_t^w h_t^w - d, 0\} \tag{28}$$

where d denotes the amount of household deduction. I set d as d = \$12,600 based on the standard deduction for married households filing jointly in 2015.

Similar to the PIA computation formula, the federal income tax has seven progressive tax rates that are applied to seven taxable income brackets. Table A.3 reports the amount of federal income tax $\tau_{F,t}$ that the household pays based on taxable household income I_t. I use the 2015 income tax brackets for married households filing jointly.

[33] See footnote 18 regarding the use of the husband's average lifetime earnings to compute the wife's retirement benefits.

[34] As noted in footnote 18, while wives can receive Social Security benefits based on either their own or spouses' earnings history (or both), I find that in my data sample, wives' Social Security retirement benefits are about half of that of their husbands' on average.

Table A.3: Federal Tax by Taxable Household Income Brackets (in $)

Taxable Household Income (I_t)	Federal Income Tax ($\tau_{F,t}$)
0 - 18,450	$0.1 \times I_t$
18,451 - 74,900	$1,845 + 0.15 \times (I_t - 18,450)$
74,901 - 151,200	$10,312.5 + 0.25 \times (I_t - 74,900)$
151,201 - 234,500	$29,387.5 + 0.28 \times (I_t - 151,200)$
234,501 - 411,500	$51,577.5 + 0.33 \times (I_t - 234,500)$
411,501 - 464,850	$111,324 + 0.35 \times (I_t - 411,500)$
464,851+	$129,996.5 + 0.396 \times (I_t - 464,850)$

Note: All values are in 2015 dollars.

D First Stage Parameters

This section provides further details on the first stage parameters used in the dynamic model. Table A.4 reports the annual job destruction and divorce rates that are estimated from the HRS data.

Table A.4: Annual Job Destruction and Divorce Rates by Husbands' Disability

Husbands' Disability	Job Destruction Rate $\delta_j(s)$	Divorce Rate $\delta_m(s)$
Healthy ($s = 0$)	.052	.0056
Moderate ($s = 1$)	.042	.0056
Severe ($s = 2$)	.075	.0094

Notes: Results are based on a sample of married households in the HRS Core survey (1992-2014) where the husband is white, has less than a bachelor's degree, and under age 65. Job destruction is defined as job separations due to a business closure or being laid off or let go.

Table A.5 reports the parameters of the wage offer functions. In order to control for selection into employment, I use a two-step Heckman estimation method. Formally, the husband and wife's model of employment is specified as equations (29) and (30), respectively.

$$P^*_{iht} = X'_{it}\beta_h + \sum_{s=1}^{s} \vartheta_s \cdot \mathbf{1}(s_{iht} = s) + Z'_{iht}\beta_{Z_h} + \epsilon_{iht} \quad (29)$$

$$P^*_{iwt} = X'_{it}\beta_w + Z'_{iwt}\beta_{Z_w} + \epsilon_{iwt} \quad (30)$$

P^*_{ijt} denotes the utility from working and the econometrician observes the indicator for whether an individual is employed or not: $P_{ijt} = \mathbf{1}(P^*_{ijt} > 0)$. Z_{ijt} is the vector of exclusion restrictions that affect the individual's probability of working but are plausibly exogenous to wages (conditional on X_{it} and disability status s_{iht}).

Table A.5: Estimates of the Wage Offer Function

	Male	Female
$s = 1$ (Moderate)	-0.154**	-
	(0.065)	
$s = 2$ (Severe)	-0.222*	-
	(0.120)	
Age	0.101*	0.121***
	(0.057)	(0.031)
Age sq./100	-0.102***	-0.112***
	(0.053)	(0.033)
High type†	0.278***	-
	(0.016)	
Variance of wage shock ($\sigma^2_{\eta,j}$)	0.022***	0.020***
	(0.002)	(0.001)
Covariance of spouses' wage shocks ($\sigma_{\eta_{h,w}}$)	0.024***	
	(0.009)	
Exclusion restrictions		
χ^2	13.58	7.99
p-value	0.004	0.005
Observations	18,803	16,416

Notes: Dependent variable: log hourly earnings. Results are based on a sample of HRS respondents who are white and under age 65, estimated separately for males and females. Controls for education, marital status, and year fixed effects. Standard errors in parentheses. ***, **, * indicate statistical significance at the 1, 5, and 10 percent levels, respectively.
† Corresponds to hubands' individual type f^h, measured using their average lifetime earnings. "High type" refers to husbands whose average lifetime earnings are greater than \$30,223 (median average lifetime earnings of males in the HRS, in \$2015).

