Chapter Four

COMPONENTS OF TEACHER DEMAND

Unlike teacher supply, the components of teacher demand are much more clear-cut. Teacher demand depends on enrollment growth, teacher turnover, and mandated curriculum or other policies including mandated class sizes. Teacher turnover includes losses from death, retirements, disability, and other events (either voluntary or involuntary) and is the most important component of teacher demand (Grissmer and Kirby, 1987). State policies have not changed dramatically over the late 1980s and early- to mid-1990s. Therefore, we focus on the first two components.

CHANGES IN STUDENT ENROLLMENT

Texas schools are enrolling increasingly diverse student bodies, and a larger proportion appear to be economically disadvantaged and likely to be at risk for educational failure. Currently, minorities account for 54 percent of all students: 37 percent are Hispanic, 14 percent are black, and 3 percent are other minority. Total school enrollment is projected to increase from about 3.8 million students in 1995 to 5.3 million by 2025, and the Texas Education Agency (1994) projects that by 2025, minorities will make up two-thirds of the student body. Hispanics will account for 46 percent of all school-aged children, blacks for 14 percent, and other minority for 4 percent. Similar projections are reported by other commissions as well.

PATTERNS OF ATTRITION

It is useful to examine the annual attrition rates of teachers because these are the most important component of teacher demand (along with changing enrollments and mandated student/teacher ratios) (Grissmer and Kirby, 1987).

As Figure 4.1 shows, although annual attrition rates have varied over the 16-year period, there has been a general downward trend over time. Recently, attrition has been about 10 percent a year over the last nine years compared with 11–14 percent in the early 1980s.[1]

There are some differences in attrition by race/ethnicity. Hispanics tend to have lower attrition rates of between 7 and 8 percent, although this has declined since the early 1980s as well.[2] The rate for black teachers shows a surprising spike during the 1984–86 period

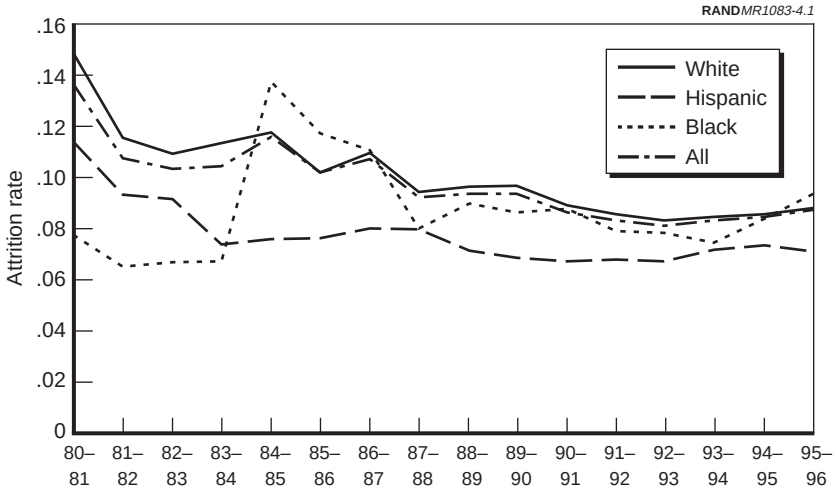

Figure 4.1—Annual Attrition, All Teachers, 1980–81 to 1995–96

[1]SREB (1996) reports a lower attrition rate for 1992–93 of 6.7 percent. However, its data included all teachers (full-time and part-time).

[2]For 1992–93, we had to estimate the rate for Hispanics by excluding one large district which had a large proportion of Hispanic teachers but appeared to have missing or poor quality data.

when attrition rose rather sharply. One possible and partial explanation might be the implementation of the Texas Examination of Current Administrators and Teachers (TECAT), a test of basic literacy given to all Texas teachers in 1986. Black teachers had much lower passing rates (82 percent) than either Hispanics (94 percent) or non-Hispanic whites/other minority (99 percent) and the advent of the test may have caused some teachers to leave teaching rather than take the test. For example, Shephard and Kreitzer (1987) cite remarks made by the Texas Commissioner of Education reporting that as a result of the test, 10,000 teachers decided to leave teaching in 1987: 2,000 who failed and 8,000 who never showed up to take the test.

Examining annual attrition is important because it indicates how many teachers will need to be replaced in a steady state. However, it masks variation in attrition by age. Figure 4.2 shows a U-shaped relationship between age and attrition, with the likelihood of attrition being much higher during the early stages of the career, very low during midcareer, and high as the teacher approaches retirement. This

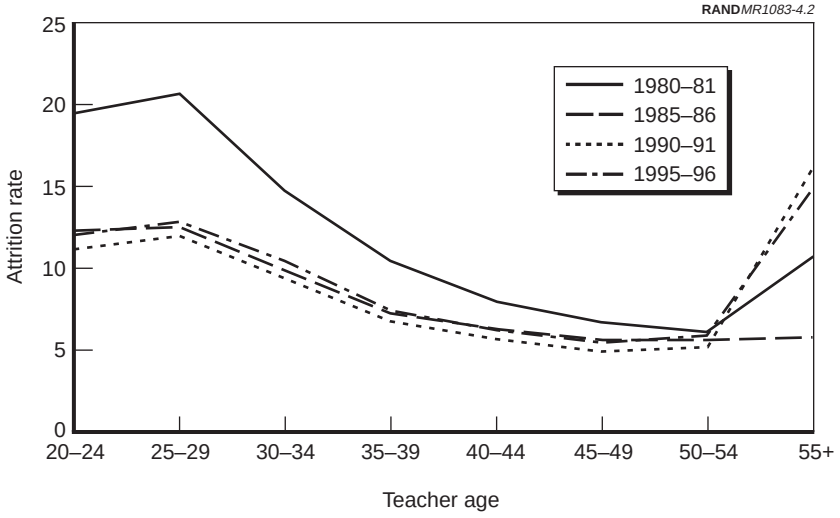

Figure 4.2—Annual Attrition by Age of Teachers, Selected Years

pattern holds true not only for a single group of teachers but for groups of teachers over time as well, with the overall curve moving down to reflect the decrease in attrition that we had shown above. By and large, attrition rates have remained stable over the past 10 years. The attrition rate of young teachers is about 11–13 percent; for those aged 40–54, the attrition rate is only 5 percent or a little higher; and for those who are 55 and older, attrition rises sharply because of retirement.

DEMAND FOR NEW TEACHER HIRES

Figure 4.3 shows that, on average, Texas hires about 25,000 teachers every year of whom roughly half are new teachers, although as we saw above, this proportion has varied considerably over time. The sharp decrease in teacher demand in 1983–84 is surprising, given the steady increase in student enrollments shown above. However, the increase in the subsequent two years is likely to result from several factors: (a) the mandated lower class size and its effect on K–2; (b)

Figure 4.3—Total Number of New Hires and New Teachers, 1980–81 to 1995–96

the need to replace teachers affected by the TECAT; and (c) increasing enrollments at the elementary level. It is interesting to note that new teachers are filling an increasing portion of new teacher demand.

