Women at the Helm: Breadwinning, Social Security, and Retirement Behaviors of Married Women

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December 2024

Preliminary and Incomplete (please do not circulate)

Abstract

This paper examines how the retirement behavior of married women differs by their relative earnings contribution and identifies key drivers in understanding the patterns. We particularly focus on two mechanisms: leisure complementarities and Social Security (spousal) benefits. First, we document that breadwinner wives have a higher number of quarters of Social Security-covered employment and are less likely to receive Social Security spousal benefits. Furthermore, they are less likely to retire jointly with their husbands or claim retirement benefits early. In contrast, husbands of breadwinner wives are more likely to receive spousal benefits and claim retirement benefits earlier. These differences are robust to controlling for the age gap between spouses. Motivated by these patterns, we construct a structural model to identify the key factors shaping retirement outcomes across different marriage types. This dynamic structural model of married women incorporates leisure complementarities and institutional details of Social Security benefits. The model is estimated by simulated method of moments and then used to investigate how married women from different marriage types respond to policy counterfactuals related to Social Security spousal benefits.

JEL codes: J12, J16, J26

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[‡]Conflicts of interest: None.

1 Introduction

Over the past sixty years, the fraction of married women who earn more than their husbands (referred to as "female breadwinners" hereon) has increased dramatically over time as shown in Figure 1. This pattern coincides with the well-documented increase in women's labor force participation and educational attainment as well as the decrease in the gender earnings gap over this period (Eckstein and Lifshitz, 2011; Goldin, 2006).

While female breadwinners exhibit significantly higher labor force participation and earnings compared to non-breadwinners during prime working ages (Gihleb and Lifshitz, 2022), how this difference translates to women's retirement behaviors—such as Social Security claiming and joint retirement with their husbands—remains insufficiently understood. This paper seeks to address this gap by examining how married couples' retirement behaviors vary based on wives' earnings contributions to the household and identifies key drivers in understanding these patterns. We particularly focus on the following mechanisms: leisure complementarities (the value spouses derive from each other's company) and Social Security (spousal) benefits.

Previous research has shown that spouses often retire at the same time even when there is a large age gap, with leisure complementarities being the leading explanation for this

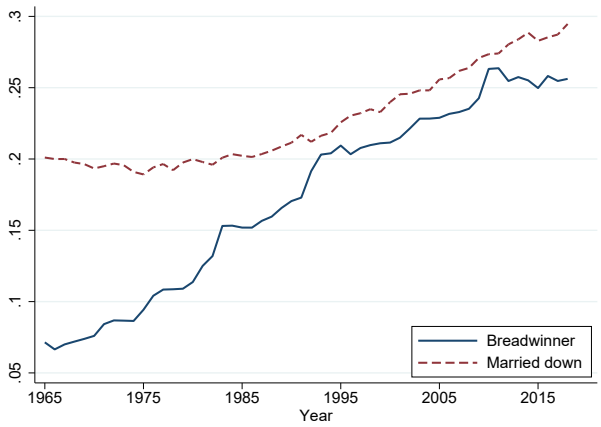


Figure 1: Trends in the Share of Breadwinner or Married-down Wives

Notes: This figure is based on a sample of married women aged 25–61 in the March Current Population Survey (CPS) from 1965–2018. "Breadwinners" indicate women whose earnings are greater than their husbands. Women with higher educational attainment than their husbands are categorized as "married down" where we use five education categories (less than high school, high school graduate, some college, college graduate, and post-college).

trend (see Maestas (2018) for a summary of this literature). Other studies have highlighted the importance of Social Security spousal benefits in dampening women's work incentives (Borella et al., 2023). However, when an individual qualifies for both primary benefits (based on their own work records) and spousal benefits (based on their spouse's work records), only the higher of the two benefits is paid. Therefore, female breadwinners are less likely to be affected by spousal benefits as their higher lifetime labor supply and earnings increase their primary benefits. Additionally, since wives are often younger than their husbands, retiring jointly often leads to wives claiming benefits at an earlier age. This early claiming can be costly for women given their longer life expectancy compared to men. For female breadwinners, the cost may be even greater as early claiming permanently reduces retirement benefits. While this suggests that the cost of retirement as well as the role of leisure complementarities and Social Security spousal benefits may vary significantly across marriage types, research that explores this aspect remains scarce. Our research aims to fill this gap.

Using the Health and Retirement Study (HRS) linked with administrative Social Security data, we first document significant differences in couples' retirement behaviors based on female breadwinner status. Compared to non-breadwinners, female breadwinners are 42% more likely to claim Social Security at or after age 65 and 66% less likely to rely on spousal benefits.[1] Furthermore, female breadwinners are 20% less likely to retire jointly with their husbands even after controlling for the age gap between spouses. In contrast, husbands of female breadwinners are 23% less likely to claim Social Security at or after age 65 but 72% more likely to receive Social Security Disability Insurance (SSDI) and four times more likely to claim spousal benefits. We also show that spousal health is correlated with breadwinner status as female breadwinners are more likely to be healthy but also have a higher likelihood of being married to a disabled, less healthy husband.

Motivated by these patterns, we construct a structural model to identify the key factors shaping retirement outcomes across different marriage types. This dynamic structural model of married women incorporates leisure complementarities and institutional details of Social Security benefits. The model is estimated by simulated method of moments and then used to investigate how married women from different marriage types respond to policy counterfactuals related to Social Security spousal benefits.

The rest of the paper is organized as follows. Section 2 provides descriptive patterns

[1] Age 65 is the full retirement age (entitled to full benefits) for individuals born before 1943 and has gradually increased to 67 for more recent birth cohorts. Benefits can be claimed as early as age 62, but the amount is discounted permanently. Claiming benefits after the full retirement age (up to age 70) increases the benefit amount.

regarding married men and women's retirement behaviors by female breadwinner status. Section **??** describes a simple theoretical model that incorporates key mechanisms that we study in this paper. Section 3 describes a fully specified dynamic programming model. Section 4 discusses the estimation method of the model parameters and reports the estimates of the model parameters. Section 5 presents the key findings from the counterfactual policy reform exercises using the estimated model. Section 6 concludes.

2 Empirical Patterns

2.1 Data and Sample Summary

We use the Health and Retirement Study (HRS), a rich panel study of Americans above age 50 and their spouses. Initiated in 1992 and conducted biennially, the HRS collects extensive information on a wide range of topics including demographics, employment, wealth, income, health, and program participation. Our analysis includes data from 1992 to 2018. Importantly, we link the HRS to administrative Social Security data containing detailed information on Social Security claiming behavior as well as their annual Social Security earnings from 1951 to 2020.

