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CASE STUDY OF BEHAVIOR DIFFERENCES BETWEEN DEFINED BENEFIT
AND DEFINED CONTRIBUTION PENSION PLANS

YING-HUI HUANG
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Reviewed and approved* by the following:

David A. Cather
Clinical Associate Professor of Insurance
Thesis Supervisor

Diane M. Henderson
Professor of Mathematics
Honors Adviser

* Signatures are on file in the Schreyer Honors College.

ABSTRACT

This study compares and contrasts the retirement and withdrawal behaviors of the two federal retirement systems: the Civil Service Retirement System (CSRS) and the Federal Employee Retirement System (FERS). CSRS is a defined benefit pension plan that was established in 1920s. FERS was later established to replace CSRS in the 1980s due to the implementation of the Social Security Amendment of 1983. In order to align with the newly established law, FERS was required included defined a contribution plan and Social Security benefits on top of a defined benefit plan. As a result, the two systems used different funding methods, and thus have different retirement and withdrawal behaviors.

This study uses the data provided by the Society of Actuaries to examine the retirement and withdrawal rates of the two systems using two variables: age and years of service. Results show that CSRS behaves similar to a defined benefit plan; higher retirement rates occur at normal retirement ages and at years of service where normal retirement requirements are met. Results also suggest that FERS behaves similar to a defined contribution plan with one exception; when retirement rates of FERS are examined with variable age, it behaves similar to a defined benefit plan due to the incentive induced by the Social Security benefits.

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I. Introduction

The purpose of this study is to compare and contrast the two federal retirement systems in terms of their retirement and withdrawal behaviors. There are currently two large federal retirement systems sponsored by the United States government, the Civil Service Retirement System (CSRS) and Federal Employees Retirement Systems (FERS). The two systems were each created under different circumstances, and therefore imbedded with different features, resulting in different behaviors in terms of their retirement and withdrawal rates.

The paper begins with a literature review describing the two fundamental structures of retirement plans: defined benefit plans and defined contribution plans. Then it will discuss the regulation reform that forced the government to change the federal employee retirement system, and other changes that decrease the popularity of defined benefit plans. As a result, defined contribution plans became more acceptable in both private and government sectors.

The paper continues with a parallel comparison on the private sector pension plan history to the government sector. It discusses the background history on how CSRS, which is similar to a defined benefit plan, was created in 1920, and the factors that led to a request to reform the new system. The reform plan eventually leads the Congress to introduce the new system, FERS, in 1987, which is similar to a defined contribution plan.

Then the paper discusses the different decrements and aspects that will be investigated for these two Federal Retirement Systems. The two main decrements that are focused on are retirement and withdrawal. The different aspects include aggregate average rate with respect to age and aggregate average rate with respect of years of service. The data that used to evaluate is provided by Mike Virga, Senior Actuary for Pension Programs of the US Office of Personnel Management. The paper closes with conclusions drawn from these data.

II. Pension Plans Fundamentals

Pension plans are designed to provide retirees adequate income streams after they retire from working for their employers. When properly planned, employer sponsored pensions protect employees from financial insufficiency during retirement. Pension plans can be sponsored by private employers or by the government, and plan sponsors often purchase retirement annuities for their workers or invest plan assets on behalf of their individual employees.

Qualified private pension plans¹ are offered to employees along with social security. Generally, a retirement income portfolio restores approximately fifty to sixty percent of the current regular earnings². A typical retirement portfolio includes both Social Security and occupational pension plans. Some retirees also receive income from

¹ The term “qualified” refers to a pension that meets certain Internal Revenue Service (IRS) pension plan requirements, such as covering a wide cross-section of employees or satisfying minimum age and service requirements. Qualified plans receive favorable tax treatment from the IRS.

² Current regular earnings do not include bonuses or overtime pay

their personal retirement savings and investments in their portfolios. While private retirement savings can vary dramatically across retirees, research indicates that Social Security benefits account for approximately thirty-nine percent of the retirees' total income on average³ (Aproberts, 2009).

A typical pension plan has three retirement ages: normal retirement age, early retirement age, and deferred retirement age. Employees retiring at the normal retirement age can receive the full amount of benefit without any reduction. Early retirement age is the earliest age that an employee can retire and still receive a retirement benefit. However, the benefit amount is reduced actuarially under early retirement (Rejda, *Employee Benefits: Retirement Plans*, 2008). In some cases, early retirement is acceptable only under special provision, involuntary separation, or voluntary separation in forced reduction of the organization (CSRS Retirement). Deferred retirement age is any age beyond the normal retirement age. Usually, there is no maximum limit to deferred retirement. As long as the employee has the ability to continue working, he is not required to retire (Rejda, *Employee Benefits: Retirement Plans*, 2008).

Pension plans can be generally described savings arrangement in which workers: invest a portion of the salary today so that they can consume this savings, as well as the investment income earned on this savings, during retirement. Mainly there are two types of pension plans: defined benefit plan and defined contribution plan.

³ The percentage varies depending on an individual's income, which will be introduced in the later section of this study

a. Defined Benefit Plan

A defined benefit (DB) pension plan determines the amount of benefit prior to retirement. Therefore, under this type of plan, the portion of current salary that will be contributed toward the pension by the plan sponsor is continuously estimated under the assumption that these contributions, as well as the investments earned on these contributions, can accumulate over time to equal the projected benefit amount. The proportions of salary that will be invested vary among individuals in order to match their own desired benefit amount.

A typical DB formula involves three factors. The first factor is years of service. The second factor is a measure of the worker's compensation, which is often calculated as the average of the basic pay earned over several consecutive working years⁴. For example, many plans calculate an average salary over the three consecutive highest-paid years during the period of employment, also known as the high-3 average. The third factor is a percentage multiplier that is predetermined by the party that offered the plan. Thus, a defined benefit plan formula can be generally defined in the form of the following formula:

$$\text{Benefit} = (\text{percentage multiplier } \%) \times (\text{years of service}) \times (\text{high} - 3 \text{ avg})$$

⁴ Basic pay is defined as salary earned from the position without any overtime pay or bonuses. Generally, the highest average occurs during the last three years, although there is always a possibility that it happened during an earlier period of employment. Other plans may base the retirement payment on simpler measures of compensation, such as the compensation earned by a worker over his or her final year of work

For example, a worker whose high-3 average salary equals \$80,000 and who earned 1.5 percent of that salary per year over her thirty year working career would be eligible for a pension equal to \$36,000 per year: 1.5 percent per year \times 30 years \times \$80,000. i. e. $\text{Benefit} = (1.5\%) \times (30) \times (\$80,000) = \$36,000$

Plan sponsors are financially responsible for making periodic contributions into the defined benefit plan to pay for the benefits promised to workers using the above formula. Many DB plans also require the employee to contribute a portion of their compensation into the fund to help pay for its costs. Typically employees receive their benefits in terms of an annuity upon retirement payable monthly. The amount of benefit is largely predetermined by the DB formula⁵. The employer bears the risk that the funds in the DB plan are insufficient to cover the promised benefit, and may have to increase its contributions to the fund to make up for financing shortfalls. The costs of the plan are paid from the payments made by the sponsor, the worker, and the investment income earned on these payments. Risks that employers have to take into account include the risk that an investment will result in a loss, which is known as the investment risk, and the risk that retirees live beyond the expected age and demand for more annuity payments, which is known as the longevity risk. Therefore, the portion of current salary that will be invested is also predetermined, so that the investments can accumulate to the projected benefit amount. The proportions of salary that will be invested vary among individuals in order to match their own desired benefit amount.

⁵ The payments can be subject to change according to the cost-of-living adjustments that occur after retirement. In general, the adjustments are positive, and the subsequent payments gradually increase.

For situations in which a worker changes his or her job, DB plans offer very poor portability. In recent years, cash balance plans have been used to convert ongoing DB plans into lump sums. This allows employees to withdraw their DB plans as cash and carry it over to their new job. Nevertheless, cash balance plans have not been popular until the past recent decades. Generally, workers, who are eligible for retirement benefits under DB plans but leave the position prior to retirement will still receive retirement annuities. They will only receive the annuities when they reach the normal retirement age in the previous DB plan they participated in. Thus, an individual who held many jobs that offered DB plans will have multiple annuity incomes upon retirement. Despite the multiple income streams, the amount of each annuity payment is small due to the small number years of service in each job. The total amount of the multiple annuities does not compensate what an individual would have received if there were no job changes at all.

There is a DB plan that covers nearly all Americans, the federal program known as Social Security. As mentioned before, retirees may also receive social security along with their private pensions if eligible.

b. Social Security

The Old-Age, Survivors, and Disability Insurance (OASDI) program, also known as Social Security, was established under the Social Security Act of 1935. It is the most important social insurance program in the United States. More than ninety percent of the

population is covered under Social Security, and about one-sixth of the covered population receives a monthly cash benefit. Social Security covers employees from a wide range of sectors. These include private firms, nonprofit organizations, self-employed workers, domestic employees in private homes, state and local government workers, and Federal civilian employees hired after 1983 (Rejda, Social Insurance, 2008).

In order to receive benefits from Social Security, one must obtain credit by working a certain length of time in covered employment. For 2007, one credit can be received for every \$1,000 of covered earnings. A maximum of four credits can be earned during a year; thus the credit is also known as the quarter of coverage. The requirement of one credit is adjusted for inflation, which generally increases the amount required for a credit. Under this provision, a person is fully insured if he or she has earned 40 credits. Only the fully insured are eligible for retirement benefits (Rejda, Social Insurance, 2008). Although Social Security used a similar scheme as a DB plan, they are not identical. Unlike a traditional DB plan that discards all the previous years of service when an employee starts a new job, Social Security accumulates the credit continuously. Hence, Social Security does not penalize workers that change jobs.

Similar to private pension plans, Social Security retirement benefits also have two retirement ages: normal retirement age and early retirement age. Currently, for persons born before 1937, the normal retirement age is 65. However, it is gradually adjusted toward age 67 to correlate with the increase in life expectancy. The early retirement age is currently 62. Under early retirement, the Social Security benefits are actuarially

reduced. To correlate with the increase in life expectancy, the amount reduced under early retirement is gradually increased to 30 percent of the full retirement benefit. More than 50 percent of the OASDI beneficiaries are covered under the early retirement option. Whether or not to apply for the retirement benefit prior to normal retirement age depends on the need and the state of health of the individual (Rejda, Social Insurance, 2008).

