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THE EFFECT OF SOCIAL SECURITY ON RETIREMENT IN THE EARLY 1970's

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ABSTRACT

Improved understanding of retirement behavior is a key to better understanding of many important economic problems. In as close as we can come to a general "social experiment," real Social Security benefits were increased substantially for the period we study the retirement patterns of a cohort of white males: 28% on average between 1970 and 1972, with the maximum benefit increased by over 50% in real terms between 1968 and 1976. Other important structural changes in the method of computing benefits were also made. Hence, we have extremely detailed longitudinal data on a cohort of people spanning the years of most active retirement behavior (ages 58-67) over a period of abrupt change in the economic incentives surrounding their retirement.

We have analyzed these data in a variety of ways to examine the impact of the changes in Social Security, as well as other factors, on retirement probabilities. The most simple to the most sophisticated analyses reveal the same set of inferences:

1. The acceleration in the decline in the labor force participation of elderly men over the period 1969-73 was primarily due to the large increase in real Social Security benefits; our probability equations estimate effects of changes in real benefits combined with the actual changes to predict declines in participation rates virtually identical to actual observed changes from independent data.

2. Social Security wealth interacts with other assets. A substantial fraction of the elderly appear to have few other assets and this group shows a markedly larger propensity to retire early, e.g., at age 62 when Social Security benefits become available. We find strong evidence of this liquidity constraint effect for an important subgroup of the elderly.

3. The magnitude of the induced retirement effect is large enough that if it is ignored in estimating the direct fiscal implications of major changes in benefit provisions, these may be substantially underestimated.

4. We interpret our results in the historical context of a particular cohort undergoing a major, unanticipated transfer of wealth via larger real benefits. We make no attempt to distinguish these from the long-run effects if the system were to remain unchanged for many years or if future changes were readily predictable.

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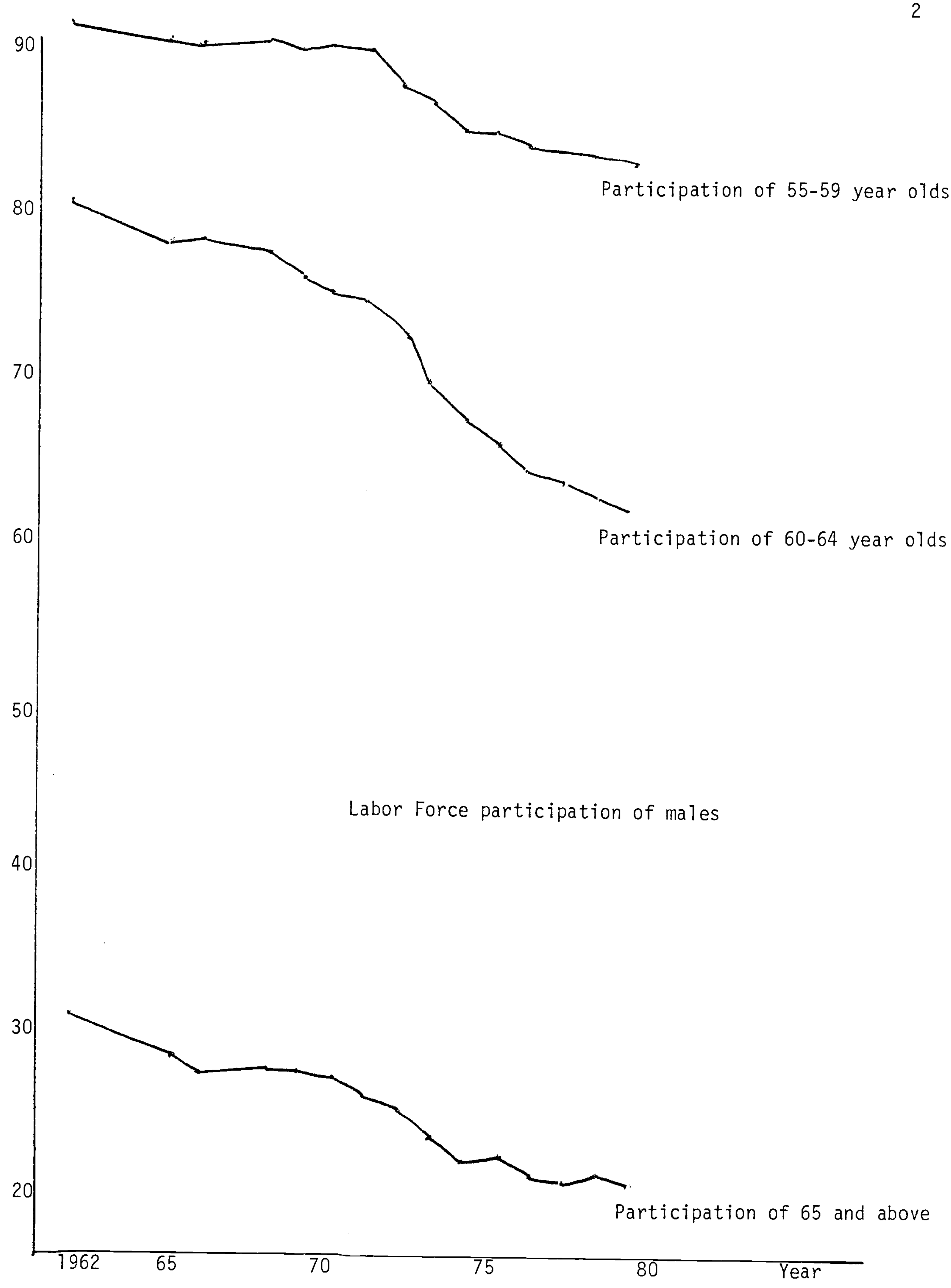
THE EFFECT OF SOCIAL SECURITY ON RETIREMENT IN THE EARLY 1970's

I. Introduction

The labor force participation rates of the elderly have been in decline for decades; but in about 1970 the rate of decline seemed to accelerate. Graph 1 shows the labor force participation rates over time of males by three age groups: it shows that even among 55-59 year olds participation dropped sharply beginning in about 1970. What were the causes of these declines, and can we expect them to continue? In this paper we attempt to give at least a partial answer to the first question by linking it with another important fact: beginning in about 1969 the level of real Social Security benefits was raised by Congressional action. These increases were by no means trivial: the average benefit of a beneficiary husband and wife increased by 28% in real terms from 1970 to 1972; between February, 1968 and January, 1976 the maximum benefit possible increased by about 133% while the Consumer Price Index (CPI) increased by about 54%. A consequence of the large increases in benefits and the decline in labor force participation of people aged 62 and over has been the increasing fraction of personal income devoted to Social Security benefit payments: in 1970 about 3% of personal income; in 1976 about 3.5%. Another consequence was that the amount of employee and employer contributions to the Social Security trust funds proved to be inadequate at the levels called for by the laws of the early 1970's. For example, the 1969 law envisioned a contribution rate of 5.7% by both employees and employers in 1976; the 1971 law changed the rate to 5.85%, which was the actual rate in 1976. More important was the increase in the tax base: its was $7800 from 1968 through 1971, but rose to $15,300 in 1976. It is scheduled to be $29,700 in 1981 with a rate of 6.65%. Thus the maximum contribution by each employee and employer rose from $374 in 1970


90
80
70
60
50
40
30
20
Participation of 55-59 year olds
Participation of 60-64 year olds
Labor Force participation of males
Participation of 65 and above
1962
65
70
75
80
Year

to $895 in 1976. It is scheduled to rise to $1975 in 1981.

We investigate the relationship between retirement and various features of Social Security with data from the Retirement History Survey (RHS). This survey of about 11,000 heads of households who were between the ages of 58 and 63 inclusive in 1969 is ideal for the period of study because the heads reached the most likely retirement ages just at the time of the increases in Social Security benefits. They thus constitute an experimental population who were subjected to substantial increases in assets, which, it is reasonable to suppose, were not anticipated.

From the RHS we have selected a subsample of white working husbands, and from the subsample we give a wide range of evidence that there was a relationship between Social Security benefits and retirement probabilities.

The evidence ranges from the calculation of simple retirement probabilities by age to the specification and estimation of logistic probability equations. The data strongly support the view that there was a positive relationship between Social Security benefits and retirement probabilities: this relationship comes out almost independently of the way in which the data are studied. In the latter part of the work when we attach magnitudes to the effect of Social Security benefits, we find that the changes in benefits in the early 1970's offer a good explanation of the decline in labor force participation over that period. We conclude it is reasonable to hold that a substantial part of the decline in participation and subsequent increase in costs of the Social Security Systems were caused by retirement induced by increases in Social Security benefits.

