The Added Worker Effect and the Lifetime Labor Supply of Older Households

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Abstract

It has been documented extensively that involuntary job loss has a substantial negative effect on the individual labor market outcomes. Much less is known about its consequences on the household level. Most of the relevant literature has focused on the added worker effect, or the changes in wife's labor supply following husband's displacement. In this paper I demonstrate that the added worker effect is not exclusively attributable to females. I estimate that older males whose spouses contributed at least 40% of the household lifetime earnings increase their labor supply by 23% within one year after wife's displacement. This increase is equivalent to the overall added worker effect in the older female population. To understand the dynamic response of an older household to job loss, I propose a life-cycle model of joint labor supply, savings and job search decisions made by two-member households with limited commitment. Simulations based on the model confirm that job loss of a spouse on average increases the lifetime labor supply for both genders. Estimated effects are positively related to the fraction of earnings of displaced spouse and are more apparent in the populations with lower pre-displacement labor supply.

Keywords: displacement, added worker effect, life-cycle labor supply

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1 Introduction

Involuntary job loss has substantial and persistent negative effect on the later life labor market outcomes. Displaced workers lose up to 50% of their earnings in the first year after job loss, and continue to earn less than comparable non-displaced workers as long as twenty years after separation.[1] While the costs associated with own job loss are well documented, much less is known about its consequences on the household level. Previous literature mainly addressed in isolation the added worker effect, a transitory increase of female labor supply during the periods of husband's unemployment. In this paper I model a joint household response to involuntary job loss by one of the spouses at older ages.

I chose to focus on older workers for a number of reasons. First, job loss plays an important role in the household decisions about retirement, affecting the labor force attachment, lifetime income and consumption of people with an easy reach of the social insurance and welfare programs. Second, older laid off workers experience the longest post-displacement unemployment spells, and in this sense endure more adversity than the other age groups. Finally, I show that the response to the spouse's job loss is more pronounced at older ages, especially for males, because transition to retirement leaves more space for adjustment of labor supply relative to younger full-time workers facing restrictions on the hours of work.

Using the Health and Retirement Study (HRS) data, I show that both spouses may increase their short-run labor supply after a job loss in the household. Female response is more obvious, amounting to an increase of annual hours of work by 176 one year after husband's displacement. While there is no statistically significant change in the labor supply of all males with displaced wives, the effects become visible as the wife's contribution to the household earnings raises. Men whose wives provided at least 40% of the households earnings worked on average 226 hours more a year after the wife lost her job. In addition, the magnitude of response differs by age, and later in life males become more sensitive to the job loss of a spouse than females of the same age. I also notice that the increase of participation rates following job loss of a spouse is higher during recessions. These results challenge the conventional added worker treatment of the household reaction to displacement. As the lifetime labor force attachment and earnings of the females increase, joint modeling of the household behavior after job loss becomes more relevant.

These reduced form results suggest that the adjustment of individual labor supply to the spouse's job loss is comparable in magnitude to the response to own job loss. I further propose a structural model of joint labor supply, savings and job search decisions in which both spouses can be affected by job loss. The model includes uncertainty about availability of jobs, health status, survival and medical expenses. It accounts for individual and family Social Security

[1] Jacobson et al. (1993), Davis and von Wachter (2011)

benefits, Medicare, employer provided health insurance, and intentional bequests. I use the model to simulate household's response to the job loss and find that the results are consistent with reduced form estimates reported in this paper. The model can further be estimated and used to evaluate the lifetime impact of layoff on the labor market outcomes of older couples and the outcomes of the policies aimed at the support of unemployed and laid off older workers.

This paper makes few contributions to the literature on the cost of displacement and the household retirement from the labor force. First, I show that both males and females adjust their labor supply following a job loss of a spouse. Second, unlike previous paper that model retirement using either unitary or full commitment framework, I model the household retirement decision in setting where households can not commit to the future allocation of resources and can renegotaite choices based on the changes of decision weights. Third, I introduce involuntary job loss into a model of household retirement behavior.

The rest of the paper has the following structure. Section 2 explains how it fits into the literature. I discuss the data characterizing labor market behavior of older households over the business cycle, with an emphasis on the labor supply of households with displaced family members, in Section 3. Section 4 provides reduced form estimates of impact of spouse's job loss on the labor supply decisions of older workers. A structural model of household retirement and labor supply is presented in Section 5. The choice of model parameters and simulation results are discussed in Section 6. Section 7 contains a brief conclusion.

2 Related literature

In this section I explain how this paper relates and contributes to other literature in the field. I focus on three most relevant areas. Literature in the first area is concerned with evaluation of the cost of job loss incurred by displaced workers. The second area shifts the attention from displaced individual to other members of their households, and includes mainly the studies of added worker effect that estimate the impact of husband's job loss on wife's labor supply. Finally, the third area comprises research of individual and household retirement from the labor force that uses structural life-cycle approach. In the rest of this section I discuss successively each of the three areas.

2.1 The cost of job loss

The first relevant direction in the literature is on the estimation of costs associated with job loss for displaced individuals. Most consideration has been shown to the employment and earnings costs. Early studies have documented that while the differences in employment rates between displaced and non-displaced workers equalize after approximately 4 years, substantial earnings gap may persist over much longer periods (Ruhm, 1991). The estimates of long-term earnings losses vary from 9 to 25% of pre-displacement wages for time horizon in a range between 2 and 20 years (Farber, 1993, Stevens, 1997, Jacobson et al., 1993, Couch and Placzek, 2010, Jacobson et al., 1993). Short-term earnings losses can be as high as 50% when displacements happen in unfavorable economic conditions (Jacobson et al., 1993).

Some of the differences in the available estimates can be traced to the data sources and definitions of displacement used. Estimates from administrative data tend to be higher than estimates based on the household surveys (Jacobson et al., 1993, Couch and Placzek, 2010, Davis and von Wachter, 2011). Papers appealing to the definition of displacement set by the federal government that classifies separation as displacement if a worker had three or more years of tenure and the job was lost due to slack work conditions, abolition of the job, closing of the plant or industry shrinkage also fall on the higher side. Most of these studies reviewed by Hamermesh (1989) and Fallick (1996) used Displaced Worker Supplement (DSW) dataset, most recently the same definition was applied by Davis and von Wachter (2011). The papers that instead consider all involuntary separations including both plant closings and layoffs, such as Ruhm (1991) and Stevens (1997), tend to obtain lower estimates and report the characteristics of affected workers closer to the workforce averages. The latter approach is conceptually closer to the methodology chosen in this paper.

This literature has identified the main factors that affect the magnitude of sustained losses. Earnings decline more for workers with longer tenure at the time of separation (Farber, 1993, Jacobson et al., 1993, Kletzer, 1989, Poletaev and Robinson, 2008) and workers who switch industry or occupation after displacement (Neal, 1995). Losses are substantially higher if job loss happened in weak labor market conditions (Davis and von Wachter, 2011). Stevens (1997) shows that additional displacements contribute to the persistence of earnings losses. Displaced workers who manage to switch jobs without claiming unemployment insurance incur practically no losses even if they lost jobs in mass layoffs (Couch and Placzek, 2010).

Although earnings losses associated with displacement dominate the literature, the costs of displacement come in other forms as well. Burgard et al. (2007) document a negative relationship between job loss and health, while Eliason and Storrie (2009) and Sullivan and von Wachter (2009) associate previously experienced layoffs with an increase in mortality. Charles and Stephens (2004) find that the divorce hazard increases following layoff in a household. Gruber (1997) and Stephens (2004) register a decline in short-term consumption expenditures following job loss that is especially salient for lower income individuals. Rogerson and Schindler (2002) show that mid-career displacement results in welfare costs equal to 1-1.5% of the output, mainly due to earnings reduction.

Of special interest to this paper are available results on the costs of job loss for older workers. Conclusions in the papers that include age as one of characteristics of laid off workers are ambiguous. For example, Jacobson et al. (1993) who so far reported the highest estimates of earnings losses find no evidence that the cost of job loss increases with age. Other studies, for example Davis and von Wachter (2011), find that older male workers tend to have higher immediate losses. Few papers that considered the cost of displacement exclusively in senior age groups using the Health and Retirement Study report values that fall on the higher end of the range of estimates for the entire workforce (Couch, 1998, Chan and Stevens, 1999, 2001, 2004, Coile and Levine, 2011). None of the previous papers however considers the impact of late career job loss on the joint retirement decision of a household. This paper contributes the estimates of the cost of displacement for older households that transition form work to retirement obtained from a dynamic structural model with job loss and search. The model incorporates a rich policy and macroeconomic framework that allows to assess the changes in the costs of job loss and retirement behavior in response to the incentives provided by the environment.

2.2 Added worker effect

In terms of individual response to job loss and unemployment of a spouse, a lot of research has focused on the females. A transitory increase in the wife's labor supply in response to husband's unemployment referred to as added worker effect has been addressed in numerous papers. Although added worker effect is predicted by the theory, at least in a simple static model (Ashenfelter, 1980), the literature has struggled to establish its presence empirically. Maloney (1987, 1991) finds no evidence supporting the existence of added worker effect in the US data.

While Heckman and MaCurdy (1980), Lundberg (1995) and Cullen and Gruber (2000) all do find statistically significant evidence of an increase in the female labor supply when husbands lose their jobs, the size of estimated effects is insubstantial.

A number of explanations has been offered to explain these difficulties with estimation. Earlier studies (Long, 1958, Mincer, 1962, Bowen and Finegan, 1965, Cain, 1966) attributed the problem to the contemporaneous impact of discouraged worker effect that offsets the inflow of new labor force participants when employment opportunities are poor and husband's unemployment is more likely. Cullen and Gruber (2000) find that the added worker effect is mitigated in the presence of formal unemployment insurance that becomes a competing instrument of protection against income loss in the household. Juhn and Potter (2007) and Hardoy and Schøne (2014) suggest that the added worker effect gets lower as female participation in the labor force increases, especially when the spouses are exposed to correlated labor market shocks.

