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Underfunded Public Sector Pension Plans, Social Security Participation, and the Retirement Decisions of Public Employees

Abstract

I analyze the effects of public pension parameters, Social Security coverage, and state pension fund sustainability on the retirement of public employees. I use data from the Health and Retirement Study, including personal early and normal retirement eligibility and state of residence. I develop a state-level measure of effective public pension plan sustainability that reflects both the degree of public plan underfunding and a state's ability to fund the plan with its own resources. Using the Public Plans Database and the Treasury Department's estimate of Total Taxable Resources, I calculate the state tax rate that, applied to a state's total taxable resources, could fund the state's unfunded actuarial accrued liability. This effective tax rate varies by Social Security status of the plan. I model retirement probability as a function of public pension eligibility, Social Security coverage in the public sector job, and effective underfunding. I find that becoming eligible for early or normal retirement, or receiving an early-out offer, significantly increases the probability of retiring beginning at age 50. Having Social Security coverage approximately doubles this probability. Public sector workers without Social Security coverage are estimated to have a lower probability of retirement at key eligibility ages. I find that the probability of retirement falls with the degree of underfunding or effective plan risk, but this effect is small compared to the response to plan features. These findings suggest that state legislative action to affect retirement decisions would be most effective operating through plan eligibility rules.

Citation

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1. Introduction

Over the period 2009 to 2012, 44 states introduced changes in state pension plans for general employees and teachers to address long-term underfunding — some states more than once.[1] The degree and implications of public pension underfunding continues as an area for concern (Aubry et al. 2020; Lenney, Lutz, and Sheiner 2019; Pew Charitable Trusts 2018). However, there is limited research to inform us on the relative importance of plan parameters and plan financial risk on the retirement choices and economic well-being of public sector workers, many of whom do not participate in Social Security. This work addresses this shortfall by analyzing how Social Security coverage and the structure and financial health of these public plans affect participant retirement from the public sector job and economic well-being at retirement.

Social Security coverage is a key dimension of difference across public sector jobs that varies greatly from state to state and even within the same state.[2] Overall, about 25% of public employees are without Social Security coverage. California, Colorado, Illinois, Louisiana, Massachusetts, Ohio, and Texas account for more than 75% of noncovered payroll (GAO 2010) and most to substantially all of the public employees in Alaska, Colorado, Louisiana, Maine, Massachusetts, Nevada, and Ohio are not in Social Security. By occupation, 40% of public school teachers, and about two-thirds of firefighters, police officers, and other first responders are not covered by Social Security. Understanding public employee retirement behavior in the absence of Social

[1] Giertz and Papke (2007) explore the interaction of state pension systems with state finances.

[2] See GAO (2010) Appendix II for the amount of covered and uncovered earnings by employees in each state.

Security coverage will inform the discussion concerning extending mandatory Social Security coverage to state and local workers (Munnell 2005; Gale, Holmes, and John 2015).

In previous work (Papke 2019), I compare the relative strengths of retirement incentives from eligibility kink points in public defined benefit pensions and financial incentives from working longer. I use the Health and Retirement Study (HRS), which includes a large number of public employees across the most populous states, supplemented with individual-specific pension parameters, benefits, and the ages at which they become eligible for their plan's early and normal retirement pensions. I find that public employee retirement is responsive to program eligibility focal points in a way generally consistent with the literature on the importance of default options in 401(k) plans (Choi et al. 2003). Further, the retirement response is stronger to focal points rather than to financial incentives, as Siebold (2021) finds with regard to the German social security system.

In this paper, I extend this work in two ways. First, I explore the interaction effect of plan eligibility for early and normal retirement and early-out offers with Social Security coverage. Understanding how Social Security coverage affects retirement behavior affects public plan solvency — more retirees and fewer participants paying in to the fund — and ultimate Social Security claiming. Second, I incorporate information on plan financial risk using the respondent's state public pension plans financial status relative to their state's revenue capacity. While pension benefits are nominally guaranteed in state constitutions, the real benefit cuts that occurred during Detroit's emergence from bankruptcy in 2013 could not have escaped notice. States differ in their ability to raise

revenue and, in any actual funding crisis, it is the degree of underfunding relative to the ability to raise revenue that matters. I use a measure of revenue capacity used in federal grant decisions, Total Taxable Resources (TTR) published by the U.S. Department of Treasury, to reflect the size of the taxable pie and plan liabilities from annual reports maintained in the Public Plans Database at the Center for Retirement Research at Boston College.

I use a binary response model that relates the probability of retirement from a public sector job to pension options available for that individual, Social Security participation, and covariates that factor into the retirement decision such as health status and employer-provided health insurance in retirement. I use three measures of states' public pension underfunding: an aggregation of each state's public plans unfunded actuarial accrued liability (UAAL), the ratio of state pension assets to benefits currently paid, and a measure I refer to as the effective tax rate — the rate that, applied to the state's taxable resources, would equal the outstanding UAAL.

To preview the main results, I find that public employee retirement is most responsive to program eligibility focal points — becoming eligible through meeting age and service requirements for the plan's early retirement or normal retirement benefit — at all ages beginning at age 50. The effect's economic magnitude is on par with the increased probability of retirement due to poor health. Depending on the particular age group, having Social Security coverage approximately doubles these retirement probabilities. Special early-out provisions also encourage earlier retirement, over and above the plan's early retirement provisions, particularly for public employees with Social Security coverage. I find that public employee retirement decisions are sensitive

to plan underfunding and sustainability, but these effects are small compared to the influence of pension eligibility and Social Security coverage.

This paper proceeds as follows. In the next section, I provide a brief overview of related work, and describe the HRS individual data that I use to estimate baseline retirement hazards, and sensitivity to plan focal points and Social Security coverage. I summarize measures of economic well-being at retirement for those with and without Social Security coverage in the HRS sample. In Section 3, I describe the plan-level characteristics from the Public Plan Database that I use to characterize state-level public pension obligations. I combine this state-level liability with a measure of state fiscal capacity to construct a summary statistic of effective underfunding risk or sustainability. Section 4 presents estimates of the sensitivity of retirement to plan retirement eligibility, Social Security coverage, and effective pension underfunding. Section 5 discusses the implication of these findings and concludes.

2. Background and HRS data description

Beginning in 1991, public employees who were not members of a qualifying state or local retirement system were generally required to have Social Security (SS) coverage. Federal law generally permits each public employer to decide which employees to cover.[3] The extent to which public employees are covered varies greatly from state to state. The GAO (2010) reports that, based on SSA data, 98% of public employees are covered by Social Security in Vermont, but in Ohio only about 3% are

[3] The GAO (2010) finds that the Social Security Administration (SSA) lacks basic data on which public employers have approved coverage, and relies on public employers to comply with coverage agreements voluntarily.

covered.[4] Further, there is variation in SS coverage among public employees working for the same employer. For example, Missouri's school districts have two separate retirement systems, one for full-time teachers and a separate one for full-time nonteachers. The full-time teachers do not generally have Social Security coverage while the full-time nonteachers do. New Hampshire law prohibits Social Security coverage for police and fire fighters who belong to a more generous plan than other public employees in New Hampshire. If certain members do not meet the criteria for the employer's pension plan(s) then they are covered by Social Security.[5] Public employees with uncovered plans may still be eligible for Social Security benefits based on their spouse's or their own earnings in other, covered employment.[6]

Public pension plan financial health may differ by Social Security coverage status. Uncovered plans are typically more generous, but less well-funded; indeed, the last decade of changes have made public plans less generous, including uncovered plans, as states reacted to the Great Recession (Aubry et al. 2020).

Virtually all public employees participate in a defined benefit (DB) plan where retirement eligibility and benefits are a function of personal employment characteristics (age and years of service) as well as plan parameters. The data requirements to

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[4] See GAO (2010) Appendix II.

[5] Employers may also choose to provide only Medicare coverage rather than both Social Security and Medicare.

[6] Approximately 95% of noncovered state and local employees become entitled to Social Security benefits as workers, spouses, or dependents. Note that Social Security has two provisions, the Government Pension Offset, which affects spousal and survivor benefits, and the Windfall Elimination Provisions, which affects retired worker benefits. Both provisions reduce SS benefits for those who receive noncovered pension benefits. See Gustman, Steinmeier, and Tabatabai (2013) for analysis of these provisions using HRS data.

estimate the influence of eligibility ages separately from financial incentives and plan financial risk are substantial and directly relevant research is limited. In Papke (2019), I discuss related work: Here, I briefly highlight three recent directly relevant papers. First, in my previous work, using these same data I discuss below, I find that public employee retirement is responsive to program eligibility focal points, especially becoming eligible through meeting age and service requirements for the plan's early retirement benefit, but not to pension wealth separately. Social Security coverage increases retirement probabilities for employees ages 60 to 64, and coordinating with Social Security through leveling is an additional incentive to retire for this age group. I make use of restricted geographic codes, which preclude me from accessing detailed Social Security earnings records, so I use Social Security coverage rather than Social Security wealth. Coile and Stewart (2020), using an alternative method of identifying public sector workers in the HRS, focus on Social Security and pension wealth from earnings records. They find public sector workers respond to financial incentives in making retirement decisions, but they do not include indicators for personal eligibility or make use of state of residence data. Siebold (2021) studies retirement behavior in Germany and eligibility for retirement in their Social Security system. Similar to Papke (2019), he finds that the framing of statutory ages as reference points for retirement explains the retirement pattern he sees in German administrative data.

