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Retirement Incentives and Behavior of Private and Public Sector Workers

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August 2019

Abstract:
Over the past several decades, private sector workers in the US with employed-sponsored pensions have experienced a dramatic shift from DB to DC type plans. However, public sector workers have not experienced a similar shift. In this paper we use (primarily) HRS data to explore changes in the retirement incentives and retirement behavior of public and private sector workers over the past quarter-century. We find that trends in retirement behavior are largely similar across the two groups. We also find that both groups have become less likely to report having a DB pension or any pension. Public sector workers have a higher level of retirement wealth and a larger financial gain from continued work at older ages than do private sector workers, and these differences by sector are growing over time. Both worker types are similarly responsive to retirement incentives.

Acknowledgements:
This paper was prepared for the NBER Conference "Incentives and Limitations of Employment Policies on Retirement Transitions: Comparisons of Public and Private Sectors," August 9-10, Jackson, WY.

The trend towards longer work lives has been underway for over two decades in the US. Many factors have likely contributed to this trend, including Social Security reforms and rising education levels (Coile, forthcoming). Changes in employer-sponsored pensions are another potentially critical factor. Pensions have shifted from defined benefit (DB) plans – which often contain strong financial incentives to work until the plan's early or normal retirement age and to retire thereafter – to defined contribution (DC) plans, which lack these age-based incentives. The loss of the financial incentive to retire at specific ages thus may be contributing to increased labor force participation at older ages.

Importantly, this shift in employed-sponsored pensions from DB to DC plans has been far more pronounced for private sector workers than for public sector workers, who comprise one-sixth of the labor force. The share of all private industry workers with DB plans fell from 35 percent in the early 1990s to 18 percent in 2011, while the share of state and local workers with DB plans stood at 78 percent in 2011 (Wiatrowski, 2012). Most federal employees also continue to have a DB plan.

Previous work has established both the prevalence of strong age-based incentives in DB plans and their importance in the retirement decision. While this was first established in studies that focused on private sector workers (Stock and Wise, 1990) or did not distinguish workers by sector (Coile and Gruber, 2007), other studies have similarly found this for public sector workers (Asch et al., 2005) and especially public school teachers (Costrell and Podgursky, 2009; Costrell and McGee, 2010). The literature estimating the impact of the shift from DB to DC pensions on retirement is more limited – Friedberg and Webb (2005) estimate that the lack of age-based incentives in DC plans leads workers to retire two years later on average, while Mermin et al.

(2007) attribute a fifth of the increase in the expected probability of working past age 62 over a 25-year period to the decline in DB coverage.

Thus, it is known that workers are retiring later, that a shift from DB to DC pension plans may be contributing to this trend, and the shift in pension plan type is concentrated among private sector workers. Perhaps surprisingly, however, the existing literature (to our knowledge) has not examined whether retirement trends are similar for public and private sector workers and whether changing retirement incentives by sector are contributing to differences in retirement behavior between these two types of worker.

In this paper, we aim to help fill that gap by exploring changes in the retirement incentives and retirement behavior of public and private sector workers over the past quarter-century. We begin by documenting trends over time in labor force participation at older ages by sector. We then use data from the Health and Retirement Study (HRS), linked to Social Security earning records and pension information from the HRS' Pension Estimation Program, to estimate the financial incentive for continued work at older ages for public and private sector workers and to explore how these incentives have changed over time. Finally, we estimate regression models relating these financial incentives to retirement decisions and use our estimates to project the effect of changing incentives on the retirement behavior of public and private sector workers.

This analysis contributes to our understanding of retirement incentives and retirement behavior by providing a comparison of public and private sector workers. While there is a substantial literature on retirement incentives and retirement, including numerous studies on public sector workers, most studies examine these workers in isolation rather than comparing their experiences to those of private sector workers; an exception is Papke (2019), discussed further below. This paper is also distinguished from the existing literature on public sector

workers (including Papke, 2019) by its ability to incorporate both Social Security and private pensions into the calculation of retirement incentives; many existing studies use state or local administrative records but lack data on Social Security covered earnings. Furthermore, this paper can add to our understanding of the implications of changing pension plan type for labor force participation at older ages by extending the work of Friedberg and Webb (2005), the primary existing reference on this question, to include nearly twenty years of additional data.[1]

We have several key findings. First, and perhaps surprisingly, we find that changes over time in labor force participation at older ages are generally similar for public and private sector workers. Second, our data suggest a shift from DB to DC plans and a rise in the share of workers without a pension (according to self-reported data) for private sector workers, and more unexpectedly, for public sector workers as well. We find that public sector workers have a larger entitlement to future retirement benefits based on their work to date and also a larger financial gain for continued work at older ages, as compared to private sector workers. Moreover, this difference across sectors is growing over time. Third, we find that public and private sector workers are similarly responsive to financial incentives for continued work at older ages. Finally, we use our estimates to project how the change over time in pension plan type has affected the retirement behavior of public and private sector workers (*PLEASE NOTE: this work has been left for the next draft of this paper*).

In the remainder of the paper, we first discuss relevant background information and literature. We then discuss the data and empirical strategy, including our measure of the

[1] There is a literature that examine the effect of changes to Social Security on retirement – see Mastrobuoni (2009), Pingle (2006), and Friedberg and Webb (2009) for examples of studies that have explored the effect of raising the Full Retirement Age, of raising the Delayed Retirement Credit, and of eliminating the Retirement Earnings Test, respectively. Changes over time in Social Security rules are incorporated into the retirement incentives calculated here (as relevant), but estimating their impact on retirement is not the focus of this paper.

financial gain to continued work at older ages, before presenting a descriptive analysis of trends in retirement behavior and incentives as well as our regression results. In the discussion, we discuss the implications of our findings for the potential connection between the shift in employer-sponsored pensions and the trend of working longer.

I. Background and Literature

An overview of Social Security and employer-provided pension provisions is necessary to understand the retirement incentives discussed below. Entitlements to Social Security benefits and pensions differ by sector and (for public sector employees) by level of government. For private sector workers, virtually all employment (and self-employment) incurs an obligation to pay Social Security payroll taxes (6.2% of wages paid each by employer and employee, on wages up to $132,900 in 2019) and an entitlement to future retired worker benefits if the worker accrues 40 quarters of covered employment over her career. The benefit amount is based on the employee's 35 best years of (wage) indexed earnings, with a progressive formula applied such that the replacement rate is higher for lower-income workers. Benefits are first available at age 62 and are reduced for those who claim before the Full Retirement Age (FRA, currently age 66 and rising to age 67) and increased for those who claim after the FRA.

Private sector workers may also be eligible for an employer-sponsored pension. In 2018, 51 percent of all private industry workers had access to a DC plan (only), 13 percent had access to a DB and a DC plan, and 4 percent had access to a DB plan (only), while 32 percent had no access to a plan (BLS, 2018). The prevalence of DB plans does not vary much by full-time status or firm size, but is dramatically higher for unionized workers – two-thirds have a DB plan (only or with DC). In addition to the large shift over time from DB to DC plans, there has been a

shift within DB plans to cash balance plans (Wiatrowski, 2012), which have some features of a DC plan, such as portability (Cahill and Soto, 2003).

While DB plan details vary considerably, there are common elements in many plans. Many plans require a certain number of years of service (YOS) before the worker is vested and eligible to receive benefits. Most plans allow workers to claim benefits after attaining a certain age, YOS, or a combination of these, often with reduced benefits at the plan's early retirement age and full benefits at the normal retirement age. Benefits are often based on a formula that depends on YOS and final earnings or average earnings over a few years. These features can combine such that retirement wealth – the present discounted value of the future stream of pension income – evolves with additional work in a highly non-linear manner, often rising sharply at vesting and between the early and normal retirement ages and falling thereafter (Stock and Wise, 1990; Costrell and Podgursky, 2009). By contrast, DC plans provide a uniform accrual, as the employer deposits a fixed percent of salary per year into the employee's account and/or a match to the employee's contribution. Cash balance plans also have uniform accrual.

