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Abstract

A critical question for Social Security policy is how program incentives affect retirement behavior. We use the wealth of new data available through the Health and Retirement Survey (HRS) to examine the impact of Social Security incentives on male retirement. We implement forward-looking models of retirement whereby individuals consider not just the incentives to work in the next year but in all future years as well. We find that such forward looking incentive measures for Social Security are significant determinants of retirement decisions. Our findings suggest that Social Security policies which increase the incentives to work at older ages can significantly reduce the exit rate of older workers from the labor force.

Introduction

One of the most striking labor force phenomena of the second half of the twentieth century has been the rapid decline in the labor force participation rate of older men. In 1950, for example, 81% of 62 year old men were in the labor force; by 1995, this figure had fallen to 51%, though it has rebounded slightly in the past few years (Quinn, 1999).

Much has been written about the proximate causes of this important trend among older men, and in particular about the role of the Social Security program. A large number of articles have documented pronounced "spikes" in retirement at ages 62 and 65, which correspond to the early and normal retirement ages for Social Security, respectively. While there are some other explanations for a spike at age 65, such as entitlement for health insurance under the Medicare program or rounding error in surveys, there is little reason to see a spike at 62 other than the Social Security program. Indeed, as Burtless and Moffitt (1984) document, this spike at age 62 only emerged after the early retirement eligibility age for men was introduced in 1961.

The presence of these strong patterns in retirement data suggest that the underlying structure of SS plays a critical role in determining retirement decisions. But the impact of changes in Social Security generosity on retirement decisions is less obvious. A large literature dating from the mid-1970s has investigated this relationship, and the broad conclusion of that literature is that the level of Social Security benefits has a significant, but modest, effect on retirement dates.

The purpose of our paper is to revisit the impact of Social Security on retirement, using the best available recent data on retirement behavior, the Health and Retirement Study (HRS). This is a comprehensive data set from the 1980s and 1990s which contains information on demographic and job characteristics, labor force attachment, earnings histories, and the features of private pension plans for a large sample of individuals near retirement age.

We use these data to revisit the important observation of Stock and Wise (1990a,b) that it is not simply the level of retirement wealth or the increment with one additional year of work that matters, but the entire evolution of future wealth with further work. Their “option value” model posited retirement decisions as a function of the difference between the utility of retirement at the current date and at the date which maximizes one’s utility. They used data from a sample of firms with pension plans to show that the option of future benefit increments affected retirement decisions today in this framework. This finding is echoed in a reduced form context (using some of Stock and Wise’s estimated utility parameters) by Samwick (1998), who used data across many firms in the Survey of Consumer Finances (SCF).

This past work, however, was subject to three potentially important limitations. First, these papers have focused on all retirement income, including pensions, and have not isolated the impact of Social Security per se. There are a number of reasons to believe that the responsiveness of retirement to Social Security and private pension incentives may differ, and it is only the former that is relevant for Social Security policy-making. Second, retirement decisions in the option value framework are a function of both pension incentives and wages, the latter of which provides the vast majority of variation across individuals in option value. If wage differences across individuals capture partly heterogeneity in tastes for work, however, then building wage variation into the retirement incentive measure can lead to misleading estimates of the responsiveness to financial incentives. Finally, the previous data have either been specific to a handful of firms, or have not contained sufficient detail to compute correctly Social

Security incentives for retirement.

Our work remedies these deficiencies by building on the strengths of this impressive new data source. We estimate detailed models of retirement decisions that first incorporate Social Security only, and then incorporate private pension incentives as well. We draw on the insights of Stock and Wise in developing forward-looking measures of incentives, but we also consider in more detail the sources of variation in these incentives, by controlling in a rich way for past earnings, and developing forward-looking measures that are not primarily driven by wage differences.

We have at least three major findings. First, retirement appears to respond much more to Social Security incentive variables defined with reference to the entire future stream of retirement incentives than to the accrual in retirement wealth over the next year alone, indicating that forward-looking measures of this type are important variables to include in retirement models. Second, these forward looking measures have a significant impact on retirement decisions; these impacts are largest for incentive measures that are identified solely from retirement income effects, and not from wage effects, and from Social Security incentives only, and not pension incentives as well. Finally, the types of policy proposals currently contemplated in the Social Security reform debates will have relatively modest effects, largely due to offsetting wealth and accrual effects, though larger effects are possible if the policy changes also affect social "norms" regarding retirement. Proposals for which these effects do not offset, such as raising incentives for work only at older ages, may have the largest effect on retirement behavior.

Our paper proceeds as follows. We begin, in Part I, with background on both the relevant institutional features of the SS system, and on the previous literature in this area. We then move on, in

Part II, to describe our data and empirical strategy. Part III presents our basic results for Social Security impacts on retirement, considering as well the impact of incorporating pension incentives. Part V carries out a series of simulation exercises to assess the impact of Social Security reform using our model, and Part VI concludes.

Part I: Background

Institutional Features of Social Security

The Social Security system is financed by a payroll tax which is levied equally on workers and firms. The total payroll tax paid by each party is 7.65 percentage points; 5.3 percentage points are devoted to the Old Age and Survivors Insurance (OASI) program, with 0.9 percentage points funding the Disability Insurance (DI) system and 1.45 percentage points funding Medicare's Hospital Insurance (HI) program.[1] The payroll tax that funds OASI and DI is levied on earnings up to the taxable maximum, $72,600 in 1999; the HI tax is uncapped.

Individuals qualify for an OASI pension by working for 40 quarters in covered employment, which now encompasses most sectors of the economy. Benefits are determined in several steps. The first step is computation of the worker's Averaged Indexed Monthly Earnings (AIME), which is 1/12th of the average of the worker's annual earnings in covered employment, indexed by a national wage index. A key feature of this process is that additional higher earnings years can replace earlier lower earnings years, since only the highest 35 years of earnings are used in the calculation (the "dropout year

[1]The total OASI +DI contribution rate has been 6.2% since 1990, although the division between the two parts has varied slightly from year to year; the OASI portion is 5.35% in 1999 and will be 5.3% starting in 2000.

provision").[2]

The next step of the benefits calculation is to convert the AIME into the Primary Insurance Amount (PIA). This is done by applying a three-piece linear progressive schedule to an individual's average earnings, whereby 90 cents of the first dollar of earnings is converted to benefits, while only 15 cents of the last dollar of earnings (up to the taxable maximum) is so converted. As a result, the rate at which SS replaces past earnings (the "replacement rate") falls with the level of lifetime earnings.

The final step is to adjust the PIA based on the age at which benefits are first claimed. For workers commencing benefit receipt at the Normal Retirement Age (currently 65, but legislated to slowly increase to 67), the monthly benefit is the PIA. For workers claiming before the NRA, benefits are decreased by an actuarial reduction factor of 5/9 of one percent per month; thus, a worker claiming on his 62nd birthday receives 80% of the PIA.[3] Individuals can also delay the receipt of benefits beyond the NRA and receive a Delayed Retirement Credit (DRC). For workers reaching age 65 in 1999, an additional 5.5% is paid for each year of delay; this amount will steadily increase until it reaches 8% per year in 2008.

While a worker may claim as early as age 62, receipt of SS benefits is conditioned on the "earnings test" until the worker reaches age 65.[4] A worker age 62 to 65 may earn up to $9,600 in

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[2]While earnings through age 59 are converted to real dollars for averaging, earnings after age 60 are treated nominally. There is a two-year lag in availability of the wage index, calling for a base in the year in which the worker turns 60 in order to be able to compute benefits for workers retiring at their 62nd birthdays. This implies particularly large effects of this dropout year provision for earnings near the age of retirement, particularly in high inflation environments.

[3]The reduction factor will be only 5/12 of one percent for months beyond 36 months before the NRA, which will become relevant once the delay in NRA becomes effective.

[4]Until 2000, workers aged 65-69 were subject to an earnings test with a higher earnings floor and

1999 without the loss of any benefits, then benefits are reduced $1 for each $2 of earnings above this amount. Months of benefits lost through the earnings test are treated as delayed receipt, entitling the worker to a delayed retirement credit on the lost benefits when he resumes full benefit receipt.

One of the most important features of Social Security is that it also provides benefits to dependents of covered workers. Spouses of SS beneficiaries receive a dependent spouse benefit equal to 50% of the worker's PIA, which is available once the worker has claimed benefits and the spouse has reached age 62; however, the spouse only receives the larger of this and her own entitlement as a worker.[5] Dependent children are also each eligible for 50% of the PIA, but the total family benefit cannot exceed a maximum which is roughly 175% of the PIA. Surviving spouses receive 100% of the PIA, beginning at age 60, although there is an actuarial reduction for claiming benefits before age 65 or if the worker had an actuarial reduction. Finally, benefit payments are adjusted for increases in the Consumer Price Index (CPI) after the worker has reached age 62; thus, Social Security provides a real annuity.

Previous Related Literature

A number of studies have used aggregate information on the labor force behavior of workers at different ages, such as that documented in the introduction, to infer the role that is played by Social Security. Hurd (1990) and Ruhm (1995) emphasize the spike in the age pattern of retirement at age 62; as Hurd (1990) states, "there are no other institutional or economic reasons for the peak". Using

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lower tax rate than that for workers aged 62-65. However, the Senior Citizens' Freedom to Work Act of 2000 eliminated the earnings test for persons aged 65-69 as of January, 2000.

[5]Spousal benefits can begin earlier if there is a dependent child in the household; spousal benefits are also subject to actuarial reduction if receipt commences before the spouse's NRA.

precise quarterly data, Blau (1994) finds that almost one-quarter of the men remaining in the labor force at their 65th birthday retire within the next three months; this hazard rate is over 2.5 times as large as the rate in surrounding quarters. Lumsdaine and Wise (1994) examine this “excess” retirement at 65 and conclude that it cannot be explained by the change in the actuarial adjustment at this age, nor by the incentives embedded in private pension plans or the availability of retirement health insurance through Medicare. However, this does not rule out a role for Social Security; by setting up the "focal point" of a normal retirement age, the program may be the causal factor in explaining this spike.

The main body of this retirement incentives literature attempts to specifically model the role that potential SS benefits play in determining retirement. Broadly speaking, there are four classes of studies in this literature. The earliest work in this area, from the early 1970s through the mid-1980s, considered reduced form models of the retirement decision as a function of Social Security wealth and pension levels. Much of this literature is reviewed in Mitchell and Fields (1982); more recent cites include Diamond and Hausman (1984), and Blau (1994). While these articles differ in the estimation strategies employed, with the more recent work using richer models such as nonlinear 2SLS or hazard modeling, the results are broadly suggestive of a significant role for Social Security, but a role which is small relative to the time trends in retirement behavior documented in the introduction.

A key limitation of this first class of study is that it considers social security effects at a point in time, but not any impacts on the retirement decision arising from the time pattern of SSW accruals. This was remedied in three different ways by subsequent literatures. The first was to consider structural modeling of retirement decisions by workers facing a lifetime budget constraint; examples here include Burtless (1986), Burtless and Moffitt (1984), Gustman and Steinmeier (1985, 1986), and Rust and

Phelan (1997). The second was to continue to estimate reduced form models, but to incorporate the accrual of SSW with a year of additional work; examples here include Fields and Mitchell (1984), Hausman and Wise (1985), and Sueyoshi (1989). Both of these types of studies continued to find an important, but modest, role for Social Security, and some (e.g. Fields and Mitchell) indicated a larger role for private pensions. The final strand of this literature is the option value work of Stock and Wise noted above.