We focus on a sample of women who were 1) married and aged 51–61 when they first entered the HRS and 2) with a record of receiving Social Security benefits at any point in time. Additionally, we focus on women whose age differences with their husbands are ten years or less (i.e., the wife-husband age difference ranges from -10 to 10) as women with extremely large age gaps with their husbands may have considerably different incentives in coordinating retirement with their husbands. In total, our sample consists of 3,722 women.

Based on annual Social Security earnings data, we categorize a female respondent as a "breadwinner" if her average lifetime earnings at age 62 is greater than that of her husband.[2] If this information is missing, we instead use prospective Social Security wealth measures available in the public HRS data and classify a female as a "breadwinner" if her prospective Social Security wealth at age 62 is greater than that of her husband.

Table 1 provides summary statistics of our sample of women and their husbands. First, non-breadwinner women are on average 1.2 years younger than their husbands whereas breadwinner women are approximately the same age as their husbands. Second, breadwinner women are not only more educated than their non-breadwinner counterparts but

[2]We use age 62 as the cutoff for measuring average lifetime earnings as it is the earliest age that individuals can claim Social Security retirement benefits.

Table 1: Sample Summary Statistics of Women by Their Breadwinner Status

	Non-breadwinner	Breadwinner	p-value of difference
Panel A: Own Summary Statistics			
Age at HRS entry	54.30	53.96	< 0.01
Wife-husband age difference	-1.23	-0.13	< 0.01
Education (%)			
Less than high school	15.20	7.65	< 0.01
High school graduates	40.56	32.59	< 0.01
Some college	24.00	28.02	0.089
College graduates	12.93	21.39	< 0.01
Post-college	7.32	10.35	0.062
Education relative to husband (%)			
Married down	23.98	35.48	< 0.01
Married same	43.34	40.82	< 0.01
Married up	32.68	23.70	< 0.01
Race (%)			
White	89.47	80.27	< 0.01
Black	5.57	12.38	< 0.01
Other	4.96	7.35	0.72
Average lifetime earnings (age 19–62, in \$)	14,339	33,415	< 0.01
Total Social Security quarters of coverage[‡]	87.3	133.7	< 0.01
Self-reported health at HRS entry[*]	3.51	3.54	0.63
Disabled at HRS entry (%)	21.4	15.0	< 0.01
Ever had psychiatric problems (%)	11.4	7.61	0.011
Panel B: Husbands' Summary Statistics			
Average lifetime earnings (age 19–62, in \$)	45,671	20,699	< 0.01
Total Social Security quarters of coverage	146.5	98.42	< 0.01
Self-reported health at HRS entry	3.52	3.25	< 0.01
Disabled at HRS entry (%)	16.67	28.5	< 0.01
Ever had psychiatric problems (%)	5.88	9.68	0.027
Observations	3,007	715	
(%)	(80.8%)	(19.2%)	

Notes: All dollar values are in 2019 dollars.

[†] A quarter of coverage (QC) refers to a quarter of Social Security-covered employment. Generally, 40 QCs are required to be insured for Social Security retirement benefits.

[*] Self-reported health is categorized as poor (1), fair (2), good (3), very good (4), and excellent (5).

also more likely to have higher educational attainment than their husbands (i.e., "married down"). This aligns with breadwinner women having higher average lifetime earnings and lifetime labor supply as measured by the total Social Security quarters of coverage (QCs; quarters of employment credited towards being insured under Social Security). Third, breadwinner women are less likely to be white, and in particular, Black women comprise 12.4% of breadwinners, which is more than double the 5.6% observed among non-breadwinners. Finally, there is a clear correlation between female breadwinner status and the couple's health as female breadwinners are more likely to be healthier than non-breadwinner women but are also more likely to be married to a husband with poorer health outcomes.

2.2 Results

To examine the relationship between the wife's breadwinner status and the couple's Social Security claiming behavior and late-life labor supply, we regress our outcomes of interest on an indicator for whether the wife is the breadwinner along with other covariates. Our outcomes of interest include 1) the types of Social Security benefits ever claimed, 2) whether the couple claimed Social Security jointly, 3) whether they claimed Social Security at or after age 65, and 4) the couple's total QCs between age 62 to 70. Our regression covariates include dummy variables for the race and education of both spouses and dummy variables for the age gap between the two spouses. We use seven categories for the wife-husband age gap (-5 or greater, -4 or -3, -2, -1, 0, 1 or 2, and 3 or greater) such that the share of each category in our sample is roughly equal.

When examining the types of Social Security benefits ever claimed, we use detailed information in the administrative Social Security files and consider the following types of benefits: primary, auxiliary, retirement, disability, spousal, and dual entitlement. First, primary benefits are those based on the respondent's own earnings record such as retirement and Social Security Disability Insurance (SSDI) benefits. In contrast, auxiliary benefits (e.g., spousal and survivors benefits) are based on the spouse's earnings record.[3] Lastly, dual entitlement refers to the simultaneous receipt of primary and auxiliary benefits. This occurs when auxiliary benefits are greater than primary benefits since beneficiaries only receive auxiliary benefits *in excess* of primary benefits.[4] Therefore, dual entitlement implies

[3]In general, spousal benefits equal 50% of the spouse's primary insurance amount (PIA) and survivors benefits for widows and widowers are 100% of the deceased spouse's PIA.

[4]For instance, a widow may be entitled to $500 per month as retirement benefits and $1,000 per month as survivor benefits. Then her total Social Security benefit would be $1,000 with $500 in primary benefits and $500 in auxiliary benefits and would be considered dually entitled.

that an individual has sufficient earnings history to qualify for primary benefits but their spouses' lifetime earnings are significantly higher than theirs.

Table 2 reports the relationship between the wife's breadwinner status and the couple's type of Social Security benefit they have ever received. Panel A indicates that breadwinner wives are more likely to receive benefits based on their own earnings records (columns (1) and (2)) and substantially less likely to receive benefits based on their husbands' earnings records (columns (4) to (6)) compared to their non-breadwinner counterparts. Interestingly, although Table 1 indicates that breadwinner wives are on average healthier than non-breadwinner wives, column (3) indicates that there is weak evidence that breadwinner wives are less likely to ever receive SSDI benefits. One possibility is that disabled non-breadwinner wives are less likely to meet SSDI's recency-of-work requirement (i.e., individuals need to have worked at least 5 years of the past 10 years before disability onset) and therefore, may not be able to apply for benefits despite having worse health conditions.

