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PENSIONS AND MORTALITY

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ABSTRACT

Pensions and age specific death rates are intertwined in several ways. Pensions provide a mechanism to remove the uncertainty about date of death from consumption planning. Age specific death rates determine the cost and value of pensions.

In this paper, we use the Retirement History Survey to estimate reduced form functions for the probability of having a pension when the person reaches 65 and on the dollar amount of the pension. We also evaluate the effect of 15% drop in age specific death rates from 1973 to 1979 on the costs of a pension.

We find that the probability of having a pension is related to education, marital status, occupation, industry and assets. The probability equation is very similar for males and females.

We find that the sharp drop in death rates has only a marginal impact on the cost of providing a pension.

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Pensions and Mortality

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Pension and age specific death rates are intertwined in several ways. A pension involves a trade of present for future consumption. The expected value of the trade depends on age specific death rates since the individual and perhaps spouse will continue to collect the pension while alive. Decreases in death rates will increase the value of the pension to the worker and the cost to the company. Individual differences in expected death rates will also alter the expected value of a pension and may well affect the choice of occupation and the distribution of current and future consumption.

People do not know with certainty when they will die. Most people plan to spend part of their life cycle retired during which their consumption will be based on past public and private savings. A pension is an asset that can remove the uncertainty about date of death from consumption planning.

The mortality and pension linakges are important currently for two different reasons. First there has been a sharp and probably unexpected drop in age specific death rates in the 1970's. Thus the cost and value of pensions have changed. In this paper we will examine the implication of this mortality decline on the present discounted value of pension benefits and the distribution across certain groups. Second there are proposals for mandatory pension coverage. If the population currently drawing pensions is a selected

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one, a mandatory pension plan could expect a different experience than history provides. Thus in this paper, we will also examine the extent to which the pension population differs from the total population in a given age cohort.

We will begin by deriving and estimating pension reduced form equations. We will then estimate mortality equations. We will also see how morbidity and mortality are related to pension coverage. Finally we will examine the implications of recent and prospective mortality changes on the present discounted value of the pension benefits.

The Demand for Pensions

In this section we will consider briefly the demand for pensions by consumers. Pensions are a form of wealth with some important risk and safety features. A pension is an asset which pays a stream of benefits beginning at some future date and terminating at the death of either the holder or the holder and spouse. The expected stream of benefits need not be fixed but may be indexed to the price level or depend on current earnings though most pensions pay a fixed nominal or real benefit level (when both holder and spouse are alive). A pension differs from an annuity in that the individual purchases the annuity but receives the pension as part of his compensation for working. Also a pension can be riskier than an annuity in that many pensions require a minimum number of years of work before the individual is entitled to any benefits. Moreover some pensions are not fully funded and will not pay full benefits if the company goes bankrupt (unless the pension is insured).

A pension differs from a savings account or other assets in that a pension (in a non-bankrupt firm) guarantees a fixed budget level till time of death but does not provide a bequest. Other assets such as a savings account, can be used to finance consumption while retired and to provide a bequest upon death, but with these assets the annual consumption stream will be reduced if a person lives longer than he expects.

A useful way to derive a demand for pensions is via the life cycle consumption savings model of Modigliani, Brumberg, and Ando (MBA). We will initially construct this model in a world with no taxes, a fixed life span and retirement date, and a single asset. We will then introduce uncertainty as to the two dates and consider the impacts on the level and composition of assets.

Assume that the consumer has an initial wealth endowment of A_o, and will receive labor earnings of Y in each year before retirement at T and zero earnings thereafter.

Then the individual wishes to maximize his utility function subject to a multiperiod wealth constraint.

1) Max $U(C_o, \ldots, C_n, B_{n+1})$

2) Subject to $A_t = A_{t-1}(1+r) + (Y_t - P_tC_t) \quad t = 1, \ldots, T < N$ and

$B_{n+1} = A_n$

A is wealth at the end of the year,

B is bequests,

C is consumption,

P is the price of consumer goods,

r is the interest rate,

T is retirement date,

N is date of death.

Maximization of (1) subject to (2) will yield first order conditions which can be manipulated to obtain demand functions for C in each time period. These are of the form:

$$3) \quad C_t = F(P_t, \ldots, P_n, r, A_o, Y_t, T, N)$$

In the original model, MBA assumed $B = r = A_o = 0$. They showed that with an homogenous utility function, a person would consume an equal amount in each period and this amount would be

$$4) \quad C = \frac{T}{N} Y$$

A person would save $Y - C = (1 = \frac{T}{N}) Y$ in all years before retiring and dissave $(T/N)Y$ each year during his retirement.

Once the dates of retirement and death are uncertain, an individual can not be guaranteed of having enough resources to consume the amount given in 4) in each year. The individual, however, can convert the uncertain stream into a certain stream by buying an annuity and life insurance to provide B. In a classic paper, Yaari shows that if an annuity pays an actuarially fair interest rate and if the consumer's rate of time preference equals the interest rate, then the consumer who purchases an annuity will have the same constant consumption stream with mortality uncertainty as with no uncertainty.

