PENSION PLAN TERMINATION AND RETIREMENT STUDY

by

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in cooperation with the
Society of Actuaries' Non-Mortality Decrement Task Force

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Abstract

Employee termination and retirement probabilities affect the valuation of employee benefit plans and thus are of concern to actuaries. To provide timely experience for the profession, the Society of Actuaries' Non-Mortality Decrement Task Force organized a data collection effort. Thirty-two contributors provided over 1.7 million life years of pension plan turnover data for years 1994-2000. This study summarizes the results of this data collection effort.

Traditionally, the most important determinants of termination and retirement are age, a proxy for attachment to the workforce, and service, a measure of attachment to a firm. This study documents the importance of these traditional quantities using current data and provides (aggregate) tables so that actuaries may quantitatively assess their importance. Moreover, select and ultimate termination tables are provided to illustrate their combined effect.

For the middle working years, ages 25-55, we find female termination probabilities are higher than those for males, although the differences are smaller than has been true historically. The differences are insignificant for the younger working years or early service years. Moreover, for ages 55 and older, males have higher retirement probabilities than females.

We also document the effect of several plan characteristics: eligibility for postretirement health benefits, benefit formula, industry, plan size, hourly/salary, union status and "prior" information. To assess the effects of plan characteristics while controlling for age, service and gender, we use multinomial logit analysis, a regression methodology suitable for categorical outcomes. We find that small plans have slightly higher termination probabilities compared to medium and large plans (plan size is our proxy for employer size). Union hourly plans have lower termination probabilities than salaried plans; in turn, salaried plans have lower termination probabilities than nonunion hourly plans.

This study documents the methodology and the results development in this analysis of recent turnover experience. For a shorter introduction that emphasizes potential applications, see the companion document by the Non-Mortality Decrements Task Force (2003) entitled, "2003 SOA Pension Plan Turnover Study (SOA03): Summary and Practical Guidelines."

Table of Contents

Section 1. Introduction

Employee turnover is of general interest to employers because of the costs associated with hiring, screening and training new (replacement) employees. Governments and public policymakers are interested in turnover because workers contribute to the tax payrolls and nonworkers often require resources through public assistance programs to become reconnected with the workforce. Employee termination and retirement affect the finances of employee benefit plans and thus are of concern to actuaries. Specifically, models for determining contribution levels for, and valuation of, defined benefit plans rely on information about employee turnover (see, for example, Bowers et al 1997, *Actuarial Mathematics*, for an introduction).

By "employee turnover," we mean some type of employee exit from an employment arrangement, and hence a pension plan. In this study, the sources of turnover are:

- termination
- retirement
- disability
- death
- other.

The "other" category consists of transfers. Termination includes situations in which the employment relationship between an individual and employer is ended, or terminated, by either party. It includes vested as well as nonvested termination (here, vesting refers to acquiring rights to pension plan benefits). It also includes voluntary (quits) as well as nonvoluntary (dismissals, layoffs, plant closures and so forth) terminations.

The purpose of this study is to summarize recent turnover experience in a form that pension actuaries may use in pension plan valuations and contribution studies. Tables that are currently used in practice include the classic "Sarason T-tables" (Crocker et al 1955, see Section 2.1) as well as the Vaughn (1992) tables (see Section 2.2). In Canada, the Ontario medium tables are sometimes used (Coward et al 1961).

Our overall results indicate that about 8.8 percent of employees terminate employment in a given year. However, it is well known in traditional actuarial practice, as well as in management and labor economics literature, that there are many determinants that influence turnover. Because of traditional practice, we focus on the well-known determinants: age, service and gender. Age is a proxy for attachment to the workforce and service is a measure of attachment to a firm; as each variable increases, termination tends to decrease. Historically, the role of women in the workforce differed substantially from that of men. The gap is delineated in our analysis in Section 3.2 and further discussed in Section 5.

We are also able to comment on the effects of unionization, firm size and industry (see Section 4). These variables are well-known in the economics literature to be important determinants of turnover. See, for example, Rebitzer (1986) and Valletta (1999).

Further, we demonstrate the importance of employee benefit program features such as the pension plan benefit formula and the availability of postretirement health care benefits. We show in Section 4 that firms that offer richer benefits enjoy lower turnover.

The Society of Actuaries' Non-Mortality Decrement Task Force collected the data for this report. Thirty-two contributors provided more than 1.7 million life years of pension plan turnover data for years 1994-2000 for 112 plans. A prior report, Gilmore and Frees (2003), documented the assembly and verification procedures used in collecting the data. This study is a follow-up to an earlier effort reported in Kopp (1997).

Section 2 begins by summarizing some important features of the data in the traditional format of aggregate and select turnover tables. No models are introduced in this section; the data are summarized using traditional smoothing methods. As will be evident from the graphical displays, age and service are important determinants of turnover.

Section 3 introduces our multinomial logit analysis models of turnover. Multinomial logit is an extension of (ordinary) linear regression modeling that allows for discrete (non-Gaussian) outcomes. The models are needed in order to provide a credible basis for deciding whether or not a variable is an important determinant of turnover. We introduce the multinomial logit model in Section 3.1, establish the importance of gender in Section 3.2 and discuss relationships among plan variables in Sections 3.3 and 3.4.

Section 4 establishes the importance of six plan characteristics: eligibility for postretirement health benefits, benefit formula, industry, plan size, hourly/salary and union status, as well as "prior" information. Many actuaries will wish to use the basic tables presented in Section 2 or the parameterized versions in Section 3. However, oftentimes an actuary has knowledge about a plan and may wish to modify the basic valuation table to incorporate this knowledge. Section 4 summarizes the appropriate modifications for six important variables.

Actuarial practice and economics literature also suggest several variables that may influence turnover that were not considered in this study. These are discussed in Section 5. Here, we also briefly summarize the changing role of women in the labor force.

Section 6 closes with a summary and some concluding remarks.

The appendices contain details on additional analyses and explanations of the multinomial logit methodology. Moreover, one portion (Appendix E) provides detailed illustrations that demonstrate how to go from the multinomial logit formula to aggregate and select-and-ultimate tables that actuaries may use in routine practice.

Section 2. Basic Aggregate and Select Tables

The unit of analysis is an individual's experience within a year. Specifically, the major end-of-the-year statuses are: active (or "continuation"), retired, disabled, dead and terminated. There is also an "other" category that consists of transfers.

Section 2.1. Aggregate Tables

To introduce the data, this section presents basic aggregate tables. Here, the aggregate Table 2.1 provides the estimated probability of turnover by age (without including the service aspect). Age is taken to be age nearest birthday at the beginning of the plan year. The first step in estimating probabilities is to compute the number attaining the end-of-year status divided by the number of records beginning the year in each category (given as "Total Life Years" in Table 2.1). For those that entered employment during the plan year (new hires), the exposure amount is adjusted for the relevant service time. Further, we used Whittaker-Henderson Type B graduation to smooth disabled, other, death and termination estimated probabilities. Retirement was not smoothed and the active, or continuance, estimated probability is determined as the residual (to ensure that estimated probabilities add up to one). The Whittaker-Henderson Type B graduation method was selected because it is the same method used in another standard pension valuation table, the RP-2000 mortality table. For handling the early and latter parts of each series, the techniques described in Miller (1949, 36) were used. Alternative smoothing methods using multinomial logit modeling are described beginning in Section 3.

Table 2.1. Aggregate Turnover by Age, Smoothed and Weighted

Age Nearest Birthday	Total Life Years	Estimated Turnover Probabilities, in Percent					
		Active	Retired	Disabled	Other	Death	Termination
18	574	64.28	0.00	0.00	0.00	0.00	35.72
19	1,630	80.03	0.00	0.00	0.27	0.00	19.71
20	4,581	82.34	0.00	0.00	0.19	0.00	17.46
21	11,494	78.53	0.00	0.00	0.23	0.01	21.23
22	19,167	77.45	0.00	0.00	0.29	0.02	22.25
23	24,487	77.79	0.00	0.01	0.36	0.02	21.82
24	30,178	79.37	0.00	0.01	0.41	0.02	20.19
25	35,486	81.01	0.00	0.02	0.45	0.02	18.51
26	39,638	82.49	0.00	0.03	0.47	0.02	16.99
27	43,077	83.93	0.00	0.04	0.49	0.02	15.53
28	46,284	85.31	0.00	0.04	0.48	0.02	14.15
29	48,744	86.45	0.00	0.05	0.47	0.02	13.02
30	50,829	87.29	0.00	0.05	0.44	0.03	12.19
31	53,502	88.07	0.00	0.05	0.41	0.02	11.44
32	57,144	88.84	0.00	0.06	0.37	0.03	10.70
33	60,512	89.65	0.00	0.06	0.34	0.03	9.91
34	63,184	90.34	0.00	0.07	0.31	0.03	9.25
35	65,421	90.84	0.00	0.07	0.29	0.03	8.78
36	66,760	91.23	0.00	0.07	0.29	0.04	8.37
37	67,082	91.59	0.00	0.06	0.31	0.04	8.00

Table 2.1. Aggregate Turnover by Age, Smoothed and Weighted							
Age Nearest Birthday	Total Life Years	Estimated Turnover Probabilities, in Percent					
		Active	Retired	Disabled	Other	Death	Termination
38	66,642	91.99	0.00	0.06	0.32	0.05	7.58
39	65,794	92.31	0.00	0.07	0.33	0.06	7.23
40	64,396	92.51	0.00	0.09	0.34	0.06	7.00
41	62,816	92.78	0.00	0.10	0.35	0.06	6.72
42	60,031	92.97	0.00	0.09	0.34	0.06	6.54
43	57,132	93.08	0.00	0.09	0.34	0.06	6.43
44	54,333	93.16	0.00	0.11	0.32	0.07	6.33
45	51,806	93.29	0.00	0.12	0.31	0.08	6.21
46	48,223	93.39	0.00	0.11	0.31	0.09	6.10
47	45,537	93.51	0.00	0.12	0.29	0.10	5.98
48	43,752	93.55	0.00	0.14	0.28	0.12	5.92
49	40,812	93.49	0.09	0.15	0.28	0.13	5.85
50	37,755	93.13	0.68	0.15	0.29	0.13	5.63
51	34,435	93.33	0.61	0.15	0.30	0.12	5.48
52	31,567	93.32	0.72	0.15	0.32	0.14	5.35
53	28,642	93.30	0.89	0.21	0.32	0.17	5.10
54	26,203	92.20	2.75	0.22	0.31	0.19	4.32
55	24,177	89.80	6.50	0.25	0.30	0.22	2.92
56	21,708	91.12	5.81	0.29	0.29	0.25	2.25
57	19,570	90.70	6.38	0.32	0.28	0.26	2.06
58	17,523	90.37	6.61	0.35	0.28	0.27	2.12
59	15,718	88.06	8.71	0.41	0.29	0.26	2.27
60	13,791	85.51	11.20	0.48	0.30	0.31	2.20
61	11,895	81.58	14.89	0.55	0.31	0.32	2.33
62	9,428	75.51	20.72	0.57	0.29	0.36	2.56
63	7,008	80.34	15.98	0.53	0.23	0.42	2.50
64	5,665	73.08	23.25	0.39	0.21	0.45	2.62
65	4,112	61.08	35.20	0.25	0.22	0.43	2.82
66	2,516	74.78	21.38	0.19	0.26	0.45	2.94
67	1,909	79.44	16.84	0.08	0.28	0.51	2.85
68	1,560	76.50	19.68	0.02	0.30	0.56	2.94
69	1,218	72.49	23.19	0.04	0.29	0.50	3.50
70	864	74.02	21.13	0.01	0.26	0.55	4.03
Total	1,768,312	89.63	1.08	0.11	0.34	0.08	8.76

Figures 2.1a and 2.1b graphically portray the estimated turnover probabilities. Figure 2.1a shows termination and retirement, the two decrements of key interest to us. Recall that estimated termination probabilities have been smoothed via Whittaker-Henderson Type B graduation, whereas estimated retirement probabilities have not been smoothed. Figure 2.1b shows death, disability and "other" estimated turnover probabilities. Note that the vertical scale of this figure is much smaller than that of Figure 2.1a, indicating that probabilities of turnover from these sources are much lower when compared to termination and retirement.

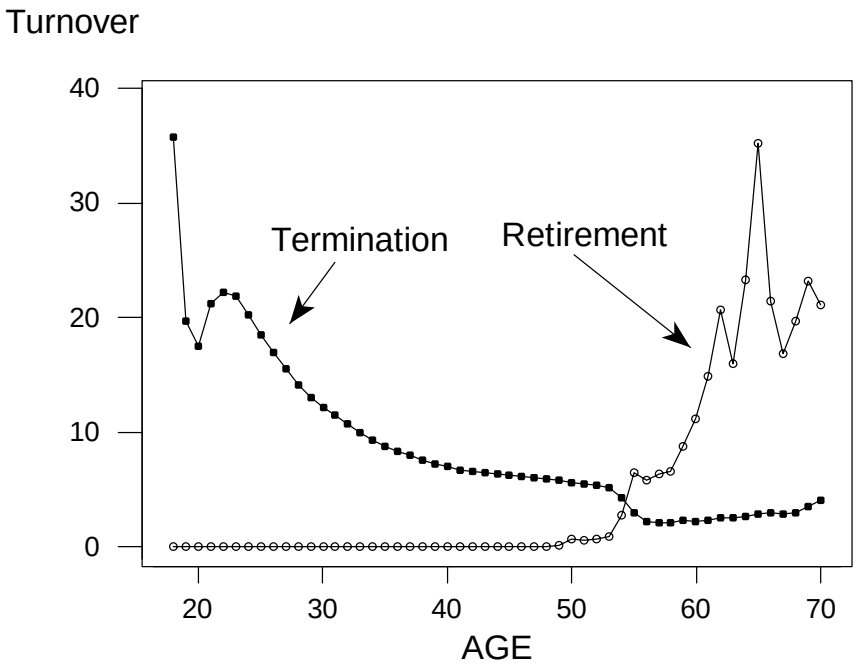

Figure 2.1a. Aggregate Turnover – Termination and Retirement. Termination estimated probabilities are smoothed via Whittaker-Henderson Type B, whereas retirement estimated probabilities are unsmoothed. Estimated probabilities are in percent.

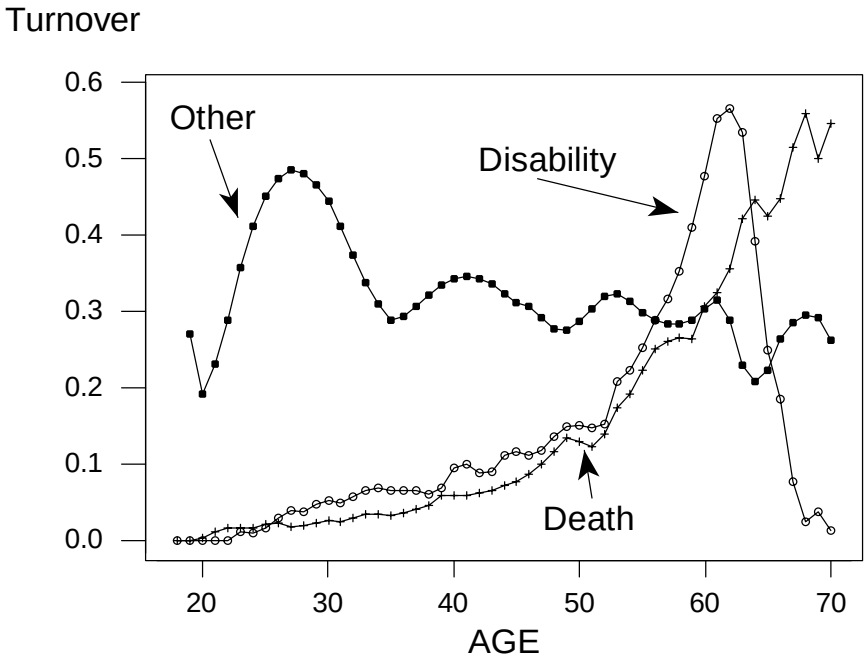

Figure 2.1b. Aggregate Turnover – Death, Disability and Other. All estimated probabilities are smoothed. The vertical scale indicates that probabilities of turnover from these sources are much smaller than retirement and termination, given in Figure 2.1a. Estimated probabilities are in percent.

Retirement probabilities were not smoothed because one anticipates retirement patterns by age to be discontinuous. More people elect to retire at ages such as 60, 62 and 65 than neighboring ages. These are ages when it is socially acceptable to bow out of the workforce. At these ages, social insurance benefits become available for some people, thus decreasing the need to work. Further, benefit and eligibility provisions of a specific plan often encourage retirement at a specific age, also leading to discontinuities. However, it is important to note that the retirement probabilities in Table 2.1 are based on an aggregation of data from several plans. Section 5 discusses this point further, noting that benefit and eligibility provisions may cause a plan's experience to differ materially from our aggregate results.

Figure 2.1c compares the aggregate termination from Table 2.1 to the classic "T-tables" taken from (Crocker, Sarason and Straight, 1955). As seen in Figure 2.2 and noted earlier by (Vaughn 1992), the shape of aggregate termination is convex (over ages 23-50), compared to the concave shapes of the T-curves.

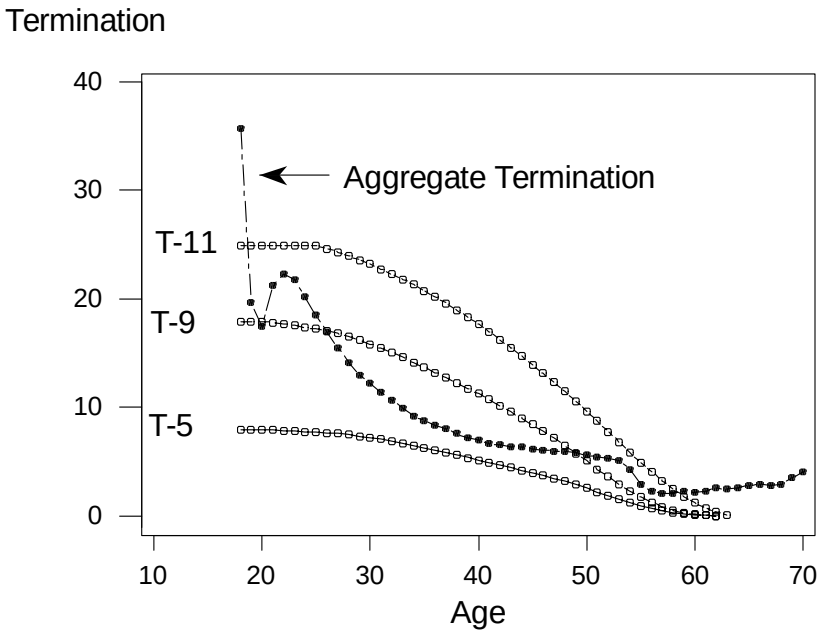

Figure 2.1c. Comparison of Aggregate Turnover to T-Tables. The solid circles represent the smoothed estimated termination probabilities from this study. Reading from lowest to highest, the plotting symbols represent T-5, T-9 and T-11 termination rates.

Section 2.2. Select and Ultimate Tables

Table 2.2 shows select termination estimated probabilities. Service is defined to be the number of completed years of service at the beginning of the plan year. Here and elsewhere we grouped service into four categories: less than 2 (new hires, 0 and 1 year of completed service), 2-4 years of service, 5-9 and 10 and over. In addition to our analysis of the data, we made the groupings because of common pension vesting rules. It is common in Canada to fully vest plan participants after two years, whereas in the United States five years is a more common standard. For virtually all plans that we considered, plan participants are fully vested by 10 years.

Table 2.2. Select Termination by Age, Smoothed and Weighted

	Life Years					Estimated Termination Probabilities, in Percent				
Age Nearest Birthday	Service < 2	Service = 2, 3, 4	Service = 5-9	Service ≥ 10	Total	Service < 2	Service = 2, 3, 4	Service = 5-9	Service ≥ 10	Overall
18	552	22	0	0	574	39.64				35.72
19	1,521	109	0	0	1,630	20.23				19.71
20	3,962	617	2	0	4,581	17.99	14.19			17.46
21	8,001	3,468	25	0	11,494	22.38	18.19			21.23
22	11,144	7,857	166	0	19,167	24.07	19.60	15.00		22.25
23	13,142	10,766	579	0	24,487	23.85	19.58	15.09		21.82
24	14,735	13,305	2,138	0	30,178	22.70	18.32	14.25		20.19
25	14,679	16,119	4,686	2	35,486	21.74	17.14	12.96		18.51
26	14,206	17,942	7,473	17	39,638	20.95	16.27	11.29		16.99
27	13,320	18,837	10,784	136	43,077	20.41	15.29	9.97		15.53
28	12,815	18,444	14,604	421	46,284	19.42	14.52	9.15	8.75	14.15
29	11,973	17,688	17,483	1,600	48,744	18.73	13.93	8.69	5.21	13.02
30	11,289	16,642	19,456	3,442	50,829	18.61	13.58	8.39	4.84	12.19
31	10,804	15,994	21,026	5,678	53,502	18.83	13.09	8.02	5.39	11.44
32	10,640	15,684	22,161	8,659	57,144	18.32	12.60	7.76	5.47	10.70
33	10,422	15,455	22,237	12,398	60,512	17.39	11.97	7.56	5.30	9.91
34	9,894	15,073	22,117	16,100	63,184	16.94	11.33	7.37	5.15	9.25
35	9,617	14,505	21,650	19,649	65,421	16.78	11.02	7.15	5.02	8.78
36	9,084	13,934	20,859	22,883	66,760	16.69	10.98	6.85	4.87	8.37
37	8,518	13,381	19,798	25,385	67,082	16.29	10.99	6.68	4.68	8.00
38	8,002	12,502	18,957	27,181	66,642	16.00	10.77	6.44	4.43	7.58
39	7,551	11,586	18,005	28,652	65,794	15.36	10.59	6.27	4.32	7.23
40	7,233	10,789	16,949	29,425	64,396	15.91	10.35	6.01	4.15	7.00
41	6,803	10,254	15,976	29,783	62,816	15.94	10.01	5.89	3.93	6.72
42	6,166	9,527	14,817	29,521	60,031	16.05	9.72	5.84	3.86	6.54
43	5,866	8,739	13,582	28,945	57,132	15.98	9.71	5.75	3.81	6.43
44	5,427	8,058	12,803	28,045	54,333	15.88	9.62	5.77	3.79	6.33
45	5,083	7,634	12,015	27,074	51,806	15.48	9.47	5.82	3.73	6.21
46	4,453	6,964	11,086	25,720	48,223	15.61	9.54	5.81	3.64	6.10
47	4,190	6,290	10,321	24,736	45,537	15.30	9.47	5.61	3.66	5.98
48	4,026	5,880	9,791	24,055	43,752	15.15	9.37	5.52	3.70	5.92
49	3,689	5,334	8,969	22,820	40,812	15.53	9.02	5.60	3.65	5.85
50	3,223	4,984	8,047	21,501	37,755	15.60	8.90	5.32	3.49	5.63
51	2,743	4,470	7,275	19,947	34,435	15.35	9.32	5.13	3.38	5.48
52	2,612	3,835	6,739	18,381	31,567	14.35	9.52	4.99	3.35	5.35
53	2,249	3,359	5,947	17,087	28,642	14.34	9.24	4.70	3.22	5.10
54	1,870	2,996	5,280	16,057	26,203	14.17	8.80	4.12	2.37	4.32
55	1,773	2,732	4,712	14,960	24,177	13.52	7.82	2.59	0.88	2.92
56	1,592	2,360	4,220	13,536	21,708	12.84	7.49	1.84	0.23	2.25
57	1,360	2,069	3,717	12,424	19,570	12.66	7.67	1.54	0.11	2.06
58	1,208	1,863	3,199	11,253	17,523	12.74	7.68	1.58	0.22	2.12
59	1,059	1,625	2,846	10,188	15,718	13.50	7.94	1.92	0.31	2.27
60	884	1,427	2,454	9,026	13,791	13.63	7.84	2.12	0.20	2.20
Totals	292,355	386,156	454,511	635,290	1,722,137	18.52	12.60	6.78	3.59	*8.76

**The overall termination rate is 8.76 for all ages, as reported in Table 2.1. For ages 18-60, the overall termination rate is 8.83 percent.*

Probabilities in Table 2.2 were estimated as in Table 2.1. Each service category was individually smoothed so that there remain some small anomalies at the beginning and the end of the data. Note that the "overall" termination rate in Table 2.2 was taken from Table 2.1. An alternative approach would be to use a weighted average of select rates, with weights as the number of life years.

Figure 2.2a emphasizes some of the inconsistencies that arise at the younger ages due to the graduation method (the corresponding raw rates are in Table A.3 in Appendix A). Rather than over-smooth these minor features, we present here the series with the exposures and allow the reader to use this part of the data as they see fit. Many plans did not provide data for the teen years and thus the experience is relatively small for these age groups. The feature of the select rates, that termination becomes lower with increased years of service, is amply displayed in Figure 2.2a.

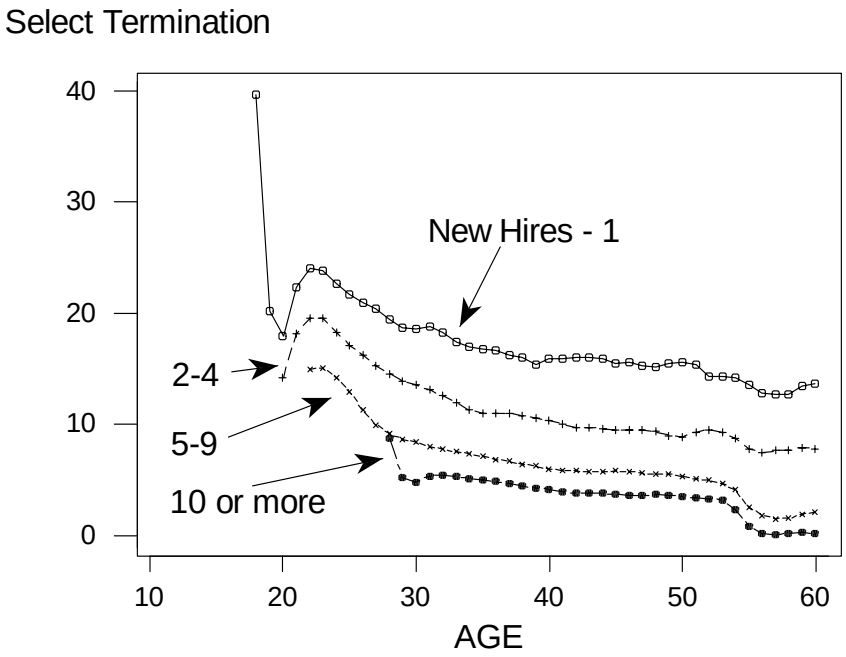

Figure 2.2a. Select Termination. Reading from highest to lowest at age 30, the plotting symbols represent estimated termination probabilities for those with service less than 2, 2-4, 5-9 and 10 or more, respectively. All estimated probabilities have been smoothed.

Figure 2.2b compares the select termination rates to those from the Vaughn (1992) study. This figure shows termination rates for those with one, two and four or more years of service, labeled as "YoS -1", "YoS – 2" and "YoS – 4 or more," respectively. For each select group, the Vaughn study shows termination probabilities declining more rapidly with age than the current study.

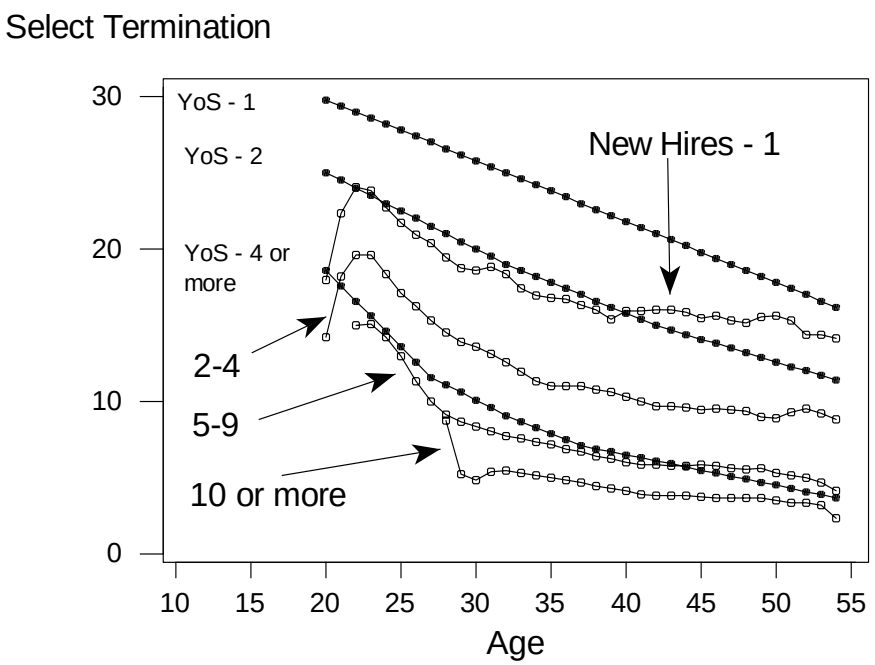

Figure 2.2b. Comparison of Select Turnover to Vaughn Tables. The solid circles represent select rates from the Vaughn Tables; the open plotting circles are from this study. "YoS" means years of service. Rates for ages 20-54, inclusive, are plotted.

