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Source: *Demography*, Vol. 27, No. 3 (Aug., 1990), pp. 337-356
Published by: Springer on behalf of the Population Association of America
Stable URL: http://www.jstor.org/stable/2061372
Accessed: 23/07/2013 10:12

Demography, Vol. 27, No. 3, August 1990

Work and Retirement Among a Cohort of Older Men in the United States, 1966–1983

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Multivariate increment–decrement working life tables are estimated for a cohort of older men in the United States for the period 1966–1983. The approach taken allows multiple processes to be simultaneously incorporated into a single model, resulting in a more realistic portrayal of a cohort's late-life labor force behavior. In addition, because the life table model is developed from multivariate hazard equations, we identify the effects of sociodemographic characteristics on the potentially complex process by which the labor force career is ended. In contrast to the assumed homogeneity of previous working life table analyses, the present study shows marked differences in labor force mobility and working and nonworking life expectancy according to occupation, class of worker, education, race, and marital status. We briefly discuss the implications of these findings for inequities of access to retirement, private and public pension consumption, and future changes in the retirement process.

Working life tables have been used over a 40-year period for a variety of purposes. These include the assessment of working and nonworking life in the population, sources of change in labor supply, expected lifetime earnings, and the number of years persons will contribute to pension plans and consume pension benefits (Hayward, Grady, & McLaughlin 1988a,b; Hoem 1977; Schoen & Woodrow 1980; Smith 1982; Willekens 1980; Wolfbein 1949). Increasingly, researchers are using working life tables to evaluate the implications of sociodemographic factors for individuals' *lifetime* labor force experiences. For example, researchers have used working life tables to assess the effects of gender, race, education, and occupation on the timing and volume of labor force accessions and separations and the working and nonworking life expectancies of the population (Hayward et al. 1988a; Schoen & Woodrow 1980; Smith 1982; Smith & Horvath 1984). These factors influence labor force behavior by affecting individuals' preferences for work and the opportunity structure that defines the limits of individuals' decisions.

The present study builds on this tradition by examining the work-life patterns of a cohort of older men. Of particular interest is the process by which men end their labor force careers. A life table model is developed that acknowledges that this process may involve multiple labor force exits and reentries. Thus we use the increment–decrement working life table approach (e.g., Schoen & Woodrow 1980). Current understanding of older men's work-life patterns is advanced in several ways. First, the transition rates on which the working life tables are based are derived from multivariate hazard models. This allows the calculation of covariate-status-specific schedules of transition probabilities from which we obtain increment–decrement working life tables for more detailed subgroups of the population than has previously been possible. Of particular substantive importance is the rich description of older men's work-life patterns that is achieved by identifying how sociodemographic characteristics shape the potentially complex process by which the labor force career is ended. As is evident in the findings, there is considerable diversity in these experiences, which is indicative of differences in lifetime achievement. Second, we differentiate nonparticipation by defining retirement and disability as separate states. Previous demographic studies of labor force behavior typically combined these states into a single state of nonparticipation. Evidence suggests, however, that the processes by which older men arrive in these statuses vary significantly (Haveman, Wolfe, & Warlick 1985; Hayward, Grady, Hardy, & Sommers 1989; Hayward, Hardy, & Grady 1989), and the present study provides new evidence on the differences in the processes by which men exit these statuses. The differentiation of retirement and disability is especially important in understanding inequities of access to retirement and the quality of life among older persons who have left the labor force. Third, we diverge from the traditional synthetic cohort approach and examine the experiences of an actual cohort over a 17-year period of observation. Specifically, labor force incumbents who are 55 years old are followed prospectively as they move out of and perhaps back into the labor force. These experiences are summarized in terms of the volume of labor force accessions and separations and the working and nonworking life expectancies of the cohort. Such information is particularly germane for developing manpower policies aimed at the older population and estimates of public and private pension consumption during late life.

The Working Life Table Model

In the current study, we examine the labor force behavior of a cohort of older men who are currently in the labor force at age 55—approximately 93% of the male noninstitutionalized population at that age. Members of this cohort are followed as they age to observe movements among four labor force states: in the labor force, retirement, disability, and death. According to the life table model shown in Figure 1, individuals may make multiple transitions between the labor force and the two nonparticipation states, disability and retirement. We assume, however, that there is no movement between the nonparticipation states, which are differentiated by the person's physical capacity to work at the time of withdrawal. This simplifying assumption is necessary because the data do not allow an assessment of changes in the physical capacity to work for nonparticipants, precluding the

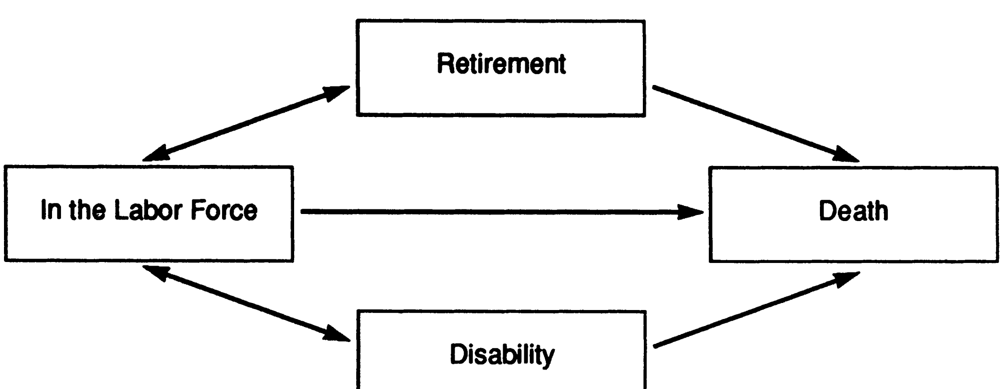

Figure 1. Life-Table Model of the Retirement Process

observation of transitions based on that capacity. Further, at age 65 retired and disabled persons are no longer differentiated by the Old Age, Survivors, Disability, and Health Insurance programs, reducing the salience of such moves during those ages.

The processes that govern the movements between labor force states in this increment–decrement model are defined by age-specific transition intensities or rates. As noted before, we diverge from prior studies in that the transition rates are derived from multivariate hazard models defined for each type of transition. In each of these models, the age-dependent risk of the event of interest (e.g., retirement) is regressed on a common set of characteristics for the cohort measured at age 55, the start of the process. Schedules of age-specific transition rates are derived from these equations for population subgroups, and increment–decrement working life tables are calculated for each of the groups. This procedure is a straightforward extension of the calculation of multivariate single-and multiple-decrement life tables (Guilkey & Rindfuss 1987; Hayward, Hardy, & Grady 1989) and is described later in the article.

Although multivariate hazard models have been used extensively to examine the determinants of aspects of labor force behavior such as unemployment (DiPrete 1981) and labor force exits (Hayward, Grady, Hardy, & Sommers 1989; Hayward, Hardy, & Grady 1989), this is the first analysis to use this approach to develop a dynamic model of a process that involves multiple, recurrent types of events (i.e., labor force exits and reentries). This aspect of the analysis is particularly important, because it provides new insights into the full variety of older men's experiences based on a set of ascribed and achieved sociodemographic characteristics measured at a common point in the life course. For example, we derive estimates of lifetime working life expectancy and number of retirements based on occupational incumbency at age 55, controlling for other characteristics such as race and marital status. Previous increment–decrement life table analyses of labor force behavior (e.g., Hayward et al. 1988a; Smith & Horvath 1984) have traditionally taken account of population heterogeneity by stratifying the state space. The case requirements of such an approach severely restrict the number of strata, thus limiting both the level of detail and the assessment of the net effects of characteristics such as occupation and race.[1]

The set of covariates considered in this analysis are those that define social contextual differences in labor force behavior and mortality. This substantive emphasis is based on the notion that modern social processes distributing opportunities, resources, and rewards are linked to both ascribed and achieved social characteristics. From this perspective, differences in labor force behavior and mortality across social groups serve to identify structural sources of inequity. In addition, social contextual factors are key elements in designing appropriate social policies, since policy interventions are typically at the macro level. For example, policymakers cannot intervene to change a person's occupation directly; instead, they might strive to affect the occupational "environment" in terms of guidelines for private pensions and health standards for work performance. Even when contextual properties are not themselves policy manipulable, it is necessary to understand which of these are related to a behavior before specific programs can be designed to produce the desired changes.