The next several sections examine patterns of attrition among new teacher cohorts. These analyses provide important information, given that demand for new teachers will rise over the next 10 to 20 years, fueled by increasing teacher retirements and increased enrollments. How long do new teachers stay in teaching? Do these patterns differ by race/ethnicity or among districts categorized by risk? What are important determinants of teacher attrition? We use both descriptive and multivariate analyses to answer these questions.

PATTERNS OF ATTRITION: NEW TEACHERS

Examining annual attrition rates for all teachers is informative but limited, and comparisons over time can be a little misleading unless we adequately account for changes in the composition of the teaching force. Tracking incoming cohorts of new teachers and examining their experience over time provide better estimates of duration as well as differences in duration by selected demographic and economic factors. That is the focus of this section.

Methodology

A distinguishing feature of our data, and most time-to-event data, is that the event—in our case, attrition from teaching—may not have occurred at the time of the analysis. That is, some teachers may not have left teaching by 1996–97, although some of them may have left later. These data are "right-censored"; we know only the amount of time that has elapsed between the time the individual entered teaching and the beginning of the academic year 1996–97 and that the individual had not left teaching by then.

We use two survival analysis techniques to study when attrition occurs (Cox, 1972; Kalbfleisch and Prentice, 1980; Marquis and Kirby, 1989). The first, called the Kaplan-Meier estimator, is a descriptive technique that allows us to look at the distribution of attrition times.

This nonparametric estimator makes no assumptions about the form of the survival function but corrects for sample losses resulting from censored observations before time t. The basic function is a plot that indicates how likely it is that the teacher will continue in teaching beyond the first year, the second year, and so on. At the beginning, 100 percent of the individuals are present in the teaching force. As time passes, they gradually leave or separate from teaching Our estimate of the cumulative survival rate—the proportion that will remain in teaching within t years—is F(t); therefore, the cumulative attrition rate is 1 – F(t). The Kaplan-Meier estimator for different subgroups allows us to examine the distribution of attrition times for groups of interest. This reveals the gross effect of that characteristic and everything else that varies with it.

To estimate the net effect of a characteristic, controlling for other characteristics, we fit a Cox proportional hazards model. This model assumes that the attrition rate function for a teacher with characteristics given by *x* is: $h(t;x) = g(x)\, h_0(t)$, where $h_0(t)$ is the underlying attrition rate function and g(x) is a function of the characteristics. In the Cox model, no assumptions are made about the underlying model and the attrition rate, $h_0(t)$, is completely unspecified. This makes it particularly attractive for our purposes because we are not so much interested in describing the shape of the function as in describing how differences in characteristics alter the likelihood of attrition. In the Cox model, one assumes that the effect of an increase in a given characteristic x is to multiply the attrition rate by a constant factor g(x) so that the attrition rates for groups of individuals with different levels of *x* are proportional. A common form for g(x) is $g(x) = \exp(bx)$, where b denotes the regression coefficients to be estimated. Here, the multiplicative effect on the attrition rate of an increase in *x* is given by exp(b).

A concrete example may help to illustrate this. Assume that we have a reference teacher—white female elementary school teacher—whose attrition function is given by the unspecified $h_0(t)$. For a second teacher who is similar in every way except in one characteristic (he is male), we estimate that the effect of this characteristic, $\exp(b_{male}) = 0.95$. This indicates that at any point in time, the probability of attrition among male teachers is 95 percent of the attrition of female teachers or, to put it a little differently, males have a 5 percent lower attrition rate than females.

We first present some Kaplan-Meier estimators of the attrition function before turning to the multivariate model. We limit our analysis to new, full-time teachers teaching in the Texas public school system from 1980–81 to 1995–96. Recall that new or beginning teachers are defined as those who had no prior experience teaching and were reported as having zero years of experience. A new teacher cohort is defined as a group of teachers who entered teaching in the Texas public school system in a given year.

Results

Timing of Attrition. Figure 4.4 shows the annual attrition curves for the combined new teacher cohorts from 1980–81 to 1995–96. About 16 percent of teachers entering teaching leave within the first year and about 26 percent leave within two years.[3] Two in five teachers leave teaching within the first four years and close to half of the cohort leaves teaching by the sixth year. Cumulative attrition levels off after the 12th year or so; after that point, we continue to lose teachers but at about one-half to 1 percent a year. By about the 15th year, about two-thirds of an entering cohort of teachers has had at least one break in teaching.[4]

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[3]These rates are lower than those found by Grissmer and Kirby (1992) for the combined Indiana new teacher cohorts, but they were analyzing data from 1965 to 1982 and, as we show below, attrition has declined markedly since then.

[4]This represents *annual* or first-time attrition and measures the proportion of the teaching force in any given year that leaves during or at the end of that academic year. This is what we normally mean by attrition or turnover and measures the length of time the individual has taught continuously without a break in service. *Permanent* attrition, however, looks at all the future years for which we have data to see whether these teachers return to teaching. If they do, they are not counted as leavers in that particular year. In this definition, teachers are counted as leavers only when they leave teaching and do not return to it (during the period for which we have data). Permanent attrition rates give us a better sense of the true proportion of each cohort that is lost to teaching because they account for later returns. Permanent attrition rates tend to be between 70 and 80 percent of annual attrition rates, suggesting that 20 to 30 percent of new teachers who leave return and most appear to do so within five years (Grissmer and Kirby, 1992; Murnane et al., 1991; SREB, 1996). In the Texas data, for example, the two-year permanent attrition rate for a cohort is 18 percent compared with 26 percent annual attrition, and the four-year rate is 28 percent compared with 40 percent. By the sixth year, about 36 percent of the cohort has permanently left teaching and by the 12th year, about half has left. However, a report from the State Board for Educator Certification (SREB, 1996) provides some evidence to suggest that the return rate is lower for the most recent cohorts.

