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Abstract

Cross-sectional evidence in the United States finds that informal caregivers have less attachment to the labor force, measured both by the number of hours worked and labor force participation. The causal mechanism is unclear: do children who work less become informal caregivers, or are children who become caregivers working less? Using longitudinal data from the *Health and Retirement Study* (HRS), this project identifies the relationship between informal care and labor force participation in the United States, both on the intensive and extensive margins, and whether there are wage penalties from informal care. We use our results to examine retirement wealth effects, in particular, changes in Social Security benefits. In our approach we carefully test for endogeneity; control for time invariant individual heterogeneity; and, lastly, explore the effects across key domains of behavior for men and women – stage and duration of care. We find that there are modest decreases – around 2 percentage points – in the likelihood of being in the labor force for caregivers. We find that female caregivers who have longer spells face significant but modest risks of not working, that the negative effect on work for male caregivers occurs right away, and that both male and female caregivers who have ended caregiving are not significantly more likely to work. In addition, wage penalties exist for female caregivers and wage premiums exist for male caregivers. There are minimal expected changes to caregivers' future Social Security benefits. Finally, despite strong instruments, there is no evidence of endogeneity between informal care and work, suggesting that controlling for individual heterogeneity with fixed effects is a sufficient approach in longitudinal inquiries of informal care's effect on work and wealth.

I. Introduction

For elderly parents, adult children are the most common type of informal care providers, especially daughters. Furthermore, adult children are predicted to be an increasingly important source of informal care as the baby boomer generation ages, the number of divorcees increases, and the differential life expectancy between men and women results in a larger number of widowed elderly women. Given that a typical adult child caregiver is in his or her late 50s or early 60s, and hence still in the labor force, the effect of caregiving on labor market decisions is an important policy issue.

Caregiving could affect work behavior on the extensive margin, the intensive margin, or both (Crespo 2006; Heitmueller 2007). Changes in the extensive margin include quitting work temporarily or retiring early. Changes in the intensive margin include reducing work hours, or taking on fewer responsibilities, or forgoing a promotion to fulfill caregiving obligations (Carmichael and Charles 2003). Both margins are important, with implications for current earnings and potentially longer-term impacts on retirement income that could affect quality of life long after the caregiving episode ends.

Although there is a substantial literature trying to estimate the causal relationship between caregiving and work, it suffers from three main problems. The most significant methodological concern in this pursuit is whether there is an endogeneity problem that leads to biased estimates of the causal effect of informal care on work. Adult children who have poor labor market opportunities may be more likely to become caregivers, creating a selection bias in reduced-form estimates. Much of the older literature ignores the problem, and newer work tries a variety of different estimation methods to address it, and draws mixed conclusions about its existence. Second, much of the longitudinal

literature has focused on Europe, leaving it an open question as to how informal care affects work in the United States over time. The United States has a relatively less generous welfare state than in Europe, less generous public pension coverage, health insurance that is tied to work under age 65, different patterns of female labor market participation, and a more fluid job market. Hence, we might find a much smaller effect of informal care on work in the United States than in Europe. Third, the literature has yet to reach a consensus. Much of the literature looks at either the extensive or intensive margin, or measures the impact on wages, but does not measure all margins of adjustment and ignores the longer-term wealth concerns. Given the lack of consensus about the impact caregiving has on work, it is very difficult to pool estimates across papers to have a comprehensive and cohesive picture of the impact caregiving has on work and wealth.

This paper strives to fill the gap in the literature. Specifically, we identify the relationship between informal care and labor force participation in a U.S. sample of nationally representative prime age working individuals (age 50-64 at the start of the study). We examine both the intensive and extensive margins of work and whether there are wage penalties from informal care. We carefully test for endogeneity and control for time invariant individual heterogeneity. Lastly, we explore the effects across key domains of behavior separately for men and women — stage and duration of informal care — and we use our results to examine retirement wealth effects. A comprehensive approach has been lacking in U.S. studies.[1]

The rest of the paper is as follows: Section Two describes the existing literature and highlights the lack of consensus. Section Three provides details about the data,

[1] Johnson and Lo Sasso (2000) control for unobserved heterogeneity using random effects, but their data is limited to two waves of the HRS and their focus on hours of work neglects to inform us about effects on the extensive margin.

sample selection criteria, and measures. Section Four presents the methodology and models. Section Five presents the main results: informal care's effect on labor force participation and on wages, estimated separately for men and women.[2] Section Five also presents the robustness checks and counterfactual estimates for the retirement wealth effects. Section Six concludes.

II. Background

Ex ante, it is not clear what effect caregiving will have on work in the United States. Time being scarce, caregivers may reduce work hours or exit employment in response to the informal care needs of a parent. However, caregivers may instead decrease their leisure time and maintain their labor force attachment due to financial considerations such as health insurance or because it provides a break from caregiving (Carmichael and Charles 2003; Wilson, Van Houtven, Stearns and Clipp 2007). Further, the relationship between caregiving and work may change over the caregiving spell. A caregiver may try to juggle both for a time, then experience burnout and forgo the other activity. Alternatively, if the care recipient's health deteriorates, the caregiving demands may fall as formal care is sought and hence the number of work hours may increase (O'Hara 2004). Conversely, with health decline of the care recipient the burden of caregiving may increase and work hours may decrease. Hence, it is important to measure the relationship between caregiving duration and work.

As proof of the importance of this topic, the literature exploring the relationship between caregiving and work is quite extensive, using a variety of datasets, country and

[2] We set out to also report the effects of informal care on hours of work (the intensive margin), but there were no significant effects in any specification, so we do not focus on this in the results section.

institutional settings, cross-section and longitudinal approaches, estimation methods, and instrumental variables. However, this long literature has not led to a consensus about the causal relationship between these two activities.[3]

Most studies have found a negative correlation between informal care provision and the extensive and intensive margins of work (Spiess and Schneider 2004; Stone, Cafferata, and Sangl 1987; Stone and Short 1990). Studies that look at different points of the caregiving spell — initiation and termination — generally suggest that women who initiate caregiving are less likely to participate in the labor force, more likely to work decreased hours, and more likely to leave the labor force than non-caregivers, and these changes are not reversed at the end of a caregiving spell (Berecki-Gisolf, Lucke, Hockey and Dobson 2008; Pavalko and Artis 1997; Pavalko and Henderson 2006; Spiess and Schneider 2003; Wakabayashi and Donato 2006).[4] In addition, some studies have found wage penalties, (Carmichael and Charles 2003; Heitmueller and Inglis 2007) forgone promotions, and losses in pension entitlements (Parker 1990) from providing informal care. The existing European literature finds substantial heterogeneity of the impact of caregiving on work, namely that the effect of caregiving on work tends to be stronger for intensive caregivers (Carmichael and Charles 2003; Casado-Marin, Garcia-Gomez, and Lopez-Nicolas 2010; Crespo 2006; Heitmueller 2007; Spiess and Schneider 2003).[5]

[3] Table A1 summarizes the findings of the main published studies that address endogeneity between informal care and work in the cross-section. Table A2 provides detail on the longitudinal studies of informal care, in which either IV methods or longitudinal methods address endogeneity.

[4] Studies that examine the initiation of caregiving include: Berecki-Gisolf et al. 2008; Pavalko and Artis 1997; Pavalko and Henderson 2006; Spiess and Schneider 2003; Wakabayashi and Donato 2005. Studies that study the termination of the spell include Pavalko and Artis 1997 and Spiess and Schneider 2003.

