Labor Market Aspects of State and Local Retirement Plans: A Review of Evidence and a Blueprint for Future Research

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1. Introduction

The retirement pensions available to most workers have shifted drastically over the last thirty years – for everyone but state and local government employees. Most private-sector employers, as well as the federal government, have stopped offering traditional defined benefit (DB) pensions, especially for new employees, replacing them with defined contribution (DC) pensions like 401(k) plans. Many of the DB plans that remain in the private sector have adopted features of contributory accounts, such as steady accruals in cash balance plans and lump-sum payouts. Figure 1 from Friedberg and Owyang (2005), reproduced here, highlights the trends in pension coverage.[2] Among full-time employees with a pension, 69% had a DB plan and 45% had a DC plan in 1983 (with some workers having both types). In 2001, only 39% had a DB plan, and a full 80% had a DC plan.

In contrast, traditional defined benefit pension plans remain the overwhelming norm for teachers, policemen, and other employees of state and local governments.[3] Average compensation in 2009 for state and local government employees was $39.66, according to the U.S. Bureau of Labor Statistics. Of that total, 7.2% consisted of DB pension contributions and 0.8% consisted of DC pension contributions. For private-sector employees, out of total compensation of $27.42, 1.5% go towards DB pensions and 1.9% go towards DC pensions.

Public sector pensions have drawn increasing concern of late for at least three reasons. First, considerable media attention has focused on underfunding and murky accounting standards in public sector pensions.[4] The Employee Retirement Income Security Act of 1974 (ERISA) began to set out funding standards for private sector pensions but does not apply to public plans. Current Governmental Accounting Standards Board standards, in place since 1996, govern the reporting – but not the funding – of public pension liabilities.[5] The percentage of all state and local pensions with funding ratios below 80% rose from 10.6% in 2001 to 41.5% in 2006 (U.S. Government Accountability Office 2006).

Second, the structure of defined benefit pensions has major implications for the staffing of

[1] I would like to thank Robert Costrell, Michael Podgursky, and Sarah Turner for helpful suggestions and Stephanie Demperio for excellent research assistance.
[2] The statistics in Figure 1 are computed using data from the nationally representative Survey of Consumer Finances. Among the full-time employees in Figure 1, 67% had some type of retirement plan in 1983, dropping to 59% in 2001
[3] Among workers with pension coverage, DB plans covered 98% of all public sector employees in 1975, compared to 92% in 2005 (Munnell et al 2007). The largest category of state and local government workers with DC plans are university faculty.
[4] "In Budget Crisis, States Take Aim at Pension Costs," Mary Williams Walsh, *The New York Times*, June 19, 2010; "States scaling back public pension plans to close funding gap," Laura Cohn, *The Washington Post*, May 16, 2010; "Growing Deficits Threaten Pensions," David Cho, *The Washington Post*, May 11, 2008.
[5] GASB Statements No. 25 and No. 27.

government jobs. Typically, the incentives for workers with DB plans to stay in their jobs shift dramatically over the course of their careers. For example, many government workers receive minimal pension benefits if they leave their jobs before the age of 45-50, then large gains for staying a few more years, after which their pension wealth begins to drain away if they do not retire. Moreover, vesting requirements associated with DB plans and limited transferability across states and between public and private jobs impede mobility in the labor market. The potential effects on staffing have recently been studied for public school teachers. These studies are finding strong retirement responses to age- and tenure-related incentives built into state pension plans (Brown 2009, Costrell and McGee 2010, Ni and Podgursky 2010, Friedberg and Turner 2010).

Third, the attention to both solvency and incentive problems has increased pressure to reduce pension obligations and, often, to switch public sector employees from DB to DC plans. Several states have reduced promised benefits and/or raised contributions required of new employees, though cuts to promised benefits to existing employees have been rare. Some have also added on DC plans to their existing DB pensions, and a handful have shifted all new employees into DC plans (Munnell et al 2008). Understanding the extent to which existing DB plans distort labor supply and affect the nature of public employee selection into retirement affects the debate on pension reform.

In spite of the potential for major changes in total pension compensation offered to state and local workers and pension incentives that they face, relatively little is known about the labor market effects of pensions. This state of affairs reflects limitations involving both data and econometric identification. The literature on private-employer pensions has made contributions on these fronts in recent years that can shed light on some local government concerns. Moreover, some of the limitations constraining research on pensions may be overcome by focusing on government workers, with recent work on public school teachers pointing the way.

In order to understand the labor market implications of pensions in the state and local government sector, Section 2 of this paper highlight key features of DB and DC pension plans. Among them is the fact that, even if total pension wealth ends up to be the same at the end of workers' careers under each plan, the path by which that pension wealth is accrued differs sharply. These different accrual paths generate major differences in incentives that workers with DB versus DC plans face to stay in jobs or leave at different points of their careers.

Section 3 offers an object lesson in understanding the labor market effects of pensions. Rather than beginning with a comprehensive review of all possible effects, I focus first on the most studied aspect in the labor economics literature – the effect of pensions on worker exit from jobs. Do pensions affect job changes at younger ages and retirement at older ages? I discuss the practical difficulties in studying this question and then present evidence from papers that have used various strategies to surmount some of them. These papers find that private-sector workers respond to DB pension incentives, especially in the timing of retirement. This explains why the shift to DC plans with flat accruals patterns plays a role in explaining recent increases in the retirement age.

Section 4 moves on to summarize broader theoretical explanations that have been offered for the structure of DB pensions as a personnel management tool. Given their observed effects on mobility and retirement, it is reasonable to think that employers have (or used to have) motives that explain the design of DB pensions. The motives themselves cannot be observed and are difficult to test for directly, though shifts in these motives may explain the new prevalence of DC pensions.

Section 5 poses empirical questions about the possible impact of DB plans that are largely or wholly unaddressed in the literature. One question involves the tradeoff between current wages and deferred compensation. Another involves the types of workers – more or less productive – who respond most readily to pension incentives. Additionally, the literature has yet to examine the effects of other features that differ between DB and DC plans. Of particular importance at the moment is the distinction that DB plans allocate the risk of managing pension fund accumulation and decumulation on employers, while DC plans allocate the risk to employees. This section highlights particular ways in which the analysis of state and local workers may shed new light on these unresolved questions.

2. The Structure of Defined Benefit Pensions

This section describes how DB pensions are typically structured and then contrasts them with DC pensions.[6] I include examples from K-12 teacher pension plans. I focus on teacher plans because teachers are a large and homogenous segment of the state and local government workforce, which makes it quite relevant to understand teacher incentives; because information about their pension plan features has been frequently and carefully compiled (by the National Education Association every two years since at least 1996); and because in about half of states teachers are covered by the same plan as other state employees. Funding concerns for teacher and non-teacher state employee plans are similar.

First in this section, I define DB pension wealth – the present value of expected future benefit flows upon retiring. Second, I discuss how the benefit flow upon retirement is determined by earnings, job tenure, and age. DB plans in different states are similar in the first respect (how benefit flows determine pension wealth) but differ substantially in the second (how worker characteristics determine benefit flows). This has been typical of private-sector plans as well. One systematic distinction which I will not mention further arises because some public-sector workers are not covered by Social Security; DB plans for these employees are typically more generous in their average benefit level while exhibiting the same accrual patterns as other DB plans do.[7]

2.1 Computing DB pension wealth at retirement

DB pensions typically pay retired workers an annuity – that is, an income flow until death.[8] Denote the annual benefit paid out each year after retirement in year t as b_t, b_{t+1}, b_{t+2}, … . In turn, this benefit flow can be assigned a cash value B_t that represents expected future benefits. *Pension wealth* B_t^{DB} in DB plans equals the expected present value of future pension benefits if the worker retires in year t:

[6] Much of this material is based on Friedberg and Owyang (2002).

[7] For example, roughly 30% of teachers are not covered by Social Security (NEA 2006). Costrell and Podgursky (2009) find somewhat larger pension contributions as a share of earnings in noncovered systems for teachers, with employees contributing an average of 7.8% and employers contributing about 11.1%. In covered systems, employee and employer contributions average 4.5% and 9%, respectively, in addition to the combined employer and employee payments to the Social Security system.