Unlike other papers, Stephens (2002) finds substantial and persistent added worker effect, present both before and after the husband's job loss, once he brings into focus a response of female labor supply decisions to displacement rather than unemployment in general. He also shows that the consequences of job loss may be not as transitory as it has been previously suggested when they are evaluated over the entire household life-cycle.

Amid all work done on female labor supply, Starr (2014) tested for added worker effect among males during the 2007-2009 recession, but could not confirm its presence. I show that, in line with the findings that were previously obtained for female added worker effect, the subsample of older males who have lower participation levels and whose wives contribute substantial part of the household earnings exhibits a strong and significant response to a spouse's job loss. More generally, the relationship between labor supply and spousal displacement experience is stronger at older ages for both genders.

2.3 Retirement from the labor force

Substantial portion of the literature that used structural life-cycle models to understand retirement from the labor force has been based on the individual rather than household decision problem. This literature has addressed the most salient features of transition from work to retirement in the United States, such as the peaks of exit from the labor force at age 62 and 65, post-retirement consumption decline, the role of financial incentives provided by the Social Security, private pensions, Medicare and health insurance (Blau, 1994, 2008, Gustman and Steinmeier, 1986, Rust and Phelan, 1997, French and Jones, 2011). Focusing on the primary male earners of the households, these papers either abstracted from the role of wife's earnings or introduced them as an exogenous process without modeling the underlying labor supply decisions. However when the households face uncertainty about the future income stream, for example owing to an appreciable possibility of job loss, distortion of self-insurance opportunities in the households with two earners that arises in these models becomes important.

Responding to the growing share of dual career couples among older married Americans that has increased from 30% in 1996 to 40% in 2012, more papers are turning to the problem of joint retirement of the spouses. While focusing on various aspects of retirement, they also take different approaches to the modeling of intrahousehold decision making process. Blau (1998) and Blau and Gilleskie (2006) use a unitary model in which households act as single agents with a utility function shared by all of their members. Gustman and Steinmeier (2000, 2004) apply the tools of noncooperative bargaining theory, albeit at the expense of details in the modeling of policy and stochastic environment. A number of papers based on cooperative approach regard household as a group of agents whose joint decisions lead to Pareto efficient outcomes (van der Klaauw and Wolpin, 2008, Casanova, 2010, Michaud and Vermeulen, 2011). These models use constant decision factors to represent the bargaining power of the individual household members. They require that a household commits to the initially agreed allocation of resources, and can not adjust it to reflect possible changes in the distribution of decision factors between the spouses. Mazzocco (2007) shows that these models, as well as unitary household models, are strongly rejected by the data in favor of models with limited commitment in which decision factors and optimal allocations may change over time. To account for this finding, I use dynamic collective model with limited commitment to describe the household behavior. This method requires that participation constraints are satisfied in each period and state of nature, so that an allocation can only be achieved if the value of staying in the household for both members is higher than the value of their outside options.

This paper therefore contributes to the retirement literature in two ways. First, none of the previous papers informs on the role that involuntary job loss plays in the retirement of dual career households. Second, it presents the first attempt to model retirement behavior of a household using an intertemporal collective model with limited commitment.

3 Labor market transitions in the older households

In this section, I document the patterns in labor market behavior of older households over the business cycle. I show that there have been substantial differences in the labor market behavior of older males and females. While the dynamics of unemployment rates in general vary by gender, these differences are even more pronounced in the older age group. I show also that the difference is most striking when only married females are taken into account. Analysis of gross flows suggests that the differences in the rates of unemployment are driven by lower rates of job loss among employed females. Guided by the evidence on higher rates of job loss among males, I further discuss the importance of the joint household response to job loss of one member. While there are many similarities, response to a job loss experienced by a spouse is very different by gender.

3.1 Unemployment rates by age and gender

The most prominent feature of the unemployment series plotted by gender is a widening gap between male and female unemployment in recessions (Figure 1-A). Male unemployment rates have been higher than female during or right after recessions since the 1980s, but the change was especially pronounced during the Great Recession of 2007-2009. Before the decline started in 2007, unemployment rates for both genders were just under 5%. In the months that followed males have experienced faster unemployment increase than females, and by 2009 the gap has reached almost 2.5 percentage points. Although initially male unemployment has grown more, the recovery that followed nearly closed the gap by the middle of 2011, bringing it back to less than a half of percentage point. For older workers between the ages of 55 and 70 gender gaps in recessionary unemployment have been larger and more persistent. For example, in the Great Recession unemployment rates of older males and females were almost 1 percentage point (30% relative to 2007 level) apart for at least two years after the differences in unemployment rates for other age groups have equalized (Figure 1-C).

It is often pointed out that unemployment rates of older workers are lower than those of other age groups (Figure 1-B). This fact may be further used to argue that older workers are less vulnerable to the economic downturns. Two points can be made to challenge such statements. First, although the absolute changes are smaller, in relative terms older workers live through larger shocks. As the most extreme example, unemployment rates of older workers more than doubled from peak to through in the 2007-2009 period, while overall unemployment increased by 80%. Second, older workers are more likely to endure long-term unemployment (Figure 2). In the same Great Recession episode the fraction of people 55 and older unemployed for 27 weeks or more has grown to 56% in March 2011, 1.25 times more than the overall number. This implies that recessions have more lasting effects on the employment of older workforce compared to the other age groups.

A possible explanation of gender differences in recessionary unemployment, especially for the older age group with higher levels of non-participation, is that increasing rates of exit from the labor force subdue the growth of female unemployment. This proposition however is not readily supported by the data. If anything, participation rates of older workers have been increasing during the two most recent recessions, while the overall fraction of civilian noninstitutionalized population in the labor force has gone slightly down (Figure 3). I next explore whether the gross flows between the states of employment, unemployment and non-participation can contribute to the understanding of gender unemployment gap in recessions.

3.2 Gross flows between the labor force states

Figure 4 shows how the rates of transition between three labor force states - employment, unemployment and out of labor force - among older workers have been changing over time. Two patterns exhibited on these graphs seem to be related to the gender unemployment gap. First, there is a striking difference in the rates of job loss. Transitions from employment to unemployment were very similar for males and females in good economy, yet in both 2001 and 2007 recessions males have experienced a sharp and prolonged increase that was not anywhere close to the moderate changes faced by the females. The absence of simultaneous leap in female transitions from employment to non-participation suggests that although job finding rates have been shown to account for most variation in the cyclical unemployment, in this instance gender unemployment differences seem to be linked to the lower job loss rates among females.

Second, both recessions are marked by a distinct increase in the number of transitions from non-participation to unemployment. This tendency is complemented by fewer exits from the labor force, suggesting both smaller number of new retirements and more returns of previously retired workers to the labor market. While other factors, such as shocks to the housing and financial markets, can contribute to these trends, in the next section I look further into the data on household displacement and labor supply to test whether some of the increased attachment to the labor force in recessions may be explained by response to job loss of another household member.

3.3 Labor supply of displaced households

Information on displacement of the CPS respondents is available from the Displaced Worker Survey that is administered every two years as a January supplement to the main questionnaire. The survey asks all household members older than 20 whether they have lost a job because of a plant or company closure or move, abolition of position or shift, insufficient work, or similar reason during the previous three calendar years. Using these data, I compare participation rates of married workers whose spouses have been displaced during the previous year to those whose spouses have been in the labor force in the last year and did not have displacement recorded over the three-year period. I use only the last year displacements because of two reasons. First, displacement data suffer from a strong recall bias because workers tend to leave out more remote instances of job loss (Topel, 1990). Second, the CPS contains a relevant measure of participation for the last year, but not for the entire three-year reference period. Without control for participation the spouses of non-displaced workers have substantially lower employment rates, especially in the older age group where employment is related to age. Comparison of displaced households to the group that includes retirees would then make the increase of spouse's participation due to displacement appear much larger.

Figure 5 plots the lowess smoothing graphs of labor force participation rates for workers between ages 16 and 80 conditional on displacement experience of a spouse. The left panels of Figure 5 show the results for both genders in the data pooled from all survey waves between 1997 and 2011. It is not easy to see convincing differences in the participation rates conditional on spouse's displacement. Male labor participation lines are practically identical except for a minor discrepancy at the older ages. There seems to be more difference along the female age profile, with a modest evidence of the added worker effect up to the age of 50, and then a larger spike past 65. Although small, the overall difference of 1.9 percentage points for females of all ages is statistically significant. Displacement effects are very persistent, and the results are similar if the treatment group included all spouse displacements observed in the three surveyed years.

I notice however that the pattern depends on the period covered by the data. Isolating the years around the recessions, I observe that participation rates among workers with displaced spouses become overall higher. The right panels of Figure 5 illustrate the differences by gender and age in the data covering the years 2001, 2007, 2009 and 2011. In these years, both genders exhibit statistically significant response to the spouse's job loss. The average difference is still higher among females, now at 3.8 percentage points for all ages. The difference in male participation rates depending on the job loss of a spouse is only 0.4 percentage points for all ages, however for males after the age of 60 it reaches 5.8 percentage points, substantially more than the overall female difference. While the findings on female participation are not surprising and are consistent with the results in the literature on added worker effect, the large effects among males are not entirely anticipated.

For both genders, the most distinct increase is observed among the oldest age group. The fact that females also respond noticeably at younger ages suggests that a sufficient out of labor force population on the margin is required in order for the response to the spouse's displacement to be visible. This is consistent with Hardoy and Schøne (2014) who find that the added worker effect does not exist in the populations with high female labor force participation, but is noticeable among females who did not work prior to husband's displacement. In the older age group, this response would likely reflect the adjustment of retirement time. To estimate the magnitude of the displacement effects, I turn to a reduced form model of adjustment to the spouse's job loss in the next section.