Unique features of public sector employment allow us to compare separately the influences of eligibility for pension income, health insurance, and Social Security benefits because these eligibilities can occur at different ages. For example, many public sector workers have employer provided retiree health insurance in retirement that

offers a bridge to Medicare for public sector workers who retire before 65. In most previous research, age 65 is also the normal or full benefits retirement age for Social Security benefits. In contrast, most public sector workers can buy into group health insurance if they retire before 65, effectively delinking the two influences at that important age. Further, since many public employees are without Social Security coverage they do not directly face its financial incentives and key eligibility ages.

The Health and Retirement Study (HRS), the most comprehensive panel survey of preretirement respondents, includes a large number of public employees across the most populous states. In addition, the HRS has obtained pension parameters from many of these public plans that, through a restricted data agreement, allow researchers access to individual-specific pension benefits at each age and the ages at which they become eligible for their plan's early and normal retirement. However, the HRS does not release the plan name, so in order to link public workers to their state of residence, I use restricted residence and detailed occupation information to identify general public employees from teachers. The data include a subset of respondents from states with limited Social Security coverage of general, public-sector employees, and states where teachers are not covered by Social Security. This variation allows me to compare the retirement choices of covered general employees and teachers to uncovered general employees and teachers. The next section describes these data in detail.

A. Public employment in the Health and Retirement Study

I use four comparable cohorts of the HRS — all the same age when they entered the HRS (ages 51 to 56 in 1992, 1998, 2004, 2010) — that face different state or local defined benefit pension landscapes as they approach and enter retirement.

Respondents are reinterviewed every other year after entering the survey. I make use of the panel structure of the HRS from 1992 to 2014 to compare initial and final self-reports of retirement with dates of public employment to find their final retirement from the public sector. Respondents indicate at their first interview whether they had ever worked for the federal, state, or local government and the start and end date of such jobs. In 2006, 2008, and 2010, the HRS added two new questions that determine if a respondent is currently employed by a government (question J720), and if so, what level of government. (In 2008, only new interviewees and those who changed jobs were asked these questions.) Going forward, this question repeats every six years. I determine public employment in other survey years by comparing the start and end date of any reported government job with the start and interview dates of their current job. I follow employment in each wave between 1992 and 2014 backward to earlier years that they remained in that same job. I identify job changes in and out of public employment across the waves (two-year intervals) and eventual retirement from the government job (if they retire from that job). So, the measure of retirement used here is based on self-reports with later wave confirmation that the respondent actually fully retired after leaving public employment.

I focus on respondents who self-report as state or local public employees at their entry into the survey.[7] Most of the data come from the RAND (version P) of the HRS with supplemental information from the RAND HRS Fat files.[8] I supplement these data

[7] See Papke (2019) for detailed discussion of the data.

[8] For details, see https://www.rand.org/labor/aging/dataprod/fattable.html. The composition of the sample of public employees consists of the original HRS sample (46%), the War

with three restricted data sources from the HRS: detailed industry and occupation, pension plan data, and geographic codes for state of residence. I use the industry and occupation data to identify and condition on finer job categories than are available in the public data.

To examine the influence of pension retirement provisions, I use detailed pension information that the HRS has matched to respondents to calculate the eligibility for early or normal retirement. These data come from four surveys of employers and from employer web sites (Fang et al. 2016). For respondents who have been matched to employer plans, the HRS Pension Estimation Program (PEP) calculates three types of present values of pension wealth for a respondent's current plan at any age: values that are available to participants who qualify for early retirement (ER), values available once the respondent qualifies for the plan's normal retirement age (NR), and vested, deferred benefits that accumulate over time prior to any eligibility for retirement. Using these values, I determine when an individual is eligible for retirement under these provisions. For public employees, these data are primarily defined benefit (DB) plan parameters — benefit formulas and age and service requirements to meet early and normal retirement. The PEP data include defined contribution balances as well as required employee contributions to the DB plan.

Table 1 illustrates respondents' early and normal retirement eligibility ages as calculated by the PEP program. That is, 1,294 respondents have an early retirement option and, based on their eventual years of service, 16.69% of them (216) were eligible

Babies/CODA sample (13%), the Early Baby Boomers (15%), and the Mid Baby Boomers (26%).

for early retirement at age 55, and 17.54% of them at age 56. The most common eligibility age is 60 in the sample, with 15.73% attaining normal retirement at that age.

I use restricted respondent geographic codes to identify the respondent's state of residence. This allows me to verify self-reports of Social Security coverage with other sources of Social Security coverage by employee type. The publicly available HRS data include estimates of Social Security wealth at key ages and an indicator of receipt, but these Social Security benefits are not necessarily due to the current job. The Wisconsin Legislative Council (2013) reports fund name, type of employee covered, as well as Social Security coverage among other features of 87 large public pension plans.[9] I match these coverage data by state of residence and employee type.

Table 2 presents summary statistics for the HRS data used in this analysis. The sample size for entry characteristics is 3,248 and 1,460 for characteristics measured in the retirement wave that I eventually observe. Sixty-two percent of the overall sample is female, and 28% enter employed as teachers. Twelve percent report being in fair or poor health and 9% have spouses that are already retired. At retirement, 19% are eligible for early retirement benefits, and 40% are eligible for normal retirement. Nine percent of the sample report being offered an early-out package over and above their plan's early retirement provisions.

Table 3 compares measures of economic well-being at the first year of retirement for retirees with and without Social Security. Those without Social Security have

[9] The HRS restricted pension data do not identify whether the respondent is covered by Social Security unless the pension benefit must be coordinated with Social Security benefits. The HRS restricted data agreements do not allow use of both the restricted geographic codes and restricted Social Security earnings records.

significantly higher housing and nonhousing wealth, as well as deferred pension wealth, reflecting the greater generosity of these plans. Of course, they do not have Social Security wealth. Only 306 of the 1,460 who retire across the HRS waves have defined contribution plans along with their DB plans. The average amount in the funds is about $30,000 in 2012 dollars, although those without Social Security have about $2,000 more.

The next step is to link the individual data to state-level financial information. The HRS has no information on plan finances and will not release pension plan names. Using geographic codes, I link these HRS respondents to financial information of their states as described in the next section.

3. Characterizing state public pension liability

The Public Plans Data (PPD) contains detailed fiscal year data on the largest state/local public pensions for 2001 to 2019, covering 95% of state/local pension assets and members.[10] Currently it includes 200 plans, 118 administered by states and 82 local plans. The plan-level data come from Comprehensive Financial Annual Reports (CAFRs) and include income statements (contributions, expenditures, earnings), investment returns, actuarial costs, and membership characteristics. The data are reported under the Government Accounting Standards Board (GASB) concepts that rely on actuarial cost methods to apportion the total cost of funding an employee's benefits in retirement to each year of their work life. Policymakers use CAFR figures to set

[10] Public Plans Data Website. 2001 to 2020. Center for Retirement Research at Boston College, Center for State and Local Government Excellence, and National Association of State Retirement Administrators. Available at: http://publicplansdata.org/.

contribution decisions, and these figures can be reflected in state and local bond rates.[11] At the time of this writing, 2018 was the most recent year with complete data so I present some summary statistics from that year. Table 4 describes the composition of the PPD by employee and Social Security coverage. Of the 189 plans, employees in 139 plans are also covered by Social Security, and employees in 50 plans are not. Figure 2 displays the across-state distribution of the number of public plans in the PPD by Social Security coverage. Plan participants have Social Security coverage in most states, but none are covered in Alaska, Massachusetts, Ohio, and Nevada. California, Illinois, and Georgia have a more even split between the number of plans with employees who are covered and those who are not.[12]

While reporting the number of plan participants and beneficiaries in CAFRs is straightforward, actuarial methods that determine reported funding status and annual required contributions use assumptions. One assumption that has drawn academic attention is the rate used to discount future liabilities. Financial economists contend that the funded ratios reported by plan sponsors overstate plan health because the rates used to discount future liabilities are artificially high (Novy-Marx and Rauh 2009). Whereas public plans currently discount liabilities by the assumed return on assets in their trust fund (around 8% historically, but between 6% and 7% currently), financial economists recommend that liabilities be discounted using a rate that reflects the risk that sponsors default on the pension debt. Since pensions benefits are guaranteed by

[11] See PEW Charitable Trusts (2018) for use in retirement system analysis.

[12] The few plans in Ohio with Social Security coverage are not in the PPD.

state constitutions, they further argue that the discount rate should be the risk-free rate on long-term Treasury bonds.

Recent changes to GASB rules moved toward both standardizing funding assumptions across plans and moving the assumed discount rates closer to an economic measure of risk (GASB 67 and 68).[13,14] Some argue that despite revisions the GASB Annual Required Contribution calculation understates what is needed to fully fund plan liability due to optimistic investment return assumptions and relatively lax methods for amortizing the unfunded liability (Aubry et al. 2020).

The present value of pension underfunding may be understated, but even this understated measure indicates some benefit risk. Monahan (2017) argues that, although state and local retirees have a legal right to disbursements from the trust fund, neither state nor federal court would grant them the right to general appropriations once the trust fund is depleted. Benefit payments then become dependent on state

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[13] GASB 67 allows a blended discount rate to discount liabilities. The blended rate is the result of a cash flow projection to determine if the plan will deplete its assets before all benefits are paid. If the projection shows that the plan will not exhaust its assets before all benefits are paid, the plan continues to use the assumed return as the discount rate for liabilities. If the projection results in an asset depletion date, all benefit payments projected to occur before that date are discounted using the assumed return, and all payments projected to occur after that date are discounted using an investment-grade municipal bond rate. GASB 68 requires that market values of assets be reported, reducing use of smoothing techniques of investment gains and losses.