In an elegant examination of a problem equivalent to ours, Rosen and Thaler demonstrate that the demand for the annuity (insurance) will depend on the load factor which reduces the return below the actuarially fair return.

In general risk adverse individuals will be willing to pay a premium to have an annuity and reduce some of their risks. The demand will also depend on the after tax rate of return.

Annuities are not a commonly held asset in the U.S. while pensions are widely held.[2] Thus it may appear that the above focus is misspent. There are however, two considerations which also bear on our specification of the demand function. First most workers in the U.S. are eligible for Social Security benefits, which is a public annuity/pension that nearly all workers are forced to buy and which pays a high after tax rate of return.[3] The low use of private annunities may reflect the substitution of public for private annuities. Second pensions are treated more favorably than annuities in the U.S. income tax laws since taxes on eligible pension contributions are deferred until paid out as benefits when a person is usually in a lower tax bracket.

The above considerations suggest that expected social security benefits should be included in the demand for annuities and the demand for pensions. The second point is that a person's tax bracket should affect his demand for pension.

If pensions were vested instantaneously, then the demand for pensions would depend on the same variables as in the annuity function. Most pensions require a minimum service and age before the benefits are vested. While this suggests the inclusion of a probability of being vested variable, this will

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[2] See for example, Projector and Weiss.

[3] The return is high because the employer's contribution is not subject to tax and because contributions of current workers are used to subsidize current retirees.

not be done because we do not have the necessary data.

The demand for pensions, thus, can be written as

$$5)\quad Q_{PEN} = F(P_{PEN}, Y, T, N, s_T^2, s_N^2, SS, A, tax, r)$$

where the new variables are

P_{PEN}	is the price of pensions,
Q_{PEN}	is the quantity of pensions,
s_T^2	is the variance or other risk measure for T,
s_N^2	is the variance or other risk measure for N,
	tax is the person's tax bracket,
SS	is the expected Social Security benefits.

The Supply of Pensions

Employers currently are not required to provide pensions. Employers may choose to do so for two distinct reasons: to maximize their own welfare and to maximize the expected worth of the firm. Even for a married person, the marginal tax rate in the federal income tax exceeds 50% when taxable income is \$60,000. When the manager is the owner, he has strong incentives to take much of his pay in tax favored forms.[4] Even in corporations in which ownership and management are separated, the principal and the agent have incentives to use pensions. In a competitive system, a worker may receive a compensation rate such that

[4] Lewellen demonstrates that managers in large corporations do this.

$$6)\quad \frac{MU_L}{MU_G} = \frac{COM}{P}$$

where

MU_L is the marginal utility of leisure,

MU_G is the marginal utility of goods,

COM is the hourly compensation rate

P is the price of goods or market product consumption.

Since COM equals the after tax wage rate plus the after tax pension contribution and the tax on the contribution is deferred to retirement, the firm can pay a smaller amount by using pensions.

There is an important additional reason for firms using pensions. Firms often make substantial investments in workers while training the worker and obtaining information as to the abilities of each worker. Following Becker, firm specific on the job training costs are borne by the employer who can have his investment wiped out by the employee leaving. Pensions based on length of service encourage employees to remain with the firm.

The above considerations will vary by position in the firm which we will proxy by education, by occupation, and by industry. Thus the supply of pensions can be written as

$$7)\quad Q_{PEN} = G(P_{PEN}, ED, OC, IND, tax, tax_H)$$

where

tax is the average tax rate of employees,

tax_H is the tax bracket of top employees.

Equating supply and demand, we obtain a reduced form equation for the quantity of pensions which does not include the price of pensions but does include all the other variables which are exogenous.

If data on the price of pensions or the load factor were available, it would be possible to estimate 5) and 7) since there are exogenous variables that appear in one and not the other. Our sample does not have such data. It does have information which will permit us to estimate the person's tax bracket late in life but not information during most of the period in which pensions are accumualted. Thus tax and tax_H will be omitted.

Econometric Specification

The model presented above obtains a reduced form equation for pensions. We will estimate the model in two steps. First we will estimate a probit equation for the probability of having or expecting to have a pension. Second for those with nonzero pensions, we will estimate an OLS equation for the dollar amount of the pension. Work of Heckman and others suggests that this two stage procedure will yield baised coefficients for the demand for dollar amount of pensions. We could use the inverse of the Mills ratio approach to eliminate the bias, but since we use the same exogenous variables in both equations and since we have no strong priors on the functional forms, identification is suspect.