[5] These studies define intensive caregivers by the number of hours of care provided per week/month. However, the data we use only records the hours of care at two-year intervals, making it particularly difficult to identify intensive caregivers based on a measure of hours. We prefer the type of care given, personal care versus chore care, as a better measure of the commitment provided by the child, and will not be able to directly compare our findings to these studies.

Coresidential caregiving has stronger negative effects on work in Europe (Casado-Marin, Garcia-Gomez and Lopez-Nicolas 2010; Heitmueller 2007; Heitmueller, Michaud and Nazarov 2010) whereas only noncoresidential women caregivers experience short-term negative work effects in the United States (Ettner 1995).[6] Some studies find stronger impacts on women caregivers compared to men (Carmichael and Charles 2003; Do, Norton, and Stearns 2008) while others do not (Bolin, Lindgren, and Lundborg 2008; Johnson and Lo Sasso 2006).

Overall, it is hard to discern from the literature the total impact of caregiving on work behavior of American caregivers over a long period. It is unclear if international experience can be generalized to the United States. Virtually all U.S. studies use cross-sectional data and thus cannot distinguish between temporary or permanent work changes. Johnson and Lo Sasso (2000) are the exception in the United States, using two waves of *Health and Retirement Study* (HRS) data and focusing on the intensive work margin (they include non-workers by assigning zero hours of work to them), but the limited panel length means that their findings are for short-term work effects only. Several European studies have focused on labor market outcomes of caregivers at very specific points in a caregiving spell, but none of the studies is truly comprehensive, exploring the intensive, extensive, and wage margins of response at different stages of caregiving, using similar methods on similar data.

[6] We do not have a large enough sample size to measure any heterogeneity of the effect for residential caregivers.

III. Data, Sample Selection Criteria, and Measures

We use data from nine waves of the HRS (1992-2008). The HRS is a nationally representative sample of the near elderly in the United States with rich informal caregiving, labor force, and wealth data. HRS respondents were ages 50 to 64 when they entered the sample, thus, their parents were prime candidates to be care recipients, with ages ranging between 70 and 100, and a mean age of 82.

Sample selection criteria. We examine men and women separately, given their different attachment to the labor force. Sample members include adult children who have at least one parent or parent in-law alive in the current wave or two previous waves, who are observed in at least two waves (Table 1). The 1992 wave did not have chore assistance included in the definition of informal care, which was used in all subsequent waves, thus, for the estimations of any chore or personal assistance, 1992 observations were eliminated (4,458 female-wave and 3,945 male-wave observations). Furthermore, to be included, sample weights had to be non-zero, in order to ensure that our results applied to a nationally representative group of near elderly and elderly adults, (eliminating 3,842 female-wave observations and 1,661 male-wave observations who were very young or very old HRS respondents). Table 1 shows details of the sample inclusion criteria for our baseline estimations — the any caregiving indicator for the LFP and wage specifications — in which there are 18,995 female-wave and 17,775 male-wave observations. The sample size changes slightly in each specification, depending on which measure of informal care we use (any care, personal care, stage, or duration) and whether we are looking at labor force participation (LFP), hours of work, or wages (The exact number of observations in each specification appears at the bottom of tables 5-8).

Dependent variables. We examine three separate self-reported labor market outcomes, taken from the RAND HRS data files. For labor force participation, our first work measure, we categorize anyone who reports that they are working for pay (either for someone else or self-employed) as working, and those out of work, looking for work, or retired as not working. We also explore the usual number of hours worked per week among workers to address the intensive margin of the work decision. Lastly, we examine wages per hour among workers to examine whether informal care causes wage penalties.[7]

Key Explanatory Variables. Informal care is self-reported by the HRS respondents. Specifically, the HRS asks, "Did you spend a total of 100 or more hours (since Previous Wave Interview Month-Year/in the last two years) helping your or your spouse's (parents/mother/father) with basic personal activities such as dressing, eating, and bathing?" The HRS also asks, "Did you spend a total of 100 or more hours (since Previous Wave Interview Month-Year/in the last two years) helping your or your spouse's (parents/mother/father) with other things, such as household chores, errands, transportation, etc.?" Our baseline specification uses the combined discrete measure of any caregiving (personal care and chores), but we explore differential effects for those providing any personal care, as a proxy for intensity of the caregiving episode.[8] Personal care likely indicates a higher commitment of time and effort to caregiving than assistance with chores, given that it represents hands-on care in the care recipient's home (Coe and Van Houtven 2009).

[7] If the respondent reports wages at a frequency other than hourly, the hourly wage rate is calculated using the usual hours worked per week, usual weeks worked per year, and pay rate, and adjusting for the periodicity of pay reported.

[8] The caregiving question regarding chores and errands was not asked in 1992. Thus, we omit the 1992 wave from our specifications that use the combined measure of caregiving. However, we include the 1992 wave in the specifications that use the personal care measure.

Besides the discrete measures of caregiving, we also examine key points during the caregiving experience, in order to examine whether there is a differential effect on work by the stage of a caregiving episode. We look at stage of caregiving, which is whether an adult child has initiated caregiving recently (defined as new to caregiving in the past wave, that is, roughly in the last two years), whether he or she is a continuing caregiver (defined as caring in the previous wave and still reporting caregiving in the most recent HRS interview), and whether he or she reported no longer caregiving in the most recent interview (but caregiving in the previous interview). Besides understanding whether there are initial or continuing effects of caregiving during the episode of care, examining the coefficient on 'ended caregiving' provides information about whether labor market effects are fleeting or permanent. That is, if caregivers who have ended an episode of caregiving are not more likely to work, it suggests that the effects of caregiving on work are permanent.

We also examine the duration of caregiving using a set of dummy variables: providing care anytime in the last two years (reporting caregiving in one wave), providing care during the last four years (reporting caregiving in two consecutive waves), last six years, and last eight or more years. The reference group is no caregiving. Examining duration of caregiving is of interest because it can capture phenomena such as informal care becoming more difficult to juggle along with work responsibilities the longer the caregiving episode lasts.

Additional explanatory variables. The models include individual fixed effects to capture time-invariant observed and unobserved individual characteristics. Thus many of the standard demographic variables shown to be important in other labor supply models

are not included here, such as the respondent's race and education. However, time-varying characteristics remain: marital status, age and age squared, a discrete variable for achieving the Social Security early entitlement age (62) or full retirement age (65-66 depending on birth year), discrete variables for self-reported health (poor/fair and good with excellent as the omitted category) and changes in home ownership (1 indicates person is a home owner).

The strength of one's attachment to the labor force is measured in years of previous work experience, tenure, and, for the wage equation only, whether a person was a salaried worker (versus a wage worker). Individual logged spousal earnings, as well as a dummy variable for one's spouse having no earnings, are included. Household characteristics in the models include household size, whether there is a child under the age of 18 in the home, and household asset quartiles (lowest quartile omitted). Wave dummies control for time trends in the data.

Selection

We take seriously the issue of differential selection into caregiving, as have many other researchers examining this question. With the exception of Crespo (2006), most studies are not able to reject exogeneity of informal care with respect to work (Bolin, Lindgren, and Lundborg 2008; Casado-Marin, Garcia-Gomez, and Lopez-Nicolas 2010; Heitmueller, Michaud, and Nazarov 2010; Heitmuller 2007; Wolf and Soldo 1994) or can reject exogeneity only at borderline significance levels (Johnson and Lo Sasso 2006). These studies use various techniques to address the selection issue, including simultaneous equations (Wolf and Soldo 1994), lags and leads of caregiving (Heitmueller

2007), dynamic panel data methods (Heitmueller, Michaud, and Nazarov 2010) or instrumental variables. However, some of the instruments are weak (Bolin, Lindgren, and Lundborg 2008; Heitmueller 2007) or their own exogeneity has been called into question (for example, distance between parents and children or lagged work status). Thus, there is no consensus about the importance of controlling for endogeneity bias in studies of informal care and work.