[14] Weinberg and Norcross (2017) evaluate the rule change for 144 plans and show CAFR figures exhibit little difference when measuring liabilities under the previous GASB 25 rule — a $2.12 trillion aggregate shortfall for the 144 plans they consider — compared to $2.23 trillion calculated with the GASB 67 blended rate. Only 13 of 144 plans used the blended rate, with New Jersey's plans the most affected. These reported liabilities both fall far short of the figure Weinberg and Norcross calculate using the economist-preferred risk-free rate on 15-year Treasury bonds of 2.59% — $4.31 trillion.

legislators. Quinby et al. (2018) use the PPD to assess the likelihood of trust fund exhaustion in the near term. They report that in the years proceeding trust fund exhaustion, several state and local governments have been able to renege on pension promises by arguing in court that pension costs are crowding out vital public services such as police protection and sanitation. They argue that the likelihood of trust fund exhaustion is an important metric of benefit risk.

I summarize membership and funding adequacy across plans and by Social Security coverage for 2018 in Table 5. While the Social Security-covered and uncovered plans look similar in terms of average number of active participants (about 77,000) and beneficiaries (between about 52,000 and 59,000), plans whose employees are without Social Security coverage are less well funded: Their funding ratio is 0.698 compared to 0.725, with $11.1 billion in unfunded actuarial accrued liabilities (UAAL) compared to $7.5 billion for plans whose participants also contribute to Social Security. As the previous HRS summary indicates, these plans are likely more generous than those whose participants also have Social Security coverage. I also calculate the average ratio of assets to benefits as a rough measure of trust fund health: This ratio illustrates the number of years the fund can pay benefits out of existing assets. An assets/benefits ratio of nine, for example, means the plan has on hand assets equal to roughly nine years of benefits. For all public plans in the PPD, this ratio is about 14 years.

Teachers are an important subset of public employee without Social Security coverage, and I break out their PPD plan statistics in Table 6. Here the differences are more striking. Plans without Social Security coverage are, on average, larger in terms of

participants and beneficiaries, and have an outstanding UAAL more than double that of plans whose teachers are also covered by Social Security – $23.7 billion compared to $10.4 billion.

To characterize the total outstanding public pension liability (UAAL) in each state, I aggregate across plans within a state, creating one state-level plan (including locally administered plans as well).[15] Table 7 displays characteristics for the 50 "state plans" in 2017, the most recent year for which I have HRS data, and Figure 3 displays state UAAL per capita. Viewed in this way, states are responsible, on average, for about 266,000 active participants, 194,000 beneficiaries, and overall about $30 billion in UAAL. Recall, this is likely an underestimate of the present value of the liability. Even evaluated at higher discount rates than preferred by economists, the total amount – 50 states times $30 billion is $1.5 trillion, more than federal discretionary spending in 2017 (6.3% of GDP). Scaled by state population — a potential "head tax" — this liability amounts to $4,400 per capita on average. There are dramatic differences across states in UAAL per resident. Connecticut, Colorado, Alaska, and Kentucky have a head tax of around $10,000, while for Illinois and Massachusetts the value is closer to $15,000. Wisconsin's and South Dakota's values are negative.

In the middle panel of Table 7, I report the liabilities by Social Security coverage. The 45 state-level plans with participants in Social Security face a median UAAL of $9.67 billion, while the 20 state-level plans for uncovered participants have a median UAAL of $10.31 billion. On a per capita basis, however, the median UAAL is $2,610 for the uncovered plans, while it is $3,242 in the 45 state plans that include Social Security

[15] Note that this aggregation could also be done by participant type.

coverage, suggesting that states with uncovered public employees are, on average, more populated. Finally, this state aggregation illustrates that plans whose participants also have Social Security coverage have a higher median assets-to-benefits ratio – 14.37, compared to 9.13 for plans with participants without coverage. In the next section, I combine these state-level measures of pension liability with a measure of state fiscal capacity to measure effective underfunding.

A. Measuring state fiscal capacity

Underfunded public pensions may increase a government's borrowing costs, and the presence of long-term underfunding means current residents are not paying the full costs of the public services they enjoy. If the state or local government has the resources to fund the pension but chooses not to raise the revenue, that is a different degree of service sustainability than in a state that maintains a certain level of public services but has limited taxable resources. My goal is to compare each state's pension liability to its ability to finance it from its own sources. In a pension funding crisis, or in forming fiscal policy toward governments with severely underfunded plans, the degree of underfunding *relative* to the ability to raise revenue matters. In this section, I construct a summary statistic measure that reflects both the amount of underfunding and state fiscal capacity.

Fiscal capacity is defined as a state's potential ability to raise revenue from its own sources. There are two categories of measures of fiscal capacity – (1) indices of relative economic resources or income in a state and (2) indices of relative revenues

that can be raised under standard fiscal policy (Gordon et al. 2016).[16] Ideally, we would include all types of taxable resources and not just those a state currently taxes. I use a measure of revenue capacity used in federal grant decisions, Total Taxable Resources (TTR) published by the U.S. Department of Treasury, to reflect the size of a state's taxable pie. [17] TTR combines Gross State Product and personal income to produce a measure of the total value of goods, services, and income the state could tax.

TTR is an example of the first category — all income flows are given equal weight with no attempt made to distinguish taxability or fiscal choices made by states. Another example is state per capita income that appears in the Federal Medical Assistance Percentage (FMAP) to determine the federal matching rate for Medicaid. Other common measures are state personal income (SPI, which combines all income flows received by residents of state, and gross state product (GSP), which accounts for all income flows produced within a state.

TTR is designed to overcome the lack of completeness associated with SPI and GSP by accounting for cross-border income flows. Note that, as a flow concept, it does not include wealth — property or real estate — and, therefore, is not quite "total" taxable resources, but it is the most comprehensive measure available. Economists prefer TTR

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[16] Relative revenue indices attempt to measure the taxability of various income flows, analyzing the composition of resources as well as the level. A state's fiscal capacity is measured by its potential tax revenues relative to the potential of other states. These indices apply different tax rates to various bases to estimate a state's potential tax revenues. The first such measure — the Representative Tax System, introduced by the Advisory Commission on Intergovernmental Relations in 1962 — was updated periodically until the commission terminated in 1996. For any revenue source, the Representative Tax System applies the average U.S. tax rate for that base to each state's tax base and measures what a state could hypothetically could collect from that source given its tax base **before** taking into account policy choices.

[17] https://home.treasury.gov/policy-issues/economic-policy/total-taxable-resources.

as a measure of fiscal capacity, but it is less used to allocate federal resources then per capita income (GAO 2013). The GAO (2013) finds that the nationwide TTR measure of income was 42% larger on a per capita basis than per capita income in 2010. The GAO and Department of Transportation use TTR as a base to measure states' efforts in the provision of public goods, and the GAO (2013) has recommended that TTR be incorporated into a new Medicaid formula to measure states' fiscal capacity. At present, TTR is used to allocate federal funds for Community Mental Health Services and Substance Abuse Prevention and Treatment block grants, amounting to $2.4 billion in FY 2017.

There is a great deal of inequality in the resources available across states. [18] Figure 4 displays TTR per capita across states in 2017. The states with the lowest level of TTR per capita — around $50,000 — include Mississippi, West Virginia, Alabama, Idaho, and New Mexico. States with some of the highest UAAL per capita also have the highest taxable resources: New Jersey, Delaware, Massachusetts, New York, and Connecticut have more than $80,000 in TTR per capita.

To create a summary measure that reflects pension plan sustainability — that is, it reflects both the state-level public pension plan liability and its ability to fund the liability— I calculate the "effective state tax rate" that, applied to a state's TTR, equals the state UAAL. I use the termination liability of state pension obligations here — that is,

[18]See Gordon et al. (2016) for a detailed comparison of capacity across states relative to needs. They find low revenue capacity and high expenditure need often exist in same state. As a result, some states cannot replicate national average spending levels — given their underlying populations and economies — even if they collect taxes and fees in line with the country as a whole.

the rate that applied to TTR would pay off the UAAL. Note that instead, one could use the annual required contribution (ARC) to see what state tax rate applied to its TTR would cover the ARC. Alternatively, the liability could be split into “legacy debt” that arose before the pension fund was substantially prefunded, and the effective tax rate calculated for “current accrued service” to reduce the intergenerational transfer of public service costs. This calculation may be useful for policymakers when determining whether a state can pay for public sector services from its own resources.

Figure 5 illustrates the calculated rate across states for 2017. These figures reflect both the size of the UAAL and the states’ TTR. For about half of the states, this effective rate is at least 5%, but for Connecticut, Mississippi, Hawaii, Alaska, Colorado, and New Mexico, the rate exceeds 10%. For New Jersey, Illinois, and Kentucky, this rate is closer to 20%. The variation in the rate reflects both plans’ funded status under the current GASB rules and the one-time burden fully funding the liability would place on residents. Figure 6 illustrates the distribution of this tax rate for the public pension funds whose participants are covered by Social Security, and Figure 7 for uncovered participants. States change position in the ranking based on the degree of underfunding in the two types of plans.