For females, I use potential UI and SNAP benefits as exclusion restrictions. For males, I use the same exclusion restrictions as females but also add their interaction terms with dummy variables that indicate disability severity. The interaction with disability severity accounts for the possibility of differences in the effect of the exclusion restriction variables by health status.

Potential UI and SNAP benefits affect one's likelihood of working through an income effect but are plausibly exogenous to wages. Unlike actual benefits which is the result of both the individual's decision to apply for benefits as well as other endogenous variables that affect the amount of benefits, potential benefits are those that a "representative" individual would have received if one took up the benefits for certain.[35] Therefore, the variation only comes from exogenous characteristics such as state of residence, year, and family size. I follow the method used by Low and Pistaferri (2015) by using federal and state legislative formulae for each calendar year from 1992 to 2014 where UI benefits vary by state and year and SNAP benefits vary by year and family size.

Table A.6 reports the annual SSDI award probability conditional on the husband's age and disability status at the year of application. SSDI eligibility is based on both medical and vocational considerations and since the vocational criteria become more lenient for applicants of ages 55 and over,[36] I use age 55 as a cutoff. Indeed, Table A.6 reports that while moderately disabled applicants younger than age 55 are significantly less likely to be awarded compared to their severely disabled counterparts, this pattern does not hold for applicants of ages 55 and older such that the award probabilities are similar for both moderately and severely disabled applicants.

Table A.6: Annual SSDI Award Rates by Husbands' Age and Disability

	Husbands' Age	
Husbands' Disability	Age < 55	$55 \leq$ Age ≤ 64
Moderate ($s = 1$)	.426	.620
Severe ($s = 2$)	.631	.640

Notes: This table reports the probability that husbands who applied for SSDI in year t would be awarded with benefits in year $t + 1$. Results are based on a sample of husbands in the HRS (1992-2014) who are white, under age 65, and hold less than a bachelor's degree. Merged administrative data on HRS respondents' disability benefit claims is primarily used. If information is not available from the administrative data, it is supplemented with the SSDI episodes data available in the public RAND HRS data.

Finally, Table A.7 reports the OLS estimates for the annual household medical expense function. Household medical expenses are the sum of both spouses' out-of-pocket medical expenses. While earlier waves of the HRS collected information on medical expenses in the past 12 months, the reference period for later waves is the past 2 years. Therefore, medical

[35] The individual is "representative" in terms of the endogenous variables (e.g., earnings, liquid assets) that enter into the computation of benefits.

[36] Chen and van der Klaauw (2008) use this institutional feature to estimate the work disincentive effects of SSDI in a regression discontinuity framework.

expenses are annualized by dividing them by the appropriate reference period.

Table A.7: Annual Household Medical Expenses (OLS Estimates)

Dependent variable: log(household out-of-pocket medical expenses)	
$s = 1$ (Moderate)	0.193***
	(0.019)
$s = 2$ (Severe)	0.269***
	(0.019)
Husbands' Age	0.0094***
	(0.0008)
High type†	0.087***
	(0.015)
Constant	6.664***
	(0.049)
Observations	37,403

Notes: Results are based on a sample of husbands in the HRS (1992-2014) who are white, of ages 50 or older, and hold less than a bachelor's degree. Out-of-pocket medical expenses are a sum of both spouses' reported medical expenses. Standard errors in parentheses with *** indicating statistical significance at the 1 percent level.
† Corresponds to husbands' individual type f^h, measured using their average lifetime earnings. "High type" refers to husbands whose average lifetime earnings are greater than $30,223 (median average lifetime earnings of males in the HRS, in $2015).

