Exploiting Variation in Coverage of Social Security:

Synopsis of "Retirement Behavior of Federal Civil Service Workers"

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1. Introduction

One of the central questions in research on the elderly is measuring the impact of Social Security and Medicare incentives on retirement probabilities. Researchers have taken a wide variety of approaches to examining the impact, with varying degrees of success. A significant hurdle faced in previous studies is the lack of variation in program coverage in the population being analyzed. In particular, both Social Security and Medicare are federally run programs and cover most individuals.

However, previous studies have overlooked the fact that coverage, although broad, is not universal. Many of the largest employers in the United States do not participate (or have not participated) in the Social Security system. For example, the U.S. Federal Government employs approximately 2.8 million workers, and those hired before 1984 generally are not covered by Social Security. In addition, the retirement systems constructed by government agencies often differ from the Social Security system.

In this paper, we examine the retirement behavior of federal civil service workers who are covered by the Civil Service Retirement System (CSRS).[1] The behavior of this group is relevant to the broader issue of retirement incentives in the general population for several reasons. First, individuals covered by CSRS are not covered by Social Security, so the group provides variation in Social Security coverage. No previous study has exploited the variation in coverage across U.S. workers. Second, the CSRS is a defined benefit pension with a remarkably simple pension formula. Consequently, understanding (and specifying) the financial incentive associated with retirement is considerably easier than it is for workers who are covered by pension schemes and Social Security. Several studies have demonstrated that retirees understand very little about pension plans (e.g., Gustman and Steinmeier, 2001), and much less about the interaction of pension plans and Social Security. Finally, unlike Social Security, the CSRS does not have any particular incentives for individuals to retire at age 65. This will allow us to more easily examine the incentives inherent in Medicare.

[1] In our final report to MRRC, we provide significantly more details about the larger project. Specifically, we discuss what can be learned about social security by studying those who are not covered by social security, the various retirement systems of federal civil service workers, and the characteristics of federal civil service workers. This synopsis presents results from part of the project that focuses on the retirement behavior of the workers who are covered by the Civil Service Retirement System.

In addition to these general reasons to study CSRS workers, another important reason rests with the widespread concern among policy makers of the pending crisis in the federal civil service. In 2001, the General Accounting Office added human capital management, and the pending retirements, to the "high-risk list" of federal activities. According to the President's Management Agenda, approximately 70 percent of the federal government's current permanent employees will be eligible for early retirement by 2010 and they estimate that 40 percent of them are expected to retire (Office of Management and Budget, 2002). Policies are needed to efficiently manage these retirements so that an efficient combination of workers can be retained.

This paper has three purposes. First, we analyze the retirement behavior of civil service workers, which serves as a first step towards understanding the effect of the financial incentive of Social Security and exploiting the variation that comes from lack of coverage among CSRS-covered employees. Second, we estimate and compare the results of several forward-looking models. These models are reviewed and discussed in the next section. Third, because the CSRS financial incentives are not coincident with ages associated with Medicare and Social Security, we take advantage of the simple financial incentives facing these workers to examine retirement behavior at age 65. The CSRS workers will provide some evidence regarding the incentives of Medicare and the social norms of retiring at this key age.

2. Background on Forward-Looking Retirement Models

The literature on retirement timing is quite large (See Hurd (1990) and Leonesio (1996) for useful reviews.) In this paper, we consider several versions of forward-looking models that can usefully be viewed as special cases of the so-called "option value model" of retirement. These models stop short of a full dynamic program of retirement (see Rust (1989), Gotz and McCall (1987), Asch and Warner (1994)), but previous research suggests these models still perform quite well relative to other models (see Lumsdaine, Stock, and Wise, 1992).

In the basic option value model, individuals are assumed to retire today at time t if the expected value of continuing work and retiring at some future date r* is less than the value of retiring today. The choice of r* is the point in the future when the expected value of retiring is maximized. Various sets of assumptions have been made to empirically implement this structural model. We group the type of assumptions into three broad classes: financial models, reduced-form option value (RFOV) models, and structural option value (OV) models. The three models,

their relationship, and some of the advantages and disadvantages are discussed in Asch, Haider, Zissimopoulos, (2002).