An alternative method of incorporating service is to use it as the main indexing variable, in lieu of (attained) age. For example, Figure A.1 in Appendix A shows the relationship between service and termination and retirement. As we will see, age is an important predictor of retirement, although service is not. However, if one is only interested in predicting termination, we demonstrate in Appendix F that service is an excellent predictor. We also demonstrate in Appendix F that the traditional select and ultimate tables provide the best combination of age and service for predicting termination. Thus, we continue to use this combination throughout the paper.

Section 3. Models of Turnover

Section 3.1. Multinomial Logit Analysis of Age and Service

This section shows how to fit a multinomial logit model to two important predictor variables, age and service. A multinomial logit model is a nonlinear regression model that allows for categorical responses. In our case, the response is 1 if the individual retires, 2 for termination and 3 for any other response (active, death, disability and other). Like ordinary (linear) regression models, the idea is to fit a parametric model to the data. This parametric model has three important features:

- It allows us to summarize the data with knowledge of only a few parameters and thus provides an alternative to Whittaker-Henderson Type B for smoothing the data.
- It allows us to incorporate additional explanatory variables and provides some well-accepted rules for deciding when an additional variable is important.
- We use the multinomial logit model to identify whether or not a variable is an important determinant of either retirement or termination.

A more detailed outline of the multinomial logit model methodology is in Appendix B. Throughout, model parameters are estimated using maximum likelihood. This is a standard feature of statistical software packages that feature multinomial logit model routines.

This multinomial model was estimated using age as a continuous variable and service as a categorical variable with four components: (1) new hire to 1 year, (2) 2-4 years, (3) 5-9 years and (4) 10 or more years of service. Table 3.1 summarizes the point estimates of the 16 parameters of the model that includes age and service. Table 3.1 also includes the four parameter estimates of the aggregate model that are based on age (but not service). To interpret these systematic components, one could use the odds ratio interpretation summarized in Appendix B. For this application, equations 3.1 and 3.2 are used to predict the probability of retirement and termination, respectively.

Table 3.1. Estimated Systematic Components.

Service	Sample Size	$V_{i,\text{Retirement}}$	$V_{i,\text{Termination}}$
New Hire – 1	292,355	-18.9022 + 0.2576*Age	-0.8747- 0.0196*Age
2-4	386,153	-19.4350 + 0.2627*Age	-0.9377- 0.0290*Age
5-9	454,511	-18.7496 + 0.2674*Age	-1.3021- 0.0350*Age
10 or more	635,290	-17.8444 + 0.2660*Age	-0.9905 - 0.0532*Age
Aggregate	1,768,309	-18.5993 + 0.2643*Age	-1.0399 - 0.0356*Age

$$\text{Prob}(y_i = \text{Retirement}) = \frac{\exp(V_{i,\text{Retirement}})}{1+\exp(V_{i,\text{Retirement}})+\exp(V_{i,\text{Termination}})} \tag{3.1}$$

$$\text{Prob}(y_i = \text{Termination}) = \frac{\exp(V_{i,\text{Termination}})}{1+\exp(V_{i,\text{Retirement}})+\exp(V_{i,\text{Termination}})} \tag{3.2}$$

The coefficients associated with age for different service categories reinforce our basic intuition about retirement systems. As anticipated, we see little variation for the retirement systematic components associated with age (ranging from 0.2576 to 0.2674). In contrast, there is substantial variation for the corresponding termination systematic components (ranging from 0.0196 to 0.0532). Thus, as anticipated, we focus on termination select probabilities that depend on service in contrast to retirement probabilities, where the focus is on aggregate rates that do not depend on service.

To interpret the fit, in subsequent sections we will use the goodness of fit statistic, minus twice the log-likelihood statistic. That turns out to be:

$$-2 \text{ Log Likelihood} = 1{,}092{,}715.8.$$

The smaller this number, the better is the fit. As another device for assessing the fit, we can compare the fitted probabilities under the multinomial logit model to our nonparametric estimates from Section 2, as follows.

Figure 3.1a compares aggregate turnover probabilities computed using the multinomial logit model with those from Section 2. In Figure 3.1a, the smoothed lines are from the multinomial logit model. These are computed using equations (3.1) and (3.2) for each individual and then averaging over our entire sample. One sees striking differences for retirement. This is because in Section 2 we did not smooth retirement rates, whereas the rates are very smooth using the parametric multinomial model. For termination, the two methods are comparable. We have not included a sufficient number of parameters in the multinomial formula to capture differences in the parts of the series corresponding to the young ages and to the mid-50s.

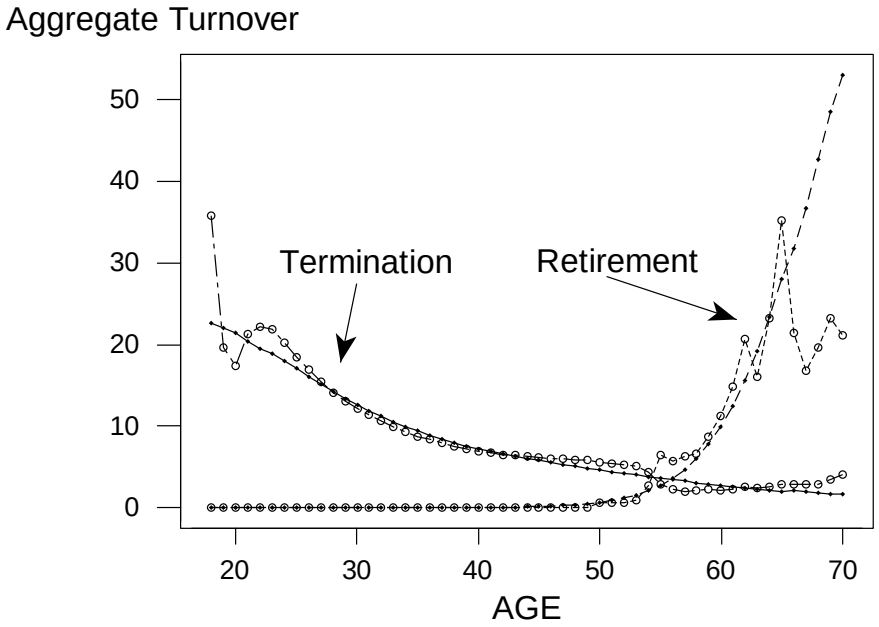

Figure 3.1a. Aggregate Turnover Rates - Comparison of Section 2 Empirical Rates to Multinomial Logit Fits. The two smooth lines represent predictions from the multinomial logit model. The jagged lines are from Figure 2.1a.

Figure 3.1b provides a comparison among select termination rates. As with Figure 3.1a, this figure demonstrates a good fit based on the agreement between the multinomial logit probabilities and the empirical probabilities derived using Whittaker Henderson Type B smoothing. An advantage of the multinomial logit probabilities is that the corresponding curves can be derived knowing only the 16 estimated parameters given in Table 3.1.

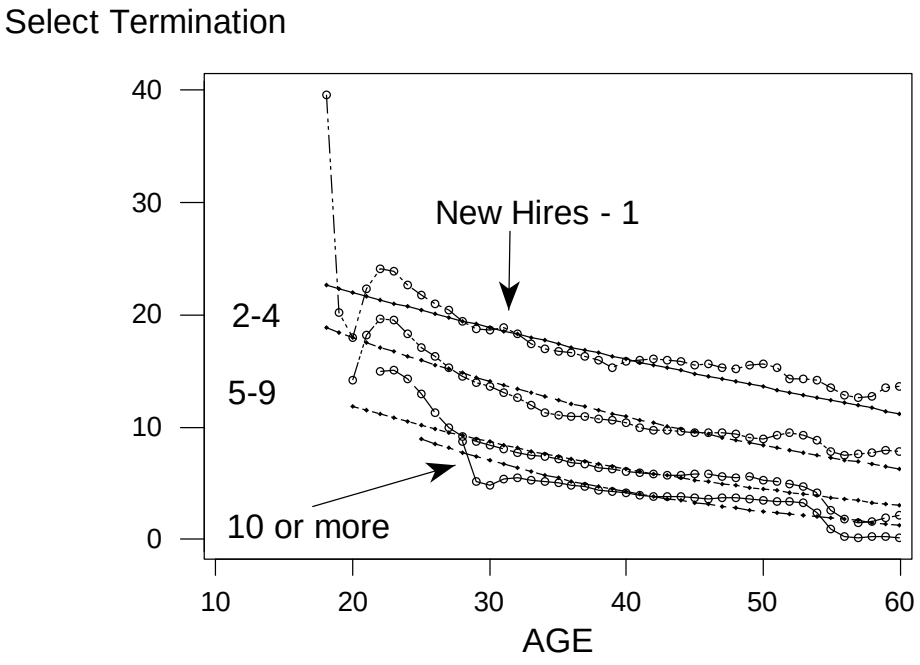

Figure 3.1b. Select Termination Rates - Comparison of Graduated Empirical Rates to Multinomial Fits. The four smooth lines represent predictions from the multinomial logit model. The jagged lines are from Figure 2.2a.

In summary, we find that service is not an important predictor of retirement; for retirement, age is more important than service. For termination probabilities, both age and service are important predictors. For service, there are large discontinuities when moving from (1) the new hire to one year of service category to (2) the 2-4 years of service to the (3) 5-9 years of service categories. There is less of a distinction between the 5-9 and the 10 or more categories; thus, many plan valuations could use a category such as "five or more years of service" as the "ultimate" portion of their termination tables. (Note that the Vaughn tables used four or more for their ultimate portion.)

Section 3.2. Analysis by Gender

In Phase I of this study, we identified many characteristics of an individual and plan that are potentially important determinants of turnover. In this section, we focus on gender and address the question, "How important is knowledge of gender in predicting turnover, given information about age and service?" We will demonstrate that gender is important, although it will turn out to be less important than other variables to be considered in Section 3.3.

We focus on gender because it is not uncommon in actuarial studies of rates to produce sex-distinct tables. By focusing on a single variable of interest, we will be able to demonstrate the reasoning underlying our assessment of a variable's importance.

To begin, we produce empirical fits of the data using the method described in Section 2 on a sex-distinct basis. Table 3.2 and Figure 3.2a show estimated aggregate turnover probabilities. From Table 3.2 and Figure 3.2a, we see that retirement probabilities between genders are roughly similar. At each age, retirement probabilities for males are slightly higher. (The largest difference is 8.6 percent at age 65.) Interestingly, because of the larger concentration of men at the younger ages relative to the older ages, the average retirement probability for men is slightly smaller than for women. (This average was computed using ages 49-70, inclusive.) For producing these empirical fits, we do not consider the 15,793 observations where gender was recorded as either unisex or missing.

Table 3.2 and Figure 3.2a also show the pattern of aggregate termination probabilities by age. For ages 20-54 inclusive, women have higher termination probabilities than men. For other ages, the reverse is true. Except through age 21, where there is relatively little exposure, the largest difference is 1.71 percent at age 52.

Table 3.2. Aggregate Turnover by Age and Gender

	Female			Male		
		Estimated Turnover Probabilities, in Percent			Estimated Turnover Probabilities, in Percent	
Age Nearest Birthday	Total Life Years	Retired	Termination	Total Life Years	Retired	Termination
18	272	0.00	33.37	276	0.00	36.81
19	594	0.00	17.69	896	0.00	20.05
20	1,830	0.00	17.00	2,489	0.00	16.64
21	4,106	0.00	22.03	6,993	0.00	19.95
22	6,643	0.00	22.95	12,098	0.00	21.36
23	8,808	0.00	22.04	15,200	0.00	21.38
24	11,067	0.00	20.15	18,609	0.00	19.95
25	13,166	0.00	18.47	21,782	0.00	18.31
26	14,787	0.00	17.04	24,303	0.00	16.71
27	16,098	0.00	15.42	26,409	0.00	15.30
28	17,430	0.00	14.01	28,279	0.00	13.96
29	18,669	0.00	13.03	29,531	0.00	12.79
30	19,753	0.00	12.56	30,571	0.00	11.78
31	20,898	0.00	12.11	32,130	0.00	10.81

Table 3.2. Aggregate Turnover by Age and Gender						
	Female			Male		
Age Nearest Birthday	Total Life Years	Estimated Turnover Probabilities, in Percent		Total Life Years	Estimated Turnover Probabilities, in Percent	
		Retired	Termination		Retired	Termination
32	22,468	0.00	11.38	34,195	0.00	10.03
33	23,888	0.00	10.45	36,107	0.00	9.33
34	24,986	0.00	9.78	37,717	0.00	8.68
35	25,878	0.00	9.26	39,041	0.00	8.24
36	26,301	0.00	8.87	39,963	0.00	7.82
37	26,401	0.00	8.52	40,159	0.00	7.44
38	26,305	0.00	8.14	39,882	0.00	7.01
39	26,027	0.00	7.81	39,319	0.00	6.65
40	25,740	0.00	7.43	38,220	0.00	6.50
41	25,267	0.00	7.20	37,116	0.00	6.20
42	24,358	0.00	7.01	35,324	0.00	6.02
43	23,490	0.00	6.97	33,280	0.00	5.86
44	22,538	0.00	6.88	31,435	0.00	5.76
45	21,627	0.00	6.70	29,804	0.00	5.66
46	20,394	0.00	6.54	27,518	0.00	5.60
47	19,453	0.01	6.45	25,775	0.00	5.45
48	18,826	0.00	6.44	24,631	0.00	5.34
49	17,603	0.06	6.50	22,914	0.12	5.19
50	16,388	0.59	6.38	21,095	0.75	4.93
51	15,016	0.48	6.33	19,181	0.72	4.67
52	13,838	0.61	6.21	17,496	0.83	4.50
53	12,739	0.73	5.78	15,675	1.03	4.37
54	11,765	2.29	4.61	14,243	3.16	3.88
55	11,036	6.36	2.78	12,951	6.68	2.78
56	9,904	5.83	1.92	11,615	5.86	2.24
57	9,026	6.62	1.74	10,369	6.21	2.06
58	8,199	6.77	1.85	9,176	6.54	2.10
59	7,385	8.71	2.07	8,212	8.72	2.24
60	6,481	10.99	1.96	7,207	11.47	2.17
61	5,575	13.08	2.04	6,228	16.53	2.39
62	4,608	17.86	2.14	4,753	25.03	2.79
63	3,640	14.88	1.89	3,328	17.28	3.00
64	3,020	21.59	2.17	2,614	25.10	3.02
65	2,268	31.33	2.64	1,823	39.93	3.02
66	1,476	20.73	2.49	1,027	22.40	3.60
67	1,159	15.44	2.36	741	18.95	3.56
68	975	19.59	2.25	575	20.17	3.81
69	751	22.50	3.01	462	24.11	4.08
70	548	20.90	3.88	314	21.34	4.28
Total	721,468	*5.40	8.85	1,031,051	*5.34	8.45

** Average retirement estimated probability is based on ages 49-70, inclusive.*

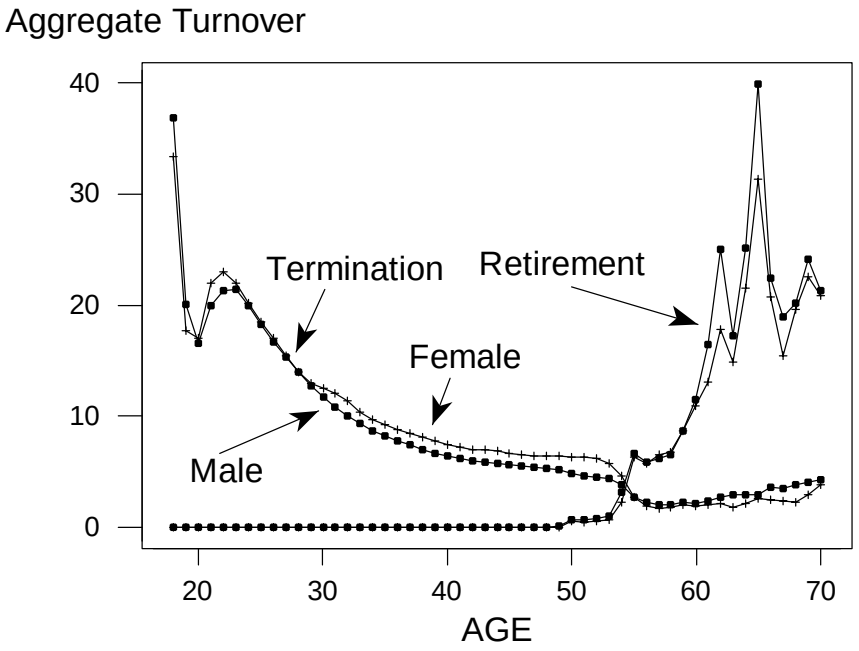

Figure 3.2a. Aggregate Turnover – Termination and Retirement by Gender. Estimated probabilities are in percent. Solid circles correspond to male, plus symbols correspond to females. Rates are estimated empirically and smoothed via Whittaker-Henderson Type B graduation formula.

Aggregate termination probabilities vary by gender. For ages 20-54 inclusive, women have a termination probability of 9.82 percent while men experience a probability of 8.94 percent (Table 3.2). The female probability for this 20-54 age group is 9.82 percent / 8.94 percent - 1 = 9.8 percent higher than for males. The experience by quinquennial age groups follows:

Age Group	Termination Probabilities		Excess Percent of Female Probabilities Over Male Probabilities
	Female	Male	
20-24	21.30%	20.50%	3.9%
25-29	15.36	15.21	1.0
30-34	11.17	10.04	11.1
35-39	8.51	7.43	14.5
40-44	7.11	6.09	16.7
45-49	6.55	5.46	19.6
50-54	5.93	4.52	31.2
20-54	9.82	8.94	9.8

For ages 55 and older, the termination probabilities are lower for women than for men.

Figure 3.2b shows select termination rates for females and males. The jagged lines with solid plotting circles are derived using Section 2 techniques—empirical probabilities that have been smoothed using the Whittaker-Henderson Type B graduation formula—based on sex-distinct data. In contrast, the multinomial logit model was estimated using gender-specific parameters, analogous to Table 3.1. Thus, there are 32 (= 16 × 2) parameters represented using the multinomial logit fit. The parameter estimates appear in Appendix C, Table C.1.

When we control for age and service, there is little difference in termination rates. As seen in Appendix C, Figure C.1, for the lower two service categories, new hires to 1 year of service and 2-4 years of service, there is little difference in male and female experience. There is a larger difference for the larger two service categories. Interestingly, for these two categories, the probabilities of termination for males are higher when compared to the estimated female probabilities. The differences are quite small, however.

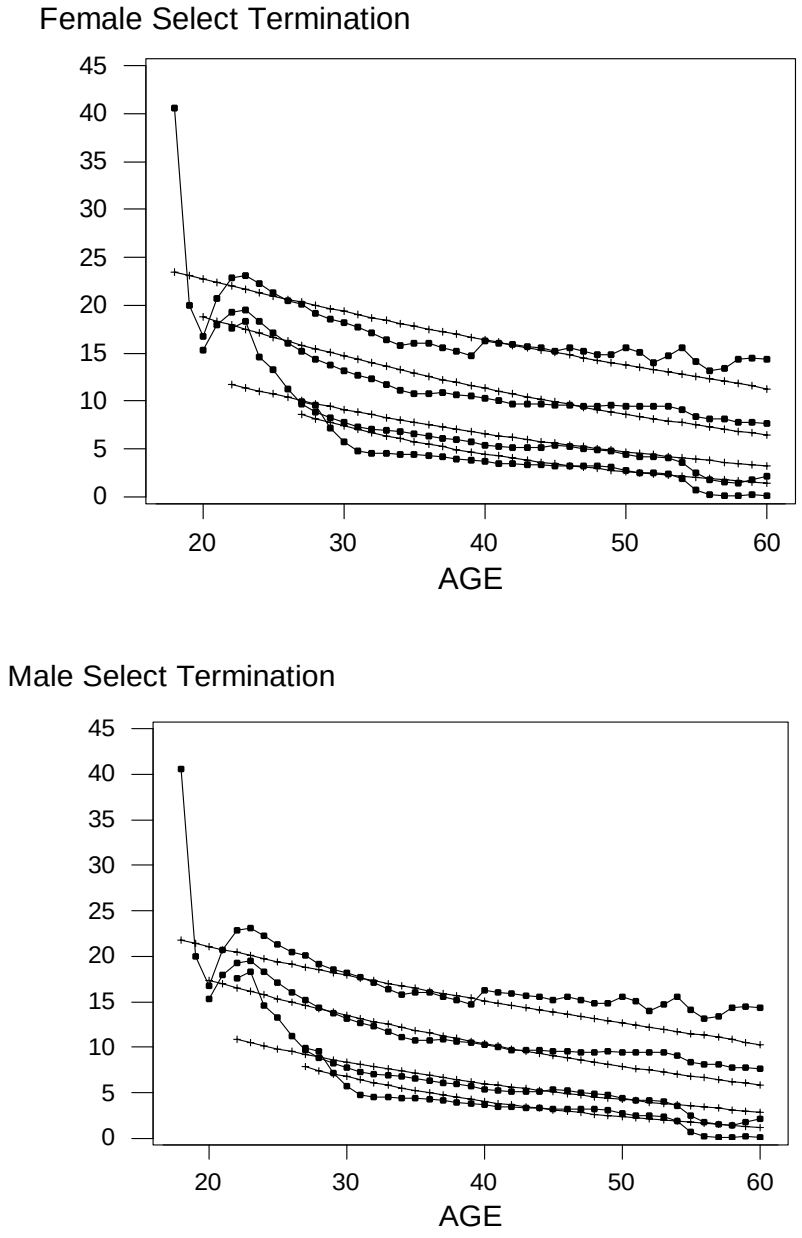

Figure 3.2b. Female and Male Select Termination for Four Service Categories. The smooth lines are from a multinomial logit fit, the jagged lines from an empirical fit with Whittaker-Henderson Type B smoothing. Estimated probabilities are in percent. The upper panel corresponds to females, the lower panel corresponds to males.

For an overall comparison of the usefulness of the gender variable, we use the log-likelihood statistic. The multinomial logit model with gender intercepts, minus twice the log-likelihood statistic turns out to be

$$-2 \text{ Log Likelihood} = 1{,}071{,}940.3.$$

Thus, when comparing it to the Section 3 model (based on data without unisex and missing sex), the difference is

$$LRT = 1{,}073{,}185.2 - 1{,}071{,}940.3 = 1{,}244.9.$$

Formally, this statistic, known as the likelihood ratio test (*LRT*) statistic, indicates that the gender variable is statistically significant. However, for large data sets such as this, it is generally accepted that many variables can be "statistically significant but practically unimportant." Thus, we will use this statistic in subsequent sections to help assess the importance of the gender variable when compared to alternative variables.

Section 3.3 First Regression Analysis Incorporating Individual and Plan Characteristics

In this section, we use multinomial logit analysis. Our interest is in producing tables of empirical fits where we partition the data into subgroups that behave differently. To identify the important variables, the strategy is to first fit smooth curves using a type of regression (multinomial logit) modeling. By fitting these parametric curves, we will be able to use standard statistical arguments to identify the important variables. Ultimately, the identification of these important variables will allow us to produce tables of empirical fits that can be readily used within the industry.

The individual level explanatory variables include age, service and gender. Age is treated as a continuous variable. Service is categorized, as described in Section 2.2. In Section 3.2, we argued for retaining gender as an important classification variable. To accommodate this variable, we omit the 15,793 records that were recorded as either unisex or missing because of the lack of data at this level. Of these omitted records, 15,465 were from one plan (approximately 20 percent of this plan's records). The remaining omitted records came from three other plans. The model fits such as likelihood statistics reported here differ slightly from those in Section 3.1 because we are now basing the analysis on 1,768,312 – 15,793 = 1,752,519 observations.

To identify the important variables, we use standard statistical practice. Specifically, we fit each model using maximum likelihood analysis and summarize the fit using the statistic minus twice the log-likelihood. Although this statistic is not as familiar as the standard coefficient of determination in linear regression analysis, it has the advantage that it can be immediately used for model selection. Specifically, we may compare two (nested) models using the likelihood ratio test (*LRT*) statistic. This statistic may be compared to a chi-square distribution with degrees of freedom equal to the difference in the number of parameters between the two models. When implementing this strategy, Table 3.3 also shows the proportional change to give us a sense of the size of change when compared to the number of parameters added.

For individual level variables, we use Model 7c as our "baseline." This model uses age as a continuous variable, service and gender as categorical variables, and allows for the interaction between age, service and gender. This is the multinomial version of the select and ultimate table presented in Section 3.2. Model 7c presents the multinomial logit analysis corresponding to sex-distinct tables by allowing each parameter to vary by gender.

Models 8-16 show the effect of adding each plan variable to model 7c. These plan variables were summarized in Section 5 of the Phase I report (Frees and Gilmore 2003) and identified by the Non-Mortality Decrement Task Force as potentially important. Based purely on the change in the log-likelihood statistic, it appears that industry (SIC), region, pay type and postretirement health are the most important variables. However, when standardized by the number of parameters added, nation, significant event and postretirement health become important.

The drawback of using industry and region is that there are a large number of possible outcomes for each variable. Thus, when experience is segregated by each of these variables, there will be insufficient experience in each bin upon which we can make reliable inferences.

Table 3.3 Summary of Several Model Fits

Model	Variables	Number of Parameters	-2 Log Likelihood*	Change (from Model 7c) in -2 Log Likelihood	Proportional Change (from Model 7c) in -2 Log Likelihood
1	Intercept only	2	1,227,222.0	-155,281.7	5,176.1
2	Age	4	1,107,613.2	-35,672.9	1,274.0
3	Service – continuous	4	1,139,758.2	-67,817.9	2,422.1
4	Service – categorical	8	1,152,385.3	-80,445.0	3,351.9
5	Age and Service, both continuous	6	1,075,780.7	-3,840.4	147.7
6	Age as continuous, Service as categorical	10	1,074,202.0	-2,261.7	102.8
7a	Age as continuous, Service as categorical, interaction terms	16	1,073,185.2	-1,244.9	77.8
7b	Model 7a plus gender	18	1,072,727.9	-787.6	56.3
7c	Model 7a plus gender, interaction terms	32	1,071,940.3	0.0	0.0
8	Model 7c plus organization	36	1,071,704.6	235.7	58.9
9	Model 7c plus pay type	38	1,066,575.4	5,364.9	894.2
10	Model 7c plus worker	38	1,070,677.6	1,262.7	210.4
11	Model 7c plus industry (SIC)	50	1,056,372.7	15,567.6	864.9
12	Model 7c plus nation	34	1,068,376.3	3,564.0	1,782.0
13	Model 7c plus region	42	1,056,692.5	15,247.8	1,524.8
14	Model 7c plus benefit formula	42	1,069,557.9	2,382.4	238.2
15	Model 7c plus postretirement health	38	1,066,790.9	5,149.4	858.2
16	Model 7c plus significant event	34	1,070,099.4	1,840.9	920.5

**smaller means a better fit*

The drawback of using postretirement health benefits is that a large number of plans fall into either the "not reported" or "not sure" categories. The drawback of using variables such as nation is that a large number of plans are concentrated in a single level of the variable. Specifically, most plans were from the United States. This makes these unlikely variables upon which we can base our turnover tables.

These models incorporate a **level** (additive) effect of the plan variables. The next step in the analysis is to incorporate plan characteristics into the model by adding interaction terms that allow for a **scale** (multiplicative) effect. However, the plan characteristics are related to one another. This relationship is explored in the following section.

Prior to introducing this additional model complexity, let us first review what we mean by a level and scale effect in this context. Consider model 7a and suppose we wish to add the variable gender. For model 7a, the estimated parameter values are given in Table 3.1. Now consider model 7b where we add a level effect for gender (only males versus females, omitting the unisex variable). This means that we add one parameter to the systematic component for both retirement and termination. The estimated parameters turn out to be 0.047 and -0.105, for termination and retirement, respectively. According to the discussion in Appendix B, we interpret the first parameter to mean that females are exp(0.047) = 1.048 times more likely to terminate employment than males. Similarly, males are 1/exp(-0.105) = 1.11 times more likely to retire than females.

Although straightforward, simply adding one parameter means that the proportional effect is the same for all ages and types of service. As an alternative, we introduce interaction terms that we say account for a scale effect. With this scale effect, there are now twice as many parameters, one set for males and another for females. This model is much more complex but provides a much better fit to the data and more closely reflects reality. Thus, for the model fitting in Section 4, we rely on graphical techniques to summarize important features of the data.