II. The Social Security Law

It may seem obvious that the Social Security system can have an effect on retirements; but this view is certainly not universally accepted in the theoretical literature, and it is not always supported in the empirical literature. Part of the disagreement comes because people do not distinguish carefully between the short run and the long run. This is especially true in the empirical literature. Gordon and Blinder [1980], for example, take as a working hypothesis that the Social Security system has no effect on retirement. They do not, however, consider that changes in the Social Security law which result in unexpected asset transfers could affect retirement even though the system might have no effect on retirements in long-run steady state. Alternatively, we (Boskin and Hurd [1978]) considered the long run effects when workers have high rates of time discount; in that situation there are very high tax rates on working past age 62.*

A second source of disagreement is that some researchers have not carefully researched the complex Social Security law. Blinder, Gordon and Wise [1980] especially have made a valuable contribution by pointing out important features of the law ignored by previous researchers. Much of what follows in this section is derived from their paper.

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*A large number of other studies have used alternative types of data and estimation techniques to examine the relationship among labor force participation rates of the elderly or individual retirement probabilities and economic incentives, including social security benefit and coverage levels. The bulk of such studies -- reviewed in Campbell and Campbell [1976] and Boskin [1977] -- conclude that Social Security does - or has - affect retirement. But each of these studies (present authors not exempted) raise problems of data or technique or interpretation while making their contribution. Thus, starting in Section III below we utilize an improved data source and an abrupt historical change in social security benefits to gain new insights into the retirement process.

Any analysis of the effect of Social Security on retirement must rest on a reasonable treatment of the complicated Social Security law. Here we shall describe the main features of the law as it pertains to retirement benefits of workers of ages 62 through 65 in the years 1969 through 1973. Then we shall discuss the possible theoretical effects of Social Security on retirement in the steady-state and in the short run following a change in benefits.

For our purposes the main features of the Social Security law are the calculation of the Primary Insurance Amount (PIA), the calculation of benefits, the earnings test and the exogenous changes in benefit levels mandated by Congress from February, 1968 through June, 1974.* The intent of the Social Security law was to make benefits depend on past earnings, and to provide income insurance at the age of retirement. As the law was initially envisioned, in steady state there would be a fair rate of return on contributions; yet workers with low lifetime earnings due either to low wage rates or to career interruptions would receive at least subsistence payments. In fact, these goals are not consistent, so the present law is a compromise.

For most people, benefit calculations depend on Average Monthly Earnings (AME), which are a function of their earnings history. Roughly speaking people with higher lifetime earnings will have higher AME. The PIA is calculated from the AME according to a piecewise linear function that is progressively redistributive in that the slope decreases in AME. AME is a complicated average of past Social Security contributions; but for our sample the important feature is that if a worker works an extra year he is allowed to replace a year of zero or low earnings in the calculation of the AME with a year of current earnings. This has the effect of raising AME, and hence the PIA and benefits, but the magnitude of the effect will vary from worker to worker because of difference in earnings histories: someone with only a few years of contribution could have a large change in PIA both due to a large change in AME and because the change in PIA for a change in AME is high when AME is low; someone with a long history of high contributions would have a small change in PIA from working an extra year. Blinder, Gordon and Wise report calculations of the magnitude of this effect for a larger population than ours and find the effect to be substantial. Because our sample has more stable and higher

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*Whether workers are covered under the Social Security law is not very important for the population we study although we take coverage into account in our calculation. Almost all of our working data set is covered.

earnings histories we find a much smaller effect, but we do take the effect into account as we shall outline in the section on estimation.

A retired worker's monthly benefits are related to the PIA according to the age of retirement. Before the age of 62 no benefits may be drawn. Between the ages of 62 and 65 benefits may be drawn upon retirement but the benefits are reduced from the PIA by 5/9% for each month of retirement before the age of 65. Thus if a worker retires at age 62 his benefits are reduced by 5/9% x 3 x 12 = 20% of his PIA. This reduction is permanent; that is, it applies even after the retired worker's 65th birthday. We call this the actuarial reduction because the aim in the law was to make the reduction roughly actuarially fair. Whether the reduction is in fact actuarially fair or not depends on a number of factors: the rate used to discount future benefits, the life expectancy, the age of retirement, and the age of a married worker's wife. In Table 1 we give some examples of the effect of the actuarial reduction on both single and married male workers for several discount rates. The entries show the fraction of the present value of Social Security benefits lost by waiting a year to retire. The entries are calculated by finding the present value of the increased benefit stream over the expected lifetime (and, in the case of a married man, the lifetime of his widow), subtracting from that the year's benefits lost by not retiring, and dividing the negative of that difference by the present value of benefits. For example, at a discount rate of 5% a 62 year old single worker would lose about .009 of the present value of his benefits by waiting a year to retire, and, therefore, the 5/9% per month gain is not quite large enough to be actuarially fair. At a discount 3% it pays, but just slightly, to wait a year to retire. Even at large discount rates, however, the fraction of present value lost by delaying retirement is not large.

Table 1

Fraction of Present Value of Social Security Benefits Lost by Waiting a Year to Retire

Single worker Age		Discount Rate 1%	3%	5%	10%
62		-.012	-.002	.009	.039
63		-.004	.006	.017	.046
64		.004	.014	.025	.054
Married worker					
Husband's Age	Wife's Age				
63	60	-.006	.001	.009	.032
64	61	.000	.007	.015	.037

Probably a more natural way to judge the effects of the actuarial reduction is in terms of an implicit tax or subsidy on working. Unfortunately there is no standard case: one can only give examples, which we do in Table 2. The entries refer to a male worker with a history of maximum Social Security contributions and, therefore, with the maximum possible PIA, $160 in 1969. He is assumed to earn $7800, the median income in our sample in 1969. It is apparent that the tax rates are not large for discount rates of 3% to 5%. The negative entries indicate that there is, in fact, a subsidy to working. The tax rises with age for two reasons: life expectancy decreases so the payback period of the higher benefits decreases; and the amount foregone by delaying retirement rises with retirement age from 0.8 PIA at age 62 to 0.933 PIA at age 64. To the extent that the actuarial reduction offers incentives to retirement, the incentives are greatest at age 62; but unless one believes that people discount at very high rates, the incentive is not large, especially for the category of worker we consider. In short, the aim of the law was to make the reduction in benefits actuarially fair for retirement before the age of 65, and reoughly speaking that seems to be the case.

Retirement after the 65th birthday is far from actuarially fair: future benefits are increased by about 1% for each year of delayed retirement versus about 7% for each year before age 65. The Social Security system, therefore, offers a strong incentive to retire at the 65th birthday.

The earnings test causes benefit payments to be reduced if earnings exceed $1680 per year.* The reduction is at a 50% rate for earnings up to $2880 and then at a 100% rate until benefits have been reduced to zero.

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*This refers to the law through December 1972; in later years the maximum permitted earnings was raised.

Table 2

Implicit Tax on Earnings Due to Delayed Retirement

		Discount Rate			
Single worker		1%	3%	5%	10%
Age					
62		-.034	-.005	.018	.059
63		-.010	.016	.037	.075
64		.013	.037	.057	.092
Married worker					
Husband's Age	Wife's Age				
63	60	.026	.004	.029	.071
64	61	.000	.027	.049	.088

Note: Negative entries represent a subsidy.

Many empirical studies have interpreted the earnings test as a tax on earnings.* If there are good capital markets and the actuarial reduction is fair, this is not the case before age 65: if benefits are reduced due to the earnings test, benefits are recomputed at age 65 and credit is given for each month's benefits withheld under the earnings test. Furthermore, if partial benefits are paid in some months, the benefits are aggregated into full-month equivalents and the appropriate credit given. Under actuarially fair reduction, therefore, the apparent taxes under the earnings test are simply savings at a fair rate of return. There is, however, a second-order effect that does discourage both part-time work and unretirements (returning to the labor force after drawing benefits): the recalculation of benefits is not made until age 65, so that the credit for benefit reduction is not realized until that age. This means that if someone decides to be retired for, say, a year during the time he is between 62 and 65, it is better to work full time until 64 and then retire permanently rather than to retire at 62 and reenter the labor force at 63. This effect and the fact that if the actuarial reduction is fair at age 62, it is unfair at later ages, both combine to discourage unretirement. We shall see that in our data there are not many unretirements, and other data suggest the same thing.

The effect of the earnings test after the 65th birthday is to provide a strong incentive to retire, or at least to earn less than $1680 per year.**

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*See Boskin and Hurd [1978], for example.

**There is a complication in the earnings test because there is also a monthly test: benefits may not be reduced in a month in which earnings are less than $140 even though earnings are high in the other months. If there were jobs with high earnings that could be started and stopped at will, this could cause bunching of earnings by month. We assume that there are substantial costs in changing jobs, which eliminates this kind of behavior, and our data seem to be consistent with this view. Gordon and Blinder [1980] also report a substantial drop in wages accompanying job changes in this age group.