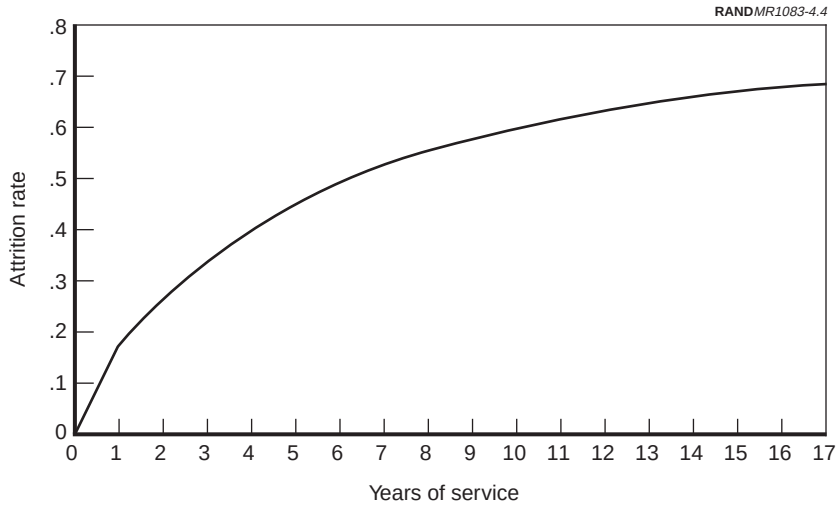

Figure 4.4—Cumulative Attrition from Teaching, Combined Cohorts

Attrition Differences by Cohort. Aggregating across all cohorts, although useful in providing a baseline pattern of attrition for a typical new teacher cohort, hides changes in attrition patterns over time. Figure 4.5 shows cumulative annual attrition for selected teacher cohorts: 1980–81, 1983–84, 1987–88, 1989–90, and 1991–92. It is evident that attrition has declined for the more recent cohorts but has remained quite stable since the mid-1980s. Later cohorts experience a first-year attrition of 14–16 percent compared with 20 percent for the 1980–81 cohort and a two-year attrition rate of 25–26 percent compared with 36 percent for the earlier cohort. This decline in attrition over time has been found in other states and more generally across the nation.

Attrition Differences by Age at Entry. Because the age distribution of entering cohorts has changed so dramatically over time, we thought it would be interesting to examine differences in attrition by age at entry (Figure 4.6). First-year annual attrition is much the same for the four age groups—between 14 and 16 percent (a little higher for the older teachers) but by the second year, a different pattern

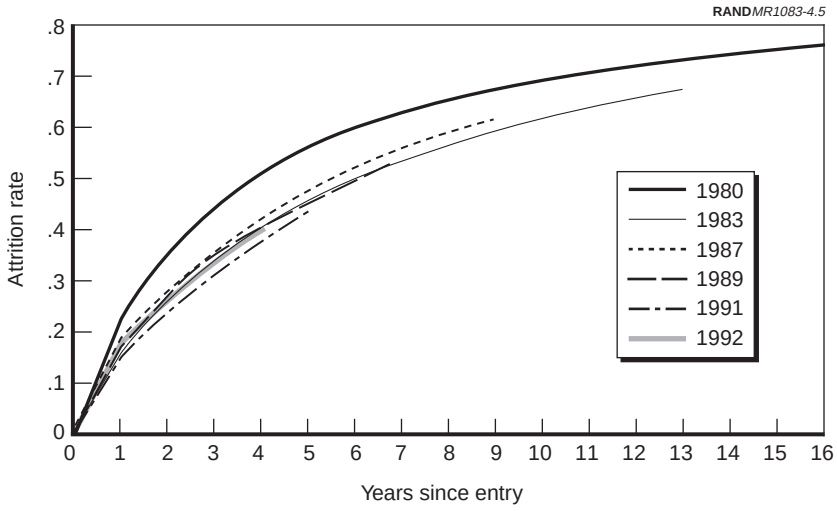

Figure 4.5—Annual Attrition from Teaching, by Entry Cohort

emerges. Older teachers tend to stay in teaching at much higher proportions (22 percent attrition compared with 25 percent for the less-than-30-year age group) and by the third year, the differences in attrition rates are large and significant. For example, by the fourth year, over 41 percent of the youngest teachers have left teaching compared with 32 percent of the teachers age 35 and over. By the 10th year, the difference has increased to 16 percentage points, with 65 percent of the youngest teachers leaving compared with 49 percent of the oldest teachers. Clearly, young teachers are at the greatest risk of leaving.[5]

[5]If we examine permanent attrition, the pattern is quite similar but the differences are not as marked, primarily because young teachers tend to return to teaching at higher rates than their older counterparts. For example, the two-year permanent attrition rate for those younger than 25 years is 15 percent compared with a first-time attrition rate of 25 percent; for teachers age 35 and older, the annual and permanent attrition rates are 16 percent and 22 percent, respectively. By the fourth year, the comparable numbers are 28 and 42 percent (age 20–24 years) and 23 and 32 percent (age 35 and over).

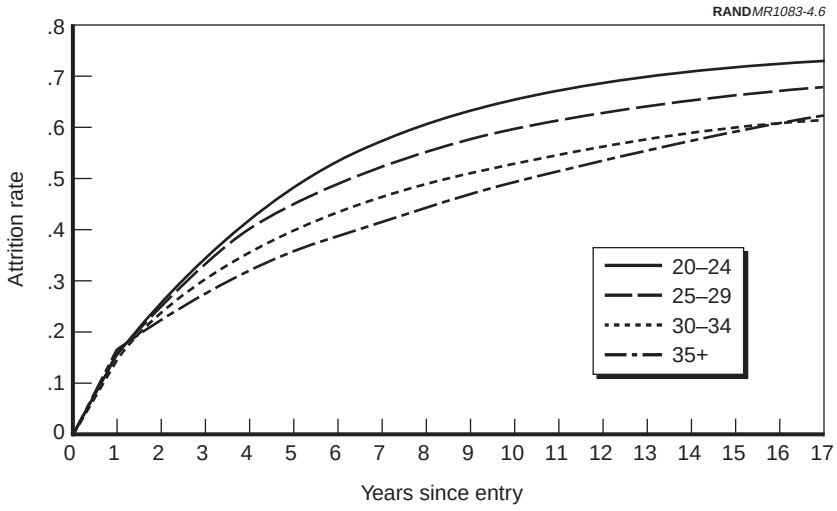

Figure 4.6—Annual Attrition from Teaching of Combined Cohorts, by Age at Entry

Attrition Differences by Subject Area. There has been considerable attention given to differences in attrition across subject areas: in particular, whether mathematics and science teachers have higher attrition rates than those teaching other specialties and whether they tend to return less frequently. Prior research (Murnane et al., 1991; Grissmer and Kirby, 1992) found that the highest rates of attrition are among physics/chemistry, English, and biology teachers. This may be partly explained by the attractive outside opportunities available to these teachers and in the case of science teachers, poor or inadequate equipment and supplies that may lead them to be frustrated and unhappy enough with working conditions to leave. Surprisingly, mathematics teachers were found to have among the lowest rates of attrition, along with elementary teachers. Although outside salaries for mathematics graduates are quite high, these may be available only to those who teach advanced courses or perhaps have a degree in mathematics as opposed to teacher education.

Figure 4.7 portrays the cumulative annual attrition for teachers characterized by primary assignment area (at entry) for Texas beginning teachers. Our findings reinforce what others have found.

