AN ANALYSIS OF TEACHER CHOICES:
TRANSFERS, ATTRITION, AND RETIREMENT

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Abstract. It is a common misperception that low teacher recruitment is the cause of the current teacher shortage in the United States. Research over the past decade suggests, however, that the source of the shortage is high levels of staffing fluctuations driven by teacher attrition. This paper examines the factors underlying teacher attrition decisions in order to make policy recommendations about which retention policies are likely to successfully reduce teacher attrition. Using pooled cross-sectional data from the Schools and Staffing Survey (SASS) and attrition decisions from the Teacher Follow-up Survey (TFS) of the same teachers one year later, we employ a multinomial logistic model to estimate the parameters associated with three kinds of teacher attrition: school transfer, exit from the profession, and retirement. The parameter estimates are used to simulate survival functions and approximate differences in teacher retention over a 15 year time horizon. The results indicate that salary is not a significant determinant of exit attrition despite its attention as an important policy tool. Additionally, although salary is a statistically significant determinant of transfer attrition, the size of the effect does not indicate that salary is an efficient or cost-effective solution to the attrition problem. Administrative support problems, student-teacher racial/ethnic matching, and school level (elementary or secondary), however, are statistically and economically important determinants of teacher attrition, indicating that teacher retention policies and incentive plans would benefit from incorporating these factors.

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I. INTRODUCTION

According to the National Education Association (NEA), only 50 percent of all individuals with a teaching credential are actually in a teaching occupation (NEA, 2003). This statistic debunks the common misconception that the current teacher shortage in the United States is due to weakness in supply. In fact, recent research suggests that the teacher shortage is due primarily to attrition from the profession.[1] Data collected by the National Center for Education Statistics (NCES) indicates that one third of teachers leave the profession within three years. Within five years of becoming teachers, 40 percent leave teaching, and this figure rises to an astounding 50 percent in urban school districts (Schools and Staffing Survey, 2003). Teacher attrition is complicated because it may be defined as a teacher moving to a different school (transfer attrition), leaving the teaching profession for an alternate occupation (exit attrition), or leaving the labor force completely (retirement). Each type of attrition poses unique challenges for schools and student outcomes. High transfer attrition may disrupt cohesion in a school and negatively impact student outcomes even though it doesn't contribute to an aggregate shortage of teachers. High exit attrition is likely to disproportionately affect some disciplines (math and science) as well as schools with undesirable demographic characteristics (*e.g.*, urban schools, schools with low socioeconomic student populations). Because policies designed to recruit and retain teachers may differentially affect the various types of teacher attrition, it is necessary to jointly examine all three types of attrition in a model of teacher decision making. This paper examines the factors underlying all three types of teacher attrition decisions – transfer, exit, and retirement – in order to quantify how successful various public policies are likely to be at alleviating teacher shortages. Using pooled cross-sectional data from the Schools and Staffing Survey (SASS) and attrition decisions from the Teacher Follow-up Survey (TFS) of the same teachers one year later, we employ a multinomial logistic model to estimate the parameters associated with three kinds of teacher attrition: school transfer, exit from the profession, and retirement. The parameter estimates are used to simulate survival functions and approximate differences in teacher retention over a 15 year time horizon.

The determinants of teacher attrition have been examined using a variety of datasets and empirical strategies, the results of which have provided somewhat conflicting conclusions (Eide, Brewer, & Goldhaber, 2004; Ingersoll, 2001; Liu & Meyer, 2005; Shen, 1997). Despite the

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[1] See Boe et al. (1997), Ingersoll (2001), Imazekwe (2005), Liu and Meyer (2005), and Shen (1997).

various conclusions about the determinants of attrition, there is some consensus that high teacher turnover may result in a lack of school cohesion and reduced student performance (Boe et al., 1997; Ingersoll, 2001; Theobald, 1990).[2] Positive teacher relationships, interdepartmental synergy, participation at school events, a shared mission, and consistent teacher attendance may create cohesion at a school that can greatly nurture teacher retention and increase student achievement. These factors can, however, deteriorate because of high attrition rates, where teachers are less stationary and a larger percentage of the faculty are either new or are still acclimating to a new school.

Much of the previous research focuses on the problem of exit attrition (Shen, 1997; Boe et al., 1997; 1998, Murnane & Olsen, 1989). However, no study can accurately model the attrition from the profession without also modeling the transfer attrition between schools as well as retirement attrition. Many leave the profession for a higher salary in another profession. Still others leave to another school or to another career citing dissatisfaction with student behavior, administrative inefficiency, or lack of administrative or parental support. Though "movers" may still be in the teaching profession at another school or another district, high fluctuation in teacher employment can be unfavorable for the school. Policy makers' attention, therefore, has been turned to policies that retain teachers, preferably at the same school. However, if the factors that influence exit attrition and transfer attrition are different, or even have opposing effects, policy makers may be interested to know which factors can be used to retain teachers, while still allowing some teacher mobility across schools. Furthermore, many teachers make their retirement decisions based on these same factors. Without understanding how incentives to retain newer teachers affect the retirement decisions of experienced teachers, policy makers may unknowingly or unintentionally alter retirement behavior. This study examines all three types of teacher attrition – transfer, exit, and retirement – and seeks to answer the following questions. What are the policy-relevant factors that affect each type of teacher attrition? Are salary increases predicted to reduce teacher attrition and are there differential effects on the various types of attrition? In addition to salary, we focus on other factors with particular policy relevance, such school level (elementary v. secondary), urbanicity, teacher education, student behavior, and administrative supportiveness. We also explore the effect of No Child Left Behind

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[2] Although some turnover is necessary in any occupation to allow for improved matching between employer and employee, turnover in those service occupations that involve strong interpersonal relationship formation may have negative consequences for the quality of the service rendered.

(NCLB) requirements on teacher attrition. We analyze data from the five cycles of the Schools and Staffing Survey (SASS) and the Teacher Follow-up Survey (TFS) with a multinomial logistic model of competing risks.

II. REVIEW OF THE LITERATURE

Liu and Meyer (2005) use the 1994-1995 cycle of the TFS and hierarchical linear modeling to perform an in-depth analysis into the qualitative reasons reported by teachers about the profession. By using a cycle of the TFS, Liu and Meyer are able to make an important contribution to the study of teachers' perceptions for stayers, movers, and leavers by regressing teacher choices on the opinions of teachers about their students and about the administration of the school. Their study finds significant differences between the perceptions and the attrition choices and identifies substantial differences by race. On a Likert scale measuring school problems with school climate, minority teachers perceived an average score 0.09 points higher (se = 0.026) than non-minority teachers, meaning that minority teachers are more likely to be teaching at a school that has issues with administrative effectiveness and support, safety, influence, and classroom autonomy. Ingersoll (2001) discusses the problem of teacher attrition with an organizational perspective, analyzing the movement of teachers from individual schools. Ingersoll finds that, in addition to the inherent individual teacher characteristics that lead to differing attrition rates, teachers tend to leave schools, either by transfer or exit, when there are underlying problems with the school's administrative effectiveness and lack of teacher satisfaction. For example, with a variable measuring administrative support for new teachers ranging from 1 to 4, Ingersoll's model estimates a coefficient of -0.26. In a logistic model, this coefficient implies that the probability to leave the profession would decrease by 23 percent for a unit increase in the independent variable.[3] Ingersoll's measure for student conflict was equally as significant.[4]

Several analysts have used duration analysis techniques to isolate causal factors in both the length of first-spell teaching and multiple spell teaching (Stinebrickner, 1998, 2001; Murnane

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[3] The independent variable in the model is a 4-point Likert scale ranging from 1 (Strongly Disagree) to 4 (Strongly Agree) to the statement, "Administration is very supportive to new teachers" (Ingersoll, 2001). Like Liu and Meyer, Ingersoll also uses SASS and TFS data in his study.
[4] A similar variable as in footnote 3 asks about the student discipline problems at their school, ranging from 1 (Not a problem) to 4 (Serious). Significant at the 5% level.

& Olsen, 1990; Singer & Willet, 1988). Stinebrickner (1998) uses a proportional hazard model to isolate causal factors of the length of the first-spell in teaching and concludes that, among other contributing factors, wage is a more important contributor to teaching spell length than enhanced working conditions or smaller class sizes. In a later paper, Stinebrickner (2001) finds that teacher aptitude, as measured by SAT scores, is positively correlated with shorter first-spell duration lengths. Teachers with higher general aptitude either leave the profession sooner or are more likely to take a break from teaching (Stinebrickner 2001, Murnane & Olsen, 1989). Stinebrickner (2001) finds that those teachers who scored in the bottom third on the SAT spent the most time teaching whereas the teachers who scored in the top tenth spent less time teaching than they did at another job. However, general aptitude testing is not required for entry into the teaching profession making the potential usage of aptitude scores in the prediction of teacher attrition intractable. Almost every teacher is required to have baseline subject matter knowledge, sitting for tests either on their subject, all subjects, or both, but teachers are required simply to pass and a successful (binary) outcome is the only such measurement.   Several measures of aptitude that are observable, albeit subject to ambition or intention, are a teacher's coursework and/or degrees attained beyond a bachelor's degree. Although not all highly qualified teachers pursue advanced degrees, the degree attainment of each teacher can also capture additional opportunity costs of teaching. Many teachers with such degrees may go on to teach at the postsecondary level. Such teachers also have increased professional opportunity outside of teaching in the private sector.

Teachers with different education face different opportunity costs. Surely, raising the salary schedule for all teachers has been the popular suggested policy to extend the employment duration, but Boe et. al. (1997) show that teachers with different specifications respond differently to incentives. Boe et. al. (1997) find that special education teachers have a higher annual mover attrition rate (9.2 percent) than do general education teachers (6.5 percent). Differing opportunity costs can play a more important role in decisions made at the high school level than at the elementary level; high schools have teachers who have more subject-specific degrees. While this says little about aptitude, some high school teachers have degrees in fields with better than average employment opportunities outside of teaching, many of which pay more than the school district or education altogether. One question often raised is whether or not teachers with science and math degrees/backgrounds have higher attrition than their peers.

Certainly there are far fewer math and science graduates (for some science fields), but the effect of a specific degree on attrition behavior is still not fully understood. Other research has shown that teachers of math or science may experience transfer attrition differently than exit attrition (Imazeki, 2005).

III. MODEL

Each teacher has unobserved propensities to stay in the current teaching position, move to a different teaching position, exit the teaching profession, and exit the labor market through retirement. Let Y_{ij}^* be the latent value to person i of choice j. Although each teacher has varying propensities to choose each option, the binary choice made, Y_{ij}, is what is observed in the data. This type of unordered choice data is best analyzed using the multinomial logistic regression model, which predicts the probability that a teacher will choose to move to another school, leave the profession, or to retire, relative to the probability of their base choice, which we assume is staying in their current teaching position. The latent values of each choice are functions of a vector of teacher attributes, teacher opinions of the school, school and district attributes, X_i:

$$Y_{ij}^* = \beta_j X_i + \varepsilon_{ij} \tag{1}$$

Assuming the error term, ε_{ij}, is distributed logistically, the probability that teacher i chooses career path j, conditional on the values in the vector of explanatory variables, X_j, is given by the choice probability in Equation (2).

$$\Pr(Y_{ij} = 1 \mid X_i) = \frac{\exp(\beta_j X_i)}{\sum_{k=1}^{4} \exp(\beta_k X_i)} \tag{2}$$

The vector β_j is the vector of parameters for the jth outcome, which indicate how the choice probabilities are predicted to change with the explanatory variables in X_j. The first choice is normalized such that $\beta_j = 0$ when $j=1$. The coefficients are estimated by maximum likelihood where the log-likelihood function is given in equation 3.

$$\text{Log } L = \sum_{i=1}^{n} \sum_{j=1}^{J} Y_{ij} \log \Pr(Y_{ij} = 1). \tag{3}$$

Maximum likelihood is the recommended estimation procedure for two reasons. First, a categorical dependent variable violates one of the necessary assumptions for using OLS. Second, maximum likelihood can be used with large samples, discrete and continuous variables,

as well as combinations of discrete and continuous variables. Because the parameter estimates are cumbersome to interpret, marginal effects of the explanatory variables on the probability of each outcome are calculated as

$$\delta_i = \frac{\partial P_j}{\partial x_i} = P_j \left[\beta_j - \sum_{k=1}^{J} P_k \beta_k \right] = P_j \left[\beta_j - \overline{\beta} \right], \tag{4}$$

where $P_j = \Pr(Y_{ij} = 1)$. Additionally, marginal effects may be calculated with a given set of conditions to examine differences in behaviors between several sets of groups.

