The Effect of Social Security on Retirement in the United States

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One of the most striking labor force phenomena of the second half of the twentieth century in the United States 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). Over the same period, the labor force participation rate of older women has risen dramatically, as shown in Figure 1, due in large part to changing roles and opportunities for women during the period.

Much has been written about the proximate causes of the decline in older men's labor force participation, 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 increases 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. However, much of this literature either relies on data that is now decades old or otherwise flawed or suffers from methodological problems.

The purpose of our paper is to revisit the impact of Social Security on retirement, taking advantage of newly available data on retirement behavior and methodological advances in retirement modeling over the past decade. Our data set, the Health and Retirement Study (HRS), follows a sample of near retirement age individuals starting in 1992 and contains detailed information on demographic and job characteristics, labor force attachment, earnings histories, health, and private pensions.

Our empirical analysis relies on 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. We use this model in a reduced form context, as well as an alternative forward-looking measure called "peak value," introduced in Coile and Gruber (2000a) and described in more detail below.

We have two 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 it is important to include forward-looking measures such as peak value or option value in retirement models. These forward-looking measures have a significant impact on retirement decisions for men, although for women only the option value model generates a significant result. Second, we conduct simulations of the effect of two possible policy changes, raising the early and normal retirement ages by three years or moving to a system with a flat benefit of 60% of earnings, and find that these policy changes could have significant effects on retirement behavior.

Our paper proceeds as follows. In Part I, we briefly discuss the relevant institutional features of the SS system in the US and provide an overview of the previous literature in this area. In Part II, we describe our data and incentive variable calculations. In Part III, we describe the empirical framework for our regression analysis and presents the results of our estimation. In Part IV, we conduct a series of simulation exercises to assess the impact of Social Security reform using our model, and we present our conclusions in Part V.

Part I: Background

Institutional Features of Social Security

The Social Security system is financed by a payroll tax that 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. The payroll tax that funds OASI and DI is levied on earnings up to the taxable maximum, $76,200 in 2000; 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. Importantly, additional higher earnings years can replace earlier lower earnings years, since only the highest 35 years of earnings are used in the calculation.1

The next step 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 (legislated to rise slowly from age 65 to 67 over the next twenty years), 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 with an NRA of age 65 claiming on his 62^{nd} birthday receives 80% of the PIA.2 Individuals can also delay the receipt of benefits beyond the NRA and receive a Delayed Retirement Credit (DRC). For workers reaching age 65 in 2000, an additional 6% 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

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1While 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.

2The reduction factor will be only 5/12 of one percent for months beyond 36 months before the NRA, which is relevant for workers with an NRA past age 65.

"earnings test" until the worker reaches age 65.[3] A worker age 62 to 65 may earn up to $9,600 in 1999 without the loss of 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 receive a 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.[4] 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

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3Until 2000, workers aged 65-69 were subject to an earnings test with a higher earnings floor and 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.

4Spousal 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.

Security provides a real annuity.

Labor Market Participation and Program Participation

Table 1 documents the transition of men and women out of the labor force and into receipt of Social Security and other benefits. At ages 50-54, 81% of men are working full-time, 4% are working part-time, and 15% are not working. The fraction of men in this age group receiving some type of benefit is about equal to the fraction not working and is divided roughly equally among those receiving Disability Insurance (DI) benefits (6%), Unemployment Insurance (UI) benefits (5%), and private pensions (5%).[5] At ages 55-59, an additional 11% of men leave the labor force, and there is a concurrent rise in the fraction receiving DI (to 9%) and private pensions (to 13%). At ages 60-64, there is a large movement out of the full-time labor market (down to 45%) and on to SS (27%) and private pensions (27%), and to a lesser extent, DI (13%). By ages 65-69, the vast majority of workers have moved out of the full-time labor market (down to 15%) and on to SS (86%) and often private pensions (45%).[6] In short, the US system features one main pathway to retirement, from full-time work to receipt of SS (and frequently private pension benefits), a move that typically occurs between ages 62 and 65. This is in contrast to many other developed countries, where many people exit the labor force at earlier ages and receive unemployment or disability benefits prior to becoming eligible for retirement benefits.

5In addition, 2% of men are receiving Supplemental Security Income (SSI), a means-tested benefit for people who are poor and either disabled or aged 65 or older.

6Receipt of disability benefits goes to zero at age 65, as DI recipients are automatically transferred to SS benefit receipt at age 65.

As use of these other paths to retirement is minimal in the US, they will not factor into our analysis.

For women, the patterns are similar, with a few notable differences. First, a lower fraction of women are initially working full-time at ages 50-54 (57%); this reflects both a higher fraction of women out of the labor force entirely (29%) and a higher fraction working part-time (14%). Second, while many women receive SS benefits based on their own work record (58% of women at ages 65-69), a significant fraction receive benefits only as a result of being a dependent spouse (16%) or widow (14%). Third, fewer women receive private pension benefits (21% at ages 65-69, vs. 45% of men).

Previous Related Literature

A number of studies have used aggregate information on the labor force behavior of workers at different ages to infer the role played by Social Security. Hurd (1990) and Ruhm (1995) emphasize the spike in the age pattern of retirement at age 62; as Hurd states, "there are no other institutional or economic reasons for the peak." Using quarterly data, Blau (1994) finds that almost one-quarter of the men in the labor force at their 65th birthday retire in 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, by the incentives in private pension plans, or by the availability of retirement health insurance through Medicare. However, Social Security may still play an important role by setting up the "focal point" of a normal retirement age.

The main body of the retirement incentives literature attempts to specifically model the role that potential SS benefits play in determining retirement. The earliest work in this area 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, with the more recent work using richer models such as nonlinear 2SLS or hazard modeling, their results generally suggest that Social Security's role is significant but small relative to the time trends in retirement behavior.

A key limitation of these studies is that they 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 use structural models of retirement decisions by workers facing a lifetime budget constraint; for example, see Burtless (1986), Burtless and Moffitt (1984), Gustman and Steinmeier (1985, 1986), and Rust and Phelan (1997). The second was to estimate reduced form models but incorporate the accrual of SSW with a year of additional work; for example, see 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 indicated a larger role for private pensions. The final type of literature is the option value work of Stock and Wise noted above.[7]

A final article that deserves particular mention is that of Krueger and Pischke (1992). They note that the key regressor in many of these articles, SS benefits, is a non-linear function of past earnings, and retirement propensities are clearly correlated with past earnings. 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, 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, Krueger and Pischke still 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

[7] See also Samwick (1998), who uses the option value model in a reduced form context.

perhaps untenable assumptions that are required to identify these very complicated structural models.8 The 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.9 If all dollars of retirement wealth are not weighed equally by potential retirees, 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

8For a criticism of this type in the context of this type of estimation of general labor supply responses, see MaCurdy (1981).

9Stock and Wise did not attempt this decomposition, and Samwick's (1998) attempt to do so with a reduced form version of the option value model was unsuccessful, perhaps due to the estimate Social Security and private pension impacts.[10]

In addition, all of these studies suffer from important data deficiencies, as they use data from the 1970s, when the structure of the Social Security system was fairly different, or from only a handful of firms, or without complete information on SS incentives. Finally, all of the 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 option value literature, as this measure is largely determined by wage differences across individuals and only secondarily influenced by the structure of retirement incentives. 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

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measurement error in Social Security incentives arising from a lack of earnings history data.

10The latter is suggested by Diamond and Hausman (1984), who find much smaller effects of pensions on retirement than those of Social Security.

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.

To address these concerns, Coile and Gruber (2000a,b) introduce a new measure, "peak value," which incorporates the insights of the option value measure but focuses solely on variation in Social Security incentives. 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. 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. Since wage is not included specifically into the peak value calculation, there is much more variation from the structure of the Social Security entitlement.11 In the empirical analysis below, both peak value and option value are used in a reduced form context.

Part II: Data and Empirical Strategy

Data

Our data for this analysis comes from the Health and Retirement Study.12 The HRS is a

11In our sample, an earnings quartic and age dummies explain only 33% of the variation in peak value, vs. 74% of the variation in option value.

12The HRS is conducted by the Survey Research Center at the University of Michigan in Ann Arbor, MI. The data is available at: http://www.umich.edu/~hrswww/. Most of the data is publicly available, although the Social Security and firm-level private pension data is restricted to survey of 12, 652 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.13 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 on the entire history of earnings.14 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 age 55-69 for our analysis, subject to the exclusions detailed below.

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approved users.

13The 1998 wave 4 data are preliminary.

14Only 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.

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.[15] 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

15One 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 find that results are similar when individuals who list their industry as public administration are dropped.

measures.[16] We only consider individuals before their first retirement; if a person who is categorized as retired re-enters the labor force, the later observations are not used.

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

Our sample selection criteria are as follows for men. There are 5,886 men who appear in waves 1, 2, or 3 of the HRS.[17] 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.[18] 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.

17Observations 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.

18Observations 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.

Finally, we exclude 988 person-year observations that represent labor force re-entry after a previous retirement. The final sample size is 17,745 male observations. A similar process generates a sample size of 11,419 female observations.

The means of our key variables are shown in Tables 2 and 3 for men and women, respectively. In any given year, a similar percentage of the male and female sample retire, 5.7% for men and 5.6% for women. The average age of our sample is 58.5 for men and 58 for women. Some 91% of our male sample is married and the typical man is 4.3 years older than his wife, while only 64% of our female sample is married and the typical woman is 1.3 years younger than her husband.19 Roughly eighty percent of both samples are white. Among the male sample, 25% are high school dropouts, 36% have only a high school degree, 14% have some college, and 25% are college graduates; for women, the figures are 19%, 42%, 17%, and 22%, respectively. The average projected earnings for the next year of work are $36,152 for men and $20,984 for women (in 1998 dollars), and the average monthly earnings over the working life are $2,470 for men and $1,102 for women. The typical spouse's earnings (averaging over single people, people with non-working wives, and people with working spouses) are $10,813 for an additional year of work and $613 per month on average a lifetime for the male sample, and $16,489 and $1,475 for the female sample. The typical man in our sample has 40 years of labor market experience and 17 years of tenure on their current job and 5.4% of our sample is missing tenure information (indicating a short-term job); equivalent figures for women are 39 and 13 years and 6.6%.

19The fact that a lower fraction of the female sample is married is a result of the fact that when the sample selection criteria is applied, women who are still working at age 55 are less likely to be married than men who are still working at age 55.

Incentive Variable Calculation - Accrual

Our goal is to measure the retirement incentives inherent in the Social Security system. 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 Coile and Gruber (2000a,b). 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 first calculate 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.20

Our SS incentive variables incorporate dependent spouse and survivor benefits, since

20Projected 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).

these are important components of SSW. For a worker with a non-working spouse, these benefits are based solely on the worker's earnings record. For a worker whose spouse is entitled to benefits on his/her own, the spouse's benefits are based (partially or fully) on the spouse's 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 spouses who are working will retire at age 62; this seems reasonable, given that the median retirement age is 62 for women in the sample and 63 for men. 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 do not incorporate private pension incentives into our analysis. Coile and Gruber (2000b) estimate retirement models that include both Social Security and pension incentives, and they find that the results differ significantly from those for Social Security alone. This suggests that changes in private pension provisions may have different impacts on retirement than changes in public pensions, so that one should not extrapolate the effect of public pension reform from private pension responses. Thus, since our primary goal is to discuss the impacts of public pensions on retirement, we exclude private pensions here.

