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RETIREMENT INCENTIVES: THE INTERACTION BETWEEN EMPLOYER-PROVIDED PENSIONS, SOCIAL SECURITY, AND RETIREE HEALTH BENEFITS

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ABSTRACT

Proposed changes in the U.S. Social Security provisions include increasing the normal retirement age from 65 to 67 and changing from 3% to 8% the increase in benefits for each year that retirement is delayed after normal retirement. The paper considers the interaction between these changes and the provisions of employer-provided pension plans. For persons with an employer-provided defined benefit plan, the conclusion is that the Social Security changes will have little effect on labor force participation, but that changes in the firm plan - like increasing the early retirement age - would have very large effects on labor force participation.

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The retirement effects of United States Social Security provisions have been the subject of study for some time. The scheduled phased increase in the Social Security normal retirement age motivates continued interest in the effects of the provisions. In considering changes in Social Security provisions and in contemplating the effects of the changes, attention has been directed primarily to the Social Security provisions themselves. The potential interaction between the effects of Social Security and the effects of employer-provided pension plan provisions has been largely ignored. Yet about half of American workers are covered by employer pension plans and about two-thirds of these are covered by defined benefit plans. These plans typically have very substantial retirement incentives and in a large proportion of cases are likely to dominate the effect of Social Security provisions. This paper considers the interaction between the effects of Social Security and employer-provided pension plans. We also give attention to the retirement effects of health benefits and to other provisions that may affect retirement.

The analysis rests on and continues our ongoing study of the retirement effects of employer-provided pension plans. The illustrations in this paper are based on data from "Firm III." We analyzed the Firm III data in an earlier paper [Lumsdaine, Stock, and Wise, 1993] and this paper uses the results from that paper as a starting point for the analysis presented here. Our work to date has emphasized the dramatic effect of employer-provided pension plan provisions on age of retirement and the enormous effects that can occur by changing the provisions. The work has also highlighted the important limitations of using Social Security provisions to predict retirement behavior,

without accounting for the effect of employer pension plan provisions, which, for employees who have such plans, is typically much more powerful than the effect of Social Security provisions.

In two initial papers, Stock and Wise [1990a, 1990b] developed an "option value" model of retirement. The central feature of this model is that in deciding whether to retire employees are assumed to compare the "value" of retiring now to the value of the maximum of the expected values of retiring at all future retirement ages. If the maximum of the future values is greater than the value of retirement now, the employee continues to work. We tested the predictive validity of this model in two ways: first, we considered the "within-sample fit" of the model, by comparing the actual pattern of retirement by age to the pattern predicted by the model, based on the data used for estimation. Second, in papers by Lumsdaine, Stock, and Wise [1990, 1991] we emphasized an external "out-of-sample" check of predictive validity, by considering how well the model predicted the effect on retirement of an unanticipated and temporary change in the pension plan provisions, occasioned by an early retirement window plan. In a subsequent paper, Lumsdaine, Stock, and Wise [1992] compared the predictive validity of the option value model and two versions of stochastic dynamic programming models. The stochastic dynamic programming model is close in spirit to the option value model, but the prediction of retirement is based on the comparison of the value of retirement now to the expected value of the maximum of the values of future retirement ages. The evidence was that the option value model predicted just as well as the stochastic dynamic programming models,

but had the advantage of being much less complex numerically. This finding was repeated in Lumsdaine, Stock, and Wise [1993], using Firm III data. Ausink [1991] pursued a similar comparison based on retirement from the military and found that the option value version was noticeably better than the stochastic dynamic programming versions. The simulations in this paper are thus based on the option value model.

The use of firm data was motivated by the absence of information on pension plan provisions in standard data sources, like the Retirement History Survey, and by the realization that the incentives inherent in such plans could be very substantial and varied widely among firms.[1] Our work to date shows quite similar results for three firms. Thus, although the results in this paper are based on a single illustrative employer pension plan, we believe that the findings are representative of typical firms with defined benefit plans.

The results are presented in the form of simulated effects of changes in the employer pension plan and Social Security provisions. The predicted retirement rates based on option value model estimates serve as the base with which simulated retirement rates under new provisions are compared. We begin in Section I with a description of the firm plan, emphasizing its key provisions. The model used in the analysis and empirical results are then explained. This material is largely abstracted from Lumsdaine, Stock, and Wise [1993]. The

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[1]See, for example, Bulow [1981], Lazear [1983], and Kotlikoff and Wise [1985, 1987, 1988].

effects of changes in provisions are discussed in Section II. A summary of findings is presented in Section III.

I. THE FIRM III PENSION PLAN AND THE RETIREMENT MODEL.

A. The Employer-Provided Pension Plan.

Employees are covered by a defined benefit pension plan with normal retirement at 65 and early retirement at 55. Cliff vesting occurs at 10 years of service, with the exception that employees are vested at 65 even if they have fewer years of service. The normal retirement benefit at 65 depends on earnings, age, and years of service at retirement (that is, at the time of departure from the firm). A person can retire and elect to start receiving benefits before age 65 but the normal benefit will be reduced by 5 percent for each year that receipt of benefits precedes age 65, as shown in figure 1. A person who retired at age 55, for example, would receive 50 percent of the normal retirement benefit of a person who left the firm at age 65. (The normal benefit also depends on years of service at the time of retirement.)

However, if a person has thirty years of service at retirement, and if the person is age 60 or older, the person is eligible for 100 percent of the normal benefit. Benefits are reduced 5 percent for each year that retirement precedes age 60, if the person has 30 years of service. For example, a person who retired at age 55 with 30 years of service would receive 75 percent of the normal benefit.

Even a person who retires before age 55 and is vested can elect to receive benefits from the pension plan as early as 55, but like the post-55 retiree, benefits are reduced 5 percent for each year that receipt

of the benefits precedes age 65. Of course, this person's benefits would be based on earnings, age, and years of service at the time of retirement, unadjusted for earnings inflation, and would thus be lower than the benefits of a person who retired later.

Employees who joined the firm before 1951, can retire as early as 50 and begin to receive benefits immediately, but at a reduced rate. An employee hired before 1951 had at least 31 years of service in 1982. The reduction for this group is indicated by the extended line that indicates benefits at age 50 of 54.3 percent of the age 60 benefits for an employee who has 30 or more years of service at retirement.

To demonstrate the effect of the pension plan provisions, figure 2a shows the expected future compensation of a person from our sample who is 51 years old and has been employed by the firm for 23 years. To compute the data graphed in figures 2a-2e, a 5 percent real discount rate and a 6 percent inflation rate are assumed. The discount rate is estimated in the empirical analysis and the inflation rate is assumed to be 6 percent. Total compensation from the firm can be viewed as the sum of wage earnings, the accrual of pension benefits, and the accrual of Social Security benefits. (This omits medical and other unobserved benefits that should be included as compensation, but for which we have no firm data.) As compensation for working another year the employee receives salary earnings. Compensation is also received in the form of future pension benefits. The annual compensation in this form is the change in the present value of the future pension benefits entitlement, due to working an additional year. This accrual is comparable to wage earnings. The accrual of Social

Security benefits may be calculated in a similar manner, and is also comparable to wage earnings. Figure 2a shows the present value at age 51 of expected future compensation in all three forms. Wage earnings represents cumulated earnings, by age of retirement from the firm (more precisely, by age of departure from the firm, since some workers might continue to work in another job). For example, the cumulated earnings of this employee between age 51 and age 60 were he to retire at age 60 would be about $482,000, discounted to age 51 dollars. The slope of the earnings line represents annual earnings discounted to age 51 dollars.

The pension line shows the accrual of firm pension benefits, again discounted to age 51 dollars. It is graphed separately with Social Security accrual in figure 2e. The shape of this profile is determined by the pension plan provisions. The present value of accrued pension benefit entitlement at age 51 is about $54,000. The present value of retirement benefits increases between 51 and 57 because years of service and nominal earnings increase. An employee could leave the firm at age 53, for example. If he were to do that, and if he were vested in the firm's pension plan he would be entitled to normal retirement pension benefits at age 65, based on his years of service and nominal dollar earnings at age 53. He could choose to start receiving benefits as early as age 55, the pension early retirement age, but the benefit amount would be reduced 5 percent for each year that the receipt of benefits preceded age 65. Because 5 percent is less than the actuarially fair discount rate, the present value of benefits of a person

who leaves the firm before 55 are always greatest if receipt of benefits begins at 55.

Recall that a person who has accumulated 30 years of service and is 55 or older, is entitled to increased retirement benefits that would reach 100 percent of normal retirement benefits at age 60. No early retirement reduction is applied to benefits if they are taken then. So a person at age 60 with 30 years of service who continues to work will no longer gain 5 percent a year from fewer years of early retirement reduction, as occurs before age 60. There is a jump in the benefits of a person younger than 60 who attains 30 years of service. That accounts for the jump in the benefits of the person depicted in the figure 2a, when he attains 30 years of service at age 58.

The Social Security accrual profile is determined by the Social Security benefit provisions. The present value of accrued Social Security benefit entitlement at age 51 is about $33,000. Social Security benefits cannot begin until age 62. If real earnings do not change much between 51 and 62, then real Social Security benefits at 62 will not change much either. After age 62, the actuarial adjustment is such that the present value of benefits, evaluated at the age of retirement, does not depend on the retirement age. But the present value of the benefits discounted to the same age (51 in this case), declines. There is a further drop after age 65 because the actuarial adjustment is reduced from 7 percent to 3 percent.

The top line shows total compensation. For example, the wage earnings of an employee who left the firm at age 60 would increase $482,000 between ages 51 and 60, shown by the wage earnings line.

Thereafter, the employee would receive firm pension plan and Social Security retirement benefits with a present value -- at age 51 -- of about $170,000. The sum of the two is about $652,000, shown by the top line. Compared to total compensation of $575,000 between 51 and 60, an average of $63,000 per year, total compensation between 60 and 65 would be only $100,000, or $23,000 per year. Thus the monetary reward for continued work declines dramatically with age.

Figures 2b through 2d show comparable compensation profiles for employees who are 57, 60, and 64 respectively in 1982; they have 29, 38, and 45 years of service respectively. The person depicted in figure 2b attains 30 years of service at age 58; thus the jump in pension benefits at that age. The present value of pension plus Social Security compensation reaches a maximum at age 59 and declines thereafter. Were this employee to continue to work after 59, until 65, the present value of total retirement benefits would fall by $33,000, offsetting about 28 percent of the present value of wage earnings over this period ($117,000). A similar prospect faces the employee depicted in figure 2c, but this employee is already entitled to 100 percent of normal retirement benefits and loses benefits for each year that he continues to work.

The employee who faces the figure 2d compensation profile is 64 and loses both pension and Social Security benefits for each year that retirement is postponed. At age 65, for example, about 54 percent of expected wage earnings would be offset by a reduction in retirement benefits, if retirement were postponed.

B. The 1983 Window.

To evaluate the predictive validity of the estimated model, we use estimates based on data for an earlier year to predict retirement under the subsequent 1983 window plan. Under the window plan, which was in effect from January 1 to February 28, all employees were eligible for a separation bonus, but the most generous payments were available to persons 55 and older who had at least 21 years of service. Retirement benefits for this group were increased depending on age and years of service. For example, a person age 59 with 28 years of service, could receive 100 percent of normal retirement benefits, instead of 70 percent under the regular plan. That is, this person's retirement benefit would be increased by 43 percent. A person who was 55 with 21 years of service could receive 55 percent of the normal benefits, instead of 50 percent. Persons age 60 or older with 30 years of service were eligible for 100 percent of normal benefits under the regular plan.

In addition, all employees were eligible for a separation bonus equal to one week's pay for every year of service, with a minimum of 2 and a maximum of 26 weeks of pay. Thus even persons who were under 55 and those who were eligible for 100 percent of normal retirement benefits faced an added inducement to retire.

C. Estimation.

1. The Data.

The data used in the analysis are drawn from the personnel records of all persons employed by the firm at any time between 1979 and 1988. A year-end file is available for each year. Earnings records

back to 1979 (or to the date of hire if after 1979) are available for each employee. In addition, the data contain some demographic information such as date of birth, gender, marital status, and occupational group. The retirement date of employees who retire is also known. (More generally, the date of any departure is known and the reason for the departure is recorded.) Thus we are able to determine whether a person who was employed at age a was also employed at age a+1, and if not, the exact age at which the employee left the firm.

The estimation of the retirement model in this paper is based on 1982 data, whether or not an employee left the firm in 1982. (To simplify the determination of age of retirement, only employees born in January and February and who had not retired before March 1, 1982 are used in this analysis.) The primary test of the predictive validity of the model is based on how well the model, estimated on 1982 data, predicts retirement under the 1983 window plan that substantially increased standard retirement benefits.

2. The Option Value Model.

The model is described in detail in Stock and Wise [1990a] and is explained only briefly here. At any given age, based on information available at that age, it is assumed that an employee compares the expected present value of retiring at that age with the value of retiring at each age in the future through age 70. The maximum of the expected present values of retiring at each future age, minus the expected present value of immediate retirement is called the option value of postponing retirement. A person who does not retire this year maintains the option of retiring at a more advantageous age later on.

If the option value is positive, the person continues to work; otherwise she retires. With reference to figure 1, for example, at age 51 the employee would compare the value of the retirement benefits that she would receive were she to retire then -- approximately $87,000 -- with the value of wage earnings and retirement benefits in each future year. The expected present value of retiring at 60 (discounted to age 51), for example, is about $652,000. Future earnings forecasts are based on the individual's past earnings, as well as the earnings of other persons in the firm. The precise model specification follows.

A person at age t who continues to work will earn Y_s in subsequent years s. If the person retires at age r, subsequent retirement benefits will be $B_s(r)$. These benefits will depend on the person's age and years of service at retirement and on his earnings history; thus they are a function of the retirement age. We suppose that in deciding whether to retire the person weighs the indirect utility that will be received from future income. Discounted to age t at the rate ß, the value of this future stream of income if retirement is at age r is given by

$$(1) \qquad V_t(r) = \Sigma_{s=t}^{r-1} \beta^{s-t} U_w(Y_s) + \Sigma_{s=r}^{S} \beta^{s-t} U_r(B_s(r)),$$

where $U_w(Y_s)$ is the indirect utility of future wage income and $U_r(B_s(r))$ is the indirect utility of future retirement benefits. It is assumed that the employee will not live past age S.

The expected gain, evaluated at age t, from postponing retirement until age r is given by

(2) $$G_t(r) = E_tV_t(r) - E_tV_t(t).$$

Letting r* be the age that gives the maximum expected gain, the person will postpone retirement if the option value, $G_t(r^*)$, is positive,

(3) $$G_t(r^*) = E_tV_t(r^*) - E_tV_t(t) > 0 .$$

The utilities of future wage and retirement income are parameterized as

(4a) $$U_w(Y_s) = Y_s^\gamma + \omega_s$$

(4b) $$U_r(B_s) = (kB_s(r))^\gamma + \xi_s$$

where ω_s and ξ_s are individual-specific random effects, assumed to follow a Markovian (first order autoregressive) process

(5a) $$\omega_s = \rho\omega_{s-1} + \epsilon_{\omega s} , E_{s-1}(\epsilon_{\omega s}) = 0 ,$$

(5b) $$\xi_s = \rho\xi_{s-1} + \epsilon_{\xi s} , E_{s-1}(\epsilon_{\xi s}) = 0 .$$

The parameter k is to recognize that in considering whether to retire the utility <u>associated</u> with a dollar of income while retired may be different from the utility associated with a dollar of income accompanied by work. Abstracting from the random terms, at any

given age s, the ratio of the utility of retirement to the utility of employment is $[k(B_s/Y_s)]^{\gamma}$.

3. Parameter Estimates.

The parameter estimates for men and women are shown in table 1. The estimates for γ suggest some risk aversion. We have typically found estimates closer to 1, suggesting that with respect to retirement income employees are essentially risk neutral. The estimated value of K is 2.580 for men and 1.329 for women. The estimate for men, for example, suggests that a dollar of retirement benefit income—unaccompanied by work—is valued more than two and one-half times as much as a dollar of income that is accompanied by work. The estimated values of beta suggest discount rates between 3 and 25 percent.

The model fits the data quite well and this is shown graphically in figures 3a through 3c for men. The principle discrepancy between actual and predicted rates occurs at age 65, with the actual rate substantially greater than the predicted rate. The predicted and actual cumulative departure rates are very close. The primary test of the predictive validity of the model is how well it predicts retirement rates under the 1983 window plan. The model predictions capture the general pattern of retirement under the window, but overpredict retirement rates of persons 55 and older, as shown in figure 3c.

Simulated retirement rates under the plan changes discussed below are typically compared to the predicted rates in figures 3a and 3b.

II. SIMULATIONS.

We consider first the effect on retirement of several provisions of the firm pension plan. The effect of specific changes in Social Security provisions are then considered. These are the actual changes that are scheduled to be phased in over the next 30 years. Then changes in both firm pension and Social Security provisions are considered. We explore in a very provisional manner the effect of retiree health insurance on retirement. To understand how the elimination of mandatory retirement may have affected departure rates, we consider departure rates if 65 were the mandatory retirement age. The effects of a defined contribution instead of the firm defined benefit plan is also investigated. Finally, we simulate, again in a very provisional manner, the effect of post-retirement employment at a reduced salary, compared to the currently typical move from full-time work to retirement.

A. Changes in the Firm Plan Provisions.

We consider each of several firm plan provisions: the early retirement reduction factor, increased benefits for persons with 30 years of service (which we refer to as the "30-year provision"), and the early retirement age.