Over the period of our data the law on the calculation of the PIA from AME was changed a number of times. These changes had the effect of increasing benefit levels considerably faster than the rate of inflation. We view these changes as causing exogenous changes in the value of Social Security to someone of retirement age, and we give evidence below that these changes in Social Security benefits are at least partly responsible for the decline in labor force participation of the elderly. That this conclusion is plausible may be seen from the magnitudes of the increases in Social Security benefits: between February, 1968 and January, 1976, the maximum benefit possible increased by 133%, yet the CPI increased over this period by about 54%. Most importantly for our study, the changes were concentrated in the early part of the 1970's: in 1969 the average benefits of a retired worker and wife were 169 in 1969 dollars; in 1972 that figures was 239, again in 1969 dollars, an increase of 41%.

We do not want to conduct here a full-scale discussion of the effect of the Social Security system on retirement in the steady-state. Rather we want to take what is possibly an extreme view, and ask if there is any effect on early retirement if the actuarial reduction is fair and the system does not cause any net transfers among individuals. Under these assumptions the system should not have any effect on retirements before the age of 65: each invididual has the same lifetime resources, and so he will want to consume the same amount of leisure including retirement years. Furthermore, the age of retirement can be chosen independently of the age at which benefits can be drawn provided the individual has private assets that can be consumed in substitution for his future Social Security benefits.* Why do there seem to be extra retirements at age 62 if the foregoing is true? Even under actuarially fair reduction

*In consonance with the literature we call future Social Security benefits (or wealth) the present value of the lifetime benefits that could be drawn were the worker to retire.

the Social Security system may have an effect on retirement if, in response to the system, some people choose not to accumulate private savings. Suppose, for example, in an actuarially fair system the required rate of saving is so high that some workers find they accumulate more in Social Security savings than they wish in total savings. Their response is to reduce private savings to zero, and, if there is a capital market in which they can borrow against future Social Security benefits, retire at the age dictated by their lifetime wealth. If that age were before the age of entitlement under Social Security, their consumption could be financed by borrowing. In the absence of such a capital market, however, people must retire to draw on their Social Security wealth. Because the consumption of Social Security wealth is tied to the consumption of leisure, the Social Security system will have an effect on retirement of people who have been forced to oversave. A prediction is that people who have a high level of Social Security wealth relative to their total wealth will not retire before age 62, and will retire at 62 compared to people with the same total wealth but with a mix towards private wealth. We call this the liquidity constraint effect.

The short-term effects of a change in the Social Security law such as those of the early 1970's are more clear. Benefits were increased by Congressional action faster than the rate of inflation. It is not unreasonable to assume that these were unanticipated transfers that increased the wealth of the elderly. As long as leisure is a normal good the increases would act to induce retirement.

The main point of the analysis of the law is to show that if the reduction is actuarially fair, the earnings test does not have to be taken into account in the estimation of the effects of the Social Security system on retirement. Further points are: to the extent that earnings affect future Social Security benefits, the gross wage needs to be adjusted to account for that effect; the liquidity constraint hypothesis suggests that the dependence of retirement on Social Security benefits is not a simple linear dependence but, at a minimum, should include an interaction between benefits and other assets; the effect of Social Security on retirement should vary with age.

Finally, it is clear that to obtain a complete empirical understanding of the effects of Social Security on retirement, a study should carefully distinguish the steady state from the transitory. With the available data this is not at all easy to do, and we do not attempt that here. Our goal here is to show that the changes in the law in the early 1970's seem to have had an effect on retirement of a substantial magnitude, and to show that the data are roughly in consonance with the theoretical expectations.

III. Empirical Evidence of the Effect of Social Security on Retirement

We do not believe that the state of research on the effect of Social Security on retirement is advanced enough that we should be dogmatic about the specification of estimating equations. Rather our aim will be to present a wide range of evidence from simple conditional probabilities to logistic probability functions. We believe that at a minimum the data show convincingly that there was some effect of Social Security on retirement; at a maximum if one has confidence in the magnitudes of our estimates they provide a good explanation of the decline in labor force participation of the elderly.

Our data come from the 1969, 1971 and 1973 waves of the Longitudinal Retirement History Survey (RHS) and from Social Security earnings history data that were merged with the RHS data. We have substantially complete information on asset holdings, wage rates, work patterns, family structure, and other usual economic and demographic variables over these years. Most importantly, from Social Security earnings records we can calculate the retirement benefits that a worker would receive were he to retire. If we understand the Social Security law correctly we can calculate the benefits with complete accuracy.

Our basic working data set consists of all white married men who were working at the beginning of our sample period as salaried employees in the private sector.*

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*Information on the calculation of the important variables and a complete description of the sample selection criteria are given in the Appendix.

Before we turn to the data on retirement, we present some evidence that the liquidity constraint hypothesis may have support in the data. As outlined in the Appendix we calculated net assets, housing wealth and Social Security wealth, which is the present value of expected Social Security benefits were the worker to retire. Of 61 year old workers, 22% had total assets, including housing but excluding Social Security wealth, of less than $12,000 in 1969 dollars. If housing wealth (because it may not be very liquid) is excluded, 22% had less than $3,000. About 9% had essentially no nonhousing assets, yet 31% of this group had more than $20,000 in Social Security wealth. These examples, taken from more extensive tables we report elsewhere, suggest that there are many people near the end of their work lives who have accumulated almost no private wealth. Whether this is in response to the savings required by the Social Security system or the result of negative ex post rates of return on investments cannot be determined in the data; but it is still true that increases in Social Security wealth could not induce retirement before age 62 in this group. We conclude that the distribution of assets certainly increases the plausibility of the liquidity constraint hypothesis.

To study retirement the data were divided into six subsets. Each subset is used to estimate the probability that a person retires at a particular age given that he has not previously retired. Thus, for example, the age 62 data set consists of all workers who reach their 62nd birthday without having retired. All the estimates presented in this paper are conditional probabilities of retiring.

We define retirement simply to occur when someone leaves the labor force and does not reenter by the end of our sample period.* We found very

*Other definitions in this data set are possible: for example, people who left the LF were asked if they were retired. We chose the behavioral definition because of considerable ambiguity in many of the answers to that question.

little evidence of unretirement even though in some cases we have a period of observation of more than five years in which to observe reentry.* This is, of course, not absolutely certain: it is possible that some workers leave the labor force and reenter after a long period out of the labor force. There are, however, a number of theoretical and empirical reasons for believing this does not happen often: the Social Security system itself makes this kind of behavior unattractive; job skills are bound to deteriorate, and reentry wages suffer. On the empirical side in addition to our calculations on labor force reentry, are data reported by Hall [1980] on job tenure. These data which come from special labor force reports of the Bureau of Labor Statistics indicate that very few workers above the age of 60 hold new jobs. Since the fraction that drops out of the labor force for more than a year and then reenters to hold a job would be very much smaller than this fraction, the number of unretirements must be very small indeed. Finally, Gordon and Blinder [1980] report that there is a substantial decline in the wage rate associated with job changes at the ages we study. This would induce workers either to remain at their job or to retire. They conclude that the typical worker will work full time until he nears retirement and then withdraw completely from the labor force.

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*In addition we were conservative in guarding against end effects. For example, the last vintage that was used in calculating the retirement probabilities at 62 was vintage 5, which is comprised of workers aged 59 on January 1, 1969. All of this vintage was 63 on January 1, 1973, and since the survey was in the Spring of 1973, we can be sure that anyone who enters the calculations of the age 62 retirement probability was observed during his entire 62nd year. Anyone who was classified as retired would have had on average, about a year of no job holding or job search activity. Of course, anyone who left the labor force at age 62, and reentered before the survey in the Spring of 1973 would not have been counted as retired; but in our data there are very few such cases. It is possible that this upper truncation could account for part of the apparently rising retirement probabilities; but if the evidence from the vintages that are observed for long periods provides a reliable indication of the effect, it is small.

In Graph 2 we present the simple conditional retirement probabilities at each age. They are calculated by dividing the number of workers who reach a certain age without retiring by the number who retire at that age. The striking feature of the graph is that the conditional retirement probabilities increase smoothly from age 59 through age 66 except for sharp jumps age 62 and 65. At age 65 there are a number of reasons why there should be a high frequency of retirement: some workers face mandatory retirement; workers may become eligible for private pensions; and the actuarial reduction is certainly not fair. At age 62 there are no institutional reasons of any serious empirical magnitude except for Social Security to explain why the retirement rate is about 50% higher than what would be expected by a straight line interpolation between ages 61 and 63. These data do not tell us of course what features of the Social Security system cause the extra retirements, but we believ they give strong support to the view that there is some effect.