4 Reduced form estimates of the labor supply adjustment to the spouse's job loss

In this section I discuss reduced form estimates of the life-cycle labor supply adjustment to the spouse's displacement. I find that older females increase labor supply by approximately 176 hours in the year of husband's displacement. While there is no overall evidence that older males respond to the displacement of their spouses, I document large and significant increase in labor supply for a subsample of males in the households where wives contribute over 40% of the total earnings. Their annual labor supply is 226 hours higher two years after the wife's job loss. This adjustment is comparable to the one made by females, as both amount to approximately 22% of the labor supply before displacement of the spouse.

4.1 Estimated model

The results draw on the estimates of the labor supply equations for a household life-cycle model with uncertainty that was first introduced by MaCurdy (1985). Similar technique has been previously employed to analyze both an individual labor supply response to own job loss (Jacobson et al., 1993, Couch and Placzek, 2010) and added worker effects among females (Stephens, 2002). Unlike the past studies, I estimate the reaction to the spouse's job loss for both husbands and wives in older households. The core idea of the implemented approach is that job loss reduces the lifetime wealth of a household through a permanent decline in the future expected wages, generating a shock to the marginal utility of wealth. In response to this shock, a spouse will increase the lifetime labor supply as soon as the household received information about displacement.

Stephens (2002) derives an empirical specification for leisure demands under assumption of intratemporal separability between consumption and leisure times of the spouse in which the effect of displacement is captured through inclusion of a set of dummies into the functional specification of the process for marginal utility of wealth. The objective function for the household that maximizes expected lifetime utility from consumption C_t and leisure times of husband

and wife, L_t^h and L_t^w, under these assumptions is

$$\max_{C_t, L_t^h, L_t^w} \mathbb{E}_t \left\{ \sum_{j=t}^{T} \beta^{j-t} \left[M_t^C (C_t)^{\omega^C} + M_t^{L^h} (L_t^h)^{\omega^{L^h}} + M_t^{L^w} (L_t^w)^{\omega^{L^w}} \right] \right\}, \tag{1}$$

where M_t^C, $M_t^{L^h}$ and $M_t^{L^w}$ are taste modifiers for consumption and leisure of the household members, and β is the household's discounting rate. The household faces a budget constraint

$$A_{t+1} = (1+r) \left[A_t + (L - L_t^h) W_t^h + (L - L_t^w) W_t^w - C_t \right], \tag{2}$$

where L is available endowment of leisure, W_t^h and W_t^w are wages earned by husband and wife. The two first-order conditions for leisure demand of each spouse $s \in \{h, w\}$ are used to generate estimated equations:

$$\omega^{L^s} M_t^{L^s} (L_t^s)^{\omega^{L^s}-1} = \lambda_t W_t^w. \tag{3}$$

Assuming that the marginal utility of wealth for a household i at time t, λ_{it}, is a function of the marginal utility of wealth in the initial period, the new information acquired in period t, the forecast errors made in the previous periods, and the shocks received from displacement of one of the spouses, it can be expressed as

$$\ln \lambda_{it} = \ln \lambda_{i0} + \tau_t + \sum_{j=\underline{j}}^{\bar{j}} \alpha_j^s d_{it}^{-s,j} + \sum_{j=1}^{t} \nu_{ij}, \tag{4}$$

where the dummy variables $d_{it}^{-s,j}$ take a value of 1 if a spouse of the household member s lost a job $j \in \{\underline{j}, \ldots, \bar{j}\}$ periods before the current period t. In general j can take both positive and negative values because labor supply may start adjusting before the actual displacement, as the household learns about the likelihood of job loss. If the average of forecast errors approaches zero as the number of periods increases, taking logs of the first-order condition (3), substituting (4) and rearranging the terms gives an expression to estimate the leisure demand L_{it} for each spouse s:

$$\ln L_{it}^s = f_i^s + \widetilde{\tau}_t + \sum_{j=\underline{j}}^{\bar{j}} \widetilde{\alpha}_j^s d_{it}^{-s,j} - \delta^s \ln W_{it}^s + \delta^s \ln M_{it}^{L^s} + \varepsilon_{it}^s, \tag{5}$$

where $\delta^s = (1 - \omega^{L^s})^{-1}$. The terms $f_i^s = \delta^s (\ln \omega^{L^s} - \ln \lambda_{i0})$ and $\widetilde{\tau}_t^s = -\delta^s \tau_t$ are respectively household and year fixed effects. The coefficients $\widetilde{\alpha}_j^s = -\delta^s \alpha_j^s$ capture the cumulative effect of spouse's displacement on labor supply accrued by the period t, and ε_{it} is a stochastic error term assumed uncorrelated across individuals and time periods.

Both wages and taste modifiers of leisure are expressed in terms of observable characteristics for the empirical implementation. Wage is assumed to be a function of the quadratic in the labor market experience and the dummies for industry and occupation with the longest reported tenure. The leisure modifiers are a function of health status, the presence of people other than husband and wife who depend on the household for more than half of their financial support, and age dummies for the periods that are associated with the major changes in the access to the social security programs: age of early eligibility for old-age benefits from 62 to 64, age of eligiblity for Medicare and a possibility to accumulate extra benefits for delayed take-up of benefits from 65 to 70, and age over 70 when the system provides no further retirement incentives.

4.2 Data

I estimate parameters of Equation 5 using 11 waves of the HRS that cover a period from 1992 to 2012. I restrict the sample to married couples in which both husband and wife are at least 50 years old. Households are retained for the analysis if there are three or more complete observations on the same couple coming from consecutive survey waves.

Involuntary job loss is determined from the questions that ask about the reason the respondent left the previous wave job or another job held between the waves. The two answer options that qualify a person as displaced are business closed and laid off or let go. I use separation dates from retrospective employment reports to determine the time in months elapsed since job loss and estimate annual effects of displacement on labor supply over a period of two years. Previous papers that considered long-term effects of displacement showed that the strongest response is observed in the first few years after job loss. Because all variables used to represent wages and taste modifiers except for age are measured in the survey wave preceding the job loss, I focus on the relatively short term impact to sustain their predictive power. The average gap between two HRS waves is two years, so with two annual lags I consider predominantly the changes between pairs of adjacent waves. The results reported in this section are qualitatively similar in a model with four lags. In case of multiple layoffs in the same household, I only consider the first one and follow a couple either for two years after displacement or until the next job loss, whatever comes first.

These conditions produce an unbalanced panel of 12,520 couples with 53,856 household-year observations. 2,847 (23%) of the households in the sample have experienced job loss. Males account for 47% of these layoffs, females for 44%, and in the remaining 9% of cases both household members have been laid off at least once. Table 1 compares estimation sample split by the couples in which husband, wife or both experienced job loss at some point of time to those who have never reported layoffs. The main differences between displaced and non-displaced households are in the wage and income variables: they typically earn lower wages, hold fewer assets and receive less non-labor income. Displaced persons are also more likely to be employed in manufacturing and hold a blue-collar job, and have slightly less education.

The differences in age are due to the exclusion of observations on laid off workers beyond two years after job loss. The same reason drives lower participation rates, hours of labor supply and worse health in the never laid off group that is more likely to be observed long into retirement.

4.3 Results

Because transition to retirement and hence participation decision is a primary concern for the households in the older age group, I explore both extensive and intensive margins of the individual labor supply decision. Table 2 contains least squares fixed effects estimates of participation equations obtained by transformation of a continuous dependent variable in Equation (5) into a binary employment indicator. Table 3 shows the estimates of leisure demands given directly by Equation (5). The upper part of Table 3 reports results for linear least squares fixed effects estimator. Since the least squares estimator is asymptotically equivalent to the coefficients of latent model times the population proportion of non-censored observations, I show for comparison another set of estimates obtained with Honoré (1992) trimmed least squares estimator for censored panel in the lower part of Table 3. All coefficients are given with the negative signs so that the main results can be directly interpreted in terms of the impact on labor supply rather than demand for leisure.

The effect of spouse's displacement on the labor supply of older females is consistent with the theory and previous results for other age groups. During the first two years after husband's job loss employment rates of wives are on average 8.6 percentage points higher than employment rates of females in non-displaced households. The labor supply of a female whose leisure consumption equals the sample mean, $\overline{L}^{w} = 7,984$ hours, increases by $\widetilde{\alpha}_1^{w}\overline{L}^{w} = 176$ hours in the first year after job loss, or by 23% of pre-displacement labor supply. A smaller increase of 32 hours two years after displacement is not statistically significant. Honore coefficients are slightly smaller, giving a 136 hours increase in the first year. The short-term results for female labor supply increase are extremely robust to model specification and the choice of estimation sample. The average increase of labor supply by 104 hours during the first two years after displacement is close to the added worker effect of 108 hours found by Stephens (2002), although the maximum impact relative to pre-displacement labor supply is about twice bigger. The difference is likely due to the sample age: older people on average work fewer hours and have wider margin to increase their effort.

I find no significant effect of wife's displacement on the labor supply of husbands in the primary sample. Estimated coefficients are small and signs vary. I notice however that the average contribution of female earnings to the wage income of the households in the estimation sample is just over 40%. Since females are the secondary earners in these couples, a negligible response of husbands to the job loss of a spouse is consistent with the theory. If the wife's earnings are low, the change in the lifetime income associated with their loss is small. The corresponding increase in the marginal utility of wealth will only lead to a minor shift of the husband's labor supply. However, as the share of wife's earnings in the household income increases, the adjustment of labor supply by husbands should become noticeable.