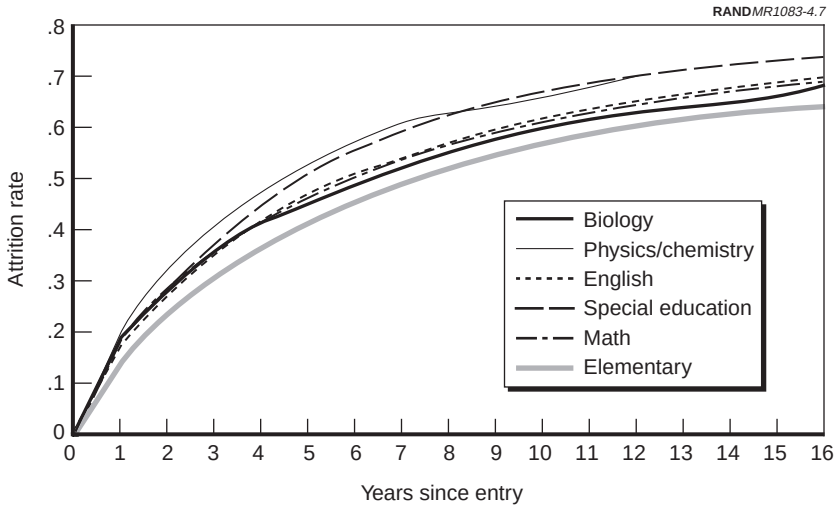

Figure 4.7—Annual Attrition from Teaching of Combined Cohorts, by Subject Area

Elementary teachers have the lowest attrition rates and physics/chemistry teachers have the highest attrition. By the end of the fourth year in teaching, 36 percent of elementary teachers have left, compared with 48 percent of physics/chemistry teachers. We also find that special education teachers leave at high rates equal to those of physics/chemistry teachers after the 8th year. We can offer two reasons: Either the demand has fallen off for special education teachers (we saw above that the proportion of special education teachers in the total teaching force has fallen quite sharply over time) or that special education teachers burn out after a while on the job. Unlike prior studies, we find that mathematics teachers experience higher attrition than elementary teachers: 43 percent. This difference narrows to 5 percentage points over time but remains stable over time. At the end of the 10th year, we find that 57 percent of elementary teachers, 60–61 percent of biology, English, and

mathematics teachers, and 67 percent of physics/chemistry and special education teachers have had at least one break in teaching.[6]

Attrition Differences by Race/Ethnicity and Gender. Other studies have generally found that women tend to have higher annual attrition rates than men but that the differences narrow substantially when other factors (including propensity to return to teaching later) are taken into account (Grissmer and Kirby, 1992; Murnane et al., 1991). Studies also show that minority teachers tend to have much lower attrition rates than nonminority teachers (Kirby and Hudson, 1993; Murnane et al., 1991). However, there is little evidence on attrition patterns by both race/ethnicity and gender.

Figures 4.8–4.10, which show cumulative attrition rates by race/ethnicity and gender, reveal some interesting differences among the subgroups.

- We do not see the large differences in attrition between men and women that was evidenced in data from earlier periods. Women are tending to take fewer breaks from the labor force and this is reflected in the fact that their attrition rates are fairly close to those of men.
- Among non-Hispanic white teachers, we find that in the first three years, men tend to have *higher* attrition than women but this changes by the fourth year when the respective attrition rates are 40 and 41 percent. By the tenth year, the difference in attrition has increased to 4 percentage points (58 percent and 62 percent, respectively) and this difference remains stable after that point.
- Black male and non-Hispanic white female teachers have the highest attrition rates of all the groups.
- Among minority teachers, we find interesting patterns by gender. For example, unlike non-Hispanic whites, black male teachers

[6]When we examine permanent attrition, the attrition rates are considerably lower but the pattern remains the same. For example, the 10-year attrition rate is 45 percent for elementary teachers, 50 percent for biology, English, and mathematics teachers, 54 percent for special education teachers, and 57 percent for physics/chemistry teachers.

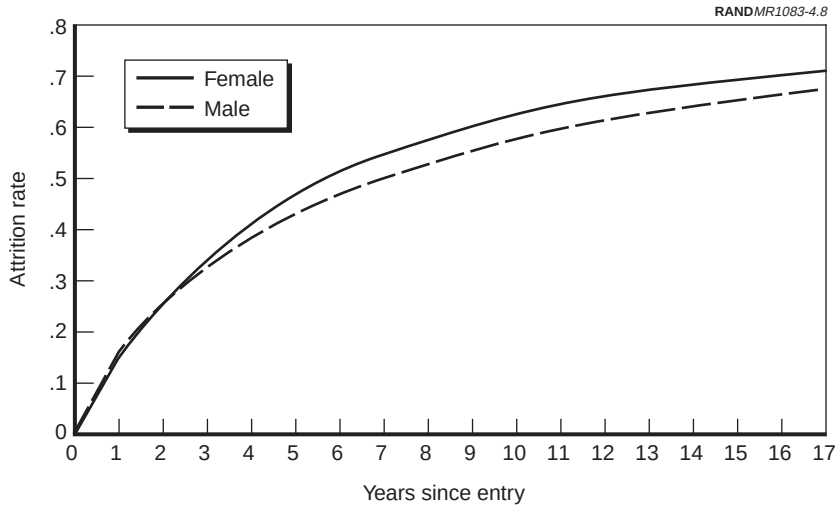

Figure 4.8—Cumulative Attrition from Teaching of Combined Cohorts, by Gender: Non-Hispanic White Teachers

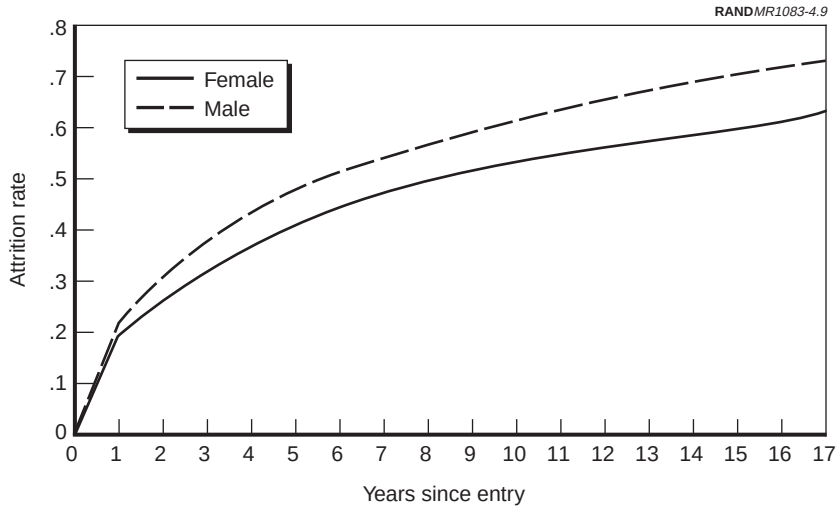

Figure 4.9—Cumulative Attrition from Teaching of Combined Cohorts, by Gender: Black Teachers