In Table 3 we give by vintage the same kind of conditional probabilities. Since we have a panal data set workers will reach a certain retirement age in different calendar years according to their year of birth. Classifying by vintage is therefore a way of finding the way the conditional retirement probabilities have varied through time. Vintage is defined according to age on January 1, 1969. Vintage 1, those who were 63 on that date is the oldest vintage; vintage 7, those who were 57 on that data is the youngest vintage. The table also reports the estimated standard errors of the estimated probabilities. Typically the estimates are based on about 200 observations.

Holding vintage constant and reading across the table, one generally finds the pattern of graph 2: rising probabilities until 62, then a decline or at least not a rise at age 63. If one reads the table from

Graph 2

Conditional prob. of retirement by age

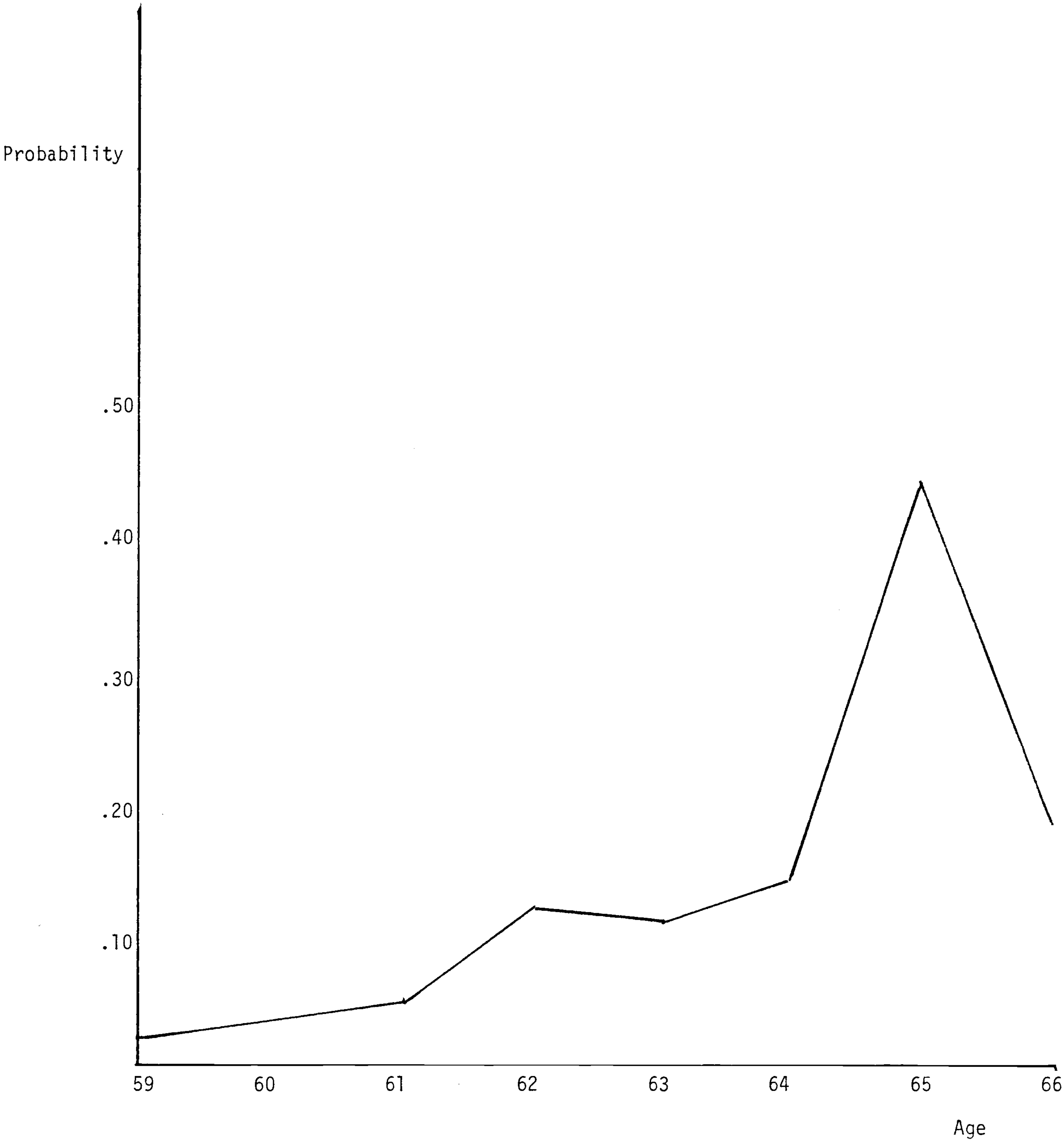

Table 3

Conditional Probability of Retirement

	Age of retirement						
Vintage	59	60	61	62	63	64	65
7	.06 63 (.03)	.03 59 (.02)	--	--	--	--	--
6	.02 254 (.01)	.05 248 (.01)	.07 235 (.02)	--	--	--	--
5	.01 246 (.01)	.05 244 (.01)	.05 232 (.01)	.19 220 (.03)	--	--	--
4	--	.02 244 (.01)	.04 239 (.01)	.14 230 (.02)	.13 197 (.02)	--	--
3	--	--	.04 215 (.01)	.11 207 (.02)	.11 184 (.02)	.16 163 (.03)	--
2	--	--	--	.05 234 (.01)	.11 223 (.02)	.17 199 (.03)	.44 166 (.04)
1	--	--	--	--	.09 151 (.02)	.09 138 (.02)	.45 125 (.04)

Probabilities, number of observations, and standard errors.

bottom to top, however, one finds the pure time trend in retirement probabilities at each age. For example, the workers of vintage 2, who would have been 62 for at least part of 1969 retired with a probability of .05 at age 62 whereas workers of vintage 5, who would have been 62 for part of 1972 retired at age 62 with probability .19. These are very large changes in retirement probabilities over just a few years, and the detail from this table shows that the decline in labor force participation of 60-64 year olds reported in the introduction is due to changes in retirement probabilities at all ages. What could have caused the large changes? At this point the answer is purely speculative; but the large changes in Social Security benefits were concentrated on the years spanned by this table. Roughly speaking, from the bottom entry in a column to the top entry spans the calendar years of 1969 to 1972, precisely the years when Social Security benefits changed most rapidly.

Our next step was to ask whether the workers with high potential levels of Social Security benefits were those who tended to retire most frequently. To answer this question and to make the comparison with other assets we constructed each worker's 1969 Social Security wealth, the present value of the Social Security both the worker and his family would receive were the worker to retire in 1969. We assumed he would live to his life expectancy and his widow to hers. We discounted at 6%.* A cross-tabulation of retirement by five categories of Social Security wealth, six categories of private assets in 1969 and seven vintages was made. The assets are net assets including housing wealth but excluding Social Security wealth. Details are given in the Appendix. From the cross-tabulations, all cases in which there were at least 10 observations on two levels of Social Security wealth holding constant the other variables are reported in Table 4 By comparing adjacent rows one can see the difference in retirement frequencies

*Since the discount factor is just multiplicative to Social Security benefits, a different discount factor would change the magnitude but not the sign of the effects. The change in magnitude from changing the discount factor is easily calculable.

Table 4

Conditional Retirement Probabilities by Assets

Age	Vintage	Social Security Wealth, 1969	Assets in 1969 10,000-25,000	25,000-45,000	45,000+
61	5	15-20,000	.06	.0	.12
		20-25,000	.0	.04	.09
	4	15-20,000	.09	.0	--
		20-25,000	.02	.0	.06
	3	20-25,000	.03	.0	.03
		25,000+	.0	.06	.07
62	5	15-20,000	.09	.16	.13
		20-25,000	.29	.35	.16
	4	15-20,000	.10	.10	--
		20-25,000	.21	.13	.16
	3	20-25,000	.12	.0	.19
		25,000+	.17	.06	.15
	2	20-25,000	.0	--	--
		25,000+	.03	.06	.08
63	3	20-25,000	.0	.16	.08
		25,000+	.10	.31	.18
	2	20-25,000	.0	--	--
		25,000+	.18	.13	.09
64	3	20-25,000	.17	.25	.09
		25,000+	--	.09	.22
	2	20-25,000	.18	--	--
		25,000+	.09	.12	.24

A dash indicates less than 10 observations.

as the value of Social Security wealth changes holding constant asset category and vintage. For example, the conditional probability of retirement at age 62 was 0.09 for workers of vintage 5, assets of 10-25 thousand and Social Security wealth of 15-20 thousand; the conditional probability of retirement of workers of the same vintage and asset category but with Social Security wealth of 20-25 thousand was 0.29. The results in this table are rather remarkable because high Social Security wealth is almost always associated with high retirement probabilities except at age 61 when assets are low, and in several cases at age 64 when there are very few observations and the standard errors are high. The discussion of the Social Security law indicated why at ages before 62 increases in Social Security benefits would not cause a change in retirement probabilities among workers with low other assets. If we exclude the three comparisons at age 61 in the first asset category on the grounds that these workers had low private assets (the median asset holding among all workers at that age was about 60 thousand) we can make 21 comparisons. Of these 17 have higher retirement probabilities associated with increased Social Security wealth. Of the four with the reverse sign, two (those at age 64) have very large standard errors (entry at vintage 2, Social Security wealth of 20-25 thousand has a standard error of about 0.12, for example).