Two basic sets of covariates are considered. The first includes two work-related factors, occupation and class of worker. The second set includes traditional demographic characteristics that define common lines of stratification in the population. These characteristics are education, race, marital status, region of residence, and rural–urban residence. Although past research has substantiated the importance of these factors for specific events, this study is the first to examine their independent effects on a process that involves multiple, recurrent types of events.

Occupation. There is considerable variation among occupations in the volume of movement to retirement and disability (Burtless 1986; Hayward, Hardy, & Grady 1989; Sickles & Taubman 1986). The dominant pattern for white-collar occupations is low rates of retirement and disability, resulting in extended labor force tenure. The exception to this pattern is the high rates of retirement and disability found among clerical workers. These rates are consistent with the presence of well-developed pension programs, above-average long-term disability insurance coverage, and the high rates of chronic morbidity found among male clerical workers (O'Rand 1986; Verbrugge 1984).[2] Skilled and semi-skilled blue-collar positions have intermediate retirement and disability rates. Among unskilled blue-collar workers, operatives also have intermediate rates of disability but very high rates of retirement. Service workers are the major exception to the pattern for blue-collar workers. They exhibit very low rates of retirement but high rates of disability—a pattern consistent with the fact that service occupations are largely devoid of high-yield pension programs and health insurance coverage and the relatively high level of acute morbidity (Verbrugge 1984). In addition, there is increasing evidence that those who are currently working in service jobs as well as those whose longest occupation was a service job exhibit higher rates of mortality (Hayward, Hardy, & Grady 1989; Moore & Hayward 1990).

With regard to reentry behavior, recent evidence suggests that blue-collar workers are more likely to return to the labor force (Hayward et al. 1988a). In part, this is because of fewer resources to maintain one's standard of living during retirement. It also may be a product of earlier retirement among blue-collar workers, which means that they experience a longer average period in which they are at risk of reentry.

Class of Worker. Class of worker is linked to retirement regulations and pension coverage. For example, in contrast to those men employed in either government- or private-sector positions, self-employed workers are generally not subject to retirement regulations and are less likely to be covered by private pension plans. Not surprisingly, self-employment has been shown to decrease the risk of retirement (Hayward, Hardy, & Grady 1989; Sickles & Taubman 1986). It also, however, increases the risk of disability (Hayward, Hardy, & Grady 1989), suggesting that poor health preempts the accumulation of the resources to finance retirement, forcing those in poor health to adopt the disability status. Among retirees, those previously self-employed may be more likely to reenter the labor force because of the lack of formal employment barriers and perhaps less adequate financial resources.

Education. Net of occupation, education differentiates the risk of disability and mortality among older men; those with lower levels of education exhibit poorer health (Sickles & Taubman 1986) and higher rates of disability (Hayward, Grady, Hardy, & Sommers 1989) and mortality (Mott & Haurin 1985). The association of education with disability may reflect the lack of alternative, less physically demanding employment opportunities among the poorly educated who are in ill health. Educational differences in mortality have been attributed to social class differences in health behaviors and the use of the health care system (Mott & Haurin 1985). Among retirees, education is also associated with the risk of labor force reentry. Since poorly educated men are likely to have low pension incomes, they are expected to return to the labor force at a higher rate than men with higher levels of education.

Race. In addition to having lower rates of labor force participation, older nonwhites are overrepresented among the disabled (Bowen & Finegan 1969; Parsons 1980), and they experience higher rates of mortality (Kitagawa & Hauser 1973; Moore & Hayward 1990). Older nonwhites also have a more marginal labor force attachment than whites, resulting in a greater volume of movement to and from the labor force (Smith & Horvath 1984). We anticipate that these behavioral patterns will be reflected in a lower working life expectancy for nonwhites but higher volumes of labor force accessions and separations.

Marital Status. Marital status is an indicator of household consumption levels, financial resources, and social support. The literature shows that married men have lower rates of retirement (Hayward, Grady, Hardy, & Sommers 1989; Quinn 1977), lower levels of labor force participation subsequent to retirement (Beck 1985), and lower rates of mortality (Kitagawa & Hauser 1973; Moore & Hayward 1990). Marital status may also have an impact on disability, since disability benefits allow for dependents' benefits as well (Haveman et al. 1985).

Region and Urban–Rural Residence. Geographic and community differences in unemployment and industrial and occupational composition also may influence the labor force behavior of older men (Parcel & Mueller 1983; Simpson, Simpson, Evers, & Poss 1982). For example, retention of older men in the labor force is higher in areas with heavy concentrations of farming (Simpson et al. 1982). Mott and Haurin (1985) suggested that there may also be an effect of residence on older men's mortality. They showed that rural residents have higher survival probabilities, although this effect was nonsignificant in a similar study by Moore and Hayward (1990).

Data and Variables

The National Longitudinal Survey of Mature Males (NLS) is used to estimate the working life tables. NLS respondents are representative of approximately 15 million men in the U.S. civilian noninstitutionalized population who were between the ages of 45 and 59 in 1966, the date of the first interview. After the initial interview, respondents were reinterviewed on an annual or biannual basis; this analysis examines the 17-year period from 1966 to 1983.

Histories of labor force behavior and mortality are constructed for 2,816 men who were exactly 55 at some time between 1966 and 1976 and who were in the labor force.[3] These histories denote age-specific statuses in that the value of a given variable for any respondent (i.e., labor force, attrition/mortality status) can be arrayed beginning at exact age 55 (the age at which respondents enter the life table) and ending at the age at which the respondent left observation (i.e., either death or censoring occurred). Because we are only able to observe the occurrence of an event within a time interval, a file of exposure intervals 1 year in length is constructed. In all, 28,264 exposure intervals were created. Deaths, attrition, and labor force transitions are all assumed to have occurred in the middle of an interval. Analyzing exposure intervals as individual observations does not affect the value of the likelihood function, which remains the same regardless of whether individuals (with multiple intervals) or person-intervals are the units of analysis (Petersen 1986, p. 233).

As noted previously, the set of covariates pertains to the characteristics of men at the initiation of the process. Although this approach does not allow us to assess the temporally proximate determinants of each type of transition, it does yield a rich description of subgroup differences in terms of *lifetime* labor force experiences based on the characteristics of the cohort measured at a common point in the life course (Schoen 1988). For example, we assess the implications of occupational achievement at age 55 on both the exiting and reentry experiences of the cohort. Thus status at age 55 serves as a common benchmark on which to evaluate subgroup differences in older men's work-life patterns. The covariates are defined in Table 1. The table also includes the total amount of person-years of exposure for each covariate category and the percentage of events that occurred within each category.[4]

Although our use of time-invariant covariates considerably simplifies the development of the increment–decrement working life tables, there is an important caveat. This simplifying assumption results in the exclusion of a time-dependent measure of period from the hazard models. Given the use of longitudinal data for the period (1966–1983), the cohort confronted significant changes in economic conditions and pension policies as members aged that very likely altered their behavior (Hayward et al. 1988a). Thus it is important to keep in mind that the parameter estimates will be conditioned by these historical factors.