Table 4 shows the medians of the retirement incentive variables for our male sample by age. The median PDV rises from $179,316 at age 55 to a peak of $205,584 at age 65, then falls to $194,555 at age 69.[21] 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.[22] After age 65, accruals become negative and rise rapidly, as the delayed 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 4. 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 $978, and the 90th percentile person has an accrual of

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21The 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).

22This 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).

$7,032; the standard deviation at that age is $2,691. It is this sizeable variation that identifies our models.

Table 5 shows the median retirement incentives for women by age. For women, median accruals are much smaller at all ages than they are for men, and there are no large accruals at ages 62-64. In large part, this is because women have typically been less attached to the labor force over their working lives and are often dually entitled to benefits as both retired workers and as a dependent (or divorced) spouses or widows. If a woman's retired worker benefits are less than what she is entitled to as a dependent spouse, then additional work will typically not result in a higher benefit. It is also worth noting that in the HRS, earnings histories are not available for divorced or deceased spouses; since more women than men are likely to be receiving benefits based on the record of a divorced or deceased spouse, estimates of women's incentives are likely to be subject to more measurement error. Table 5 also shows that there is significant heterogeneity in women's accruals.

Incentive Variable Calculation - Forward Looking Measures

The recent work on retirement has highlighted 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, as documented in Coile and Gruber

(2000). For a sizeable minority of workers, accrual patterns are non-monotonic, so that forward-looking measures can deliver very different incentives than one year accruals.

As noted above, Stock and Wise (1990a) propose 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 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. As a structural estimation of the option value model is beyond the scope of this paper, we instead calculate the option value using reasonable utility parameters and include it as a regressor in a retirement model.23

As mentioned above, one possible weakness of the option value model is that much of the variation in this measure arises from differences in wages, which may not be a legitimate source of identification of retirement effects. We take two approaches to addressing this potential shortcoming. First, we include rich controls for earnings in the retirement model, to capture the heterogeneity which may bias these estimates. However, since wages enter highly non-linearly in the option value and the form of heterogeneity is unknown, even rich wage controls may not fully capture the underlying correspondence between option value and tastes for work.

23We 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 0.97, relative to the very high discount rate of 0.75 obtained from their model. We also tested the robustness of our model to the choice of k and g and the results are not sensitive to this choice.

Therefore, we also estimate retirement models utilizing the peak value measure. As described above, peak value is the difference between SSW at its *maximum expected value* and SSW at today's value.[24] In this way, the peak value incorporates the insights of the option value measure and appropriately considers the tradeoff between retiring today and working to a period with much higher SSW, but focuses solely on variation in Social Security incentives.

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[24] 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.

Table 6 shows the age pattern and heterogeneity for peak and option value for the male sample. 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.[25] 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 62, 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, 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.

Table 7 shows the distribution of the peak value and option value measures by age for the

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25Note 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 4 and 6, 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 (2000a), this is a fallacy of composition, and for any given female sample. The age trends are largely similar to those for men, although the dollar amounts are smaller, as women typically benefit less from additional work for reasons described above and also have lower earnings, which lowers the option value.

Part III: Empirical Framework and Results

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 additional work.

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

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

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individual the peak value is just the sum of accruals to the peak SSW age.

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[26], tenure at the firm and its square, 13 major industry dummies, 17 major occupation dummies); AGE is either entered linearly or as 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;[27] 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

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[26]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.

[27]Note that AIME is time varying because additional years of work change average lifetime earnings through the dropout years provision.

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 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.

Social Security Incentives and Retirement

Table 8 shows the results of estimating equation (2) for men for the three incentive measures and the two possible sets of age controls. Peak value, accrual, and Social Security Wealth are expressed in $100,000; option value is expressed in units of 10,000. The magnitude of the coefficients is 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.

In all the models, we estimate a positive impact of Social Security wealth levels, as expected; however, the coefficient is significant at the 5% level in only two of the six models. The coefficient implies that each $10,000 increase in SSW increases the probability of retirement by about 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. The coefficients are about 50% greater in the models with linear age than in those with age dummies.

The coefficient on the accrual is wrong-signed (positive), and highly insignificant once age dummies are included in the model. 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 sets of columns, which show the estimates from the peak value and option value models. 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 0.05%, 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.

The coefficients on peak value and option value are similar whether age is controlled for using a linear variable or age dummies. The goodness of fit of all six models is similar, with a pseudo R-squared of about 12% in models without age dummies and 14% in models with age dummies. 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 have their expected impacts.[28] There is a rising pattern of retirement propensities with age, with particularly large effects at ages 62, 63, 65, and 69. Figure 2 displays the empirical retirement hazard for the sample and the age dummies estimated in the three models. The age dummies in the accrual and peak value models are nearly identical to the empirical hazard, indicating that these models explain little of the variation across ages in retirement propensities; on the other hand, the age dummies in the option value model are significantly below the empirical hazard.

28Only coefficients on age or age dummies are shown in Table 8.

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 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 higher retirement rate in the western region and a lower rate in New England.[29]

29See Coile and Gruber (2000) for a discussion of results incorporating pensions in the retirement incentive variables and including health status and health insurance as regressors.

The retirement probits for the female sample are shown in Table 9. The SSW coefficients are roughly the same size as in the men's probits and are significant in the accrual and peak value models. As in the men's probits, the coefficients on accrual are positive and highly insignificant. Surprisingly, the results using the forward-looking incentive variables are mixed: the coefficients on peak value are negative but small and insignificant, while the coefficients on option value are negative and significant. One possible explanation for the insignificant coefficients is the measurement error in women's incentive variables, due to a lack of earnings histories for divorced and deceased spouses; however, this would not explain why option value is significant.30 The linear age variable and age dummies are similar to those in the men's model, and again the age dummies from the option value model are below the empirical hazard. The pseudo R-squared is about 15% in all six models.

In summary, SSW has a positive and marginally significant effect on retirement behavior for both men and women. The one-year accrual has a wrong-signed and insignificant effect, while the forward-looking incentive measures, peak value and option value, have a significant negative effect (although peak value is not significant for women). However, the implications of the 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, we conduct simulations of changes to the Social Security system in the following section.

30Coile (1999) estimates similar models and finds that women respond to both peak value and option value measures. Her sample differs in two ways from the female sample here: first, she looks only at married women (who may have less measurement error in their incentive variables than unmarried women) and second, she conditions on working at age 50 or later (vs. 55 here).

Part IV: Policy Simulations

In this section, we consider two potential major reforms to the Social Security system. The first policy change examined is to raise both the ERA and the NRA by 3 years, to 65 and 68, respectively. The second policy change is to move from the current Social Security system to a common system simulated by all chapters in this book: an ERA of 60 and NRA of 65, a replacement rate of 60% of AIME at age 65, and a 6% annual actuarial adjustment factor between ages 60 and 70.

Our basic procedure is to re-estimate the incentive variables under the new policy, then use the probit estimates discussed above to predict changes in retirement behavior. But executing these simulations raises the difficult question of how to translate the earlier models into policy responses. In particular, we face the difficulty that our models are largely unable to explain the age pattern of retirement, an age pattern which is certainly at least partly due to Social Security incentives (in particular the spike at age 62).

We therefore consider three possible simulation approaches. First, in simulation S1, we use the model with linear age. This simulation does not allow for any age-specific deviations from a linear baseline, therefore increasing the explanatory power of our financial incentive variables. Second, in simulation S2, we use the model with age dummies, but we only consider the impact of changing the financial incentive variables; that is, when retirement ages change, we only consider the impact that this has through changing peak or option value, and not through any other structural shifts. In contrast, the third approach, simulation S3, is also based on the model where age dummies are used, but imposes a shift in the spikes of the retirement hazard when the policy is changed; that is, when retirement ages change, we assume that there is a corresponding change in the underlying hazard of retirement by age.[31] In other words, simulation S2 corresponds to the assumption that any age pattern not captured by our financial measures is not due to retirement programs; simulation S3 assumes that the entire age pattern is driven by retirement programs. Since it is unknown whether the policy changes would move the spikes in the retirement hazard, simulations S2 and S3 can be thought of as bounding the true effect of the policy change, with simulation S1 somewhere inbetween.

We present our findings in two formats. Table 10 shows the baseline average retirement rate as well as the average retirement rates in the various policy simulations.[32] The second format is graphical. Each of the figures 4-12 shows the impact on the hazard of retirement, and the cumulative probability of being in the labor force, for the baseline and for each of the two reforms. The different figures correspond to different models and simulations: figures 4-6 are for the peak value model for males, for simulations S1-S3; figures 7-9 are for the option value model for males; and figures 10-12 are for the option value model for females.

31For the first policy, all age dummies are incremented by three years, so that the retirement hazard at age 62 is moved to age 65, etc. For the second policy, the age 62 dummy is moved to age 60, the dummies before age 60 and at ages 65+ are unaffected, and the age dummies at ages 61-64 are replaced with an average of the age 63 and 64 dummies. Admittedly, these are ad hoc adjustments, but it is difficult to predict how these policy changes would affect the underlying propensity to retire at various ages.

32Accrual is not used in the simulations, as the coefficients are wrong-signed and insignificant. Peak value is not used in the simulations for women, as the coefficients are highly insignificant.

Raising the ERA and NRA by Three Years

The first policy change, raising the ERA and NRA, would have the effect of lowering the average retirement rate for both men and women. The reduction is 1 percentage point or less in the S1 and S2 simulations, but 2-3 percentage points under the S3 simulations. The larger reduction in average retirement rate under the S3 simulation is not surprising, as this case moves the spikes in the retirement hazard back by three years.

We can assess the wealth and accrual effects underlying these results. 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 62-64, this change will decrease work incentives, as work in these years now only benefits the individual through the dropout year provision and no longer through a more than fair actuarial adjustment for delayed claiming; and for ages 65-67, there will be an increase in work incentives, as the less fair DRC is replaced by the 6.67% per year actuarial adjustment. Due to offsetting wealth and accrual effects, there are only modest effects of this change on labor supply when there is no change in retirement "norms"; however, when a change in retirement norms is applied, the labor supply effects will be substantially larger.

The results of these simulations for the first policy change are clearly visible in figures 4-12. In each case, for simulation S1, there is relatively little impact on retirement; the simulated pattern of retirement or labor force participation closely follows the linear baseline model. Similarly, in simulation S2, there is little deviation from the baseline; here, the baseline has a non-linear shape, as it is allowed to reflect variation in the age pattern according to the model with age dummies. But, in simulation S3, there are more significant impacts. Indeed, at age 65, this policy raises the odds of participating in the labor force by about one-half from the baseline. For example, for the option value model, the odds of participating at age 65 rise from 0.46 to 0.68. This is an enormous effect. This effect peaks at age 65, and then fades over time, as at older ages retirement is very high under either model.

Common Retirement System

The second policy change, moving to a flat 60% replacement rate benefit with an age 60 early retirement age, has a somewhat different pattern of effects. First of all, it significantly raises, rather than lowering, retirement rates. The policy has the effect of raising both SSW (from $177,000 to $269,000 for the median man in the sample) and the incentive variables (PV rises from $13,000 to $35,000 for the median man). Again, there are offsetting wealth and accrual effects, but here the wealth effects are much larger and the result is a much higher retirement rate.