Section 3.4 Relationships among Plan Characteristics

In any regression analysis, one is always concerned with *collinearity*. Collinearity means that linear combinations of explanatory variables may potentially be related to one another. In our application, because plan-level variables take on the same value for all observations within a plan, there is a natural collinearity inherent in the data. This does not mean that we cannot estimate model parameters reliably. It does, however, mean that we do not have as many "degrees of freedom" as one would normally expect with a data set of over 1.7 million observations. Thus, caution is needed when introducing explanatory variables into the model because of potential problems of collinearity and of "empty cells." That is, it is not unusual for a combination of variables to uniquely identify a plan or for no plan to exist for a certain combination, hence the term "empty cell."

This statistical concern is corroborated by the Non-Mortality Decrement Task Force's desire that no model rely on one or a very limited number of plans. We would like to produce models based on data that average over the experience of several plans; in this way, we hope that the model that we produce is more robust and not dependent upon the experience of a single plan.

To quantify the relationships among plan variables, this section provides several (2×2) frequency tables. Thus, no model assumptions are required and immediate insights can be gained by examining the data closely. (Please bear in mind that the tables that we present are *not* weighted by the number of records available in a plan. Although this presentation would be more directly related to the regression analyses that we present, to do so may compromise the confidentiality of our contributors.)

Plan Characteristics by Industry

Tables 3.4a, 3.4b and 3.4c provide frequency tables using industry as one of the variables. The other variables are nation, organization type, eligibility for postretirement health benefits, benefit formula, plan pay type and plan workforce. These were the potentially important plan variables identified in Section 3.3.

The "empty cell" aspect is immediately evident in, for example, Table 3.4a. To illustrate, we could not use both "nation" and "industry" because, for our data, many industries are not represented in Canada.

Even using industry by itself is problematic because we have 10 categories. Thus, for example, if we were to use industry directly, then only three plans would contribute to the "mining, construction" category. To pursue industry further, one would need to combine industries in some meaningful way, such as "Mining and Manufacturing," "Services and Trade," "Financial, Personal and Professional Services" and "Tax Exempts and Others." Even with this classification, it would still be difficult to include nation because there are no Canadian plans in the "Financial, Personal and Professional Services" industries.

Table 3.4a. Plan Characteristics by Industry

SIC Classification	Nation		Organization Type			Totals
	US	Canada	Single-employer private plan	Multi-employer private plan	Public Sector plan	
1-Mining, Construction	2	1	2	1		3
2–Manufacturing I	16	1	17			17
3–Manufacturing 2	27	2	29			29
4–Services	10	2	12			12
5–Trade	3	2	4	1		5
6–Financial Services	12		12			12
7–Personal Services	5		5			5
8–Professional Services	17		16		1	17
9–Tax Exempts	6	1	4		3	7
Could not be easily classified	5		3	2		5
Totals	103	9	104	4	4	112

Table 3.4b. Plan Characteristics by Industry

SIC Classification	Eligible for Postretirement Health Benefits?				Benefit Formula			Totals
	More than 90%	Less than 10%	Other Mixture	Not Sure	Final Average Pay	Career Average Pay	Hybrid	
1-Mining, Construction				3	1		2	3
2–Manufacturing I	9	1	1	6	6	1	10	17
3–Manufacturing 2	3	8	2	16	9	3	17	29
4–Services	7	3		2	7		5	12
5–Trade		1	2	2	3	1	1	5
6–Financial Services	2	3	1	6	9		3	12
7–Personal Services	1	3		1	2	1	2	5
8–Professional Services		7	1	9	12	2	3	17
9–Tax Exempts		2		5	5		2	7
Could not be easily classified				5	2		3	5
Totals	22	28	7	55	56	8	48	112

Table 3.4c. Plan Characteristics by Industry									
	Plan Pay Type				Plan Workforce				
SIC Classification	More than 90% Hourly	More than 90% Salary	Other combination	Don't know	More than 90% Unionized	More than 90% Nonunion	Other mixture	Don't know	Totals
1-Mining, Construction	1	1		1	1	1		1	3
2–Manufacturing I	7	3	2	5	5	5	3	4	17
3–Manufacturing 2	9	3	5	12	9	12	1	7	29
4–Services	4	3	3	2	4	4	2	2	12
5–Trade	2	2	1		1	4			5
6–Financial Services	1	6	2	3	1	7	1	3	12
7–Personal Services	2	2		1	1	2	1	1	5
8–Professional Services		3	6	8		9		8	17
9–Tax Exempts	1	3		3	2	3		2	7
Could not be easily classified		2		3	2	2		1	5
Totals	27	28	19	38	26	49	8	29	112

Plan Characteristics by Region

Tables 3.4d, 3.4e and 3.4f provide frequency using region as one of the variables. The other variables are nation, organization type, eligibility for postretirement health benefits, benefit formula, plan pay type and plan workforce.

As with industry, using six regions partitions the data too finely. One possibility is to combine regions.

Table 3.4d. Plan Characteristics by Region				
	Organization Type			
SIC Classification	Single-employer private plan	Multi-employer private plan	Public Sector plan	Totals
US – Northeast	18			18
US – Midwest	38	1	3	42
US – South	14			14
US – West	5	1		6
US – Widely Dispersed or Unknown	21	2		23
Canada	8		1	9
Totals	104	4	4	112

Table 3.4e. Plan Characteristics by Region								
	Eligible for Postretirement Health Benefits?				Benefit Formula			
SIC Classification	More than 90%	Less than 10%	Other Mixture	Not Sure	Final Average Pay	Career Average Pay	Hybrid	Totals
US – Northeast	1	4	1	12	9	1	8	18
US – Midwest	5	11	1	25	24	3	15	42
US – South	1	5	1	7	7	1	6	14
US – West	2	1	1	2	2		4	6
US – Widely Dispersed or Unknown	9	6	2	6	10	2	11	23
Canada	4	1	1	3	4	1	4	9
Totals	22	28	7	55	56	8	48	112

Table 3.4f. Plan Characteristics by Region									
	Plan Pay Type				Plan Workforce				
SIC Classification	More than 90% Hourly	More than 90% Salary	Other combination	Don't know	More than 90% Unionized	More than 90% Nonunion	Other mixture	Don't know	Totals
US – Northeast	1	5	3	9	2	9		7	18
US – Midwest	9	10	6	17	12	17	2	11	42
US – South	5	1	2	6	1	6		7	14
US – West	2	1	1	2	1	2		3	6
US – Widely Dispersed or Unknown	6	7	6	4	5	12	5	1	23
Canada	4	4	1		5	3	1		9
Totals	27	28	19	38	26	49	8	29	112

Plan Characteristics by Workforce and Pay Type

Table 3.4g shows that there is a strong relationship, as expected, between union status and pay type status.

Table 3.4g. Plan Characteristics by Workforce and Pay Type

	Plan Pay Type				
Plan Workforce	More than 90% Hourly	More than 90% Salary	Other combination	Don't know	**Totals**
More than 90% Unionized	17	1		8	26
More than 90% Nonunion	3	27	13	6	49
Other mixture	3		5		8
Don't know	4		1	24	29
Totals	27	28	19	38	112

Plan Characteristics by Eligibility for Postretirement Health Benefits

Table 3.4h shows that a large number of plans fell into the "not sure" category for postretirement health benefits, making this an unlikely variable upon which to base turnover tables.

Table 3.4h. Plan Characteristics by Postretirement Health Benefits

Eligible for Postretirement Health Benefits?	**Nation**		**Totals**
	US	Canada	
More than 90%	18	4	22
Less than 10%	27	1	28
Other Mixture	6	1	7
Not Sure	52	3	55
Totals	103	9	112

Section 4. Analysis by Plan Characteristic

In this section, we analyze experience by each of several important plan characteristics. The strategy is to examine each variable in isolation of the others, but controlling for age, service and gender. These characteristics are:

- availability of postretirement health plan
- type of benefit formula
- industry
- plan size
- hourly versus salary and union status
- prior opinion.

The definitions, as well as the effects of each plan characteristic are described in Sections 4.1-4.6. Section 4.6 will discuss a "prior opinion" that we will interpret to mean the actuary's assessment of overall plan turnover characteristics.

In part, the analysis will rely on the likelihood statistics. Thus, Table 4.1 presents these summary statistics in a format comparable to Table 3.3. This table suggests that the availability of a postretirement health plan and hourly versus salary and union status are important predictors of turnover.

Table 4.1 Summary of Several Model Fits

Model	Variables	Number of Parameters	-2 Log Likelihood	Change (from Model 7c) in -2 Log Likelihood	Proportional Change (from Model 7c) in -2 Log Likelihood
7c	Age as continuous, Service as categorical, gender, interaction terms	32	1,071,940.3	0	0
15	Model 7c plus post-retirement health	38	1,066,790.9	5,149.4	858.2
17	Model 7c plus post-retirement health, interaction terms	128	1,061,538.9	10,401.4	100.0
14*	Model 7c plus benefit formula (four levels)	38	1,070,182.1	1,758.2	293.0
18	Model 7c plus benefit formula, interaction terms	128	1,067,229.1	4,711.2	49.1
11*	Model 7c plus industry (four levels)	38	1,070,202.6	1,737.7	289.6
19	Model 7c plus industry, interaction terms	128	1,065,847.8	6,092.5	63.5
20	Model 7c plus plan size (three levels)	36	1,071,222.0	718.3	180.0
21	Model 7c plus plan size, interaction terms	96	1,070,078.6	1,861.7	29.1
22	Model 7c plus hourly/salary and union (five levels)	40	1,053,956.7	17,983.6	2,247.9
23	Model 7c plus hourly/salary and union, interaction terms	160	1,050,465.5	21,474.8	167.8
24	Model 7c plus prior intercept (three levels)	36	1,057,496.2	14,444.1	3,611.0
25	Model 7c plus prior, interaction terms	96	1,050,000.7	21,939.6	342.8

Note: Models 11 and 14 were defined earlier in Table 3.3. These models are the same except the number of levels have been simplified. See detailed explanations in Sections 4.2 and 4.3.

As discussed in Section 3.3, adding a variable to Model 7c amounts to a level shift. The interaction terms allow for a change in the shape of our turnover curves, thus amounting to scale shifts.

Section 4.1 Eligibility for Postretirement Health Benefits

This section explores the effect of the eligibility for postretirement health benefits on plan turnover. As noted in Section 3.4, there are four levels of this plan variable:

- More than 90 percent
- Less than 10 percent
- Other Mixture
- Not Sure.

We define Model 17 to be Model 7c, with interaction variables for each level of the eligibility variable. Thus, there are now eight separate combinations of gender and eligibility. That is, for each combination, there are 16 parameters, as in our baseline model in Table 3.1. In total, there are $8 \times 16 = 128$ parameters. The parameter estimates are given in detail in Appendix D.1, Table D.1.

Model 17 summarizes the fit using age, service, gender and eligibility variables. Not surprisingly, the addition of the eligibility variable improves our model fit in a statistically significant fashion; see Table 4.1. The proportional change in the likelihood statistics suggests that the increase in model fit is desirable, even when based on the number of parameters.

Figure 4.1a shows the effect of eligibility for postretirement benefits on aggregate turnover. In the left-hand panel, we see that termination probabilities are lower for plans having more than 90 percent eligible for a postretirement health benefit. It is interesting that the differential is more apparent for younger ages rather than older. The right-hand panel shows that "Other mixture" and "Not Sure" have the highest retirement probabilities. Figure D.1a in Appendix D.1 suggests that gender is important for plans without eligibility for postretirement benefits ("Less than 10" percent") for retirement probabilities. For other plans, this figure suggests that the availability of eligibility for postretirement benefits is more important than gender for retirement probabilities.

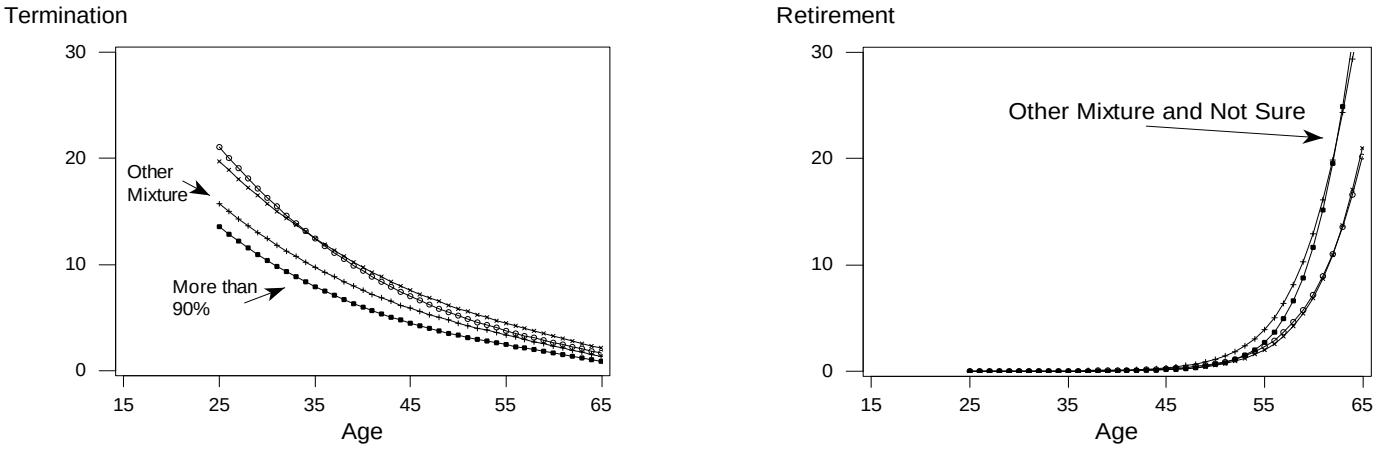

Figure 4.1a. Aggregate Turnover by Eligibility for Postretirement Health Benefits. Estimated probabilities are in percent. Rates are derived from a multinomial logit model fit. The left-hand panel illustrates termination, the right-hand panel illustrates retirement.

Figure 4.1b shows the effect of availability of postretirement health benefits on aggregate termination by gender. The right-hand panel shows that females are more sensitive to whether postretirement benefits are offered; here, "Not Sure" and "Less Than 10" percent" categories exhibit the highest termination rates for young females. For young males, the left-hand panel shows that males are most likely to leave with a plan that has "Less than 10" percent" eligible for postretirement benefits.

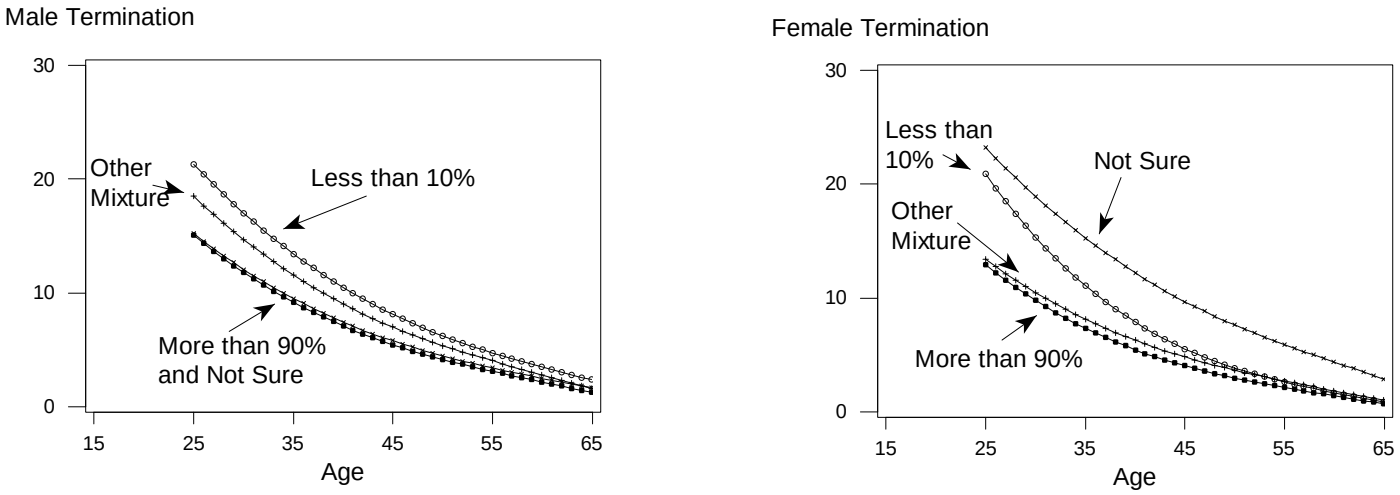

Figure 4.1b. Male and Female Aggregate Termination by Eligibility for Postretirement Health Benefits. Estimated probabilities are in percent. Rates are derived from a multinomial logit model fit. The left-hand panel corresponds to males, the right-hand panel corresponds to females.

Figure D.1b of Appendix D.1 shows the effect of eligibility for postretirement health benefits on select termination. For those with less than five years of service, the service effect is more important than the eligibility for postretirement health benefits. For those with 10 or more years of service, there does not seem to be an effect for eligibility for postretirement health benefits on termination probabilities. Interestingly, for those with 5-9 years of service, those in plans with 90 percent or more eligible for postretirement benefits have lower termination probabilities than the other three categories.

Section 4.2 Benefit Formula

As noted in Section 5.9 of the Phase I report, there are six levels of this plan variable:

- Final Average Pay
- Career Average Pay
- Flat Dollar
- Cash Balance
- Life Cycle / Pension Equity
- Other.

Here, 73.2 percent of life years experience was in the "Final Average Pay" group. Based on a suggestion by the Non-Mortality Decrement Task Force, the last three groups were combined into what we call a "Hybrid" group. From the Phase I analysis (Frees and Gilmore 2003), we know that the Hybrid group has higher termination as well as retirement rates when compared to either Final Average Pay or Career Average Pay (although not the Flat Dollar) plans. We also note that cash balance plans represent about 76 percent of the experience of the Hybrid group in terms of life years of exposure.

We define Model 18 to be Model 7c, with interaction variables for each level of the benefit formula variable. In total, there are $8 \times 16 = 128$ parameters. The parameter estimates are given in Appendix D.2, Table D.2. Not surprisingly, the addition of the benefit formula variable improves our model fit in a statistically significant fashion; see Table 4.1. However, it is not as good a fit as the postretirement health variable.

Figure 4.2a shows the effect of benefit formula on aggregate turnover. In the left-hand panel, we see that termination probabilities are lower for plans having a career average pay plan; this was anticipated from the Phase I report (see Table 5.9). It is interesting that the differential is more apparent for younger ages rather than older. The right-hand panel shows that career average plans have the lowest retirement probability. Figure D.2a in Appendix D.2 shows that males have a lower probability of retirement than females in career average plans; this is opposite to the general trend of higher male retirement noted in Section 3.2. For other plans, this figure suggests that the benefit formula is more important than gender for retirement probabilities when controlling for age.

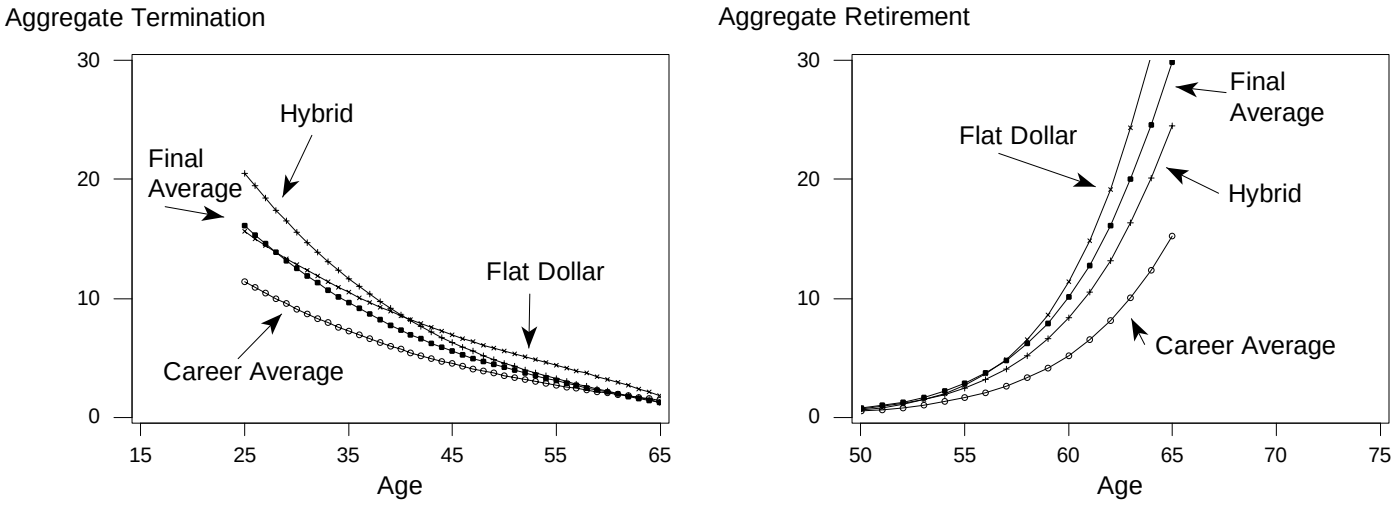

Figure 4.2a. Aggregate Turnover by Benefit Formula. Estimated probabilities are in percent. Rates are derived from a multinomial logit model fit. The left-hand panel illustrates termination, the right-hand panel illustrates retirement.

Figure 4.2b shows the effect of benefit formula on aggregate termination by gender. The left-hand panel shows that young males are less likely to leave a plan that has a flat-dollar pay

formula but are otherwise not sensitive to the type of benefit offered. Comparing the right- and left-hand panels, we see that males and females react similarly to final average and hybrid plans and react differently to career average and flat-dollar plans.

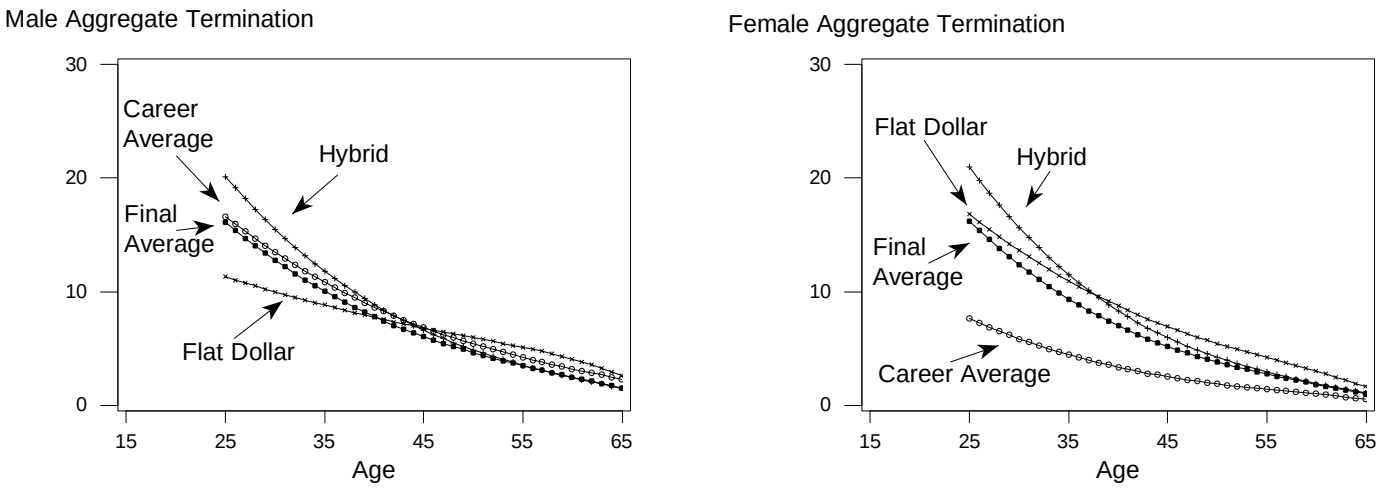

Figure 4.2b. Male and Female Aggregate Termination by Benefit Formula. Estimated probabilities are in percent. Rates are derived from a multinomial logit model fit. The left-hand panel corresponds to males, the right-hand panel corresponds to females.

Figures D.2b and D.2c of Appendix D.2 show the effect of benefit formulas on select termination, by gender. As with aggregate probabilities, there is little difference by gender for final average and hybrid plans for select termination probabilities. Career average and flat-dollar select probabilities vary dramatically by gender. Although not evident from these two figures, it turns out that the effect of service is more important than the type of benefit formula.

Section 4.3 Industry

This section explores the industry effect. In the data request, four-digit standard industrial classification (SIC) codes were provided. Only the first digit was used for the Phase I and Section 3 analysis, a standard technique in literature. To further summarize the effects of industry, we consider the four categories:

- Manufacturing – corresponding to SIC first digits 1, 2 and 3 for mining, construction and manufacturing industries
- Services and Trade – corresponding to SIC first digits 4 and 5
- Services – corresponding to SIC first digits 5, 6 and 7 for financial services, personal services and professional services
- Other – corresponding to SIC first digits 9 and 0, for tax exempts and firms that could not be easily classified.

The SIC codes are available from the U.S. Census Bureau at http://www.census.gov/epcd/naics/nsic2ndx.htm.

We define Model 19 to be Model 7c, with interaction variables for each level of the new industry variable. In total, there are $8 \times 16 = 128$ parameters. The parameter estimates are given in detail in Appendix D.3, Table D.3. Not surprisingly, the addition of the industry variable improves our model fit in a statistically significant fashion; see Table 4.1. However, it is not as good a fit as the postretirement health benefit variable.

Figure 4.3a shows the effect of industry on aggregate turnover. In the left-hand panel, termination probabilities are higher for our fourth class, tax-exempt plans and plans that are not easily classified. It is interesting that the differential is more apparent for younger ages rather than older. The right-hand panel shows that manufacturing has the highest retirement probabilities. This was not anticipated from the Phase I report (see Table 5.4 of that report).

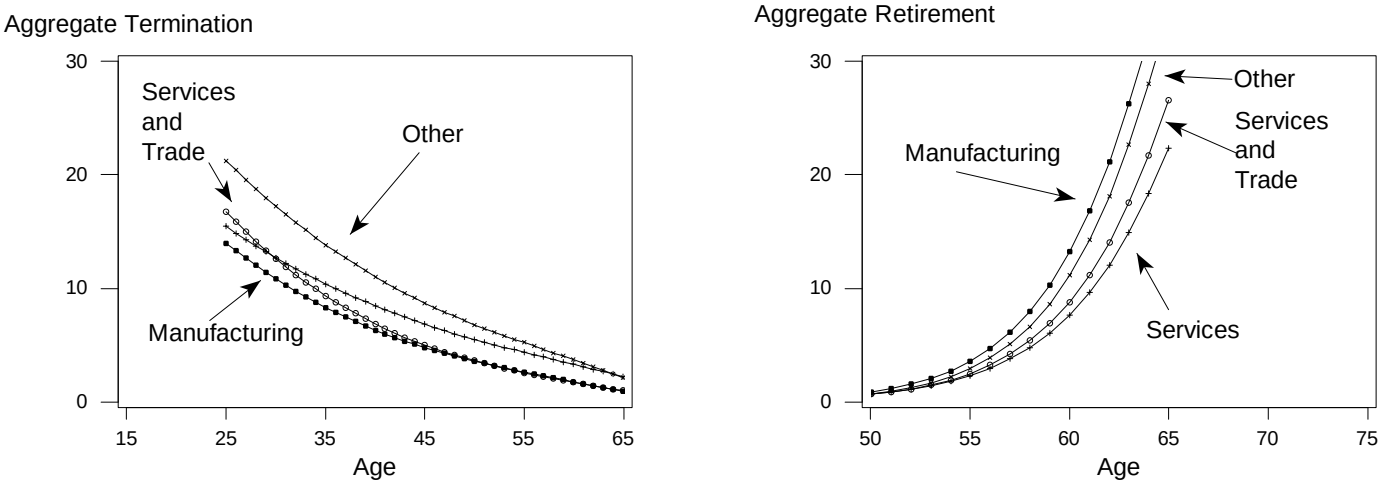

Figure 4.3a. Aggregate Turnover by Industry. Estimated probabilities are in percent. Rates are derived from a multinomial logit model fit. The left-hand panel gives termination, the right-hand panel gives retirement.

Figure 4.3b shows the effect of industry on aggregate termination by gender. In comparing these panels, we see important differences in the industry effect by gender. For example, the "Other" category is similar for both males and females. However, the other industries vary substantially by gender.