Column (1) of Panel B indicates a relatively small difference in the likelihood of ever receiving primary benefits between husbands of breadwinner and non-breadwinner wives. However, this can be explained by the fact that husbands of breadwinner wives are 9.7 percentage points (10.5%) less likely to claim retirement benefits and instead, 11.7 percentage points (72%) more likely to claim SSDI benefits than husbands of non-breadwinner wives (columns (2) and (3)). Moreover, columns (4) and (5) exhibit stark differences in the likelihood of husbands receiving benefits based on their wives' earnings as husbands of breadwinner wives are four times more likely to ever receive spousal benefits and more than ten times more likely to ever receive dual entitlements.

Next, Table 3 reports differences in joint Social Security claiming and late-life labor supply by breadwinner status. First, columns (1) and (2) report that breadwinner wives are less likely to claim Social Security benefits in the same year as their husbands with the average gap in claiming years being 1.53 years larger than that among couples with non-breadwinner wives. Columns (3) and (4) indicate that breadwinner wives are more likely to claim Social Security at or after age 65 and on average work 3.8 quarters more between ages 62 to 70. In contrast, husbands of breadwinner wives are less likely to claim at or after age 65 and have lower late-life labor supply between ages 62 and 70 (columns (5) and (6)). This pattern aligns with the finding from Table 2, where husbands of breadwinner women are more likely to claim SSDI, as SSDI benefits are only available before full retirement age.

Tables 2 and 3 show that breadwinner wives are more likely to delay benefits claiming, and rely less on spousal benefits, reflecting their stronger labor market engagement and

Table 2: OLS Estimates of Social Security Receipt on Wives' Breadwinner Status

	Ever primary benefits (1)	Ever retirement benefits (2)	Ever SSDI (3)	Ever spousal benefits (4)	Ever dual entitlement (5)	Auxiliary benefits only (6)
Panel A: Wife						
Wife is breadwinner	0.069***	0.080***	-0.026	-0.173***	-0.304***	-0.083***
	(0.017)	(0.021)	(0.023)	(0.020)	(0.019)	(0.010)
Mean when wife is non-breadwinner	0.863	0.799	0.168	0.263	0.422	0.117
Observations	2,559	2,559	2,559	2,559	2,559	2,559
Panel B: Husband						
Wife is breadwinner	-0.042*	-0.097***	0.117***	0.043***	0.092***	0.002
	(0.023)	(0.029)	(0.029)	(0.016)	(0.018)	(0.006)
Mean when wife is non-breadwinner	0.971	0.918	0.162	0.014	0.008	0.005
Observations	2,547	2,547	2,547	2,547	2,547	2,547

Notes: This table reports OSL regression results using our sample from the HRS (1992-2018). All specifications include dummy variables for the race and education of both spouses and the age gap between the two spouses. Standard errors are in parentheses, clustered at the household level. ***, **, * indicate statistical significance at the 1, 5, and 10 percent levels, respectively.

Table 3: OLS Estimates of Joint Social Security Claiming and Late-life Employment on Wives' Breadwinner Status

	Claim in the same year	|Gap between claiming years|	Wife claims at age 65+	Wife's QCs (age 62-70)	Husband claims at age 65+	Husband's QCs (age 62-70)
	(1)	(2)	(3)	(4)	(5)	(6)
Wife is breadwinner	-0.033*	1.533**	0.075***	3.776***	-0.060**	-2.643***
	(0.019)	(0.720)	(0.023)	(0.718)	(0.025)	(0.7774)
Mean when wife is non-breadwinner	0.172	5.35	0.180	5.354	0.258	8.876
Observations	3,141	3,141	3,711	2,687	3,160	2,648

Notes: This table reports OSL regression results using our sample from the HRS (1992-2018). All specifications include dummy variables for the race and education of both spouses and the age gap between the two spouses. Standard errors are in parentheses, clustered at the household level. ***, **, * indicate statistical significance at the 1, 5, and 10 percent levels, respectively.

higher lifetime earnings. Furthermore, they are less likely to claim benefits jointly with their husbands. In contrast, their husbands show increased reliance on spousal and disability benefits and tend to retire earlier. These findings highlight shifting gender roles in retirement strategies and the intra-household dynamics where traditional breadwinning roles are reversed, as more women attain higher education and marry down.

3 Quantitative Model

This section presents a dynamic life-cycle model of labor supply, consumption, savings, and Social Security claiming decisions of couples, in which Social Security rules are modeled in great detail to match that of the current U.S. system. Life-cycle from ages $t = 50, 55, 56, ..., 95$ is modeled.

Couples are heterogeneous with respect to permanent breadwinning states, i.e., female-breadwinner and male-breadwinner couples, as well as evolving states, including household assets (a_t), stochastic earnings (w_t^n), health status (h_t), social security wealth ($\bar{y}_t$), and application status (b_{t-1}^{ss}) of both wives and husbands. Given this vector of states, couples choose optimal household consumption and make work and Social Security benefit application decisions (if eligible) of both spouses to maximize the present discounted value of life-time

utility.

The breadwinning status of a couple is defined by the average lifetime earnings at age 55 ($\bar{y}_t$) of spouses. We categorize a wife as "breadwinner" if her average lifetime earnings exceed her husband's.

3.1 Preferences

Every single person has preferences over consumption c_t and leisure l_t. The within period utility is non separable between the two and is given as follows.

$$u(c_t, l_t) = \frac{1}{1-\rho}\left(\left(\frac{c_t}{\zeta}\right)^{\nu} l_t^{1-\nu}\right)^{1-\rho}$$

Where ρ is the coefficient of relative risk aversion and ν is the weight on consumption. ζ is the equivalent scale in consumption.

The preferences for a couple is given as follows

$$w(c_t, l_t^i, l_t^j) = \frac{1}{1-\rho}\left(\left(\frac{c_t}{\zeta}\right)^{\nu} (l_t^i)^{1-\nu}\right)^{1-\rho} + \frac{1}{1-\rho}\left(\left(\frac{c_t}{\zeta}\right)^{\nu} (l_t^j)^{1-\nu}\right)^{1-\rho} + \varphi \mathbb{I}\{n_t^i = n_t^j = 0\}$$

The parameter φ captures the leisure complementary if both spouses not working.

The total amount of leisure in period t for each individual is given by:

$$l_t = \bar{l} - n_t - \phi_P(t)\mathbb{I}\{n_t > 0\} - \phi(h_t) \tag{1}$$

Where $\bar{l}$ is the total endowment of leisure each period, n_t is the hours corresponding to the discrete labor supply decision. ϕ_P determines the participation cost incurred if hours worked n_t are positive. $\phi(h_t)$ is the time lost due to bad health.

