Hire Today, Gone Tomorrow: The Determinants of Attrition among Public School Teachers

Li Feng
Florida State University

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Abstract

Increases in the school-age population, maximum class size requirements in various states and the No Child Left Behind Act's mandate of a "highly qualified teacher" in every classroom collectively will increase the demand for teachers. However, public school teachers are exiting the profession in large numbers. This poses a serious challenge for policymakers. In this paper I analyze the determinants of teacher attrition using matched teacher-student class-level information for all Florida public school teachers. In addition to teacher demographics and school characteristics employed in previous studies, I include a number of variables measuring the characteristics of the specific students assigned to each teacher. The results indicate that classroom characteristics, such as students' performance on standardized tests and the average number of disciplinary incidents, play a larger role than school average student characteristics in determining teacher attrition. Teacher pay has a positive influence on retention, while the results for class size are mixed. There is also some evidence that more able teachers are more likely to exit the teaching profession. These findings suggest that in addition to salary, classroom assignment is an important factor when considering policies to promote teacher retention and teacher quality.

1 Introduction

The demand for public school teachers is rapidly increasing. According to the National Center for Educational Statistics (NCES), total elementary and secondary school enrollment in the United States will

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*Department of Economics, 288 Bellamy Building, Florida State University, Tallahassee, FL 32306-2180. Email: lff6254@garnet.acns.fsu.edu. I wish to thank my major adviser, Dr. Tim Sass, for his direction and encouragement. I would also like to thank the staff of Florida Department of Education's K-20 Education Data Warehouse for their assistance in obtaining the data used in current study. This dissertation is partly funded by the American Education Research Association Dissertation Grant program. However, any views expressed in this paper are solely my own and do not necessarily reflect the views of Florida Department of Education or the American Education Research Association.

increase by four percent between 2002 and 2014.[1] In addition, since the 1980s 24 states, including Florida, have implemented either voluntary or mandatory class size reduction initiatives.[2] Further exacerbating the demand for new teachers, the No Child Left Behind Act requires that for every classroom there is a "highly qualified teacher" by the year 2006.[3]

One important element in meeting the growing demand for teachers is to bolster efforts to train and hire well qualified teachers. However, increasing the number of new recruits into teaching will do little to ameliorate looming teacher shortages unless new and existing teachers stay in the teaching profession. On a national level, about eight percent of teachers stopped teaching from one year to the next; this percentage has been increasing since 1987.[4] Among those who left teaching, only a quarter of them retired while half left for other professions or careers. Some studies find attrition to be even higher for individual states.[5]

Reducing teacher attrition also has potentially important implications for school finance. Searching for and hiring a new teacher is an expensive proposition. In Texas, the cost of turnover per lost teacher based on the salary of first-year teachers is estimated to be between $6,060 and $48,480.[6] The U.S. Department of Labor offers a middle range per-teacher turnover cost estimate of $7,999.[7]

Despite the magnitude of the teacher attrition problem there is relatively scant empirical evidence on the factors affecting teachers' exit decisions. In particular, there is little evidence on the impact of a teacher's classroom environment, including student ability, student behavior and class size on teachers' decisions to leave the profession. It is the goal of this paper to fill this void. By studying this issue, I will be able to provide evidence relevant to policymakers seeking ways to reduce teacher attrition in a cost-effective manner.

Attrition is just one component of teacher turnover. Teachers may move from one school to another (migration) or exit the teaching profession entirely (attrition). Since migration does not

[1] U.S. Department of Education (2005).
[2] Education Commission of the States (2005).
[3] To be deemed highly qualified, teachers must have a bachelor's degree, full state certification or licensure and provide evidence of content knowledge for each subject they teach.
[4] U.S. Department of Education (2004).
[5] For state-level analyses, see Hanushek, Kain and Rivkin (2004) and Imazeki (2004).
[6] Texas Center for Educational Research (2000). The first estimate only includes the number of leavers and their annual salary in the calculation while the second estimate includes other factors such as separation costs, hiring costs, vacancy costs, training costs and learning curve loss.
[7] Texas Center for Educational Research (2000).

represent a net loss in the total supply of public school teachers, I analyze teacher attrition in the present research.[8] In particular, I consider the impacts of both monetary and non-monetary factors affecting teacher attrition. Unlike most prior research, which focuses on school-level characteristics, I investigate whether the specific classroom environment affects the probability an individual leaves teaching. I estimate the impacts of class size, student ability, and student behavior on the probability of exiting teaching, while controlling for other factors such as teacher pay and ability.

I utilize administrative data from the state of Florida for more than 127,000 public school teachers who taught during the 2001-2002 school year. For each teacher, I have detailed information on their demographic characteristics, certification status, employment history and compensation. For teachers who entered a Florida public university in 1999 or later I also possess information on their pre-service history, including course work and college entrance exam scores. These data are matched to the records of the students they taught. In order to compare my results for Florida with the rest of the nation I also analyze data from the 1999-2000 School and Staffing Survey (SASS) and the associated 2000-2001 Teacher Follow-up Survey (TFS).[9]

The remainder of the paper is organized in the following manner. Section 2 reviews the relevant literature. Section 3 lays out the empirical model and methodology. Section 4 describes the two sets of data used in the analysis, along with the advantages and disadvantages of each. Section 5 presents results for both the full sample of teachers as well as the subset of teachers who are in the early stage of their careers. In the final section I discuss the policy implications of my research.

2 Literature Review

There is a substantial body of literature that studies the factors affecting teachers' decisions to exit the teaching profession. Past research can be categorized by the three general influences on teacher attrition: teacher ability, monetary job characteristics and the non-monetary aspects of teaching.