For federal employees, retirement benefits depend on date of hire. Those hired in or after 1987 are in the Federal Employees Retirement System (FERS), a multi-tier system that includes Social Security, a DB plan, and a DC plan (Thrift Savings Plan, TSP). DB benefits for most workers are equal to 1 percent of average salary (over the 3 best years) times YOS and may be available as early as age 55. There is a small employer contribution to the TSP and employees may also make contributions, which are matched. Employees contribute 0.8% of pay to the DB plan and pay Social Security taxes. Federal employees hired before 1987 are covered by the Civil Service Retirement System (CSRS). They are ineligible for Social Security but receive a

DB plan roughly twice as generous as the DB plan in FERS, for which they contribute 7 to 8% of pay. These workers may participate in TSP but there is no employer contribution or match.[2]

State and local employees have the most variation in retirement benefits, as they may be covered by a public (employer-sponsored) pension, Social Security, or both, depending on their jurisdiction and occupation. Since 1951, states have been able to enter into "Section 218" agreements (named for the relevant section of the Social Security Act) to provide Social Security benefits to public employees. While all states have such agreements, the share of public workers covered varies – in 2008, more than 90% of workers were covered in 26 states, but fewer than 50% were covered in 5 states, including Texas and California. Most of the 28% of state and local employees not covered by Social Security are local employees, often police, firefighters, and teachers (IRS, 2014).[3] As noted earlier, there has been little shift to DC plans in public pensions – in 2012, 91% of public pension participants had a DB plan, 7% had both a DB and DC plan, and only 2% had only a DC plan (Munnell et al, 2014).

A final institutional feature that can affect retirement benefits for public sector workers is the Windfall Elimination Provision (WEP). The WEP can reduce Social Security retired worker benefits for workers who are eligible for a pension from a job in non-covered employment, such as state and local workers who are not covered by Social Security on their public job but have attained eligibility for Social Security based on other jobs. The WEP limits the ability of these workers to benefit from Social Security's progressive benefit formula, which is intended to raise

[2] More information on these benefits is at: https://www.opm.gov/retirement-services/my-annuity-and-benefits/

[3] An interesting example of how coverage can vary by occupation comes from Missouri's school districts, where there are different retirement systems for full-time teachers and non-teachers and only the non-teachers have Social Security (GAO, 2010).

replacement rates for career low-income earners.[4] A related program, the Government Pension Offset (GPO) can reduce spouse and survivor benefits under similar circumstances. Gustman et al. (2013) estimate that 3.5% of households are subject to either WEP or GPO.

There is a substantial literature examining the effect of Social Security and private pensions on retirement, dating back to the 1980s. As recognized by some early studies, these benefits could affect retirement decisions through both wealth and accrual effects – that is, both the presented discounted value of the stream of future benefits the worker can expect to receive over her lifetime based on her work to date ("PDV") and the change in PDV associated with working one more year ("accrual") may matter.[5] Stock and Wise (1990) observe that working this year provides the option to work in future years that may have positive accruals, pointing to a need for more forward-looking incentive measures.[6] They develop and structurally estimate an option value model based on the change in utility arising from retiring at the optimal future date rather than today; Samwick (1998) includes an option value ("OV") measure (the utility gain from retiring at the optimal date) directly in retirement regressions. Coile and Gruber (2007) develop an alternative measure, peak value ("PV"), that captures the change in PDV between its present and maximum future value. Their measure is similar to OV, but PV does not incorporate the gain from additional earnings and is a financial rather than a utility-based measure.

[4] More specifically, under the regular benefit formula, a worker's basic monthly benefit amount (the Primary Insurance Amount, PIA) is 90% of their average indexed monthly earnings (AIME) up to $926, plus 32% of the next $4,657 of AIME and 15% of AIME over $5,583. The WEP lowers the initial replacement rate from 90% to as little as 40%; however, the benefit reduction cannot exceed half of the value of the pension from non-covered work.
[5] See Mitchell and Fields (1982), Quinn and Burkhauser (1983), and Hausman and Wise (1985) for examples of these studies. For a review of the literature on retirement incentives and retirement, see Coile (2015).

[6] Stock and Wise (1990) draw this insight in the context of DB pensions. Coile and Gruber (2001) illustrate the relevance of this point for Social Security as well, finding that workers often have positive wealth accruals in future years (not only in the following year) and may even face non-linearities in the wealth accrual profile.

In all of these studies, retirement decisions are found to be responsive to retirement incentive measures. While most of the studies are based only on private sector workers or do not distinguish workers by sector, there is a related literature that focuses on public sector workers. Asch et al. (2005) estimate retirement models using PV and OV for a sample of federal workers covered by CSRS and find that these incentive measures affect their retirement. Many of the studies focus on public school teachers, making use of administrative data from one or a few jurisdictions. Costrell and Podgursky (2009) document "peaks, cliffs, and valleys" in the retirement wealth accruals by age in six state teacher pension systems. Costrell and McGee (2010) estimate retirement regressions that include accrual, PV, and PDV for Arkansas teachers and find that these measures have the expected effects. Brown (2013) obtains similar results in a study of California teachers that uses a pension reform for identification.

The study most similar to ours is Papke (2019). Both studies use HRS data to estimate pension incentives for public sector workers and run retirement regressions including PV. Although Papke focuses on public sector workers, she runs regressions for private sector workers also. Clarifying how we differ from Papke is thus useful. A first key difference is in motivation – our paper is focused on whether retirement incentives and retirement behavior are trending differently over time for private vs. public sector workers and whether changes in incentives and in behavior are related, so while both papers estimate retirement regressions, we provide other analyses and apply our regression estimates in order to answer this question. Second, we use restricted Social Security earnings records to calculate retirement incentive measures that reflect the worker's and spouse's entitlement to both Social Security and employer-sponsored pension benefits. By contrast, Papke calculates incentives that include pensions only and then includes

indicator variables for Social Security coverage and "leveling."[7] As noted above, many public workers are covered by Social Security, so incorporating these benefits allows us to measure their incentives accurately. It is useful to compare our results and Papke's, as she finds that PV and retirement wealth have no significant effect on retirement, a finding at odds with the existing literature. A final difference is that our analysis includes federal government workers, who are excluded by Papke.

To summarize, the retirement benefit landscape is complex. All private sector workers have Social Security and about two-thirds have access to an employer-sponsored pension, with a major shift over time from DB to DC plans. Federal workers are in a multi-tier system that includes a DB and DC plan, and for more recent hires, Social Security. Roughly four in five state and local government workers has a public pension, nearly all of which are DB plans, and a similar fraction has Social Security coverage. Among the many differences between DB and DC plans, the most salient for our analysis is that retirement wealth accruals in DB plans often feature strong incentives to work to certain ages and retire thereafter (the "pull" and "push" of positive and negative accruals, in Costrell and McGee, 2010). Many studies find that workers are responsive to these incentives in making retirement decisions. The shift away from DC plans in the private but not public sector might therefore be expected to lead to differential trends in retirement behavior. We seek to explore whether retirement incentives and behavior are trending differently for public vs. private sector workers and whether changing incentive measures can explain changes in behavior over time.

II. Data and Empirical Strategy

[7] Leveling refers to the option within a DB plan to receive a larger benefit on a temporary basis, prior to becoming eligible for Social Security at age 62; see Clark et al. (2017) for more information on this option.

The data for our analysis comes from the Health and Retirement Study (HRS), a longitudinal, biennial survey of the US population age 50 and above. Following the launch of the survey in 1992 with the HRS original cohort (born 1931-1941 and then ages 51-61) and the subsequent addition of older respondents, new cohorts ages 51 to 56 have been introduced to the survey every 6 years (in 1998, 2004, 2010, and 2016), ensuring continual coverage of this population. We use all thirteen HRS survey waves that are currently available, encompassing the years 1992 through 2016. Where possible, we draw variables from the RAND HRS Longitudinal Data 2016 (V1), a cleaned, easy-to-use version of the HRS that includes consistently-defined variables for a subset of the original data. As needed, we supplement this with variables from the RAND HRS Fat Files, which include the raw data from each wave.

Our analysis also makes use of three HRS restricted data sets, which can be linked to the main data. First, we use Social Security earnings records (Respondent Cross-Year Summary Earnings v4.0), which include annual earnings in covered employment for the years 1951 to 2013, to determine Social Security eligibility and benefits. Second, we use the HRS Pension Estimation Program Package (v3.1) to calculate pension entitlements. The HRS periodically collects Summary Plan Descriptions (SPDs) from the employers of HRS respondents. The pension program codes this detailed pension information and combines it with respondent data (such as salary and start year) to create a database that researchers can use to create customized pension data. We describe in more detail below how we use the Social Security and pension data to construct our retirement incentive measures. Finally, we use the Industry and Occupation Data (v4.0.1) to assist in identifying public sector workers, a process also detailed below.

The HRS has a number of important advantages for our purposes. First, the availability of detailed data on Social Security earnings and employer-sponsored pensions allow us to

calculate retirement incentive measures that encompass both kinds of retirement benefit. Second, the survey includes both private and public sector workers among its respondents, in large enough numbers to allow for meaningful comparisons, and contains information that can be used to identify sector. Third, the long-running nature of the HRS allow us to explore how both incentives and behavior have been changing over time.