While these techniques used are straightforward, there are several difficulties to be faced. Persons choosing jobs generally have available to them different mixes of wages and pensions for a given compensation rate. Some people may have different risk preferences. Often such taste differences are assumed to vary by education level which is already included in our system and whose coefficients will be difficult to interpret uniquely. However if tastes differ within education groups, the Thaler-Rosen analysis suggests that people with different risk preferences will sort themselves by occupation and that observed wage and pension packages partly reflect differences in preferences for risk. This also suggests that we should not include wage rates or earnings as exogenous variables in our equations.

The Data

The primary data to be used come from the Retirement History Survey (RHS).[5] The Retirement History Survey commenced in 1969. In that year a random sample of some 11,000 men and women who were heads of household and between the ages of 58 and 63 inclusive participated in a lengthy survey. The major areas in which data were collected include current and past labor force activity, current earnings and income, family structure, education, expenditures of various sorts, and health and the availability of public and private pensions. The same people or their widows were reinterviewed every second year until 1979. We currently have the 1969, 1971 and 1973 waves.

Results

We have estimated probit equations for the probability of (expecting to) receive a pension and OLS regressions for the dollar amount of nonzero pensions. The probability of receiving a pension is measured by the answer to the 1971 question "Which of the following sources of income do you expect to receive money from (when you have stopped working or five years from now")?

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[5] This sample is being used extensively in economics. For a full description see Ireland. For some uses, see Boskin, Burkhauser, or Quinn.

There are at least three difficulties with this question. First some people in the sample do not expect to ever stop working and the above wording could elicit a "no" answer to the expected pension question if the pension will start later than 1976. To control for this problem, we have included a dummy variable which has a value of 1 if people expect to stop working in the 5 years after 1971 when all the men will be at least 65 years old. However, one of the reasons that people may expect to stop working is that they are in poor health and have a shorter life expectancy.

Second the pension question was asked first in 1971. Those who died in 1969 or 1970 could not answer the pension question and were excluded from the analysis. Third in 1971 when they are at least 60 years old, some people may not expect to receive a pension but qualify subsequently. We believe this to be a minor problem.

Results for men are given in Table 1. We find nearly every variable used is statistically significant and only two have "t" statistics less than 1. Most of the coefficients seem quite reasonable. Based on the derivative of the probability function evaluated at the means, married and single men are about 10% more likely to expect to have a pension than divorced men. Divorced men in this age group have much worse life expectancy prospects. Moreover ongoing research by Bartel and Taubman suggests that those that many of the divorced contract severe mental problems that affect earnings and quite possibly job stability and thus risk loss of nonvested pensions.

The more educated are more likely to have pensions. As noted earlier, there are a number of possible reasons for this finding. It is of some interest that this derivative is about 50% greater when industry is not controlled for. Black men are about 14% less likely to expect a pension even when we control for industry and occupation and total wealth.

To help capture the business supply of pensions we have included occupation and industry dummies. The RHS obtains information on current and longest occupation. We have used the longest occupation. The omitted occupations are clerical and kindred, and sales and the few cases of no answer. Once we control for industry, professionals (and technical) and blue collar (and operators and farm laborers) workers have higher probabilities of receiving pensions while nonfarm managers and technicians have a lower though statistically insignificant probability. However when the industry variables are omitted, the professional dummy is insignificant and the manager dummy is significantly negative.[6]

Self employed people are much less likely to have a pension in this time period.[7] Compared to those in mining, construction, wholesale and retail trade, finance, insurance and real estate, the probability of receiving a pension is significantly higher for those in government, manufacturing, and utilities, and significantly lower for those in farming.

Those who expect to stop working are 10% more likely to receive a pension than those who don't. While this may simply mean that those who expect not to retire don't have to have much private saving to finance old age consumption, we believe that this variable either corrects for a deficiency in the pension

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[6] Several people have suggested that there are many small stores with a few employees and a manager. These managers may not receive pensions. We do not have information on size of firms to test this proposition. We have data on Social Security covered earnings in previous years. We ran some equations in which we include the monthly benefits a pension is entitled to from Social Security. The benefit variable is significant but its inclusion has little impact on the coefficient on manager.

[7] This is before Keogh's were available, but such plans might logically be included in annuities rather than pensions.

question asked or is a proxy for health. Omission of this variable has little impact on the other variables except being single which becomes insignificant and being a manager which becomes significant.[8]

We have added together the midpoint of the holdings in the various categories for each asset and liability except pensions to obtain net assets. We expect this variable to be quite noisy. It has, however, a highly significant positive coefficient.

We have estimated another equation in which we add the square of the assets and the interaction of eduation with assets and its square. The results are presented in Table 2. The three new variables are highly significant with diminishing returns to assets and with education effects growing for assets less than 1/3 of $1 million.

The impact of longer life expectancy of pension companies depend on the size of the pension holding of various groups. In Table 3 we present some OLS regressions for expected nonzero pension payments for five years hence for those alive in 1971. We find far fewer variables are significant than in the probit equations.