The rise in retirement rates for men ranges from 0.7 percentage points in the peak value model with simulation method S2 to 2.6 percentage points for the option value model with simulation method S3. For females, the range is from 2.2 percentage points with simulation method S2 to 3.4 percentage points with simulation method S3.

Once again, we show the implications for retirement and cumulative labor force participation at each age in Figures 4-12. In this case, there is fewer differences across our modeling and simulation methods: there is a general finding of a small rise in the hazard rate at all ages. Unlike the effects of the first reform, which fade over time, these impacts are constant or grow at all ages, reflecting the fact that this policy does not so much shift incentives towards earlier retirement as it does raise the wealth level of retirees at all ages.

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 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 for men, although for women only the option value model generates significant results. Simulations of policy changes indicate that these changes could have significant impacts on retirement decisions. An increase in the ERA and NRA could result in a 2 percentage point decrease in the average annual retirement rate if the increase has the effect of changing retirement "norms," although the effect would be much smaller if norms are unchanged, due to offsetting wealth and accrual effects. A move to a policy with a 60% replacement rate at age 65, a much more generous policy than the current Social Security system, would have very large wealth effects, raising the average annual retirement rate by 2-3 percentage points.

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Table 1: Labor Market Participation and Program Participation, 1997

	Age				
	50-54	55-59	60-64	65-69	70-74
Men, Labor Market Participation					
Working Full-Time	81.2%	69.8%	44.6%	14.8%	7.1%
Working Part-Time	3.5%	5.2%	8.3%	10.5%	8.3%
Not Working	15.2%	25.0%	47.1%	74.7%	84.6%
Men, Program Participation					
Received SS Retired Worker Benefits	0.0%	0.0%	26.9%	85.9%	95.3%
Received SS Dependent Spouse Benefit	0.0%	0.0%	0.1%	0.1%	0.2%
Received SS Survivor's Benefits	0.0%	0.0%	0.4%	0.1%	0.1%
Received Disability Insurance Benefits	5.7%	9.0%	12.9%	0.0%	0.0%
Received Supplemental Security Income Benefits	2.1%	2.7%	3.1%	4.0%	4.1%
Received Unemployment Insurance Benefits	5.1%	3.8%	3.4%	1.0%	0.2%
Received Private Pension Benefits	4.8%	13.2%	27.4%	45.2%	48.5%
Women, Labor Market Participation					
Working Full-Time	57.4%	48.2%	27.5%	8.6%	2.6%
Working Part-Time	13.6%	12.8%	12.1%	10.0%	6.5%
Not Working	29.0%	39.0%	60.4%	81.5%	90.9%
Women, Program Participation					
Received SS Retired Worker Benefits	0.0%	0.0%	21.3%	57.5%	61.3%
Received SS Dependent Spouse Benefits	0.3%	0.3%	7.0%	15.9%	15.8%
Received SS Survivor's Benefits	0.6%	1.4%	10.6%	14.2%	18.3%
Received Disability Insurance Benefits	4.0%	5.9%	7.4%	0.0%	0.0%
Received Supplemental Security Income Benefits	3.4%	4.3%	5.2%	6.9%	7.6%
Received Unemployment Insurance Benefits	2.7%	2.5%	1.6%	0.7%	0.3%
Received Private Pension Benefits	2.2%	5.3%	12.4%	20.9%	24.6%

Sources:
(1) Population figures are from Table 14 of the 1998 Statistical Abstract of the United States and from the Bureau of Census website (www.census.gov/population/estimates/nation/intfile2-1.txt).
(2) SS, Disability, and SSI Benefit figures are from Tables 5.A1 and 7.E3 of the 1998 Annual Statistical Supplement to the Social Security Bulletin.
(3) Labor force participation, unemployment benefits, and private pension benefits are authors' calculations from the March 1998 Current Population Survey.

Table 2: Summary Statistics for the Male Sample

Variable	Mean	Standard Deviation
Retired	0.057	0.232
Age	58.5	3.0
Educ: Less than High School	0.241	0.428
Educ: High School	0.363	0.481
Educ: Some College	0.136	0.343
Married	0.914	0.281
Age Difference with Spouse	4.3	4.9
Race: Black	0.101	0.301
Race: Other Non-White	0.081	0.273
Earnings	36,152	18,926
AIME	2,470	945
Spouse's Earnings	10,813	14,117
Spouse's AIME	612	654
Experience	40	4
Job Tenure	17	12
Job Tenure Missing	0.054	0.227
Have Pension	0.348	0.476
# Observations	17,745	
# Individuals	3,217	

Table 3: Summary Statistics for the Female Sample

Variable	Mean	Standard Deviation
Retired	0.056	0.230
Age	58.0	2.6
Educ: Less than High School	0.193	0.395
Educ: High School	0.424	0.494
Educ: Some College	0.168	0.374
Married	0.640	0.480
Age Difference with Spouse	-1.3	3.6
Race: Black	0.163	0.369
Race: Other Non-White	0.071	0.257
Earnings	20,984	14,887
AIME	1,102	735
Spouse's Earnings	16,489	21,168
Spouse's AIME	1,475	1,413
Experience	39	4
Job Tenure	13	10
Job Tenure Missing	0.066	0.248
Have Pension	0.325	0.468
# Observations	11,419	
# Individuals	2,526	

Table 4: The Distribution of the One-Year Accrual, Male Sample

Age	Number of Obs	Median SSW	Accrual				Median Tax Rate	Median Tax Rate 2
			Median	10th Percentile	90th Percentile	Standard Deviation		
55	2,809	179,316	2,554	322	5,492	2,334	-0.072	-0.022
56	2,747	181,870	2,369	243	5,032	3,859	-0.066	0.046
57	2,444	184,239	2,128	167	4,555	3,382	-0.061	0.06
58	2,143	186,367	1,948	66	4,233	2,497	-0.054	0.069
59	1,823	188,315	1,793	12	4,136	3,191	-0.048	0.072
60	1,546	190,108	1,662	0	4,190	2,007	-0.042	0.071
61	1,255	191,770	1,670	0	4,170	5,113	-0.043	0.064
62	1,021	193,440	4,349	978	7,032	2,691	-0.118	-0.028
63	716	197,789	4,511	430	7,394	3,532	-0.122	-0.005
64	483	202,300	3,284	0	6,152	2,631	-0.093	0.031
65	344	205,584	(1,123)	(4,741)	1,785	4,470	0.027	0.118
66	191	204,461	(2,301)	(5,591)	600	2,996	0.059	0.225
67	110	202,160	(3,302)	(6,773)	0	8,027	0.114	0.269
68	71	198,858	(4,303)	(7,530)	0	2,693	0.134	0.439
69	42	194,555	(4,758)	(7,825)	0	2,735	0.119	0.455

Notes:
(1) Tax Rate 2 is from Diamond and Gruber (1999). Definitions of other variables are provided in the text. Median SSW is the age 55 median SSW incremented by the median accrual.
(2) All figures are $1998.
(3) One source of difference between Tax Rate and Tax Rate 2 is that Tax Rate 2 includes SS contributions. Adding the 12.4% payroll tax to Tax Rate results in figures very similar to Tax Rate 2.

Table 5: The Distribution of the One-Year Accrual, Female Sample

Age	Number of Obs	Median SSW	Accrual: Median	Accrual: 10th Percentile	Accrual: 90th Percentile	Accrual: Standard Deviation	Median Tax Rate
55	2,124	163,139	1,100	0	3,200	2,506	-0.055
56	1,954	164,239	1,176	0	3,185	2,503	-0.057
57	1,711	165,415	1,186	0	3,168	2,319	-0.059
58	1,455	166,601	1,200	0	3,138	2,975	-0.061
59	1,201	167,801	1,203	0	3,122	2,576	-0.064
60	944	169,004	1,282	0	3,119	2,355	-0.065
61	726	170,286	1,317	0	3,365	4,334	-0.069
62	547	171,603	1,360	(586)	5,126	3,732	-0.639
63	352	172,963	919	(1,264)	4,647	3,094	-0.045
64	217	173,882	104	(1,927)	4,126	2,597	-0.012
65	119	173,986	(1,534)	(4,711)	1,319	7,173	0.052
66	48	172,452	(1,649)	(5,031)	1,251	5,572	0.062
67	12	170,803	(2,692)	(6,940)	332	5,831	0.087
68	5	168,111	(4,066)	(7,998)	(443)	2,780	0.186
69	4	164,045	(4,178)	(5,280)	(745)	2,081	0.151

Notes:
(1) Tax Rate 2 is from Diamond and Gruber (1999). Definitions of other variables are provided in the text. Median SSW is the age 55 median SSW incremented by the median accrual.
(2) All figures are $1998.
(3) One source of difference between Tax Rate and Tax Rate 2 is that Tax Rate 2 includes SS contributions. Adding the 12.4% payroll tax to Tax Rate results in figures very similar to Tax Rate 2.

Table 6: The Distribution of the Peak Value and Option Value, Male Sample

Age	Peak Value				Option Value			
	Median	10th Percentile	90th Percentile	Standard Deviation	Median	10th Percentile	90th Percentile	Standard Deviation
55	23,579	4,785	42,312	16,253	23,755	4,956	37,331	11,461
56	21,266	4,276	39,893	15,790	22,030	4,728	35,302	10,780
57	18,548	3,929	37,021	14,386	20,207	4,134	32,641	10,119
58	16,804	3,630	34,450	13,865	18,390	3,258	30,507	9,512
59	15,456	3,105	31,339	13,398	16,894	2,879	28,240	8,861
60	14,083	2,479	28,931	12,559	15,225	2,041	25,728	8,217
61	12,925	2,059	24,597	12,320	13,623	1,775	23,146	7,477
62	11,886	1,769	21,665	10,363	11,877	1,442	20,767	6,649
63	8,102	762	15,267	9,707	10,143	1,257	18,164	5,913
64	3,508	0	8,805	7,954	8,057	452	15,343	5,113
65	(1,042)	(4,692)	4,908	9,099	6,187	0	12,606	4,396
66	(2,250)	(5,591)	1,520	7,556	4,342	0	9,850	3,612
67	(3,302)	(6,773)	0	9,033	2,690	0	7,662	3,048
68	(4,303)	(7,530)	0	2,871	1,962	0	5,151	1,937
69	(4,758)	(7,825)	0	2,735	893	0	2,616	963

Notes:
(1) Tax Rate 2 is from Diamond and Gruber (1999).
(2) Peak Value is in \$1998; Option Value is in utility units.