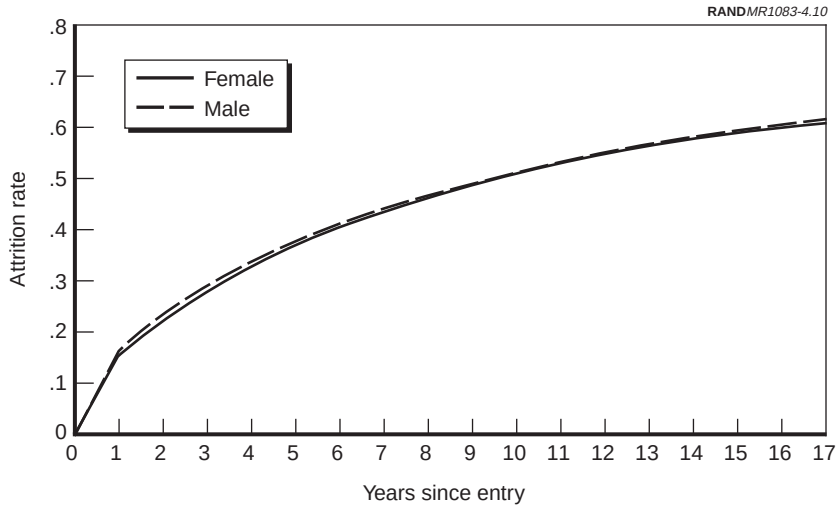

Figure 4.10—Cumulative Attrition from Teaching of Combined Cohorts, by Gender: Hispanic Teachers

have consistently higher attrition rates than black female teachers: In the first year, 24 percent of black men leave teaching compared with 20 percent of black women; by the fourth year, the difference in attrition increased to a difference of 7 percentage points (44 percent compared with 37 percent) and, by the 10th year, to 9 percentage points (62 compared with 53 percent). Given the need for black male role models in our schools, the fact that black male teachers have higher attrition than black female teachers is disturbing.

- Among Hispanic teachers, there is little or no difference between men and women. In the first five years, there is a 1 to 3 percentage point difference in attrition: For example, the two-year attrition rate of Hispanic male teachers is 25 percent compared with 22 percent for Hispanic female teachers; the four-year attrition rates are 34 and 33 percent, respectively. By the 10th year, a little over half of both groups have left teaching (51 percent).

Changes over Time. As we saw above, attrition has declined over time and we were interested in seeing whether this pattern held up for all three race/ethnic groups. We grouped our entry cohorts into three groups based on year of entry (1979–84, 1985–89, 1990–95) and examined their annual attrition patterns for the three groups separately (Figures 4.11–4.13). Among non-Hispanic white teachers, the decline in attrition over time is quite marked. For example, the four-year attrition rate declined from 49 percent for the earliest cohorts to 42 percent for those entering in 1985–89, and still further to 34 percent for the most recent cohorts. Among black teachers, however, the pattern is somewhat different: The middle years saw a significant increase in attrition. For example, the attrition rates for the 1985–89 cohorts were 9–10 percentage points higher for the first five years and then remained 3–5 percentage points higher through the 11 years for which we have data on these cohorts. The experience of the most recent cohorts is similar to that of the 1979–84 cohorts, especially after the first four years. Hispanic teachers show the same pattern of increased attrition for the middle cohorts but the most recent cohorts show somewhat lower attrition than the earliest cohorts. For example, the four-year attrition rates were 33, 37, and 31 percent for the 1979–84, 1985–89, and 1990–95 cohorts, respectively. The much higher attrition rates of the 1985–89 cohorts for black and Hispanic teachers but not for non-Hispanic white teachers suggest the existence of some policy or practice that differentially affected minority teachers but not majority teachers. One possibility is the implementation of the TECAT during this time; we have seen that minorities do not fare as well as white teachers on standardized tests. Another possibility is that particular districts—particularly those with high numbers of minority teachers—faced cutbacks in funding and so instituted reductions-in-force.

Attrition Differences by Type of School District (Low, Medium, and High Risk). As Figure 4.14 shows, the findings run somewhat contrary to our expectations. In the first three years, attrition in the high-risk districts is slightly higher than in medium- or low-risk districts by 1–3 percentage points but for later years, attrition is actually *lower* in high-risk districts. By the 10th year, for example, 60 percent of teachers working in low- to medium-risk districts have had a break in teaching compared with 56 percent of teachers working in high-risk districts. As we show in the multivariate analysis, part of this

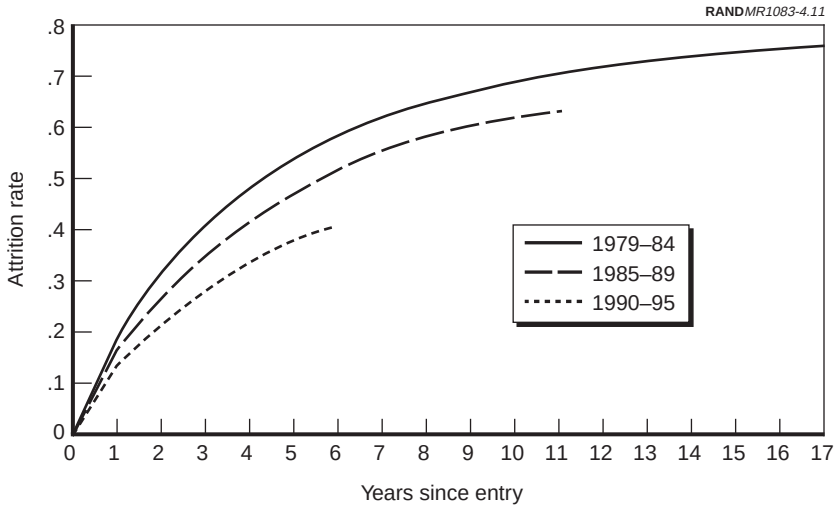

Figure 4.11—Annual Attrition from Teaching of Non-Hispanic White Teachers, Grouped Entry Cohorts

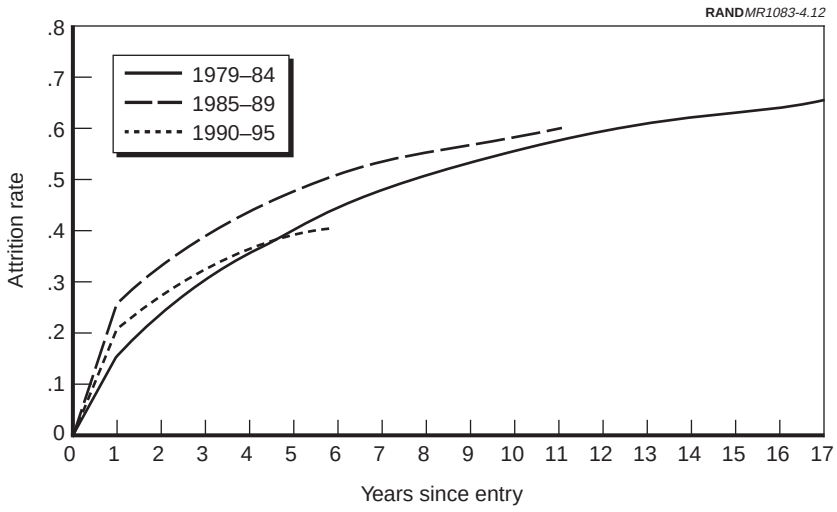

Figure 4.12—Annual Attrition from Teaching of Black Teachers, Grouped Entry Cohorts