Table 1. Distribution of Exposure and Events by Covariate Category

Labor force incumbents*		Events		
Variable	Exposure	Retirement	Disability	Death
Age				
55	14.09	4.28	17.99	10.53
56	12.96	3.83	12.13	13.91
57	12.16	6.17	12.97	9.77
58	11.17	5.37	10.46	10.90
59	10.74	7.21	14.23	13.16
60	9.81	9.25	14.64	10.15
61	8.37	14.53	8.37	10.15
62	6.21	11.89	6.28	4.89
63	4.62	9.20	1.67	6.02
64	3.46	9.90	1.26	4.51
65	2.35	8.11	—	3.38
66	1.51	3.98	—	1.13
67	1.07	3.08	—	.75
68	.68	1.54	—	.00
69	.43	.80	—	.38
70	.25	.85	—	.38
Occupation				
Professional	11.41	9.65	3.77	9.77
Manager	16.27	13.78	12.13	12.41
Clerical	4.80	5.42	7.53	4.51
Sales	6.48	5.37	5.02	4.51
Craft	24.07	26.42	26.78	20.30
Operative	17.22	18.76	18.83	20.68
Service	6.25	6.42	8.37	10.15
Farmer	6.90	6.77	10.04	7.52
Farm laborer	1.96	2.19	1.67	3.76
Laborer	4.64	5.22	5.86	6.39
Class of worker				
Private	65.24	64.43	65.69	62.41
Government	15.61	17.76	8.79	16.17
Self-employed	19.15	17.81	25.52	21.43
Education				
≤12	80.40	83.33	87.87	86.84
13–15	8.72	7.51	7.53	6.39
16+	10.88	9.15	4.60	6.77
Race				
Nonblack	92.81	91.94	88.28	90.60
Black	7.19	8.06	11.72	9.40
Marital status				
Single	10.28	11.39	14.64	14.66
Married	89.72	88.61	85.36	85.34
Region				
South	28.44	28.76	28.45	28.57
Non-South	71.56	71.24	71.55	71.43
SMSA				
Rural	30.67	31.59	39.75	33.08
Urban	69.33	68.41	60.25	66.92
Total *N*	19,753	2,010	239	266

Nonparticipants		Events	
Variable	Exposure	Reentry	Death
Age			
56	2.04	6.95	1.93
57	2.84	7.52	2.90
58	4.34	11.77	4.83
59	4.92	9.22	3.86
60	6.53	8.94	8.70
61	8.31	8.94	6.76
62	10.32	8.79	9.18
63	11.45	10.50	8.70
64	10.90	5.82	10.63
65	10.73	8.94	14.01
66	9.53	5.82	10.63
67	7.73	3.83	9.18
68	5.55	1.42	5.80
69	3.25	1.28	1.45
70	1.55	.28	1.45
Occupation			
Professional	7.90	9.22	1.93
Manager	13.44	14.61	13.53
Clerical	5.84	5.96	9.66
Sales	4.12	5.82	6.28
Craft	27.64	22.98	28.99
Operative	20.48	16.17	19.81
Service	6.93	6.38	8.70
Farmer	5.47	10.64	3.86
Farm laborer	1.80	3.12	.97
Laborer	6.37	5.11	6.28
Class of worker			
Private	67.17	56.74	70.53
Government	17.70	15.32	16.43
Self-employed	15.13	27.94	13.04
Education			
≤12	86.83	82.55	87.44
13–15	6.20	7.94	6.76
16+	6.97	9.50	5.80
Race			
Nonblack	90.75	91.49	91.30
Black	9.25	8.51	8.70
Marital status			
Single	10.60	14.33	12.56
Married	89.40	85.67	87.44
Region			
South	27.22	30.64	21.74
Non-South	72.78	69.36	78.26
SMSA			
Rural	29.65	37.87	29.95
Urban	70.35	62.13	70.05
Total *N*	6,338	705	207

* The distribution of exposure and events by covariate category refers to the proportion of person-years and events in each covariate category. For any covariate, the figures sum to 1.0. The total amount of exposure and numbers of events are provided to facilitate calculations of the raw frequencies.

Statistical Approach

We evaluate older men's movements between the labor force states identified in Figure 1 in two stages. First, multivariate hazard models are estimated to determine the net impact of older men's sociodemographic characteristics on the risks of movement from and to the labor force. Second, the transition rates derived from these hazard models are incorporated into multiple increment–decrement working life tables to achieve a substantive interpretation of the implications of the *combined* set of hazard-model estimates for men's late-life labor force behavior. Separate working life tables are developed for each subgroup defined by the covariates included in the hazard models. These working life tables are used to compare subgroup differences in work-life patterns.

Hazard-Model Equations

As identified in Figure 1, the state space is defined in terms of ($J = 4$) states, including mortality. The movements (or flows) between labor force states can be characterized as rates or transition intensities that govern individuals' labor force and mortality experiences. Leaving one state i (e.g., in the labor force) for any state j at time t is defined by the overall hazard rate. Leaving state i for a specific state j is captured by a conditional hazard rate, because the occurrence of a transition (e.g., exiting the labor force to retirement) precludes the occurrence of other transitions (e.g., moving to disability). This type of model is known as a competing-risk model.[5]

To define the destination-specific transition rate, let $P_{ij}(t, t + \Delta t)$ be the probability that event type j occurs in the interval between t and $t + \Delta t$, given that the person is in state i at time t. Based on this information, the destination-specific hazard rate can be defined as

$$m_{ij}(t) = \lim_{\Delta \downarrow 0} \mathrm{P}_{ij}(t, t + \Delta t)/\Delta t, \tag{1}$$

and the overall hazard rate is

$$m(t) = \sum_{j=1}^{J} m_{ij}(t). \tag{2}$$

In traditional demographic (life table) analyses of mortality, the overall hazard rate corresponds to the central death rate.

Given our ultimate goal of estimating increment–decrement working life tables, the underlying Markovian assumption of the model forces us to "ignore" the specific effects of duration in each state and previous mobility experiences. That is, we are interested only in the age-specific transition intensities, regardless of individuals' previous history. Despite heterogeneity in the risk set (e.g., some of those at risk of exiting the labor force may have previously exited and then returned, and others may have never exited), the age-specific transition rates accurately summarize the *current* mobility experiences of the cohort (Schoen 1988). Moreover, when these rates are incorporated into an increment–decrement life table, we obtain unbiased estimates of the cohort's experiences in terms of labor force accessions and separations, and working and nonworking life expectancies. Thus we specify Markov-based hazard models in the sense that the risk set refers to incumbents of a state at exactly age x, regardless of the means by which they arrived.

To illustrate this approach, we will focus for the moment on the process of exiting the labor force to some destination state j (where j = retirement, disability, or death). We assume that the process depends only on age and two sociodemographic characteristics—occupation and race—and that all covariates are measured prior to the onset of the process.

Suppose that age (A) is categorized into i segments and that race and occupation are defined in terms of k and l categories, respectively. Then a simple model for the force of movement to state j associated with occupation l and race category k at the beginning of the age interval $[a_{i-1}, a_i)$ is (Namboodiri & Suchindran 1987, pp. 203–204)

$$m_{ikl} = \exp(D + A_i + B_k + C_l) \tag{3}$$

or, equivalently,

$$\ln(m_{ikl}) = D + A_i + B_k + C_l, \tag{4}$$

where D is a constant for all persons, A refers to the effect of age $i - 1$, B to the effect of being in race category k, and C to the estimate for incumbency in occupational group k. The model can be easily expanded to accommodate additional covariate information and interaction terms (Trussell & Hammerslough 1983).

The log-linear approach to estimating this type of model prevents m_{ikl} from being less than zero and allows us to estimate a linear model of the dependency of each rate on the set of explanatory variables identified in Table 1. Thus we estimate the models by using a nonparametric, categorical variable approach (e.g., Trussell & Hammerslough 1983). The nonparametric (or piecewise exponential) specification of time in this model has the advantage of informing us of the actual form of this relationship for each of the transitions (Guilkey & Rindfuss 1987). Almost no empirical evidence currently exists for the rates considered in the present analysis.