[8] Some private-sector DB plans now offer the option of cashing out at retirement via a lump-sum distribution that is actuarially equivalent to the annuity promised value of payouts. Some public-sector plans offer options for survivor benefits, whereby the retiree accepts a lower payment and designates a survivor to receive benefits after her death, until the survivor's death. These are not incorporated above.

$$B_t^{DB} = E\left[\sum_{j=0}^{\tilde{T}} \frac{b_{t+j}}{(1+\tilde{r}_{t+j})^j}\right] \approx \sum_{j=0}^{\bar{T}} \frac{\pi_{t+j} b_{t+j}}{(1+r_{t+j})^j} = b_t + \frac{\pi_{t+1} b_{t+1}}{1+r_{t+1}} + \frac{\pi_{t+2} b_{t+2}}{(1+r_{t+2})^2} + \ldots \cdot$$

Pension wealth equals the discounted sum of expected future benefits. Benefit payments are discounted by the future interest rate $\tilde{r}$, representing the opportunity cost of receiving, say, b_{t+1} one year after retirement instead of immediately at *t*. The expectations operator *E[.]* reflects four possible sources of uncertainty, the first two of which are represented in this formula. First, the cumulative benefit flow is uncertain because the date $\tilde{T}$ of death is unknown. To deal with this uncertainty, the formula discounts benefits in year *t+j*, for example, by including the probability π_{t+j} of surviving until future period *t+j*, conditional on having reached *t+j-1*. Second, the future interest rate is uncertain today, as represented by $\tilde{r}$ instead of known values r. The approximation after the expectations term abstracts from this uncertainty. Third, the real value of future pension benefits is uncertain in pension plans that do not automatically adjust for inflation.[9] Fourth, political uncertainty over the likelihood of receiving future benefit payments may arise if pensioners anticipate that states may cut promised benefits in the event of underfunding. This is not allowed by some state constitutions and is politically difficult even when allowed.[10]

Pension wealth B_t can be viewed as the value of leaving one's job today and claiming the resulting pension benefits. A worker who is deciding whether to retire this year or to delay should also consider the value of waiting to claim benefits at a future retirement date. This can be defined in terms of *pension wealth accrual* ΔB_{t+1}, the difference between the discounted value of waiting one more year and then retiring and gaining B_{t+1} and retiring today and gaining B_t:

$$\Delta B_{t+1} = \frac{1}{1+r} B_{t+1} - B_t \ .$$

Again, the discounting stems from the fact that receiving a dollar today is more valuable than receiving a dollar next year (and the interest rate is assumed to be known).

2.2 The evolution of DB pension wealth

Pension wealth evolves nonlinearly as workers move through their career. This is because benefits depend in complicated ways on the path of career earnings and on job tenure and age upon retirement. To see this in a snapshot, Figure 2-A shows pension wealth B_t^{DB} in the Teacher Retirement System of Texas, and Figure 3-A shows a typical DB plan and, by contrast, a typical DC plan, both from the private sector and observed in the Health and Retirement Study (Friedberg and Webb 2005).[11] Figures 2-B and 3-B, in turn, show pension wealth accrual ΔB_{t+1} in the same plans.

As people work longer in a job offering a DB pension, DB pension wealth rises, but in a starkly nonlinear fashion, with occasional jumps upward and, in many cases, a late drop-off. There are often between one and three crucial dates when the path of DB pension accrual spikes upward, for

[9] Many states offer formulaic cost of living adjustments, for example 3% per year in Georgia and Florida, and the Consumer Price Index up to 3% per year in Colorado. Income taxes are not shown in this formula, but some states offer preferred income tax treatment for public employee benefits.

[10] Monahan (2009) documents the legal and constitutional status of benefit obligations across states.

[11] These pension plans are based on information in the Health and Retirement Study (HRS) and have been slightly altered, as described in Friedberg and Webb (2005), to protect confidentiality. The HRS is a nationally representative study of households with at least one member aged 50-62 in 1992. The HRS obtained detailed information about pension plans directly from employers of survey respondents.

example with one very large spike in Figure 2-B (and two small ones) and twice in Figure 3-B, and most plans show later losses in pension wealth.

The first jump occurs at the vesting date, when a worker first qualifies for future benefits. The modal vesting period in teacher plans is five years, as in Texas, although Arizona and Wisconsin vest immediately while thirteen states have vesting windows of ten years (NEA 2008). The plan in Figure 3-A vests after a worker spends ten years on the job, after which she begins to accrue a claim to future benefits – though she does not yet qualify for an immediate benefit upon leaving the job. Pension wealth in 3-A leaves the horizontal axis upon vesting and jumps up to a value of almost $60,000.

The other spike in Figures 2-B and 3-B occurs when someone reaches full years of service at the plan's *normal retirement age* (NRA). In Texas, the NRA is either age 65 with 5 year of service or follows a "rule of 80", where age and years of service (for five or more years of service) must at least equal 80. In Illinois, the NRA is 62 with 5 years of service, 60 with 10 years, or 55 with 35 years. If a worker retires at the NRA, then her DB plan will start to pay out benefits immediately. The initial benefit b_t at the NRA is typically a proportion of the worker's recent salary, with the proportion increasing in tenure, along the following lines:

$$b_t^{NRA} = \text{years of service} * \text{final average salary} = \alpha_t \overline{Y}_t$$

$$\alpha_t = \alpha(t-\theta), \quad \overline{Y} = \frac{\sum_{s=t-\tau}^{t} y_s}{t-\tau} .$$

The benefit b_t^{NRA} is proportional to the *final average salary* $\overline{Y}_t$, which is average earnings in the τ years before retirement, where τ generally ranges between 1 and 5 years (NEA 2008). The proportional factor α_t that multiplies final average salary usually rises with *service credits*, measured as each year of service since the starting year θ in the job. Virginia, for example, pays α = 2.3% multiplied by each year of service multiplied by the average salary over the τ = 5 highest consecutive years, while in Illinois, α = 2.2% and τ = 4, and in addition b_t cannot exceed 75% of $\overline{Y}_t$.

Retiring before the NRA often reduces pension wealth for a few reasons. Many plans have an "early retirement age" (ERA); upon reaching that age, one can immediately receive benefits, but they will be reduced from the value in the formula above. Plans with an ERA exhibit a middle spike between vesting and the NRA. In Texas, retiring at the ERA of age 55 with 5 years of service or at any age with 30 years of service reduces annual benefits according to an actuarial formula; in other states, the reduction rate varies between 3% and 6% for each year before the NRA. Whether or not a plan offers early retirement, retiring before the NRA erodes pension wealth because fewer service credits are accumulated (so α_t is smaller) and because final average salary is not adjusted for inflationary gains after retirement and before benefits begin (so $\overline{Y}_t$ is smaller, whereas staying in the job would yield those gains). These factors account for the gradual increase in pension wealth after the vesting date in Figures 2 and 3.

Lastly, retiring after the NRA reduces the number of years that full benefits are received and hence reduces the present value of benefits at retirement – one gives up current pension benefits income without replacing them later on, as benefits cease upon death. This accounts for the decline in pension wealth after the NRA.

2.3 DC pension wealth

At this point, we contrast the path of pension wealth accrual in DB plans to DC plans, like 401(k) accounts. As may be apparent from Figure 3, DC plans require only a brief explanation. Simply put, an annual contribution is made to a retirement account and that account belongs to the worker whenever she leaves her job, possibly after a vesting period. The funds grow at the rate of return $\tilde{r}$. Pension wealth after vesting is simply

$$B_t^{DC} = B_{t-1}^{DC}(1+\tilde{r}_t) + c_t^{DC},$$

the amount of accumulated funds plus this period's contribution c_t.[12] Pension wealth accrual is therefore constant if there is no change in the rate of return or in the contribution rate, as is assumed in Figure 3. The smooth path of DC pension wealth accrual shown stands in stark contrast to the bumpy path of DB accrual.

3. Studying the Impact of Pensions on Worker Mobility and Retirement

This section offers an object lesson in understanding the labor market effects of pensions. While I review many possible effects later on, I focus first on the most studied aspect of pensions in the labor economics literature – the effect on worker exit from jobs. The nonlinear pension wealth accruals generated by the features of DB plans should influence worker mobility in distinct ways over the course of one's career. Workers have an incentive to stay in their jobs until reaching the late-tenure peaks. Later, the incentives abruptly reverse, inducing retirement after the last peak is reached and continued tenure then erodes pension wealth. It is not surprising to find, then, that the recent spread of DC plans with flat accrual rates appears to be generating delays in retirement.

I discuss the practical difficulties in studying this question – especially in obtaining useful data and establishing convincing econometric identification. I discuss the potential for surmounting these problems in studying government workers and then present evidence from papers that have done so in broader studies. These papers find that DB pensions have influenced job exit, especially the timing of retirement.

3.1 Empirical limitations in studying pensions

A common theme later on, when I discuss numerous theoretical implications of pensions on labor markets, is that the empirical evidence is inadequate to confirm or refute these implications. I will discuss some major reasons for this here, as they are common across various questions of interest. I will then show how these issues have been addressed in studying labor market effects of pensions and finish by suggesting ways in which studying state and local pension plans may provide additional opportunities to surpass these limitations.

Data limitations. It is typically quite difficult to obtain detailed data on the structure of compensation. As seen above, numerous pieces of information about both the individual and the plan are required to compute complicated pension benefits. Moreover, studies of worker mobility require observing not just current work status but mobility – either job exits or retirement, or at the very least current tenure in a job (as long tenure is a result of reduced mobility).

[12] Contributions are tax-deductible (as are a firm's contributions to fund a DB pension), and returns accumulate tax-free. Withdrawals from DC pensions, like DB pension benefits, are taxable. Thus, the tax treatment of DB and DC plans is equivalent.

The most successful studies of pensions have dealt with these requirements by using longitudinal data that tracks workers into retirement and includes detailed data on earnings and pensions, the latter usually obtained directly from employers. Cross-sectional data is unlikely to be useful because it fails to report data on compensation structure in past jobs of currently retired workers, or at best only includes worker-reported data. Workers' reports on the structure of compensation have not proven to be reliable because individuals often make mistakes in reporting their earnings histories and routinely make mistakes in describing their pension parameters (Gustman and Steinmeier 1999, Chan and Stevens 2004).