A final article that deserves particular mention here is that of Krueger and Pischke (1992). They note that the key regressor in many of the articles summarized here, SS benefits, is a non-linear function of past earnings, and retirement propensities are clearly correlated with past earnings levels. They solve this problem by using a unique "natural experiment" provided by the end of double-indexing for the "notch generation" that retired in the late 1970s and early 1980s. For this cohort, SS benefits were greatly reduced relative to what they would have expected based on the experience of the early-mid 1970s, yet the dramatic fall in labor force participation continued unabated in this era. This raises important questions about the identification of the cross-sectional literature. However, even with this natural experiment, Krueger and Pischke find significant and sizeable impacts of SS accruals on retirement, which highlights the value of the dynamic approach, and suggests that the additional non-linearities which govern the evolution of SSW (as opposed to its level) may be a fruitful source of identification for retirement models.

Each of these dynamic literatures has important limitations. The first suffers from the perhaps untenable assumptions that are required to identify these very complicated structural models.[6] The

[6]For a criticism of this type in the context of this type of estimation of general labor supply responses,

second suffers from the limited way in which dynamic retirement incentives are specified. Some of these problems are remedied by the option value literature, but this literature has not separated the impact of Social Security incentives, as distinct from pension incentives, on retirement. Stock and Wise did not attempt this decomposition, and Samwick's attempts were unsuccessful, perhaps due to the measurement error in Social Security incentives arising from a lack of earnings history data. If all dollars of retirement wealth are weighed equally by potential retirees, then pension differences provide a legitimate source of identification of retirement income effects. But if they are not, either because individuals understand their firm's pension incentives better than Social Security incentives, or because the real annuity provided by Social Security is valued differently than the nominal annuity provided by most defined benefit pensions, then it is important to separately estimate Social Security and private pension impacts.[7]

In addition, all of these studies suffer from important data deficiencies, either because the estimates are based on data from the 1970s, when the structure of the Social Security system was fairly different, or data from only a handful of firms, or data without complete information on SS incentives. Finally, all of these literatures suffer from a lack of careful attention to the sources of identification of the retirement incentive effects that they estimate. As highlighted by Krueger and Pischke (1992), SS benefits are a non-linear function of earnings, making it difficult to disentangle their impact from the separate impact of earnings on the work decision. This problem is not necessarily surmounted, and is potentially compounded, by the later literature, which uses a measure of future incentives (the "option

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see MaCurdy (1981).

[7]The latter is suggested by Diamond and Hausman (1984), who find much smaller effects of

value") that is largely determined by wage differences across individuals and only secondarily influenced by the structure of retirement incentives; we discuss this issue at more length below.

Part II: Data and Empirical Strategy

Data

Our data for this analysis comes from the Health and Retirement Study. The HRS is a survey of individuals aged 51-61 in 1992 with re-interviews every two years; the first four waves of the survey (1992, 1994, 1996, and 1998) are available at this time.[8] Spouses of respondents are also interviewed, so the total age range covered by the survey is much wider.

A key feature of the HRS is that it includes Social Security earnings histories back to 1951 for most respondents. This provides two advantages for our empirical work. First, it allows us to appropriately calculate benefit entitlements, which depend (through the dropout year provision) on the entire history of earnings.[9] Second, it allows us to construct a large sample of person-year observations by using the earnings histories to compute SS retirement incentives and labor force participation at each age. We use all person-year observations on men age 55-69 for our analysis, subject to the exclusions detailed below.

We focus on males in this analysis, to follow the previous literature; see Coile (1999) for a

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pensions on retirement than those of Social Security.

[8]The 1996 wave 3 data is available partly in final release form and partly in preliminary form; the 1998 wave 4 data are preliminary.

[9]Only earnings since 1950 are required to compute SS benefits for our sample's age range; the benefit rules specify that a shorter averaging period is used for persons born prior to 1929.

related analysis of female retirement decisions. Our sample is selected conditional on working, so that we examine the incentives for retirement conditional on being in the labor force. Work is defined in one of two ways. For those person-years before 1992, when we are using earnings histories, we define work as positive earnings in two consecutive years; if earnings are positive this year but zero the next (and if the year of zero earnings occurs at or after age 55), we consider the person to have retired this year.[10] For person-years from 1992 onwards, when we have the actual survey responses, we cannot use this earnings-based definition, since we only have earnings at two year intervals. For this era, we use information on self-reported retirement status and dates of retirement to construct retirement measures.[11]

While these are somewhat different constructs, the hazard rates in the two samples by age are almost identical, as is illustrated in Figure 1. Although the hazard rate at the oldest ages becomes noisy for the pre-1992 sample, due to small sizes, the key tendencies in the data, most notably the spikes at age 62 and 65, are present and quite similar in both halves of the sample. Thus, we combine them for precision purposes. It is important to note that we only consider individuals before their first retirement; if a person who is categorized as retired reenters the labor force, the later observations are not used.

Our sample selection criteria are documented in Table 1. There are 5,886 men who appear in

[10] One potential problem with using earnings histories to define retirement is that an individual may move from the private sector to the state and local government sector, in which case he would be classified as retired when in fact he is still working. We check for this by dropping all individuals who list their industry as public administration and find that the results are similar.

[11] If an individual simultaneously reports his labor supply status as working and retired, we treat him as working.

waves 1, 2, or 3 of the HRS.[12] We first exclude 1,533 men who are missing SS earnings history data. These data, fortunately, appear to be missing essentially randomly, as noted by Haider and Solon (1999). We then exclude 99 observations where the respondent or spouse is born prior to 1922, as these individuals are subject to different SS benefit rules. We also exclude 240 observations where the wife is missing SS earnings history data (necessary due to the family structure of benefits) and 67 observations with an ambiguous work history.[13] Next, we exclude 730 men who retired prior to age 55. The remaining 3,217 men are converted into 18,733 person-year observations by creating one observation for each year from 1980 through 1997 in which the individual is between the ages of 55 and 69 and working at the beginning of the year. Finally, we exclude 988 person-year observations that represent labor force re-entry after a previous retirement. The final sample size is 17,745 observations.

The means of our key variables are shown in Table 2. In any given year, 5.7% of our sample retires. The hazard rate of retirement by age is depicted in Figure 1. For our sample, we see a pronounced spike at age 62, an elevated hazard at age 63 as well, and then a much larger spike at age 65. The average age of our sample is 58.5, and 91% of our sample is married; the typical man in our sample is 4.3 years older than his wife. About eighty percent of the sample is white. Roughly 25% of the sample are high school dropouts, 36% have only a high school degree, 14% have some college, and

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[12]Observations which enter the sample at wave 4 will not be used in the analysis, as multiple observations on the same person are required to establish work and retirement status.

[13]Observations with missing spouse data are those for which we know that the spouse worked at least half as many years as her husband, but where we don't have her SS earnings records. Observations with an ambiguous work history are those who have zero covered earnings in the administrative data from age 54 through 1991, have positive self-reported earnings in 1991, and report that they have changed jobs between age 54 and 1991; they are excluded because it is impossible to know whether they have retired prior to 1991 and re-entered the labor force.

25% are college graduates. The average projected earnings for the next year of work are slightly above $31,000 (in 1992 dollars), and the average monthly earnings over the working life are just over $2,100. The typical spouse's earnings (averaging over single men, men with non-working wives, and men with working wives) are about $9,400 for an additional year of work and $525 per month on average over her lifetime. The typical man in our sample has 40 years of labor market experience and 17 years of tenure on their current job; 5.4% of our sample is missing tenure information (indicating a short-term job).

Incentive Variable Calculation - Accrual

Our goal is to measure the retirement incentives inherent in SS and private pension systems. The first step in this calculation uses a simulation model we have developed to compute the PIA for any individual at all possible future retirement dates. This process is based on a careful modeling of Social Security benefits rules and has been cross-checked against the Social Security Administrations's ANYPIA model for accuracy. The appropriate actuarial adjustment is applied to the PIA to obtain the monthly benefit entitlement.

The next step is to compute the expected net present discounted value of Social Security Wealth (SSW) associated with each retirement date. Our methodology for doing so is described in Appendix I. For single workers, this is simply a sum of future benefits, discounted by time preference rates and survival probabilities. For married workers it is more complicated, since we must include dependent spouse and survivor benefits and account for the joint likelihood of survival of the worker and dependent. We use a real discount rate of 3% and survival probabilities from the age and sex specific U.S. life tables from U.S. Department of Health and Human Services (1990).

We next compute the other SS incentive variables. We initially follow the literature and focus on the accrual, the change in SSW resulting from an additional year of work. There are two routes through which an additional year of work affects SSW. First, the additional year of earnings will be used in the recomputation of SS benefits. For workers who have not yet worked 35 years, this replaces a zero in the benefits computation; for workers who have worked 35 years, it may replace a previous low earnings year. So the recomputation raises SSW (or leaves it unchanged). Second, at ages 62 and beyond, the additional year of work implies a delay in claiming; this raises future benefits through the actuarial adjustment, but reduces the number of years of benefit receipt, so the net effect is uncertain. Both of these factors will affect workers differently, depending on their potential earnings next year, earnings history, mortality prospects (which will vary over time and cohort in our data), family structure, and spouse's earnings. Thus, the net effect of an additional year of work on SSW is theoretically ambiguous and will vary significantly across people.

Computing the accrual and other incentive variables requires projecting the worker's potential earnings next year (or in all future years). We considered a number of different projection methodologies, and found that the best predictive performance was from a model which simply grew real earnings from the last observation by 1% per year, so we use this assumption in our simulations.[14]

Our SS incentive variables incorporate dependent spouse and survivor benefits, since these are important components of SSW. For men with non-working wives or wives whose benefits entitlement

[14]Projected earnings always represent potential earnings for one full year. For example, in the case where an individual earns $2X in year t and $X in year t+1 because he retires halfway through the year, the year t+1 observation has projected real earnings of $2X*(1.01) and there is no t+2 observation (since the individual retires in year t+1).

is less than one-half of the husband's, these benefits are based on the husband's earnings record. For men whose wives have a larger benefit entitlement on their own, these benefits are based on her record but are also included in SSW. Since a full modeling of the joint retirement decision is beyond the scope of this paper, we simply assume that the wives in this sample who are working will retire at age 62; this seems reasonable, given that the median retirement age is 62 among married women in the HRS who are working at age 50. For more evidence on joint retirement decisions, see Coile (1999).

For the simulations below, we assume that workers claim SS benefits at retirement, or when they become eligible (age 62) if they retire before then. In fact, this is not necessarily true; retirement and claiming are two distinct events, and for certain values of mortality prospects and discount rates it is optimal to delay claiming until some time after retirement, due to the actuarial adjustment of benefits. Coile, Diamond, Gruber, and Jousten (2000) investigate this issue in some detail, and they find that a relatively small share of those retiring before age 62 delay claiming until age 62 (about 10%), and that virtually none of those retiring at age 62 or later delay claiming. Given these findings, we choose not to jointly model delayed claiming here. Our incentive measures will therefore slightly overstate any subsidies to continued work, since part of this subsidy will come from delayed claiming that could be obtained without delaying retirement.

We also incorporate private pension incentives into our analysis. The HRS collected detailed pension determination information from employers for roughly half of the people with pensions in the HRS. They then used this information to create a pension benefits calculator that is comparable to the PIA simulation model we developed for Social Security. We use these calculated pension benefits at each retirement age to create an analogous set of retirement incentive variables which include pensions.

