DEFINED CONTRIBUTION PENSIONS AND RETIREMENT DURING THE FINANCIAL CRISIS: A NATURAL EXPERIMENT[*]

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Abstract

I investigate how DC pensions affect retirement using a 1984 federal retirement system change that quasi-randomly assigns DC pensions. I find no evidence that DC pensions affect retirement before the financial crisis. During and after the crisis, employees with DC pensions retire less. This effect is largest for high-income employees. The average high-income employee with a DC pension delays retirement 1.4 to 3 months longer than a comparable non-DC employee does. I argue that this increased retirement delay is caused by a decline in DC pension value, which I estimate is equivalent to three months' worth of income.

Key Words: Defined Contribution Pensions, Financial Crisis, Retirement

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Over the past few decades, defined contribution (DC) pensions have replaced defined benefit (DB) pensions as the dominant source of private retirement income for American employees. Poterba, Venti, and Wise (2000) project this trend to accelerate and for the value of DC pensions to pass that of Social Security by 2035.[1] This transition passes risk from the employer to the employee by eliminating the *de facto* retirement income insurance provided by DB pensions (Bodie (1990)) and exposing employee wealth to the financial markets. By linking retirement wealth to the financial markets, DC pensions increase both the volatility of retirement wealth and the correlation of changes in employees' retirement wealth. Under Ando and Modigliani (1963)'s life-cycle hypothesis, these correlated wealth shocks will increase retirement cyclicality, especially for retirement-aged employees. The following anecdote exemplifies this during the financial crisis.

> To the long list of reasons American companies aren't hiring … add the fact that many of their older workers are unable, or afraid, to retire. In other parts of the developed world, people are retiring as planned...But here in the United States, financial security in old age rests increasingly on private savings…As a result, companies are not only reluctant to create new jobs, but have fewer job openings to fill from attrition. – Rampell, C. and Saltmarsh, M. "A Reluctance to Retire Means Fewer Openings." *New York Times* 2 September 2009.

Although there is a large body of literature investigating the effect of the crisis on retirement, there is no direct evidence on the extent to which DC pensions exacerbated this effect.[2] In fact, the dearth of exogenous wealth shocks makes any evidence on the relation between wealth loss and retirement rare. Brown, Coile, and Weisbenner (2010)'s finding that large inheritances expedite retirement begins to attack this issue,[3] but the predictability of inheritances and unique characteristics of the employees receiving them may affect their estimate of the sensitivity of

[1] See Table I of Poterba, Venti, and Wise (2000) assuming the sixth income decile and a 50/50 stock bond split.
[2] See for example, Gustman, Steinmeier, and Tabatabai (2010), Goda, Shoven, and Slavov (2010 and 2011), Hurd and Rohwedder (2010), McFall (2011), and Chai, Maurer, Mitchell, and Rogalla, (2010).
[3] This result is an extension of the more general finding that wealth shocks reduce lifetime labor supply to the retirement-aged population (Holtz-Eakin, Joulfaian, and Rosen (1993) and Imbens, Rubin, and Sacerdote (2001))

retirement to wealth loss. In this paper, I use a new dataset of actual retirements during the recent financial crisis and exploit a legislative change that quasi-randomly assigns DC pensions to identify the sensitivity of retirement to DC pension wealth loss.

In 1987 the federal government retroactively replaced the Civil Servants Retirement System (CSRS), which is a pure DB pension plan, with the Federal Employees Retirement System (FERS), a hybrid plan with three components – DB, DC, and Social Security. All employees hired after January 1, 1984 are in FERS, while over 93% of employees hired prior to 1984 are in CSRS.[4] The intention is for FERS and CSRS to be equally attractive. They have similar employee contributions, government costs (Schreitmueller (1988)), and retirement incentives (Asch and Warner (1998)). The primary difference between FERS and CSRS is that DC pensions comprise an estimated one-quarter of FERS employees' pension plan value.[5]

To approximate a setting with random DC pension assignment, I restrict the sample to the last batch of retirement-age CSRS employees and the first batch of retirement-age FERS employees. Since the crisis occurs almost exactly 25 years after the introduction of FERS, I accomplish this by including only employees over 60 years old with between 20 and 29 YOS. Consistent with Asch and Warner (1998), CSRS and FERS employees in this subsample exhibit similar retirement patterns before the crisis. For instance, from September of 2004 through March of 2008, between 20.1% and 21.9% of CSRS employees and 20.8% and 23.0% of FERS employees retire each year.

In the year ending in March of 2008, which I define as the pre-crisis period, 20.8% of FERS employees and 20.1% of CSRS employees retire. Over the following year, during the

[4] There were two open seasons during which less than 7% of CSRS employees switched to FERS (Isaacs (2013)).
[5] There are other differences between CSRS and FERS (Table III of Schreitmueller (1988)), but because I restrict my analysis to voluntary retirements for employees with between 20 and 30 years of service they are not relevant. For example, details regarding early retirement or disability are tangential to my study.

beginning of the financial crisis, these annual retirement rates drop to 15.8% for FERS employees and 16.6% for CSRS employees. This amounts to a 38% larger retirement reduction for FERS employees, which corresponds to a one-month longer retirement delay. The incremental retirement delay associated with FERS status is largest for the 40% of employees making over $90,000 per year. Within this high-income subsample, FERS status is associated with a 1.4-month longer retirement delay.

The difference-in-differences results showing that FERS employees delay retirement longer in response to the crisis do not reverse by the end of my sample in 2011. An accumulation of the difference-in-differences estimates from 2008Q4 through 2011Q1, suggests that, as of July of 2011, 3.5% of all FERS employees over 60 years old continue to work when they otherwise would have retired.

To generalize my findings beyond FERS employees and the financial crisis, I estimate the size of DC pension losses that is associated with the observed retirement delay. I estimate that DC investments account for 20% to 30% of the average retirement-aged FERS employee's retirement plan value and that this percentage is increasing with income.[6] During the financial crisis, the DC exposure causes a representative high-income FERS employee making $100,000 per year to lose $25,000 more than a comparable CSRS employee. Thus, it would take approximately three months to recoup their losses. In contrast, an employee making $40,000 per year would be able to recoup their $3,000 loss in less than a month. These treatment estimates suggest that it is likely a smaller treatment and not a smaller sensitivity to wealth loss that causes low-income employees to delay retirement less.

[6] DC contributions also account for 7-10% of CSRS plan value. These estimates are based on calculations using government records and survey data that decomposes DC participation rates, contribution rates, and asset allocations by age, income, and YOS.

Overall my study offers a new approach and new answers to questions such as – To what extent did workers delay retirement in response to the financial crisis?, What role did DC retirement plans play?, and What does this say about the sensitivity of retirement to market performance or other wealth shocks going forward? The findings suggest that retirement will become more cyclical as DC plans and incentive compensation continue to expose employee wealth to the financial markets. By quantifying the sensitivity of retirement to market wealth shocks, my results add to the debate on the best way for firms, government entities, and policy makers to fund retirement and structure employee contracts going forward. For example, my findings are relevant to state governments as they deal with rising pension liabilities, which Novy-Marx and Rauh (2011) estimate at $3-$4 trillion.

1. Motivation

Today's American employee bears more financial risk than ever before. Employers increasingly tie executive salaries to firm performance (Frydman and Saks (2010)) and offer market-based DC plans instead of DB pensions (Bloom and Freeman (1992)), which Bodie (1990) argues eliminates employees' implicit retirement income insurance. For instance, Bureau of Labor Statistics (BLS) reports show that between 1980 and 2008, the percentage of employees covered by a DB pension dropped from 38 to 20 while the percentage of DC employees rose from 8 percent to 31.[7]

The corporate finance literature documents several benefits to employee risk sharing. For instance, Rauh (2006) and Campbell, Dhaliwal, and Schwartz (2012) link mandatory DB pension contributions to suboptimal investment, while Bakke and Whited (2011) and Franzoni (2009) respectively link mandatory contributions to lower employment and stock returns. In this paper, I focus on a cost to DC pensions – increased retirement cyclicality.

[7] This BLS fact is abstracted from a 2009 Social Securities Buliten by Butrica, B., Iams, H., Smith, K., and Toder, E.

By making retirement wealth dependent on the financial markets, DC pensions increase both the volatility of retirement wealth and the positive correlation of changes in employees' retirement wealth. Under Ando and Modigliani (1963)'s life-cycle hypothesis, these correlated wealth shocks will increase retirement cyclicality, especially amongst retirement-aged employees. I exploit the financial crisis to investigate the magnitude of this effect.

Many employees suffered a loss in retirement savings during the crisis, and there is no shortage of anecdotal evidence that this caused significant delays in planned retirement. For example, a Reuters survey of 9,000 workers, conducted in the spring of 2010, found that 40% of U.S. workers are planning to delay retirement with 56% citing the decline in value of their employer-sponsored retirement plans.[8]

The existing literature confirms a portion of this survey evidence. Gustman, Steinmeier, and Tabatabai (2010), Goda, Shoven, and Slavov (2010 and 2011), Hurd and Rohwedder (2010), McFall (2011), and Chai, Maurer, Mitchell, and Rogalla, (2010) all investigate the claim that the financial crisis causes the retirement (or near retirement) age population to work (or to expect to work) more. Although the preponderance of the evidence suggests that employees did delay retirement during the crisis, the magnitude of the delay and the mechanism behind the delay are less clear. For example, Coile and Levine (2007) argue that it is difficult to separate the effects of the labor market deterioration from the effects of lower asset prices and wealth loss. In fact, Coile and Levine (2011a; 2011b) argue that the dominant effect of the crisis is the shock to labor market conditions, which could serve to increase observed retirement rates. Most evidence concerning the role of the stock market crash in the retirement delay suggests that the effect is small. Gustman, Steinneier, and Tabatabai (2010) estimate that employees between 55 and 60

[8] "Forty percent of U.S. workers delay retirement: poll". The report, by Helen Kearney, was published on October 5, 2010.

years old at the time of the crisis will delay retirement by only 1.5 months, a result they rationalize by retirement age employees having only 15% of their wealth in the financial markets. In an extreme case, Crawford (2013) finds no effect of wealth loss on retirement in the United Kingdom during the financial crisis.