Upon dying, an individual values bequests of any leftover wealth:

$$beq(a_t) = \frac{\theta_{beq}}{1-\rho}\left(a_t + \kappa_{beq}\right)^{(1-\rho)\nu}$$

The coefficient θ_{beq} measures the strength of bequest motive and κ_{beq} measures the curvature of the bequest function. Increase in θ_{beq} increases the marginal utility of a unit of bequest and increase in κ_{beq} indicate that the bequest is valued more like a luxury good.

3.2 Wages

Each household i receives wage offers and makes labor supply decisions once wages are revealed. The wage offer process evolves according to

$$\log w_{it}^h = \alpha_0^h + \alpha_1^h \cdot t + \alpha_2^h \cdot t^2 + \alpha_3 \cdot e_i^h + \sum_{s=1}^{2} \varphi_s^h \cdot \mathbf{1}(s_{it}^h = s) + \zeta_{it}^h + \epsilon_{it}^h \quad (2)$$

$$\log w_{it}^w = \alpha_0^w + \alpha_1^w \cdot (t-3) + \alpha_2^w \cdot (t-3)^2 + \tilde{\alpha_3} \cdot e_i^w + \varphi^w \cdot \mathbf{1}(s_{it}^w = 1) + \zeta_{it}^w + \epsilon_{it}^w \quad (3)$$

$$\zeta_{it}^j = \zeta_{i,t-1}^j + \nu_{it}^j, \quad \begin{pmatrix} \nu_{it}^h \\ \nu_{it}^w \end{pmatrix} \overset{iid}{\sim} N\left[0, \begin{pmatrix} \sigma_{\nu,h}^2 & \sigma_{\nu_{h,w}} \\ \sigma_{\nu_{h,w}} & \sigma_{\nu,w}^2 \end{pmatrix}\right], \quad j \in \{h, w\} \quad (4)$$

$$\begin{pmatrix} \epsilon_{it}^h \\ \epsilon_{it}^w \end{pmatrix} \overset{iid}{\sim} N\left[0, \begin{pmatrix} \sigma_{\epsilon,h}^2 & \sigma_{\epsilon_{h,w}} \\ \sigma_{\epsilon_{h,w}} & \sigma_{\epsilon,w}^2 \end{pmatrix}\right] \quad (5)$$

where w_{it}^j denotes the hourly wage of spouse $j \in \{h, w\}$. For both spouses, log hourly wages depend on their own age, education type, and health status. Each spouse receives a permanent wage shock ν_{it}^j and a transitory shock ϵ_{it}^j and these two shocks are assumed to be independent. The permanent (transitory) wage shocks of the two spouses are assumed to be contemporaneously correlated with covariance $\sigma_{\nu_{h,w}}$ ($\sigma_{\epsilon_{h,w}}$).

3.3 Health, Disability, Mortality

In each time period, husband or both spouses face uncertainty in health, $h_t \in \{0, 1\}$, which takes two values: with 0 being in good health and 1 being in bad health (or disabled). Health in the next period, h_{t+1}, depends on the individual's current health and age, and evolves according to the Markov chain between two states, with an age-dependent Markov transition matrix. A typical element of the health transition matrix at age t is given by:

$$\pi_{j,i,t+1} = Pr(h_{t+1} = j | h_t = i, t+1), \qquad i, j \in \{0, 1\} \quad (6)$$

The parameter s_{t+1} denotes the probability that an individual is alive at age $t+1$ conditional on being alive at age t. The survival probability depends on age and previous health status, as: $s_{t+1} = S(h_t, t+1)$. Because individuals live up to a maximum age T, $s_{T+1} = 0$ for any h.

3.4 Social Security

The Social Security system in the U.S. provides retirement incentives at the time when these benefits become available. Benefits are computed in several steps. First, the earnings of the 35 highest earning years are averaged into an index – Average Indexed Monthly Earnings (AIME). The AIME increases by working an additional year if earnings in that year are higher than the lowest earnings embedded in it and are also capped at a threshold.

Let $\bar{y}_t$ be the Social Security wealth in the model (annualized measure of AIME). Then the Social Security wealth evolution is approximated in the model in the following simple way:

$$\bar{y}_{t+1} = \max\{[(1 + g_{awi}\{t \leq 60\})\bar{y}_t + \max\{0, (w_t^n - (1 + g_{awi}\{t \leq 60\})\bar{y}_t)/35\}], \tilde{y}\} \quad (7)$$

Where $\tilde{y}$ is the threshold at which the Social Security wealth is capped and g_{awi} captures the indexing of the Social Security benefits for real wage growth and w_t^n denotes annual earnings for period t.[5] Note that in equation 7, we assume that the high earnings year only replaces an average earnings year, as modeling the actual system would require keeping track of entire earnings history which is computationally infeasible.

Second, AIME is converted to obtain the Primary Insurance Amount (PIA), which determines the Social Security benefits using the following piece-wise linear function:

$$\begin{aligned} pia(\bar{y}_t) = 0.90 \times \min\{\bar{y}_t, b_0\} + 0.32 \times \min\{\max\{\bar{y}_t - b_0, 0\}, b_1 - b_0\} \\ +0.15 \times \max\{\bar{y}_t - b_1, 0\} \end{aligned} \quad (8)$$

The Social Security system in the model provides several work disincentives at older ages. For instance, the Social Security wealth $\bar{y}_t$ is recomputed upwards only if current earnings are greater than average past earnings (as shown in equation 7). For instance, staying longer in the labor market by working part-time may not increase the benefits for the individuals in the model.[6] Additionally, there are strong work disincentives due to penalty/reward system associated with the timing of SS application and earnings test as described below.

[5] Note that in practice, a worker's annual nominal earnings each year are indexed to economy-wide earnings as of the year the worker turns age 60, which is accomplished by multiplying the annual nominal earnings by the ratio of the national Average Wage Index (AWI) in the year the worker turns 60 to the AWI in the year the nominal earnings were paid.

[6] In practice, the highest 35 years of covered earnings are used to compute AIME. If the individual has not yet worked for 35 years, some zeros are included in the average, and any positive earnings, including part-time work, will increase the AIME.

3.4.1 Adjustments

Social Security benefits, ssb_t, are a function of the PIA as discussed above and two possible adjustments: a penalty/credit for claiming early/late (Γ_t) and a decrease in benefits for those workers who continue working while also claiming benefits (Υ_t).

$$ssb_t = pia(\bar{y}_t) * \Gamma_t - \Upsilon_t \tag{9}$$

Each of these adjustments is discussed below.