We undergo extensive testing for potential endogeneity. Appendix Table A3 provides detailed results of these tests. The group of identifying instruments differs slightly across specifications, but includes: an indicator for parent or in-law needs assistance with ADLs; indicator for parent or in-law cannot be left alone; separate indicators for mother, father, mother-in-law, and father-in-law has not been alive at any time in the last two years; separate indicators for mother (mother-in-law) became widowed at some point since the last wave. The instruments are empirically strong (Table A3). Regardless of which of the four groups of instruments is used, the joint *F*-statistics are far above the conventionally accepted floor of 10 (Staiger and Stock 1997) and the partial *R*-squared values range from .015 to .05.

The instruments are also theoretically strong. Having a parent or in-law who is widowed means the spouse is not available to assume the caregiving role, increasing the demand for an adult child or child-in-law to provide care. ADL limitations or memory problems of a parent or parent-in-law should directly increase demand for informal care but not directly affect work behavior other than through the informal care path. A parent's health is not likely to affect the work outcome directly, but instead through the informal care behavior of the child. There is some concern that one's parents' health may

affect work directly, if this provides new information about the child's own ability to work later, or if the mental health of watching a parent decline has a direct negative effect (Amirkhanyan and Wolf 2006). We suspect these pathways are unlikely to be strong enough to affect work directly. Yet even in specifications that did not use parent health as identifying instruments (bottom row of Table A3), the instruments were jointly strong (*F*-statistic ranging between 32 and 84, and partial *R*-squared statistics of .015 to .05). Thus, if parent health is not viewed to be theoretically palatable, the other instruments remain strong.

IV. Methods

We model the labor market decisions of the HRS respondents as a function of individual characteristics and caregiving activity. The basic specification is:

$$LFP_{c,t+2} = \alpha + \beta_1 A_{c,t+2,t} + \beta_2 X_c + \beta_3 X_s + \beta_4 X_H + \mu_c + \varepsilon_{c,t} \quad (1)$$

The work outcome, *LFP*, measures whether or not an adult child works.[9] Informal Care, A_c, is defined as: any personal or chore informal care; any personal care; stage of informal care (initial, continuing, or recently ended); and duration of informal care (two waves, four waves, six waves, eight or more waves). The vector X_c refers to time varying individual characteristics of the adult child, such as age, marital status, self-reported health, home ownership, and work attributes, such as experience. X_s refers to spousal work attributes, such as logged spousal earnings and zero spousal earnings. X_H

[9] We also ran the same regression on the number of hours worked per week, conditional on being in the labor force. Caregiving never has an impact in the hours equation (results available by request).

refers to time-varying household characteristics such as household asset quartiles, having a child under 18 in the household, and household size.

For the subsample who work, we also estimate the log hourly wage, using the following equation:

$$W_{c,t+2} = \alpha + \beta_1 A_{c,t+2,t} + \beta_2 Y_c + \beta_3 J_c + \mu_c + \varepsilon_{c,t} \quad (2)$$

We augment a traditional Mincer wage equation by including informal care, A_c, defined as above, and Y_c is a vector of time-varying individual characteristics, including a married indicator and self-reported health category indicators. J_c is a vector of job characteristics, including experience, experience squared, tenure, tenure squared, and indicator for whether a person was a salaried or a wage worker.

Both models include fixed effects (μ_c), to control for time invariant individual unobserved heterogeneity. The use of fixed effects helps ensure that differences in labor market attachment not attributable to caregiving, such as distaste for work or unobserved disability, are not driving the results.

V. Results

Descriptive results.

Caregiving adult daughters were very similar to non-caregiving adult daughters in their labor force participation, with around 48 percent of them reporting working. Caregiving daughters worked around half an hour less a week than non-caregiving daughters, 34.2 compared to 34.8 hours per week. Along with working fewer hours, caregiving daughters had slightly lower average hourly wages among workers, at $15.07 per hour compared to $16.67 per hour for non-caregivers. Among adult sons, labor

participation was 3 percentage points higher across all waves for non-caregivers, with 56 percent of caregivers working compared to 59 percent of non-caregivers. Hours of work per week were similarly slightly lower among caregiving sons compared to non-caregiving sons by just under two hours per week, as were wages (by $0.60 an hour).

There are some surprising characteristics of caregivers compared to non-caregivers in the sample. Caregivers were more educated than non-caregivers, with 18.7 percent (25.7 percent) of adult female (male) caregivers completing college compared to 16.4 percent (24.3 percent) of non-caregiving females (males), and a similar pattern exists for the other education categories. Most striking, 17 percent (17.8 percent) of caregiving females (males) had less than a high school education whereas nearly 26 percent (27.5 percent) of non-caregiving females (males) did. In general, differences by caregiving status are more evident for females than for males. Female caregivers had higher rates of home ownership than non-caregiving women (by 5 percentage points), had longer attachment to the labor force (as measured by years of experience), and rated their own health higher than non-caregiving females. These descriptive statistics do not square with the conventional wisdom that the adult child with the lowest opportunity cost of time may become the caregiver.

Age and marital status are similar by caregiving status, yet a lower proportion of caregiving females are non-white compared to non-caregiving females. This difference is more pronounced among men: 12.9 percent of caregiving males were non-white, whereas 15.8 percent of non-caregiving males were non-white.

In addition, there is great variation in caregiving stages and duration in the sample (Table 2a). Eleven percent (10.63 percent) of the female (male) sample recently had

initiated caregiving and 18.8 percent (13.6 percent) of the female (male) sample was in a continuing caregiving phase. It was most common to be observed caregiving in an early duration of caregiving, with just under 14 percent of the female sample and 13 percent of the male sample providing care for one wave. The proportion of the sample providing longer-term caregiving declined as one looked farther out in duration, with 4 percent and 3 percent of women and men, respectively, providing care for three waves (up to six years) and 4.5 percent and 2.7 percent of women and men, respectively, providing care for four waves or more.

Transitions between work and caregiving are found in tables 3 (for women) and 4 (for men). Looking across the diagonal from top left to bottom right shows that behavior is persistent: for example, 60 percent of women who were not working and not caregiving in time *t* were also not working and not caregiving two years later (*t+2*). Around two-thirds of women and men who were working and not caregiving in time t were also in that state in time *t+2*. Caregiving behavior is less persistent than working behavior, with around 50 percent (46 percent) of women (men) remaining in a caregiving-only state in *t+2*. Similarly, around 46 percent (43 percent) of women (men) were working and caregiving at *t* and t+2.

Among women working and caregiving in time *t*, 12.8 percent were only caregiving two years later. This compares to just under 10 percent for men. Not surprisingly given the age profile of the sample, few persons who were caregiving only in time *t* picked up work two years later, around 4 percent of women and 5 percent of men. A higher proportion of women (men) who were only working in *t* started caregiving (and remained working) two years later, around 14.6 percent (12.2 percent).

Main Results.

After including individual fixed effects, we could not reject exogeneity between informal care and work, despite strong instrumental variables (Table A3). Thus, we present the results from reduced form models of informal care and work treating informal care as exogenous. We discuss both the decision to work or not (extensive margin) and logged wages among workers, examining differential effects by the different caregiving definitions (any chore or personal; any personal care; stage of care; duration of care). Unless noted in parentheses in the text, the significant effects discussed below have a significance level of at least 5 percent.