Individual teacher attributes included in X_j are years of experience, teacher race, family and marriage variables, the extra hours that a teacher works with and without students, and indicator variables for having a master's degree and a degree beyond a masters. Teacher opinions are recorded responses to the effectiveness and support of the administration and the problem of student absenteeism on their campus. School and district attributes are the student minority percentage, logged teacher salary, the level of the school (secondary or elementary), an urban indicator, and interaction terms between an indicator of teacher minority status with the urbanicity of the school and with the student minority percentage. The math, science, and special education indicators are binary variables indicating a bachelor's degree in mathematics, a science field, or a special education field, as well as interaction terms of those subjects with salary to measure the difference in effectiveness of salary changes for teachers of such subjects. A complete list of these variables and their definitions is provided in Table 1.

We expect additional experience, marriage, and children to have negative effects on the propensity to leave or move from the profession, whereas more advanced degrees and additional hours without students to increase the propensity to leave either the school or the profession altogether. One of the major stated complaints of teachers concerns a heavy workload or teaching load, which means simply too much work to do or too many total students, respectively. Some extra hours spent before or after school or on weekends that involve student interaction could be a sign of teacher involvement of sports and or clubs. Such interaction can have an effect on the connectedness of the teacher to the school and thus may be a negative effect on the attrition rate. Teachers who have degrees in math, science, or special education fields have control factors included as a proxy for subject specialty differentiation as there are a multitude of different college majors, many of which are either of little to no mention in previous literature or have little theoretical pressure for inclusion.

A measure of administrative support is included as a binary response to whether a teacher is dissatisfied or not with the administration and their support. Student absenteeism, highly correlated with student tardiness, and student truancy, can be seen as a way to measure the degree of student apathy to school altogether. If students do not value school, they are not as affected by being marked tardy, being caught for cutting class, or missing a large amount of days. This can be seen as having a harmful impact on attrition rates as lower student voluntary involvement would imply lower class participation, poorer student attitudes, and poorer teacher attitude about their students, thus about teaching altogether. Another possible captured effect of student absenteeism is the influence of parental involvement. Parents who do not buy-in to the objective of the school, may be more willing to allow their children to miss more days of school or are not aware of their student missing school.

Though correlated with the urban school indicator, the student minority percentage is a continuous measure of the composition of the student body. To further capture the composition of the school chemistry, an indicator for a teacher being a member of an underrepresented minority is interacted with both the student minority percentage and the urban indicator. Schools with high student minority percentages may experience higher racial tension and conflicts between different racial groups if the racial composition of the student body is highly diverse.[5] Students have also been known to differentially interact with teachers based on own and teacher race. Same-race teachers may experience more student interaction or rapport. This may lower attrition rates for minority teachers in schools with minority students, if the teacher race matches the race of many students at their school. In addition, high schools tend to have more tension between students than elementary schools regardless of the urbanicity and student body composition. Students in adolescence with more physical ability, more social activity, and high academic expectations can provide a sometimes hostile environment. This combined with more specific subject requirements for teachers (many high school teachers must show intense competencies within their field) can lead to a higher migration of teachers from this public sector to other private sector jobs.

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[5] A better measure of student body racial composition may be a Herfindahl-Hirschman Index of the different minority groups, however, the SASS-TFS do not offer the specific minority decomposition required to generate this variable. Such a measure of racial diversity would capture the fact, for example, that a racially homogeneous student body would arguably experience much lower racial tension than a heterogeneous one.

IV. DATA

The datasets used in much of the previous research can be divided into three types: statewide and metropolitan area longitudinal data, national longitudinal data, and cross-sectional data. Although we analyze a pooled cross-sectional dataset in this research, it is useful to briefly discuss the various data types since there are benefits and drawbacks to each. Naturally, the national longitudinal datasets are the most appealing to analysts, as longitudinal data is generally more comprehensive than cross-sectional data given that individual teacher behavior can be measured over time and causal inferences are easier to determine. Although it has had widespread usage since its inception and is chosen by many economists for analysis, the National Longitudinal Study of the class of 1972 (NLS-72) is older than most other currently used datasets employed to study teacher behavior.[6,7] Last updated in 1986, the baseline year of data collection for the NLS-72 is now thirty-five years old and the latest follow-up survey is over twenty years old. Much state and national legislation has been passed or overwritten since then, such as the No Child Left Behind Act (NCLB). It is because of such new monumental changes in public policy that new analyses using more recent datasets are needed as it is possible that teacher attrition behavior has changed since the last year of the NLS-72.

Statewide or metropolitan longitudinal data also provide information on the same set of individuals over time and are rich in observable characteristics beyond that of cross-sectional data. In addition, many statewide datasets contain large amounts of education-specific information and high numbers of observations as some such datasets are created by large school districts and include all or most of the teachers and staff within the district. However, these datasets are hard or expensive to acquire, are sometimes out of date, and can be biased by state-specific legislation not necessarily similar to or comparable to other states in the U.S. In addition, employment of the teachers who left to teach in another state may not be known in a statewide dataset. Many studies have utilized such datasets in the past, yet only a handful of states and metropolitan areas have been analyzed with such data.[8]

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[6] http://nces.ed.gov/surveys/nls72/
[7] See Eide, Brewer, and Goldhaber (2004), Goldhaber and Brewer (1997), Harris and Adams (2005), Stinebrickner (1998, 2001), Stoddard (2005).
[8] See Gritz and Theobald (1996), Hanushek, Kain, and Rivkin (2004), Imazekwe (2005), Krieg (2004), Murnane and Olsen (1989, 1990), Podgursky (2004), Singer and Willet (1988), Theobald (1990), Willet and Singer (1991).

The National Center for Education Statistics (NCES) of the U.S. Department of Education (USDE) surveyed teachers and administrators about student, school, administration, and teacher characteristics in their Schools and Staffing Survey (SASS) since 1988. The SASS is a national survey consisting of over 50,000 teachers and administrators, both public and private, from thousands of school districts and is administered every three to four years. There are five such cycles of the SASS in 1987-88, 1990-91, 1993-94, 1999-2000, and 2003-04. Following the SASS, the NCES added a semi-longitudinal component to the investigation called the Teacher Follow-up Survey (TFS), conducted the year after each SASS survey year, that asks a portion of the teachers from the previous year's cycle of the SASS about their current employment, whether they have stayed at the same school, moved to a different school, left the profession entirely, or retired, as well as a myriad of other related characteristics.[9] Data in the TFS are responses from teachers, both current and former, and are linked to each teacher's previous responses in the SASS. We observe an individual's responses both before and after leaving the profession or changing schools, or from one year to the next for those teachers that stayed. Though not a true longitudinal survey, the purpose of the TFS is to provide information about teachers who stayed at the same school ("stayers"), teachers who moved to different schools ("movers"), teachers who left the profession for other employment ("leavers"), and those who retired. Many different types of studies have been conducted using the SASS and TFS datasets including logistic regressions, two-stage and three-stage least squares regressions, and general mean comparison reports (Boe et al., 1997; Figlio, 1996; Ingersoll, 2001; Liu & Meyer, 2005, Shen, 1997; Singer & Willett, 1988, 1996). The present research builds on these studies by utilizing the data in a multinomial logistic model, including an additional employment choice, retirement, above and beyond the choices of stayers, movers, and leavers. This research provides a model that may be used to compare results from the SASS and the TFS to other more popular datasets, such as the NLS-72 and state-wide data. In addition, the SASS and the TFS have one proctored cycle after the issuance of additional teacher requirements implemented by NCLB, allowing for the examination of the effects of NCLB on teacher attrition.

We restrict the sample to current and former full-time public school teachers for several reasons. First, public policy mainly impacts public schools and teachers, and private schools usually react differently than public schools to public policy. Second, the majority of teachers in

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[9] http://nces.ed.gov/surveys/sass/methods89.asp

the U.S. teach in a public school.[10] Third, we want to control for large scale effects and simulate policies that could be implemented on a district, state, or nationwide scale. Fourth, a teacher could be working part-time for several reasons, yet the most likely reason falls within two categories: by school choice or by teacher choice. If a school chooses to employ a teacher on a part-time basis, the teacher may not be a highly desired employee, in which case a study of their attrition is not worthwhile. Alternatively, a teacher may not want to work full-time, in which case the teacher is already not fully vested in the place of employment. Therefore, part-time teachers are not considered in this study since retention incentives are not designed to retain part-time teachers.[11] Other teachers have either left the profession or have moved to another school involuntarily. Involuntary staffing actions could occur either by a teacher being "Non-reelect", meaning that the teacher has not been asked to fulfill a new probationary or temporary contract, or by being fired. With reasons unknown, it can be assumed that such teachers should not fall into any choice category, and have been omitted from the sample.[12]

Some teachers exit the profession to find a different career or just because they want out of teaching but others exit the profession, quite legitimately, because they have chosen to retire altogether. This is not the kind of leaving that is considered to be exit attrition. Retirement is not only an attrition choice that needs to be separate from exit and transfer attrition, but is an employment decision that policymakers may want to encourage. By offering early retirement incentives, districts may be able to free up resources and be able to hire newer teachers, who are paid a lower salary.[13]

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[10] According to the 1999-2000 and 2003-2004 SASS, there are over 6.5 times as many public school teachers as private school teachers.
[11] Excluding part-time teachers from the sample reduced the sample by 5,575 teachers. More than 3,000 of the omitted part-time teachers are part of one survey year where it seems that so many were included because of a different sampling design. Other survey years included less than 800 part-time teachers.
[12] Such teachers who have been fired or have not been asked to come back, were classified as "fired" and were deleted from the sample. This excluded 792 observations. Determination of such involuntary staffing action, as well as retirement, full-time status, and each of the attrition choices are derived from questions in the TFS survey. In the first three cycles of the TFS, 1988-1989, 1991-1992, and 1994-1995, the respondent is asked for their reasons for leaving the profession, offered a first, second, and third reason if desired. If the respondent stated that a staffing action was part of any of their first, second, or third reason, if given, then the teacher was considered released by a staffing action. In the last two cycles of the TFS, 2000-2001 and 2004-2005, the respondent was asked specifically how much a part of their decision a "staffing action" played. If the respondent stated that a staffing action was any part of their transfer or exit attrition decision, the teacher was also considered released by a staffing action.
[13] Similar to the questions regarding involuntary staffing action, questions (for the 2000-2001 and 2004-2005 surveys) are asked regarding retirement and the same determination was used (See footnote 15). 2,935 teachers are classified as retired.

Table 2 displays summary statistics for the pooled dataset used in this study.[14]   The reported means for teachers' four employment choices indicate the proportion of the sample population that is categorized as making each decision. Approximately 42.8 percent of the sample were stayers, 25.2 percent were movers, 18 percent were leavers and 14 percent retired. We have chosen additional variables to include in this study based on the literature and their potential relationship to teacher employment choices.