Because the cross-tabulation is by wealth and Social Security wealth in 1969 and by vintage, the row comparisons are cross-section comparisons. Roughly they indicate differences in retirement probabilities when people are classified according to initial wealth and they are observed through time. But since our comparison is over people who have not retired, and the changes in the law were changes raising benefits of everyone to preserve rankings in the distribution of benefits a row comparison is probably a good comparison over ranking of benefits in the year of retirement. Some comparison of the trend in probabilities can be seen by comparing probabilities across vintage holding

Social Security wealth constant. For example, at retirement age 62 and assets of 10-25 thousand the probabilities in the 20-25,000 Social Security wealth category increased from .0 to .29 as vintage increased from 2 to 5. Because vintage 2 reached age 62 in 1968 and vintage 5 reached age 62 in 1971, the latter vintages actually had considerable higher Social Security wealth than indicated in the table due to the increases in benefits from changes in the law.

It is difficult to find any systematic relationship between asset levels in 1969 and subsequent retirement. Simple theory would suggest cet par. a positive relationship: if assets are exogenous they will be used at least partly to purchase leisure; if assets are endogenous, people who plan early retirement will accumulate at high levels to finance the retirement. Of course, in these tables everything else is not held constant: in particular there is no control for the wage rate, which is correlated with assets.

More extensive cross tabulations are not practical so we estimated conditional probability of retirement equations, which, within our functional form, allow us to account for many more variables than in the cross tabulations. In particular the probability equations were made to depend on an adjusted wage rate, private assets, Social Security wealth, vintage, health status and interactions among these variables. At one extreme, these equations may be viewed as pure data description, a more complicated, specific functional form version of the cross tabulations. At the other, one may interpret them as giving estimates of behavioral parameters. Since we have not constructed a complete life-cycle model of retirement choice and savings behavior, we feel uncomfortable at the latter extreme. Nevertheless, we view a substantial part of the variation in Social Security wealth to be unexpected asset transfer, and, therefore, we are more willing to give a behavioral interpretation to the Social Security wealth parameters.

We estimated conditional probability of retirement equations for each of the ages 59 through 65 inclusive. The wage rate is adjusted to take into account the effect working has on eventual benefits. As we mentioned in the discussion of the Social Security law, an additional year's work allows a year of zero earnings to be dropped in the calculation of the average monthly wage. The apparent return to work, the actual wage, is, therefore, less than the true return, which includes the present value of the increased PIA. We calculated this difference and treated it as a wage subsidy. The asset variable is a categorical variable which indicates in which quartile of the asset distribution the observation lies. Social Security wealth is the present value of Social Security benefits the worker and his wife would receive were the worker to retire, and both the worker and his wife live for their life expectancies. Discounting was at 6%. In some cases the wife's benefit on her own earnings history is larger than her benefit as a wife and in that case her worker's benefit was used in the calculations. Health status takes the value one if the person's health was judged by him to be worse than average in 1969, and zero otherwise. Because everyone in the sample was at work when the question was asked, the response is free from the most obvious kind of *ex post* bias.

Both linear and logistic probability equations of varying degrees of generality were estimated. The most general had categorical variables like the asset variables for both Social Security wealth and wages and interactions between the variables; but the specification was too general to admit interpretation. The results from a slightly less general logistic specification are reported in Table 5. The specification does allow the variation of probabilities with assets to be nonlinear, and the variation with Social Security wealth and with

Table 5

Logit Estimates of Determinants of Retirement

	Age						
Variable	59	60	61	62	63	64	65
SS Wealth	-.30 (.27)	.31 (.15)	.030 (.036)	.107 (.066)	.019 (.012)	-.008 (.062)	.060 (.051)
SS Wealth·D1	.50 (.23)	-.14 (.13)	-.087 (.068)	-.058 (.053)	-.029 (.035)	.021 (.057)	.026 (.043)
SS Wealth·D2	.27 (.21)	-.18 (.12)	-.050 (.087)	-.051 (.057)	.059 (.039)	-.210 (.066)	-.036 (.048)
SS Wealth·D3	.56 (.34)	.26 (.15)	.057 (.094)	-.024 (.045)	.002 (.041)	-.042 (.046)	-.064 (.039)
SS Wealth·D4	--	--	--	--	--	--	--
SS Wealth·Wage	-.010 (.016)	-.036 (.020)	.007 (.006)	-.012 (.011)	.005 (.003)	.007 (.011)	-.006 (.010)
Wage	.53 (.21)	.77 (.48)	-.18 (.17)	.22 (.30)	-.14 (.08)	-.28 (.39)	.11 (.33)
Wage.D1	-.44 (.24)	-.77 (.44)	-.11 (.25)	-.11 (.21)	-.09 (.21)	.14 (.17)	.17 (.17)
Wage·D2	-.53 (.58)	-.60 (.34)	-.58 (.38)	-.04 (.14)	-.10 (.16)	.32 (.16)	.01 (.21)
Wage·D3	-.54 (.50)	.46 (.35)	-.00 (.23)	-.05 (.17)	-.14 (.14)	.18 (.19)	.52 (.20)
Wage·D4	--	--	--	--	--	--	--
D1	-1.4 (3.2)	4.9 (3.5)	2.2 (1.7)	.57 (1.6)	1.4 (.9)	-1.3 (1.8)	-.9 (1.5)
D2	-3.4 (3.2)	3.5 (3.3)	2.7 (1.9)	.94 (1.6)	-1.6 (1.2)	5.1 (1.9)	1.3 (1.7)
D3	-2.6 (3.8)	-7.2 (3.9)	-1.5 (2.5)	.36 (1.3)	.8 (1.2)	.4 (1.5)	1.0 (1.5)
D4	--	--	--	--	--	--	--

Table 5 (continued)

Variable	Age 59	60	61	62	63	64	65
Vintage 7	--	--	*	*	*	*	*
6	-.81 (.64)	.72 (.74)	--	*	*	*	*
5	-2.1 (.85)	.74 (.80)	-.16 (.39)	--	*	*	*
4	*	.07 (.82)	-.26 (.42)	-.13 (.26)	--	*	*
3	*	*	-.51 (.43)	-.70 (.30)	-.09 (.30)	--	*
2	*	*	*	-1.26 (.34)	-.18 (.30)	-.12 (.29)	--
1	*	*	*	*	-.36 (.34)	-.86 (.38)	-.09 (.26)
Health	2.0 (.67)	1.5 (.43)	.65 (.50)	.92 (.32)	.99 (.34)	.32 (.46)	-.50 (.43)
Wife Age	.008 (.06)	-.068 (.040)	-.18 (.17)	.048 (.021)	-.021 (.022)	.022 (.026)	.038 (.027)
Mand Ret 65	*	*	*	*	*	*	2.3 (.3)
Constant	-5.1	-10.6	-3.6	-3.6	-2.7	-1.1	-2.5

Notes:
1. a dash indicates the normalization
2. an asterisk indicates variable not appropriate
3. Vintage 1 is the oldest cohort; Vintage 7, the youngest.
4. SS wealth in thousands of 1969 dollars
5. D1-D4 are dummy variables that indicate the quartile in the wealth distribution. D1 is lowest quartile.
6. Wage in 1969 dollars
7. Mand Ret 65 indicates mandatory retirement at age 65.
8. Health indicates bad health in 1969.

wage to be different for each asset category. There is also an interaction between Social Security wealth and wage. It is not particularly interesting to give the results for other more restrictive specifications because the important conclusions were very robust to variation in the function form.

Because of the interactions and because this is a logistic function, the interpretation of the results directly from the table is not straightforward. In Table 6 we give the change in retirement probabilities associated with a $10,000 change in Social Security wealth, where the wage interaction is evaluated at the median of the wage in each group. The point estimate of the change in probability is used; that is, if $P = \frac{1}{1+e^{-x'\beta}}$ then $\frac{\partial P}{\partial x_j} = P(1-P)\beta_j$. In the estimate, P was taken to be the observed frequency.