To date, no study investigates the role that DC pensions played in exacerbating the retirement delay during the financial crisis. Perhaps the most related strand of literature finds mixed evidence on the association between market returns and retirement during the market boom of the late 1990s (Cheng and French (2002); Gustman and Tabatabai (2002); Coile and Levine (2006)). Coronado and Perozek (2003) and Sevek (2002) use regression analysis to show that this retirement increase is larger for employees with market exposure or DC pensions. Although most of these studies are suggestive of the intuitive result that wealth loss leads to retirement delay, they are not suited to identify the magnitude of the sensitivity of retirement to wealth loss because of potential self-selection problems regarding the employees with DC pensions or market exposure.

I extend this literature by introducing a new dataset of actual retirements around the crisis and a new identification technique that quasi-randomly assigns DC pension exposure. This allows for a more direct investigation into the effect of DC pensions on retirement.

2. Experimental Design: A Legislative Shift to DC Retirement Plans

I exploit a federal government legislation that quasi-randomly assigns DC pensions and perform a difference-in-differences analysis to investigate how DC employees differentially retire during the financial crisis.

In 1987, the federal government retroactively closed the Civil Servants Retirement System (CSRS) and imposed the Federal Employee Retirement System (FERS) on all employees

hired on or after January 1, 1984. The government's goal was to make FERS and CSRS equally attractive. For example, each plan requires a 7% employee contribution[9] and Schreitmueller (1988) documents that the government estimated costs to be 25% for CSRS employees and 23% for FERS employees. Finally, Asch and Warner (1998) find that FERS and CSRS embed the same retirement incentives in terms of age and YOS.

The main difference between the two plans is that the CSRS is a pure DB plan while FERS is a hybrid plan with three components – DB, DC, and Social Security. The DC component of the FERS is called a Thrift Savings Plan (TSP), which is almost identical to a 401(k). The government contributes an automatic 1% of salary along with an additional 4% matching contribution. FERS employees can contribute a maximum of 10% of their salary to the TSP. CSRS employees are also eligible to make TSP contributions of up to 5% of their salary, but with no matching contributions. A second difference is Social Security, which creates discontinuous incentives to retire around certain ages and makes the amount of DB pension coverage (as a percentage of salary) dependent on income. Other differences between CSRS and FERS (Table III of Schreitmueller (1988)), such as details regarding early retirement or disability, are not relevant to my study because I restrict my analysis to voluntary retirements for employees with between 20 and 30 YOS.

The government imposes FERS on all new federal employees. Thus, this legislative shift affects the entire population making the DC pension assignment quasi-random. The most obvious non-random aspect of FERS assignment is that assignment is based on the time of hire. Thus, on average CSRS employees will have more YOS and be older than FERS employees are. To make the FERS and CSRS employees as similar as possible, I restrict the sample to

[9] For FERS employees much of this contribution is to Social Security. They contribute the difference between 7% and their Social Security contributions to the DB portion of their pension.

employees over 60 years old with between 20 and 30 YOS. Thus, at the time of the financial crisis, almost all employees in my sample were hired at some point in the 1980s and were at least 30 years old at the time of hire.

Another potential source of non-randomness in retirement plan assignment are two "open seasons" in 1987 and 1998 during which employees could leave the CSRS in favor of the FERS. Although less than 7% of CSRS employees decided to switch (Isaacs (2013)), the proportion of likely switchers is larger in my sample. I provide descriptive evidence and perform robustness checks that suggest that this self-selection into FERS does not drive the difference-in-differences estimates.

3. Sample, Data, and Descriptive Statistics

Firm-level retirement data are rare in academic research. For this reason, most previous studies investigating retirement patterns rely on the Health and Retirement Survey conducted by the University of Michigan. I introduce a new dataset of the realized retirements of United States federal employees, which I obtain from the Office of Personnel Management (OPM).

I use a dataset provided upon request by the OPM for most of my analysis.[10] This dataset consists of quarterly voluntary retirements and total employees for non-defense federal employees enrolled in the FERS or CSRS retirement plans. Throughout the analysis, I restrict the sample to retirement age employees (over 60 years old) and employees with between 20 and 29 YOS. The age restriction is because there are not many voluntary retirements before the age of 60 with fewer than 30 YOS and the YOS restriction is to make the FERS and CSRS employees as similar as possible.

Table I shows that in the first quarter of 2009 approximately 65% of the 34,748 employees in my sample are enrolled in the FERS. The number of CSRS employees in my

[10] I thank Robert Heim and Stanislas Ezoua from the OPM.

sample decreases over time as most CSRS employees retire and/or graduate to more than 30 YOS, while the number of FERS employees in the sample increases over time. Because of this, I focus most of my analysis on the year's directly surrounding the financial crisis – April of 2007 through April of 2010. The dataset also contains indicators for employees making over $90,000 per year, employees over 65 years old, and employees with over 25 YOS.

[INSERT TABLE I HERE]

There are 2,047 CSRS employees with less than 25 YOS. It is likely that these employees took some time off during their career. There are also 4,455 FERS employees with more than 25 YOS. These are the employees most likely to have voluntarily switched retirement plans. As a robustness check, I replicate all of my results while excluding these two groups. Panel B of Table I shows that the age breakdown is similar for FERS and CSRS employees and both groups have between 40 and 45 percent of employees making over $90,000 per year.

4. Main Results

4.1 Pre-Crisis Retirement of FERS and CSRS Employees

Table II shows that the annual retirement rates from September of 2004 to April of 2008 are between 20.1% and 23.0% for both FERS and CSRS employees. Moreover, the annual difference-in-differences estimates, estimated every six-months, in the pre-crisis period are -0.4%, -0.1%, -0.4%, and -0.3%. Thus, FERS and CSRS employees exhibit similar retirement patterns prior to the crisis. Thus, I find no evidence that DC pension affect retirement in the years leading up to the crisis.

[INSERT TABLE II HERE]

This result supports an important assumption underlying this analysis. In order for the difference-in-differences estimates and standard errors to be valid there cannot be shock to a

specific treatment group at a specific time (Donald and Lang (2007)). While quasi-random treatment mitigates this concern, it is not sufficient. An additional necessary assumption is that there is no "pre-treatment" effect. The unpredictability of the crisis alleviates concerns that employees anticipate treatment, which is a common problem in difference-in-differences analyses (Besley and Case (2000)), but it is still possible that the market performance in the years leading up to the crisis causes FERS employees to retire differently. The results in Table II provide no evidence of this.[11]

4.2 Difference-in-differences Results: The Effect of FERS on Crisis Retirement

To determine the effect of FERS status on retirement during the financial crisis, I perform a difference-in-differences analysis. The previous section shows that FERS and CSRS employees retire similarly prior to the crisis. Thus, any differences in crisis and post-crisis retirement patterns of FERS and CSRS employees is attributable to the pension plans' interactions with the financial crisis. My hypothesis is that the DC pensions inherent in FERS will lead to a larger reduction in retirement during the crisis because it leads to wealth loss.

I use two definitions of the financial crisis period – from April of 2008 through March of 2009 and from October of 2008 through September of 2009. I compare the retirement rates during these periods to the retirement rate during the pre-crisis period, which I define as April of 2007 through March of 2008. The first of these crisis period definitions has the benefit of directly following the pre-crisis period. This makes the difference-in-differences estimates more comparable to the year-over-year retirement rate changes prior to the crisis that I present in Table

[11] Ideally, I could employ a longer time series of FERS and CSRS retirement behavior in the years leading up to the pre-crisis period to mitigate this concern, however FERS applies only to employees hired after 1984 making the sample of retirement age FERS employees small prior to 2004. In unreported results, I find that the historical retirement patterns of employees with 20-24 YOS are similar to those of employees with 25-29 YOS.

II. The second crisis period definition is similar to the existing literature, which uses the fourth quarter of 2008 as the beginning of the crisis period (Novy-Marx and Rauh (2012)).

Using these definitions, the pre-crisis period begins with the S&P at 1,387 and ends with the index at 1,330, a decline of 4%. The middle half of 2008 comprises most of the long-lasting market losses experienced during the crisis as the S&P drops by over 32% during these six months. In October of 2008, the S&P 500 index is at approximately 1100. Over the next year, the index drops by approximately 7% to 1,025. The relatively stable returns during the pre-crisis period and through 2009 suggest that the wealth lost during the middle half of 2008 is the most likely source of market wealth loss that will affect retirement.[12]

Consistent with existing evidence, Figure I shows that the retirement rate of federal employees declines during the years of the crisis. The retirement rate of employees over the age of 60 with between 20 and 29 YOS, drops from over 20% during the pre-crisis period to approximately 15% during the crisis. This 5-percentage point drop is striking because it is more than three times as large as any other drop since the beginning of the sample in 2004.

[INSERT FIGURE I HERE]

Table III shows that FERS employees delay retirement significantly more that CSRS employees do in response to the crisis. During the pre-crisis period, 20.8% of FERS employees and 20.1% of CSRS employees retire. The following year, 15.8% of FERS employees and 16.6% of CSRS employees retire. The 3.5% drop for CSRS employees suggests that the base effect of the financial crisis on retirement is to make 17.58% of employees delay retirement. The 1.50% difference-in-differences estimate suggests that FERS status is associated with a 38% increase in the likelihood of delaying retirement. Panel B of Table III shows that this result is

[12] There is also a large drop in January of 2009. The speed with which this decline reverses makes it unlikely to be a driver of retirement delay.

robust to defining the crisis period as October of 2008 through September of 2009. Not surprisingly given that the crisis begins in earnest in late 2008 , the point estimate using this latter definition is larger.

Table IV presents the same analysis in the form of a logistic regression. The significantly negative coefficient on the *FERS*Crisis Period* interaction indicates that FERS employees postpone retirement significantly more in response to the crisis than do their CSRS counterparts. The odds ratio of 0.90 suggests that being a FERS employee in the crisis period reduces the odds of retirement 10% more than during the pre-crisis period. Comparing this to the magnitude of the main effect of the crisis suggests that FERS status magnifies the effect of the crisis by approximately 50%.

[INSERT TABLE IV HERE]

Table IV also confirms the similarity between the FERS and CSRS pre-crisis retirement rates. The coefficient on FERS treatment is never significant at the 5% level.

An additional benefit to the regression framework is the ability to control for other determinants of retirement even if they change between the pre-crisis and crisis periods. The results show that older employees and lower income employees retire significantly more frequently. Importantly, the similarity of the interaction coefficient in Columns 1 and 2 (and 3 and 4) suggests that the inclusion of additional control variables has no impact on the findings in Table III. Column 5 of Table IV further suggests that the results are robust to using a linear probability model.