The retirement benefit amount distributed by Social Security is based on workers' Primary Insurance Amount (PIA), which is based on the Average Indexed Monthly Earnings (AIME). The AIME reflects the relative standing of workers' wages among the national economy at the time of retirement by adjusting wages earned during prior working years for inflation. This guarantees that Social Security replaces workers' earnings in the same proportion regardless of the year of retirement. (Rejda, Social Insurance, 2008)

A worker's PIA is then determined using their AIME. Social Security is more favorable for the low-income wage earners, since the weighted benefit formula used provides a heavier weight for workers' that have a lower standing in the AIME (Rejda, Social Insurance, 2008). According to Social Security Online, 90% of the first \$749 AIME are restored, followed by 32% of the next \$3786 AIME, then 15% for every one AIME above \$4517. Table 1 summarizes the PIA calculation (Primary Insurance Amount, 2010).

Table 1: Benefit Calculation Formula for PIA

AIME (x)	Formula used to calculate PIA benefit Benefit = _____% × AIME
$0 < x \leq \$749$	$90\% \times x$
$\$749 < x \leq \4517	$90\% \times \$749 + 32\% \times (x - \$749)$
$x > \$4517$	$90\% \times \$749 + 32\% \times \$3768 + 15\% \times (x - \$4517)$

Due to the DB characteristic in Social Security, the retirement rate is high at normal retirement age. According to Geweke, Zarkin and Slomin (1993) the probability for an individual to apply for a Social Security benefits spikes in the first quarter after his/her 65th birthday. Nevertheless, according to Friedberg and Owyang (2002) DB plans still possess an equal or larger effect than Social Security in terms of timing of retirement.

Social Security is often described as a “pay as you go” plan. The amount received from the current work force is paid to the current beneficiaries. Funding Social Security is an important and challenging task. As it impacts more than ninety percent of the population, it is essential to have sufficient but not excessive funds.

c. Defined Contribution Plan

Under a defined contribution (DC) plan, the plan sponsor agrees to pay a predetermined contribution toward its employees’ retirement plan. These contributions are paid into individualized investment accounts that have been created for each worker covered under the plan. Unlike defined benefit plans, the plan sponsor makes no guarantee about the amount of benefits that a worker will be eligible to receive upon

retirement. Instead, the plan sponsors obligation is limited only to making periodic contributions to the plan, and the covered worker bears the risk that the accumulated funds in his or her plan may be inadequate due to such adverse factors as poor investment returns or excessive longevity.

A typical DC plan accepts contributions from both the employee and the employer. The amount that the employer contributes depends on the contribution of the employee. For example, an employee could invest \$5,000 into the account, which is 5% of his current salary. Plan sponsors often agree to match all or a portion of the contributions made by the employee. For example the company might offer to match the first 3% dollar to dollar, and the last 2% fifty cent to a dollar as agreed in the contract. At the end of the period, this employee will have \$9,000 in his personal pension account: his contribution of \$5,000 plus the \$4,000 from the company. In turn, the employee then chooses the method of investment. Bonds, stocks, and mutual funds are common methods of investment.

Employees do not automatically own the money that the company contributes. Instead, they earn ownership of the contributions in plan assets made by company over time through a process called vesting. Employees only have the rights to the portion that they are vested in if they terminate the plan prior to retirement. Commonly known vesting rules include cliff vesting and graded vesting. Under cliff vesting, employees do not own any company contributions before certain amount of years of service. However, they become fully vested in the contribution of the company after they meet the required

years of service. Common cliff vesting rules include 3-year cliff vesting and 5-year cliff vesting, where employees are a hundred percent vested after three or five years of service. Under graded vesting, employees are gradually vested in the company contribution until they eventually become fully vested. Employees must be vested in 20% of the company contribution after three years of service and 40% after four years. After seven years of service, they become fully vested (Rejda, *Employee Benefits: Retirement Plans*, 2008).

Under the DC plan, the benefit amounts at retirement vary among employees. The amounts differ according to differences in the employer's and employees' contribution rates, as well as differences in investment returns. Unlike the DB plan, the amount of total benefit can only be estimated. DC plans allow employees to participate in the investment of their own plans, but require employees to bear the consequences of their investment risk. If an employee earns low investment returns, his employer is not responsible for making additional payments into the plan to compensate for the poor investment results, as was the case for defined benefit plans. Thus, the defined contribution plan requires employees to have some knowledge about investing, as they bear the consequence of poor investment choices.

d. Comparative Analysis

After reviewing all the differences between the two retirement plans, it is reasonable to infer that there are dissimilarities in terms of retirement and withdrawal behaviors between DB and DC plans.

A first inference is that DB plans provide employees incentives to retire once normal retirement requirements are met, since it is then that the value of their pension is optimized. DB plans also lower the incentive for employees to work efficiently. As long as employees remain on the job, they are guaranteed a pension. As a result, it often creates a group of “golden handcuff” workers, those that are close to normal retirement without the motivation to be productive. Additionally, the accrual value of the plan is optimized at normal retirement age. Because the retirement income amount is predetermined by the formula and adjusted by cost of living, it does not adjust actuarially. Hence, the present value of the pension benefit decreases once the worker passes normal retirement age. Moreover, an employee could only increase his or her retirement incomes under a DB plan from two sources: (1) an increase in final pay or 3 high pay, (2) an additional year of service in the benefit formula (Manchester, 2010). Nonetheless, the increments generated by these two sources rarely compensate the actuarial differences, which as a result cause high retirement rates at normal retirement ages.

On the other hand, DC plans are considered as age-neutral pension plans with respect to retirement (Manchester, 2010). An additional year of service beyond normal retirement age can increase the value of the plan from three sources: (1) an additional year of contribution; (2) an additional year of market return, which can increase total value of the pension exponentially; (3) a larger annuity payment due to the actuarial adjustment for shorter life expectancy. Since the present value of accrual pension of wealth does not change, the direct incentive for employees to retire exactly at normal

retirement age is not inherently strong. Because an additional year after normal retirement age under a DC plan can generate more retirement benefit than under a DB plan, DC plans are considered as age neutral, providing no incentive to retire at the normal retirement age. However, an employee's decision to retire is closely related to the stock market under a DC plan. Since the value of the equity assets in a DC plan fluctuates with the rate of return in the stock market, retirement rates are often lower when the stock market performs poorly.

Friedberg and Owyang (2002) also support the inference regarding the high incentive to retire at a normal retirement age under a DB plan. DB plans generate spikes in their accrual of pension wealth, which occurs first when workers become vested and again when they reach the early retirement age. It is therefore rational to presume that the retirement rate is high around the peak of pension wealth, assuming workers maximize their utility.

The question of how retirement age differs across retirement plans is discussed in Manchester (2010). He shows that when workers are sorted into plans without a choice, the difference in average retirement age is not significant. This is because occupational pension plans (DB or DC) are only a portion of their entire retirement income portfolios. As individuals try to optimize the entire portfolio, neither plan generates an incentive high enough to effect the expected retirement age. In the opposite case, where workers were offered a choice between the two plans, there is a significant difference in the average expected retirement age. The difference relies heavily on the normal retirement

age of the DB plan. If the normal retirement age of the corresponding DB plan is 65, the difference is not significant. However, if the normal retirement age is lower than 65 in the corresponding DB plan, then workers who desire for shorter career lengths are more likely to enroll in the plan. As a result, there is a significant difference in average retirement age. Although the study used college and university faculties as participants, it summarizes the behavior of DB and DC plans in all sectors (Manchester, 2010).

The National Bureau of Economic Research (NBER), on the other hand, published a paper by Lumsdaine, Stock and Wise (1995), regarding the high retirement rate at age 65. The paper points out the high retirement rate at this age regardless of the differences among plans. This paper retrieves data from three firms, including one large Fortune-500 firm, and examines the “age 65-retirement effect.” The paper indicates that Medicare eligibility at age 65 is not sufficient to explain the effect, nor is the family status or the utility cost. It concludes that the “age 65-retirement effect” is a phenomenon of culture (Lumsdaine, Stock, & Wise, 1995).

A second inference after comparing DB and DC plan is that the withdrawal rate for a DC plan is higher than for a DB plan, because employees do not get penalized for job termination under a DC plan. DB plans are designed to reward employees with long term employment; hence, it is not portable⁶ when switching jobs. Since years of service have a direct effect on the final benefit, staying under the same plan for a longer period of

⁶ Unless the firm converts it to a cash balance plan, then it has the portability. Nevertheless cash balance plans are not popular till the late 1990s. (Schrager, 2009)

time implies a larger benefit amount at retirement. The portability associated with DC plans is favored by employees seeking to change jobs. In contrast to DB plans, years of service are no longer a factor in determining the final benefit amount. As an individual switches from job to job throughout his or her career, the previous commitments toward the pension plan are not discarded under vesting provisions.

Table 2 summarizes the differences between a DB and a DC plan.

Table 2: Comparing and Contrasting the Two retirement plans

	Defined Benefit	Defined Contribution
Determined in Advance	Pension benefit	Pension contribution
Portability	Low	High
Age neutral in terms of timing of retirement	No	Yes
Encourages optimal retirement	Yes	No
Risk –bearer (both investment and lifespan)	Firm	Worker

e. Historical Changes in Retirement Plans

DC plans were introduced to the public later than DB plans. In the last 30 years there has been a significant decrease in the demand for DB plans. Scholars identified several factors related to the shift in demand of DB and DC plans. These issues include changes in government regulations, demographics firm characteristics, economics, and mortality.

Government Regulation

Changes in governments' regulations have also diminished the desire for firms to sponsor DB plans. Employee Retirement Income Security Act of 1974 (ERISA) re-

regulated firms' responsibilities, which resulted in higher administration costs and compliance fees. Increases in life expectancy have also become a financial burden to companies, as retirees who are living longer are paid for longer periods of time. As companies have had to bear the cost of increased longevity risk in DB plans, many have chosen to offer DC plans instead (Aaronson & Coronado, 2005).

As for Social Security, concerns regarding its funding were raised during the late 1970's. As the Baby Boom Generation flooded the labor force, it stressed the long-term funding of Social Security. In response to this problem, the Amendment of 1983 hastened the increase in the payroll tax rate, the normal retirement age, and potential taxable income (Munnell & Soto, 2007).

The government also sought to increase the number of employees covered under Social Security to increase its source of funding. Prior to 1983, Federal civil services employees were exempt from OASDI tax. According to United States Code Title V, Federal civil service employees are defined as "all appointive positions in the executive, judicial, and legislative branches of the Government of the United States, except positions in the uniformed services," otherwise known as workers of Congress, the U.S. postal office, and the military (5 U.S.C. § 2101, Title 5 of the United States Code). In response to the problem of Social Security funding, the Social Security Amendment of 1983 prohibited all federal civilian employees hired after 1983 from opting out of the OASDI (Social Security) tax. The change in the Amendment also forced the government

to establish a new retirement plan for federal workers that integrated the Social Security benefits into system (Svahn & Ross, 1983).