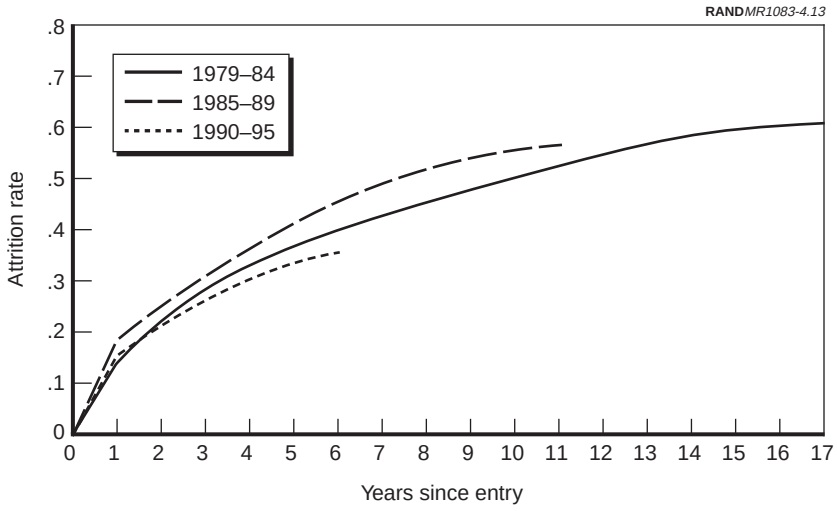

Figure 4.13—Annual Attrition from Teaching of Hispanic Teachers, Grouped Entry Cohorts

difference is because high-risk districts are staffed largely by minority teachers who have lower attrition than nonminority teachers.[7]

Median Survival Times for Selected Groups of Teachers

It is useful to summarize the attrition differences among the various groups of teachers by looking at the median lifetime of a typical teacher within that group. This statistic, which captures how rapidly the survivor function drops (or alternatively, the cumulative attrition function increases), represents the length of time that must pass before 50 percent of a particular group of teachers leaves teaching.

Table 4.1 shows the median survival time for typical teachers in each of the subgroups for the annual definitions of attrition, calculated from the descriptive functions presented above.

[7]There is no difference in this pattern when we look at permanent attrition, suggesting that the propensity to return to teaching does not differ across types of districts.

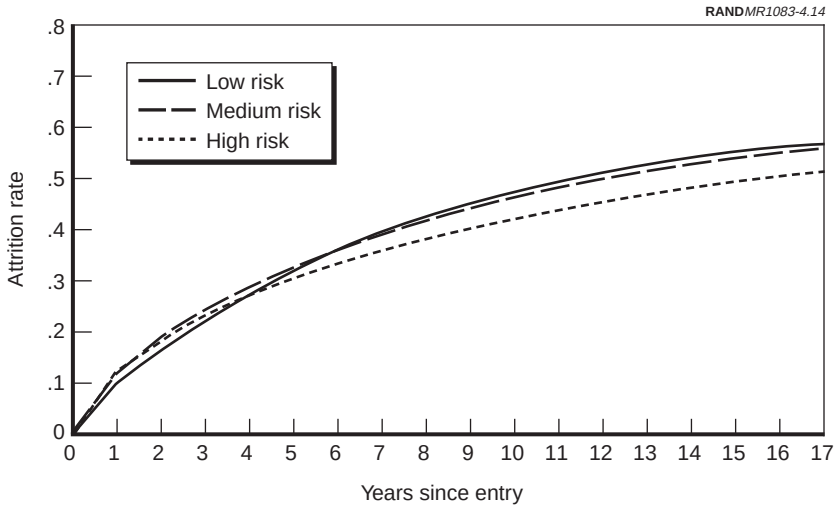

Figure 4.14—Annual Attrition from Teaching of Combined Cohorts in Low-, Medium-, and High-Risk Districts

Table 4.1

Median Survival Time in Years for Selected Groups

All cohorts	7
Gender by race/ethnicity	
Non-Hispanic white female	6
Non-Hispanic white male	7
Hispanic female	10
Hispanic male	10
Black female	9
Black male	6
Age at entry	
20–24	6
25–29	7
30–34	9
35+	11
Districts categorized by risk	
Low risk	7
Medium risk	7
High risk	8

For the combined cohorts as a whole, we find that the typical teacher will stay seven years in teaching before a break in service. Hispanic teachers (both male and female) and black female teachers have much longer median survival times (and higher return rates compared with the other groups, when one examines permanent attrition). Black male and non-Hispanic white female teachers have the shortest survival times. The large differences we saw by age at entry are quite evident here. Median survival times increase sharply with age. As we saw above, high-risk districts have somewhat longer median survival times than low- or medium-risk districts; this is largely because they tend to be staffed primarily by minority teachers, who have longer survival times.

Thus far, the graphs and table displayed here present the total effect of a characteristic and everything correlated with that characteristic rather than the net effect of that variable alone, holding all other variables constant. We present below multivariate models that estimate the net effect of each characteristic on attrition.

Multivariate Results. We estimated several different versions of the same basic model with characteristics of teachers (gender, age at entry, degree, primary teaching assignment, type of district in terms of risk category and urbanicity, race/ethnicity, beginning salary) for different cohorts of teachers. The basic conclusions are robust across the different versions, which gives us confidence in our results. The results offer interesting insights on attrition patterns of minority teachers and those teaching in high-risk districts.

The models presented here use data only from the 1987–88 to 1995–96 cohorts of new teachers because this allowed us to control for certain district variables as well.[8] For example, in addition to the teacher variables, the model controls for beginning teacher salaries, differences in student/teacher ratios, instructional expenditures per pupil, and percentage administrative and support staff, all of which can be regarded as proxies for working conditions and resources available to teachers. Another reason for using more recent data is that attrition patterns have changed markedly over the 1970s and

[8]The complete model, which is based on the entire 16-year period for which we have data, uses only teacher characteristics because we do not have district data for the 16-year period. The results of the complete model are presented in Appendix A.

1980s. As a result, we felt that these results are likely to be more relevant to describing relationships holding in the labor market today. In addition, the model was estimated separately for the three racial/ethnic groups: non-Hispanic whites, Hispanics, and blacks.

Table 4.2 presents the means and standard deviations of the variables used in the Cox models. Some interesting differences emerge among the three racial/ethnic groups. For example, black teachers tend to be somewhat older (a third of them are over 35) than whites or Hispanics. A higher proportion of black and Hispanic teachers do not have a college degree (10–14 percent) compared with 3 percent of non-Hispanic white teachers. Sixty percent of new Hispanic teachers are teaching in high-risk districts compared with only 15 percent of whites and 27 percent of black teachers. New black teachers are predominately teaching in medium-risk districts, whereas 50 percent of non-Hispanic white teachers are teaching in low-risk districts. There are also some noteworthy differences by the district community type where these different groups of teachers are teaching. For example, over half of all new black teachers are teaching in major urban school districts, whereas a quarter of Hispanic teachers are teaching in other central city school districts. Forty-four percent of non-Hispanic white teachers are hired into suburban school districts compared with only 31 percent of Hispanic and 26 percent of black teachers.