Figure 3.1 shows the percentage of the sample that have earned degrees in math, science, and special education disaggregated by salary quintile. In order to determine differential behavior for those who have earned such degrees, it is important to interact these degree indicators with the salary variable. If the salary interaction coefficients are significant, then it would show that the teachers with these degrees react to changes in salary differently than others who do not hold these degrees. Math and Science degrees open up greater opportunity to many job fields where quantitative skills are in high demand. Teachers of special education have high burn-out rates. For these reasons, we choose to include Math, Science, and Special Education degree indicators since these positions are particularly hard to keep filled. The population of teachers holding a math degree is quite low compared to science and special education degrees, and it is interesting that across the salary quintiles, the proportion of science degree holders increases. The decreasing number of special education degree holders is in agreement with the higher burnout rate experienced by teachers of special education. Therefore, it would seem that Special Education teachers are not sticking around long enough to move up the pay scale. Figure 3.2 shows that sample proportion of additional salary earners across base salary quintiles.[15] It seems that the largest portion of additional salary earners is in the lowest salary quintile, indicating that there are many newer teachers working in additional capacities.

Note that the NCES established sampling weights to adjust the probabilities of being in the TFS compared to the sample population of the SASS. The TFS suffers from selection bias compared to the SASS because of stratified sampling design and the sample weights are utilized in this analysis to ensure accurate results. All teachers who quit the profession from the original

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[14] All five cycles of the SASS and TFS are used. The TFS is used primarily to determine to employment status and attrition decisions of each teacher in the sample as well as to utilize sampling weights offsetting stratified sampling techniques used by the NCES creating a large enough sample of teachers to allow full-analysis. The vast majority of the teacher attributes, school characteristics, and other variables used come from the SASS responses.

[15] Additional salary earners are those teachers earning income from the school district in addition to their base salary by teaching additional classes, coaching, advising, tutoring, or other activities.

SASS were over-sampled in the TFS the following year to ensure that there were enough moving and leaving teachers to conduct analysis, whereas a smaller proportion of those who continued in the profession were re-interviewed (Boe et al., 1997; Shen, 1997). This bias implies that the summary statistics in Table 2 do not accurately represent a random sample of the teaching population and should only be interpreted as a description of the sample itself.

Teachers have qualitative opinions about their school; student behavior and administrative effectiveness are several examples (Gritz & Theobald, 1996; Liu & Meyer, 2005; Shen, 1997). Most teachers who leave the teaching profession cite problems with administrative effectiveness or policy and student discipline as one of their reasons for leaving (Liu & Meyer, 2005). These findings provide support for the inclusion of attributes related to students and administration in the analysis we conduct in the next chapter. In the TFS, teachers are asked about the degree of an existing student attendance problem. A teacher could respond that the attendance problem is severe, moderate, slight, or none at all. A binary indicator for a problem with student absenteeism is used to measure this condition. If the teacher responded with moderate or severe, then the attendance indicator takes on a value of one. Over 50 percent of the sample population cited a moderate or severe student attendance problem at their school. Grades are also a measure of such student involvement and participation, yet are more difficult to collect, and are not included. A similar question is asked about administrative support for teachers and is measured similarly with a binary indicator. Nearly 17 percent of the teachers included in this sample stated agreement to having administrative support problems at their school.

V. RESULTS

Unlike a binary-choice model where transfers and retirees would be grouped together with those exiting the profession for other jobs, Table 3 shows the parameter estimates for each attrition choice. However, the coefficients are difficult to interpret. More easily interpreted, and more exploitable, are the estimated marginal effects displayed in Table 4 and calculated by equation (4).

Salary

The majority of school districts in the U.S. use experience and post-baccalaureate education as sole determinants of a teacher's base salary. It makes sense that salary plays a significant role in the choice to move to another district, where the salary schedule might be different, however a move to another school in the same district is not likely to result in a different salary.[16] The variation in the estimated attrition determined by yearly increases in salary is therefore mainly captured by the experience and educational attainment terms.[17] This means that the attrition variation explained by salary is almost entirely the variation across districts. It is clear and consistent with previous research that districts which pay larger base salaries locally draw teachers from neighboring districts (Imazeki, 2005). It is worth mentioning that, although salary has a positive effect on the probability of retiring, those who retire generally earn more than further-from-retirement teachers. This is not to be interpreted that an increase in salary could act as a possible incentive for earlier retirement, the high salary significance with retirement is merely a sign of predictive power and not of causality.

Any additional salary, extra income earned from other school activities such as coaching or club affiliated stipends, or extra teaching load, decreases the exit attrition rate but is only significant at the 10 percent level. This effect could be working through self-selection, only those who are not leaving the profession participate volunteer for such activities. Alternatively, it could be a causal factor; those who choose to participate become more involved and connected to the school and their students and choose to not leave the profession as a result of their participation.

Teacher Characteristics

As can be seen in Table 3, teacher experience and education are significant explanatory variables in all attrition choices and, according to the marginal effects in Table 4, show

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[16] Note that we do not distinguish between intra- and inter-district transfers in the data.

[17] Therefore, inherent endogeneity exists is the specification as it is used in this study, however there are several differences across districts regarding the number of columns that a teacher may "move over" after earning graduate units and graduate degrees, the number of units required to "move over" a column, and experience requirement to be allowed a column movement. In addition, many districts reward teachers who have earned graduate degrees by considering such degrees as worth more graduate units than transcripts actually indicate as well as offering yearly stipends, though these stipends tend to be small. An interaction between the experience level and the salary may be able to capture and isolate the effects of yearly salary increases for experience, leaving the coefficient for experience to capture the effect of additional experience, without the increase in salary. In a preliminary regression, an experience and salary interaction term was included in the specification to determine if there was a positive effect of salary on retirement attrition, apart from the inherent yearly salary increases, but along with issues of multicollinearity, the interaction lacked significance in two of the three categories, and was dropped.

significant changes in the probabilities of different types of attrition. For example, Table 4 indicates that a teacher who has a master's degree has a 1.1 percentage point higher probability of moving to a different school, a 0.8 percentage point higher probability of leaving the profession, and a 0.2 percentage point lower probability of retiring than a teacher with a bachelor's degree, holding all other factors constant. Even with retirement attrition, years of experience is strongly significant, although it has a positive relationship with retirement for obvious reasons. Any graduate degree is associated with a higher probability of leaving the school and the profession; the effect of a degree beyond a master's is quite large by both magnitude and significance except in the retirement choice, where such degrees have a negative effect on the choice probability. The interpretation of this outcome could be that the likelihood that a teacher with such a degree actually reaches the age of retirement, still at the elementary or high school, is smaller.

Not surprisingly, estimates show family factors to be significant only in the leaver decision. Those that move to other schools aren't really changing employment, just the location of employment and possibly accepting a better position. Although the sign on the marriage indicator is positive, indicating high leaver attrition for married teachers, the coefficient estimate on the marriage/gender interaction is negative, indicating that married male teachers are less likely to leave than their unmarried male peers and the greater magnitude of the coefficient suggests that married male teachers are also less likely to leave their position than married females. Children also only seem to be a negative factor in the retirement choice, though this result is not by any means surprising. Those choosing to retire have, on average, over 28 years of experience. Since most teachers start teaching certainly no earlier than 22 years of age, assuming a four year degree and a teaching credential after high school, the probability of having dependents at home at the age of retirement is quite low.

Subject Characteristics

A science degree shows no significance in any of the attrition decisions. This is an interesting result compared to previous literature; other studies have found the opposite effect (Imazeki, 2005; Stinebrickner, 1998). This may be because math and science teachers have

before been grouped together where a single binary variable would indicate that the teacher taught math or science. If this result is accurate, it is clearly important for math and science teachers to be disaggregated from one another. An alternative reason could be the method of measurement. Instead of a customary measurement by teaching assignment, this study uses the major of the teacher's bachelor's degree. As a measure of the opportunity cost of each teacher, the academic talents attractive to the private sector are in large part determined by the chosen collegiate major of the teacher. Thus, being a math teacher does not necessarily imply that they possess the analytic or mathematical skills of a person with a math degree. In this case, a math degree only seems to be significant in the leaver decision, not the mover decision. The coefficient estimate shows that the attrition rate is higher for those teachers with a math degree, and there is a counteracting salary response. The marginal effect of a bachelor's degree in math indicates a 98.2 percentage point increase, yet the value of the marginal effect of the salary interaction term lowers that probability to a 40.0 percentage point increase in the probability that a teacher with a math degree would leave. Such strong propensity could be indicative of the few number of teachers with a math degree and the possible job opportunities they could command outside of teaching. Of the nearly 20,000 teachers in the sample, only about 5 percent held bachelor's degrees in math. Science degrees show no significant variance in the binary subject indicator nor in the salary interaction. Imazeki finds significant differences in the transfer attrition rate for women with a math or science degree, but not with exit attrition. Stinebrickner finds weakly significant differences in exit attrition rates between those that hold a math or science degree. The reason for such differences between this study and findings of other studies could be the different measurement of opportunity costs. Some studies use the teaching assignment for a proxy of opportunity cost (Imazeki, 2005); others do not (Stinebrickner, 1998). These differences could also be attributed to the aforementioned grouping of math and science indicators. A degree in a special education field indicates a much higher retirement attrition rate than a math degree shows for leaver attrition. Even though there is a similar salary counteracting response, the probability that a special education teacher retires is predicted at a 75.8 percent chance.

School Characteristics

As to be expected from previous discussion based on the literature, the student minority percentage at a school and the racial interaction between the teacher and the student minority percentage is statistically significant. A positive sign for the student minority percentage indicates the greater the student minority population, the more likely the teacher is to move to another school. Yet, the size and the negative sign on the racial interaction between teacher and the student minority percentage indicate that if the teacher is also an underrepresented minority, then that teacher is much less likely to attrite, more than offsetting the positive effect of the student minority population on transfer attrition.

Reaffirming to the popular criticism from many teachers is the effect of a supportive administration, or in this case of the current specification, the negative effect of an unsupportive administration. Recall that a value of one for this variable indicates disagreement on the part of the teacher that the administration is supportive. Not only is the variable statistically significant, it carries a large magnitude. The marginal effect estimate implies that a teacher's predicted mover probability under an unsupportive administration is approximately 2.8 percentage points greater than the probability with a supportive administration. Exit attrition and retirement estimates of the administrative support variable are insignificant. These results would indicate that as long as a teacher is satisfied with teaching, an unsupportive administration will simply make them desire to move to another school. As a measure of the student body "buy in", the student absenteeism factor is insignificant in all decisions. We believe that this lack of significance for any of the attrition choices offers evidence that most teachers know what conditions exist in the teaching profession before entry; such knowledge may pre-select those who are willing to tolerate conditions and who are not, before entry into the profession.

There are two stories that could be told about the role of workload in attrition decisions. First, an extra teaching load could be part of the reason a teacher decides to leave the profession. Clearly, if a teacher moves schools, they most likely realize that their load would not change much and would not therefore be part a strong factor of a mover decision, though some work load change is to be expected between different schools. If a teacher has a workload far beyond what was expected before entering the profession, they may choose to leave their job based on lower utility derived from teaching as a profession. This story, however, does not seem to coincide with the negative estimated effects of extracurricular work that is present in these results. The second possible story is that the teacher may be so vested in the profession that they

choose to work those extra hours. Note that two types of extra hours are measured and utilized in the analysis. It is hypothesized that extra hours with students, which are hours *chosen* to be spent with the student by the teacher in such situations including but not limited to tutoring after school coaching, mentoring, and advising, would predict a lower propensity to leave the profession. Extra hours spent on activities not including students, which are often non-voluntary teaching workload tasks, such as preparing and grading, are hypothesized to increase the propensity to leave the profession. Extra hours spent are not compensated hours, but are necessary for lesson preparation; it is assumed that large amounts of these hours would increase teacher burn-out, though this theory is not supported by the empirical results. In the retirement decision, it is interesting that extra hours with or without students is not a strongly significant determinant of retirement.