Table 7: The Distribution of the Peak Value and Option Value, Female Sample

Age	Peak Value				Option Value			
	Median	10th Percentile	90th Percentile	Standard Deviation	Median	10th Percentile	90th Percentile	Standard Deviation
55	9,359	166	33,369	14,639	12,506	1,174	27,876	10,113
56	8,981	134	32,237	14,144	12,195	953	26,443	9,599
57	8,097	120	30,074	13,791	11,309	794	24,471	8,952
58	6,799	90	28,006	13,325	10,235	574	22,223	8,311
59	5,724	78	24,602	12,323	9,334	369	20,350	7,649
60	4,889	70	21,578	11,991	8,705	338	18,780	7,046
61	3,685	39	19,680	12,077	7,584	131	16,594	6,352
62	2,121	(553)	17,115	9,432	6,447	130	14,218	5,460
63	1,434	(1,264)	12,171	8,539	5,514	88	12,292	4,778
64	280	(1,927)	7,806	7,574	4,382	0	10,169	4,040
65	(1,534)	(4,711)	3,880	9,901	3,496	0	8,995	3,535
66	(1,601)	(5,031)	3,651	7,387	2,504	0	7,761	2,761
67	(2,692)	(6,940)	332	6,362	2,281	0	5,800	2,194
68	(4,066)	(7,998)	(443)	2,780	1,417	130	4,796	1,804
69	(4,178)	(5,280)	(745)	2,081	274	0	706	340

Notes:
(1) Tax Rate 2 is from Diamond and Gruber (1999).
(2) Peak Value is in $1998; Option Value is in utility units.

Table 8: Retirement Probits, Male Sample

Variable	Specification					
	Accrual		Peak Value		Option Value	
	(1)	(2)	(3)	(4)	(5)	(6)
SSW	0.3581	0.2190	0.2519	0.1718	0.1730	0.1075
	(0.1163)	(0.1162)	(0.1157)	(0.1170)	(0.1146)	(0.1173)
$10,000 Change	**[0.0030]**	**[0.0018]**	**[0.0021]**	**[0.0014]**	**[0.0015]**	**[0.0009]**
Incentive Measure	1.8360	0.4560	-0.4289	-0.5697	-0.2368	-0.2106
	(0.3648)	(0.4137)	(0.2238)	(0.2367)	(0.0539)	(0.0522)
$1,000 Change	**[0.0015]**	**[0.0004]**	**[-0.0004]**	**[-0.0005]**		
Age	0.0922		0.0877		0.0691	
	(0.0154)		(0.0155)		(0.0162)	
Age56		-0.0311		-0.0332		-0.0470
		(0.0706)		(0.0707)		(0.0711)
Age57		-0.0693		-0.0759		-0.1075
		(0.0808)		(0.0810)		(0.0816)
Age58		0.0587		0.0479		0.0009
		(0.0877)		(0.0878)		(0.0890)
Age59		0.0696		0.0579		-0.0065
		(0.0986)		(0.0989)		(0.1006)
Age60		0.2079		0.1932		0.1082
		(0.1088)		(0.1092)		(0.1117)
Age61		0.3032		0.2847		0.1794
		(0.1178)		(0.1179)		(0.1215)
Age62		0.8999		0.8897		0.7650
		(0.1279)		(0.1268)		(0.1321)
Age63		0.8122		0.7852		0.6512
		(0.1446)		(0.1439)		(0.1495)
Age64		0.6908		0.6424		0.5050
		(0.1622)		(0.1628)		(0.1682)
Age65		1.0796		0.9881		0.8534
		(0.1779)		(0.1819)		(0.1870)
Age66		0.5924		0.4928		0.3540
		(0.2062)		(0.2097)		(0.2146)
Age67		0.4542		0.3467		0.1953
		(0.2539)		(0.2578)		(0.2615)
Age68		0.7229		0.5974		0.4231
		(0.2387)		(0.2429)		(0.2483)
Pseudo R-squared	0.1215	0.1379	0.1198	0.1386	0.1223	0.1402

Notes:
(1) All regressions include controls for education, race, experience, marital status, industry, occupation, region, year, as well as a quartic in earnings, a quartic in lifetime earnings, and the interctions of these quartics (plus same earnings variables for the spouse).

Table 9: Retirement Probits, Female Sample

Variable	Specification					
	Accrual		Peak Value		Option Value	
	(1)	(2)	(3)	(4)	(5)	(6)
SSW	0.2619	0.2265	0.2430	0.2169	0.2080	0.1838
	(0.1132)	(0.1130)	(0.1132)	(0.1129)	(0.1142)	(0.1135)
$10,000 Change	**[0.0020]**	**[0.0017]**	**[0.0019]**	**[0.0017]**	**[0.0016]**	**[0.0014]**
Incentive Measure	0.7727	0.4773	-0.0618	-0.0132	-0.2695	-0.2414
	(0.7291)	(0.8169)	(0.2853)	(0.2856)	(0.0772)	(0.0752)
$1,000 Change	**[0.0006]**	**[0.0004]**	**-[0.00005]**	**[-0.00001]**		
Age	0.1219		0.1217		0.1040	
	(0.0219)		(0.0219)		(0.0223)	
Age56		0.0223		0.0217		0.0101
		(0.0825)		(0.0824)		(0.0826)
Age57		0.0474		0.0480		0.0312
		(0.0960)		(0.0959)		(0.0961)
Age58		0.1254		0.1268		0.0964
		(0.1104)		(0.1103)		(0.1104)
Age59		0.1186		0.1212		0.0784
		(0.1295)		(0.1294)		(0.1298)
Age60		0.4364		0.4389		0.3811
		(0.1415)		(0.1414)		(0.1422)
Age61		0.4587		0.4632		0.3928
		(0.1585)		(0.1584)		(0.1599)
Age62		1.0015		1.0075		0.9102
		(0.1702)		(0.1699)		(0.1720)
Age63		0.9872		0.9918		0.8721
		(0.1939)		(0.1937)		(0.1966)
Age64		0.8106		0.8119		0.6718
		(0.2229)		(0.2223)		(0.2262)
Age65		1.2619		1.2533		1.0901
		(0.2464)		(0.2456)		(0.2497)
Age66		0.8181		0.8086		0.6318
		(0.3377)		(0.3371)		(0.3406)
Age67		0.2807		0.2714		0.0774
		(0.5925)		(0.5941)		(0.6078)
Age68		0.8993		0.8815		0.6609
		(0.5079)		(0.5084)		(0.5215)
Pseudo R-squared	0.1418	0.1530	0.1416	0.1530	0.1441	0.1549

Notes:
(1) All regressions include controls for education, race, experience, marital status, industry, occupation, region, year, as well as a quartic in earnings, a quartic in lifetime earnings, and the interctions of these quartics (plus same earnings variables for the spouse).

Table 10: Average Retirement Rates in Simulations

Case	Simulated Reform	
	Plus 3 Years	Common Reform
Males: Base Retirement Rate	0.057	0.057
Males: Peak Value, S1	0.048	0.080
Males: Peak Value, S2	0.051	0.064
Males: Peak Value, S3	0.037	0.076
Males: Option Value, S1	0.048	0.081
Males: Option Value, S2	0.051	0.071
Males: Option Value, S3	0.039	0.083
Females: Base Retirement Rat(	0.066	0.066
Females: Option Value, S1	0.057	0.094
Females: Option Value, S2	0.056	0.088
Females: Option Value, S3	0.039	0.100