These pension data, unfortunately, have two key weaknesses. First, they are available for only 60% of our observations with pensions, and the response patterns appear to be non-random. Among those who report having a pension, men with missing pension data work at smaller firms and have lower retirement rates, less education, lower earnings, and shorter job tenure. In the absence of information about these missing observations, for the analysis incorporating pensions we will only use those observations with non-missing pension data.[15] Second, pension data was matched at wave 1 for the current job (or last job for those not working) and for past jobs lasting at least 5 years; therefore, the data may misstate incentives if individuals change jobs after wave 1 or if the provisions of the pension plan changed.

Table 3 shows the medians of the retirement incentive variables for our sample by age. The median PDV rises from $154,000 at age 55 to a peak of $177,000 at age 65, then falls to $167,000 at age 69.[16] The age pattern of accruals demonstrates how the various effects of working an additional year enter in at different ages. From ages 55 to 61, accruals are positive but small, reflecting the value of the dropout year provision. From ages 62 to 64, accruals are two to three times larger; this is the delayed claiming effect, whereby an additional year of work increases the actuarial adjustment and raises future benefits.[17] After age 65, accruals become negative and rise rapidly, as the delayed

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[15]We are grateful to Steve Venti for the use of his self-reported pension wealth calculations, which we use to determine which observations have missing pension data.

[16]The SSW median displayed in Table 3 is the median SSW at age 55 increased or decreased each year by the median accrual. The median SSW at each age in the sample rises much more rapidly with age due to a sample selection effect (those working at later ages have higher SSW).

[17]This large subsidy to work at age 62 is at odds with the common wisdom that the actuarial reduction at age 62 is approximately fair. This point is developed much further in Coile and Gruber (2000).

retirement credit is insufficient to compensate for the value of lost benefits.

Most importantly for our analysis, there is enormous heterogeneity in accruals, as is also shown in Table 3. The standard deviation in accruals is substantial, averaging roughly $3,000 per year. At 62, for example, while there is a sizeable positive median accrual, the 10th percentile person has an accrual of only $813, and the 90th percentile person has an accrual of $6,074; the standard deviation at that age is $2,369. It is this sizeable variation that identifies our models.

Incentive Variable Calculation - Forward Looking Measures

As noted earlier, the more recent work on pension incentives and retirement has focused not on accruals, but rather on more forward-looking incentive models which incorporate the entire future path of retirement incentives. This literature highlights an important weakness of the accrual measure. For any given year from age 55-61, as we show in Table 3, a typical worker sees a small positive accrual from additional work through the recomputation of the AIME. But, by working, that worker is also buying an option on the more than fair actuarial adjustment that exists from age 62-64. Incorporating this option, dramatically changes the nature of Social Security incentives, particularly at ages before age 62. This point is emphasized in Coile and Gruber (2000), where we document the important differences in single year versus multi-year accruals. Most importantly, for a sizeable minority of workers, accrual patterns are non-monotonic, so that forward looking measures can deliver very different incentives than one year forward accruals.

As noted above, Stock and Wise (1990a) suggested an approach to account for these option values, by contrasting the utility of retiring today versus at the optimal point in the future. Their option value model is based on the individual's indirect utility function over work and leisure:

(1)

where R is the retirement date, d is the discount rate, p is the probability of being alive at some future date conditional on being alive today, y is income while working, B is retirement benefits, gamma is a parameter of risk aversion, k is a parameter to account for disutility of labor ($k>=1$), and T is maximum life length.

In this model, additional work has three effects. First, it raises total wage earnings, increasing utility. Second, it reduces the number of years over which benefits are received, lowering utility. Third, it may raise or lower the benefit amount, depending on the shape of the benefit function, B(R). The latter two effects are weighted more heavily because of the disutility of labor, which acts as a devaluation of wage income relative to retirement income. The optimal date of retirement is therefore the date where the utility gained from the increase in earnings resulting from additional work is outweighed by the utility lost from the decrease in retirement income. The "option value" is the difference between the indirect utility from retirement at the optimal date, R^*, and the indirect utility from retirement today.

This approach to modeling retirement incentives has the important advantage, particularly when considering private pensions, of allowing the individual to be forward looking, and consider incentives beyond the coming year. While theoretically attractive, however, implementation of the option value model runs into an important difficulty in a retirement regression context: the vast majority of the variation in the option value derives from the variation in wages. Indeed, in our HRS sample, a set of age dummies plus a quartic in earnings alone explains 74% of the variation in option value. This potentially poses problems for the option value measure if the goal of the empirical exercise is to measure the impact of SS policy changes on retirement behavior. If, for example, wages are correlated in some way with underlying tastes for retirement (e.g. high wage individuals are those motivated individuals with tastes for continued work, even conditional on wage), then variation in wages does not provide a legitimate source of identification for learning about retirement income effects.

In principle, this problem can be surmounted by structural estimation of the option value model, which will identify the difference in the impacts of wages and retirement income on retirement decisions, through the value of leisure parameter. But, in practice, this is only true if the particular utility structure is correct, for example if the additional leisure of utility enters the model only as a multiplier on post-retirement income and not in some other way.

We take two approaches to addressing this potential shortcoming with the option value model. One is to include controls for earnings directly in the model, in order to capture the heterogeneity which may bias these estimates. This is only an indirect approach, however, since wages enter highly non-linearly in the option value model, and the form of heterogeneity is unknown, so that even rich wage controls may not fully capture the underlying correspondence between option value and tastes for work.

The second is to construct a measure which incorporates the insights of the option value measure, but focuses solely on variation in Social Security incentives. We do so by creating a forward looking measure of incentives which we call “peak value”. This is comparable to the accrual, but looks forward more than just one year: it calculates the difference between SSW at its *maximum expected value* and SSW at today’s value, to measure the incentive to continued work. In this way, the peak value appropriately considers the tradeoff between retiring today and working to a period with much higher SSW, thereby capturing the option value of continued work even before Social Security entitlement ages are reached. If the individual is at an age that is beyond the SSW optimum, then the peak value is the difference between retirement this year and next year, which is exactly the accrual rate. Since wage is not included specifically into the peak value calculation, there is much more variation from the structure of the Social Security entitlement; an earnings quartic and age dummies explain only 33% of the variation in peak value.

Table 4 shows the age pattern and heterogeneity for peak and option value. For option value, we follow Stock and Wise in assuming values of 1.5 and 0.75 for k and g, respectively. But we found that the fit of our model was much better with a more reasonable assumption for d of 0.03, relative to the very large estimate of 0.25 obtained from their model.

The important differences between peak value and accrual, particularly at younger ages, are immediately apparent; peak values are quite large from age 55-61, a range where accruals are small.[18] The peak value declines sharply with age, as people move closer to or reach their optimal retirement date; the declines occur at a fairly constant rate up until about age 63, then become very large. The peak value is positive for the median person until they reach age 65, and then becomes negative. As with the accrual, there is an enormous amount of heterogeneity in all of these measures which can be used to identify our models. Part of this variance arises from heterogeneity in the peak year. For 38% of our sample, age 65 is the peak; for 11%, it is age 70, and there are substantial masses at ages 66,

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[18]Note that we take the median of each variable, so that all the numbers in any given row do not necessarily represent the incentives facing a single person. This explains a seeming inconsistency between Tables 3 and 4, which is that the accruals from age 55 through age 64 add up to more than the peak value at age 55, despite the fact that age 65 is often the peak for SSW. As we show in Coile and Gruber (2000), this is a fallacy of composition, and for any given individual the peak value is just the sum of accruals to the peak SSW age.

67, 68, and 69. Partly, this reflects the evolving generosity of the delayed retirement credit over time; the peak occurs after age 65 for 28% of the workers in the oldest cohorts in our sample vs. 73% of the workers in the youngest cohorts.

Although option value is measured in utility units and cannot be directly compared to peak value, option value follows the same declining pattern as peak value. The median option value falls monotonically with age, but remains positive even beyond age 65, as additional earnings offset losses in SSW. There is also substantial heterogeneity in the option value measure.

Regression Framework

In a standard retirement model, Social Security will play two roles in the decision whether to retire this year or to continue working. The first is through wealth effects: higher social security wealth (SSW) will induce individuals to consume more of all goods, including leisure, and to retire earlier. The second is through accrual effects: the individual's decision to continue to work is a function of the increase in retirement consumption resulting from an additional year of work, relative to the value of an additional year of leisure.

Following this discussion, we use the incentive variables described above to run regressions of the form:

$$R_{it} = b_0 + b_1 SSW_{it} + b_2 INCENT_{it} + b_3 X_{it} + b_4 AGE_{it} + b_5 EARN_{it} + b_6 AIME_{it} + b_7 MAR_{it} + b_8 AGEDIFF_i + b_9 SPEARN_{it} + b_{10} SPAIME_{it} + b_{11} Y_t + e \tag{2}$$

where SSW is the expected PDV of SS benefits that is available to the person if he retires that year (t); INCENT is one of the incentive measures noted above (accrual, option value, peak value);X is a vector of control variables that may importantly influence the retirement decision but do not enter directly into the calculation of SSW (education, race, veteran status, born in the U.S., region of residence, experience in the labor market and its square[19], tenure at the firm and its square, 13 major industry dummies, 17 major occupation dummies); AGE is a set of dummies for each age 55-69; EARN is a control for potential earnings in the next year; AIME is a control for average monthly lifetime earnings as of period t;[20] MAR is a dummy for marital status; AGEDIFF controls for the age difference with the spouse; SPEARN and SPAIME are the spouse's next year and average lifetime earnings; and Y is a series of year dummies. Since our dependent variable is dichotomous, we estimate the model as a probit. We have also estimated these models as Cox proportional hazard models and the results were very similar; this is not surprising, given that the models all include a full set of age dummies, which pick up the same factors captured by the baseline in the hazard model.

This model parallels the types of models used in the first round of research on Social Security and retirement, with one important exception: the earnings controls. Most articles in this literature did not control for earnings, and no articles controlled for both earnings around retirement and average lifetime earnings. Yet both of these variables are clearly important determinants of both SS incentives and retirement decisions, so excluding them from the model imparts a potential omitted variables bias. Moreover, there is no reason to suspect that heterogeneity is a purely linear function of earnings. Thus, for each of the earnings controls above, we include squared, cubed, and quartic terms as well. Moreover, it is possible that heterogeneity in retirement is also related to the relationship between

[19]Experience is defined as age minus years of education minus six, since the HRS self-reported earnings histories may have gaps and administrative data do not include employment in non-covered sectors.

[20]Note that AIME is time varying because additional years of work change average lifetime earnings

current and average lifetime earnings; we therefore include as well a full set of interactions between the EARN and AIME quartics to reflect this.

Finally, it is important to highlight that our work is focused on the impact of SS on the labor force participation decision. A separate and interesting issue is the impact of SS on the marginal labor supply decision among those participating in the labor force. This is more complicated for those around retirement age, since it involves incorporating the role of the earnings test, which we avoid with our analysis of participation. This, in turn, would involve modeling expectations about the earnings test, since individuals appear not to understand that this is just a benefits delay instead of a benefits cut. This is clearly a fruitful avenue for further research.

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through the dropout years provision.

Part III: Results

Social Security Incentives and Retirement

Table 5 shows the results of estimating equation (2), for each of our three incentive measures. Peak value, accrual, and Social Security Wealth are expressed in $100,000; option value is expressed in units of 10,000. The magnitudes of these coefficients are illustrated by the term in square brackets, which gives the implied percentage point impact of a $1,000 increase in the accrual/peak value and a $10,000 increase in SSW. There is no natural means of expressing a comparable magnitude for the option value; the relative impacts of this metric will be shown in the simulation exercise below.