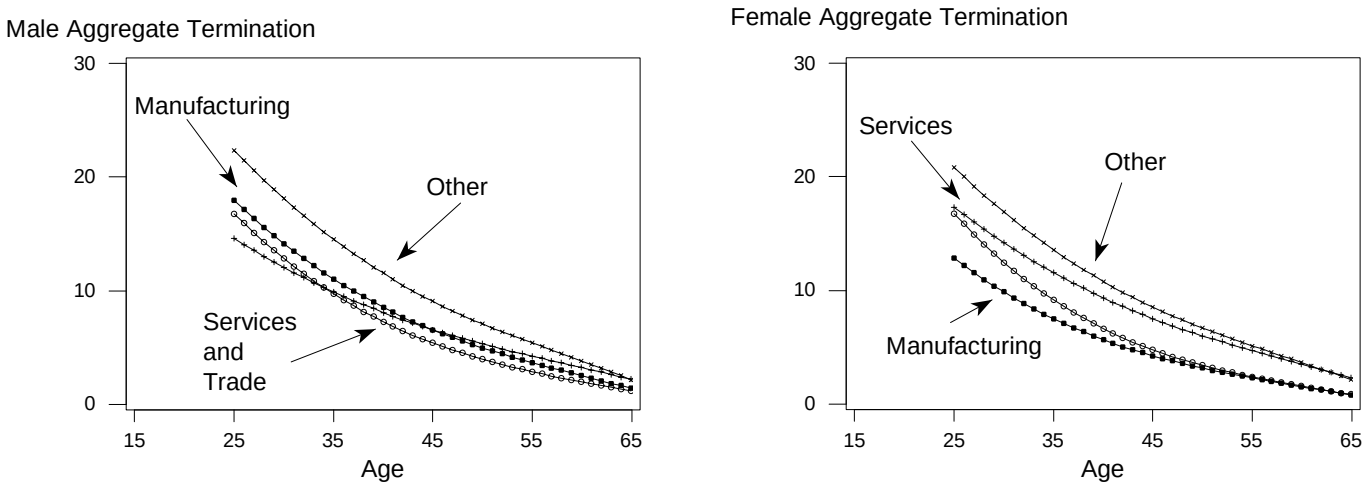

Figure 4.3b. Male and Female Aggregate Termination by Industry. Estimated probabilities are in percent. Rates are derived from a multinomial logit model fit. The left-hand panel corresponds to males, the right-hand panel corresponds to females.

Section 4.4 Plan Size

As a proxy for employer size, the size of the plan was examined. Specifically, the average number of life years of exposure was computed for each plan. Based on this average number of life years, plans were classified as follows:

- large plans, plans with an average of 10,000 or more active plan participants per year,
- medium plans, plans with an average of less than 10,000 but greater than or equal to 1,000 active plan participants per year and
- small plans, plans with an average of less than 1,000 active plan participants per year.

We defined plan size as "small," "medium" and "large" in order to classify plans into categories that would have meaningful credibility when examining turnover rates. Note that these definitions do not agree with conventions used in the US regulatory Form 5500.

To understand the importance of plan size, we begin with Table 4.4a, which presents summaries of turnover rates by plan size. This table is comparable to those in Section 5 of the Frees and Gilmore (2003) report, in that there are no controls for age, service or gender. Comparing turnover differentials between plan size and other plan characteristics in Section 5 of the Frees and Gilmore (2003) report, this table suggests that the size of the plan is not an important determinant of turnover.

Table 4.4a. Turnover Rates by Plan Size								
Plan Size	Number of Plans	End of Year Status						Total Life Years
		Active	Retired	Disabled	Other	Death	Termination	
Less than 1,000	68	88.40	1.26	0.18	0.17	0.10	9.89	82,489
More than 1,000 but less than 10,000	33	89.54	1.50	0.27	0.80	0.08	7.81	439,294
More than 10,000	11	90.09	0.92	0.04	0.19	0.08	8.68	1,230,739
Totals	112	89.87	1.09	0.11	0.34	0.08	8.52	1,752,522

Of course, it is possible that differences in plan size are masked by differences in age, service or gender distributions. Thus, we now define Model 20 to be Model 7c but with an intercept that varies by plan size, as well as Model 21, with interaction variables for each level of the plan size variable. The parameter estimates are given in Appendix D.4, Table D.4. Not surprisingly, the addition of the plan size variable improves our model fit in a statistically significant fashion; see Table 4.1. However, it is not as good a fit as the postretirement health benefits, benefit formula or industry variables.

Figure 4.4a shows the effect of plan size on aggregate turnover. In the left-hand panel, we see that termination probabilities are higher for small plans (1000 lives or less). It is interesting that the differential is consistent over age. The right-hand panel shows that large plans have the highest retirement probabilities. It is interesting that this contradicts the evidence in Table 4.4a (where large plans have the smallest overall retirement probabilities). Recall that Figure 4.4a is based on the multinomial logit analysis that controls for age, service and gender, in contrast to the unadjusted statistics in Table 4.4a.

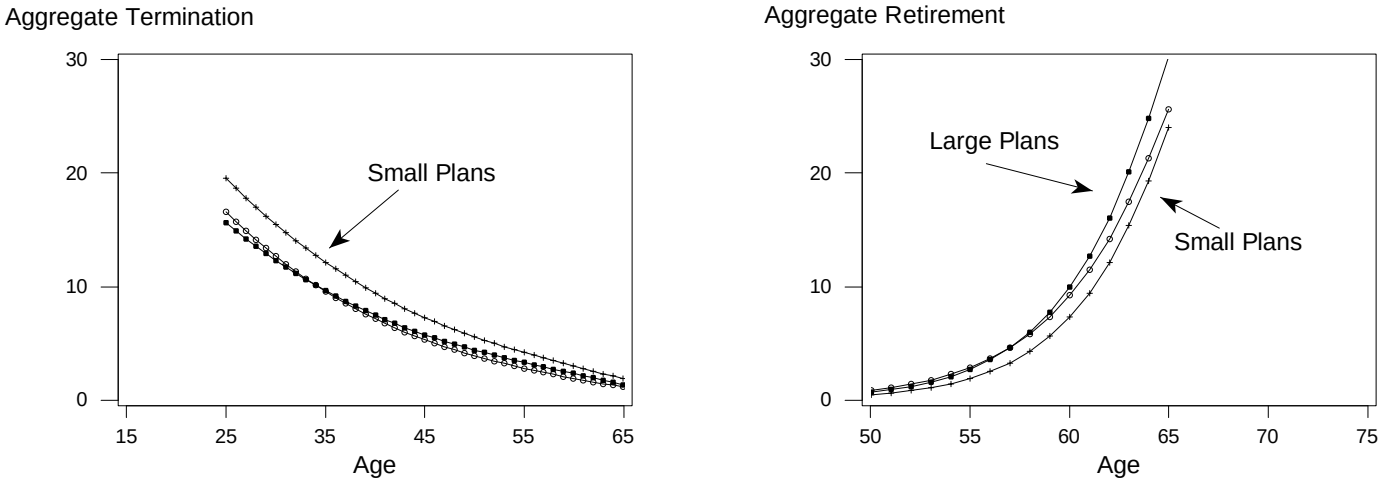

Figure 4.4a. Aggregate Turnover by Plan Size. Estimated probabilities are in percent. Rates are derived from a multinomial logit model fit. The left-hand panel gives termination, the right-hand panel gives retirement.

Figure 4.4b shows the effect of plan size on aggregate termination by gender. The right-hand panel shows that the effect for females is level over ages. In contrast, the left-hand panel (males) shows that the plan size effect is large for younger ages and diminishes with age. Appendix E.1 demonstrates how to use the multinomial logit fits to create tables for small plans (1000 lives or less).

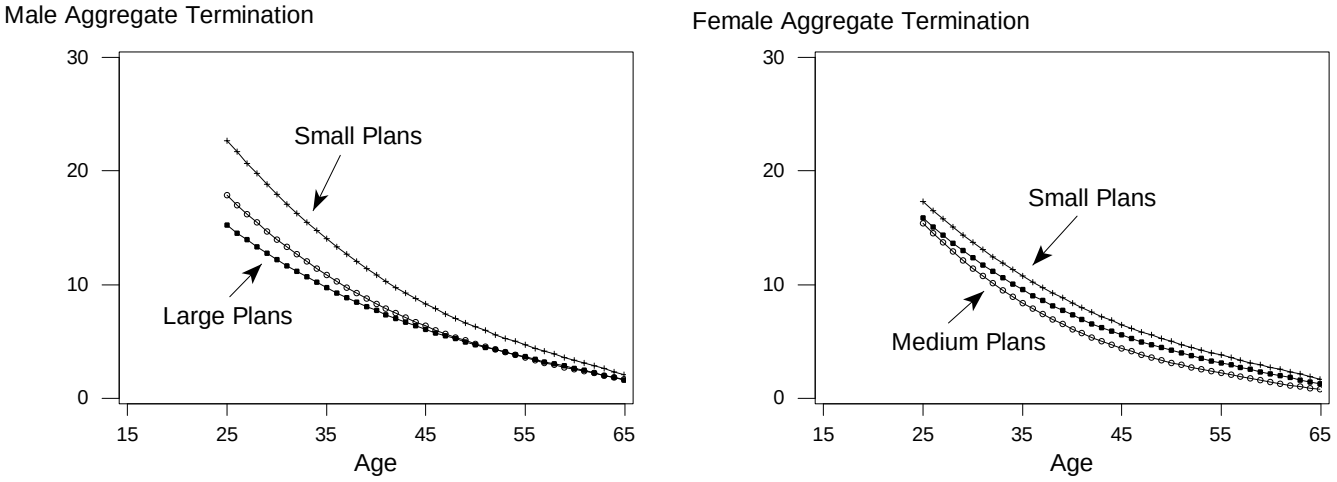

Figure 4.4b. Male and Female Aggregate Termination by Plan Size. Estimated probabilities are in percent. Rates are derived from a multinomial logit model fit. The left-hand panel corresponds to males, the right-hand panel corresponds to females.

Section 4.5 Hourly/Salary and Union Status

In the Phase I report, we reported statistics on plan pay type (more than 90 percent hourly, more than 90 percent salaried, other combination and "don't know") as well as plan workforce (more than 90 percent unionized, more than 90 percent nonunion, other mixture and "don't know"). As noted in Section 3.4, there is a strong overlap between these characteristics.

A combined category was created to summarize this set of plan characteristics. The new variable, called "hourly/salary and union status," consists of five categories:

- Salaried (plans with more than 90 percent salaried workers, unionized or not)
- Hourly union (plans with more than 90 percent union and with more than 90 percent hourly)
- Hourly nonunion (plans with more than 90 percent hourly and with more than 90 percent nonunion)
- Other combination (plans where either the plan pay type is a combination of hourly and salaried, or the plan workforce is a mixture of union and nonunion)
- Unknown (plans where either the plan pay type or the plan workforce is unknown)

Table 4.5a provides a breakdown of turnover rates. This table shows that hourly nonunion plans have the highest termination and lowest retirement rates. Note that the summary statistics in this table do not control for age, service and gender. Not surprisingly, the low retirement and high termination rates for hourly nonunion plans are in part because membership in these plans is

dominated by younger workers. For example, for the three hourly nonunion plans, the median age is 31, and the 90th percentile is 49. In contrast, for the 17 hourly union plans, the median age is 41, and the 90th percentile is 55. Further, about 75 percent of the members of the hourly plans (union and nonunion) were males, in contrast to only 42 percent in the salaried plans.

Table 4.5a. Turnover Rates by Hourly/Salary and Union Status

Status	Number of Plans	End of Year Status						Total Life Years
		Active	Retired	Disabled	Other	Death	Termination	
Salaried	28	91.05	1.43	0.08	0.16	0.07	7.22	567,937
Hourly Union	17	93.34	1.46	0.79	2.49	0.13	1.80	91,504
Hourly non-union	3	77.02	0.14	0.08	0.03	0.02	22.70	106,803
Other Combination	21	91.25	0.69	0.04	0.27	0.09	7.65	758,308
Unknown	43	86.95	1.84	0.13	0.32	0.08	10.69	227,970
Totals	112	89.87	1.09	0.11	0.34	0.08	8.52	1,752,522

Table 4.1 summarizes the multinomial logit model fit (that incorporates controls for age, service and gender). The parameter estimates are in Appendix D.5, Table D.5.1, based on Model 23. Here, we see that the hourly/salary and union status variable is an excellent determinant of turnover, even compared to other variables explored in Sections 4.1-4.4.

To explain why the hourly/salary and union status variable is such an excellent predictor of turnover, Figure 4.5a shows aggregate termination by this variable. This figure shows that the hourly nonunion plans have much higher termination rates and hourly union plans have much lower termination rates.

Appendices E.2-E.4 demonstrate how to use the multinomial logit fits to create tables for salaried, hourly union and hourly nonunion workers.

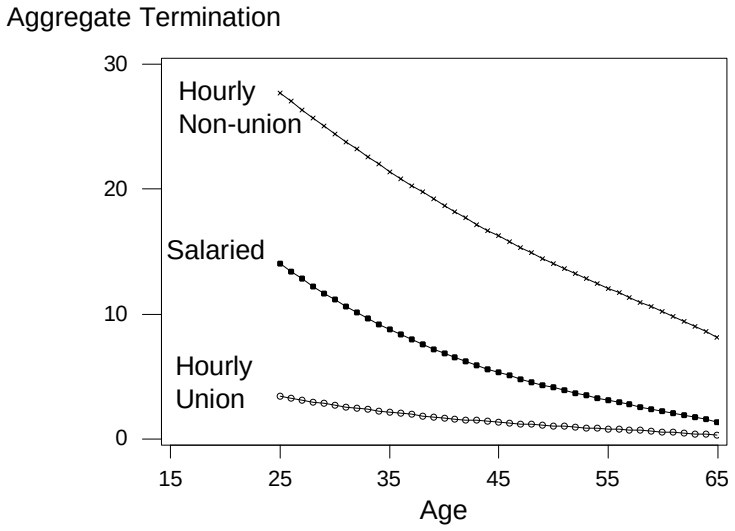

Figure 4.5a. Aggregate Termination by Hourly/Salary and Union Status. Estimated probabilities are in percent. Rates are derived from a multinomial logit model fit.

Is this due to gender differences? Figure 4.5b suggests the answer is not exclusive, at least for termination rates. Figure D.5a, in Appendix D.5, also suggests that the answer is no for retirement rates.

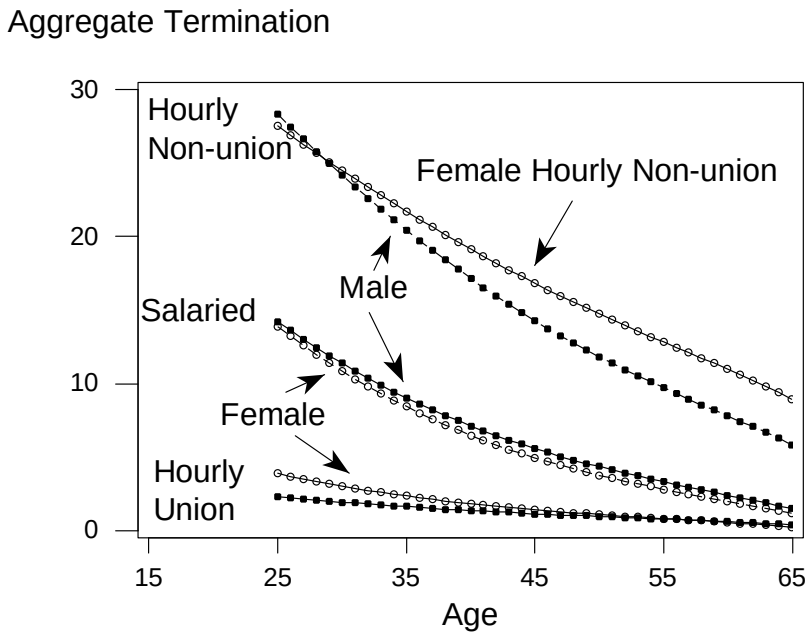

Figure 4.5b. Male and Female Aggregate Termination by Hourly/Salary and Union Status. Estimated probabilities are in percent. Rates are derived from a multinomial logit model fit.

Section 4.6 Prior Information

We know that termination rates are higher for younger workers and lower for longer service workers, other things being equal. Sections 4.1-4.5 established additional patterns for other plan characteristics. However, there may be other pieces of information available to the actuary that help him or her assess whether a plan is likely to experience "low" or "high" turnover, even after controlling for age, service and sex.

This section assumes such ideal prior information is available. The objective is to see how far we can go in understanding and predicting turnover rates. To quantify this ideal, we classified plans as experiencing low, intermediate and high turnover by examining the ratio of observed minus expected turnover, as a proportion of expected turnover. Here, turnover includes termination and retirement. Based on the distribution of these ratios (not reported here), nine plans were classified as having lower turnover than expected, nine as having higher turnover than expected and 94 intermediate plans. We used our Section 3.2 model to calibrate expected values—that is, controlling for age, service and sex.

Table 4.6a reports turnover rates by this classification according to this "prior" information. Although the ordering of retirement and termination probabilities is not surprising, their relative magnitude (especially for termination) is.

Table 4.6a. Turnover Rates by Prior Information

Prior Information	Number of Plans	End of Year Status						Total Life Years
		Active	Retired	Disabled	Other	Death	Termination	
Low	9	95.32	0.66	0.54	1.62	0.09	1.79	132,025
Intermediate	94	89.62	1.11	0.07	0.20	0.08	8.91	1,593,924
High	9	77.83	1.51	0.03	2.21	0.07	18.35	26,573
Totals	112	89.87	1.09	0.11	0.34	0.08	8.52	1,752,522

Multinomial logit models were fit. Model 24 includes prior information as a level effect. Model 25 includes it as both shape and level effects. Not surprisingly, this parameter turned out to be extremely statistically significant. The parameter estimates are given in Appendix D.6, Table D.6.

Figure 4.6a shows the effect of prior information classification on aggregate turnover. In the left-hand panel, we see that termination probabilities are clearly separated at all ages, with the larger differences at younger ages. As anticipated, curves with lower overall aggregate termination are flatter with age. The right-hand panel shows that there is little difference in retirement rates for high and intermediate classified plans, although low plans are clearly distinct from the other two categories. Table D.6b in Appendix D.6 provides these estimated probabilities.

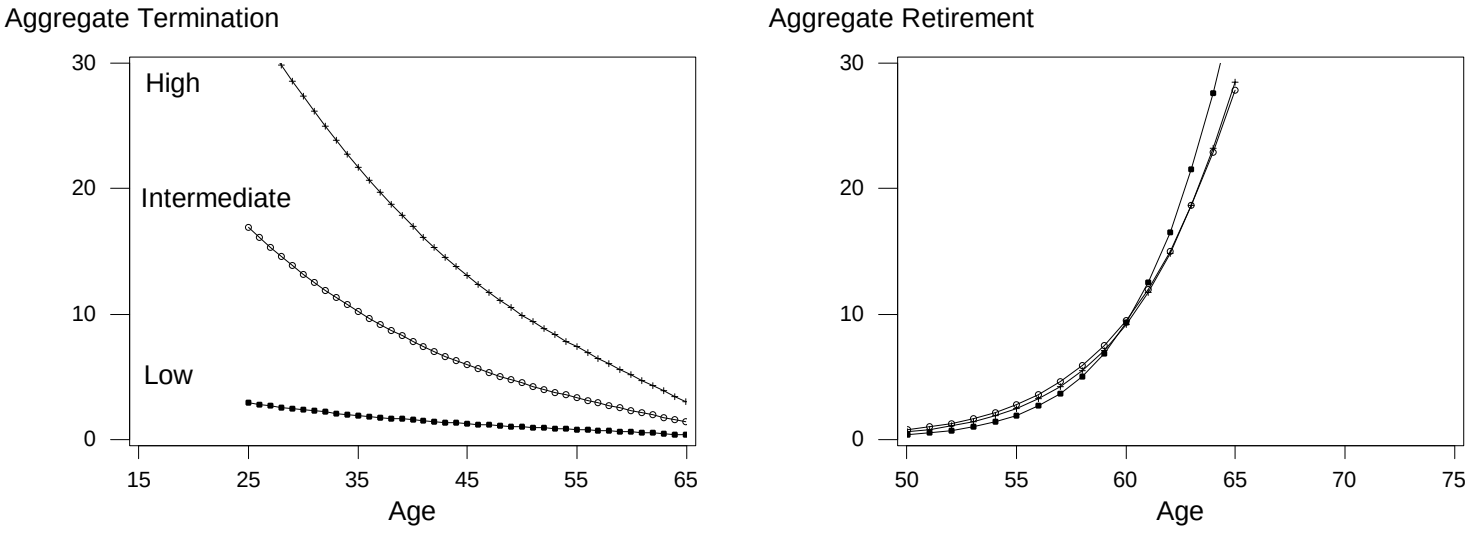

Figure 4.6a. Aggregate Turnover by Prior Information. Estimated probabilities are in percent. Rates are derived from a multinomial logit model fit. The left-hand panel gives termination, the right-hand panel gives retirement.

Figure 4.6b shows the effect of prior information on aggregate termination by gender. This figure shows that prior information is much more important than gender.

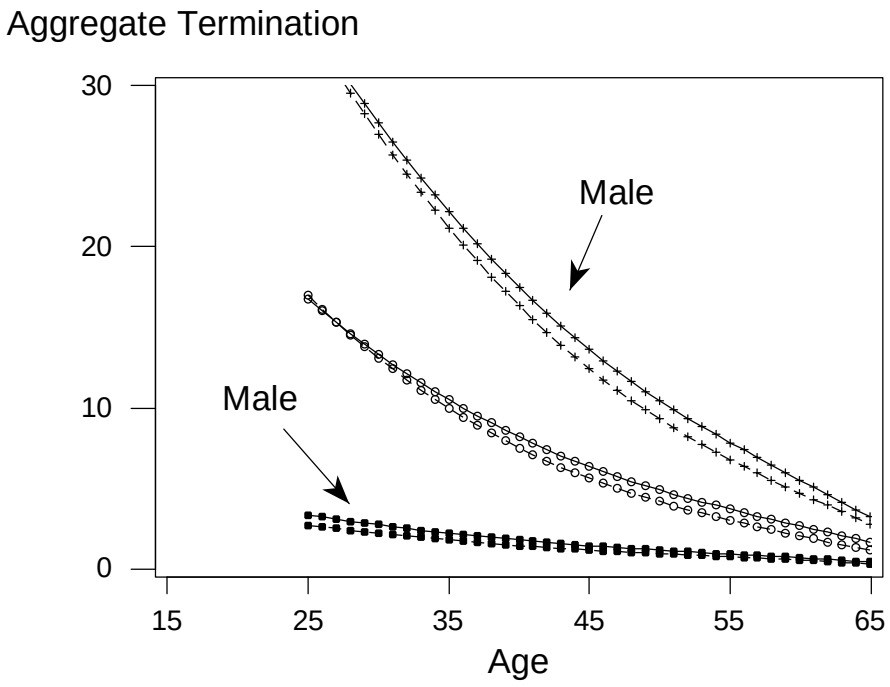

Figure 4.6b. Male and Female Aggregate Termination by Prior Information. Estimated probabilities are in percent. Rates are derived from a multinomial logit model fit. The solid lines correspond to males, the dashed lines correspond to females.

Section 5. Caveats

When extrapolating the findings of this study to other situations of interest, there are several caveats that the actuary should keep in mind.

To begin, we note that although our sample size is large with respect to the number of life years considered, it is not a representative sample of the population of active pension plan participants in North America. As one consequence, a relatively small number of plans are represented (112 in our final sample); inferences to industry-wide trends should not be based on this study. That is, at first glance one may think that with 1.7 million life years of exposure, we enjoy a tremendous amount of statistical significance. This is true, yet statistical significance is based on assumed independence of outcomes and no unobserved variables. There is substantial collinearity among plan characteristics. For example, with only 112 plans, it is difficult to tease out differences among industry effects and region effects, both of which should have strong influences on turnover. We must treat findings about plan characteristics with caution.

Moreover, instead of a long-term longitudinal study, we considered only five years of data. Because turnover rates are susceptible to general economic conditions, we are not able to infer how robust our results are to changing economic conditions.

Because of the short time span of our study, we were not able to document changes in female termination rates over time. Fortunately, the closely related concept of female *labor force participation rates* has been summarized in other studies, see, for example, Frees (2002). As noted in that study, women's participation in the labor force changed fundamentally in the latter part of the 20th century. Unlike men, the trend of labor force participation rates for women continues to increase, although rates of increase for periods 1990-1998 are lower than in prior years (Fullerton 1999).

There are several explanations for increased female labor force participation. These include young women postponing and reducing fertility, reduction of marriage and increases in divorce (Olsen 1994; Blau 1998). Other important determinants of female labor force participation rates include education and the presence of young children. Also, it is well documented that levels of education affect labor force participation rates. Although labor force participation rates for less educated males have fallen over the last 25 years, female rates have not risen as quickly as other education level groups (Blau 1998). There is also strong evidence that the presence of young children in the household tends to reduce the labor participation of women. Nonetheless, there seems to be a substantial rise in attachment to the labor force among new mothers, particularly married women.

We have also not considered several variables that have been identified in the management and labor economics literature to be important determinants of turnover. These include wages, wage growth, education status, marital status and prior mobility. Of these, wages (and wage growth) are probably most important for actuarial applications. Essentially, the literature has established that employees who earn more and who have enjoyed larger wage increases are less likely to terminate employment. The Society of Actuaries' Non-Mortality Decrement Task Force did

request wage data. Unfortunately, because of the many different conventions for reporting salary information by our contributors, a consistent salary variable was not available for this study.

The Task Force also requested information on accrued benefits; as with salary, a variable that was consistently defined over all contributors was not available for this study. This is unfortunate because termination probabilities weighted by estimated liabilities or accrued benefits may be of interest to the profession (for example, Prien, 1978, suggested that this alternative basis would yield lower estimated termination probabilities). We leave this as an area for potential future investigation.

Another variable that is of considerable interest to actuaries is the impact of corporate events such as mergers and acquisitions of plan sponsors, closures of plans, offering of early retirement windows and so forth. Some analysis of this variable was included in an earlier report (Frees and Gilmore 2003). The earlier version of this study, (Kopp 1997), also includes an analysis. Unfortunately, because of our limited information, we have little to offer in the way of guidance for handling these types of corporate events.

The Task Force also collected information on benefit and eligibility provisions of each plan. As noted in Section 2.1, one anticipates these plan provisions to influence retirement behavior, as well as termination at the older ages. Unfortunately, because of the wide array of provisions within the limited number of plans that were analyzed, we were only able to provide estimates of retirement probabilities aggregate over all plans. We conjecture that benefit and eligibility provisions may cause a plan's experience to differ materially from our aggregate results.

Section 6. Summary and Concluding Remarks

This report is designed to offer actuaries information about turnover as it pertains to defined benefit pension plans at several different levels.

Section 2 provides classic aggregate as well as select and ultimate tables of turnover. Here, we see that age is an important determinant of turnover. Service is also important. For some valuations, actuaries will choose to use select and ultimate tables. For most ages, we found it important to distinguish between service for employees with less than five years of service; we use the categories (1) new hires to less than two years and (2) two to less than five years of completed service. The difference was smaller between the categories (3) five to less than 10 and (4) 10 or more years of completed service. Section 2 provides traditional actuarial tables that may be used directly for valuation purposes.

The Section 2 tables are nonparametric in the sense that, although smoothed, they cannot be summarized without loss of information. As an alternative, Section 3 provides a parametric model fit using multinomial logit analysis. One advantage of these parametric fits is that both aggregate as well as select and ultimate tables can be produced knowing only the multinomial logit equations (3.1) and (3.2) and the parameter estimates (with the sample size weights for the aggregate tables).

Another important advantage of the multinomial logit fits is that this type of regression analysis provides a systematic way for deciding whether or not a variable is

- an important determinant of turnover, and
- whether it is an important determinant of termination, retirement or both.

As anticipated, retirement probabilities are influenced by the provisions of a pension plan. In this report, we also document that pension plan provisions influence termination rates. Section 4 shows that plans with a richer array of benefits enjoy lower turnover. Specifically, the availability of a postretirement health plan significantly lowers termination probabilities. Moreover, the plans that offer retirement benefits using a final average salary formula enjoy significantly lower termination probabilities. We also noted that females were more sensitive to the type of benefit offered than males. We remind the reader, however, of the cautionary notes offered in Section 5 on making causal interpretations regarding plan characteristics.

References

Blau, Francine D. 1998. "Trends in the Well-Being of American Women, 1970-1995," *Journal of Economic Literature* 36(1): 112-165.

Bowers, Newt L., Hans U. Gerber, James. C. Hickman, Donald A. Jones and Cecil J. Nesbitt. 1997. *Actuarial Mathematics*. Society of Actuaries.

Coward, Laurence, Sam Eckler and Norm Sheppard. 1961. "Cost of vesting in pension plans." Unpublished manuscript prepared for the Ontario Committee on Portable Pensions.

Crocker, T. F. Jr., H. M. Sarason and B. W. Straight. 1955. *The Actuary's Pension Handbook.* Publications, Los Angeles.

Frees, Edward W. 2002. "Forecasting labor force participation rates." Submitted for publication. Available at http://research.bus.wisc.edu/jfrees/.

Frees, Edward W. and Gilmore, Ray A. 2003. "Pension plan turnover study phase 1 report." Society of Actuaries. Available at http://www.soa.org/research/pension_turnover.pdf.

Fullerton, Howard N., Jr., "Labor force participation: 75 years of change, 1950-1998 and 1998-2025," *Monthly Labor Review* 122(12): 3-12.

Greene, William. 1993. *Econometric Analysis*. New York: Milliman.

Kopp, Steve 1997. "Pension plan turnover rate table construction." Society of Actuaries. Available at http://www.soa.org/research/.