None of the marital status variables are significant. Professionals and managers have significantly larger pensions than clerical, sales and blue collar workers. Government workers have much larger and the self-employed

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[8] For some purpose vested pensions and annuities might be considered near perfect substitutes. We have reestimated the probit equation where the dependent variable is 1 if you expect a pension of an annuity or both.

There are no changes in sign of the coefficient. The extra probabilities, calculated at the mean, are little changed except that the coefficient on self-employed is somewhat closer to zero and the coefficient on assets is larger. Both changes are sensible since the self-employed could treat annuities and pensions as near perfect substitutes and since the wealthy may wish to convert non job related wealth into a safe asset for the retirement period.

much smaller pensions. The more educated and the wealthier also have larger pensions.

The RHS sample also contains information on women who are heads of household. About 22% of the women compared to 35% of the men expect to receive a pension. While far fewer women than men expect to receive a pension, the pattern of coefficients and derivatives at the mean are very similar except that single and widowed women are more likely to have pensions thna divorced women. See Table 4.

The regressions for women with positive pensions are given in Table 5. There are only 565 observations which may explain why the results differ so from men and why so few variables are significant.

Self Selection into Pension Plans

In 1971 about 1/3 of the men and 1/4 of the women heads of household expected to receive a pension. There can be a variety of reasons why most were not vested. One possible reason is that people with shorter expected lives would prefer, ceteris paribus to take jobs with higher current earnings. In this section, we will explore some suggestive but inconclusive evidence; however, we acknowledge at this point that even for the results there is an alternative explanation which is that severe health problems may cause an individual to be ineligible for certain jobs or to remain at a firm long enough to become vested.

The RHS survey asks people how their health compares to others of the same age. The possible answers are better, same, or worse. While subjective, Taubman and Rosen argue that this variable behaves like one would expect an objective measure to behave. For example, those in worse health in 1969 are several times more likely to die over the next 4 years than those in better health.

Of course the variable measures health in 1969 when the men were at least 58 years old. This variable need not be strongly correlated with health when pension acquisition and occupation and industry decisions were made. However the R^2 between 1971 and 1973 health is about .6.

We have included 1969 and 1971 health in some pension probit equations. The two sets of health variables are intercorrelated and it is difficult to obtain sensible results when both sets are included. Our best results are obtained using 1969 health. Those in worse health are significantly less likely to expect to receive a pension 5 years after 1971. The derivative at the mean of the variables is -.03. The coefficients on the other variables are not greatly affected when health is added except that of widower which is reduced in size but increased in significance.

The social security benefits one is entitled to depend partly on past earnings and thus health.[9] When a retirement benefit variable is calculated on the basis of past earnings reported to Social Security is included in the probit equations, the benefit variable becomes insignificant.[10]

An alternative way to examine the self selectionissue is to compare the pattern of results of age specific mortality rats and the probability of having a pension. Table 6 contains the probit for 1969-1973 mortality for men.

There are several variables in Table 6 that are statistically

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[9] Bartel and Taubman show that certain diseases have very long run and large effects on earnings.

[10] This positive coefficient is not consistent with the substitution of public for private pensions. We have made corresponding runs for women when average monthly benefits are added, it has a negative, significant coefficient of 6.7.

significant. These include being married, age, planning to stop work, assets, and longest industry being manufacturers. While some of these results are interesting in explaining sources of differences in age specific death rates, our concern here is whether people expecting pensions are less likely to die. The only three variables significant in both Tables 1 and 6 are married, stop work, and manufacturing. The first and third of these have opposite signs in the two tables which is consistent with the self selection idea. The stop work variable maybe measuring several forces. Those who expect to work have less need for pensions because they will not retire. Those in poor health may be forced to retire because of pain and suffering.

When prior health is added, the coefficients on better and worse health are significant and have expected signs. Variables previously significant remain so and do not change sign.

These results suggest that many people in poor health around age 60 have been in poor health for long periods of time and that these people either opt for positions with higher proportion of compensation in current wages or poor health forced them to change jobs before the pension was vested.

Of course a comparison of the pattern of coefficients is not conclusive evidence. It would seem that a better method would be to include the death variable in the pension probit equation. Unfortunately since the pension variable was asked in 1971, we must omit nearly half the people who died from the analyses.

This death dummy variable has a positive sign but is not significant when included in the analysis. It may be argued that the death rate variable is insignificant because too many other variables are included.

In Table 7 we present for those who died between 1971 and 1973 the proportion of people who expected to have a pension. In the sample, 34.8% of the people have pensions. Thus for the period 1971-1973, a slightly higher proportion of the people who died expected to have a pension.

To check further on the relationship between pensions and death we decided to use the white males 65 and older in the 1973 CPS-SSA Exact Match Tape. A description of this sample can be found in Taubman and Rosen. But briefly the March 1973 CPS was matched to Social Security Administration records which record date of death for those who died subsequent to the date the match is made. In our version of the tape we have fairly complete death information through 1976 and partial data for 1977.[11] The pension data are taken from the 1973 source of income questions.