1. Actuarially Fair Early Retirement Reduction.

An important feature of the firm plan is that the 5 percent per year reduction in benefits if they are taken before normal retirement—the early retirement reduction—is less than actuarially fair. An actuarially fair reduction would be about 7 percent, instead of 5 percent. The effect of changing to an actuarially fair reduction is

shown in figure 4. The effect is concentrated among employees 56 to 59 years old. With the fair reduction, only 22 percent of persons employed at 50 would have retired by 59, compared to 29 percent under the 5 percent reduction factor. The effect at older ages would apparently be greater were it not for the 30-year provision, that has an important effect on retirement as employees approach age 60.

2. The 30-Year Provision.

As described with reference to figure 1, the firm plan also provides for increased benefits when 30 years of service are attained. At age 60, for example, a person with 30 years of service is eligible for 100 percent of normal retirement benefits. The effect of eliminating this provision is shown in figure 5. The effects are substantial, reducing from 41 to 29 percent the proportion retired by 60 and from 64 to 46 percent the proportion retired by 62. The age 60 departure rate is reduced by more than 50 percent.

3. Early Retirement at 60 Instead of 55.

Under the current firm plan, employees can begin to receive pension benefits at 55. Suppose that the early retirement age were 60 instead of 55. There would be a very substantial reduction in departure rates before age 60, as shown in Figure 6. Indeed, in this firm, almost no employee would retire before 60. Under the current plan, 41 percent of persons employed at 55 would have retired before 60, according to our predictions. But if early retirement were at 60, only 4 percent would retire before age 60.

4. Early Retirement at 62 Instead of 55.

In this case, we suppose that early retirement is at 62—the same as the Social Security early retirement age—and that the 30-year provision provides 100 percent benefits at 62, instead of 60. The results are much like those discussed just above, except that in this case retirement tends to be delayed until 62, as shown in figure 7. The percent retired before age 62 is reduced from 51 percent to 8 percent. The simulations make it clear that employees are unlikely to retire before pension retirement benefits can be received. This is consistent with the evidence that most American families have very limited personal financial assets on the eve of retirement and would be unable to support themselves in retirement without employer-provided pension or Social Security benefits.

In general, the firm pension plan provisions have an important effect on retirement. The simulations below show that for persons with a firm plan like the one presented here, changes in Social Security provisions are much less important.

B. Changes in Social Security Provisions.

We consider three changes in Social Security provisions: actuarially fair increases in benefits after age 65, an increase in the normal retirement age to 67, and both changes together.

1. Actuarially Fair Post-65 Benefit Increases.

Under current Social Security provisions, benefits are increased only 3 percent per year if receipt of benefits begins after 65. An actuarially fair increase would be close to 7 percent. The effect of this change is shown in figure 8. The aggregate effects are small, although

the age 65 departure is reduced from 35 to 29 percent. The proportion retired by 65 is reduced only from 86 to 85 percent. This is because a large fraction of firm employees have already retired by age 65 and thus an increase in the retirement rate of the small proportion that is still working at that age has only a small effect on cumulative retirement.

2. An Increase in the SS Normal Retirement Age from 65 to 67.

Over the next three decades the Social Security normal retirement age is scheduled to increase from 65 to 67. The Social Security early retirement age will remain at 62, but benefits will be reduced actuarially from full benefits at 67, instead of 65. The simulated effects of this change are shown in figure 9. Again, although the retirement rates of persons over age 60 are reduced, the aggregate effect is small. The retirement rate of persons age 62, for example, is reduced from 26 to 23 percent and the rate of persons 65 from 35 to 26 percent. But the percent of 50-year-olds retired by 65 is reduced only from 86 to 83 percent.

3. An Increase in the SS Normal Retirement Age from 65 to 67 and Actuarially Fair Post-67 Benefit Increases.

Combining the two changes above yields results much like the latter change alone, as shown in figure 10. There is a noticeable effect on retirement rates of persons 62 and older but the cumulative effect is small, reducing the percent retired by 65 only by 3 percentage points, from 86 to 83 percent. Thus compared to changes in the firm plan

provisions, the effect of the scheduled changes in Social Security provisions is very small.

4. No Social Security Early Retirement or No Social Security.

Although the effect of the proposed Social Security changes is small, and even eliminating Social Security early retirement would have a small effect, no Social Security at all would have a substantial effect. As shown in figure 11, even eliminating Social Security early retirement would have only a modest effect on cumulative departure rates from this firm, reducing departures by 65 from 86 to 80 percent, although departure rates for ages 62 to 64 are reduced substantially. But no Social Security benefits at all would reduce departure rates by 65 from 86 to 67 percent, as shown in figure 12. Thus it would be inaccurate to say, with respect to its effect on retirement, that Social Security by itself doesn't matter.

C. Social Security and Firm Provisions "Coordinated."

If the scheduled Social Security changes are imposed and the firm provisions were changed to "correspond" to the Social Security provisions, the effects would be much like the corresponding effects if only the firm plan provisions were changed. We consider two versions: the firm early retirement age is increased to 62 and the firm 30-year provision applies at 62 instead of 60 (like figure 7 above), the firm early retirement age is increased to 62 and the 30-years provision applies at 62 instead of 60 and the firm normal retirement age is increased from 65 to 67.

1. Social Security Scheduled Changes and Firm Early Retirement at 62.

The effect of this change can be compared to the firm change without any change in Social Security provisions, described in figure 7. The effect of the joint change—shown in figure 13—is very large, but the comparison with figure 7 makes clear that most of the effect is due to the change in the firm plan. Retirement before 62 is reduced from 51 to 8 percent, the same as in figure 7. Retirement by 65 is reduced from 86 to 72 percent; the reduction in figure 7 is from 86 to 74 percent.

2. Social Security Scheduled Changes, Firm Early Retirement at 62, and Firm Normal Retirement at 67.

If in addition to increasing the firm early retirement age to 62 the firm normal retirement age were increased to 67, the effect on retirement—shown in figure 14—would be much like the effect shown above. But increasing the firm normal retirement age has a substantial effect on the departure rates of older employees. Cumulative departure at 65 would be 64 percent as compared to 72 percent in the case just above, and compared to 86 percent in the base case. Cumulative departure by 62 would be 27 percent as compared with 32 percent above and 64 percent under the base case.

D. Firm Retiree Health Insurance.

Health insurance coverage under Medicare does not begin until age 65. Whether an employee is eligible for retiree health insurance before age 65 may affect the retirement decision. This issue has been analyzed in some detail by Gruber and Madrian [1993]. Employees in

Firm III are covered by employer health insurance while they are working and are covered by retiree health insurance after retirement. An employee who retires at 55, for example, would be covered by retiree health insurance. The retiree plan is essentially the same as the current employee plan. After 65, however, the plan pays only for care that is not covered by Medicare, but is covered by the employer plan; the employer is the payer of last resort. It is unclear how persons value health insurance. In particular, the dollar cost of purchasing the insurance may not be an adequate measure of the value of the insurance. Nonetheless, to gain some insight as to how the retiree insurance coverage might affect retirement, we suppose that there were no retiree insurance so that employees who retired before 65 would have to purchase insurance privately. We assume that the cost would be $1,000 per year until age 65, when the person would be covered by Medicare. Therefore, before age 65, we assume that the dollar amount of retirement benefits would be $1,000 lower, the cost of the health insurance that the retiree would have to purchase. The effect on retirement is shown in figure 15. Retirement rates before age 65 are importantly lower, but, compared to the effect of pension plan provisions, the effect is small. For example, the cumulative percent retired by 61 is reduced from 51 to 45 percent. In contrast increasing the firm plan early retirement age from 55 to 62 would reduce cumulative retirement by 61 from 51 to 8 percent, as shown in figure 7.

E. Mandatory Retirement.

Before 1978 mandatory retirement at age 65 was common in the United States. It is still common in Japan. We consider here how mandatory retirement in Firm III would change retirement rates. The results are described in figure 16. Only departure rates at 64 and 65 are affected by the change; the cumulative effect is small. The age 64 retirement rate, for example, is increased from 25 to 36 percent. Departure by 65 is increased from 86 to 91 percent.

F. Defined Contribution versus Defined Benefit Plan.

Unlike the firm defined benefit plan under which benefits are determined by a formula that can incorporate substantial incentives, benefits under a defined contribution plan are typically determined only by the cumulated assets that the employee has in the plan at retirement. Other than the level of assets, there are no plan incentive effects that encourage or discourage retirement at specific ages. To provide some idea of how retirement might change under such a plan, we assume that individual pension assets accumulate with years of employment through pension plan contributions equal to 7.5 percent of wage earnings. The benefit at retirement is the annuity value of the accumulated assets. Retirement rates under this plan are described in figure 17. Cumulative retirement at 55 is increased from 7 to 14 percent; cumulative retirement at 62 is reduced from 64 to 60 percent. At 65, the cumulative rate is reduced from 86 to 80 percent. In particular, there are no noticeable jumps in retirement rates between 55 and 61, as there are under the current defined benefit plan. The increased departure rates at younger ages occur because under the defined contribution plan

there is no incentive to wait for the jump in benefits that would occur at age 55 or at 30 years of service, when the 30-year provision would apply.

G. Post-Retirement Work.

The typical American employee goes from full-time work to retirement, although a small proportion of workers are employed for a short period of time after retirement, typically fewer than three years. It may be that gradual withdrawal from the labor force would be preferred to the current practice. Our model estimation does not adequately recognize such possibilities. Nonetheless, to explore how a large change in retirement policy might affect departure rates, we consider an option to the present plan that requires persons who retire to work half-time (and, correspondingly, receive one-half current salary, with no salary increases) until age 70. In this case, we assume that the parameter K is 1 until age 70 and is the estimated value after age 70. The results suggest that such a plan would lead to much earlier retirement. For example, cumulative retirement by 55 is increased from 7 to 44 percent; the departure rate at 55 is increased from 3 to 12 percent. The implication is that under this arrangement the discounted value of retirement plus pension benefits outweighs the value of continuing to work for many employees at a relatively young age. The implementation of the simulation, however, does not recognize the value of the leisure associated with half-time work. Were the value of leisure accounted for, the departure rates at younger ages would presumably be higher than the simulation implies.

III. SUMMARY.

The results of the analysis support several conclusions. First, changes in key firm pension plan provisions would have very substantial effects on retirement. For example, increasing the firm early retirement age from 55 to 60 would reduce cumulative departure by 59 from 29 to 4 percent. Second, the scheduled changes in Social Security provisions would have only a modest effect on firm retirement. The firm pension plan provisions dominate the Social Security provisions. Third, if changes in firm pension plan and Social Security provisions were coordinated—for example, if in both early retirement were at 62 and normal retirement at 67—the effect on retirement would be very substantial. For example, cumulative departure by 61 would be reduced from 51 to 8 percent. Cumulative departure at 65 would be 64 percent as compared with 86 percent in the base case. Although the individual simulations cannot be treated as exact, we have confidence in the general order of magnitude. In addition, the simulations suggest that the availability of retiree health insurance is associated with some increase in retirement between 55 and 65, although the effect is modest compared to the effect of pension plan provisions on retirement. We also considered the effect of very large changes in retirement policy—half time work from retirement to age 70. Although these simulations must be considered as exploratory, the results suggest that such changes could change current retirement practices very substantially.

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Table 1. Parameter Estimates by Gender			
Parameter	Men	Women	Men & Women
Gamma	0.546	0.738	0.574
	(0.063)	(0.173)	(0.069)
K	2.580	1.329	2.434
	(0.175)	(0.241)	(0.320)
Beta	0.987	0.720	0.979
	(0.024)	(0.235)	(0.022)
Sigma	0.110	0.071	0.112
	(0.010)	(0.023)	(0.028)
Log Likelihood:			
At Maximum	381.56	100.98	486.51
Age Averages	362.55	91.26	461.30
Chi Square:			
Fitted Data	27.67	15.14	30.47
Window	99.77	54.66	125.80