For the accrual model, we estimate a positive and marginally significant impact of Social Security wealth levels, as expected. The coefficient implies that each $10,000 increase in SSW increases the probability of retirement by 0.2%, or about 3.5% of the sample average retirement rate; evaluated at the mean, this corresponds to an elasticity of non-participation with respect to benefits of 0.60. But the coefficient on the accrual is wrong-signed (positive), and highly insignificant. This suggests that there is little impact of one-year forward incentives on retirement decisions. This could reflect the fact that individuals are not at all forward looking in their decisions. Alternatively, given non-linearities in future accruals, it could represent the fact that individuals are not considering solely the accrual to the next year but the entire future path of incentives.

This possibility is addressed in the next two columns, which show the estimates from the peak value and option value models. For both models, we estimate a more modest impact of SSW, and neither is significant. But, in both cases, we now estimate significant negative impacts of the forward looking incentive measures for retirement decisions. We find that each $1,000 in peak value lowers the odds of retirement by 0.5 percentage points, or about 1% of the sample average retirement rate; this corresponds to an elasticity of non-participation with respect to benefits of 0.15. For option value, it is not possible to calculate the impact of a simple $1,000 increment, since this is a utility based metric. We will return to comparisons of these two models in the simulation section below.

These findings suggest that the forward-looking models of the type advocated by Stock and Wise are very important for explaining retirement behavior. Individuals do appear to recognize the future path of SSW accumulation, and take this into account in making their retirement decisions.

The other variables in the regression, shown in Appendix Table 1, have their expected impacts. There is a rising pattern of retirement propensities with age, with particularly large effects at ages 62, 63, 65, and 69. Being married and having a larger age difference with one's wife decrease the probability of retirement, though only the former is significant. More experience lowers the odds of retirement, conditional on age, but this relationship is decreasing in absolute value. There is no distinct relationship with tenure, although there is a very significant positive impact of being in the 6% of the sample with missing tenure data; this is consistent with lower labor force attachment among those in jobs of short duration. The industry and occupation dummies, not shown, do not show a particularly strong pattern, with the exception of higher retirement rates in the armed forces and the cleaning and building services occupation. There is no significant time pattern to retirement behavior, which is consistent with Quinn (1999), who shows that the strong time series trend towards earlier retirement was arrested beginning in the mid-1980s. There is no strong regional pattern, other than a significantly higher retirement rate in the western pacific region and a lower rate in New England.

Incorporating Pensions

A key focus of much of the recent retirement literature has been on pension incentives as well as SS incentives. Pensions are important for this type of retirement modeling for two reasons. First, the underlying structure of pensions is such that they introduce important dynamic retirement incentives through features such as vesting, retirement "windows", and strong early and normal retirement bonuses. Second, they provide a substantial increase in the underlying variation of retirement income, through both the fact that only a share of individuals have pensions, and the fact the pension incentives differ by firm among those who have them.

Fortunately, the HRS provides rich pension detail for a large share of the sample, allowing us to incorporate pensions into our estimation. As noted above, however, these pension data have important limitations, through non-random non-response and their point-in-time nature. We estimate our retirement models only for the subsample that has pension incentive information computed by the HRS. For comparison, we show the estimates from our SS-only models for this subsample as well.

The results of incorporating pensions for peak and option value are shown in Table 6. In the first 3 columns of the table, where we change the sample but continue to use SS incentives only, we find that the estimates of our earlier models are fairly similar in terms of the dynamic incentive variables (peak and option value), but very different in terms of SSW, which now has a coefficient roughly twice as large as in Table 5. When we incorporate pensions, in the second set of columns, there are two notable effects on the estimates. First, the coefficient on SSW is now highly significant but much smaller than in the previous models, indicating that each $10,000 in SSW raises retirement probabilities by about 0.04 percentage points, or about 0.7% of baseline retirement rates. Second, the coefficient on peak value is now only about half as large, indicating that another $1000 in peak value will lower retirement rates by

0.025 percentage points, or about 0.5% of baseline retirement rates. The coefficient on option value is slightly larger than that excluding pensions; it is not surprising that the option value coefficient changes less, since, as we discussed above, most of the variation in option value comes from wages, not from retirement incentives.

Our findings for peak value suggests that individuals are less responsive to changes in pension incentives than to change in SS incentives, which is consistent with the findings of Diamond and Hausman (1984). On the other hand, these coefficients are much more precisely estimated, and they are certainly not significantly different than what was shown in Table 5. As a result, it is difficult to conclude with certainty whether the estimates with and without pensions are to be preferred for policy simulations; we therefore present simulations below using both sets of estimates.[21]

Other Control Variables

The HRS includes information on a number of other factors that may affect retirement decisions, and in particular health, health insurance coverage, and wealth holdings. We have excluded these variables from the analysis thus far since they are only measured for the 1992-1997 part of our sample. Excluding these measures, however, may bias our estimates, if they are correlated ith both SS

[21] An interesting issue regarding pensions is possible differences in responses to incentives from defined benefit (DB) and defined contribution (DC) pensions. Retirement wealth from DC pensions will usually continue to rise with age, while DB pensions often have strong incentives to work to a particular age and disincentives to work beyond this age. Moreover, increments to retirement wealth in DC plans often depend on individuals' discretionary contributions, while increments to DB wealth are determined by the pension plan formula (in our calculations, we assume that future discretionary contributions will be made at the same level as in the past). In regressions not shown, we explore this issue by interacting a dummy for type of plan with the incentive variables. We find very similar PV and OV coefficients for both types of plans, though men with DB pensions are more responsive to the PDV of retirement wealth.

incentives and retirement decisions. In this section we demonstrate the impact of including these controls, both on our estimates of interest, and on retirement in general.

All three of the factors noted above have been shown in other contexts to be key determinants of retirement; see Currie and Madrian (1999), Gruber (1999), and Lumsdaine and Mitchell (1999) for reviews. We measure health status by a dummy variable for self-reported fair or poor health. We also include in our regression dummies for whether the individual has insurance on the job but not when retired, insurance on the job and when retired, or no insurance in either context. We expect that there will be a lower odds of retiring for the middle group, who may be "locked" into their jobs by lack of retiree insurance, at least until Medicare becomes available at age 65. Finally, we include dummies for being in the second, third, or fourth quartiles of the wealth distribution, relative to being in the bottom quartile.

Each of these measures has difficulties of interpretation. Self-reported health may be endogenous to retirement decisions, for example as workers justify retirement by reporting poor health. Health insurance offerings may be endogenous to tastes for retirement as well, as workers who desire to retire early work for firms that offer retiree insurance. And wealth is clearly jointly determined with the retirement decisions. Our primary purpose for including these measures, however, is not to interpret them directly, but to ensure that their omission is not significantly biasing our retirement incentive estimates.

The first and second columns of Table 7 show our estimates from the basic peak and option value models estimated just over the subsample of data for which these control variables are available.[22]

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[22]Besides restricting ourselves to the 1992 and forward observations, this sample also includes

In fact, we find that our results are somewhat different over this subsample, with a larger PV coefficient and smaller SSW coefficients in both specifications. But none of these coefficients is significantly different from what we showed as our basic results in Table 5.

The third and fourth columns show the effect of including these control variables. Most importantly for the discussion thus far, we find essentially no effect of these controls on our regressors of interest. Thus, our results do not appear to be biased by the exclusion of these control variables over the full sample period.

Second, the signs on the control variables are exactly what one would predict based on theory and previous evidence. Workers in fair or poor health are significantly more likely to retire than workers in good or excellent health; in fact, their retirement rate is 2.3 percentage points higher, a figure which corresponds to 40% of the average sample retirement rate. Relative to workers with no health insurance coverage, workers with both on-the-job and retiree health insurance are about equally likely to retire; however, workers with on-the-job coverage but without retiree coverage are significantly less likely to retire, with a retirement rate 1.2 percentage points lower than the comparison group. Finally, workers with higher net worth are more likely to retire; relative to workers in the lowest net worth quartile, workers in the third and top quartile have a retirement rate that is about 2 percentage points higher.

Part IV: Policy Simulations

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some observations that would be considered labor force re-entry if 1980-1991 retirement definition was applied.

The implications of the wide variety of estimates that we have presented thus far are difficult to interpret in a vacuum; are $1,000 changes in peak value large or small? To provide some more context for the magnitudes of our results, in this section we present the results of two policy simulations designed to currently scheduled changes to the Social Security system: raising the Normal Retirement Age to age 67, and raising the Delayed Retirement Credit to 8%.

The detailed results of our simulations are shown in Tables 8 and 9; table 8 focuses on the models with Social Security incentives alone, and Table 9 incorporates pension incentives as well. We show simulations based on each of our two forward looking incentive measures. For each simulation, we show at each age the baseline hazard and the post-policy change hazard, and the baseline percentage working and the post-policy percentage working. As noted above, there are arguments for preferring the estimates either with or without incorporating pension incentives; we therefore discuss both sets of estimates together.

Raising the NRA

We first consider raising the normal retirement age to 67 for this sample, as opposed to having it rise gradually over the next 25 years. In doing this simulation, we account only for the financial implications of this change, and not for any “norms” effect which might move the spike at age 65 to the right as the Normal Retirement Age changes. At all ages, this change will have a negative wealth effect on retirement, since this amounts to a benefit cut for any retirement age, which will encourage work. The accrual effects are more complicated: For ages 62-63, this change will decrease work incentives, as the actuarial adjustment is falling; for age 64, there will be no change in incentives; and for ages 65-66, there will be an increase in work incentives, as the less fair DRC is replaced by the 6.67% per year actuarial adjustment.

Figures 2 and 3 show the results of this simulation, using peak value. Figure 2 shows the baseline and post-policy hazard rates, both with and without pensions included in the incentive measure.[23] Without pensions included, there is a modest reduction in the retirement hazard rate at all ages that peaks at age 65 with a 2.4 percentage point (or roughly 11%) decline in the hazard. But, with pensions included, there is essentially no effect; at age 65 the decline in the hazard is less than 1 percentage point. This is also reflected in the labor force participation rate graph in the Figure 3. The labor force participation rate is higher after the NRA is raised in the model without pensions, with a differential of about 2 percentage points (or roughly 5%) by age 65. But, when pensions are included, the effect of raising the NRA on labor force participation rates is only about 1 percentage point. Our results using option value are quite similar for the model with pensions, and are somewhat more modest for the model without pensions.

Our primary conclusion is therefore that, due to offsetting wealth and accrual effects, there are at best modest effects of this change on labor supply, and potentially quite a small effect. Once again, we may be understating the impact of this particular change due to "norm" effects of moving the NRA. But the financial incentives of this change alone would seem to produce little net impact on labor supply for older men.

Raising the Delayed Retirement Credit

[23]The baselines with and without pensions are very slightly different; in order to avoid putting four lines in the graph, we have simply averaged the two baselines to yield the baseline hazard shown. We do the same with the other figures here.

We next consider raising the delayed retirement credit to 8% for our entire sample, as opposed to the slow phase in that will take place over the next decade. This should encourage additional work after age 65 through an accrual effect, but will reduce work among those already working past age 65 through an income effect. The average DRC in our sample is roughly 5%, so these simulations provide a good approximation to the impact of raising the DRC immediately from its value today to 8%.

Figures 4 and 5 show the impact of this change, once again for the peak value model with and without pensions, for hazard rates and labor force participation rates. Interestingly, before age 65, we estimate even stronger impacts of this policy change than of changing the NRA on retirement decisions, since there are now only accrual effects without offsetting income effects. In particular, by age 65, we estimate from the model without pensions an increase in labor force participation of four percentage points, or almost 10%. The impact is then substantially weakened after age 65, as the offsetting wealth effects are introduced, and the hazard rates in particular are essentially unchanged by this reform after age 65. Once again, with pensions, these effects are muted, but remain stronger than changing the NRA.