Employer-reported data on pensions can be obtained in one of two ways. One is with an employer-based data set, which uses personnel records to track workers of a single employer. The advantages of this are extremely accurate information on employment history in the job, earnings history, and pension parameters. A major disadvantage of this is lack of availability, as most firms do not share such records, and, if they do share them with a particular researcher, they are not made widely available to the research community. Conditional on obtaining such data, another disadvantage is the lack of further information about factors (spouse's employment status, health, family finances) that affect retirement but are not observed by employers. Another concern is that behavior of workers in a particular firm may tell us little about expected behavior of the population as a whole, as these workers may be quite different from average individuals. A last set of concerns about identification (small sample size, lack of variation in pension parameters) will be discussed soon.

The other source of employer-reported data is a handful of nationally representative longitudinal surveys. These surveys asked permission to contact the employers of respondents to get pension information, via the Summary Plan Description that employers are legally required to provide to the U.S. Department of Labor and to plan participants. This was done one time in the 1980s by the Survey of Consumer Finances and has been done periodically since 1992 by the Health and Retirement Study. This process yields incomplete information, however, since not all respondents give permission or give usable information that allows contact, and sometimes specific plans cannot be matched to a respondent when an employer administers multiple plans. In other ways this approach solves many of the problems noted above for single employers, as rich information can be collected from the individual about factors influencing retirement and sampling methods make such data sets nationally representative.

Two possibilities arise for studying government employees in this manner. One is to obtain administrative records from state governments on a confidential basis. Another is to use nationally representative data with enough state and local government employees, or focused exclusively on government employees, and with information on location of residence, since state pension plan data is publicly available.

Limitations of econometric identification. Another problem with studying the impact of pensions on behavior is incorporating variation in plan incentives that is sufficiently great in magnitude and convincing in exogeneity. Using data on a single employer raises some particular difficulties here. Variation in pension plan incentives arising across workers within a single firm is a function partly of particular pension parameters, which may (with caveats discussed below) be viewed as idiosyncratic and exogenous to the individual, and partly of individual earnings, tenure, and age, which are unlikely to be independent of individual retirement behavior. It is possible that worker behavior could be studied before and after a firm changes its pension parameters; however, ERISA

does not allow employers to make changes that alter pension wealth already earned by the worker (though a recent court decision does allow changes to future pension wealth accruals). In practice, most plan changes apply to newly hired workers, resulting in a long time horizon before job exit effects could be observed.[13]

This issue arises to some extent with data like the HRS, but the large multitude of plans observed among respondents gives a much greater role to idiosyncratic plan parameter variation. Using either type of data, one can control separately for individual earnings and tenure, which influence both pension benefits and job exit, when estimating the effect of pensions on job exit. With a single-employer data set, this may not leave sufficient variation in pension incentives to obtain precise estimates. Studies of public sector employees, again, offer new opportunities to incorporate variation in pension plan incentives, especially to the extent it is possible to obtain data on state employees across multiple states.

So far, this discussion has treated variation in plan parameters across as essentially random – as almost every study of pension plan effects does. The discussion later about motives for offering pensions suggests, though, that particular firms (or U.S. states) may choose pension parameters to suit their particular needs (for example, inducing retirement when worker productivity begins to fall) or to attract certain types of workers (those who do not want to change jobs often before retirement). If so, that could make plan parameters endogenously determined with worker characteristics – a problem that has not been solved in any empirical paper to date, but that must be kept in mind when reading the empirical evidence discussed next.

3.2 Evidence about pensions and retirement

As little analysis has focused on public-sector workers, this section and the next review evidence from the labor economics literature, based in part on the analysis in Friedberg and Turner (2010), about mobility responses of workers in general. This literature suggests that the timing of retirement responds strongly to the timing of DB pension wealth peaks.

Evidence from employer-specific DB pension plans. Early evidence about retirement effects originated in case studies of employer plans (Kotlikoff and Wise 1985, 1987, 1989, Stock and Wise 1990a, 1990b, Lumsdaine, Stock and Wise 1992, Ausink and Wise (1996). The spikes and dips highlighted in Figures 2-3 were if anything more extreme in many of these plans. Those papers made it clear that DB pension incentives were often substantially sharper than similar incentives arising through Social Security, which had already been much studied.[14]

Among these, Stock and Wise (1990a) developed the most sophisticated econometric analysis to estimate the impact of the DB pension incentives. They emphasized the importance of the "Option Value" of continuing to work. In contrast, previous research had estimated the effect of the next year of DB pension wealth accrual on retirement, which did not capture the fact that early retirement eliminates the option to gain later spikes like those in Figure 2-3. The Option Value

[13] Two other problems with this approach are that other things may be changing at the same time in that firm, and observing workers in one firm offers no possible control group; and that other things changing at the same time may be driving the pension or other staffing changes.

[14] Perhaps the first paper pointing out the link between pensions and retirement was Burkhauser (1979), but early work was hampered by a lack of data.

approach reflects the extent to which deciding not to retire today affects the full future path of pension accruals.

To gauge the importance of the option to continue work, Stock and Wise not only computed the full path of pension accruals but also parameterized a utility function to weigh the tradeoff between leisure and consumption across current and all future periods that is implicit in the retirement decision.[15] Thus, a person who retires today gains more leisure time but surrenders the option to gain future pension peaks that augment consumption later on. This highly parameterized structural econometric approach involves the usual trade-offs – gaining a great deal of insight from the resulting structural estimates into a variety of possible retirement scenarios, at the cost of relying on strong assumptions that underlie the structure.

Stock and Wise estimated their retirement model using personnel records for 1,500 salesman in a large Fortune 500 firm. The salesman were aged 50 and over as of January 1, 1980, so the results are somewhat dated. Their estimates show that most workers in their sample retired before age 62, when Social Security benefits first become available – suggesting that pension rather than Social Security incentives drive retirement, especially due to the plan's early retirement age (ERA) of 55. Simulating an ERA of 60 instead of 55 results in a predicted drop in the percentage of workers leaving the firm before age 60 from 65% to 42%. In fact, the percentage leaving between ages 50 and 54 rises, as the pension wealth spike at the ERA grows more distant at those ages, but the percentage leaving between ages 55 and 59 drops substantially, from 46% to 14%, with almost no one leaving at age 59.

Ausink and Wise (1996) estimated the option value model for a sample of U.S. Air Force pilots. As a study of government employees, this has some added relevance for understanding state and local employee retirement. Ausink and Wise incorporated data on private-sector opportunities, as most Air Force pilots exit at relatively young ages and do not retire into leisure but take jobs with commercial airliners. The estimated model parameters, reflecting preferences over consumption today versus at future dates and earnings from different sources take somewhat different values than those of the same model in Lumsdaine, Stock and Wise (1992). This shows that pilots would respond differently than the private-sector workers in the earlier paper, given the same pension incentives. This is not surprising, as the samples are quite different in age and perhaps in preferences for leisure, risk-taking, etc. This paper may be most relevant for public-sector occupations, like police, with relatively similar private-sector alternatives. An additional paper, by Asch, Haider, and Zissimopoulos (2005), focus on federal government workers, but since they use methods discussed next, I will hold off on discussing their analysis.

The set of results in these papers brought new attention to the study of employer pensions. However, the results are limited in the ways discussed earlier. Personnel records offer very limited information about factors other than compensation that are relevant to retirement decisions. Also, the results may not generalize to the whole population. A related concern that is difficult to deal with is that the sample of workers at the firm they examine may be selected – they may choose to work at a firm like this because they value retirement security as opposed to a higher salary upfront.

[15] Their formulation of the retirement problem did not reach the complexity observed in the retirement literature that focused on Social Security, as they lacked the type of information about individuals that is present in surveys but not employer records.

Evidence from nationally representative surveys. Subsequent papers made advances on the concerns raised in the earlier work by using data from large, broadly representative longitudinal surveys that contacted employers of respondents to obtain pension data. Two data sets, the Survey of Consumer Finances (SCF) and the Health and Retirement Study (HRS), have done this, and the HRS has also undertaken the laborious process of programming a pension calculator available to researchers that incorporates all key pension plan parameters in each of a few thousands of plans.

Samwick (1998) used the SCF, which obtained pension data for respondents in 1983. The SCF also had a short panel that re-surveyed respondents in 1986, yielding observations on some retirements.[16] Samwick's goal was to compare the importance of Social Security and DB pensions in explaining early retirement trends. Samwick used the Option Value measure developed by Stock and Wise and described above.[17] He found that the level of pension wealth does not significantly affect retirement, while the path of accruals strongly does. This result has been confirmed in later papers, discussed next. Samwick also confirmed that the Option Value measure, capturing the full path of future pension accruals, does a superior job in explaining retirement as compared to the one-year pension wealth accrual measure in this large sample of workers from numerous firms. His estimates suggest that extending DB pension coverage, using a representative plan, to all workers in the SCF would raise the probability of retirement between ages 50-70 by 4.9%. As this corresponds to roughly the increase in DB coverage observed in the postwar period, it suggests further that DB pensions account for over a quarter of the total decline in the average U.S. retirement age. The estimates indicate that altering Social Security incentives would have smaller effects on retirement.

Coile and Gruber (2007) and Friedberg and Webb (2005) studied retirement using data from the HRS, the most current and comprehensive data set that follows workers into retirement.[18] Each emphasized distinct aspects of the relationship between retirement and the accrual of retirement wealth.