Extensive Margin.

Any informal care. The linear probability model with individual fixed effects indicates that caregiving of any type, e.g., assistance with either chores, personal tasks, or both, has a modest, but significant, negative effect on labor force participation for both men and women (Table 5). Women caregivers have a reduction in the likelihood of working by 1.3 percentage points ($p<0.10$), whereas male caregivers have a reduction of 1.7 percentage points. These represent a reduction in the mean participation rates of almost 3 percent (2.7 percent for women and 2.9 percent for men). Limiting the definition of informal care to personal assistance with activities of daily living, the effects are about twice as strong for women (2.4 percentage points) or a 5 percent decrease from mean LFP rates. For men, the impacts are also stronger; there is a 2.3 percentage point reduction in the likelihood of any work, or a 4 percent decrease from the mean.

Some of the strongest negative effects on labor force participation are the Social Security early and full retirement ages. Being over 62 makes women 6-7 percentage points less likely to work and men 9-10 percentage points less likely. The effects are similar for being at least 65 years old. Being married makes one less likely to work for men and women, with a larger magnitude for women. Being in poor or fair health makes one less likely to work for women and men than those in good health or better — women in poor or fair health are 7.6 percentage points less likely to work compared to women in excellent health, whereas men are 10 percentage points less likely to work. More experience increases the likelihood of working for men and women. Finally, higher earnings of one's wife make a man more likely to work, but one's husband's earnings do not matter for women. Many of these secondary findings are consistent across all of the definitions of informal care, which we will discuss next.

Stage of informal care. To define stage of informal care, we looked at where the person was in the caregiving episode, in the first wave (initiate), in the middle of caregiving (e.g., provided care in the previous wave and reported still caregiving at the last HRS interview), and recently ended caregiving (e.g., caregiving in the previous wave(s) but no longer caregiving in the last wave). Caregiving includes the broader definition for these specifications — chores and/or personal assistance. Among women, caregivers who were in the continuing stage of caregiving had a reduced likelihood of working by 2.2 percentage points ($p<0.10$) (Table 6). For men, the only stage of caregiving that significantly reduces labor force participation is when caregiving is first initiated, that is, when a man has provided care for less than two years ($p<0.10$).

A positive and significant sign on the "end caregiving" dummy variable would

indicate that caregivers have an increased likelihood of entering, or re-entering, or remaining in the labor force. We find no evidence that caregivers are more likely to work once caregiving has ended (Table 6). We have also tested for lagged impacts of returning to work after a caregiving episode ends, that is, to understand whether people are more likely to work two years after the care episode ended, and still do not find any significant effects on work. This suggests that the measured impacts of informal care on labor force participation are permanent.

Duration of informal care. For women caregivers, the reduction in labor force participation observed using a discrete measure of caregiving (Table 5), appears to occur between the first two and the first four years of being a caregiver (see coefficient on "2 waves of caregiving" in Table 6), with women caregivers in this phase having a 2.5-percentage-point reduction in their labor force participation compared to non-caregivers. This finding is consistent with the findings that continuing caregivers have a negative impact on work. The effect of caregiving for other durations (four-six, six-eight, or eight or more years) on any work are not significant for women.

The labor force participation effects of caregiving for men, by contrast, are more immediate. Controlling for the duration of caregiving, men who had provided care for two years or less (one wave only) were significantly less likely to work compared to non-caregivers (1.7 percentage points less likely). There were no other periods of duration that have significant effects on work for male caregivers (Table 6).

Wage Penalties.

Providing any informal care (chores and/or personal care) has a negative effect on female workers' wages. Becoming a caregiver leads to a 3-percent reduction in a woman's hourly wage on average compared to not becoming a caregiver ($p<0.10$) (Table 7). Using a Duan smearing factor to account for retransformation bias (Duan 1983), female caregivers are predicted to have a wage of $12.57 compared to $12.94 for non-caregivers, or a loss of $0.37 per hour in absolute terms. Extrapolating to a year's worth of work given mean hours a week worked among workers observed in our sample was 35 and, assuming 52 weeks of paid work a year, the wage penalty accumulates to $670 in lost earnings for one year. Being a personal care task caregiver does not have a significant effect on women's wages. We do not find evidence of a wage penalty among male workers in this specification (Table 7).

Examining stage of informal care, there is evidence that female caregivers in the continuing stage, that is, caring for at least two years and not yet finished caregiving, have a significant wage penalty, by just under 5 percent ($p<0.10$). There is no evidence that caregivers who have recently ended caregiving face a wage penalty, thus, the wage effects among caregivers who remain in the workforce are limited to during the caregiving episode.

For men, caregivers in the initial phase see a statistically significant increase in their hourly wage, by 9.1 percent (Table 8, column III). This result is somewhat puzzling, considering time trends are controlled for in the model. For men who have recently ended caregiving, there is the same magnitude increase in the hourly wage, of 9.5 percent. Using predictions of the linear wage and adjusting by a Duan smearing

factor to account for retransformation bias, this translates to a predicted hourly wage increase of $2.26 for male caregivers who have recently ended caregiving, compared to never-caregivers ($24.88 for caregivers versus $22.62 for non-caregivers). One potential explanation is that male caregivers are also likely to have a wife providing care, and thus he may be increasing his work hours in order to make up for her lost wages. We leave it to future work to examine the intra-household bargaining decisions between husbands and wives during a caregiving episode.

Regarding duration of care, there were no commensurate wage effects for men — men with longer duration of caregiving had negative but non-significant wage effects. Working women caregivers, on the other hand, were seen to have a considerably lagged effect on wages. Female workers who reported providing care in four or move waves of the HRS faced a large wage penalty, upward of a 14-percent reduction in the hourly wage (Table 8). Relating this effect to the predicted hourly wages of long duration caregivers ($11.25) versus non-caregivers ($12.90), this translates to a loss of $1.65 an hour. Of course, this is the rarest type of caregiver, with only 4.5 percent of the female sample providing care for such a long duration (Table 2a). Nevertheless, making the same assumptions about hours per week and weeks per year paid, this totals around $3,000 in lost earnings per year for this sub-group. Notably, this wage difference is much higher in magnitude than in the case where caregiving is measured discretely as providing any care in the past two years. Thus, considering stage and duration picks up important dynamic effects of the relationship between informal care and work that would be masked with a more simplistic approach.

Impact of Informal Caregiving on Retirement Income.

Beyond the immediate impact caregiving has on labor market outcomes, it is also important to estimate the longer-term impact that caregiving may have on lifetime wealth and retirement income. In order to do so, we use our results to estimate the change in Social Security wealth for caregivers.

First, we use the labor force participation model results (detailed in Table 5) to predict the probability that an individual is working. We define a cutoff point in the predicted probability (58 percent for men, 50 percent for women) over which we say the individual is working, based on the threshold that best matches the prediction to observed behavior. For informal care providers, we then run the counterfactual for the wave in which they begin caregiving and all subsequent waves, and predict the likelihood they would work if they did not provide care. Using the same cutoff points described above, our estimates indicate that an additional 2.4 percent of caregivers would work if they had not been caregivers.