The empirical implementation of the RFOV assumes the values for the underlying structural parameters of the utility functions. The form of the utility function that is often used is the constant relative risk aversion (CRRA), with an additional parameter k to allow for differences in the value of income flows during retirement versus the value of the income flows while working. Thus, the three parameters are the relative value of not working k, risk aversion or intertemporal substitution g, and the subjective discount factor b. Past studies (Coile and Gruber (2000), Samwick (1998), and Samwick and Wise (2001)) usually assume the utility function parameters that were obtained from the early Stock and Wise (1990) study, one of the few that actually estimated the utility function parameters.

A series of studies have also implemented the basic option value model by adopting a set of assumptions that are sufficient to reduce the retirement incentive to a simple financial incentive. Such financial models, often referred to as "Annualized Cost of Leaving" (ACOL) models, have been commonly used since the late 1970s to examine the retirement and retention behavior of military personnel (Warner, 1978; Warner and Goldberg, 1984; Smith, Sylwester, and Villa, 1991). More recently, Coile and Gruber (2000) use a similar financial model to examine the financial incentives of the social security system, referring to their model as a "Peak Value" (PV) model. The main difference between the PV model and the ACOL model is that the PV model ignores the role of some financial incentives of working, such as earnings and DC pensions. The main drawback to all of these financial models is that they ignore the disutility of work. This is a potentially important restriction in light of estimates that provide evidence to the contrary (Stock and Wise, 1990).

The final type of empirical approach implements the full option value model and estimates the underlying utility parameters (e.g., Stock and Wise (1990)). Now, with appropriate additional assumptions, error terms are built into the model structurally. If an individual is found to retire at an age that differs from her peak, it is assumed that this deviation was caused by a particular draw from the utility function. It is not assumed that it was due to private information (with

respect to the econometrician) on the part of the individual. Full OV models are estimated infrequently because they are more computationally difficult to implement.[2]

3. The Data

Until 1987, the Civil Service Retirement System (CSRS) was the primary retirement system covering federal civil service personnel. Because CSRS was legislated in the 1920s before the Social Security system was created, civil service employees participating in CSRS are not covered by Social Security.[3] CSRS is a typical defined benefit retirement plan. Benefits are vested after 5 years of service (YOS), and the individual's earnings (in the highest three years) and YOS determine the benefit level. The normal retirement age is determined by ones' years of service. Individuals who reach age 55 with 30 YOS are entitled to receive full benefits, individuals who reach age 60 with 20 YOS are entitled to receive full benefits, and individuals who reach age 62 with 5 YOS are entitled to receive full benefits.

Those who separate before they have become eligible to retire can claim benefits at age 62 if they have at least 5 years of service. Their annuity is based on the highest three years of earnings at the time of separation.[4] Consequently, their pension annuity is eroded by inflation between the date of separation and age 62. However, those who are eligible to retire get a pension annuity that is adjusted annually by the full CPI amount. Thus, the benefit is essentially inflation protected for those who are retirement eligible at the time of separation. This protection creates a strong incentive to stay in the civil service until retirement eligibility is reached as will be seen below when we show pension accruals and peak values under CSRS.

We limit our analysis to permanent federal civil service personnel in the Department of Defense (DoD), covering fiscal years 1980 to 1996. The Defense Manpower Data Center (DMDC) provided the data and they represent administrative personnel records for the entire

[2] There is also accumulating evidence that full OV models are not always stable. We have experienced difficulties in estimating these models (see below). Samwick (1998) reports that his attempts at estimating OV models were not successful, and others have obtained parameter estimates that are difficult to interpret.

[3] In 1987, the Federal Employees Retirement System (FERS) was created; importantly, FERS includes Social Security coverage. In future research, we will compare these workers to CSRS workers.

[4] The benefit formula under CSRS equals 1.5 percent of an individual's highest three-year average earnings times his or her years of service (YOS) for the first five YOS, plus 1.75 percent of the highest-three average earnings times YOS for the next five YOS, plus 2 percent of the highest-three average earnings times all YOS over 10. The maximum annuity an individual can receive is 80 percent of the highest-three average earnings. Normally, this is acquired after 41 years of credible civilian and military service.

population of permanent workers in DoD during this time frame. DoD is the largest employer of federal civil service workers outside of the Post Office, employing around 900,000 permanent workers, on average, annually, over the data period. We have 16.5 million personnel records on civil service workers in DoD over the 17-year period.