The level of school plays an important factor in the mover decision; high school teachers have fewer local transfer alternatives as high schools tend to be larger and less prevalent in the local area. Although elementary schools are smaller in student population and are more frequent in number, there are also more elementary grades; overall there may be more transfer alternatives for elementary school teachers. This effect would not hold for those leaving the profession, however. If a teacher decides that they no longer desire to teach, the number of alternative schools likely plays little role in their leaver decision. At the high school level there are also different physical hazards that may play a role in any attrition decision. Gang violence or racial tension between students can make a campus a more hazardous work environment. This may be the explanation behind a marginally significant (positive) high school indicator in the leaver decision.

Survival Rates

Using marginal effects we estimate effects of different variables at each year of teaching experience. These effects along the years of experience allow for the estimation of a series of hazard rates for different characteristics. From these hazard rates, we compute cumulative hazard rates and thereby simulate a survival probability function. Although marginal effects calculate the effect of a given policy or condition over the course of one year, it is more interesting to simulate effects over a longer time horizon; few policies are implemented for short term effects in teacher retention. As a result, simulated survival functions provide a better

estimate of the long term effects of a policy or condition. The simulated difference between the survival paths signifies the approximate size of the effect that simulated factor would have on the teaching population or, realistically, the teaching population at a specific school.

For the purpose of this analysis, typical terminology is preserved: the term retention refers to the percentage of teachers that did not attrite. A survival probability function for retention is constructed according to equation (5), which is the predicted probability that teacher i in time t is still working at the same school at m years of experience, Ex_i.

$$\Pr\left(y_{ij}=1\mid j=1,t\geq m\right)=\prod_{n=1}^{m}\left(1-\overline{\Pr\left(y_{ij}=1\mid j=2,\ 3,\ \text{or }4,Ex_i=n\right)}\right) \quad (5)$$

$$\Pr\left(y_{ij}=1\mid j\neq 2,t\geq m\right)=\prod_{n=1}^{m}\left(1-\overline{\Pr\left(y_{ij}\neq 1\mid j=2,Ex_i=n\right)}\right) \quad (6)$$

$$\Pr\left(y_{ij}=1\mid j\neq 3,t\geq m\right)=\prod_{n=1}^{m}\left(1-\overline{\Pr\left(y_{ij}=1\mid j=3,Ex_i=n\right)}\right) \quad (7)$$

$$\Pr\left(y_{ij}=1\mid j\neq 4,t\geq m\right)=\prod_{n=1}^{m}\left(1-\overline{\Pr\left(y_{ij}=1\mid j=4,Ex_i=n\right)}\right) \quad (8)$$

The probabilities are predicted by finding the product of the predicted survival rates in each time period (Survival Rate = 1 – Hazard Rate) at each of the n years of experience, up to m years of experience. Outcome $j\neq 1$ ($j=2,\ 3,\ $ or 4) is where the teacher has left the profession, left the school, or has retired. Outcome $j=2$ is where the teacher has moved schools, outcome $j=3$ is where the teacher has left the profession, and outcome $j=4$ is where the teacher has retired. For instance, $\overline{\Pr\left(y_{ij}=1\mid j=2,Ex_i=n\right)}$ is the predicted probability that teacher i has chosen outcome 2, moving schools, at n years of experience, given that they have not moved schools at any previous year. A survival function against mover attrition may be constructed in a similar fashion using equation (6), a survival function against leaver attrition may be constructed by equation (7), and a survival function against retirement attrition may be constructed using equation (8). Figures 7.1 – 7.12 are constructed using equations (5) – (8). Figure 7.1 shows a baseline survival probability for movers, leavers, and retirees over the course of 40 years. Survival probability in this figure over the first fifteen years can be compared to the subsequent simulations for comparison. Figure 7.2 depicts the cumulative difference in survival probability by school level for movers. As discussed before, results suggest elementary school

teachers tend to move more than high school teachers. The simulation in Figure 7.2 suggests that there will be approximately 7 percent fewer elementary school teachers at their site after 15 years compared to high school teachers. Figure 7.3 shows the survival differences between leavers at the elementary and high school level. The difference in survival after 15 years, again, is almost 7 percent. Although these differences may not seem to be large in magnitude, these are survival rates against *one kind* of attrition. Combining the two simulations suggests that there may be the same number of teachers at the same school after 15 years at both levels, however, more elementary school teachers will have changed schools and more high school teachers will have left the profession entirely.

Figures 7.4 and 7.5 show the changes in survival over 15 years derived from a 10 percent increase in salary offered to movers.[18] Regression results show that attrition probabilities are not significantly altered by changes in salary from year to year, but mover attrition rates are. In both school levels, this is only a 2 percent difference in survival probabilities after 15 years. This evidence may be grounds to suspect that salary is not the only motivation for school-to-school movement. Stinebrickner (1998) estimates that a one standard deviation change in salary would only constitute a 9 percent difference in simulated survival rates after 10 years.[19] The insignificance of the wage effect on leaver attrition combined with the small magnitude of the wage effects for mover attrition and the concurring results of Stinebrickner (1998) only reinforces the notion that salary changes may increase teacher recruitment without improving teacher attrition.

Figure 7.6 shows the survival differences in leaver attrition between males and females, both married and unmarried. The simulations are exceptionally consistent with the findings of Stinebrickner (1998). Both studies estimate a simulated survival function and find a 14 percent disparity between married and unmarried women. Although this does not suggest any policies for teacher retention, it does offer evidence that these results are consistent across datasets.[20]

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[18] A one standard deviation change in the salary for the dataset used in this study would translate approximately to a 31.5 percent raise.

[19] A one standard deviation change in the dataset used by Stinebrickner (1998) would approximately translate to a 40% increase in the weekly wage. Stinebrickner uses a binary choice model.

[20] Stinebrickner uses longitudinal data from the NLS-72 while this study uses pooled cross-sectional data from almost 20 years later.

Figure 7.7 shows the cumulative survival differences for minority and non-minority teachers at high and low minority high schools.[21] The solid lines show the survival paths of minority teachers and the dotted lines show the survival paths of non-minority teachers. The drastic attrition difference between high and low student minority populations only provides further evidence of the additional hazard and difficulty of working at such diverse and racially dense schools. A non-minority teacher at a high minority school has a 15 percentage point lower chance of not having moved schools compared to the same teacher at a low minority school. The significant difference in attrition when matching teacher minority status with student minority population firmly indicates that local recruitment may have an important place within recruitment practice.

Figure 7.8 shows the effect of earning additional salary or stipends on the leaver attrition rate over the 15 year time span. These additional wages are earned by a teacher who chooses to do additional work such as coaching, teaching extra classes, or sponsoring activities. Such activities provide the teacher with more interaction and more participation with the school and/or the student body, which arguably may increase retention. The survival discrepancy between the two groups is almost 9 percent. This participation of teachers in school activities has not been used in an attrition model that analyzed simulated survival functions or duration analysis to my knowledge, but the result suggests that attrition may be reduced by encouraging participation in additional activities, which are paid, to newer teachers.

Figure 7.9 shows the effect of administrative support problems on mover attrition. It should come as no surprise that a problematic administration drives teachers away. With administrative problems, nearly 13 more teachers out of 100 will have left the profession after 15 years. For a school struggling with mover attrition, such as high minority schools or lower paying districts, this result suggests that a higher performing administration may be a worthwhile investment.

Figures 7.10 and 7.11 show the effect of graduate degrees on mover and leaver attrition, respectively. After accounting for the salary difference for Master's degree holders, there does not seem to be a difference between the mover attrition rates for those with and without a

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[21] High and low minority schools are defined as those with a percent minority population one standard deviation above and approximately one standard deviation below the percent minority mean. We say approximately one standard deviation below, since exactly one standard deviation below would use a -1 percent minority population. Thus, a 0 percent minority population is used instead.

Master's, however there is a difference for doctorate degree holders in mover attrition. Nearly 9 percent more teachers with a doctorate degree will have left the school after 15 years, not counting leavers or retirees. The attrition difference is much higher at nearly a 7 percent gap between Master's degree holders and those with no graduate degree and an additional 18 percent difference between Doctorate and Masters degree holders. This means that the survival rate discrepancy between Doctorates and those with no graduate degrees is nearly 25 percent after 15 years.

Finally, Figure 7.12 shows the retirement survival in the NCLB year against the retirement survival of the years before NCLB. After 15 years, there is a survival rate gap over 15 percent, implying that the retirement attrition rate since NCLB has increased. This shows the *short term* effects of NCLB; the differences in the simulated survival paths do not necessarily indicate that the same effect would be seen over time. For teachers with very high levels of experience, retirement may be a choice that policy makers want to incentivize.

VI. DISCUSSION AND CONCLUSION

Salary is a statistically significant predictor of both transfer and retirement attrition, but not exit attrition. Although a popular policy recommendation for solving teacher attrition problems is to increase teacher salaries, the empirical results suggest that salary increases maybe have little effect on teachers' decisions to leave the profession. Table 3 shows that salary is not a significant factor for leavers, even at the 10 percent significance level; this finding is consistent with the findings of Liu and Meyer (2005). In results not presented here, a very simplified version of this model with limited numbers of explanatory variables still yielded no significant effect of salary in the leaver decision.[22] As mentioned before, the majority of school districts use experience and education as sole determinants of base salary. Once experience is included in estimation, salary loses significance as a predictor of teacher attrition. Reflecting back to the unsupported hypothesis of extra-curricular hours worked, it is interesting that both workload and

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[22] We employed an iterative process of using a multinomial logit function to predict the attrition choices utilizing the teacher sampling weights and adding independent variables in an order from basic to subtle. Starting with logged salary, coefficient significance was high ($|z| > 6.00$). Experience and squared experience were added next, which is where salary lost significance ($|z| \leq 1.02$). Even when the high school indicator and education terms are added while controlling for race, salary remained to be significant at any level. Since salary is almost completely determined by experience and graduate education, it seems logical that the decreases in attrition that would seem to be caused by the natural increases in salary over time are captured by the increases in experience.

low salary are the two largest complaints of those in the profession, yet are two factors that are not statistically significant in this analysis. This provides evidence that most teachers already know their expected salary level prior to entry into the profession, implying that those who teach and leave the profession do not leave *because* of low pay but instead leave for some other unanticipated factor. These results are supported by the research of Stinebrickner, Scafidi, and Sjoquist (2008), who find that salary is not a determinant of exit attrition. This is not to say, however, that a large increase in teacher pay across the board would not ultimately lead to a resolution to the staffing problem. The results indicate that an increase in pay would not provide a practical or economical solution to the attrition problem, but this result does not imply that salary is an unimportant teacher recruitment tool. It is both possible and plausible to assume that an increase in teacher pay would lure more qualified persons into the teaching profession. Another explanation of the insignificance of salary could be that at least a large percentage of those who leave the profession may *not* have originally intended to teach as a life profession. It is possible that there are many people who begin teaching as a stepping stone to another profession. It is both plausible and easily conceivable to use teaching as temporary career to gain access to other positions, possibly including school administration, district administration, or state administrative positions. Other possibilities may include careers where teaching experience would be favorably viewed such as teaching at the community college, professional or technical institutes, or small private college positions. Such positions would require less interaction with students than at high school or elementary positions, yet would benefit from teaching experience. Based on the results, those who leave the profession seem to work, in general, fewer hours on student related activities, fewer hours on tasks not including students, and are relatively unaffected by incentive changes in salary. The results imply that the more time that a teacher spends outside of school hours on student related activities, or even non-student related activities, the *less* likely that teacher is to leave the profession. This suggests that those teachers who are investing more into their job are those who are unlikely to leave the profession.