These advantages notwithstanding, there are some data-related challenges to our analysis. One significant challenge is that HRS only began asking respondents to identify whether their current job was in the public or private sector starting in 2006. To identify sector in earlier survey waves, we use two methods. First, if the worker says in 2006 that she has not changed jobs since the previous wave, then we apply the sector reported in 2006 to the 2004 wave, and we repeat this process for earlier waves where possible. Second, in cases where the first method cannot be applied because the worker has changed jobs over time or retired before 2006, we impute sector as follows. Using data from the 2006-2016 waves, we run a cross-tabulation of sector and detailed (3-digit) occupation code to ascertain the share of workers in each occupation who report that they are in the public sector. Next, we code occupations as being public sector when this share is 70% or above, private sector when this share is 5% or below, and of mixed or indeterminate sector when this share is between 5-70% (see Appendix Figures 1a and 1b for the frequency of occupations by fraction of workers reporting that they are in the public sector and Appendix Table 1 for the five most common occupations coded as public, private, and indeterminate using this approach). Finally, we apply the occupation-level public/private flag to respondents' detailed occupation code data for 1992-2004 in order to impute sector.

Given that sector is critical to our analysis, it is worth explaining how the threshold values in our imputation process (5% and 70%) were chosen. The choice of these values

involves trading off two kinds of error – requiring a higher share of workers in an occupation to be from the public (or private) sector for an occupation to be deemed public (or private) reduces the chance of assigning sector incorrectly, but raises the number of workers for whom we will not be able to impute sector. Given that roughly 23% of the HRS sample is in the public sector (based on self-reported data from 2006-2016)[8], using a 70% value means that we require a concentration of public sector workers in an occupation that is roughly three times as high as what we would see if there were no correlation between sector and occupation (e.g., if 23% of workers in every occupation were in the public sector) in order to code it as public, while a 5% value requires a much lower concentration of public sector workers in an occupation than would occur with zero correlation in order to code it as private. To further support our choice of these values, in Appendix Table 2, we compare self-reported and imputed sector for waves 2006-2016 and show that we assign sector correctly for 94% of private sector workers and 93% of public sector workers. In Appendix Table 3, we show that our process produces a share of public sector workers by wave that is essentially constant over time and similar across waves with (1992-2004) and without (2006-2016) imputations.

A second data challenge is that Social Security and pension information is not available for all respondents. About one-quarter of respondents did not give permission for their Social Security records to be used; Haider and Solon (2000) find that this decision varies "only weakly" with respondents' observable characteristics. There are also respondents covered by an employer-provided pension for which the HRS was not able to obtain an SPD. Recent efforts to reduce missing SPDs have included directing respondents to ask their employer for a copy of the

[8] This value is somewhat higher than the share of workers in the population that is in the public sector. One likely source of the difference is that the public sector question was not asked of self-employed individuals. If such individuals were treated as being in the private sector and included in this calculation, the resulting public sector share would be more similar to that in the population.

SPD in 2004 and using information available on government employer websites (for public sector employees) and in Form 5500 filings (for private sector employees) in 2010. As a result, rates of missing pension data have declined over time.[9] We restrict our analysis to those HRS respondents who have linked Social Security data and who either are included in the HRS Pension Estimation Program or report that they do not have a pension.

As discussed in the literature review, useful retirement incentive measures may include retirement wealth (PDV) and various measures of the gain to continued work, including the change in wealth associated with working one more year (accrual), the change in wealth associated with working to the future date at which wealth is maximized (PV), and the change in utility associated with working to the future date at which lifetime utility is maximized (OV). It is useful to recall that pension accruals (the change in wealth arising from additional work due to the pension alone) and Social Security accruals (defined similarly) can be either positive or negative. Once a worker has attained eligibility for either type of benefit (e.g., reached the early retirement age), working another year generally means giving up one year of benefit receipt. In return, the worker may be entitled to a larger benefit through the benefit formula (if current earnings are higher than earnings that would otherwise have been used in the calculation) and/or through a more favorable actuarial adjustment for later claiming. For Social Security, there are also payroll taxes to be paid.[10] The net of all of these factors may be positive or negative.[11]

[9] The omission of those with missing pension information from the sample should not bias a comparison of the levels (and trends) in pension incentives by sector unless the rate of missing data varies by sector (differentially over time) and the plans with missing SPDs are not characteristic of DB plans overall (e.g., tend to have lower benefits or smaller wealth accruals). Unfortunately, it is not possible to test whether this is the case.

[10] We exclude payroll taxes from our calculations, in order to treat Social Security and pensions symmetrically, as DB plans may also require contributions (e.g., as in the CSRS DB plan) but we lack this information.

[11] In cases where the worker has already passed the maximum PDV value and future accruals are negative, we define PV to be equal to the accrual.

To compute these incentive measures, we first calculate the Social Security benefit and DB pension annuity (if any) that the worker would be entitled at each possible retirement age from 55 to 69.[12] Next, we calculate the PDV of retirement wealth at each retirement age, discounting future benefits for time preference (at a real rate of 3%) and mortality (using life tables from the Social Security Administration). We assume that workers claim Social Security when they retire or at age 62 if retiring before that age, and also commence pension benefits at retirement. We measure retirement wealth at the household level, including the spouse's entitlement to retired worker, dependent spouse, and/or survivor benefits (appropriately accounting for the probability that either/both spouses are alive in each future year) and fixing the spouse's retirement age at 62 so as to ensure that our incentive measures reflect only the gain in wealth associated with the respondent's own retirement delay. In future drafts, we will update our calculations to incorporate the WEP and GPO provisions, which may lower Social Security benefits, and to add DC pension balances to the PDV of retirement wealth.

We construct a person-year sample in which HRS respondents contribute one observation to the sample for each year between 1992 and 2015 that they are between the ages of 55 and 69 and are working at the beginning of the year.[13] Our dependent variable is retirement by the end of the year.[14] We treat retirement as an absorbing state and exclude future observations once we observe any retirement after age 55. Conducting the analysis in this way is essentially equivalent to estimating a retirement hazard model with non-parametric baseline hazard. We estimate regressions such as:

[12] The worker is assumed to claim her DB pension as a single life annuity.

[13] Although the HRS is conducting biennially, we are able to determine whether the individual was working at the beginning of a non-survey year and whether she retired during that year by using data collected at the next wave.

[14] Specifically, we first use the RAND HRS variable rXwork (where X refers to the survey wave) to determine who is working or retired at a specific wave, and then for those who have transitioned from work to retirement across waves, we use rXretyr to determine the year of retirement.

$$Retired_{it} = PV_{it} + PDV_{it} + AGE_{it} + X_{it} + \varepsilon_{it} \quad (1)$$

where i refers to individual and t to year, Retired is an indicator variable equal to 1 if the individual retires this year, PV (or a similar measure) and PDV are incentive measures that incorporate Social Security and employer-sponsored pension benefits, AGE is a set of age dummies, and X includes individual characteristics such as education, occupation, and marital status as well as current and lifetime earnings. As our analysis focuses on how the evolution of retirement incentives is affecting private vs. public sector workers, we estimate this model separately by sector as well as for all workers combined.

III. Results

A. Trends in Retirement Behavior

We now turn to documenting trends in retirement behavior. While it is well-known that older workers are staying in the labor force longer, trends by sector are not as well known. We begin with an analysis using data from the March Current Population Survey (CPS), a large labor force survey commonly used to calculate labor force statistics. As CPS data is not longitudinal, establishing whether workers who are employed in the public sector at a given age, say age 55, subsequently retire earlier or later than those working in the private sector at the same age is not straightforward. To provide such an estimate, we compute an employment "survival rate" by age by calculating, at each age a (after 55), the share of the population working in the public (or private) sector at age a relative to the share of the population working in that sector at age 55 (measured in the same year, or group of years).[15] Since we do not follow the same people over

[15] Note that this methodology does not require the employment rate at age a+1 to be lower than the employment rate at age a. Therefore, it is possible to have more than 100% of age 55 workers survive to the labor force at age 56, as is apparent in Figures 2 and 3, particularly when sample sizes are smaller and estimates correspondingly more noisy.

time but rather use the employment rate of adjacent birth cohorts at a given point in time to infer labor market persistence, these estimates may differ from what would be obtained from longitudinal data. We make these calculations for three groups of years – 1988-1997, 1998-2007, and 2008-2017 – to display trends over time.[16]

We first show results in Figure 1 for all workers. As expected, the data show a significant increase in labor force participation at older ages, with the share of age 55 workers still employed at ages 62-65 rising by about 14 percentage points between the first and last decades. Figure 2 shows comparative data for private sector workers and state and local workers (omitting the middle decade for clarity). The employment profile by age among those employed at age 55 in the first time period (1988-1997) is quite similar for these two types of workers, with government workers retiring only slightly earlier than private sector workers, and the increase in participation over time is also similar for the two groups. In Appendix Figures 2 and 3, we show the implied retirement hazard by age for the two groups of workers; for both, the spikes as ages 62 and 65 diminish markedly over time. Thus, while the shift away from DB pensions in the private sector might have been expected to lead to divergent retirement trends, with a larger increase in participation at older ages for private sector workers than for public sector workers due to the loss of age-specific retirement incentives for many private sector workers, such a divergence is not clearly evident from Figure 2. Figure 3 compares private sector workers with federal workers. As the federal workforce is about one-quarter the size of the state and local workforce, the survival rate for this group is noisier. However, there is some indication that federal employees retire earlier than their public sector counterparts in the first period (1988-2007) and that the trend towards worker longer is less pronounced for them.