Miller, Morton D. 1949. *Elements of Graduation.* The Actuarial Society of America, New York.

Non-Mortality Decrements Task Force. 2003. "2003 SOA Pension Plan Turnover Study (SOA03): Summary and Practical Guidelines." Society of Actuaries. Available at http://www.soa.org/research/.

Olsen, Randall, J. 1994. "Fertility and the size of the U.S. labor force," *Journal of Economic Literature*. 33(1): 60-100.

Prien, Barthus. 1978. "Review of withdrawal rates for a pension valuation." *Proceedings of the Conference of Actuaries in Public Practice* 27, 1977-1978. 48-75.

Rebitzer, James. 1986. "Establishment size and job tenure," *Industrial Relations.* 25: 292-302.

Vaughn, Roger. L. 1992. "Employee termination study"," *The Pension Forum*. 7(1). Available at: http://www.actuariallibrary.org/.

Valletta, Robert. G. 1999. "Declining job security." *Journal of Labor Economics* 17(4-part 2): S170-S197.

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Appendix A. Data Summary Statistics

This section assesses the influence of age and service on turnover.

Appendix A.1. Turnover by Age

The data provide turnover rates, given in percentages. We computed the age of the individual, at the beginning of the year, on an age nearest birthday basis.

Table A.1 summarizes turnover by age, for ages 18-70, inclusive. For example, there were 574 records that had age nearest birthday equal to 18 at the beginning of the plan year. Of those, 574*69.86/100 = 401 were active by plan year-end date, 574*29.62/100=170 were terminated and 574*0.52/100=3 others exited due to other causes.

Table A.1. Turnover by Age

Age Nearest Birthday	Total Life Years	Turnover					
		Active	Retired	Disabled	Other	Death	Termination
18	574	69.86	0.00	0.00	0.52	0.00	29.62
19	1,630	73.37	0.00	0.00	0.49	0.06	26.07
20	4,581	84.37	0.00	0.00	0.26	0.00	15.37
21	11,494	78.41	0.00	0.02	0.23	0.01	21.32
22	19,167	76.87	0.00	0.03	0.27	0.02	22.82
23	24,487	78.42	0.00	0.02	0.33	0.02	21.22
24	30,178	79.94	0.00	0.01	0.39	0.01	19.64
25	35,486	81.29	0.00	0.01	0.48	0.02	18.19
26	39,638	82.71	0.00	0.03	0.42	0.03	16.81
27	43,077	84.17	0.00	0.05	0.50	0.01	15.27
28	46,284	85.51	0.00	0.03	0.44	0.02	14.00
29	48,744	86.68	0.00	0.05	0.45	0.02	12.80
30	50,829	87.26	0.00	0.06	0.45	0.03	12.21
31	53,502	88.32	0.00	0.04	0.41	0.02	11.21
32	57,144	88.88	0.00	0.06	0.39	0.03	10.65
33	60,512	89.73	0.00	0.07	0.36	0.04	9.81
34	63,184	90.43	0.00	0.07	0.36	0.04	9.11
35	65,421	90.87	0.00	0.06	0.33	0.03	8.72
36	66,760	91.32	0.00	0.07	0.32	0.04	8.26
37	67,082	91.59	0.00	0.07	0.31	0.04	7.99
38	66,642	92.10	0.00	0.06	0.32	0.04	7.49
39	65,794	92.43	0.00	0.05	0.32	0.07	7.12
40	64,396	92.54	0.00	0.11	0.32	0.05	6.97
41	62,816	92.80	0.00	0.11	0.37	0.06	6.67
42	60,031	93.06	0.00	0.08	0.32	0.06	6.47
43	57,132	93.14	0.00	0.08	0.35	0.06	6.37
44	54,333	93.24	0.00	0.12	0.31	0.07	6.26
45	51,806	93.34	0.00	0.12	0.27	0.08	6.19
46	48,223	93.41	0.00	0.11	0.34	0.09	6.06
47	45,537	93.63	0.00	0.11	0.29	0.10	5.87
48	43,752	93.59	0.00	0.14	0.24	0.11	5.92

Table A.1. Turnover by Age							
Age Nearest Birthday	Total Life Years	Turnover					
		Active	Retired	Disabled	Other	Death	Termination
49	40,812	93.46	0.09	0.15	0.25	0.15	5.90
50	37,755	93.24	0.66	0.15	0.25	0.13	5.56
51	34,435	93.42	0.61	0.15	0.28	0.11	5.42
52	31,567	93.45	0.72	0.12	0.31	0.13	5.27
53	28,642	93.22	0.89	0.25	0.30	0.19	5.15
54	26,203	91.99	2.71	0.20	0.30	0.18	4.62
55	24,177	90.33	6.49	0.25	0.29	0.23	2.42
56	21,708	91.15	5.80	0.29	0.28	0.26	2.22
57	19,570	90.73	6.37	0.32	0.28	0.26	2.05
58	17,523	90.46	6.59	0.34	0.29	0.28	2.05
59	15,718	88.01	8.66	0.41	0.25	0.23	2.43
60	13,791	85.81	11.20	0.46	0.22	0.33	1.97
61	11,895	81.66	14.80	0.59	0.32	0.32	2.30
62	9,428	74.50	21.46	0.55	0.32	0.34	2.83
63	7,008	80.68	15.97	0.56	0.20	0.43	2.17
64	5,665	73.06	23.12	0.39	0.25	0.48	2.70
65	4,112	61.38	35.12	0.19	0.32	0.41	2.58
66	2,516	74.96	21.38	0.24	0.24	0.40	2.78
67	1,909	79.52	16.82	0.05	0.26	0.52	2.83
68	1,560	76.60	19.68	0.00	0.32	0.64	2.76
69	1,218	72.41	22.91	0.08	0.41	0.41	3.78
70	864	74.31	21.06	0.00	0.12	0.58	3.94
Total	1,768,312	89.73	1.08	0.11	0.34	0.08	8.67

Appendix A.2. Turnover by Service

Table A.2a provides turnover experience by service. Here, service is the number of completed years at the beginning of the plan year. The "new hires" are those who entered employment sometime during the plan year. In contrast to new hires, those with zero years of completed service were active at the beginning of the plan year and had been working for less than one year at that time.

Table A.2a. Turnover by Service							
Completed Years of Service	Total Life Years	Turnover					
		Active	Retired	Disabled	Other	Death	Termination
new hires	12,242	85.79	0.54	0.00	1.36	0.01	12.30
0	77,099	80.84	0.20	0.06	0.56	0.04	18.30
1	203,014	81.35	0.10	0.03	0.38	0.03	18.11
2	156,574	84.31	0.10	0.04	0.46	0.04	15.05
3	125,705	87.87	0.12	0.05	0.23	0.04	11.69
4	103,877	89.35	0.27	0.08	0.36	0.05	9.88
5	98,063	90.36	0.45	0.08	0.67	0.07	8.37
6	93,851	91.73	0.46	0.09	0.28	0.06	7.39
7	91,842	92.59	0.53	0.10	0.24	0.08	6.45
8	86,990	93.16	0.60	0.08	0.16	0.08	5.91

Table A.2a. Turnover by Service							
Completed Years of Service	Total Life Years	Turnover					
		Active	Retired	Disabled	Other	Death	Termination
9	83,765	93.61	0.87	0.12	0.21	0.09	5.09
10	72,780	93.78	0.86	0.11	0.21	0.11	4.92
11	65,642	94.20	0.83	0.10	0.22	0.08	4.57
12	56,203	94.53	0.93	0.13	0.19	0.09	4.14
13	49,587	94.64	1.10	0.09	0.17	0.09	3.91
14	42,939	94.30	1.30	0.14	0.21	0.10	3.95
15	38,967	94.51	1.40	0.12	0.21	0.12	3.65
16	35,949	94.44	1.61	0.13	0.27	0.11	3.44
17	34,791	94.59	1.66	0.17	0.24	0.08	3.25
18	32,896	94.67	1.81	0.19	0.29	0.13	2.91
19	29,843	93.70	2.66	0.23	0.27	0.14	3.00
20	25,818	93.64	2.83	0.27	0.32	0.14	2.80
21	22,172	93.62	2.87	0.32	0.40	0.13	2.66
22	19,447	93.11	3.41	0.35	0.45	0.16	2.50
23	17,135	93.66	3.18	0.27	0.48	0.12	2.28
24	15,193	92.82	3.98	0.25	0.39	0.21	2.35
25	13,239	92.88	4.09	0.27	0.48	0.18	2.09
26	10,784	92.28	4.78	0.31	0.32	0.18	2.13
27	9,123	92.07	5.09	0.32	0.44	0.19	1.90
28	8,242	90.92	6.16	0.29	0.61	0.27	1.75
29	6,976	89.03	8.33	0.36	0.46	0.16	1.66
30	5,752	88.20	9.20	0.30	0.40	0.38	1.53
31	4,593	87.05	10.32	0.44	0.52	0.37	1.31
32	3,783	86.07	11.63	0.34	0.34	0.26	1.35
33	2,899	86.69	11.28	0.28	0.45	0.31	1.00
34	2,249	83.86	14.23	0.53	0.27	0.40	0.71
35	1,790	83.63	14.69	0.39	0.56	0.34	0.39
36	1,422	82.63	15.61	0.77	0.42	0.35	0.21
37	1,222	80.52	18.74	0.08	0.25	0.41	0.00
38	1,035	81.06	17.68	0.29	0.48	0.29	0.19
39	835	72.69	26.59	0.24	0.24	0.24	0.00
40	583	72.56	25.73	0.86	0.69	0.17	0.00
41	495	72.93	25.86	0.61	0.20	0.40	0.00
42	340	68.53	29.71	0.29	0.88	0.29	0.29
43	220	67.73	31.36	0.45	0.45	0.00	0.00
44	147	63.95	32.65	0.68	2.04	0.68	0.00
45	88	61.36	37.50	0.00	0.00	1.14	0.00
46	48	52.08	45.83	0.00	0.00	2.08	0.00
47	24	66.67	33.33	0.00	0.00	0.00	0.00
48	18	61.11	33.33	0.00	0.00	0.00	5.56
49	9	77.78	22.22	0.00	0.00	0.00	0.00
50	8	62.50	37.50	0.00	0.00	0.00	0.00
51	4	50.00	50.00	0.00	0.00	0.00	0.00
Total	1,768,312	89.73	1.08	0.11	0.34	0.08	8.67

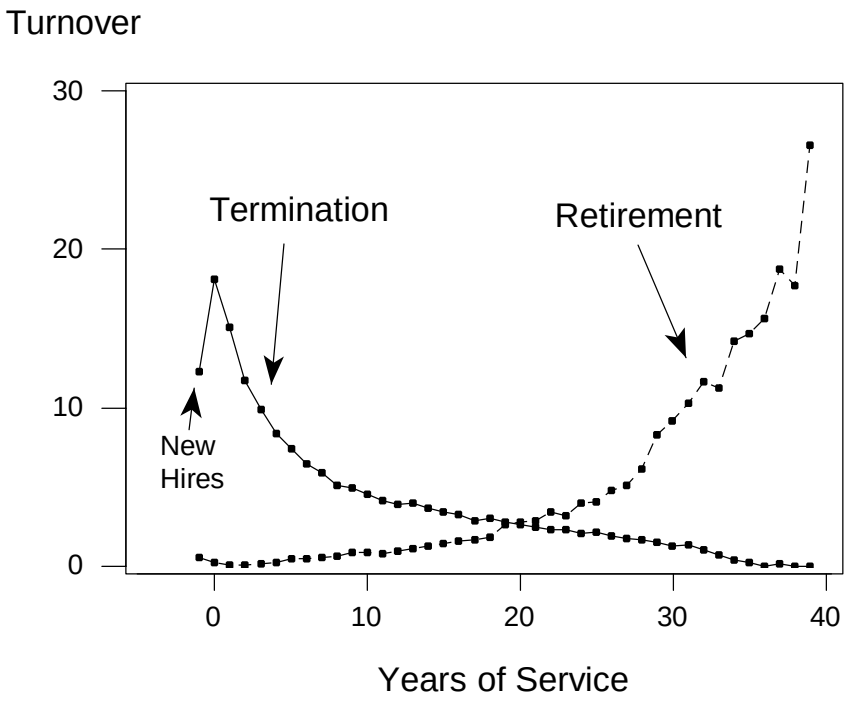

Figure A.1. Aggregate Turnover by Years of Service. Estimated probabilities are in percent.

Table A.2b provides termination experience by service. Here, termination estimated probabilities are smoothed via Whittaker-Henderson Type B graduation methods.

Table A.2b. Termination by Service. Termination estimated probabilities are smoothed via Whittaker-Henderson Type B. Estimated probabilities are in percent.

Completed Years of Service	Total Life Years	Termination
new hires	12,242	16.42
0	77,099	17.13
1	203,014	16.02
2	156,574	15.63
3	125,705	11.98
4	103,877	9.87
5	98,063	8.34
6	93,851	7.36
7	91,842	6.46
8	86,990	5.88
9	83,765	5.13
10	72,780	4.91
11	65,642	4.55
12	56,203	4.16
13	49,587	3.92
14	42,939	3.92
15	38,967	3.66

Table A.2b. Termination by Service. Termination estimated probabilities are smoothed via Whittaker-Henderson Type B. Estimated probabilities are in percent.		
Completed Years of Service	**Total Life Years**	**Termination**
16	35,949	3.45
17	34,791	3.23
18	32,896	2.96
19	29,843	2.96
20	25,818	2.81
21	22,172	2.66
22	19,447	2.49
23	17,135	2.31
24	15,193	2.31
25	13,239	2.12
26	10,784	2.11
27	9,123	1.91
28	8,242	1.75
29	6,976	1.66
30	5,752	1.52
31	4,593	1.34
32	3,783	1.31
33	2,899	1.02
34	2,249	0.71
35	1,790	0.40
36	1,422	0.20
37	1,222	0.00
38	1,035	0.00
39	835	0.00
40	583	0.00
41	495	0.00
42	340	0.00
43	220	0.00
44	147	0.00
45	88	0.00
46	48	0.00
47	24	0.00
48	18	0.00
49	9	0.00
50	8	0.00
51	4	0.00
Total	1,768,312	8.67

Appendix A.3. Termination by Age and Service

Table A.3 shows how the interplay between age and service can affect termination. We isolated termination rates for less than two years of completed service because of our difficulties in isolating the effects of plan eligibility; see Section 4.2 of Frees and Gilmore (2003). Two years of service is a common requirement for vesting in Canada, whereas five years is a common requirement among U.S.-based plans. Virtually all plans report vesting by 10 years of service. Thus, we investigated the effects of the categorization of service into four cells, <2, 2-4, 5-9 and 10 or more years of service. Table A.3 shows the effects of these different service categories on termination rates, even when controlling for age.

Table A.3. Termination by Age and Service

	Life Years					Termination Proportions				
Age Nearest Birthday	Service < 2	Service = 2, 3, 4	Service = 5-9	Service ≥ 10	Total	Service < 2	Service = 2, 3, 4	Service = 5-9	Service ≥ 10	Overall
18	552	22	0	0	574	30.62	4.55	0.00	0.00	29.62
19	1,521	109	0	0	1,630	27.42	7.34	0.00	0.00	26.07
20	3,962	617	2	0	4,581	16.58	7.62	0.00	0.00	15.37
21	8,001	3,468	25	0	11,494	22.47	18.80	4.00	0.00	21.32
22	11,144	7,857	166	0	19,167	24.10	21.17	14.46	0.00	22.82
23	13,142	10,766	579	0	24,487	22.68	19.69	16.23	0.00	21.22
24	14,735	13,305	2,138	0	30,178	22.16	17.71	14.31	0.00	19.64
25	14,679	16,119	4,686	2	35,486	20.72	17.19	13.72	0.00	18.19
26	14,206	17,942	7,473	17	39,638	20.34	16.40	11.07	23.53	16.81
27	13,320	18,837	10,784	136	43,077	19.75	15.31	9.75	10.29	15.27
28	12,815	18,444	14,604	421	46,284	18.94	14.44	9.25	9.50	14.00
29	11,973	17,688	17,483	1,600	48,744	17.92	13.87	8.67	7.88	12.80
30	11,289	16,642	19,456	3,442	50,829	18.38	13.64	8.45	6.22	12.21
31	10,804	15,994	21,026	5,678	53,502	18.19	12.99	7.92	5.13	11.21
32	10,640	15,684	22,161	8,659	57,144	17.73	12.69	7.83	5.49	10.65
33	10,422	15,455	22,237	12,398	60,512	16.75	12.05	7.51	5.32	9.81
34	9,894	15,073	22,117	16,100	63,184	16.18	11.23	7.39	5.12	9.11
35	9,617	14,505	21,650	19,649	65,421	16.29	10.95	7.21	5.01	8.72
36	9,084	13,934	20,859	22,883	66,760	16.15	10.94	6.75	4.87	8.26
37	8,518	13,381	19,798	25,385	67,082	15.47	11.22	6.73	4.76	7.99
38	8,002	12,502	18,957	27,181	66,642	16.01	10.63	6.38	4.30	7.49
39	7,551	11,586	18,005	28,652	65,794	13.89	10.62	6.38	4.39	7.12
40	7,233	10,789	16,949	29,425	64,396	15.82	10.31	5.90	4.19	6.97
41	6,803	10,254	15,976	29,783	62,816	15.54	10.12	5.91	3.86	6.67
42	6,166	9,527	14,817	29,521	60,031	15.44	9.55	5.93	3.88	6.47
43	5,866	8,739	13,582	28,945	57,132	15.55	9.83	5.63	3.81	6.37
44	5,427	8,058	12,803	28,045	54,333	15.16	9.58	5.79	3.79	6.26
45	5,083	7,634	12,015	27,074	51,806	14.89	9.42	5.84	3.80	6.19
46	4,453	6,964	11,086	25,720	48,223	15.14	9.71	5.93	3.55	6.06
47	4,190	6,290	10,321	24,736	45,537	14.89	9.22	5.47	3.65	5.87
48	4,026	5,880	9,791	24,055	43,752	14.48	9.73	5.42	3.75	5.92

Table A.3. Termination by Age and Service										
	Life Years					Termination Proportions				
Age Nearest Birthday	Service < 2	Service = 2, 3, 4	Service = 5-9	Service ≥ 10	Total	Service < 2	Service = 2, 3, 4	Service = 5-9	Service ≥ 10	Overall
49	3,689	5,334	8,969	22,820	40,812	15.32	8.79	5.89	3.70	5.90
50	3,223	4,984	8,047	21,501	37,755	15.79	8.69	5.16	3.46	5.56
51	2,743	4,470	7,275	19,947	34,435	14.98	9.60	5.03	3.32	5.42
52	2,612	3,835	6,739	18,381	31,567	13.74	9.57	5.10	3.23	5.27
53	2,249	3,359	5,947	17,087	28,642	14.05	9.05	4.52	3.43	5.15
54	1,870	2,996	5,280	16,057	26,203	12.83	9.15	4.79	2.77	4.62
55	1,773	2,732	4,712	14,960	24,177	13.42	7.58	1.93	0.33	2.42
56	1,592	2,360	4,220	13,536	21,708	12.37	7.29	1.94	0.24	2.22
57	1,360	2,069	3,717	12,424	19,570	11.84	7.93	1.56	0.14	2.05
58	1,208	1,863	3,199	11,253	17,523	11.92	7.51	1.47	0.25	2.05
59	1,059	1,625	2,846	10,188	15,718	13.22	8.37	2.18	0.43	2.43
60	884	1,427	2,454	9,026	13,791	12.78	7.15	1.92	0.11	1.97
61	768	1,250	2,173	7,704	11,895	12.76	8.80	2.53	0.14	2.30
62	571	977	1,862	6,018	9,428	16.46	10.24	3.49	0.13	2.83
63	386	737	1,490	4,395	7,008	11.92	8.01	2.35	0.27	2.17
64	319	561	1,273	3,512	5,665	11.29	9.80	4.40	0.17	2.70
65	252	409	933	2,518	4,112	12.70	10.02	3.00	0.20	2.58
66	196	327	582	1,411	2,516	12.24	8.87	2.41	0.21	2.78
67	157	266	440	1,046	1,909	15.29	6.77	2.05	0.29	2.83
68	133	209	349	869	1,560	9.77	7.66	3.44	0.23	2.76
69	105	165	274	674	1,218	10.48	12.73	5.11	0.00	3.78
70	88	136	184	456	864	10.23	11.03	5.43	0.00	3.94
Totals	292,355	386,156	454,511	635,290	1,768,312	17.91	12.57	6.70	3.45	8.67

Appendix B. Multinomial Logit Methodology

Because the response, y_i, is a categorical variable, we use a multinomial logit model that is now well-established; see, for example, Greene, (1993, Chapter 21). Specifically, we are interested in understanding the behavior of the end-of-year status. This status may be active, vested termination, retired, non-vested termination, disabled and so forth, depending on the plan. The outcome is categorical, so the numerical value assigned is arbitrary and should not be used in a standard linear regression routine. For example, we use:

$$y_i = \begin{cases} 1 & \text{retired} \\ 2 & \text{termination} \\ 3 & \text{active, death, disability, other} \end{cases} .$$

More generally, one could use c for the number of possible categories of outcomes. Also associated with each individual is $\mathbf{x_i}$, a vector of explanatory variables including age, service, gender and so forth.

Like standard linear regression, multinomial logit models are concerned with linear combinations of explanatory variables of the form:

$$V_{i,j} = \mathbf{x'}_i \boldsymbol{\beta}_j \quad . \tag{B.1}$$

Because outcomes are not numerical, we cannot model the response y as a linear combination of explanatory variables plus an error. Instead we use the probabilities

$$\text{Prob}(y_i = j) = \frac{\exp(V_{i,j})}{\sum_{k=1}^{c} \exp(V_{i,k})} \ , \ j = 1, 2, \ldots, c \tag{B.2}$$

Note here that $\boldsymbol{\beta}_j$ is the corresponding vector of parameters that may depend on type of outcome. Thus, actives will have a set of regression coefficients, as will retirees, and so forth. So that probabilities add up to one, a convenient normalization for this model is $\boldsymbol{\beta}_c = 0$.

Parameter estimates are determined via maximum likelihood, as are standard errors and p-values. We refer the reader to, for example, Greene (1993) for a description of these techniques.

We now describe an interpretation of coefficients in multinomial logit models. Using equation (B.1), assume that there are K explanatory variables and that the kth variable, $x_{i,k}$, is either a 0 or 1. Thus, the vector of explanatory variables is $\mathbf{x}_i = \begin{pmatrix} x_{i,1} & \cdots & x_{i,k} & \cdots & x_{i,K} \end{pmatrix}'$. With the vector of choice variables as $\boldsymbol{\beta}_j = (\beta_{1j}, \ldots, \beta_{K,j})'$, we may express the kth coefficient as:

$$\beta_{k,j} = \begin{pmatrix} x_{i,1} & \cdots & 1 & \cdots & x_{i,K} \end{pmatrix} \boldsymbol{\beta}_j - \begin{pmatrix} x_{i,1} & \cdots & 0 & \cdots & x_{i,K} \end{pmatrix} \boldsymbol{\beta}_j . \tag{B.3}$$

From equations (B.1) and (B.2), we have

$$\frac{\text{Prob}(y_i = j \mid \mathbf{x}_i)}{\text{Prob}(y_i = c \mid \mathbf{x}_i)} = \exp\left(\mathbf{x}_i'\boldsymbol{\beta}_j\right) \quad . \tag{B.4}$$

Equations (B.3) and (B.4) yield

$$\beta_{k,j} = \ln\left(\frac{\text{Prob}(y_i = j \mid x_{i,k} = 1)}{\text{Prob}(y_i = c \mid x_{i,k} = 1)}\right) - \ln\left(\frac{\text{Prob}(y_i = j \mid x_{i,k} = 0)}{\text{Prob}(y_i = c \mid x_{i,k} = 0)}\right).$$

Thus,

$$e^{\beta_{k,j}} = \frac{\text{Prob}(y_i = j \mid x_{i,k} = 1) / \text{Prob}(y_i = c \mid x_{i,k} = 1)}{\text{Prob}(y_i = j \mid x_{i,k} = 0) / \text{Prob}(y_i = c \mid x_{i,k} = 0)}. \tag{B.5}$$

The numerator of the right-hand side of equation (B.5) is interpreted to be the odds of choosing choice *j* compared to choice *c* when $x_{i,k}$ is 1. Similarly, the denominator is interpreted to be the odds of choosing choice *j* compared to choice *c* when $x_{i,k}$ is 0. Thus, the right-hand side of equation (B.5) is interpreted to be the *odds ratio*. Thus, taking logarithms, we have

$$\beta_{k,j} = \ln\left(\frac{\text{Prob}(y_i = j \mid x_{i,k} = 1) / \text{Prob}(y_i = c \mid x_{i,k} = 1)}{\text{Prob}(y_i = j \mid x_{i,k} = 0) / \text{Prob}(y_i = c \mid x_{i,k} = 0)}\right). \tag{B.6}$$

Thus, a regression coefficient is known as the *log odds ratio*.

Fitted values come directly from equation (B.2), with estimators of the regression coefficients $\beta_{k,j}$.

Appendix C. Analysis by Gender

Table C.1 provides multinomial logit parameter estimates. As described in Section 3.1, we use the equations to go from parameter estimates to fitted values.

$$\text{Prob}(y_i = \text{Retirement}) = \frac{\exp(V_{i,\text{Retirement}})}{1+\exp(V_{i,\text{Retirement}})+\exp(V_{i,\text{Termination}})}$$

and

$$\text{Prob}(y_i = \text{Termination}) = \frac{\exp(V_{i,\text{Termination}})}{1+\exp(V_{i,\text{Retirement}})+\exp(V_{i,\text{Termination}})}$$

Table C.1. Multinomial Logit Parameter Estimates by Gender and Service

Service	Male Sample Size	Female Sample Size	Intercept		Slope	
			Male	Female	Male	Female
Termination						
≤1	168,322	114,452	-0.843	-0.938	-0.021	-0.018
2_4	229,797	150,602	-0.820	-0.962	-0.033	-0.029
5_9	257,841	196,264	-1.267	-1.256	-0.033	-0.039
≥10	375,091	260,150	-0.827	-1.065	-0.053	-0.055
Aggregate	1,031,051	721,468	-0.938	-1.075	-0.038	-0.039
Retirement						
≤1			-18.033	-19.610	0.238	0.271
2_4			-18.011	-20.743	0.237	0.285
5_9			-17.394	-20.391	0.245	0.295
≥10			-17.013	-18.905	0.250	0.286
Aggregate			-17.497	-19.805	0.244	0.286

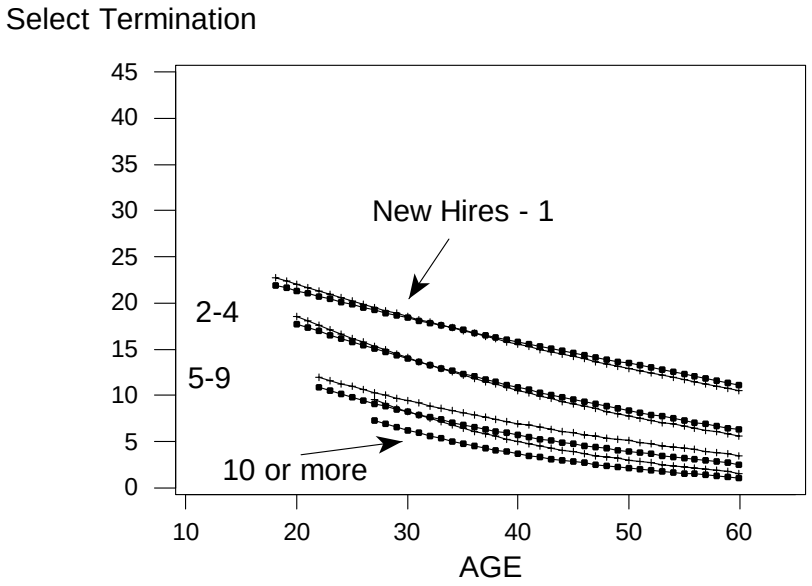

Figure C.1. Select Termination by Gender. Estimated probabilities are in percent. Rates are derived from a multinomial logit model fit with parameter estimates in Table C.1. The solid circles correspond to females, the plus symbols correspond to males.

Appendix D. Analysis by Plan Characteristics

Appendix D.1 Analysis by Eligibility for Postretirement Benefits

Figure D.1a. Aggregate Retirement by Eligibility for Postretirement Benefits and Gender. Estimated probabilities are in percent. Rates are derived from a multinomial logit model fit with the parameter estimates of Table D.1. The solid circles correspond to 'More Than 90 Percent Eligible', the open circles to 'Less Than 10 Percent Eligible', the plus symbols to 'Other Mixture' and the crosses to 'Not Sure'.