Our probit estimate (with t statistics in parentheses) for 5038 men is

$$\text{Prob of Pension} = \underset{(2.0)}{.41} + \underset{(5.1)}{-.14}\ \text{Age} + \underset{(1.7)}{.079}\ \text{Died 7377}$$

Once again those who died are more likely to have a pension and this time the t value has risen to 1.7.

In many instances a person must stop working for a company to receive a pension from it. Poor health may induce a person to stop working and collect his pension. People eligible for but not drawing a pension may be in very good health. When a nonparticipation in the labor force in 1973 variable is included, the coefficient on died decreases to .029 and the t statistic falls to .62. Of course the labor force variable may represent other factors than

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[11] Taubman and Rosen indicate that the data on death for white males in this age range are close to complete in this sample.

those just described, but in any event there is no direct evidence that those with pensions have longer life expectancies.

Changes in Mortality and the Present Discounted Value of Pension Benefits

The present discounted value of pension benefits obviously depend on expected longevity. Recently the age specific death rates have changed sharply. In this section we will examine some of these trends and indicate some of the redistributive effects of the changes.

The 1973-79 percentage changes in death rates in various age intervals are shown in Table 8. For those 45 and over the reduction is about 15% for all age, race and sex groups though it is a little lower than this in the 75 to 84 and a little larger in the 85 and over group. To evaluate the impact of this change we rely on a study by Winkelvoss which is summarized in the tables 9 and 10.

The effects of unexpected changes in mortality on pension funds can be measured by the change in the present discounted value of benefits paid. Winkelvoss provides such an estimate.

He uses a standard plan in which the pension benefits are based on the final 5 year average earnings. For those not retired, earnings grow 7% a year. The nominal interest rate is 7%. Nonactive workers benefits are assumed fixed in nominal terms. Benefits are reduced actuarially for early retirement. There are also vested benefits, disability benefits, and surviving spouse benefits. However retirement benefits account for 77.9% of the present discounted value of the benefit package.

Winkelvoss has investigated the impacts of various mortality rate changes. For example in Table 3, which along with the text is drawn from his Chapter 15, a mortality rate of .5 indicates that all age specific mortality rates are reduced to 1/2 of their GAM level (but in all instances no one lives beyond 110 years).

The first column applies if only pre 65 mortality rates are changed, the second if only post 65 rates are changed and the third if both pre and post 65 rates are changed. As shown in the table, changes in pre 65 mortality do not have important monetary effects but the post 65 changes are more important. A 25% reduction at all ages will increase the present value of all the costs by about 10%.[3]

Suppose the death rates stay at their 1979 levels which are about 15% below those in 1971. Interpolating from Winkelvoss the PDV of the benefits rise by about 5%. Of course the change in the premiums required to make the payments depend on whether the plan has been partially or fully funded. Winklevoss and McGill, for example, report that in response to a 25% drop in mortality, a 50% funded plan would have its costs rise an extra 3 1/2 percentage points.

Let us suppose that for those 65 and over that death rates continue to decline at the rate of 2 1/2% per year.[12] Then by the end of 35 years in which the member of the current 25 to 34 year old cohort reaches 65, the average annual death rate would decrease by nearly 60%, for example, for the "all" category from 2.9% a year to 1.7%. Winkelvoss' table suggests an increase in costs of about 20%. The corresponding reductions for the current-

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[3] No adjustment is made to the mortality expectations for the spouse. The surviving spouse who receives a pension will have a longer life and greater payments if her life expectancy increases. However since this benefit only accounts for 4% of the cost of the standard plan, the bias is small.

[12] There are obviously better techniques to estimate a trend but the intervening years clearly show the trend. For the types of results we pursue here, the 2 1/2% per year figure yields correct orders of magnitude.

ly 35-45, 45-55 and 55 to 65 age groups are 47%, 32% and 12%. Approximate costs estimates can be interpolated from tables 9 and 10.

Vital Statistics classifies people by age, race and sex. It is known, however, that age specific death rates vary by eduation and other personal characteristics, Rosen and Taubman (RT), for example, have calcualted age specific death rates for various education and marital status groups using data for the 1970's and have compared their results with those from 1960 obtained by Kitagawa and Hauser (KH). The relevant information is summarized in Table 11. For white males 65 and over, KH find no effects of education while RT find the more educated have substantially lower death rates. Interestingly when RT restrict their analysis to those 78 and older in 1973, who are the survivors of the KH 65 and older group of 1960, RT still find the most educated have a death rate about 60% of that of the least educated.

Between 1960 and 1970, there was about a 10% drop in the overall death rate in the 25-64 and 65+ age groups for white males. We have recalculated the death rates in each year using the education distribution in the other year. Using 1975 weights, the 1960 computed rate would differ by .001 from the 1975 rate. Similarly using the 1960 weights, the recalculated value for 1975 differs by .002 from the 1960 actual figure. Thus if education is a causative factor, much of the observed shift from 1960 to 1975 is attributable to a shift in the educational attainment of the population.

