Household Responses to a Late-Life Job Loss

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This paper demonstrates that spousal earnings affect an individual's decision to retire. I find that husbands with higher-earning spouses are more likely to retire following an involuntary job loss. Earlier studies show that job reduces subsequent employment, earnings, and wealth, but they do not explain why some workers return to work and others do not. I add an important dimension to these studies by considering how spousal earnings and household assets affect a worker's post-displacement labor supply. To explore the household's problem, I develop a stylized two-period model to illustrate how labor supply responds to spousal earnings and household assets in an uncertain environment. Using data from the Health and Retirement Study, I test my theoretical model's predictions using a reduced-form empirical specification. Relative to displaced men with low-earning spouses, husbands with higher-earning wives are more likely to exit the labor force following displacement. The same effect is not detectable in the population of older women. In both populations, a displaced worker with higher household assets is less likely to return to the labor force. At the household level, job loss as a profound impact on retirement well-being. At a broader level, a reduction in the labor supply of older workers has negative fiscal consequences.

Keywords: retirement, retirement policies, economics of the elderly, economics of the handicapped, non-labor market discrimination, other

INTRODUCTION

A late-life job loss is potentially devastating for retirement security. Displaced older workers typically have high pre-displacement job tenure, more difficulty finding a new job, and few years in which to make up for lost earnings and savings. As a result, a household that experiences a late-life employment shock will be unable to smooth consumption as it transitions into retirement. It will respond to a displacement by reducing consumption and/or increasing labor supply later in life, and as a result, its welfare will suffer. Rates of job loss for older workers are surprisingly high and have converged with the job loss rates of younger workers over the past 33 years. For the cohort born between 1942 and 1947, twenty-one and a half percent lost at least one job between 1998 and 2014.

The impact that a job loss has on retirement security depends on household characteristics. For displaced workers with high earning spouses, intra-household insurance mitigates the cost of an unexpected earnings shock. In addition, wealthy households are better equipped to moderate the effect of such a shock. In a family labor supply model, a household can adjust consumption and the leisure of each spouse in response to reduced earnings potential. The contribution of this paper is establishing why some workers retire following a job loss and others do not. I argue that spousal earnings and household assets account for the differential response. This assertion is supported by the predictions of a theoretical model and reduced-form regression estimates. This study lies at the confluence of a long literature on the theory of retirement and a literature on individual and household responses to job loss.

My definition of displacement is consistent with earlier studies, and I make no distinction between retirement and being out of the labor force in a population of older workers. When a worker leaves a job because the "business closed" or she was "laid off or let go," I classify her as displaced. This event is a plausibly exogenous shock to her earnings potential that does not limit her ability to work.[1] Throughout this paper "retirement" and "labor supply" are used interchangeably. In an older population, I regard the decision to retire and the decision to exit the labor force as the same. Most individuals do not permanently exit the labor force after leaving their career job, and so I do no treat retirement as an absorbing state. While workers who leave long-tenure, full-time jobs may describe themselves as retired, the majority (60%) move to a bridge job.[2] A sizable portion (13%) reverse course and reenter employment following at least two years out of the labor force (Cahill et al., 2013). Because data on self-reported retirement are subjective and do a poor job explaining the employment patterns of older individuals, my empirical estimations use data on labor force participation. This measure is consistent with my theory, which models labor supply.

Two demographic trends make the study of older workers' labor supply and its interaction with spousal earnings particularly timely. The United States will transition to an older population in the coming decades. The ratio of people over 64 to people 20–64 will increase by 80 percent by 2030. The macroeconomic and fiscal consequences of this shift will depend on how long people stay in the labor force. People are living longer, and if workers continue to exit the labor force in their early 60's, the fraction of the population that is retired will increase. During retirement, households typically draw down their assets and reduce consumption. The shift toward an older population may affect the aggregate savings rate, and in turn, the productive capacity of the economy and the rate of return on capital assets. In addition, the solvency of government programs such as Social Security, Medicare, and Medicaid will depend on older workers' labor supply. Working longer provides more resources to pay for Social Security and the health care costs associated with an aging population. The second major demographic shift relevant to this paper is married women's increased labor force participation over the last six decades. As a result of this change, more individuals from dual-career households have reached the typical retirement age in recent decades. Characterizing the effect of spousal earnings on the retirement decision contributes to our understanding of older worker's labor force participation (see Appendix 1 for historical trends).

This study explores the link between spousal earnings and labor supply. It fits within the broader literature in labor economics on job displacement and retirement. The existing literature in this field documents the patterns of job loss and the effects of job loss on earnings, employment, wealth, health, and spousal labor supply.

LITERATURE REVIEW

Older workers typically have longer job tenure than younger workers, and therefore should face less employment risk. While survey data confirm this pattern–the job loss rate is relatively lower for workers ages 30-64–their absolute employment risk is surprisingly high. Using the Displaced Worker Survey, Farber (2011) estimates that the three-year job loss rate for workers ages 30-64 exceeded 14 percent during the 2007–2009 recession. Further, over the past three decades the job loss rates of older workers have converged with that of younger workers (ages 20-39). Finally, older workers' job security is equally sensitive to the business cycle. The variation in job loss rates over time is approximately the same for all age groups. Farber's study documents that involuntary job loss is a significant threat to employees later in life.

The consequences of job loss vary by age. These consequences include persistent and substantial earnings declines, reduced wealth, higher mortality, and a decline in health insurance coverage. Earnings declines are particularly large for high tenure workers, who tend to be older and have occupation–or industry-specific human capital. The average earnings loss for displaced workers with 13 or more years of tenure is 27 points larger than that of workers with less than one year of tenure (Farber, 2011). In addition to experiencing a larger earnings declines following displacement, late-life job losers have fewer years during which they can replace lost earnings or savings. Indeed, Stevens and Moulton (2013) show household wealth falls substantially in the years following a job loss. Relative to workers who are not displaced, household wealth is 8 percent lower for those who lose a job after 30. A further difference between older and younger workers is that job loss has a smaller effect on mortality in a population of older workers. Compared to older workers, displaced workers younger than age 33 suffer significantly higher percentage increases in mortality (Sullivan & von Vachter, 2009). Finally, older workers are more likely to be displaced from a job with health insurance. If they reenter the labor force, older single workers are no more likely than young single workers to enter a job with coverage. Older married workers are only slightly more likely than young married workers to find coverage through an employer (Olson, 1992). The expected value of health insurance is greater later in life because older individuals' have greater expected health expenditures. For these reasons, the loss of health insurance accompanying a job loss is more costly for older workers. Earnings potential, household wealth, health, and access to health insurance will influence an individual’s post-displacement labor supply. Since the effects of job loss on these variables differ by age, the population of older households warrants separate study.

The ability to replace labor income and the cost of finding new employment differ by age as well. Older workers are either at or near an age when (1) they have fully accrued their benefits in a defined benefit pension plan; (2) they can receive defined contribution distributions without incurring a penalty; (3) they are eligible to receive Social Security retirement benefits; and (4) they become eligible for Medicare at 63. Not only is the option value of exiting the labor force greater for older individuals, but the cost of staying in the labor force is greater at older ages as well. Despite its illegality, Neumark (2009) shows that older workers continue to face age discrimination in hiring. As a consequence of this practice, unemployed older workers need to search longer for a new job and are more likely to become discouraged and exit the labor force. In order to avoid separating the effects of displacement from normal retirement behavior, several job loss studies exclude older workers.[3]

In all years between 1984 and 2010, older workers (ages 30-64) were more likely than younger workers to exit the labor force following a displacement. However, older workers’ likelihood of retiring post-displacement declined steadily between 1984 and 2010, whereas displaced younger workers’ likelihood of exiting the labor force remained flat over this period (Farber, 2011). That is, a displaced older worker was less likely to retire in 2010 than he was in 1984. Despite this convergence, retirement is still an appealing option after a late-life job loss. Chan and Stevens (2001) find large and lasting effects of job loss later in life. Four years after a job loss, the difference in employment rates between displaced and non-displaced workers is approximately 20 percent. Both the rates of return to employment and the higher rates of exit from post-displacement jobs explain this long-term effect.

In married households, the interaction between household labor supply and displacement varies by age. Stephens (2002) finds a significant “added worker effect” following a husband’s job loss in families where both members are between the ages 23 and 63. In the “average” married household, a wife increases her work effort by an average of 11% during the years following displacement. This estimate incorporates changes on both the intensive and extensive margin. In a sample of workers over 30, there is no significant added worker effect (Toohey, 2013). The reason for this difference may be that older worker’s hours are less flexible, a spouse with a limited work history will have difficulty finding employment, or the household has preferences for joint retirement. In an empirical study of older workers, Lee (2017) finds that displaced workers and their spouses are less likely to retire at the same time. Vives delay retirement when their husbands retire following a job loss. Lee infers that intra-household insurance mitigates the impact of an earnings shock. These studies inform my decision about which variables belong in a theoretical model. I develop a two-period model of family labor supply to better understand how husbands’ and wives’ demands for leisure are affected by job loss.

THEORETICAL MODEL

The objective of my theory is to describe the effect of spousal earnings and household assets on labor supply following a job loss. I write a two-period model of the retirement decision with uncertain earnings. A job loss is modeled as a shock to potential earnings in the second period. I assume unitary decision-making in married households, and I assume households cannot divorce. Each household maximizes expected utility over consumption and the leisure of each spouse subject to a lifetime budget constraint. The leisure choice is binary in each period, during which each agent is either working full-time or out of the labor force. There are no labor market frictions–a worker can always find employment that pays his potential earnings. An individual is retired if he chooses not to work in the second period, and so retirement is implicitly an absorbing state. My model abstracts from uncertain longevity, liquidity constraints, bequest motives, pension plan incentives, and social security retirement benefits. Despite its simplicity, the model offers analytical insights into how an earnings shock affects the labor supply of each worker in a married household. My theoretical approach is nested within the class of dynamic life-cycle models of the retirement decision with uncertainty.[4] Instead of structurally estimating the model's parameters, I calibrate them and analyze the comparative statics to develop hypotheses about the relationships between spousal earnings, household assets, and labor supply. I then test these predictions in a reduced-form regression.

Modeling leisure as a binary choice is better suited to the retirement problem. A different class of dynamic life-cycle models of household labor supply treat leisure as a continuous variable. These theoretical frameworks, such as MaCurdy (1981), are not particularly well- suited to the retirement problem because most career jobs have minimum hours constraints. These constraints are reflected in the HRS data-very few workers gradually draw down their hours at career jobs.[5] Those workers who do reduce their annual hours typically transition to a lower wage bridge job (Rust and Phelan, 1997). Thus, there is a significant cost to reducing one's hours. Since the continuous leisure model is less applicable to the labor supply decisions of an older population, I treat leisure as a discontinuous variable. As a result, I must calibrate and simulate my model to make theoretical predictions.

The Household Problem

A household consists of two potential workers and no children. I use the terms "husband" and "wife" and describe the effects of displacement from the husband's perspective for expositional clarity. The model is symmetric, and so the same conclusions apply to a wife's labor supply. The service flow to the household in each period is Cobb-Douglas (Equation 1). It is "produced" from joint household consumption expenditures (c_t), the leisure of the husband (h_t), and the leisure of the wife (f_t) using Cobb-Douglas technology with constant returns to scale.

$$g(c_t, h_t, f_t) = c_t^{\alpha} h_t^{\beta} f_t^{(1-\alpha-\beta)} \tag{1}$$

The marginal products are:

$$\begin{aligned} \frac{\partial g}{\partial c_t} &= \alpha c_t^{\alpha-1} h_t^{\beta} f_t^{(1-\alpha-\beta)} \\ \frac{\partial g}{\partial h_t} &= \beta c_t^{\alpha} h_t^{\beta-1} f_t^{(1-\alpha-\beta)} \\ \frac{\partial g}{\partial f_t} &= (1-\alpha-\beta) c_t^{\alpha} h_t^{\beta-1} f_t^{(-\alpha-\beta)} \end{aligned} \tag{2}$$

In most life-cycle models of family labor supply, consumption and the leisure of each spouse are additively separable. The advantage of the Cobb-Douglas functional form is that it allows for changes in consumption at retirement and for joint retirement preferences. In the flow of services function (Equation 1), there are diminishing marginal returns to consumption expenditures and the leisure of each spouse such that $\alpha, \beta,$ and $\alpha + \beta \in (0, 1)$. Leisure is binary, h_t and $f_t \in \{0.5, 1\}$, corresponding to full-time work and out of the labor force, respectively. The parameter for full-time employment is chosen as 0.3 to approximate the discretionary leisure of a full-time worker relative to an individual not out of the labor force.[6] The marginal product of consumption increases discontinuously as the household's labor supply moves from both spouses working, to one spouse working to both spouses retired. The productivity of each spouse's leisure increases continuously in consumption and discontinuously in the leisure of their partner. Therefore, the husband's leisure, the wife's leisure, and consumption are complementary in the production of service flows to the household. This feature of the model accommodates findings from earlier studies. Gustman and Steinmeier (2000) and Casanova (2011) present empirical evidence of the complementarity of leisure in older households.