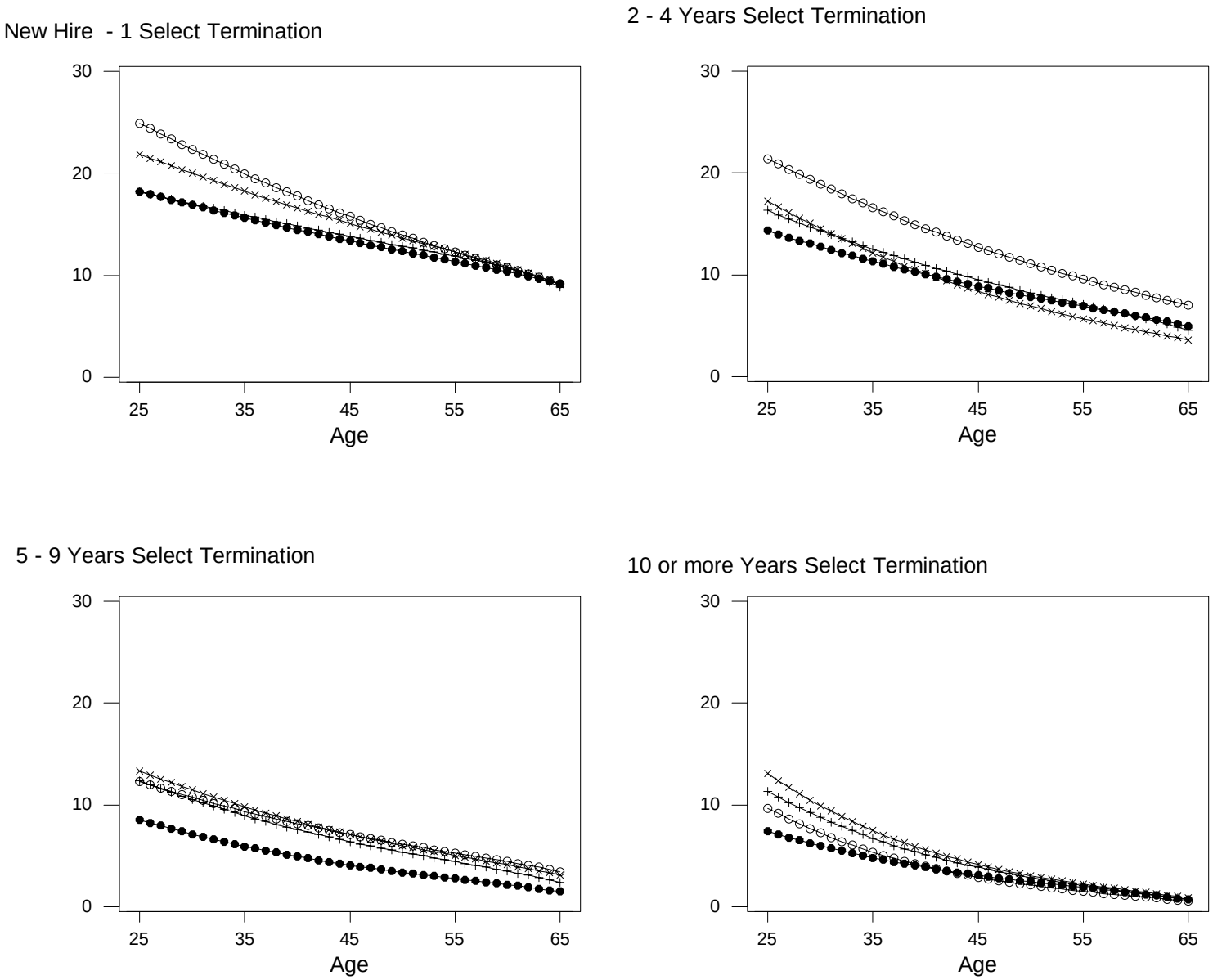

Figure D.1b. Select Termination by Eligibility for Postretirement Benefits and Service. Estimated probabilities are in percent. Rates are derived from a multinomial logit model fit with the parameter estimates of Table D.1a. The solid circles correspond to 'More Than 90 Percemt Eligible', the open circles to 'Less Than 10 Percent Eligible', the plus symbols to 'Other Mixture' and the crosses to 'Not Sure'.

Table D.1 Multinomial Logit Parameter Estimates by Eligbility for Postretirement Health Benefits

Other control variables are gender, age (as a continuous variable) and service (as a discrete variable)

				Intercepts				Slope			
Gender	**Type**	**Service**	**Population**	**More than 90%**	**Less than 10%**	**Other Mixture**	**Not Sure**	**More than 90%**	**Less than 10%**	**Other Mixture**	**Not Sure**
Male	Term	≤1	168,322	-0.892	-0.467	-1.003	-0.850	-0.020	-0.026	-0.017	-0.024
		2_4	229,797	-1.024	-0.417	-0.535	-0.654	-0.027	-0.032	-0.036	-0.046
		5_9	257,841	-1.529	-0.857	-0.835	-1.162	-0.033	-0.037	-0.039	-0.035
		≥10	375,091	-1.368	-0.556	-0.208	-0.671	-0.043	-0.063	-0.062	-0.055
		Aggregate	1,031,051	-0.330	0.093	-0.109	-0.383	-0.056	-0.056	-0.055	-0.053
	Retirement	≤1		-20.456	-20.131	-22.041	-17.000	0.270	0.256	0.308	0.230
		2_4		-24.188	-15.996	-18.999	-18.279	0.338	0.196	0.268	0.238
		5_9		-19.643	-16.332	-18.242	-16.467	0.280	0.221	0.267	0.227
		≥10		-19.208	-15.453	-16.739	-17.411	0.291	0.220	0.250	0.252
		Aggregate		-19.522	-15.447	-17.633	-17.451	0.290	0.212	0.262	0.248
Female	Term	≤1	114,452	-1.262	-0.271	-1.224	-0.491	-0.016	-0.032	-0.016	-0.021
		2_4	150,602	-1.252	-0.678	-1.360	-0.359	-0.026	-0.030	-0.023	-0.034
		5_9	196,264	-1.207	-1.676	-1.345	-0.779	-0.048	-0.021	-0.033	-0.035
		≥10	260,150	-1.404	-0.759	-1.200	0.116	-0.050	-0.065	-0.051	-0.071
		Aggregate	721,468	-0.333	0.544	-0.477	0.094	-0.063	-0.075	-0.056	-0.052
	Retirement	≤1		-22.774	-19.412	-17.916	-19.501	0.311	0.258	0.258	0.267
		2_4		-21.920	-17.825	-19.257	-20.896	0.297	0.222	0.269	0.289
		5_9		-22.263	-19.688	-18.312	-19.609	0.329	0.278	0.263	0.276
		≥10		-20.960	-20.979	-17.449	-17.956	0.323	0.318	0.266	0.263
		Aggregate		-20.905	-19.779	-16.986	-18.349	0.316	0.293	0.253	0.263
Combined	Term	Aggregate	1,752,519	-0.344	0.254	-0.319	-0.038	-0.060	-0.063	-0.054	-0.055
	Retirement	Aggregate		-20.437	-16.635	-17.233	-17.840	0.307	0.235	0.256	0.254

Appendix D.2 Analysis by Benefit Formula

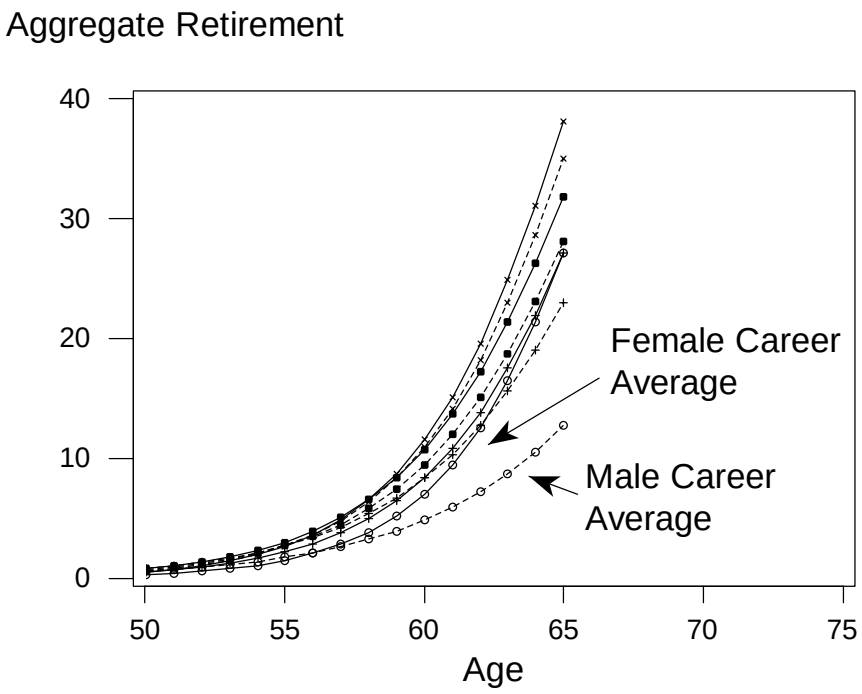

Figure D.2a. Aggregate Retirement by Benefit Formula and Gender. Estimated probabilities are in percent. Rates are derived from a multinomial logit model fit with the parameter estimates of Table D.2. The solid circles correspond to final average, the open circles to career average, the plus symbols to hybrid and the crosses to flat dollar. The solid lines correspond to males and the dotted lines correspond to females.

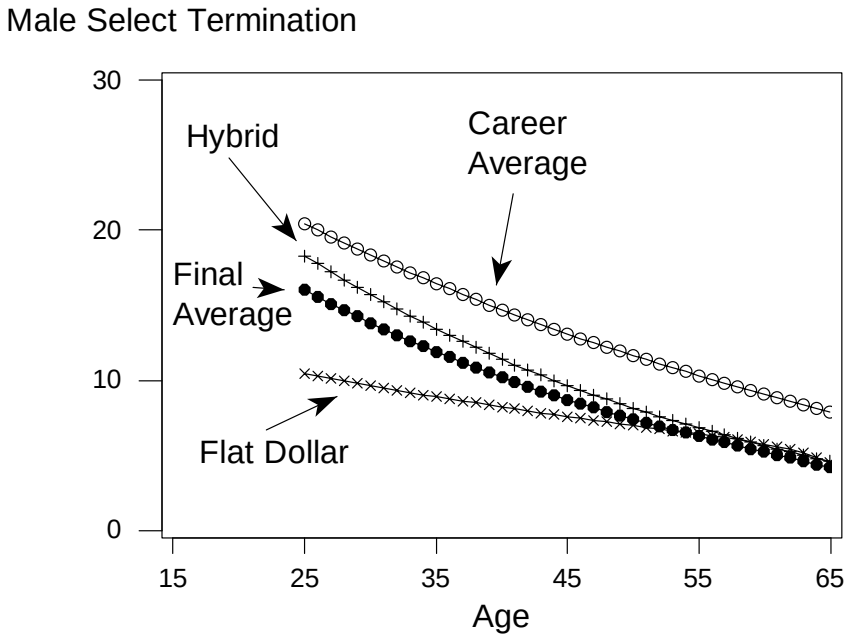

Figure D.2b. Male Select Termination by Benefit Formula, Two to Four Years of Service. Estimated probabilities are in percent. Rates are derived from a multinomial logit model fit with the parameter estimates of Table D.2. The solid circles correspond to final average, the open circles to career average, the plus symbols to hybrid and the crosses to flat dollar.

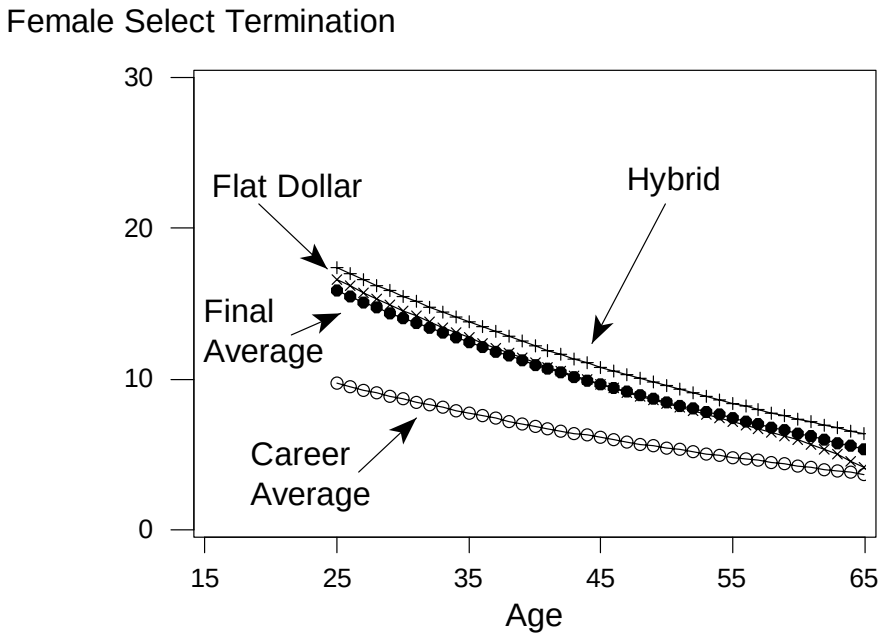

Figure D.2c. Female Select Termination by Benefit Formula, Two to Four Years of Service. Estimated probabilities are in percent. Rates are derived from a multinomial logit model fit with the parameter estimates of Table D.2. The solid circles correspond to final average, the open circles to career average, the plus symbols to hybrid and the crosses to flat dollar.

Table D.2. Multinomial Logit Parameter Estimates by by Benefit Formula

Other control variables are gender, age (as a continuous variable) and service (as a discrete variable)

				Intercepts				Slope			
Gender	Type	Service	Population	Final Avg Pay	Career Avg Pay	Hybrid	Flat Dollar	Final Avg Pay	Career Avg Pay	Hybrid	Flat Dollar
Male	Term	≤1	168,322	-0.851	-0.875	-0.072	-1.955	-0.022	-0.021	-0.037	0.008
		2_4	229,797	-0.794	-0.695	-0.574	-1.716	-0.035	-0.027	-0.037	-0.017
		5_9	257,841	-1.224	-1.290	-1.123	-2.285	-0.034	-0.035	-0.033	-0.013
		≥10	375,091	-0.757	-0.906	-1.098	-1.016	-0.054	-0.058	-0.045	-0.049
		Aggregate	1,031,051	-0.286	-0.372	0.201	-1.365	-0.055	-0.050	-0.063	-0.028
	Retirement	≤1		-20.338	-20.761	-19.635	-18.573	0.269	0.263	0.224	0.279
		2_4		-18.992	-19.121	-15.480	-25.414	0.256	0.241	0.196	0.367
		5_9		-18.383	-16.488	-13.734	-22.414	0.263	0.223	0.184	0.319
		≥10		-17.408	-15.101	-16.874	-19.192	0.258	0.211	0.245	0.291
		Aggregate		-17.979	-15.412	-16.448	-19.688	0.263	0.208	0.235	0.294
Female	Term	≤1	114,452	-0.830	-1.994	-0.153	-1.216	-0.021	-0.009	-0.033	-0.010
		2_4	150,602	-0.959	-1.602	-0.868	-0.839	-0.028	-0.025	-0.028	-0.031
		5_9	196,264	-1.107	-2.432	-1.468	-1.353	-0.043	-0.028	-0.025	-0.026
		≥10	260,150	-1.003	-3.104	-0.746	0.048	-0.056	-0.027	-0.057	-0.074
		Aggregate	721,468	-0.072	-1.028	0.459	-0.350	-0.063	-0.058	-0.071	-0.050
	Retirement	≤1		-18.780	-25.320	-20.201	-22.862	0.255	0.325	0.239	0.335
		2_4		-20.136	-20.302	-15.649	-24.317	0.270	0.261	0.182	0.357
		5_9		-20.192	-23.463	-17.412	-22.378	0.293	0.339	0.236	0.326
		≥10		-18.411	-23.755	-19.730	-20.228	0.279	0.360	0.294	0.309
		Aggregate		-18.237	-21.650	-19.074	-20.497	0.269	0.318	0.278	0.308
Combined	Term	Aggregate	1,752,519	-0.175	-0.791	0.318	-0.552	-0.059	-0.050	-0.067	-0.045
	Retirement	Aggregate		-18.070	-16.969	-17.505	-20.253	0.265	0.235	0.252	0.304

Appendix D.3 Analysis by Industry

Table D.3. Multinomial Logit Parameter Estimates by Industry
Other control variables are gender, age (as a continuous variable) and service (as a discrete variable)

				Intercepts Service				Slope Service			
Gender	**Type**	**Service**	**Population**	**Manufact**	**Trade**	**Service**	**Other**	**Manufact**	**Trade**	**Service**	**Other**
Male	Term	≤1	168,322	-0.878	-0.519	-1.093	-0.824	-0.015	-0.029	-0.021	-0.011
		2_4	229,797	-1.105	-0.586	-1.126	-0.300	-0.019	-0.038	-0.029	-0.039
		5_9	257,841	-1.747	-1.168	-1.210	-0.683	-0.021	-0.040	-0.030	-0.041
		≥10	375,091	-0.458	-0.898	-0.829	0.429	-0.065	-0.055	-0.048	-0.076
		Aggregate	1,031,051	-0.098	-0.027	-0.657	0.077	-0.057	-0.063	-0.044	-0.053
	Retirement	≤1		-19.821	-18.840	-23.685	-17.382	0.274	0.236	0.307	0.256
		2_4		-25.376	-17.529	-17.604	-18.161	0.361	0.229	0.222	0.256
		5_9		-20.115	-17.772	-16.059	-20.411	0.291	0.250	0.222	0.300
		≥10		-17.518	-16.680	-17.332	-18.366	0.264	0.244	0.252	0.277
		Aggregate		-18.380	-16.911	-17.386	-18.567	0.274	0.242	0.248	0.277
Female	Term	≤1	114,452	-1.371	-0.695	-0.944	-0.737	-0.014	-0.022	-0.021	-0.019
		2_4	150,602	-1.422	-0.843	-0.881	-0.501	-0.020	-0.031	-0.029	-0.036
		5_9	196,264	-1.716	-0.917	-1.000	-0.899	-0.029	-0.052	-0.033	-0.034
		≥10	260,150	-1.244	-0.957	-1.019	0.703	-0.054	-0.061	-0.043	-0.084
		Aggregate	721,468	-0.418	0.139	-0.385	-0.040	-0.060	-0.070	-0.047	-0.052
	Retirement	≤1		-19.606	-19.733	-18.570	-21.427	0.282	0.252	0.246	0.312
		2_4		-24.998	-19.704	-17.598	-23.376	0.350	0.260	0.230	0.342
		5_9		-22.928	-20.838	-16.269	-21.663	0.336	0.303	0.224	0.317
		≥10		-18.299	-20.505	-17.468	-18.072	0.278	0.313	0.258	0.272
		Aggregate		-18.830	-19.448	-17.029	-19.127	0.283	0.287	0.244	0.284
Combined	Term	Aggregate	1,752,519	-0.354	0.066	-0.564	-0.012	-0.058	-0.067	-0.045	-0.052
	Retirement	Aggregate		-18.715	-18.089	-17.270	-18.916	0.281	0.263	0.247	0.281

Appendix D.4 Analysis by Plan Size

Table D.4. Multinomial Logit Parameter Estimates by Plan Size
Other control variables are gender, age (as a continuous variable) and service (as a discrete variable)

				Intercepts			Slope		
Gender	**Type**	**Service**	**Population**	**Large**	**Medium**	**Small**	**Large**	**Medium**	**Small**
Male	Term	≤1	168,322	-1.085	-0.547	-0.128	-0.016	-0.027	-0.033
		2_4	229,797	-0.800	-0.783	-0.524	-0.036	-0.031	-0.031
		5_9	257,841	-1.228	-1.373	-0.765	-0.035	-0.031	-0.033
		≥10	375,091	-0.885	-0.801	-0.752	-0.050	-0.057	-0.052
		Aggregate	1,031,051	-0.444	-0.073	0.243	-0.051	-0.058	-0.059
	Retirement	≤1		-19.184	-18.348	-19.106	0.266	0.229	0.242
		2_4		-20.078	-15.904	-18.198	0.275	0.198	0.243
		5_9		-18.758	-15.333	-18.649	0.270	0.205	0.265
		≥10		-17.409	-16.267	-18.440	0.258	0.236	0.269
		Aggregate		-18.155	-15.847	-18.732	0.266	0.222	0.270
Female	Term	≤1	114,452	-0.952	-0.935	-0.659	-0.018	-0.020	-0.023
		2_4	150,602	-0.919	-1.130	-1.116	-0.030	-0.026	-0.020
		5_9	196,264	-1.043	-1.869	-1.854	-0.045	-0.022	-0.015
		≥10	260,150	-1.229	-1.067	-0.836	-0.049	-0.061	-0.055
		Aggregate	721,468	-0.219	0.009	-0.190	-0.058	-0.069	-0.055
	Retirement	≤1		-19.958	-18.762	-18.013	0.280	0.247	0.225
		2_4		-21.621	-17.336	-22.418	0.301	0.221	0.311
		5_9		-20.733	-19.117	-20.999	0.302	0.269	0.301
		≥10		-19.031	-19.195	-18.842	0.290	0.291	0.276
		Aggregate		-18.812	-18.559	-19.413	0.278	0.276	0.282
Combined	Term	Aggregate	1,752,519	-0.311	-0.043	-0.010	-0.055	-0.063	-0.056
	Retirement	Aggregate		-18.492	-16.868	-19.081	0.272	0.243	0.276

Appendix D.5 Analysis by Hourly/Salary and Union Status

Table D.5. Multinomial Logit Parameter Estimates by Hourly/Salary and Union Status
Other control variables are gender, age (as a continuous variable) and service (as a discrete variable)

				Intercepts					Slopes				
Gender	Type	Service	Population	Salaried	Hourly union	Hourly Non-union	Other Combination	Don't Know	Salaried	Hourly union	Hourly Non-union	Other Combination	Don't Know
Male	Term	≤1	168,322	-1.097	-2.283	-0.295	-0.794	-0.509	-0.025	-0.053	-0.017	-0.021	-0.016
		2_4	229,797	-0.961	-2.124	-0.055	-1.043	-0.875	-0.037	-0.059	-0.036	-0.024	-0.020
		5_9	257,841	-0.934	-3.293	-0.400	-1.560	-1.537	-0.040	-0.022	-0.042	-0.030	-0.016
		≥10	375,091	-0.475	-3.443	-0.084	-1.327	-0.192	-0.059	-0.023	-0.067	-0.043	-0.065
		Aggregate	1,031,051	-0.510	-2.856	0.154	-0.422	-0.043	-0.051	-0.035	-0.043	-0.051	-0.049
	Retirement	≤1		-21.184	-13.425	-12.690	-19.375	-17.210	0.276	-0.128	-0.175	0.244	0.247
		2_4		-17.410	-18.965	-31.215	-20.144	-21.081	0.233	-0.003	0.412	0.261	0.294
		5_9		-17.147	-22.939	-26.303	-17.809	-17.528	0.244	0.306	0.378	0.247	0.245
		≥10		-17.026	-18.911	-22.266	-16.883	-17.006	0.250	0.284	0.330	0.245	0.255
		Aggregate		-17.465	-19.025	-22.366	-16.853	-17.215	0.254	0.277	0.312	0.237	0.253
Female	Term	≤1	114,452	-0.998	-2.416	-0.462	-1.157	-0.745	-0.024	-0.022	-0.012	-0.018	-0.017
		2_4	150,602	-1.258	-2.024	-0.420	-1.204	-0.767	-0.026	-0.047	-0.024	-0.026	-0.029
		5_9	196,264	-1.327	-3.803	-0.594	-1.117	-1.198	-0.033	-0.002	-0.033	-0.049	-0.027
		≥10	260,150	-1.214	-2.635	-0.615	-1.394	-0.060	-0.050	-0.040	-0.049	-0.049	-0.070
		Aggregate	721,468	-0.423	-1.924	-0.182	-0.302	-0.115	-0.056	-0.051	-0.031	-0.062	-0.053
	Retirement	≤1		-19.402	-14.405	-17.078	-21.447	-18.962	0.267	-0.128	-0.046	0.284	0.273
		2_4		-18.316	-21.050	-28.578	-20.442	-23.510	0.247	0.279	0.377	0.271	0.342
		5_9		-18.215	-26.049	-23.281	-21.815	-20.122	0.259	0.382	0.328	0.322	0.288
		≥10		-17.880	-21.763	-21.197	-21.958	-16.006	0.265	0.336	0.315	0.338	0.241
		Aggregate		-17.760	-21.757	-21.689	-21.147	-16.413	0.259	0.334	0.298	0.318	0.242
Combined	Term	Aggregate	1,752,519	-0.483	-2.161	-0.106	-0.381	-0.092	-0.053	-0.047	-0.034	-0.057	-0.051
	Retirement	Aggregate		-17.579	-20.858	-21.740	-18.704	-16.655	0.256	0.316	0.299	0.272	0.245

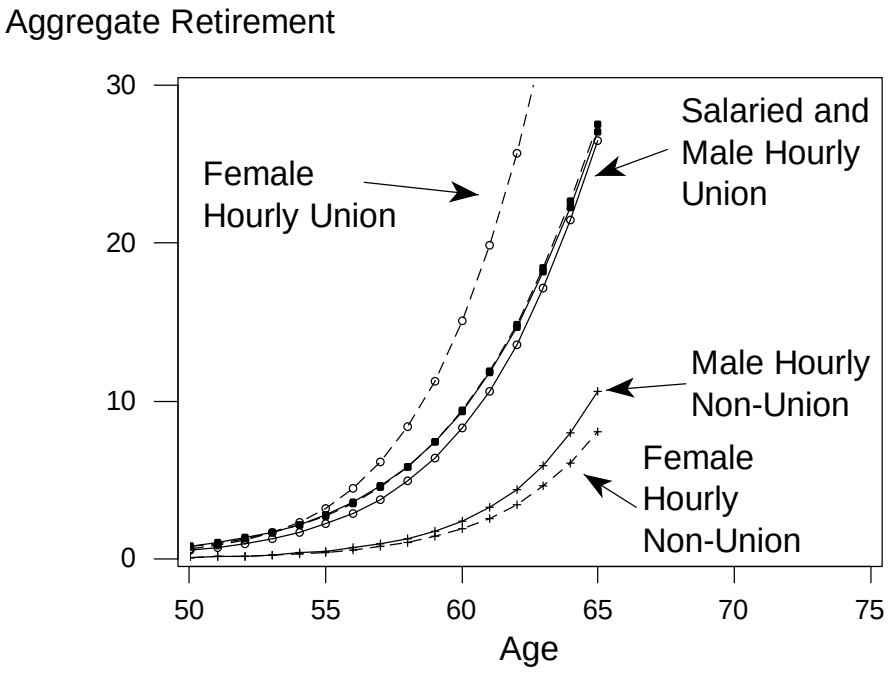

Figure D.5a. Aggregate Retirement by Hourly/Salary and Union Status. Estimated probabilities are in percent. Rates are derived from a multinomial logit model fit with parameter estimates in Table D.5. The dashed lines correspond to females, the solid lines to males. For hourly union workers, females have higher retirement probabilities than males. For non-hourly and salaried workers, there is little difference between males and females.