Both KH and RT find that widowed and divorced men have substantially higher death rates than comparable married men. Using the marital status distribution in 1960 and 1975, we have recalculated death rates with the other year weights. For those under 65, the weights are similar and the recalculated numbers are unchanged. For those over 65, there would have been almost no change in the death rates if the weights had not changed, i.e., if the percent of married had not risen sharply.

If education is a cause of death differentials, the shift in the educational distribution of the population will cause even further shifts in the average age specific mortality level. For example if we take the Rosen-Taubman death rates by education level for 1975 by individual age and impose a trend decrease of 2 1/2% per year, the death rate in the 65-74 year age group would decline about 70%. If, howver, the education distribution had not changed the decline would have been 64%. Similar differences are found at other age levels.

Conclusion

The probability of having a pension is related to education, marital status, occupation, industry and assets. Most variables have the expected sign though managers is negative for males. The probability equation is very similar for males and females.

There is some indication that less healthy elderly people, who in general are more likely to die sooner, are less likely to have pensions. However, in both RHS and the CPS-SSA samples those with pensions are at least as likely to die as those without.

There has been a sharp drop in the age specific death rate in recent years. Longer life expectancy will increase the present value of pension payments. The extra costs, however, will only be large either if the trend continues into the far future or if the especially sharp decrease among the educated and married, who are more likely to have pensions and to have larger amounts continue.

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Notes

Occupation	
Prof.	= - Professional, technical, and kindred workers - farmers and farm managers
Blue Collar	= - Craftsmen, foremen and kindred workers - Operatives and kindred workers - Private household workers - Service workers except private household - farm laborers and foremen - Laborers except farm and mine
Managers	= - Managers, officials, proprietors
Excluded	= - Clerical and kindred workers (except farm) - Sales workers
Industry	
Govt.	= - Public Administration
Mfg.	= - Manufacturing
Service	= - Business and repair services =- Personal services =- Personal services =- Entertainment and recreation =- Professional and related services
Util.	= - Transportation, communication and public utilities
Farm	= - Agriculture, forestry and fisheries
Excluded	= - Mining =- Construction =- Wholesale and retail trade =- Finance, insurance and real estate

Table 1

Probit for Probability of Expecting a Pension: Males

	Variable	Maximum Likelihood Estimate	T-Value	Derivative of Probability Function Evaluated at Independent Variable Means
2	MSP	.254359	3.052668	.913003D-01
3	Single	.279518	2.337631	.100331
4	Widowed	.150396	1.241051	.539833D-01
5	Ed	.478876D-01	7.768236	.171889D-01
9	Blacks	-.381477	-5.671901	-.136928
6	Age	.120976D-01	1.175341	.434233D-02
7	Prof	.253484	3.088976	.909860D-01
8	BlueCol	.162999	2.593242	.585072D-01
12	Managers	-.692433D-01	-0.960004	-.248543D-01
10	SelfEmp	-.901528	-15.046259	-.323597
13	StopWork	.305413	8.468363	.109626
14	Assets	.124405D-05	4.037046	.446543D-06
15	Govt	1.18616	14.600386	.425764
16	Mfg	.378546	8.478167	.135876
17	Service	.113421	1.737852	.407117D-01
18	Util	.229211	3.669361	.822736D-01
19	Farm	-.466716	-5.195474	-.167524
20	Consultant	-2.12525	-3.316920	-.762842

Proportion Dependent Variable > 0 = 0.3574

Estimated Mean Probability that Dep Var > 0 = 0.3576
Estimated Probability at Sample Means = 0.3228

Log of Likelihood Function = -3591.3885

(-2.0) Times Log Likelihood Ratio = 1371.6697
Degrees of Freedom for Chi-Square = 17

Probit Coefficients Have Been Written on Unit 10

End of Probit Estimated No. 3

Table 2

Probit for Probability of Expecting a Pension: Males

Variable	Maximum Likelihood Estimate	T-Value	Derivative of Probability Function Evaluated at Independent Variable Means
MSP	105783	1.419967	.374078D-01
SINGLE	.792746D-01	0.746478	.280336D-01
WIDOWED	.192315D-01	0.178800	.680076D-02
ED	.606923D-01	8.650348	.214624D-01
BLACKS	-.266850	-4.220812	-.943654D-01
AGE	.174813D-01	1.858977	.618185D-02
PROF	.172129	2.236169	.608693D-01
BLUECOL	.151577	2.590837	.536016D-01
MANAGERS	-.230776	-3.419410	-.816085D-01
SELEMP	-.980631	-16.608638	-.346777
ASSETS	.205076D-01	9.646734	.725204D-02
GOVT	1.11747	15.494513	.395169
MFG	.400034	9.660781	.141463
SERVICE	.911230D-01	1.497082	.322235D-01
UTIL	.279263	4.885376	.987549D-01
FARM	-.519408	-6.028453	-.183676
ASSETS2	-.301055D-04	-7.472396	-.106461D-04
EDASSET	-.104213D-02	-6.667739	-.368525D-03
69BET	-.615128D-03	-0.17120	-.217526D-03
69WOR	.200382D-01	0.452156	.708603D-02
CONSTANT	-2.55152	-4.332434	-.902287