[16] Prior to 1988 it was not possible to identify state and local employees separately from federal employees.

Next, we provide a similar calculation using the HRS. As the HRS data is longitudinal, we conduct a cohort-based analysis that follows the same workers over time. We focus on those ages 51-56 at their initial entry to the survey and compare 4 birth cohorts: the younger half of original HRS cohort (born 1936-1941), the War Babies (WB, born 1942-47), the Early Baby Boomers (EBB, born 1948-1953), and the Mid Baby Boomers (MBB, born 1954-1959). We restrict our analysis to those working at their first HRS survey wave, so our calculations reflect the probability of continuing to work at older ages among this group. We use data through 2016, such that cohorts are followed for between 4 and 13 survey waves, and present results separately by sector. Our outcome of interest is withdrawal from the labor force rather than retirement from the career job.[17]

The results of this exercise, shown in Figure 4, do not provide clear evidence of a trend towards longer work lives among more recent cohorts, perhaps due to sampling variation arising from the relatively small sample sizes for each cohort, age, and sector. However, there is some tendency for those working in the public sector (here including federal, state, and local workers) at their first survey wave to retire sooner than those working in the private sector. For example, at age 62 the probability of work among those working at their first HRS survey wave is 3 to 11 percentage points lower among public vs. private sector workers, depending on cohort.

In sum, there is some evidence that public sector workers retire earlier than private sector workers, particularly federal employees. In our analysis of CPS data, we find similar increases over time in work at older ages for state and local government workers as for private sector workers, but some indication that the increase in work of federal employees has been smaller.

[17] Papke (2019) reports that only about 5% of public sector workers in the HRS report later part-time subsequent to retirement from the career job.

B. Retirement Incentives

Next, we examine descriptive statistics on self-reported pension coverage and retirement incentives by sector and over time. We caution that self-reports of pension coverage are subject to measurement error. Gustman and Steinmeier (2008) report that one-third of survey respondents report a plan type that is incompatible with the type reported by their employer; while much of this error is offsetting, so that aggregate statistics from the two sources are more similar, it is not possible to know from their study whether this is also true within each sector.

Table 1 provides data on self-reported pension coverage on the current job at the entry survey by sector and cohort for the four cohorts referenced above plus the late baby boomers (LBB, born 1960-65).[18] Information for up to four pension plans is combined to determine whether the worker has a DB plan, DC plan, both a DB and DC plan, or is not included in any plan. About one-quarter of each cohort are in the public sector. Among private sector workers, half of workers are not included in any pension plan, and this figure is fairly constant across cohorts. The well-known shift from DB to DC plans is evident for this group – the probability of DB (only) coverage fall by about 10 percentage points between the first and last cohorts, from 18 to 9 percent, while the probability of DC (only) coverage rises by a similar amount, from 19 to 27 percent. The share with both a DB and DC plan is roughly constant across cohorts at about 12 percent.

Public sector workers are much more likely to be in a pension plan – only one in five is not covered (except in the LBB cohort, where the share not covered rises to nearly three in ten). There is a dramatic decline in the share of workers with a DB plan only, from 45 percent in the

[18] These data are based on self-reported information (variables rXjcpen in the RAND HRS), not on whether there is pension information for the respondent in the Pension Estimation Program (PEP).

HRS cohort to 21 percent in the LBB cohort. This is offset in part by a rise in the share with both a DB and DC plan, but there is also a rise in the share with a DC plan only, from 12 to 23 percent. The share with any DB plan (DB only or DB and DC) falls by 19 percentage points between the HRS to the LBB cohorts. While some caution may be warranted around the exact magnitude of these changes – about half of the change occurs between the MBB and LBB cohorts and additional data will be needed to determine whether the recent acceleration in trend persists – there is clearly a long-term trend of public sector workers becoming less likely to have a DB plan in these data.

In Table 2, we report summary statistics for our main incentive measures, PV and PDV, by sector and HRS cohort. We report mean and median values (in $2011), and also show values that include Social Security and employer-sponsored pension benefits (top panel) and Social Security only (bottom panel), to make it possible to infer the importance of pensions.

A few findings emerge from this table. In the top panel where pensions are incorporated, PDV (a household measure) is higher for respondents in the public sector than for private sector respondents. As an example, for the median respondent in the original HRS cohort, PDV is $209,000 in the public sector vs. $182,000 in the private sector. This difference is apparent in both mean and median values and grows fairly dramatically across cohorts, to a difference of about $80,000 for the WB and EBB cohorts and about $130,000 for the MBB cohort (whether using mean or median values). It is worth noting, however, that our calculations exclude DC pension wealth; if DC account balances are larger for private sector workers, this would tend to mitigate their apparent disadvantage in retirement resources as reported in Table 2.

In the PDV values that exclude pensions (lower panel), PDV values are roughly equivalent across sectors and do not seem to grow over time (indeed, values are slightly lower in

the EBB and MBB cohorts as compared to the HRS and WB cohorts). While it may initially seem counterintuitive that the PDV of Social Security benefits is similar for respondents in the private and public sectors, this could reflect several factors: 1) the majority of public workers are covered by Social Security; 2) our calculations do not (yet) include WEP and GPO provisions, which will lower Social Security benefits; 3) PDV is a household measure that includes the Social Security benefits of the respondent's spouse, who may work in the private sector.

PV is our primary measure of the financial incentive for continued work at older ages. Including both Social Security and pensions (top panel), mean PV for private sector respondents is roughly $5,000 for the HRS cohort and grows to nearly $19,000 for the MBB cohort; median values are lower, about $600 for the HRS cohort and $8,000 for the MBB cohort. PV values in the public sector are two to three times as large, reaching $41,000 at the mean and $28,000 at the median for the MBB cohort. Thus, the return to working until the age when retirement wealth is maximized is much greater in the public sector, particularly for recent cohorts. The important role of pensions is again made clear by comparing these results to the PV values when pensions are excluded (lower panel). As with PDV, values across the two sectors here are roughly comparable at both the mean and median. These values do grow somewhat over time, reaching values of $7,000 to $12,000 (depending on sector and mean vs. median) for the MBB cohort.

The picture that emerges from these tables is a complex. The patterns in pension coverage in Table 1 match national (non-age-specific) statistics in some respects, as with the decline in DB pensions in the private sector, but less so in others, as with the (even larger) decline in DB pensions in the public sector (although much of this drop occurs at the very end of our sample period). Patterns from Table 2 seem more in line with our expectations. First, workers in the public sector have larger PDV values (future retirement benefits based on their

work to date) than do workers in the private sector, and we can infer that this is due to their more generous DB benefits since Social Security-only PDV measures are similar across sector. Second, workers in the public sector have larger PV values, indicating that the financial gain from working until the future date when retirement wealth will be maximized is also greater for them. These gains can be substantial -- $28,000 at the median for the most recent cohort in our sample. The rising PV values over time for public sector workers suggest that the reward for choosing the "right" retirement age is growing for this group of workers.

C. Retirement Regressions

Finally, we turn to our regression results, which explore whether public and private sector workers are responsive to these retirement incentive measures. Descriptive statistics for the sample and by sector are included in Table 3. They reflect the higher PV and PDV values for public sector workers discussed above, and also show that public sector workers are more likely to be female (62 percent of public sector workers vs. 52 percent of private sector workers) and college-educated. The average probability of retirement (over a one-year period) is similar for public and private sector workers, at 7.4 percent and 7.6 percent, respectively.

We report regression results in Table 4, estimated for all workers and separately by sector, using incentives that incorporate both Social Security and employer-sponsored pensions.[19] In column 1, the PV coefficient has the expected negative sign, indicating that those with a greater financial incentive to continue work are less likely to retire, and it is statistically significant. In terms of the magnitude, a $10,000 increase in PV reduces the probability of retirement by 0.75 percentage points, or about 10 percent relative to the mean retirement rate, a

[19] We trim the sample and drop observations with PV values in the top and bottom 1%, to avoid an outsize influence of outlier values on the regression estimates.

non-trivial effect. The PDV coefficient implies that an additional $100,000 of retirement wealth raises the probability of retirement by 0.3 points, or about 4 percent relative to the mean.