Then, we use our estimated wage equations to predict the wage for caregivers, both in the baseline and in the counterfactual when they do not provide care. If we predicted them to work and they had not otherwise, we also adjust upward the experience and tenure variables in the wage equation, allowing indirect effects on wages to enter through the increased experience and tenure. We then use the historical earnings information from the Social Security matched dataset and our estimates of earnings between the initial wave of caregiving for an individual until 2008 to calculate an individual's Social Security monthly benefit amount as if they claimed at age 62.[10]

[10] For some respondents we only estimate their counterfactual behavior until 2006 because they attrite from the sample by 2008.

Comparing Social Security benefits under these two scenarios leads us to believe that caregiving does not lead to substantial changes in Social Security benefits for this cohort, for a variety of reasons. First, the additional number of workers is small, only 2.4 percent (36 of 1494 individuals). Second, the increase in the primary insurance amount (PIA) associated with these added workers is too small to amount to a large change in the benefit. The additional years of work for most of these individuals do contribute to the top 35 years of their working history (30 out of the 36), with a resulting increase to the PIA ranging from $1.52 to $65.86 a month (in 2008 dollars). Yet, because 98 percent of the sample faces no increase in their PIA through an increase in wages, the end result is that there is very little impact on Social Security benefits. Finally, 23 percent of the care providers who are married with both members of the couple being at least age 62 have sufficiently higher-earning spouses, so a few additional years of earnings do not change their actual Social Security benefit.

VI. Conclusion

In general, the magnitude of the effects on labor force participation of providing any informal care is similar for men and for women. Our findings, of a 1.2 to 2.4-percentage-point drop in labor force participation for women and 1.7 to 2.3-percentage-point drop for men, is near the lower end of the zero (Bolin 2008) to 40 (Crespo 2006) range found in the current international literature. The lower response in the United States may be due to the relatively less generous social safety net in the United States compared to Europe. That said, we also find no change in the intensive work margin, in contrast to the only other U.S. study using panel data and controlling for unobserved

heterogeneity. Johnson and LoSasso (2006), who find that women caregivers who provided care in the past two years cut back their current work hours by 367 hours in the current year (1998), a 41-percent reduction on average (Johnson and Lo Sasso 2006). Their approach differs from ours in considering non-caregivers in the estimation of the intensive margin (assigning zero hours to them) and using only two waves of data.

We find that longer-duration female caregivers face significant but modest risks of exiting the labor force, that the negative effect on work for male caregivers occurs right away, and that both male and female caregivers who have ended caregiving are not significantly more likely to be working.

We also find modest wage penalties among female caregivers when measuring caregiving discretely, around $0.40 per hour in wages. Wage penalties become more pronounced for long-duration caregivers, upward of $3,000 for one year of work among caregivers who had cared for four or more waves, compared to non-caregivers. We find a wage premium among male caregivers who recently initiated caregiving and who recently ended caregiving, compared to non-caregivers. The wage benefits to these male caregivers are not insubstantial — a $2.20-an-hour gain in predicted wages. This result is hard to interpret, but may have to do with joint-caregiving decisions in the household, in which the caregiving responsibility falls primarily upon the wife. It could also be that lower wage caregiving men drop out of the labor force, and higher paid men are still in the labor market, so the average wage increases among workers.

Using the results from the labor force participation estimations, we find that the ramifications for a caregiver's future Social Security benefits are miniscule, mostly driven by the lack of movement in working behavior that informal care is found to

induce. The counterfactual exercise shows that only a very small proportion of caregivers would have experienced higher Social Security benefits (2.4 percent) if they had never become caregivers.

Our approach has allowed us to learn about three important features that should be considered in future work: 1) We do not find evidence of endogeneity across any of the specifications explored in this paper, despite theoretically and empirically strong instruments. We conclude from this that selection bias may not be a major concern in this line of research once one controls for individual heterogeneity with fixed-effects. 2) Overall there are not major work disruptions or large negative wage effects of caregiving except in special cases, such as for long-duration caregivers in the United States. Not measuring caregiving in terms of stage and duration would have missed these important effects. Finally, 3) it is important to model separately the effects of caregiving on men and women. Whereas the women and men look very similar to each other in the labor force participation equations, male caregivers tend to experience work effects immediately upon caregiving whereas for women caregivers, there is a lagged effect. In addition, men experience a wage premium from caregiving whereas women experience a wage penalty in several cases.

It is likely that labor market effects of caregiving occur that we did not measure. We do not model the joint labor supply changes of a couple in the face of caregiving. Given that decisions about caregiving for one's parents or in-laws is likely a household decision, there may be minimal effects in our current paper because a non-working spouse can take up the slack. Extending this work to considering joint-labor market effects and joint-caregiving will enlighten us about the importance of this phenomenon.

Table 1. Sample Attrition

	LFP Estimation		Wage Estimation	
	Women	**Men**	**Women**	**Men**
Person-wave observations (1992-2008)	50,867	40,756	50,867	40,756
Have at least one parent or parent in-law alive in current wave or previous two waves	27,430	23,458	27,430	23,458
Eliminate 1992 wave (no chore caregiving question asked)	22,972	19,513	22,972	19,513
Have non-zero sample weight	19,130	17,852	19,130	17,852
Working in current wave			9,112	10,303
Non-missing wage			7,854	8,702
Person-wave observations in estimation	18,995	17,775	7,744	8,562
Unique individuals in estimation	4,239	3,879	2,629	2,670

Note: This sample size is for the any caregiving specification that predicts labor force participation and wages. For duration of caregiving (2, 4, 6, and 8 or more waves) we use the same sample as described in this table. When we use the personal caregiver indicator we gain observations since we can also estimate on the 1992 wave. For stage of caregiving (initiate, continue, and recently ended caregiving) we lose observations since we can only create such variables for 1996 and on. The sample sizes for the latter two specifications are reported in each of the results tables.

Table 2. Characteristics of Adult Children

Variable Description	Women		Men	
	Caregivers	**Non-Caregivers**	**Caregivers**	**Non-Caregivers**
Dependent variables				
Working for pay	0.485	0.473	0.556	0.585
Hours of work /week (for those who work)	34.19 (14.61)	34.78 (14.17)	39.37 (15.32)	41.12 (15.13)
Hourly wage	15.07 (24.25)	16.67 (51.63)	24.89 (58.00)	25.50 (65.70)
Log hourly wage (for those who work)	2.43 (0.68)	2.42 (0.75)	2.77 (0.87)	2.75 (0.88)
Age	61.18 (4.96)	61.06 (5.39)	62.99 (5.37)	62.95 (5.79)
Between ages of 62 and 65	0.194	0.181	0.201	0.192
Age 65 or older	0.214	0.218	0.338	0.335
Married	0.723	0.716	0.852	0.860
Non-white	0.162	0.188	0.129	0.158
Less than high school education	0.170	0.256	0.178	0.275
High school education	0.413	0.369	0.349	0.298
Some years of college	0.230	0.211	0.216	0.184
College graduate	0.187	0.164	0.257	0.243
Has a child under 18	0.029	0.041	0.056	0.088
Household size	2.314 (1.03)	2.372 (1.21)	2.415 (0.98)	2.504 (1.17)
Excellent or very good self-reported health	0.495	0.468	0.470	0.448
Good self-reported health	0.304	0.290	0.323	0.313
Fair or poor self-reported health	0.201	0.242	0.207	0.239
Years of work experience	28.18 (13.68)	25.984 (14.10)	40.132 (9.25)	39.673 (9.97)
Home owner	0.881	0.833	0.898	0.865
Person-wave observations	5,783	13,212	4,392	13,383

Source: Authors' calculations from the HRS.