Figure 1. Early Retirement Benefit

As % of Normal Age 65 Benefit

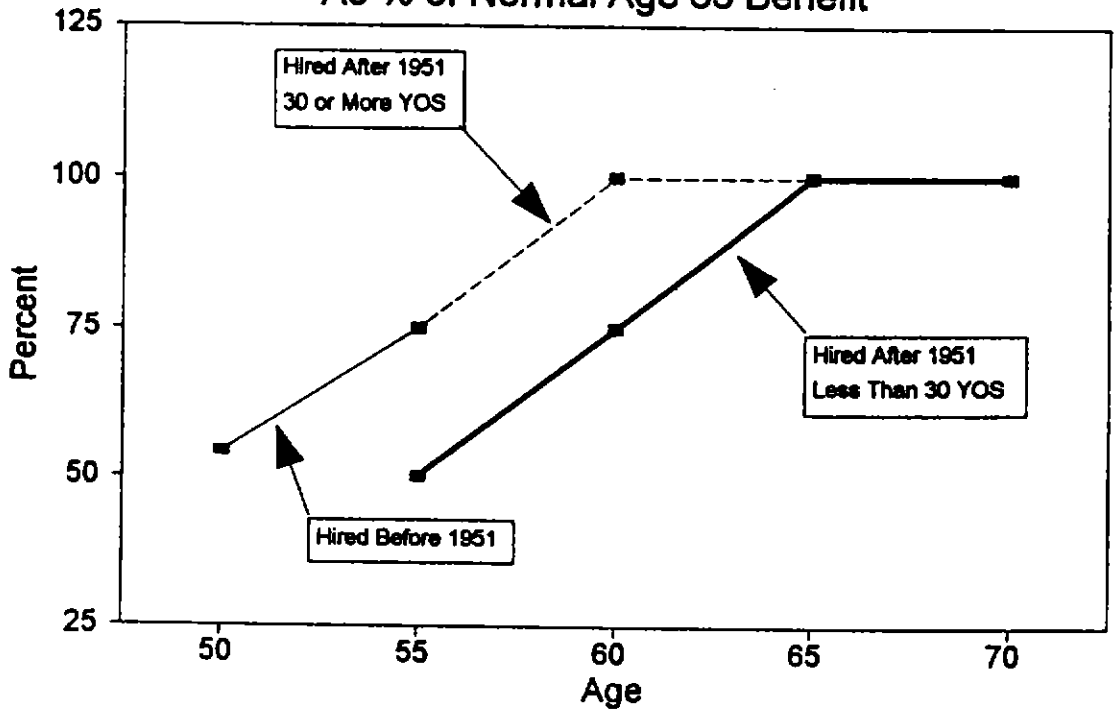


Figure 2a. Future Compensation
For Person Age 51 & 23 YOS in 1982

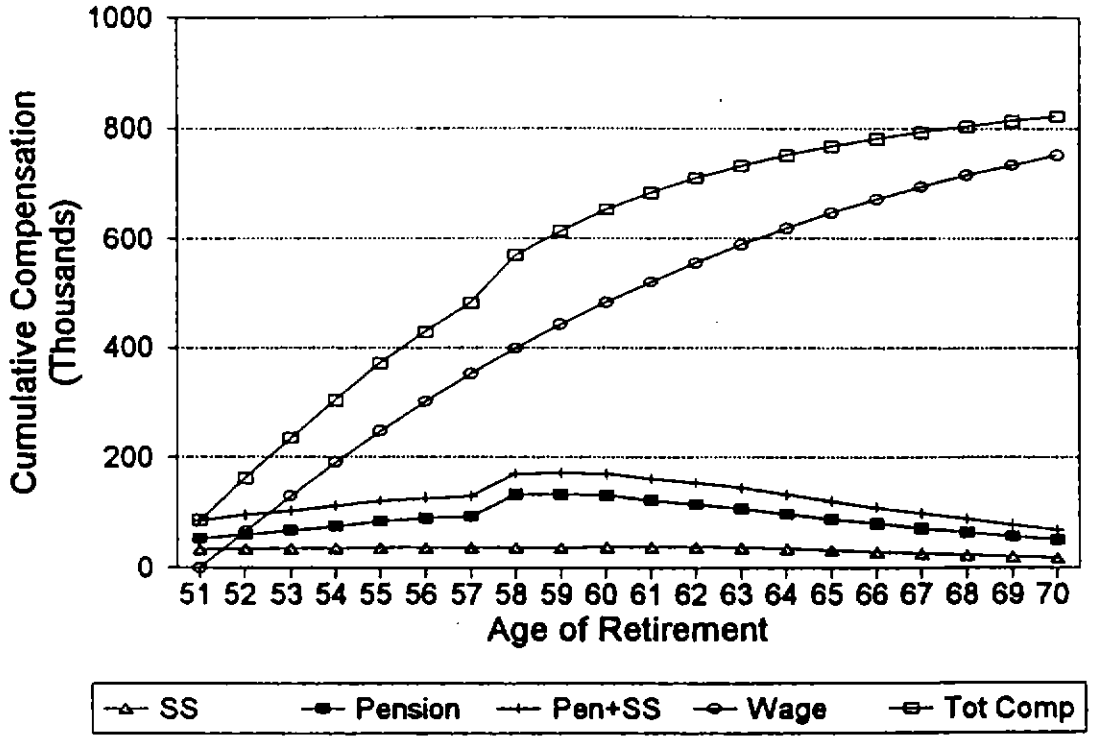


Figure 2b. Future Compensation
For Person Age 57 & 29 YOS in 1982

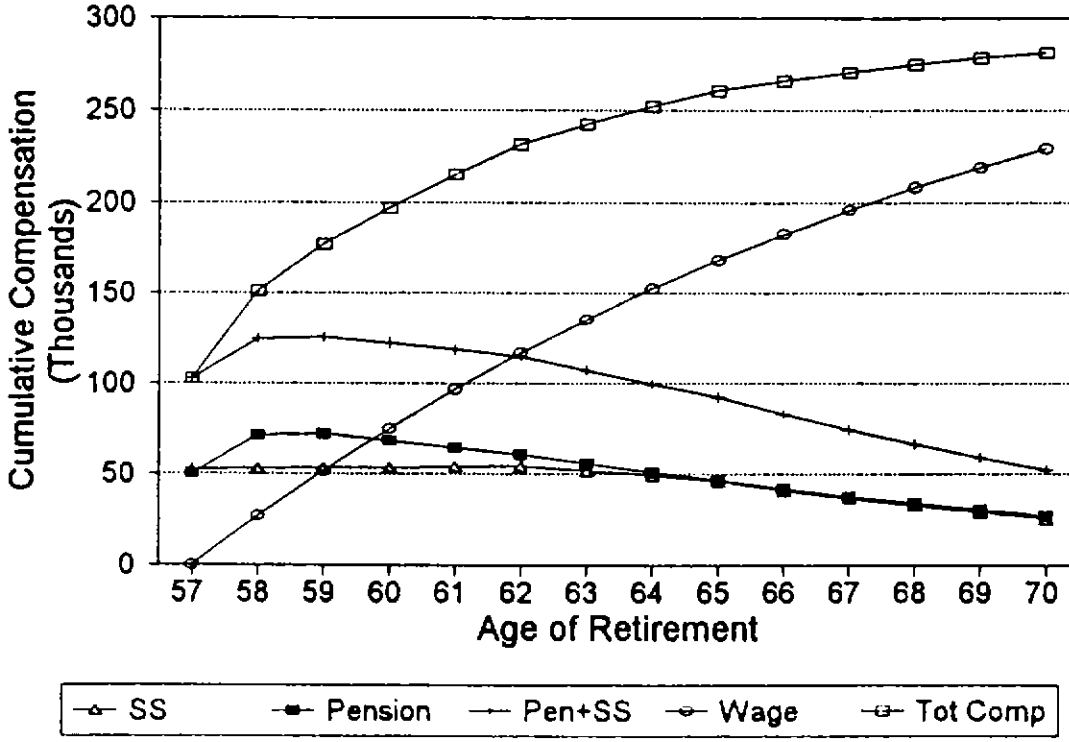


Figure 2c. Future Compensation
For Person Age 60 & 38 YOS in 1982

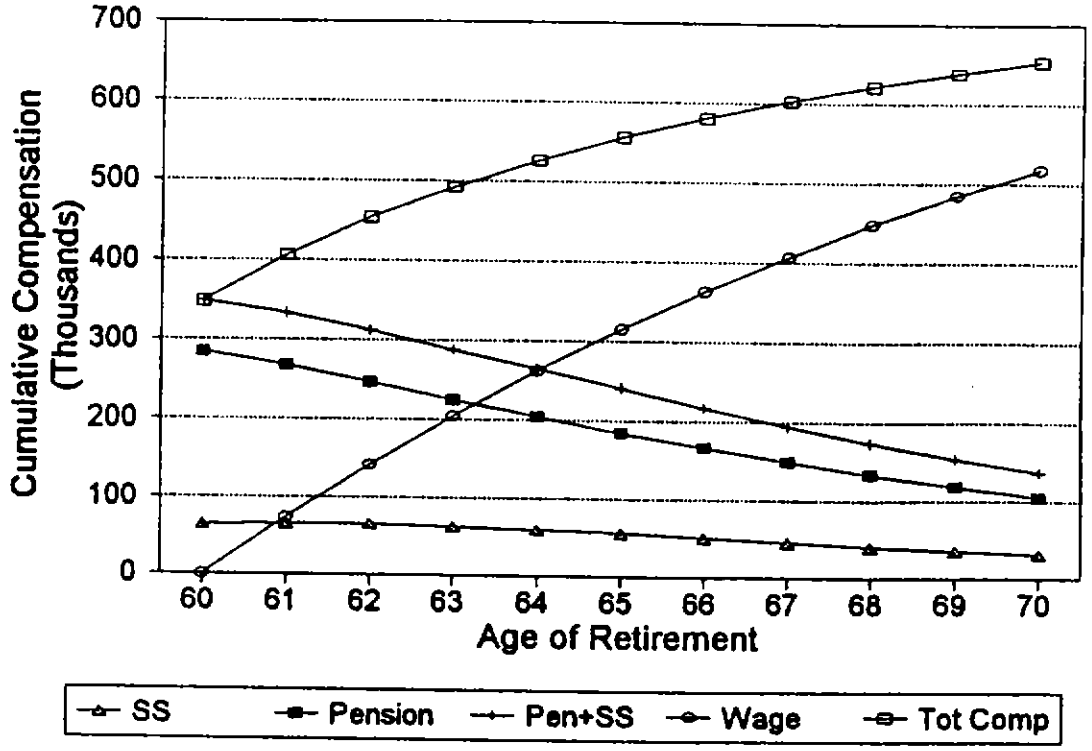


Figure 2d. Future Compensation
For Person Age 64 & 45 YOS in 1982

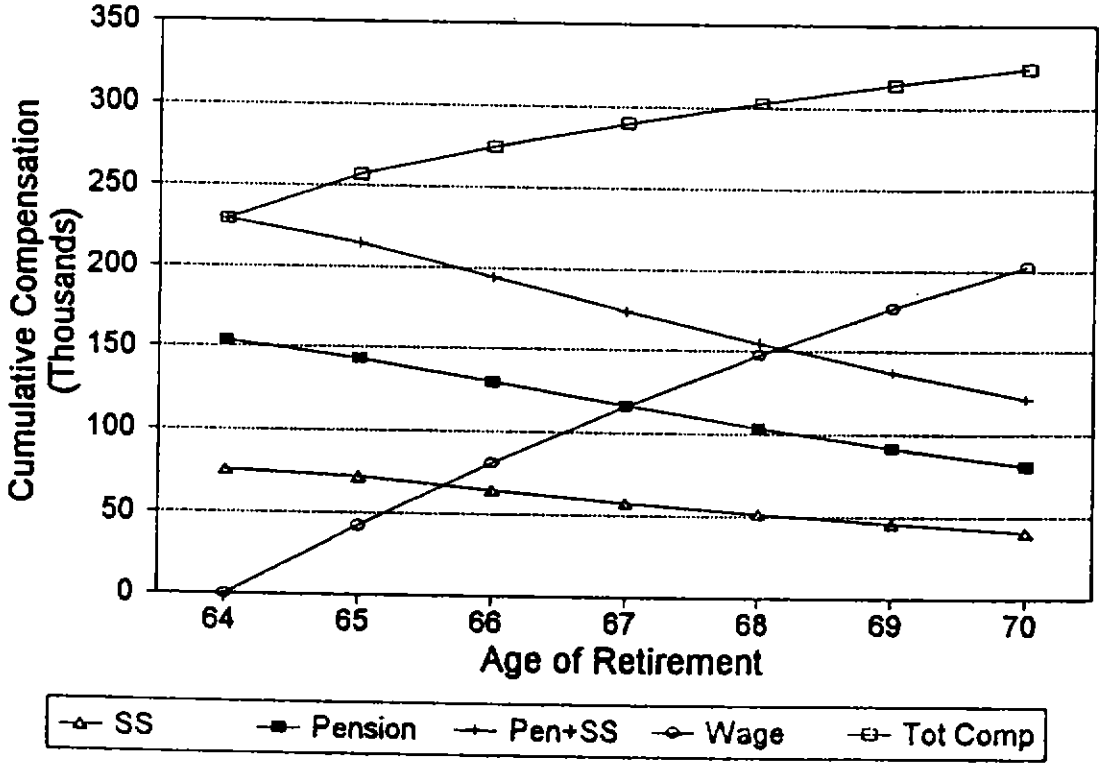


Figure 2e. Future Social Security and Pension Compensation Only

For person Age 51 & 23 YOS in 1982

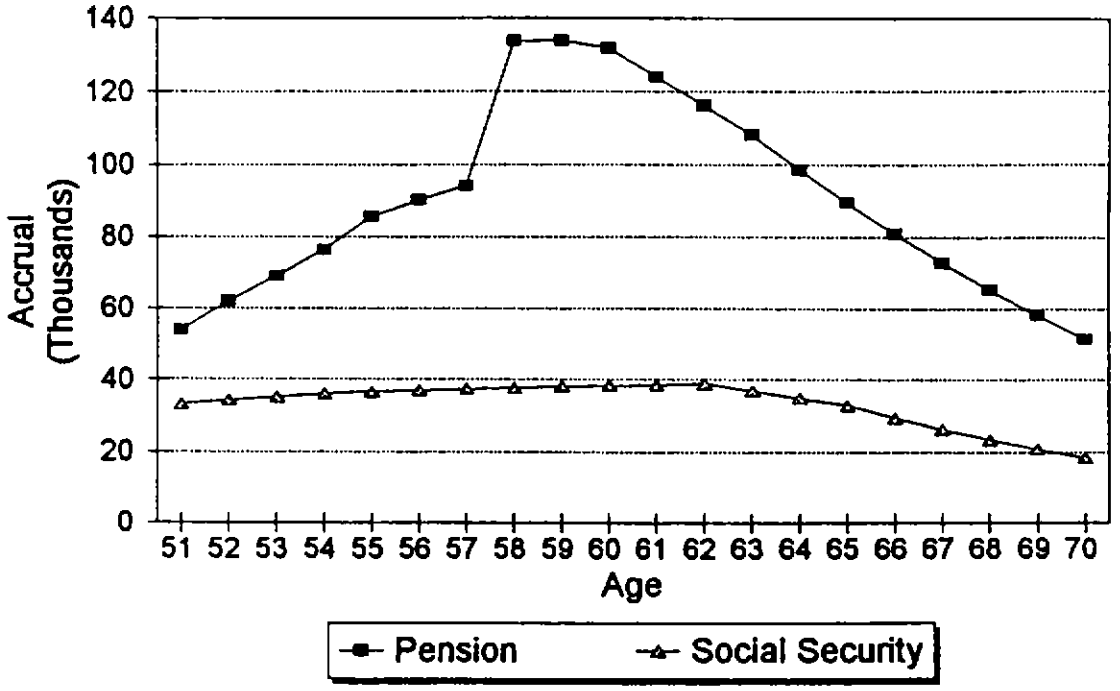


Figure 3a. Predicted Versus Actual
Annual Departure Rates--OV-Men

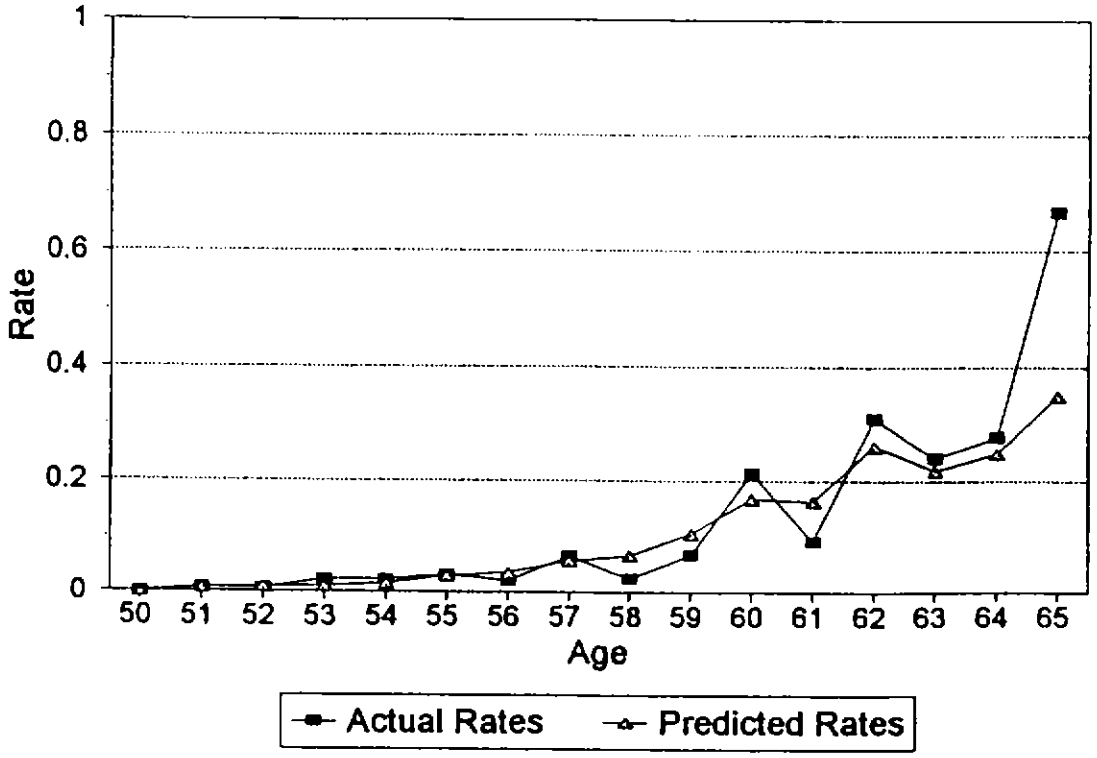


Figure 3b. Predicted Versus Actual
Cumulative Departure Rates--OV-Men

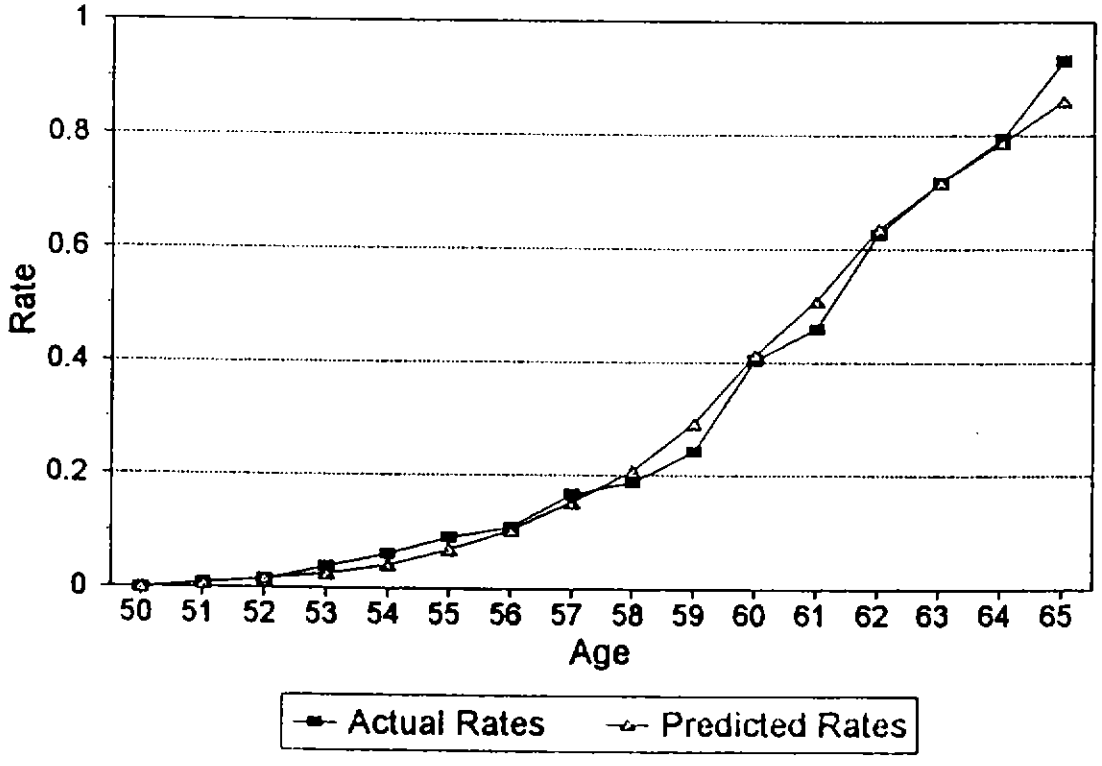


Figure 3c. Predicted Versus Actual
Window Departure Rates--OV-Men

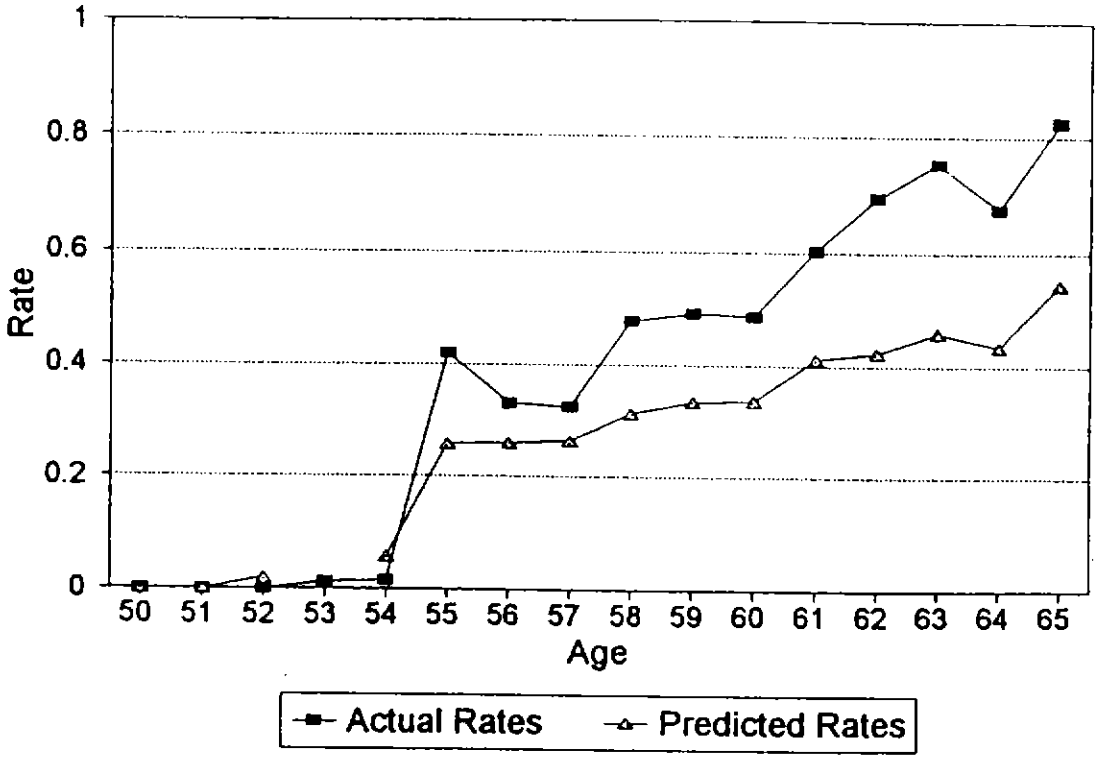


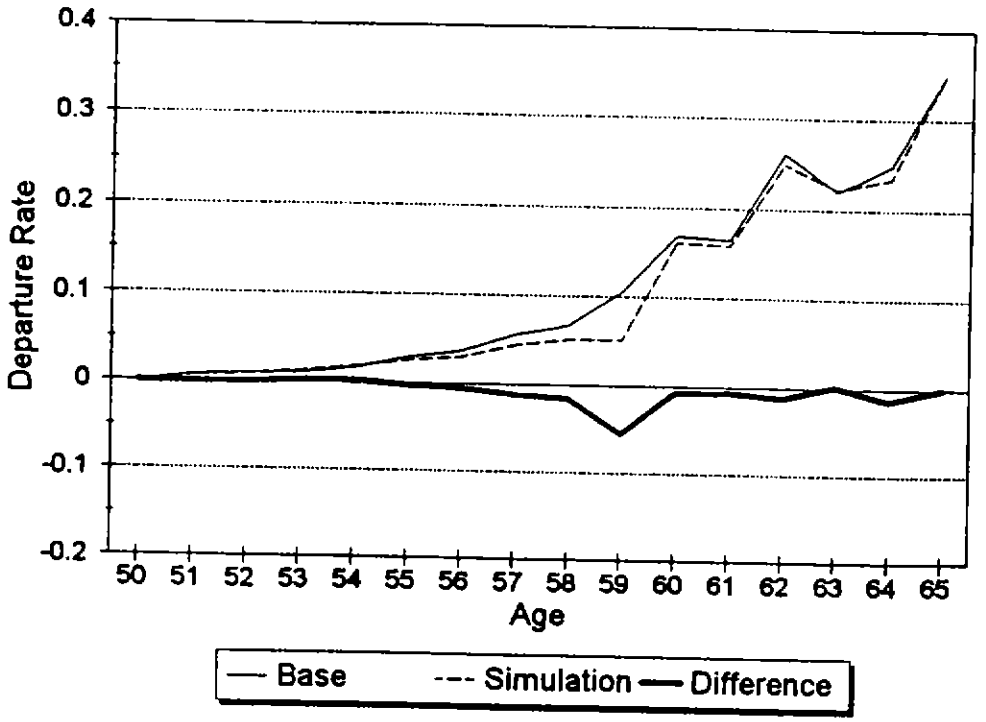
Figure 4. Simulation: Firm Actuarially Fair Early Retirement Reduction

a. Data

Age	Retirement Rates			Cumulative Rates		
	Base	Simulation	Difference	Base	Simulation	Difference
50	0	0	0	0	0	0
51	0.007	0.006	-0.001	0.007	0.006	-0.001
52	0.009	0.008	-0.001	0.016	0.015	-0.001
53	0.01	0.012	0.002	0.025	0.026	0.001
54	0.016	0.018	0.002	0.041	0.044	0.003
55	0.029	0.026	-0.003	0.068	0.069	0.001
56	0.036	0.03	-0.006	0.102	0.097	-0.005
57	0.056	0.044	-0.012	0.152	0.136	-0.016
58	0.067	0.051	-0.016	0.208	0.18	-0.028
59	0.106	0.051	-0.055	0.292	0.223	-0.069
60	0.169	0.161	-0.008	0.412	0.348	-0.064
61	0.165	0.158	-0.007	0.509	0.451	-0.058
62	0.262	0.25	-0.012	0.637	0.588	-0.049
63	0.22	0.222	0.002	0.717	0.68	-0.037
64	0.249	0.235	-0.014	0.788	0.755	-0.033
65	0.35	0.35	0	0.862	0.841	-0.021