The flow of services function is nested within an isoelastic utility function (Equation 3). These functional forms (Cobb-Douglas and isoelastic) allow for positive or negative changes in consumption at retirement and increases or decreases in leisure when one's spouse retires. These utility maximizing choices depend on the curvature of the utility function (γ) and the enhanced productivity of consumption expenditures and leisure when at least one spouse retires (a function of α and β). The next sub-section discusses these effects in more detail.

$$u(c_t, h_t, f_t) = \begin{cases} \frac{g^\gamma}{\gamma} & \text{for } \gamma < 1 \\ \ln(g) & \text{for } \gamma = 0 \end{cases} \tag{3}$$

In each period's budget constraint, the household's labor income (y_t) depends on the leisure choice of each spouse and their earnings potential (Equation 4). Each worker's time endowment is normalized to one. The earnings potential (e^i) of each spouse is multiplied by two, so that labor income equals earnings potential when an individual is working full-time. The second period budget constraint shows that earnings potential declines in the second period if a spouse does not work in the first period. Labor productivity falls by a factor of ρ, which enters the earnings equation as an interaction with the indicator function ***1*** (). This function takes a value of one if an individual chooses not to work in the first period. This restriction is consistent with a theory of human capital depreciation in which work during one's early career maintains skills valued by employers.

$$\begin{aligned} y_1 &= 2e_1^H(1-h_1) + 2e_1^F(1-f_1) \\ y_2 &= 2e_2^H(1-h_2)\big(1-\rho\cdot 1(h_1=1)\big) + 2e_2^F(1-f_2)\big(1-\rho\cdot \mathbf{1}(f_1=1)\big) \end{aligned} \tag{4}$$

I combine equations 1, 3, and 4 to express the household's two-period optimization problem.

$$\begin{aligned} &\max_{c_1,h_1,f_1,c_2,h_2,f_2} \frac{\left[c_1^\alpha h_1^\beta f_1^{(1-\alpha-\beta)}\right]^\gamma}{\gamma} + \delta\mathbb{E}\left\{\frac{\left[c_2^\alpha h_2^\beta f_2^{(1-\alpha-\beta)}\right]^\gamma}{\gamma}\right\} \\ &\text{subject to } c_1 + \frac{c_2}{1+r} = y_1 + \frac{y_2}{1+r} + A_0 \end{aligned} \tag{5}$$

Households have the subjective discount factor δ and can save and borrow at interest rate r. A household begins the first period with assets A_0. The second period earnings potential of each spouse is stochastic. In the context of this paper, I interpret any earnings shock to be the result of a displacement.[7] That is e_2^i declines when a worker is displaced. The timing of the model is as follows. In the first period, the household chooses its consumption and the labor supply of each spouse. After making these decisions, it learns each member's potential earnings in the second period. Then, the household chooses consumption and labor supply for the second period. Earnings are not formally insurable. However, income diversification in a dual-earner household provides informal insurance against displacement. Within this model, each spouse is incentivized to work in the first period to reduce the variance of expected lifetime income. A two-period model is sufficient to identify the essential elements of the relationship between job loss and the household's retirement decision. An alternative to the two-period model is a multi-period model in which each period corresponds to one year. I expect such a model would yield one additional prediction: If a household is further is from its terminal period (i.e., younger), then it is less likely to retire. I allow for age effects in the reduced-form regression, so this theoretical simplification will not affect my hypothesis tests.

Intra-Period Complementarities and Inter-Period Substitutability

A displaced workers' labor supply depends on the within period complementarities between household consumption and the husband's leisure, household consumption and the wife's leisure, and the husband's leisure and the wife's leisure. These complementarities are deter- mined by α and β. A displaced worker's labor supply will also depend on the household's first-period savings, which is determined by the substitutability of the flow of services across periods. The substitutability of service flows declines as γ declines. To illustrate how these parameters affect the household's decisions, I elaborate on the the consumption-leisure tradeoff and the leisure-leisure tradeoff.

Earlier studies have found that consumption typically declines at retirement (Haider and Stephens, 2007).[8] The flexible function form of utility in this model allows for increases or decreases in consumption at retirement. The interaction between consumption and the labor supply of either spouse depends on two counteracting forces in the model: (1) the productivity of expenditures in the flow of household services (a function of α and β), and (2) the curvature of the utility function (determined by γ).[9]

The productivity of expenditures, that is the marginal product of consumption, increases when one or both spouses are not working. In the model, when both spouses are employed, the $MPC = \alpha(0.5)^{1-\alpha}$. When only one spouse is working, either $MPC = \alpha(0.5)^{\beta}$ or $MPC = \alpha(0.5)^{(1-\alpha-\beta)}$. And, when neither is employed, the $MPC = \alpha$. The increasing productivity of consumption property holds if $(1-\alpha) > \beta > 0$. The model simulations impose equal returns to the husband's leisure and the wife's leisure, that is $\beta = \frac{1-\alpha}{2}$, which satisfies this condition. If $\gamma = 1$, then the household flow of services becomes the objective function. In this case, the household unambiguously wants to take advantage of the increased productivity of consumption when one or both members retire. It saves a lot when household members work in the first period, and it consumes a lot when they retire. In a model with uncertainty, the household has an additional incentive to save first-period savings serve as insurance against a displacement. If a household does not receive a negative potential earnings shock, the additional savings will be spent on consumption during retirement. The curvature of the utility function counteracts this effect.

With concave utility $\gamma < 1$, a household wants to smooth its service flow over time. This creates an incentive to decrease consumption after retirement–the household wants to offset increases in the service flow (Equation 1) that would otherwise occur from increased leisure. As γ decreases, it becomes less willing to substitute these flows across time. In a three-factor flow of services function, γ, α and β determine whether the complementarity of consumption and leisure or the desire to smooth over time dominates.

Similarly, the counteracting forces between intra-period complementarities and inter-period substitutability affect a couple's decision to coordinate the timing of retirement. Earlier studies have found that couples typically coordinate the timing of retirement (Gustman & Steinmeier, 2000). This model allows for either joint or separate retirement. A husband's marginal product of leisure increases as his wife transitions from work to leisure and vice versa (Equation 2). In other words, the complementarities in the flow of services function incentivize joint retirement. With concave utility, however, the desire to smooth encourages spouses to work in opposite periods to offset increases in the service flow that would otherwise occur from both spouses taking leisure. With earnings uncertainty and human capital depreciation, both spouses are more likely to work in the first period to insure against income risk. Relative to the case with no uncertainty, they will save more in the first period. If no earnings shock is realized, the household has higher than expected second-period consumption and at least one spouse will be more likely to retire to take advantage of the complementarity between consumption and leisure in the second period. If one household member is displaced, the effect on the labor supply of the other spouse is unclear. The threshold at which joint retirement dominates cannot be solved analytically in my model. Simulations of my model will show how spousal earnings and household assets affect joint retirement.

Solution

Due to the non-differentiability of the household's objective function, I solve the problem computationally using backward induction.[10] I find the household's maximum lifetime expected utility by searching over a grid of choice variables.

$$\underset{A_1,h_1,f_1,h_2,f_2}{\arg max} \frac{\left[c_1^{\alpha} h_1^{\beta} f_1^{(1-\alpha-\beta)}\right]^{\gamma}}{\gamma} + \delta\mathbb{E}\left\{\frac{\left[c_2^{\alpha} h_2^{\beta} f_2^{(1-\alpha-\beta)}\right]^{\gamma}}{\gamma}\right\}$$

$$\text{subject to } c_1 + \frac{c_2}{1+r} = y_1 + \frac{y_2}{1+r} + A_0$$

First- and second-period labor income (γ_1 and γ_2) are defined in Equation 4. To gain additional insights into household utility-maximizing behavior, I derive demand functions for two simpler models (Appendix 2). These include a one period, continuous-leisure model and a two-period model, discrete-leisure model without uncertainty. For the single period model, the husband's demand for leisure is a function of two ratios household assets divided by his earnings and his wife's earnings divided by his earnings. The problem is symmetric, and so the same holds for his wife. I test whether this result carries through to the more complex model and whether it is consistent with the data.

TABLE 1
CALIBRATION

Parameter	Value	Comments
α	0.5	Inferred from Altig et al. (2001)
γ	-0.1	From Laitner and Silverman (2012)
e_1^H	1	The husband's earnings potential is normalized to one. The model is homothetic. Therefore, the ratios of earnings $\left(\frac{e_t^F}{e_t^H}\right)$ and assets to earnings $\left(\frac{A_0}{e_t^H}\right)$ determine the household labor supply in each period.
$e_2^i \mid disp$	0.75	Earnings potential declines by 23% if a worker loses a job (Farber, 2011).
$pr(disp)$	0.15	The probability of displacement is 13 percent (from HRS descriptive statistics).

SIMULATED RESULTS

Baseline Parameterization

The model's parameters are calibrated from descriptive statistics and previous research (Table 1). I assume the returns to leisure are the same for each spouse $\left(\beta = \frac{1-a}{2} = 0.25\right)$. I am not interested in the effects of household discounting and the interest rate. Therefore, I impose that the gross interest rate is one ($\delta(1+r) = 1$) and $\delta = 0.95$. I assume human capital depreciates by 30 percent if an individual does not work in the first period. While seemingly large, this choice is sensible. Farber (2011) estimates that the earnings of a worker displaced from a long-tenure job decline by at least 23 percent. The potential earnings of an individual not employed in the first period should be smaller than those of a displaced worker. In addition, and perhaps more intuitively, an individual who enters the labor force in his late 30's after not working when middle-aged will have a significantly lower earnings potential than a similarly a trained and educated worker who is employed throughout his life. The continuously employed worker will possess greater occupational-specific and firm-specific human capital. The comparative statics of the model are sensitive to the parameter values of γ, α and β but less sensitive to the other parameter values.

No Employment Risk and No Human Capital Depreciation

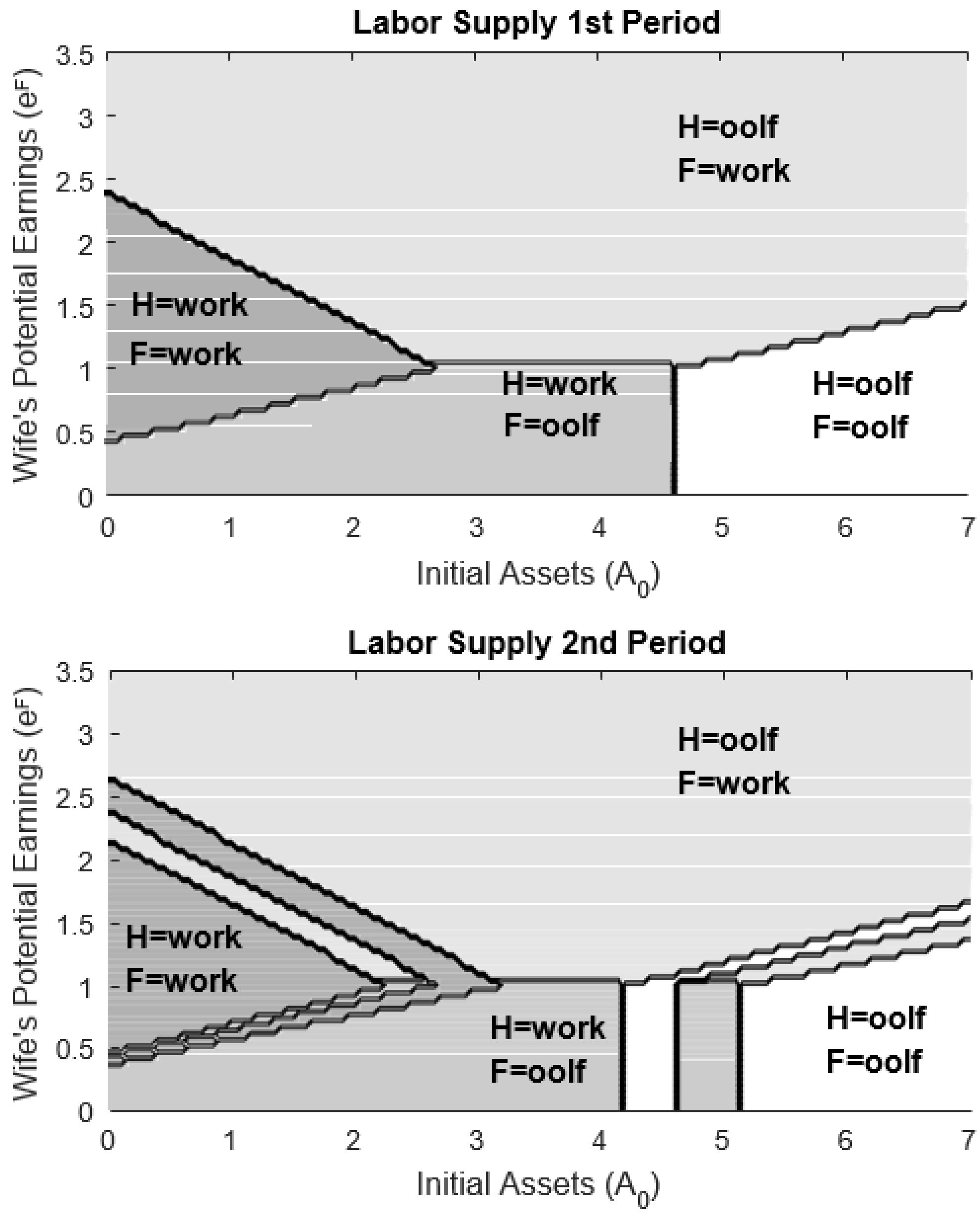
Presenting the case in which a household does not face a potential job loss nor human capital depreciation allows me to examine the comparative statics and dynamics of the model before introducing complicating factors. The outcomes of the simulation refer to whether the husband and the wife are working.