Demographics

From employees' perspective, demographic, firm characteristic and economic changes have accelerated the demand for DC plans. An example of change in the demographics of the workforce is an increase in the participation of married women in the labor force. Married women are the most likely to move in and out of the labor force during the process of merging their careers with their family lives. Since DB plans reward employees on long-term service rather than performance, married women did not show a preference for this plan (Munnell & Soto, 2007).

Firm Characteristics

Firms' production characteristics are also another factor behind the change from DB to DC. As jobs become more technical, skills of employees are more transportable than before. Technological development has also lead to an increase in mobility, leading to a result of a shorter tenure at each job. As a result, the demand of DC plans has significantly increased (Aaronson & Coronado, 2005).

Economics

Economic factors have also decreased the desirability of DB plans throughout the 1970's. Employees now favor in DC plans due to the steady increase in stock prices from 1982 to 2000. On average, the stock prices rose at an annual rate of 16.9% per year,

compared to 8.7% per year from 1955 to 1981. Most investors preferred to invest in retirement funds when the returns were high. Therefore, rather than letting others invest their pension plans, employees preferred to take control of their own (Munnell & Soto, 2007).

From the employers' perspective, there are some advantages to replacing a DB plan with a DC plan. DB plans created incentives for older employees with decreasing job skills to stay on the job despite their declining productivity. Also, the dynamic of companies have changed. Companies have changed from large, unionized, manufacturing corporations to small, non-unionized, high-tech firms. Due to the lack of solidity, companies could not offer DB plans.(Munnell & Soto, 2007)

The debate about whether firms or workers initiated the shift from DB plans to DC plans continues. Regardless, DC plans grew rapidly in the nation from 1979 to 1998. Estimated workers with only a DC plan grew 400%, and workers with only a DB plan dropped 66% (Schragger, 2009).

III. Pension Plans for Federal Employees

There are currently two large Federal Retirement Systems, Civil Service Retirement System and Federal Employees Retirement Systems. The amendment made to the Social Security law in 1983 along with the pressures from unfunded liabilities and

the changes in the economy prompted calls for the creation of a new federal pension system. The new system would need features to (1) combine the benefit from Social Security with the federal retirement system, (2) incorporate a solid, long-term funding basis and let the employees participate in the process of investing their funds and bear the risk, and (3) reward employees on their performance rather than long-term services by allowing employees to change from job to job without jeopardizing their pension funds. In response to these needs, Federal Employees Retirement System (FERS) was established and effective in 1987. Employees hired after 1984 were all covered under the new system, in which the retirement benefit is a combination of a DB plan, a DC plan and Social Security.

a. Civil Service Retirement System (CSRS)

History of CSRS

According to the Congressional Report, the Pendleton Act of 1883 initiated the modern Federal Civil Services⁷. However, when this law was created, it did not include a retirement plan. Employees during that time period were neither expected nor prepared to retire. Most employees had to work their entire lives to support themselves and their families. Under these circumstances, firing employees solely for the reason of old age was considered inhumane. Therefore, in order to avoid loud and antagonistic public reactions, the government preferred to keep all of their employees rather than to dismiss

⁷ The Act shifted the federal employees from a patronage to a merit system. The change no longer allowed political influence on federal employees. The government positions were filled based on competitive examinations.

them from their positions. In 1900, a voluntary association of federal employees was organized to lobby Congress for a retirement system. Franking MacVeagh, the Secretary of the Treasury, also launched a four-year campaign for a federal retirement system. Until 1919, demands for a retirement plan were a primary objective for the new federal employee unions. In 1919, the largest of these groups, Federal Employee Union (FEU), sponsored the Joint Conference on Retirement, which ended with all of the federal unions joined together behind plans to feature workers' contributions. Finally in 1920 the Congress passed The Civil Services Retirement Act establishing Civil Services Retirement System (CSRS) in response to the growing need for an efficient and humane method to revitalize the workforce in the federal government (Snook, Civil Service Retirement System: History, Provision, and Financing, 1981).

Features of CSRS

Type of System

The CSRS includes a DB pension plan along with two optional DC plans. However, for the most part, CSRS is known as the DB plan because there is no government contribution toward the optional DC plans, which are voluntary contribution and the Thrift Savings Plan.

Benefits

According to the CSRS handbook, the benefit annuity that a retiree receives is calculated based upon two components: the number of years of service and the average of the highest three consecutive year (high-3 average) salary.

Variations from a typical DB plan include multiple percentage multipliers. There is a maximum limit to the amount payable to retirees. The cap is set at 80% of the high 3 average salary, which affects employees with 42 years of service or more. On average, an employee who has thirty years of service is provided annually approximately 56.25 % of the high-3 average salary.

Table 3: Benefit Calculation Formula for CSRS

Total Service Years (x)	Formula used to calculate annual benefit Benefit = _____% \times years of service \times (high-3 average salary)
$0 < x \leq 5$	$1.5 \% \times x \times (\text{high 3 average salary})$
$5 < x \leq 10$	$[(1.5 \times 5)\% + 1.75(x - 5)\%] \times (\text{high 3 average salary})$
$x > 10$	$[(1.5 \times 5)\% + (1.75 \times 5)\% + 2(x - 10)\%] \times (\text{high 3 average salary})$

Employees covered under CSRS generally pay 7 to 8 % of their salary to CSRS although they are not subject to old-age, survivor, retirement, and disability insurance (OASDI) tax. However, they are still required to pay the Medicare tax. Employees are also allowed to contribute up to 10 % of their salary into voluntary contributions. These funds can be withdrawn at any time or used toward purchasing an annuity upon retirement. Employees may also contribute up to 5 % of their salary toward the Thrift Savings Plan.

Eligibility

Eligibility for normal retirement under CSRS is determined by two main factors: age and number of years of service. According to the CSRS handbook, employees at age

55 with 30 years of service, age 60 with 20 years of service, or age 62 with 5 years of service are eligible for normal retirement. Table 4 summarizes normal retirement eligibility.

Eligibility for early retirement under CSRS is also determined by these two main factors. According to the CSRS handbook, employee of age 50 with 20 years of service and employees at any age with 25 years of service are eligible for early retirement. However, the payment of the deferred benefit annuity is reduced by $\frac{1}{6}\%$ for each full month that the retiree is under age 55.

Table 4: CSRS Normal Retirement Eligibility

Age	Service Years
55	30
60	20
62	5

In the case of withdrawal, such as leaving the job before becoming eligible for retirement, CSRS offers two options. Under the first option, employees can receive their own share of contributions in a lump sum payment. However, if employees choose to receive their contributions now, they are exempt from receiving monthly annuity payments when they reach retirement age, unless they are later reemployed under CSRS or FERS. If an employee is reemployed under federal service, the previous service years are counted toward the benefit formula, as long as the lump sum amount is paid back with interest. Under the second option, the employees who have more than five years of

service are allowed to apply for deferred retirement. Deferred retirement pays a benefit annuity once the (former) employee turns age 62.

b. Federal Employees Retirement System (FERS)

History of FERS

Social Security was established fifteen years later than CSRS, thus workers covered under CSRS were not subject to Social Security. However, the Social Security Amendment of 1983 urged the government to reform the system. Without the reform, workers under CSRS would need to contribute more than thirteen percent of the salary to obtain full retirement pension including Social Security. (Purcell, 2009)

In addition to the Social Security Amendment of 1983, CSRS was creating a financial burden on the government. CSRS was a generous pension plan compared to most pension plans offered by private sectors. The pension plan provided retirement and disability insurance benefits for a covered enrollment of approximately 2.7 million employees, 1.3 million retired employees, and 430,000 beneficiaries of employees or annuitants. In terms of liability and funding, the unfunded liability was approximately \$540 billion in 1982. The account for full funding of pension obligations accrued fell short of the actual amount. The direct expenditure budget considered by Congress should have been about 22% higher. This implies that federal labor expenses should have been increased to avoid the inadequacy (Leonard, 1985).

Moreover, the popularity of defined contributions plans in the private sector also pushed the government for a compatible pension plan. As a result, FERS was established and effective in 1987. Federal Civil Employees hired after 1984 were all covered under the new system. Unlike CSRS, which only consisted of one main source of income after retirement, employees who participated in FERS received benefits from three components: FERS Basic Benefit plan, Thrift Savings Plan (TSP), and Social Security (Snook, Federal Employees' Retirement System Handbook for Member of Congress, 1987).

Features of FERS

Type of System

According to FERS's handbook, FERS fused a DB plan, a DC plan, and Social Security together in its system. The changes have included Social Security in the plan in response to Social Security Amendment of 1983. It was also designed to shift the financial burden off the government by shifting part of the investment risk on to the employees.

Benefits

A. FERS Basic Benefit Plan:

FERS Basic Benefit Plan is a DB plan, where the amount of benefit FERS is based on the high-3 average salary and the number of years of service under the federal government. Similar to private retirement plans, the benefit is reduced for early retirement. If employees choose to continue working in a private sector after retirement,

the benefit is also reduced. Table 5 shows how the benefit for FERS Basic Benefit Plan is calculated⁸. The amount payable is not capped under FERS, since the percentage multiplier is max at 63.8% with 58 years of service.

Table 5: Benefit Calculation Formula for FERS

Conditions:	Formula used to calculate annual benefit Benefit = _____% × years of services × (high-3 average salary)
Retire at age ≥ 62 with Service years (x) ≥ 20	$1.1 \% \times x \times (\text{high 3 average salary})$
Otherwise	$1.0 \% \times x \times (\text{high 3 average salary})$

B. Thrift Savings Plan (TSP):

Thrift Saving Plan is a type of DC plan that accepts contributions from the employees and the employers. Contributions to the TSP are made to an individual account. The benefit is determined by the balance of the account that is available to the worker upon retirement. Employees under FERS can contribute up to 10% of their salary. In addition, the government makes contributions that match the individual contributions, up to a maximum of 5% of salary.

Sources of contributions to TSP can be further broken down into three parts: Employee Contribution, Agency Automatic (1%) Contribution, and a Matching Contribution. Agency Automatic (1%) One percent of the employees' basic salary is automatically contributed into the account, regardless of the amount of the Employee

⁸ Benefit for employees who were covered under CSRS for more than five years and chose to transfer to FERS is slightly different. The years they worked under CSRS are calculated with the CSRS formula, and the years they worked under FERS are calculated with the FERS formula. The sum of the two components is the benefit such an employee would receive upon retirement.

Contribution. Employee Contributions are deducted from salary before taxes and transferred into their TSP accounts. The percentage of Employee Contribution determines the percentage contributed from the Matching Contribution. According to the FERS handbook, the first three percent contributed by the employee is matched dollar to dollar by the Matching Contribution, while the next two percent are matched 50 cents to the dollar. Any further contributions are not matched. The Agency Automatic Contribution is subject to three-year cliff vesting, which means that employees are entitled to keep the Agency Automatic Contribution only after the completion of three years of service. If an employee chooses to leave the federal occupation before becoming vested, the Agency Automatic (1%) Contribution is forfeited from their TSP.