To test this proposition, I estimate the model using only the households in which wife contributed more than the sample average before being laid off. The last columns of Tables 2 and 3 show estimation results for husbands whose wives matched at least 70% of the male wage in the household. As expected, estimated coefficients are much larger for this subsample, and the standard errors are small given a substantial decrease in the sample size. Unlike female response though, the strongest effect strikes two years after displacement happens. Delayed response here probably signifies postponed retirement rather than an immediate increase of working hours among already full-time employed husbands. After two years, husbands of displaced wife are 11.7 percentage points more likely to be employed, and their annual labor supply is on average 226 hours higher than before job loss. In relative terms, this result is very close to the one for females, as increase in hours represents 23% relative to pre-displacement labor supply.

This analysis suggests important preliminary insights into the problem of response to job loss by older households. While confirming the presence of substantial labor supply and possibly retirement adjustment for both genders, it would not be able to answer a whole range of relevant questions about labor supply and retirement of the households that experienced job loss. It gets harder to analyze long-term consequences of job loss because observed effects are contaminated by simultaneous shocks to the exogenous variables, such as health and dependents used to represent leisure modifiers in this model. It makes problematic any inferences on endogenous decisions that are essential to both retirement and insuring agains the risk of job loss, for example accumulation of assets or health insurance. It does not say much about the process of job search and response of displaced households to the tightening of labor market conditions. Finally, it has limited potential for studying the results of changes to policy environment. In the next section I describe a structural model of household retirement and job loss that allows to address most of these questions.

5 A structural model of household labor supply and retirement with job loss

I develop a dynamic model of labor supply and retirement for households with limited commitment to the future allocation of resources. The model accounts for a possibility of job loss and the costs of job search. Households face uncertainty regarding earnings, health, medical expenses and survival. The model incorporates essential features of the Social Security policy, unemployment benefits, government transfer and taxes.

5.1 Household decisions

The decision problem begins when the oldest household member reaches age $t_0 > 50$. Initial conditions drawn from the data account for heterogeneity in the households experiences up to this age. Household life path is modeled at annual time intervals. In each period t, a household may consist of a married couple or a single individual. An individual of gender $g \in \{m, f\}$ lives at most until the terminal age T, facing exogenous mortality risk π_t^g that increases with age.

Households make decisions about consumption and savings, employment and leisure, job search, and Social Security take up for each household member. Each household member consumes a composite private good in the amount C_t^g. Consumption is modeled as a continuous decision. Households can borrow up to the age-specific limit $\underline{A}_t$ and invest non-consumed funds A_t at a rate of return r. After death of a married individual all assets are transferred to the surviving spouse who continues to live as a single household. Assets of deceased single individuals are left as bequest to the heirs.

Leisure L_t^g is measured in hours out of a fixed time endowment L. Continuous choice of employment hours is made subject to the availability of wage offers. In each period, jobs are destroyed with probability δ^g. Unemployed workers may choose whether they want to search for a new job. Search is costly, and is modeled as a binary yes or no decision, $S_t^g \in \{0, 1\}$. Individuals who decide to search receive offers with probability λ^g. In addition, each individual can work only up to the age T^w.

Individuals become eligible to collect Social Security income at age 62. All individuals are assumed to take up Social Security by the age 70. The choice of Social Security decision is indicated by one if an individual receives benefits and by zero otherwise, $SS_t^g \in \{0, 1\}$. The choice set for a person of gender g at time t consists of all feasible combinations of these decisions, $D_t^g = \{C_t^g, L_t^g, S_t^g, SS_t^g\}$. For a married couple, the choice set is a Cartesian product of the individual choice sets, $D_t^{mf} = D_t^m \times D_t^f$.

5.2 Time and budget constraints

The amount of consumed leisure L_t^g is determined from the individual time constraint. Out of the available time endowment L, working individuals allocate N_t^g hours for employment. In addition, work is associated with fixed cost that increases linearly in age, $\phi_0 + \phi_1 t$. People in bad health ($H_t^g = 0$) face an additional time cost of work given by parameter ψ. Unemployed individuals give away ς hours of leisure to pursue search activities. The time constraints for each period are given by:

$$L_t^g = L - N_t^g - (\phi_0 + \phi_1 t + \psi \mathbb{1}\left\{H_t^g = 0\right\})\mathbb{1}\left\{N_t^g > 0\right\} - \varsigma S_t^g \quad \forall \ \ t \in [0,T]. \tag{6}$$

Households receive income from the labor market earnings determined as the product of hourly wage W_t^g and the number of hours worked, returns on assets carried from the previous period, Social Security income SSB_t^g, private pensions P_t^g, unemployment benefits UB_t^g and government transfers G_t. Apart from consumption and savings, households must cover medical expenses M_t^g. The household budget constraint is

$$(1+r)A_{t-1} + G_t + \sum_{g=m,f}\left(W_t^g N_t^g + SSB_t^g + P_t^g + UB_t^g\right) \geq A_t + \sum_{g=m,f}\left(C_t^g + M_t^g\right), \tag{7}$$
$$A_t \geq \underline{A}_t \quad \forall\, t \in [0,T]$$

The government provides a minimal per capita level of consumption $\underline{C}$ in case the household's own assets are insufficient to provide minimal consumption after covering the medical expenses, interest on debt and meet the borrowing constraint in the next period. The rule used to compute the government transfers to the household is

$$G_t = \max\{0,\ n\underline{C} - [A_t + Y_t - \sum_{g=m,f} M_t^g]\}, \tag{8}$$

where n is the number of people in the household and $Y_t = \sum_{g=m,f}\left(W_t^g H_t^g + SSB_t^g + P_t^g + UB_t^g\right)$ is household income.

5.3 Preferences of married households

To model decision making process within a two-person household, I adopt no-commitment intertemporal collective framework developed by Mazzocco (2007, 2008). The household intertemporal behavior is described as a solution to Pareto problem, in which individual decision weights determine the choice of point on the Pareto frontier. Married couples maximize utility from consumption and leisure of both spouses, which is a weighted average of the individual discounted present values of the remaining lifetime utilities. It is assumed however that the household members can not commit to the future allocation of resources as agreed in the initial period. Depending on how the individual decision weights $\mu_g(Z_t)$ change over time, previously accepted terms may require renegotiation. A vector Z_t includes variables that affect the distribution of individual powers at time t, such as individual income or health. Each individual compares the benefit of staying in the household to the value of an outside option, so that a feasibility constraint for chosen allocation needs to hold in each period. An allocation can only be achieved if both members are better off in the household in any period and state of nature $\omega \in \Omega$ than the value of their outside options $\underline{U}_t^g(Z_t)$. The reservation value is set as the value of being single in the current period plus the expected value of future utility form being single in the periods that follow.

The preferences of each household member are given by an increasing, concave, and twice continuously differentiable utility function U^g. Preferences are assumed separable across time and states of nature. Individual utility of each household member depends additively on the spouse's private consumption and leisure with altruism parameter ν_g:

$$U^g(C_t^g, C_t^{-g}, L_t^g, L_t^{-g}) = \tilde{U}^g(C_t^g, L_t^g) + \nu_g \tilde{U}^{-g}(C_t^{-g}, L_t^{-g}), \tag{9}$$

where superscript $-g$ refers to the spouse.

Saving decisions are made jointly. The household members have identical beliefs over the likelihood of future states realization. Each member discounts payoffs using a personal discount factor β_g. The household decision problem is then formulated as

$$\max_{D_t^{mf}} \left\{ \sum_{g=m,f} \mu_g(Z_t) \mathbb{E}_t \left[\sum_{j=t}^{T} \beta_g^{j-t} U^g(C_t^g, C_t^{-g}, L_t^g, L_t^{-g}) \right] \right\} \tag{10}$$

$$\mu^m(Z_t) + \mu^f(Z_t) = 1$$

subject to the time constraints (6), budget constraints (7) and participation constraints

$$\mathbb{E}_\tau \left\{ \sum_{j=t}^{T-\tau} \beta_g^{j-t} \tilde{U}^g(C_t^g, L_t^g) \right\} \geq \underline{U}_\tau^g(Z_t) \qquad \forall \omega \in \Omega, \tau > t, g = 1,2. \tag{11}$$

A married individual may become single because of spouse death or divorce. If one spouse dies, the other inherits all of the couple's assets. The weights are renegotiated each time it turns out that one of the spouses would be better of outside of the marriage. If there is a new combination of weights such that both participation constraints are satisfied, the couple renegotiates and continues together. If not, the two divorce and continue to operate as single agents. Savings are divided equally between the spouses in case of divorce, as would be the case in the community property states.

5.4 Preferences of single households

In each period $t \in \{0,\dots,T\}$, the problem of a single household of gender g is to maximize the expected lifetime utility

$$\max_{D_t^g} \mathbb{E}_t \left\{ \sum_{j=t}^{T} \beta_g^{j-t} \tilde{U}^g(C_t^g, L_t^g) \right\}, \tag{12}$$

subject to a set of budget and time constraints. Individual utility function takes into account possibilities of death and survival:

$$\tilde{U}^g = (1-\pi_t^g)u^g(C_t^g, L_t^g) + \pi_t^g b^g(A_t). \tag{13}$$

Individual preferences over consumption C_t and leisure L_t are described by within-period utility function of constant relative risk aversion form:

$$u^g(C_t^g, L_t^g) = \frac{1}{\theta_1^g(1-\theta_2^g)} \left[(C_t^g)^{\theta_1^g} (L_t^g)^{1-\theta_1^g} \right]^{1-\theta_2^g} + \zeta, \tag{14}$$

where parameter $0 < \theta_1^g < 1$ is the weight put on consumption and $\theta_2^g \geq 0$ characterizes the degree of risk aversion. Intertemporal elasticity of substitution $-1 \big/ \theta_2^g$ captures the willingness to substitute the composite consumption-leisure good between time periods. The term $\zeta \sim N(0, \sigma_\zeta)$ represents individual heterogeneity in preferences.