In the current study, seven hazard rates are of interest: the three rates that govern movement out of the labor force to retirement, disability, and death and the rates that determine movement back to the labor force or death from disability and retirement. Rates of movement to retirement, disability, and death among labor force incumbents are estimated by using three separate destination-specific hazard equations. Rates of movement to the labor force and death among nonparticipants are estimated by using two destination-specific hazard models. Both retired and disabled men are included in the models, and nonparticipant status is defined as a covariate. We tested for the presence of interactions by nonparticipant status in a continuous time framework and no significant interactions were found. Thus the main-effects models are used to generate the schedules of transition rates of labor force reentry.[6]

Calculation of Multiple Increment–Decrement Life Tables

To summarize the working life implications of the transition rates for population subgroups, age-specific transition rates are calculated for persons of specific characteristics and these rates are incorporated into standardized multiple increment–decrement working life tables. Following the procedures described by Rodriguez, Hobcraft, McDonald, Menken, and Trussell (1984), the first step in this procedure is to calculate the predicted risk of the event of interest for each combination of covariate categories in the model. For example, the predicted rate for event type j for persons in age category i, race category k, and occupational group l in Equation (4) is found by transforming the equation back to its exponential form (3). The transition rates are then placed in an array defined by the covariate categories in the model. Within each age category (or age-covariate category), the array is collapsed to produce a rate that is a weighted average of the rates for each combination of covariate categories. The weight applied to each cell in this calculation is the proportion of the sample (based on NLS case-weights for 1966) with that combination of characteristics. Since the same marginal distributions are used to obtain the weighted average of the rates for the other age-covariate categories, the resulting (standardized) transition rates are those that would occur in the absence of age differences in composition. This produces average yearly estimates for each age-covariate category (e.g, race-specific schedules of transition rates), controlling for the other covariates in the model.

The transition rates (m_x's) are the basis on which the working life tables are calculated.[7] To obtain these tables, we first use the matrix of the transition rates ($\mathbf{M}_x$) to calculate a transition probability matrix, $\mathbf{P}_x$, by (Rogers & Ledent 1976)

$$\mathbf{P}_x = (\mathbf{I} + \tfrac{1}{2}\mathbf{M}_x)^{-1}(\mathbf{I} - \tfrac{1}{2}\mathbf{M}_x). \tag{5}$$

This allows us to specify the familiar life table relationship from which survivorship values for all ages from 55 on up can be calculated (Rogers 1975; Schoen & Woodrow 1980; Willekens 1980):

$$\mathbf{l}_{x+h} = \mathbf{l}_x\mathbf{P}_x, \tag{6}$$

where $\mathbf{l}_{x+h}$ is a survivorship matrix whose elements, ${}^{kj}l_{x+1}$, represent the number of persons in state k at exact age x who were in state j at exact age $x + 1$; $\mathbf{l}_x$ is a survivorship matrix similar to l_{x+1}, but whose elements, ${}^{kj}l_x$, represent the number of persons in both state k and state j at exact age x (i.e., ${}^{kj}l_x = 0$, where $k \neq j$) such that its diagonal elements represent the number of survivors in state k at exact age x; and $\mathbf{P}_x$ is a transition probability matrix whose elements ${}^kp_x^j$, represent the probability that a person in state k at exact age x will be in state j at exact age $x+1$. Once the survivorship matrix is derived, we can evaluate the expected magnitude of flows among states during a specified age interval (e.g., beyond age 55). For example, we can calculate the anticipated number of retirement events or labor force reentries beyond a given age. Calculation of the number of transfers between states for each age, $\mathbf{D}_x$, is based on the matrix of occurrence/exposure transfer rates, $\mathbf{M}_x$, and a matrix of person-years lived, $\mathbf{L}_x$. In matrix notation,

$$\mathbf{D}_x = \mathbf{L}_x^i\mathbf{M}_x^j, \tag{7}$$

where

$$\mathbf{L}_x = \tfrac{1}{2}(\mathbf{l}_x + \mathbf{l}_{x+1}). \tag{8}$$

The last expression represents a linear approximation of the number of person-years lived in each interval.

The technique outlined here also allows the calculation of state-specific (in and out of the labor force) life expectancy estimates. Specifically, life expectancy in state i (e.g., in the labor force) at age x (${}^ie_x$) is calculated as follows:

$${}^ie_x = ({}^iT_x)/l_x, \tag{9}$$

where

$${}^iT_x = \sum_{h=0}^{\infty} {}^iL_{x+h}. \tag{10}$$

As noted previously, two status life expectancies are of interest: working and nonworking life expectancy. The relationship among these expectancies is arithmetic such that total life expectancy is equal to their sum.

Our approach is a direct extension of prior-hazard analyses, which develop life table summary measures of single- and multiple-decrement processes. Examples of such applications include fertility (Guilkey & Rindfuss 1987), contraceptive behavior (Grady, Hayward, & Florey 1988; Grady, Hayward, & Yagi 1986; Hammerslough 1984), labor force behavior (Hayward, Hardy, & Grady 1989), and mortality (Moore & Hayward 1990). In each of these studies, including the present analysis, the life table summary measures are the products of the estimated parameters of random variables. This aspect of the approach suggests the possibility of developing standard errors and confidence intervals of the summary measures to aid in interpretation (Guilkey & Rindfuss 1987). As yet, however, there has been no attempt to pursue this line of inquiry even for relatively simple single-event processes. Furthermore, we suggest that the issues involved in developing such measures for multi-process increment–decrement models are less than straightforward and that their resolution must wait for serious in-depth attention in future research.[8] For the present analysis, we adopt a very pragmatic approach to interpreting the life table summary measures. This interpretation rests on the general guidelines used to obtain the final hazard models on which the life tables are based. Specifically, adopting a model-trimming strategy used by prior multivariate (and categorical) life table analyses of single- and multiple-decrement processes, covariates were included in the final models if one of two conditions was met: (1) the covariate as a whole had a statistically significant effect in one of the hazard models, and (2) the exclusion of the covariate altered the effects of other covariates. Interpretation of the life table summary measures thus generally depends on whether a given *covariate* had a statistically significant effect in one of the hazard models. (Footnotes in the tables identify these covariates.) Accordingly, our discussion of the results highlights the patterns of results across covariate categories rather than specific category point estimates to achieve the substantive interpretation of the full set of hazard-model estimates offered by the increment–decrement life table framework.

The multivariate increment–decrement life table approach just outlined can potentially be applied to any process that involves multiple and recurrent types of events. For example, such an approach may be useful in achieving a better understanding of the major lines of stratification in marriage behavior, living arrangements, migration, and contraceptive switching—traditional processes of interest to demographers. We emphasize, however, that these types of processes are not inherently demographic. Other processes that may be amenable to such an empirical assessment include morbidity/disability experiences, poverty, psychological well-being, Aid to Families With Dependent Children recipiency, strikes, and membership in voluntary associations, to name just a few.

Our approach to developing a multivariate working life table model also is not necessarily limited to cohort-based longitudinal data. The method could be adapted easily to make use of data sources such as the Current Population Survey or the Survey of Income and Program Participation, which have information for two or more points in time for a cross-section of individuals. This would permit the development of working life table models for synthetic cohorts. Although such models are not without potential problems (e.g., one must assume that the multivariate parameter estimates are cohort invariant), they would have some utility in evaluating how changes in structural conditions (e.g, pension policy and economic conditions) alter the behavior in question (e.g., Hayward et al. 1988; Tuma & Sandefur 1988). Specifically, by estimating such models for a series of time points, one would produce working life tables that are both multivariate and sensitive to period effects. This has the advantage of pinpointing historical changes in the timing of specific behavior and the degree to which all members of the population were affected. Although we would prefer to use multiple cohort-based longitudinal data sets to document the effects of structural changes on age-dependent late-life labor force behavior, there are no such data sets currently available.