C. Social Security:

The benefit from Social Security is based on the employees' work experience during employment covered by Social Security and not on financial need. Employees are able to receive benefit from Social Security up to certain limit depending on work experience, even if they choose to continue to work in the private sector.

Eligibility

Eligibility for normal retirement under FERS is determined by two main factors: age and number of years of service. In contrast to CSRS, FERS has a Minimum Retirement Age (MRA) requirement that counts age down to months. Table 6 and Table 7 summarize the normal retirement eligibility. Unlike in CSRS, not all employees with normal retirement under FERS can receive full amount of benefit. Employees retiring at

the MRA with less than 30 years of service will receive a reduction of 5% for each year under age 62.

Table 6: FERS Minimum Retirement Age

Year of Birth	MRA
Before 1948	55
In 1948	55 and 2 months
In 1949	55 and 4 months
In 1950	55 and 6 months
In 1951	55 and 8 months
In 1952	55 and 10 months
In 1953-1964	56
In 1965	56 and 2 months
In 1966	56 and 4 months
In 1967	56 and 6 months

Table 7: FERS Normal Retirement Eligibility

Age	Service Years
62	5
60	20
MRA	30
MRA	10

Eligibility for early retirement under FERS is also determined by these two main factors. According to the FERS handbook, employees age 50 with 20 years of service or any age with 25 years of service are eligible for early retirement. However, the payment of the deferred benefit annuity is reduced by $\frac{1}{6}\%$ for each full month that the retiree is under age 55. Eligibility for early retirement is the same for both FERS and CSRS.

In the case of withdrawal, such as leaving the job before becoming eligible for retirement, FERS offers two options. Under the first option, employees can receive their own share of contributions in a lump sum payment. However, if employees choose to receive their share at the time of withdrawal, they are permanently exempt from receiving monthly annuity payments when they reach retirement age⁹. Under the second option, the employees who have more than five years of service are allowed to apply for deferred retirement. Deferred retirement pays an annuity once the (former) employee reaches the age requirement with respect to his or her previous service years.

All existing federal employees were given an opportunity to switch from CSRS to FERS in 1986, but once they chose to transfer their coverage, they could not transfer back. For employees who transferred from CSRS to FERS, the service years under CSRS were subject to the policies under CSRS. Employees could specify that they wanted the refund lump sum to include only the amount generated under CSRS. In this case, if the employee was later reemployed, they were permitted to pay back the amount plus interest for CSRS deduction.

As compared to DB plans in the private sector, FERS offers two advantages. First, it maintains the ability for employees to obtain control over the investment of their retirement funds. This allows employees to change jobs without their prior years of

⁹ Even if the employee is reemployed under federal service, lump sum payback is not permitted and all of the previous service years will no longer count toward the benefit formula. This is the major difference between CSRS and FERS in the case of withdrawal.

service being disregarded. It also includes the FERS Basic Benefit Plan, which makes the retirement benefit more stable with multiple income strings.

Establishment of FERS also solved the problems that the government was facing. New features of the new retirement system incorporated Social Security, which was the major concern of the Amendment of 1983. It also transferred part of the financial burden from the government to the employees, which was proposed by the reform proposal in 1985. Also, the new features rewarded the employees on performance rather than on long-term service, and allowed employees to change jobs without having to worry about losing their service record. Table 8 gives a brief summary of the differences between the two retirement systems.

Table 8: Comparing and Contrasting the Two Systems

	CSRS	FERS
Type	Defined Benefit Plan + optional Defined Contribution Plans	Defined Benefit Plan + Defined Contribution Plan + Social Security
Benefit Sources	CSRS + TSP (without government contribution) + Voluntary Contributions	FERS Basic Benefit Plan + TSP (with government contributions) + Social Security
Formulas on Annuity	Relies heavily on years of service	Relies less on years of service
Living Cost Adjustment	Any time after retirement	Only after age 62

IV. Compare and Contrast the Two Federal Retirement Systems

Since CSRS and FERS were each created under different circumstances, the imbedded features of the two programs are also different. The purpose of this study is to compare and contrast these two federal retirement systems in terms their behaviors in

retirement and withdrawal based on age and years of service. By using the available data, this paper is going to examine whether the different features used in the systems has impact on their retirement and withdrawal behaviors.

a. Data Sources

The data that are examined for this study are obtained from the Society of Actuaries (SOA), provide by Mike Virga, Senior Actuary for Pension Programs of the US office of Personnel Management. The retirement data are retrieved from the current retirement annuity payroll, and the withdrawal data are retrieved from the employee personnel data.

The data contain information regarding the number of employees under the two systems. It includes the number of total employees at the beginning of each calendar year (exposure) with respect to age and service years. It also includes the number of employees under the two systems that decremented¹⁰ due to retirement or withdrawal with respect to age and services years in each calendar year. Data used to calculate withdrawal rates are collected from years 1984 to 2006; data used to calculate retirement rates are collected from 1984 to 2007. The ages in both sets of data ranged from 17 to 75, and service years ranged from 0 to 58¹¹.

¹⁰ Decrementing due to retirement is defined as the worker is no longer an employee due to retirement or early retirement. Decrementing due to withdrawal is defined as the worker left the system prior to retirement.

¹¹ Both data also included other information such as gender, whether the employee service was under postal or non-postal, and the number disability retirements. However, this research will only discuss the difference between the retirement and withdrawal rates of the two systems.

b. Number of Participants

The total number of participants under each system is based on the calendar year, regardless of their age or years of service. The number of participants under each of the two systems is expected to change after the establishment of FERS. The Number of active employees covered by CSRS is expected to decrease over time as covered employees retire and no new employees are added to the plan. On the other hand, the number of active employees covered by FERS is expected to increase over time, as all newly hired employees after 1984 are covered by FERS.

Figure 1 summarizes the actual number of Active Employees covered by CSRS and FERS from 1984 to 2006 from the data. The blue line represents the number of active working employees under CSRS from 1984 to 2006; the red line represents the number of active working employees under FERS from 1988 to 2006. The green line is the total number of participants, including employees covered under CSRS and FERS from 1984 to 2006.

The number of active employees under CSRS increases from 1984 to 1986, but a significant drop occurs during 1986. The observations match the expectations: as FERS was implemented, CSRS had a significant decrease in the number of participants. A portion of federal employees had chosen to move from CSRS to FERS causing the drop in participants. As CSRS became a closed system that did not allow new employees to enter the system, its number of participants decreased steadily over time as covered employees

gradually retired. FERS, however, showed a steady increase starting from 1988 soon after it was implemented.

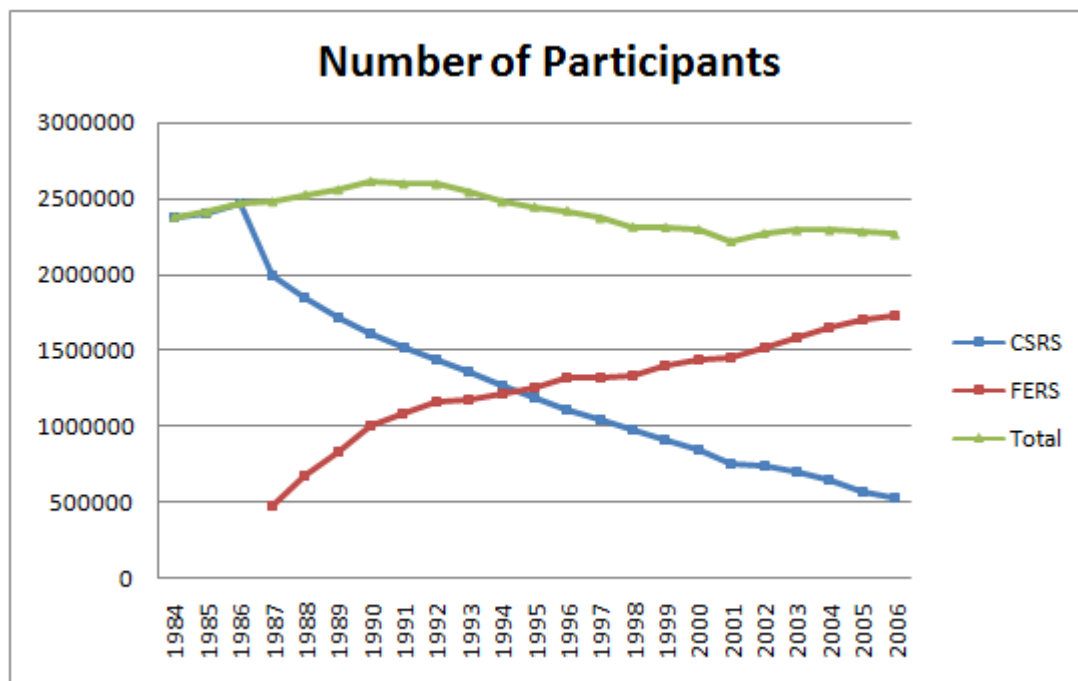


Figure 1: Number of Active Employees Cover by CSRS and FERS from 1984 to 2006

After the transfer window period closed in 1986, the average age of participants covered under CSRS increased from 42.27 to 44.13 in 1987, and the average of service years of participant increased from 13.65 years to 16.08 years during the same year. Although the data do not include specific information concerning individual employees who choose to transfer, it is certain that a significant portion of active working employees originally covered under CSRS chose to change to FERS are younger employees with fewer service years. Since the features imbedded in FERS allow employees to change jobs with less concern regarding their pension funds, younger employees with fewer

service years are likely to take advantage of this feature in order to avoid their previous service years from being discarded in the future. On the other hand, employees who choose not to transfer to FERS are the older employees regardless of service years. As older employees approach retirement age, they are less likely to switch to a DC plan, since they may not have enough time to earn enough credit to be eligible for Social Security. Also, once they are eligible for retirement, the retirement annuity string is stable and adjusts with the cost of living immediately. Overall, CSRS creates a higher incentive for older employees to stay.