Given our focus on retirement behavior, we restrict our data to civilian personnel in DoD who are between ages 50 and 70. We also limit our analysis to those covered by CSRS. We make other data restrictions to ensure that individuals are not covered by social security. For example we limit our analysis to those with 15 or more years of service, to reduce the likelihood that individuals in our sample had prior employment in the covered sector. We also deleted individuals with prior military experience because military service is covered by social security since 1956. Our longer paper describes other data issues and restrictions.

4. Who are the federal civil service workers?

Although the Social Security Program is extremely large, coverage is not universal. The large number of federal employees under CSRS, together with many state and local government workers, and railroad workers, represent a large segment of workers who are not covered by Social Security. Table 1 shows the extent of Social Security coverage in terms of wages and salaries. In 1996, Social Security covered about 92 percent of the non-self-employed wages and salaries. Although only about 8 percent of wages and salaries were uncovered, it represents about $300 Billion in 1996. Federal employment wages and salaries represent a significant fraction of this uncovered amount. Table 2 reports means and standard deviations of characteristics of the sample.[5]

CSRS embeds strong incentives to retire at very specific ages, namely at the normal retirement ages. This point is seen in Table 3 where we show the present discounted value (PDV) of CSRS pension wealth for a representative 50 year old in our sample. The calculation assumes future annual earnings growth of 0.25 percent, a real interest rate of 3 percent, an inflation rate of 4 percent. We consider two cases. The first case assumes that the individual will be eligible for retirement at Normal Retirement Age (NRA) of 55. The second case assumes eligibility for retirement at a NRA of 60. Therefore, in the former case, we assume the individual

[5] See the Final Report and the full paper for a comparison of these workers to the general population.

has a least 30 years of service at age 55 and in the latter case, we assume she has at least 20 years of service at age 60.

In the first case, we find that pension wealth more than doubles at age 55 where it is maximized. In the second case, pension wealth increases with age and then rises by over 35 percent at age 60. Beyond age 55 in the first case and age 60 in the second, pension wealth declines with age as the effects of fewer years of pension receipt (given an assumed death age of 99) offsets the growth in earnings and the increase in years of service.

Before presenting estimates of the effect of CSRS on retirement, it is interesting to consider the aggregate retirement hazards, shown in Figure 1. Two points are worth noting. First, the retirement hazards spike up at ages 55, 60, and 62, the three normal retirement ages embedded in the CSRS pension formula. Second, we see a small spike at ages 64, an age that has no particular significance under CSRS. These retirements might be due to social norms, spousal retirement plans (including Social Security) or other factors unobserved to us.

5. Estimates of Retirement Models

Table 4 presents logistic regression model results. The first specification follows Coile and Gruber (2000) and includes the CSRS pension peak value as the measure of the retirement incentives. The peak value is denominated in dollars thus allowing for ease in interpretation. The second specification, the option value model, represents the incentive in terms of utility. We follow other studies and set the parameters of the utility function to assumed values. Based on the original Stock and Wise (1990) study, we set κ to 1.5 and γ to 0.75.

Our results are consistent with earlier studies. Using logistic regression we estimate a negative and statistically significant effect of the peak value and of the reduced form option value. Our coefficient estimate for the peak value (measure in $10,000) is -0.023. The estimate is the correct sign—an increase in the peak value associated with staying in the civil service reduces the probability of retirement—and is statistically significant at the 1 percent level. The coefficient implies a $10,000 increase in peak values decreases retirement by 0.0075 or 10% of the average retirement rate. This translates into an elasticity of 0.10 --a one percent increase in peak value decreases retirement by 0.1 percent.

Similarly, our estimate on the option value of retirement is negative and statistically different than zero at the 1 percent significance level (0.04). To examine the economic content of the

option value model, we use the parameters estimated from the option value model to simulate the effect on retirement of a decrease of 20 percent of retirement wealth. The model predicts average retirement rate that is 2 percent lower than the baseline retirement rate, which represents a 35 percent decrease from the mean retirement rate.