Results

Hazard-Model Estimates

Labor Force Participants. The results in Table 2 show the effects of the sociodemographic characteristics on the rates of retirement, disability, and death among labor force incumbents. Among the covariates that significantly influence the risk of retirement is

Table 2. Hazard-Model Estimates for Labor Force Exits

Variable	Retirement[a] Coeff.	Retirement[a] Antilog	Disability[b] Coeff.	Disability[b] Antilog	Death[c] Coeff.	Death[c] Antilog
Intercept	−.557	.573	−5.044	.006	−4.667	.009
Age						
55	−2.746	.064	1.137	3.117	−.016	.984
56	−2.771	.063	.833	2.300	.350	1.419
57	−2.224	.108	.969	2.635	.069	1.071
58	−2.293	.101	.819	2.268	.250	1.284
59	−1.928	.145	1.196	3.307	.508	1.662
60	−1.564	.209	1.344	3.834	.361	1.435
61	−.902	.406	.989	2.689	.567	1.763
62	−.789	.454	1.000	2.718	.143	1.154
63	−.734	.480	−.029	.971	.649	1.914
64	−.310	.733	ref		.684	1.982
65	−.077	.926			.800	2.226
66	−.387	.679			ref	
67	−.263	.769				
68	−.491	.612				
69	−.738	.478				
70	ref					
Occupation						
Professional	−.111	.895	−.706	.494	.381	1.464
Manager	−.138	.871	−.224	.799	−.039	.962
Clerical	.136	1.146	.813	2.255	.200	1.221
Sales	−.215	.807	−.191	.826	−.136	.873
Craft	.178	1.195	.221	1.247	.045	1.046
Operative	.214	1.239	.140	1.150	.413	1.511
Service	−.061	.941	.481	1.618	.624	1.866
Farmer	ref		ref		ref	
Farm laborer	−.110	.896	−.362	.696	.752	2.121
Laborer	.209	1.232	.219	1.245	.500	1.649
Class of worker						
Private	−.189	.828	.688	1.990	−.087	.917
Government	ref		ref		ref	
Self-employed	−.361	.697	1.071	2.765	.235	1.265
Education						
≤12	.136	1.146	−.029	.971	.292	1.339
13–15	ref		ref		ref	
16+	−.081	.922	−2.84	.753	−.312	.732
Race						
Nonblack	−.010	.990	−.434	.648	−.053	.948
Black	ref		ref		ref	
Marital status						
Single	ref		ref		ref	
Married	−.104	.901	−.372	.689	−.292	.747
Region						
South	ref		ref		ref	
Non-South	−.013	.987	.033	1.034	.023	1.023
SMSA						
Rural	ref		ref		ref	
Urban	−.012	.988	−.396	.673	−.041	.960
L	−7,086.560		−1,388.060		−1,553.830	

[a] Covariates that significantly contribute to the fit of the retirement model are age, occupation, and class of worker ($p < .05$) and education ($p < .10$).

[b] Covariates that significantly contribute to the fit of the disability model are age, occupation, class of worker, marital status, and SMSA ($p < .05$) and race ($p < .10$).

[c] Mortality risks are not significantly differentiated by the covariates, with the exception of age.

occupation at 55 (X^2 test not shown). The pattern of results shows that professionals, managers, and sales personnel have much lower risks than operatives and laborers. This is consistent with previous work that suggested that the unattractive nature of work, in combination with the access to private pensions, facilitates early retirement among operatives and laborers (Hayward, Grady, Hardy, & Sommers 1989; Hayward, Hardy, & Grady 1989). Also noteworthy is the very high disability rate among clerical workers. As noted earlier, this very likely reflects the high rate of long-term disability insurance coverage in combination with the high rates of chronic morbidity found among incumbents (O'Rand 1986; Verbrugge 1984). Finally, mortality risks among labor force participants are not significantly differentiated by occupation (or any of the remaining covariates in the model).

In regard to the effects of class of worker, self-employment slows the rate of retirement but increases the rate of disability. Other studies (Fuchs 1982; Quinn 1980) noted the delayed retirement behavior of self-employed workers, but the higher rates of disability place this earlier result in a new light. Researchers have generally suggested that self-employed workers could opt for later retirement because they had more control over their work activities, more flexibility in defining suitable job tasks, and fewer external constraints on their continued employment through the absence of mandatory retirement policies. The pattern shown here, however, implies a less positive view. For many self-employed workers, retiring typically means reliance on savings. Whereas older workers in wage and salaried positions may wish to time their retirement relative to the achievement of pension eligibility, self-employed workers must generally achieve acceptable levels of unearned income without employer contributions. This may delay the accumulation of savings such that a deterioration in health occurs prior to the accumulation of sufficient savings to finance retirement.

Marital status and rural–urban residence both have significant effects on disability. Being married and living in an urban area operate to reduce the incidence of disability. The marital status effect is consistent with recent evidence showing that being divorced is associated strongly with engaging in adverse health behaviors (Umberson 1987) and perceived poor health (Ries 1983). The effect of urban–rural residence may be indicative of the relative lack of access to health care in rural areas.

Nonparticipants

Turning to the reentry and mortality models for nonparticipants shown in Table 3, many of the sociodemographic characteristics of men at age 55 are found to affect the risk of reentry. Only the person's disability or retirement status at the time of his labor force withdrawal and his occupation at age 55, however, are significant determinants of the risk of death among nonincumbents (X^2 significance tests for variables not shown).

Those occupational effects displayed for the reentry model are a product of the very low rates of reentry among managers, craftsmen, operatives, and laborers relative to farm laborers. It is likely that farm laborers reenter the labor force in large part because of the lack of pension benefits and savings. Relatedly, since the attachment of many farm laborers to the labor force is marginal throughout the entire career cycle, the mobility behavior reported here may also be a function of the greater tendency of farm laborers to move into and out of the labor force. In contrast, of course, the low rate of reentry characteristic of the traditional blue-collar occupations is indicative of extensive pension systems achieved through collective bargaining. The low rate of reentry exhibited by managers is also indicative of a high level of postretirement income, perhaps in combination with the fact that managers are characterized by firm-specific skills that are not generally transferable to other employers.

Only two occupations differ significantly in terms of mortality among nonparticipants. Those in clerical occupations at 55 have a significantly higher mortality rate than professionals ($T = -1.78$). Interestingly, this is net of disability status (which is a relatively common destination for clerical workers).

Table 3. Hazard-Model Estimates for Labor Force Reentry and Death Among Nonparticipants

		Reentry[a]		Death[b]	
Category	Variable	Coeff.	Antilog	Coeff.	Antilog
Intercept		−3.338	.036	−3.145	.043
Age	56	3.327	27.855	−.363	.696
	57	3.053	21.179	−.282	.754
	58	3.031	20.718	−.112	.894
	59	2.631	13.888	−.504	.604
	60	2.331	10.288	.019	1.019
	61	2.014	7.493	−.441	.643
	62	1.749	5.749	−.282	.754
	63	1.787	5.972	−.390	.677
	64	1.212	3.360	−.115	.891
	65	1.654	5.228	.229	1.257
	66	1.269	3.557	.104	1.110
	67	1.022	2.779	.186	1.204
	68	.348	1.416	.031	1.032
	69	.766	2.151	−.788	.455
	70	ref		ref	
Occupation	Professional	−.208	.812	−.997	.369
	Manager	−.580	.560	.557	1.745
	Clerical	−.309	.734	1.085	2.960
	Sales	−.164	.849	.898	2.455
	Craft	−.504	.604	.567	1.763
	Operative	−.523	.593	.509	1.664
	Service	−.483	.617	.694	2.002
	Farmer	−.392	.676	.411	1.508
	Farm laborer	ref		ref	
	Laborer	−.689	.502	.525	1.691
Class of worker	Private	−.694	.500	.241	1.273
	Government	−.941	.390	.289	1.335
	Self-employed	ref		ref	
Education	≤12	−.215	.807	−.253	.777
	13–15	ref		ref	
	16+	−.128	.880	.128	1.137
Race	Nonblack	−.094	.910	.173	1.189
	Black	ref		ref	
Marital status	Single	ref		ref	
	Married	−.277	.758	−.197	.821
Region	South	ref		ref	
	Non-South	−.080	.923	.267	1.306
SMSA	Rural	ref		ref	
	Urban	−.352	.703	−.009	.991
Origin	Disability	ref.		ref	
	Retirement	1.368	3.928	−1.054	.349
L		−2,394.700		−1,002.390	

[a] Covariates that significantly contribute to the fit of the reentry model include age, occupation, class of worker, marital status, SMSA, and disability status ($p < .05$).
[b] Covariates that significantly contribute to the fit of the mortality model include age, occupation, and disability status ($p < .05$).

Class of worker at age 55 has a significant impact on reentry but no effect on mortality. The results show clearly that self-employed men have a much greater probability of returning to the labor force. Given the general lack of private pensions among the self-employed, this result may reflect older men's response to economic necessity combined with low barriers to entry.

Among the remaining covariates, being married and living in an urban environment reduce the risk of reentry. With regard to retirement or disability status at the time of withdrawal, the results show the dramatic impact of this factor on both reentry and death. Not surprisingly, disability significantly increases the risk of death while lowering the risk of reentry.