Note that Figure 1 only represents the active working employees covered by the two systems rather than reflecting the number of annuitants that receive benefit from federal government retirement systems. Since FERS was introduced just a little over two decades ago, the majority of current federal retirees receive their annuity benefits from CSRS.

c. Retirement Rates

Retirement rates are examined with respect to two variables: age and years of service in the following sections.

i. Retirement Rate based on Age

The retirement rate based on age is the percentage of employees that are eligible for retirement who choose to retire at the given age. Each rate is the ratio of the numbers of employees who retire at a particular age divided by the number of employees that are eligible to retire at the same particular age. Using this formula, at each age there is a number that represents the rate of employees who departing due to retirement. The formula does not take calendar years into account; however service year is used to determine the eligibility. As a result, the rate also represents an aggregate rate of all of the calendar years over which the data has been collected.

$$\frac{\sum_{i=1984}^{2007} \text{Number of Retirements at Age}(X) \text{ in year}(i)}{\sum_{i=1984}^{2007} \text{Eligible Exposure at Age}(X) \text{ in year}(i)}$$

Although both FERS and CSRS include DB and DC plans, their retirement behaviors are expected to be similar to a DB plan. Since DC plans are age-neutral, retirement timing should have been fully driven by the incentive induced from the accompanied DB plans. The rate is expected to be significantly higher once the eligible age and service years are reached, since the value of the plan is optimized. The retirement rates under CSRS and FERS are expected to correspond to the retirement ages; hence the retirement rate is expected to peak around ages 55, 60, and 62, which are the eligible ages for normal retirement. Rates are also expected to be high for age 65 for social reasons (Lumsdaine, Stock, & Wise, 1995).

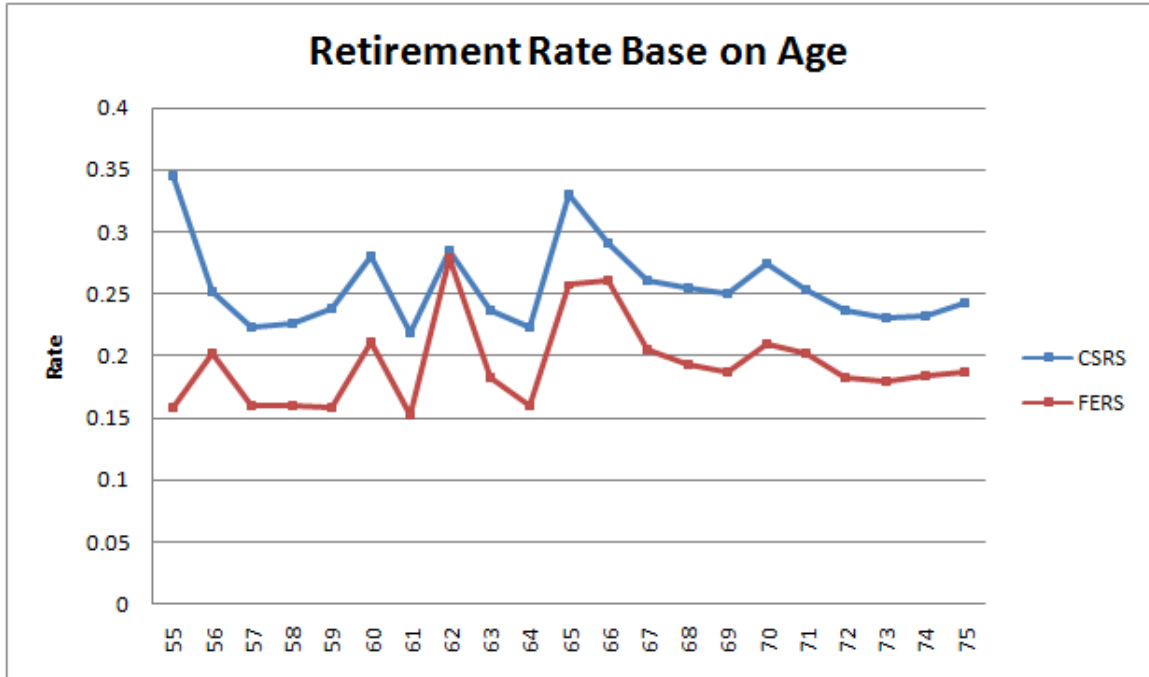


Figure 2: Retirement Rates of CSRS and FERS based on Age

According to the result calculated from the data presented in Figure 2, the retirement behaviors of CSRS and FERS followed the expectation of a DB plan. Hence, retirement rates are relatively high for normal retirement ages. According to the data, the retirement rate under CSRS begins to rise slowly starting at age 50. The first peak occurs at age 55 which has a rate of 34.56%, followed by ages 60, 62, and 65 with rates of 28.00%, 28.49% and 33.08%, respectively. The DB plan in CSRS creates a higher incentive for employees to retire once the requirements are fulfilled. The retirement rate under FERS also starts to rise at age 54, but does not peak at age 55. Its first major peak occurs at age 60 with a rate of 21.09%; its second peak is at 62 with a rate of 27.96%, and its third peak is at age 65 with a rate of 25.76%.

The rates under both systems have similar behaviors, with the greatest difference between the two schemes occurring for age 55. This can be explained by the assumption used by Manchester (2010). He mentioned that occupational pensions are only a portion of the entire retirement income portfolio, and he assumes that the individual would retire when the entire portfolio is maximized. Recall that individuals covered by CSRS have less diversity in their retirement income portfolio for two reasons. The first reason is that CSRS rewards employees with long tenures. Consequently, employees in the system have a higher likelihood to remain in the system, and therefore have fewer opportunities to be exposed to other pension plans. As a result, they have a portfolio with lower diversity that only has one or a few pension benefits upon retirement.

The second reason is that CSRS is dominated by one DB income stream, and it does not include Social Security. Therefore, the value of their portfolios approaches optimization whenever the normal retirement status is fulfilled under CSRS. Moreover, as soon as employees retire from the government plan, they are allowed to work in the private sector and enroll in other pension plans that include Social Security benefits. This behavior is commonly known as “pension double-dipping”, where people receive retirement benefit from a plan while remaining in the workforce. Therefore, for employees under CSRS to maximize their entire portfolio, including the new pension plans acquired after retiring from the government job, is to leave the government as soon as they are guaranteed the full amount in CSRS plan and start in the private sector. Due to these factors, CSRS has the highest retirement rate at the youngest normal retirement age. In contrast, FERS offers a more diverse retirement income portfolio naturally with three

benefit sources. As Social Security is one of the three income streams, the portfolio is undoubtedly not optimized at age 55. Therefore, retirement rate at age 55 is lower given the individuals behave rationally.

The major peak under FERS occurs at age 62. This retirement spike can be explained by the features of the plan. The formula used to calculate the benefit for the Basic Plan compensates workers with a higher percentage multiplier when they retire at age 62 or older. Age 62 is also the early retirement age for Social Security benefits. Although the benefits for early retirement under Social Security are actuarially reduced, benefits received from the Basic Plan are not decreased actuarially. In addition, living cost adjustments only become effective when retirees are 62 and older. Hence, accrual of pension wealth for the entire portfolio can be at its maximum at this age, inducing a high rate of retirement. The same assumption that Manchester had introduced earlier can be used to explain the observations for the data.

The data have reflected the “age 65-retirement-effect” (Lumsdaine, Stock, & Wise, 1995). The peak at age 65 under FERS is induced by the normal retirement eligibility of Social Security; however, age 65 is not an age for normal retirement for CSRS. Regardless the rate is still at a peak at age 65. According to Lumsdaine, Stock and Wise (1995), the high retirement rate at age 65 is not explained by any of their hypotheses, including Medicare eligibility. It is simply what the general public would normally do.

ii. Retirement Rate based on Years of Service

Retirement rates based on Years of Service is the percentage of employees who are eligible for retirement that choose to retire, where the employees are grouped according to their years of service. Each rate is calculated by dividing the number of employees retiring with a particular number of service years by the total number of employees that are eligible to retire in that same service year. Using this formula, at each service year, there is a number that represents the rate of employees who are terminating employment due to retirement. The formula does not take calendar years into account; noted age is used to determine the eligibility. As a result, the rate also represents an aggregate rate of all of the calendar years over which the data have been collected.

$$\frac{\sum_{i=1984}^{2007} \text{Number of Retirements at Service Years}(X) \text{ in year}(i)}{\sum_{i=1984}^{2007} \text{Eligible Exposure at Service Years}(X) \text{ in year}(i)}$$

Although there have been no previous published studies to date that examine the relationship between years of service and retirement rate in the federal retirement programs, it is anticipated that CSRS will exhibit the characteristics of DB plans while FERS will reflect the traits of DC plans.

Since under CSRS the sole income comes from a DB plan, its retirement behavior should be entirely driven by its attributes. In the case of CSRS with respect to service years, the rate is expected to be high at years of service that satisfy the eligibility of normal retirement. This is because when the value of the plan is optimized it induces

larger incentives. Since the benefit formula depends heavily on the number of years of service, rates should appear to have some associations with years of service.

In contrast, although the results from section examining Retirement Rate based on Age suggests that the DB traits in FERS have a stronger effect on retirement timing than its infused DC plan, FERS is not anticipated to have similar behavior in this case. While the benefit formula of FERS also depends heavily on years of service, it should have less variation compared to CSRS. Unlike CSRS, which breaks the formula of percentage multipliers down to three parts with respect to years of service, FERS only breaks its formula of percentage multiplier down to two parts. Under FERS, employees are able to apply the higher percentage multiplier in their formula only if they retire at age 62 or older with 20 or more years of service; for all the other normal retirement retirees, their percentage multiplier does not vary with years of service. Additionally, Social Security does not discard previous years of service as job change occurs, which a typical DB plan would do. Since it is a public pension plan, the worker accumulates an additional year of service as long as his or her service meets the credit requirement. Its portability in terms of years of service thus behaves in a manner similar to a DC plan. As a result, only one of the three retirement income sources under FERS has typical DB plan traits, and the other two have typical DC traits. With less DB traits in FERS, the retirement rates based on year of service under FERS become similar to a DC plan. As discussed in previous chapter, retirement rates of DC plans are more likely to be less associated with service years and ages. The accrual value of pension benefits under a DC plan does not decrease

when an employee ages beyond normal retirement. This creates less incentive for employees to retire when eligibilities are met.