Coile and Gruber (2000) in a model incorporating Social Security and pension wealth find that $1,000 in peak value lowers retirement by 0.5 percent of the sample average retirement rate. Our estimate effect of peak value likewise leads to a slightly larger, 1 percent decrease of the average retirement rate for a $1,000 increase in peak value. Samwick and Wise (2001) estimate that a $1,000 increase in their accrual measure (accrual to age 65) reduces baseline retirement probabilities by 1.8 percent. Our estimates are remarkable similar to estimates for workers covered by Social Security and pensions in the HRS as analyzed by other studies.

We also include a full set of age dummies in both reduced form specifications. These dummies capture the effects of age on retirement, over and above their effects through the retirement incentive variables. Generally, we find statistically significant age dummy effects in both specifications and interpret this as 'excess retirements' -- retirements associated with age that are not explained by the incentive variables. On the other hand, the magnitude of the age dummy effects are not large and while statistically different than age 55, the age dummies are generally not statistically different than the prior or following age. We do not find the age 65 spike that many previous studies have found (Lumsdaine, Stock, Wise 1996; Phelan and Rust, 1991, 1993; Stock and Wise 1990). Civil service workers in our sample, who have at least 5 years of service have access to retiree health insurance upon separation from the job thus the availability of Medicare at age 65 is unlikely to cause an age 65 spike in retirement. The lack of an effect at age 65 also suggests that there is no 'social norm' associated with retirement at age 65.

We examine whether the option value estimates are affected by the inclusion of age dummies in the specification by estimating the models with age excluded. The option value coefficient estimate (x1000) is now -0.005 which is a large change from our previous estimate of -0.04 showing the estimates are sensitive to the inclusion of non-linearity of age. We compare to actual retirement probabilities simulated retirement probabilities based on one option value model that includes age dummies and one that does not include age dummies (Figure 2). The model without age does a remarkable job of picking up the increase in retirement at age 55 and age 60 but does

not capture the decrease in retirement in the immediate following year. Overall, the model with age dummies excluded underestimates that probability of retirement at each age.

In results not shown here, we also estimate various full option value models. Our initial results are very much in line with previous studies when we estimate the various parameters individually, assuming realistic values for the remaining parameters. However, in models where we estimate parameters jointly, the results are much more sensitive. This finding that the results are sensitive is not surprising given the underlying structure of the model and previous attempts at estimating the full option value model (see Samwick (1998)). Despite this initial sensitivity, the full OV model is appealing because it captures many of the important aspects of the retirement decision. For example, it allows for forward-looking behavior and for work and leisure to be valued differently. Our data are providing an important opportunity to explore this sensitivity because the underlying financial incentives are easy to understand and they are stark.

5. Conclusions

The results in this paper represent the first step in a larger project to exploit variation in Social Security coverage to better understand its incentives. In this paper, we focus on the retirement behavior of the Department of Defense Civil Service workers. This population provides an interesting group to study because they are not covered by Social Security, their financial incentives to retire do not coincide with Social Security and Medicare rules, and their retirement plan is very simple to understand.

We find that the civil service workers respond to their financial incentives to retire. The modal retirement ages are 55 and 60, corresponding to their incentives. Moreover, our parameter estimates suggest that these individuals respond to their financial incentives very similarly to how individuals respond to the financial incentives inherent in the Social Security system.

References

Asch, Beth, and John Warner, *A Policy Analysis of Alternative Retirement Systems*, RAND, MR-465-OSD, 1994.

Asch, Beth J. and John Warner, *Separation and Retirement Incentives in the Federal Civil Service: A Comparison of the Federal Employees Retirement System and the Civil Service Retirement System*, RAND, MR-986-OSD, 1999.

Asch, Beth J., *The Pay, Promotion, and Retention of High-Quality Civil Service Workers in the Department of Defense*, RAND, MR-1193-OSD, 2001.

Asch, Beth J., Steven Haider and Julie Zissimopoulos, "The Retirement Behavior of Federal Civil Service Workers," RAND manuscript, 2002.