With the NCLB legislation of 2001 being signed into effect in early 2002, the last cycle of the SASS and the TFS is the only survey year that might capture the effects of this law. Unfortunately, a few problems exist in the data that prohibit the model, in its present form, to be used to simulate and draw out the No Child Left Behind (NCLB) law and its effects on teacher

attrition. The questions about the number of extra hours spent with and without students are not included in the 2004-05 survey. In addition, the 2004-05 survey does not provide information regarding the number of dependent children in the household of the teacher being observed. In order to evaluate the effect of NCLB on teacher attrition, we temporarily exclude the children and extra hours variables. Thus, the coefficient estimate on the year indicator for the 2004-05 survey accurately captures any differences attributable to NCLB. As can be seen in Table 5, the coefficient of the 2004-05 year, which serves as the NCLB proxy indicator, is not significant both for the mover and the leaver decision, but is significant for the retirement decision. Due to the significance and the negative sign on both the leaver and the mover coefficient, this means that attrition rates rose after the passing of the NCLB legislation. A possible explanation for this could be the higher credentialing, or "full-qualification", requirements. By this year, those who did not have full teacher credentials and or certification is a subject field of teaching either may not have been able to hold on to their position, or decided to retire to avoid worrying about additional legislative complications. Those with emergency credentials would be replaced by those who would have full, more permanent credentials. Also, providing another barrier to entry into the teaching profession would "weed-out" those who may wish to "try out" teaching as a profession. This may also have cut from the teaching force those people who were not so fully vested into the profession that they needed to earn full credentials and certification. The NCLB indicator in the original model[23] was not statistically significant, but when the variables with missing observations are omitted from the regression, the NCLB indicator becomes significant and suggests that the probability for teacher retirement increased during the observed year of the legislation. It is conceivable that there may have been many teachers apprehensive about being classified as "not fully qualified" and were much more willing to retire, even if it was an early retirement.

In this study, we find that, despite its popularity among policymakers and union activists, increases in salary appear to not be an effective policy tool for combating teacher retention. Although these results estimate salary increases to be a significant incentive to keep teachers from leaving their current school, the magnitude of the effect is quite small. Additionally, there is no significant effect of salary increases against teachers exiting the profession. This study

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[23] In the original model, the NCLB indicator absorbed the effects from the missing number of dependent children as well as the effects from the missing observations of extra hours spent.

goes on to theorize that many teachers enter the profession never intending to retire as a teacher of an elementary school or high school, but to either use the profession as temporary work or as a stepping stone to separate yet related positions in education outside of the K-12 classroom. This and other evidence shows that the motivating factors behind transfer attrition and exit attrition are drastically different; there are several significant factors connected to transfer attrition, yet are not significant for exit attrition. Teachers who leave and teachers who stay spend significantly different amounts of extra hours with student or school activities. Teachers with master's degrees or doctorate degrees are more likely to both move schools and leave the profession compared to those who do not have these degrees. There are major links between higher attrition rates and the matching of the teacher race with the ethnic make-up of the school. Though student absenteeism problems are not a good predictor of attrition, unsupportive administrations significantly drive teachers to other schools, but not necessarily out of the profession, which is of serious concern especially to urban schools that experience higher transfer attrition than exit attrition. These results combined with the evidence that salary is not an effective incentive to keep teachers in the classroom indicate that new policy measures are needed and are available to reduce the attrition problem.[24] New and forthcoming research is showing that mentoring programs are effective at improving both teacher retention and student achievement (Rockoff, 2008). Teacher induction programs are a more recent phenomenon, yet are already showing some success in solving the teacher attrition problem. Local teacher recruitment, encouraging graduating students that become teachers to come back and teach at the schools where they graduated, could also improve teacher retention.

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[24] Stinebrickner, Scafidi, and Sjoquist (2008) also find, after examining salaries earned by teachers after leaving the profession, that salary is not a significant draw for teachers to exit the profession.

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Table 1: Variable Descriptions

Variable	Description
Stayer	1 if the teacher stayed at their school, 0 otherwise
Mover	1 if the teacher moved to another school, 0 otherwise
Leaver	1 if the teacher left teaching as a profession, 0 otherwise
Retiree	1 if the teacher retired from the workforce, 0 otherwise
Experience	Years of full-time experience
Experience (Squared)	Years of full-time experience, squared
Masters Degree	1 if the teacher has a Masters degree, but no higher, 0 otherwise
Doctorate (or degree beyond Masters)	1 if the teacher has a Doctorate degree, 0 otherwise
Race (Black)	1 if the teacher is Black, 0 otherwise
Race (Hispanic)	1 if the teacher is Hispanic, 0 otherwise
Race (Asian)	1 if the teacher is Asian, 0 otherwise
Race (Native American)	1 if the teacher is Native American, 0 otherwise
Urban	1 for an Urban school, 0 otherwise
Student Minority Percentage	Percentage of the Student Body at the teacher's school that are Black or Hispanic
URM	1 if the teacher is Black or Hispanic, 0 otherwise
URM * Student Minority Percentage	Interaction term of teacher race with the Student Body Minority Percentage; URM = 1 for a Black or Hispanic teacher, 0 otherwise;
URM * Urban	Interaction term of teacher race with the binary Urban indicator;
Number of Children	Number of dependent children the teacher has
Married	1 for a married teacher, 0 otherwise
Male	1 for a male teacher, 0 otherwise
Married * Male	1 for a married & male teacher, 0 otherwise
Salary (natural logarithm)	Natural log of teacher's base year salary
Teaches High School	1 for a high school teacher, 0 otherwise
Bachelors Degree in Math	1 for a teacher with a Bachelor's degree in Math, 0 otherwise
Bachelors Degree in Science	1 for a teacher with a Bachelor's degree in Science, 0 otherwise
Bachelors Degree in Spec. Ed	1 for a teacher with a Bachelor's degree in Special Education, 0 otherwise
Administration Problems	1 if the teacher believes that the school administration is not supportive
Absenteeism Problems	1 if the teacher believes that the school has a problem with student absenteeism
Extra Hours Spent without Students	Number of hours spent each week on school-related activities, not involving students
Extra Hours Spent with Students	Number of hours spent each week on school-related activities, involving students
Year Dummies	1 for a teacher from the indicated TFS survey year, 0 otherwise

Table 2: Summary Statistics - All Years

Variable	Obs	Mean	Std. Dev.	Min	Max
Stayer	19796	0.428	0.495	0	1
Mover	19796	0.252	0.434	0	1
Leaver	19796	0.180	0.384	0	1
Retiree	19796	0.140	0.347	0	1
Years of Experience	19796	13.135	10.970	1	53
Masters Degree	19796	0.354	0.478	0	1
Doctorate (or degree beyond Masters)	19796	0.057	0.232	0	1
Race (White)	19796	0.848	0.359	0	1
Race (Black)	19796	0.072	0.259	0	1
Race (Hispanic)	19796	0.044	0.205	0	1
Race (Asian)	19796	0.018	0.135	0	1
Race (Native American)	19796	0.016	0.127	0	1
Urban	19796	0.594	0.491	0	1
Student Minority Percentage	19796	31.914	32.884	0	100
URM[25] * Student Minority Percentage	19796	7.545	23.747	0	100
URM * Urban	19796	0.088	0.283	0	1
Number of Children	19796	0.402	0.490	0	1
Married	19796	0.699	0.459	0	1
Male	19796	0.297	0.457	0	1
Married * Male	19796	0.224	0.417	0	1
Salary (natural logarithm)	19796	10.549	0.316	0	11.568
Teaches High School	19796	0.502	0.500	0	1
Bachelors Degree in Math	19796	0.026	0.160	0	1
Bachelors Degree in Science	19796	0.051	0.220	0	1
Bachelors Degree in Spec. Ed	19796	0.054	0.226	0	1
School has Administration Problems	19796	0.167	0.373	0	1
School has Absenteeism Problems	19796	0.509	0.500	0	1
Extra Hours Spent without Students	19796	6.299	6.389	0	50
Extra Hours Spent with Students	19796	2.669	5.310	0	50
1988-89 Year Dummy	19796	0.211	0.408	0	1
1991-92 Year Dummy	19796	0.202	0.402	0	1
1994-95 Year Dummy	19796	0.192	0.394	0	1
2000-01 Year Dummy	19796	0.182	0.386	0	1
2004-05 Year Dummy	19796	0.213	0.409	0	1

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[25] URM: Acronym for Under-Represented Minority.

Table 3: Parameter Estimates

Variable	Mover		Leaver		Retiree	
	β	SE	β	SE	β	SE
Experience	**-0.079**	(0.013)	**-0.104**	(0.021)	**0.206**	(0.044)
Experience 2	**0.001**	(0.000)	0.001	(0.001)	-0.001	(0.001)
Masters Degree	**0.182**	(0.068)	**0.281**	(0.124)	**-0.400**	(0.133)
Doctorate	**0.558**	(0.147)	**0.847**	(0.197)	-0.266	(0.211)
Race (Black)	**0.619**	(0.194)	-0.033	(0.314)	**0.790**	(0.403)
Race (Hispanic)	0.343	(0.214)	-0.060	(0.326)	0.140	(0.591)
Race (Asian)	-0.170	(0.216)	**-1.319**	(0.256)	**1.202**	(0.485)
Race (Native Am.)	**-0.818**	(0.261)	-0.692	(0.359)	**-0.788**	(0.370)
URM * Student Minority Percentage	**-0.011**	(0.003)	-0.004	(0.005)	-0.003	(0.007)
URM * Urban	0.078	(0.211)	0.256	(0.284)	0.109	(0.443)
Urban	0.030	(0.070)	0.133	(0.103)	**-0.314**	(0.133)
Student Minority Percentage	**0.007**	(0.001)	0.002	(0.002)	0.000	(0.002)
Number of Children	-0.091	(0.079)	-0.067	(0.117)	**-1.132**	(0.137)
Married	-0.039	(0.077)	**0.465**	(0.123)	**0.459**	(0.162)
Male	0.032	(0.128)	0.333	(0.190)	-0.090	(0.225)
Married * Male	-0.004	(0.148)	**-0.853**	(0.228)	0.024	(0.253)
Salary (natural log)	**-0.650**	(0.149)	-0.318	(0.304)	**0.745**	(0.295)
Add. Salary (natural log)	0.010	(0.011)	-0.033	(0.018)	-0.039	(0.028)
High School	**-0.193**	(0.068)	0.181	(0.110)	0.175	(0.150)
Bachelors Degree in Math	1.510	(8.116)	**21.025**	(6.875)	-5.030	(9.739)
Bachelors Degree in Science	-2.030	(6.777)	-10.944	(13.85)	-4.237	(9.759)
Bachelors Degree in Spec. Ed	2.776	(4.669)	-13.107	(9.942)	**55.536**	(21.14)
B.A. in Math * Salary	-0.143	(0.769)	**-1.984**	(0.659)	0.411	(0.893)
B.A. in Science * Salary	0.195	(0.645)	1.046	(1.317)	0.374	(0.901)
B.A. in Spec. Ed. * Salary	-0.243	(0.444)	1.268	(0.944)	**-5.181**	(1.992)
Admin. Problems	**0.411**	(0.076)	-0.036	(0.115)	0.156	(0.178)
Abs. Problems	-0.035	(0.059)	-0.038	(0.101)	-0.052	(0.128)
Ex. Hours Spent without Students	-0.002	(0.007)	**-0.028**	(0.009)	-0.013	(0.011)
Ex. Hours Spent with Students	-0.003	(0.006)	-0.019	(0.010)	-0.027	(0.014)
1991-92 Year Dummy	-0.067	(0.100)	-0.203	(0.150)	0.265	(0.187)
1994-95 Year Dummy	-0.172	(0.098)	0.107	(0.147)	**0.405**	(0.184)
2000-01 Year Dummy	-0.122	(0.099)	0.103	(0.144)	**0.670**	(0.188)
2004-05 Year Dummy	-0.207	(0.118)	**-0.467**	(0.167)	-0.017	(0.207)

(Parameter estimates in bold indicate significance at the 95% level or higher)