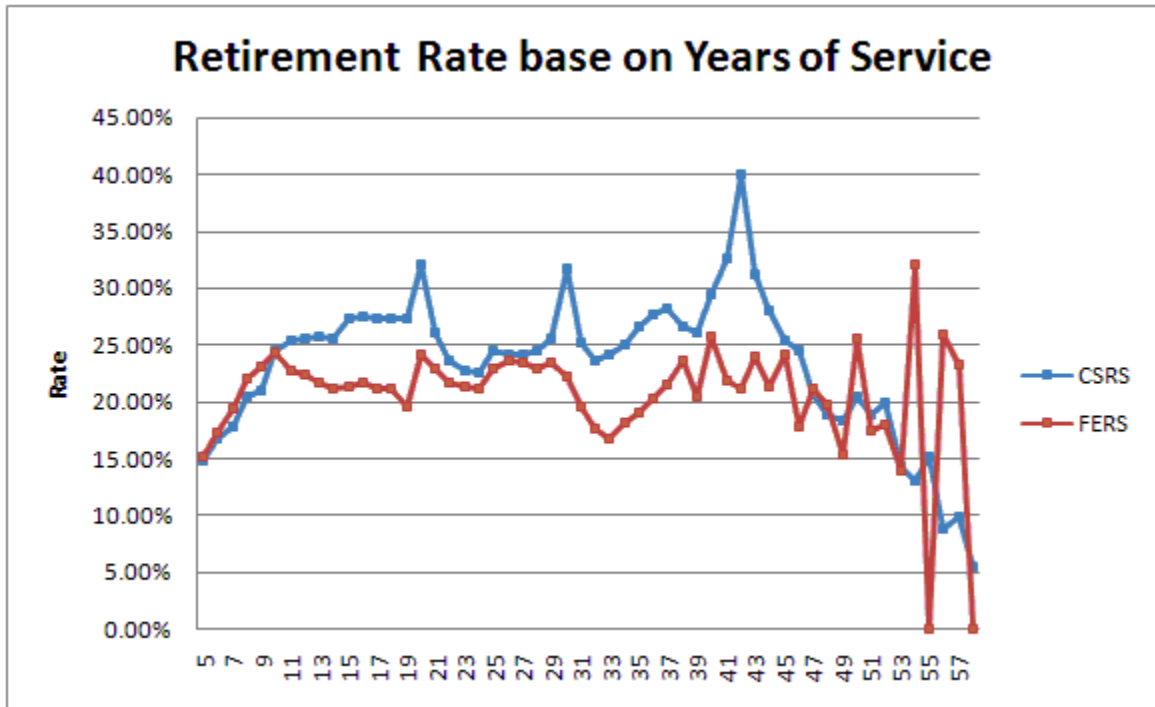


Figure 3: Retirement Rates of CSRS and FERS based on Service Year

According to the result calculated from the data presented in Figure 3, the retirement rate under CSRS has its first peak at 20 years of service with a rate of 24.14%, and its second peak at 30 years of service with a rate of 22.18%. Its major peak arises at 42 years of service with a rate of 39.99%, and then it decreases steadily afterward. The retirement rate under FERS shows a smooth pattern until 38 years of service. Starting at 39 years of service, the rate begins to oscillate. The range of oscillation between 38 and 50 years of service is relatively small, but as the years of service increase, the range of oscillation also increases. The small variation of the retirement rate between 38 and 50

years of service suggests that the rates are similar between these service years. The greater variability of the rate that occurs after 50 years of service can be explained by the small amount of data of FERS that is currently available. FERS has a much shorter history than CSRS, which means that it does not contain a large amount of data for higher service years. Statistically, a small set of data results in dramatic changes even from small changes, which leads to larger oscillations. However, as years go by and there is more data available from FERS, the oscillations will likely be reduced and graphs will be smoother, since most employees are not usually expected to work beyond 30 years.

The CSRS retirement rate reflects more of the DB traits as projected. It shows a higher retirement rate at certain service years when normal retirement requirements are met, for example, at 20 and 30 years of service. It also has its greatest peak at 42 years of service, when the percentage multiplier reaches its maximum limit. Results observed in this section are consistent with the ones described in the previous section; employees retire when they obtain their maximum retirement amount. The highest rate, at age 42, is strong evidence to support this theory, since the value of accrual pension is optimized at this point. On the other hand, FERS retirement behavior also accords with the anticipations. The retirement rates under FERS don't have an apparent peak when normal retirement requirements are met. Additionally, rates under FERS have a smaller variance than CSRS even when sample sizes that are smaller than 30 are not discarded. The steady variance and lack of a major peak suggest that the rates do not fluctuate with service years as much as CSRS does, which is consistent with the anticipated DC traits in FERS.

d. Withdrawal Rates

Withdrawal rates are examined with respect to two variables: age and years of service in the following sections.

i. Withdrawal Rate based on Age

Withdrawal rates based on Age are calculated as the percentage of employee that chooses to withdrawal at the given age. Each rate is calculated by dividing the number of employees decremented in a particular age by the total number of employees in that same age category. Using this process, at each age there is a number that represents the rate of employees decrementing to withdrawal. The formula does not take calendar years or service years into account; it only compares the rates among different ages. As a result, the rate also represents an aggregate rate of all of the calendar years over which the data has been collected.

$$\frac{\sum_{i=1984}^{2006} \text{Number of Withdrawal at Age}(X) \text{ in year}(i)}{\sum_{i=1984}^{2006} \text{Exposure at Age}(X) \text{ in year } (i)}$$

Withdrawal rates among different ages in CSRS are expected to decrease as the variable age increases. Since CSRS is a DB plan, retirees are guaranteed to receive full pension benefits as long as they fulfill all requirements; this is expected to create fewer incentives for older employees to withdraw from the plan as they may be eligible to retire anytime. Withdrawal rates among different ages in FERS are expected to be nearly uniformly distributed over age, with the rates uncorrelated to age.

Although FERS reflects DB traits in its retirement rate, it is not expected to have the same behavior in its withdrawal rate, as the DB traits that appear in retirement rates under FERS are induced by the Basic Plan and Social Security. However, Social Security is a public pension plan; hence, it is transferable when an individual leaves FERS. Therefore, since the incentive to remain in the system is only promoted by the Basic Plan, which is only one third of the income stream in FERS, it is not expected to show as much DB traits as in retirement rates.

According to the result calculated from the data presented in Figure 4, withdrawal rates under CSRS with respect to age start very high and decrease sharply at early ages, and remain relatively low and steady at older ages. The DB plan imbedded in CSRS encourages older employees to stay employed until they become eligible for normal retirement. However, the same feature motivates younger employees to withdraw early before they put on the “golden handcuff”. The withdrawal rate under FERS with respect to age has less variability; the rate for all ages is under 10%. However, it is comparatively higher at younger ages and relatively lower at older ages. The steady rate of FERS is also consistent with that of a DC plan. As the plan embodies higher tolerance for change of jobs, age becomes a less crucial factor in determining causes of withdrawal. Because the rate is less correlated to age, a flat curve is observed. Comparing the two rates, CSRS has a higher rate than FERS before age 33. The two rates cross between ages 33 and 34, and after age 34, FERS remains higher than CSRS.

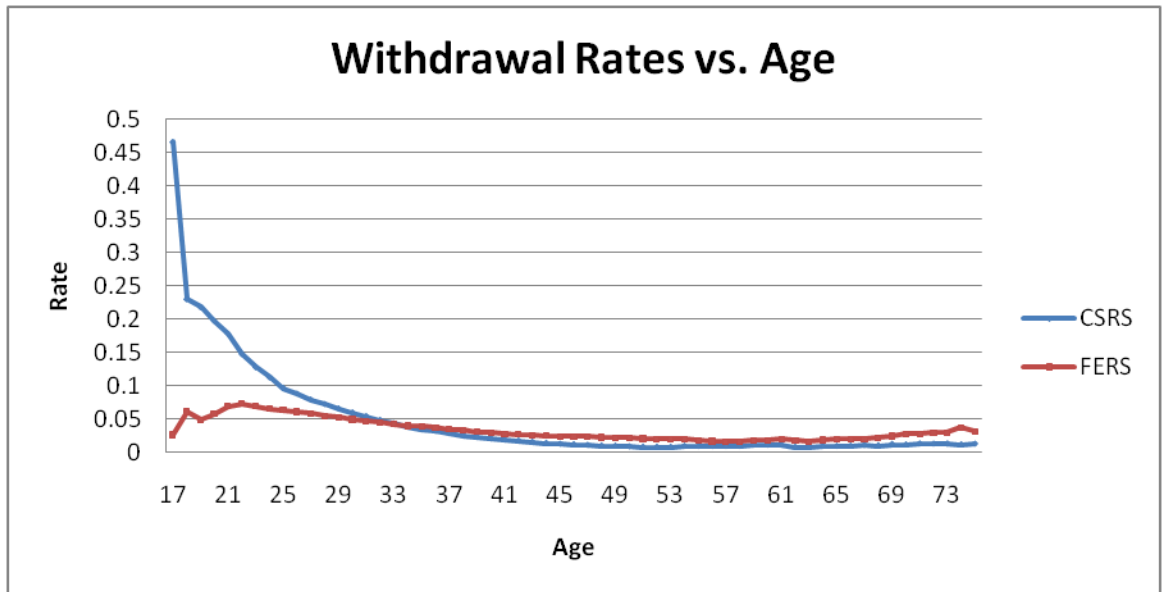


Figure 4: Withdrawal Rates of CSRS and FERS based on Age

ii. Withdrawal Rate based on Years of Service

Withdrawal rates based on years of service are calculated as the percentage of employees who choose to withdrawal at the given service year. The rate is calculated by dividing the number of employees that decremented in a particular number of service years by the number of total employees in the same particular service years. Using this formula, at each service year, there is a number that represents the rate of employees decrementing due to withdrawal. The formula does not take calendar years or age into account. It only compares the rates among changes in service years. As a result, the rate also represents an aggregate rate of all of the calendar years over which the data has been collected.

$$\frac{\sum_{i=1984}^{2006} \text{Number of Withdrawal at Service Years}(X) \text{ in year}(i)}{\sum_{i=1984}^{2006} \text{Exposure at Service Years}(X) \text{ in year}(i)}$$

The withdrawal rate under CSRS is expected to be significantly higher at lower service years. The retirement benefit that is generated from the formula increases as years of services increase, thus it is expected to create fewer incentives among employees with high years of services to withdraw from the plan as they are eligible for a larger benefit. This is similar to the results based on age. The withdrawal rate under FERS is expected to be less correlated with years of service, similar to withdrawal rate with respect to age. Since the Basic Plan is only a one third portion of the entire retirement system, service years do not affect the amount of benefit in FERS as much as in CSRS. Hence, withdrawal rates with respect to service years are expected to be higher than CSRS at higher service years. However, the 3-year cliff vesting rule may create an incentive for employees to stay at least three years, which may lead to a withdrawal rate peak at three years of service.