Early/Late Claiming Penalty

SS benefits can be claimed without any penalty at the normal retirement age (t_{NRA}).[7] However, individuals can claim benefits with some penalty starting the Early Retirement Age (t_{ERA}) of age 62. For every year before the NRA that these benefits are claimed, the Social Security amount received is permanently reduced by the early claiming penalty. Individuals can also delay their benefit claim beyond NRA. In that case, future benefits are permanently increased by the delayed claiming credit.

This penalty or credit shows up at a percentage decrease, γ_t^{ss}, for each year prior to the normal retirement age that a worker claims or a percentage increase for each year after the normal retirement age that a worker delays claiming.

$$\Gamma_t = \begin{cases} (1-\gamma_t^{ss})^{(t_{NRA}-t)} & \text{if } t < t_{NRA} \\ 0 & \text{if } t = t_{NRA} \\ (1+\gamma_t^{ss})^{(t-t_{NRA})} & \text{if } t > t_{NRA} \end{cases} \tag{10}$$

Earnings Test

Social Security earnings test taxes the labor income, above a certain threshold y_t^{ss}, of the Social Security beneficiaries at a rate τ_t^{ss}, until the age of 70. Specifically, for each additional dollar earned above the threshold, Social Security benefits are reduced by τ_t^{ss}, until all benefits are taxed away as shown below:

$$\Upsilon_t = \min\{pia\left(\bar{y}_t\right), \max\{0, w_t^n n_t - y_t^{et}\}\tau_t^{et}\}$$

[7] The NRA is slightly different for different birth cohorts.

Υ_t denotes benefits lost through the earnings test. Taxed benefits are credited back through permanent increases in future benefits, which is implemented in the model through increases in the Social Security wealth.

Disability Insurance

DI benefit application is not an endogenous choice (since it is not the primary focus of the paper). As the probability of applying for disability insurance successfully depends on age and health status, and disabled individuals are more likely to qualify for DI benefits, to keep the model simplified, we assume that DI benefits are exclusively granted to disabled individuals if the income requirements are met.

Disabled individuals can receive DI benefits prior to the NRA if their labor income is below a certain threshold y_{db}. Upon reaching the NRA, DI benefits automatically convert to retirement benefits. The benefit amount db_t is set at the level an individual would receive if they claim retirement benefits at the NRA. To account for the probability of disabled individuals receiving benefits, the amount db_t is discounted as

$$db_t = \pi^{db} PIA_t \mathbb{I}_{\{h_t=1\}} \mathbb{I}_{\{w_t n_t \leq y_{db}\}} \quad \text{if age} < NRA \tag{11}$$

where π^{db} is the probability for old age groups with severe work limitation. This is to capture average amount of DI benefits received by disabled individuals.

3.4.2 Marriage Related Benefits: Social Security spousal benefits and survival benefits

For couples, there is an additional benefit provided by the Social Security system called the spousal benefits. Married individuals can decide to claim their own benefits or 50% of their spouse's benefits (whichever is higher). Individuals are entitled to 50 percent of spouse's benefits through Social Security, as soon as they reach the age of eligibility (62). At the same time, they can switch to the higher of the two benefits as a later date. Singles and married individuals whose spouse is not yet eligible for benefits receive no additional spousal benefits.

3.5 Taxes and Transfers

Both singles and couple faces the effective time-varying tax rates. As common in the literature, we adopt a functional form that allows for negative tax rates (and thus incorporates

the EITC), and we allow it to depend on marital status and age for each cohort (and thus time). Taxes paid are thus given by:

$$T(Y) = (1 - \lambda Y^{-\xi})Y.$$

Where Y is the total family income. $Y_t = w_t^{1n} + w_t^{2n} + rat_t$ in the case of married working households and $Y_t = w_t^h + rat_t$ in the case of single working households. Note that we allow the parameters of the above tax function to vary by time and marital status.

The government also uses a proportional payroll tax τ_t^{ss} on labor income, up to a Social Security cap $\tilde{y}_t$ to help finance old-age Social Security benefits. We also allow the payroll tax and the Social Security cap to change over time for each cohort as in the data. We thus assume that the tax changes were anticipated by the households.

There is a standard consumption floor which guarantees a minimum level of consumption:

$$c_t \geq \bar{c} \tag{12}$$

Government transfers, tr_t, bridge the gap between this minimum level of consumption and individual's liquid resources. This is a simple approximation to the federal safety net programs in the U.S. like Supplemental Nutritional Assistance Program (SNAP), Supplemental Security Income (SSI), Temporary Assistance for Needy Families (TANF), and other programs.

$$tr_t = \min\{0, \underline{c} - (Y_t + ssb_t)\} \tag{13}$$

3.6 Recursive Formulation

Let z_t, be the period t state vector. Then both couples and singles solve a finite-horizon Markovian decision problem where they choose a sequence of consumption $\{c(z_t)\}_{t=1}^T$, hours $\{n(z_t)\}_{t=1}^T$ and Social Security benefit application $\{b^{ss}(z_t)\}_{t=1}^T$ rules to maximize the expected discounted lifetime utility subject to the exogenous processes for survival, and labor earnings, a set of budget, borrowing, and time constraints, government transfer rule, and policies for taxes and Social Security.

The life cycle of an individual between ages 55 and 99 is divided into three distinct phases. The first is the *employment* phase between ages 55 and 61 where individuals make

consumption, savings, and employment decisions.[8]The second is the *retirement choice* phase between ages 62 and 69 where individuals also make Social Security application decisions (b_t^{ss}). Finally there is a *retired* phase where individuals make only consumption and savings decisions. The decision problems for both singles and couples are given below:

3.6.1 Couples in Employment phase (Ages 55 to 61)

The state variable for a married couple during the working age is $(a_t, \bar{y}_t^1, \bar{y}_t^1, w_t^1, w_t^2)$. The couple decides on consumption, savings, labor supply (both husband and wife):

$$
\begin{aligned}
W(a_t, \bar{y}_t^1, \bar{y}_t^1, w_t^1, w_t^2) = \max_{\{c_t, n_t^1, n_t^2\}} \Bigg\{ & w(c_t, l_t^1, l_t^2) \\
& + \beta \pi_{t+1}^s \Bigg[EW((a_{t+1}, \bar{y}_{t+1}^1, \bar{y}_{t+1}^1, w_{t+1}^1, w_{t+1}^2)) \\
& + \beta(1 - \pi_{t+1}^s) beq(a_{t+1}) \Bigg\} \quad s.t.
\end{aligned}
$$

$$
c_t + a_{t+1} = a_t(1+r) + w_t^{1n} + w_t^{2n} + tr_t - \tau^{ss}\big(\min(w_t^1, \tilde{y}_t) + \min(w_t^2, \tilde{y}_t)\big) - T(w_t^1 + w_t^2 + ra_t)
$$

$$
\begin{aligned}
l_t^1 &= \bar{l} - n_t^1 - \phi_P(t)\mathbb{I}\{n_t^1 > 0\}, \qquad l_t^1 \geq 0 \\
l_t^2 &= \bar{l} - n_t^2 - \phi_P(t)\mathbb{I}\{n_t^2 > 0\}, \qquad l_t^2 \geq 0 \\
a_{t+1} &\geq 0, \qquad (7) - (12).
\end{aligned}
$$

3.6.2 Couples in Retirement choice phase (Ages 62 to 69)

In the following, I consider decisions of couples and allow for switching from own to spousal benefits.

At any given point in time between ages 62 and 69, there are four possible claiming states they can wake up with $(b_t^{1ss}, b_t^{2ss}) \in \{(0,0),(0,1),(1,0),(1,1)\}$. Let $s_t = (a_t, \bar{y}_t^1, \bar{y}_t^1, w_t^1, w_t^2)$ represents all non-claiming state vector for the couple.

[8]We do not allow individuals to claim disability benefits in the model for now.

$$W(s_t, b_{t-1}^{1ss} = 0, b_{t-1}^{2ss} = 0) = \max\{W_{00}^{11}, W_{00}^{10}, W_{00}^{01}, W_{00}^{00}\} \tag{14}$$
$$W(s_t, b_{t-1}^{1ss} = 1, b_{t-1}^{2ss} = 1) = W_{11}^{11} \tag{15}$$
$$W(s_t, b_{t-1}^{1ss} = 0, b_{t-1}^{2ss} = 1) = \max\{W_{01}^{11}, W_{01}^{01}\} \tag{16}$$
$$W(s_t, b_{t-1}^{1ss} = 1, b_{t-1}^{2ss} = 0) = \max\{W_{10}^{11}, W_{10}^{10}\} \tag{17}$$

Both husband and wife have not claimed previously: we start with the scenario described in equation 14 where both the husband and wife wake up without having claimed in the previous period. The different value functions are given as below:

$$W_{00}^{11j} = \max_{\{c_t, n_t^1, n_t^2\}} \Bigg\{ w(c_t, l_t^1, l_t^2) + \beta \pi_{t+1}^s \Big[EW(s_{t+1}, b_t^{1ss} = 1, b_t^{2ss} = 1) \Big] + \beta(1 - \pi_{t+1}^s) beq(a_{t+1}) \Bigg\} \quad s.t.$$

$$\begin{aligned}
c_t + a_{t+1} &= a_t(1+r) + w_t^{1n} + w_t^{2n} + tr_t - \tau^{ss}\big(\min(w_t^{1n}, \tilde{y}_t) + \min(w_t^{2n}, \tilde{y}_t)\big) - T(w_t^{1n} + w_t^{2n} + ra_t) \\
&\quad + \max\{ssb_t^1 + 0.5ssb_t^1, 0.5ssb_t^2 + ssb_t^2, ssb_t^1 + ssb_t^2\} \\
l_t^1 &= \bar{l} - n_t^1 - \phi_P(t)\mathbb{I}\{n_t^1 > 0\}, \qquad l_t^1 \geq 0 \\
l_t^2 &= \bar{l} - n_t^2 - \phi_P(t)\mathbb{I}\{n_t^2 > 0\}, \qquad l_t^2 \geq 0 \\
a_{t+1} &\geq 0, \qquad (7-12).
\end{aligned}$$

There are three possibilities available to the household in this scenario. First the husband claims on his earnings record and the wife claims spousal benefits (household gets $ssb_t^1 + 0.5ssb_t^1$), second husband claims on his earnings record and wife claims her benefits (household gets $ssb_t^1 + ssb_t^2$) and finally husband claims spousal benefits (household gets $0.5ssb_t^2 + ssb_t^2$).

$$W_{00}^{00j} = \max_{\{c_t, h_t^1, h_t^2\}} \Bigg\{ w(c_t, l_t^1, l_t^2) + \beta \pi_{t+1}^s \Big[EW(s_{t+1}, b_t^{1ss} = 0, b_t^{2ss} = 0) \Big] + \beta(1 - \pi_{t+1}^s) beq(a_{t+1}) \Bigg\} \quad s.t.$$

$$\begin{aligned} c_t + a_{t+1} &= a_t(1+r) + w_t^{1n} + w_t^{2n} + tr_t - \tau^{ss}\big(\min(w_t^{1n}, \tilde{y}_t) + \min(w_t^{2n}, \tilde{y}_t)\big) - T(w_t^{1n} + w_t^{2n} + ra_t) \\ l_t^1 &= \bar{l} - n_t^1 - \phi_P(t)\mathbb{I}\{n_t^1 > 0\}, \qquad l_t^1 \geq 0 \\ l_t^2 &= \bar{l} - n_t^2 - \phi_P(t)\mathbb{I}\{n_t^2 > 0\}, \qquad l_t^2 \geq 0 \\ a_{t+1} &\geq 0, \qquad (7-12). \end{aligned}$$

$$W_{00}^{01j} = \max_{\{c_t, h_t^1, h_t^2\}} \Bigg\{ w(c_t, l_t^1, l_t^2) + \beta \pi_{t+1}^s \Big[EW(s_{t+1}, b_t^{1ss} = 0, b_t^{2ss} = 1) \Big] + \beta(1 - \pi_{t+1}^s) beq(a_{t+1}) \Bigg\} \quad s.t.$$

$$\begin{aligned} c_t + a_{t+1} &= a_t(1+r) + w_t^{1n} + w_t^{2n} + tr_t - \tau^{ss}\big(\min(w_t^{1n}, \tilde{y}_t) + \min(w_t^{2n}, \tilde{y}_t)\big) - T(w_t^{1n} + w_t^{2n} + ra_t) + ssb_t^2 \\ l_t^1 &= \bar{l} - n_t^1 - \phi_P(t)\mathbb{I}\{n_t^1 > 0\}, \qquad l_t^1 \geq 0 \\ l_t^2 &= \bar{l} - n_t^2 - \phi_P(t)\mathbb{I}\{n_t^2 > 0\}, \qquad l_t^2 \geq 0 \\ a_{t+1} &\geq 0, \qquad (7-12). \end{aligned}$$