The value of bequest in the amount A_t for a single individual is

$$b^g(A_t) = \frac{b_1^g}{1-\theta_2^g} \cdot \left(b_2^g + A_t \right)^{\theta_1^g(1-\theta_2^g)}, \tag{15}$$

where parameter b_1^g captures the strength of bequest motive and b_2^g characterizes the curvature of bequest function and determines to what extent bequests are luxury good. I do not model matching and formation of new households, so by assumption there are no new marriages and single individuals remain in this state till the end of their lives.[2]

5.5 Bellman equations

Because the model does not have a closed form solution, the simulations discussed in Section 6 are generated numerically. I use backward induction to solve the value functions at annual time intervals starting from the terminal age T, and then apply obtained decision rules to construct

[2] In the data, 2.8% of the HRS households started new marriages after age 50.

simulated datasets. Given initial conditions drawn from the data, the state space of the individual problem Ω is described by wage rate, health status, medical expenses, assets, employment and search decisions made in the previous period, and binary indicators for job offer indicator ϑ, and layoff experience ℓ:

$$\Omega = \{W_t, M_t, H_t, A_t, N_{t-1}, S_{t-1}, \vartheta, \ell\}. \tag{16}$$

It is convenient to present individual Bellman equations separately by the current wage offer state. The value of being in a state $\omega_t \in \Omega$ in which an individual has a wage offer, $\vartheta = 1$, is denoted as V_t^o and contains four terms: the current utility from consumption and leisure and the expected present values of unemployment in case of layoff, employment if not affected by job loss, and utility of bequest if the worker does not survive to the next period. Omitting gender superscripts, it as expressed as

$$\begin{aligned} V_t^o(\omega_t, D_{t-1}, \theta) = \max_{D_t} \Bigg\{ & u_t(\omega_t, D_t, \theta) + \\ & \beta \cdot \Bigg[(1-\pi_t) \cdot \Bigg(\delta_{N_t} \int_\Omega V_{t+1}^n (\omega_{t+1}, D_t, \theta) \cdot p(d\omega_{t+1} | \omega_t, D_t, \theta_p) + \\ & (1-\delta_{N_t}) \int_\Omega V_{t+1}^o (\omega_{t+1}, D_t, \theta) \cdot p(d\omega_{t+1} | \omega_t, D_t, \theta_p) \Bigg) + \pi_t b(A_{t+1}) \Bigg] \Bigg\}, \end{aligned} \tag{17}$$

where the vector of parameters $\theta = \{\theta_s, \theta_p\}$ includes parameters of the state transition probability function θ_p and parameters of the structural model θ_s. V_t^n is the value of a state without a wage offer, determined by equation

$$\begin{aligned} V_t^n(\omega_t, D_{t-1}, \theta) = \max_{D_t} \Bigg\{ & u_t(\omega_t, D_t, \theta) + \\ & \beta \cdot \Bigg[(1-\pi_t) \cdot \Bigg(\lambda_{S_t} \int_\Omega V_{t+1}^o(\omega_{t+1}, D_t, \theta) \cdot p(d\omega_{t+1} | \omega_t, D_t, \theta_p) + \\ & (1-\lambda_{S_t}) \int_\Omega V_{t+1}^n(\omega_{t+1}, D_t, \theta) \cdot p(d\omega_{t+1} | \omega_t, D_t, \theta_p) \Bigg) + \pi_t b(A_{t+1}) \Bigg] \Bigg\} \end{aligned} \tag{18}$$

The probabilities of job loss and job finding in equations (17) and (18) satisfy conditions that rule out the possibilities of losing a job for non-employed workers and getting an offer without searching:

$$\delta_{N_t} = \begin{cases} 1 & \text{if } N_t = 0 \\ \delta \in (0,1) & \text{if } N_t > 0 \end{cases} \qquad \lambda_{S_t} = \begin{cases} 0 & \text{if } S_t = 0 \\ \lambda \in (0,1) & \text{if } S_t = 1 \end{cases} \tag{19}$$

For a married household, the state space is a Cartesian product of the state spaces of the spouses, with the two sharing assets. The problem of a two-person household is described by four Bellman equations, each corresponding to one possible combination of job offer states for husband and wife and referred to as $VH_t^i = \{VH_t^{oo}, VH_t^{on}, VH_t^{no}, VH_t^{nn}\}$. The probabilities of transition between the household offer states are given by 4×4 the matrix Λ with elements λ_{ij}:

$$\Lambda = \begin{bmatrix} (1-\delta_{N_t}^m)(1-\delta_{N_t}^f) & (1-\delta_{N_t}^m)\delta_{N_t}^f & \delta_{N_t}^m(1-\delta_{N_t}^f) & \delta_{N_t}^m\delta_{N_t}^f \\ (1-\delta_{N_t}^m)\lambda_{S_t}^f & (1-\delta_{N_t}^m)(1-\lambda_{S_t}^f) & \delta_{N_t}^m\lambda_{S_t}^f & \delta_{N_t}^m(1-\lambda_{S_t}^f) \\ \lambda_{S_t}^m(1-\delta_{N_t}^f) & \lambda_{S_t}^m\delta_{N_t}^f & (1-\lambda_{S_t}^m)(1-\delta_{N_t}^f) & (1-\lambda_{S_t}^m)\delta_{N_t}^f \\ \lambda_{S_t}^m\lambda_{S_t}^f & \lambda_{S_t}^m(1-\lambda_{S_t}^f) & (1-\lambda_{S_t}^m)\lambda_{S_t}^f & (1-\lambda_{S_t}^m)(1-\lambda_{S_t}^f) \end{bmatrix}, \tag{20}$$

where the terms $\delta^g(N_t)$ and $\lambda^g(S_t)$ satisfy conditions in (19). The value of being in the offer state ij for a household is then expressed as a sum of five terms. The first term is the current household utility. The other four terms represent the expected present value obtained in the next period depending on the couple's survival status:

$$\begin{aligned} VH_t^i(\omega_t^{mf}, D_{t-1}^{mf}, \theta) = \max_{D_t^{mf}} \Bigg\{ & \sum_{g=m,f} \mu_g U_t^g(\omega_t^{mf}, D_t^{mf}, \theta) + \\ \beta \cdot \Bigg[& (1-\pi_t^m)(1-\pi_t^f) \sum_{j=1}^{4} \lambda_{ij} \int VH_{t+1}^j(\omega_{t+1}^{mf}, D_t^{mf}, \theta) \cdot dp + \\ \sum_{g=m,f} \Bigg(& \pi_t^{-g}(1-\pi_t^g)\Big(\mu_{-g} b^{-g}(A_t) + \\ & \mathbb{1}\{\vartheta_g = 0\}\,\mu_g\Big(\lambda_{S_t}^g \int V_{t+1}^{o^g} \cdot dp + (1-\lambda_{S_t}^g)\int V_{t+1}^{n^g} \cdot dp\Big) + \\ & \mathbb{1}\{\vartheta_g = 1\}\,\mu_g\Big(\delta_{N_t}^g \int V_{t+1}^{n^g} \cdot dp + (1-\delta_{N_t}^g)\int V_{t+1}^{o^g} \cdot dp\Big)\Big) + \\ & \pi_t^m \pi_t^f \Big(\mu_m b^m(A_t) + \mu_f b^f(A_t)\Big)\Bigg], \end{aligned} \tag{21}$$

where abbreviated terms are $V_{t+1}^i = V_{t+1}^i(\omega_{t+1}^g, D_t^g, \theta)$, $dp = p(d\omega_{t+1}^{mf} | \omega_t^{mf}, D_t^g, \theta_p)$ and $\mu_g = \mu_g(Z_t)$. The household's decisions in period t are determined by (21) if the following conditions hold for both males and females

$$\begin{aligned} \mu_g(Z_t)VH_t(\omega_t^{mf}, D_{t-1}^{mf}, \theta) &\geq V^{n^g}(\omega_t^g(0.5A_t), D_t^g, \theta) \quad \text{if } \vartheta^g = 0, \forall g \in \{m,f\} \\ \mu_g(Z_t)VH_t(\omega_t^{mf}, D_{t-1}^{mf}, \theta) &\geq V^{o^g}(\omega_t^g(0.5A_t), D_t^g, \theta) \quad \text{if } \vartheta^g = 1, \forall g \in \{m,f\}. \end{aligned} \tag{22}$$

The state $\omega_t^g(0.5A_t)$ indicates a point in the state space of a single household which retains all individual values from the married household state except for the joint assets that are divided in halves. Otherwise, participation constraints are violated, the household splits and individuals make decisions governed by Equations (17) and (18).

6 Simulations

This section explains the choice of the model parameters that were used to generated simulated results. I start modelling at age $t_0 = 55$, set the terminal age $T = 100$ and the maximum working age $T^w = 75$. For simplicity I only model households with age difference between husband and wife under one year.

The probability of involuntary separation $\delta = 0.035$ is set as the average annual probability of job loss among older workers in the HRS over the period 1992-2010. The annual probability of transition from unemployment to employment for the same period adjusted for time aggregation bias is taken as a probability of job finding, $\lambda = 0.4$. The annual rate of return on assets is set at 4% and discounting factors are assumed equal for males and females, $\beta_m = \beta_f = 0.96$.

Transition probabilities for survival, health, wages and medical expenses states are estimated from the HRS data separately for males and females. Survival probabilities are estimated using binary logit models conditional on age and lagged health. Health is modeled as a binary indicator, good or bad. Health transitions are obtained from logit models conditional on age and health. Medical expenses and wages follow error components models with autoregressive terms conditional on age, health and lifetime earnings.

Parameters of the time constraint are based mainly on the estimates in French and Jones (2011) who use a similar expression of the leisure consumption. The time endowment $L = 4,000$ hours corresponds to roughly half of the number of hours in a calendar year. Hours of work are discretized into five-point grid. The fixed costs of work are 800 hours per year at age 60, and increase by 50 hours with each additional year of age. The cost of working for a person with in bad health is $\psi = 500$ hours per year. The cost of search $\varsigma = 1200$ is set at a level of part-time employment.