The key conclusion from this second simulation is that changing the DRC can have important effects that may even be (absent norm effects) as large as those of changing the NRA. This is because, unlike the NRA change, which has offsetting accrual and wealth effects, the DRC change only has positive incentives for work until age 65 at least.

Part V: Conclusion

The Social Security program is the most important source of retirement income support for older Americans. As such, it is possible that the incentives embodied in this system for continued work or retirement at various ages are a critical determinant of retirement decisions. Understanding the influence that Social Security has on retirement decisions is particularly important now, as any of the proposed reforms to the Social Security system will change the structure of the program in a manner which has important impacts on retirement incentives.

Our paper has used the richest available current data, the Health and Retirement Study, to provide new evidence on the impact of Social Security on retirement. We find that retirement decisions appear to be made with reference to the entire stream of future SS wealth accruals, rather than just the level or wealth or the accrual over the next year, so that forward-looking measures such as our peak value measure are important variables to include in retirement models. These forward looking measures have a significant impact on retirement decisions; these impacts are largest for incentive measures that are identified solely from retirement income effects, and not from wage effects, and from Social Security incentives only, and not pension incentives as well. Finally, the types of policy proposals currently contemplated will likely have modest impacts on retirement decisions, due in most cases to offsetting wealth and accrual effects, though actual effects could be much larger if there are important "norm" effects associated with program parameters such as the NRA and DRC. Most interestingly, our findings suggest that policies that minimize the wealth offset to dynamic incentive change, such as raising the benefits for working at older ages, can have large impacts on the work decisions of older persons.

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Appendix

In this appendix, we provide the formula for the computation of SS wealth.

Notation:

t = year of observation
R = year of retirement
T = last year either spouse could be alive (max age is 120)
$pr_{h,s|t}$ = probability husband is alive at time s conditional on being alive at time t
$pr_{w,s|t}$ = probability wife is alive at time s conditional on being alive at time t
d = real discount rate (.03 in base case)
$age62_{h,s}$ = indicator variable equal to 1 if husband is age 62 or over at time s
$age62_{w,s}$ = indicator variable equal to 1 if wife is age 62 or over at time s
$age60_{h,s}$ = indicator variable equal to 1 if husband is age 60 or over at time s
$age60_{w,s}$ = indicator variable equal to 1 if wife is age 60 or over at time s
$rwb_{h,s}$ = retired worker benefit of husband if husband retires at time s
$rwb_{w,62}$ = retired worker benefit of wife if wife retires at age 62
$dsb_{h,62}$ = dependent spouse benefit of husband if wife retires at age 62
$dsb_{w,s}$ = dependent spouse benefit of wife if husband retires at time s
$svb_{h,s}$ = survivor benefit of husband if wife dies at time s
$svb_{w,s}$ = survivor benefit of wife if husband dies at time s
s, k = simple counting variables

Notes:

1. An important assumption built into the calculation is that the spouse retires at age 62.

2. The benefit variables (rwb, dsb, and svb) are adjusted appropriately for actuarial adjustment or delayed retirement credit. The adjustment depends on R, the birth year of each spouse (since SS rules differ by birth cohort), and age difference between the spouses. It is assumed that individuals do not claim survivor's benefits before age 62 (in fact, they are eligible at age 60, or earlier if there are dependent children).

3. Claiming is assumed to occur at first eligibility (the age of retirement or age 62, whichever is later). Thus, the earnings test is not built into the calculations.

4. The formula above is a simplification of the actual calculations in the following way. The formula above suggests that while both spouses are alive, each receives the greater of his/her retired worker benefits and dependent spouse benefits. In fact, a wife first receives her retired worker benefits, then an additional monthly benefit of $.5*PIA_H-PIA_W$ if the husband's PIA is more than twice as large as the wife's PIA (and the husband gets an additional benefit if the wife's PIA is at least twice as large as his PIA). These two calculations may be slightly different due to different actuarial adjustments on retired worker and dependent spouse benefits.

5. The calculations including pensions are analogous, except that pension receipt commences as soon as the individual retires (not at age 62).