To summarize, the goal of this paper is to estimate retirement sensitivity to pension features, Social Security coverage, and measures effective funding risk. In the next section, I discuss estimates of a proportional hazard model at the public employee level, incorporating these measures of public plan sustainability.

4. Methods and results

The model underlying this analysis is a proportional hazard model with time-varying covariates that reflect state pension policy — eligibility for early or normal retirement, whether the public sector job is covered by Social Security, whether it includes employer-provided health insurance in retirement, as well as rich demographic characteristics. I have chosen a straightforward estimation approach that avoids strong assumptions about functional forms of utility.

Recall, the HRS sample consists of state and local public employees employed in the public sector at their baseline interview. As in Papke (2019), I model their retirement in a duration framework. The model underlying the analysis is a proportional hazard model with time-varying covariates that can be written as

$$h(t; \boldsymbol{Z}_{it}) = base(t)\exp(\boldsymbol{Z}_{it}\boldsymbol{\beta})$$

where the $\boldsymbol{Z}_{it}$ includes covariates that may change over time. As shown in Jenkins (1995), the proportional hazards model leads to a binary response model for retirement at age *t* conditional on not having retired prior to age *t*. The resulting response probability has the complementary log-log form, which is different from both logit and probit in that it is the cumulative distribution function of an asymmetric distribution. The implied model relates the probability of retirement from a public sector job, conditional on not having retired prior to that age, to pension options available for that individual, adjusting for covariates that factor into the retirement decision such as health status, Social Security participation, and employer-provided health insurance in retirement.

To be more specific, the conditional probability that public employee *i* retires at age *t* is

$$\Pr(retire_{it} = 1 | \cdot)$$

$$= F(\beta_0 + \beta_1 eligible_{it} + \beta_2 SScov * agecat_{it} + \beta_3 SScov * agecat_{it} eligible_{it}$$

$$+ \beta_4 DC@entry_{it} + \beta_5 RetireeHI_{it} + \beta_6 earlyoutoffer_{it} + \beta_7 statefunding_{it}$$

$$+ \boldsymbol{X}_{it}\boldsymbol{\beta_7} + \beta_8 wave_t + \boldsymbol{age_{it}}\boldsymbol{\beta_9})$$

where *retire* is a binary indicator for whether individual *i* retires at age *t*. Because retirement is taken as the final state in the analysis, it takes on zero followed by one if a person is observed to retire. The function $F(u)$ for argument *u* is the complementary log-log cumulative distribution function:

$$F(u) = 1 - \exp(-\exp(u))$$

which is used in a pooled binary response estimation.

The vector $\boldsymbol{age_{it}}$ represents a vector of age dummies, whose coefficients can be turned into estimates of the baseline hazard. Employee retirement options are captured by *eligible*, that is, the employee may be eligible for early retirement or normal retirement. [19] The HRS PEP includes defined contribution balances for the small set of employees who have them in addition to their defined benefit plan. I include in indicator for whether they have balances at entry into the survey to control for individual saving propensity. Demographic variables are included in ***X***. *SSCov* is the indicator for participation in Social Security. I adjust the standard errors by clustering at the household level.

Many of the dollar amounts (measured in 2012 dollars) in the data are zero (before pension benefits are vested, for example) and there are extreme values for total

[19] I set the early retirement dummy variable to zero once normal-age retirement eligibility is reached.

assets and pension wealth. I use the log-modulus transformation (John and Draper 1980) to dampen extreme values without having to use a special convention for zero values.[20] For values of pension wealth away from zero, the log modulus transformation is very similar to taking the log. Therefore, when interpreting the results, it makes sense to change the log modulus by something like 0.10 (a 10% increase in UAAL). In the latter case, this is the same as dividing the coefficient by 10. But because the model is nonlinear, I will report the average partial effects of changing each variable, but these, too, must be multiplied by the desired change on the log modulus.

The baseline hazard, estimated with only age dummies (ages 51 to 72 and older) using 13,455 observations, is pictured in Figure 1. The underlying structure of public pension plans — early and normal retirement eligibility ages — plays a critical role in determining retirement decisions. There is a small peak at age 55; that is, conditional on working to 55, the probability of retiring at this age is about 0.08. The largest spike occurs around ages 60 and 62: The probability of exiting during this interval conditional on not having exited is 0.25. Next, I discuss how public pension plan features and Social Security coverage shifts this hazard.

To parse the influence of the various pension features and Social Security coverage on retirement probability, Table 8 first presents the maximum likelihood estimation results of the complementary log-log response probability using only HRS participant data. I report only the marginal effects of interest, but also have included age

[20] The transformation is $g(x) = \text{sign}(x)\log(|x| + 1)$ where $\text{sign}(x) = 1$, $x > 0$, $\text{sign}(x) = -1$, $x < 0$, and $\text{sign}(x) = 0$, $x = 0$. The function is strictly increasing and continuously differentiable, even at $x = 0$.

and wave dummies, a female dummy, race, education, marital status, fair or poor health self-reported status, whether a spouse is retired, broad occupation dummies, as well as the teacher indicator, tenure, and defined contribution balances at survey entry in the current job, and earnings and assets transformed as discussed earlier. These are estimated on a sample that includes missing data indicators.

The marginal effects of the dummy variables are interpreted as changes in the probability of retiring from one's public sector job. Multiplying the coefficient by 100 gives the percentage point increase in the probability. The results are consistent across all specifications so I discuss the estimates from the most complete model in column 6. Two personal characteristics — having a spouse who is already retired and being in fair or poor health — increase the probability of retirement by 0.029 and 0.060 respectively. The estimates are highly statistically significant. Employer-provided retiree health insurance particularly encourages retirement for the two age categories highlighted, and these estimates are precisely measured. Similar to the effects found by Shoven and Slavov (2014), retiree health insurance increases the probability of retiring by 0.04 for those ages 55 to 59 and by 0.05 for those 60 to 64, holding pension eligibility and Social Security coverage fixed.

Social Security coverage is not estimated to affect retirement for the youngest (omitted) age group, 50 to 54. But someone in the 60 to 64 age group who also has Social Security coverage has an increased probability of retirement of 0.053 even without eligibility for retirement, and this effect is statistically significant at conventional levels. But my primary interest here is in how being eligible for Social Security affects retirement once one becomes eligible for public pension retirement.

I estimate that becoming eligible for early retirement or normal retirement between the ages of 50 and 54 increases the probability of retirement by about 0.05 and 0.06. Participants at the key preretirement age categories who are also covered by Social Security are much more likely to retire than those without Social Security in the same age group, however. For example, participants ages 55 to 59 eligible for early retirement and covered by Social Security are an additional 3.3 percentage points more likely to retire than those in that age group without Social Security. The difference is 7.6 percentage points for those ages 60 to 64. Those similarly situated for normal retirement with Social Security are 6.2 and 4.9 percentage points more likely to retire than those uncovered. Social Security coverage substantially increases the probability of retirement at every age category — at some age groups roughly doubling the probability. These estimates are economically meaningful and highly statistically significant.

The HRS PEP is programed with the typical structure of the public sector pension plans but not with special one-time offers to encourage retirement. The HRS publicly available data includes questions about this potentially important labor management tool, and I include a general indicator for being offered an early-out package, as well as this indicator interacted with Social Security and the two preretirement age groups of interest. Social Security coverage substantially increases the retirement probabilities by 9.6 percentage points for both participants ages 55 to 59 and 60 to 64 who receive an early-out offer.

Next I add measures of the states' financial ability from own sources to address the total costs of public services, absent federal revenue sharing. This is a smaller

sample, so for continuity, I reproduce select Table 8 results in Table 9 before adding these state-level variables.[21] Despite some loss in precision due to the smaller sample size, the same basic story emerges from columns (1) to (3): Social Security coverage makes it more likely public sector workers retire for most age categories. The increase in probability ranges from about 5 to 11 percentage points. These economically large effects are precisely measured. And, in the absence of pension eligibility, Social Security coverage is estimated to increase the probability of retiring by about 5 percentage points only for those ages 60 to 64.

In columns (4) to (6) I test whether individual retirement probabilities are sensitive to the funding sustainability of the state's public plans. Public sector employees have an incentive to be aware of state funding status since their benefits may depend ultimately on fund solvency. I include three measures of effective pension funding risk: the (log of the) state UAAL per capita, the state effective tax rate I calculate from the state's UAAL and TTR, and the (log of) the ratio of state pension assets to current benefits. All three columns tell a similar story: Public plan participants are less likely to retire if their plan funded status is at risk. The effect is precisely measured for two of the three measures, but is economically small compared to the effects of Social Security and pension eligibility. The estimates in column (4) suggests that the probability of retirement falls by 0.001, or 0.1 percentage points, if the state effective tax rate increases by one percentage point (from 10 to 11%, for example). This is not precisely measured. Column (5) includes the state's UAAL per capita — a number one might expect public

[21] PPD data are only available for the latter half (Waves 6-12) of the HRS, so adding the state-level data reduces the sample size.

employees to be aware of — and the estimate suggests that the probability of retirement falls by 0.02 percentage points when the unfunded liability rises by 10%. The estimate, while smaller than other effects, is statistically significant. Finally, column (6) estimate includes the (log of the) ratio of state assets to state benefits. A 10% increase in the ratio of pension assets/benefits is estimated to increase retirement probabilities by 0.05 percentage points. It is precisely measured at conventional levels, but again, economically small compared to the effect of Social Security coverage and plan features.