They are presented in a contour plot over the parameter space (A_0, e^F) – Figure 1. The interpretation of "$F = work$" is that the wife is working full-time, and "$F = oolf$" means the wife is out of the labor force. The vertical axis represents the wife's earnings potential, and the horizontal axis represents the household's assets when it enters the first period. The model is homothetic, and the husband's earnings potential is normalized to one. So, each axis can be interpreted as a ratio with the husband's earnings in the denominator, that is $\left(\frac{e_t^F}{e_t^H}\right)$ and $\left(\frac{A_0}{e_t^H}\right)$. Since both the wife's earnings and the husband's earnings are flow variables, the numeric values on vertical axis can be interpreted as the ratio of spouses' annual earnings. The magnitudes on the horizontal axis have no definitive interpretation. Since the numerator is a stock variable and the denominator a flow, the magnitude depends on the length of each period. In my application of the model, I imagine the two periods covering the ages between 30 and 64. Within this context each period is approximately 7.3 years, and $A_0 = 4$ is interpreted as initial assets equaling 30 times annual earnings. This choice is somewhat arbitrary, and therefore, these numerical values are not particularly meaningful.

The top panel depicts the household's labor supply in the first period. For household assets less than approximately 2.73, we can see how the household labor supply changes as the wife's potential earnings increase. For low levels of earnings, only the husband works in the initial period. As her earnings increase, both members choose to work. As they increase further, only the wife chooses to work. These results are intuitive. When the wife has low potential earnings, her returns to leisure are greater than the returns to the additional consumption that her income could provide. As a result, she chooses not to work. As her potential earnings increase, she passes a threshold at which she decides to enter the labor force. For mid-range assets $(2.75 < A_0 < 4.7)$, only the spouse with higher potential earnings is employed in the first period. When initial assets are above 4.7 and the wife's earnings are less than her husband, neither spouse works. The frontier between both spouses enjoying leisure (i.e., both retired) and the wife working but not the husband is upward sloping. This result can be easily understood. As assets increase, the wife needs to be compensated with more potential earnings to sacrifice leisure in favor of work. The household's response to an increase in assets is a bit more straightforward. For a given level of the wife's earnings, household labor supply (either 2, 1, or 0 members employed) decreases as its assets increase. The behavior of second period labor supply is more complex. Bands surround the frontiers that divided the household's first period labor supply (Panel 2, Figure 1). These represent a non-monotonic relationship between the wife's potential earnings, initial household assets, and the household's second-period labor supply. This non-monotonic relationship is a consequence of the counteracting forces derived from the household's smoothing preference and its flow of services function. The bands surround the first-period labor supply frontiers because it is only for these parameters of e^F and A_0 that the household adjusts its savings to take advantage of the complementarities between consumption and leisure in the second period. That is, away from these regions a change in savings will affect neither its first nor second period labor supply. When the flow of services is highly substitutable over time, the household prefers to sacrifice in the first period and enjoy its reward in the second, or vice versa. Intertemporal substitutability is determined by γ. For larger values of γ the service flows are more substitutable, and for lower values the household prefers to smooth over time. Indeed, these bands are wider in the simulation where $\gamma = 0.6$ and narrower where $\gamma = -1$ (see Appendix 3).

Consider a concrete example. The frontier where $A_0 \approx 4.7$ and $e^F < 1$ divides the household labor supply in the first period. To the left of this line, the household sacrifices its first-period service flow. The husband works, the household consumes less (not visible in this graph), and its savings are large.[11] With these additional savings, the household "lives large" in the second period it consumes more, and both spouses are retired. Conversely, to the right of this frontier, the household has a high service flow in the first period and low service flow in the second. When I introduce earnings uncertainty and human capital depreciation into the model, the non-monotonic relationship between the wife's potential earnings, initial household assets, and the household's second-period labor supply persists. However, this relationship only appears in a limited portion of the parameter space.

FIGURE 1
NO DISPLACEMENT, NO HUMAN CAPITAL DEPRECIATION



My model with no earnings uncertainty does not predict joint retirement. That is, this simulation does not show a transition where both spouses work in the first period to both retire in the second. This result is determined by two features of the model. First, intertemporal substitutability dominates the complementarity between spouses' leisure in the flow of services function. Second, within the Cobb-Douglas flow of services function, the complementarity between consumption and the leisure of each spouse is larger than the complementarity between their leisure. This behavior does not fit with observed household retirement patterns (Gustman & Steinmeier, 2000). However, Lee (2017) shows that households in which one worker is displaced are less likely to coordinate the timing of their retirement. In Appendix 3, I present a simulation that accommodates joint retirement. The parameter values now reflect a strong desire to smooth service flows and the complementarity between spouses' leisure is greater than the consumption-leisure complementarity ($\alpha = 0.3, \beta = 0.35, \gamma = -3$). In this simulation, the household does choose to jointly retire.

In order to distinguish between the effects of human capital depreciation and earnings uncertainty on second-period labor supply, I introduce these effects individually. In a model with human capital depreciation no employment risk, the second period labor supply outcomes change slightly. The opportunity cost of staying out of the labor force in the first period mitigates the household's preference to consume and take leisure in the first period and sacrifice in the second. However, on the opposite side of these frontiers the same incentives exist. That is, a household will sacrifice in the first period in order to enjoy more consumption and leisure in the second.

One Spouse Faces Employment Risk

Consider an older individual who faces a relatively high probability of job loss, and if displaced, his earnings potential sharply declines. Relative to a worker who faces less uncertainty, his household should save more to insure against employment risk. If his wife earns less than average or does not work at all, the incentive to save is even greater. In addition to household savings, the presence of a working spouse will influence his decision to return to work after a job loss. My model characterizes how both household assets and spousal earnings affect a displaced worker's labor supply. I begin by limiting my attention to scenarios in which only the husband faces employment risk. This allows the results to be displayed clearly, and the comparative statics do not change when both spouses face uncertainty.

This section focuses solely on the displaced worker's labor supply. My simulations use the baseline parameterization specified in Table 1. The husband's earnings potential is normalized to one, the vertical axis represents his wife's earnings potential, and the horizontal axis represents the household's initial assets in period one. The probability of displacement is 13%, and the decline in potential earnings associated with a displacement is 23%. The "marginal effect" of an increase in spousal earnings or an increase in assets on a husband's labor supply is relatively insensitive to these parameter choices (in quotes here because the effect is discontinuous). Compared to the scenario in which the household faced no employment risk, it will save more to insure against an income shock.

Figure 2 depicts a contour plot of his first period labor supply over the (A_0, e^F) parameter space. For lower values of assets and spousal earnings (to the "southwest" of the frontier), the husband is employed in the first period. If his wife earns less than he does, the threshold at which he decides not to work depends only on assets. You can see this by looking across a "row" of the parameter space where ($e^F < 1$). Once he reaches a value of $A_0 \approx 5.1$, the husband decides to take leisure in the first period. As mentioned above, I caution against interpreting the numeric value of initial assets. It depends on the length of the first period, which can be arbitrarily defined. When a wife earns more than her husband, the frontier dividing his labor supply depends on both her earnings and household wealth. This relationship is linear. As her earnings increase, it takes fewer assets to induce the husband to take leisure in the first period. These observations can be summarized as follows. If a wife is the primary bread winner, then her husband's labor supply will depend on the interaction between her earnings and household assets. If a husband is the primary bread winner, then his initial labor supply depends only on assets.

I ignore the parameter space outside of the frontier delineating first period labor supply because, by definition, a husband must be employed to be at risk of displacement. Figures 3, 4, and 3 describe his second-period labor supply. The frontier dividing his first period labor choice is depicted in each graph for reference. After learning he is not displaced, the husband retires given sufficiently high wealth or spousal earnings. As you can see in Figure 3, the parameter space in which the husband works is reduced relative to the first period. This response is intuitive. The household no longer needs to save to insure against uncertainty nor is the husband penalized for not working (in the form of human capital depreciation), and so he enjoys leisure. The shape of the response can be best understood by dividing households into high earning wives and lower earning wives. When his spouse is the primary bread winner ($e^F > 1$), his decision to retire is a function of both her relative earnings and household wealth (the area between the downward-sloping diagonals). When the husband has higher earnings potential, his reduction in labor supply is only dependent on assets with one exception. When both spouses' earnings potential is approximately equal

($e^H \approx e^F$) and $A_0 \in (3.2, 4)$, the husband chooses to retire despite having higher earnings potential. Recall the case in which the household faces no employment risk (section 3.2). Its first period savings are non-linear around these labor supply frontiers in order to take advantage of the intertemporal substitutability of its “flow of services”. These savings non-linearities are present when the household faces uncertainty as well. In this specific region of figure 3, the household sacrifices in period one in order to enjoy joint leisure in the second period.

Figure 4 delineates the husband’s labor supply following a job loss. Relative to Figure 3, the domain in which he works is smaller. That is, he is less likely to work following a displacement. This result is consistent with the literature that shows late-life job loss has large and lasting effects on employment. The contribution of my model is that it demonstrates how the displaced worker’s labor supply depends on spousal earnings and household assets. Similar to the scenario in which the husband is not displaced, his second period labor supply depends on the interaction between wealth and spousal earnings if his wife earns more. And, if he is the bread winner ($e^F < 1$), it depends only on assets (with an exception). As was the case above, the household builds up savings around the frontiers that divide first period labor supply in order to take advantage of intertemporal substitutability. In the approximate region $A_0 \in (1.3, 3.2)$ and $e^F \in (0.75, 1)$, these savings encourage the husband to retire after losing a job. The buildup of savings at the boundary between $\{h_1 = 0.5, f_1 = 0.5\}$ (both spouses work) and $\{h_1 = 0.5, f_1 = 1\}$ (only the husband works) causes the non-convexity in this graph.

FIGURE 2
HUSBAND'S LABOR SUPPLY 1ST PERIOD

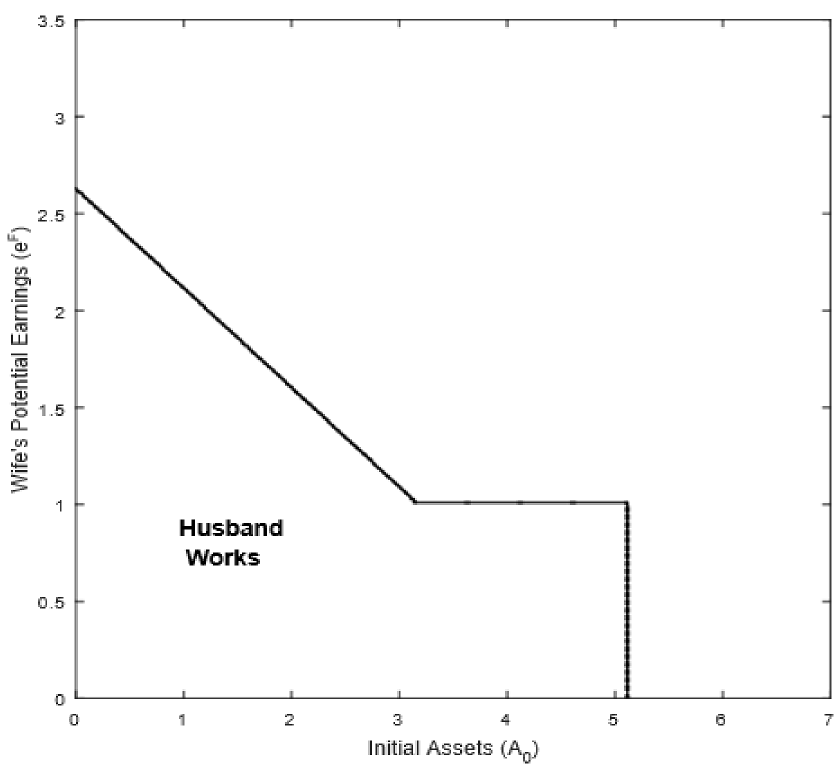


FIGURE 3
HUSBAND'S LABOR SUPPLY 2ND PERIOD (NOT DISPLACED)