All CSRS employees started working with the federal government before January 1, 1984. Most FERS employees began in 1984 or later. A small percentage of FERS employees started out in the CSRS and elected to switch. Systematic differences in these employees could

potentially affect the interpretation of my results. In unreported results, I exclude all FERS employees with more than 25 YOS and all CSRS employees with fewer than 25 YOS. Neither exclusion significantly affects the results.

4.3 Income and the Effect of FERS Status on Retirement Delay

If FERS employees delay retirement more during the crisis because of DC pension losses then the employees with the largest such losses should delay retirement longest. The relative value of the DC and DB components determines the expected loss for FERS employees during the crisis. The more important the DC plan is, the more wealth a FERS employee will lose during the crisis and the longer they would be expected to delay retirement.

The most important determinant of the percentage of a FERS pension that the DC pension represents is income. High-income employees invest more aggressively and receive smaller Social Security benefits relative to income compared to low-income employees. Thus, if DC pension losses cause the observed retirement delay one would expect the delay to be largest for high-income employees. To investigate this issue, I partition the sample on whether or not an employee makes over $90,000 per year.[13]

Panel A of Table V presents the difference-in-differences results for employees making over $90,000 per year. FERS employees reduce their retirement rate from 17.55% to 12.79% in the first year of the crisis. This 4.81 percentage point drop is more than 2 percentage points larger than the 2.66 percentage point drop in the CSRS sample. Put in percentage terms, high-income FERS employees reduce their retirement rate 85% more than their CSRS counterparts do.

[INSERT TABLE V HERE]

[13] Results using YOS as a proxy for FERS status motivate this cutoff. Within this sample, results are very similar using a $100,000 cutoff but get weaker as lower income employees are included. Within the main sample, the only income information I have is whether it is greater than $90,000.

Panel B of Table V shows that there is no significant difference between the retirement drop of low-income FERS and CSRS employees. The difference-in-differences estimate is in the expected direction and about 45% of the size of the high-income group estimate. Figure II shows that these conclusions are robust to various crisis period definitions.

[INSERT FIGURE II HERE]

Table VI partitions the logistic regression results by income. The first two columns show that FERS status is not a significant predictor of retirement delay for low-income employees during the first year of the crisis. Columns 3 and 4 show that using the latter definition of the crisis FERS status is associated with a retirement delay even for low-income employees.

[INSERT TABLE VI HERE]

The last four columns confirm the finding in Table VI that FERS status is associated with a significantly larger retirement delay for high-income employees. Using either definition of the crisis period, FERS status approximately doubles the odds of delaying retirement during the crisis. As in Table IV, there is no evidence of differential pre-crisis retirement rates for FERS and CSRS employees and including available controls does not significantly affect the results.

5 Secondary Sample Analysis

I also use a second sample for a portion of my analysis, which I download from the OPM website. The benefit of this sample is that more data items are available. The cost is that it does not have a direct measure of retirement plan. Thus, for this portion of my analysis I proxy for FERS status using YOS. Employees with more than 25 YOS are assumed to be on the CSRS plan while employees with less than 25 YOS are denoted FERS employees. I motivate this classification by the fact that the legislative shift occurred almost exactly 25 years before the financial crisis. Table I shows that as of January 1, 2009 this classification categorizes

approximately 73% of employees correctly and in unreported results, I find that 80% of employees are categorized correctly at the beginning of 2008.

Table VII shows that employees with 20-24 YOS are similar to those with 25-29 YOS. Both groups are almost exactly 50% male and 25% over the age of 65. Both groups have a median *Income* of 7 and a median *White Collar Index* of 5. *Income* is a count variable from 1 to 11 where 1 represents an income of less than $20,000 and 11 represents an income of more than $110,000. Each other value represents a $10,000 income bucket. Thus, the median employee in my sample makes between $70,000 and $80,000. The *White Collar Index* is a count variable ranging from 1 to 5 where 1 is a blue collar employee and 5 is a professional employee. A value of 4 corresponds to a Technical employee, a value of 3 corresponds to a clerical employee, and a value of 2 corresponds to other white collar employees. Table VII shows that more than half of the employees in the sample are designated as professional employees.

[INSERT TABLE VII HERE]

One benefit of this extended sample is that it identifies the employee's state of residence. I exploit this by including variables for the *State Home Price Drop* during the crisis, the *State Unemployment Rate,* and the *20-year State Home Price Appreciation*. *State Home Price Drop* equals the annual percentage drop in the state level all-transactions HPI index provided by the FRED database at the St. Louis Federal Reserve Bank. The drop is measured beginning in the first quarter of 2007 and ending at the end of 2007 for observations in the pre-crisis period and the end of 2008 for observations in the crisis period. *State Unemployment Rates* are taken from the BLS. The *20-year State Home Price Appreciation* is the percentage difference between the state level HPI at the beginning of 1987 and 2007. None of these economic indicators vary by YOS.

Column 1 of Table VIII shows that the FERS proxy has a similar effect on the retirement response to the crisis as did the true FERS indicator used in the earlier analysis. Columns 2 and 3 once again show that the effect of FERS status on retirement delay during the crisis is only significant for high-income employees.

[INSERT TABLE VIII HERE]

In addition to demonstrating that the previous results hold using the FERS proxy and controlling for more variables, Table VIII provides evidence on several other determinants of retirement. After controlling for other factors, males are significantly less likely to retire. Interestingly, this effect differs significantly for high and low-income employees. Males making over $90,000 per year are significantly more likely to retire.

The negative coefficient on *State House Price Drop* suggests that employees whose homes fall in value are less likely to retire. This effect is strongest for high-income employees, which is consistent with high-income employees being more likely to own a home. This result offers a second piece of evidence on how wealth loss impacts retirement. However, the economic sensitivity is hard to measure because of the lack of data on the home value of federal employees.

In unreported results, I show that all results are robust to interacting all control variables with the crisis period indicator. In addition, none of the control variables are significant predictors of the FERS treatment effect as all triple interactions are insignificant.

5 Generalization of Findings

The results in section 4 show that FERS employees delay retirement more in response to the financial crisis. Importantly, this effect is strongest for high-income employees. These

findings are consistent with DC pension losses being the cause for the increased retirement delay.

In this section, I generalize these findings. First, I investigate how long FERS status causes employees to delay retirement and how many generations of retirees are affected by this delay. Second, I estimate how large of a wealth loss causes this retirement delay. Finally, I discuss the implications of these findings on the sensitivity of labor supply to wealth loss and future retirement patterns.

5.1 The Magnitude of Retirement Delay Caused by FERS Status

Interpreting the above difference-in-differences analysis provides evidence on how much longer FERS employees delayed retirement during the crisis compared to CSRS employees. By dividing the 1.50% and 1.90% difference-in-differences estimate in Table III by the crisis period retirement rates for CSRS employees of 16.60% and 15.40% respectively equals .09 and .12 respectively. This amounts to a retirement delay of approximately 10% of a year or 1.2 months with the delay being larger for employees expecting to retire during the later of the two crisis periods. A similar calculation using the difference-in-differences results from Table V demonstrates that high-income employees delay retirement by approximately 1.7 months, which is more than twice as long as low income employees (although the difference is not statistically significant).

Figure III shows that this result is robust to defining the crisis period as ending any time between 2008Q3 and 2009Q3. The flatness of the line through this period also suggests that all employees planning anytime in late 2008 or 2009 experience a similar retirement delay.

[INSERT FIGURE III HERE]

If this 1.7-month delay is the only effect of the financial crisis than the difference-in-differences result should more than reverse in 2010. Not only should there be no difference in retirement rates for CSRS and FERS employees planning to retire in 2010, but also the FERS employees that delayed in 2009 should increase the observed 2010 FERS retirement rate. There is no sign of such a reversal. In spite of FERS employees delaying retirement in 2009, Figure III suggests that less FERS employees relative to CSRS employees retire between 2009Q4 and 2010Q3 than in the pre-crisis period. The positive difference-in-differences estimate suggests that the effect of the crisis on FERS retirement is stronger (although not significantly) than in 2009. Combining the 2% of employees that delayed in 2009 with the 1% fewer FERS employees that retire in 2010 suggests that the average employee planning to retire in 2010 delayed retirement for approximately 2.25 months.

The fact that the financial crisis influences retirees over several years raises the question of what percentage of the FERS workforce continues to work because of the incremental market losses. Figure IV cumulates the difference-in-differences estimates from Figure III from 2009Q1 through the end of the sample in 2011Q1. The results show that by 2011 approximately 4% more FERS employees continue to work. Thus, effect of FERS status on retirement has yet to reverse.

[INSERT FIGURE IV HERE]

5.2 The Magnitude of Wealth Loss Caused by FERS Treatment

I argue that FERS treatment interacts with the financial crisis to create an exogenous wealth shock that causes employees to delay retirement. The goal of this section is to estimate the magnitude of this wealth shock.

I use historical wage tables to estimate the value of the average employee's retirement assets, conditional on a given income during the pre-crisis period. Table IX presents the estimated salary progression for two representative employees making approximately $100,000 and $40,000 per year prior to the crisis. The estimates begin with the inception of the TSP in 1988. The salary progression includes estimated step increases, cost of living adjustments, and three grade promotions throughout the 21 YOS charted.

[INSERT TABLE IX HERE]

To get the TSP account value, I combine the salary estimates with government records and surveys describing TSP participation, contribution, asset allocation, and asset returns.[14] The second column of Table IX provides the estimated asset returns for a TSP portfolio of the average employee in my sample (i.e.: over 60 with 20-29 YOS as of 2007) over time. The average employee puts approximately 33% of their assets in equity indices and the remainder in bond funds, most of which are United States treasuries. High-income employees invest in riskier assets (2008 TSP Participant Survey). Based on my reading of TSP fund reports, I estimate that the equity exposure decreases from 55% at age 41 to 35% at age 63 for high-income employees and 40% to 20% for lower income employees. Contribution and participation rates are increasing over time and are significantly larger for FERS employees. The contribution differences between FERS and CSRS employees are driven both by the government's 5% matching policy for FERS employees and by the increased contribution incentive this provides.

[14] Documents include the 2008 TSP Participant Survey Results, the annual release of the Thrift Savings Fund Statistics, and the Federal Employees' Retirement System: Benefits and Financing by Katelin Isaacs and dated January 5, 2011 (Isaacs (2011)). Precise data is not always available. Many assumptions are extrapolations from descriptive evidence presented throughout the documents.