Table 2

(Continued)

```
PROPORTION DEPENDENT VARIABLE > 0 =                          0.3488

ESTIMATED MEAN PROBABILITY THAT DEP VAR > 0 =                0.3492
ESTIMATED PROBABILITY AT SAMPLE MEANS =                      0.3116

LOG OF LIKELIHOOD FUNCTION =                             -4145.0987

(-2.0) TIMES LOG LIKELIHOOD RATIO =                       1565.6999
DEGREES OF FREEDOM FOR CHI-SQUARE =                              21

PROBIT COEFFICIENTS HAVE BEEN WRITTEN ON UNIT 10

END OF PROBIT ESTIMATE NO.    4
```

Table 3

$ Amount of Having a Pension - Males

Variable	Estimated Coefficients	T-Ratio
MSP	-45.10	-.11
SINGLE	-94.34	-.16
WID	19.9	.035
PROF	978.88	2.93
MANAGERS	1380.9	4.46
BLUECOLL	-249.30	-.95
BLACKS	374.80	1.03
SELFEMPL	-1562.8	-4.55
STOPWORK	146.37	.79
GOVT	1699.7	6.13
MFG	-315.65	-1.54
SERVICE	156.16	.51
UTIL	183.73	.66
FARM	-562.69	-1.05
ED	73.3	2.52
AGE	-81.1	-1.82
ASSETS	.020	14.97
69BET	80.91	.50
69WOR	-678.50	-3.00
INTERCEPT	6170.0	2.22
R^2	0.19	

Table 4

Probability of Having a Pension - Female

Variable	Maximum Likelihood Estimate	T-value	Derivative of Probability Function Evaluated at Independent Variable Means
Single	.360265	3.790220	.991311D-01
Widowed	.257881	3.383033	.709588D-01
ED	.3887490D-01	3.357628	.106969D-01
Blacks	-.372488D-01	-0.378556	-.102494D-01
Age	.241106D-01	1.481507	.663431D-02
Prof	.269545	2.659951	.741683D-01
Bluecoll	-.212350	-2.534697	-.584306D-01
Managers	-.353396	-2.625461	-.972408D-01
Housewife	-.152892	-1.093091	-.420700D-01
Selfempl.	-.410552	-2.701376	-.112968
Assets	.580450D-05	4.278275	.159717D-05
Govt.	.983381	7.180103	.270588
Mfg.	.410370	4.609207	.112918
Service	.479601D-01	0.565006	.131968D-01
Utilities	.510214	3.328758	.140391
Farm	-.720256	-2.120472	-.198186
Constant	-3.04601	-3.050660	-.838143

Notes to Table 4

Proportion Dependent Variable > 0 =	0.2164
Estimated Mean Probability that Dep. Var. > 0 =	0.2161
Estimated Probability at Sample Means =	0.1943
Log of Likelihood Function =	-1331.1199
(-2.0) Times Log Likelihood Ratio =	287.0077
Degrees of Freedom for Chi-Square =	16

Table 5

Pension $ Regression: Females

Variable	Estimated Coefficient	T-Ratio	Elasticity at Pt. of Means
Single	1445.2	2.3805	.15708
Widowed	-2.1745	-.40363E-02	-.53540E-03
Prof.	332.72	.52148	.38870E-01
Managers	-667.85	-.75809	-.15308E-01
Bluecollar	-1285.6	-2.0550	-.15209
Blacks	406.46	.46290	.90159E-02
Selfempl.	-1229.7	-1.0254	-.14547E-01
Govt.	1616.1	2.2150	.74087E-01
Mfg.	1373.8	1.9937	.13917
Service	546.89	.86246	.91387E-01
Utilities	-86.88	-.93140E-01	-.19272E-02
Farm	-318.50	-.67776E-01	-.23550E-03
Housewife	335.58	.23455	.27294E-02
Ed	131.29	1.4478	.64478
Age	94.009	.85053	2.3809
Assets	9.5863	1.1030	.96401E-01
Intercept	-5864.1	-.85965	.96401E-01
$\bar{R}^2$	.0855		