Figure 1: LFPR of Men and Women 55-64, 1948-1998

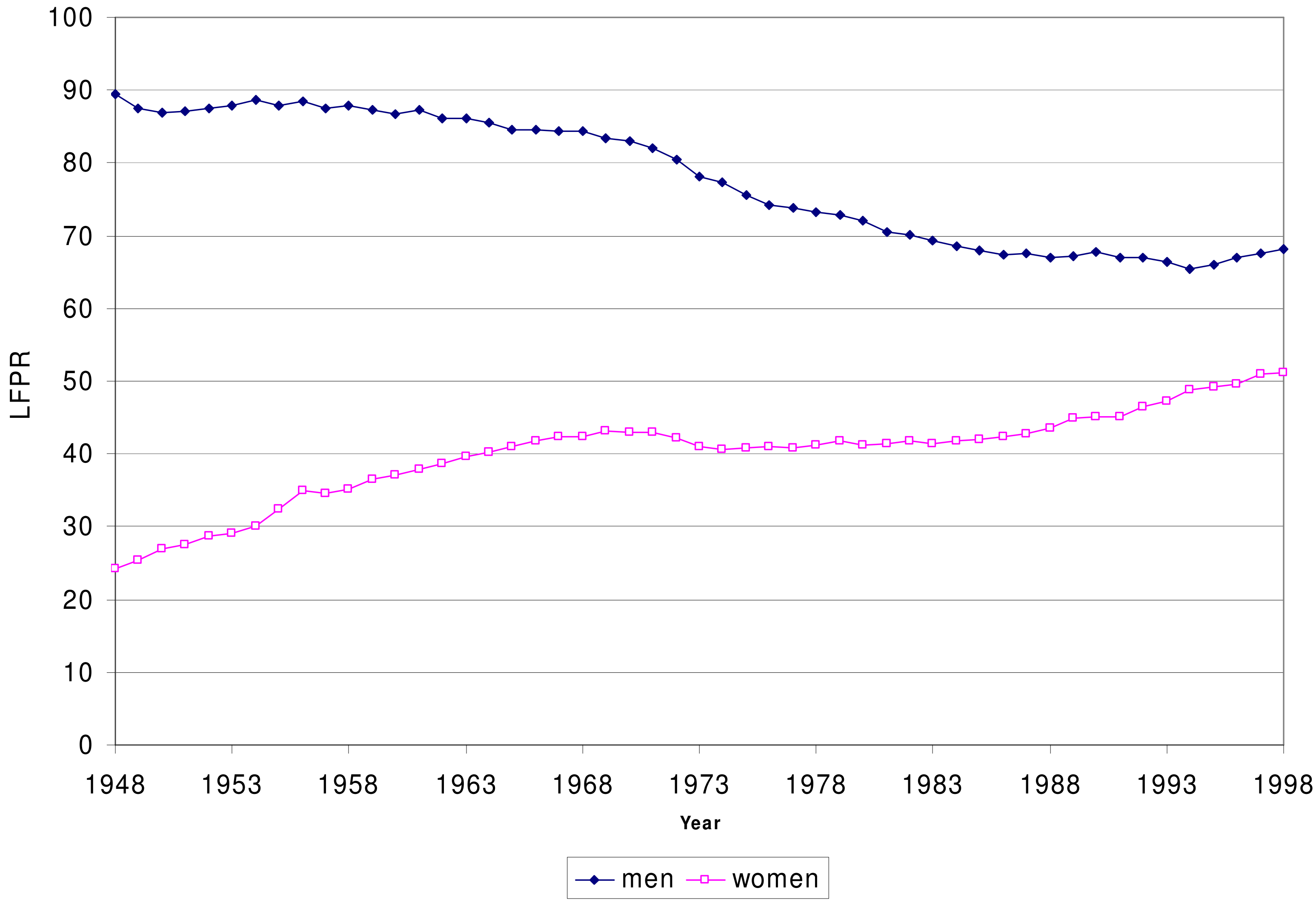


Figure 2: Retirement Hazard and Age Dummies for Males

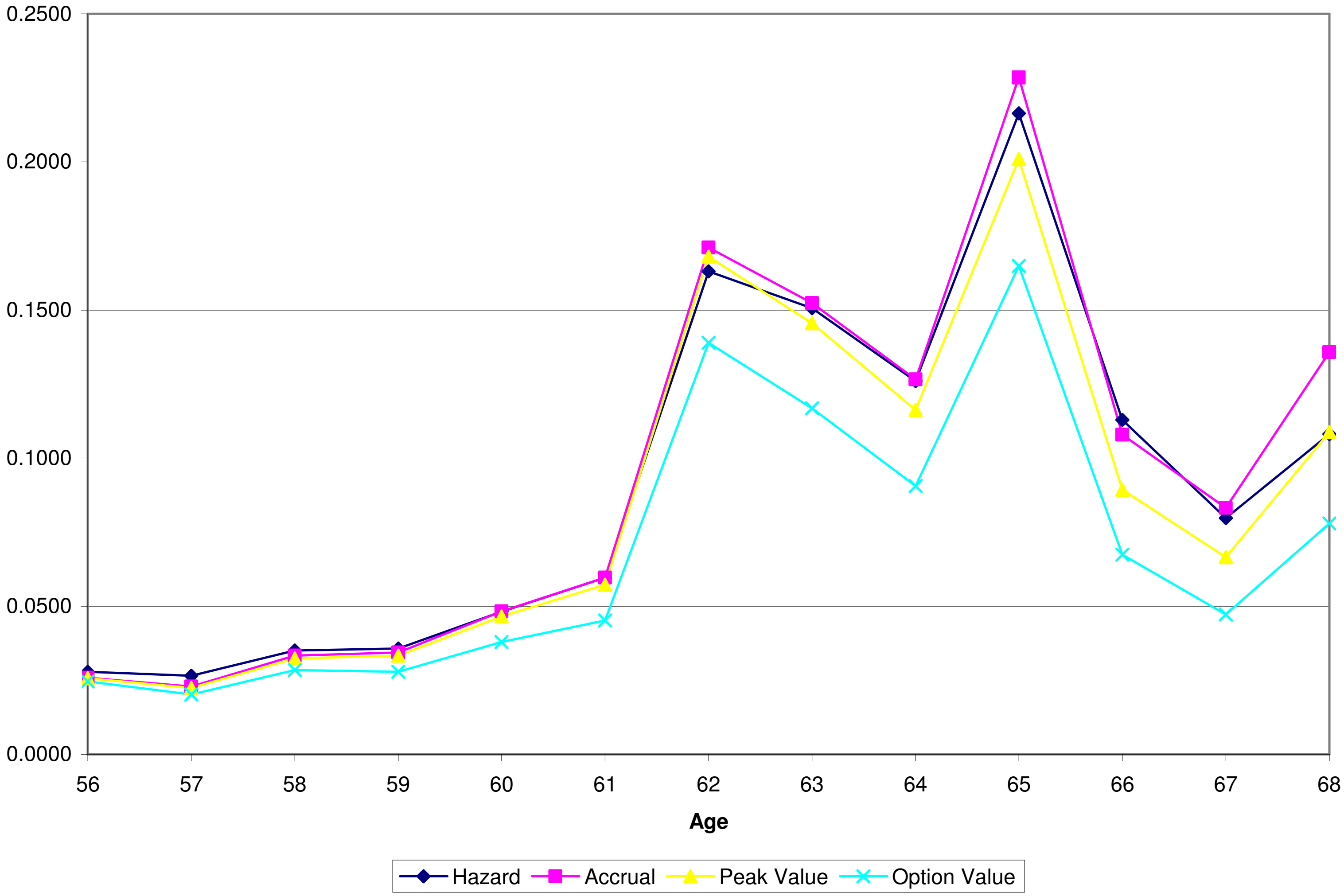
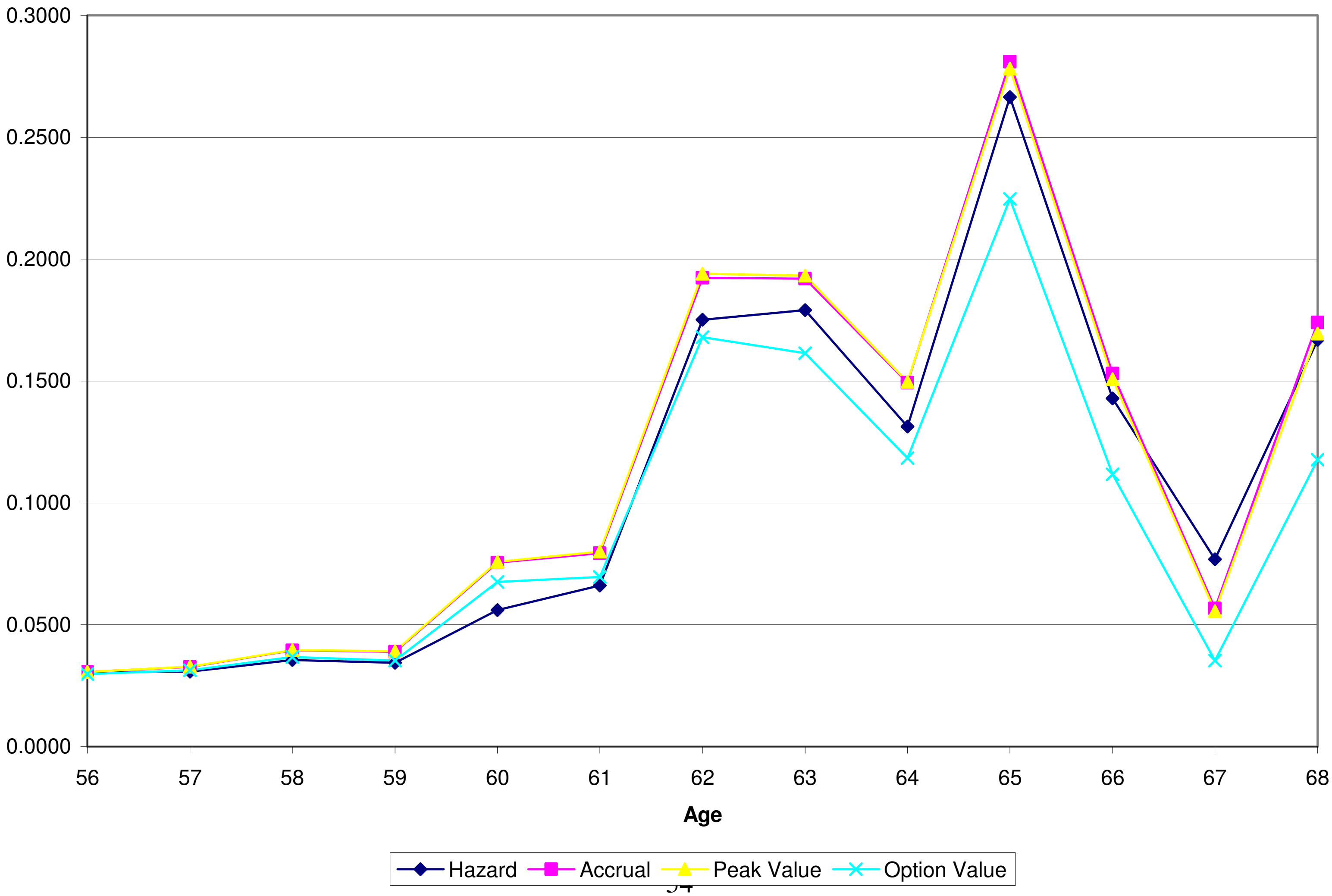


Figure 3: Retirement Hazard and Age Dummies for Females



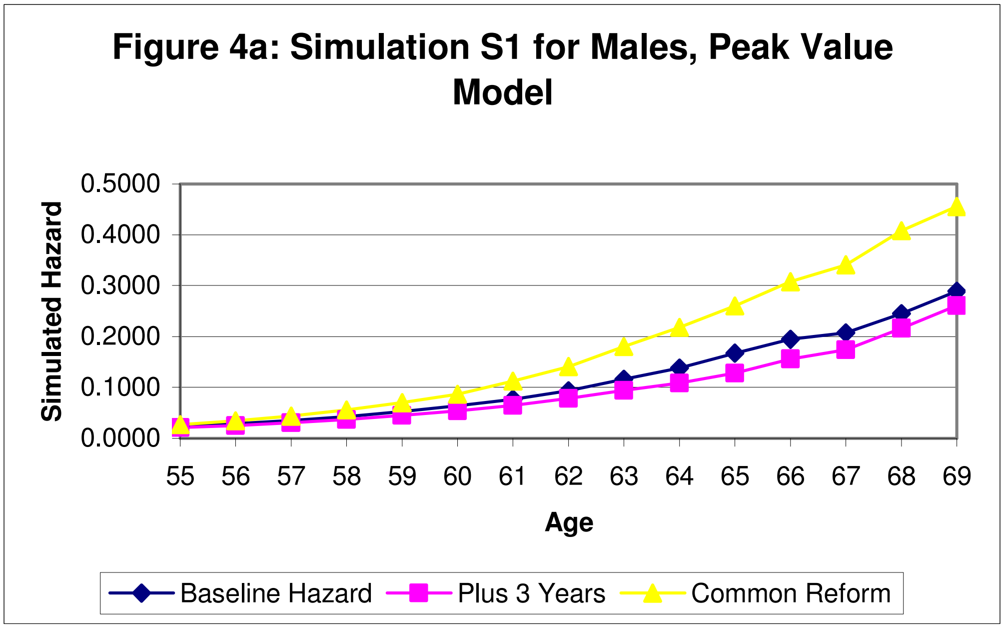


Figure 4a: Simulation S1 for Males, Peak Value Model
Simulated Hazard
0.5000
0.4000
0.3000
0.2000
0.1000
0.0000
55 56 57 58 59 60 61 62 63 64 65 66 67 68 69
Age
Baseline Hazard
Plus 3 Years
Common Reform

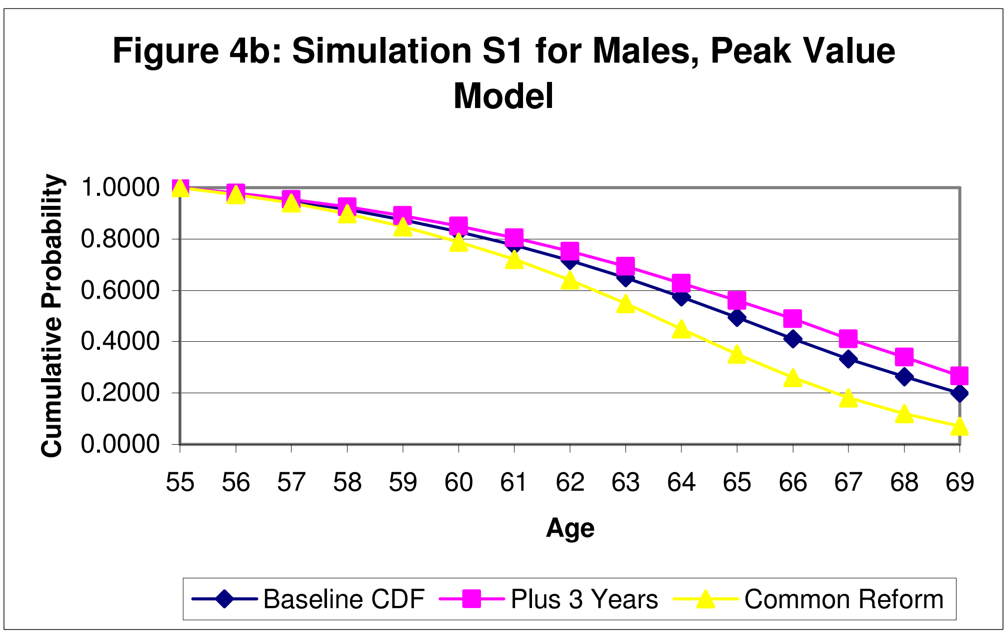


Figure 4b: Simulation S1 for Males, Peak Value Model
Cumulative Probability
1.0000
0.8000
0.6000
0.4000
0.2000
0.0000
55 56 57 58 59 60 61 62 63 64 65 66 67 68 69
Age
Baseline CDF
Plus 3 Years
Common Reform