The results of Table 6 are remarkably consistent with the cross tabulations: when assets are low before the age of 62, Social Security wealth does not have a positive association with retirement probabilities; of the other 20 entries all but three are positive. Although standard errors were not calculated for the entries it is apparent from Table 5 that most of them would be fairly large. It is also apparent from Table 5 that a number of the individual entries are significant. We will discuss below a formal test in a more restrictive model. If these results are interpreted as giving changes in retirement probabilities from an unexpected change in Social Security wealth, they are in very close agreement with the two main predictions made in Section II: that Social Security wealth would have a positive effect on retirement; that people younger than 62 with low assets would be little affected by changes in Social Security wealth. One result that was not predicted by the theory, but which comes out quite strongly in these results is that until the age of 65 workers with low private assets are not strongly affected by changes in Social Security wealth. For

Table 6

Change in Retirement Probabilities for a $10,000 Change in

Social Security Wealth

Wealth Category	Age					
	60	61	62	63	64	65
1	.012	-.013	.005	.008	.047	.169
2	-.005	.004	.012	.096	-.230 (-.116)	.015
3	.165	.052	.041	.039	-.028	-.055
4	.065	.026	.067	.037	.022	.104
Average	.059	.017	.031	.045	-.019	.058

Notes:
1. The wealth categories are the quartiles at each age
2. The changes include the wage interaction evaluated at the medians.
3. The changes are calculated on the linear approximation as p(1-p) · (logit coefficient) where p is the observed probability.
4. The entry at wealth=2 and age=64 gives an estimated probability of -.091 when the linear approximation is used. The number in parentheses gives the change when the logit function is used. The second number is used in calculating the average.

example, the average change in probability before the age of 65 over the two lower wealth groups was just .005 whereas the average over the two higher wealth groups was .049. This difference will show up in a more illuminating way later when we analyze the implied effects on labor force participation.

In the cross tabulation very little variation of retirement with assets was discovered. In the interactive specification some was found although the evidence is far from overwhelming. In Table 7 we report those effects evaluating the interaction at the medians.* They indicate how retirement probabilities were found to vary by asset quartile, taking into account the variation by Social Security wealth, the wage and the other variables of Table 5. Probably the only mildly consistent finding is that workers in the highest quartile retire more frequently than other workers, but there are a number of exceptions.

The wage also appears interacted with other variables in Table 5; its association with retirement probabilities is not immediately obvious. When the interactions are evaluated at the medians, we find that there is very little systematic variation of the wage with probabilities, and certainly no pattern in them with respect to wealth. Again, if these results are interpreted as giving how individuals would react to a change in their wage rates, there is no evidence of much effect in our results.

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*These results are for a linear probability specification; but the results in the logit specification were so similar it was superfluous to make the extra calculations to convert the logit coefficients to probabilities.

Table 7

Wealth Effects in Linear Model

	Age					
Wealth Level	60	61	62	63	64	65
1	-.035	-.014	-.133	.026	-.018	.016
2	-.038	-.021	-.074	-.028	-.030	-.042
3	-.034	.007	-.061	.036	-.039	.036
4	-	-	-	-	-	-

Notes:
1. Wealth levels are the quartiles.
2. The interactions in wage and Social Security wealth are evaluated at the medians.
3. The entries are differences in retirement probabilities from the reference group.

The effects of health status in 1969 are all in the direction that one would expect except for the entry at age 65. Because the variable refers to status in 1969 in some cases the status is several years before the retirement age. That is particularly the case for retirement at age 65: anyone who is found in that data set could have been no older than 63 in 1969, and, therefore, at a minimum two years would have passed since the health questions had been asked. In Table 8 we have translated the logistic health coefficients into probability changes using the logistic function itself rather than the point derivative because the coefficients are so large.* It may be seen that the effects of bad health are strong at all ages.** There is a dip at age 61 because people in bad health postpone retirement until they are able to draw Social Security benefits at age 62. Of course the effects cumulate on labor force participation until by the 65th birthday the labor force participation rate of people who were in the labor force at their 59th birthday but in bad health is estimated to be .298 whereas for healthy workers it is estimated to be .601.

Mandatory retirement at age 65 operates very strongly to cause complete retirement: the probability of retirement at age 65 rises from .445 to .889 when the worker has a job with mandatory retirement at age 65.

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*Specifically we calculate t such that $p_0 = \frac{1}{1+e^{-t}}$ where p_0 is the observed retirement probability. Then we find $p_1 = \frac{1}{1+e^{-t-b}}$ where b is the estimated coefficient on health. $p_1 - p_0$ is reported.

**We have included here results for 59 year olds. The basic logistic probability function was estimated for them, but we generally have not reported them because the retirement probabilities are so low: .023. But the health effect is so strong we thought it would be interesting here.

Table 8

Probabilities of Retirement by Health Status in 1969

	Age						
Health Status	59	60	61	62	63	64	65
Average or better	.023	.040	.047	.122	.111	.139	.445
Below average	.148	.157	.086	.259	.252	.182	.327
Difference	.125	.117	.039	.137	.141	.043	-.118

A variable indicating the age of the wife was included in the probability equations because the fairness of the actuarial reduction depends on the age of the wife through the life expectancy of the widow. This is especially true if the wife is 65 or over because she cannot draw benefits unless the husband is retired; yet, she receives a wife's benefit of half the husband's PIA regardless of when she starts to draw benefits. Thus, there is not even the 1% delayed retirement credit that a worker receives for retirement after the 65th birthday. If the wife draws benefits before she is age 65 her benefits are reduced at a slightly higher rate (25/36 per cent for each month of early benefits) than the rate of reduction for a worker (5/9 of a percent). The results in Table 5 do not show any systematic variation in the retirement probabilities with the wife's age.

The other set of variables that appears in Table 5 is the vintage variables. The normalization in each case is on the youngest vintage for which there are observations; except at age 60, the trend is toward higher probabilities of retirement. This is, of course, a finding that takes into account within the functional form the growing size of Social Security wealth. It is, of course, possible that we have underestimated the size of the effect of Social Security on retirement: part of the effect of the growing Social Security wealth would be attributed to vintage. If the vintage coefficients are translated into probabilities, they show less variation than the vintage effects that can be deduced from the probabilities of Table 3. Thus some of the trend in probabilities that appeared in Table 3 by scanning up the columns has been accounted for by the variables that appear in the logistic function. Probably the most important of these variables is Social Security wealth. We make two conclusions from the vintage variables: first, the substantial collinearity between Social Security wealth and vintage requires that vintage should be taken into account when estimating the effects of Social Security on retirement; second, even though increasing Social Security benefits may be partly responsible for the trend toward early retirement, there is a residual trend that should be the subject of further investigation.

We have not emphasized hypothesis testing in this paper because we do not feel the state of research is far enough advanced. In particular there are many issues to be resolved such as the proper formulation of the life cycle problem that will lead to econometrically tractable estimating equations, the treatment of uncertainty, implicit taxes under the Social Security benefit schedule, and so forth. However, as we indicated earlier, some of the coefficients in the results of Table 5 are signficant. As a more formal test of the null hypothesis that Social Security has no influence on retirement probabilities, we tested the null hypotheis that there is no influence at any age against the one-sided alternative that there is some positive influence at least at one age. We made this test with a more restrictive version of the logistic function than what is reported in Table 5 because the interactions make this kind of test statistic very difficult to calculate. In the restricted model there were no interactions between variables. As a description of the average effects of Social Security, the restricted model gives generally the same picture as the formulation with interactions: the influence of Social Security was estimated to be positive at all ages except 64; the average effect of $10,000 of Social Security wealth was about .02 in proability against an average of about .03 in the model with interactions. One of the coefficients was itself significant at the 5% level. For a test of the null hypothesis of no effect at any age we calculated a one-sided chi-square statistic. Our test statistic has a value of 9.29; under the null hypothesis our test statistic would exceed this value about .036 of the time by chance, and, therefore, we can reject the null hypothesis at the usual 5% level. More details of this test are given in the Appendix.

We consider the results of Table 5 and the interpretations derived from that table to be our main results. However, there are a number of other ways to calculate the effects of Social Security on retirement from the data. We report now the results of several of these calculations, mainly to show that in these data there is a positive relationship between retirement behavior and Social Security wealth which comes out almost independently of the statistical specification.

Using observations on individuals we estimated both logistic and linear probability models. The specifications all had the same explanatory variables, but the functional form in which the variables entered differed. A summary of the effects of Social Security for four specifications in a linear model is given in Table 9. The general impression is that the estimates are very stable with respect to the functional forms given here. The only large difference is at age 64 when an interaction with the wealth category variables is included. This is caused by a very large (-.28) effect of an increase in Social Security wealth of $10,000 on the retirement probability of people in the second wealth category. A comparison with the logistic specification shows that the linear probability specification produces smaller estimated effects, which is to be expected on theoretical grounds.