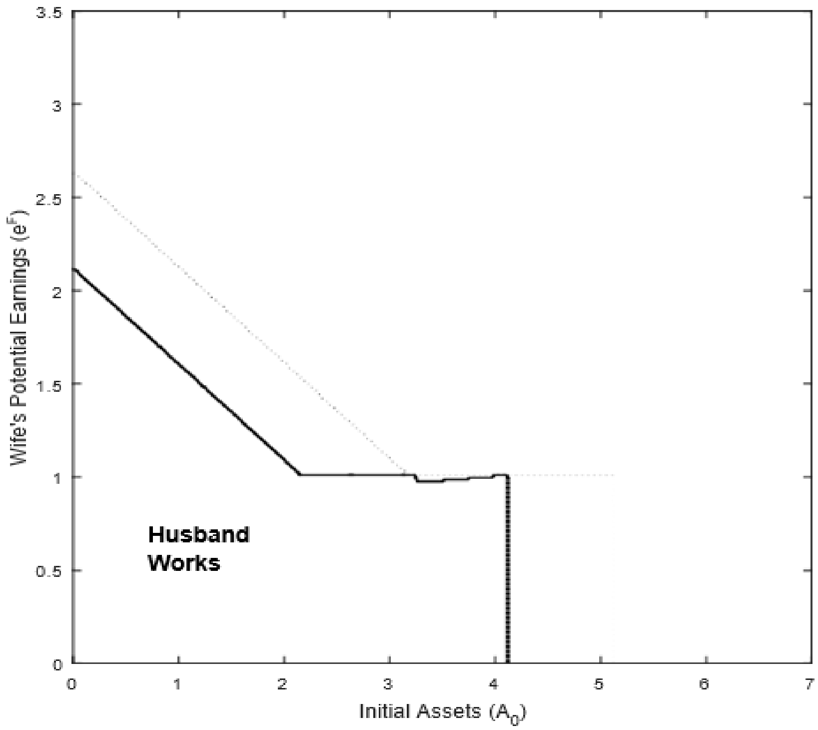


FIGURE 4
HUSBAND'S LABOR SUPPLY 2ND PERIOD (DISPLACED)

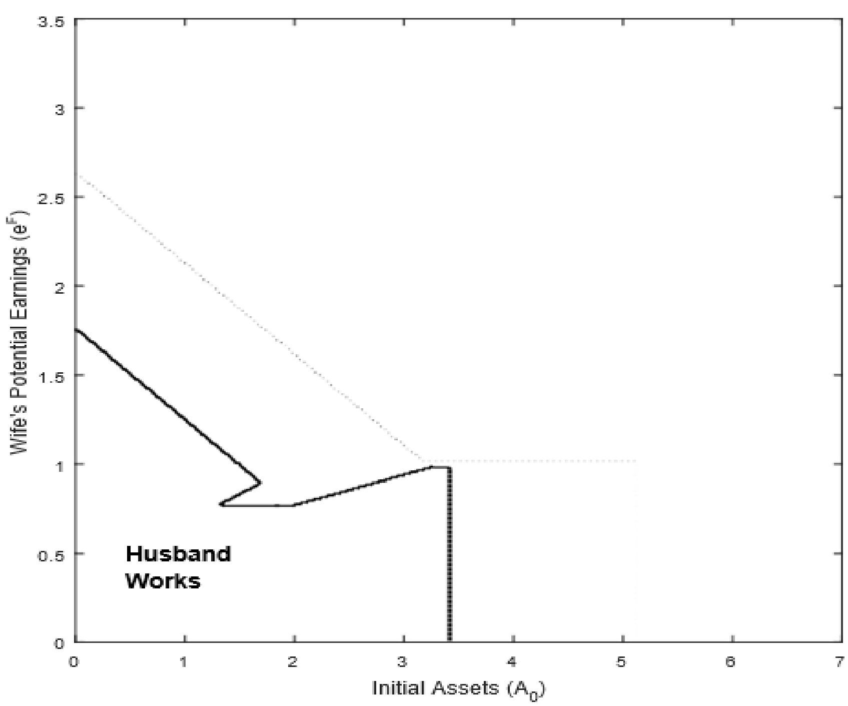
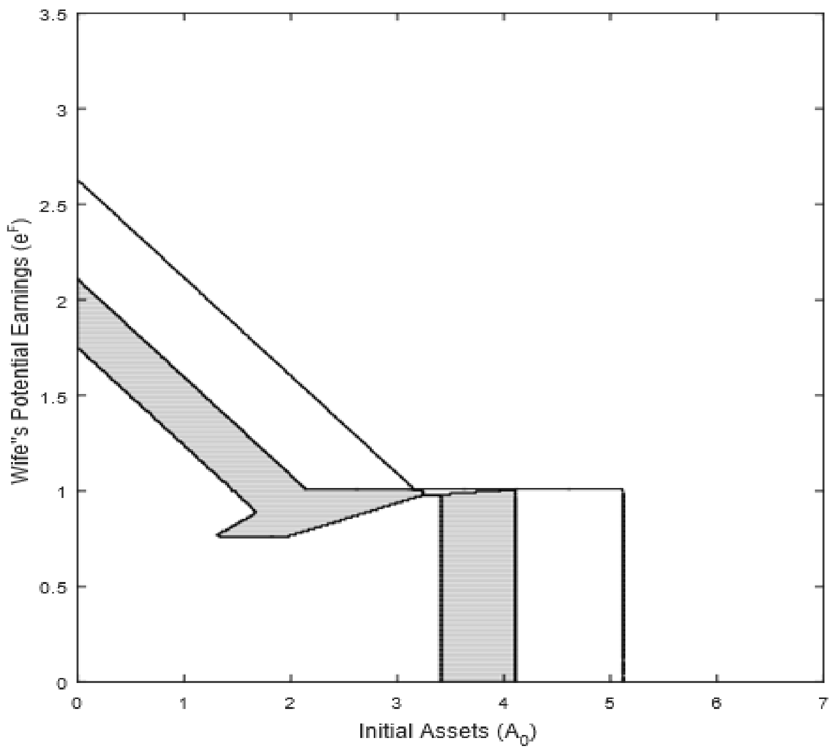


FIGURE 5
MARGINAL EFFECTS



The objective of this paper is to characterize how spousal earnings and household assets affect labor supply following a job loss. The shaded area in figure 3 illustrates the region in which second period employment differs for displaced and non-displaced workers. The marginal effects are linear and easily interpreted for certain parameter values but not others. All of the effects discussed in the subsequent paragraphs should be interpreted as comparing a displaced worker to a control who is not displaced. Simply demonstrating that a displaced worker would retire for specific parameter values is not sufficient. It could be that a non-displaced worker in the same situation would have retired as well. Therefore, I am describing the regions in which their behavior differs.

Consider a household where $\{e^F = 0.5, A_0 = 4\}$. If this husband were not displaced, he would continue to work. Following a job loss, however, he chooses to retire. For $e^F < 0.75$, the model predicts that given sufficient assets a displaced husband would retire, while a member of the control group (a non-displaced husband with identical assets and spousal earnings) would continue to work. You can see this effect by looking across rows of the parameter space where spousal earnings are less than 0.73. In order to test this prediction empirically in a reduced-form model, I would determine whether below a specific threshold of the spousal earnings ratio $\left(\frac{e_1^F}{e_1^H}\right)$ there exists a threshold of the asset ratio $\left(\frac{A_0}{e_1^H}\right)$ where displaced worker retire, but the control group does not. I discuss the suitability of ratios instead of levels later in this section.

When $e^F > 1$, the marginal effect of assets on a displaced worker's response to a job loss depends on the value of spousal earnings. That is, the interaction between spousal earnings and wealth determines whether our displaced husband returns to work. For example, in a household with $A_0 = 1$, a displaced husband whose wife earns $e^F = 1.25$, would retire, while one whose wife earns $e^F = 1$ would not. Investigating whether this result is reflected in the data would involve testing whether above a certain spousal earnings threshold, the husband's labor supply following a job loss depends on the interaction between spousal earnings and household wealth.

Finally, within a middle range of spousal earnings, the effect of initial household wealth on labor supply following displacement will be nonlinear. This prediction is evident by looking across a row in Figure 3 in the range of $0.75 < e^F < 1$. A husband who loses a job would respond in the following ways. If household wealth is low, he is employed in the second period. As assets increases, he retires in the second period (where a member of the control group would not). As they increase further, he supplies labor, and if they increase even more, he withdraws from the labor force. The source of this non-linearity arises from household building up savings along the first-period labor supply boundary discussed above. It had originally planned to adjust its second period service flow by increasing consumption. Following a decline in the husband's earnings potential, however, it equilibrates its flow of services by increasing his leisure. This non-linear effect of the interaction between assets and spousal earnings cannot be captured in a reduced form empirical test of this model.

Another way to express these results is to hold assets fixed (looking at columns in the parameter space). Below a certain threshold of assets (in this parameterization $A_0 < 3.4$), the response to job loss depends on the interaction between spousal earnings and assets, and this relationship could be nonlinear. Above this threshold, the second-period labor supply of a "treated" (i.e., displaced) worker would differ from that of a "non-treated" worker. And, as assets increase further ($A_0 > 4.1$) there would be no difference in their labor supply.

When both spouses face employment risk, the generalizable predictions of my model do not change. The primary difference in behavior is that households save more to insure against greater uncertainty. I present an example to support this claim. Due to the difficulties representing multiple outcomes for multiple workers, I present results for specific values of the parameter space in Appendix 6.

Testable Predictions of the Model

I test my theoretical predictions in a reduced form empirical model. One limitation of this approach is that it cannot capture the non-monotonic relationship described above. However, it appears that these nonlinearities are limited to a relatively small domain of the (A_0, e^F) parameter space. The second limitation is that my sample does not yield enough statistical power to test both the marginal effects of e^F and A_0 and the effect of their interaction. Nevertheless, certain predictions should translate to the reduced form approach. First, relative to the control group, a husband's labor supply following a job loss are negatively related to the ratio of spousal earnings potential $\left(\frac{e_t^F}{e_t^H}\right)$ and the ratio of household wealth to the husband's earnings potential $\left(\frac{A_0}{e_t^H}\right)$. This prediction is a consequence of the homotheticity of the utility function. Appendix 4 shows a simulation where the husband's potential first-period earnings are all doubled. The parameter space in which a displaced husband's second-period labor supply differs from the control group is identical to figure 3. Second, the model predicts the labor supply of "treated" husbands will differ from the control group at specific thresholds. The thresholds depend on my model's parameters. In particular, the earnings ratio that divides the parameter space is particularly sensitive to each spouse's return to leisure in the flow of services function. Appendix 4 illustrates my theoretical results when $\beta = 0.3$. Next, I test the theoretical predictions of my model.

ESTIMATION STRATEGY

My primary goal is to measure the effect of spousal earnings and household assets on a worker's post-displacement labor supply. I include a control group of non-displaced workers because spousal earnings and household assets may affect labor supply, independent of displacement. I modify the approach used in previous studies of displacement.

$$h_{it} = \sum_{k=1}^{4} \eta_k D_{it}^k + \beta \mathbb{I}_i + \sum_{k=1}^{4} \delta_k \mathbb{I}_i \cdot D_{it}^k + \gamma ar_i + \sum_{k=1}^{4} \theta_k ar_i \cdot D_{it}^k + \varphi X_{it} + \alpha_i + \mu_t + \epsilon_{it} \quad (4)$$

h_{it} is a binary outcome variable indicating whether individual i is in the labor force at time period t. D^1_{it} is assigned a value of one if individual i in time period t was displaced 0-2 years ago and zero otherwise. Similarly, $D^2_{it} = 1$ if individual i in time period t was displaced 2-4 years ago. D^3_{it} corresponds to 4-6 years ago and D^4_{it} corresponds to more than 6 years ago. I_i takes the value of one if the spousal earnings ratio is greater than 0.8 in the period when a respondent enters the survey ($\frac{e_1^F}{e_1^H} > 0.8$ or $\frac{e_1^H}{e_1^F} > 0.8$). The spousal earnings ratio enters the regression as a binary variable because the labor supply response to this variable is strongly non-linear. I chose the threshold of 0.8 because it divides the sample evenly, which allows for sufficient power to estimate both the male and female regressions. For male respondents, one-third of spouses earn more than 80% of their labor income and two-thirds earn less. For women, the converse is true. Two-thirds of their husbands earn more than 80% of their labor income and one-third earn less. ar_i is a continuous measure of the household assets to respondent earnings ratio in the initial period $\left(\frac{A_1}{e_1^i}\right)$, henceforth referred to as the "household asset ratio." Each respondent's spousal earnings ratio and asset ratio is time-invariant. X_{it} is a linear age effect, allowing for intercept differences between 30-61, 62-62, and 63 and older. I choose these ages because work incentives change when individuals become eligible for Social Security and Medicare. α_1 is an individual random effect, which account for time-invariant characteristics of individuals. μ_t is a year fixed effect that captures the effect of the business cycle on labor supply.

While previous studies of displacement model the individual effect α_i as a fixed effect, a random effects model is more appropriate for my question and for my data. First, the random effects approach yields consistent estimates when there is a short time series for each respondent. Fixed effects models do not. The median length a respondent is in the sample is four waves. Second, the results from a random effects model allow one to make out-of-sample predictions for an "average" respondent. Third, random effects models allow the disturbance covariance matrix to be unrestricted. That is, they account for the within household error variance over time. Finally, random effects estimations do not drop respondents whose dependent variable is constant across the entire sample period. As a result, individuals who are employed in every wave are not excluded from the estimation.[12] Jakubson (1988) estimates female labor supply using both fixed and random effects models and find that both "give almost numerically identical estimates of the key parameters."