5. Discussion and conclusion

In this work I have taken an eagle's eye view of public pension liabilities by aggregating across DB plans within a state and comparing them to a state's fiscal capacity. Some states start with fewer resources so they may be unable to provide a basic set of goods and services society deems important. In the absence of federal revenue sharing, using underfunded DB plans may be a way to currently provide a minimal level of public services. DB plan liability is an important source of public sector borrowing.

Addressing adequacy of service levels is beyond the scope of this work, but the effective tax rate that reflects both liabilities and taxable resources provides a state ranking of potential funding problems. A higher tax rate indicates more problematic sustainability. Figure 5 illustrates that Connecticut, Mississippi, Hawaii, Alaska, Colorado, New Mexico, New Jersey, Illinois, and Kentucky rank at the bottom of my 2017 calculation of fiscal sustainability. That is, they would have to levy a tax rate of at least 10% on all their taxable resources to fully address the unfunded liability for public

sector workers. Kentucky's rate is 23%. Breaking this down by Social Security coverage, Figure 6 illustrates that Minnesota, Kentucky, South Carolina, Mississippi, Hawaii, New Mexico, and New Jersey rank at the bottom in terms of their ability to fully address the unfunded liability for public sector workers who are also covered by Social Security – New Jersey's rate is about 18%. Figure 7 compares the sustainability measure for Kentucky, Illinois, Alaska, and Colorado whose public sector workers do not have Social Security: Their effective tax rates are between 10 and 14%. While a complete assessment of plan risk is beyond the scope of this paper, this comparison of pension liabilities to state fiscal capacity suggests that economists' preference for using a risk-free rate to value the liabilities may be naive. Several states may not have the fiscal capacity or political will to fully fund their plans, implying that the benefits are in fact not risk free, despite constitutional protection.

Evidence presented here suggests that public employee retirement is responsive to measures of plan underfunding – participants are less likely to retire from more underfunded plans. But this effect is less important than plan features, in particular, early and normal retirement rules based on age and years of service. This finding is consistent with the literature on default options in 401(k) plans documented by Choi at al. (2002, 2003). Defaults established in 401(k) plans affect plan participation and individual savings rates, for example, perhaps because employees view them as implicit suggestions. The results in this paper suggest that the same may be true for defined benefit plans in the public sector. It is possible that if becoming eligible for early retirement is perceived as reference point, deviations from that point may be

psychologically uncomfortable.[22] Siebold (2021) finds that the framing of statutory ages as reference points for retirement explains the retirement pattern he sees in German administrative data and that shifting these statutory ages via pension reforms is an effective policy to influence retirement behavior.

These estimates suggest that state and local governments, or school districts, might expect public sector workers without Social Security coverage to be less sensitive to achieving retirement eligibility than same-aged covered workers. Further, these results imply that extending Social Security coverage to uncovered workers is estimated to increase early and normal retirement probabilities by between 4.7 and 10.1 percentage points, potentially further increasing employer retirement costs.

While personal circumstances such as poor health have similarly sized economic effects, governments might encourage retirement by offering retiree health insurance, and offering an early-out package. Or, conversely, they may choose to retain employees longer by eliminating retiree health insurance (which, unlike pension benefits in most state, are not constitutionally protected) or by changing the age/service combination for early and normal retirement focal points as the latter appear to most affect retirement decisions.

Some caveats of this work should be mentioned. I am unable to control for the present value of Social Security wealth that is known to influence retirement along with pensions, although I do control for earnings and coverage. Further, this work focuses on the decision to fully retire from the public sector — that is, the employees do not return to work elsewhere. Only 2.53% of this sample report later full- or part-time employment

[22] See Samuelson and Zeckhauser (1988) for a discussion of status quo bias.

following retirement from their public sector job — too small a sample to examine empirically. But, given the use of final average salary in the defined benefit annuity, part-time work would have to be done under a special arrangement such as a DROP plan, or with another employer. In future work, it may be possible to identify states where DROP plans are used for public employees. It is possible that different factors influence the decision to work part-time and future waves of the HRS may assist in the study of unretirement in the public sector.

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Figure 1: Retirement Age Hazard Function.

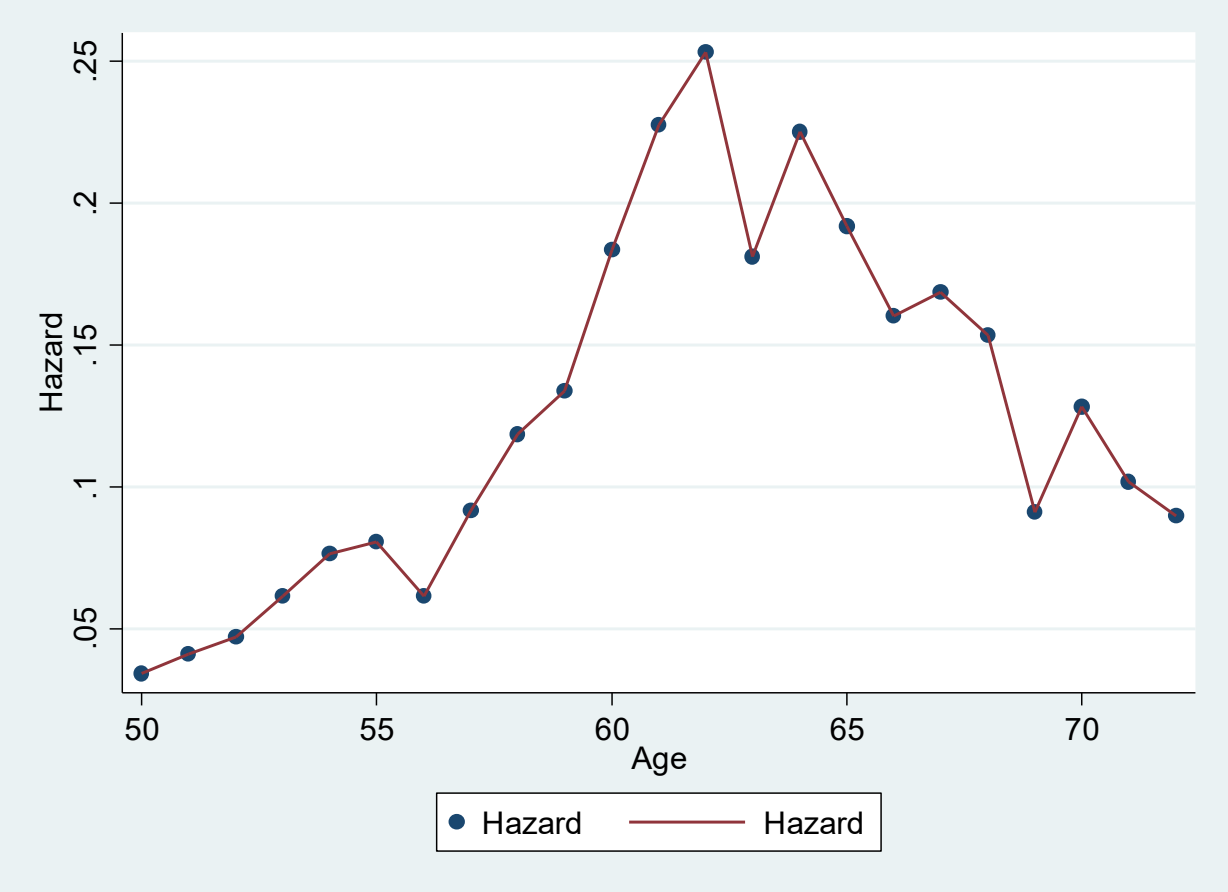
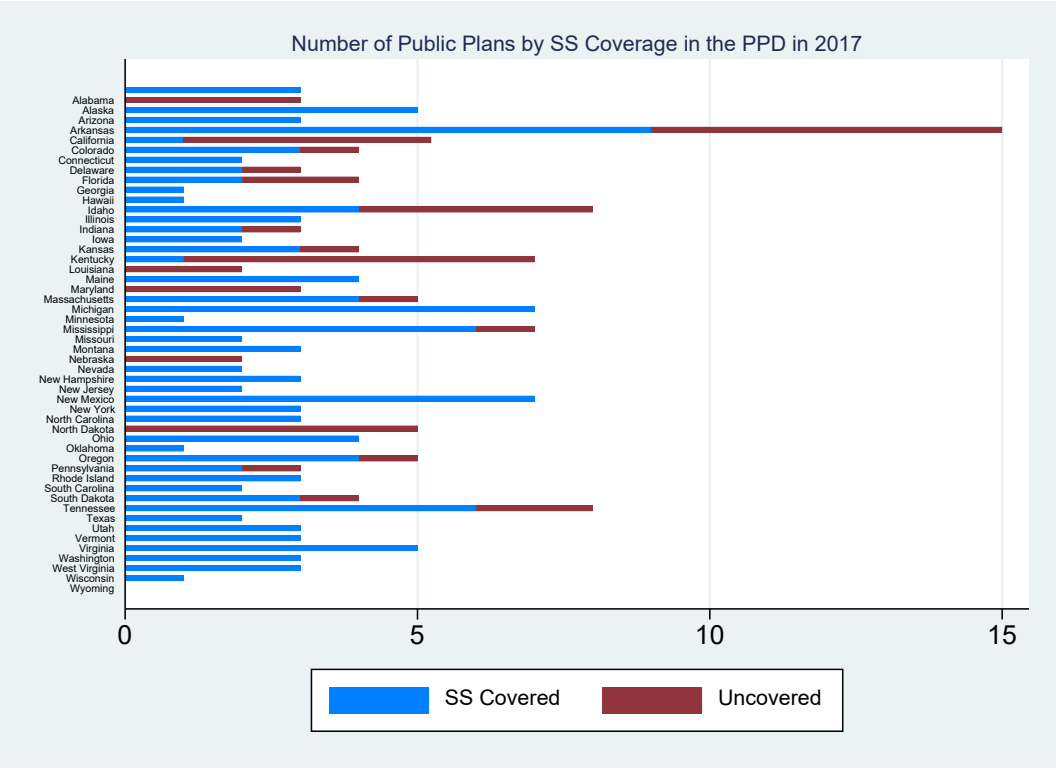
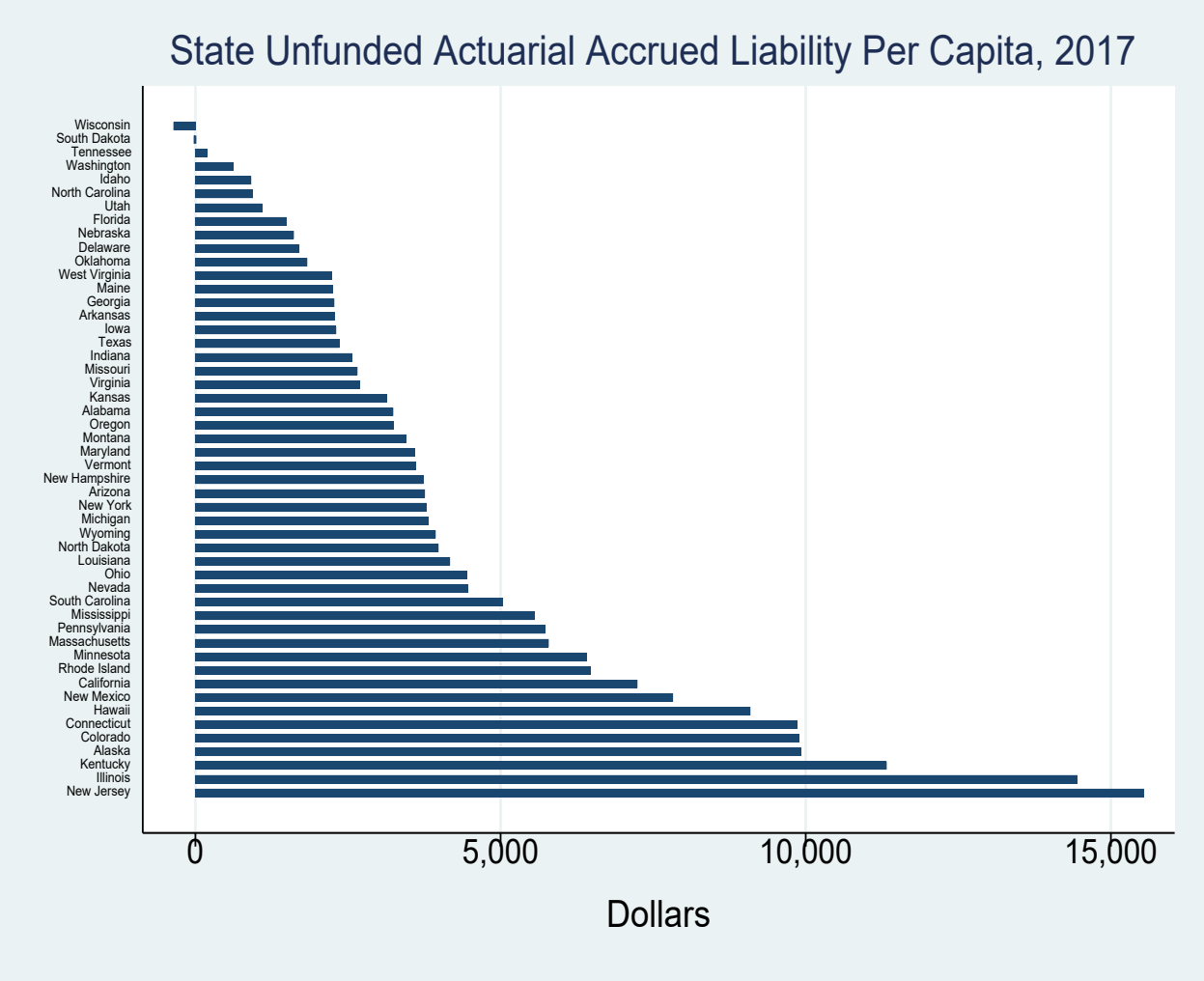