Figure 4. Simulation: Firm Actuarially Fair Early Retirement Reduction

4b. Retirement Rates



4c. Cumulative Rates

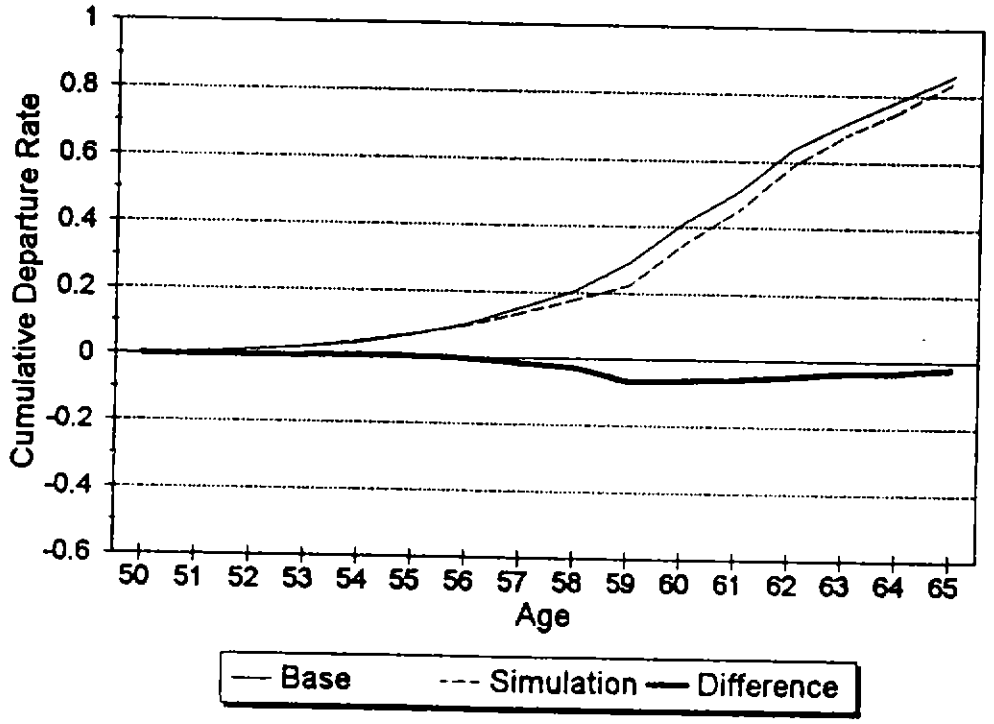
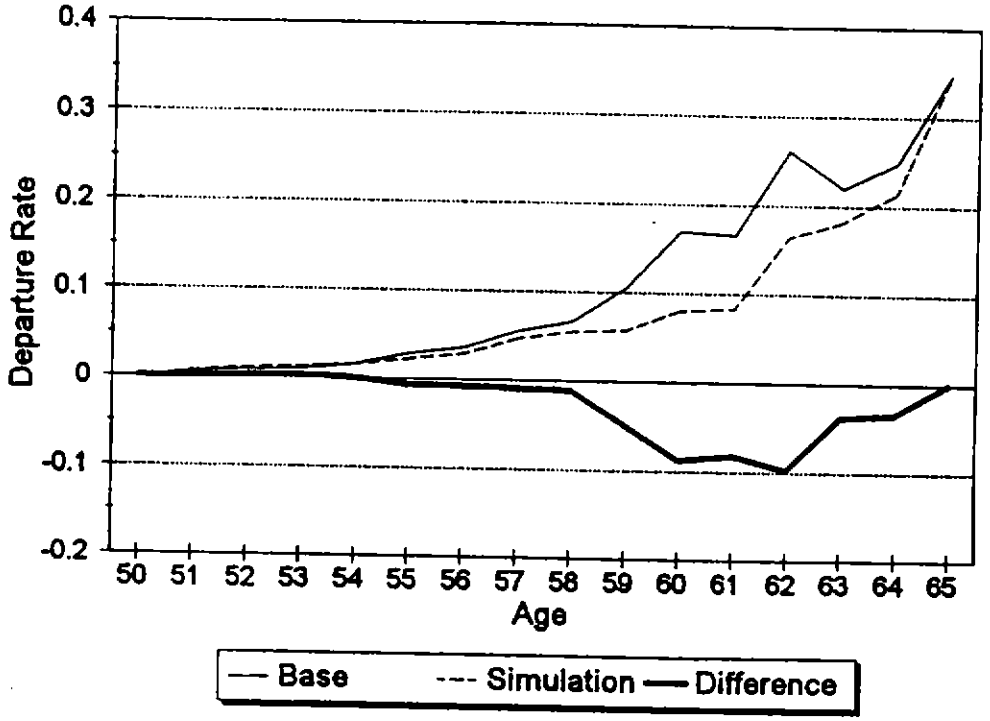


Figure 5. Simulation: Eliminate Firm 30 Year Provision
a. Data

Age	Retirement Rates			Cumulative Rates		
	Base	Simulation	Difference	Base	Simulation	Difference
50	0	0	0	0	0	0
51	0.007	0.008	0.001	0.007	0.008	0.001
52	0.009	0.011	0.002	0.016	0.018	0.002
53	0.01	0.013	0.003	0.025	0.031	0.006
54	0.016	0.016	0	0.041	0.046	0.005
55	0.029	0.022	-0.007	0.068	0.068	0
56	0.036	0.029	-0.007	0.102	0.095	-0.007
57	0.056	0.047	-0.009	0.152	0.138	-0.014
58	0.067	0.056	-0.011	0.208	0.186	-0.022
59	0.106	0.057	-0.049	0.292	0.232	-0.06
60	0.169	0.081	-0.088	0.412	0.294	-0.118
61	0.165	0.083	-0.082	0.509	0.353	-0.156
62	0.262	0.164	-0.098	0.637	0.46	-0.177
63	0.22	0.182	-0.038	0.717	0.558	-0.159
64	0.249	0.215	-0.034	0.788	0.653	-0.135
65	0.35	0.35	0	0.862	0.774	-0.088

Figure 5. Simulation: Eliminate Firm 30 Year Provision

5b. Retirement Rates



5c. Cumulative Rates

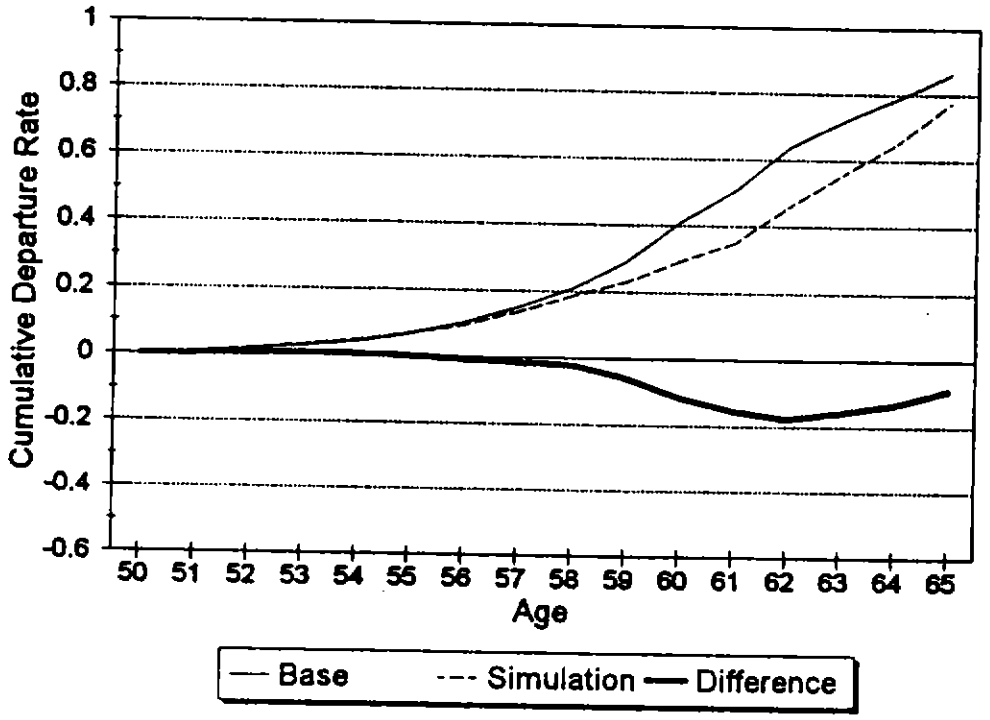
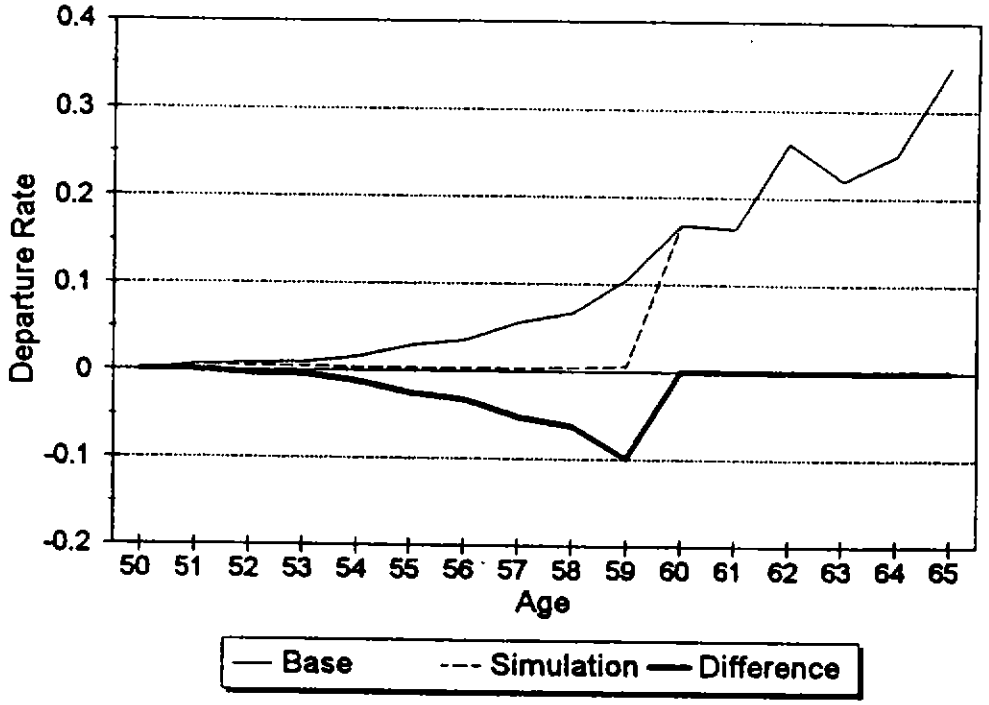


Figure 6. Simulation: Firm Early Retirement at 60, Not 55
a. Data

Age	Retirement Rates			Cumulative Rates		
	Base	Simulation	Difference	Base	Simulation	Difference
50	0	0	0	0	0	0
51	0.007	0.007	0	0.007	0.007	0
52	0.009	0.005	-0.004	0.016	0.012	-0.004
53	0.01	0.005	-0.005	0.025	0.018	-0.007
54	0.016	0.004	-0.012	0.041	0.021	-0.02
55	0.029	0.004	-0.025	0.068	0.025	-0.043
56	0.036	0.004	-0.032	0.102	0.029	-0.073
57	0.056	0.004	-0.052	0.152	0.033	-0.119
58	0.067	0.005	-0.062	0.208	0.038	-0.17
59	0.106	0.007	-0.099	0.292	0.044	-0.248
60	0.169	0.169	0	0.412	0.206	-0.206
61	0.165	0.165	0	0.509	0.337	-0.172
62	0.262	0.262	0	0.637	0.511	-0.126
63	0.22	0.22	0	0.717	0.618	-0.099
64	0.249	0.249	0	0.788	0.713	-0.075
65	0.35	0.35	0	0.862	0.813	-0.049