Increment–Decrement Working Life Table Estimates

The implications of these effects for labor force accession and separation rates and working and nonworking life expectancies are shown in Table 4. As is evident from the column totals, 55-year-old male labor force incumbents can expect, on average, to live 21.16 additional years. Of this total, 8.7 years will be spent in the labor force; 11.6 years will be spent in retirement; and .88 year will be spent in disability. In addition, members of the cohort can expect, on average, .99 retirements, .09 disability exits, and .13 deaths (before age 70) from the labor force. Similarly, this cohort can expect .33 reentries and .11 deaths while out of the labor force.

Of special interest is that the working life expectancy estimates for the total sample mirror those obtained from period-based working life tables using Current Population Survey (CPS) data for the 1970s (Hayward et al. 1988a; Smith 1982). For example, using CPS data for 1977, working life expectancy for 55-year-old male labor force incumbents is estimated to be 8.5 years (Smith 1982), only .2 years less than the estimate shown in Table 4. Thus despite differences in methodology and data, the striking similarity of the estimates underscores the robustness of both current and previous estimates. Remember, however, that previous studies did not use a multivariate life table technique. Thus they could not examine the independent effects of occupation and other factors on older men's work-life patterns.

Turning first to the occupational estimates, the results show substantial disparity in working life expectancy between occupational categories. Sales personnel, professionals, and farm laborers have very high working life expectancies at 55, almost an additional 10 years of labor force participation. This is in marked contrast to craft, operative, and clerical occupations, in which workers are only expected to work an additional 8 years of their lives. Importantly, these patterns do not align themselves strictly on a blue-collar/white-collar dimension. For example, it is likely that the high working life expectancy of farm laborers cannot be attributed to the intrinsic qualities of the work environment, as one might assume for professionals.

Nonworking life expectancy is also highly variable: retirement life expectancy at 55 ranges from a high of 12 years down to 10 years; disability life expectancy at 55 ranges from 1.2 years to a low of about .5 years. These patterns signify substantial differences in the quality of life out of the labor force, the consumption of public and private pensions, and the likely use of health care services such as medicare. For example, professionals clearly have greater access to retirement and will consume pension benefits over a much longer period of time than clerical workers or salesmen. Moreover, the higher disability expectancies among clerical and service workers suggest that incumbents of those occupations are likely to be overrepresented in terms of the consumption of health care services.

The pattern of labor force accessions and separations is also illustrative of occupational differences in lifetime labor force behavior. For example, among workers aged 55, the volume of retirement ranges significantly from .86 retirement exits for service workers to more than

Table 4. Summary Measures of Covariate-Specific Working Life Tables

Covariate stratification	Status expectancies				Labor force accessions and separations before the age of 70						
					From I to			From R to		From D to	
	T	I	R	D	R	D	M	I	M	I	M
Total	21.16	8.69	11.60	.88	.99	.09	.13	.33	.11	.02	.04
Occupation											
Professional	22.39	9.77	12.04	.59	.98	.04	.16	.37	.03	.01	.01
Managerial	21.38	9.28	11.41	.69	.93	.07	.13	.27	.11	.01	.03
Clerical	18.33	7.89	9.26	1.18	.91	.17	.17	.32	.16	.04	.10
Sales	20.67	10.02	10.12	.53	.92	.07	.15	.33	.12	.02	.04
Crafts	20.22	8.00	11.12	.97	.98	.10	.16	.32	.12	.02	.05
Operative	20.98	8.09	11.95	.94	1.03	.09	.13	.34	.12	.02	.04
Service	19.70	8.46	10.07	1.18	.86	.13	.18	.27	.11	.03	.07
Farmer	21.39	8.96	11.58	.86	.98	.09	.13	.33	.10	.02	.03
Farm laborer	21.35	9.82	10.91	.61	.97	.06	.18	.40	.06	.02	.02
Laborer	20.84	7.83	11.98	1.03	1.00	.01	.13	.30	.12	.02	.05
Class of worker											
Self-employed	20.96	9.79	10.00	1.18	.94	.13	.17	.41	.07	.05	.04
Government sector	21.05	7.90	12.70	.50	1.04	.04	.13	.29	.14	.01	.02
Private sector	21.22	8.58	11.74	.90	.98	.09	.12	.30	.12	.02	.04
Education											
High school or less	20.90	8.40	11.58	.91	1.01	.09	.14	.34	.11	.02	.04
High school + some college	21.15	9.43	10.93	.79	.99	.10	.12	.36	.12	.03	.04
College degree	21.68	9.88	11.20	.60	.96	.07	.09	.30	.13	.02	.04
Race											
Black	20.63	8.54	10.78	1.31	.98	.13	.13	.34	.09	.03	.05
Nonblack	21.15	8.70	11.60	.85	1.00	.09	.13	.33	.11	.02	.05
Marital status											
Single	20.01	8.41	10.60	1.00	1.00	.12	.16	.38	.12	.03	.06
Married	21.30	8.72	11.71	.86	.99	.08	.13	.32	.11	.02	.04
Region											
South	21.63	8.79	11.90	.94	1.02	.09	.13	.35	.09	.02	.03
Non-South	20.98	8.65	11.47	.87	.99	.09	.13	.32	.12	.02	.04
SMSA											
Yes	21.22	8.60	11.82	.80	.99	.08	.13	.30	.11	.02	.04
No	21.01	8.84	11.10	1.06	1.01	.12	.14	.37	.10	.03	.05

Note: T = total; I = in the labor force; R = retirement; D = disability; M = death.

1 exit for operatives. When viewed in combination with the other exits, these results clearly indicate that retirement is not a one-time event in many people's lives, particularly among the traditional blue-collar occupations (with the exception of service) and professionals. Relatedly, there are substantial occupational differences in the volume of reentry, ranging from .27 reentries for managers and service workers to .37 reentries for professionals and .4 reentries for farm laborers. Interestingly, despite the similarity in both the exit and reentry patterns of professionals and farm laborers, it is clear that the underlying causal processes are very different.

With regard to class of worker, self-employed workers have the longest working life expectancy, the longest disability expectancy, and the shortest retirement expectancy. Moreover, in terms of mobility, they experience fewer separations and a high number of accessions. This pattern is in stark contrast to that for government-sector workers. Their working life expectancy is more than 1 year less, their retirement expectancy is 2.7 years greater, and their disability expectancy is almost nonexistent. Moreover, government workers evidence a very low volume of reentry compared with self-employed men.

Among the demographic covariates, some interesting differences in work-life patterns obtain for education, race, and marital status. For example, there is a strong positive association between educational attainment and the total and working life expectancies. In terms of the effects of race, there is little difference in working life expectancy but large differences in the retirement, disability, and total life expectancies. Blacks live fewer total years, they enjoy fewer years of retirement, and they spend a greater amount of time disabled. This pattern underscores racial inequities in the quality of life out of the labor force among the older population. Moreover, the point should not be lost that these inequities persist when controlling for factors such as occupation and class of worker. The life expectancy estimates for marital status also parallel those observed in previous research, with married men having a 1.3 year advantage over single men at 55. Most of this difference is translated into a longer period of retirement.

Conclusions

The current study substantially broadens our understanding of older men's labor force behavior by casting this behavior within a life table framework and examining the social contextual differences in older men's work-life experiences. The increment–decrement life table approach is uniquely powerful in that multiple processes can be simultaneously incorporated into a single model, resulting in a more realistic portrayal of a cohort's labor force behavior. The multivariate approach taken in developing these life tables offers unique insights into the cleavages that exist with respect to the process by which men end their labor force careers.

The results bring into sharp focus the complexity of older men's labor force behavior. For example, this study shows clearly that retirement is not a single event in many men's lives and that postretirement labor force participation represents a significant portion of older men's total working life expectancy. This pattern belies the traditional popular notion of retirement as the "gold watch and the rocking chair" and suggests that statistical norms pertaining to postretirement labor force activity are at variance with traditional social norms that define retirement as a single event that ends persons' labor force careers. To the extent that this view is accurate, it seems plausible that social norms may also be changing to institutionalize this pattern, signaling a fundamental change in how we view retirement both as a status and a process.