(No. of Observations = 19796, Pseudo R^2 = 0.0912)

Table 4: Marginal Effects (standard errors in parenthesis)

Variable	Movers		Leavers		Retirees	
	Coefficient	SE	Coefficient	SE	Coefficient	SE
Experience	**-0.005**	(0.001)	**-0.003**	(0.001)	**0.001**	(0.000)
Experience^2	**0.000**	(0.000)	0.000	(0.000)	0.000	(0.000)
Masters Degree	**0.011**	(0.004)	**0.008**	(0.004)	**-0.002**	(0.001)
Doctorate	**0.038**	(0.013)	**0.032**	(0.010)	-0.001	(0.001)
Race (Black)	**0.046**	(0.018)	-0.002	(0.008)	0.005	(0.004)
Race (Hispanic)	0.024	(0.017)	-0.002	(0.008)	0.001	(0.003)
Race (Asian)	-0.009	(0.011)	**-0.021**	(0.002)	0.011	(0.007)
Race (Native Am.)	**-0.034**	(0.008)	**-0.014**	(0.006)	**-0.002**	(0.001)
URM * SMP	**-0.001**	(0.000)	0.000	(0.000)	0.000	(0.000)
URM * Urban	0.004	(0.013)	0.008	(0.010)	0.000	(0.002)
Urban	0.002	(0.004)	0.004	(0.003)	**-0.002**	(0.001)
SMP	**0.000**	(0.000)	0.000	(0.000)	0.000	(0.000)
No. of Children	-0.005	(0.005)	-0.002	(0.003)	**-0.005**	(0.001)
Married	-0.003	(0.005)	**0.012**	(0.003)	**0.002**	(0.001)
Male	0.001	(0.008)	0.010	(0.006)	0.000	(0.001)
Married * Male	0.001	(0.009)	**-0.019**	(0.004)	0.000	(0.001)
Salary (ln)	**-0.038**	(0.009)	-0.008	(0.008)	**0.004**	(0.001)
Add. Salary (ln)	0.001	(0.001)	-0.001	(0.001)	0.000	(0.000)
High School	**-0.012**	(0.004)	0.005	(0.003)	0.001	(0.001)
B.A. in Math	**-0.062**	(0.012)	**0.982**	(0.003)	**-0.005**	(0.002)
B.A. in Science	-0.058	(0.084)	-0.046	(0.027)	-0.005	(0.003)
B.A. in Special Ed	**-0.054**	(0.013)	**-0.058**	(0.029)	**1.000**	(0.000)
Math * Salary	-0.005	(0.046)	**-0.055**	(0.019)	0.002	(0.004)
Science * Salary	0.010	(0.038)	0.029	(0.037)	0.002	(0.004)
Special Ed. * Salary	-0.015	(0.026)	0.037	(0.026)	**-0.024**	(0.01)
Admin. Problems	**0.028**	(0.006)	-0.002	(0.003)	0.001	(0.001)
Abs. Problems	-0.002	(0.004)	-0.001	(0.003)	0.000	(0.001)
Ex. Hours Spent without Students	0.000	(0.000)	**-0.001**	(0.000)	0.000	(0.000)
Ex. Hours Spent with Students	0.000	(0.000)	-0.001	(0.000)	**0.000**	(0.000)
1991-92 Year Dummy	-0.004	(0.006)	-0.005	(0.004)	0.001	(0.001)
1994-95 Year Dummy	-0.010	(0.005)	0.003	(0.004)	0.002	(0.001)
2000-01 Year Dummy	-0.007	(0.006)	0.003	(0.004)	**0.004**	(0.002)
2004-05 Year Dummy	-0.011	(0.006)	**-0.011**	(0.004)	0.000	(0.001)

(Marginal effects estimates in bold indicate significance at the 95% level or higher)

(No. of Observations = 19796)

Table 5: NCLB Parameter Estimates (standard errors in parenthesis)

Variable	Movers β	Movers SE	Leavers β	Leavers SE	Retirees β	Retirees SE
Experience	**-0.081**	(0.013)	**-0.101**	(0.021)	**0.215**	(0.047)
Experience^2	**0.001**	(0.000)	0.001	(0.001)	-0.001	(0.001)
Masters Degree	**0.185**	(0.067)	**0.291**	(0.124)	**-0.385**	(0.131)
Doctorate	**0.560**	(0.147)	**0.838**	(0.196)	-0.333	(0.206)
Race (Black)	**0.611**	(0.194)	0.000	(0.314)	0.533	(0.403)
Race (Hispanic)	0.344	(0.214)	-0.049	(0.325)	0.028	(0.562)
Race (Asian)	-0.169	(0.216)	**-1.327**	(0.252)	**1.054**	(0.490)
Race (Native Am.)	**-0.809**	(0.260)	-0.646	(0.355)	**-0.778**	(0.369)
URM * Student Minority Percentage	**-0.011**	(0.003)	-0.004	(0.005)	-0.003	(0.007)
URM * Urban	0.074	(0.210)	0.218	(0.282)	0.204	(0.425)
Urban	0.033	(0.069)	0.131	(0.102)	**-0.292**	(0.131)
Student Minority Percentage	**0.007**	(0.001)	0.002	(0.002)	0.001	(0.002)
Married	-0.062	(0.073)	**0.462**	(0.119)	0.251	(0.156)
Male	0.035	(0.128)	0.340	(0.191)	-0.082	(0.222)
Married * Male	-0.018	(0.147)	**-0.872**	(0.225)	-0.162	(0.252)
Salary (natural log)	**-0.650**	(0.148)	-0.331	(0.301)	**0.654**	(0.299)
Add. Salary (natural log)	0.009	(0.011)	-0.036	(0.018)	-0.042	(0.027)
High School	**-0.197**	(0.068)	0.160	(0.110)	0.139	(0.145)
Bachelors Degree in Math	1.589	(8.141)	**21.200**	(6.799)	-3.449	(9.845)
Bachelors Degree in Science	-2.165	(6.744)	-11.158	(13.643)	-6.648	(10.606)
Bachelors Degree in Spec. Ed	2.707	(4.667)	-12.925	(10.089)	**50.630**	(20.202)
B.A. in Math * Salary	-0.150	(0.772)	**-2.002**	(0.651)	0.259	(0.904)
B.A. in Science * Salary	0.207	(0.642)	1.063	(1.297)	0.590	(0.974)
B.A. in Spec. Ed. * Salary	-0.236	(0.444)	1.254	(0.958)	**-4.719**	(1.902)
Admin. Problems	**0.413**	(0.076)	-0.038	(0.115)	0.163	(0.177)
Abs. Problems	-0.034	(0.059)	-0.040	(0.101)	-0.047	(0.126)
1991-92 Year Dummy	-0.072	(0.099)	-0.243	(0.148)	0.194	(0.189)
1994-95 Year Dummy	-0.178	(0.098)	0.052	(0.146)	0.311	(0.186)
2000-01 Year Dummy	-0.137	(0.099)	0.039	(0.142)	**0.425**	(0.186)
2004-05 Year Dummy	-0.138	(0.090)	-0.188	(0.147)	**0.495**	(0.178)

(Parameter estimates in bold indicate significance at the 95% level or higher)

(No. of Observations = 19796, Pseudo R^2 = 0.0867)