DATA

Survey and Sample Description

My analysis uses the first 12 waves (1992–2014) of the Health and Retirement Study (HRS). In 1992 the HRS originally interviewed individuals ages 30-61 and their spouses regardless of age, yielding 12,632 respondents from 7,704 households. New cohorts in the same age range were added in 1998, 2004, and 2010[13]. When respondents initially enter the study, they are asked questions about their current job and previous job (prior to entering the study). Reinterviewed respondents are asked about their current labor force status and recent employment history. Their responses to these questions allow me to identify workers who recently left a job and the reason for the change. The HRS also provides detailed information on income and wealth. Missing data on income and wealth are imputed by the RAND Center for the Study of Aging across all waves. Their contribution makes these data more accessible, and my data set incorporates these imputations. I test the predictions of my model using two longitudinal samples from the HRS–one of female respondents and the other of male respondents.

My sample selection criteria follow from the assumptions of my model and are consistent with other studies of displacement. First, I divide the data into male respondents and female respondents to create separate samples. I perform separate analysis on each population because the previous literature shows that responses to job loss differ by gender. Second, all cohorts born after 1931 are included in my analysis, so that prime working-age respondents are measured across the entire 1992-2014 time period. Third, I require respondents to be married to the same individual throughout their participation in survey. I am interested in measuring the effect of spousal earnings on post-displacement labor supply. Next, both the respondent and his or her spouse must be between the ages of 40 and 80 when interviewed. Next, I restrict my sample to individuals who are employed when they first enter the HRS but not self-employed. This criterion ensures that both the control (non-displaced) and treated (displaced) groups are similar insofar as they are both at risk of job loss. Sixth, individuals who were displaced in the two years prior to entering the survey are dropped. Vere they not, the sample would be biased towards people who are most likely to seek a new job following displacement. In other words, they had already been subjected to the "experiment" and were found to rebound from a job loss quickly. Finally, the respondent must appear in at least two survey waves. For male respondents, the resulting unbalanced panel has 32,826 person-wave observations, comprised of 3,140 individuals. The sample for women consists of 30,433 person-wave observations and 4,884 respondents (see Table 2).

Measurement

To identify a recent job loss for new HRS respondents, I use information from the job history section of the survey. For reinterviewed respondents, I rely on the employment section. Individuals who left a job are asked, "Why did you stop working at that job?" If their response is either the "business closed" or they were "laid off/let go," I classify them as displaced. Combining layoffs and firings ("let go") is inconsequential for testing the theoretical predictions of my model. In both cases an individual's potential earnings decline and his ability to work is unaffected.[14]

I rely on RAND contributions to the HRS to accurately measure each spouse's earnings (labor income). Earnings are reported for the calendar year prior to respondent's interview. RAND interpolates missing earnings data. Constructing the spousal earnings ratio from only the respondent's initial observation yields a noisy measure. To measure each spouse's contribution more accurately to household earnings, I use earnings data from when the respondent initially enters the survey until the household labor supply changes. This span is comprised of consecutive periods when both the respondent and his spouse have the same labor force status as their first wave. The spousal earnings ratio equals the sum of spousal earnings divided by the sum of respondent earnings over this span. This measure is constructed in this manner for both displaced and non-displaced workers.

The measure of total household assets is constructed from RAND and researcher contributions to the HRS. Respondent assets include financial wealth, housing wealth (primary residence only), and pension wealth. Financial and housing wealth are interpolated by RAND where missing. I include housing wealth because most of the reduction in wealth following a displacement comes from individuals' reported values of their homes, with little change in the amount of mortgage debt. The explanation of this decline is twofold. Job losses are associated with declining local economies, and so the displacement shock may be correlated with negative shocks to home values. Second, displaced workers are more likely to move. Moving to a less expensive home provides access home equity when a loan is unavailable (Stevens and Moulton, 2013). Aggregated measures of pension wealth are imported from Gustman, Steinmeier, and Tabatabai's data contribution to the publicly available HRS data. In an effort to more accurately measure the household asset ratio, it is constructed using the same method as the spousal earnings ratio.[15] The household asset ratio is bottom-coded and top-coded at the 1st and 99th percentiles.

Descriptive Statistics

A comparison of the sample of men and women reveals how older workers' employment outcomes differ by gender (Table 2). Twenty-one percent of men and 18.3% of women experience a job loss at some point during their participation in the study. These statistics are somewhat surprising as we typically consider women to be employed in industries that have not had mass layoffs over the previous 30 years. On average, men experience their first displacement at a slightly older age (38.8 vs. 36.3). Men are on average two years older than their wives when they lose a job, and women are on average three years younger than their husbands at displacement (not reported in table). When respondents are first observed, men's median salaries are significantly higher than women's, and they are less likely to have a working spouse. In addition, men's spouses earn significant less, conditional on employment. Differences between workers who are "never displaced" and those who are displaced at some point in the panel are consistent with one's presuppositions. The averages in Table 3 correspond to the year in which respondents first appear in the survey. Never-displaced respondents and their spouses earn significantly more than their displaced counterparts. Both groups are equally likely to have working spouses. In other words, never-displaced respondents are no more likely to be in dual-earner households. On average, workers who are never displaced earn more income and are better educated.

TABLE 2
SAMPLE COMPARISON OF MEN AND WOMEN

	Men	Women
Person-year observations	32,826	30,435
Respondents	5,140	4,884
Respondents with at least one displacement	1,082	907
Respondents with multiple displacements	226	182
Median age at first displacement	58.8	56.3
Respondent's First Observation:		
Median Earnings	$54,254	$31,507
% with positive earning spouses	68.5%	78.7%
Spouse's Median Earnings (conditional)	$30,833	$53,990

Note: Unweighted tabulations using the 1992-2014 HRS survey. Dollar figures are in 2014 dollars using the CPI-U.

TABLE 3
COMPARISON OF NEVER-DISPLACED AND DISPLACED RESPONDENTS

	Never Displaced	Displaced
Median Earnings	$42,751	$37,684
% with working spouse	73.3%	74.1%
Spouse's Median Earnings (conditional)	$42,479	$37,206
% HS graduate	80.5%	76.1%
% College graduate	26.8%	21.4%

Note: Based on respondent's first observation. Unweighted tabulations using the 1992-2014 HRS survey. Dollar figures are in 2014 dollars using the CPI-U.

ESTIMATION RESULTS

The dependent variable in my regression is labor force participation, and the omitted category is low spousal earnings ratio and non-displaced. I present estimates from a random effects linear probability model estimated using maximum likelihood estimation. The marginal effects of the linear probability model and the logit model are comparable (see Appendix 5). My analysis is limited to a worker's first job loss. For workers who experience multiple displacements, the decline in their earnings is largest at their first displacement (Stevens, 1997). My focus on the most severe job loss is consistent with testing my theoretical model, which assumes a significant decline in potential earnings.

TABLE 4
ESTIMATES OF MEN'S LABOR FORCE PARTICIPATION

	No Interaction	High Spousal Ratio Indicator	Asset Ratio
Non-Interacted Terms		-0.0120	0.000592***
		(0.0107)	(0.000222)
Displaced		$I \cdot D^{k***}$	$ar \cdot D^{k***}$
0–2 years ago		-0.0551***	-0.0425
		(0.0149)	(0.0303)
2–4 years ago		-0.0618***	-0.103***
		(0.0160)	(0.0324)
4–6 years ago		-0.0394**	-0.0553
		(0.0174)	(0.0366)
6+ years ago		-0.0268**	-0.0312
		(0.0136)	(0.0270)
$N_{OBS} = 27{,}247$	$N_{GROUPS} = 5{,}019$		Median $ar \approx 6$

Note: All regressions include year fixed effects and age effects allowing for discontinuities at 62 and 65.
*p < .10. **p < .05. ***p < .01

The effects of the spousal earnings ratio and household asset ratio on men's post-displacement labor supply are consistent with my theoretical predictions. Men who have relatively high earning spouses are more likely to exit the labor force following a job loss (Table 4). Relative to a non-displaced worker in a low spousal ratio household, displaced men in low spousal ratio households at the median asset ratio are 6.3 percent more likely to be out of the labor force 0-2 after a job loss.[16] This effect persists in the years following a displacement but diminishes slightly after four years (column 1). A non-displaced husband with a high spousal ratio is 1.2 percent less likely to be in the labor force in any period following his first observation (column 2). While this effect is not statistically significant, it indicates that non-displaced men with high-earning spouses retire earlier. Relative to displaced men with a low spousal earnings ratio, displaced husbands with a high spousal earnings ratio are less likely to be in the labor force in every subsequent period (column 2). For example, these men are 4.23 percent less likely to be in the labor force 0-2 years after a displacement, relative to their counterparts with a low spousal earnings ratio. Compared to non-displaced men in low spousal ratio households, they are 12 percent less likely to be in the labor force.[17] This effect is only statistically significant for men who were displaced 2-4 years ago, but these parameters are jointly significant (p-value = 0.027). These results are consistent with my theoretical prediction that husbands with a high spousal earnings ratio are less likely to return to work after a displacement.

The household asset ratio has a minor impact on men's labor supply following a job loss. For workers who were displaced 0-2 years ago, an increase in total assets equivalent to their annual earnings would reduce the probability of returning to the labor force by 0.17 percent. This effect is persistent in the years following a job loss, indicating that displaced men with higher household asset ratios are less likely to return to work. The coefficients of the interactions between the household asset ratio and the displacement dummies are jointly significant (p-value = 0.031). The effect of the household asset ratio is similar for displaced women, but the effect of spousal earnings is not.

The relationship between women's spousal earnings ratio and post-displacement labor supply is not consistent with my theoretical predictions. In the years following a job loss, displaced women are less likely to be in the labor force than non-displaced women (Table 5). For example, a displaced worker with a low spousal earnings ratio at the median asset ratio is 12.9 percent less like to be in the labor force, relative to a similar non-displaced worker.[18] This effect persists in the years following displacement (column 1). Compared to men in the same type of household, women from a low spousal ratio household are less likely to return to work after a job loss. A non-displaced woman with a high spousal ratio is 4.2 percent less likely to be in the labor force in any period after her first observation (column 2). This suggests that non-displaced women with high-earning husbands retire earlier than non-displaced women with low-earning husbands. Compared to displaced women with a low spousal earnings ratio, displaced women with a high spousal earnings ratio are only slightly less likely (0.94%) to be in the labor force 0-2 years after a displacement (column 2). This effect is insignificant and is not consistent over time. Further, the post-displacement effects are jointly insignificant. In contrast to men, women's post-displacement labor supply is unaffected by their spouse's earnings.

TABLE 5
ESTIMATES OF WOMEN'S LABOR FORCE PARTICIPATION

	No Interaction	High Spousal Ratio Indicator	Asset Ratio
Non-Interacted Terms		-0.0420***	-0.000125
		(0.00953)	(0.000155)
Displaced		$I \cdot D^{k***}$	$ar \cdot D^{k***}$
0–2 years ago	-0.118***	-0.00935	-0.00139***
	(0.0228)	(0.0276)	(0.000429)
2–4 years ago	-0.116***	-0.0101	-0.000726
	(0.0247)	(0.0297)	(0.000442)
4–6 years ago	-0.107***	0.0332	-0.00135***
	(0.0284)	(0.0330)	(0.000464)
6+ years ago	-0.0488**	-0.0103	0.0000641
	(0.0222)	(0.0252)	(0.000328)
$N_{OBS} = 24{,}906$	$N_{GROUPS} = 4{,}734$		Median $ar \approx 8$

Note: All regressions include year fixed effects and age effects allowing for discontinuities at 62 and 65.
*p < .10. **p < .05. ***p < .01

The effect of the household asset ratio on displaced women's labor supply is similar to the effect on displaced men. For workers who lost a job 0-2 years ago, an increase in total assets equivalent to their annual earnings would reduce the probability of returning to the labor force by 0.14 percent. This effect is persistent in the years following a job loss, indicating that displaced women with higher household asset ratios are slightly less likely to return to work. The coefficients of the interactions between the household asset ratio and the displacement dummies are jointly significant.

My empirical results are consistent with previous studies of older workers' labor supply. These studies find that displacement has large and lasting effects on older workers' labor supply. They also show that the response to displacement differs by gender. If men and women have different returns to leisure, my theoretical model predicts that the relationship between their post-displacement labor supply and spousal earnings ratio will differ. Because the cohorts of men in my sample are more likely to be in physically demanding occupations and because women are more likely to have older spouses, men might plausibly have higher returns to leisure within the average household.