Black, Matthew, Robert Moffitt, and John Warner, "The Dynamics of Job Separation: The Case of Federal Employees," *Journal of Applied Econometr*ics, Vol. 5, 1990, pg 245-262.

Coile, Courtney, and Jonathan Gruber, "Social Security and Retirement," NBER Working paper No. W7830, Cambridge, MA, 2000.

Daula, Thomas and Robert Moffitt, "Estimating Dynamic Models of Quit Behavior: The Case of Military Reenlistment," *Journal of Labor Economics*, Vol. 13, No. 3, 1995, pg 499-523.

Gotz, Glenn and John McCall, *A Dynamic Retention Model for Air Force Officers: Theory and Estimates*, Santa Monica, CA: RAND, 1984, R-3028-AF.

Gustman, Alan, and Thomas Steinmeier, "Imperfect Knowledge, Retirement, and Savings, National Bureau of Economic Research Working Paper 8406, Cambridge, MA: August 2001.

Hogan, Paul, and Matthew Black, "Reenlistment Models: A Methodological Review" In Curtis Gilroy, David Horne, and D. Alton Smith (eds.), Military Compensation and Personnel Retirement: Models and Evidence. Alexandria, VA: U.S. Army Research Institute for the Behavioral and Social Sciences, 1991.

Hurd, Michael, "Research on the Elderly: Economic Status, Retirement, and Consumption and Savings," *Journal of Economic Literature*, 28, June 1990. pp 565-637.

Leonesio, Michael V. "The Economics of Retirement: A Nontechnical Guide, Social Security Bulletin, 59(4) 1996, pp29-50.

Lumsdaine, Robin, James Stock, and David Wise, "Three Models of Retirement: Computational Complexity versus Predictive Ability," in David A. Wise (ed.), *Topics in the Economics of Aging*. Chicago: University of Chicago Press, 1992.

Lumsdaine, Robin, James Stock, and David Wise, "Why are Retirement Rates So High at Age 65," in David A. Wise (ed.), *Advances in the Economics of Aging*. Chicago: University of Chicago Press, 1996.

Office of Management and Budget, "The President's Management Agenda, Fiscal Year 2002," Washington DC: Government Printing Office, 2002.

Rust, John, "A Dynamic Programming Model of Retirement Behavior," *in The Economics of Aging*, David Wise (Ed.), National Bureau of Economic Researrch Project Report series, Chicago: University of Chicago Press, 1989.

Samwick, Andrew, "New Evidence on Pensions, Social Security, and the Timing of Retirements," *Journal of Public Economics*, Vol. 70, 1998, pg 207-236.

Samwick, Andrew, and David Wise, "Option Value Estimation with HRS Data," Working Paper, March 2001.

Smith, D. Alton, and Stephen Sylwester, "The Federal Retirement Decision: An Analysis of DoD Civilians," Systems Research and Applications Corporation (SRA), Arlington Virginia, 1988.

Smith, D. Alton, Stephen Sylwester, Christine Villa, "Army Reenlistment Models," In Curtis Gilroy, David Horne, and D. Alton Smith (eds.), Military Compensation and Personnel Retirement: Models and Evidence. Alexandria, VA: U.S. Army Research Institute for the Behavioral and Social Sciences, 1991.

Stock, James, and David Wise, "Pensions, the Option Value of Work, and Retirement," Econometrica, Vol. 58, No. 5, 1990, pg 1151-1180.

Stock, James, and David Wise, "The Pension Inducement to Retire: An Option Value Analysis," in David Wise (ed.) *Issues in the Economics of Aging*, Chicago: University of Chicago Press, 1990, pg 205-224..

United States Government Accounting Office, "High-Risk Series: An Update," Washington DC: GAO-01-263, January 2001.

United States Government Accounting Office, "Managing in the New Millennium: Shaping a More Efficient and Effective Government for the 21st Century," Washington DC: GAO-/T-OCG-00-9, March 29, 2000.

Warner, John and Matthew Goldberg, "The Influence of Non-Pecuniary Factors on Labor Supply: The Case of Navy Enlisted Personnel," *Review of Economics and Statistics*, Vol. 66, 1984, pg 26-35.