Figure 3.1 Degree Subject, by Salary Quintile
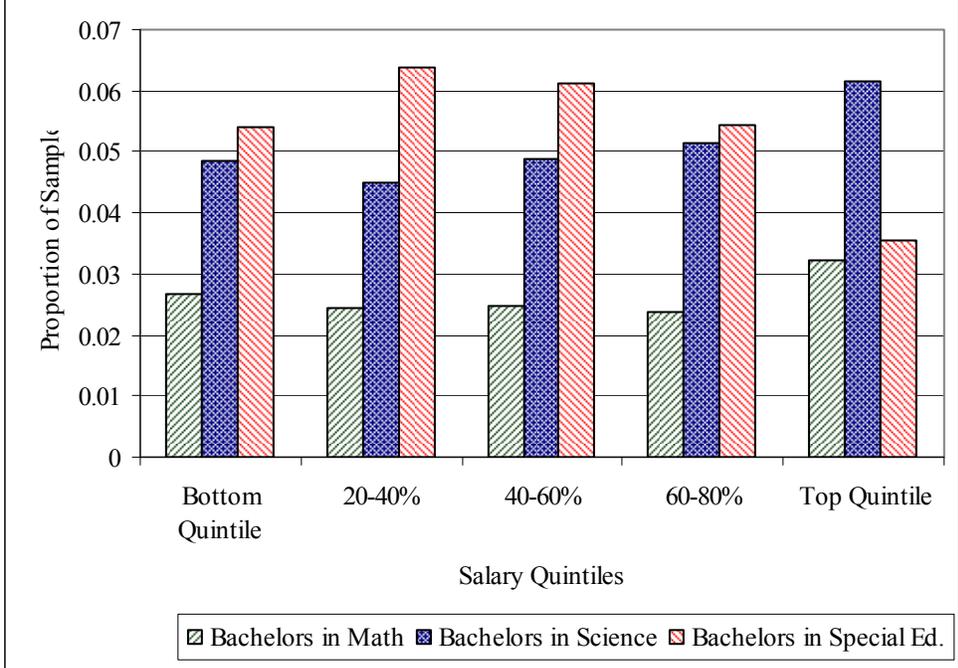
Figure 3.2 Additional Salary Earners, by Salary Quintile
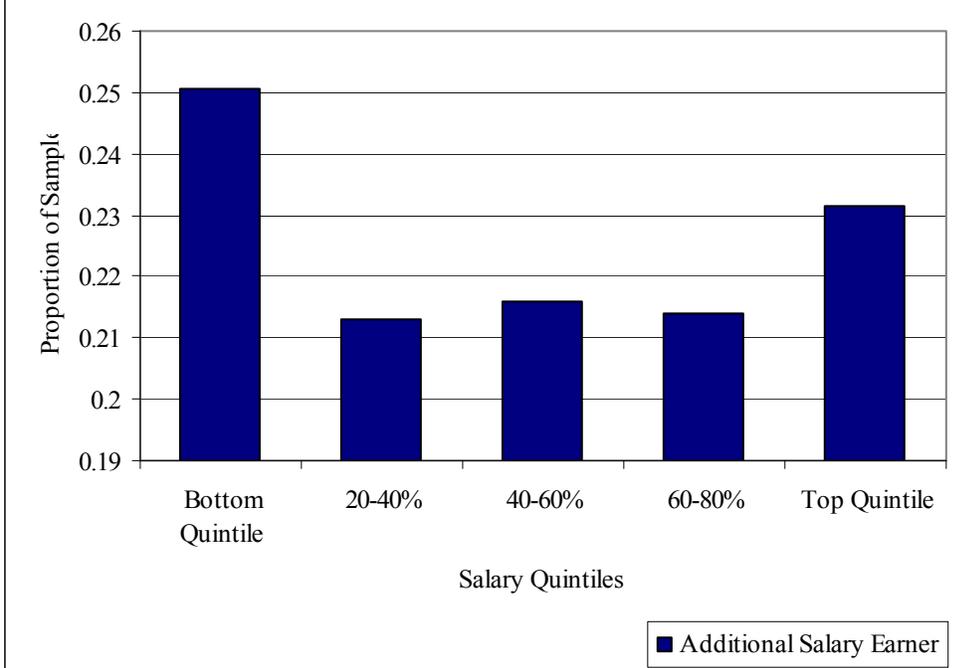
Figure 7.1 Movers, Leavers, and Retirees
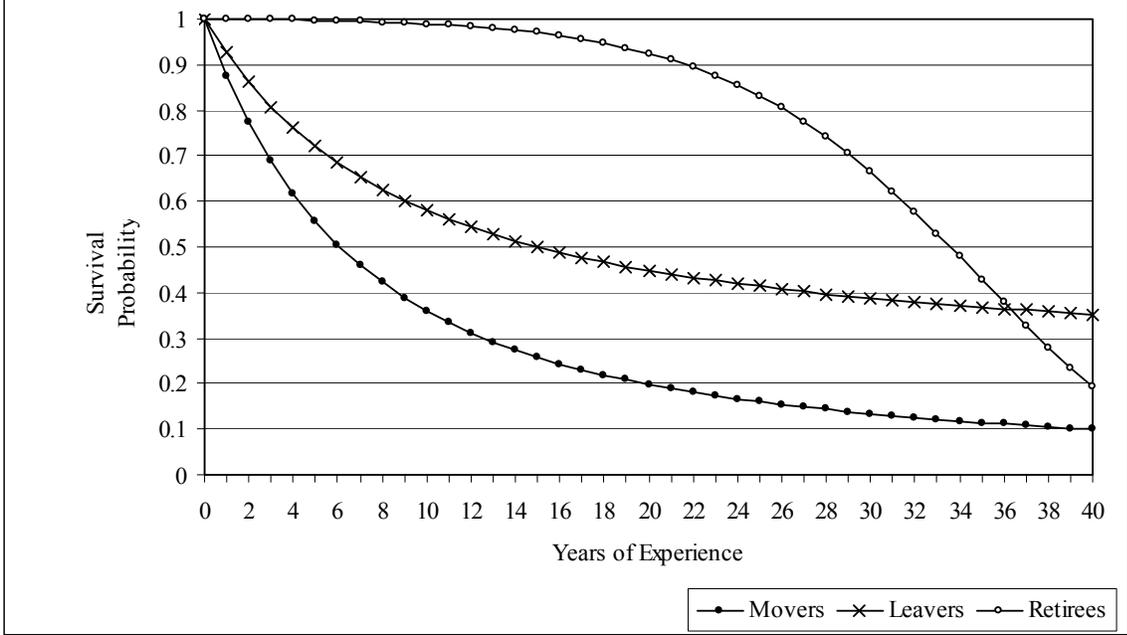
Figure 7.2 Mover Effect of School Level
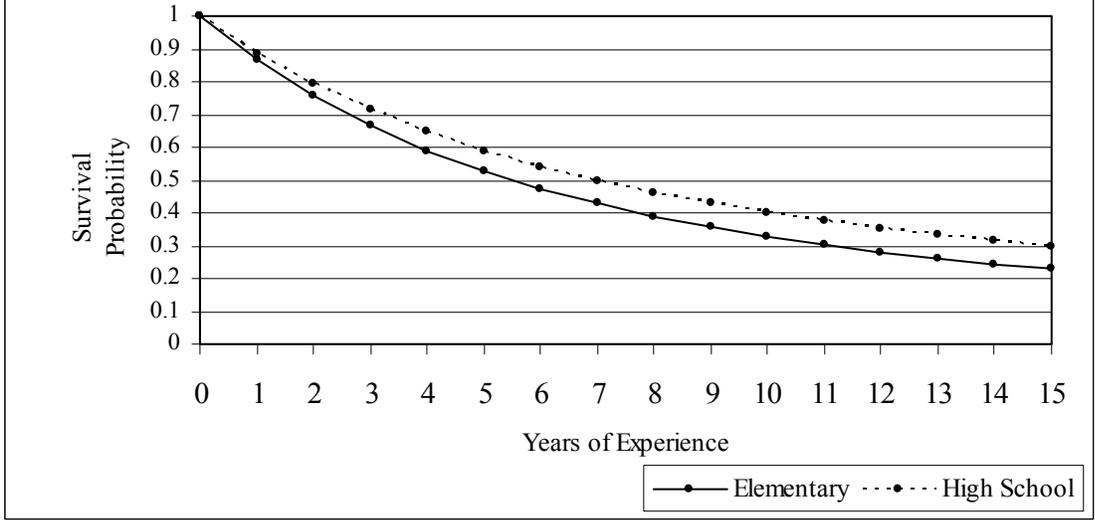
Figure 7.3 Leaver Effect of School Level
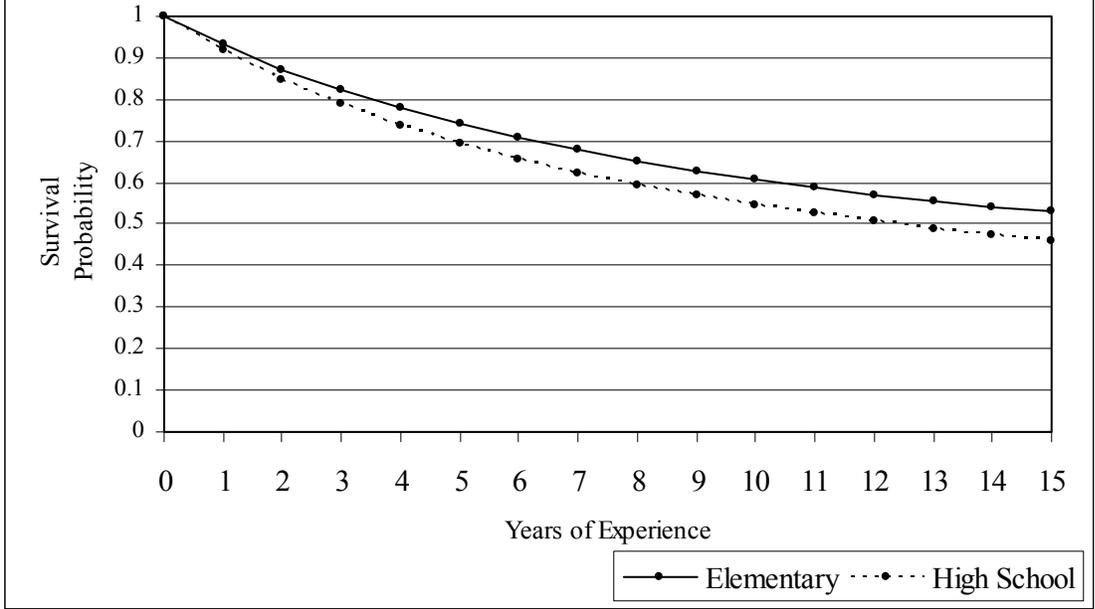
**Figure 7.4 Mover Effect of 10% Raise in Salary : HS**
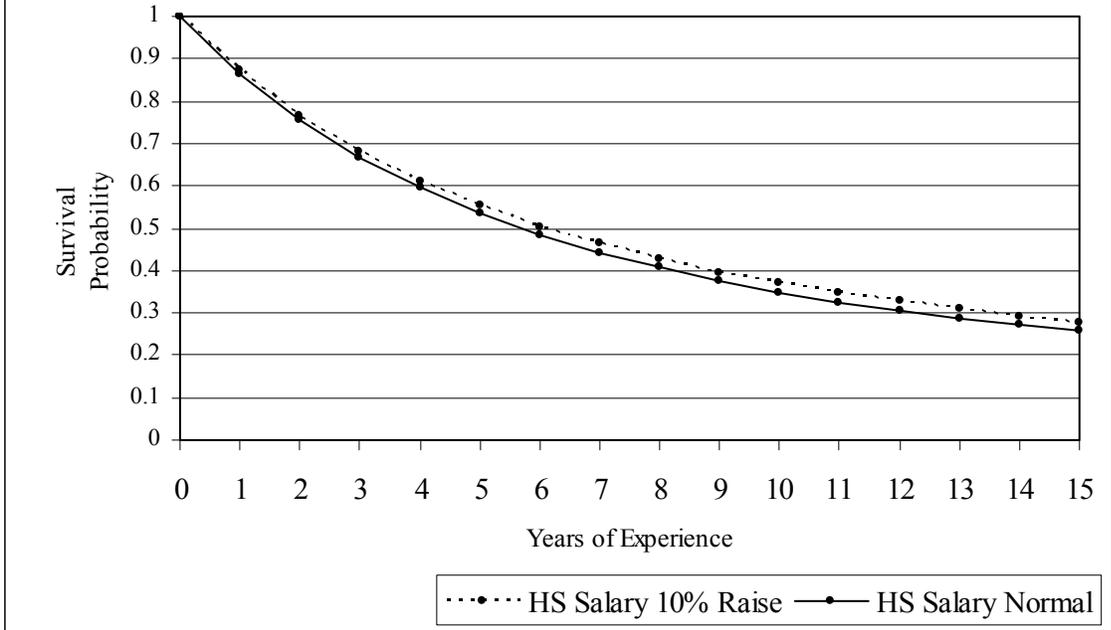
Figure 7.5 Mover Effect of 10% Raise in Salary : Elem.

Years of Experience

······•······ Elementary Salary 10% Raise ——•—— Elementary Salary Normal
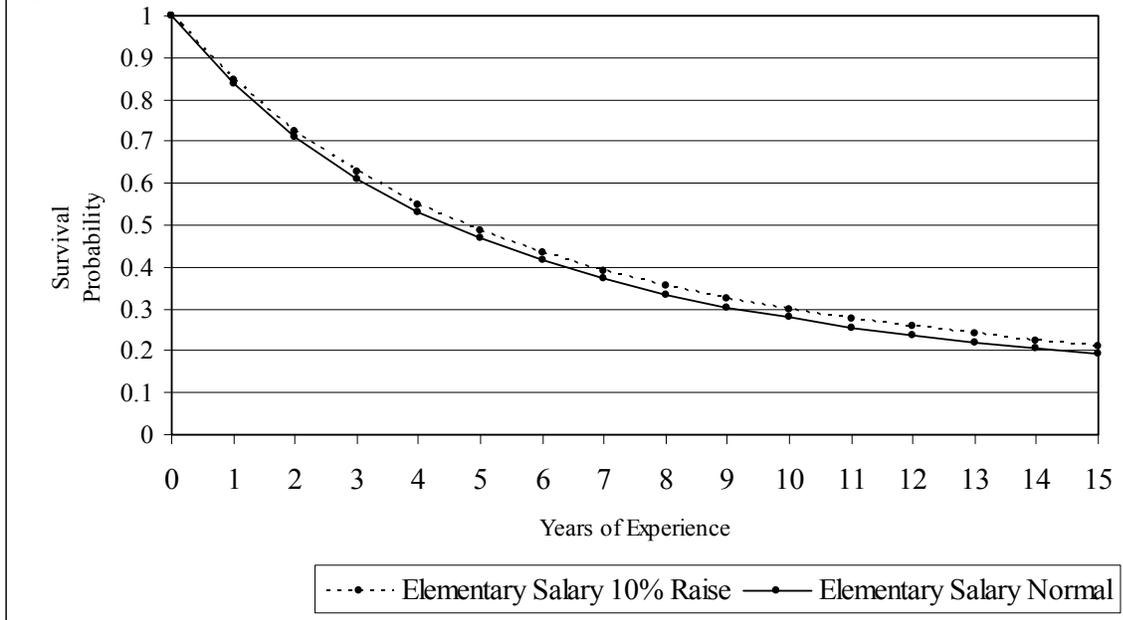
Figure 7.6 Leaver Effect of Marriage, by Gender