Another way to find rough estimates of the effects of Social Security on retirement is to use the observed frequencies in Table 3 as estimates of the probabilities at each age by vintage. The regression of these frequencies on the means of Social Security wealth, assets, wage, health, age of wife, and dummies for age of retirement, and vintage was calculated. It was estimated that a $10,000 increase in Social Security wealth would cause an

Table 9

Summary of Linear Specifications:

Average Change in Probabilities of Retirement for a

$10,000 Change in SS Wealth

Form in which variable was entered		Age					
SS wealth	Wage	60	61	62	63	64	65
Linear	Linear	.019	.009	.024	.025	-.016	.068
Linear	Linear, * wealth	.020	.009	.025	.027	-.016	.067
Linear, * wealth	Linear, *wealth	.021	.005	.023	.027	-.055	.070
Linear, *wealth, *wage	Linear, *wealth, *SS wealth	.027	.006	.028	.027	-.060	.081

Notes: In all cases wealth is represented by four categorical variables indicating quartiles. The notation "*wealth, *wage, and *SS wealth" indicates an interaction. The probabilities are averaged over wealth groups and evaluated at the median wages.

increase of .12 in the conditional probability of retirement averaged over the ages 59-65 inclusive. This is substantially larger than the estimates in Table 6, which average about .03.

Finally, the results in Table 6 give the probability changes when the slope of the logistic function is evaluated at the observed frequency, and the slope at that point is used to estimate the probability change. An alternative method when the change in the right-hand variable is large is to estimate the probability for the new value of the right-hand variable from the logistic function, and subtract from that the initial frequency. Because the starting frequencies are small except for 65 year olds, this method will increase the estimated probability changes associated with a change in Social Security wealth of $10,000. In fact, the average change in conditional probability is estimated to be .070 by this method. This compares with an average taken from Table 6 of .032.

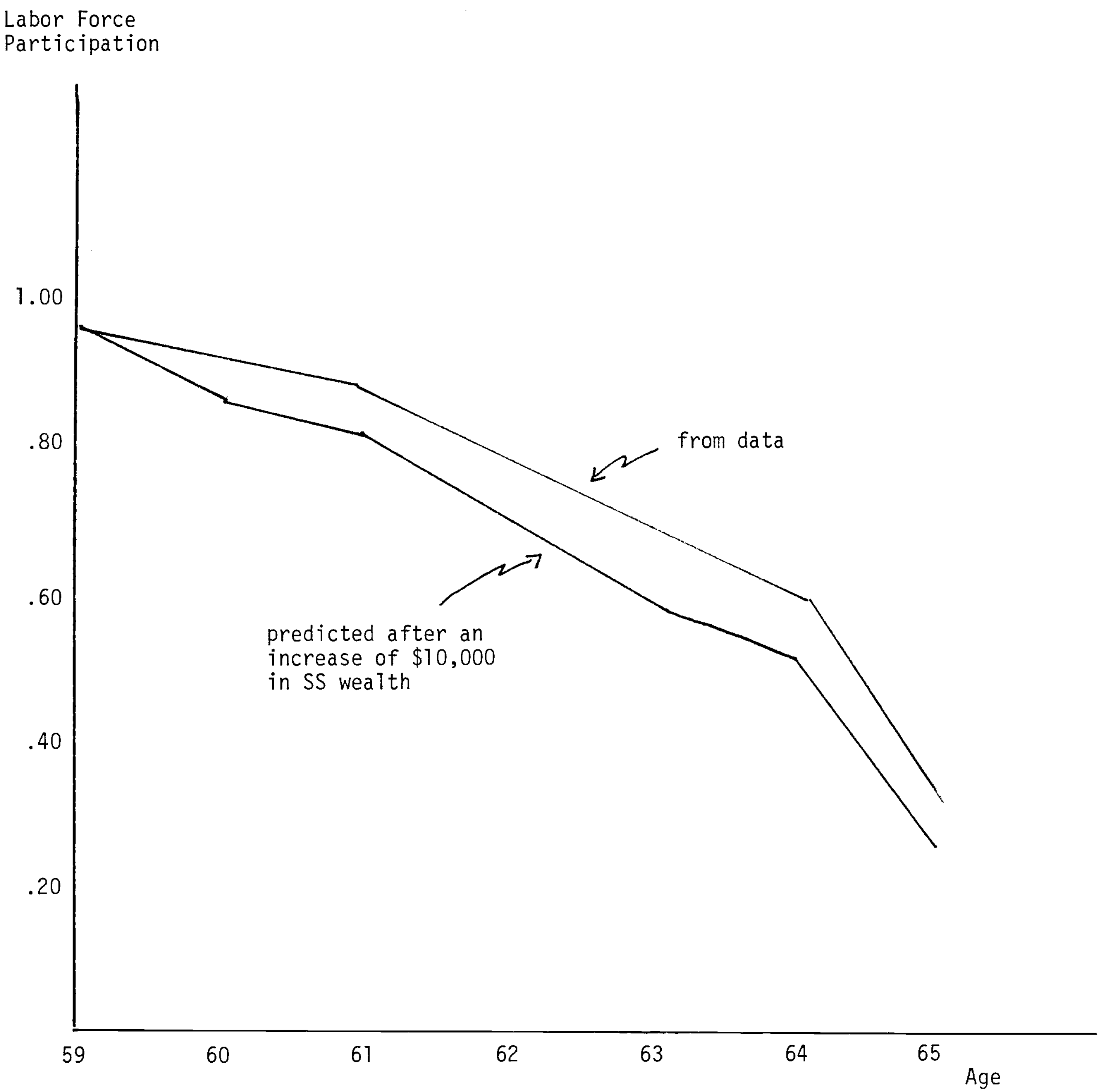
V. Induced Retirement and Labor Force Participation

If we continue to interpret the results of Tables 5 and 6 as changes in retirement probabilities caused by a change in Social Security wealth, we can ask how would labor force participation of the elderly change when Social Security benefits change as they did during the early 1970's. Under the assumption that no one reenters the labor force once he has retired, the conditional probabilities of retirement can be used to calculate the labor force participation rates by age of people who were working at age 59. Graph 3 gives the participation rates at age j calculated according to $(1-p_i)(1-p_2)\ldots(1-p_j)$ where the p_i are the observed frequencies of retirement conditional on working until the ith age. The changes in conditional probabilities for a change in Social Security wealth are taken from Table 6, and added to the observed frequencies. These new conditional probabilities produce the lower labor force participation rates shown in the graph. The average decline in participation of 60-64 year olds is about .078. This decline can be compared to the actual declines in participation that occur during the early 1970's as follows: Taking the base date as February 1968, the law was changed several times to increase benefits, given work history. By September 1972, the increases totaled 52%. Someone contemplating retirement in 1973 would, therefore, have benefits about 52% higher than a comparable person in 1968.* The median Social Security wealth in our sample in 1969 was about 25,000 (real 1969), and a 52% change would be 13,000. This is a nominal change which is 10,726 in 1969 dollars. According to our probability of retirement equations a 10,000 real change produces a .078 decline in participation, so a 10,726 change would produce a .084 decline (ignoring second order effects). The actual participation rates were 77.3% in 1968 and 69.1% in 1973, a decline of 8.2%!** We see, therefore, that the estimated effects of Social Security on

*From the Social Security Bulletin, Annual Statistical Supplement, 1976, p.22.

**From various issues of Employment and Earnings.

Graph 3



Change in Labor Force Participation

from a change in Social Security wealth

retirement probabilities are very close to the actual declines in participation during the period of study. Because the comparison on changes in labor force participation is made with independent data, we feel it lends support to the interpretation that a substantial part of the variation in Social Security wealth is the result of unexpected changes caused by legislation, and that therefore, the interpretation of the changes in conditional probabilities as partial regression effects is reasonable.

V. Conclusion

It is only a slight exaggeration to say that in any way the data were analyzed we found a positive association between retirement probabilities and Social Security wealth. When probability equations were specified to allow numerical magnitudes to be estimated for this association, the sizes of the effects were found to be reasonable in the sense that the observed changes in labor force participation taken from an independent data source were consistent with the observed changes in Social Security benefits and the estimated effects of changes in Social Security benefits.