Warner, John, "Analysis of the Retention Effects of the Proposed Retirement System," in *Supplementary Papers of the President's Commission of Military Compensation*. Washington, DC: U.S. Government Printing Office, April 1978.

Warner, John, Military Compensation and Retention*: An Analysis of Alternative Models and Simulation of a New Model*, Alexandria, VA: Center for Naval Analyses Research Contribution 436.

Table 1: Wage and Salary Coverage by Major Public Retirement Program

		Wage and salary covered by Major Retirement Schemes			
Year	Total Wage and Salary	OASDHI	Railroad	Fed. Civil Servants	State/local gov'ts
1986	2,095	1,896	12	72	190
1996	3,632	3,328	13	107	365

Note: The data for this table comes form the Annual Statistical Supplement to the Social Security Bulletin, 1999. Table 3.B2, p. 141. The categories in the last four columns are not mutually exclusive. Starting in 1984, for example, some federal civil servants could elect to be part of the Social Security system. Wages that are earned in the civil service and are covered by Social Security would be counted in both columns.

Table 2: Descriptive Statistics for CSRS Sample

	Mean	Std. dev.
Annual wages and salaries	44,538	17,986
Age	53.2	3.180
Less than high school degree	0.088	0.282
High school diploma or less	0.436	0.497
Some college	0.252	0.434
College degree	0.224	0.304
Male	0.405	0.491
White	0.744	0.437

Note: CSRS-covered population in the Department of Defense, 1982-1996, with age and other restrictions as described in the text.

Table 3: Mean CSRS Pension Wealth, Normal Retirement Ages 55 and 60

Retirement Age	NRA=55	NRA=60
50	141,912	66,182
51	156,074	75,293
52	172,590	85,269
53	190,501	96,199
54	209,852	108,113
55	483,989	121,094
56	477,817	135,111
57	468,314	149,953
58	456,333	165,740
59	442,345	182,548
60	426,741	248,576
61	409,949	243,648
62	392,257	237,282
63	373,917	229,718
64	355,242	221,266
65	346,322	218,574
66	336,640	214,962

Note: These values are the projected present discounted value (adjusted for survival rates at each age) of retiring over 17 years from the CSRS pension, calculated for an individual who is 50 years old. The calculations assume an earnings growth rate of 0.25%.

Table 4: Logistic Model of Retirement, Financial and Reduced Form Option Value Models

	Peak Value		Reduced Form OV	
Parameter	Estimate	Std. er.	Estimate	Std. er.
Intercept	-13.3066	0.4338	-6.9169	0.3567
Financial Incentive				
Peak value (x1000)	-0.0023	0.0001		
Option value (x1000)			-0.0400	0.0012
Annual earnings (x1000)	-0.0300	0.0032	0.0130	0.0033
earnings squared (x10-8)	0.0133	0.0021	-0.0073	0.0021
Ln(PDV Pension wealth)	0.9446	0.0442	0.3160	0.0339
Age 50	-1.0186	0.0448	-0.8985	0.0436
Age 51	-0.8836	0.0391	-0.7792	0.0382
Age 52	-0.6771	0.0328	-0.5916	0.0321
Age 53	-0.6081	0.0297	-0.5433	0.0292
Age 54	-0.4325	0.0266	-0.3956	0.0262
Age 55 (omitted)	--	--	--	--
Age 56	-0.2001	0.0181	-0.2253	0.0181
Age 57	-0.3249	0.0199	-0.3758	0.0200
Age 58	-0.3544	0.0215	-0.4319	0.0217
Age 59	-0.4201	0.0238	-0.5274	0.0240
Age 60	0.0967	0.0238	-0.0315	0.0242
Age 61	-0.0758	0.0287	-0.2339	0.0292
Age 62	-0.0099	0.0340	-0.1977	0.0344
Age 63	-0.1904	0.0435	-0.4072	0.0438
Age 64	-0.2100	0.0522	-0.4533	0.0523
Age 65	-0.1901	0.0728	-0.4624	0.0727
Age 66	-0.1551	0.1037	-0.4462	0.1034
Age 67	-0.2154	0.1920	-0.5283	0.1913
Age 68	-0.8507	558.20	-1.2041	571.50
Age 69	-0.1024	6739.60	-0.3617	6739.60