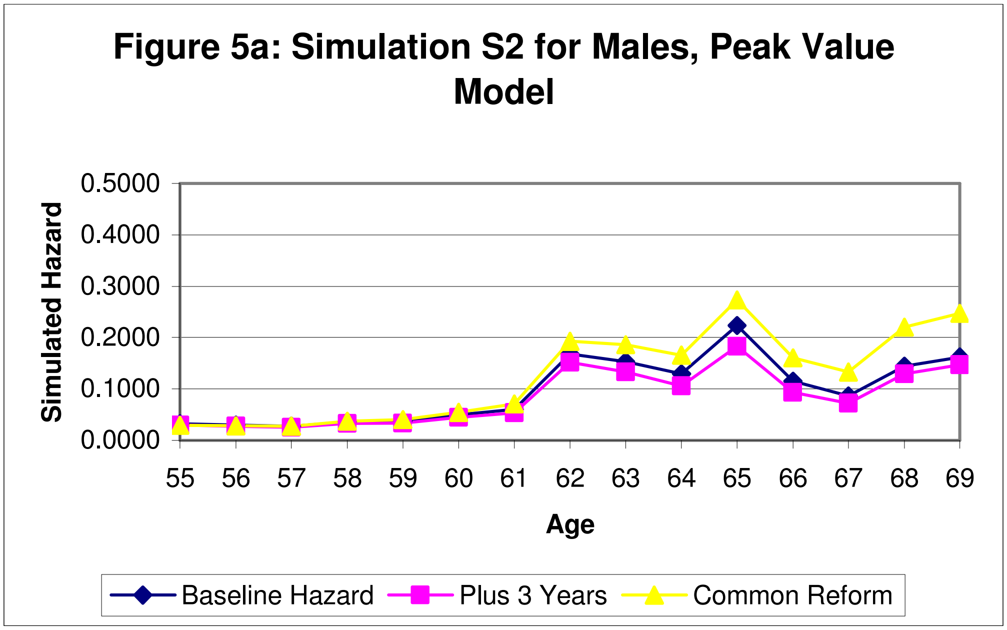


Figure 5a: Simulation S2 for Males, Peak Value Model
Simulated Hazard
0.5000
0.4000
0.3000
0.2000
0.1000
0.0000
55 56 57 58 59 60 61 62 63 64 65 66 67 68 69
Age
Baseline Hazard
Plus 3 Years
Common Reform

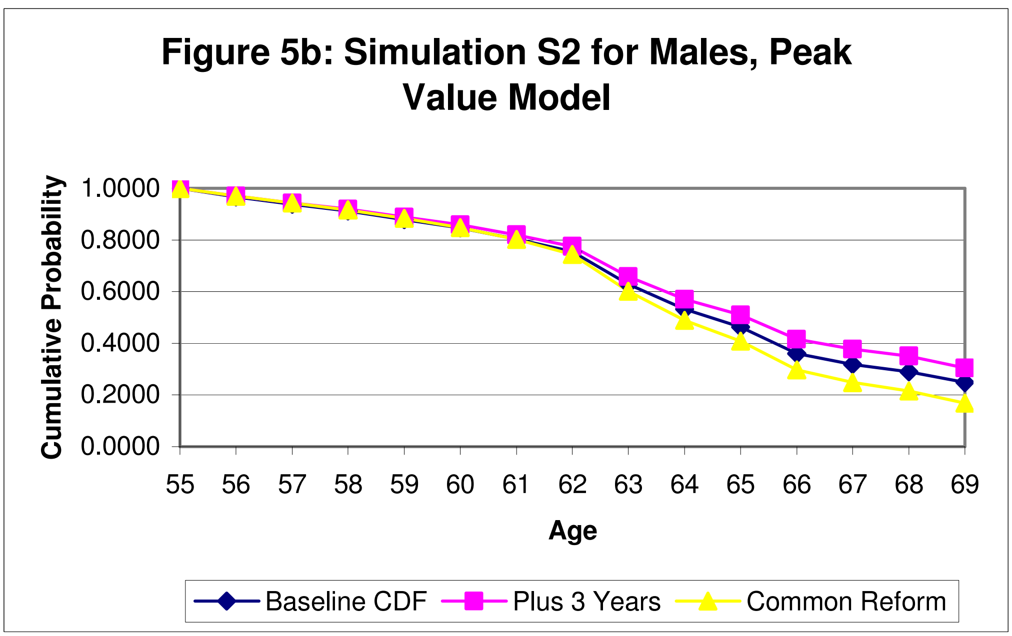


Figure 5b: Simulation S2 for Males, Peak Value Model
Cumulative Probability
1.0000
0.8000
0.6000
0.4000
0.2000
0.0000
55 56 57 58 59 60 61 62 63 64 65 66 67 68 69
Age
Baseline CDF
Plus 3 Years
Common Reform

Figure 6a: Simulation S3 for Males, Peak Value Model

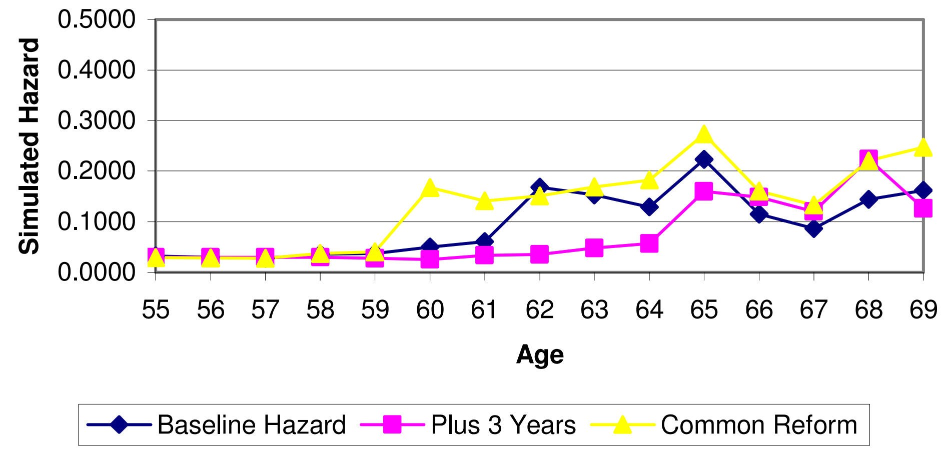
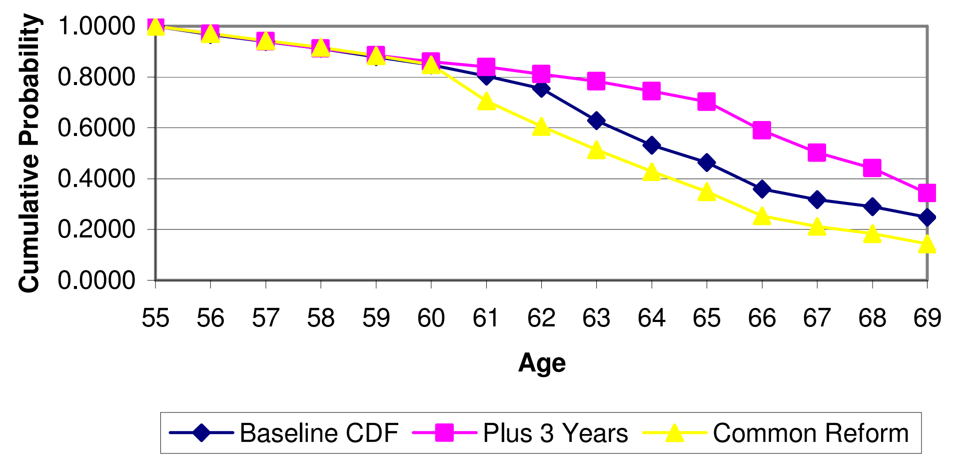


Figure 6b: Simulation S3 for Males, Peak Value Model



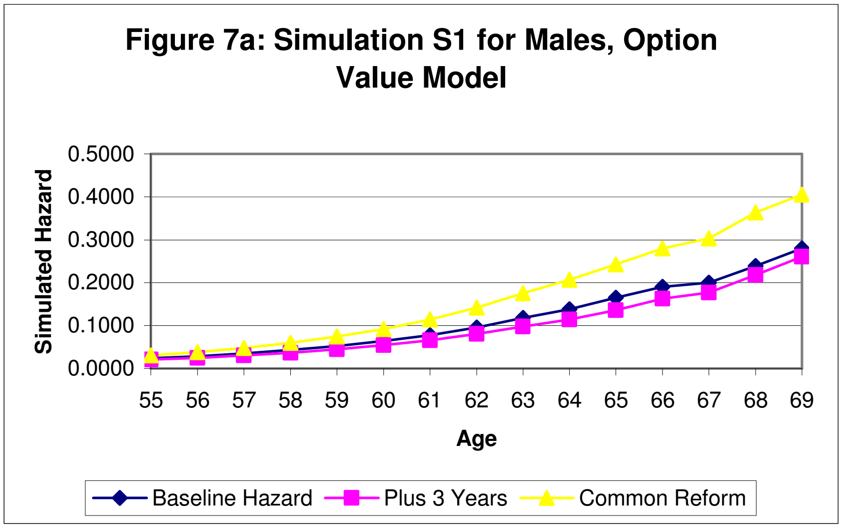


Figure 7a: Simulation S1 for Males, Option Value Model
Simulated Hazard
0.5000
0.4000
0.3000
0.2000
0.1000
0.0000
55 56 57 58 59 60 61 62 63 64 65 66 67 68 69
Age
Baseline Hazard
Plus 3 Years
Common Reform

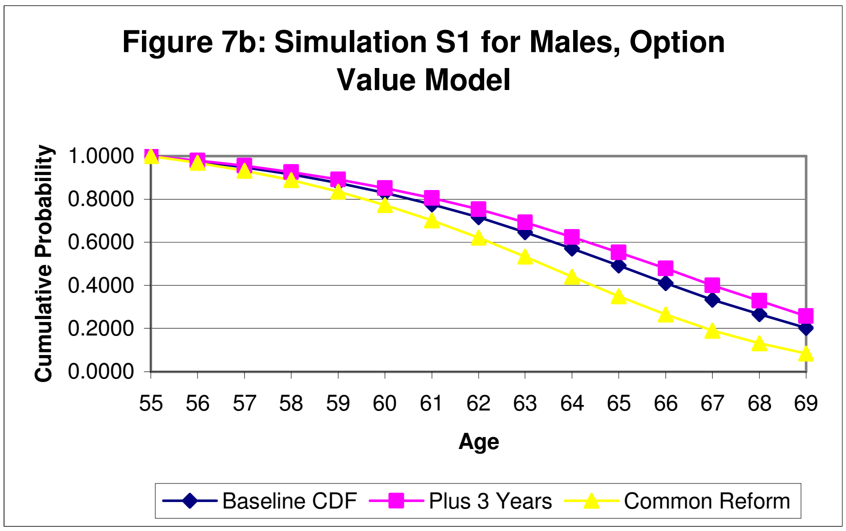


Figure 7b: Simulation S1 for Males, Option Value Model
Cumulative Probability
1.0000
0.8000
0.6000
0.4000
0.2000
0.0000
55 56 57 58 59 60 61 62 63 64 65 66 67 68 69
Age
Baseline CDF
Plus 3 Years
Common Reform