Table 4.3 presents the results of the estimation. Because the coefficient estimates are rather difficult to interpret, we present the multiplicative factor defined as exp(b), where b is the estimated coefficient. For the continuous variables, the multiplicative factor gives the proportional shift in the attrition rate associated with a one-unit increase in that variable (for example, a $1,000 increase in pay, a one point increase in student/teacher ratio, or a one percentage point increase in percentage administrative or professional support staff). For the other characteristics, the multiplicative factor shows the shift in the attrition rate for an individual with the particular characteristic (e.g., male) relative to that of an otherwise similar individual with the reference or omitted value for that characteristic (in this case, female). The results from the separate models largely agree, so in the discussion we focus on the results from the total model although we point out differences where they exist.

Table 4.2

Means and Standard Deviations of Analysis Variables, 1987–88 to 1995–96

Characteristic	All	Non-Hispanic White	Hispanic	Black
Sample size	98,951	76,160	15,338	6,502
Teacher pay ($1,000)	23.85 (3.2)	23.82 (3.1)	23.72 (3.5)	24.49 (4.2)
Student teacher ratio	16.15 (1.9)	16.01 (1.9)	16.52 (1.5)	16.8 (1.3)
Instructional expenditures per pupil ($1,000)	2.43 (0.8)	2.40 (0.8)	2.51 (0.8)	2.50 (0.7)
% administrative staff	3.95 (1.2)	4.08 (1.2)	3.48 (1.0)	3.62 (0.9)
% professional support staff	5.94 (1.9)	5.81 (1.9)	6.15 (1.7)	6.94 (1.5)
Gender				
Female	0.75	0.77	0.70	0.72
Male	0.25	0.23	0.30	0.28
Age at entry				
20–24	0.27	0.30	0.20	0.18
25–29	0.36	0.35	0.40	0.31
30–34	0.12	0.11	0.16	0.17
35+	0.25	0.24	0.24	0.34
Degree				
BA	0.89	0.91	0.87	0.77
MA or Ph.D.	0.06	0.06	0.03	0.09
None	0.05	0.03	0.10	0.14
Primary teaching assignment				
Nondepartmental (elementary)	0.54	0.53	0.62	0.53
Special education	0.08	0.08	0.06	0.11
English	0.09	0.09	0.08	0.07
Mathematics	0.07	0.07	0.05	0.07
Physics/chemistry	0.004	0.005	0.003	0.002
Biology	0.02	0.03	0.02	0.02
Other departmental	0.20	0.20	0.17	0.20
District educational risk				
Low	0.41	0.50	0.11	0.18
Medium	0.36	0.35	0.29	0.55
High	0.23	0.15	0.60	0.27
District community type				
Major urban	0.20	0.15	0.27	0.57
Other central city	0.14	0.12	0.24	0.09
Suburban fast growing	0.22	0.24	0.21	0.12
Suburban stable	0.18	0.20	0.10	0.14
Nonmetro with 1000+ ADA	0.14	0.15	0.12	0.06
Nonmetro with town	0.05	0.06	0.02	0.01
Rural	0.07	0.08	0.04	0.01
Race/ethnicity				
Non-Hispanic white	0.78	—	—	—
Hispanic	0.15	—	—	—
Black	0.07	—	—	—

Table 4.3

Multiplicative Factor Estimates for Cox Regression on Time to Attrition from Teaching, with District Variables, 1987–88 to 1995–96

Characteristic	All	Non-Hispanic White	Hispanic	Black
Teacher pay ($1,000)	0.971**	0.993**	0.937**	0.948**
Student teacher ratio	1.033**	1.027**	1.040**	1.072**
Instructional expenditures per pupil ($1,000)	0.926**	0.934**	0.874**	0.908**
% administrative staff	1.044**	1.042**	1.040*	1.059*
% professional support staff	0.984**	0.985**	0.979*	0.912**
Gender				
Female	*1.0*	*1.0*	*1.0*	*1.0*
Male	0.979	0.948**	0.982	1.103*
Age at entry				
20–24	*1.0*	*1.0*	*1.0*	*1.0*
25–29	0.775**	0.806**	0.770**	0.596**
30–34	0.668**	0.678**	0.733**	0.604**
35+	0.633**	0.613**	0.789**	0.631**
Degree				
BA	*1.0*	*1.0*	*1.0*	*1.0*
MA or Ph.D.	1.493**	1.478**	1.564**	1.364**
None	1.751**	1.507**	1.597**	2.350**
Primary teaching assignment				
Nondepartmental (elementary)	*1.0*	*1.0*	*1.0*	*1.0*
Special education	1.178**	1.183**	1.224**	1.134
English	1.184**	1.167**	1.335**	1.221**
Mathematics	1.238**	1.233**	1.232**	1.493**
Physics/chemistry	1.452**	1.563**	1.098	0.751
Biology	1.170**	1.152**	1.342**	1.214
Other departmental	1.131**	1.112**	1.214**	1.144*
District educational risk				
Low	*1.0*	*1.0*	*1.0*	*1.0*
Medium	1.064**	1.069**	1.017	0.964
High	1.148**	1.247**	0.888*	1.033
District community type				
Major urban	1.240**	1.234**	1.134*	1.356**
Other central city	1.037	1.069**	0.954	1.304**
Suburban fast growing	0.991	1.002	0.815**	1.118
Suburban stable	*1.0*	*1.0*	*1.0*	*1.0*
Nonmetro with 1000+ ADA	0.861**	0.885**	0.812**	1.163
Nonmetro with town	0.810**	0.838**	0.813	1.168
Rural	0.925**	0.957	0.948	1.302
Race/ethnicity				
Non-Hispanic white	*1.0*	—	—	—
Hispanic	0.838**	—	—	—
Black	1.018	—	—	—

NOTE: For each variable, the omitted or reference group is given in italics.

* Significant at the .05 level.

**Significant at the .01 level.

Although in the overall model males and females have similar attrition rates, we find interesting differences in the submodels: White males have attrition rates that are 5 percent lower than those of white females but black males have 10 percent higher attrition rates than comparable black females. As we found above in the simple bivariate results, older teachers have significantly lower attrition rates (20–40 percent lower) than younger teachers. Those with advanced degrees at entry tend to have considerably higher attrition rates than those entering with a bachelor's degree, suggesting that these teachers may have greater opportunities in the nonteaching labor market. All departmental teachers have higher attrition than elementary teachers; this has been found in several previous studies. In particular, the much higher attrition rates of science teachers is worth noting.