Figure 6. Simulation: Firm Early Retirement at 60, Not 55

6b. Retirement Rates



6c. Cumulative Rates

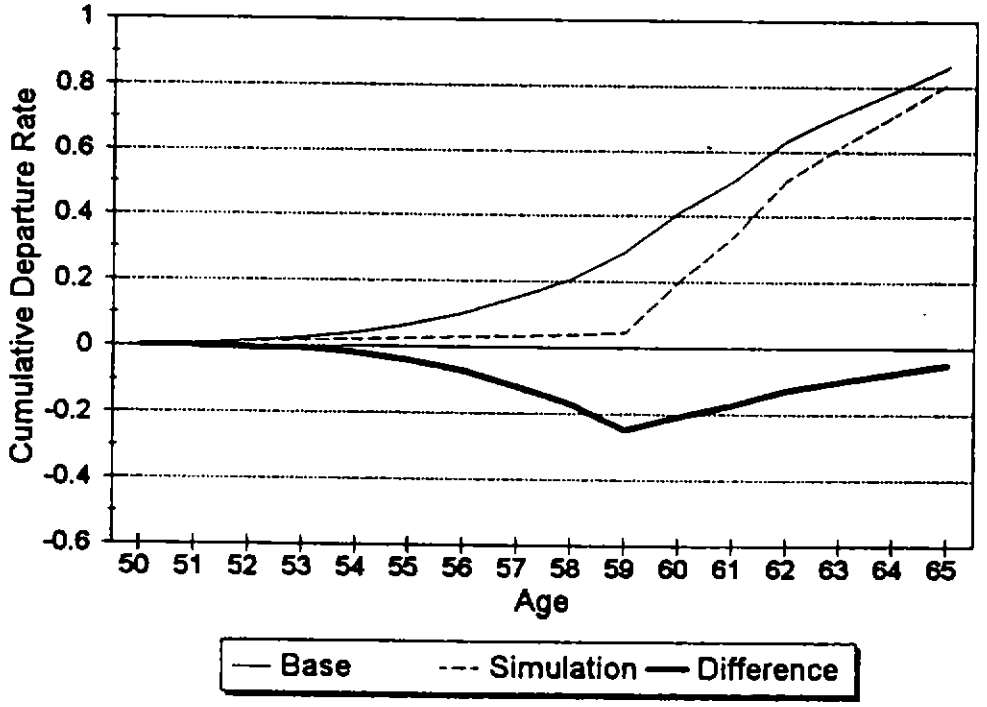
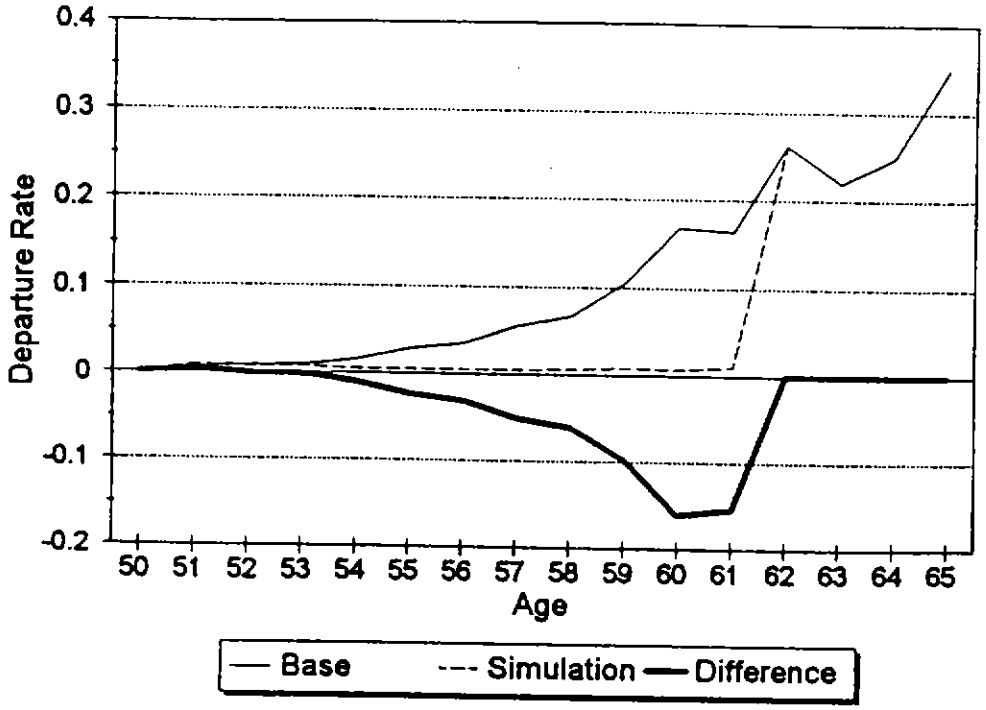


Figure 7. Simulation: Firm Early Retirement at 62, Not 55
a. Data

Age	Retirement Rates			Cumulative Rates		
	Base	Simulation	Difference	Base	Simulation	Difference
50	0	0	0	0	0	0
51	0.007	0.01	0.003	0.007	0.01	0.003
52	0.009	0.008	-0.001	0.016	0.017	0.001
53	0.01	0.008	-0.002	0.025	0.025	0
54	0.016	0.006	-0.01	0.041	0.031	-0.01
55	0.029	0.006	-0.023	0.068	0.037	-0.031
56	0.036	0.006	-0.03	0.102	0.043	-0.059
57	0.056	0.006	-0.05	0.152	0.049	-0.103
58	0.067	0.007	-0.06	0.208	0.056	-0.152
59	0.106	0.009	-0.097	0.292	0.064	-0.228
60	0.169	0.008	-0.161	0.412	0.071	-0.341
61	0.165	0.011	-0.154	0.509	0.081	-0.428
62	0.262	0.262	0	0.637	0.321	-0.316
63	0.22	0.22	0	0.717	0.471	-0.246
64	0.249	0.249	0	0.788	0.602	-0.186
65	0.35	0.35	0	0.862	0.741	-0.121

Figure 7. Simulation: Firm Early Retirement at 62, Not 55

7b. Retirement Rates



7c. Cumulative Rates

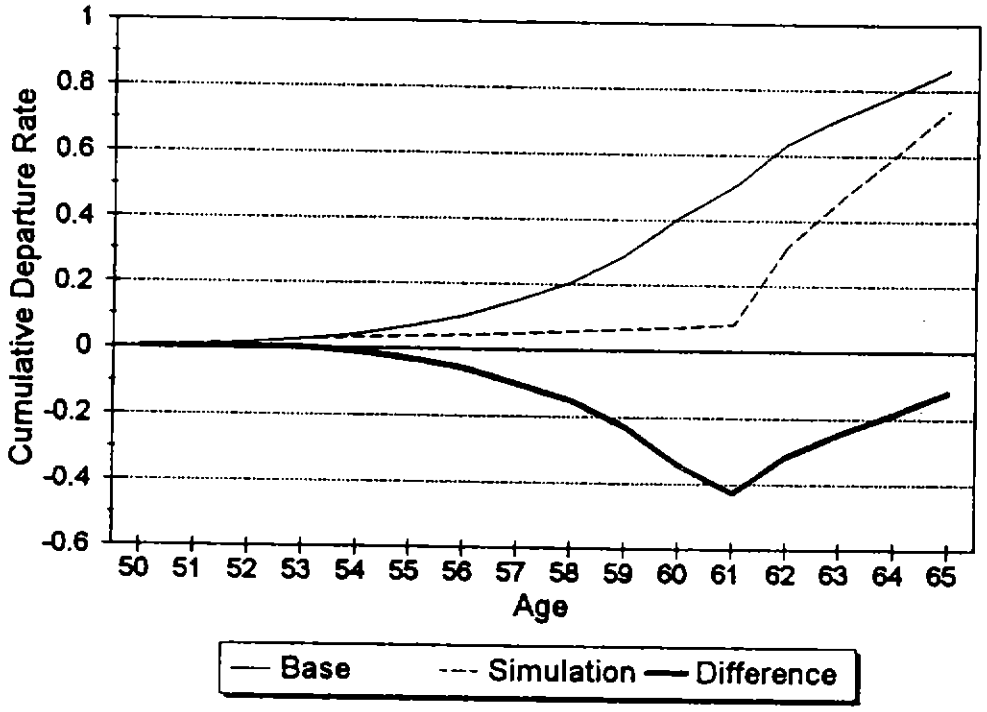


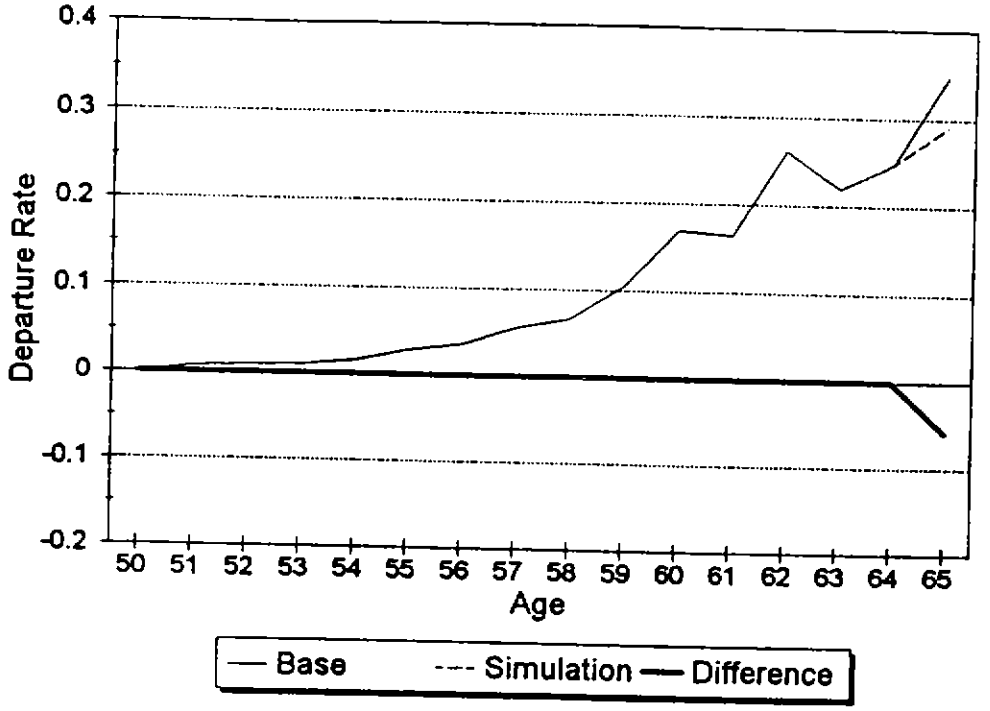
Figure 8. Simulation: Actuarially Fair Post-65 Social Security Benefit

a. Data

Age	Retirement Rates			Cumulative Rates		
	Base	Simulation	Difference	Base	Simulation	Difference
50	0	0	0	0	0	0
51	0.007	0.007	0	0.007	0.007	0
52	0.009	0.009	0	0.016	0.016	0
53	0.01	0.01	0	0.025	0.025	0
54	0.016	0.016	0	0.041	0.041	0
55	0.029	0.029	0	0.068	0.068	0
56	0.036	0.036	0	0.102	0.102	0
57	0.056	0.056	0	0.152	0.152	0
58	0.067	0.067	0	0.208	0.208	0
59	0.106	0.106	0	0.292	0.292	0
60	0.169	0.169	0	0.412	0.412	0
61	0.165	0.165	0	0.509	0.509	0
62	0.262	0.262	0	0.637	0.637	0
63	0.22	0.22	0	0.717	0.717	0
64	0.249	0.249	0	0.788	0.787	-0.001
65	0.35	0.292	-0.058	0.862	0.849	-0.013

Figure 8. Simulation: Actuarially Fair Post-65 Social Security Benefit

8b. Retirement Rates



8c. Cumulative Rates

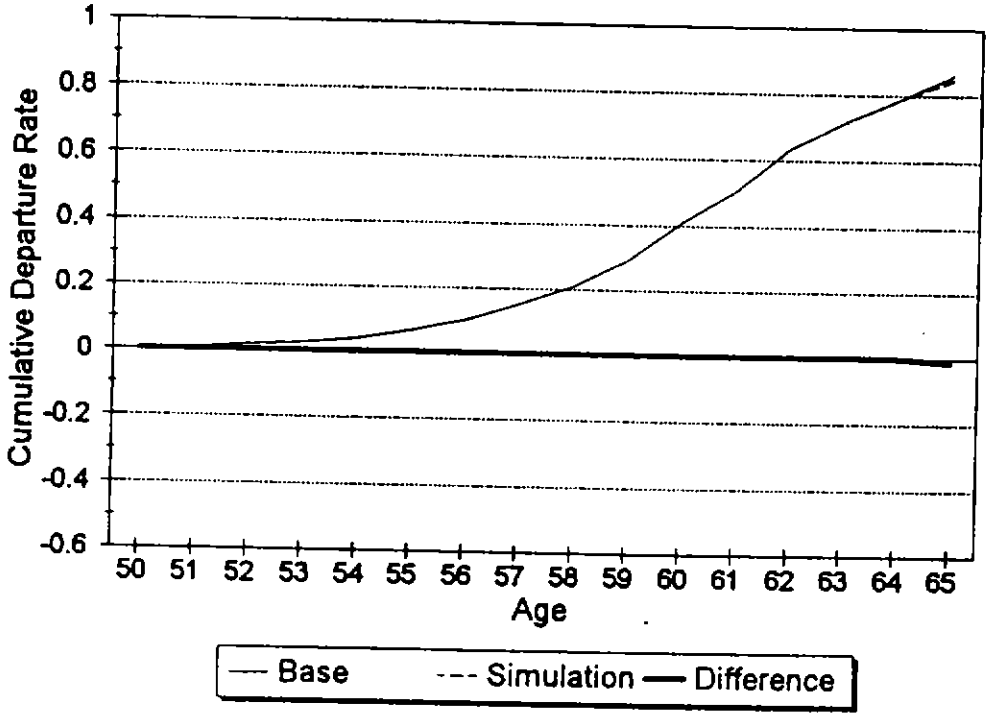
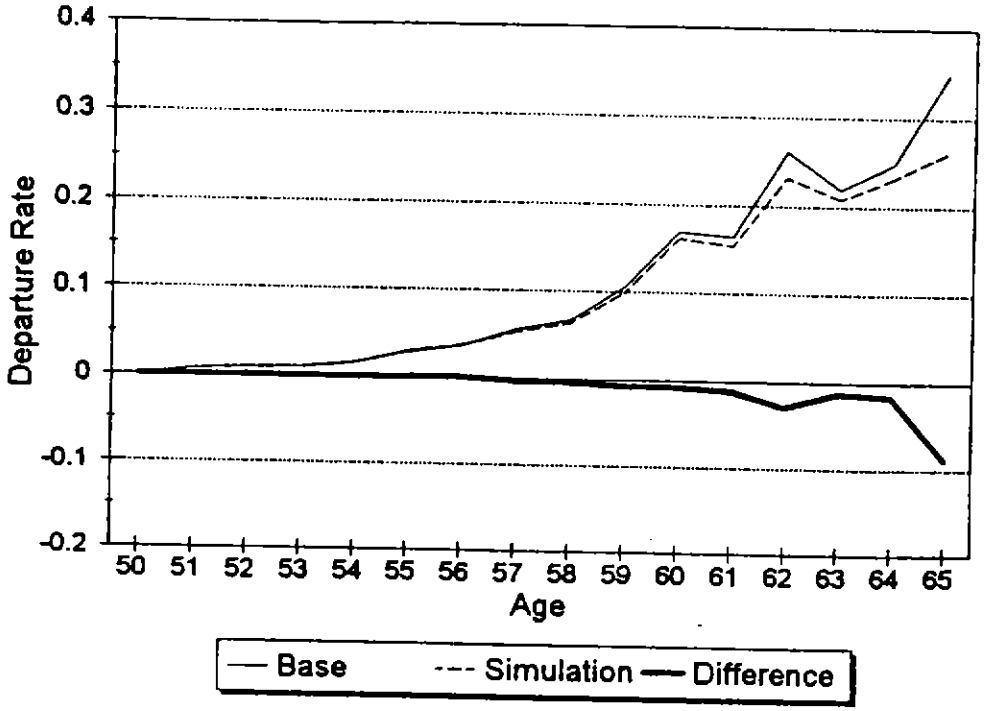


Figure 9. Simulation: Social Security Retirement at 67, Not 65
a. Data

	Retirement Rates			Cumulative Rates		
Age	Base	Simulation	Difference	Base	Simulation	Difference
50	0	0	0	0	0	0
51	0.007	0.007	0	0.007	0.007	0
52	0.009	0.01	0.001	0.016	0.017	0.001
53	0.01	0.01	0	0.025	0.026	0.001
54	0.016	0.016	0	0.041	0.042	0.001
55	0.029	0.03	0.001	0.068	0.071	0.003
56	0.036	0.037	0.001	0.102	0.105	0.003
57	0.056	0.053	-0.003	0.152	0.153	0.001
58	0.067	0.063	-0.004	0.208	0.206	-0.002
59	0.106	0.099	-0.007	0.292	0.285	-0.007
60	0.169	0.162	-0.007	0.412	0.401	-0.011
61	0.165	0.154	-0.011	0.509	0.493	-0.016
62	0.262	0.233	-0.029	0.637	0.611	-0.026
63	0.22	0.208	-0.012	0.717	0.692	-0.025
64	0.249	0.233	-0.016	0.788	0.764	-0.024
65	0.35	0.262	-0.088	0.862	0.826	-0.036