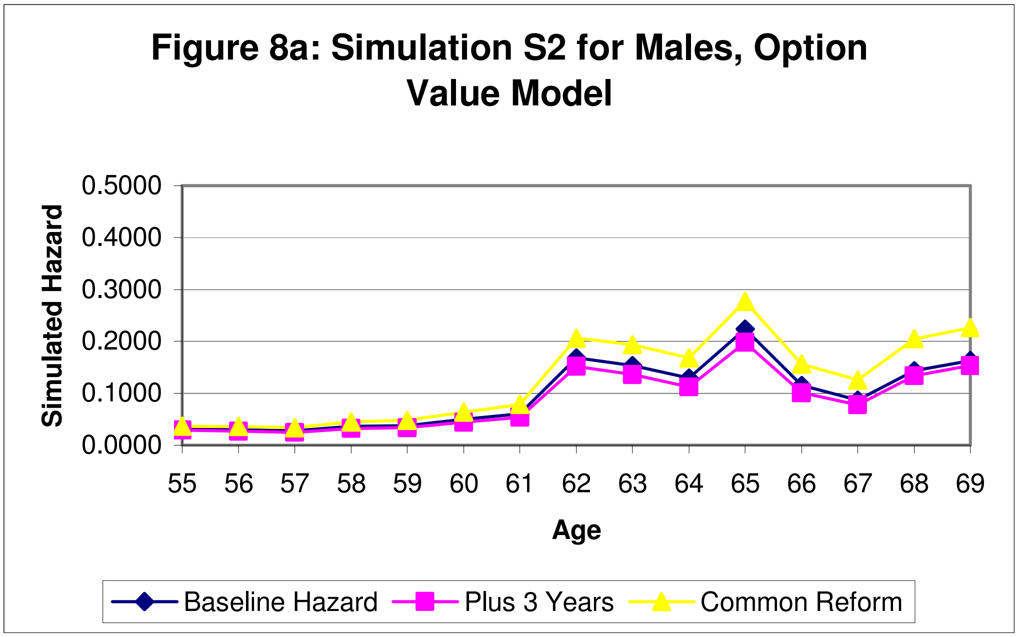


Figure 8a: Simulation S2 for Males, Option Value Model
Simulated Hazard
0.5000
0.4000
0.3000
0.2000
0.1000
0.0000
55 56 57 58 59 60 61 62 63 64 65 66 67 68 69
Age
Baseline Hazard
Plus 3 Years
Common Reform

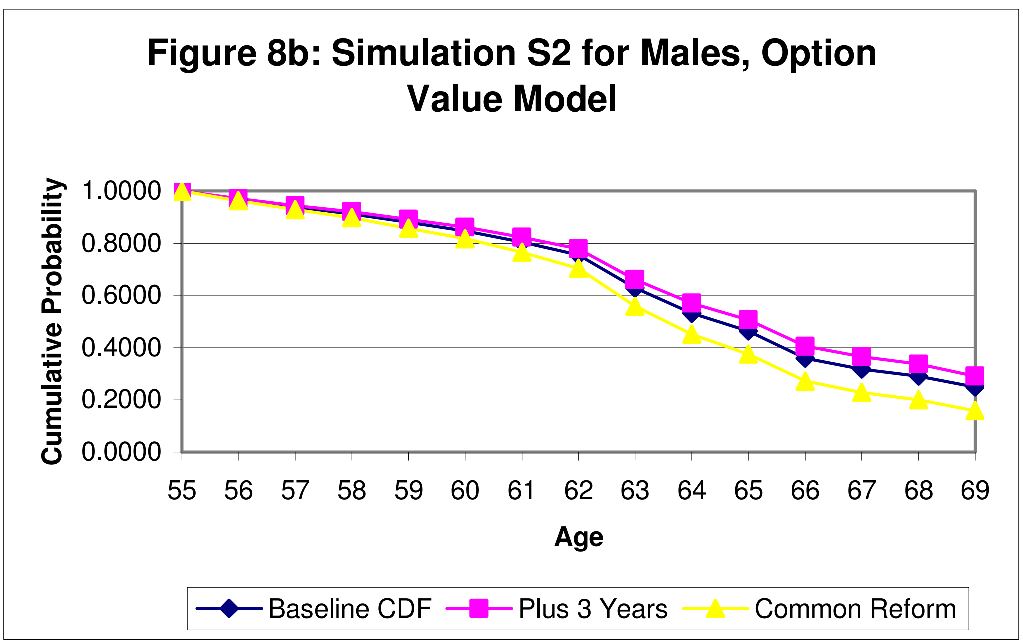


Figure 8b: Simulation S2 for Males, Option Value Model
Cumulative Probability
1.0000
0.8000
0.6000
0.4000
0.2000
0.0000
55 56 57 58 59 60 61 62 63 64 65 66 67 68 69
Age
Baseline CDF
Plus 3 Years
Common Reform

Figure 9a: Simulation S3 for Males, Option Value Model

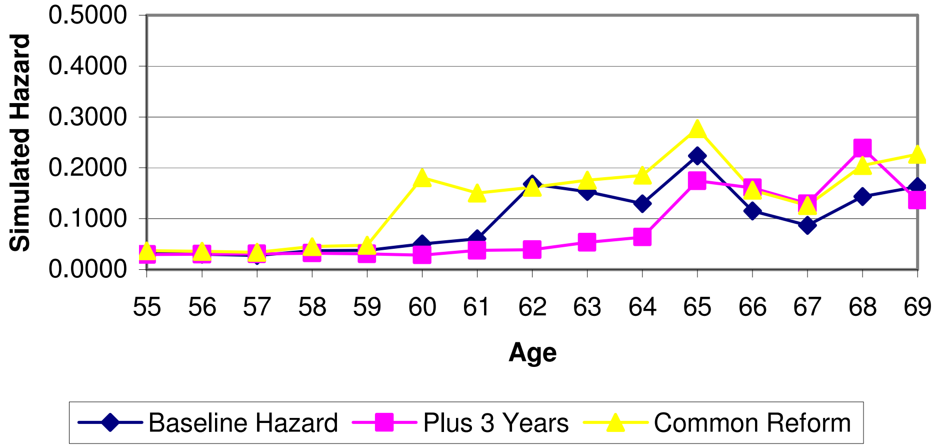
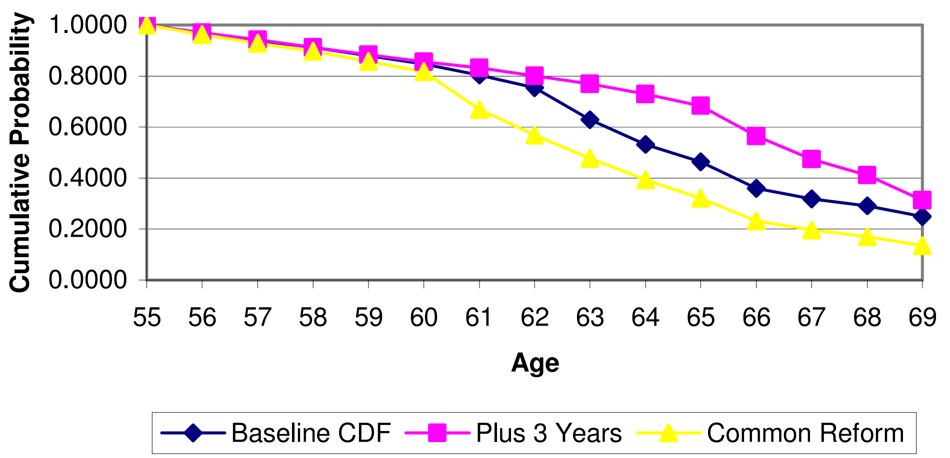


Figure 9b: Simulation S3 for Males, Option Value Model



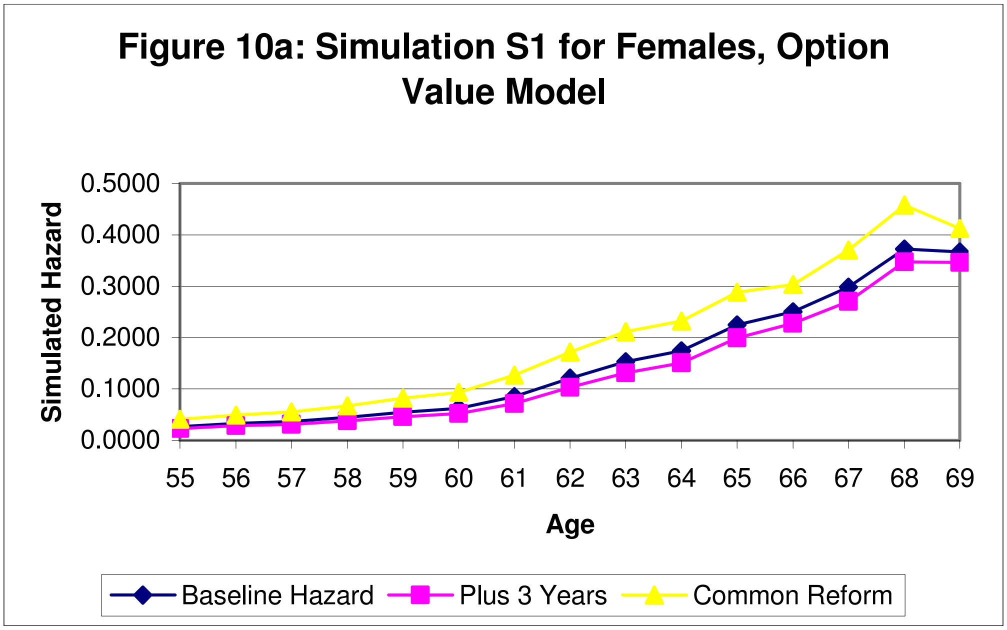


Figure 10a: Simulation S1 for Females, Option Value Model
Simulated Hazard
0.5000
0.4000
0.3000
0.2000
0.1000
0.0000
55 56 57 58 59 60 61 62 63 64 65 66 67 68 69
Age
Baseline Hazard
Plus 3 Years
Common Reform