The innovation in Coile and Gruber was to use a simpler measure of retirement incentives, which they termed *Peak Value,* instead of the utility-based Option Value measure from Stock and Wise. Peak Value is similar to the annual pension wealth accrual measure defined in Section 2. But, instead of subtracting this year's pension wealth upon retirement from the discounted value of next year's pension wealth, in order to measure the gain from working one additional year, it is subtracted from the discounted value of peak pension wealth, to measure the gain from working until pension wealth reaches its peak. In Figure 3-B, this occurs at the plan's Normal Retirement Age. Thus, the Peak Value *PV* of pension wealth is defined as

$$PV = \frac{1}{(1+r)^m} B_{t+m} - B_t \quad \text{if} \quad m > 0$$

where *m* represents the number of years from today until the peak in pension wealth is reached. If a person has reached or passed her pension's peak, then Coile and Gruber define Peak Value as simply the annual pension wealth accrual, so *m = 1* above.

[16] Both of the components that facilitated Samwick's research – pension information from employers and the panel aspect of the SCF – were subsequently discontinued.

[17] The version in Samwick assumes rather than estimates values for the discount rate and relative value of leisure due to identification problems.

[18] While Coile and Gruber was published after Friedberg and Webb, it was begun a little earlier.

The attraction of Peak Value is that, first, it abstracts from numerous functional form assumptions that Stock and Wise required in order to estimate the utility function and, second, it avoids directly incorporating earnings into the same measure as pension accruals, which Option Value does. Coile and Gruber make a point of controlling separately for earnings and job tenure, so these possibly endogenous variables only influence pension wealth, and indirectly retirement, through the idiosyncrasies of the pension formula. Otherwise, the estimated relationship between pension wealth or pension wealth accruals and retirement might result spuriously from a true correlation between, say, earnings and retirement.

Coile and Gruber focus primarily on using Peak Value to measure Social Security incentives, though in some specifications they included Peak Value from employer pensions as well. In their probit estimates, controlling for either the Peak Value or Option Value measures of Social Security wealth accrual yields statistically significant estimates. The estimation with Option Value raises the log likelihood, but not by a great deal; Coile and Gruber argue that this may occur because earnings do in fact add explanatory power, though it may be spurious, in the model. In models that included both, they estimated that Social Security and employer pension accruals have similar effects on retirement. Specifically, a one standard-deviation increase in someone's Peak Value from either Social Security or their pension raises their likelihood of retirement by one percentage point, or 14% of the baseline retirement hazard.

Friedberg and Webb (2005) built on Samwick's focus on DB pension incentives in a large data set by exploring the effects of the major shift from DB to DC plans that began in the early 1980s. They built on Coile and Gruber's use of the HRS and the Peak Value measure by clarifying the definition of Peak Value and by exploring the further impact of other pension plan details. Coile and Gruber applied the Peak Value definition above to both DB and DC plans. Friedberg and Webb only defined Peak Value for DB plans, as DC pensions never reach a peak as long as DC plan contributions remain constant and the individual time discount rate does not exceed the interest rate. As long as these reasonable assumptions hold, then simply controlling for DC pension wealth incorporates the full information about the path of DC pension wealth accruals. They also defined Peak Value as zero after the peak is passed, adding a separate dummy variable indicating that the peak has past, so as not to impose linear effects of Peak Value even after pension wealth has passed its peak. Lastly, they explored the sensitivity of the empirical specification to additional related pension controls.[19]

The estimates in Friedberg and Webb indicate that having the mean Peak Value for stand-alone DB plans, rather than a Peak Value of zero (which happens upon reaching or passing the peak or if one has a DC plan) reduces the annual retirement hazard by 1.7 percentage points at ages 55-59, a 29% reduction compared to the observed hazard. Based on this, they simulated the effect of the ongoing shift in pension structure from DB to DC plans. The results imply that this will raise the median retirement age of full-time employees with a pension by about ten months when comparing cohorts aged 53-57 in 1983 and in 2015.

[19] They found that the NRA has a significant effect on retirement independent of Peak Value, while controlling separately for years to peak along with Peak Value does not. They allowed for separate effects of DB Peak Value depending on whether someone has a stand-alone DB plan or a DC plan too and found that the estimated effects of DB incentives in either situation are quite similar; this is a piece of evidence against endogenous sorting of heterogeneous workers based on their ex ante preferences for DB or DC plans.

A final paper by Asch, Haider, and Zissimopoulos (2005) uses administrative data, rather than survey data, but employs the Peak Value and Option Value measures to analyze retirement among federal civil service workers. Their results suggest that the probability of retirement falls by 4% for each additional $10,000 of expected pension wealth they would gain by working another year. This estimate is very similar in magnitude to the Coile and Gruber estimates for the impact of Social Security in the HRS sample – giving us reason to think that public-sector workers respond similarly to pension incentives as private-sector workers.

3.3 Evidence about pensions and worker mobility at younger ages

The evidence described in the previous section indicates that retirement timing is strongly influenced by the timing of peaks in DB pension wealth accumulation. At younger ages, we should see the inverse relationship – workers should have a lower propensity to exit jobs with DB pensions so that they can gain access to these future peaks. The present value of those peaks is relatively small early in a career, however, attenuating the incentive to stay (Gustman and Steinmeier 1993). These deterrents then grow, with an average pension loss associated with switching jobs for workers aged 35-54 of approximately half a year's earnings, computed for representative workers in the mid-1980s (Allen, Clark, and McDermed 1988). Thus, mobility should be increasingly inhibited as tenure rises.

Empirical evidence from the labor economics literature about this response is suggestive but not definitive. The empirical limitations discussed earlier account for the less substantive evidence in this case, compared to the analysis of retirement. Mobility at younger ages has been more difficult to study than retirement because the HRS only covers people aged 50 and over, and the SCF pension data is quite dated. Firm-level administrative data has not been used to examine younger workers either. The only alternative in the literature has been to use other nationally representative data sets, relating simple indicators of pension coverage or pension type to exit from or years of tenure in the current job – forgoing the chance to gain identification from idiosyncratic variation in mobility incentives across workers with DB plans.

Early attempts, as in Allen, Clark, and McDermed (1988), compared mobility of workers with and without pensions. More recently, the spread of DC pensions has offered the opportunity to compare mobility of workers with DB and DC plans. Such workers are more similar in other observable characteristics than workers with and without pensions, reducing (but not eliminating) concerns that workers with different characteristics, and hence different propensities to leave later, choose jobs based partly on pension type. This type of comparison underlies the strategies in Gustman and Steinmeier (1993) and Friedberg and Owyang (2005). Gustman and Steinmeyer used the Survey of Income and Program Participation, observing job changes between 1984 and 1985. Friedberg and Owyang used the 1983-2001 releases of the Survey of Consumer Finances (SCF) and the 1993 pension supplement of the Current Population Survey (CPS), both of which asked workers about job tenure.[20]

Friedberg and Owyang found that workers with DB pensions in the SCF have significantly longer job tenure, as measured by both current tenure and expected future tenure, than do workers without pensions and workers with DC pensions. Workers with a DB pension have total expected tenure

[20] The SCF, a repeated cross-section occurring every three years, is the only survey that was undertaken regularly since the early 1980s, when DC plans began to supplant DB plans; that reports both current and expected remaining job tenure; and that reports pension type for a large, nationally representative sample.

that is 5.0-7.0 years longer on average than workers without a pension, while workers with a DC pension have total expected tenure that is 2.5-4.0 years longer, with very similar findings in the CPS. They found further that workers with higher DB pension wealth (though imperfectly measured, as it is based on self-reported and not employer-reported pension parameters) have longer tenure, controlling for the level of earnings. Thus, workers with DB plans stay in jobs considerably longer than do other workers, though it is puzzling to find that workers with DC plans also stay in jobs somewhat longer than workers without pension coverage – possibly reflecting some unobserved heterogeneity in worker type.

The results from Friedberg and Owyang differ importantly from the earlier estimates of Gustman and Steinmeier (1993). Gustman and Steinmeier found similar mobility rates for workers with DB and DC pensions, apparently undermining the hypothesis that DB plans deter mobility relative to DC plans. The Gustman and Steinmeier results arise in a different data set, the SIPP, which has not been used again to study pensions and job mobility. They used a short panel from the first SIPP, observing job changes from 1984 to 1985 – a much earlier time period when DC plans were only beginning to proliferate, possibly one reason why they do not find mobility differences across pension types. The SIPP does not query respondents as carefully or persistently about pension coverage as the SCF does, generating concerns about measurement error, especially in light of the Gustman and Steinmeier (1999) evidence that people have imperfect knowledge about even their pension type. Another difference is that Gustman and Steinmeier, unlike Friedberg and Owyang included a control for compensation in the likeliest alternative job for each worker. They did so by using compensation changes associated with observed job switches to impute alternative compensation for workers, with an adjustment for selection bias, who did not change jobs. The results then hinge on specifying this relationship correctly. Yet, they obtain an anomalous result that a dollar of delayed pension compensation has a much greater effect in deterring mobility than does a dollar of current compensation, when measured in equivalent present value terms. In Friedberg and Owyang, current earnings having a greater effect than pension wealth on job tenure.

To sum up, the evidence that DB pensions deter worker mobility at younger ages is less definitive than evidence about their influence on the timing of retirement. Econometric identification of the estimates is less straightforward without the opportunity to idiosyncratic variation in mobility incentives across workers with DB plans. Hence, this remains an open question, one that may be possible to answer by studying teachers' careers.