For this report, the racial/ethnic results and those pertaining to districts categorized by risk are the most important. Controlling for other variables, we find that Hispanic teachers have attrition rates that are about 16 percent lower than comparable white teachers but that there is no difference in the attrition rates of black and white teachers. Although our results in the bivariate analysis were mixed with respect to attrition patterns in districts categorized by risk, here we find a clearer indication that controlling for other variables, attrition is about 15 percent higher in high-risk districts. The differences across the different racial/ethnic models are interesting. Whites in high-risk districts have much higher attrition rates (almost 25 percent higher) than those in low-risk districts. This contrasts sharply with Hispanics in high-risk districts, who have about a 10 percent *lower* attrition rate than those teaching in low-risk districts, and black teachers, who show no difference in attrition across the three types of districts.

In general, central cities and major urban districts have higher attrition than suburban districts or nonmetropolitan areas.

Increases in pay significantly lower attrition, especially among Hispanic and black teachers. The multiplicative factors for pay show that a $1,000 increase in beginning salary reduces attrition by about 2.9 percent in the overall model and by 5–6 percent in the Hispanic and black models.

An increase in student/teacher ratios has a detrimental effect on attrition; an increase of one point (say from 16.15 to 17.15) would increase attrition by 3.3 percent in the overall model, and 4–7 percent in the Hispanic and black models. An increase of $1,000 in instructional expenditures per pupil (a very large increase) would reduce attrition by about 7–13 percent. An increase of 1 percentage point in administrative staff would increase attrition by 4–6 percent, whereas an increase of 1 percentage point in professional support staff would lower attrition by 2–9 percent.

It is interesting to note that the separate models indicate that minority teachers are particularly sensitive to working conditions as proxied by these variables. This is not surprising, given that they are working under what are likely to be rather difficult and underresourced conditions.

Tables 4.4–4.5 present two other versions of the full model. Here, instead of estimating separate models for each racial/ethnic group, we allow for interactions between race/ethnicity and risk and race/ethnicity and gender to see whether and how these differ. Because the other results mostly mirror the model with all teachers discussed above, we focus on the results of the interaction terms. Somewhat surprisingly, compared with non-Hispanic whites teaching in low-risk districts, blacks in low-risk districts have significantly *higher* attrition—about 12 percent higher. Compared to whites teaching in low-risk districts, whites in medium-risk districts have a 6 percent higher attrition rate, whereas those teaching in high-risk districts have a considerably higher attrition rate: 23 percent higher. Blacks have significantly higher attrition rates than whites teaching in low-risk districts, regardless of where they are teaching. Hispanics, on the other hand, have attrition rates similar to those of non-Hispanic whites in low- and medium-risk districts but Hispanics teaching in high-risk districts have much *lower* attrition (about 10 percent lower) than non-Hispanic whites in low-risk districts, a finding that offers some promise for these districts faced with high attrition among non-Hispanic teachers.

Table 4.5 underscores what we found above in the survival function results. Controlling for other characteristics, we find that black male teachers have significantly higher attrition than non-Hispanic white female teachers (13 percent higher), whereas every other group (with

Table 4.4

Multiplicative Factor Estimates for Cox Regression on Time to Attrition from Teaching, with Race/Ethnicity and Risk Interactions, 1987–88 to 1995–96

Characteristic	All
Teacher pay ($1,000)	0.971**
Student teacher ratio	1.034**
Instructional expenditures per pupil ($1,000)	0.926**
% administrative staff	1.044**
% professional support staff	0.984**
Gender	
Female	*1.0*
Male	0.978
Age at entry	
20–24	*1.0*
25–29	0.775**
30–34	0.666**
35+	0.632**
Degree	
BA	*1.0*
MA or Ph.D.	1.493**
None	1.770**
Primary teaching assignment	
Nondepartmental (elementary)	*1.0*
Special education	1.181**
English	1.185**
Mathematics	1.241**
Physics/chemistry	1.454**
Biology	1.171**
Other departmental	1.131**
District risk category and race/ethnicity interactions	
*Low-risk*non-Hispanic white*	*1.0*
Low-risk*Hispanic	0.982
Low-risk*black	1.124*
Medium-risk*non-Hispanic white	1.063**
Medium-risk*Hispanic	1.001
Medium-risk*black	1.075*
High-risk*non-Hispanic white	1.230**
High-risk*Hispanic	0.894**
High-risk*black	1.176**
District community type	
Major urban	1.226**
Other central city	1.047*
Suburban fast growing	0.993
Suburban stable	1.0
Nonmetro with 1000+ ADA	0.862**
Nonmetro with town	0.813**
Rural	0.932**

NOTE: For each variable, the omitted or reference group is given in italics.

*Significant at the .05 level.

**Significant at the .01 level.

Table 4.5

Multiplicative Factor Estimates for Cox Regression on Time to Attrition from Teaching, with Race/Ethnicity and Gender Interactions, 1987–88 to 1995–96

Characteristic	All
Teacher pay ($1,000)	0.971**
Student teacher ratio	1.033**
Instructional expenditures per pupil ($1,000)	0.925**
% administrative staff	1.044**
% professional support staff	0.984**
Gender	
Non-Hispanic white female	*1.0*
Non-Hispanic white male	0.953**
Hispanic female	0.828**
Hispanic male	0.827**
Black female	0.957
Black male	1.132**
Age at entry	
20–24	*1.0*
25–29	0.771**
30–34	0.670**
35+	0.634**
Degree	
BA	*1.0*
MA or Ph.D.	1.494**
None	1.749**
Primary teaching assignment	
Nondepartmental (elementary)	*1.0*
Special education	1.179**
English	1.185**
Mathematics	1.240**
Physics/chemistry	1.464**
Biology	1.174**
Other departmental	1.134**
District educational risk	
Low	*1.0*
Medium	1.066**
High	1.149**
District community type	
Major urban	1.240**
Other central city	1.037*
Suburban fast growing	0.991
Suburban stable	*1.0*
Nonmetro with 1000+ ADA	0.862**
Nonmetro with town	0.811**
Rural	0.926**

NOTE: For each variable, the omitted or reference group is given in italics.

*Significant at the .05 level.

**Significant at the .01 level.

the exception of black females) has significantly lower attrition, even white males. Hispanics, regardless of gender, have attrition rates that are markedly lower than those of white female teachers.

We also estimated separate models for low-, medium-, and high-risk districts as well as separate models by race/ethnicity within each of these risk categories. These models largely bear out what we saw above. Overall, teachers in high-risk districts are more sensitive to pay (a $1,000 increase in pay reduces attrition in these districts by 6.2 percent compared with 1 percent in low-risk districts and 1.6 percent in medium-risk districts) and minority teachers, regardless of type of district, are more sensitive to pay than white teachers. Although the attrition of all teachers is affected by working conditions, in high-risk districts, we find that black teachers appear to be particularly sensitive to student/teacher ratios and the presence of support staff. Unlike Hispanic teachers and black teachers, white teachers seem to react more to the district community type. For example, in high-risk districts, attrition of white teachers is 23 percent higher in both central city schools and rural schools than in suburban stable school districts.