According to the result calculated from the data presented in Figure 5, both CSRS and FERS rates remain under two percent for most of the service years. Comparing the two rates, CSRS has a higher rate before 17 years of service. Starting at 18 years of service, FERS has a higher withdrawal rate than CSRS. The withdrawal rate under CSRS decreases sharply at early ages and remains relatively low and steady at older ages. The pattern is similar to the withdrawal rate of CSRS with respect to age, shown in Figure 2. The benefit formula in CSRS is designed to award long-term employees; therefore, CSRS

provides incentives to employees with higher service years to continue in the plan, while urging employees with fewer service years to move out of the plan before they become too late to join a new pension plan. As a result, the withdrawal rate appears to decrease as years of service increase. The withdrawal rate under FERS has its first peak at three years of service. Thereafter, the rate decreases slowly and remains relatively low. Employees under FERS with fewer service years have less incentive to remain in the plan compared to CSRS, since the Social Security and TSP are both portable, which allows them to change jobs without previous pension investments being discarded. As a result, FERS has a relatively lower rate than CSRS at lower service years. However, the 3-year vesting rule in FERS creates a high rate at this particular number of service years. In order to receive the full amount contributed by the government and agency in their TSP, employees under FERS are required to complete at least three years of service. Applying the assumption Manchester used again, most employees would prefer to acquire the full amount since it optimized their pension. Therefore, they tend to wait three years before withdrawing, resulting in a peak. The DC features in FERS also provide incentives for employees with higher service years to continue in the plan past normal retirement age; nevertheless, the force of attraction is weaker compared to CSRS. As a result, FERS has a slightly higher rate at higher service years.

The same oscillation observed in the retirement rate of FERS with respect to service years (Figure 3) appears again at higher service years of FERS withdrawal rate. The oscillation can be explained by the same reason. Due to the small amount of data that

are currently available from FERS, small changes in numbers may result in significant changes in the rate.

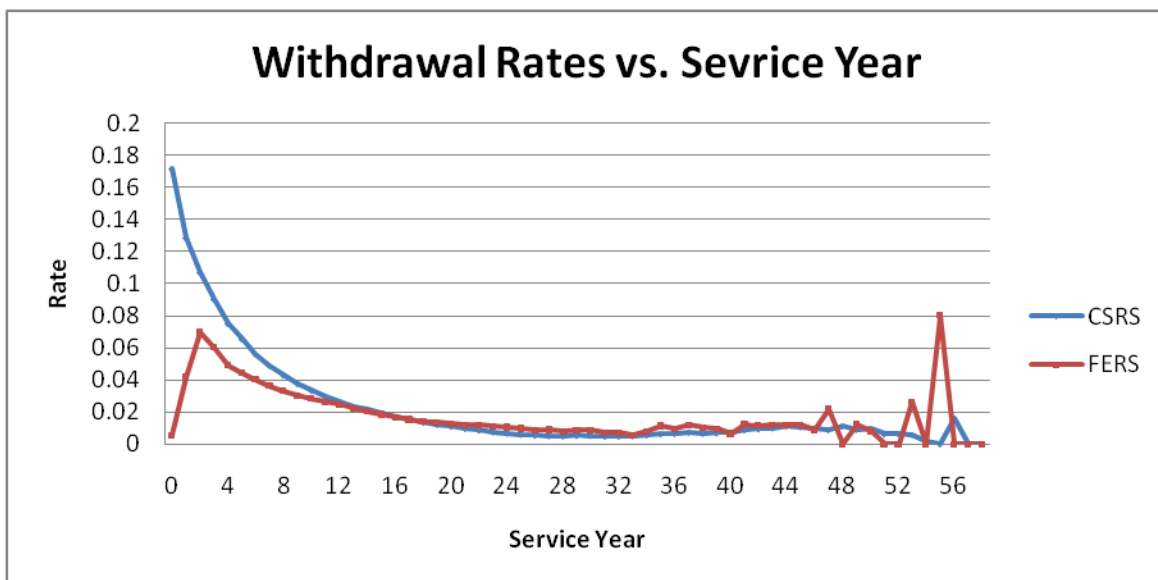


Figure 5: Withdrawal Rates of CSRS and FERS based on Years of Service

V. Conclusions

This study discusses the retirement and withdrawal behavior of the two federal retirement systems, Civil Service Retirement System (CSRS) and Federal Employee Retirement System (FERS). CSRS was created in 1920 and replaced by FERS during the 1980s. CSRS is a system that has a mandatory DB plan along with two optional DC plans. However, its retirement and withdrawal behaviors are driven entirely by its DB plan as addressed in previous sections. FERS is a system consisting of three retirement income streams: one DB and one DC plan in addition to Social Security benefits. The factor that caused the termination of CSRS was primarily the Amendment of 1983. Nevertheless,

pressure posed from the private sector and its own financial burden has also accelerated the reform. As the private sector faced demographic, firm characteristic, economics, government regulation and mortality changes, popularity for DC plans grew rapidly. In order to remain competitive in the workforce, FERS was designed to embrace Social Security and DC plans into its system.

Both plans exhibit DB traits in terms of retirement rate based on age. Although FERS includes a DC plan in the system, its retirement rate behavior is still dominated by the corresponding DB plans. Rates under both systems are significantly higher at normal retirement ages, as well as at age 65. Since under a typical DB plan, the value of a pension is optimized at normal retirement, and it encourages employees to retire. As for age 65, according to Lumsdaine, Stock and Wise (1995) the high retirement rate at this age is a common practice for the general public even when it's not a normal retirement age in pension plans. This phenomenon cannot be explained by Medicare eligibility or other factors they examined.

In terms of retirement rate based on years of service, two systems show discordant results. Behaviors of retirement rate under CSRS remain consistent with results found for the retirement rate based on age. The DB traits continue to dominate the retirement behavior. Whenever the normal retirement eligibilities are met, the retirement rates appear to have a peak. In addition, the largest rate happens at 42 years of service, which is when the percent multiplier used in the benefit formula is optimized. As predicted, DB plans induce high incentives for employees to retire when the value of the

plan is optimized. However, in contrast to CSRS, the retirement rate based on years of service under FERS is not dominated by its DB plans. This is because Social Security in this case does not behave like a typical DB plan. Because Social Security is a public pension plan, it accumulates years of service continuously despite any job changes. As a result, the amount of Social Security benefits doesn't directly associate with number of years of service; therefore, only the basic plan under FERS induces typical DB traits in terms of years of service. Since the basic plan is only one third of the income streams within FERS, the rest of the DC plans dominates the retirement rate behavior.

In contrast to retirement rates among CSRS and FERS, in which similar behaviors were found, withdrawal rates manifest two different trends with respect to the two systems. Under CSRS, withdrawal rates with respect to variable age, as well as variable years of service, appeared to be decreasing gradually as the corresponding variable increases. The decrease is influenced heavily by the DB plan within CSRS. DB plans guarantee the amount of retirement income once requirements are met, and they also reward employees with long tenure. Therefore, the incentive to leave the plan once employees are older or have more service years diminishes. In contrast, withdrawal rates under FERS do not have these properties. Withdrawal rates of FERS with respect to variable age have a flatter pattern. Since the Social Security benefits do not get penalized when job changes occur; it is not as likely to induce long tenures to employees as a normal DB plan. As a result, two out of the three retirement income streams in the system are transferable like DC plans. Hence, withdrawal rates under FERS behave similar to a DC plan. Likewise, withdrawal rates under FERS with respect to years of service have a

flat pattern. The vesting provision provokes a peak at three years of service, as it is the amount of time an employee needs to fully acquire the contribution made by employers. Nevertheless, it has less variation in terms of overall pattern comparing to withdrawal rates under CSRS.

There are some limitations to this study. Since FERS was only implemented two decades ago, the amount of data is insufficient to generate a normal distribution. This problem exists explicitly in groups that have higher ages and larger years of service. As more data will be collected in the future, the trend for FERS is expected to manifest itself. Moreover, this study did not take tax exemption or regulation into account. It is uncertain how much they would contribute to the behavior trend. In order to fully understand the causation between factors and decrement behaviors, future related studies are encouraged to include tax provisions.

Pension plans are essential for everyone, as all individuals in the workforce will face retirement someday. The purpose of this study is not to favor one plan over another, but a general understanding how pension plans effect retirement behavior. Law makers and regulators are encouraged to use the results from this study to provide more efficient and convenient plans in the future. Both DB and DC plans have the ability to prepare an individual financially for retirement. However, it is especially important for DC plan participants to manage their retirement accounts, as they bear the full consequence of adverse investment returns and higher than expected longevity during retirement. When participating in a DC plan, it is essential to start making contributions in earlier ages.

Deferring contribution until later years will only generate smaller pension benefit. In order to avoid insufficient funding in DC plans upon retirement, it is advised to avoid high volatility investments, for example stocks, at older ages. In addition, it is strongly encourage using the lump sums obtained from DC plans to purchases annuity to hedge longevity risks.

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Appendix A

Retirement Rates Based on Age 1984-2007

Retirement Rate 1984-2007						
AGE	CSRS			FERS		
	# Retiree	# Eligible Employees	Rate	# Retiree	# Eligible Employees	Rate
55	168979	488983	34.56%	1505	9,547	15.76%
56	96004	381900	25.14%	1688	8,383	20.14%
57	75536	338486	22.32%	1208	7,544	16.01%
58	67869	301245	22.53%	1100	6,891	15.96%
59	62956	264061	23.84%	994	6,273	15.85%
60	141069	503850	28.00%	11006	52,177	21.09%
61	87545	401019	21.83%	6286	41,410	15.18%
62	129585	454777	28.49%	45887	164,107	27.96%
63	81847	346984	23.59%	21872	120,327	18.18%
64	62278	279728	22.26%	15107	94,654	15.96%
65	71892	217344	33.08%	18547	72,011	25.76%
66	44718	153944	29.05%	12913	49,500	26.09%
67	30583	117186	26.10%	7622	37,075	20.56%
68	22888	89967	25.44%	5433	28,172	19.29%
69	17310	69371	24.95%	4017	21,464	18.71%
70	14577	53040	27.48%	3391	16,231	20.89%
71	10047	39771	25.26%	2439	12,054	20.23%
72	7215	30490	23.66%	1654	9,100	18.18%
73	5454	23687	23.03%	1255	6,991	17.95%
74	4263	18360	23.22%	990	5,374	18.42%
75	3396	13983	24.29%	760	4,074	18.66%