CONCLUSION

This paper examines the effects of spousal earnings and household assets on a worker's labor supply following a job loss. Theoretical predictions for the response are generated from a stylized two-period model of family labor supply. In this model, a husband's labor supply depends on the ratio of his wife's earnings to his own earnings and the ratio of household assets to his earnings. The model is symmetric, and so the converse is true for a wife's labor supply. The model predicts that individuals with higher spousal earnings ratios and higher household asset ratios are more likely to exit the labor force after a displacement.

The response is not monotonic. Therefore, a reduced form empirical model does fully test the predictions of my theory.

Displaced men with wives who make a significant contribution to household earnings are less likely to return to the labor force following a job loss. In addition, displaced men with higher household asset ratios are less likely to return to work. These patterns are consistent with the theoretical predictions of the two-period family labor supply model. Spousal earnings to do not have a significant effect on women's post-displacement labor supply. Within the context of my model, this result implies that older women's return to leisure is lower than their husbands. While this paper cannot definitively confirm that conclusion, it is consistent with two patterns in the data. On average, men may have more physically demand jobs, which makes work more costly at older ages. On average, men are older than their wives and returns to leisure may be correlated with age. Earlier studies have not investigated returns to leisure within the household, and it warrants further study.

ENDNOTES

1. In comparison, a worker who leaves a job because of poor health also experiences a decline in her potential earnings, but this event is more likely to limit her physical ability to work.
2. Bridge jobs are attractive because they allow older workers to gradually reduce their hours, but the cost is typically a large decline one's wage rate.
3. Examples include Jacobsen, LaLonde, and Sullivan (1993) and Couch and Placzek (2010).
4. For example, Rust and Phelan (1997), Rust (1989), Gustman & Steinmeier (2000, 2005)
5. There are coordination economies with team production and high costs of health care benefits for older workers (Hurd, 1993).
6. I assume 13 hours of discretionary leisure each day, which allows for 8 hours of sleep and 3 hours for personal care and eating. Of the 91 discretionary hours per week, I assume 45 hours devoted to work and commuting each week.
7. An uncertain health shock could also be interpreted as a decline in potential earnings. However, the physical inability to work implies zero potential earnings in the second period.
8. However, recent empirical work shows no decline in consumption at retirement (Aguila et al., 2011).
9. Laitner and Silverman (2012) present a dynamic life-cycle model of retirement without uncertainty. They prove consumption after retirement is a function these two factors-the productivities of consumption expenditures and the concavity of the utility function.
10. I specify a joint probability density function over the husband and wife's second period potential earnings. For a given amount of savings it carries into the second period $((1 + r)A_1$, and after the realization of both spouses' earnings, the household chooses each spouse's labor supply to maximize second-period utility. This decision yields a vector of utility across all joint potential earnings outcomes. I multiply this vector with the joint probability density to find expected utility in period 2. The specific value of A1that the household saves in period one corresponds to first-period utility maximizing choices of c_1, h_1, and f_1. I add first-period utility to second period expected utility. Finally, I choose the A_1 that maximizes lifetime expected utility to determine the household's behavior in both periods.
11. Savings increase linearly as initial assets increase and are constant for a given level of initial assets except around these frontiers. First-period savings exhibit a discontinuous peak and then a trough around these boundaries.
12. The disadvantage of random effects models is the requirement that the individual effect is normally distributed and independent of the regressors and the error term. Since I am not interpreting the magnitude of the random effect, this limitation will not affect my interpretation of the results.
13. 1998: Added 2529 respondents from the War Baby cohort (WB) born 1942-1947. 2004: Added 3330 respondents (2154 households) from the Early Baby Boomer cohort (EBB) born 1948-1953. 2010: Added Mid Baby Boomer cohort (MBB) born 1954-1959.
14. Firings comprise a small proportion of this category. Boisjoly et al. (1998) disaggregate the "laid off/fired" response for an identical question in the Panel Study of Income Dynamics and find that only 16% of workers in this category are fired.
15. Stevens and Moulton (2013) do not find significant pre-displacement effects household assets.
16. Calculated as -0.0653 = -0.0551 + 6*(-0.0017)

17. -0.1198 = -0.012 - 0.0551 - 0.0425 + 6*(-0.0017)
18. -0.129 = = -0.118 + 8*(-0.00139)

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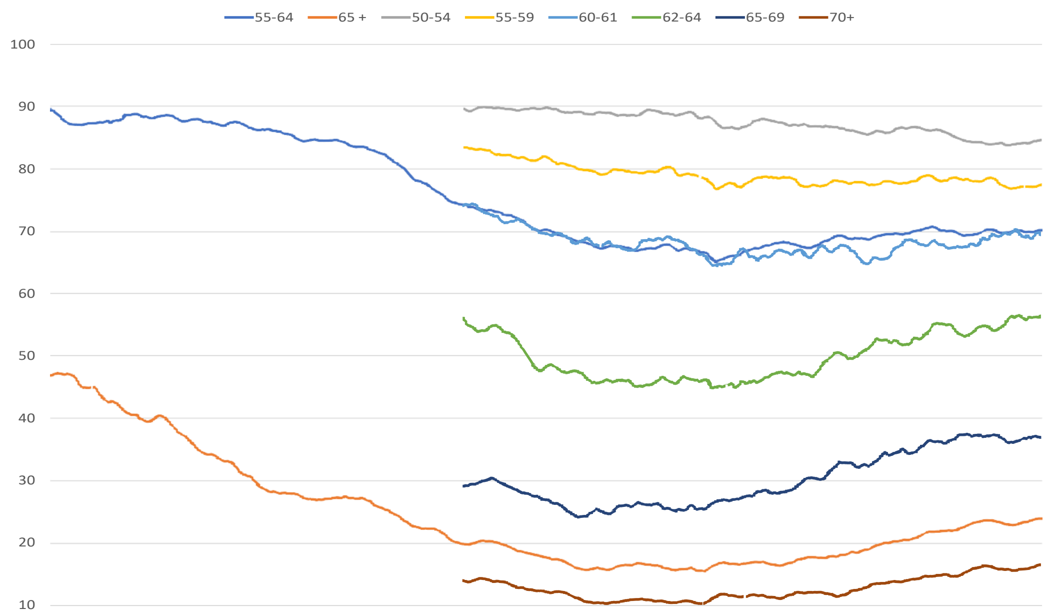
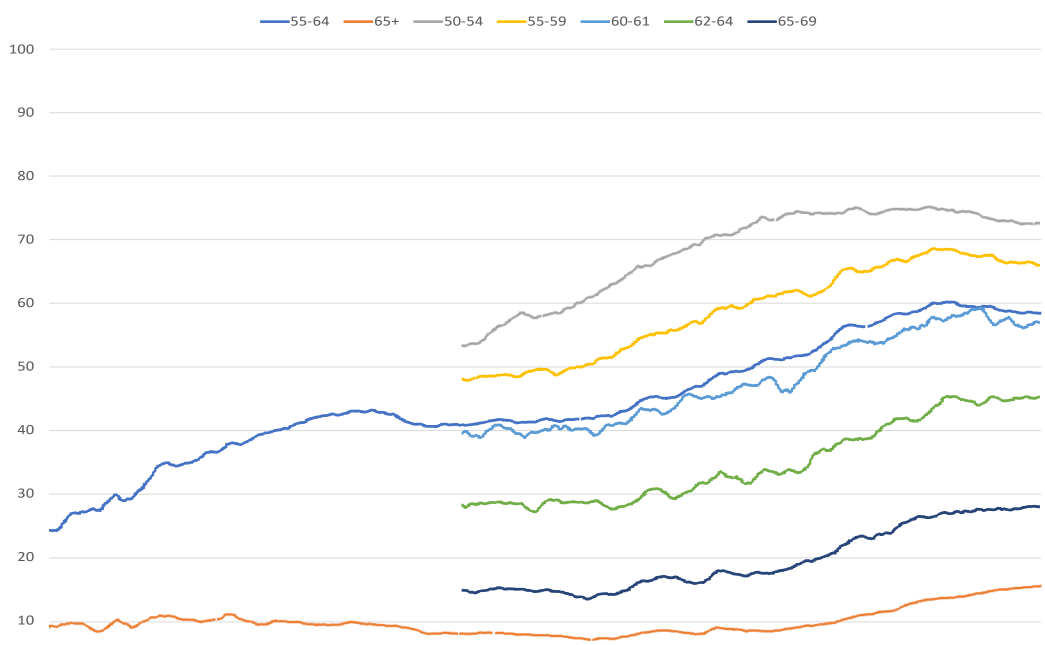
APPENDIX 1: PATTERNS OF LABOR FORCE PARTICIPATION

FIGURE 6
MEN OVER AGE 33



Source: Displaced Worker Survey supplement to the Current Population Survey

FIGURE 7
WOMEN OVER AGE 33



Source: Displaced Worker Survey supplement to the Current Population Survey

APPENDIX 2: DERIVATION OF DEMAND FUNCTIONS

2.1 One-Period Model with Continuous Leisure

Flow of services to the household are Cobb-Douglas:

$$g(c,h,f) = c^{\alpha} h^{\beta} f^{(1-\alpha-\beta)}$$

Utility is isoelastic:

$$v(g) = \begin{cases} \frac{g^{\gamma}}{\gamma} & \text{for } \gamma < 1, \gamma \neq 1 \\ ln(g) & \text{for } \gamma = 0 \end{cases}$$

Maximization problem:

$$\begin{gathered} max \frac{[c^{\alpha} h^{\beta} f^{(1-\alpha-\beta)}]^{\gamma}}{\gamma} \\ \text{subject to } c = (1-h)e^{H} + (1-f)e^{F} + A \\ h \leq 1 \\ f \leq 1 \end{gathered}$$

Kuhn-Tucker Lagrangian (excluding non-negativity constraints):

$$\mathcal{L} = \frac{[c^{\alpha} h^{\beta} f^{(1-\alpha-\beta)}]^{\gamma}}{\gamma} - \lambda(c + he^{H} + fe^{F} - A - e^{H} - e^{F}) - \mu_1(h-1) - \mu_2(f-1)$$

The marginal utility of income to the family is λ. First order conditions:

$$\begin{gathered} \frac{\alpha}{c} g^{\gamma} = \lambda \\ \frac{\beta}{h} g^{\gamma} = \lambda \\ \frac{(1-\alpha-\beta)}{f} g^{\gamma} = \lambda \\ c + he^{H} + fe^{F} = A + e^{H} + e^{F} \\ \mu_1(h-1) = 0 \\ \mu_2(f-1) = 0 \end{gathered}$$

For a corner solution where either h = 1 or $\boldsymbol{f}$ = 1 the marginal utility of leisure is greater than the marginal utility of income:

$$\begin{gathered} \frac{\beta}{h} g^{\gamma} > \lambda \\ \frac{(1-\alpha-\beta)}{f} g^{\gamma} > \lambda \end{gathered}$$

Demand Equations for an interior solution:

$$c = \alpha(A + e^H + e^F)$$
$$h = \beta\left(1 + \frac{e^F}{e^H} + \frac{A}{e^H}\right)$$
$$f = (1 - \alpha - \beta)\left(1 + \frac{e^H}{e^F} + \frac{A}{e^F}\right)$$

2.2 Two-Period Model Without Earnings Uncertainty

Find demand equations for (c1, c2). Leisure is discrete, ht and ft ∈ {0.5, 1}. The flow of services to the household are Cobb-Douglas

$$g\left(c_t, h_t, f_t\right) = c_t^{\alpha} h_t^{\beta} f_t^{(1-\alpha-\beta)}$$

There is no human capital depreciation

$$y_t = (1 - h_t)e_t^H + (1 - f_t)e_t^F$$

The maximization problem is:

$$\max_{c_1, c_2} \frac{\left[c_1^{\alpha} h_1^{\beta} f_1^{(1-\alpha-\beta)}\right]^{\gamma}}{\gamma} + \delta \cdot \frac{\left[c_2^{\alpha} h_2^{\beta} f_2^{(1-\alpha-\beta)}\right]^{\gamma}}{\gamma}$$
$$\text{subject to } c_1 + \frac{c_2}{1+r} = y_1 + \frac{y_2}{1+r} + A_0$$

Lagrangian:

$$\mathcal{L} = \frac{\left[c_1^{\alpha} h_1^{\beta} f_1^{(1-\alpha-\beta)}\right]^{\gamma}}{\gamma} + \delta \cdot \frac{\left[c_2^{\alpha} h_2^{\beta} f_2^{(1-\alpha-\beta)}\right]^{\gamma}}{\gamma} + \lambda\left(y_1 + \frac{y_2}{1+r} + A_0 - c_1 - \frac{c_2}{1+r}\right)$$

First Order Conditions for an interior solution:

$$\frac{\partial \mathcal{L}}{\partial c_1} = g_1^{\gamma-1} \cdot \frac{\alpha}{c_1} \cdot g_1 - \lambda = 0 \Leftrightarrow \frac{\alpha}{c_1} \cdot g_1^{\gamma} = \lambda$$
$$\frac{\partial \mathcal{L}}{\partial c_2} = \delta \cdot g_2^{\gamma-1} \cdot \frac{\alpha}{c_2} \cdot g_2 - \frac{\lambda}{1+r} = 0 \Leftrightarrow \frac{\delta\alpha}{c_2} \cdot g_2^{\gamma} = \frac{\lambda}{1+r}$$