Figure 9. Simulation: Social Security Retirement at 67, Not 65

9b. Retirement Rates



9c. Cumulative Rates

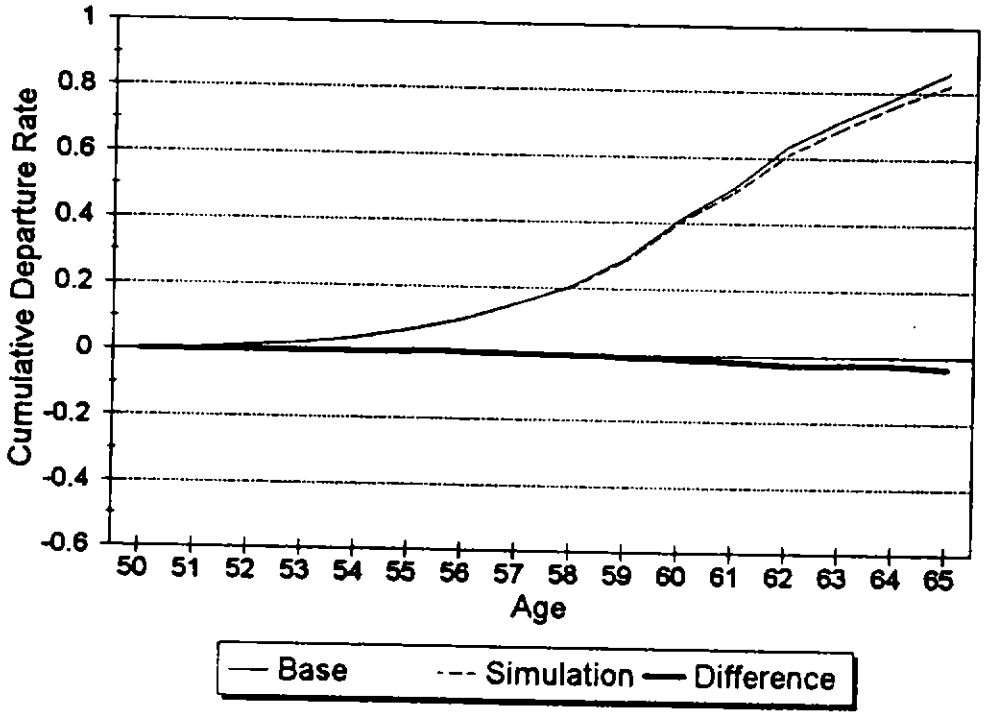
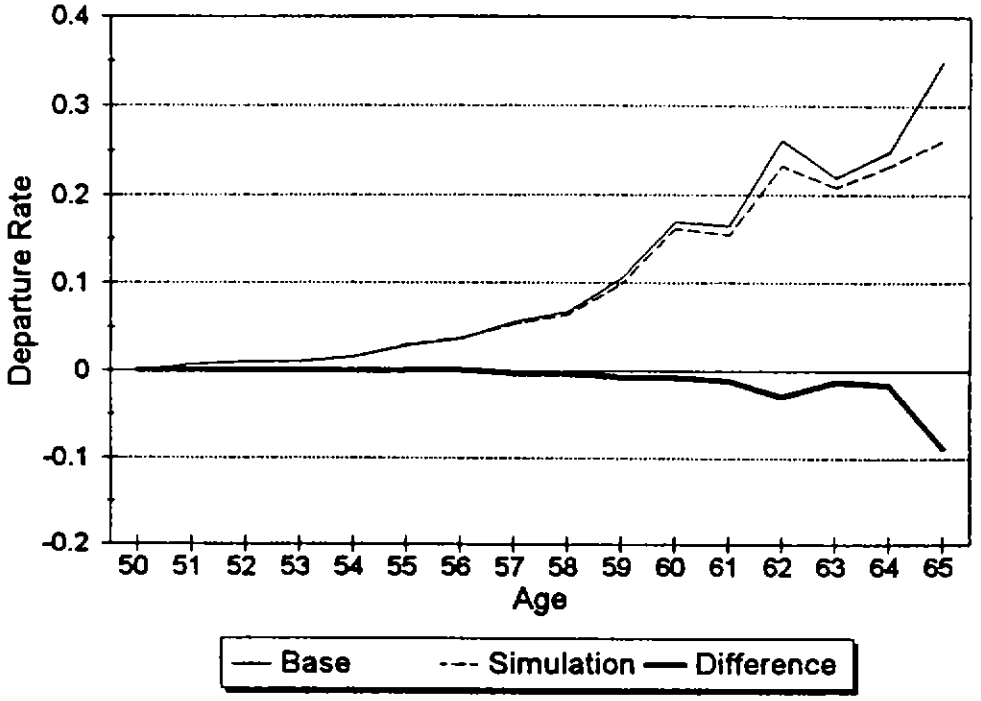


Figure 10. Simulation: Social Security Retirement at 67 and Actuarially Fair Post-67 Benefit
a. Data

	Retirement Rates			Cumulative Rates		
Age	Base	Simulation	Difference	Base	Simulation	Difference
50	0	0	0	0	0	0
51	0.007	0.007	0	0.007	0.007	0
52	0.009	0.01	0.001	0.016	0.017	0.001
53	0.01	0.01	0	0.025	0.026	0.001
54	0.016	0.016	0	0.041	0.042	0.001
55	0.029	0.03	0.001	0.068	0.071	0.003
56	0.036	0.037	0.001	0.102	0.105	0.003
57	0.056	0.053	-0.003	0.152	0.153	0.001
58	0.067	0.063	-0.004	0.208	0.206	-0.002
59	0.106	0.099	-0.007	0.292	0.285	-0.007
60	0.169	0.162	-0.007	0.412	0.401	-0.011
61	0.165	0.154	-0.011	0.509	0.493	-0.016
62	0.262	0.233	-0.029	0.637	0.611	-0.026
63	0.22	0.208	-0.012	0.717	0.692	-0.025
64	0.249	0.233	-0.016	0.788	0.764	-0.024
65	0.35	0.262	-0.088	0.862	0.826	-0.036

Figure 10. Simulation: Social Security Retireme at 67 and Actuarially Fair Post-67 Benefit

10b. Retirement Rates



10c. Cumulative Rates

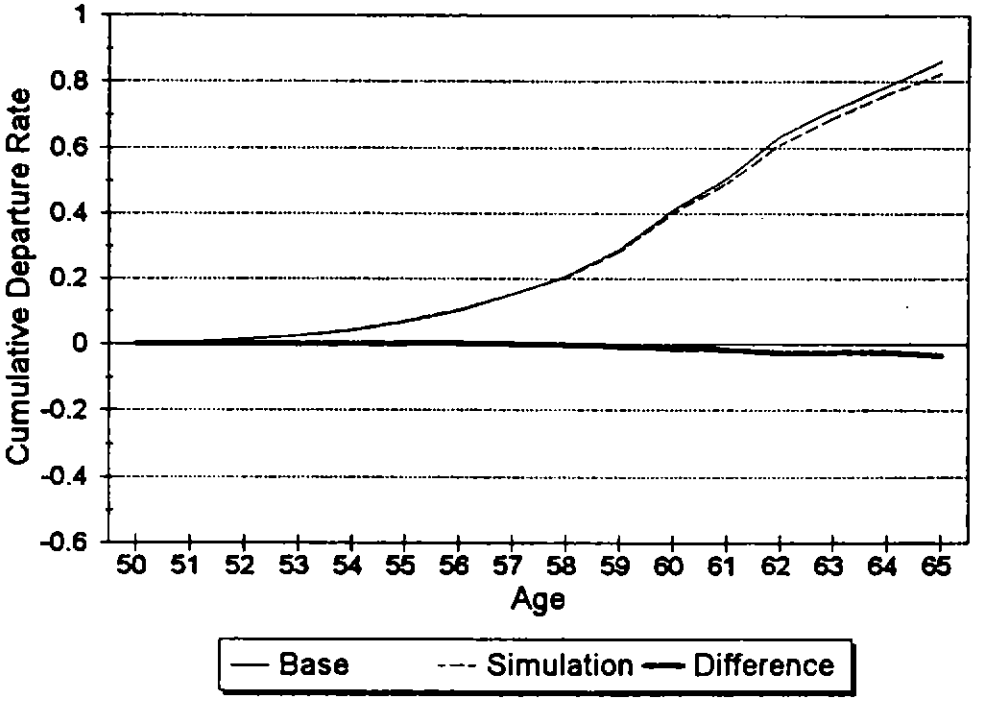
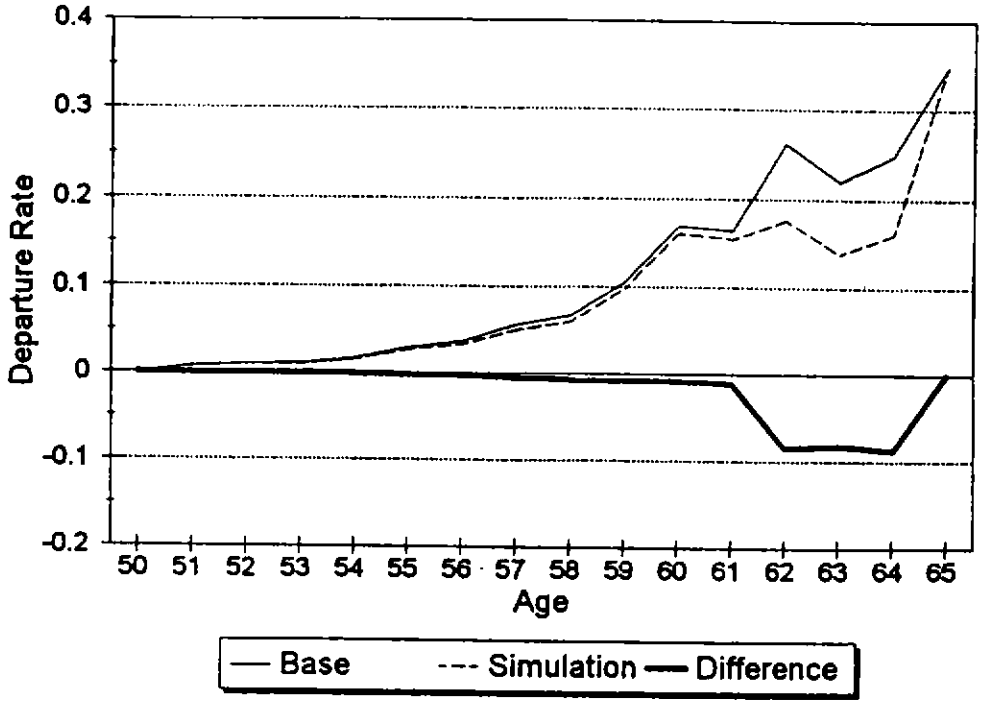


Figure 11. Simulation: Eliminate Social Security Early Retirement
a. Data

Age	Retirement Rates			Cumulative Rates		
	Base	Simulation	Difference	Base	Simulation	Difference
50	0	0	0	0	0	0
51	0.007	0.006	-0.001	0.007	0.006	-0.001
52	0.009	0.009	0	0.016	0.015	-0.001
53	0.01	0.009	-0.001	0.025	0.024	-0.001
54	0.016	0.015	-0.001	0.041	0.038	-0.003
55	0.029	0.026	-0.003	0.068	0.064	-0.004
56	0.036	0.033	-0.003	0.102	0.095	-0.007
57	0.056	0.05	-0.006	0.152	0.14	-0.012
58	0.067	0.06	-0.007	0.208	0.192	-0.016
59	0.106	0.098	-0.008	0.292	0.271	-0.021
60	0.169	0.161	-0.008	0.412	0.389	-0.023
61	0.165	0.154	-0.011	0.509	0.483	-0.026
62	0.262	0.177	-0.085	0.637	0.574	-0.063
63	0.22	0.138	-0.082	0.717	0.633	-0.084
64	0.249	0.161	-0.088	0.788	0.692	-0.096
65	0.35	0.35	0	0.862	0.8	-0.062

Figure 11. Simulation: Eliminate Social Securit Early Retirement

11b. Retirement Rates



11c. Cumulative Rates

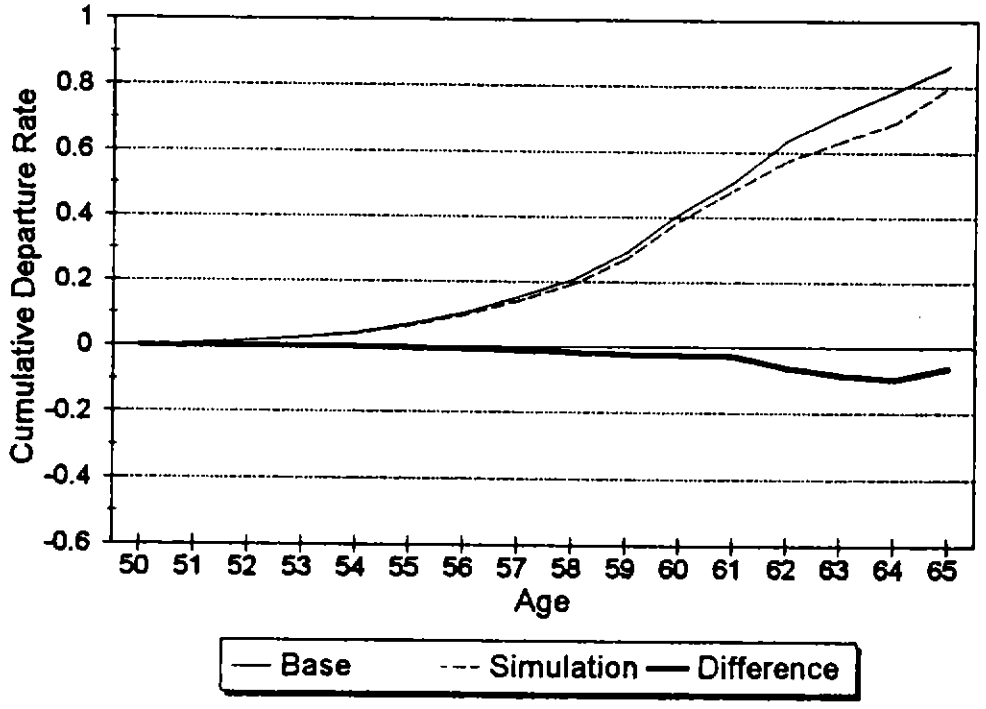
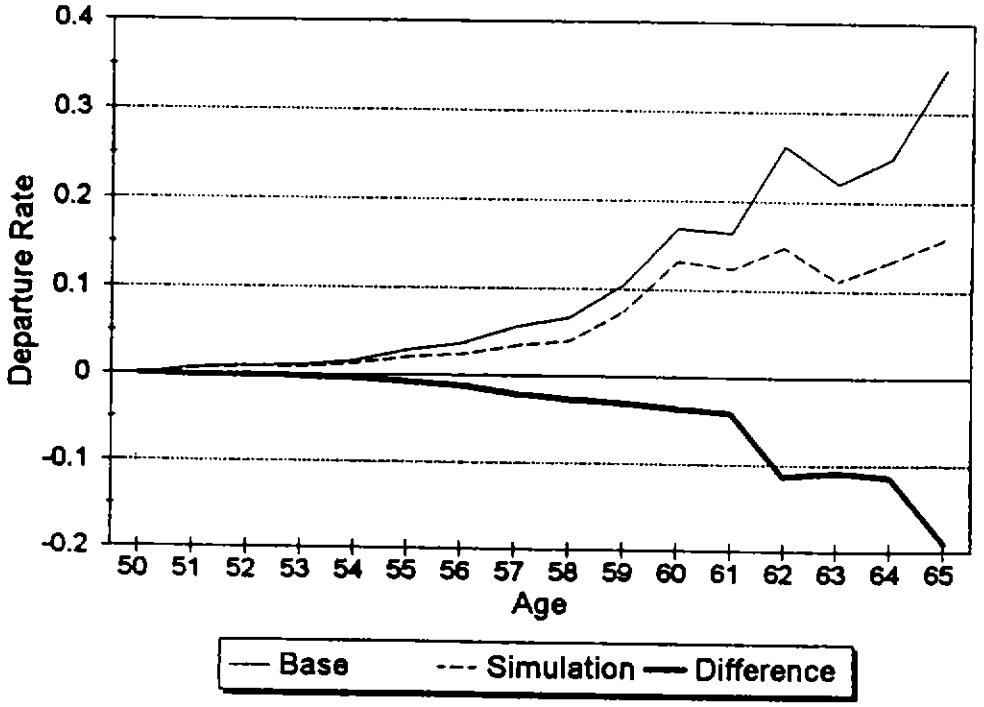


Figure 12. Simulation: Eliminate Social Security
a. Data

Age	Retirement Rates			Cumulative Rates		
	Base	Simulation	Difference	Base	Simulation	Difference
50	0	0	0	0	0	0
51	0.007	0.005	-0.002	0.007	0.005	-0.002
52	0.009	0.008	-0.001	0.016	0.013	-0.003
53	0.01	0.007	-0.003	0.025	0.02	-0.005
54	0.016	0.012	-0.004	0.041	0.032	-0.009
55	0.029	0.021	-0.008	0.068	0.052	-0.016
56	0.036	0.024	-0.012	0.102	0.075	-0.027
57	0.056	0.034	-0.022	0.152	0.106	-0.046
58	0.067	0.04	-0.027	0.208	0.142	-0.066
59	0.106	0.075	-0.031	0.292	0.206	-0.086
60	0.169	0.133	-0.036	0.412	0.312	-0.1
61	0.165	0.124	-0.041	0.509	0.397	-0.112
62	0.262	0.149	-0.113	0.637	0.487	-0.15
63	0.22	0.111	-0.109	0.717	0.544	-0.173
64	0.249	0.135	-0.114	0.788	0.605	-0.183
65	0.35	0.16	-0.19	0.862	0.668	-0.194