Figure 1: Retirement Hazard by Age

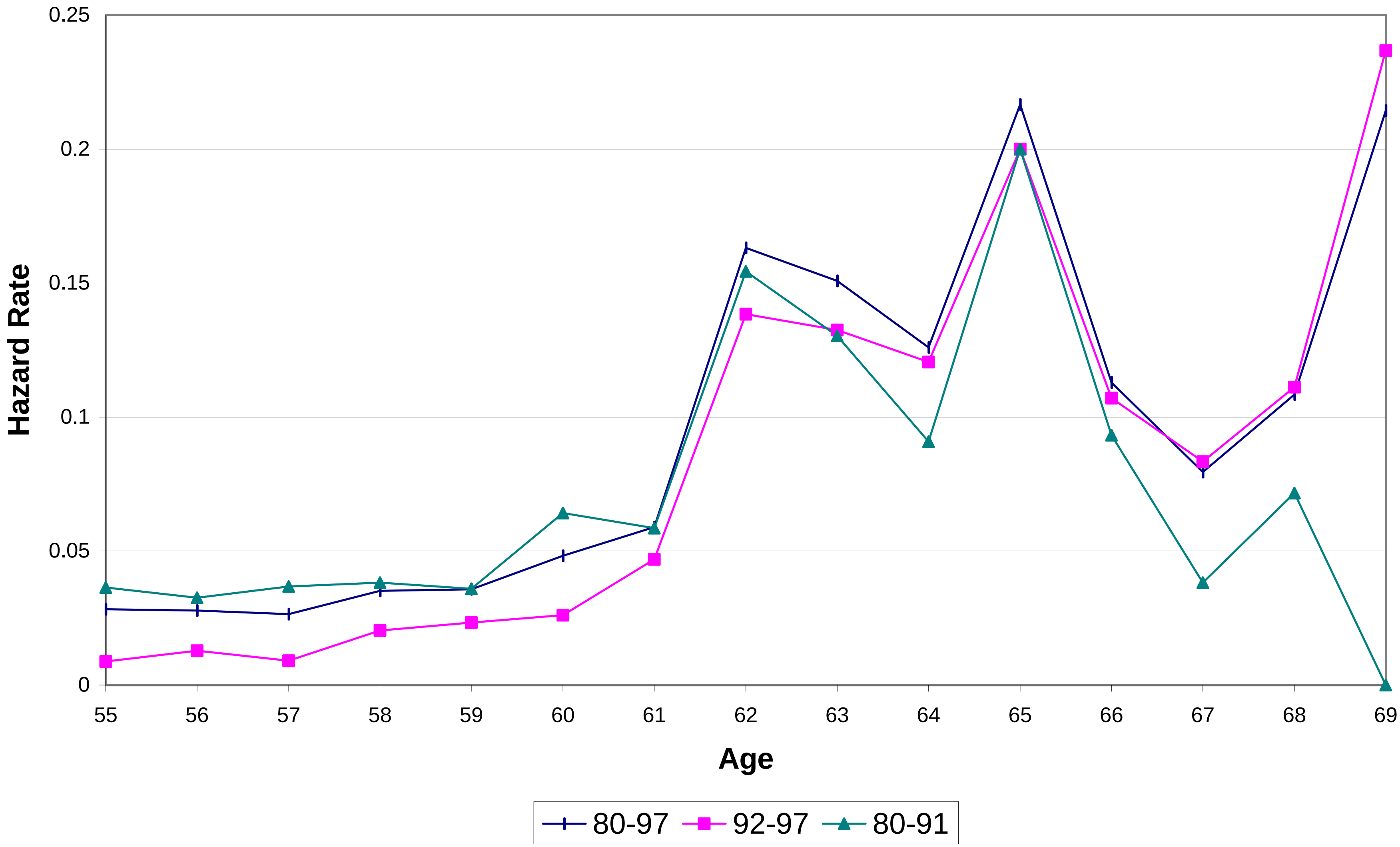

Figure 2: Raise NRA to 67, Hazard Rates

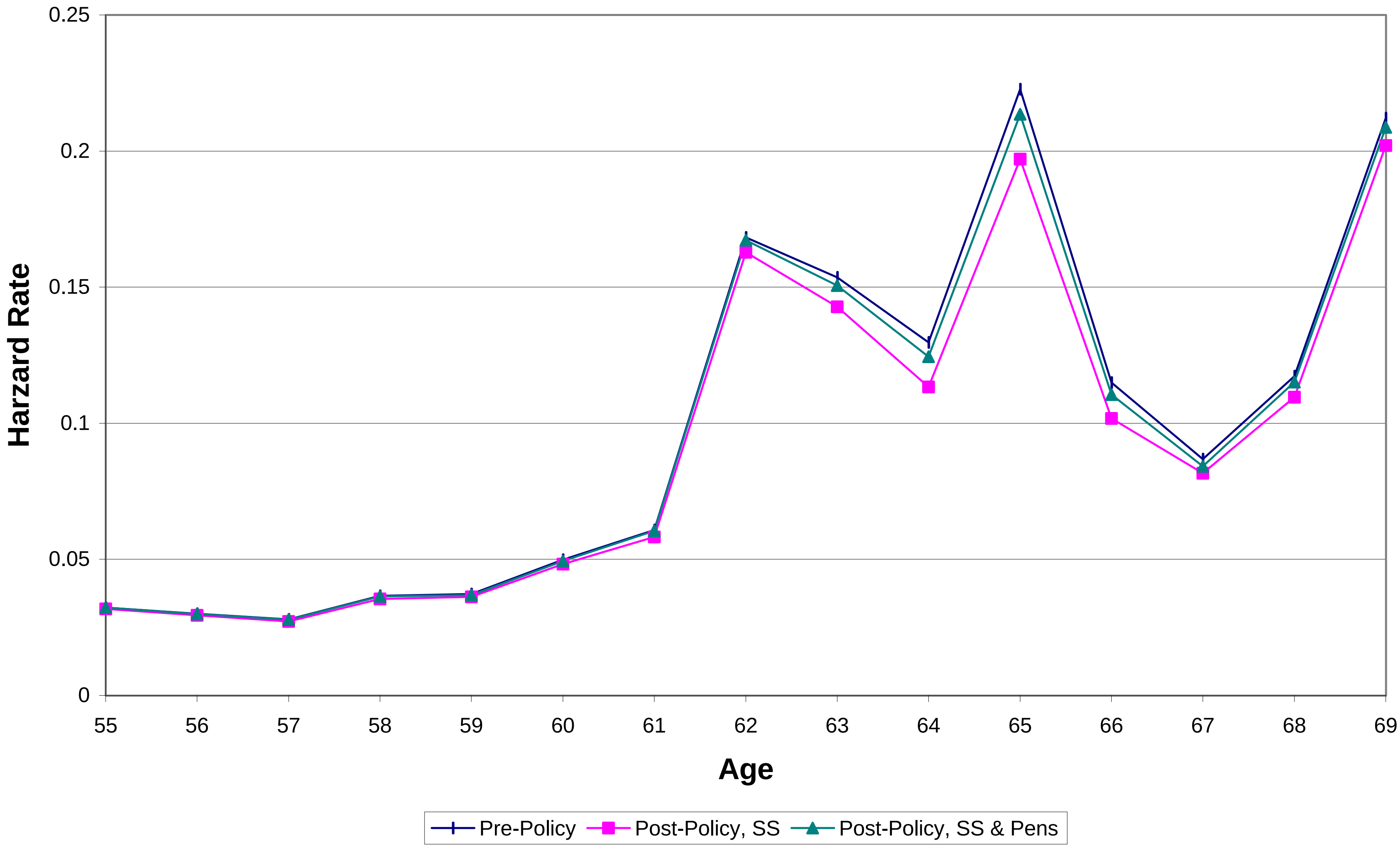

Figure 3: Raise NRA to 67, % Working

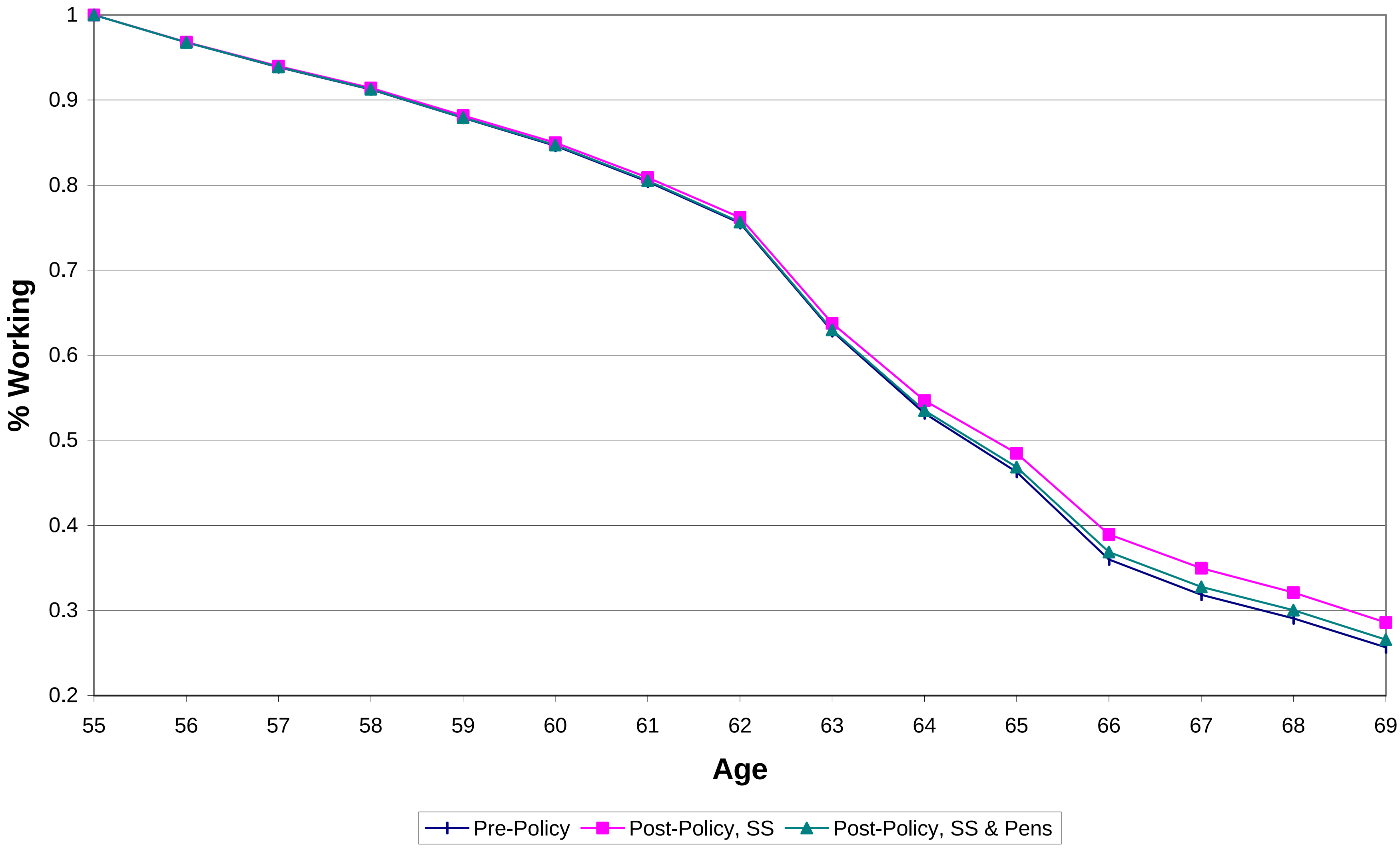

Figure 4: Raise DRC to 8%, Hazard Rates

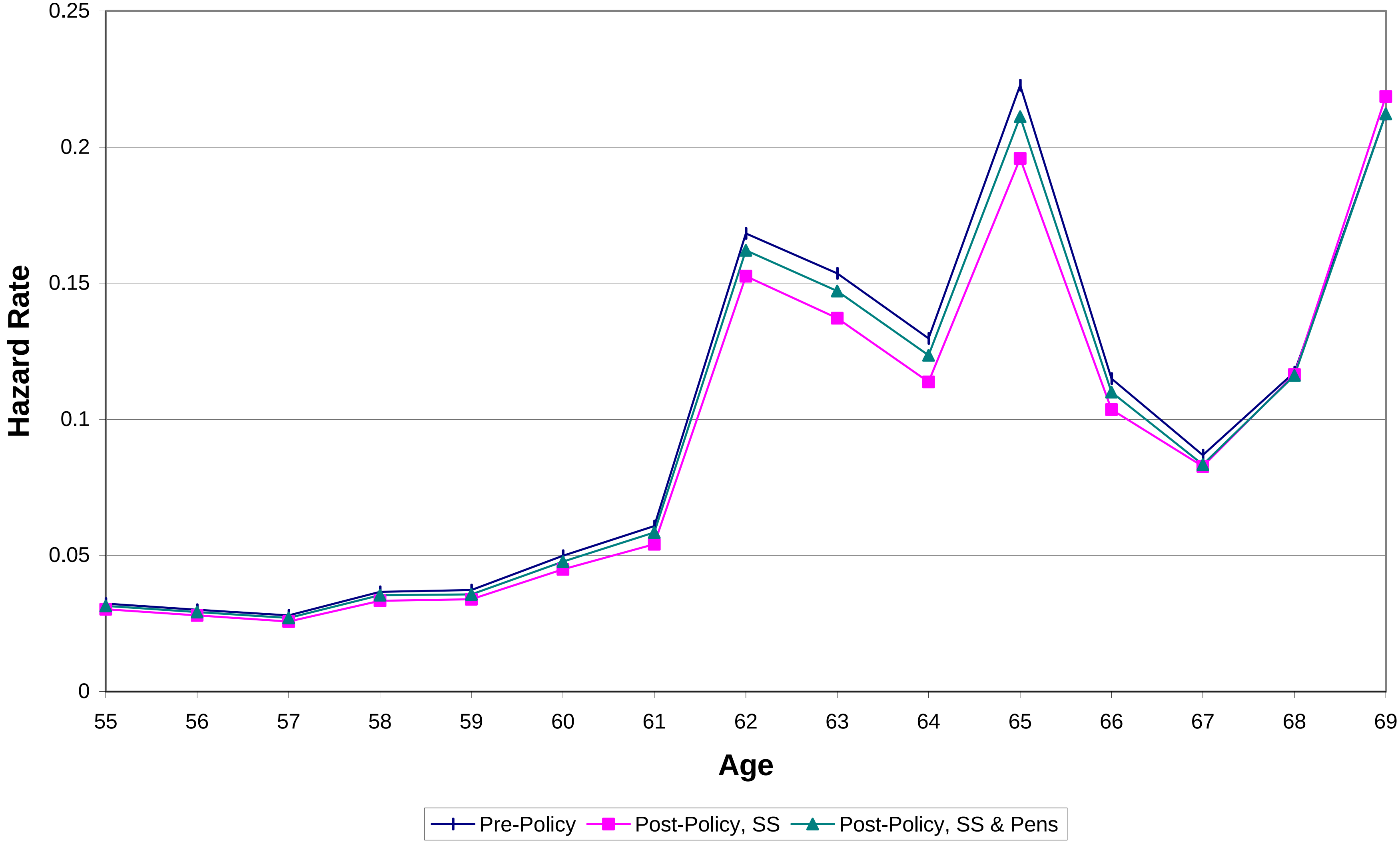

Figure 5: Raise DRC to 8%, % Working

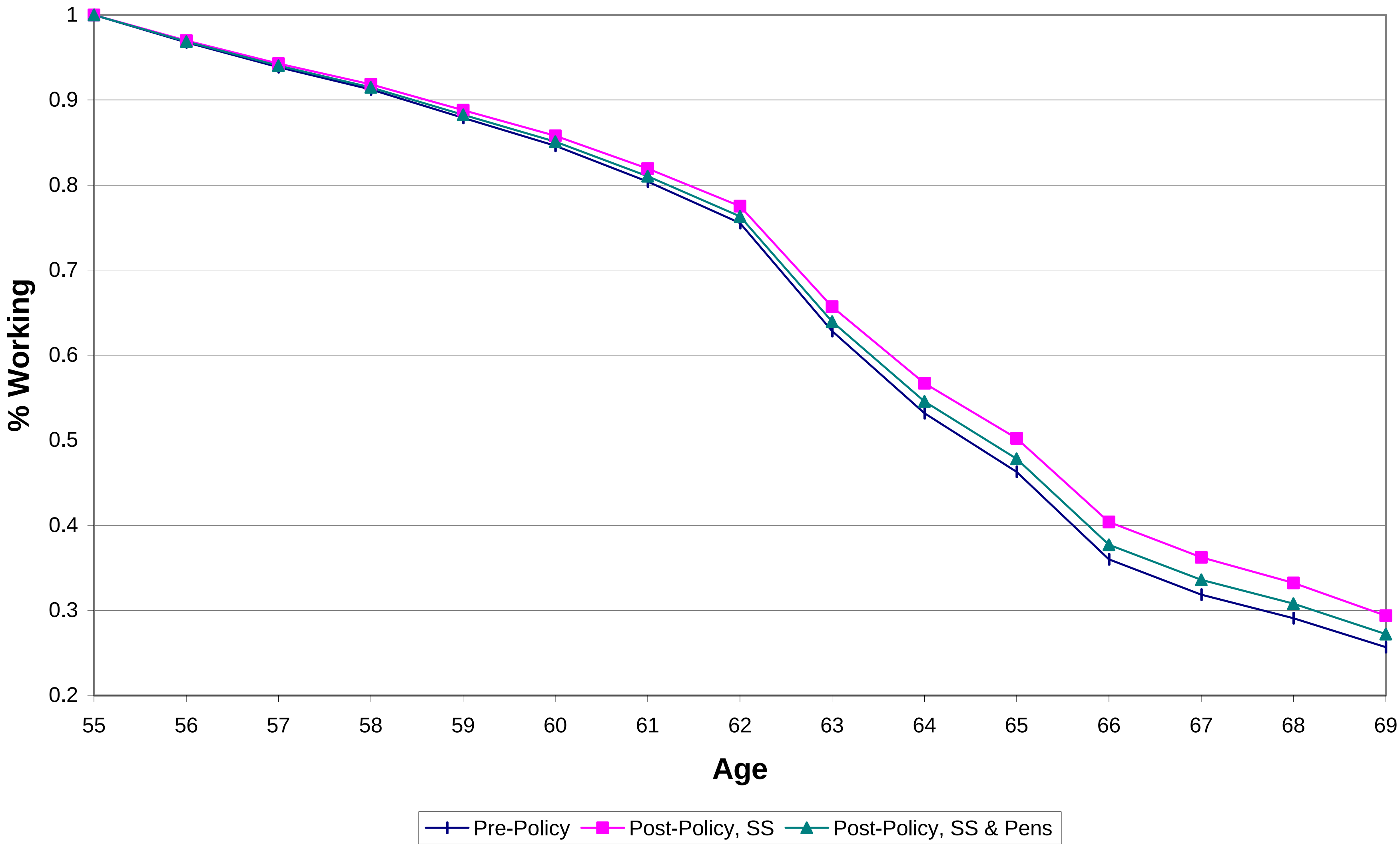

Table 1:
Sample for Analysis

Category	**Obs Lost**		**Number of Obs**	
	Person-Year Obs	**Obs**	**Person-Year Obs**	**Obs**
Men Age 55-69, 1980-1997	--	--	45,959	5,886
Drop if missing earnings history	11,837	1,533	34,122	4,353
Drop if resp/spouse born pre-1922	806	99	33,316	4,254
Drop if missing spouse earn. hist.	1,828	240	31,488	4,014
Drop if ambiguous work history (2)	667	67	30,821	3,947
Drop if not working	12,088	730	18,733	3,217
Drop later obs if re-enter labor force	988	0	**17,745**	3,217

Notes:
(1) First set of columns shows the number of person-year and person observations lost due to various sample restrictions. Second set of columns shows remaining number of person-year and person observations.
(2) Ambiguous work history refers to individual with zero SS earnings from age 54 through 1991, positive self-reported earnings in 1991, and a job change between age 54 and 1991. These observations are dropped because it is not possible to tell whether they retired prior to 1991.