3.4 Evidence about public school teachers

Recently, researchers have begun to apply the tools developed in the labor economics literature to study how retirement of public school teachers responds to DB pension incentives. These tools include acquiring longitudinal data to track job exit, carefully measuring pension wealth accruals over long horizons, and estimating models that match the timing of pension wealth peaks and job exit. Two types of data are being employed in this ongoing work. Costrell and McGee (2010), Ni and Podgursky (2010), Brown (2009), and Ferguson, Strauss, and Vogt (2006) use administrative data from particular states, while Friedberg and Turner (2010) use nationally representative teacher survey data.

In the earliest effort along these lines, Ferguson, Strauss, and Vogt use Pennsylvania teacher records to study a temporary retirement incentive program. Using a simple reduced-form strategy, the authors estimate that the substitution elasticity of retirement is significant and quite negative, so that

retirement responses were substantial. As Brown notes, though, it is not clear that responses to a temporary program can tell us much about the effects of permanent pension reform.

Costrell and McGee estimate the effect of Peak Value on retirement of Arkansas teachers. They modify the Peak Value definition by limiting the time period *m* over which the peak is calculated to five years. They suggest that behavioral responses occur over limited time horizons but also report that this makes no substantive difference in their estimates. One of their explanatory variables is an indicator that a teacher chose to participate in the Arkansas "T-DROP" program, which allows teachers with at least 28 years of service to save a portion of their otherwise foregone pension benefits if they continue to work. While this variable is recognized as endogenous, the authors' goal is to control for a revealed preference to delay retirement. Lastly, the authors are able to include some characteristics of the school environment in which teachers work, finding that teachers in districts that are larger and have higher math scores retire later. They use estimates from their random-effects probit model to simulate pension reforms. Interestingly, eliminating early retirement, currently available at 25 years of service, would lead some teachers to work until full retirement at 28 or 30 years but would lead others to retire earlier, as they face a reduced incentive to wait until 25 years and find waiting even longer unappealing. With the two effects moving in opposite directions, the average retirement age is predicted to increase by a half year overall. Ni and Podgursky (2010) are undertaking a similar effort for Missouri teachers, and their analysis compares the simple Peak Value measure with Stock and Wise's full structural estimation approach.

Brown uses some novel empirical strategies that are more closely related to the income tax literature. These methods are applicable here when viewing pensions as altering the lifetime budget constraint that a worker faces when deciding in which year to retire; however, they are less suited for capturing year-to-year variation in circumstances such as classroom characteristics or health status. She applies them to studying California teachers and gains identification from an unexpected boost policy change in 1999 designed to induce teachers to delay retirement. One estimation strategy in the paper uses a reduced-form approach and then applies the insights of Saez (2002) to infer the elasticity of retirement at the kink in the lifetime budget constraint that shifted at 60 years in age and/or 30 years of service. The other strategy in the paper estimates a structural retirement model based on the piecewise linear budget constraint approach of Burtless and Hausman (1978) and Burtless and Moffitt (1985). The resulting estimates from the two approaches are similar, indicating an elasticity of retirement with respect to its price of 0.02 in the medium-run and 0.10 in the long-run (within five years). Brown describes this as a surprisingly price-inelastic response and shows that the average retirement age will increase by only 1.5 months if the annual financial return to working increases by 10%. The fact that California teachers adjusted their retirement plans over time in response to this change may help explain the relative unresponsiveness over the time horizon examined here. The small aggregate change may also mask the contradictory effects at the micro level that Costrell and McGee uncovered, with some teachers delaying retirement as its price is reduced but others perhaps retiring earlier as the gains from waiting have been reduced as well.

Lastly, Friedberg and Turner (2010), in work that is underway, use the Teacher Follow-Up Survey (TFS) component of the Schools and Staffing Survey (SASS). The SASS offers repeated cross-sections of approximately 50,000 teachers per year and has been undertaken every 3-4 years since 1987. The TFS follows up with respondents a year later, revealing whether they have exited from their jobs and retired or taken another job. In addition to demographic information, the SASS asks a full battery of questions about teaching credentials, characteristics of the schools in which teachers

work, subject matter taught, type of students instructed, classroom autonomy, and job satisfaction. These provide measures of teacher quality and satisfaction that will help determine what kinds of teachers respond to retirement incentives. Friedberg and Turner compute pension wealth accruals and Peak Value using pension data from state websites and from the National Education Association, which issues biannual reports tabulating pension plan parameters in all state plans. They estimate probit models of retirement as a function of Peak Value, and preliminary results indicate significant and strong responses.

Future work in this area can be extended in at least two directions. One approach will be to link student and teacher personnel records. The education literature has used longitudinal test score data to form measures of value-added, using average test-score gains of students to compute the effects coming from being in a particular classroom that year. This offers the most promising way of examining whether better or worse teachers respond most readily to retirement incentives.

The other approach will be to examine mobility of younger teachers. One unanswered question is whether the long delay in substantive pension wealth accrual for new teachers impedes optimal mid-career entry into the teaching labor force by people who have built up private-sector experience. Another is whether the lack of portability across pension programs for schools operating under different organizational control impedes entry of young teachers or encourages their rapid exit. These questions involve not just mobility across public school systems but also across public, private, and charter schools. The potential to answer them using administrative data or the SASS bears further investigation.

4. Why Do Pensions Exist?

I move on now to discuss theories that explain the existence of pensions and of the peculiar structure typically observed among DB pensions. The empirical difficulties discussed earlier move to the fore here, making it difficult to distinguish among particular theories.

4.1 Theories of DB pensions

Why is part of compensation commonly deferred in the form of a pension? Individuals should prefer to receive cash up-front rather than waiting for it. The prevalence of pensions suggest that they must make employers or employees or both better off.[21] A theory of pensions as a form of deferred compensation was developed in a series of papers by Lazear and summarized in Lazear (1986); it is also related to Becker and Stigler (1974).

Lazear viewed pensions as a component of an implicit contract that alters the incentives for long-term employment. While employers often avoid explicit long-term contracts because they hamper flexibility and are subject to limited enforceability, many nonetheless wish to encourage workers to stay in a job or to devote greater effort to a job. Several benefits may arise from longer time horizons in jobs. Less turnover reduces hiring costs and allows employers to gain the benefits of investing in the human capital formation of particular workers. The expectation of longer tenure then raises the rate of job training and results in higher productivity and profits, which the employer can share with the worker in the form of a DB pension. Alternatively, deferred compensation may function as an efficiency wage, encouraging workers to devote greater effort to their jobs. In some jobs it is difficult or costly for employers to monitor workers who may shirk their responsibilities.

[21] Much of this discussion is based on Friedberg and Owyang (2002, 2005).

Paying an *efficiency wage* that is higher than the going wage in other jobs can deter shirking, since a worker will lose her high-wage job if shirking is detected. Deferred compensation can also function as an efficiency wage – in which case the DB pension is like a bond – since a shirking worker can lose her job before qualifying for a pension.

An obvious form of deferred compensation is the implicit promise of future wage increases. If a fixed amount of wages are to be paid over some duration, wages can be structured to rise over time by paying a worker less than her marginal product early on and more than her marginal product later.[22] However, two problems arise with either implicit or explicit promises of wage increases. First, they encourage workers to stay *too* long in a job. An aging worker should retire when her marginal utility of leisure, which undoubtedly increases with age, exceeds her wage; the promise of rising wages leads her to retire later than the efficient date.[23] Second, if the long-term contract is implicit and not binding, the rising wage profile creates an incentive for employers to violate the implicit promise by firing workers as their marginal wage gains begin to exceed their marginal productivity gains. This credibility problem undermines the implicit contract; workers will not agree to a rising wage profile if they anticipate getting fired when their wages rise.

DB pensions help resolve both of these problems. A DB pension encourages the worker to retire when the real value of her pension accruals is turning negative, even if wages continue to rise. That, in turn, reduces the incentive of employers to fire older workers, which helps maintain the credibility necessary for the implicit contract.

An alternative to the Lazear framework proposes that DB pensions are designed to attract workers who value stability and are also productive in other unobservable ways (Viscusi 1985, Ippolito 1994). Following from the self-selection models that were pioneered by Salop and Salop (1976), productive workers may also have high private moving costs or a low discount rate – characteristics that are difficult to observe in the job application process. Jobs that offer part of their compensation in the form of a DB pension will attract workers with long time horizons but not mobile or myopic workers.

4.2 Reconciling the existence of DB and DC pensions

While one or both of the explanations discussed in this section may explain the existence of DB pensions, they are quite difficult to distinguish empirically. In the Lazear framework, pensions make workers more productive, and in the sorting model, pensions attract more productive workers. Papers that have sought to test one or the other of these explanations have encountered severe identification problems (Allen, Clark, and McDermed 1993, Even and Macpherson 1990). However, consider the contrast between DB plans and the DC plans which have replaced them – with the exception of generally short vesting periods, DC plans are neutral with respect to tenure incentives. The trend away from DB and towards DC plans may be informative about the purposes of deferred compensation.

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[22] Akerlof and Katz (1989) showed that, in the absence of up-front performance bonds, a rising wage profile alone, without a pension, is insufficient to deter shirking early in the career. On the other hand, wage tilt in Ippolito (1994) is necessary when the DB pension is too small to deter quits, though Ippolito (1991) found that wage tilt had no significant effect on job tenure, while DB pensions did.

[23] Lazear (1979) argued that mandatory retirement ages, which are now prohibited for most workers, helped solved this problem as well.