Table 2a. Caregiving behavior by stage and duration of care

	Women	Men
Caregiving Stage (%)		
Recently initiated caregiving	11.00	10.63
Continuing caregiving	18.82	13.58
Recently ended caregiving	13.89	12.50
Not caregiving in current wave and did not recently end caregiving	56.29	63.29
Number of observations	18,995	17,775
Caregiving Duration (%)		
0 waves	70.60	76.30
1 wave	13.82	12.68
2 waves	6.90	5.47
3 waves	4.23	2.86
4+ waves	4.45	2.69
Number of observations	22,111	21,049

Note: The table shows the percentage of female-waves and male-waves falling into each category of caregiving stage for the specification for LFP with caregiving stage indicators on the RHS (Table 6 results, columns II, IV) and the percentage of female-waves and male-waves falling into each category of duration for the specification for LFP with duration indicators on the RHS (Table 6 results, columns I, III) and into each category. As such, the number of non-caregivers is not exactly the same across samples. Adding up the proportion who were initial and continuing caregivers roughly equals the proportion who were 1, 2, 3, or 4+ duration caregivers.

Table 3. Transitions between Work and Caregiving for Women

	Time *t+2*			
Time *t*	Not working, not caregiving	Working only	Caregiving only	Working, caregiving
Not working, not caregiving	4,618 (59.59)	1,557 (20.09)	1,023 (13.20)	551 (7.11)
Working only	821 (15.40)	3,536 (66.33)	198 (3.71)	776 (14.56)
Caregiving only	1,053 (40.38)	105 (4.03)	1,300 (49.85)	150 (5.75)
Working, caregiving	237 (8.90)	842 (31.63)	341 (12.81)	1,242 (46.66)

Source: Authors' calculations from the HRS. Percent of each row given in parenthesis.

Table 4. Transitions between Work and Caregiving for Men

	Time *t+2*			
Time *t*	Not working, not caregiving	Working only	Caregiving only	Working, caregiving
Not working, not caregiving	3,467 (51.23)	2,088 (30.85)	679 (10.03)	534 (7.89)
Working only	940 (14.54)	4,539 (70.23)	199 (3.08)	785 (12.15)
Caregiving only	727 (43.82)	86 (5.18)	771 (46.47)	75 (4.52)
Working, caregiving	196 (8.89)	842 (38.19)	213 (9.66)	954 (43.27)

Source: Authors' calculations from the HRS. Percent of each row given in parenthesis.

Table 5: Linear probability model of Informal Care's Effect on Labor Force Participation

	Women		Men	
	I	**II**	**III**	**IV**
Care Definition				
Caregiver (any type)	-0.0129*		-0.0170**	
	(0.0075)		(0.0081)	
Personal caregiver		-0.0242***		-0.0228**
		(0.0091)		(0.0107)
Demographics				
Age	-0.0446**	-0.0173	-0.0732***	-0.0526**
	(0.0226)	(0.0202)	(0.0246)	(0.0208)
Age squared	0.0002*	0.0000	0.0005***	0.0004***
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Age 62 indicator	-0.0648***	-0.0744***	-0.0891***	-0.1028***
	(0.0098)	(0.0093)	(0.0104)	(0.0095)
Age 65 indicator	-0.0947***	-0.1016***	-0.1114***	-0.1249***
	(0.0146)	(0.0142)	(0.0144)	(0.0135)
Married	-0.0627***	-0.0706***	-0.0394**	-0.0391**
	(0.0166)	(0.0150)	(0.0194)	(0.0167)
Child under 18 indicator	-0.0394*	-0.0533***	-0.0304*	-0.0284**
	(0.0228)	(0.0179)	(0.0173)	(0.0136)
Household size	-0.0137***	-0.0119***	0.0115**	0.0100**
	(0.0043)	(0.0038)	(0.0046)	(0.0040)
Good self-reported health	-0.0105	-0.0056	-0.0276***	-0.0226***
	(0.0088)	(0.0080)	(0.0088)	(0.0079)
Fair/poor self-reported health	-0.0768***	-0.0758***	-0.0959***	-0.0968***
	(0.0128)	(0.0118)	(0.0123)	(0.0112)
Work Attributes				
Experience	0.0053***	0.0038**	0.0279***	0.0313***
	(0.0017)	(0.0015)	(0.0020)	(0.0017)
Spouse's Work Attributes				
Log spousal earnings	0.0053	0.0070	0.0150***	0.0142***
	(0.0052)	(0.0048)	(0.0055)	(0.0047)
No spousal earnings indicator	-0.0097	0.0069	0.0610	0.0580
	(0.0523)	(0.0479)	(0.0522)	(0.0452)
Socio-economic Status				
Home owner	-0.0026	-0.0048	0.0314*	0.0349**
	(0.0163)	(0.0144)	(0.0175)	(0.0153)
2nd asset quartile	-0.0001	-0.0003	0.0493***	0.0417***
	(0.0118)	(0.0108)	(0.0121)	(0.0109)
3rd asset quartile	-0.0119	-0.0090	0.0356**	0.0242*
	(0.0141)	(0.0129)	(0.0146)	(0.0130)
4th asset quartile	-0.0268	-0.0251*	0.0140	-0.0025
	(0.0167)	(0.0152)	(0.0169)	(0.0150)
Constant	2.2604*	1.4854	2.2604*	1.4746
	(1.2849)	(0.9241)	(1.1812)	(0.9736)
Person- wave observations	18,995	22,111	17,775	21,049
Unique individuals in estimation	4,239	4,371	3,879	4,074
R-squared	0.69	0.67	0.68	0.66

Robust standard errors in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%
Note: All regressions also include individual fixed effects and wave dummy variables.

Table 6: Linear probability model of Stage of Informal Care's Effect on Labor Force Participation

	Women		Men	
	I	**II**	**III**	**IV**
Care Definition				
Initiate caregiving	-0.0184		-0.0214*	
	(0.0115)		(0.0122)	
Continue caregiving	-0.0218*		-0.0115	
	(0.0120)		(0.0135)	
End caregiving	-0.0035		0.0012	
	(0.0101)		(0.0114)	
1 wave of caregiving		-0.0083		-0.0166*
		(0.0089)		(0.0093)
2 waves of caregiving		-0.0245**		-0.0140
		(0.0120)		(0.0133)
3 waves of caregiving		-0.0146		-0.0203
		(0.0152)		(0.0184)
4+ waves of caregiving		0.0024		0.0050
		(0.0170)		(0.0216)
Person-wave observations	16,130	18,995	14,824	17,775
Unique individuals in estimation	4,084	4,239	3,691	3,879
R-squared	0.72	0.69	0.70	0.68

Robust standard errors in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%
Note: All regressions also include all variables shown in table 5, individual fixed effects, and wave dummy variables.