The contribution, salary, and returns data combine to indicate that the average FERS employee making $100,000 per year in 2007 has approximately $291,000 in TSP savings before the crisis compared to $88,000 for the average CSRS employee.

This additional market exposure for FERS employees leads to larger losses during the crisis period. Figure V shows that TSP equity investments fall by more than 30% in 2008. The average weighted TSP portfolio takes more than two years to recover its 2008 losses. Table IX shows how the magnitude of this drop differs for high and low-income employees. The average TSP account of retirement-aged employees making $100,000 per year drops by 12%, but the average employee making $40,000 a year suffers only a 6% drop.

[INSERT FIGURE V HERE]

Applying this 12% drop to the differential TSP wealth for FERS employees suggests that the FERS treatment amounts to approximately $24,000 is lost retirement wealth for the average $100,000 per year employee. This estimate assumes that CSRS and FERS employees invest identically outside of their pension plans. To the extent that the DB pension of CSRS employees causes more aggressive non-retirement investments, this treatment may be overstated.

To make the DC value comparable to the DB and Social Security income, I annuitize the lump sum assuming that the average employee expects to live 20 years and invests at an interest rate of 3%. Table X shows that under these assumptions DC plans account for approximately 30% of the average high-income FERS employee's retirement income and only 9% for a similar CSRS employee. Thus, the treatment amounts to converting approximately 20% of an employee's retirement assets from DB to DC. Table X summarizes the retirement plan value composition for representative FERS and CSRS employees making approximately $100,000 and

$40,000 per year in 2007. In these terms the FERS treatment is a loss of 2.35% and 0.69% of retirement income for high and low-income employees respectively.

[INSERT TABLE X HERE]

The above treatment applies best to employees planning to retire in early 2009. For an employee retiring later in the sample the treatment is more complicated. For example, an employee making $100,000 per year and planning to retire in early 2010 experiences the same $25,000 wealth loss as someone planning to retire in 2009 followed by a full year of returns. The returns to the Lifecycle 2010 fund (a fund designed for those planning to retire in 2010) were 10.0% in 2009 and 5.65% in 2010. These are in line with the returns in the pre-crisis period, which ranged from three to eleven percent. Given the similarity in treatment for employees planning to retire in 2009 and 2010, the similar retirement delays are not surprising.

The biggest assumption underlying these estimates is that the current documents apply to earlier periods. The only data available prior to 2006 is average participation and contribution rates by retirement plan and the returns to each of the TSP investment options. Thus, I use asset allocation data and more detailed data on contribution and participation rates from recent surveys that are partitioned by age, income, and YOS to estimate how asset allocation and participation rates differ across retirement plans in earlier time periods. Adjusting the assumptions does not significantly affect the size of the treatment except for the assumption that low-income employees are significantly less likely to invest in stocks. This is the primary driver between the difference in the estimated treatment for high and low-income employees. This assumption is motivated by low-income employees' tendency to leave their funds in the default category, which is a US treasury index. It is also worth noting that the assumptions regarding the

magnitude of the treatment are relevant for interpreting the results, but are not involved in the statistical tests.

5.3 Implications of Results

Combining the results concerning the magnitude of retirement delay with those concerning the magnitude of wealth loss associated with that delay provides new evidence on the sensitivity of retirement to wealth loss. I find that an employee making approximately $100,000 per year delays retirement by two months in response to a $25,000 wealth loss. Thus, FERS employees delay retirement two-thirds the time needed to recoup their market losses with income. I cannot rule out that this result is unique to federal employees, however there is no reason to suspect that federal employees will respond to a wealth shock in a systematically different way from other employees.

This result represents some of the first evidence on the sensitivity of retirement to income. Pencavel (1986) attributes the dearth of evidence to the difficulty of finding exogenous variation in wealth. Holtz-Eakin, Joulfaian, and Rosen (1993) and Imbens, Rubin, and Sacerdote (2001) use large inheritances or lottery winnings to address this issue and find that employees reduce lifetime labor supply in response to large cash windfalls. More recently, Brown, Coile, and Weisbenner (2010) find that inheritance accelerates retirement. Although this is an important starting point, the predictability of inheritance masks the full sensitivity of retirement to wealth loss.

My results also have implications regarding the effect of the transition to DC pensions on retirement. Section 5.2 shows that the FERS treatment amounts to increasing the market exposure of the retirement plan from 10% to 30%. A private sector employee relying exclusively on DC pensions is likely to have between 80 and 90 percent of their retirement wealth exposed to the financial markets. Assuming no changes in investment strategies, this

employee will experience a treatment four times the magnitude of the FERS employee. In this case, a market downturn one fourth the size of the financial crisis will cause a $25,000 wealth loss followed by a two month retirement delay. Although this is likely to overstate the effect of DC pensions on retirement, it highlights the fact that my results significantly understate the aggregate effect of DC pensions on retirement.

The above assumptions generalize my findings to other individual wealth shocks and other types of individuals. In order to generalize the aggregate retirement delay to other (non-crisis) settings, a broader definition of the treatment is needed because all $25,000 wealth shocks are not equal. For example, if a market downturn lasts a single week before reversing it will not cause a four-month retirement delay. At the time of the initial decline employees adjust retirement based on the expected future market performance, but the length of their delay also depends on the realized market recovery. My interpretation of the results thus far assumes that the wealth shock is followed by expected returns over the retirement delay. A faster recovery will cause the estimated delay to be understated.

In the case of the financial crisis, the stock market dropped by over 30% in 2008 and took years to recover. The 2008 drop occurred most noticeably in October when the market dropped by 25% within 2 weeks. This drop was relatively slow to reverse as the market and did not return to the October levels for approximately 18 months. This quick drop and slow reversal are important because it reduces the likelihood of the market reversal factoring heavily into retirement decision.[15] Thus, my findings are not likely to be significantly understated when compared to other market fluctuations of similar magnitude to the crisis.

[15] This is one reason why I estimate my treatment effect using the market value at the end of 2008. The low point in March of 2009 was quick to reverse.

8. Conclusion

I investigate how the losses to DC pension value during the financial crisis affect retirement. I exploit a change in the federal employee retirement code that quasi-randomly DC pensions. During the crisis, I estimate that the average DC employee making $100,000 per year in my sample loses $25,000 more in retirement income than a comparable non-DC employee. Using a difference-in-differences analysis, I show that this wealth loss causes the average employee planning to retire to delay retirement by approximately two months. This provides new evidence on the sensitivity of retirement to wealth loss, a topic that is becoming increasingly important as the transition to DC pensions continues.

By aggregating the retirement delays across several years of employees, I estimate that 6% of the retirement-aged workforce that would have retired continues to work in July 2011 because of the $25,000 in lost wealth.

The DC treatment amounts to only 20% of retirement wealth. Extrapolating this to a setting where employees are fully reliant on DC pensions suggests the possibility of much larger effects. For instance, my results suggest that the average employee that is fully reliant on DC pensions delayed retirement by up to eight months during the crisis. Thus, passing market risk on to the employee causes a meaningful increase in retirement cyclicality. Understanding this unintended consequence of DC pensions is important for both employers and policy makers.

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Figure I
Annual Voluntary Retirement Rate by Pension Plan Type

Panel A plots the annual voluntary retirement rates of federal employees over the age of 60 with between 20 and 29 YOS. The dashed (red) line is FERS employees and the solid (black) line is CSRS employees.

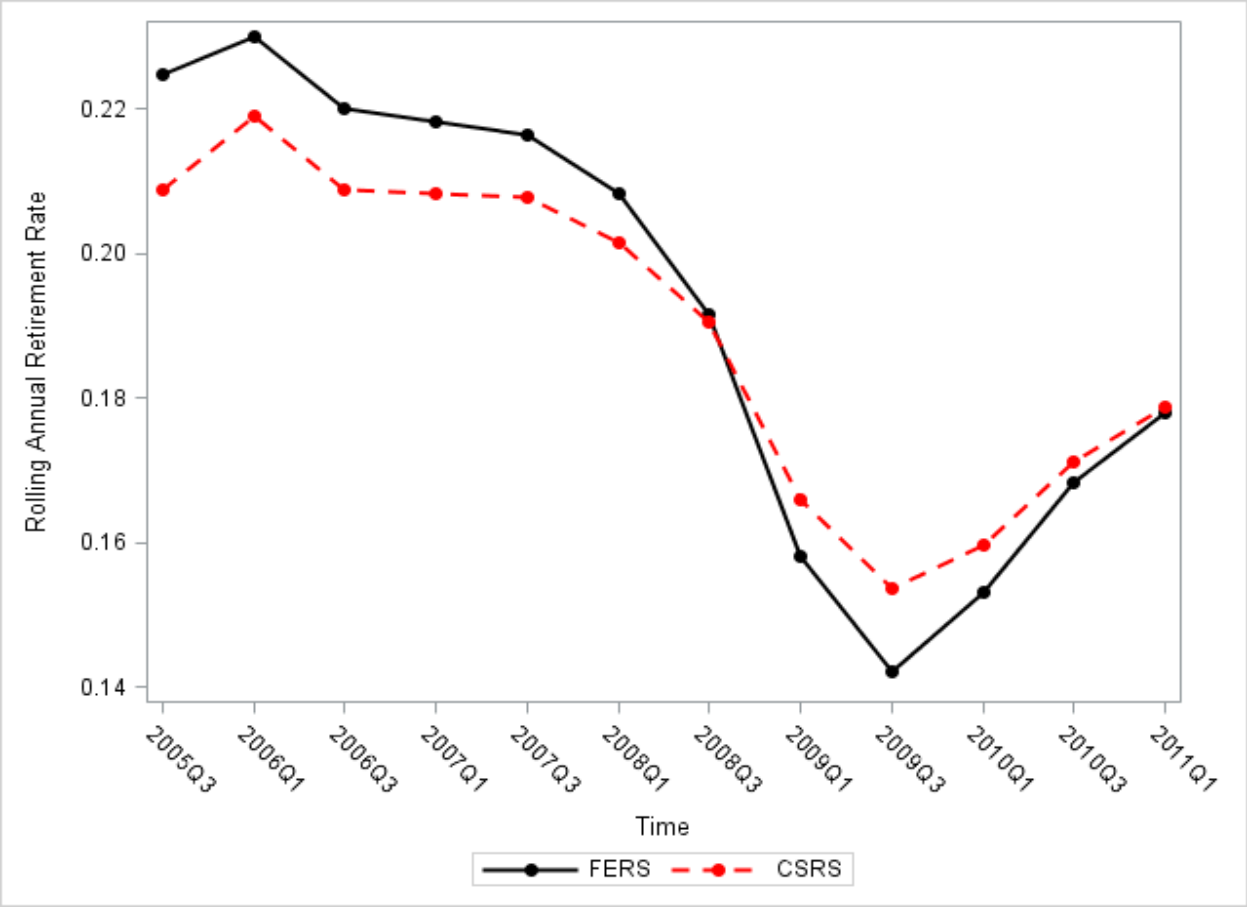

Figure II

Annual Voluntary Retirement Rate by Pension Plan Type: Partitioned by Income

This figure plots the rolling annual voluntary retirement rates of federal employees over the age of 60 with between 20 and 29 YOS. The solid lines are FERS employees and the dashed lines are CSRS employees. The top two lines (red) are for employees making less than $90,000 per year, while the bottom two lines (black) are employees making more than $90,000 per year.