This trend implies two things that may point the way towards future research. First, whatever motives governed the use of DB pensions in the first place, perhaps along the lines that Lazear suggested, have diminished. Friedberg and Owyang (2005) suggest a connection between the decline in DB pensions from the mid-1980s on and a decline in current and expected future job tenure over a similar period. In the SCF, total expected job tenure (current plus expected future tenure) declined from 27.2 years in 1983 to 22.3 years in 2001 among male full-time employees.[24] They are not able to establish the direction of causation – reduced DB pensions causing declines in job tenure or reductions in desired job tenure reducing the appeal of DB pensions – but these patterns are consistent with more rapid obsolescence of job-specific skills (Friedberg and Owyang 2005, Aaronson and Coronado 2005) or reduced costs of job search (Friedberg, Owyang, and Sinclair 2006).

Second, the shift in pension structure implies that pensions must serve an additional purpose besides influencing worker mobility. The statistics in Figure 1 show that overall pension coverage has declined, but this is dominated by the magnitude of the shift in structure among those who continue to have a pension. Here, I will mention candidate explanations involving taxes, motives for saving, government regulations, and unions, though none of them can fully explain both the existence of pensions and the shift from DB to DC.

Pension contributions by employers or employees are tax-preferred, which may explain the existence of pensions but not the form they take. Tax preferences for DC plans were codified and extended in the 1970s and very early 1980s, leading to the use of some types of DC plans, such as 401(k) accounts. Other DC plans existed previously, however, and the tax explanation for pensions does not account for the form that DB pension accruals take – smoothly accruing DB pensions would enjoy the same tax preferences.

Government may offer tax preferences in order to promote deferred compensation as a way of encouraging workers to save for retirement. One possible reason for government involvement is that optimal long-term saving plans might otherwise be neglected due to the self-control and planning problems that have been emphasized in behavioral economics (Thaler and Sunstein 2008). These notions are in part challenged in a body of research that analyzes whether Individual Retirement Accounts and 401(k) plans lead people to save more than they would otherwise, or simply to shift the form in which they save.[25] Early work suggested that Social Security (Diamond and Hausman 1984) and employer pensions (Dicks-Mireaux and King 1983) also raise total saving by individuals, but these studies face the identification problems noted earlier – factors (like higher earnings and tenure) leading to higher public and private pension benefits may be associated with higher savings rates for other reasons. Consequently, economic research has not established definitive reasons why government may want to subsidize deferred compensation.

Aside from the tax preferences, the government has frequently altered and tightened pension regulations since ERISA passed in 1974. These changes have established funding standards for DB pensions, extended tax incentives for DC pensions, and constrained the structure of pensions,

[24] For women, changes in job tenure have been smaller, reflecting the growing attachment to long-term jobs that is tied to the substantial increase in labor force participation of married women.

[25] Poterba, Venti, and Wise (1995, 1998) find significant positive savings effects, while Engen, Gale, and Scholz (1994, 1996) find that savers with 401(k) plans would have saved as much without them. In the most comprehensive analysis using these methods, Engen and Gale (2000) show that middle-earning groups of workers with 401(k) plans save somewhat more than they would otherwise, but high earners save less.

primarily DB plans. As a result, the costs of administering pension plans have increased, but at a similar rate for all but the smallest plans (Ippolito 1995, Kruse 1995). Moreover, enhanced funding standards may increase the appeal of DB pensions to workers, so that they would be willing to sacrifice additional pay upfront as the security of later payments has increased. Some of the regulatory changes have limited the extent to which DB plans can be designed as incentive contracts (Clark and McDermed 1990). Yet, it is not clear how binding these restrictions are, as DB pension wealth can still accrue highly nonlinearly through various manipulations of the pension formulas described earlier. Moreover, these regulatory changes may have responded to, rather than caused, increases in worker mobility that brought attention to losses by workers of claims to future pension benefits. Ippolito (2001, 2003) makes a further argument that regulatory changes in reversion taxes allowed companies to escape their DB pension obligations more easily than before, which undermined worker confidence and motivated the shift to DC pensions. Coronado and Copeland (2003), however, found that only about half of the S&P conversions which they examined were in a position to be influenced by reversion taxes, however, and a majority increased pensions of existing workers.

Another explanation has focused on the prominent role of unions in negotiating DB pensions. In labor economics models, unions represent workers with an interest in staying with the firm, and they use DB pensions to appropriate surplus from short-tenure workers (Freeman 1985). It follows that the decline in unionization rates might explain the declining use of DB pensions. A problem with this argument is that DB pensions were also prevalent in non-unionized private-sector and federal-government jobs as well in unionized jobs, and they have become less common universally (Friedberg and Owyang 2005).

5. Unanswered Questions

In the previous two sections, I discussed research about the impact of pensions on worker mobility and retirement. I highlighted limitations involving data and econometric identification that this research has had some success in addressing. Next, I discussed the more general question of why DB pensions exist, and here I pointed out the graver difficulties in confronting these empirical limitations. In the current section, I will point out several additional effects that pensions may have on labor markets, some following from the general theories just discussed and some from the particularities of their design. I will emphasize areas where research advances may be possible.

5.1 Pensions and total compensation

In the productivity or selection theories of pensions, lifetime compensation with a pension in place need not exceed the lifetime total if, say, pay were constant each year and no compensation were deferred. Yet, the theories above suggest that deferring compensation will raise productivity, generating additional surplus in the employment relationship that can be shared between workers and firms. The matching and bargaining literature might be most relevant in suggesting a Nash bargaining model to govern this split (Mortensen 1987).

A relevant empirical test, then, is whether an extra dollar in deferred compensation results in an offset to current pay of zero (the employee gets all the surplus), one (the employer gets all the surplus), or something in between. From a practical perspective, though, it remains unclear how much workers know about the details of their pension plans (Gustman and Steinmeier 1999), and, if so, this may depress the offset to current compensation that workers are willing to accept for a dollar of deferred compensation. Lastly, the complexities of the pension accrual formulas make it

difficult to see how employers could offset future benefits exactly for each particular worker, since wage changes typically depend on civil service formulas that apply to all workers. The identification problems of obtaining estimates of the wage-pension offset are acute, moreover, as a model in which employers choose current and deferred compensation simultaneously makes it impossible to estimate the causal effect of deferred compensation on current compensation in a simple econometric framework.

It has been some time since there has been an active literature estimating the tradeoff between pension benefits and current wages. Woodbury and Hamermesh (1992) estimate a broader model of the demand by workers for current wages and for fringe benefits. They use data on dollars spent per employee on wages and benefits at 1477 universities during the 1980s. This data spans before and after the Tax Reform Act of 1986 altered the marginal tax rate and hence the tax subsidy for paying fringes rather than wages, though they do not have information on the precise marginal tax rate that university employees face. Their estimates suggest a high rate of offset. The estimated elasticity of substitution between wages and benefits with respect to their relative price is between 2 and 3, depending on the specification (and underlying identification assumptions). Thus, a 1% increase in the price of paying fringe benefits (due to, say, a decline in the marginal income tax rate), reduces the ratio of fringe benefits to wages by 2-3%. As a consequence, the average reduction in the marginal tax rate of university employees from 44.9% to 40.0% is simulated to reduce the share of benefits in total compensation by 1.5 percentage points, given a baseline share in 1984-85 of 18.0%. Their results further indicate that Social Security coverage raises total compensation – which works against the idea that the after-tax tradeoff between pay and benefits is a full dollar-for-dollar. Unionization has little effect on the composition of compensation for university employees, while public and private universities have the same fraction of compensation going to fringe benefits – suggesting that taxpayers may not bear a disproportionate share of the cost of providing pensions to public employees.

Additional relevant, and more recent, evidence may be obtained from related work that examines the tradeoff between health insurance benefits and current pay. Large jumps in the cost of health insurance provide over-time variation in the cost to employers of providing this benefit. Baicker and Chandra (2006) use even more narrowly defined variation that is driven by rising medical malpractice costs. They estimate that a 10% increase in premia reduces wages by 2.3% – much less than a one-for-one offset. They also find disemployment effects, suggesting real consequences of this apparent wage rigidity. If these results hold as well for pension benefits, the implications are that state and local governments, and hence taxpayers, pay a substantial share of the costs of deferred compensation. Conversely, it suggests that cuts in state pension benefits would not necessarily have to be met with increases in current pay.

One way to extend research on this question is to build on the studies mentioned here by seeking plausibly exogenous changes in pension compensation – for instance, in response to federal regulations (for private-sector plans), income tax rate changes, or state budget crises (though this will affect current compensation as well). In this way, one may observe whether, for example, mandates which increase pension benefits (like the 1974 decrease in maximum vesting dates) lead to higher pensions and subsequent reductions in pay.

5.2 Other features of pension plans

The pension literature has not yet provided evidence about the impact of other differences between DB and DC plans. Table 1, adapted from Friedberg and Owyang (2002) offers a comprehensive

review of these differences. Understanding the impact of these differences is critical as state governments consider shifting workers into DC plans. Besides those related to accrual patterns and portability, a key distinction is that, under DB plans, employers bear the risk of managing pension fund accumulation and decumulation, while employees bear these risks under DC plans.