Appendix B

Retirement Rates Based on Years of Service 1984-2007

Retirement Rate Base on Years of Service						
Years of Service	CSRS			FERS		
	# Retiree	# Eligible Employees	Rate	# Retiree	# Eligible Employees	Rate
5	681	4621	14.74%	4088	27090	15.09%
6	1023	6140	16.66%	5077	29216	17.38%
7	1495	8366	17.87%	5991	30913	19.38%
8	2277	11112	20.49%	7070	32172	21.98%
9	2962	14088	21.02%	7555	32733	23.08%
10	4233	17252	24.54%	8169	33470	24.41%
11	5217	20539	25.40%	7704	33899	22.73%
12	6178	24204	25.53%	7748	34667	22.35%
13	7310	28392	25.75%	7611	35139	21.66%
14	8574	33578	25.53%	7588	35716	21.25%
15	10696	39148	27.32%	7759	36228	21.42%
16	12342	44858	27.51%	7808	35980	21.70%
17	14081	51654	27.26%	7379	34881	21.15%
18	16006	58692	27.27%	7123	33545	21.23%
19	18078	66019	27.38%	6204	31681	19.58%
20	39948	124576	32.07%	11625	48166	24.14%
21	31919	122314	26.10%	8913	38940	22.89%
22	29510	124660	23.67%	6651	30594	21.74%
23	28693	126306	22.72%	4842	22682	21.35%
24	28591	127055	22.50%	3771	17749	21.25%
25	31032	127147	24.41%	3223	14106	22.85%
26	30113	124875	24.11%	2631	11162	23.57%
27	29764	123718	24.06%	2073	8827	23.49%
28	29663	121061	24.50%	1685	7325	23.00%
29	30124	118192	25.49%	1427	6097	23.40%
30	109256	344495	31.71%	2977	13424	22.18%
31	78144	309193	25.27%	2105	10789	19.51%
32	74398	314460	23.66%	1629	9244	17.62%
33	76150	315134	24.16%	1349	8010	16.84%
34	74881	299316	25.02%	1156	6392	18.09%
35	76167	285780	26.65%	982	5170	19.00%
36	71523	259206	27.59%	833	4123	20.20%
37	60453	214659	28.16%	703	3258	21.58%
38	42461	160131	26.52%	545	2305	23.64%
39	31442	120391	26.12%	347	1700	20.42%
40	26538	90393	29.36%	317	1228	25.81%
41	20967	64288	32.61%	210	957	21.94%
42	17627	44082	39.99%	164	774	21.18%
43	9107	29129	31.26%	155	646	24.00%

44	5662	20187	28.05%	113	530	21.33%
45	3577	14131	25.31%	106	438	24.18%
46	2453	10028	24.46%	62	348	17.82%
47	1511	7348	20.56%	60	283	21.21%
48	1018	5387	18.90%	46	234	19.70%
49	733	4010	18.28%	27	176	15.37%
50	579	2833	20.43%	32	126	25.50%
51	349	1859	18.78%	15	86	17.54%
52	246	1241	19.83%	11	61	18.03%
53	119	830	14.34%	5	36	13.93%
54	69	526	13.11%	7	22	32.11%
55	47	309	15.22%	0	13	0.00%
56	16	180	8.89%	2	8	25.97%
57	7	71	9.92%	1	4	23.26%
58	1	18	5.46%	0	2	0.00%

Appendix C

Withdrawal Rates Based on Age 1984-2006

Withdrawal Rates Based on Age 1984-2006						
AGE	CSRS			FERS		
	# Retiree	# Eligible Employees	Rate	# Retiree	# Eligible Employees	Rate
17	41	88	46.59%	72	2625	2.74%
18	450	1955	23.02%	532	8700	6.11%
19	1612	7388	21.82%	1293	26244	4.93%
20	3175	16044	19.79%	3308	57318	5.77%
21	5121	28720	17.83%	6873	97980	7.01%
22	7000	47271	14.81%	11401	155947	7.31%
23	9511	74307	12.80%	16241	232247	6.99%
24	11551	102480	11.27%	20690	312005	6.63%
25	12823	131879	9.72%	24683	383383	6.44%
26	14676	165751	8.85%	27517	448303	6.14%
27	16376	205627	7.96%	29806	506029	5.89%
28	18302	251525	7.28%	30690	557393	5.51%
29	19869	300068	6.62%	32026	605208	5.29%
30	21138	350236	6.04%	32486	650887	4.99%
31	22084	402962	5.48%	33182	696034	4.77%
32	22392	456424	4.91%	33195	734136	4.52%
33	22534	512430	4.40%	33198	767949	4.32%
34	22796	573540	3.97%	32279	797123	4.05%
35	23052	640048	3.60%	32443	819668	3.96%
36	23019	709521	3.24%	31253	832877	3.75%
37	22624	775631	2.92%	29922	847370	3.53%
38	21590	815937	2.65%	29177	860638	3.39%
39	20489	854612	2.40%	27514	873048	3.15%
40	19236	895487	2.15%	26837	884421	3.03%
41	18477	941606	1.96%	25668	888226	2.89%
42	17776	979377	1.82%	24389	881645	2.77%
43	16604	1012497	1.64%	23121	867389	2.67%
44	15402	1041570	1.48%	21963	849369	2.59%
45	14306	1069334	1.34%	20751	825541	2.51%
46	13781	1094850	1.26%	19833	797428	2.49%
47	12856	1114274	1.15%	18513	766830	2.41%
48	12119	1128300	1.07%	17285	732801	2.36%
49	11796	1141056	1.03%	15811	697720	2.27%
50	10858	1142585	0.95%	14867	658178	2.26%
51	10309	1134644	0.91%	13426	614465	2.18%
52	9950	1124096	0.89%	12293	573077	2.15%
53	9686	1109920	0.87%	11067	532495	2.08%
54	11106	1089947	1.02%	9973	493552	2.02%
55	10144	1025265	0.99%	8535	461450	1.85%
56	8543	865233	0.99%	7257	406047	1.79%
57	7747	781700	0.99%	6345	363925	1.74%
58	7155	711943	1.01%	5545	321500	1.72%
59	7671	650856	1.18%	5166	283166	1.82%
60	6647	568230	1.17%	4486	239422	1.87%

61	5690	471208	1.21%	4334	204466	2.12%
62	3466	391832	0.88%	3178	166264	1.91%
63	2471	298248	0.83%	2118	121592	1.74%
64	2411	240081	1.00%	1889	94448	2.00%
65	1876	186182	1.01%	1509	72203	2.09%
66	1388	132263	1.05%	1046	50635	2.07%
67	1128	100356	1.12%	785	38369	2.05%
68	855	76788	1.11%	664	29085	2.28%
69	775	59315	1.31%	568	22235	2.55%
70	562	45441	1.24%	490	16924	2.89%
71	471	33942	1.39%	352	12620	2.79%
72	350	26080	1.34%	291	9609	3.03%
73	279	20278	1.38%	228	7454	3.06%
74	196	15705	1.25%	219	5716	3.83%
75	160	11990	1.33%	137	4265	3.21%

Appendix D

Withdrawal Rates Based on Years of Service 1984-2006

Withdrawal Rates Based on Years of Service 1984-2006						
Years of Service	CSRS			FERS		
	# Retiree	# Eligible Employees	Rate	# Retiree	# Eligible Employees	Rate
0	27033	157530	17.16%	4609	852400	0.54%
1	36818	286112	12.87%	73754	1767841	4.17%
2	27422	256129	10.71%	120793	1740880	6.94%
3	28918	319997	9.04%	103124	1720683	5.99%
4	31345	417030	7.52%	81913	1665251	4.92%
5	32541	496523	6.55%	70053	1588687	4.41%
6	31496	560767	5.62%	60263	1495762	4.03%
7	30484	623084	4.89%	52397	1443948	3.63%
8	29067	679526	4.28%	44676	1355150	3.30%
9	28076	745277	3.77%	37413	1239041	3.02%
10	27398	819462	3.34%	33172	1174639	2.82%
11	25813	873002	2.96%	29181	1109307	2.63%
12	24395	924521	2.64%	24872	1015035	2.45%
13	22807	973764	2.34%	21372	952492	2.24%
14	21799	1023837	2.13%	18463	909037	2.03%
15	20197	1066639	1.89%	15452	832676	1.86%
16	19067	1111224	1.72%	12933	771176	1.68%
17	17606	1140128	1.54%	11247	729254	1.54%
18	16153	1196565	1.35%	8588	613741	1.40%
19	14725	1210796	1.22%	6794	507440	1.34%
20	13467	1222608	1.10%	5184	413944	1.25%
21	11783	1215575	0.97%	3807	317232	1.20%
22	10411	1218194	0.85%	2695	228533	1.18%
23	8978	1190892	0.75%	2022	178979	1.13%
24	7797	1158909	0.67%	1532	144418	1.06%
25	6663	1116980	0.60%	1128	114966	0.98%
26	5640	1048017	0.54%	805	89881	0.90%
27	4878	979519	0.50%	634	70351	0.90%
28	4553	930967	0.49%	450	55807	0.81%
29	4482	859004	0.52%	374	43561	0.86%
30	4034	778503	0.52%	284	33379	0.85%
31	3171	674436	0.47%	178	24577	0.72%
32	2794	586020	0.48%	130	18102	0.72%
33	2515	496940	0.51%	72	13179	0.54%
34	2337	414066	0.56%	74	9691	0.76%
35	2148	345092	0.62%	82	7194	1.14%
36	1772	274830	0.64%	49	5175	0.94%
37	1493	203522	0.73%	45	3731	1.21%
38	993	149610	0.66%	26	2636	1.00%
39	776	113918	0.68%	18	1851	0.97%
40	635	87166	0.73%	9	1335	0.67%
41	575	65186	0.88%	12	969	1.24%
42	436	46717	0.93%	9	776	1.16%

43	304	30675	0.99%	7	619	1.16%
44	227	20117	1.13%	6	532	1.17%
45	148	13866	1.07%	5	424	1.18%
46	95	9878	0.96%	3	356	0.84%
47	63	7102	0.88%	6	275	2.18%
48	58	5215	1.12%	0	215	0.00%
49	33	3697	0.90%	2	162	1.23%
50	25	2683	0.93%	1	121	0.83%
51	11	1811	0.62%	0	92	0.00%
52	8	1240	0.65%	0	54	0.00%
53	5	855	0.58%	1	38	2.63%
54	1	536	0.19%	0	20	0.00%
55	0	341	0.00%	1	15	8.00%
56	3	198	1.62%	0	9	0.00%
57	0	90	0.00%	0	3	0.00%
58	0	35	0.00%	0	2	0.00%

VITA

Ying-Hui (Zoe) Huang

(814) 441-0118 ▪ zoe.psu@gmail.com

EDUCATION**The Pennsylvania State University**

Bachelor of Science in Mathematics Actuarial Option

Minors in Statistics, Economics, and French

Thesis Title: Case study of behavior differences between defined benefit and defined contribution pensions plans

Thesis Supervisor: David A. Cather

Actuarial Exams :	P/1	<i>January, 2009</i>
	FM/2	<i>August, 2009</i>
	MLC/3L	<i>November, 2009</i>
	MFE/3F	<i>May, 2010</i>

RELATED EXPERIENCE

Nan Shan Life, AIG member company in Taiwan	<i>Intern</i>	<i>Summer 2010</i>
Society of Actuaries	<i>Project Researcher</i>	<i>Summer 2009</i>
Peking University, Beijing, China	<i>Project Researcher</i>	<i>Summer 2008</i>
The Penn State University	<i>Teaching Assistant</i>	<i>Fall 2009 –Fall 2010</i>

LANGUAGE

Proficient in Mandarin, English, and French