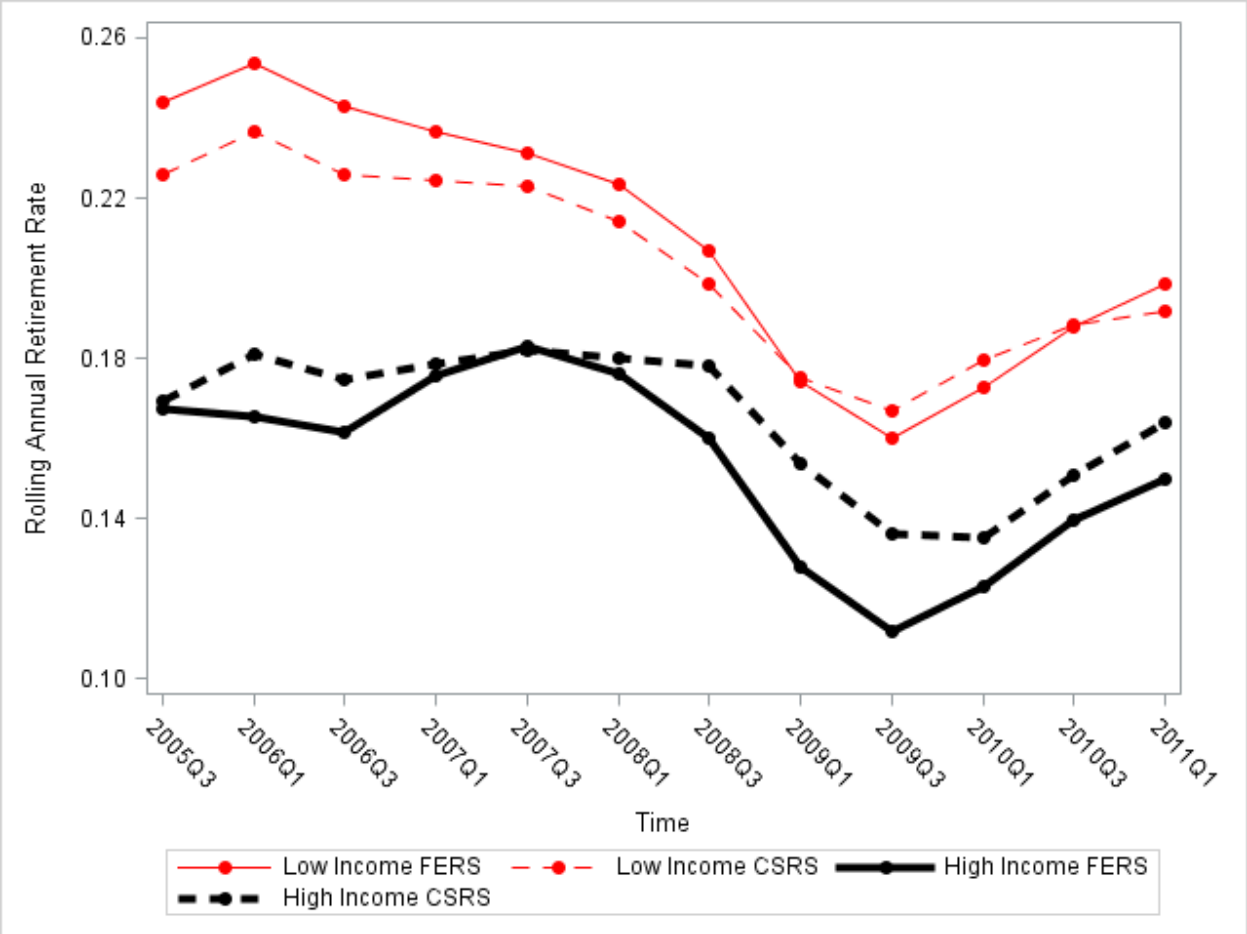

Figure III

Difference-in-Differences Estimates for Alternate Crisis Period Definitions

This figure plots difference-in-difference estimates using April 2007 through March 2008 as the pre-crisis period and varying definitions of the crisis period. The x-axis represents the last quarter in the crisis period used for the difference-in-differences calculation. For example, 2009Q3 presents the difference-in-differences results from Table VII. The sample contains federal employees over the age of 60 with between 20 and 29 YOS. The solid line presents high-income employees (over $90,000 per year) and the dashed line low-income employees (less than $90,000 per year).

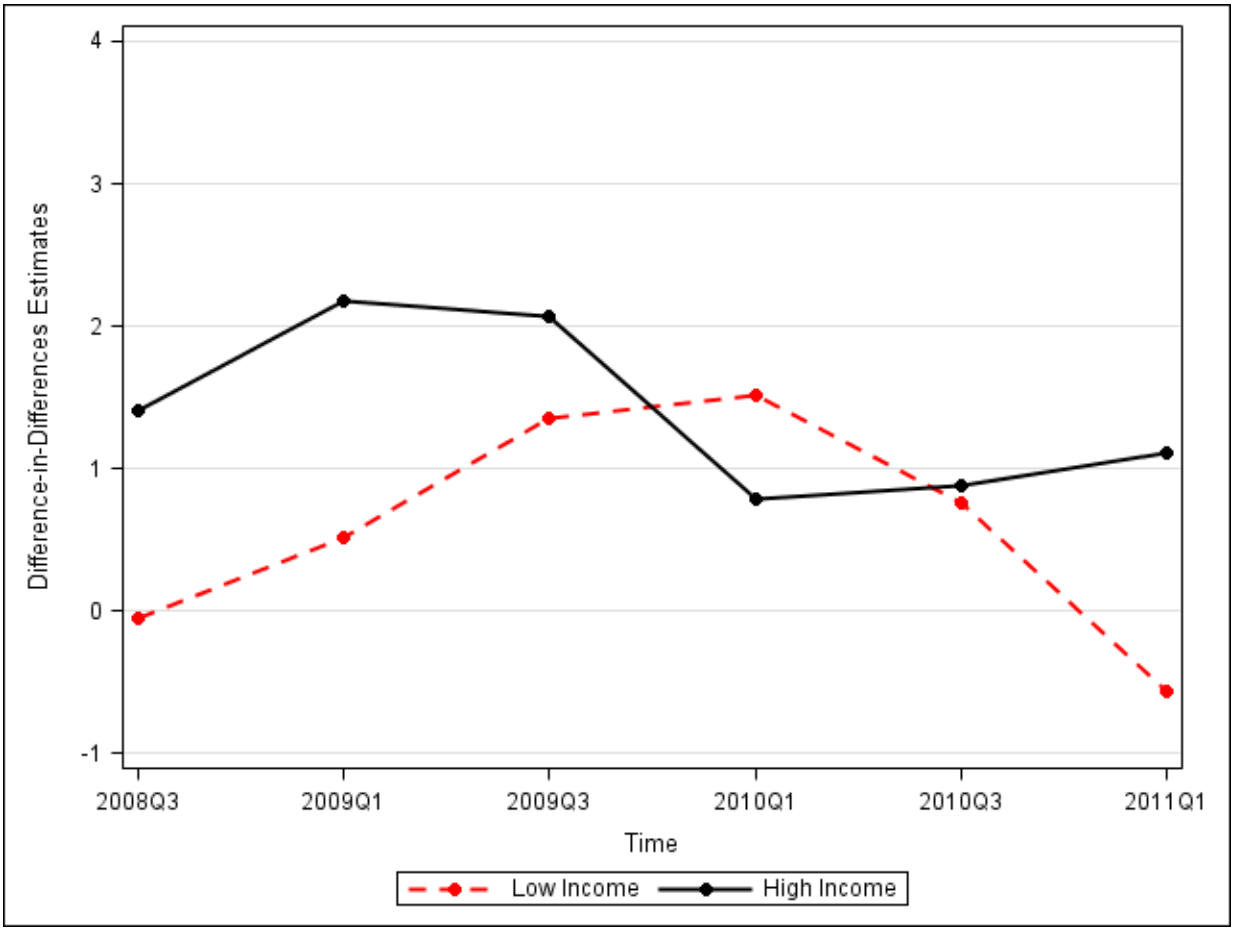

Figure IV

Estimated Percentage of Working FERS Employees that Would Have Retired

This figure plots the annual percentage of FERS employees that would have retired if not for their DC plan losses. This percentage is a function of the preceding annual difference-in-differences estimates generated by comparing the pre-crisis period to the year ending on the date on the x-axis. The solid line is employees with making over $90,000 per year and the dashed line is employees making less than $90,000 per year.