For public sector workers, the effect is about 25% larger (a 0.9 percentage point effect), although this difference is likely not statistically significant; conversely, for private sector workers the estimated effect is slightly smaller than that for all workers. The PDV coefficient for public sector workers is essentially zero, while for private sector workers it remains positive and statistically significant.

In short, we find that both types of workers respond to our dynamic incentive measure, PV. This finding is at odds with Papke (2019), who fails to find a statistically significant effect of PV. One potential explanation is that her regressions also include indicator variables for whether the individual has reached the pension plan's early and normal retirement ages, variables that may be strongly correlated with the PV measure. A second explanation could be the inclusion of Social Security benefits in our measure.

[PLEASE NOTE: The final step in our analysis, using these results in combination with the changes in retirement incentives from Table 2 to project the potential effect on retirement behavior over time is (unfortunately) left for the next draft of the paper.]

IV. Conclusion

Over the past several decades, there has been a dramatic shift in employer-sponsored pensions from DB to DC type. It has been suggested that this shift may be contributing to the dramatic increase in labor force participation at older ages, and some evidence supports this hypothesis (Friedberg and Webb, 2005). However, national statistics suggest that public sector workers have been largely immune from this shift. This naturally leads to the question: are there

different trends in the retirement incentives of public and private sector workers that are contributing to divergent trends in retirement behavior?

Our findings are consistent with our expectations in some ways but so less in others. While we might have expected to see a divergence in labor force participation at older ages by sector, with public sector workers failing to keep up with participation increases in the private sector being driven by the shift away from DB pensions, in fact we find that the retirement behavior of state and local government workers is fairly similar to that of private sector workers and that the rise in participation at older ages over time has also been similar in the two groups. Federal workers appear to retire a bit earlier and to have not delayed retirement by as much over time. In terms of pension coverage and incentives, in the HRS data we see a decline in self-reported DB pension coverage across cohorts (as measured at first survey appearance) for private sector workers, as expected, but also a decline for public sector workers (most notably in the LBB cohort). We do find, however, that the financial incentive to work at older ages – as captured by our PV measure – is larger for public sector workers and that this differential is growing over time and is driven by differences in DB pensions and not Social Security. This is consistent with a story of diverging importance of DB pension incentives by sector, even if these diverging incentives are not ultimately reflected in diverging retirement trends. Finally, in our retirement models, we find that public and private sector workers are similarly responsive to financial incentives. In future work, we will use these estimates more directly to predict how changes in incentives over time by sector have affected retirement behavior.

As a final note, our (still preliminary) findings should be interpreted cautiously in light of the numerous data issues discussed above. As one example, employees who report that they have a pension on their current job but who are not in the Pension Estimation Program (meaning

that an SPD was not collected from their employer) are omitted from our sample, and the rate of missing SPDs is declining over time. If plans with missing SPDs differ from those with valid data, their omission could bias our estimates of the changes in retirement incentives (PV and PDV) over time. There are also a number of outstanding data issues that we will be able to address in future drafts, and improving our analysis may affect our conclusions.

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Figure 1: Employment Survival Rate among All Workers, by Age and Year, CPS 1988-2017

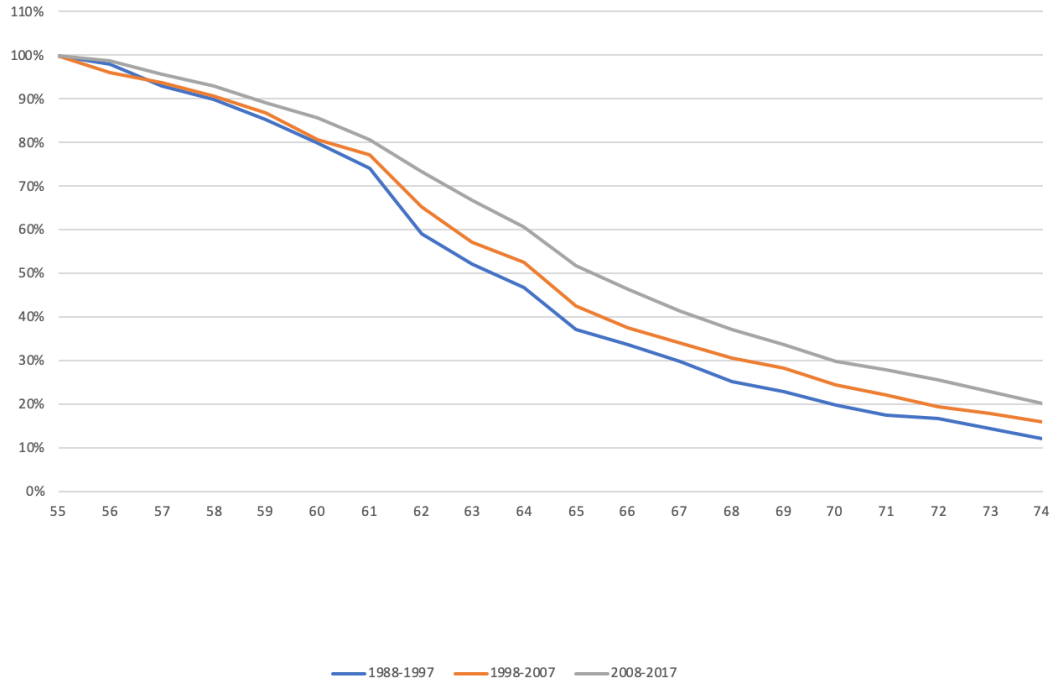


Figure 2: Employment Survival Rate among Private vs. State/Local Employees, by Age and Year, CPS 1988-2017

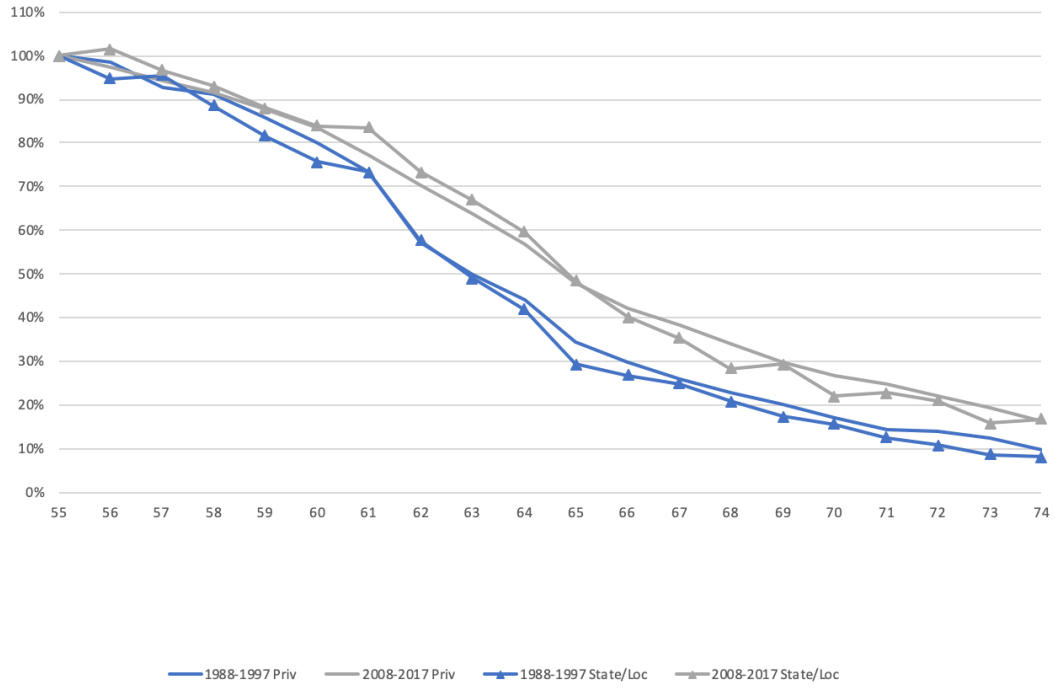


Figure 3: Employment Survival Rate among Private vs. Federal Employees, by Age and Year, CPS 1988-2017