Table 2:
Summary Statistics

Variable	Mean	Standard Deviation
Retired	0.057	0.232
Age	58.5	3.0
Married	0.914	0.281
Age Difference	4.3	4.9
Black	0.101	0.301
Other Nonwhite	0.081	0.273
Educ: <12 yrs	0.241	0.428
Educ: 12 yrs	0.363	0.481
Educ: 13-15 yrs	0.136	0.343
Earnings	31,068	16,751
AIME	2,125	813
Spouse's earnings	9,358	12,453
Spouse's AIME	526	563
Experience	40.2	4.5
Job tenure	17.2	12.5
Missing job tenure	0.054	0.227
Veteran	0.630	0.483
Born in US	0.917	0.276
Number of Obs	17,745	

Note:
(1) Authors' calculations from waves 1-4 of the HRS data, as described in the text.

Table 3:
SS Incentives by Age

Age	Obs	SSW Median	Accrual Median	Accrual 10th %	Accrual 90th %	Accrual Std. Dev.
55	2,809	154,493	2,193	143	4,751	2,103
56	2,747	156,686	2,036	114	4,374	3,410
57	2,444	158,722	1,837	45	3,942	2,916
58	2,143	160,559	1,679	0	3,694	2,172
59	1,823	162,238	1,549	0	3,622	2,667
60	1,546	163,787	1,419	0	3,667	1,803
61	1,255	165,206	1,439	0	3,592	4,289
62	1,021	166,645	3,755	813	6,074	2,369
63	716	170,400	3,832	268	6,474	3,125
64	483	174,232	2,726	0	5,418	2,288
65	344	176,958	-941	-4,094	1,687	3,991
66	191	176,017	-2,013	-5,256	455	2,593
67	110	174,004	-2,769	-5,886	0	7,404
68	71	171,235	-3,571	-6,340	0	2,464
69	42	167,664	-3,830	-6,666	0	2,461

Notes:
(1) Social Security Wealth (SSW) is the stream of future Social Security benefits to which the respondent and his spouse are entitled, based on his working to the beginning of age X and assuming a 3% real discount rate and age- and sex-specific survival probabilities. See text for more detail.
(2) Accrual at age X is the change in SSW that results if the respondent postpones retirement to age X+1.
(3) Median SSW is age 55 median SSW increased or decreased each year by the median accrual. The actual median SSW in the sample rises more rapidly with age due to a sample selection effect.

Table 4:
Forward-Looking SS Incentives by Age

Age	Peak Value				Option Value			
	Median	**10th %**	**90th %**	**Std Dev**	**Median**	**10th %**	**90th %**	**Std Dev**
55	21,260	4,097	39,259	15,232	24,703	4,444	39,393	12,332
56	19,225	3,766	37,302	14,918	22,902	4,304	37,284	11,643
57	16,736	3,549	34,670	13,322	20,840	3,312	34,426	10,838
58	15,079	3,233	32,160	12,817	18,933	2,842	32,115	10,181
59	13,714	2,733	28,900	12,285	17,351	2,432	29,648	9,491
60	12,381	2,041	26,511	11,521	15,600	1,660	27,119	8,781
61	11,193	1,571	23,204	11,088	13,832	1,554	24,485	7,976
62	10,268	1,346	20,253	9,489	11,985	1,151	21,677	7,102
63	6,999	590	14,702	8,852	10,446	902	19,027	6,347
64	3,080	0	9,065	7,037	8,568	386	16,143	5,457
65	-893	-4,051	5,218	8,045	6,423	0	13,223	4,634
66	-1,939	-5,256	774	6,844	4,404	0	10,397	3,818
67	-2,769	-5,886	0	8,533	2,814	0	8,106	3,240
68	-3,571	-6,340	0	2,743	1,893	0	5,308	2,040
69	-3,830	-6,666	0	2,461	1,128	0	2,657	995

Notes:
(1) Peak Value (PV) is the change in SSW that results from working to the age at which SSW is maximized; if the peak age has passed, PV is simply the accrual.
(2) Option Value (OV) is the change in utility that results from working to the optimal retirement age (determined by maximizing lifetime utility over consumption and leisure). OV is measured in utility units. See equation (1) in the text for the exact parameterization of utility function.

Table 5:
Retirement Probits with SS Incentives

Variable	**Specification**		
	(1)	**(2)**	**(3)**
Accrual	0.438		
Std. Error	(0.515)		
$1K Increase	[0.00037]		
Peak Value		-0.630	
Std. Error		(0.251)	
$1K Increase		[-0.00052]	
Option Value			-0.171
Std. Error			(0.044)
SSW	0.249	0.197	0.140
Std. Error	(0.136)	(0.137)	(0.137)
$10K Increase	[0.00207]	[0.00163]	[0.00116]
Number of Obs	17,745	17,745	17,745

Notes:
(1) ACC, PV, and SSW are in $100,000, OV is /10,000.
(2) Results from estimating equation (2) in text by probit. Regression also includes full set of covariates shown in Appendix Table 1 and in footnotes to that table.
(3) Standard errors in parentheses; implied marginal probability effects in square brackets.

Table 6:
Retirement Probits with SS and Pension Incentives

Variable	SS Incentives			SS and Pension Incentives		
	(1)	(2)	(3)	(1)	(2)	(3)
Accrual	0.762			-0.520		
Std. Error	(0.697)			(0.189)		
$1K Increase	[0.00065]			[-0.00044]		
Peak Value		-0.552			-0.298	
Std. Error		(0.283)			(0.070)	
$1K Increase		[-0.00047]			[-0.00025]	
Option Value			-0.150			-0.270
Std. Error			(0.048)			(0.044)
SSW	0.409	0.368	0.319	0.046	0.057	0.025
Std. Error	(0.151)	(0.150)	(0.150)	(0.011)	(0.013)	(0.010)
$10K Increase	[0.00350]	[0.00313]	[0.00272]	[0.00039]	[0.00047]	[0.00020]
Number of Obs	13,222	13,222	13,222	13,222	13,222	13,222

Notes:
(1) ACC, PV, and SSW are in $100,000, OV is /10,000.
(2) Sample excludes observations who report having a pension but are missing employer-provided pension data. Regressions include the same covariates as those in Table 5.
(3) Standard errors are in parentheses; implied marginal probabilities are in square brackets.

Table 7:
Probits with Additional Control Variables

Variable	**Original Model**		**+ Additional Controls**	
	(2)	**(3)**	**(2)**	**(3)**
Peak Value	-0.900		-0.950	
Std. Error	(0.347)		(0.347)	
$1K Increase	[-0.00073]		[-0.00075]	
Option Value		-0.161		-0.173
Std. Error		(0.059)		(0.059)
SSW	0.059	0.020	0.054	0.010
Std. Error	(0.159)	(0.160)	(0.160)	(0.160)
$10K Increase	[0.00048]	[0.00016]	[0.00042]	[0.00008]
Fair/poor health			0.246	0.245
			(0.065)	(0.065)
HI: job & ret			0.004	0.011
			(0.059)	(0.058)
HI: job, no ret			-0.162	-0.159
			(0.065)	(0.065)
Net worth: 2nd quartile			0.084	0.087
			(0.071)	(0.071)
Net worth: 3rd quartile			0.231	0.234
			(0.073)	(0.073)
Net worth: highest quartile			0.257	0.258
			(0.079)	(0.079)
Number of Obs	10,012	10,012	10,012	10,012

Notes:
(1) PV and SSW are in $100,000, OV is /10,000.
(2) Sample includes only observations for 1992-1997.
(3) Incentives are SS incentives. Regressions include all covariates included in the regressions in Table 5.

Table 8:
Policy Simulations, SS Incentives

Age	Peak Value				Option Value			
	Baseline Ret Rate	Post-Policy Ret Rate	Baseline % Working	Post-Policy % Working	Baseline Ret Rate	Post-Policy Ret Rate	Baseline % Working	Post-Policy % Working
Raise NRA								
55	0.0323	0.0318	1.0000	1.0000	0.0322	0.0310	1.0000	1.0000
56	0.0300	0.0294	0.9677	0.9682	0.0301	0.0288	0.9678	0.9690
57	0.0279	0.0272	0.9386	0.9398	0.0279	0.0266	0.9387	0.9412
58	0.0365	0.0354	0.9124	0.9142	0.0366	0.0347	0.9124	0.9161
59	0.0375	0.0362	0.8791	0.8818	0.0375	0.0355	0.8791	0.8843
60	0.0500	0.0482	0.8461	0.8498	0.0500	0.0473	0.8461	0.8529
61	0.0606	0.0582	0.8038	0.8089	0.0607	0.0573	0.8039	0.8126
62	0.1682	0.1628	0.7551	0.7618	0.1685	0.1609	0.7551	0.7660
63	0.1535	0.1428	0.6281	0.6377	0.1536	0.1442	0.6279	0.6427
64	0.1294	0.1133	0.5317	0.5467	0.1293	0.1184	0.5314	0.5501
65	0.2230	0.1971	0.4628	0.4847	0.2230	0.2072	0.4627	0.4849
66	0.1149	0.1017	0.3596	0.3892	0.1143	0.1064	0.3596	0.3844
67	0.0877	0.0816	0.3183	0.3496	0.0873	0.0828	0.3184	0.3435
68	0.1172	0.1095	0.2904	0.3211	0.1175	0.1122	0.2906	0.3151
69	0.2124	0.2021	0.2564	0.2859	0.2114	0.2045	0.2565	0.2797
Raise DRC								
55	0.0323	0.0302	1.0000	1.0000	0.0322	0.0313	1.0000	1.0000
56	0.0300	0.0279	0.9677	0.9698	0.0301	0.0292	0.9678	0.9687
57	0.0279	0.0257	0.9386	0.9427	0.0279	0.0270	0.9387	0.9404
58	0.0365	0.0333	0.9124	0.9185	0.0366	0.0352	0.9124	0.9150
59	0.0375	0.0338	0.8791	0.8879	0.0375	0.0359	0.8791	0.8828
60	0.0500	0.0449	0.8461	0.8579	0.0500	0.0478	0.8461	0.8511
61	0.0606	0.0541	0.8038	0.8194	0.0607	0.0579	0.8039	0.8105
62	0.1682	0.1525	0.7551	0.7750	0.1685	0.1620	0.7551	0.7636
63	0.1535	0.1372	0.6281	0.6568	0.1536	0.1467	0.6279	0.6399
64	0.1294	0.1138	0.5317	0.5667	0.1293	0.1227	0.5314	0.5460
65	0.2230	0.1958	0.4628	0.5023	0.2230	0.2128	0.4627	0.4790
66	0.1149	0.1035	0.3596	0.4039	0.1143	0.1110	0.3596	0.3771
67	0.0877	0.0826	0.3183	0.3621	0.0873	0.0871	0.3184	0.3352
68	0.1172	0.1164	0.2904	0.3322	0.1175	0.1209	0.2906	0.3060
69	0.2124	0.2186	0.2564	0.2935	0.2114	0.2207	0.2565	0.2690

Notes:
(1) The baseline retirement rate is calculated by predicting the probability of retirement for each observation using the regressions from Table 5, then averaging these probabilities by age.
(2) The post-policy retirement rate is calculated by re-estimating the incentives variables under the new SS rules, using the coefficients from Table 5 to re-calculate the predicted probability of retirement with the new incentive variables, and averaging the new retirement probabilities by age.
(3) The percentage working at age X is calculated by applying the retirement rate at age X-1 to the percentage working at age X-1.