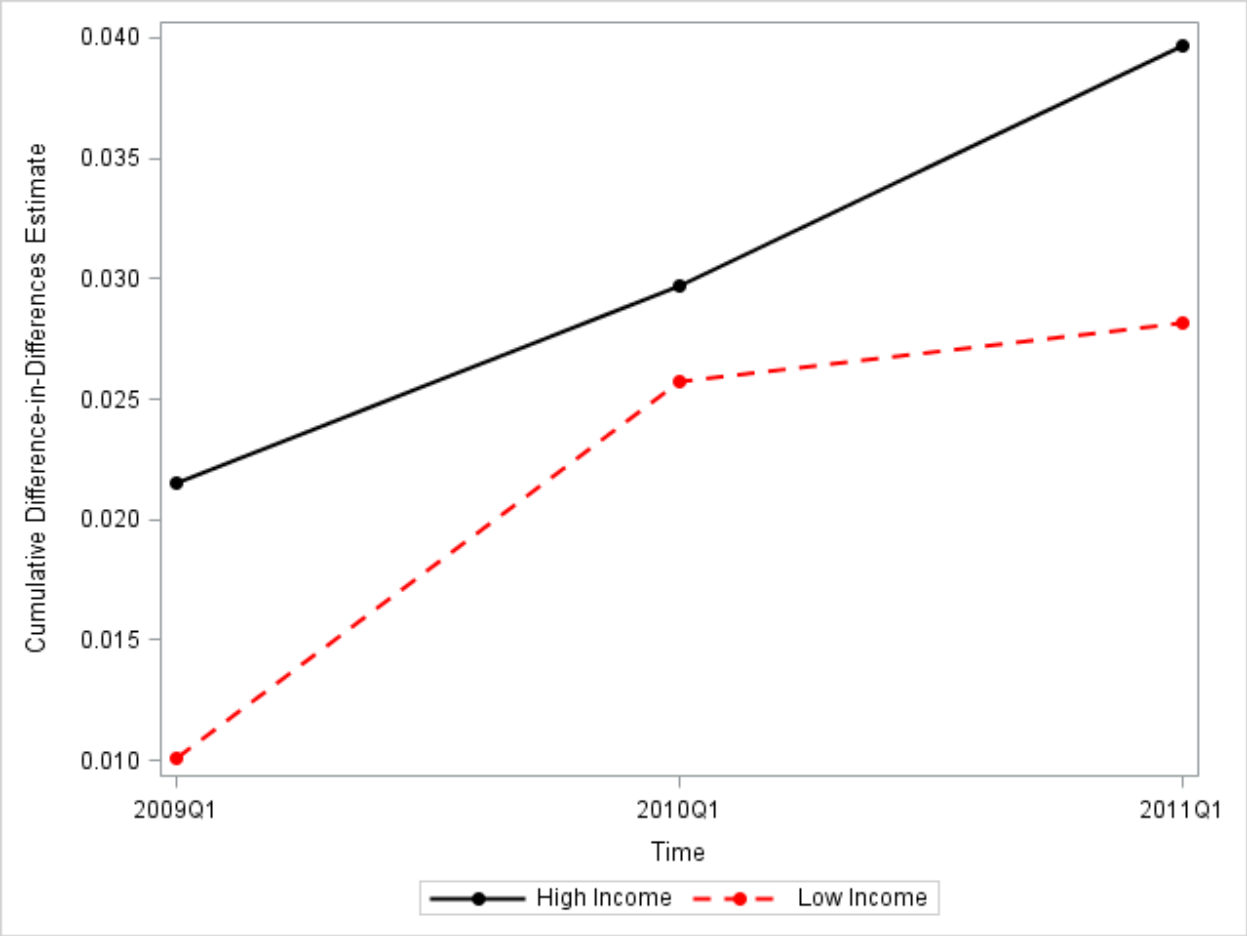

Figure V

Value of $1 Invested in TSP Accounts in 2002

The dotted (red) line presents the annual value of $1 invested in the TSP treasury index in 2002 for each year through 2011. The dashed (blue) line presents the same information for $1 invested in the TSP S&P fund. The solid (black) line presents the same information for the mixed portfolio of high-income employees based on my estimated weights for an employee of retirement age.

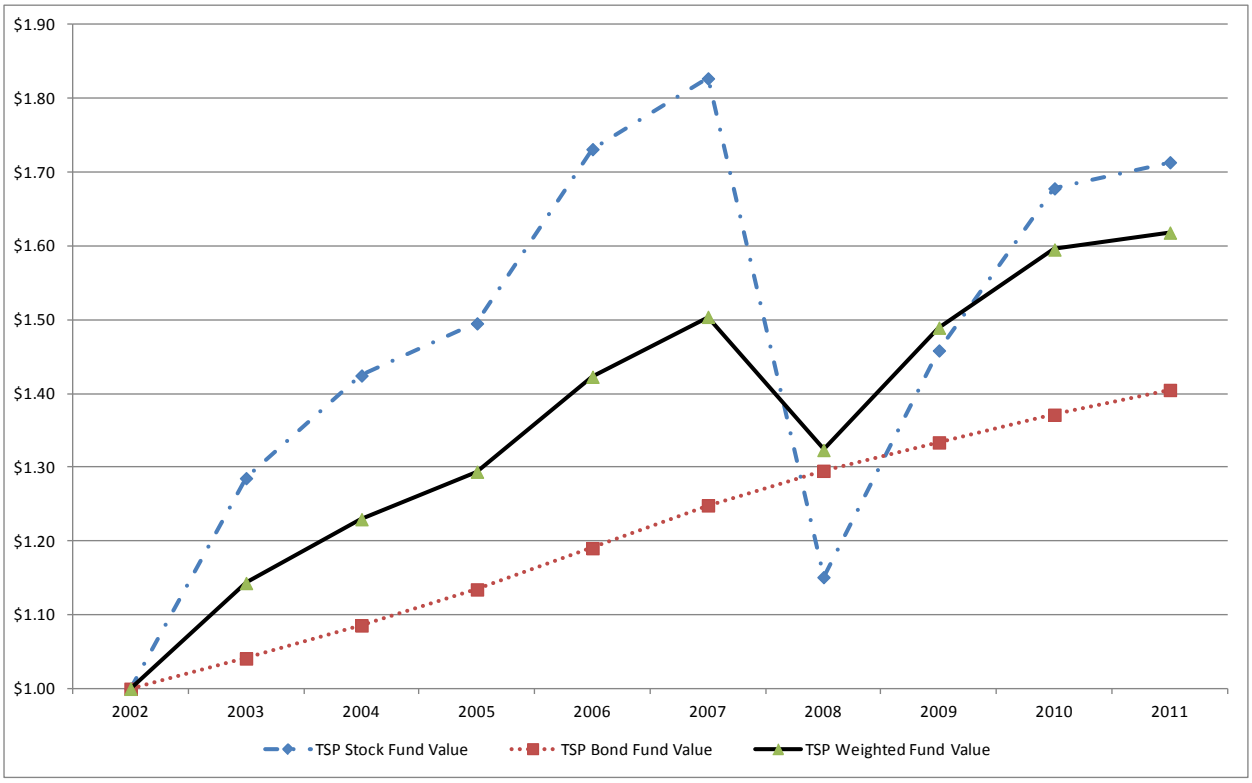

Table I

Retirement Plan Sample Size by Years of Service, Age, and Income[16]

Panel A: YOS Breakdown				
		20-24 YOS	25-29 YOS	Total
	FERS	17,866	4,455	22,321
	CSRS	2,047	10,380	12,427
	Total	19,913	14,835	34,748
Panel B: Age and Income Breakdown				
		Income > $90,000		Income < $90,000
		Age 60-64	Age 65+	Age 60-64	Age 65+
FERS	20-24 YOS	5734	2235	9388	3068
	25-29 YOS	1764	600	2588	735
	Total	7498	2835	11976	3803
CSRS	20-24 YOS	438	182	616	199
	25-29 YOS	3124	1221	3813	1458
	Total	3562	1403	4429	1657

[16] This table provides the number of observations partitioned by retirement plan, YOS, age, and whether annual income is greater than $90,000. All data are as of the end of 2008.

Table II

Annual Retirement Rates Partitioned by FERS Status[17]

Year	FERS Employees		CSRS Employees		
	Annual Voluntary	Year-over-year Change	Annual Voluntary	Year-over-year Change	Difference in Changes
			Pre-Crisis Period		
2004Q4-2005Q3	22.40%		20.80%		
2005Q2-2006Q1	23.00%		21.90%		
2005Q4-2006Q3	22.00%	-0.400%	20.80%	0.000%	-0.400%
2006Q2-2007Q1	21.80%	-1.200%	20.80%	-1.100%	-0.100%
2006Q4-2007Q3	21.60%	-0.400%	20.80%	0.000%	-0.400%
2007Q2-2008Q1	20.80%	-1.000%	20.10%	-0.700%	-0.300%
			Crisis Period		
2007Q4-2008Q3	19.10%	-2.500%	19.10%	-1.700%	-0.800%
2008Q2-2009Q1	15.80%	-5.000%	16.60%	-3.500%	-1.500%
2008Q4-2009Q3	14.20%	-4.900%	15.40%	-3.700%	-1.200%

[17] This table presents the annual retirement rates separately for FERS and CSRS employees.

Table III

Differential Retirement Response of FERS Employees[18]

Panel A	Voluntary Retirement Rates		
	FERS (DC Treated)	CSRS (Not DC Treated)	Difference-in-Differences
Before Crisis (2007Q2-2008Q1)	20.84%	20.14%	
Crisis (2008Q2-2009Q1)	15.80%	16.60%	
Mean Difference	**5.04%**	**3.54%**	**1.50%**
Standard Deviation of Difference	0.37%	0.47%	0.60%
Percentage drop in Retirement Rate	24.18%	17.58%	

Panel B	Voluntary Retirement Rates		
	FERS (DC Treated)	CSRS (Not DC Treated)	Difference-in-Differences
Before Crisis (2007Q2-2008Q1)	20.84%	20.14%	
Crisis (2008Q2-2009Q1)	14.20%	15.40%	
Mean Difference	**6.64%**	**4.74%**	**1.90%**
Standard Deviation of Difference	0.63%	0.73%	0.96%
Percentage drop in Retirement Rate	31.86%	23.54%	

[18] This table presents Difference-in-Differences results where the treatment is being a FERS employee, which means that the employee's pension plan has a DC component. The financial crisis defines the before and after periods. I define the pre-crisis period as April of 2007 through March of 2008. In Panel A, the crisis period is April of 2008 through March of 2009 and in Panel B the crisis period is October of 2008 through September of 2009. Column 1 presents the voluntary retirement rates for FERS employees while Column 2 presents the same information for CSRS employees, which have a purely DB pension. Finally, Column 3 presents the Difference-in-Difference results. Proportions are the sum of two six-month retirement rates (ie: Voluntary Retirement Rate $= \frac{Voluntary\ Retirements_{Month\ 1-6}}{Total\ Employees_{Month\ 6}} + \frac{Voluntary\ Retirements_{Month\ 7-12}}{Total\ Employees_{Month\ 12}}$). Standard errors are computed assuming independence of the reported proportions.