Asset market risk. The issue of risk has received enormous attention during the recent turmoil in financial markets, as financial market volatility has been transmitted to pension plans. For example, DC plans lost 20% of their value between 2007 and 2008.[26] As a consequence, employers who run DB plans have sounded alarms about managing the effects of asset market declines on pension funding levels. The regulatory necessity of making large contributions to pension funds at a time when capital is particularly scarce has raised concerns that some employers will shed their insured pension obligations to the federal government and that even more will stop offering DB plans altogether. The situation among state and local government pension plans is more severe, as the option to turn over plans to the federal Pension Benefit Guaranty Corporation is unavailable, and funding concerns grew acute just as states were hit by declining tax revenue.

On the other hand, private sector workers and retirees are newly exposed to financial market gyrations through their DC plans, which have lost substantial value over the last year. While the expected rate of return on DC pension wealth in Figure 3 is assumed to be constant, unpredictable changes in the actual return will shift the realized path of pension wealth accrual. Moreover, these shifts appear to be putting a damper on worker enthusiasm for DC plans, whose portability was previously seen as appealing. A broader prediction is that the shift from DB to DC plans will increase the correlation between financial market realizations and the timing of retirement, an effect that has not been closely examined.[27]

Lifespan risk. Another issue in need of study is how retirees will manage decumulation of DC plan assets. DB plans, by offering annuities, provide lifespan insurance, reducing the risk that someone who is lucky enough to live to a very old age will be unlucky enough to outlive their saving. DC plans do not offer this insurance, though they are, instead, bequeathable to one's heirs. Additionally, private annuity markets are extremely small (Friedberg and Webb 2007) and offer products with high load factors (Mitchell et al 1999). Workers with DC plans, lacking lifespan insurance, may choose to save more or retire later. The lack of annuitization should also lead retirees to consume their pension wealth more slowly, even if it is equal to a DB annuity in present value terms. The lessons of behavioral economics raise a different concern, though, that DC plan holders may consume their pension wealth too rapidly. It should be possible to study this issue in the HRS as it follows retirees with different types of pensions through old age.

5.3 Interactions between pension and health insurance benefits

The funding of retiree health insurance is in an even greater crisis than is the funding of pension benefits (Clark 2009). This arises in states that offer to pay some or all of retiree health insurance premia – an increasingly valuable asset. In 2006, 14 states paid none of the premia for retiree health insurance, and 14 paid all (U.S. GAO 2006). Increasing evidence also shows that retirement of

[26] Investment Company Institute, http://www.ici.org/pdf/fm-v19n3.pdf.

[27] See, for example Crary, David, "Market Turmoil Clouds Retirement Hopes of Many Investors." *AP Online*, 18 March, 2001, Sunday Financial pages. *Lexis-Nexis Academic Universe: News: Wire Service Reports*. Online 23 April, 2001. Coile and Levine (2006) did not find evidence that the stock market downturn of 2000 led to delays in retirement, as stock market investments in 401(k) plans of older workers were small at the time.

private-sector workers is influenced by the availability of health insurance coverage after retirement (Gruber and Madrian 1995).

Consequently, any steps to shift greater costs of retiree health insurance onto state and local government workers may affect retirement decisions and hence the drain on pension funds as well. Using administrative or survey data, like the SASS, and exploiting variation in retiree health insurance contributions across states and, possibly, within states over time, should yield some insight into the interaction of pension and health insurance benefits on retirement.

6. Conclusion

State and local government workers have the highest rates of DB pension coverage in any sector in the U.S. economy. Yet, little is known about the labor market effects of DB pensions on state and local workers. This paper reviewed relevant evidence available from studying private-sector workers, as well as very recent studies that have started to look at public school teachers. Given that the current teaching force includes an increasing share of teachers approaching peak pension wealth, understanding how pension incentives affect the labor supply decisions is central to policy discussions. As the federal government workforce has been aging as well, it is likely that the state and local government workforce more broadly is too, bringing them closer to cashing in on their pension benefits. The wealth of variation in pension plan parameters across localities and growing researcher access to staffing records offers new opportunities to study these issues.

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Table 1: Summary of Defined Benefit and Defined Contribution Pension Characteristics

	Defined benefit	**Defined contribution**
Key pension characteristics		
determined by formula	pension benefit	pension contribution
depends on rate of return on funds	pension contribution	pension benefit
influences timing of retirement later	yes	no
Differences during employment		
Pension design		
median vesting period	5 years	0-2 years
timing of pension wealth accruals	most of pension wealth accrues late in career	smooth accrual
portable	no	yes
Administrative control		
controls investment of assets	firm	worker, firm [a]
can borrow against assets [b]	possibly the firm	possibly the worker
bears costs of administration	firm	worker, firm
bears costs of regulatory compliance	firm	firm
Risk		
interest rate risk	firm	worker
underfunding risk	firm [b]	worker [c]
risk of early job severance	worker	-
Differences after employment		
Pension design		
form of pension benefit	annuity	lump-sum
Administrative control		
controls investment of assets	firm	worker
bears costs of administration	firm	worker
bears costs of regulatory compliance	firm	worker [e]
Risk		
interest rate risk	firm	worker
risk of exhausting funds due to long life	firm	worker/heirs
claimant to excess funds due to early death	firm, possibly heirs [d]	worker/heirs

Notes to Table 1:

Source: Friedberg and Owyang (2002)

[a] Employers choose which investment options to offer, usually including investment in company stock and several different mutual funds.

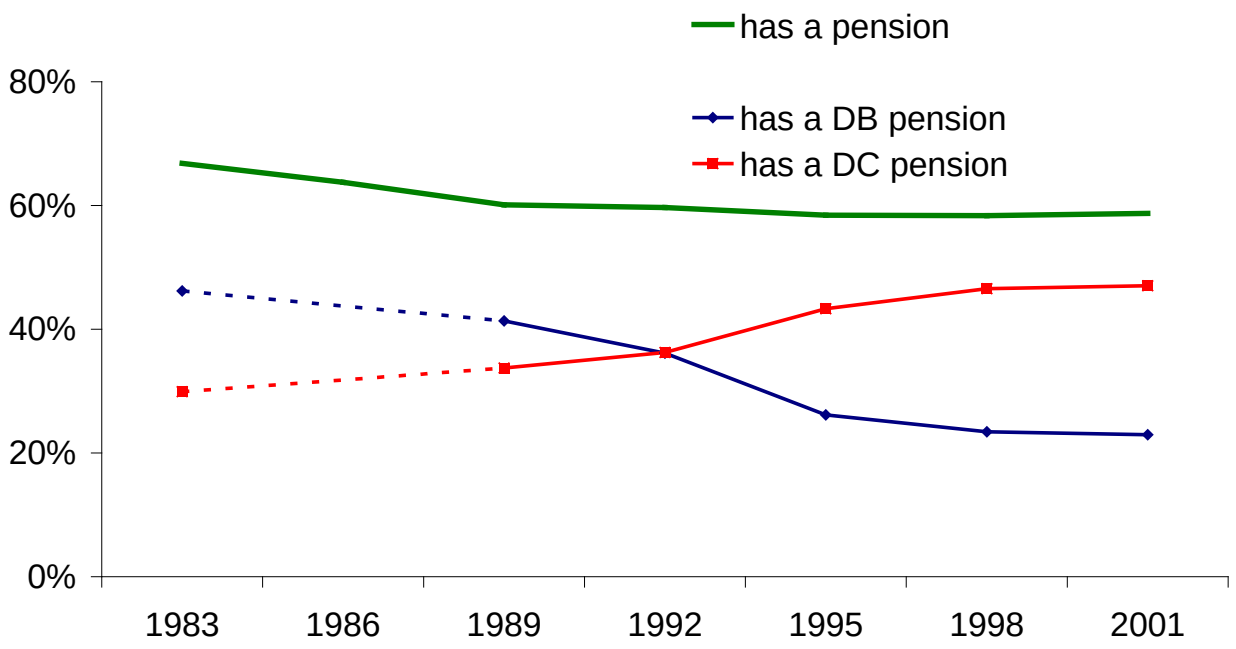
[b] Government regulations constrain both under- and over-funding of DB pensions by firms.

[c] Contributions to 401(k) plans are voluntary and hence are subject to underfunding risk, but contributions to other types of DC plans are mandatory. Workers can withdraw DC assets in case of financial hardship or separation from the firm; if they do so when under age 59 ½, they owe a 10% penalty to the government. Some firms allow 50% of worker contributions to the 401(k) (up to $50,000) to be used as collateral for loans with a term of no more than 5-10 years.

[d] Many DB pensions allow retirees a choice between a larger annual benefit payable until the retiree dies, or a smaller annual benefit payable until both the retiree and his or her spouse die.

[e] Individuals are required to make regular withdrawals of assets from their DC plans beginning at age 70. If they do not, they or their heirs face tax penalties, limiting the extent to which DC assets can be saved for a bequest.