The focus on social contextual differences in the cohort's experiences is particularly important to understand the *diversity* of late-life labor force experiences. In contrast to the assumed homogeneity of traditional working life table analyses, the present study shows that the older population's labor force experiences are markedly stratified along occupational, racial, and sector of employment lines. Moreover, these effects are orthogonal to each other. This strongly contradicts the pervasive notion that the elderly are a homogeneous group. A more accurate characterization is that the elderly are a highly diverse group in terms of experiences and needs. Such a characterization is consistent with a life-course perspective suggesting that older people's characteristics and behavior are products of a lifetime of achievement or the lack thereof. Accumulated lifetime advantages and disadvantages are thus displayed in the form of highly varied retirement experiences.

This point is shown no more clearly than in the marked inequities of access to retirement for groups defined by occupation and class of worker. Collective bargaining in the case of traditional blue-collar jobs and superior pension programs and lifetime accumulated savings for high-status white-collar positions have substantially benefited incumbents and provided them with the resources to spend considerable periods of their lives in retirement. In large part, however, farm laborers, clerical workers, service workers, and the self-employed have been excluded from these benefits. Clerical and service workers, for example, spend more of their lives disabled and fewer years in retirement, a pattern also displayed by self-employed men. The experiences of farm laborers, although similar to professionals, are a reflection of their marginal attachment to the labor force, nonexistent pension benefits, and low income. Future changes in pension policy should thus be targeted toward these occupational groups.

Finally, we must not lose sight of the fact that the observed sociodemographic differences in retirement life expectancy are of major policy significance in accurately estimating pension consumption during late life. Current public and private pension programs are largely ignorant of those sociodemographic differences noted for occupation, class of worker, race, and marital status. Moreover, recognition of such differences is likely to be increasingly important as employers expand pension programs to include health care benefits during the retirement years. Compositional differences among retirees in terms of the aforementioned sociodemographic factors may play a significant role in determining the fiscal viability of such programs.

The cohort-based approach makes a strong case that the retirement process is not necessarily a single isolated act but, rather, may consist of a series of acts involving movements both out of and back into the labor force. This is reminiscent of the sorting process that occurs as young individuals establish their careers; individuals move in and out of the labor force and between jobs until a match occurs between a person's skills and preferences and the characteristics of the job. Here, the sorting process refers to the conclusion of the career as older persons take on the retired status. In neither case, the establishment or the ending of the labor force career, is the transition necessarily smooth. We also must not lose site of the fact that the present cohort's labor force experiences are very likely a product of their distinctive attributes and unique historical circumstances. Our focus on a single cohort's experiences has precluded an examination of *alterations* in the retirement process. That such changes have occurred is evident in a number of recent studies of time series of labor force participation rates and comparisons of period-specific working life table models. To grasp more adequately the forces that are shaping these changes, we suggest that the cohort-based approach shown here would be useful in future analyses. As Ryder (1965) observed, the study of comparative cohort careers offers uniquely powerful insights into the analysis of social change in general and, we submit, into the analysis of changes in retirement process in particular. Comparisons of cohort biographies would make it possible to examine explicitly shifts in underlying labor force behavior; the responses of the population to changes in cohort characteristics, social policy, economic conditions, and structural changes in the economy; and the diversity of responses across important population subgroups. The heterogeneity of responses is particularly important, since it signifies that individuals have characteristics that influence their "degrees of freedom with respect to change" (Ryder 1965, p. 860). These issues lie at the heart of future manpower and pension policies aimed at the older population. Unfortunately, there is currently no means to resolve these issues satisfactorily, since efforts to collect new longitudinal data (i.e., the New Retirement History Survey) remain in the planning stages.

Notes

[1] The use of hazard models to estimate the risks of mortality provides an additional advantage over prior studies because we drop the traditional assumption that the force of mortality is constant across labor force states and covariate categories. By estimating multivariate hazard models of the risk of mortality by labor force status (see Fig. 1), we derive status-specific mortality schedules.

[2] Because the physical demands of clerical positions are relatively low, the high rates of chronic morbidity are indicative of the selection process whereby blue-collar men in poor health move to clerical positions with fewer physical demands (Moore & Hayward 1990; Verbrugge 1984).

[3] Prior to weighting, missing data for variables included in the analysis were imputed using a "hot deck" procedure. This involved creating a matrix cross-classifying broad categories of education, age, race, labor force status, and survey year. Variable means were calculated for each group of individuals defined by this cross-classification and stored as an array in the corresponding cells of the matrix. Each case was then read, and for each survey year, its cell in the imputation matrix was determined. A case's valid values replaced those previously stored and missing values were replaced by those held in the matrix. This procedure has the desirable property of maintaining the means and variances within each cell of the matrix for all variables. Matrix dimensions where chosen to reflect major sample characteristics for which there were no missing data. The cutpoints for each dimension were calculated to ensure that a sufficient number of cases would match the characteristics of each cell, causing values held in the matrix to be frequently replaced.

[4] Blacks were substantially oversampled in the NLS. We therefore weighted both exposure and events so that the resulting coefficients would apply to the population of older men who were 45–55 years old in 1966. The analysis treats the weighted sample as a simple random sample. We applied the 1966 sample weights, which were normalized to average 1.0. A reviewer pointed out that this provides less efficient estimates, although all estimates are equally asymptotically unbiased.

[5] An important assumption in using this type of model is that the destination-specific rates are independent: if one of the choices is removed, the remaining rates should remain unchanged. The validity of this assumption in general is dubious (Tuma & Hannan 1984, p. 254), and our situation is no exception. For example, it seems likely that the rates of disability, retirement, and mortality may be interdependent (Hayward, Hardy, & Grady 1989). This does not undermine the validity of results from the present study as a description of the pattern of labor force exits and reentries under current conditions. It does, however, argue against using these results to generalize to situations in which the structure of the alternatives is different.

[6] Complementing the tests for interaction in the reentry models, a series of hierarchical models were estimated in a prior study (Hayward, Hardy, & Grady 1989) to assess whether certain types of interactions were present for the process governing labor force withdrawal. Of particular interest were first-order interactions involving age, race, and period. In no case were any interactions statistically significant, and they were deleted from the final models. We also inspected the interaction estimates themselves, but we discerned no meaningful patterns. The data are, however, relatively thin in all of the models except the retirement model. This hinders the detection of interactions and suggests that a larger sample size is needed to assess fully whether interactions are present.

[7] Since observation of the oldest members of the cohort stopped at approximately age 70, we assume that the rates of exiting and reentry for the open interval of the life table are the same as those exhibited at age 70. We also assume that the death rate of the open interval is equal to the rate for all males aged 70 in 1980 (National Center for Health Statistics 1984). The exception is in the construction of race-specific working life tables, where the death rates for the open interval are race-specific.

[8] In the instance of a single-event process, the approach seems generally straightforward. Covariance and variance estimates of the parameter estimates could be used to generate standard errors

and confidence intervals for the life table summary measures. Serious complications ensue, however, when considering processes of the type considered in the present analysis. In particular, given the multiplicity of *interacting* events in a single system, covariates may have significant effects for only a subset of events. This suggests ideally that a variance–covariance matrix of the parameter estimates from all of the constituent hazard models should be calculated. We also suspect that this involves the necessity of estimating *simultaneous* hazard equations, although it is unclear to us whether this can be done given multiple interacting populations. It is also possible to conduct a sensitivity analysis to establish the range of life table summary measures associated with varying levels of covariate values. This could potentially yield insights into the distributional properties of the summary measures. In an increment–decrement model, however, this tack is complicated by the number of parameter estimates to be varied. In its simplest case, this would result in a $(k \times k)$ dimensional array of simulated life table summary estimates for each covariate, where k references the number of possible events in the state space. Further, the substantive (not statistical) impact of a covariate is a function not only of its size but also of the size of the baseline hazard rate (Teachman & Hayward 1989). For example, as the baseline hazard rate increases, the effect of a covariate as shown in status-specific survival curves diminishes. The end result in this instance is that there is very little impact on the life table summary measures.