Table IV

Logit Model of the Retirement Decision[19]

Parameter	Crisis Period - 2008Q2-2009Q1		Crisis Period - 2008Q4-2009Q3		
	0.9830	0.9480	0.9830	0.9500	
FERS	-0.0175	-0.0530	-0.0175	-0.0510	-0.0070
	(0.0274)	*(0.0314)*	*(0.0274)*	*(0.0314)*	*(0.0043)*
	0.8090	0.8190	0.7840	0.8010	
Crisis Period	-0.2119**	-0.2002**	-0.2431**	-0.2225**	-0.0307**
	(0.031)	*(0.0311)*	*(0.0320)*	*(0.0321)*	*(0.0043)*
	0.9050	**0.9010**	**0.8440**	**0.8410**	
FERS*Crisis Period	**-0.0996***	**-0.1042****	**-0.1697****	**-0.1727****	**-0.0199****
	(0.0404)	***(0.0404)***	***(0.0411)***	***(0.0411)***	***(0.0054)***
		1.185		1.1570	
Over 65		0.1700**		0.1460**	0.0196**
		(0.0221)		*(0.0223)*	*(.0030)*
		0.959		0.9690	
Long Service		-0.0419		-0.0315	-0.0041
		(0.0253)		*(0.0255)*	*(0.0033)*
		0.778		0.7310	
High Income		-0.2512**		-0.3129**	-0.0396**
		(0.0213)		*(0.0215)*	*(0.0030)*
Intercept	-1.5022**	-1.4277**	-1.5022	-1.4081**	0.1950**
	(0.0205)	*(0.0299)*	*(.0205)*	*(0.030)*	*(.0045)*
Observations (Retire=0)	63,448	63,448	64,856	64,856	64,856
Observations (Retire=1)	12,214	12,214	11,992	11,992	11,992
Liklihood Ratio Test Statistic	209	411	358	619	

[19] Columns 1 through 4 perform a logistic regression where the dependent variable equals one for employees that voluntarily retire in a given year and zero for those that remain employed at the end of the year. Column 5 performs an OLS analysis with the same dependent variable. The sample is restricted to employees over 60 years old with between 20 and 30 YOS. The sample contains observations from April 2007 through March 2008 (the pre-crisis period) and the crisis period. In Columns 1 and 2 the crisis period is defined as April 2008 through March of 2009 and in Columns 3 through 5 the crisis period is October 2008 through September 2009. FERS equals one for employees enrolled in the FERS retirement plan and zero for employees in the CSRS plan. Over 65 is an indicator for employees over 65 years old, Long Service is an indicator for employees with over 25 YOS, and High Income is an indicator for employees making over $90,000 per year. Column 3 performs the same analysis using a linear probability model. Standard errors are presented below the coefficients in parentheses and odds ratios are presented above the coefficients. Coefficients superscripted by *,** are significant at the 5% and 1% levels respectively.

Table V

Differential Retirement Response of FERS Employees Partitioned by Income[20]

Panel A: Income > $90,000	Voluntary Retirement Rates		
	FERS (DC Treated)	CSRS (Not DC Treated)	Difference-in-Differences
Before Crisis (2007Q2-2008Q1)	17.60%	18.01%	
Crisis (2008Q2-2009Q1)	12.79%	15.35%	
Mean Difference	**4.81%**	**2.66%**	**2.15%**
Standard Deviation of Difference	0.59%	0.71%	0.93%
Percentage drop in Retirement Rate	27.33%	14.77%	
Panel B: Income < $90,000	Voluntary Retirement Rates		
	FERS (DC Treated)	CSRS (Not DC Treated)	Difference-in-Differences
Before Crisis (2007Q2-2008Q1)	22.35%	21.43%	
After Crisis (2008Q2-2009Q1)	17.42%	17.51%	
Mean Difference	**4.93%**	**3.92%**	**1.01%**
Standard Deviation of Difference	0.48%	0.63%	0.79%
Percentage drop in Retirement Rate	22.06%	18.29%	

[20] This table presents Difference-in-Differences results where the treatment being a FERS employee, which means that the employee's pension plan has a DC component. The stock market crash is the event to which the treated group has increased exposure. I define the pre-crisis period as April of 2007 through March of 2008 and the crisis period as April 2008 through March 2009. Column 1 presents the voluntary retirement rates for FERS employees while Column 2 presents the same information for CSRS employees, which have a purely DB pension. Finally, Column 3 presents the Difference-in-Difference results. Proportions are the sum of two six-month retirement rates (ie: Voluntary Retirement Rate $= \frac{Voluntary\ Retirements_{Month\ 1-6}}{Total\ Employees_{Month\ 6}} + \frac{Voluntary\ Retirements_{Month\ 7-12}}{Total\ Employees_{Month\ 12}}$). Standard errors are computed assuming independence of the reported proportions. Panel A restricts the sample to employees making greater than $90,000 per year and Panel B restricts the sample to employees making less than $90,000 per year.

Table VI

Retirement Logit Partitioned by Income and Age[21]

	Income < $90,000				Income > $90,000			
Parameter	Crisis Period - 2008Q2-2009Q1		Crisis Period - 2008Q4-2009Q3		Crisis Period - 2008Q2-2009Q1		Crisis Period - 2008Q4-2009Q3	
	0.9930	0.9700	0.9930	0.9670	0.9180	0.9040	0.9180	0.9240
FERS	-0.0067	-0.0300	-0.0067	-0.0338	-0.0858	-0.1010	-0.0857	-0.0785
	(0.0332)	*(0.0382)*	*(0.0332)*	*(0.0383)*	*(0.0489)*	*(0.0553)*	*(0.0489)*	*(0.0553)*
	0.8000	0.8020	0.8180	0.8220	0.8410	0.8400	0.7580	0.7560
Crisis Period	-0.2236**	-0.2204**	-0.2005**	-0.1956**	-0.1733**	-0.1745**	-0.2776**	-0.2800**
	(0.0392)	*(0.0393)*	*(0.0405)*	*(0.0406)*	*(0.0508)*	*(0.0508)*	*(0.0524)*	*(0.0525)*
	0.9430	**0.9410**	**0.8730**	**0.8700**	**0.8380**	**0.8340**	**0.7790**	**0.7800**
FERS*Crisis Period	**-0.0590**	**-0.0611**	**-0.1359****	**-0.1396****	**-0.1811****	**-0.1814****	**-0.2493****	**-0.2491****
	(0.0498)	***(0.0498)***	***(0.0508)***	***(0.0508)***	***(0.0702)***	***(0.0703)***	***(0.071)***	***(0.0711)***
		1.1850		1.1580		1.1890		1.1600
Over 65		0.1700**		0.1470**		0.1735**		0.1487**
		(0.027)		*(0.0272)*		*(0.0384)*		*(0.0388)*
		0.9530		0.9480		0.9730		1.0120
Long Service		-0.0487		-0.0535		-0.0270		0.0115
		(0.0309)		*(0.0312)*		*(0.044)*		*(0.0442)*
Intercept	-1.4312**	-1.4426**	-1.4312**	-1.4320**	-1.6270**	-1.6537**	-1.6271**	-1.6776**
	(0.0254)	*(0.0357)*	*(0.0254)*	*(0.0359)*	*(0.0348)*	*(0.0509)*	*(0.0348)*	*(0.0512)*
Observations (Retire=0)	40,107	40,107	39,946	39,946	23,341	23,341	24,910	24,910
Observations (Retire=1)	8,411	8,411	8,265	8,265	3,803	3,803	3,727	3,727
Liklihood Ratio Test Statistic	123	165	161	193	95	115	192	214

[21] This table presents a logit with retirement as the dependent variable. The sample is restricted to employees over 60 years old with between 20 and 30 YOS. The sample contains observations from April 2007 through March 2008, which I define as the pre-crisis period, and the crisis period, which is April 2008 through March 2009 in Columns 1, 2, 5, and 6 and October 2008 through September 2009 in columns 3, 4, 7, and 8. FERS equals one for employees enrolled in the FERS retirement plan and zero for employees in the CSRS plan. Over 65 is an indicator for employees over 65 years old, Long Service is an indicator for employees with over 25 YOS, and High Income is an indicator for employees making over $90,000 per year. Columns 1 through 4 restrict the sample to employees making less than $90,000 per year while columns 5 through 8 include only employees making over $90,000. Standard errors are presented below the coefficients in parentheses and odds ratios are presented above the coefficients. Coefficients superscripted by *,**,*** are significant at the 10%, 5%, and 1% levels respectively.

Table VII

Descriptive Statistics by Years of Service[22]

	20-24 YOS		25-29 YOS	
	Mean	Median	Mean	Median
Crisis Period	0.55	1.00	0.52	1.00
Over 65	0.26	0.00	0.26	0.00
Male	0.49	1.00	0.50	0.00
State House Price Drop	0.02	0.01	0.02	0.01
20-year State Home Appreciation	2.01	1.77	2.07	1.85
State Unemployment Rate	6.62	6.70	6.50	6.20
White Collar Index	4.30	5.00	4.36	5.00
Income	7.03	7.00	7.41	7.00

[22] This table provides descriptive statistics partitioned by YOS. Observations from October 2008 through September 2009 are considered in the Crisis Period. Over 65 is an indicator for an employee over 65 years old and Male indicates a male. State House Price Drop is the percentage difference between the state level average home price in the first quarter of 2007 and the end of the observation year, 20-year State Home Appreciation is the state level percentage increase in average home value from January 1987 through January 2007, and State Unemployment is the state level unemployment rate. White Collar Index is a count from one to five where one is a blue collar job and 5 is listed as a professional job requiring at least a college degree. Income is a count variable from one to eleven for $10,000 annual income buckets from $20,000 to $120,000 and above.