Table 9:
Policy Simulations, SS and Pension Incentives

Age	Peak Value				Option Value			
	Baseline Ret Rate	Post-Policy Ret Rate	Baseline % Working	Post-Policy % Working	Baseline Ret Rate	Post-Policy Ret Rate	Baseline % Working	Post-Policy % Working
Raise NRA								
55	0.0323	0.0323	1.0000	1.0000	0.0323	0.0319	1.0000	1.0000
56	0.0300	0.0299	0.9677	0.9677	0.0301	0.0298	0.9677	0.9681
57	0.0279	0.0278	0.9387	0.9388	0.0280	0.0276	0.9386	0.9393
58	0.0366	0.0364	0.9125	0.9127	0.0365	0.0360	0.9123	0.9134
59	0.0371	0.0369	0.8791	0.8794	0.0372	0.0366	0.8790	0.8805
60	0.0497	0.0494	0.8465	0.8470	0.0499	0.0490	0.8462	0.8483
61	0.0609	0.0605	0.8044	0.8052	0.0609	0.0597	0.8040	0.8068
62	0.1683	0.1673	0.7554	0.7565	0.1686	0.1658	0.7551	0.7587
63	0.1536	0.1506	0.6283	0.6299	0.1534	0.1489	0.6278	0.6328
64	0.1299	0.1245	0.5318	0.5351	0.1294	0.1234	0.5315	0.5386
65	0.2225	0.2135	0.4627	0.4685	0.2225	0.2139	0.4627	0.4721
66	0.1150	0.1105	0.3598	0.3685	0.1139	0.1104	0.3598	0.3711
67	0.0860	0.0842	0.3184	0.3278	0.0859	0.0846	0.3188	0.3302
68	0.1174	0.1151	0.2910	0.3002	0.1177	0.1163	0.2914	0.3023
69	0.2118	0.2088	0.2568	0.2656	0.2106	0.2091	0.2571	0.2671
Raise DRC								
55	0.0323	0.0314	1.0000	1.0000	0.0323	0.0311	1.0000	1.0000
56	0.0300	0.0291	0.9677	0.9686	0.0301	0.0289	0.9677	0.9689
57	0.0279	0.0270	0.9387	0.9403	0.0280	0.0267	0.9386	0.9409
58	0.0366	0.0353	0.9125	0.9149	0.0365	0.0347	0.9123	0.9159
59	0.0371	0.0357	0.8791	0.8826	0.0372	0.0351	0.8790	0.8841
60	0.0497	0.0477	0.8465	0.8511	0.0499	0.0469	0.8462	0.8531
61	0.0609	0.0584	0.8044	0.8105	0.0609	0.0570	0.8040	0.8131
62	0.1683	0.1621	0.7554	0.7632	0.1686	0.1594	0.7551	0.7668
63	0.1536	0.1471	0.6283	0.6395	0.1534	0.1437	0.6278	0.6445
64	0.1299	0.1235	0.5318	0.5454	0.1294	0.1201	0.5315	0.5519
65	0.2225	0.2112	0.4627	0.4780	0.2225	0.2081	0.4627	0.4856
66	0.1150	0.1099	0.3598	0.3771	0.1139	0.1071	0.3598	0.3845
67	0.0860	0.0833	0.3184	0.3356	0.0859	0.0818	0.3188	0.3434
68	0.1174	0.1161	0.2910	0.3077	0.1177	0.1149	0.2914	0.3153
69	0.2118	0.2122	0.2568	0.2720	0.2106	0.2099	0.2571	0.2791

Notes:

(1) The baseline retirement rate is calculated by predicting the probability of retirement for each observation using the regressions from Table 6, then averaging these probabilities by age.

(2) The post-policy retirement rate is calculated by re-estimating the incentives variables under the new SS rules, using the coefficients from Table 6 to re-calculate the predicted probability of retirement with the new incentive variables, and averaging the new retirement probabilities by age.

(3) The percentage working at age X is calculated by applying the retirement rate at age X-1 to the percentage working at age X-1.

Age	Full Sample		92-97		80-91	
	1	80-97	1	92-97	1	80-91
55	0.9717	0.0283	0.9912	0.0088	0.9636	0.0364
56	0.9447	0.027786	0.9785	0.012813	0.9322	0.032586
57	0.9197	0.026463	0.9696	0.009096	0.8979	0.036795
58	0.8874	0.03512	0.9499	0.020318	0.8636	0.0382
59	0.8557	0.035722	0.9278	0.023266	0.8326	0.035896
60	0.8144	0.048265	0.9036	0.026083	0.7792	0.064136
61	0.7664	0.058939	0.8612	0.046923	0.7336	0.058522
62	0.6414	0.1631	0.742	0.138412	0.6204	0.154308
63	0.5447	0.150764	0.6437	0.13248	0.5396	0.130239
64	0.4761	0.125941	0.5661	0.120553	0.4906	0.090808
65	0.373	0.216551	0.4529	0.199965	0.3925	0.199959
66	0.3309	0.112869	0.4044	0.107088	0.3559	0.093248
67	0.3046	0.07948	0.3707	0.083333	0.3423	0.038213
68	0.2716	0.108339	0.3295	0.111141	0.3178	0.071575
69	0.2134	0.214286	0.2515	0.236722	0.3178	0

Age	Average baseline Hazard	post policy hazard w/out pens	post policy hazard w/ pens	Average baseline CDF	post policy CDF w/out pens	post policy CDF w/ pens
NRA	Pre-Policy	Post-Policy	Post-Policy	Pre-Policy	Post-Policy	Post-Policy, SS & Pens
55	0.032294	0.031773	0.032258	1	1	1
56	0.030011	0.029401	0.029927	0.967706	0.968227	0.967743
57	0.027923	0.027209	0.027832	0.938665	0.93976	0.938781
58	0.036558	0.035447	0.036433	0.912454	0.91419	0.912653
59	0.037271	0.036223	0.036856	0.879097	0.881784	0.879403
60	0.049871	0.048234	0.049387	0.846332	0.849843	0.846991
61	0.060767	0.058175	0.060453	0.804124	0.808852	0.80516
62	0.168257	0.162835	0.167276	0.75526	0.761797	0.756486
63	0.153552	0.142802	0.150556	0.628182	0.63775	0.629944
64	0.12966	0.113314	0.124455	0.531724	0.546678	0.535102
65	0.222733	0.197062	0.21354	0.46278	0.484732	0.468506
66	0.114934	0.101738	0.110476	0.359704	0.389209	0.368461
67	0.086858	0.081622	0.08421	0.318362	0.349612	0.327755
68	0.117328	0.109542	0.115146	0.290709	0.321076	0.300155
69	0.212069	0.202054	0.208752	0.256601	0.285905	0.265593
DRC	Pre-Policy	Post-Policy	Post-Policy	Pre-Policy	Post-Policy	Post-Policy, SS & Pens
55	0.032294	0.03021	0.031434	1	1	1
56	0.030011	0.027919	0.029142	0.967706	0.96979	0.968566
57	0.027923	0.025691	0.027036	0.938665	0.942715	0.94034
58	0.036558	0.033312	0.03533	0.912454	0.918496	0.914917
59	0.037271	0.033835	0.035662	0.879097	0.887898	0.882593
60	0.049871	0.044877	0.047709	0.846332	0.857856	0.851118
61	0.060767	0.054079	0.058397	0.804124	0.819358	0.810512
62	0.168257	0.15252	0.162099	0.75526	0.775048	0.763181
63	0.153552	0.137165	0.147126	0.628182	0.656838	0.63947
64	0.12966	0.113752	0.123478	0.531724	0.566743	0.545387
65	0.222733	0.195842	0.211188	0.46278	0.502274	0.478044
66	0.114934	0.103525	0.109915	0.359704	0.403908	0.377087
67	0.086858	0.082638	0.083305	0.318362	0.362093	0.335639
68	0.117328	0.116426	0.116053	0.290709	0.332171	0.307679
69	0.212069	0.218616	0.212182	0.256601	0.293497	0.271972

PIA	Pre-Policy	Post-Policy	Post-Policy	Pre-Policy	Post-Policy	Post-Policy, SS & Pens	%change		change	
55	0.032351	0.031551	0.03233	0.600965	0.229334	1	-0.02471	-0.00065	0.371631	-0.39903
56	0.03	0.028854	0.029817	0.581531	0.222098	0.96767	-0.0382	-0.0061	0.359433	-0.38614
57	0.027936	0.026496	0.027672	0.564098	0.21569	0.938817	-0.05156	-0.00948	0.348408	-0.37472
58	0.036551	0.034286	0.036112	0.548338	0.209975	0.912838	-0.06198	-0.01202	0.338363	-0.3645
59	0.037258	0.034846	0.036456	0.528282	0.202776	0.879874	-0.06472	-0.02152	0.325506	-0.35159
60	0.049854	0.046284	0.048806	0.508672	0.19571	0.847797	-0.07162	-0.02104	0.312962	-0.33912
61	0.060783	0.055494	0.059632	0.483365	0.186652	0.80642	-0.08702	-0.01894	0.296713	-0.32306
62	0.168207	0.156193	0.165146	0.453928	0.176294	0.758332	-0.07143	-0.0182	0.277634	-0.3044
63	0.153553	0.139975	0.149886	0.377566	0.148758	0.633096	-0.08842	-0.02388	0.228808	-0.25553
64	0.129569	0.115273	0.125707	0.319577	0.127935	0.538204	-0.11034	-0.02981	0.191641	-0.21863
65	0.222781	0.200397	0.215947	0.278126	0.113188	0.470548	-0.10047	-0.03068	0.164939	-0.19242
66	0.114618	0.099608	0.11011	0.216208	0.090505	0.368935	-0.13095	-0.03933	0.125703	-0.15273
67	0.087072	0.075548	0.082507	0.19142	0.08149	0.328312	-0.13236	-0.05243	0.10993	-0.13689
68	0.117291	0.101059	0.112439	0.174856	0.075334	0.301224	-0.13839	-0.04137	0.099523	-0.12637
69	0.211701	0.189606	0.204728	0.154336	0.067721	0.267354	-0.10437	-0.03294	0.086616	-0.11302