Table 7. Informal Care's Effect on Logged Hourly Wage

	Women		Men	
	I	**II**	**III**	**IV**
Care Definition				
Caregiver (any type)	-0.0296*		0.0281	
	(0.0173)		(0.0253)	
Personal caregiver		-0.0176		-0.0054
		(0.0238)		(0.0326)
Demographics				
Married	-0.0008	-0.0307	0.0213	0.0144
	(0.0416)	(0.0339)	(0.0528)	(0.0429)
Good self-reported health	0.0130	0.0045	0.0122	0.0137
	(0.0207)	(0.0180)	(0.0225)	(0.0193)
Fair/poor self-reported health	0.0560*	0.0388	0.0307	0.0323
	(0.0335)	(0.0296)	(0.0342)	(0.0289)
Work Attributes				
Experience	0.0107	0.0190	0.0650**	0.0802***
	(0.0218)	(0.0185)	(0.0261)	(0.0201)
Experience squared	-0.0001	-0.0002**	-0.0003*	-0.0004**
	(0.0001)	(0.0001)	(0.0002)	(0.0002)
Tenure	0.0206***	0.0221***	0.0225***	0.0225***
	(0.0045)	(0.0037)	(0.0052)	(0.0040)
Tenure squared	-0.0002	-0.0003**	-0.0002	-0.0003**
	(0.0002)	(0.0001)	(0.0001)	(0.0001)
Salaried worker	0.0656**	0.0480*	0.0626*	0.0887***
	(0.0282)	(0.0252)	(0.0381)	(0.0330)
Constant	2.2598***	1.7890***	0.2650	0.0570
	(0.8182)	(0.4437)	(1.0815)	(0.5866)
Person-wave observations	7,744	9,472	8,562	10,832
Unique individuals in estimation	2,629	2,918	2,670	3,013
R-squared	0.75	0.74	0.72	0.71

Robust standard errors in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%
Note: All regressions also include individual fixed effects and wave dummy variables.

Table 8. Stage of Informal Care's Effect on Logged Hourly Wage

	Women		Men	
	I	**II**	**III**	**IV**
Care Definition				
Initiate caregiving	-0.0295		0.0914**	
	(0.0264)		(0.0427)	
Continue caregiving	-0.0490*		0.0536	
	(0.0284)		(0.0554)	
End caregiving	-0.0164		0.0953**	
	(0.0310)		(0.0464)	
1 wave of caregiving		-0.0248		0.0352
		(0.0201)		(0.0257)
2 waves of caregiving		-0.0224		0.0500
		(0.0248)		(0.0467)
3 waves of caregiving		-0.0272		-0.0452
		(0.0300)		(0.0589)
4+ waves of caregiving		-0.1370***		-0.0544
		(0.0483)		(0.0623)
Demographics				
Married	-0.0127	0.0049	0.0429	0.0208
	(0.0399)	(0.0419)	(0.0545)	(0.0527)
Good self-reported health	-0.0047	0.0117	0.0078	0.0129
	(0.0233)	(0.0208)	(0.0279)	(0.0226)
Fair/poor self-reported health	0.0395	0.0551	0.0097	0.0327
	(0.0381)	(0.0336)	(0.0388)	(0.0341)
Work Attributes				
Experience	0.0070	0.0099	0.0964***	0.0644**
	(0.0264)	(0.0219)	(0.0335)	(0.0259)
Experience squared	-0.0001	-0.0001	-0.0005*	-0.0003*
	(0.0001)	(0.0001)	(0.0002)	(0.0002)
Tenure	0.0198***	0.0207***	0.0214***	0.0223***
	(0.0047)	(0.0045)	(0.0072)	(0.0052)
Tenure squared	-0.0002	-0.0002	-0.0002	-0.0002
	(0.0002)	(0.0002)	(0.0002)	(0.0001)
Salaried worker	0.0604*	0.0624**	0.0219	0.0590
	(0.0330)	(0.0280)	(0.0465)	(0.0379)
Constant	2.4576**	2.2870***	-0.5398	0.2891
	(0.9822)	(0.8197)	(1.0725)	(1.0729)
Person-wave observations	6,292	7,744	6,655	8,562
Unique individuals in estimation	2,325	2,629	2,348	2,670
R-squared	0.77	0.75	0.74	0.72

Robust standard errors in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%
Note: All regressions also include individual fixed effects and wave dummy variables.

Appendix Table 1. Cross-sectional studies that test for endogeneity of informal care and work.

Paper	Country	X-Section v. Long	Intensive vs. Any?	Co-residential	Men v. Women	Married v. Single	Instruments	IVs Empirically Strong?	Evidence of Exogeneity
Bolin, Lindgren, Lundborg (2008)	Europe	Cross-Section	Log of weekly hours of care is variable of interest; indicator for any caregiving in sensitivity analysis	Exclude coresidents in main analysis; distinguish between them using indicators in sensitivity analysis	Yes	Marital status controlled for in regressions	Indicator for mother's health is bad/very bad, indicator for father's health is bad/very bad, mother's age, father's age, indicator for mother lives 100+ km away, indicator for father lives 100+ km away, indicator for mother is deceased, indicator for father is deceased, total # of living siblings	Generally strong for full sample and female sample; poor for male sample	Generally cannot reject exogeneity
Casado-Marin, Garcia-Gomez, Lopez-Nicolas (2010)	Spain	Longitudinal	Yes	Yes	Only Women	Marital status controlled for in regressions	Does not IV in main analysis but employs FE and allows for state dependence in a dynamic ordered probit model; in sensitivity analysis they estimate a bivariate dynamic model of caregiving and employment with fixed effects and allowing for correlation among the random components of the eqns where the instrument or excluded variable in the caregiving eqn is an indicator for whether there was anyone 65+ in the household in the previous period.	Indicator for 65+ in household in previous period is significant at 5%	Cannot reject exogeneity (in this case no correlation between random components of error terms)
Crespo (2006)	Europe	Cross-Section	Only consider caregivers who provide care on daily or weekly basis	Not in estimation, only descriptive stats	Only women	Marital status controlled for in regressions	Age of oldest parent (Yes), dummies for health status of parent that is in worst health (Sometimes), dummies for having sisters (Yes) and brothers (No), dummy for both parents alive (Sometimes), parents' income (No)	Some are significant. The validity and explanatory power of the variables used as `instruments' for the caregiving indicator have been checked.	Evidence of positive correlation between unobservables in the error term of the LFP equation and caregiving regressor (note: simultaneous bivariate probit is the estimation technique).

Appendix Table 1 (cont.). Cross-sectional studies that test for endogeneity of informal care and work.

Paper	Country	X-Section v. Long	Intensive vs. Any?	Co-residential	Men v. Women	Married v. Single	Instruments	IVs Empirically Strong?	Evidence of Exogeneity
Ettner (1996)	US	Cross-Section	No	Yes	Yes	Marital status controlled for in regressions	Subsets of indicator for parents are married, # of brothers, # of sisters, assessment of father's health on 1-5 scale, assessment of mother's health on 1-5 scale, father's age, mother's age, indicator for father's health and age missing, indicator for mother's health and age missing, father's SES, mother's SES, indicator for father's SES missing, indicator for mother's SES missing	Yes	No discussion or statistics provided, just comparison of coefficients when assuming endogeneity v. exogeneity.
Heitmueller (2007)	UK	Both	Yes	Yes	Gender controlled for in regressions	Marital status controlled for in regressions	In cross section analysis: # of sick/disabled people in household, age of 3 closest friends of respondent; in longitudinal analysis quasi-fixed effects method used with lags and leads of caregiving in all periods used	Varies with specs, but generally no	Varies with specs, but generally cannot reject exogeneity
Wolf and Soldo (1994)	US	Cross-Section	No	No	Only women	Only married women	Indicator for having a parent who is 65+ whose health is poor/very poor, indicator for having a living parent of any age who is not in poor health, interaction between the two above indicators, same 3 variables as above but for a parent in-law, # of brothers, # of sisters, # of sibling in-laws	No discussion, but generally significant	There is a borderline significant negative correlation between the residuals of the propensity to provide care equation and the propensity to work equation.

Appendix Table 1 (cont.). Cross-sectional studies that test for endogeneity of informal care and work.