Table VIII

Retirement Logit with FERS Proxy and State Level Controls[23]

Parameter	Full Sample	Income < $90,000	Income > $90,000
	0.9800	0.9850	0.9750
FERS Proxy	-0.0203	-0.0155	-0.0249
	(0.0294)	*(0.0355)*	*(0.0532)*
	0.7030	0.6780	0.5990
Crisis Period	-0.3531**	-0.3890**	-0.5123**
	(0.0477)	*(0.0579)*	*(0.0875)*
	0.9150	0.9760	0.7710
FERS Proxy*Crisis Period	-0.0893*	-0.0239	-0.2607**
	(0.0433)	*(0.0529)*	*(0.0771)*
Over 65	0.1786**	0.1747**	0.2084**
	(0.0239)	*(0.0293)*	*(0.0419)*
Male	-0.1235**	-0.4352**	0.6169**
	(0.3001)	*(0.3757)*	*(0.527)*
State House Price Drop	-0.9121**	-0.4697	-1.5425**
	(0.0145)	*(0.0195)*	*(0.0226)*
20-year State Home Appreciation	-0.0200	-0.0484*	0.0289
	(0.0093)	*(0.0111)*	*(0.0178)*
State Unemployment Rate	0.0001	-0.0028	-0.0043
	(0.0121)	*(0.0129)*	*(0.0605)*
White Collar Index	0.0361**	0.0042	-0.0638
	(0.0051)	*(0.0097)*	*(0.0231)*
Income	-0.0571**	-0.0025	-0.1797**
	(0.0685)	*(0.0844)*	*(0.3758)*
Intercept	-1.0257**	-0.9770**	0.3786
	(0.0685)	*(0.0844)*	*(0.3758)*
Observations (Retire=0)	57,870	35,612	22,258
Observations (Retire=1)	10,250	7,078	3,172
Liklihood Ratio Test Statistic	724	510	581

[23] This table presents a logit with retirement as the dependent variable. The sample is restricted to employees over 60 years old with between 20 and 30 YOS. The sample contains observations from April 2007 through March 2008 and October 2008 through September 2009. Crisis Period equals one for observations between October 2008 and September 2009 and zero otherwise. FERS Proxy equals one for employees with 20-24 YOS as they are likely enrolled in the FERS retirement plan as opposed to the CSRS plan. Over 65 is an indicator for employees over 65 years old and Male indicates a male. State House Price Drop is the percentage difference between the state level average home price in the first quarter of 2007 and the end of the observation year, 20-year State Home Appreciation is the state level percentage increase in average home value from January 1987 through January 2007, and State Unemployment is the state level unemployment rate. White Collar Index is a count from one to five where one is a blue collar job and 5 is listed as a professional job requiring at least a college degree. Income is a count variable from one to eleven for $10,000 annual income buckets from $20,000 to $120,000 and above. Columns 2 and 3 further restrict the sample to employees making under and over $90,000 respectively. Standard errors are presented below the coefficients in parentheses and odds ratios are presented above the coefficients of the first three variables. Coefficients superscripted by * and** are significant at the 5%, and 1% levels respectively.

Table IX

Estimating the Magnitude of the FERS Treatment[24]

Panel A: $100,000 Employee			Contribution Rate		Participation Rate		Total % Contributed		Estimated TSP Value	
Year	Wage	TSP Returns	FERS	CSRS	FERS	CSRS	FERS	CSRS	FERS	CSRS
1988	$34,712	10.14%	7.00%	5.50%	53.00%	20.00%	6.36%	1.10%	$2,431	$421
1989	$37,281	20.89%	7.10%	5.60%	55.00%	24.00%	6.66%	1.34%	$5,939	$1,114
1990	$39,853	2.58%	7.20%	5.70%	64.00%	28.00%	7.81%	1.60%	$9,284	$1,795
1991	$44,117	19.92%	7.30%	5.80%	68.00%	32.00%	8.36%	1.86%	$15,558	$3,135
1992	$47,426	7.46%	7.40%	5.90%	73.00%	39.00%	9.05%	2.30%	$21,332	$4,541
1993	$49,181	8.22%	7.50%	6.00%	78.00%	41.00%	9.75%	2.46%	$28,274	$6,224
1994	$52,771	3.90%	7.60%	6.10%	85.00%	44.00%	10.71%	2.68%	$35,249	$7,938
1995	$54,143	21.07%	7.70%	6.20%	87.00%	47.00%	11.05%	2.91%	$49,920	$11,521
1996	$57,229	13.49%	7.80%	6.30%	89.00%	54.00%	11.39%	3.40%	$64,055	$15,285
1997	$58,946	18.03%	7.90%	6.40%	89.00%	59.00%	11.48%	3.78%	$83,590	$20,668
1998	$64,546	15.22%	8.00%	6.50%	90.00%	60.00%	11.70%	3.90%	$105,018	$26,715
1999	$66,870	11.56%	8.10%	6.60%	90.00%	61.00%	11.79%	4.03%	$125,957	$32,808
2000	$72,286	0.67%	8.20%	6.70%	90.00%	62.00%	11.88%	4.15%	$135,442	$36,049
2001	$74,961	-1.43%	8.30%	6.80%	90.00%	63.00%	11.97%	4.28%	$142,352	$38,700
2002	$80,883	-4.09%	8.40%	6.90%	90.00%	63.00%	12.06%	4.35%	$145,880	$40,488
2003	$84,199	14.33%	8.50%	7.00%	90.00%	63.00%	12.15%	4.41%	$178,484	$50,536
2004	$87,651	7.57%	8.60%	7.10%	90.00%	63.00%	12.24%	4.47%	$203,527	$58,576
2005	$96,592	5.23%	8.70%	7.20%	90.00%	63.00%	12.33%	4.54%	$226,709	$66,252
2006	$99,586	9.94%	8.80%	7.30%	90.00%	65.00%	12.42%	4.75%	$262,843	$78,033
2007	$101,777	5.71%	8.90%	7.40%	90.00%	65.00%	12.51%	4.81%	**$291,301**	**$87,661**
2008		**-12.00%**							**$256,355**	**$77,144**

[24] This table presents estimates of wage and Thrift Savings Plan (TSP) value for FERS and CSRS employees from 1988, when the TSP program began, until 2008. Panel A is for a representative employee earning approximately $100,000 in 2007 and Panel B for an employee earning $40,000 per year before the crisis.

Panel B: $40,000 Employee			Contribution Rate		Participation Rate		Total % Contributed		Estimated TSP Value	
Year	Wage	TSP Returns	FERS	CSRS	FERS	CSRS	FERS	CSRS	FERS	CSRS
1988	$13,651	9.68%	5.50%	4.00%	40.00%	20.00%	4.20%	0.80%	$629	$120
1989	$14,661	17.78%	5.60%	4.10%	45.00%	24.00%	4.77%	0.98%	$1,564	$311
1990	$15,673	4.51%	5.70%	4.20%	50.00%	28.00%	5.35%	1.18%	$2,511	$518
1991	$17,350	16.75%	5.80%	4.30%	55.00%	32.00%	5.94%	1.38%	$4,135	$883
1992	$18,651	7.38%	5.90%	4.40%	58.00%	39.00%	6.32%	1.72%	$5,706	$1,292
1993	$19,341	7.66%	6.00%	4.50%	60.00%	41.00%	6.60%	1.85%	$7,518	$1,775
1994	$20,753	4.84%	6.10%	4.60%	65.00%	44.00%	7.22%	2.02%	$9,452	$2,301
1995	$21,292	16.82%	6.20%	4.70%	67.00%	47.00%	7.50%	2.21%	$12,908	$3,238
1996	$22,506	10.92%	6.30%	4.80%	69.00%	54.00%	7.80%	2.59%	$16,264	$4,239
1997	$23,181	14.07%	6.40%	4.90%	74.00%	59.00%	8.44%	2.89%	$20,782	$5,599
1998	$25,384	11.59%	6.50%	5.00%	75.00%	60.00%	8.63%	3.00%	$25,635	$7,098
1999	$26,297	9.32%	6.60%	5.10%	75.00%	61.00%	8.70%	3.11%	$30,525	$8,654
2000	$28,427	2.85%	6.70%	5.20%	75.00%	62.00%	8.78%	3.22%	$33,959	$9,843
2001	$29,479	0.90%	6.80%	5.30%	75.00%	63.00%	8.85%	3.34%	$36,895	$10,924
2002	$31,808	-0.68%	6.90%	5.40%	75.00%	63.00%	8.93%	3.40%	$39,465	$11,925
2003	$33,112	10.92%	7.00%	5.50%	75.00%	63.00%	9.00%	3.47%	$47,079	$14,500
2004	$34,470	6.55%	7.10%	5.60%	75.00%	63.00%	9.08%	3.53%	$53,498	$16,746
2005	$35,711	5.17%	7.20%	5.70%	75.00%	63.00%	9.15%	3.59%	$59,701	$18,960
2006	$36,818	8.25%	7.30%	5.80%	75.00%	65.00%	9.23%	3.77%	$68,303	$22,027
2007	$37,628	5.60%	7.40%	5.90%	75.00%	65.00%	9.30%	3.84%	**$75,821**	**$24,784**
2008		**-5.77%**							**$71,447**	**$23,354**

The wage estimates are based on historical federal government wage tables and incorporate step promotions, COLA adjustments, and 3 grade promotions. The contribution and participation rates are estimated using government records and survey evidence regarding TSP contribution, asset allocation, and account returns. The Total % Contributed includes the government's 5% match for FERS employees, but the contribution rate column does not.

Table X

Estimated Components of Retirement Wealth by Retirement Plan[25]

Panel A: $100,000 per Year Employee		
	FERS Employee	CSRS Employee
Annual DB Pension Payment	$28,422	$49,092
Annual Social Security Payment	$15,568	$0
Combined DB Payment	$43,990	$49,092
Annual DC Payments	$18,646	$5,536
Total Annual Retirement Income	$62,636	$54,628
Percentage DC	29.77%	10.13%
Returns During Crisis	-12.00%	-12.00%
Retirement Wealth Loss During Crisis	-3.57%	-1.22%

Panel B: $40,000 per Year Employee		
	FERS Employee	CSRS Employee
Annual DB Pension Payment	$10,507.00	$18,150.00
Annual Social Security Payment	$9,395.72	$0.00
Combined DB Payment	$19,902.72	$18,150.00
Annual DC Payments	$4,927.18	$1,544.16
Total Annual Retirement Income	$24,829.90	$19,694.16
Percentage DC	19.84%	7.84%
Returns During Crisis	-5.77%	-5.77%
Retirement Wealth Loss During Crisis	-1.14%	-0.45%

[25] This table estimates the retirement wealth breakdown for the FERS and CSRS employee. Panels A and B are estimations for a representative employee making $100,000 per year and $40,000 per year respectively. The retirement wealth calculation incorporates DB based on 25 YOS and estimates the value of all DC and SS benefits since 1988, the beginning of Thrift Savings Plans. Annual DB and Social Security values are estimated using an estimated salary progression (see Table I) and the respective benefits formula. The annual value of the DC plan is calculated by annuitizing the estimated pre-crisis TSP account value (the second to last row of Table I) for 20 years at a 3% annual rate.