Parameters of utility function differ by gender, and the values are chosen to account for gender differences in a way discussed in Mazzocco (2008). Females are assumed to be more risk averse ($\theta_1^m = 4.5$ and $\theta_1^f = 6.5$) and put lower weight on consumption ($\theta_2^m = 0.7$ and $\theta_2^f = 0.4$). In this version of the simulations I fix the decision weights $\mu = 0.5$ and omit altruism parameter ν, hence returning to the full-commitment specification. The government transfers are designed so that to provide annual consumption floor per household member of $\underline{C} = \$8,000$.

Individuals become eligible for Social Security income at age 62, and receive additional credit to the benefits until 65. The amount of benefits depends on the AIME and the minimum and maximum values for individual and family. Married individuals can choose between the benefits based on their own AIMEs or the AIMEs of retired spouse, the fraction of benefits in the latter case depends on the age of withdrawal. Individuals pay federal, state, payroll taxes. Social Security benefits of employed recipients are taxed according to the Social Security

Earnings Test. I omit pension wealth and unemployment insurance in this version.

Given these values of parameters, I generate the dataset for 10,000 households based on the initial conditions drawn from the 2000 wave of the HRS. Simulations with the chosen values of parameters show that the model can replicate some of the data patterns discussed in Section 3.

First, I confirm that older males do work more following wife's job loss. Figure 6 shows the annual labor supply at ages from 60 to 70 generated by two sets of simulations. The dotted line is the labor supply of workers at each age given that their spouses never experienced involuntary job loss. I show the average number of hours worked for the entire sample, including zeros for non-working individuals. The negative slope of the line matches the data and reflects retirement from the labor force. The solid line shows the labor supply of the same workers drawn from a different simulation, the only difference being that their spouse has been displaced one year before. The average difference by spouse's layoff experience for males of all ages is 64 hours per year. It is larger at younger ages (105 hours at age 60), and gradually declines to only 43 hours at age 70. Relatively speaking though the response slightly increases with age, on average corresponding to 10% of the labor supply without displacement.

Second, the model shows that the increase of male labor supply is larger for higher values of displaced wife's earnings. Figure 7 plots predicted increase of husband's labor supply at age 60 one year after wife's displacement. Further inferences and application of the model require estimation of all structural parameters that can be done with the method of simulated models.

7 Conclusions

This paper explores the impact of involuntary job loss on the labor supply and retirement decisions of the older households. Most of the previous literature on adjustment to a layoff has focused either on the labor supply of affected worker or on the response of the wife's labor supply to husband's displacement. I show that the added worker effect is not exclusively female phenomenon. When the wife's earnings get close to a half of the household's labor income, older males exhibit adjustment to wife's job loss that is comparable with female adjustment. To understand better how the households react to the loss of income following involuntary displacement, I develop a structural model of labor supply and retirement with job loss and costly search. Simulations based on the model are consistent with the results of regression analysis. Further estimation of the model parameters is required to evaluate the cost of displacement for a dual career household.

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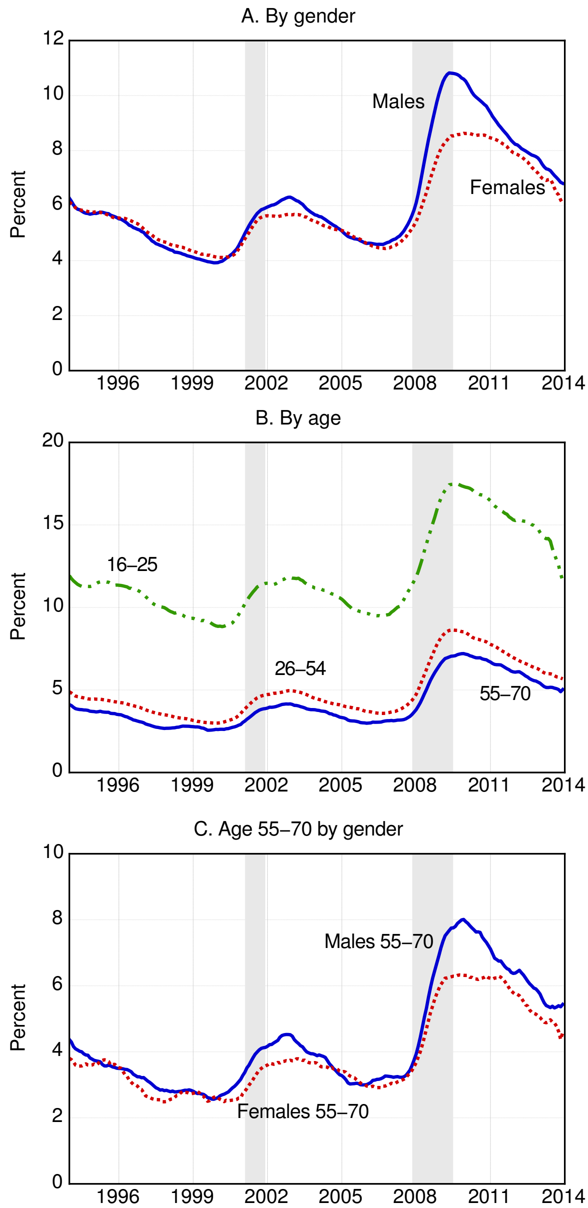
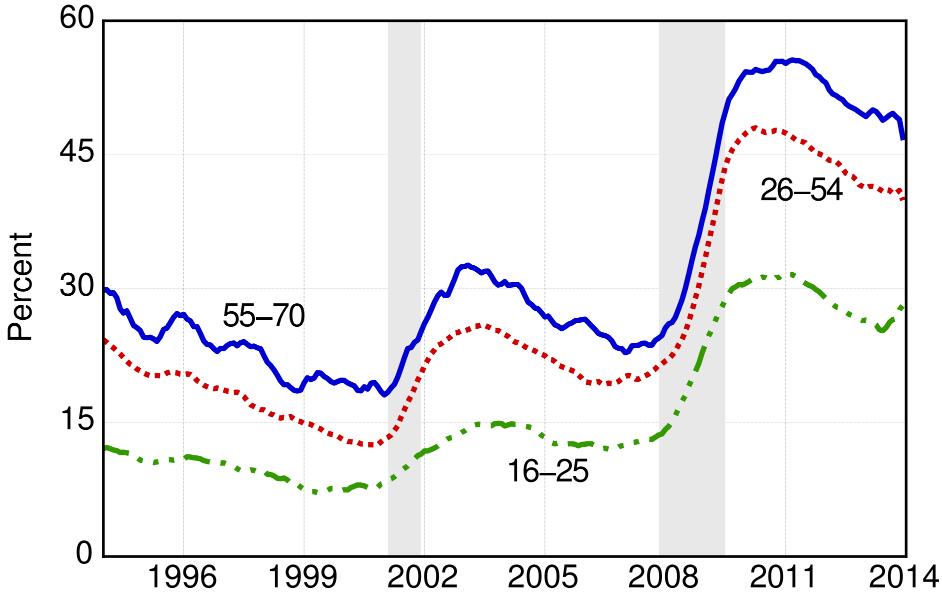
Figures and Tables

Figure 1: Unemployment rates, 1994-2013



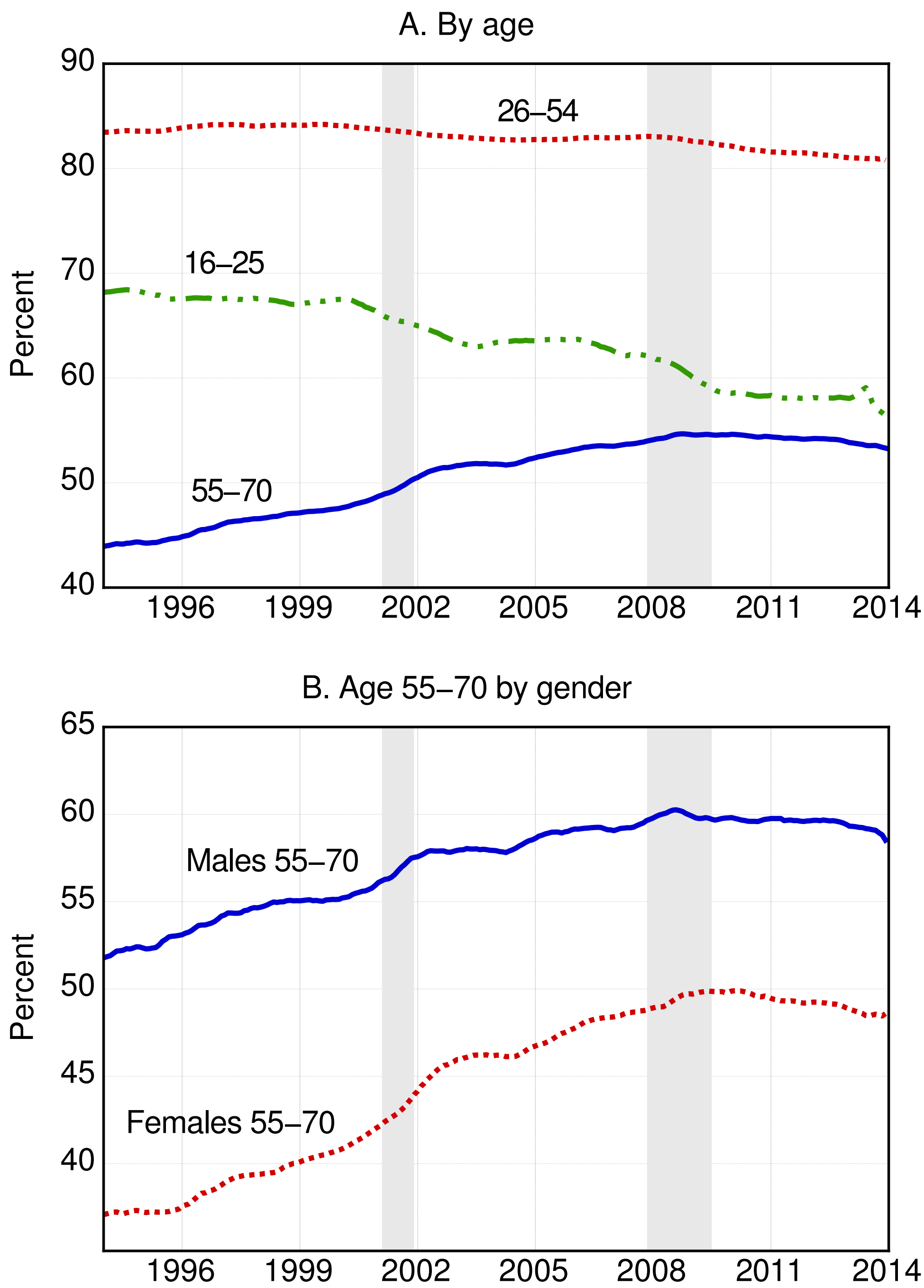
Note: Monthly CPS data, 12 months moving averages. Shaded areas indicate recessions.