E Computing Standard Errors of the Second Stage Model Parameters

Given the first stage parameter estimates ($\hat{\boldsymbol{\theta}}_{\boldsymbol{f}}$), the second stage estimates ($\hat{\boldsymbol{\theta}}_{\boldsymbol{s}}$) are chosen such that they minimize the weighted distance between the vector of data moments $\boldsymbol{m_d}$ and the vector of simulated moments $\boldsymbol{m_s}(\hat{\boldsymbol{\theta}}_{\boldsymbol{f}}, \hat{\boldsymbol{\theta}}_{\boldsymbol{s}})$ where the weight is specified by the matrix $\hat{W}$:

$$\hat{\boldsymbol{\theta}}_{\boldsymbol{s}} = \arg\min_{\boldsymbol{\theta_s}} \left(\boldsymbol{m_d} - \boldsymbol{m_s}(\hat{\boldsymbol{\theta}}_{\boldsymbol{f}}, \boldsymbol{\theta_s})\right)' \hat{W} \left(\boldsymbol{m_d} - \boldsymbol{m_s}(\hat{\boldsymbol{\theta}}_{\boldsymbol{f}}, \boldsymbol{\theta_s})\right) \tag{31}$$

Standard errors of $\hat{\boldsymbol{\theta}}_{\boldsymbol{s}}$ are computed based on the following formula (Gourieroux et al., 1993)

$$var(\hat{\boldsymbol{\theta}}_{\boldsymbol{s}}) \quad = \quad \left(1+\frac{1}{H}\right)(J'\hat{W}J)^{-1}(J'\hat{W}S\hat{W}J)(J'\hat{W}J)^{-1} \tag{32}$$

where H is the number of simulations, $J = \frac{\partial \boldsymbol{m_s}(\hat{\boldsymbol{\theta}}_{\boldsymbol{f}},\boldsymbol{\theta_s})}{\partial \boldsymbol{\theta_s}}$, and S is the variance-covariance matrix of the data moments such that $S = var(\boldsymbol{m_d})$. S is computed via bootstrap and J is computed using numerical derivatives (i.e., finite differences).

F Model Fit for the "No-caregiving" Model

Table A.8 reports the model fit between the simulated and data moments for the "no-caregiving model" where the model assumes that wives spend their time allocation to market work and leisure only (i.e., caregiving utility κ_t is always zero).

Table A.8: Targeted Moments for the "No-caregiving" Model

	Model	Data	Model	Data
Panel A: Changes in Wives' Labor Supply by Husbands' Disability†				
	Wives' Employment Rate		Wive's Weekly Hours (in hours)	
Moderate	-0.025	-0.021 (0.014)	-0.544	-0.223 (0.540)
Severe	-0.014	-0.009 (0.018)	-0.066	-0.213 (0.644)
Panel B: Husbands' Employment Rates by Health Status				
	Employment Rate		Part-time Employment Rate	
Healthy	0.838	0.839 (0.006)	-	-
Moderate	0.436	0.436 (0.018)	0.108	0.109 (0.011)
Severe	0.198	0.200 (0.014)	0.046	0.043 (0.006)
Panel C: Wives' Employment Rate				
	0.716	0.716 (0.009)		
Panel D: Household Assets (by husbands' age, in $1,000)				
	50th Percentile		25th Percentile	
Ages 50 - 54	174.70	170.52 (5.803)	85.71	70.95 (3.317)
Ages 55 - 59	198.22	205.03 (4.749)	85.14	81.56 (2.825)
Ages 60 - 64	235.92	232.00 (5.373)	91.83	91.37 (3.525)
Panel E: SSDI Application Rates by Husbands' Disability				
	Moderate		Severe	
	0.082	0.083 (0.007)	0.134	0.142 (0.009)

Notes: Standard errors in parentheses. All moments are computed conditional on both spouses being younger than age 65. Dollar values are in 2015 dollars.
† Based on fixed effect regressions of labor supply variables on indicators of husbands' disability severity, a quartic in both spouses' ages, and household fixed effects. The reported moments are the regression coefficients for the indicators of husbands' disability severity.