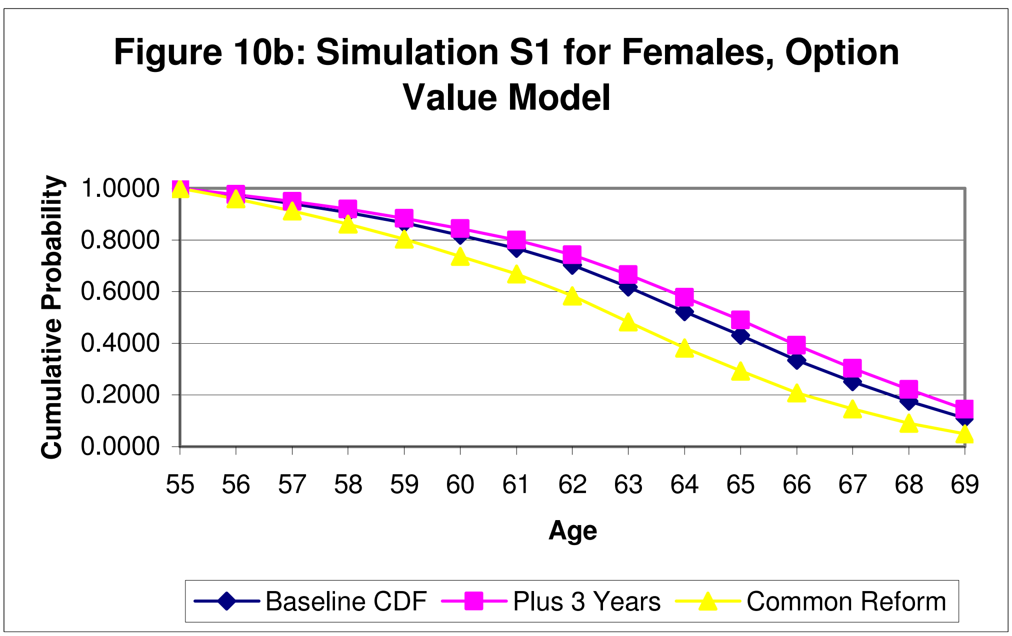


Figure 10b: Simulation S1 for Females, Option Value Model
Cumulative Probability
1.0000
0.8000
0.6000
0.4000
0.2000
0.0000
55 56 57 58 59 60 61 62 63 64 65 66 67 68 69
Age
Baseline CDF
Plus 3 Years
Common Reform

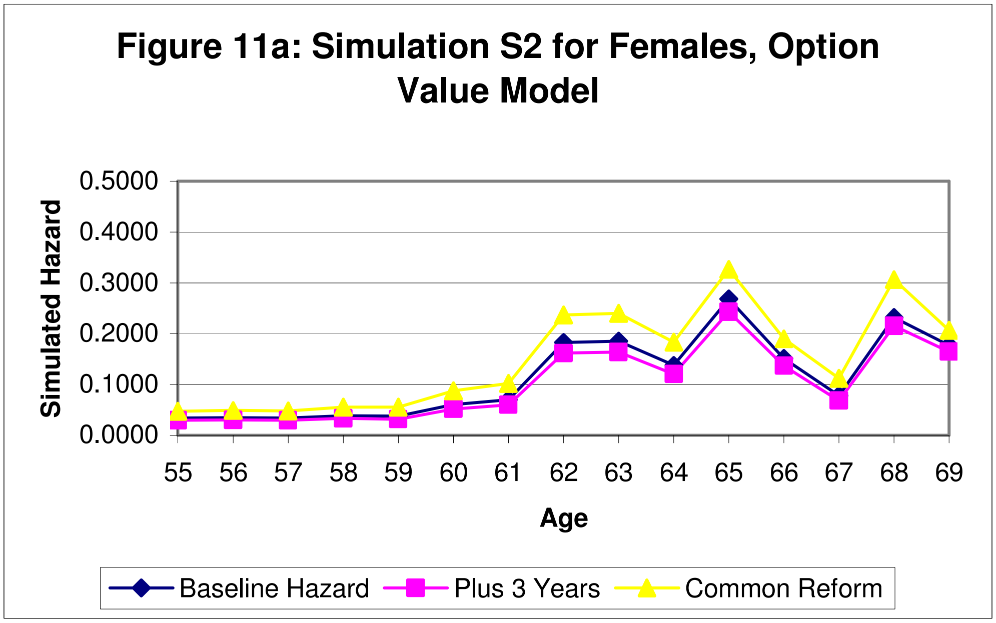


Figure 11a: Simulation S2 for Females, Option Value Model
Simulated Hazard
0.5000
0.4000
0.3000
0.2000
0.1000
0.0000
55
56
57
58
59
60
61
62
63
64
65
66
67
68
69
Age
Baseline Hazard
Plus 3 Years
Common Reform

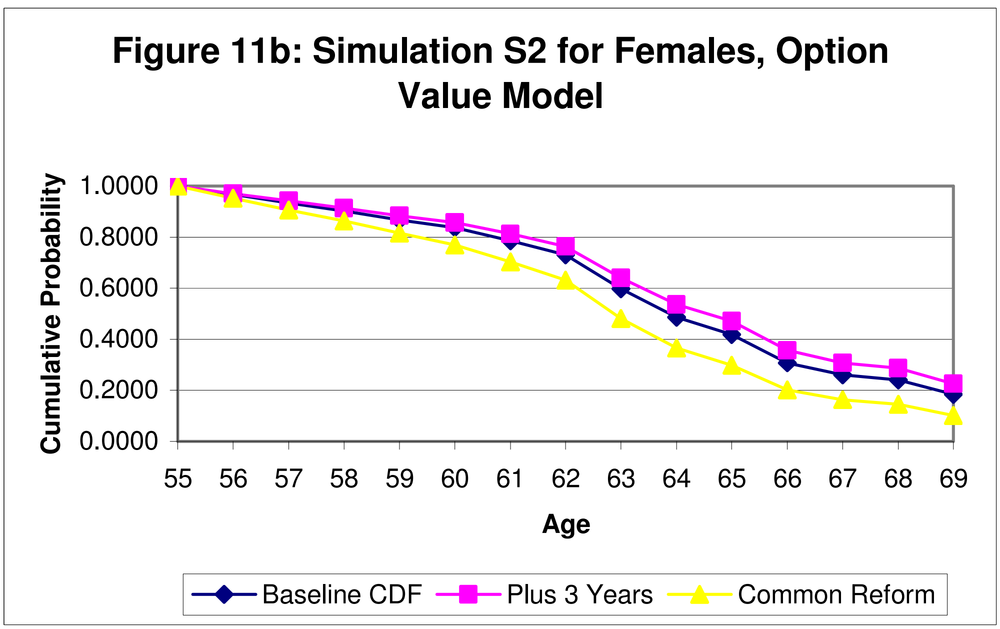


Figure 11b: Simulation S2 for Females, Option Value Model
Cumulative Probability
1.0000
0.8000
0.6000
0.4000
0.2000
0.0000
55
56
57
58
59
60
61
62
63
64
65
66
67
68
69
Age
Baseline CDF
Plus 3 Years
Common Reform

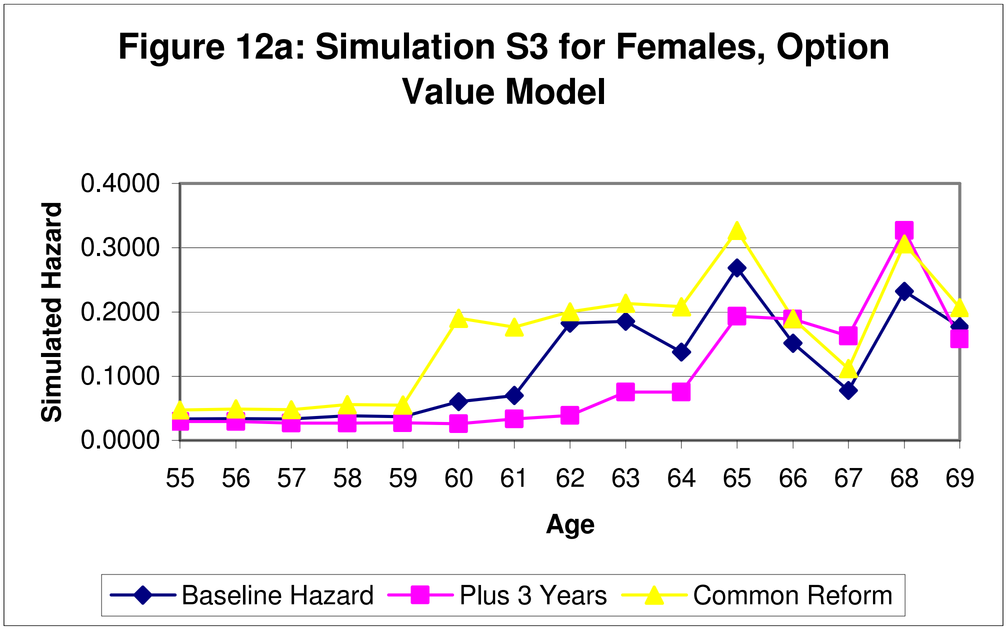


Figure 12a: Simulation S3 for Females, Option Value Model
Simulated Hazard
0.4000
0.3000
0.2000
0.1000
0.0000
55 56 57 58 59 60 61 62 63 64 65 66 67 68 69
Age
Baseline Hazard
Plus 3 Years
Common Reform

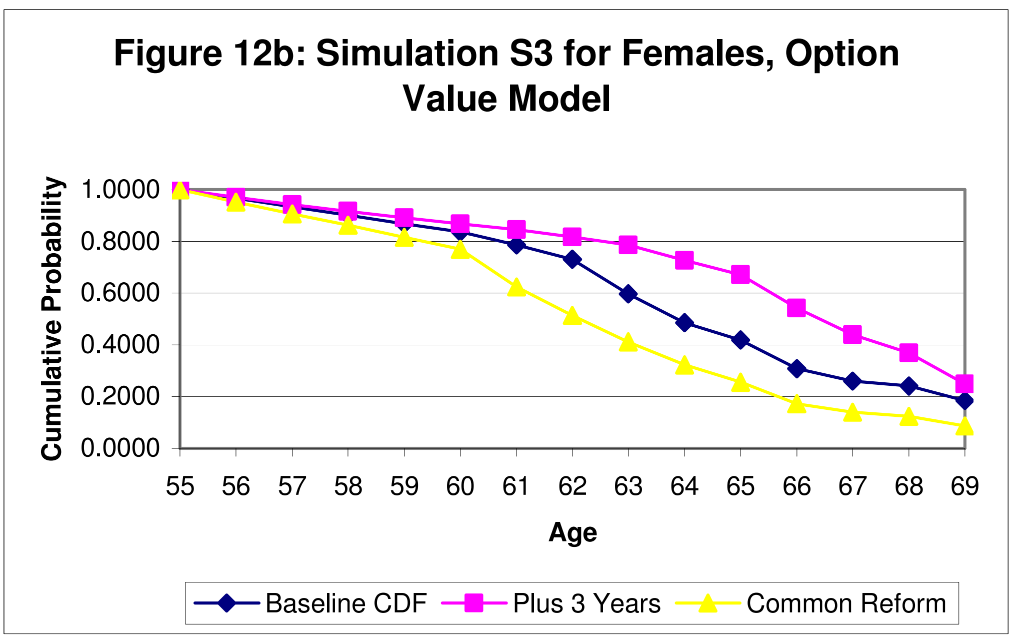


Figure 12b: Simulation S3 for Females, Option Value Model
Cumulative Probability
1.0000
0.8000
0.6000
0.4000
0.2000
0.0000
55 56 57 58 59 60 61 62 63 64 65 66 67 68 69
Age
Baseline CDF
Plus 3 Years
Common Reform