Figure 2: Percent of unemployed workers with observed unemployment spells of 27 weeks or more by age group, 1994-2013



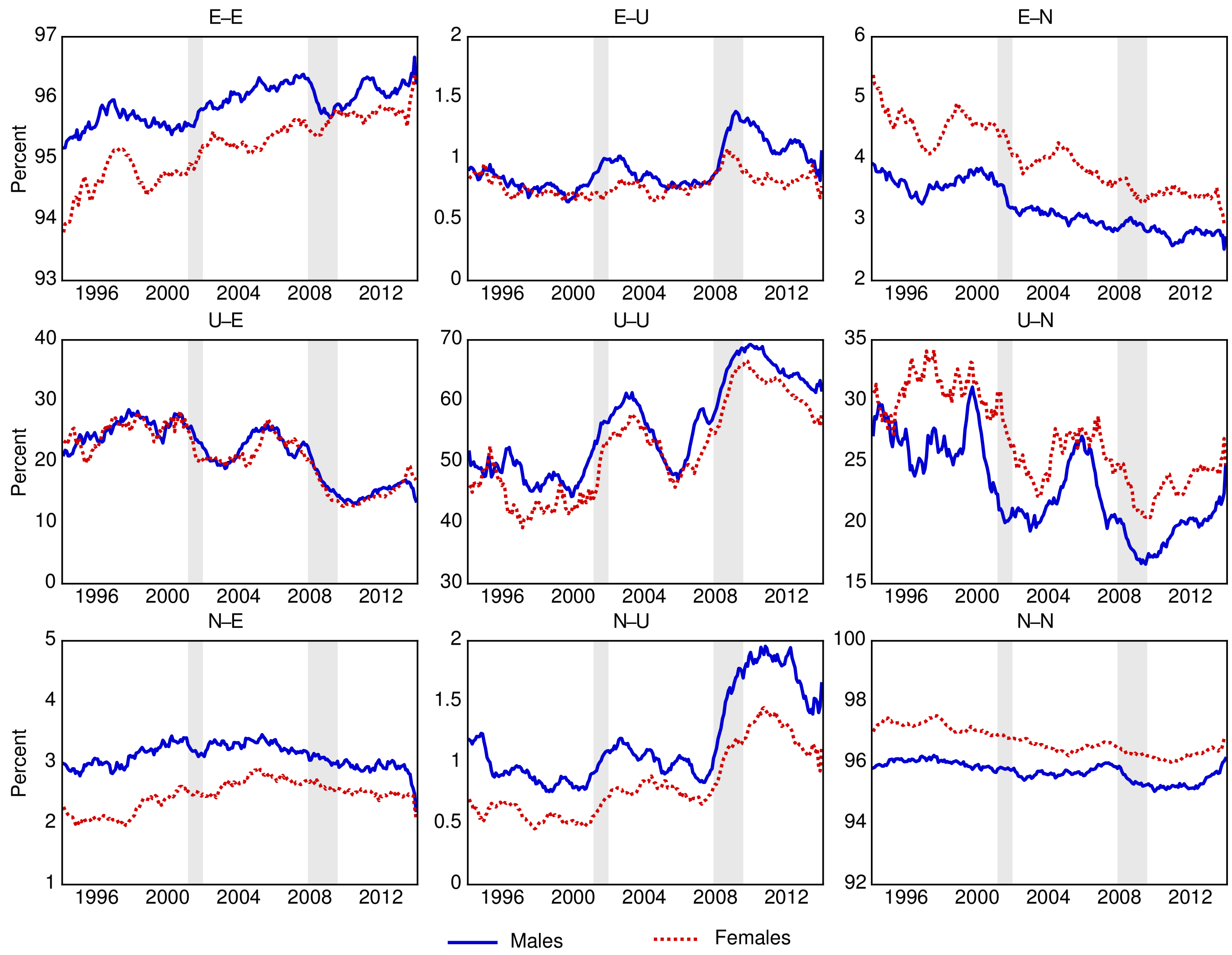
Note: Monthly CPS data, 12 months moving averages. Shaded areas indicate recessions.

Figure 3: Labor force participation rates, 1994-2013



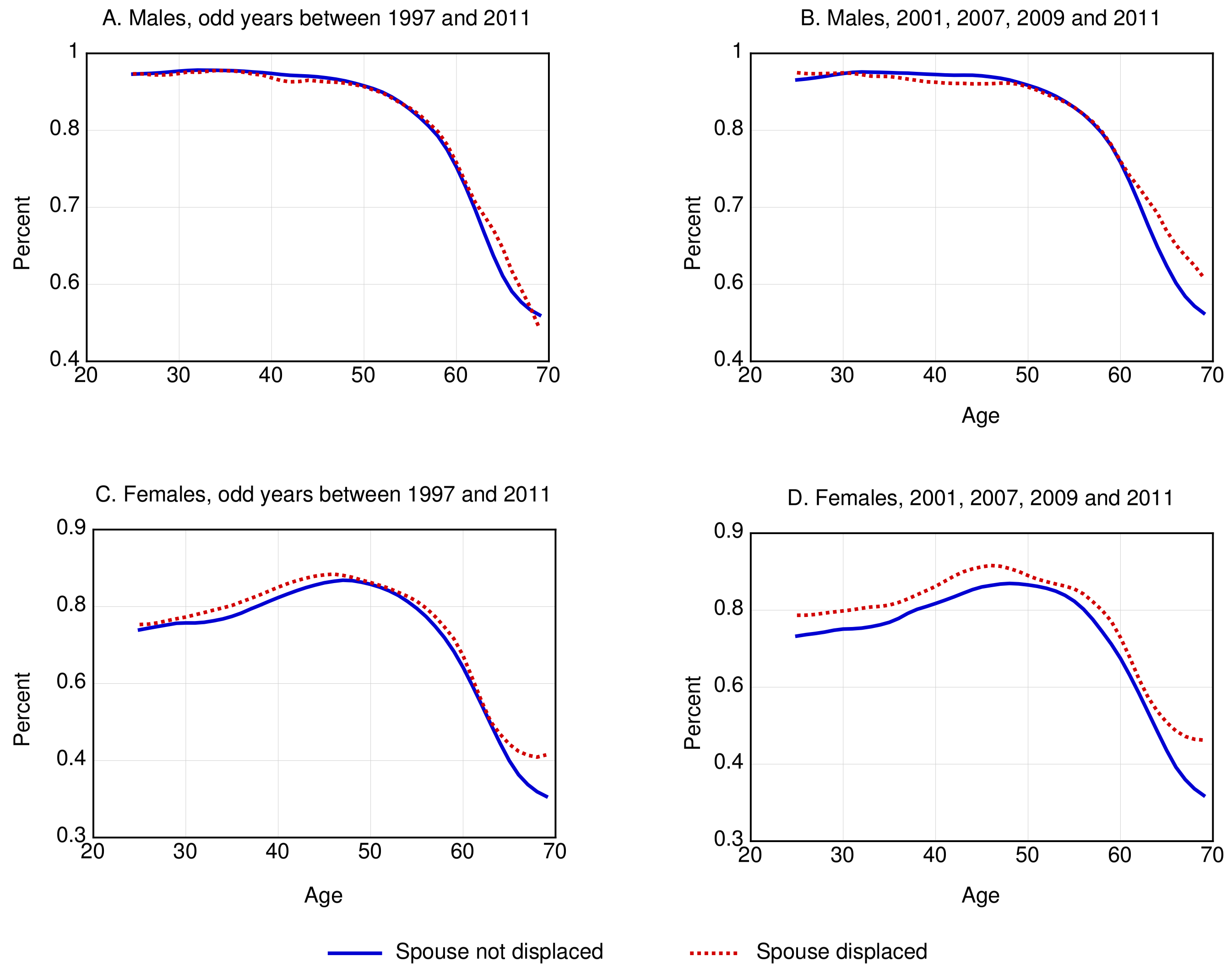
Note: Monthly CPS data, 12 months moving averages. Shaded areas indicate recessions.