Figure 2



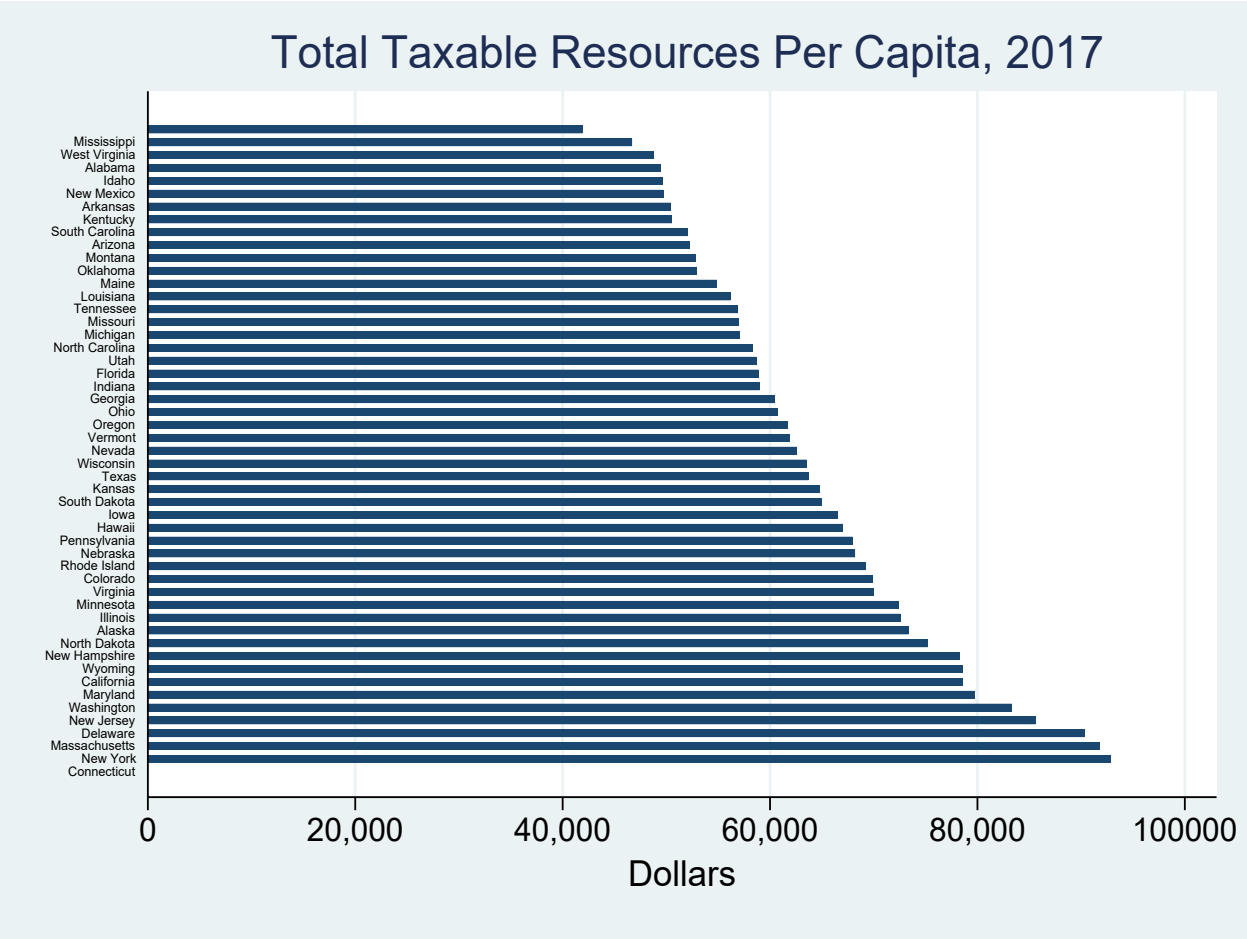
Source: Author's calculation from Public Plans Data. Center for Retirement Research at Boston College, Center for State and Local Government Excellence, and National Association of State Retirement Administrators.