Euler Equation:

$$\frac{c_1}{c_2} \cdot \left(\frac{g_2}{g_1}\right)^{\gamma} = \frac{1}{\delta(1+r)}$$

Solve for c_2:

$$\frac{c_1}{c_2}\cdot\frac{c_2^{\gamma\alpha}h_2^{\gamma\beta}f_2^{\gamma(1-\alpha-\beta)}}{c_1^{\gamma\alpha}h_1^{\gamma\beta}f_1^{\gamma(1-\alpha-\beta)}}=\frac{1}{\delta(1+r)}$$

$$\frac{c_1^{1-\gamma\alpha}}{c_2^{1-\gamma\alpha}}\cdot\frac{h_2^{\gamma\beta}f_2^{\gamma(1-\alpha-\beta)}}{h_1^{\gamma\beta}f_1^{\gamma(1-\alpha-\beta)}}=\frac{1}{\delta(1+r)}$$

$$c_2^{1-\gamma\alpha}=\delta(1+r)\cdot c_1^{1-\gamma\alpha}\cdot\frac{h_2^{\gamma\beta}f_2^{\gamma(1-\alpha-\beta)}}{h_1^{\gamma\beta}f_1^{\gamma(1-\alpha-\beta)}}$$

$$c_2=c_1\cdot[\delta(1+r)]^{\frac{1}{1-\gamma\alpha}}\cdot\left[\frac{h_2^{\beta}f_2^{(1-\alpha-\beta)}}{h_1^{\beta}f_1^{(1-\alpha-\beta)}}\right]^{\frac{\gamma}{1-\gamma\alpha}}$$

Plug into budget constraint and solve for demand function for c_1:

$$c_1+c_1\cdot\delta^{\frac{1}{1-\gamma\alpha}}\cdot(1+r)^{\frac{\gamma\alpha}{1-\gamma\alpha}}\cdot\left[\frac{h_2^{\beta}f_2^{(1-\alpha-\beta)}}{h_1^{\beta}f_1^{(1-\alpha-\beta)}}\right]^{\frac{\gamma}{1-\gamma\alpha}}=y_1+\frac{y_2}{1+r}+A_0$$

$$c_1=\left(1+\delta^{\frac{1}{1-\gamma\alpha}}\cdot(1+r)^{\frac{\gamma\alpha}{1-\gamma\alpha}}\cdot\left[\frac{h_2^{\beta}f_2^{(1-\alpha-\beta)}}{h_1^{\beta}f_1^{(1-\alpha-\beta)}}\right]^{\frac{\gamma}{1-\gamma\alpha}}\right)^{-1}$$
$$\left((1-h_1)e_1^H+(1-f_1)e_1^f+\frac{1}{1+r}\cdot[(1-h_2)e_2^H+(1-f_2)e_2^F]+A_0\right)$$

APPENDIX 3: SIMULATIONS: NO EMPLOYMENT UNCERTAINTY

FIGURE 8
NO DISPLACEMENT, NO HUMAN CAPITAL DEPRECIATION, $\gamma = -1$

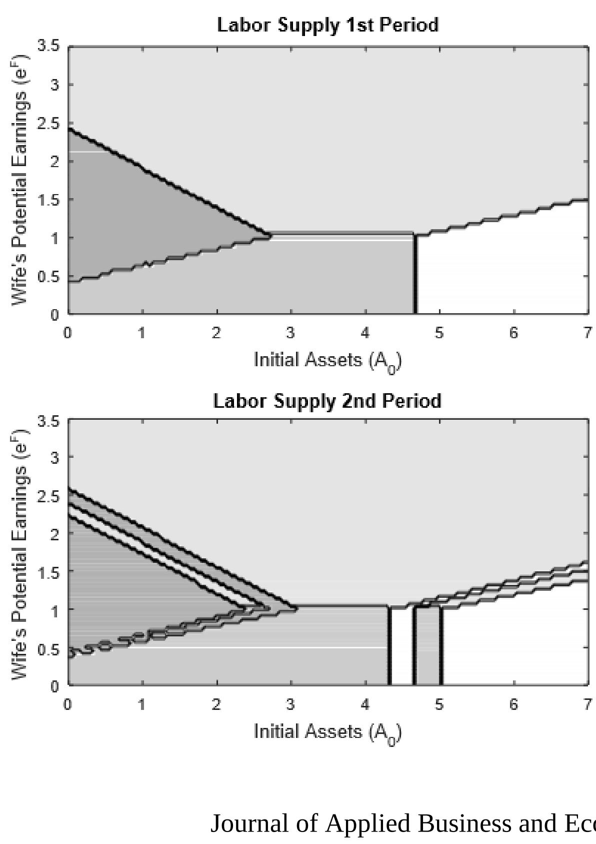


FIGURE 9
NO DISPLACEMENT, NO HUMAN CAPITAL DEPRECIATION, $\gamma = 0.6$

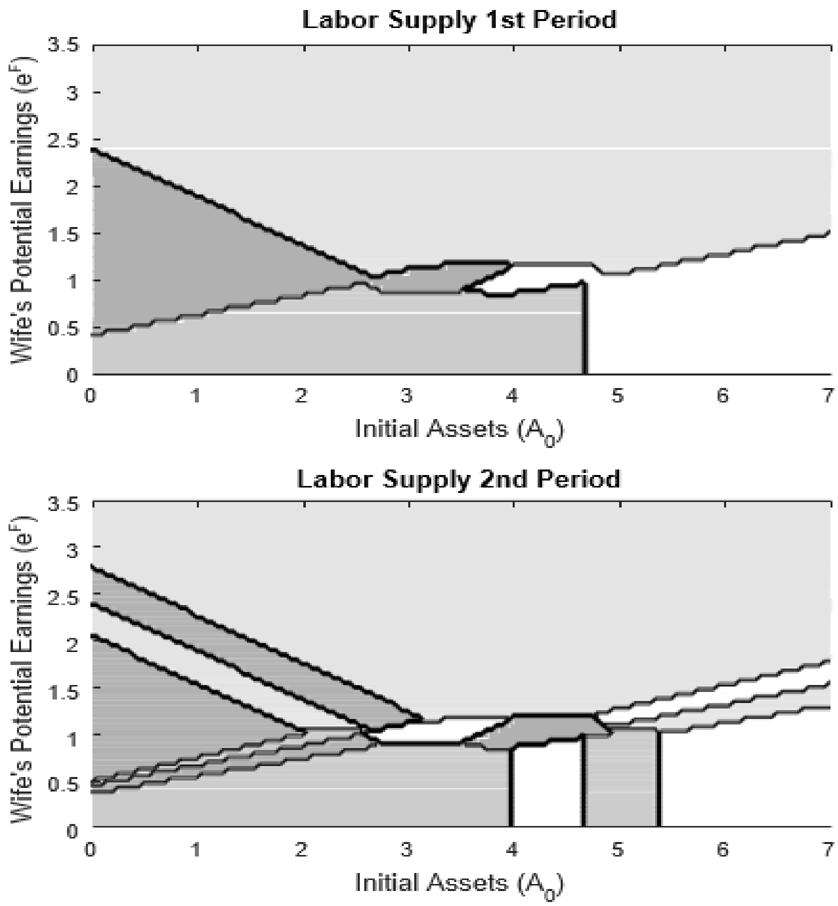
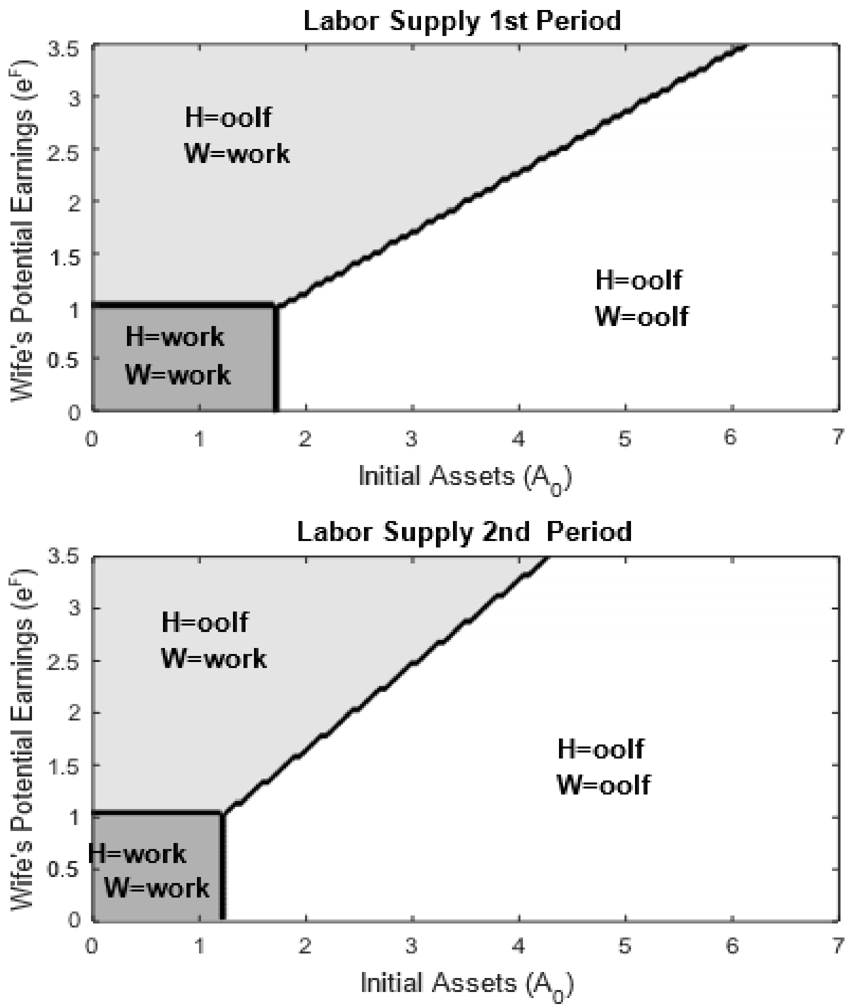


FIGURE 10
NO DISPLACEMENT, $\rho = 0.5$, $\alpha = 0.3$, $\beta = 0.35$, $\gamma = -3$