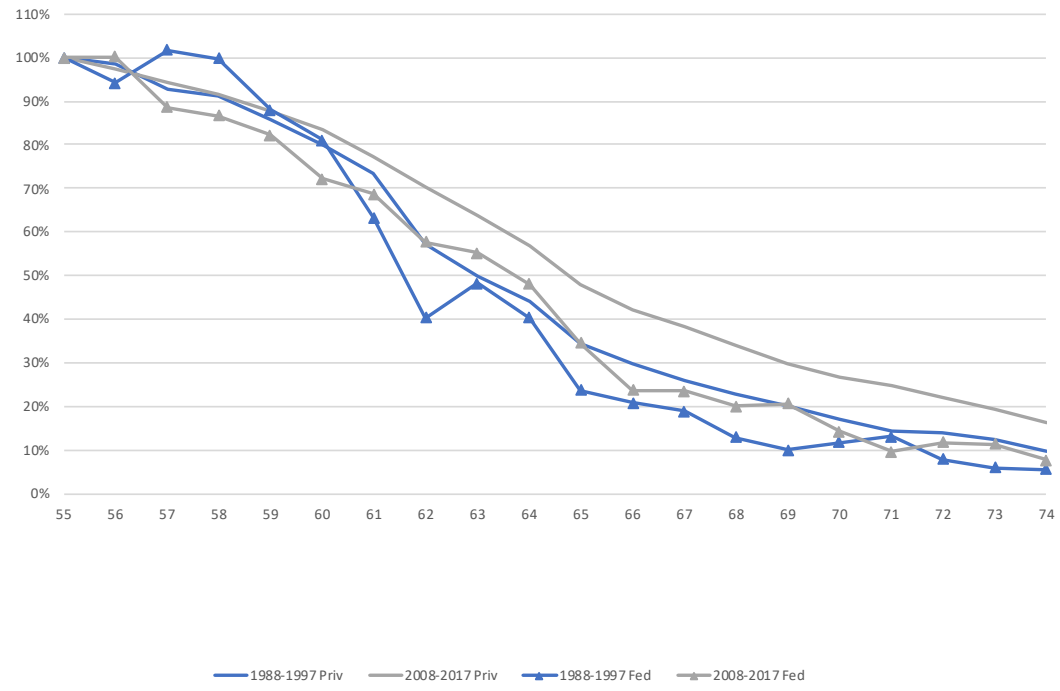


Figure 4: Employment Survival Rate by Cohort and Sector, HRS Data

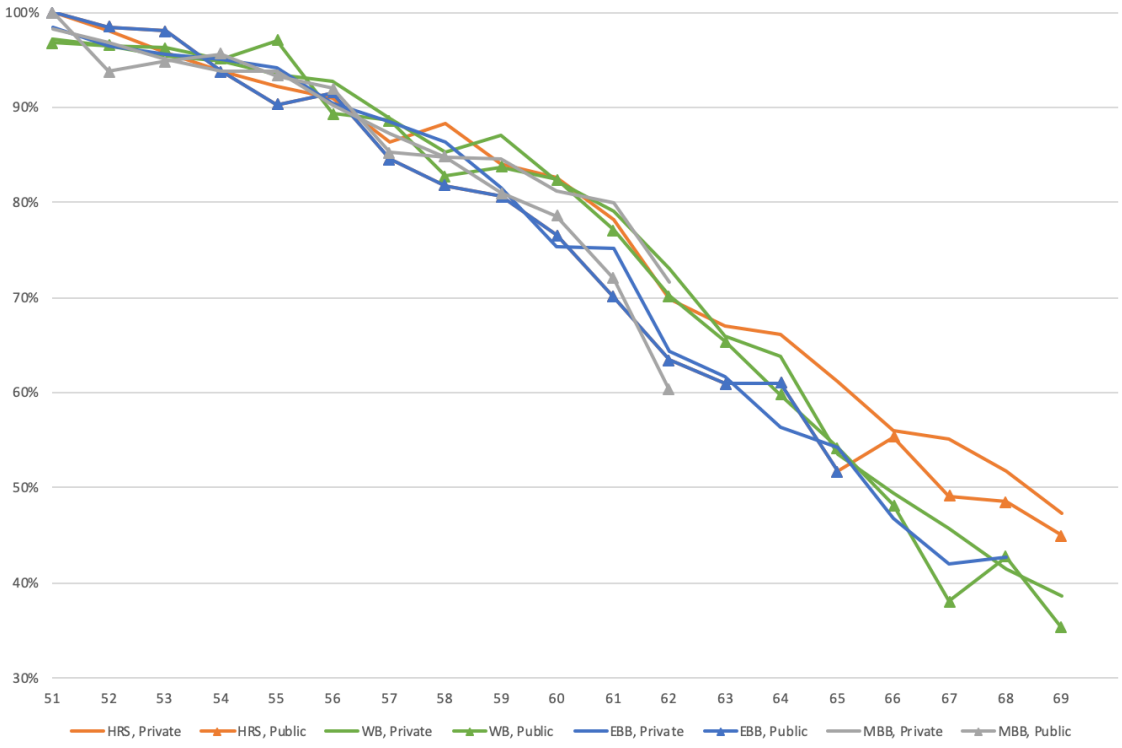


Table 1: Pension Coverage in HRS by Cohort and Sector

Cohort	HRS*	WB	EBB	MBB	LBB
Public Sector					
DB	45%	40%	35%	34%	21%
DC	12%	18%	22%	22%	23%
DB+DC	22%	20%	24%	24%	27%
No Pens	21%	21%	20%	21%	29%
Private Sector					
DB	18%	13%	10%	9%	9%
DC	19%	27%	32%	31%	27%
DB+DC	12%	15%	13%	12%	9%
No Pens	50%	45%	45%	49%	55%
Share Public	20%	23%	24%	24%	24%
# of Obs	2,270	1,693	2,186	2,890	2,497

Notes: *HRS cohort includes those born in 1936-1941 only. Sample (for all cohorts) includes only those who are working at their first HRS survey and for whom sector can be identified; see text for details. Pension plan coverage is based on self-report at the respondent's first survey, using data on up to 4 pension plans (RAND variables rXjcpenY for wave X and pension plan Y).

Table 2: Retirement Incentives by Sector and Cohort

Cohort	HRS	WB	EBB	MBB
Social Security & Pensions				
Public Sector				
PV-mean	11,336	21,336	28,616	41,297
PV-median	2,022	8,550	14,810	27,781
PDV-mean	253,752	321,591	321,098	338,321
PDV-median	208,653	272,329	257,389	279,690
Private Sector				
PV-mean	5,014	11,227	15,193	19,192
PV-median	623	2,657	5,139	8,187
PDV-mean	208,177	241,537	226,265	205,105
PDV-median	182,438	202,231	177,377	147,095
Social Security Only				
Public Sector				
PV-mean	3,583	6,363	7,459	11,854
PV-median	511	2,445	3,665	8,788
PDV-mean	159,330	180,651	153,538	152,997
PDV-median	141,642	175,110	140,269	148,077
Private Sector				
PV-mean	2,417	3,740	5,850	9,946
PV-median	423	1,342	2,976	6,610
PDV-mean	183,795	190,613	172,046	157,395
PDV-median	170,822	178,413	158,244	140,621
# Obs - Public	3,206	2,452	2,529	916
# Obs - Private	12,225	6,856	6,938	2,497

Notes: Values are reported in $2011. Sample is HRS person-wave sample used in the regression analysis (see Table 3 for descriptive statistics).