Although we believe our results show convincingly that there was an effect on retirement from the large changes in benefits in the early 1970's, we readily acknowledge that much needs to be done to understand the complete effects of a Social Security system. In particular, we have not distinguished in this work between transitory effects caused by changes in the system and long-run effects which would remain if the system were to remain unchanged for a long period. We did not attempt to estimate separately the effects for several reasons. First, our data were not well suited for this because all of the observations were subject to the large changes in benefits. As the later years of the RHS are made available for analysis, it may become possible to do this because in later years the changes in benefit levels were made to depend on the CPI rather than on Congressional action. Even so, within a life cycle context, the transition from the shocks of the early 1970's to the steady state may take more years than the RHS will cover. The second major reason our results cannot distinguish between the long run and the short run is that we have not constructed a complete life-cycle model of asset accumulation and labor supply. In particular, we have not taken into account that at least in the steady state, assets, Social Security wealth and the wage may be econometrically endogenous, which will produce formidable statistical difficulties. We believe that by taking advantage of what was essentially an experiment on the retirement-age population these difficulties are lessened. At a minimum we would claim that changes in benefits have some effect on retirement.

An implication to be drawn from these results is that if the law on benefits calculation is changed, the costs of the law change will not be simply the direct costs of the change in benefits over the retired population. Rather there will be induced retirement in addition, and that will have to be taken into account to forecast accurately the effects of a law change.

Appendix

A. Sample Selection

The basic working sample consisted of white, married males. They must have satisfied the following criteria: private wage worker in 1969 or at last job if not employed; a calculable wage rate in 1968 or 1969; a non-working wife; not a welfare recipient in 1969; a wage rate between $1 and $35; net wealth between $-5000 and $1,000,000; survived until the 1973 survey.

B. Calculation of Important Variables

1. Net wealth.

Data were reported on every important category of assets and liabilities. For example, we have the individual's estimate of his house value, his stock value, savings accounts, bonds and so forth. There are corresponding entries on the liability side. The major uncertainties are insurance and private pensions: the former is reported with ambiguity and the latter is known only with considerable uncertainty by many respondents. We decided to ignore insurance, which will be an error for those who hold some kinds of insurance. Pensions were reported to be a monthly payment which we converted to a wealth stock by discounting at 6% expected payments until death.

2. Social Security (SS) wealth.

Under the Social Security law benefits are usually calculated from earnings since 1950; however, in some circumstances earnings before 1950 may be used. The wife's benefits is 50% of the husband's PIA but in some circumstances her benefit on her own contribution would be greater than her wife's benefit. The law allows the maximums always to be taken. Our calculation of SS wealth finds the benefits of the husband and of the wife taking into account these provisions. We can do this accurately because we have data on contribution of both the husband and wife. The present value of SS, which is what we call SS wealth, is the present value of the future benefit payments to the husband, and the wife (and later to the widow if she outlives the husband) discounted at 6%. Each is assumed to live to his life expectancy. The benefits are calculated according to the law in effect at the time of the calculation. The value of SS wealth varies as a worker ages for several reasons: his earnings change; the law may change; his life expectancy changes; the wife's life expectancy changes. We therefore, calculate his SS wealth each year from 1969 through 1973, and the value that enters the probability of retirement at a given age will be the value faced at that age.

3. The wage rate.

The two main problems in calculating the wage rate are that there is no standard time interval over which earnings are reported, and that earnings increase the value of Social Security wealth through the recalculation of AME and PIA. The first problem was not empirically important but it did cause us to drop some observations from the sample when we were unable to calculate an hourly wage. The second problem was handled by converting the increase in Social Security wealth into a wage subsidy. This was done by calculating what Social Security wealth would be if the person were to work another year. The difference between that value and the actual value of Social Security wealth was converted into a wage subsidy by assuming he works during the coming year the number of hours he worked the past year.

B. The One-Sided χ^2 Test

Because the one-sided χ^2 test is not found in empirical literature, we outline its derivation and calculation. It is a generalization of the one-sided t test, and it is used when the null hypothesis is that a number of coefficients are zero against the alternative that at least one coefficient is positive. The conventional F test (or two-sided χ^2 test in large samples) is appropriate when the alternative is that at least one coefficient is not zero. We use the one-sided χ^2 test because the one-sided alternative is appropriate: most people, we believe, would agree that the effect of Social Security wealth on retirement is not negative.

Suppose that y_i, $i=1,\ldots,n$ are independent $N(\mu_i,1)$ random variables and consider the statistic $Q = z_1^t + \ldots + z_n^t$ where $z_i^t = y_i^2$ if $y_i \geq 0$ and $z_i^t = 0$ otherwise. Under H_0, $\mu_i = 0$. Under H_0, $P(Q>q) = P(Q>q|y_1,\ldots,y_n$ are negative$)\cdot P(y_1,\ldots,y_n$ are negative$) + P(Q>q|y_1\geq 0, y_2,\ldots,y_n$ negative$)\cdot P(y_1>0, y_2,\ldots,y_n$ negative$) + P(Q>q|y_2>0, y_1\leq 0, y_3,\ldots,y_n$ negative$)\cdot P(y_2>0, y_1\leq 0, y_3,\ldots,y_n$ negative$) + \ldots + P(Q>q|y_1>0, y_2>0, y_3,\ldots,y_n$ negative$)\ P(y_1>0, y_2>0, y_3,\ldots,y_n$ negative$) + \ldots + P(Q>q|y_1>0, y_2>0, \ldots y_n>0)\cdot P(y_1>0, y_2>0,\ldots,y_n>0)$.
$P(Q>q|y_1>0, y_2,\ldots,y_n$ negative$) = P(y_1^2>q|y_1>0) = P(y_1>\sqrt{q}|y_1>0) = 2P(y_1>\sqrt{q}) = P(y_1<-\sqrt{q}) + P(y_1>\sqrt{q}) = P(y_1^2>q)$. But under H_0, y_1^2 has the $\chi^2(1)$ distribution. $P(y_1>0, y_2,\ldots,y_n$ negative$)= 1/2^n$, so the first term is $\frac{1}{2^n}\ (1\cdot P(\chi^2(1)>q))$

where $P(\chi^2(t)>q)$ means the probability that a χ^2 with t degrees of freedom is greater than q. The first n terms in $P(Q>q)$ are the same and sum to

$$\frac{1}{2^n}\ \frac{n!}{1!(n-1)!}\ P(\chi^2(1)>q) = \frac{n}{2^n}\ P(\chi^2(1)>q).$$

The next set of terms arises when two of the y's are positive. For example $P(Q>q|y_1>0, y_2>0, y_3,\ldots,y_n$ negative$) = P(y_1^2 + y_2^2>q|y_1>0, y_2>0)$. Since each conditional random variable is $\chi^2(1)$ and they are independent, their sum is $\chi^2(2)$. There are $\frac{n!}{2!(n-2)!}$ terms in this set and they sum to

$\frac{1}{2^n} \frac{n!}{2!(n-2)!} P(\chi^2(2)>q)$. By similar reasoning it may be seen that $P(Q>q) =$

$$\frac{1}{2^n} \sum_{i=1}^{n} \frac{n!}{i!(n-i)!} P(\chi^2(i)>q).$$

Although we have not investigated the power of this test in general, it is easy to see that it is more powerful than the F test in several extreme examples. If $n = 1$, it is the same as the one-sided t test which is more powerful than the F test. If the μ become large so that the probability that all the Y's are positive becomes large, the probability of rejecting the null hypothesis is approximately the probability that the noncentral $\chi^2(n)$ is greater than q. But q is less than the critical point of the F test of the same size; that is $q<c$ where c is found from $P(\chi^2(n)>c) = \alpha$ and α is the size of the test. Thus $P(Q>q) > P(F>c)$ when all the μ are large and the one-sided χ^2 test is more powerful. It would be surprising if the general result is not true. In any event it is clear that the F test is not uniformly most powerful.

Because the one-sided χ^2 test is almost impossible to calculate in our general model, we estimated a simpler model which had no interactions between Social Security wealth and any of the other variables. The estimated coefficients divided by their estimated standard errors, are given below. We take these to be i.i.d. N(0,1) under the null hypothesis.

Age

60	61	62	63	64	65
1.66	.79	1.53	1.53	-.90	1.11

Q is the sum of squares of the positive values and is calculated to be 9.29. From the χ^2 tables it may be found that $\frac{1}{64} \sum_{i=1}^{6} \frac{6!}{i!(6-i)!} P(\chi^2(i)>9.29)$ is approximately .036. Thus a 5% critical point would be less than 9.29, and we can reject the null hypothesis that all the effects are zero in favor of the alternative that at least one coefficient is positive.

We make two observations about this test. At the 5% level the coefficient for age 60 falls in the critical region of the one-sided t test; however, this is an inappropriate testing procedure (to reject the null hypothesis if any of the t statistics is greater than 1.645). Under the F test, which is the same as a two-sided χ^2 test since the degrees of freedom in the denominators are large the null hypothesis cannot be rejected: the sum of squares (including the age 64 coefficient) is 10.1 and the critical point of the $\chi^2(6)$ is 12.59.

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