Grade	0.0251	0.0100	0.1260	0.0101
Performance rating	0.1245	0.0069	0.1255	0.0069
No performance rating	0.3834	0.0228	0.3823	0.0228
Years of service	0.0449	0.0043	0.0684	0.0035
Grade*Years of service	-0.0009	0.0003	-0.0043	0.0003
Pay plans				
WC	0.3537	0.1961	0.3477	0.2017
WG	-0.0344	0.0472	-0.0219	0.0472
WS	0.0387	0.0531	0.0580	0.0533
WL	-0.1149	0.0693	-0.0927	0.0693
Male	-0.0266	0.0170	-0.2047	0.0171
Occupation				
Blue collar	-0.3999	0.1310	-0.4318	0.1314
Professional	-1.0290	0.1262	-1.0695	0.1265
Administrative	-0.8516	0.1248	-0.8791	0.1252
Technical	-0.8702	0.1244	-0.8877	0.1247
Clerical	-0.9908	0.1245	-1.0155	0.1248
Has a disability	0.1745	0.0138	0.1756	0.0138
Education				
Less than High school	0.0150	0.0195	0.0187	0.0194
High school (omitted)	--	--	--	--
Some college	-0.1463	0.0131	-0.1489	0.0131
College	-0.3260	0.0237	-0.3399	0.0239
Graduate degree	-0.6018	0.0272	-0.6086	0.0273
Black	-0.1459	0.0150	-0.1445	0.0150
Hispanic	-0.1608	0.0238	-0.1584	0.0237
Other	-0.3937	0.0249	-0.3895	0.0249
White (omitted)	--	--	--	--
Agency				
Army (omitted)	--	--	--	--
Navy	-0.0200	0.0139	-0.0221	0.0139

Marine	-0.2984	0.0408	-0.2928	0.0408
Airforce	0.0013	0.0146	0.0031	0.0146
Other	0.0667	0.0172	0.0702	0.0172

Note: Regressions included the variables in Table 1 and fiscal year dummies as additional controls.

The reduced form option value assumes: $\gamma = .75$, $\kappa = 1.5$.

Appendix Table: Mean and standard deviation of explanatory variables

	Mean	Std. Deviation
Annual earnings	44538	17986
Earnings squared	2307081038	1980915343
Ln(PDV pension)	12.0262	0.8184
Grade	9.2311	3.3840
Performance rating	1.4996	1.0660
No rating	0.1227	0.3281
Years of service	26.6151	5.8266
Grade*years of service	250.54	116.30
Pay plan		
WC	0.0007	0.0271
WG	0.1054	0.3071
WS	0.0235	0.1516
WL	0.0079	0.0887
Age 50	0.1082	0.3106
Age 51	0.1182	0.3228
Age 52	0.1280	0.3341
Age 53	0.1210	0.3261
Age 54	0.1143	0.3182
Age 56	0.0848	0.2785
Age 57	0.0642	0.2451
Age 58	0.0490	0.2159
Age 59	0.0366	0.1878
Age 60	0.0267	0.1613
Age 61	0.0172	0.1299
Age 62	0.0110	0.1044
Age 63	0.0067	0.0814
Age 64	0.0041	0.0636
Age 65	0.0023	0.0476

Age 66	0.0012	0.0349
Age 67	0.0006	0.0235
Age 68	0.0002	0.0137
Age 69	0.0000	0.0013
Male	0.4051	0.4909
Occupation		
Blue collar	0.1497	0.3567
Professional	0.1744	0.3794
Administrative	0.3118	0.4632
Technical	0.1639	0.3701
Clerical	0.1990	0.3992
Has a disability	0.1511	0.3581
Education		
Less than High school	0.0877	0.2828
Some college	0.2520	0.4342
College	0.1031	0.3041
Graduate degree	0.1211	0.3262
Black	0.1529	0.3598
Hispanic	0.0502	0.2183
Agency		
Other	0.0529	0.2239
Navy	0.2686	0.4432
Marine	0.0188	0.1357
Airforce	0.2524	0.4344
Other	0.1111	0.3143
Yr 81	0.0330	0.1787
Yr 82	0.0405	0.1972
Yr 83	0.0489	0.2156
Yr 84	0.0568	0.2314
Yr 85	0.0656	0.2475
Yr 86	0.0695	0.2544