$$W_{00}^{10j} = \max_{\{c_t, h_t^1, h_t^2\}} \Bigg\{ w(c_t, l_t^1, l_t^2) + \beta \pi_{t+1}^s \Big[EW(s_{t+1}, b_t^{1ss} = 1, b_t^{2ss} = 0) \Big] + \beta(1 - \pi_{t+1}^s) beq(a_{t+1}) \Bigg\} \quad s.t.$$

$$
\begin{aligned}
c_t + a_{t+1} &= a_t(1+r) + w_t^{1n} + w_t^{2n} + tr_t - \tau^{ss}\big(\min(w_t^{1n}, \tilde{y}_t) + \min(w_t^{2n}, \tilde{y}_t)\big) - T(w_t^{1n} + w_t^{2n} + ra_t) + ssb_t^1 \\
l_t^1 &= \bar{l} - n_t^1 - \phi_P(t)\mathbb{I}\{n_t^1 > 0\}, \qquad l_t^1 \geq 0 \\
l_t^2 &= \bar{l} - n_t^2 - \phi_P(t)\mathbb{I}\{n_t^2 > 0\}, \qquad l_t^2 \geq 0 \\
a_{t+1} &\geq 0, \qquad (7-12).
\end{aligned}
$$

Both husband and wife have already claimed previously:

$$
\begin{aligned}
W_{11}^{11j} = \max_{\{c_t, h_t^1, h_t^2\}} \Bigg\{ & w(c_t, l_t^1, l_t^2) + \beta \pi_{t+1}^s \Big[EW(s_{t+1}, b_t^{1ss} = 1, b_t^{2ss} = 1) \Big] \\
& + \beta(1 - \pi_{t+1}^s) beq(a_{t+1}) \Bigg\} \quad s.t.
\end{aligned}
$$

$$
\begin{aligned}
c_t + a_{t+1} &= a_t(1+r) + w_t^{1n} + w_t^{2n} + tr_t - \tau^{ss}\big(\min(w_t^{1n}, \tilde{y}_t) + \min(w_t^{2n}, \tilde{y}_t)\big) - T(w_t^{1n} + w_t^{2n} + ra_t) \\
&\quad + \max\{ssb_t^1 + 0.5ssb_t^1, 0.5ssb_t^2 + ssb_t^2, ssb_t^1 + ssb_t^2\} \\
l_t^1 &= \bar{l} - n_t^1 - \phi_P(t)\mathbb{I}\{n_t^1 > 0\}, \qquad l_t^1 \geq 0 \\
l_t^2 &= \bar{l} - n_t^2 - \phi_P(t)\mathbb{I}\{n_t^2 > 0\}, \qquad l_t^2 \geq 0 \\
a_{t+1} &\geq 0, \qquad (7-12).
\end{aligned}
$$

Only wife has claimed previously:

$$
\begin{aligned}
W_{01}^{11j} = \max_{\{c_t, h_t^1, h_t^2\}} \Bigg\{ & w(c_t, l_t^1, l_t^2) + \beta \pi_{t+1}^s \Big[EW(s_{t+1}, b_t^{1ss} = 1, b_t^{2ss} = 1) \Big] \\
& + \beta(1 - \pi_{t+1}^s) beq(a_{t+1}) \Bigg\} \quad s.t.
\end{aligned}
$$

$$
\begin{aligned}
c_t + a_{t+1} &= a_t(1+r) + w_t^{1n} + w_t^{2n} + tr_t - \tau^{ss}\big(\min(w_t^{1n}, \tilde{y}_t) + \min(w_t^{2n}, \tilde{y}_t)\big) - T(w_t^{1n} + w_t^{2n} + ra_t) \\
&\quad + \max\{ssb_t^1 + 0.5ssb_t^1, 0.5ssb_t^2 + ssb_t^2, ssb_t^1 + ssb_t^2\} \\
l_t^1 &= \bar{l} - n_t^1 - \phi_P(t)\mathbb{I}\{n_t^1 > 0\}, \qquad l_t^1 \geq 0 \\
l_t^2 &= \bar{l} - n_t^2 - \phi_P(t)\mathbb{I}\{n_t^2 > 0\}, \qquad l_t^2 \geq 0 \\
a_{t+1} &\geq 0, \qquad (7-12).
\end{aligned}
$$

$$
\begin{aligned}
W_{01}^{01j} = \max_{\{c_t, h_t^1, h_t^2\}} \Bigg\{ & w(c_t, l_t^1, l_t^2) + \beta\pi_{t+1}^s \Big[EW(s_{t+1}, b_t^{1ss} = 1, b_t^{2ss} = 1) \Big] \\
& + \beta(1 - \pi_{t+1}^s) beq(a_{t+1}) \Bigg\} \quad s.t.
\end{aligned}
$$

$$
\begin{aligned}
c_t + a_{t+1} &= a_t(1+r) + w_t^{1n} + w_t^{2n} + tr_t - \tau^{ss}\big(\min(w_t^{1n}, \tilde{y}_t) + \min(w_t^{2n}, \tilde{y}_t)\big) - T(w_t^{1n} + w_t^{2n} + ra_t) + ssb_t^2 \\
l_t^1 &= \bar{l} - n_t^1 - \phi_P(t)\mathbb{I}\{n_t^1 > 0\}, \qquad l_t^1 \geq 0 \\
l_t^2 &= \bar{l} - n_t^2 - \phi_P(t)\mathbb{I}\{n_t^2 > 0\}, \qquad l_t^2 \geq 0 \\
a_{t+1} &\geq 0, \qquad (7-12).
\end{aligned}
$$

3.6.3 Couples in Retired phase (Ages 69 to 99)

There is no more benefit claiming as all individuals upon reaching 70 become eligible for the maximum possible benefits available to them. The value function is then fairly simple and given as follows:

$$
\begin{aligned}
W(a_t, \bar{y}_t^1, \bar{y}_t^1) = \max_{c_t, a_{t+1}} \Big\{ & u(c_t, \bar{l}, \bar{l}) + \beta\pi_{t+1}^s EW(a_{t+1}, \bar{y}_{t+1}^1, \bar{y}_{t+1}^1) + \beta(1 - \pi_{t+1}^s) beq(a_{t+1}) \Big\} \quad s.t. \\
c_t + a_{t+1} &= a_t(1+r) + tr_t - T(ra_t) + \max\{ssb_t^1 + 0.5ssb_t^1, 0.5ssb_t^2 + ssb_t^2, ssb_t^1 + ssb_t^2\} \\
& (7-12).
\end{aligned}
$$