Figure 12. Simulation: Eliminate Social Security

12b. Retirement Rates



12c. Cumulative Rates

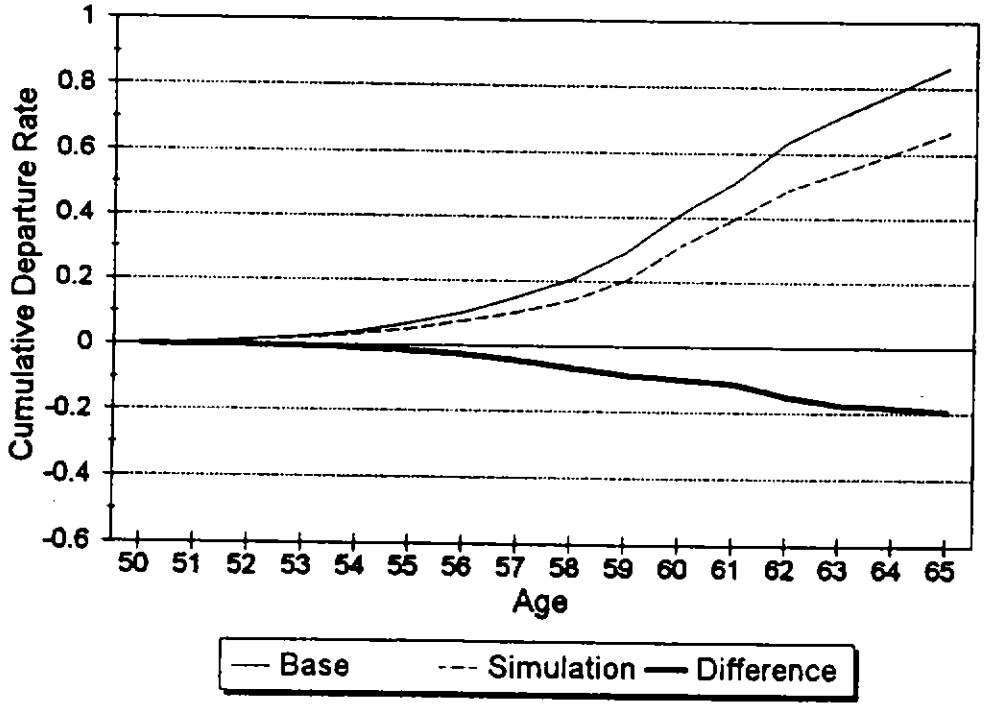


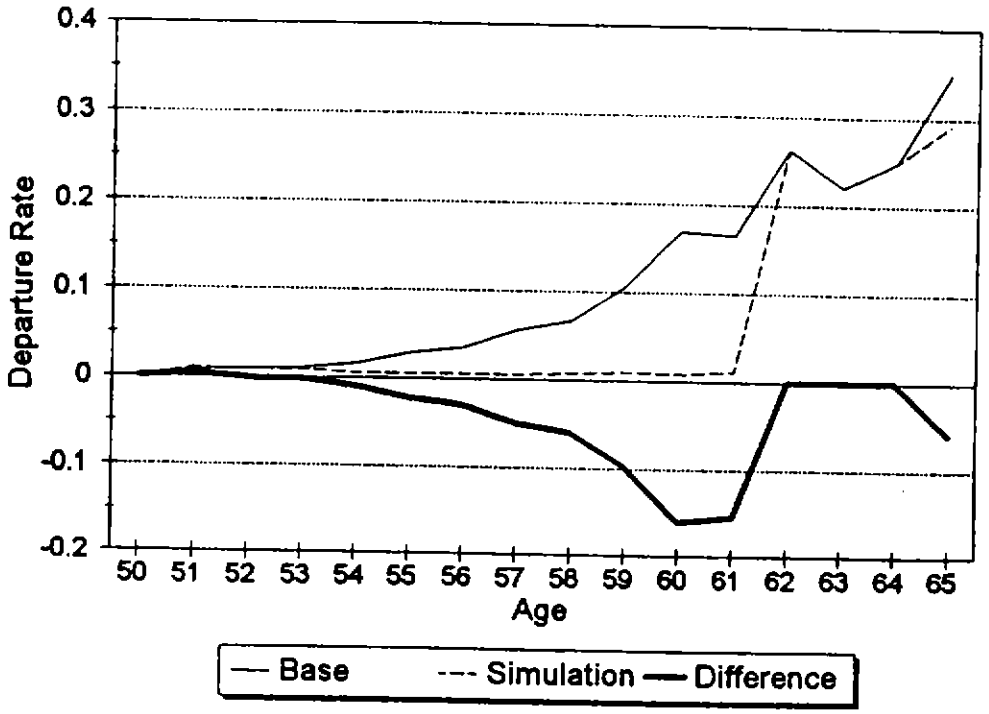
Figure 13. Simulation: Planned Social Security Law Changes and Firm Early Retirement at 62, Not 60

a. Data

	Retirement Rates			Cumulative Rates		
Age	Base	Simulation	Difference	Base	Simulation	Difference
50	0	0	0	0	0	0
51	0.007	0.01	0.003	0.007	0.01	0.003
52	0.009	0.008	-0.001	0.016	0.017	0.001
53	0.01	0.008	-0.002	0.025	0.025	0
54	0.016	0.006	-0.01	0.041	0.031	-0.01
55	0.029	0.006	-0.023	0.068	0.037	-0.031
56	0.036	0.006	-0.03	0.102	0.043	-0.059
57	0.056	0.006	-0.05	0.152	0.049	-0.103
58	0.067	0.007	-0.06	0.208	0.056	-0.152
59	0.106	0.009	-0.097	0.292	0.064	-0.228
60	0.169	0.008	-0.161	0.412	0.071	-0.341
61	0.165	0.011	-0.154	0.509	0.081	-0.428
62	0.262	0.262	0	0.637	0.321	-0.316
63	0.22	0.22	0	0.717	0.47	-0.247
64	0.249	0.249	0	0.788	0.602	-0.186
65	0.35	0.292	-0.058	0.862	0.718	-0.144

Figure 13. Simulation: Planned Social Security Law Changes and Firm Early Retirement at 62, Not 60

13b. Retirement Rates



13c. Cumulative Rates

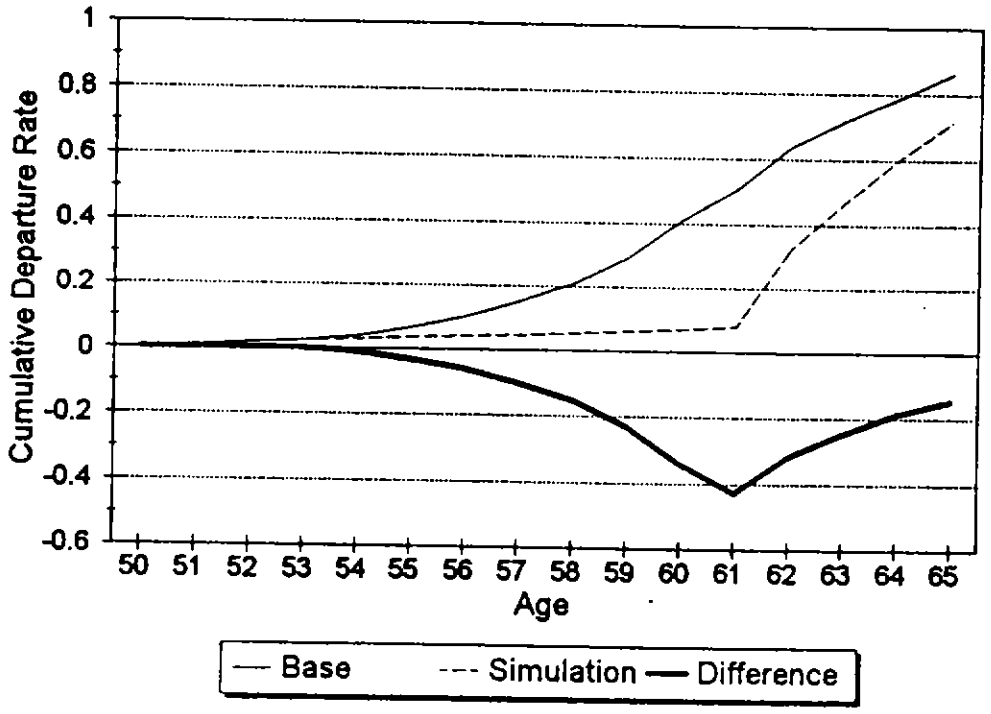
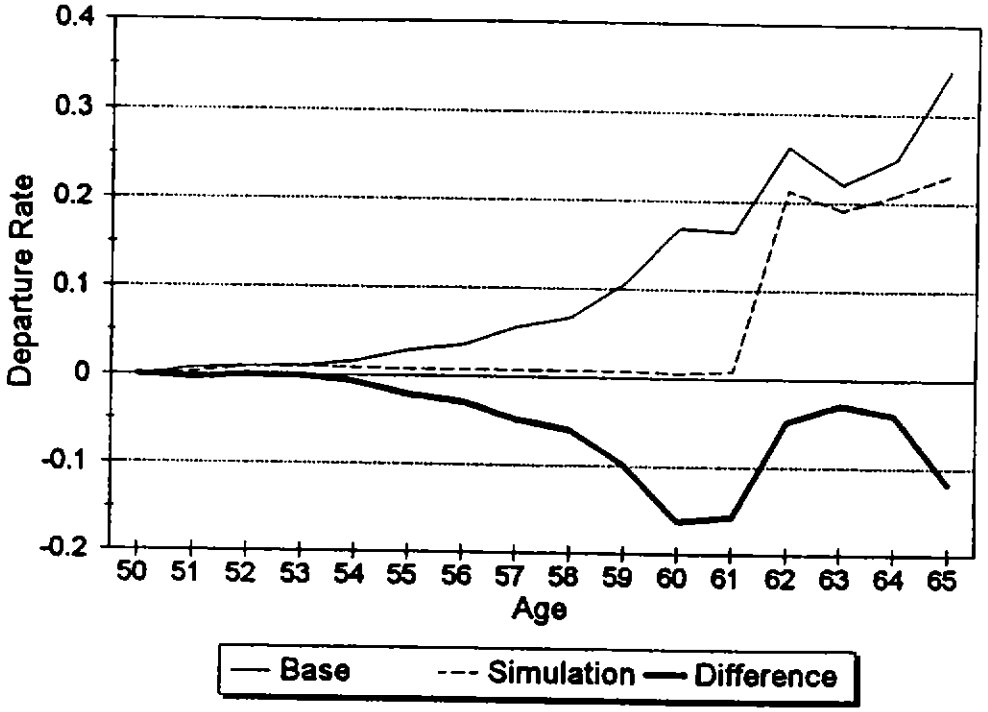


Figure 14. Simulation: Planned Social Security Law Changes and Firm Early Retirement at 62, Normal Retirement at 67
a. Data

Age	Retirement Rates			Cumulative Rates		
	Base	Simulation	Difference	Base	Simulation	Difference
50	0	0	0	0	0	0
51	0.007	0.003	-0.004	0.007	0.003	-0.004
52	0.009	0.009	0	0.016	0.012	-0.004
53	0.01	0.009	-0.001	0.025	0.021	-0.004
54	0.016	0.008	-0.008	0.041	0.029	-0.012
55	0.029	0.007	-0.022	0.068	0.035	-0.033
56	0.036	0.007	-0.029	0.102	0.042	-0.06
57	0.056	0.007	-0.049	0.152	0.048	-0.104
58	0.067	0.007	-0.06	0.208	0.055	-0.153
59	0.106	0.007	-0.099	0.292	0.062	-0.23
60	0.169	0.006	-0.163	0.412	0.068	-0.344
61	0.165	0.008	-0.157	0.509	0.075	-0.434
62	0.262	0.213	-0.049	0.637	0.272	-0.365
63	0.22	0.191	-0.029	0.717	0.411	-0.306
64	0.249	0.209	-0.04	0.788	0.534	-0.254
65	0.35	0.232	-0.118	0.862	0.642	-0.22

Figure 14. Simulation: Planned Social Security Law Change and Firm Early Retirement at 62, Normal Retirement at 67

14b. Retirement Rates



14c. Cumulative Rates

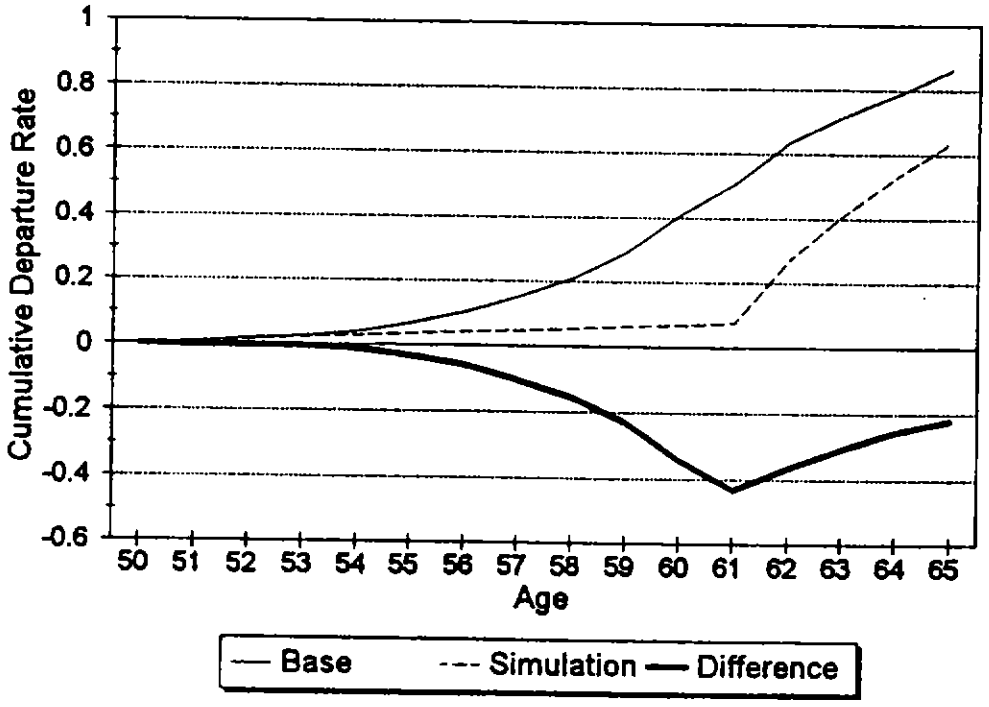
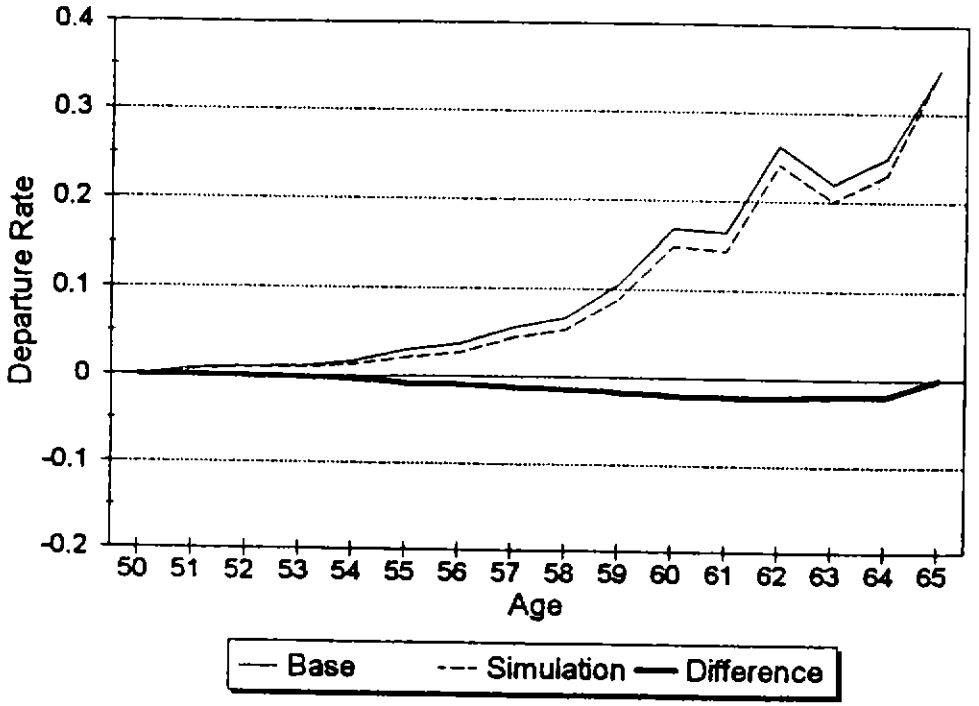


Figure 15. Simulation: Eliminate Firm Retiree Health Insurance
a. Data

Age	Retirement Rates			Cumulative Rates		
	Base	Simulation	Difference	Base	Simulation	Difference
50	0	0	0	0	0	0
51	0.007	0.006	-0.001	0.007	0.006	-0.001
52	0.009	0.008	-0.001	0.016	0.013	-0.003
53	0.01	0.008	-0.002	0.025	0.021	-0.004
54	0.016	0.012	-0.004	0.041	0.032	-0.009
55	0.029	0.02	-0.009	0.068	0.052	-0.016
56	0.036	0.026	-0.01	0.102	0.077	-0.025
57	0.056	0.044	-0.012	0.152	0.117	-0.035
58	0.067	0.053	-0.014	0.208	0.164	-0.044
59	0.106	0.089	-0.017	0.292	0.238	-0.054
60	0.169	0.149	-0.02	0.412	0.352	-0.06
61	0.165	0.144	-0.021	0.509	0.445	-0.064
62	0.262	0.24	-0.022	0.637	0.578	-0.059
63	0.22	0.201	-0.019	0.717	0.663	-0.054
64	0.249	0.23	-0.019	0.788	0.741	-0.047
65	0.35	0.35	0	0.862	0.831	-0.031