Figure 4: Transitions between the labor force states among older workers, 1994-2013



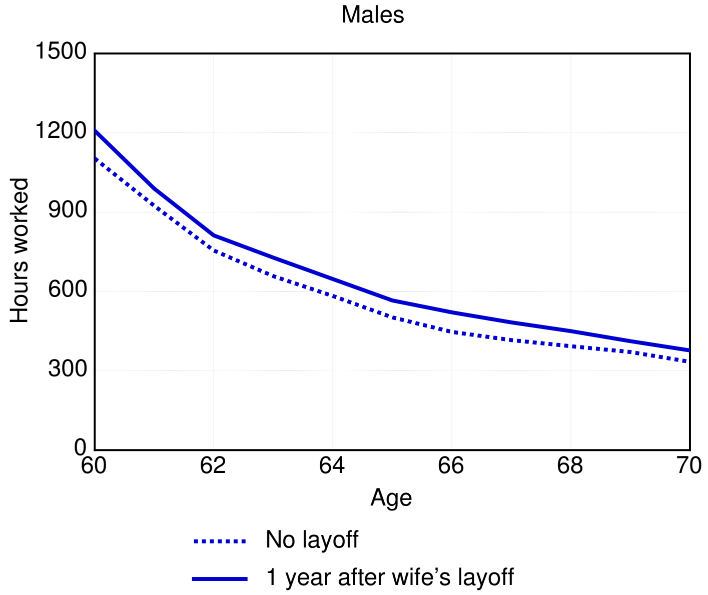
Note: Transition rates computed from the rotating part of the CPS monthly data, 12 months moving averages. Includes ages 55-70. Shaded areas indicate recessions. E = employed, U = unemployed, N = not in the labor force.

Figure 5: Labor force participation rates by age and job loss of a spouse, 1994-2013



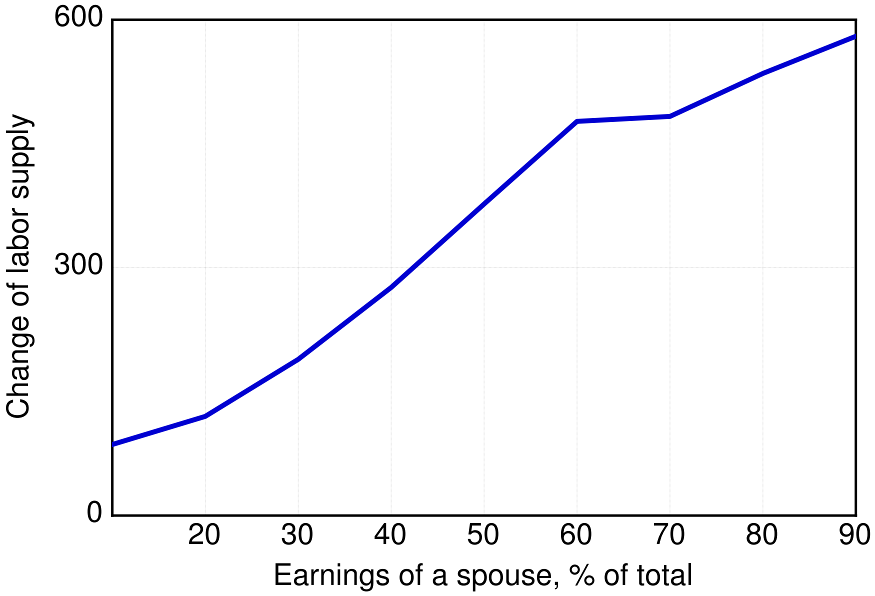
Note: Data from Displaced Worker Supplement, local polynomial smoothing of participation rates by age. Participation rates are conditional on spouse being in the labor force in the previous year.

Figure 6: Labor supply by layoff experience of a spouse: simulations results



Note: The graphs show average labor supply by age in hours per year, including non-working individuals. Based on 10,000 simulated households.

Figure 7: Labor supply change by wife's earnings



Note: The graph shows the change of labor supply at age 60 due to a spouse's layoff in the previous year. Averages in hours per year, including non-working individuals. The horizontal axis gives the pre-displacement earnings of laid off spouse. Based on 10,000 simulated households.

Table 1: Descriptive statistics for couples by layoff experience

Variable	No Layoff	Laid off: Husband	Laid off: Wife	Laid off: Both
		Wives		
Age	62.6	58.3	60.7	57.7
White, %	87.1	85.8	86.8	89.0
Education, years	12.8	12.8	12.5	12.3
Good health, %	80.3	81.4	83.5	87.4
Experience, years	29.2	27.2	30.5	28.4
In the labor force, %	45.8	59.5	67.6	81.6
Annual hours of work	1583	1610	1441	1622
Hourly wage, $	17.4	14.8	12.9	14.0
Annual earnings, $	24,465	21,701	18,767	25,315
Blue-collar occupation, %	7.5	8.9	11.6	9.7
Employed in manufacturing, %	10.0	10.0	15.8	18.6
		Husbands		
Age	66.2	63.8	61.9	60.9
White, %	87.5	87.2	85.6	88.0
Education, years	12.7	12.5	12.3	12.1
Good health, %	76.8	82.4	76.8	86.0
Experience, years	41.8	41.9	39.7	39.9
In the labor force, %	47.7	70.8	69.2	89.5
Annual hours of work	1867	1703	1968	1713
Hourly wage, $	34.7	42.0	19.3	19.1
Annual earnings, $	37,912	33,201	33,025	31,130
Blue-collar occupation, %	25.1	31.5	31.4	39.7
Employed in manufacturing, %	25.4	35.6	28.2	40.6
		Households		
Non-labor income, $	57,599	49,426	53,707	44,921
Net worth, $	490,778	351,925	361,673	261,042
Households with dependents, %	11.8	15.9	15.2	19.4
Number of couples	9,673	1,334	1,250	263
Number of household-year observations	42,889	5,475	4,831	661

Notes: Unweighted means from 1992-2012 HRS. Dollar amounts are converted to 2000 values using CPI-U-RS. Averages for non-laid off series are based on all person-year observations for the households that never reported layoffs. Averages for laid off households are based on all person-year observations up to 2 years after the first recorded displacement. Hours of work, wages, earnings, occupation and indusrty exclude observations for non-workers.

Table 2: Estimates of labor force participation equations

	Wives		Husbands			
			All		High income wife*	
Independent variable	Estimate	SE	Estimate	SE	Estimate	SE
Spouse lost job:						
over the last year	0.093	0.025	0.008	0.028	0.027	0.045
one year ago	0.078	0.026	0.023	0.031	0.117	0.050
Good health	0.036	0.008	0.044	0.007	0.051	0.015
Age 62-64	-0.059	0.008	-0.062	0.008	-0.069	0.017
Age 65-70	-0.107	0.010	-0.097	0.011	-0.083	0.024
Age over 70	-0.138	0.016	-0.113	0.015	-0.104	0.036
Dependents	0.006	0.008	0.008	0.008	0.018	0.017
Experience	-0.045	0.003	-0.030	0.005	0.005	0.012
Experience squared	0.012	0.004	0.000	0.005	-0.044	0.014
Industry**	1.78	(0.045)	1.2	(0.275)	0.76	(0.688)
Occupation**	3.04	(0.000)	2.0	(0.012)	1.6	(0.060)
Post-displacement effects:						
average value	0.086		0.016		0.072	
Wald test statistics (p-value)	10.38	(0.000)	0.3	(0.740)	2.8	(0.062)
N	25,527		28,329		7,373	

Notes: OLS fixed effects estimator. Dependent variable is a binary employment indicator. All models include year fixed effects.
* Wife's earnings are at least 70% of husband's.
** The estimates for industry and occupation for the job with the longest reported tenure are shown as Wald statistics with p-value for the test of joint significance in the parentheses.

Table 3: Estimates of labor supply equations

	Wives		Husbands			
			All		High income wife*	
Independent variable	Estimate	SE	Estimate	SE	Estimate	SE
			OLS fixed effects estimator			
Spouse lost job:						
over the last year	0.022	0.008	-0.004	0.009	-0.008	0.013
one year ago	0.004	0.008	-0.000	0.010	0.029	0.014
Good health	0.007	0.003	0.011	0.002	0.015	0.004
Age 62-64	-0.015	0.003	-0.029	0.003	-0.019	0.005
Age 65-70	-0.026	0.003	-0.055	0.003	-0.043	0.007
Age over 70	-0.030	0.005	-0.058	0.005	-0.046	0.010
Dependents	-0.002	0.002	0.005	0.002	0.002	0.005
Experience	-0.008	0.001	-0.016	0.001	-0.011	0.003
Experience squared	-0.007	0.001	0.003	0.002	-0.004	0.004
Industry**	3.0	(0.000)	1.78	(0.046)	1.16	(0.306)
Occupation**	1.92	(0.015)	1.99	(0.012)	2.29	(0.003)
Post-displacement effects:						
Average value	0.013		-0.002		0.011	
Wald test statistics (p-value)	3.59	(0.028)	0.11	(0.897)	2.47	(0.085)
			Honoré (1992) estimator†			
Spouse lost job:						
over the last year	0.017	0.009	-0.009	0.016	-0.008	0.025
one year ago	-0.006	0.014	-0.009	0.016	0.033	0.021
Good health	0.013	0.007	0.015	0.006	0.017	0.009
Age 62-64	-0.015	0.005	-0.021	0.005	-0.017	0.008
Age 65-70	-0.030	0.011	-0.046	0.008	-0.044	0.013
Age over 70	-0.052	0.018	-0.060	0.013	-0.056	0.020
Dependents	-0.001	0.004	-0.001	0.004	-0.003	0.009
Experience	0.009	0.004	0.008	0.003	0.008	0.006
Experience squared	-0.005	0.005	-0.001	0.003	-0.004	0.006
Industry**	28.5	(0.005)	14.1	(0.294)	28.3	(0.005)
Occupation**	82.0	(0.000)	23.3	(0.078)	247.6	(0.000)
Post-displacement effects:						
average value	0.009		-0.015		0.024	
Chi-2 test statistics (p-value)	13.7	(0.001)	1.57	(0.456)	10.48	(0.005)
N	25,527		28,329		7,373	

Dependent variable - log of annual leisure hours, coefficients in the table are reported with a negative sign to show the relationship between independent variables and labor supply. All models include year fixed effects.

* Wife's earnings are at least 70% of husband's

** The estimates for industry and occupation for the job with the longest reported tenure are shown as Chi-squared statistics with p-value for the test of joint significance in the parentheses.

† The table shows marginal effects - coefficient estimates times the fraction of non-censored observations.