Figure 3



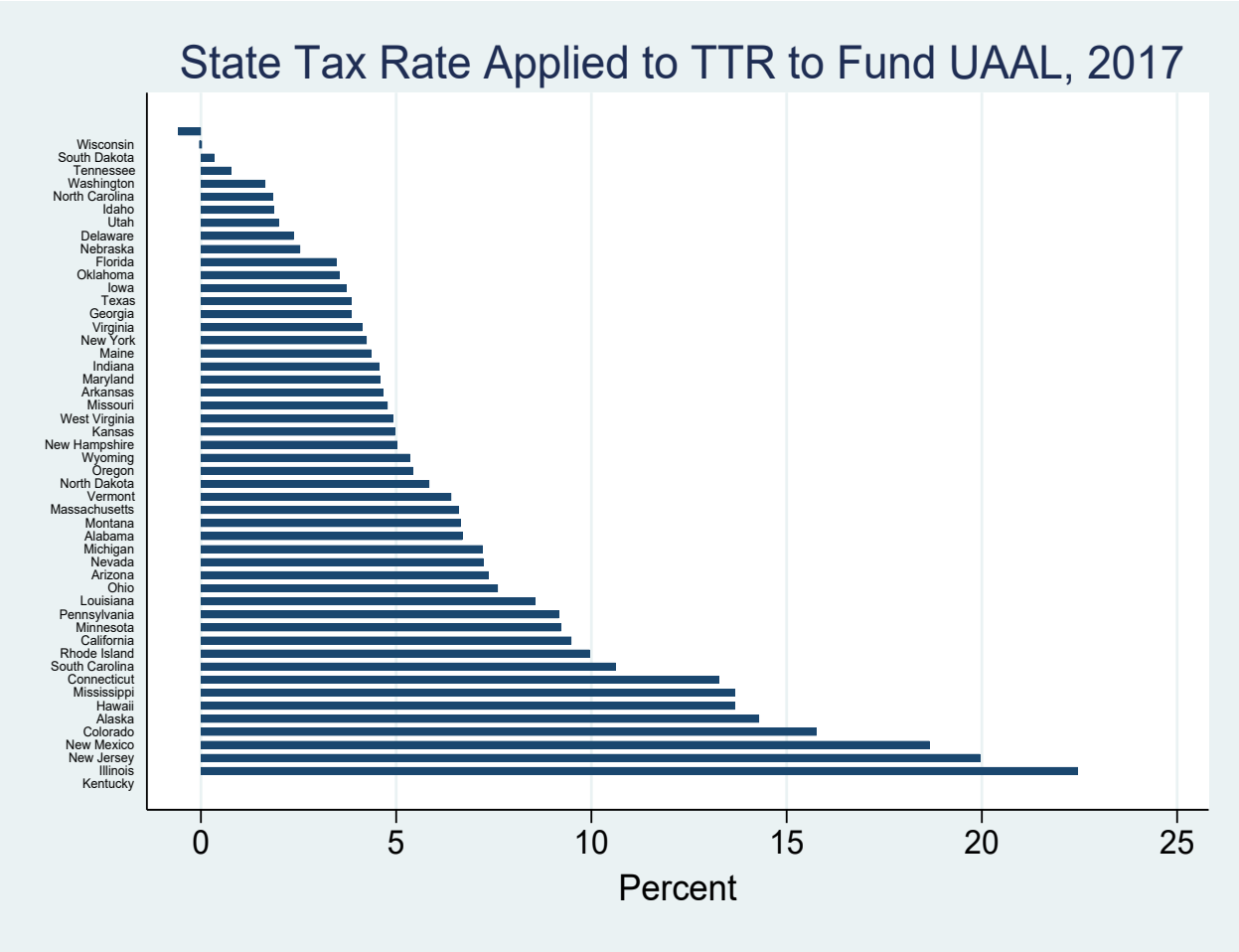
Source: Author's calculation from Public Plans Data, Center for Retirement Research at Boston College, Center for State and Local Government Excellence, and National Association of State Retirement Administrators. State unfunded actuarial accrued liability is summed across all of a state's public pension plans.

Figure 4.



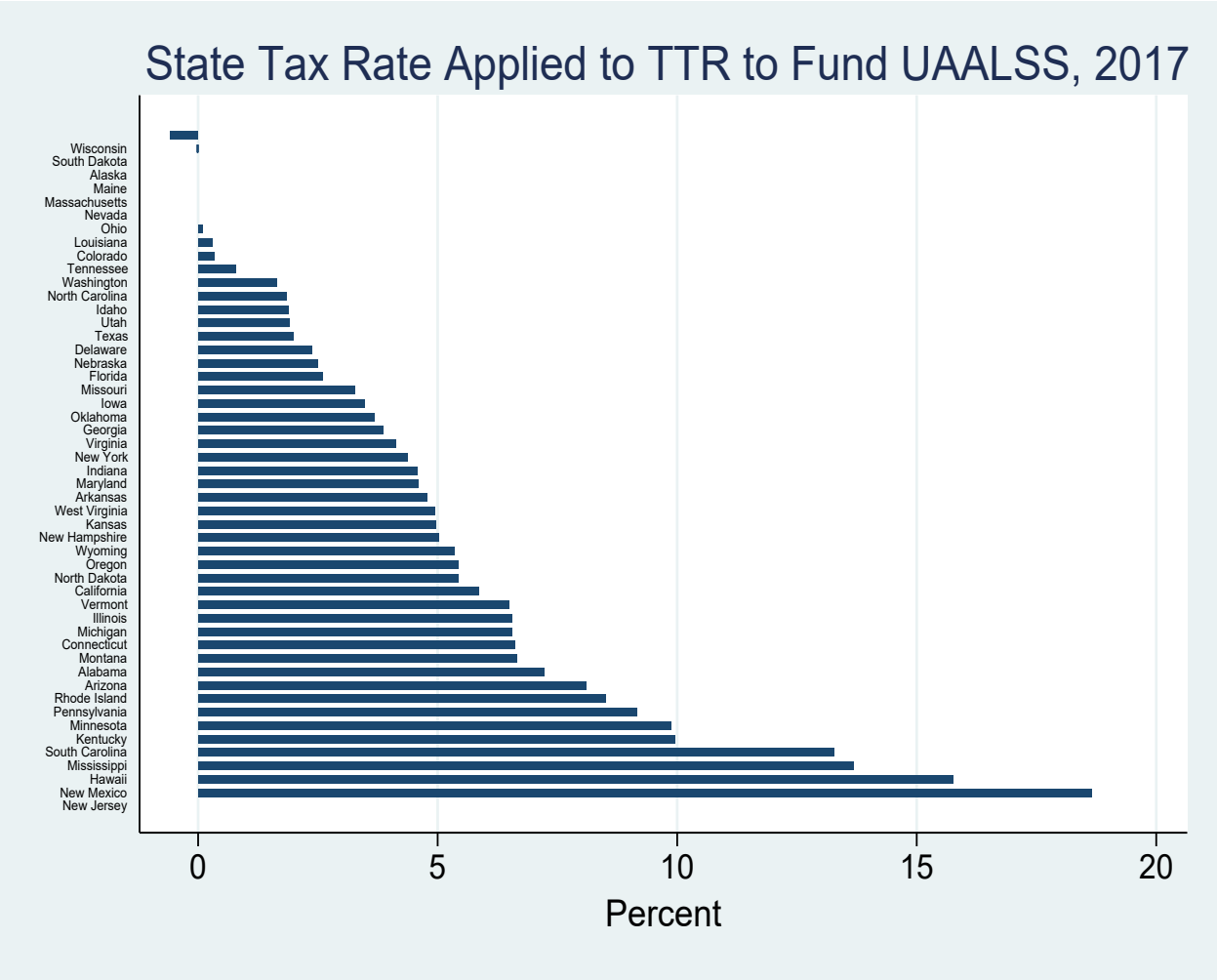
Source: https://home.treasury.gov/policy-issues/economic-policy/total-taxable-resources.

Figure 5.



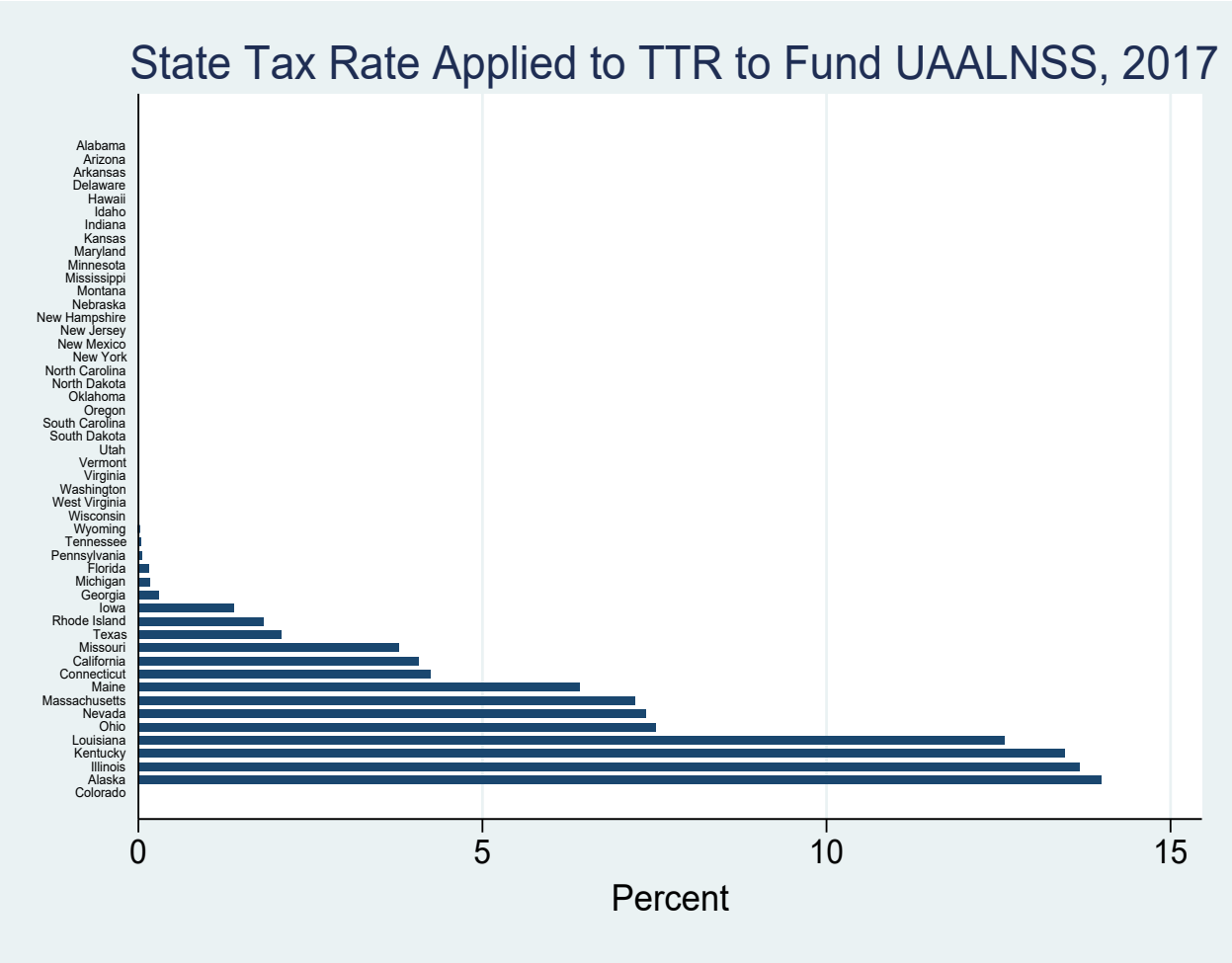
Source: Author's calculation using the Public Plans Data and Total Taxable Resources. UAAL is total unfunded actuarial accrued liability across all of a state's public pension plans.