APPENDIX 4: SIMULATIONS: ONE SPOUSE FACES EMPLOYMENT RISK

FIGURE 11
HOMOTHETICITY$\left(e_1^H = 2\right)$

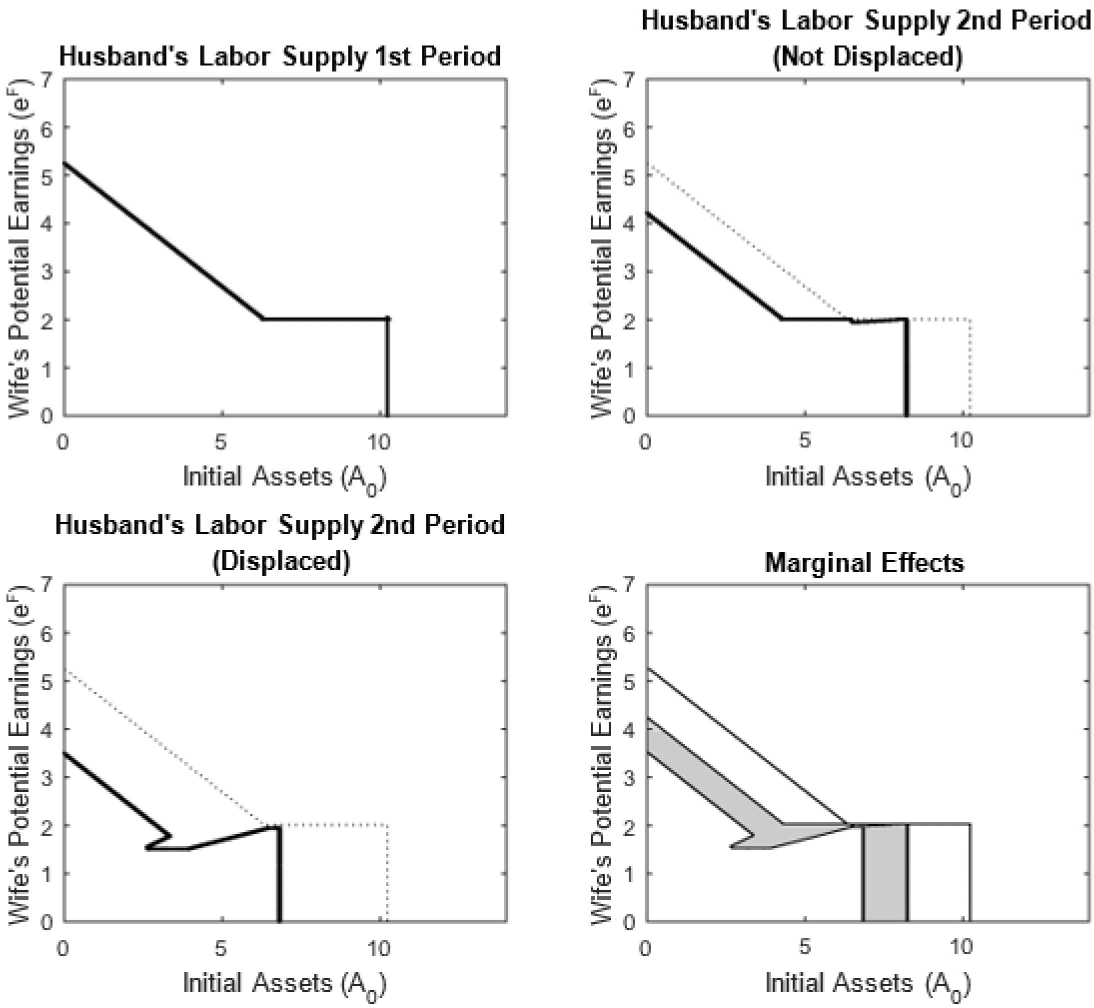
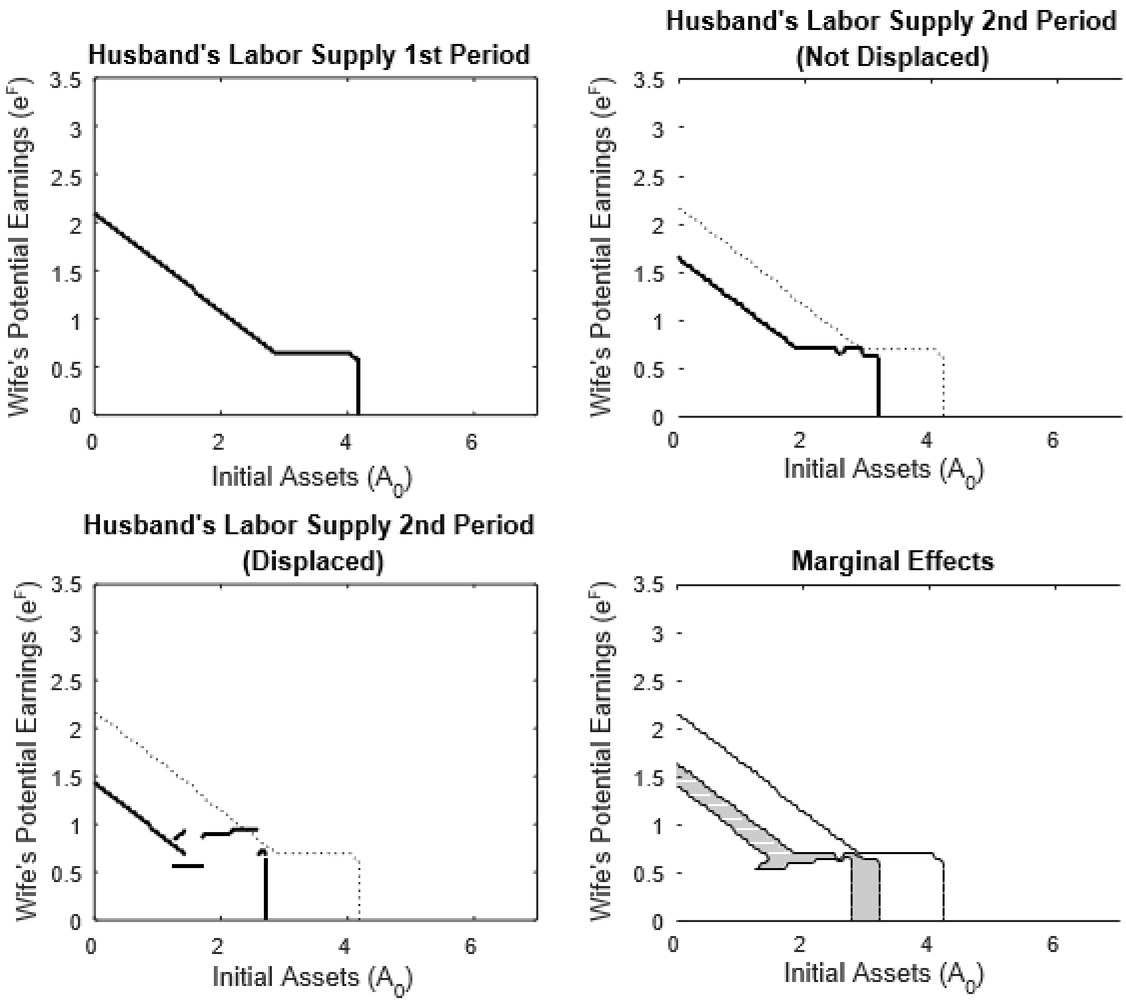


FIGURE 12
HUSBAND HAS GREATER RETURN TO LEISURE (β = 0.3)



APPENDIX 5: COMPARISON OF LOGIT AND LINEAR PROBABILITY MODELS

TABLE 3
ESTIMATES OF MEN'S LABOR FORCE PARTICIPATION

Independent Variable	Men		
	Linear Probability Model	Logic	Marginal Effects†
High spousal ratio	-0.012 -0.0107	-0.211 -0.14	-0.0149
Effects of displacement for low spousal ratio households			
0 - 2 years ago	-0.0551*** (0.0149)	-1.020*** (0.174)	-0.0736
2 - 4 years ago	-0.0618*** (0.0160)	-0.866*** (0.181)	-0.0623
4 - 6 years ago	-0.0394** (0.0174)	-0.685*** (0.192)	-0.0491
6+ years ago	-0.0268** (0.0136)	-0.498*** (0.171)	-0.0355
Differences between the effects of displacement for low and high ratio households			
0 - 2 years ago	-0.0425 -0.0303	-0.499 -0.348	-0.0531
2 - 4 years ago	-0.103*** (0.0324)	-0.999*** (0.361)	-0.0908
4 - 6 years ago	-0.0553 -0.0366	-0.538 -0.404	-0.0554
6+ years ago	-0.0312 -0.027	-0.373 -0.345	-0.0428
Asset ratio	0.000592*** (0.000222)	0.00586** (0.00276)	0.005
Interaction of displacement with asset ratios			
0 - 2 years ago	-0.00170*** -0.000597	-0.0159** -0.00685	-0.0139
2 - 4 years ago	-0.000239 -0.000634	-0.00385 -0.00682	-0.0034
4 - 6 years ago	-0.00113 -0.000701	-0.00751 -0.00754	-0.0065
6+ years ago	-0.00175*** (0.000507)	-0.0165** (0.00720)	-0.0144

Note: All regressions include year fixed effects and age effects allowing for discontinuities at 62 and 65.
†Marginal effects corresponding to logit coefficients are defined as the difference in predicted probabilities of being out of the labor force when comparing households with high spousal contributions to households with low spousal contributions.

TABLE 6
ESTIMATES OF WOMEN'S LABOR FORCE PARTICIPATION

	Women		
Independent Variable	Linear Probability Model	Logic	Marginal Effects†
High spousal ratio	-0.0420*** (0.00953)	-0.636*** (0.134)	-0.0400
Effects of displacement for low spousal ratio households			
0 - 2 years ago	-0.118*** (0.0228)	-1.831*** (0.282)	-0.1206
2 - 4 years ago	-0.116*** (0.0247)	-1.651*** (0.299)	-0.1080
4 - 6 years ago	-0.107*** (0.0284)	-1.464*** (0.337)	-0.0951
6+ years ago	-0.0488** (0.0222)	-0.802*** (0.294)	-0.0507
Differences between the effects of displacement for low and high ratio households			
0 - 2 years ago	-0.00935 (0.0276)	-0.0482 (0.337)	-0.0491
2 - 4 years ago	-0.0101 (0.0297)	0.061 (0.357)	-0.0407
4 - 6 years ago	0.0332 (0.0330)	0.571 (0.391)	-0.0045
6+ years ago	-0.0103 (0.0252)	0.156 (0.338)	-0.032
Asset ratio	-0.000125 (0.000155)	-0.00285 (0.00211)	-0.0036
Interaction of displacement with asset ratios			
0 - 2 years ago	-0.00139*** (0.000429)	-0.0129** (0.00522)	-0.0177
2 - 4 years ago	-0.000726 (0.000442)	-0.00522 (0.00533)	-0.0071
4 - 6 years ago	-0.00135*** (0.000464)	-0.0120** (0.00561)	-0.0164
6+ years ago	0.0000641 (0.000328)	0.00331 (0.00446)	0.0043

Note: All regressions include year fixed effects and age effects allowing for discontinuites at 62 and 65.
†Marginal effects corresponding to logit coefficients are defined as the difference in predicted probabilities of being out of the labor force when comparing households with high spousal contributions to households with low spousal contributions.

APPENDIX 6: BOTH SPOUSES FACE EMPLOYMENT RISK

When both spouses are at risk of displacement and there is a probability distribution across the costs associated with a job loss, the general predictions of my model do not change. I present an example to support this claim. The primary difference from the previous section is that households save more in the first period to insure against greater uncertainty. Due to the difficulties representing multiple outcomes for multiple workers, I discuss results for specific values of the parameter space.

In my baseline simulation the second-period effective labor of each spouse is discretely distributed across (0.8, 0.9, 1) multiplied by their first period effective labor. The probability of each outcome is (3%, 7%, 88%) respectively. Human capital depreciation is 11% ($\rho = 0.89$). All other parameters are the same as those listed in table 1. I discuss how changes to wealth affect each spouse's decision in each possible outcome of second-period earnings. You can imagine this discussion as being analogous to looking across the rows in figures 2 through 3. That is, what happens to labor supply as we increase initial assets for a given $\left(\frac{a^F}{e_t^H}\right)$. I set the spousal earnings ratio to one and examine how initial household assets affect labor supply.

The first column in Table 7 lists a household's initial assets when it enters the first period. In the second column, the letter listed before the comma denotes the wife's labor supply and the husband's choice comes after the comma. 'w' stands for 'working', and 'o' abbreviates for 'out of the labor force'. The 3x3 matrix in the third column describes the household's choices conditional upon carrying the expected-utility-maximizing level of assets into the second period. The first, second, and third rows of this 3x3 matrix correspond to a 'bad', 'moderate', and 'no' shock for the wife, respectively. The first, second, and third columns correspond to a 'bad', 'moderate', and 'no' shock for the husband, respectively. A_1 denotes the amount of savings carried into the second period.

Differences in wealth on the order of magnitude of 10% induce change household labor supply in the second period. When $A_0 \leq 0.8$, both spouses work in both period regardless of the shock to their earnings potential. When $A_0 = 0.9$, both spouses work in the first period, and the spouse receiving the 'bad' shock does not work in the second period. This finding is consistent with the story of a husband remaining out of the labor force when he is laid off from a long-tenure job or from a disappearing industry. For $1.1 \leq A_0 \leq 1.4$, both spouses work in the first period and only one spouse works in the second period for all possible states. As expected, the person receiving the negative shock does not work in the second period. Along the diagonal of the 3x3 matrix, where both spouse receive the same shock, the household is indifferent between either spouse working. For simplicity, the wife is listed as 'out of the labor force' in these cases.

TABLE 7
***A_0* THRESHOLDS AT WHICH HOUSEHOLD CHANGES LABOR SUPPLY**

A0	Labor Supply t=1	Labor Supply t=2	A1	Lifetime Expected Utility
A0 ≤ 0.8	w,w	w,w w,w w,w w,w w,w w,w w,w w,w w,w	0.3985	-24.724
A0 = 0.9	w,w	w,w w,w o,w w,w w,w w,w w,o w,w w,w	0.4722	-24.688
A0 = 1	w,w	w,w o,w o,w w,o w,w w,w w,o w,w w,w	0.5225	-24.653

1.1 ≤ A0 ≤ 1.4	w,w	o,w o,w o,w w,o o,w o,w w,o w,o o,w	0.7713 (lower bound)	-24.617 (lower bound)
1.5 ≤ A0 ≤ 1.6	w,w	o,o o,w o,w w,o o,w o,w w,o w,o o,w	0.9656 (lower bound)	-24.475 (lower bound)
1.7 ≤ A0 ≤ 1.8	w,w	o,o o,o o,o o,o o,o o,o o,o o,o o,o	1.2974 (lower bound)	-24.407 (lower bound)
1.9 ≤ A0 ≤ 2.0	o,w	o,o o,w o,w o,o o,w o,w w,o o,w o,w	0.9307 (lower bound)	-24.337 (lower bound)
A0 = 2.1	o,w	o,o o,o o,o o,o o,o o,o o,o o,o o,o	1.2580	-24.269

For $A_0 \in (1.5, 1.6)$, both members withdraw from the labor force when they experience the worst productivity shock, and in all other states of the world, only one spouse supplies labor in the second period. When $A_0 \in (1.7, 1.8)$, both spouses work in the first period and jointly retire in the second. As initial wealth increases further, the first period labor supply decision changes. When $A_0 \in (1.9, 2.0)$, only the husband works in the first period. If he experiences the worst possible productivity shock, then he withdraws from the labor force. In this scenario, we see an "added worker effect". His wife picks up works in the second period following his job loss. In all other scenarios, the husband works in both the first and second period.