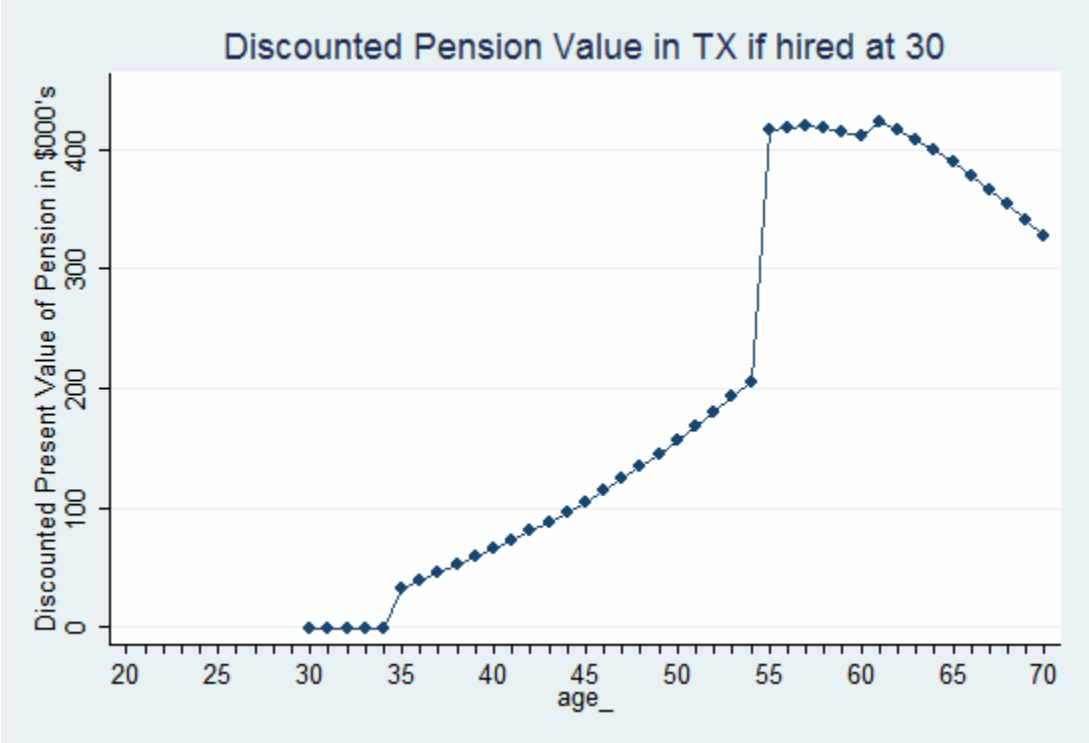
Figure 1: Pension Coverage of Full-Time Employees



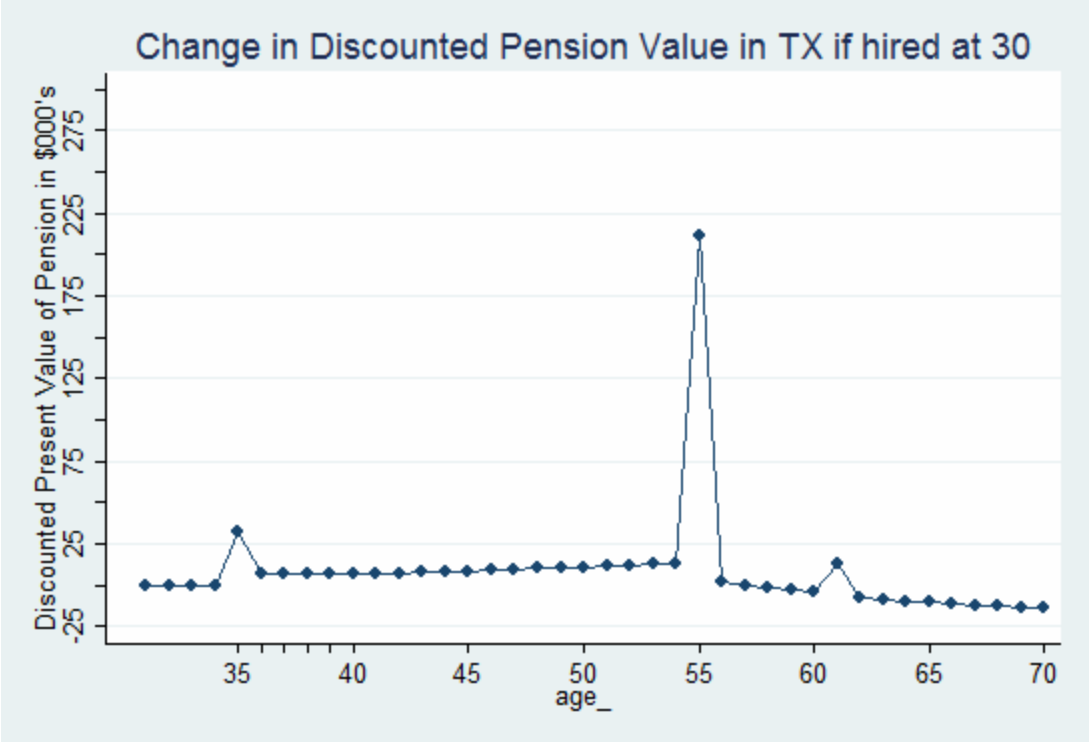
Source: Survey of Consumer Finance, Friedberg and Owyang (2005).

Figure 2. Pension Wealth Stock and Accrual under the Teacher Retirement System of Texas

Panel A: Pension Wealth



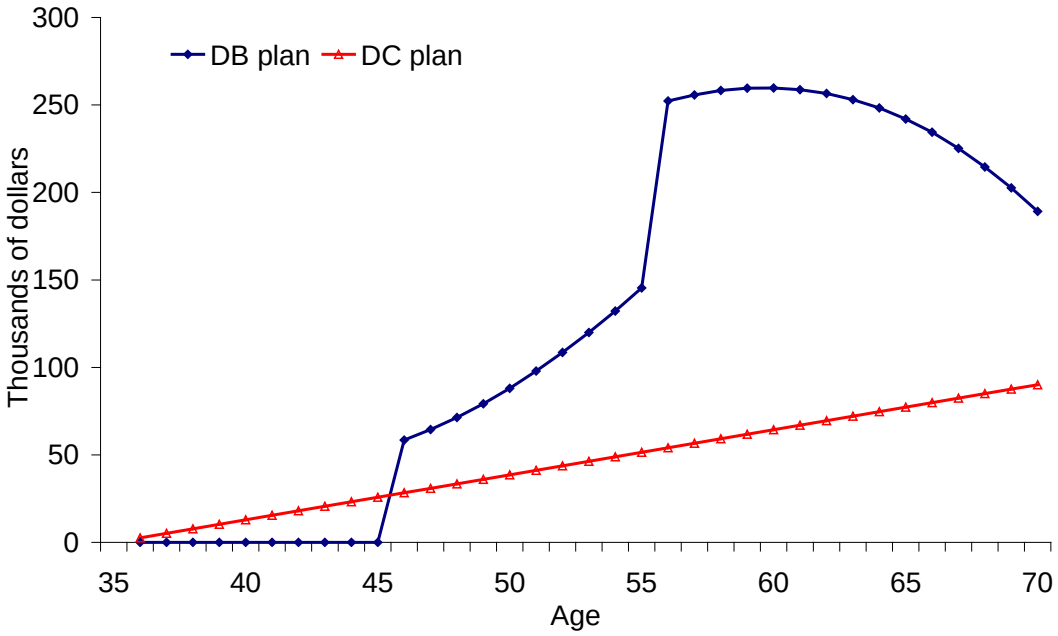
Panel B: Pension Wealth Accrual



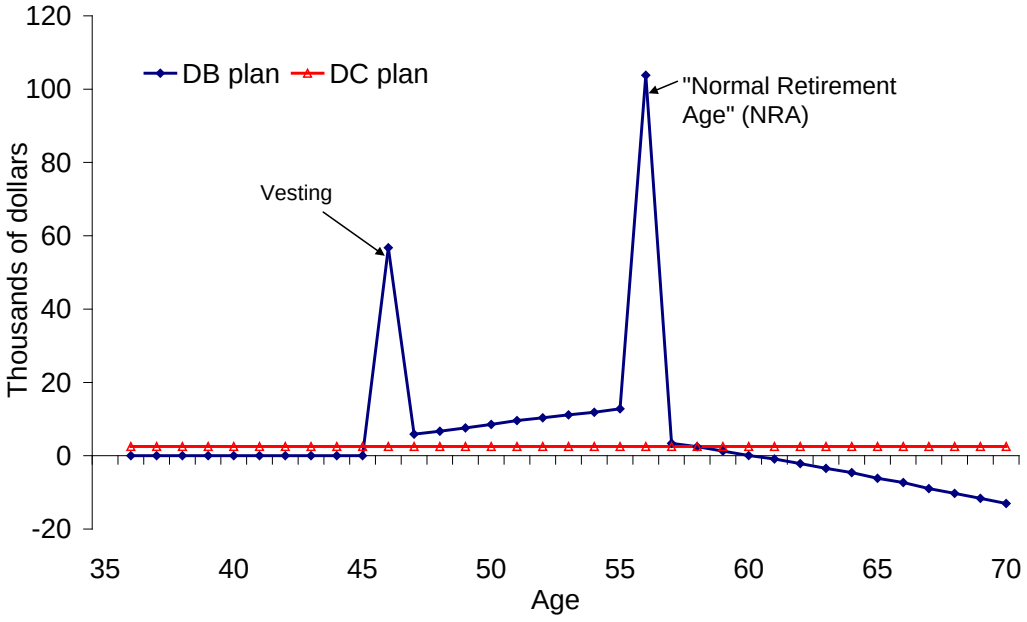
Source: Author’s calculations.

Figure 3. Pension Wealth Stock and Accrual under a Defined Benefit and Defined Contribution Plan from the HRS

Panel A: Pension Wealth



Panel B: Pension Wealth Accrual



Source: The plans were observed in the 1992 Health and Retirement Study and are reproduced from Friedberg and Webb (2005).