Table 6

Probability of Dying 1969-1973, Males

Variables	Maximum Likelihood Estimate	T-Value	Derivative of Probability Function Evaluated at Independent Variable
MSP	-.367264	-4.854859	-.595411D-01
SINGLE	-.132403	.110447	-.214653D-01
WIDOWED	-.143126	.111767	-.232036D-01
ED	.472791D-03	0.068824	.766493D-04
BLAKCS	.256144D-01	0.363051	.415262D-02
AGE	.418063D-01	3.612713	.677768D-02
PROF	-.125317D-01	0.089511	.107305D-02
MANAGERS	.937966D-02	0.109995	.152064D-02
SELFEMP	-.645798D-01	-1.018632	-.104695D-01
STOPWORK	.309628	6.547639	.501972D-01
ASSETS	-.304698D-05	-4.949771	-.493979D-06
GOVT	-.750505D-01	-0.847123	-.121672D-01
MFG	-.104775	-1.983589	-.169862D-01
SERVICE	-.599061D-01	-0.797345	-.971202D-02
UTIL	-3.89518D-01	-0.547717	-.631491D-02
FARM	-.897591D-02	-0.098345	-.145518D-02
CONSTANT	-3.59578	-5.004047	-.582950

Table 6

(Continued)

PROPORTION DEPENDENT VARIABLE > 0 =	0.0973
ESTIMATED MEAN PROBABILITY THAT DEP VAR > 0 =	0.0973
ESTIMATED PROBABILITY AT SAMPLE MEANS =	0.0896
LOG OF LIKELIHOOD FUNCTION =	-2468.3349
(-2.0) TIMES LOG LIKELIHOOD RATIO =	165.8691
DEGREES OF FREEDOM FOR CHI-SQUARE =	17

PROBIT COEFFICIENTS HAVE BEEN WRITTEN ON UNIT 10

END OF PROBIT ESTIMATE NO. 1

Table 7

Percentage of People who Died 1971-1973
Who Expected to Receive a Pension

Age in 1969	Expecting a Pension
58	36%
59	39
60	35
61	36
62	33
63	38

Table 8

Percentage Change in Death Rate 73-79

$$\frac{DR_{79} - DR_{73}}{DR_{73}}$$

	AGE						
	25-34	35-44	45-54	55-64	65-74	75-84	85+
Total	-9.4	-22.9	-15.6	-14.9	-15.1	-11.6	-20.6
Male	-4.6	-20.2	-16.3	-15.9	-15.1	-9.7	-18.8
Female	-20.3	-27.4	-14 7	-13.3	-15.0	-12.5	-21.0
White	-6.4	-21.3	-15.0	-14.8	-14.1	-12.8	-19.3
White Male	-1.9	-19.9	-15.9	-16.5	-14.6	-10.6	-17.0

Source: Vital Statistics.

Table 9
Effect of Mortality

Pension Costs as a Percentage of the Cost under Standard Assumptions for the $\Sigma(PVFB)_x$ Function

Mortality Rate Multiple	Ages Less than 65 Only	Ages 65 and over Only	All Ages
0.50....................	105.6	116.1	123.0
0.75....................	102.8	107.0	110.0
1.00....................	100.0	100.0	100.0
1.25....................	97.3	94.4	91.9
1.50....................	98.4	89.7	85.2

Source: Winkelvoss, Chapter 15 (Table 15-1).

Table 10

Pension Cost Components as a Percentage of the Cost under Standard Assumptions for the $\Sigma(PVFB)_x$ Function

Mortality Rate Multiple	Retirement Benefits	Vested Benefits	Disability Benefits	Surviving Spouse Benefits	Total Cost
0.50............	128.1	130.2	105.1	52.5	123.0
0.75............	112.3	113.2	102.5	76.9	110.0
1.00............	100.0	100.0	100.0	100.0	100.0
1.25............	90.0	89.2	97.6	122.0	91.9
1.50............	81.6	80.2	95.2	142.8	85.2

Source: Winkelvoss, Chapter 15 (Table 15-2).

Table 11

Relative, Age Adjusted, Death Rates by
Education, Earnings and Marital Status:
1960, 1973-1976, White Males

Item	25-64		65+	
	1960	1973-1977	1960	1973-1977
Education[a]				
0-8 years	1.11	1.24	1.01	1.06
9-11	1.03	1.34	.99	.93
12	.91	.99		1.06
13-15	.85	1.13	.98	.77
16+	.70	.84		.77
Family Income in 1969 $[d/a]				
2,000	1.51	2.65	1.10	1.22
2,000-3,999	1.20	1.3	.99	.95
4,000-5,999	.99	1.05 }	.92	{ .89
6,000-7,999	.88	.9 }		{ 1.09
8,000-9,999	.93	.8	.96	{ .93
10,000+	.84	.95		{ 1.90
Marital status[b]				
Single	1.75	1.13	1.44	.95
Married	1.00	1.00	1.00	1.00
Widower	1.78	2.84	1.33	1.44
Other[c]	2.30	1.86	1.33	1.49

Notes:

a/ Relative to average death rate.

b/ Relative to average death rate for married.

c/ Mostly divorced.

d/ Inflated by the CPI and by the growth in real per capita income from 1959-1972.

Source: 1960 is KH, pp. 12, 109. 1973 is CPS-SSA.