Yr 87	0.0764	0.2656
Yr 88	0.0753	0.2638
Yr 89	0.0806	0.2722
Yr 90	0.0865	0.2811
Yr 91	0.0820	0.2744
Yr 92	0.0768	0.2662
Yr 93	0.0613	0.2400
Yr 94	0.0504	0.2188
Yr 95	0.0398	0.1956
Yr 96	0.0325	0.1774

Note: These tabulations are for the CSRS sample used for the models reported in this synopsis. See the full paper for further details.

Figure 1: CSRS Retirement Hazard

Note: This figure presents the retirement rate by age for the CSRS sample.

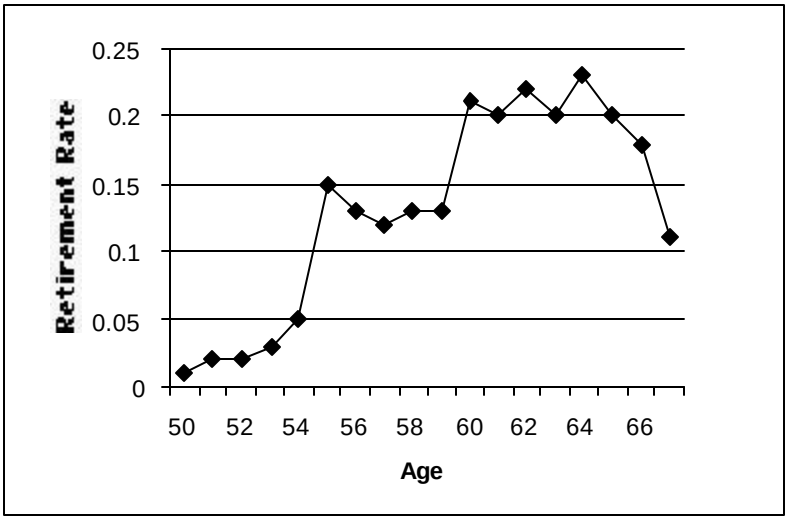
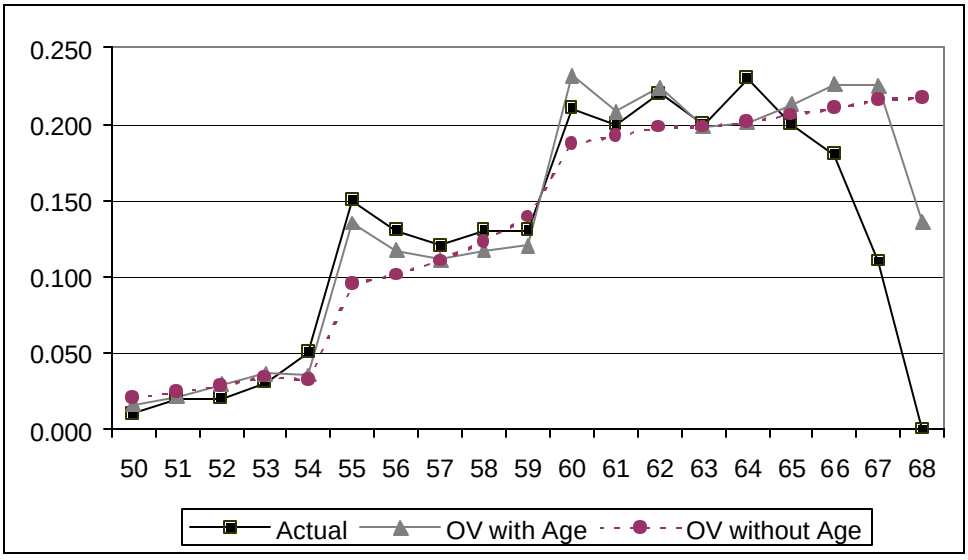


Figure 2: Actual Retirement Rates and Simulated Option Value Retirement Rates



Note: This figure presents the actual retirement hazard and the predicted retirement hazard based on two different option value models, a model with age and a model without age.