Years of Experience

——♦—— Married Females ——✕—— Married Males

······♦······ Unmarried Females ···✕··· Unmarried Males
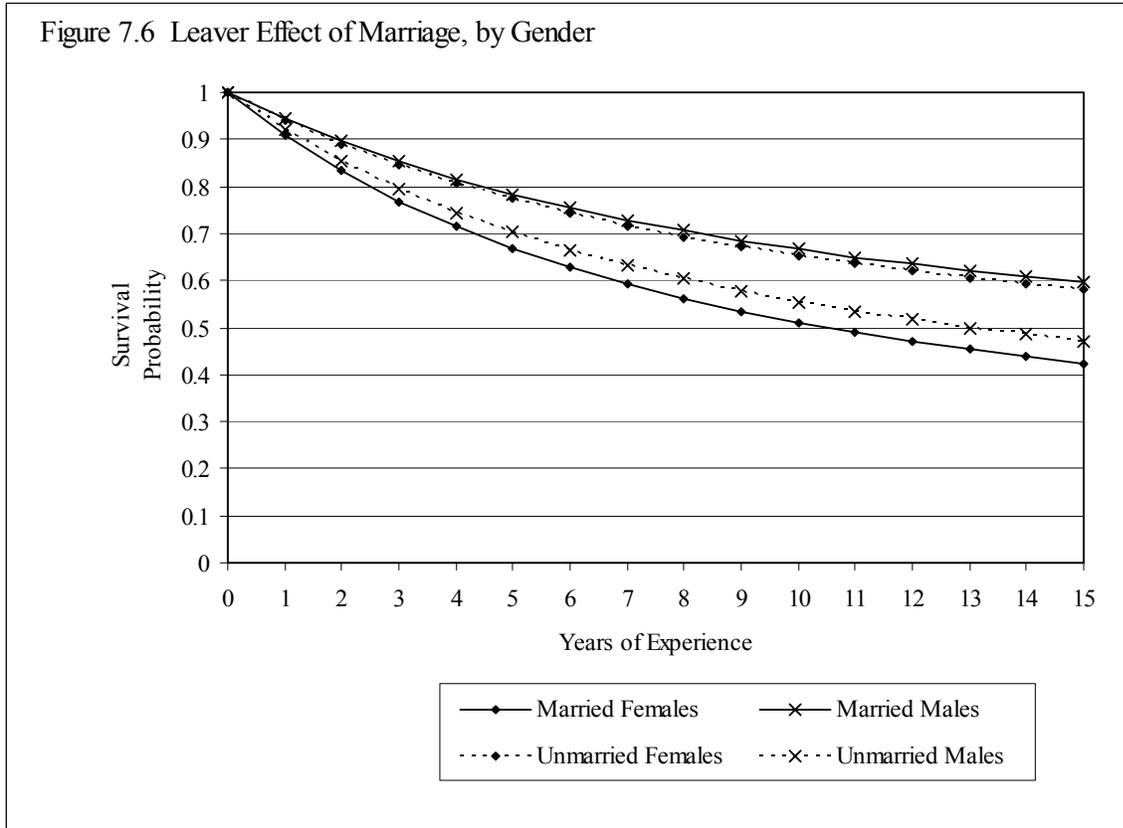
Figure 7.7 Mover Effect of Teacher Minority Status

Survival Probability

Years of Experience

Minority Teacher @ High Minority School
Non Minority Teacher @ High Minority School
Minority Teacher @ Low Minority School
Non-Minority Teacher @ Low Minority School
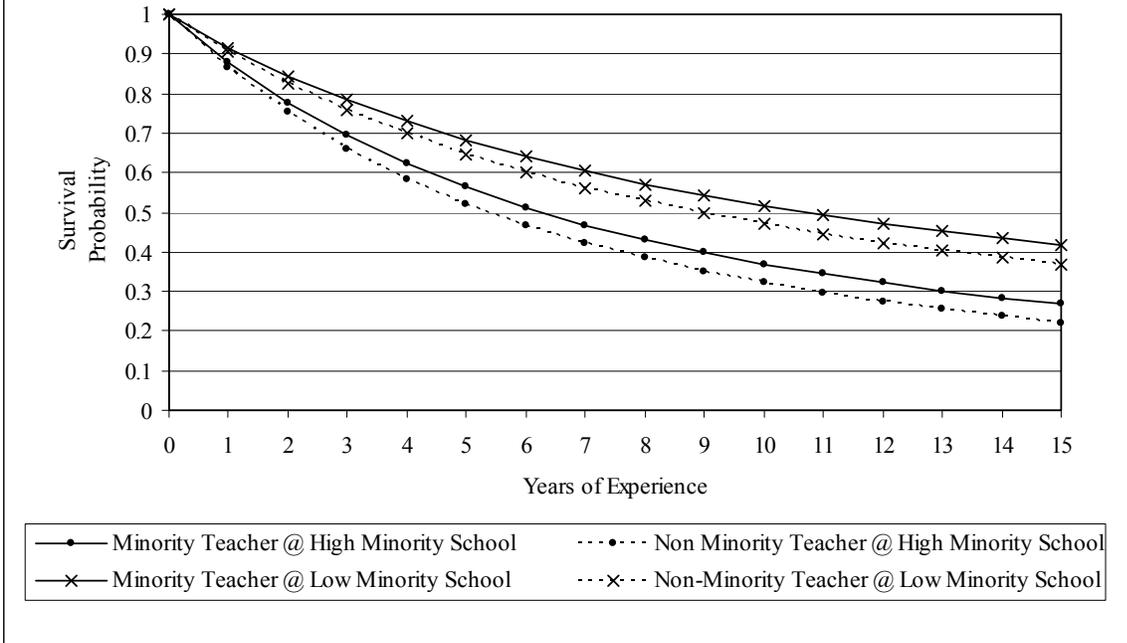
Figure 7.8 Leaver Effect of Additional Salary

Survival Probability

Years of Experience

No Additional Salary   Some Additional Salary

Figure 7.9 Mover Effect of Admin Support Problems
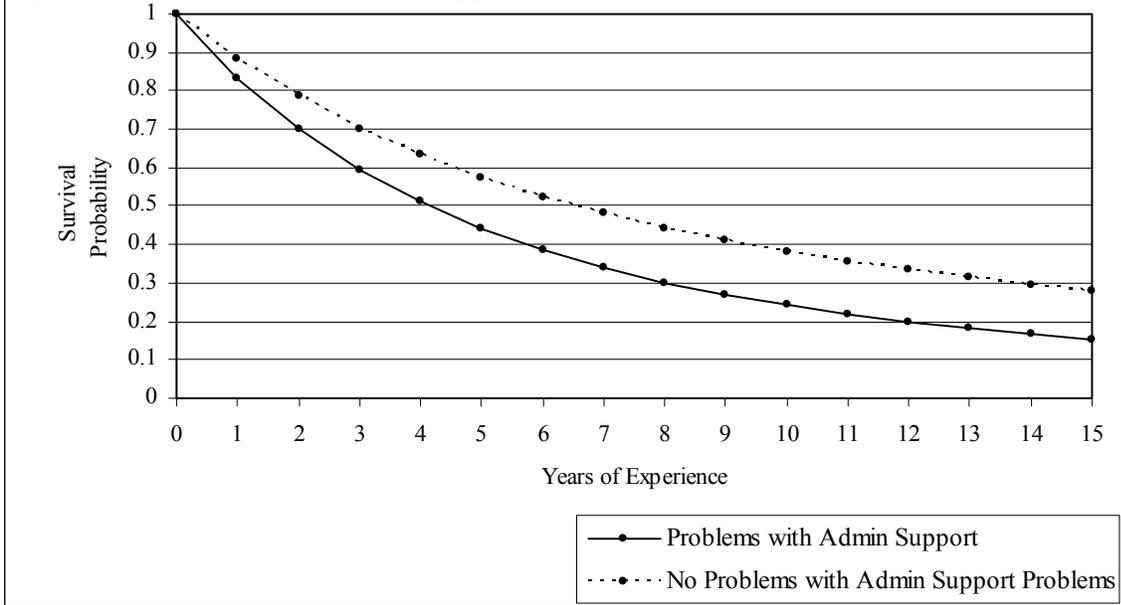
Figure 7.10 Mover Effect of Graduate Degrees
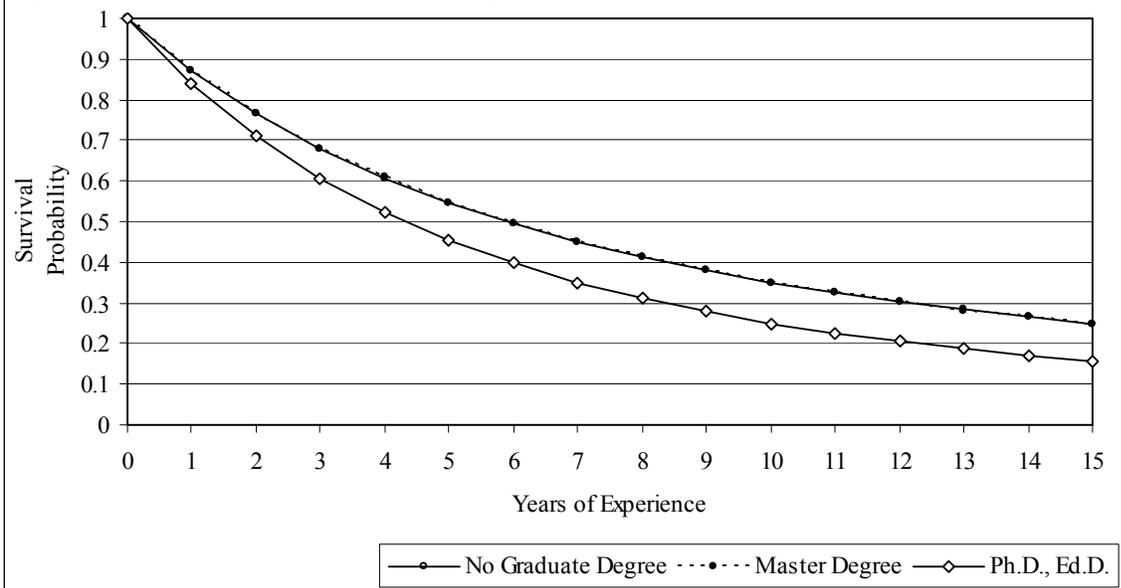
Figure 7.11 Leaver Effect of Graduate Degrees
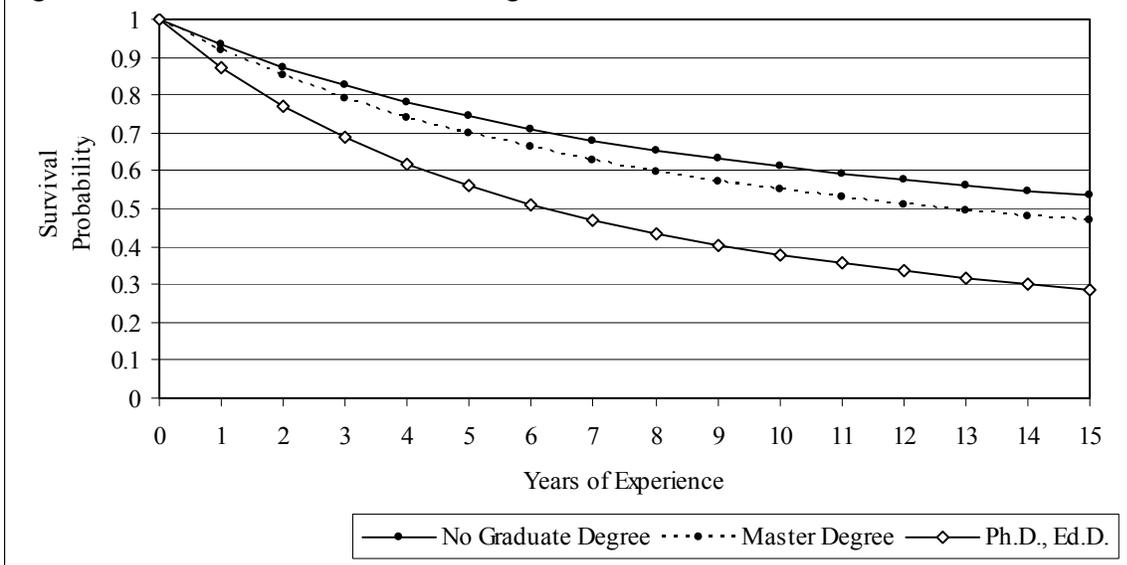
Figure 7.12 Retiring Effect of NCLB