Appendix D.6 Analysis by Prior Information

	Table D.6a. Multinomial Logit Parameter Estimates by Prior Information								
	Other control variables are gender, age (as a continuous variable) and service (as a discrete variable)								
					Intercepts			Slopes	
Gender	**Type**	**Service**	**Population**	**Low**	**Intermediate**	**High**	**Low**	**Intermediate**	**High**
Male	Term	≤1	168,322	-2.814	-0.801	0.231	-0.021	-0.022	-0.024
		2_4	229,797	-1.621	-0.780	-0.188	-0.062	-0.033	-0.029
		5_9	257,841	-2.761	-1.187	-0.459	-0.032	-0.034	-0.031
		≥10	375,091	-2.085	-0.754	0.354	-0.049	-0.054	-0.066
		Aggregate	1,031,051	-2.280	-0.251	0.809	-0.043	-0.054	-0.059
	Retirement	≤1		-14.177	-17.871	-16.856	-0.009	0.236	0.197
		2_4		-15.593	-17.784	-23.380	-0.024	0.233	0.332
		5_9		-23.468	-17.217	-18.124	0.326	0.242	0.265
		≥10		-21.003	-16.869	-18.696	0.319	0.247	0.278
		Aggregate		-20.831	-17.081	-19.060	0.306	0.246	0.281
Female	Term	≤1	114,452	-3.480	-0.797	0.248	0.001	-0.020	-0.026
		2_4	150,602	-2.491	-0.897	-0.595	-0.036	-0.029	-0.017
		5_9	196,264	-3.367	-1.116	-1.010	-0.023	-0.040	-0.015
		≥10	260,150	-3.233	-0.871	1.516	-0.035	-0.058	-0.090
		Aggregate	721,468	-2.501	-0.049	0.913	-0.043	-0.061	-0.064
	Retirement	≤1		-15.804	-19.429	-16.094	0.006	0.269	0.211
		2_4		-35.607	-20.475	-28.336	0.503	0.281	0.407
		5_9		-28.967	-20.080	-16.599	0.428	0.290	0.234
		≥10		-21.796	-18.747	-18.154	0.332	0.284	0.268
		Aggregate		-22.487	-18.541	-17.847	0.339	0.274	0.259
Combined	Term	Aggregate	1,752,519	-2.435	-0.144	0.855	-0.043	-0.058	-0.061
	Retirement	Aggregate		-21.941	-17.735	-18.524	0.328	0.258	0.271

Table D.6b. Estimated Probabilities from the Multinomial Logit Fit by Prior Information						
	Termination Probabilities, in Percent			Retirement Probabilities, in Percent		
Age	Low	Intermediate	High	Low	Intermediate	High
25	2.9	16.9	33.8	0.0	0.0	0.0
26	2.8	16.1	32.5	0.0	0.0	0.0
27	2.7	15.3	31.1	0.0	0.0	0.0
28	2.6	14.6	29.8	0.0	0.0	0.0
29	2.5	13.9	28.6	0.0	0.0	0.0
30	2.4	13.2	27.4	0.0	0.0	0.0
31	2.3	12.5	26.2	0.0	0.0	0.0
32	2.2	11.9	25.0	0.0	0.0	0.0
33	2.1	11.3	23.9	0.0	0.0	0.0
34	2.0	10.8	22.8	0.0	0.0	0.0
35	1.9	10.2	21.7	0.0	0.0	0.0
36	1.9	9.7	20.7	0.0	0.0	0.0
37	1.8	9.2	19.7	0.0	0.0	0.0
38	1.7	8.7	18.8	0.0	0.0	0.0
39	1.6	8.3	17.9	0.0	0.0	0.0
40	1.6	7.8	17.0	0.0	0.1	0.0
41	1.5	7.4	16.1	0.0	0.1	0.1
42	1.5	7.0	15.3	0.0	0.1	0.1
43	1.4	6.7	14.5	0.0	0.1	0.1
44	1.3	6.3	13.8	0.1	0.2	0.1
45	1.3	6.0	13.1	0.1	0.2	0.2
46	1.2	5.7	12.4	0.1	0.3	0.2
47	1.2	5.3	11.7	0.1	0.4	0.3
48	1.1	5.1	11.1	0.2	0.5	0.4
49	1.1	4.8	10.5	0.3	0.6	0.5
50	1.0	4.5	9.9	0.4	0.8	0.6
51	1.0	4.3	9.4	0.5	1.0	0.8
52	0.9	4.0	8.9	0.7	1.3	1.1
53	0.9	3.8	8.3	1.0	1.7	1.4
54	0.9	3.6	7.9	1.4	2.2	1.9
55	0.8	3.3	7.4	2.0	2.8	2.5
56	0.8	3.1	6.9	2.7	3.6	3.2
57	0.7	2.9	6.5	3.7	4.6	4.2
58	0.7	2.7	6.0	5.1	5.9	5.5
59	0.7	2.5	5.6	6.9	7.5	7.1
60	0.6	2.4	5.2	9.3	9.5	9.2
61	0.6	2.2	4.7	12.5	12.0	11.7
62	0.5	2.0	4.3	16.5	15.0	14.9
63	0.5	1.8	3.9	21.6	18.7	18.7
64	0.4	1.6	3.5	27.6	22.9	23.2
65	0.4	1.4	3.0	34.7	27.8	28.5

Appendix E. Illustrative Tables

This section provides several illustrative tables using the multinomial fits developed in Section 4. Specifically, we provide aggregate tables by age, aggregate tables by service and select and ultimate tables by age and service for selected subgroups. The subgroups are small plans (1000 lives or less), salaried workers, union hourly and nonunion hourly, considered in Appendices E.1-E.4, respectively.

Parameter estimates that were used to produce these illustrative tables are summarized in Appendix E.5.

Appendix E.1 Small Plan Tables

Table E.1a. Small Plan (1000 lives or less)
Aggregate Turnover by Age
Probabilities from Fitted Multinomial Logit Models

Age Nearest Birthday	Total Life Years	Estimated Turnover Probabilities, in Percent	
		Termination	Retired
18	33	26.4	0.0
19	74	25.4	0.0
20	176	24.3	0.0
21	410	23.3	0.0
22	649	22.3	0.0
23	917	21.3	0.0
24	1,256	20.4	0.0
25	1,433	19.5	0.0
26	1,659	18.6	0.0
27	1,799	17.8	0.0
28	1,864	17.0	0.0
29	1,955	16.2	0.0
30	2,082	15.5	0.0
31	2,114	14.7	0.0
32	2,281	14.0	0.0
33	2,436	13.4	0.0
34	2,579	12.7	0.0
35	2,646	12.1	0.0
36	2,704	11.5	0.0
37	2,753	11.0	0.0
38	2,773	10.4	0.0
39	2,823	9.9	0.0
40	2,840	9.4	0.0
41	2,864	9.0	0.0
42	2,814	8.5	0.1
43	2,632	8.1	0.1
44	2,541	7.7	0.1

Table E.1a. Small Plan (1000 lives or less)
Aggregate Turnover by Age
Probabilities from Fitted Multinomial Logit Models

Age Nearest Birthday	Total Life Years	Estimated Turnover Probabilities, in Percent	
		Termination	Retired
45	2,431	7.3	0.1
46	2,340	6.9	0.2
47	2,265	6.6	0.2
48	2,335	6.2	0.3
49	2,222	5.9	0.4
50	2,123	5.6	0.5
51	1,948	5.3	0.6
52	1,784	5.0	0.8
53	1,596	4.7	1.1
54	1,515	4.5	1.5
55	1,449	4.2	1.9
56	1,376	4.0	2.5
57	1,269	3.7	3.3
58	1,194	3.5	4.3
59	1,082	3.3	5.6
60	992	3.0	7.3
61	890	2.8	9.4
62	734	2.6	12.1
63	538	2.3	15.4
64	423	2.1	19.3
65	290	1.9	24.0
66	183	1.7	29.5
67	130	1.4	35.5
68	118	1.2	42.1
69	92	1.0	49.0
70	63	0.8	55.9
Total	82,489	9.9	*4.6

** Average retirement estimated probability is based on ages 49-70, inclusive.*

Table E.1b. Small Plan (1000 lives or less)
Aggregate Turnover by Service
Probabilities from Fitted Multinomial Logit Models

Completed Years of Service	Total Life Years	Estimated Turnover Probabilities, in Percent	
		Termination	Retired
new hires	845	21.6	0.2
0	3,260	19.8	0.2
1	7,989	18.1	0.3
2	6,697	16.5	0.3
3	5,601	15.0	0.3
4	4,959	13.6	0.4
5	4,300	12.3	0.4
6	4,031	11.2	0.5

Table E.1b. Small Plan (1000 lives or less)
Aggregate Turnover by Service
Probabilities from Fitted Multinomial Logit Models

Completed Years of Service	Total Life Years	Estimated Turnover Probabilities, in Percent	
		Termination	Retired
7	3,845	10.1	0.5
8	3,801	9.1	0.6
9	3,529	8.2	0.7
10	3,036	7.4	0.8
11	2,665	6.7	0.8
12	2,347	6.0	0.9
13	2,038	5.4	1.1
14	1,876	4.9	1.2
15	1,786	4.4	1.3
16	1,815	3.9	1.4
17	1,791	3.5	1.6
18	1,793	3.2	1.8
19	1,699	2.8	2.0
20	1,528	2.5	2.2
21	1,433	2.3	2.4
22	1,344	2.0	2.7
23	1,176	1.8	3.0
24	1,064	1.6	3.3
25	955	1.4	3.6
26	798	1.3	4.0
27	606	1.1	4.5
28	561	1.0	4.9
29	531	0.9	5.4
30	474	0.8	6.0
31	391	0.7	6.6
32	353	0.6	7.3
33	291	0.6	8.0
34	250	0.5	8.8
35	192	0.4	9.6
36	164	0.4	10.6
37	142	0.3	11.6
38	127	0.3	12.7
39	101	0.3	13.9
40	72	0.2	15.1
41	69	0.2	16.5
42	56	0.2	18.0
43	37	0.2	19.5
44	23	0.1	21.2
45	17	0.1	23.0
46	7	0.1	24.8
47	8	0.1	26.8
48	7	0.1	28.8
49	3	0.1	31.0
50	3	0.1	33.2
51	3	0.1	35.5
Total	82,489	9.9	1.3

Table E.1c. Small Plan (1000 lives or less) Select Turnover by Age and Service Probabilities from Fitted Multinomial Logit Models

Age Nearest Birthday	Service < 2			Service = 2, 3, 4			Service = 5-9			Service ≥ 10		
	Total Life Years	Termination	Retired	Total Life Years	Termination	Retired	Total Life Years	Termination	Retired	Total Life Years	Termination	Retired
18	33	28.4	0.0									
19	72	27.9	0.0	2	21.0	0.0						
20	159	27.3	0.0	17	20.6	0.0						
21	291	26.8	0.0	117	20.2	0.0	2	13.7	0.0			
22	376	26.2	0.0	267	19.8	0.0	6	13.4	0.0			
23	528	25.7	0.0	371	19.4	0.0	18	13.2	0.0			
24	662	25.2	0.0	519	19.0	0.0	75	12.9	0.0			
25	640	24.7	0.0	645	18.6	0.0	148	12.6	0.0			
26	637	24.1	0.0	725	18.3	0.0	296	12.4	0.0	1	9.9	0.0
27	545	23.6	0.0	806	17.9	0.0	446	12.1	0.0	2	9.5	0.0
28	493	23.1	0.0	771	17.5	0.0	583	11.9	0.0	17	9.0	0.0
29	444	22.7	0.0	710	17.2	0.0	737	11.7	0.0	64	8.6	0.0
30	451	22.2	0.0	658	16.8	0.0	814	11.4	0.0	159	8.2	0.0
31	436	21.7	0.0	615	16.5	0.0	815	11.2	0.0	248	7.8	0.0
32	428	21.2	0.0	646	16.2	0.0	835	11.0	0.0	372	7.4	0.0
33	395	20.8	0.0	668	15.8	0.0	869	10.8	0.0	504	7.1	0.0
34	388	20.3	0.0	652	15.5	0.0	890	10.5	0.0	649	6.7	0.0
35	388	19.9	0.0	585	15.2	0.0	872	10.3	0.0	801	6.4	0.0
36	384	19.5	0.0	559	14.9	0.0	818	10.1	0.0	943	6.1	0.0
37	359	19.0	0.0	580	14.5	0.0	751	9.9	0.0	1,063	5.8	0.0
38	301	18.6	0.0	560	14.2	0.0	693	9.7	0.0	1,219	5.5	0.0
39	311	18.2	0.0	537	13.9	0.0	688	9.5	0.0	1,287	5.2	0.0
40	293	17.8	0.0	487	13.6	0.0	726	9.3	0.0	1,334	5.0	0.0
41	276	17.4	0.0	503	13.4	0.0	692	9.1	0.0	1,393	4.7	0.1
42	267	17.0	0.0	474	13.1	0.0	649	8.9	0.0	1,424	4.5	0.1
43	257	16.6	0.0	416	12.8	0.0	576	8.8	0.0	1,383	4.3	0.1
44	251	16.2	0.0	378	12.5	0.0	539	8.6	0.1	1,373	4.1	0.1
45	212	15.9	0.0	365	12.3	0.0	536	8.4	0.1	1,318	3.9	0.2
46	210	15.5	0.0	357	12.0	0.1	503	8.2	0.1	1,270	3.7	0.2
47	191	15.1	0.0	354	11.7	0.1	467	8.1	0.1	1,253	3.5	0.3
48	195	14.8	0.1	358	11.5	0.1	456	7.9	0.2	1,326	3.3	0.4

Table E.1c. Small Plan (1000 lives or less) Select Turnover by Age and Service Probabilities from Fitted Multinomial Logit Models

Age Nearest Birthday	Service < 2			Service = 2, 3, 4			Service = 5-9			Service ≥ 10		
	Total Life Years	Termination	Retired	Total Life Years	Termination	Retired	Total Life Years	Termination	Retired	Total Life Years	Termination	Retired
49	173	14.4	0.1	308	11.2	0.1	423	7.7	0.3	1,318	3.1	0.5
50	155	14.1	0.1	317	11.0	0.2	395	7.5	0.3	1,256	3.0	0.6
51	128	13.8	0.1	285	10.7	0.2	384	7.4	0.4	1,151	2.8	0.8
52	101	13.4	0.1	224	10.5	0.3	361	7.2	0.6	1,098	2.7	1.1
53	102	13.1	0.2	179	10.2	0.3	321	7.1	0.8	994	2.5	1.4
54	91	12.8	0.2	175	10.0	0.4	289	6.9	1.0	960	2.4	1.9
55	90	12.5	0.3	159	9.8	0.6	253	6.7	1.3	947	2.3	2.5
56	74	12.2	0.4	155	9.5	0.8	231	6.6	1.8	916	2.1	3.2
57	57	11.9	0.5	132	9.3	1.0	222	6.4	2.3	858	2.0	4.2
58	56	11.6	0.6	120	9.1	1.3	186	6.2	3.1	832	1.9	5.4
59	48	11.3	0.7	115	8.8	1.7	161	6.0	4.0	758	1.8	7.0
60	34	11.0	0.9	97	8.6	2.3	160	5.8	5.3	701	1.6	9.0
61	30	10.7	1.2	85	8.3	2.9	158	5.6	6.9	617	1.5	11.5
62	28	10.4	1.5	62	8.1	3.8	139	5.4	8.9	505	1.4	14.6
63	17	10.1	1.9	47	7.8	5.0	103	5.1	11.4	371	1.2	18.4
64	9	9.8	2.3	26	7.5	6.4	81	4.8	14.6	307	1.1	22.9
65	8	9.5	3.0	13	7.2	8.3	52	4.5	18.5	217	1.0	28.0
66	7	9.2	3.7	16	6.9	10.6	29	4.1	23.1	131	0.9	33.9
67	2	8.9	4.6	13	6.5	13.5	18	3.8	28.4	97	0.7	40.2
68	4	8.6	5.8	12	6.1	17.0	18	3.4	34.5	84	0.6	46.9
69	5	8.2	7.2	8	5.6	21.2	13	3.0	41.1	66	0.5	53.8
70	2	7.9	9.0	7	5.2	26.1	9	2.6	48.0	45	0.4	60.4
Totals	12,094	20.6	0.4	17,257	14.8	1.2	19,506	9.4	3.2	33,632	3.8	5.9

Appendix E.2 Salaried Workers Tables

Table E.2a. Salaried Workers Aggregate Turnover by Age
Probabilities from Fitted Multinomial Logit Models

Age Nearest Birthday	Total Life Years	Estimated Turnover Probabilities, in Percent	
		Termination	Retired
18	201	19.2	0.0
19	435	18.4	0.0
20	943	17.6	0.0
21	1,860	16.8	0.0
22	3,463	16.1	0.0
23	5,573	15.4	0.0
24	8,001	14.7	0.0
25	10,161	14.1	0.0
26	11,535	13.4	0.0
27	12,578	12.8	0.0
28	13,545	12.2	0.0
29	14,331	11.7	0.0
30	14,878	11.1	0.0
31	15,795	10.6	0.0
32	16,848	10.1	0.0
33	17,678	9.7	0.0
34	18,171	9.2	0.0
35	18,627	8.8	0.0
36	18,941	8.4	0.0
37	19,220	8.0	0.0
38	19,362	7.6	0.0
39	19,414	7.2	0.0
40	19,627	6.9	0.1
41	19,631	6.5	0.1
42	19,237	6.2	0.1
43	18,843	5.9	0.1
44	18,191	5.6	0.2
45	17,593	5.3	0.2
46	16,810	5.1	0.3
47	16,299	4.8	0.4
48	16,170	4.6	0.5
49	15,263	4.3	0.6
50	14,418	4.1	0.8
51	13,380	3.9	1.0
52	12,384	3.7	1.3
53	11,495	3.5	1.7
54	10,621	3.3	2.2
55	9,818	3.1	2.8
56	8,800	2.9	3.6

Table E.2a. Salaried Workers Aggregate Turnover by Age
Probabilities from Fitted Multinomial Logit Models

Age Nearest Birthday	Total Life Years	Estimated Turnover Probabilities, in Percent	
		Termination	Retired
57	7,993	2.8	4.6
58	7,181	2.6	5.8
59	6,397	2.4	7.4
60	5,644	2.3	9.4
61	4,842	2.1	11.8
62	4,041	1.9	14.7
63	3,287	1.7	18.3
64	2,760	1.6	22.4
65	1,986	1.4	27.2
66	1,195	1.2	32.6
67	881	1.1	38.4
68	694	0.9	44.6
69	525	0.8	51.0
70	371	0.6	57.4
Total	567,937	7.2	*5.4

** Average retirement estimated probability is based on ages 49-70, inclusive.*

Table E.2b. Salaried Workers Aggregate Turnover by Service
Probabilities from Fitted Multinomial Logit Models

Completed Years of Service	Total Life Years	Estimated Turnover Probabilities, in Percent	
		Termination	Retired
new hires	3,167	13.7	0.2
0	23,414	12.7	0.3
1	56,864	11.9	0.3
2	44,259	11.0	0.4
3	36,609	10.2	0.4
4	32,745	9.5	0.5
5	30,497	8.8	0.5
6	29,884	8.2	0.6
7	28,874	7.5	0.7
8	27,451	7.0	0.7
9	25,020	6.5	0.8
10	21,868	6.0	0.9
11	19,028	5.5	1.0
12	16,002	5.1	1.2
13	14,291	4.7	1.3
14	13,618	4.3	1.5
15	14,132	4.0	1.7
16	14,526	3.7	1.9
17	14,899	3.4	2.1
18	14,498	3.1	2.4
19	13,072	2.9	2.6

Table E.2b. Salaried Workers Aggregate Turnover by Service Probabilities from Fitted Multinomial Logit Models

Completed Years of Service	Total Life Years	Estimated Turnover Probabilities, in Percent	
		Termination	Retired
20	11,517	2.7	3.0
21	10,072	2.4	3.3
22	8,909	2.2	3.7
23	7,615	2.1	4.1
24	6,461	1.9	4.6
25	5,556	1.7	5.1
26	4,564	1.6	5.7
27	3,899	1.5	6.4
28	3,276	1.3	7.1
29	2,641	1.2	7.9
30	2,046	1.1	8.8
31	1,542	1.0	9.8
32	1,179	0.9	10.8
33	883	0.8	12.0
34	662	0.8	13.3
35	542	0.7	14.6
36	437	0.6	16.1
37	333	0.6	17.7
38	253	0.5	19.5
39	223	0.5	21.3
40	161	0.4	23.3
41	143	0.4	25.4
42	113	0.3	27.6
43	79	0.3	30.0
44	55	0.3	32.4
45	28	0.2	35.0
46	13	0.2	37.6
47	7	0.2	40.3
48	3	0.2	43.1
49	2	0.1	45.9
50	3	0.1	48.8
51	2	0.1	51.6
Total	567,937	7.2	1.4

Table E.2c. Salaried Workers Select Turnover by Age and Service Probabilities from Fitted Multinomial Logit Models

Age Nearest Birthday	Service < 2			Service = 2, 3, 4			Service = 5-9			Service ≥ 10		
	Total Life Years	Termination	Retired	Total Life Years	Termination	Retired	Total Life Years	Termination	Retired	Total Life Years	Termination	Retired
18	182	18.4	0.0	19	15.9	0.0						
19	351	18.0	0.0	84	15.5	0.0						
20	707	17.7	0.0	234	15.1	0.0	2	13.7	0.0			
21	1,179	17.3	0.0	665	14.6	0.0	16	13.3	0.0			
22	2,038	17.0	0.0	1,312	14.2	0.0	113	12.9	0.0			
23	3,297	16.7	0.0	1,957	13.9	0.0	319	12.5	0.0			
24	4,282	16.3	0.0	2,965	13.5	0.0	754	12.1	0.0			
25	4,273	16.0	0.0	4,397	13.1	0.0	1,489	11.7	0.0	2	10.3	0.0
26	4,236	15.7	0.0	4,978	12.7	0.0	2,311	11.3	0.0	10	9.8	0.0
27	3,956	15.3	0.0	5,352	12.4	0.0	3,177	11.0	0.0	93	9.3	0.0
28	3,876	15.0	0.0	5,155	12.0	0.0	4,268	10.6	0.0	246	8.9	0.0
29	3,699	14.7	0.0	5,017	11.7	0.0	5,009	10.3	0.0	606	8.4	0.0
30	3,452	14.4	0.0	4,638	11.4	0.0	5,687	9.9	0.0	1,101	8.0	0.0
31	3,373	14.1	0.0	4,546	11.1	0.0	6,160	9.6	0.0	1,716	7.6	0.0
32	3,376	13.8	0.0	4,511	10.7	0.0	6,369	9.3	0.0	2,592	7.2	0.0
33	3,144	13.5	0.0	4,448	10.4	0.0	6,326	9.0	0.0	3,760	6.9	0.0
34	2,935	13.3	0.0	4,308	10.1	0.0	6,071	8.7	0.0	4,857	6.5	0.0
35	2,719	13.0	0.0	4,157	9.9	0.0	5,852	8.4	0.0	5,899	6.2	0.0
36	2,618	12.7	0.0	3,937	9.6	0.0	5,602	8.1	0.0	6,784	5.9	0.0
37	2,384	12.4	0.0	3,825	9.3	0.0	5,382	7.8	0.0	7,629	5.6	0.0
38	2,250	12.2	0.0	3,581	9.0	0.0	5,222	7.6	0.0	8,309	5.3	0.0
39	2,201	11.9	0.0	3,365	8.8	0.0	5,005	7.3	0.0	8,843	5.0	0.1
40	2,125	11.7	0.0	3,252	8.5	0.0	4,895	7.1	0.1	9,355	4.8	0.1
41	2,002	11.4	0.0	3,199	8.3	0.0	4,787	6.8	0.1	9,643	4.5	0.1
42	1,806	11.2	0.0	3,103	8.0	0.0	4,583	6.6	0.1	9,745	4.3	0.1
43	1,794	10.9	0.0	2,944	7.8	0.1	4,411	6.4	0.1	9,694	4.1	0.2
44	1,555	10.7	0.0	2,692	7.6	0.1	4,320	6.2	0.1	9,624	3.9	0.2
45	1,514	10.5	0.0	2,565	7.3	0.1	4,080	5.9	0.2	9,434	3.7	0.3
46	1,357	10.2	0.0	2,380	7.1	0.1	3,930	5.7	0.2	9,143	3.5	0.4
47	1,368	10.0	0.1	2,147	6.9	0.1	3,764	5.5	0.3	9,020	3.3	0.5
48	1,317	9.8	0.1	2,146	6.7	0.2	3,605	5.3	0.4	9,102	3.1	0.6

Table E.2c. Salaried Workers Select Turnover by Age and Service
Probabilities from Fitted Multinomial Logit Models

Age Nearest Birthday	Service < 2			Service = 2, 3, 4			Service = 5-9			Service ≥ 10		
	Total Life Years	Termination	Retired	Total Life Years	Termination	Retired	Total Life Years	Termination	Retired	Total Life Years	Termination	Retired
49	1,175	9.6	0.1	2,001	6.5	0.2	3,322	5.2	0.5	8,765	2.9	0.8
50	999	9.4	0.1	1,933	6.3	0.3	2,993	5.0	0.6	8,493	2.8	1.0
51	897	9.2	0.2	1,638	6.1	0.3	2,803	4.8	0.8	8,042	2.6	1.3
52	845	9.0	0.2	1,403	5.9	0.4	2,607	4.6	1.0	7,529	2.5	1.7
53	698	8.8	0.3	1,308	5.7	0.6	2,303	4.4	1.3	7,186	2.3	2.1
54	581	8.6	0.4	1,158	5.6	0.7	2,065	4.3	1.7	6,817	2.2	2.7
55	510	8.4	0.5	1,054	5.4	0.9	1,851	4.1	2.1	6,403	2.1	3.5
56	456	8.2	0.6	915	5.2	1.1	1,635	3.9	2.7	5,794	1.9	4.5
57	395	8.0	0.8	767	5.0	1.4	1,447	3.8	3.5	5,384	1.8	5.7
58	322	7.8	1.1	685	4.9	1.8	1,281	3.6	4.4	4,893	1.7	7.3
59	264	7.6	1.4	607	4.7	2.3	1,080	3.4	5.6	4,446	1.6	9.2
60	222	7.4	1.8	525	4.5	2.9	932	3.3	7.0	3,965	1.5	11.6
61	175	7.2	2.4	425	4.3	3.7	811	3.1	8.8	3,431	1.3	14.5
62	140	7.0	3.1	340	4.2	4.6	749	2.9	11.1	2,812	1.2	18.0
63	95	6.7	4.0	266	4.0	5.8	649	2.7	13.8	2,277	1.1	22.0
64	86	6.5	5.2	206	3.8	7.3	546	2.5	17.0	1,922	1.0	26.7
65	55	6.3	6.8	146	3.6	9.1	398	2.3	20.8	1,387	0.9	32.1
66	42	6.0	8.7	118	3.4	11.2	250	2.1	25.2	785	0.7	37.9
67	40	5.7	11.1	87	3.2	13.9	173	1.9	30.2	581	0.6	44.0
68	32	5.4	14.1	57	3.0	17.0	139	1.7	35.7	466	0.5	50.4
69	24	5.0	17.8	49	2.8	20.6	108	1.5	41.6	344	0.4	56.8
70	26	4.7	22.1	46	2.6	24.8	75	1.3	47.8	224	0.4	62.9
Totals	83,445	13.4	0.9	113,613	9.7	1.5	141,726	7.4	3.9	229,153	3.7	6.8

Appendix E.3 Hourly Union Workers Tables

Table E.3a. Hourly Union Workers Aggregate Turnover by Age
Probabilities from Fitted Multinomial Logit Models

Age Nearest Birthday	Total Life Years	Estimated Turnover Probabilities, in Percent	
		Termination	Retired
18	29	4.7	0.0
19	84	4.5	0.0
20	203	4.3	0.0
21	403	4.1	0.0
22	637	3.9	0.0
23	923	3.7	0.0
24	1,169	3.6	0.0
25	1,522	3.4	0.0
26	1,734	3.3	0.0
27	1,981	3.1	0.0
28	2,131	3.0	0.0
29	2,314	2.8	0.0
30	2,442	2.7	0.0
31	2,511	2.6	0.0
32	2,628	2.5	0.0
33	2,738	2.4	0.0
34	2,814	2.3	0.0
35	2,867	2.2	0.0
36	2,960	2.1	0.0
37	3,126	2.0	0.0
38	3,247	1.9	0.0
39	3,369	1.8	0.0
40	3,360	1.7	0.0
41	3,376	1.6	0.0
42	3,256	1.6	0.1
43	3,217	1.5	0.1
44	3,126	1.4	0.1
45	3,068	1.4	0.1
46	2,870	1.3	0.2
47	2,745	1.2	0.2
48	2,690	1.2	0.3
49	2,456	1.1	0.5
50	2,266	1.1	0.6
51	2,072	1.0	0.9
52	1,949	1.0	1.2
53	1,794	0.9	1.6
54	1,676	0.9	2.2
55	1,505	0.8	3.0
56	1,389	0.8	4.1

Table E.3a. Hourly Union Workers Aggregate Turnover by Age
Probabilities from Fitted Multinomial Logit Models

Age Nearest Birthday	Total Life Years	Estimated Turnover Probabilities, in Percent	
		Termination	Retired
57	1,272	0.7	5.5
58	1,157	0.7	7.4
59	1,030	0.6	9.9
60	938	0.6	13.1
61	765	0.5	17.1
62	581	0.5	22.1
63	406	0.4	28.0
64	319	0.4	34.8
65	196	0.3	42.3
66	70	0.3	50.1
67	49	0.2	58.0
68	35	0.2	65.4
69	21	0.1	72.2
70	18	0.1	78.1
Total	91,504	1.8	*5.9

** Average retirement estimated probability is based on ages 49-70, inclusive.*

Table E.3b. Hourly Union Workers Aggregate Turnover by Service
Probabilities from Fitted Multinomial Logit Models

Completed Years of Service	Total Life Years	Estimated Turnover Probabilities, in Percent	
		Termination	Retired
new hires	780	3.0	0.1
0	5,390	2.9	0.1
1	5,766	2.8	0.1
2	4,695	2.6	0.1
3	5,081	2.5	0.1
4	4,767	2.4	0.1
5	4,495	2.3	0.1
6	4,447	2.2	0.2
7	4,611	2.1	0.2
8	3,900	2.0	0.2
9	3,937	1.9	0.3
10	3,522	1.8	0.3
11	2,949	1.7	0.4
12	2,320	1.6	0.4
13	1,900	1.5	0.5
14	1,434	1.5	0.6
15	1,276	1.4	0.7
16	1,297	1.3	0.8
17	1,783	1.3	0.9
18	2,341	1.2	1.1
19	2,648	1.1	1.3