Paper	Results: Extensive Margin?	Results: Extensive Margin-Reentry?	Results: Intensive Margin?
Bolin, Lindgren, Lundborg (2008)	10% increase in weekly hours of care leads to 3.7% reduction in employment probability for full sample, 2.8% decrease for female sample, 3.2% decrease for male sample		10% increase in weekly hours of care leads to 2.6% reduction in # hours worked, but effects insignificant when men and women are analyzed separately
Casado-Marin, Garcia-Gomez, Lopez-Nicolas (2010)	Caring for someone at home reduces probability of working FT by 2.7%; caring elsewhere has no effect; probability of working FT does not diminish significantly in first caregiving year, but in subsequent years; caring 28+ hours a week reduces probability of working as much as 4.5%	In one specification, stopping care has a positive effect on leaving non-work and entering PT or FT	No evidence of women transiting from FT to PT, only evidence of transitions from FT/PT to non-work
Crespo (2006)	Caregiving decreases LFP 30% on average for southern European countries and from 30-40% in northern European countries when endogeneity is taken into account; finds a 4-6% decrease when caregiving is treated as exogenous.		
Ettner (1995)	Coresident caregiving significantly decreases LFP		Coresident caregiving leads to a large, significant reduction in work hours
Ettner (1996)			Non-coresidential caregiving significantly decreases women's work by 11-12 hours per week; effect only significant for women caregiving outside the household.
Heitmueller (2007)	Cross section: Being a care provider reduces LFP by 6%; coresident caregiving reduces LFP by up to 15%, extra-residential caregiving has no effect; caring 20+ hours a week reduces LFP by 26%		
Wolf and Soldo (1994)	Caregiving does not significantly reduce married women's employment		Caregiving does not significantly reduce married women's hours of work

Appendix Table 2. Studies using longitudinal data that either test for endogeneity of informal care and work or use longitudinal methods to control for unobserved heterogeneity.

Paper	Country	Cross-Section v. Longitudinal	Intensive vs. Any?	Co-residential	Men v. Women?	Panel Techniques Used
Heitmueller, Michaud, and Nazarov (2010)	UK	Longitudinal	Only in sensitivity analysis	Yes	Women only	Time invariant unobserved heterogeneity via a random effect specification; state dependence (lagged work status, lags of past caregiving in the propensity to work eqn) but note current caregiving is not in the eqn for propensity to work
Johnson and Lo Sasso (2000)	US	Longitudinal (two periods only)	No	No	Yes	Simultaneous equations model of annual hours of paid work and any informal care provision. Individual unobserved heterogeneity in the caregiving and labor supply equations incorporated via random effects. The informal care equation also includes several variables which are excluded from the labor supply equation including the age of the older parent, indicator for parent needs personal care assistance, indicator for parent cannot be left alone, indicator for mother alive, indicator for parents are married, indicator for parent owns a home, indicator for finances of parent are better than respondent's, indicator for finances of parent are worse than respondent's. Time-invariant individual effects can be correlated with one another across equations.
Moscarola (2010)	Netherlands	Longitudinal	No	No	Women only	LFP and CG equations are estimated jointly with a dynamic binary probit model. State dependence and cross-state dependence are incorporated via lagged work and CG decisions in both eqns. Unobserved heterogeneity introduced via random effects in both eqns which are allowed to be correlated across eqns. Current CG is NOT in current work eqn and current work NOT in current CG eqn.
Spiess, Schneider (2003)	Europe	2 survey year panel	Indicators for increase, decrease, and stable care hours are included	No	Women only	OLS regressions but with a simplified version of a difference-in-difference approach where changes in work hours between 1996 and 1994 are regressed on changes in care status/intensity and other control variables measured at 1994.
Viitanen (2005)	Europe	Both	No	No	Women only	Dynamic random effects probit models controlling for lagged work (state dependence) and a pooled estimator are estimated.

Appendix Table 2 (cont). Studies using longitudinal data that either test for endogeneity of informal care and work or use longitudinal methods to control for unobserved heterogeneity.

Paper	Results: Extensive Margin?	Results: Intensive Margin?
Heitmueller, Michaud, and Nazarov (2010)	Current coresidential caregiving, but not non-coresidential caregiving, is significantly negatively associated with future employment. After one year of CG, average employment probabilities go down by 4.8% for coresidential caregivers and less than 1.6% for non-coresidential caregivers. Within 3 years of the caregiving decision, the change is mostly eliminated. Conclusions are largely unchanged in the sensitivity analysis where people are only defined as caregivers if they care 10+ hours per week (in the baseline model caregivers provided at least 5+ hours per week).	
Johnson and Lo Sasso (2000)		Providing at least 100 hours of time assistance to parents in past 12 months reduces annual labor supply for women by 459 hours and 462 hours for men.
Moscarola (2010)	Caring in the *previous* period reduces the probability of working by 5.8%. Note, they conclude "no significant impediment seems to hinder the contemporaneous practice of work activities and care" based on the finding that there is no significant correlation between the time variant error terms of the eqns.	
Spiess, Schneider (2003)	Result that terminating care is insignificantly related to change in work hours suggests reductions in work hours or exits from the labor force are not likely to be recovered after caregiving stops.	Starting care and increasing care are negatively correlated with a change in work hours. Terminating care, reducing care effort, or maintaining the same care intensity are insignificantly related to change in work hours.
Viitanen (2005)	Caregiving only has a negative impact on the probability of being employed in the case of Germany. However, when using only specific subgroups of women, there are significant negative effects of caregiving in several countries among middle-aged women (Belgium, Finland and Germany) and among single women (Greece, The Netherlands, Italy and Germany).	

Appendix Table 3. IV FE Specification Tests Results for Women

Instrumenting for beginning caregiving, continuing caregiving and ending caregiving for female LFP linear probability model with FE.

Instruments	**F-Stat Range**	**Partial R-Squared Range**	**Reject Exogeneity?**
Indicator for Parent or In-law Has ADL Needs, Indicator for Parent or In-law Cannot be Left Alone, Separate Indicators for Mother, Father, Mother-in-law, and Father-in-law Died, Separate Indicators for Mother Became Widowed and Mother-in-law Became Widowed	22.53 – 59.64	0.0170 – 0.0514	No
Separate Indicators for Mother, Father, Mother-in-law, and Father-in-law Died, Separate Indicators for Mother Became Widowed and Mother-in-law Became Widowed	28.13 – 68.83	0.0157 – 0.510	No
Indicator for Parent or In-law Has ADL Needs, Indicator for Parent or Inlaw Cannot be Left Alone, Separate Indicators for Mother, Father, Mother-in-law, and Father-in-law Died, Indicator for a Parent or In-law Became Widowed	24.64 – 68.03	0.0160 – 0.0513	No
Separate Indicators for Mother, Father, Mother-in-law, and Father-in-law Died, Indicator for a Parent or In-law Became Widowed	32.19 – 82.49	0.0146 – 0.0509	No

Note: Similar results for men and exogeneity are not rejected in any specification. Joint F tests were run on each of the three potentially endogenous caregiving measures, initial, continuing, and recently ended caregiving. Results are very similar for the labor force participation equation with any caregiving. The instruments perform least well for the wage equations when stage of caregiving is used (sometimes dipping below a joint-F statistic of 10), but in no case is exogeneity rejected in the specifications where they are jointly strong.

First stage models also controlled for: Age, age squared, achieving the Social Security early entitlement age (62) or full retirement age, discrete variables for self-reported health, home ownership, years of work experience, logged spousal earnings, indicator for one's spouse having no earnings, household size, indicator for having a child under the age of 18 in the home, household asset quartiles, wave dummies.

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