Acknowledgments

This work was partially supported by National Institute on Aging Grant No. AG04915. Our thanks to Eileen Crimmins, Richard Easterlin, Jersey Liang, and Jay Teachman for their insightful comments. Address correspondence to Mark D. Hayward, Andrus Gerontology Center, University Park MC 0191, University of Southern California, Los Angeles, California 90089-0191.

[*Received March 1989. Revised January 1990.*]

References

Beck, S. H. (1985). "Determinants of Labor Force Activity Among Retired Men." *Research on Aging*, 7, 251–280.

Bowen, W. G., & Finegan, T. A. (1969). *The Economics of Labor Force Participation*. Princeton, NJ: Princeton University Press.

Burtless, G. (1986). "Occupational Effects on the Health and Work Capacity of Older Men." In *Work, Health, and Income Among the Elderly*, ed. G. Burtless. Washington, DC: Brookings Institution, pp. 103–142.

DiPrete, T. A. (1981). "Unemployment Over the Life Cycle: Racial Differences and the Effect of Changing Economic Conditions." *American Journal of Sociology*, 87, 286–307.

Fuchs, V. R. (1982). "Self Employment and Labor Force Participation of Older Males." *Journal of Human Resources*, 17, 339–357.

Grady, W. R., Hayward, M. D., & Florey, F. A. (1988). "Contraceptive Discontinuation Among Married Women in the United States: Results From the 1982 National Survey of Family Growth." *Studies in Family Planning*, 19, 227–235.

Grady, W. R., Hayward, M. D., & Yagi, J. (1986). "Contraceptive Failure in the United States: Estimates From the 1982 National Survey of Family Growth." *Family Planning Perspectives*, 18, 200–209.

Guilkey, D. K., & Rindfuss, R. R. (1987). "Logistic Regression in Multivariate Life Tables." *Sociological Methods and Research*, 16, 276–300.

Hammerslough, C. R. (1984). "Characteristics of Women Who Stop Using Contraceptives." *Family Planning Perspectives*, 16, 14–18.

Haveman, R., Wolfe, B., & Warlick, J. (1985). *Behavioral Responses to Social Security Retrenchment: Estimates From a Trichotomous Choice Model*, IRP Discussion Paper No. 789-85. Madison: University of Wisconsin, Institute for Research on Poverty.

Hayward, M. D., Grady, W. R., Hardy, M. A., & Sommers, D. (1989). "Occupational Influences on Retirement, Disability, and Death." *Demography*, 26, 393–409.

Hayward, M. D., Grady, W. R., & McLaughlin, S. D. (1988a). "Changes in the Retirement Process Among Older Men in the United States: 1972–1980." *Demography*, 25, 271–386.

———. (1988b). "Recent Changes in Mortality and Labor Force Behavior Among Older Americans: Consequences for Nonworking Life Expectancy." *Journal of Gerontology*, 43, S194–S199.

Hayward, M. D., Hardy, M. A., & Grady, W. R. (1989). "Labor Force Withdrawal Patterns Among Older Men in the United States." *Social Science Quarterly*, 70, 425–448.

Hoem, J. (1977). "A Markov Chain Model of Working Life Tables." *Scandinavian Actuarial Journal*, 1, 1–20.
Kitagawa, E. M., & Hauser, P. M. (1973). *Differential Mortality in the United States*. Cambridge, MA: Harvard University Press.
Moore, D. E., & Hayward, M. D. (1990). "Occupational Careers and Mortality of Elderly Men." *Demography*, 27, 31–53.
Mott, F. L., & Haurin, R. J. (1985). "Factors Affecting Mortality in the Years Surrounding Retirement." In *Retirement Among American Men*, eds. H. S. Parnes, J. E. Crowley, R. J. Haurin, L. J. Less, W. R. Morgan, F. L. Mott, & G. Nestel. Lexington, MA: D.C. Heath, pp. 31–56.
Namboodiri, K., & Suchindran, C. M. (1987). *Life Table Techniques and Their Applications*. New York: Academic Press.
National Center for Health Statistics. (1984). *Vital Statistics of the United States, 1980*. Vol. 2(Sec. 6): *Life Tables*. Washington, DC: U.S. Government Printing Office.
O'Rand, A. M. (1986). "The Hidden Payroll: Employee Benefits and the Structure of Workplace Inequality." *Sociological Forum*, 1, 657–683.
Parcel, T. L., & Mueller, C. W. (1983). *Ascription and Labor Markets: Race and Sex Differences in Earnings*. New York: Academic Press.
Parsons, D. (1980). "The Decline in Male Labor Force Participation." *Journal of Political Economy*, 88, 117–134.
Petersen, T. (1986). "Estimating Fully Parametric Hazard Rate Models With Time-Dependent Covariates." *Sociological Methods and Research*, 14, 219–247.
Quinn, J. F. (1977). "Microeconomic Determinants of Early Retirement: A Cross-Sectional View of White Married Men." *Journal of Human Resources*, 12, 329–346.
———. (1980). "Labor-Force Participation Patterns of Older Self-Employed Workers." *Social Security Bulletin*, 43, 17–28.
Ries, P. W. (1983). *Americans Assess Their Health: United States, 1978*, Vital and Health Statistics, Ser. 10, No. 142. Washington, DC: U.S. Government Printing Office.
Rodriguez, G., Hobcraft, J., McDonald, J., Menken, J., & Trussell, J. (1984). *A Comparative Analysis of Determinants of Birth Intervals*, World Fertility Survey Comparative Studies, No. 30. Voorburg, Netherlands: International Statistical Institute.
Rogers, A. (1975). *Introduction to Multiregional Mathematical Demography*. New York: Wiley.
Rogers, A., & Ledent, J. (1976). "Increment–Decrement Life Tables: A Comment." *Demography*, 13, 287–290.
Ryder, N. B. (1965). "The Cohort as a Concept in the Study of Social Change." *American Sociological Review*, 30, 843–861.
Schoen, R. (1988). *Modeling Multigroup Populations*. New York: Plenum.
Schoen, R., & Woodrow, K. (1980). "Labor Force Status Life Tables for the United States, 1972." *Demography*, 17, 297–322.
Sickles, R. C., & Taubman, P. (1986). "An Analysis of the Health and Retirement Status of the Elderly." *Econometrica*, 54, 1339–1356.
Simpson, I. H., Simpson, R. L., Evers, M., & Poss, S. S. (1982). "Occupational Recruitment, Retention, and Labor Force Cohort Representation." *American Journal of Sociology*, 87, 1287–1313.
Smith, S. J. (1982). *Tables of Working Life: The Increment–Decrement Model*, Bulletin 2135. Washington, DC: U.S. Bureau of Labor Statistics.
Smith, S. J., & Horvath, F. W. (1984). "New Developments in Multistate Working Life Tables." Paper presented at the Annual Meeting of the Population Association of America, Minneapolis.
Teachman, J. D., & Hayward, M. D. (1989). "Interpreting Hazard Rate Models Substantively." Unpublished manuscript, University of Maryland, Dept. of Sociology.
Trussell, J., & Hammerslough, C. (1983). "A Hazards-Model Analysis of the Covariates of Infant and Child Mortality in Sri Lanka." *Demography*, 20, 1–26.
Tuma, N. B., & Hannan, M. T. (1984). *Social Dynamics, Models and Methods*. New York: Academic Press.
Tuma, N. B., & Sandefur, G. D. (1988). "Trends in the Labor Force Activity of the Elderly in the United States, 1940–1980." In *Issues in Contemporary Retirement*, eds. R. Ricardo-Campbell & E. P. Lazear. Stanford, CA: Hoover Institution Press, pp. 38–75.
Umberson, D. (1987). "Family Status and Health Behaviors: Social Control as a Dimension of Social Integration." *Journal of Social and Health Behavior*, 28, 306–319.
Verbrugge, L. M. (1984). "Physical Health of Clerical Workers in the U.S., Framingham, and Detroit." *Women and Health*, 9, 17–41.
Willekens, F. (1980). "Multistate Analysis: Tables of Working Life." *Environment and Planning* A, 12, 563–588.
Wolfbein, S. L. (1949). "The Length of Working Life." *Population Studies*, 3, 286–294.