Table E.3b. Hourly Union Workers Aggregate Turnover by Service Probabilities from Fitted Multinomial Logit Models

Completed Years of Service	Total Life Years	Estimated Turnover Probabilities, in Percent	
		Termination	Retired
20	2,437	1.1	1.5
21	2,153	1.0	1.7
22	1,863	1.0	2.0
23	2,015	0.9	2.3
24	2,083	0.9	2.7
25	1,920	0.8	3.1
26	1,406	0.8	3.7
27	1,148	0.7	4.2
28	1,116	0.7	4.9
29	1,011	0.7	5.7
30	924	0.6	6.6
31	792	0.6	7.6
32	732	0.6	8.8
33	534	0.5	10.2
34	365	0.5	11.7
35	234	0.5	13.4
36	232	0.4	15.3
37	281	0.4	17.4
38	236	0.4	19.8
39	210	0.3	22.3
40	135	0.3	25.2
41	134	0.3	28.2
42	89	0.3	31.5
43	49	0.2	34.9
44	27	0.2	38.5
45	16	0.2	42.3
46	11	0.2	46.1
47	4	0.1	50.0
48	6	0.1	53.9
49	1	0.1	57.7
50	1	0.1	61.5
51	0	0.0	0.0
Total	91,504	1.8	1.5

Table E.3c. Hourly Union Workers Select Turnover by Age and Service Probabilities from Fitted Multinomial Logit Models

Age Nearest Birthday	Service < 2			Service = 2, 3, 4			Service = 5-9			Service ≥ 10		
	Total Life Years	Termination	Retired	Total Life Years	Termination	Retired	Total Life Years	Termination	Retired	Total Life Years	Termination	Retired
18	29	5.4	0.0									
19	81	5.2	0.0	3	4.8	0.0						
20	196	5.1	0.0	7	4.6	0.0						
21	347	4.9	0.0	55	4.4	0.0	1	2.2	0.0			
22	482	4.8	0.0	153	4.2	0.0	2	2.2	0.0			
23	650	4.6	0.0	250	4.0	0.0	23	2.2	0.0			
24	652	4.5	0.0	436	3.8	0.0	81	2.2	0.0			
25	692	4.3	0.0	615	3.6	0.0	215	2.2	0.0			
26	609	4.2	0.0	703	3.4	0.0	420	2.1	0.0	2	2.2	0.0
27	568	4.1	0.0	738	3.2	0.0	660	2.1	0.0	15	2.2	0.0
28	484	4.0	0.0	714	3.1	0.0	881	2.1	0.0	52	2.1	0.0
29	503	3.8	0.0	682	2.9	0.0	1,010	2.1	0.0	119	2.0	0.0
30	507	3.7	0.0	672	2.8	0.0	1,058	2.0	0.0	205	1.9	0.0
31	467	3.6	0.0	659	2.6	0.0	1,081	2.0	0.0	304	1.9	0.0
32	450	3.5	0.0	625	2.5	0.0	1,107	2.0	0.0	446	1.8	0.0
33	420	3.4	0.0	646	2.4	0.0	1,110	2.0	0.0	562	1.7	0.0
34	408	3.3	0.0	609	2.3	0.0	1,087	2.0	0.0	710	1.7	0.0
35	380	3.2	0.0	577	2.2	0.0	1,069	1.9	0.0	841	1.6	0.0
36	387	3.1	0.0	514	2.0	0.0	1,014	1.9	0.0	1,045	1.6	0.0
37	387	3.0	0.0	521	1.9	0.0	917	1.9	0.0	1,301	1.5	0.0
38	355	2.9	0.0	529	1.8	0.0	834	1.9	0.0	1,529	1.5	0.0
39	357	2.8	0.0	499	1.7	0.0	802	1.9	0.0	1,711	1.4	0.0
40	288	2.7	0.0	457	1.7	0.0	769	1.8	0.0	1,846	1.4	0.0
41	259	2.6	0.0	460	1.6	0.0	733	1.8	0.0	1,924	1.3	0.0
42	264	2.6	0.0	416	1.5	0.0	634	1.8	0.0	1,942	1.3	0.1
43	234	2.5	0.0	379	1.4	0.0	588	1.8	0.0	2,016	1.2	0.1
44	209	2.4	0.0	324	1.4	0.0	568	1.8	0.0	2,025	1.2	0.1
45	210	2.3	0.0	288	1.3	0.0	540	1.7	0.0	2,030	1.1	0.1
46	174	2.3	0.0	275	1.2	0.0	472	1.7	0.0	1,949	1.1	0.2
47	138	2.2	0.0	273	1.2	0.0	417	1.7	0.0	1,917	1.1	0.3
48	146	2.1	0.0	258	1.1	0.0	412	1.7	0.0	1,874	1.0	0.4

Table E.3c. Hourly Union Workers Select Turnover by Age and Service
Probabilities from Fitted Multinomial Logit Models

Age Nearest Birthday	Service < 2			Service = 2, 3, 4			Service = 5-9			Service ≥ 10		
	Total Life Years	Termination	Retired	Total Life Years	Termination	Retired	Total Life Years	Termination	Retired	Total Life Years	Termination	Retired
49	106	2.0	0.0	221	1.0	0.0	369	1.7	0.1	1,760	1.0	0.5
50	92	2.0	0.0	173	1.0	0.0	320	1.6	0.1	1,681	1.0	0.7
51	80	1.9	0.0	133	0.9	0.1	293	1.6	0.1	1,566	0.9	1.0
52	73	1.9	0.0	114	0.9	0.1	272	1.6	0.2	1,490	0.9	1.4
53	51	1.8	0.0	104	0.8	0.1	240	1.6	0.2	1,399	0.8	1.9
54	44	1.7	0.0	93	0.8	0.1	203	1.6	0.3	1,336	0.8	2.7
55	42	1.7	0.0	77	0.8	0.2	183	1.6	0.4	1,203	0.8	3.7
56	26	1.6	0.0	64	0.7	0.2	168	1.5	0.6	1,131	0.7	5.0
57	23	1.6	0.0	55	0.7	0.3	155	1.5	0.8	1,039	0.7	6.8
58	22	1.5	0.0	42	0.6	0.4	133	1.5	1.2	960	0.7	9.1
59	15	1.5	0.0	30	0.6	0.6	114	1.5	1.6	871	0.6	12.2
60	5	1.4	0.0	25	0.6	0.7	93	1.4	2.3	815	0.6	16.1
61	4	1.4	0.0	16	0.6	1.0	79	1.4	3.1	666	0.5	21.0
62	5	1.4	0.0	16	0.5	1.3	79	1.4	4.3	481	0.5	26.9
63	2	1.3	0.0	10	0.5	1.7	51	1.3	5.9	343	0.4	33.7
64	2	1.3	0.0	5	0.5	2.3	53	1.3	8.0	259	0.3	41.3
65	5	1.2	0.0	5	0.4	3.0	32	1.2	10.9	154	0.3	49.3
66	3	1.2	0.0	6	0.4	4.0	17	1.2	14.5	44	0.2	57.4
67	1	1.2	0.0	8	0.4	5.2	13	1.1	19.2	27	0.2	65.1
68	1	1.1	0.0	6	0.4	6.8	7	1.0	24.9	21	0.1	72.0
69	1	1.1	0.0	2	0.3	8.9	5	0.9	31.6	13	0.1	78.1
70				1	0.3	11.5	6	0.8	39.2	11	0.1	83.1
Totals	11,936	3.6	0.0	14,543	2.3	0.3	21,390	1.9	1.3	43,635	1.1	7.3

Appendix E.4 Hourly Nonunion Workers Tables

Table E.4a. Hourly Nonunion Workers Aggregate Turnover by Age
Probabilities from Fitted Multinomial Logit Models

Age Nearest Birthday	Total Life Years	Estimated Turnover Probabilities, in Percent	
		Termination	Retired
18	7	32.7	0.0
19	35	32.0	0.0
20	991	31.3	0.0
21	3,573	30.5	0.0
22	5,122	29.8	0.0
23	5,395	29.1	0.0
24	5,557	28.4	0.0
25	5,663	27.7	0.0
26	5,519	27.0	0.0
27	5,170	26.4	0.0
28	4,822	25.7	0.0
29	4,415	25.1	0.0
30	4,066	24.4	0.0
31	3,806	23.8	0.0
32	3,672	23.2	0.0
33	3,557	22.6	0.0
34	3,379	22.0	0.0
35	3,108	21.4	0.0
36	2,956	20.9	0.0
37	2,820	20.3	0.0
38	2,643	19.8	0.0
39	2,477	19.2	0.0
40	2,367	18.7	0.0
41	2,287	18.2	0.0
42	2,127	17.7	0.0
43	1,941	17.2	0.0
44	1,901	16.7	0.0
45	1,804	16.2	0.0
46	1,623	15.8	0.0
47	1,520	15.3	0.0
48	1,465	14.9	0.1
49	1,359	14.5	0.1
50	1,241	14.0	0.1
51	1,118	13.6	0.1
52	1,023	13.2	0.2
53	858	12.8	0.2
54	742	12.4	0.3
55	663	12.1	0.4
56	613	11.7	0.6

Table E.4a. Hourly Nonunion Workers Aggregate Turnover by Age
Probabilities from Fitted Multinomial Logit Models

Age Nearest Birthday	Total Life Years	Estimated Turnover Probabilities, in Percent	
		Termination	Retired
57	540	11.3	0.8
58	518	10.9	1.1
59	474	10.6	1.5
60	411	10.2	2.0
61	352	9.8	2.7
62	285	9.4	3.6
63	207	9.0	4.8
64	166	8.6	6.4
65	144	8.2	8.5
66	95	7.7	11.1
67	75	7.2	14.5
68	51	6.6	18.7
69	49	6.0	23.7
70	31	5.4	29.6
Total	106,803	22.7	*1.3

** Average retirement estimated probability is based on ages 49-70, inclusive.*

Table E.4b. Hourly Nonunion Workers Aggregate Turnover by Service
Probabilities from Fitted Multinomial Logit Models

Completed Years of Service	Total Life Years	Estimated Turnover Probabilities, in Percent	
		Termination	Retired
new hires	0	0.0	0.0
0	1,043	33.3	0.0
1	33,448	29.6	0.0
2	21,324	26.2	0.0
3	13,775	23.0	0.1
4	9,332	20.1	0.1
5	6,565	17.5	0.1
6	4,889	15.1	0.1
7	3,832	13.1	0.2
8	3,140	11.2	0.2
9	2,467	9.6	0.2
10	1,837	8.2	0.3
11	1,313	7.0	0.4
12	988	6.0	0.5
13	689	5.1	0.6
14	463	4.3	0.7
15	285	3.7	0.8
16	204	3.1	1.0
17	115	2.6	1.3
18	140	2.2	1.5
19	134	1.9	1.9

Table E.4b. Hourly Nonunion Workers Aggregate Turnover by Service Probabilities from Fitted Multinomial Logit Models

Completed Years of Service	Total Life Years	Estimated Turnover Probabilities, in Percent	
		Termination	Retired
20	120	1.6	2.3
21	75	1.3	2.8
22	135	1.1	3.4
23	119	0.9	4.1
24	105	0.8	4.9
25	89	0.6	5.9
26	85	0.5	7.1
27	23	0.4	8.6
28	18	0.4	10.3
29	12	0.3	12.2
30	9	0.2	14.5
31	5	0.2	17.1
32	7	0.2	20.1
33	5	0.1	23.5
34	4	0.1	27.3
35	1	0.1	31.3
36	1	0.1	35.8
37	0	0.0	0.0
38	0	0.0	0.0
39	2	0.0	50.2
40	2	0.0	55.1
41	1	0.0	59.9
42	1	0.0	64.6
43	1	0.0	68.9
44	0	0.0	0.0
45	0	0.0	0.0
46	0	0.0	0.0
47	0	0.0	0.0
48	0	0.0	0.0
49	0	0.0	0.0
50	0	0.0	0.0
51	0	0.0	0.0
Total	106,803	22.7	0.1

Table E.4c. Hourly Nonunion Workers Select Turnover by Age and Service Probabilities from Fitted Multinomial Logit Models

Age Nearest Birthday	Service < 2			Service = 2, 3, 4			Service = 5-9			Service ≥ 10		
	Total Life Years	Termination	Retired	Total Life Years	Termination	Retired	Total Life Years	Termination	Retired	Total Life Years	Termination	Retired
18	7	34.1	0.0									
19	34	33.8	0.0	1	30.2	0.0						
20	789	33.5	0.0	202	29.7	0.0						
21	2,398	33.2	0.0	1,175	29.1	0.0						
22	2,901	32.9	0.0	2,215	28.6	0.0	6	21.0	0.0			
23	2,611	32.6	0.0	2,715	28.0	0.0	69	20.4	0.0			
24	2,570	32.3	0.0	2,687	27.5	0.0	300	19.8	0.0			
25	2,252	32.0	0.0	2,821	27.0	0.0	590	19.3	0.0			
26	2,022	31.7	0.0	2,748	26.5	0.0	749	18.8	0.0			
27	1,684	31.4	0.0	2,544	26.0	0.0	935	18.2	0.0	7	12.8	0.0
28	1,416	31.2	0.0	2,279	25.5	0.0	1,106	17.7	0.0	21	12.2	0.0
29	1,268	30.9	0.0	1,970	25.0	0.0	1,097	17.2	0.0	80	11.7	0.0
30	1,060	30.6	0.0	1,779	24.5	0.0	1,096	16.7	0.0	131	11.1	0.0
31	1,016	30.3	0.0	1,539	24.0	0.0	1,066	16.2	0.0	185	10.6	0.0
32	896	30.0	0.0	1,476	23.5	0.0	1,072	15.8	0.0	228	10.1	0.0
33	918	29.8	0.0	1,368	23.1	0.0	1,005	15.3	0.0	266	9.6	0.0
34	780	29.5	0.0	1,306	22.6	0.0	981	14.9	0.0	312	9.2	0.0
35	756	29.2	0.0	1,171	22.2	0.0	854	14.4	0.0	327	8.7	0.0
36	748	28.9	0.0	1,083	21.7	0.0	793	14.0	0.0	332	8.3	0.0
37	674	28.7	0.0	1,084	21.3	0.0	736	13.6	0.0	326	7.9	0.0
38	590	28.4	0.0	1,014	20.8	0.0	710	13.2	0.0	329	7.5	0.0
39	536	28.1	0.0	953	20.4	0.0	643	12.8	0.0	345	7.1	0.0
40	531	27.9	0.0	852	20.0	0.0	668	12.4	0.0	316	6.8	0.0
41	563	27.6	0.0	780	19.6	0.0	647	12.0	0.0	297	6.5	0.0
42	500	27.3	0.0	788	19.2	0.0	540	11.6	0.0	299	6.1	0.0
43	464	27.1	0.0	717	18.8	0.0	487	11.3	0.0	273	5.8	0.0
44	480	26.8	0.0	689	18.4	0.0	467	10.9	0.0	265	5.5	0.1
45	415	26.5	0.0	691	18.0	0.0	454	10.6	0.0	244	5.3	0.1
46	345	26.3	0.0	634	17.6	0.0	439	10.3	0.0	205	5.0	0.1
47	339	26.0	0.0	568	17.2	0.0	416	10.0	0.0	197	4.7	0.1
48	352	25.8	0.0	504	16.8	0.0	394	9.6	0.0	215	4.5	0.2

Table E.4c. Hourly Nonunion Workers Select Turnover by Age and Service Probabilities from Fitted Multinomial Logit Models

Age Nearest Birthday	Service < 2			Service = 2, 3, 4			Service = 5-9			Service ≥ 10		
	Total Life Years	Termination	Retired	Total Life Years	Termination	Retired	Total Life Years	Termination	Retired	Total Life Years	Termination	Retired
49	315	25.5	0.0	481	16.5	0.0	354	9.3	0.1	209	4.3	0.3
50	279	25.3	0.0	453	16.1	0.0	305	9.0	0.1	204	4.1	0.4
51	260	25.0	0.0	420	15.8	0.0	263	8.8	0.1	175	3.8	0.5
52	257	24.8	0.0	369	15.4	0.0	240	8.5	0.2	157	3.6	0.7
53	217	24.5	0.0	314	15.1	0.0	208	8.2	0.2	119	3.5	1.0
54	163	24.3	0.0	283	14.8	0.0	184	7.9	0.3	112	3.3	1.3
55	173	24.0	0.0	251	14.4	0.0	141	7.7	0.5	98	3.1	1.8
56	152	23.8	0.0	230	14.1	0.0	129	7.4	0.6	102	2.9	2.5
57	131	23.6	0.0	210	13.8	0.1	116	7.2	0.9	83	2.7	3.4
58	137	23.3	0.0	192	13.5	0.1	96	6.9	1.3	93	2.6	4.6
59	117	23.1	0.0	180	13.2	0.1	100	6.7	1.8	77	2.4	6.3
60	88	22.9	0.0	156	12.9	0.2	93	6.4	2.5	74	2.2	8.5
61	71	22.6	0.0	142	12.6	0.3	70	6.1	3.4	69	2.0	11.3
62	51	22.4	0.0	102	12.3	0.5	68	5.8	4.7	64	1.8	15.0
63	37	22.2	0.0	84	12.0	0.7	46	5.6	6.5	40	1.7	19.5
64	24	21.9	0.0	53	11.6	1.0	51	5.2	8.9	38	1.5	25.1
65	30	21.7	0.0	41	11.3	1.4	43	4.9	12.1	30	1.3	31.6
66	21	21.5	0.0	34	11.0	2.1	22	4.5	16.1	18	1.1	38.9
67	21	21.3	0.0	26	10.6	3.1	19	4.1	21.3	9	0.9	46.7
68	9	21.0	0.0	26	10.2	4.5	10	3.7	27.5	6	0.7	54.8
69	15	20.8	0.0	17	9.8	6.4	10	3.2	34.7	7	0.6	62.5
70	8	20.6	0.0	14	9.3	9.2	5	2.7	42.7	4	0.4	69.7
Totals	34,491	30.4	0.0	44,431	23.4	0.2	20,893	14.0	1.7	6,988	6.3	5.2

Appendix E.5 Parameter Estimates

Table E.5a- Appendix E Parameters		
	Intercept	Slope
Table E.1a Aggregate Age		
Term	-0.010	-0.056
Retirement	-19.081	0.276
Table E.1b Aggregate Service		
Term	-1.397	-0.112
Retirement	-5.821	0.103
Table E.1c Select		
Term ≤1	-0.428	-0.028
Term 2_4	-0.856	-0.025
Term 5_9	-1.364	-0.023
Term ≥10	-0.828	-0.053
Retirement ≤1	-18.487	0.232
Retirement 2_4	-19.914	0.271
Retirement 5_9	-19.611	0.280
Retirement ≥10	-18.658	0.273

Table E.5b - Appendix E Parameters						
	Intercept	**Slope**	**Intercept**	**Slope**	**Intercept**	**Slope**
Aggregate Age	Table E.2a - Salaried		Table E.3a - Hourly Union		Table E.4a - Hourly NonUnion	
Term	-0.483	-0.053	-2.161	-0.047	-0.106	-0.034
Retirement	-17.579	0.256	-20.858	0.316	-21.740	0.299
Aggregate Service	Table E.2b - Salaried		Table E.3b - Hourly Union		Table E.4b - Hourly NonUnion	
Term	-1.920	-0.083	-3.513	-0.049	-0.694	-0.171
Retirement	-5.744	0.114	-7.307	0.156	-7.696	0.198
Select	Table E.2c - Salaried		Table E.3c - Hourly Union		Table E.4c - Hourly NonUnion	
Term ≤1	-1.051	-0.024	-2.287	-0.032	-0.423	-0.013
Term 2_4	-1.086	-0.032	-1.978	-0.053	-0.341	-0.026
Term 5_9	-1.098	-0.037	-3.542	-0.011	-0.555	-0.035
Term ≥10	-0.786	-0.055	-2.854	-0.036	-0.459	-0.054
Retirement ≤1	-20.172	0.271	-13.879	-0.097	-14.911	-0.106
Retirement 2_4	-17.749	0.238	-22.010	0.285	-28.978	0.383
Retirement 5_9	-17.441	0.248	-23.730	0.333	-23.820	0.337
Retirement ≥10	-17.333	0.255	-21.092	0.324	-21.573	0.320

Appendix F. Analysis of Termination

We have seen that service, by itself, is not a very good predictor of retirement. Suppose instead that we are only interested in predicting termination. Figures 2.1a and A.1 suggest that age and service, respectively, are each good predictors. Which is the better predictor, service or age?

To respond to this question, we run several regression fits using termination (zero or one) as the response variable (a logistic regression). Table F.1 summarizes the fit of several models. Recall that we are using -2 Log Likelihood as our goodness of fit statistic; a smaller statistic means a better fit.

Models two through six summarize the relationship using only one variable. From Table F.1, we see that service by itself is a better predictor than either attained age or hire age. This suggests that if the actuary wishes only to use one index, then service may be preferred. We recommend caution on this interpretation; please recall the plan eligibility difficulties that we had in collecting the data (Frees and Gilmore 2003, Section 4.2). It may be that estimated probabilities for the early service years are less reliable than the rest of the data.

Models seven through 10 bring in two variables linearly, and Models 11 and 12 allow for interactions between the two variables. From the summary statistics, we see that Model 11 is preferred. This model corresponds to the Table 2.2 select and ultimate table, using (attained) age as the continuous variable. To get better insights to the alternative Model 12, Table F.2 shows the corresponding select and ultimate table. Here, Table F.2 is produced not using logistic regression smoothing but by the Whittaker-Henderson Type B graduation method (similar to Appendix A).

Models 13-16 introduce gender. Overall, the best model is Model 15, corresponding to sex-distinct select and ultimate tables.

Table F.1 Summary of Several Logistic Model Fits
Termination is the response variable

Model	Variables	Number of Parameters	-2 Log Likelihood	Change (from Model 11b) in -2 Log Likelihood
1	Intercept only	1	1,020,745.4	70,285.7
2	Attained Age	2	980,942.3	30,482.6
3	Hire Age	2	1,019,202.5	68,742.8
4	Service	2	962,348.7	11,889.0
5	Hire Age—categorical*	4	1,019,126.5	68,666.8
6	Service—categorical	4	962,296.7	11,837.0
7	Attained Age and Service, both continuous	3	954,090.3	3,630.6
8	Hire Age and Service, both continuous	3	954,196.6	3,736.9
9	Attained Age as continuous, Service as categorical	5	952,530.8	2,071.1
10	Service as continuous, Hire Age as categorical	5	955,231.3	4,771.6
11	Age as continuous, Service as categorical, interaction terms	8	951,304.9	845.2
12	Service as continuous, Hire Age as categorical, interaction terms	8	953,268.3	2,808.6
13	Model 11 plus gender	9	951,018.7	559.0
14	Model 12 plus gender	9	953,040.9	2,581.2
15	Model 11 plus gender, interaction terms	16	950,459.7	0.0
16	Model 11 plus gender, interaction terms	16	952,513.3	2,053.6

*hire age is age nearest birthday at hire date. For hire age categories, we used:
Category 1 – hire age less than 30
Category 2 – hire age greater than or equal to 30 and less than 40
Category 3 – hire age greater than or equal to 40 and less than 50
Category 4 – hire age greater than or equal to 50

Table F.2. Select Termination by Service and Hire Age, Smoothed and Weighted

	Life Years					Estimated Termination Probabilities, in Percent				
Completed Years of Service	Hire Age < 30	30 ≤ Hire Age < 40	40 ≤ Hire Age < 50	Hire Age ≥ 50	Total	Hire Age < 30	30 ≤ Hire Age < 40	40 ≤ Hire Age < 50	Hire Age ≥ 50	Overall
new hires	5,132	4,053	2,218	839	12,242	34.15	27.03	24.41	27.08	29.55
0	29,974	22,515	13,188	6,125	71,802	15.77	12.30	10.80	9.11	13.20
1	94,310	61,669	30,824	11,927	198,730	15.10	11.29	10.54	9.27	12.86
2	72,840	48,559	23,447	8,677	153,523	18.00	13.09	11.85	10.78	15.10
3	57,633	40,251	19,055	6,924	123,863	15.74	10.93	9.75	8.19	12.83
4	47,041	33,965	16,203	5,807	103,016	12.76	8.95	7.73	5.56	10.31
5	44,262	32,459	15,632	5,398	97,751	10.33	7.49	6.17	3.57	8.35
6	43,640	30,852	14,725	4,585	93,802	8.83	6.55	5.43	3.05	7.26
7	44,091	30,053	13,709	3,972	91,825	7.66	5.86	4.80	2.71	6.43
8	42,838	28,340	12,469	3,328	86,975	6.97	5.37	3.96	2.00	5.82

Table F.2. Select Termination by Service and Hire Age, Smoothed and Weighted										
	Life Years					Estimated Termination Probabilities, in Percent				
Completed Years of Service	Hire Age < 30	30 ≤ Hire Age < 40	40 ≤ Hire Age < 50	Hire Age ≥ 50	Total	Hire Age < 30	30 ≤ Hire Age < 40	40 ≤ Hire Age < 50	Hire Age ≥ 50	Overall
9	42,583	27,057	11,381	2,731	83,752	6.21	4.83	3.02	1.02	5.16
10	39,166	23,259	8,604	1,743	72,772	5.71	4.62	2.80	0.71	4.90
11	36,242	20,908	7,265	1,220	65,635	5.18	4.28	2.42	0.93	4.51
12	31,924	17,473	5,977	825	56,199	4.77	4.14	1.77	0.80	4.20
13	28,855	15,249	4,952	527	49,583	4.46	4.03	1.10	0.72	3.95
14	25,644	12,807	4,112	374	42,937	4.38	4.06	0.49	0.00	3.87
15	23,759	11,276	3,662	269	38,966	4.22	3.73	0.14	0.00	3.66
16	22,477	10,077	3,216	178	35,948	4.00	3.40	0.06	0.00	3.46
17	22,173	9,574	2,942	101	34,790	3.76	2.95	0.04	0.00	3.21
18	21,403	8,875	2,541	76	32,895	3.56	2.49	0.06	0.00	2.99
19	19,788	7,939	2,080	35	29,842	3.50	2.23	0.05	0.00	2.92
20	17,484	6,881	1,442	10	25,817	3.39	1.92	0.00	0.00	2.81
21	15,319	5,822	1,031	0	22,172	3.26	1.56	0.00	0.00	2.67
22	13,665	5,041	741	0	19,447	3.14	1.10	0.00	0.00	2.49
23	12,405	4,229	501	0	17,135	3.02	0.62	0.00	0.00	2.34
24	11,285	3,600	308	0	15,193	2.94	0.37	0.32	0.00	2.28
25	10,028	3,005	202	0	13,235	2.76	0.21	0.00	0.00	2.14
26	8,343	2,318	119	0	10,780	2.65	0.15	0.00	0.00	2.09
27	7,211	1,834	74	0	9,119	2.41	0.14	0.00	0.00	1.93
28	6,701	1,494	44	0	8,239	2.12	0.24	0.00	0.00	1.76
29	5,891	1,066	16	0	6,973	1.94	0.00	0.00	0.00	1.64
30	5,004	746	2	0	5,752	1.74	0.00	0.00	0.00	1.51
31	4,126	467	0	0	4,593	1.53	0.00	0.00	0.00	1.37
32	3,511	272	0	0	3,783	1.34	0.37	0.00	0.00	1.27
33	2,742	157	0	0	2,899	1.08	0.00	0.00	0.00	1.02
34	2,161	88	0	0	2,249	0.75	0.00	0.00	0.00	0.73
35	1,752	38	0	0	1,790	0.44	0.00	0.00	0.00	0.43
36	1,393	29	0	0	1,422	0.18	0.00	0.00	0.00	0.17
37	1,210	12	0	0	1,222	0.00	0.00	0.00	0.00	0.00
38	1,025	10	0	0	1,035	0.20	0.00	0.00	0.00	0.19
39	831	4	0	0	835	0.00	0.00	0.00	0.00	0.00
40	583	0	0	0	583	0.00	0.00	0.00	0.00	0.00
41	495	0	0	0	495	0.00	0.00	0.00	0.00	0.00
42	340	0	0	0	340	0.29	0.00	0.00	0.00	0.29
43	220	0	0	0	220	0.00	0.00	0.00	0.00	0.00
44	147	0	0	0	147	0.00	0.00	0.00	0.00	0.00
45	88	0	0	0	88	0.00	0.00	0.00	0.00	0.00
46	48	0	0	0	48	0.00	0.00	0.00	0.00	0.00
47	24	0	0	0	24	0.00	0.00	0.00	0.00	0.00
48	18	0	0	0	18	5.56	0.00	0.00	0.00	5.56
49	9	0	0	0	9	0.00	0.00	0.00	0.00	0.00
50	8	0	0	0	8	0.00	0.00	0.00	0.00	0.00
51	4	0	0	0	4	0.00	0.00	0.00	0.00	0.00
Totals	929,846	534,323	222,682	65,671	1,752,522	8.82	7.35	6.73	6.52	8.02