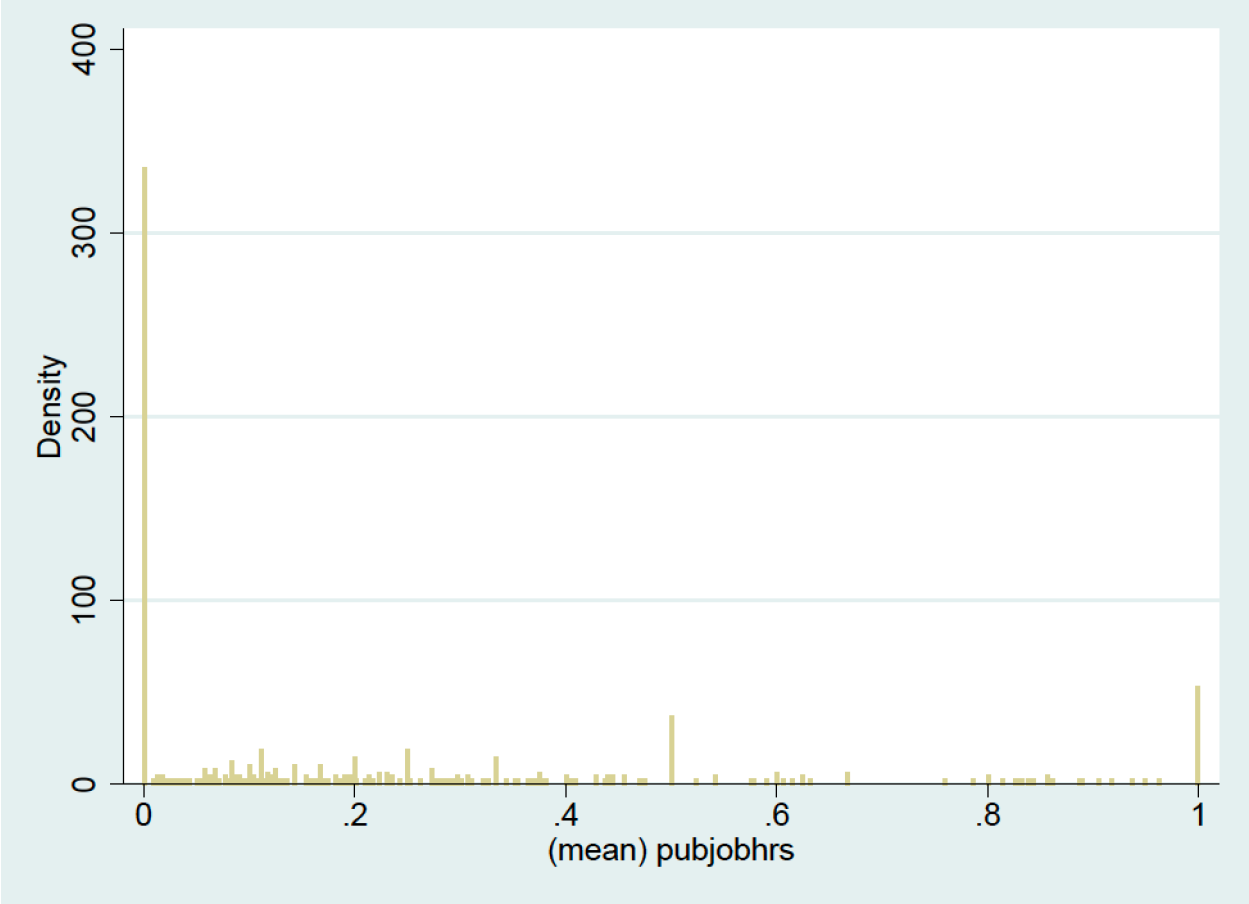
Table 3: Descriptive Statistics

Characteristic	All Workers	Public Workers	Private Workers
Retired	7.6%	7.4%	7.6%
PV	12,715	21,561	9,938
PDV	239,309	304,385	218,881
Earnings	31,462	33,651	30,775
AIME	2,482		
Female	54.1%	62.1%	51.6%
Married	74.5%	72.5%	75.1%
Working Spouse	51.1%	50.9%	51.1%
Assets	82,167	80,207	82,786
Educ <HS	13.8%	6.7%	16.0%
Educ=HS	33.0%	21.4%	36.7%
Educ Some Coll	25.0%	23.0%	25.6%
# of Obs	38,211	9,129	29,082

Table 4: Retirement Models

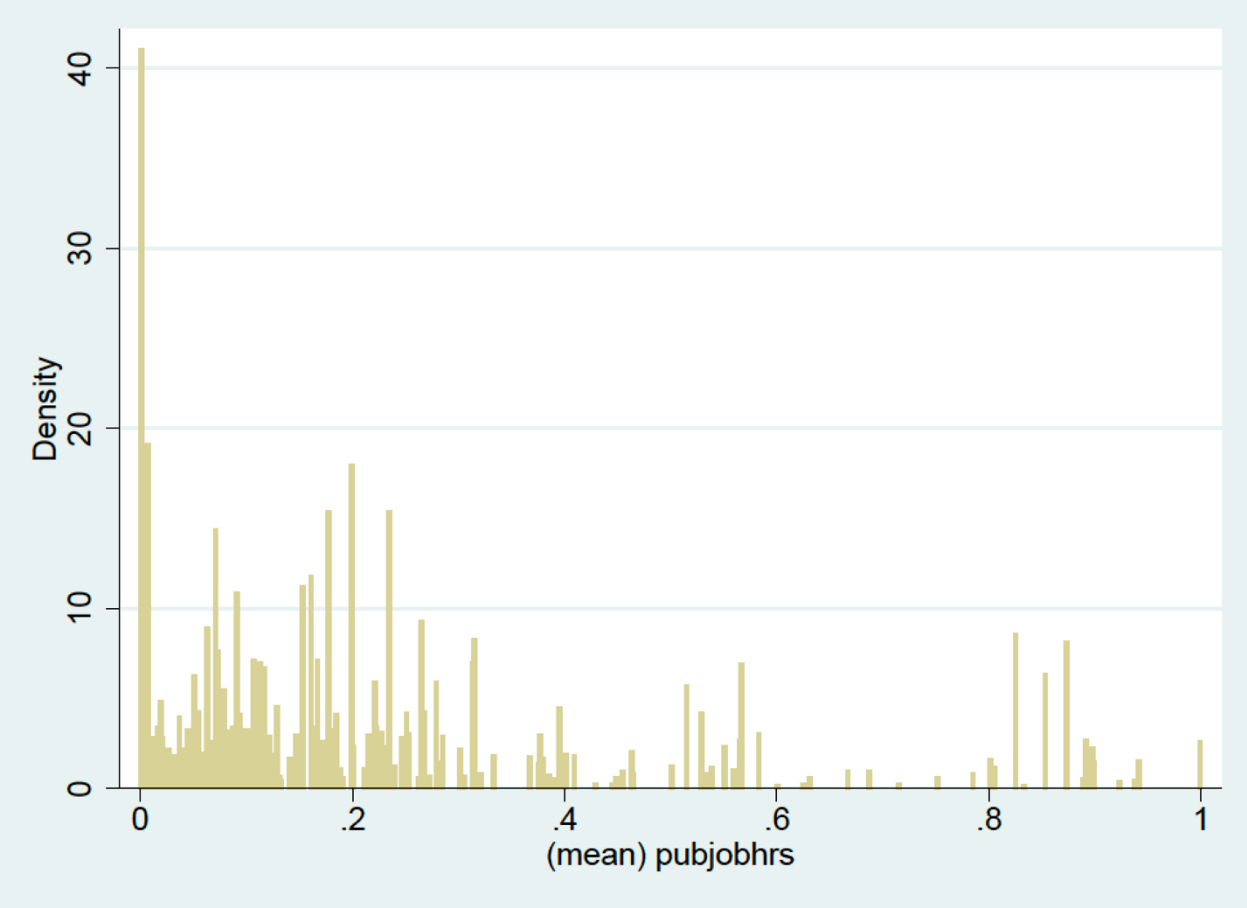
	All Workers SS & Pens	Public SS & Pens	Private SS & Pens
PV/10K	-0.0075	-0.0093	-0.0065
	(0.0009)	(0.0014)	(0.0013)
PDV/100K	0.0028	-0.0015	0.0033
	(0.0010)	(0.0016)	(0.0015)
Earnings/10K	-0.0114	-0.0096	-0.0122
	(0.0008)	(0.0015)	(0.0009)
AIME/10K	0.0904	0.1267	0.0880
	(0.0130)	(0.0265)	(0.0162)
Female	0.0142	0.0111	0.0135
	(0.0032)	(0.0061)	(0.0038)
Married	0.0040	0.0056	0.0043
	(0.0034)	(0.0067)	(0.0040)
Work Spouse	-0.0159	-0.0149	-0.0169
	(0.0030)	(0.0062)	(0.0034)
Assets/100K	0.0000	0.0029	-0.0004
	(0.0004)	(0.0011)	(0.0004)
Educ <HS	0.0219	0.0067	0.0329
	(0.0061)	(0.0139)	(0.0075)
Educ = HS	0.0108	-0.0005	0.0199
	(0.0043)	(0.0076)	(0.0053)
Educ Some Coll	0.0128	-0.0022	0.0247
	(0.0044)	(0.0070)	(0.0058)
Age Dummies	X	X	X
Occ Dummies	X	X	X
# Obs	37,123	8,894	28,215