Figure 6.



Source: Author's calculation using the Public Plans Data and Total Taxable Resources. UAALSS is total unfunded actuarial accrued liability across all of a state's public pension plans whose participants also participate in Social Security.

Figure 7.



Source: Author's calculation using the Public Plans Data and Total Taxable Resources. UAAL is total unfunded actuarial accrued liability across all of a state's public pension plans whose participants are not covered by Social Security.

Table 1: Early and Normal Retirement Eligibility Ages for Public Employees in the HRS, Frequency and Percent of Sample of Public Employees at Entry

Age	Early Retirement Eligibility Frequency	Early Retirement Eligibility Percent	Normal Retirement Eligibility Frequency	Normal Retirement Eligibility Percent
51	38	2.94	23	1.65
52	50	3.86	27	1.94
53	48	3.71	34	2.44
54	35	2.70	36	2.59
55	216	16.69	104	7.47
56	227	17.54	89	6.39
57	108	8.35	55	3.95
58	77	5.95	61	4.38
59	75	5.80	46	3.30
60	97	7.50	219	15.73
61	99	7.65	196	14.08
62	55	4.25	121	8.69
63	38	2.94	92	6.61
64	24	1.85	31	2.23
65	27	2.09	116	8.33
66	15	1.16	77	5.53
67	16	1.24	27	1.94
68	12	0.93	12	0.86
Obs.	1,294		1,392	

Source: Author's calculations using the HRS Pension Estimate Program (Fang et al. 2016).

Note: These are empirical eligibility ages based on an individual's age/service history.

Table 8. Impact of Pension Features and Social Security Coverage on the Probability of Retiring from the Public Sector

	(1)	(2)	(3)	(4)	(5)	(6)
Spouse retired	0.029*** (0.010)	0.027*** (0.009)	0.028*** (0.009)	0.028*** (0.009)	0.029*** (0.009)	0.029*** (0.009)
Poor health	0.059*** (0.010)	0.060*** (0.010)	0.060*** (0.010)	0.062*** (0.010)	0.061*** (0.010)	0.060*** (0.010)
Ret. Health Ins.		0.024* (0.010)	0.025** (0.009)	0.020* (0.009)	021* (0.009)	022* (0.009)
Ret. HI 55-59		0.045*** (0.010)	0.044*** (0.009)	0.059** (0.021)	0.039** (0.009)	0.039*** (0.009)
Ret. HI 60-64		0.059*** (0.015)	0.057*** (0.015)	0.042** (0.020)	0.050*** (0.015)	0.049*** (0.045)
SS Coverage			-0.001 (0.009)	-0.001 (0.009)	-0.0005 (0.009)	-0.0005 (0.009)
SS Coverage 55-59			-0.013 (0.015)	.002 (0.002)	-0.011 (0.015)	-0.012 (0.015)
SS Coverage 60-64			0.049* (0.021)	0.038* (0.022)	.052* (0.021)	.053* (0.021)
SS Coverage 65+			.009 (0.017)	.002 (0.002)	.011 (0.016)	.011 (0.016)
Elig ER				0.048*** (0.010)	0.048*** (0.011)	0.048*** (0.011)
Elig NR				0.057*** (0.008)	0.062*** (0.009)	0.062*** (0.009)
SS*Elig ER 55-59					0.034** (0.013)	0.033** (0.013)
SS*Elig ER 60-64					0.078** (0.026)	0.076** (0.026)
SS*Elig ER 65+					0.068* (0.031)	.056 (0.031)
SS*Elig NR 55-59					0.063*** (0.017)	0.062*** (0.017)
SS*Elig NR 60-64					0.052** (0.019)	0.049* (0.019)
SS*Elig NR 65+					0.064*** (0.012)	0.061*** (0.012)
Offered EO						0.058*** (0.016)
SS*Offered EO 55-59						.016 (0.021)
SS*Offered EO 60-64						0.096** (0.036)

SS*Offered EO 65+						0.096** (0.032)
Obs.	12,285	12,285	12,285	12,257		12,257

Source: Author's calculations from the HRS Waves 1 to 12.

Notes: Marginal effects are reported above standard errors clustered at the household level. Marginal effects for wealth variables are reported at eligibility. Personal/job characteristic controls include age and wave dummies, a female dummy, race and ethnicity, marital status, fair/poor health indicator, occupation dummies, education dummies, tenure and defined contribution balances at entry, and total assets. Total assets and pension wealth variables are transformed via the logmodulus transformation in estimation. SS = Social Security, ER = early retirement, NR = normal retirement, EO = offered early-out. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table 9. Impact of Pension Features and Social Security Coverage on the Probability of Retiring from the Public Sector

	(1)	(2)	(3)	(4)	(5)	(6)
Log(State UAAL pc)					-0.002** (0.001)	
State UAAL Tax rate				-0.001 (0.001)		
Log(State assets/benefits)						0.005* (0.002)
Spouse retired	.012 (0.010)	.010 (0.010)	.011 (0.010)	.011 (0.010)	.002 (0.010)	.012 (0.010)
Poor health	0.049*** (0.012)	0.053*** (0.012)	0.051*** (0.012)	0.051*** (0.012)	0.051*** (0.012)	0.051*** (0.012)
Ret. HI 55-59	0.033* (0.012)	0.029* (0.012)	0.026* (0.012)	0.026* (0.012)	0.026* (0.012)	0.027* (0.012)
Ret. HI 60-64	0.042* (0.017)	0.034* (0.017)	0.037* (0.017)	0.036* (0.017)	0.036* (0.017)	0.037* (0.017)
SS Coverage	0.0006 (0.010)	.001 (0.010)	0.0007 (0.010)	-0.003 (0.011)	-0.005 (0.011)	-0.006 (0.011)
SS Coverage 55-59	-0.022 (0.019)	-0.020 (0.019)	-0.019 (0.019)	-0.023 (0.020)	-0.025 (0.020)	0.028 (0.020)
SS Coverage 60-64	0.048* (0.023)	0.049* (0.023)	0.047* (0.024)	.042 (0.025)	.038 (0.025)	.040 (0.025)
SS Coverage 65+	.005 (0.018)	.008 (0.017)	.007 (0.018)	.003 (0.018)	.002 (0.018)	.002 (0.018)
Elig ER		0.066*** (0.014)	0.061*** (0.016)	0.061*** (0.016)	0.062*** (0.016)	0.062*** (0.016)
Elig NR		0.054*** (0.010)	0.058*** (0.010)	0.058*** (0.010)	0.058*** (0.010)	0.058*** (0.010)
SS*Elig ER 55-59			0.046** (0.018)	0.046** (0.018)	0.049** (0.019)	0.047** (0.018)
SS*Elig ER 60-64			0.109** (0.035)	0.107** (0.034)	0.107** (0.034)	0.108** (0.034)
SS*Elig ER 65+			.070 (0.039)	.069 (0.039)	.070 (0.039)	.068 (0.038)
SS*Elig NR 55-59			0.053* (0.021)	0.052* (0.021)	0.053** (0.021)	0.052* (0.020)
SS*Elig NR 60-64			0.0472* (0.023)	.048* (0.023)	0.049* (0.023)	0.048* (0.023)
SS*Elig NR 65+			0.058*** (0.014)	0.059*** (0.014)	0.059*** (0.014)	0.058*** (0.014)
Obs.	7,594	7,594	7,594	7,594	7,594	7,559

Source: Author's calculations from the HRS Waves 6-12.

Notes: Marginal effects are reported above standard errors clustered at the household level. Marginal effects for wealth variables are reported at eligibility. Personal/job characteristic controls include age and wave dummies, a female dummy, race and ethnicity, marital status, fair/poor health indicator, occupation dummies, education dummies, tenure and defined contribution balances at entry, and total assets. Total assets and pension wealth variables are transformed via the logmodulus transformation in estimation. SS = Social Security, ER = early retirement, NR = normal retirement, EO = offered early-out. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.