Figure 15. Simulation: Eliminate Firm Retiree Health Insurance

15b. Retirement Rates



15c. Cumulative Rates

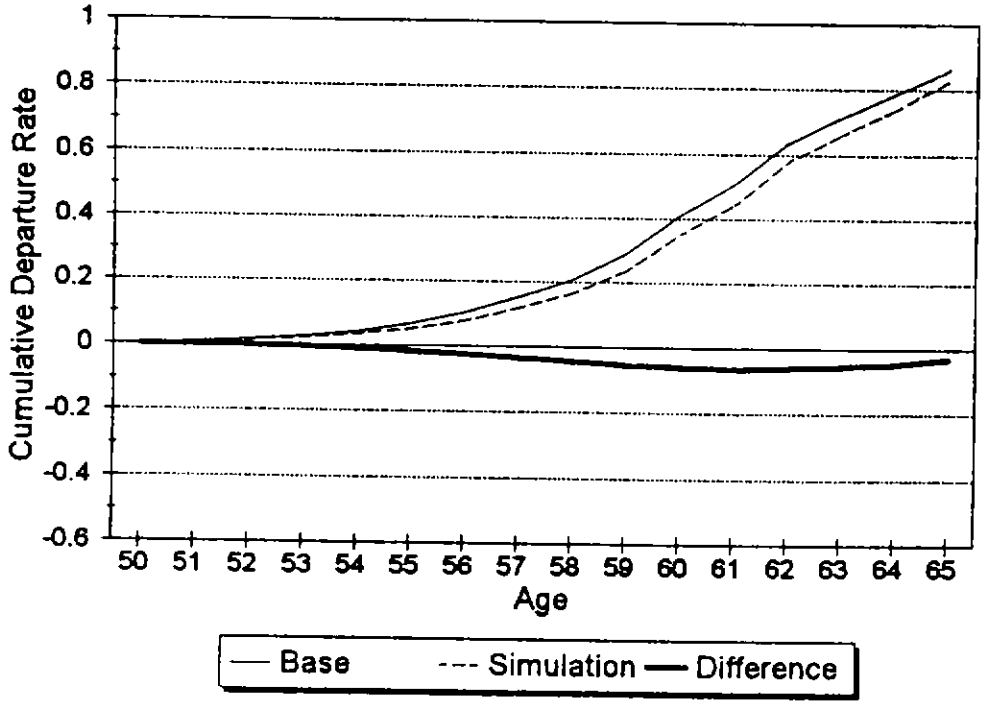
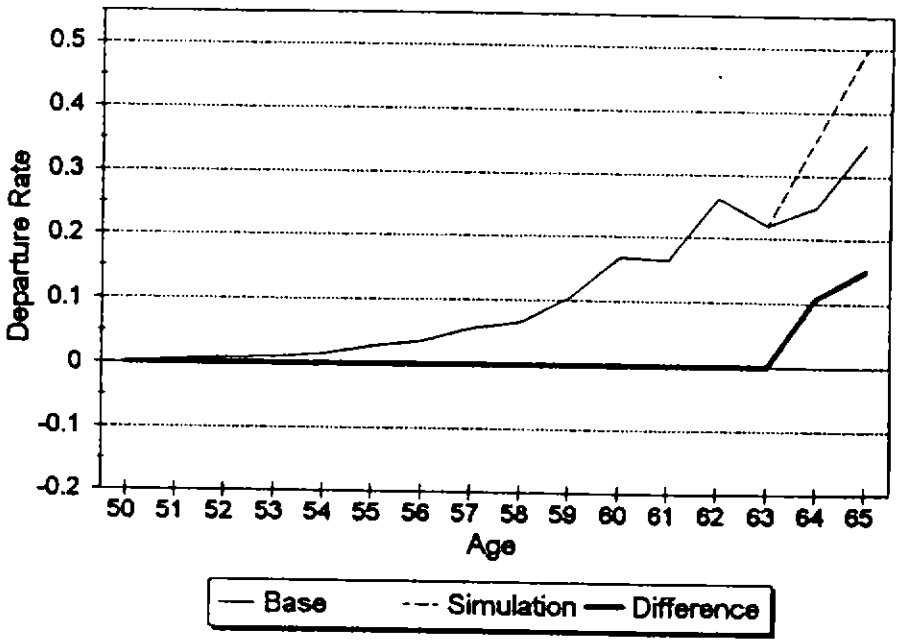


Figure 16. Simulation: Firm Mandatory Retirement at Age 65
a. Data

	Retirement Rates			Cumulative Rates		
Age	Base	Simulation	Difference	Base	Simulation	Difference
50	0	0	0	0	0	0
51	0.007	0.007	0	0.007	0.007	0
52	0.009	0.009	0	0.016	0.016	0
53	0.01	0.01	0	0.025	0.025	0
54	0.016	0.016	0	0.041	0.041	0
55	0.029	0.029	0	0.068	0.068	0
56	0.036	0.036	0	0.102	0.102	0
57	0.056	0.056	0	0.152	0.152	0
58	0.067	0.067	0	0.208	0.208	0
59	0.106	0.106	0	0.292	0.292	0
60	0.169	0.17	0.001	0.412	0.412	0
61	0.165	0.165	0	0.509	0.509	0
62	0.262	0.262	0	0.637	0.638	0.001
63	0.22	0.22	0	0.717	0.718	0.001
64	0.249	0.357	0.108	0.788	0.818	0.03
65	0.35	0.5	0.15	0.862	0.909	0.047

Figure 16. Simulation: Firm Mandatory Retirement at Age 65

16b. Retirement Rates



16c. Cumulative Rates

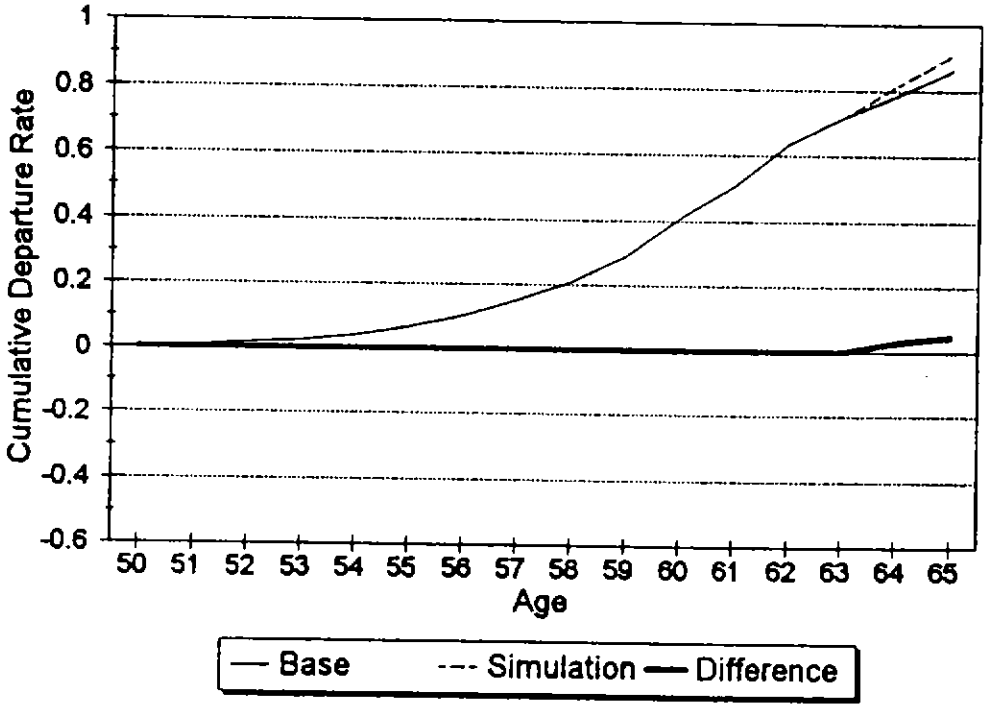
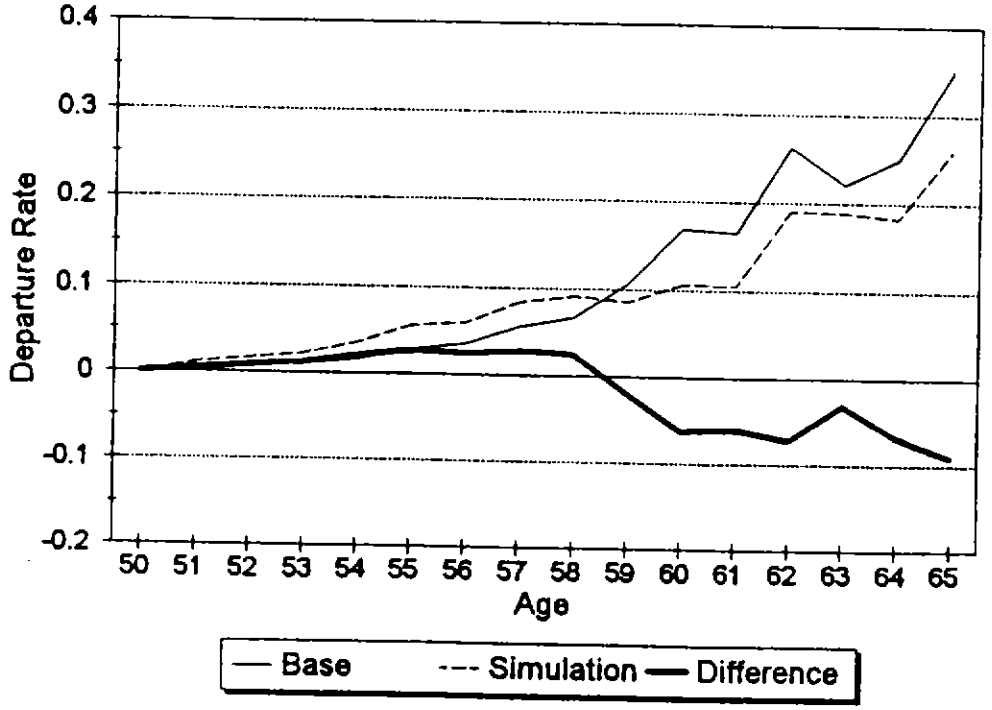


Figure 17. Simulation: Defined Contribution Plan of 7.5%
a. Data

Age	Retirement Rates			Cumulative Rates		
	Base	Simulation	Difference	Base	Simulation	Difference
50	0	0	0	0	0	0
51	0.007	0.011	0.004	0.007	0.011	0.004
52	0.009	0.017	0.008	0.016	0.028	0.012
53	0.01	0.022	0.012	0.025	0.05	0.025
54	0.016	0.036	0.02	0.041	0.084	0.043
55	0.029	0.056	0.027	0.068	0.135	0.067
56	0.036	0.06	0.024	0.102	0.187	0.085
57	0.056	0.084	0.028	0.152	0.255	0.103
58	0.067	0.091	0.024	0.208	0.323	0.115
59	0.106	0.086	-0.02	0.292	0.381	0.089
60	0.169	0.106	-0.063	0.412	0.447	0.035
61	0.165	0.105	-0.06	0.509	0.505	-0.004
62	0.262	0.19	-0.072	0.637	0.599	-0.038
63	0.22	0.189	-0.031	0.717	0.674	-0.043
64	0.249	0.182	-0.067	0.788	0.734	-0.054
65	0.35	0.259	-0.091	0.862	0.803	-0.059

Figure 17. Simulation: Defined Contribution Plan of 7.5%

17b. Retirement Rates



17c. Cumulative Rates

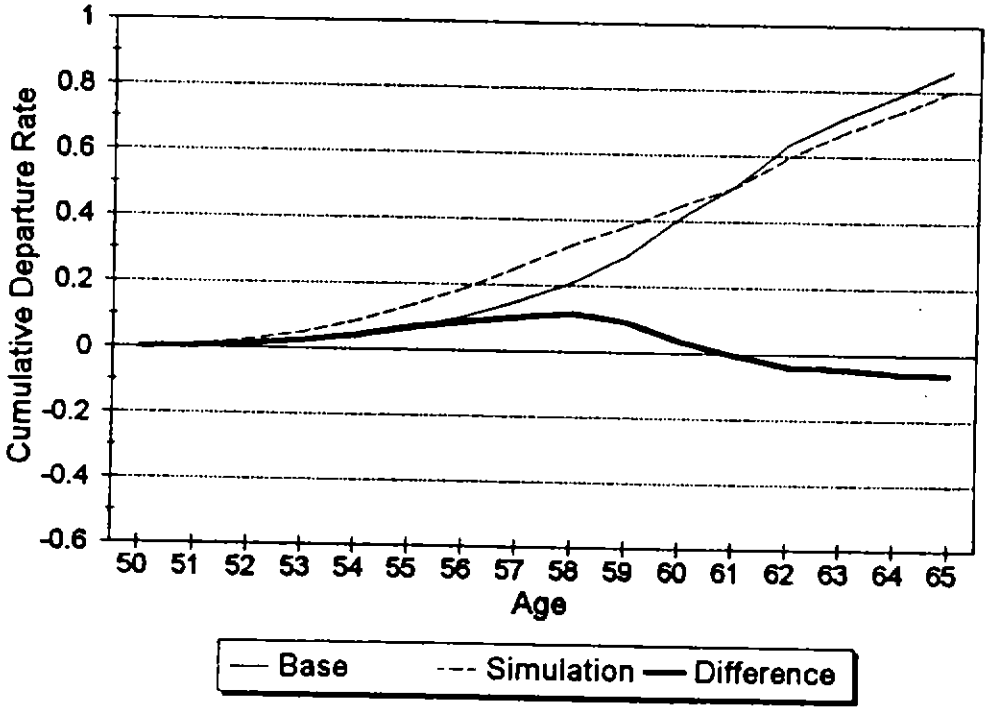
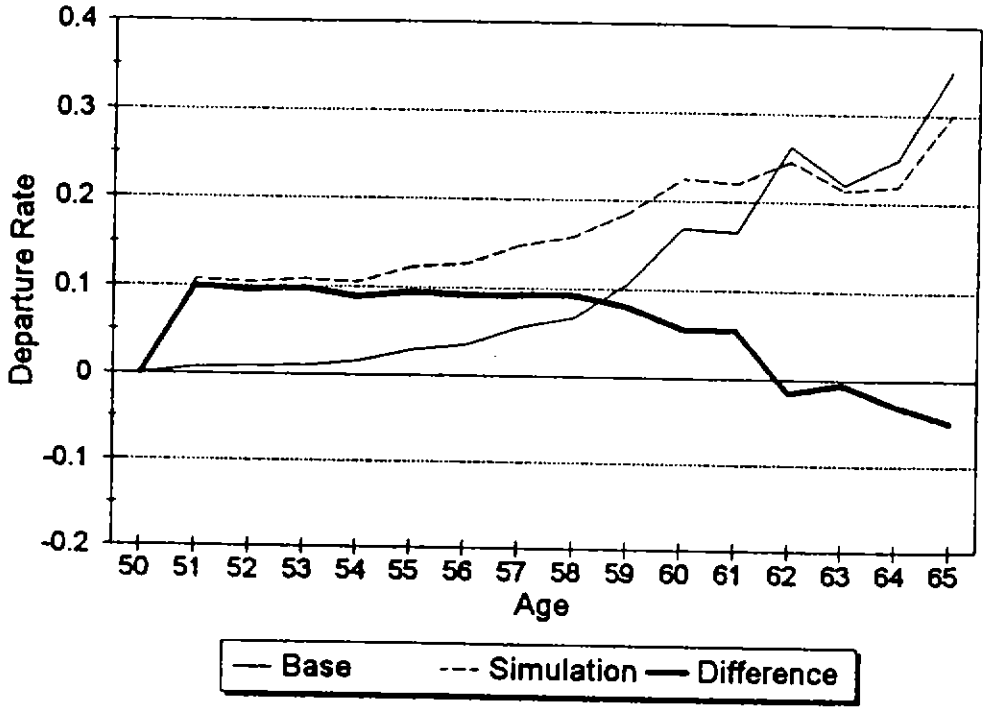


Figure 18. Simulation: Require Post-Retirement Work
a. Data

Age	Retirement Rates			Cumulative Rates		
	Base	Simulation	Difference	Base	Simulation	Difference
50	0	0	0	0	0	0
51	0.007	0.107	0.1	0.007	0.107	0.1
52	0.009	0.104	0.095	0.016	0.199	0.183
53	0.01	0.108	0.098	0.025	0.286	0.261
54	0.016	0.105	0.089	0.041	0.361	0.32
55	0.029	0.123	0.094	0.068	0.439	0.371
56	0.036	0.127	0.091	0.102	0.511	0.409
57	0.056	0.148	0.092	0.152	0.583	0.431
58	0.067	0.159	0.092	0.208	0.65	0.442
59	0.106	0.186	0.08	0.292	0.715	0.423
60	0.169	0.225	0.056	0.412	0.779	0.367
61	0.165	0.22	0.055	0.509	0.828	0.319
62	0.262	0.246	-0.016	0.637	0.87	0.233
63	0.22	0.214	-0.006	0.717	0.898	0.181
64	0.249	0.219	-0.03	0.788	0.92	0.132
65	0.35	0.3	-0.05	0.862	0.944	0.082

Figure 18. Simulation: Require Post-Retirement Work

18b. Retirement Rates



18c. Cumulative Rates