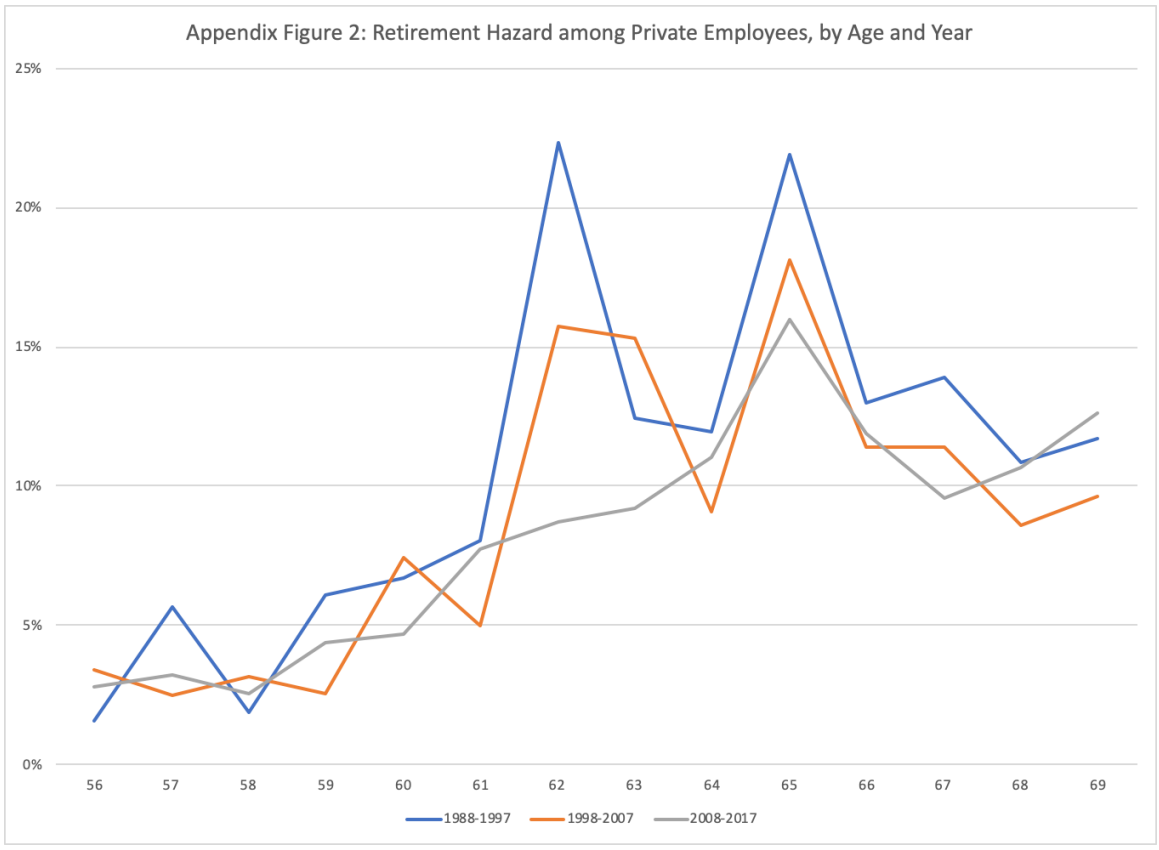
Appendix Figure 1a: Frequency of Occupations by Share of Workers Reporting They Are in the Public Sector

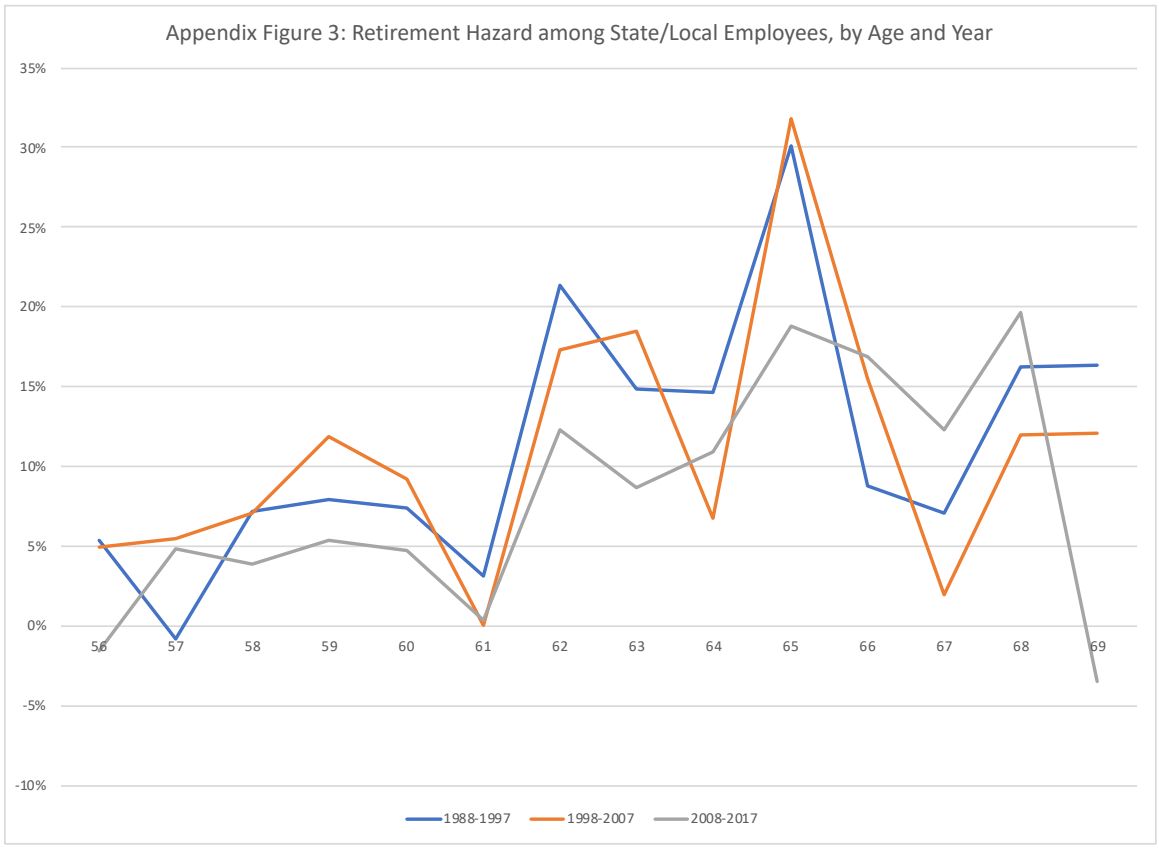


Source: authors' calculations from the HRS public data and restricted detailed occupation data, 2006-2016.

Appendix Figure 1b: Frequency of Occupations by Share of Workers Reporting They Are in the Public Sector (weighted by number of workers)




Appendix Figure 2: Retirement Hazard among Private Employees, by Age and Year
25%
20%
15%
10%
5%
0%
56
57
58
59
60
61
62
63
64
65
66
67
68
69
1988-1997
1998-2007
2008-2017


Appendix Figure 3: Retirement Hazard among State/Local Employees, by Age and Year
35%
30%
25%
20%
15%
10%
5%
0%
-5%
-10%
56
57
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59
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61
62
63
64
65
66
67
68
69
1988-1997
1998-2007
2008-2017

Appendix Table 1: Most Common Occupations, by Assigned Sector

Sector	Occupation Title	Share Public	# Obs
Public	Elementary and Middle School Teachers	82.5%	292
	Secondary School Teachers	87.3%	277
	Teaching Assistants	85.2%	217
	Special Education Teachers	89.6%	77
	Library Assistants, Clerical	89.1%	46
	Court, Municipal, and License Clerks	89.1%	46
	Postal Service Mail Carriers	80.0%	45
Private	Retail Salespersons	0.8%	384
	First-Line Supervisors/Managers of Retail Sales Workers	0.7%	269
	Sales Representatives, Wholesale and Manufacturing	0.0%	179
	Laborers and Freight, Stock, and Material Movers, Hand	4.5%	112
	Miscellaneous Assemblers and Fabricators	1.8%	109
	Marketing and Sales Managers	2.1%	97
	Other Agricultural Workers	1.0%	96
Unclear	Secretaries and Administrative Assistants	19.8%	615
	Janitors and Building Cleaners	23.5%	527
	Nursing, Psychiatric, and Home Health Aides	17.6%	431
	Driver/Sales Workers and Truck Drivers	7.1%	423
	Registered Nurses	16.1%	403
	First-Line Supervisors/Mgrs of Office & Admin. Support Wkrs	26.4%	318
	Personal and Home Care Aides	31.4%	283

Appendix Table 2: Self-Reported vs. Assigned Sector

		Assigned Sector	
		Private	Public
Self-Reported	Private	94.2%	5.8%
	Public	6.7%	93.3%

Note: Comparison is of self-reported sector in waves 8-13 (2006-2016) with sector assigned using imputation method described in the text.

Appendix Table 3:
Share of Workers in Public Sector

Wave	Share Public
1	23.2%
2	23.6%
3	22.4%
4	23.2%
5	24.3%
6	23.0%
7	23.2%
8	22.0%
9	22.2%
10	23.8%
11	23.2%
12	21.9%
13	23.8%

Note: Reflects the share of workers assigned to public sector, using method described in the text (including primarily self-reported data for waves 8-13 and primarily imputations for waves 1-7)