3.6.4 Singles in Employment phase (Ages 55 to 61)

$$V(a_t, \bar{y}_t, w_t) = \max_{\{c_t, n_t\}} \left\{ u(c_t, l_t) + \beta \pi^s_{t+1} \left[EV(a_{t+1}, \bar{y}_{t+1}, w_{t+1}) \right] + \beta(1 - \pi^s_{t+1}) beq(a_{t+1}) \right\} \quad s.t.$$

$$c_t + a_{t+1} = (1 + r)a_t + w^n_t + tr_t - \tau^{ss}(\min\{w^n_t, \tilde{y}_t\}) - T(w^n_t + ra_t)$$

$$a_{t+1} \geq 0$$

$$l_t \geq 0$$

$$(1), (7 - 12).$$

3.6.5 Singles in Retirement choice phase (Ages 62 to 69)

Starting age 62, singles also make benefit claiming decisions:

$$V(a_t, \bar{y}_t, w_t, b^{ss}_{t-1} = 0) = \max \left\{ V^0, V^1 \right\}$$

$$\begin{aligned} V^0(a_t, \bar{y}_t, w_t, b^{ss}_{t-1} = 0) = \max_{\{c_t, n_t\}} \Bigg\{ & u(c_t, l_t) \\ & + \beta \pi^s_{t+1} \left[EV(a_{t+1}, \bar{y}_{t+1}, w_{t+1}, b^{ss}_t = 0) \right] \\ & + \beta(1 - \pi^s_{t+1}) beq(a_{t+1}) \Bigg\} \quad s.t. \end{aligned}$$

$$c_t + a_{t+1} = (1 + r)a_t + w^n_t + tr_t - \tau^{ss}(\min\{w^n_t, \tilde{y}_t\}) - T(w^h_t + ra_t)$$

$$a_{t+1} \geq 0, \qquad l_t \geq 0, \qquad (1), (7 - 12).$$

The above is the value function corresponding having not claimed benefits in the previous period and not deciding to claim benefits in the current period either.

$$
\begin{aligned}
V^1(a_t, \bar{y}_t, w_t, b^{ss}_{t-1} = 0) = \max_{\{c_t, n_t\}} \Bigg\{ & u(c_t, l_t) \\
& + \beta \pi^s_{t+1} \Big[EV(a_{t+1}, \bar{y}_{t+1}, w_{t+1}, b^{ss}_t = 1) \Big] \\
& + \beta (1 - \pi^s_{t+1}) beq(a_{t+1}) \Bigg\} \quad s.t. \\
c_t + a_{t+1} &= (1 + r) a_t + w^n_t + tr_t - \tau^{ss}(\min\{w^n_t, \tilde{y_t}\}) - T(w^h_t + r a_t) + ssb_t \\
a_{t+1} \geq 0, & \qquad l_t \geq 0, \qquad (1), (7-12).
\end{aligned}
$$

The above value function corresponds to having not claimed benefits in the previous period but deciding to claim benefits in the current period.

3.6.6 Singles in Retired phase (Ages 70 to 95)

At age 70, if an individual has still not claimed their benefits, then they automatically start receiving their benefits.

$$
\begin{aligned}
V(a_t, \bar{y}_t) = \max_{c_t} \Bigg\{ & u(c_t, \bar{l}) + \beta \pi^s_{t+1} EV(a_{t+1}, \bar{y}_{t+1}) \\
& + \beta (1 - \pi^s_{t+1}) beq(a_{t+1}) \Bigg\} \quad s.t. \\
c_t + a_{t+1} &= (1 + r) a_t + tr_t - T(r a_t) + ssb_t \\
a_{t+1} \geq, & \qquad (1), (7-12).
\end{aligned}
$$

4 Estimation

The model is estimated using a two-step Method of Simulated Moments (MSM) estimation strategy, as standard in the literature. In the first step, I estimate or calibrate the parameters that can be cleanly identified without explicitly using my model. These parameters are derived directly from data, based on existing literature evidence, or calculated from program rules.

In the second step, taking the parameters that were estimated in the first step as given, I use the Generalized Method of Moments (GMM) techniques to estimate the remaining

preference parameters: $\Theta = (\gamma, \nu, \theta_p^{h=0}, \theta_p^{h\neq 0}, \varphi, \phi, L, \beta, \theta_b, \kappa)$. The objective is to find a vector of parameters Θ that generates simulated decision profiles that *best match* (measured by a GMM criterion function) the corresponding profiles from the data.

4.1 First-Step Estimation

We use the HRS data sets for the first-step estimation. In addition, I borrow parameters, such as the consumption floor ($\underline{c}$) and the pre-tax interest rate (r), from previous literature, and I compute the SS related parameters using the information from the SSA, including health transitions, survival probabilities, out-of-pocket medical spending, spousal earnings, wage profiles, wage process, initial distributions, and SS program rules.

4.2 Second Step Estimation

In the second step, I use GMM techniques to estimate the remaining nine preference parameters: $\Theta = (\gamma, \nu, \theta_p^{h=0}, \theta_p^{h=1,2}, \phi, L, \beta, \theta_b, \kappa)$. The objective is to find a vector of preference parameters $\hat{\Theta}$ that minimizes the weighted distance between the estimated target profiles from the PSID and the simulated profiles generated by the model. The estimator $\hat{\Theta}$ is given by the minimized GMM criterion function:

$$\hat{\Theta} = \arg\min_{\Theta} \frac{I}{1+\tau} \hat{\varphi}(\Theta; \chi)' \hat{\mathbf{W}}_I \hat{\varphi}(\Theta; \chi) \tag{18}$$

where τ is the ratio of the number of observations to the number of simulated observations and $\hat{\varphi}(\Theta; \chi)$ is a vector of moment conditions that my model is estimated to match:

1. Labor force participation by health status (healthy and unhealthy) and ages (55-69) for both spouses in each breadwinning status, resulting in $8\mathbb{T}$ moment conditions.

2. Mean and median non-pension assets over ages (55-69) for couples in each breadwinning status, resulting in $4\mathbb{T}$ moment conditions.

3. Mean joint retirement over ages (55-69) for couples in each breadwinning status, resulting in $2\mathbb{T}$ moment conditions.

This gives a total of $14 \times \mathbb{T} = 210$ moment conditions.

5 Estimation Results

To be added

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