[8] There are obviously important policy issues with respect to the distribution of teachers across schools. For example, one concern is that schools serving minority or economically disadvantaged students may lose recruits and existing teachers to schools serving students from high-income families. The second essay in my dissertation addresses the issue of teacher migration both within and between school districts.
[9] SASS is a random sample of all teachers in the U.S. and their whereabouts one year later.

Teacher Ability and Teacher Turnover

The first group of studies, also the most limited in terms of the quantity of research produced, seeks to determine if teacher attrition affects the average quality of teachers as well as their total number. In other words, are high-quality teachers more likely to leave than their less able peers?[10] Using Missouri public school data from 1990-2000, Podgursky et al. (2004) find that teachers with higher ACT scores have a higher probability of exiting the teaching profession. In a recent study of New York City teachers, Boyd et al. (2005) find that schools with low-performing students have a difficult time staffing high-quality teachers, where quality is measured by performance on the general knowledge portion of the teacher certification exam.

Salary and Teacher Turnover

The second group of extant literature focuses on the monetary aspects of occupational choice for teachers, studying teachers' salaries and the value of their outside (non-teaching employment) options. A handful of studies provide evidence that higher salaries are associated with higher teacher retention rates. Murnane and Olsen (1989a), using a sample of over 7,800 Michigan public-school teachers, show that a $1000 increase (1967 dollars) in salary is associated with an increase of more than four years in the median teaching spell duration for Michigan public school teachers. Similar effects are found for a small sample of Colorado teachers (Murnane and Olsen (1989b)). Using the National Longitudinal Study of the Class of 1972 and its follow-ups, Stinebrickner (1998) finds that a higher wage will lengthen teacher duration. Specifically, a person with wages that are one standard deviation above the mean is nine percent more likely to stay in teaching than a person with the mean wage during a five-year span. However, Stinebrickner's analyses are based on a small sample of only 341 certified teachers.

In addition, the opportunity cost of teaching can also affect teacher turnover. Brewer (1996) uses the ratio of the average countywide teacher salary divided by an individual teacher's salary to indicate the outside teaching opportunities in other districts in the county. He finds that increases in alternative pay relative to current salary are positively correlated with quits. Theobald and Gritz (1996) include a measure of the opportunity cost of teaching in the current school district—the average of alternative teacher salaries in all school districts within the state of Washington. They find that higher alternative

[10] Stinebrickner (2001), Podgursky et al. (2004), Boyd et al. (2005) all found that higher ability teachers have greater likelihood of exiting teaching profession.

salaries increase both male and female teacher attrition. Imazeki (2004) finds that the higher wage of an individual teacher relative to the average of the Cooperative Education Service Agencies in Wisconsin the less likely the teacher would exit. Similarly, Murnane and Olsen (1990) measure a teacher's opportunity cost by their performance on the National Teacher Exam (NTE) and find that those with higher scores tend to have a shorter tenure as teachers.

Non-monetary Job Characteristics and Teacher Turnover

In addition to monetary compensation, a teacher's utility will depend on the non-pecuniary aspects of her job, particularly the costs she incurs and the satisfaction she derives from teaching her students. The last set of papers emphasizes these non-pecuniary aspects of teaching. The existing literature primarily focuses on school-level and district-level characteristics and how they affect the employment decisions of teachers.

Smith and Ingersoll (2004), Hanushek, Kain and Rivkin (2004), Shen (1997) and Murnane et al.(1991) find that teachers from schools with a high proportion of minority students or a large fraction of students who are eligible for free and reduced-price lunch are more likely to leave. Hanushek, Kain and Rivkin (2004) find that Texas public school teachers prefer non-minority, non-low-income students regardless of the teachers' gender, race and experience level. However, African-American teachers favor schools with higher shares of black student enrollment. Imazeki (2004) finds a similar preference among African-American teachers in Wisconsin.

In terms of school-level average student achievement, Hanushek, Kain and Rivkin (2004) find that Texas public school teachers are less likely to exit schools with relatively high-achieving students. Contradicting the results in Texas, Scafidi, Sjoquist, and Stinebrickner (2003) find that Georgia public school teachers tend to flee schools with a large proportion of minority students while the impact of school-level student test scores on leaving is insignificant once student racial composition is taken into account. In a recent analysis of the New York city school teachers, Boyd, et. al. (2005) find that high ability elementary school teachers have a strong preference for schools with high achieving students.

Although the number of students a teacher must instruct likely affects the difficulty of the job, few studies of teacher attrition explicitly include class size in the analysis. Indeed there has been no large-scale study of the impact of teacher-specific class sizes on teacher attrition. The one study to employ teacher-specific class-size information, Mont and Rees (1996), analyzes 525 New York high school teachers and finds that smaller class sizes are associated with a reduced probability of leaving. In addition to the obvious sample size limitation, the estimates may suffer from omitted variable bias since no other school-level information on student composition is included. Further, there is a potential endogeneity problem if less effective teachers are assigned fewer students. What appear to be class-size effects may actually reflect unobserved teacher quality. Using the school-level average student-teacher ratio, Kirby, Berends and Naftel (1999) corroborate the positive correlation between class size and teacher turnover.

3 Model and Methodology

A Model of Teachers' Job Choice

I model a teacher's leaving/staying decision in a random utility framework, where a teacher chooses between staying in teaching and leaving teaching according to whichever decision provides higher utility.[11] The additive random utility function specifies the utilities of leaving (1) and staying (0) to be the sum of a deterministic and a random component:

(1) $$U_0=V_0+\varepsilon_0$$
$$U_1=V_1+\varepsilon_1$$

Where V_0 and V_1 represent the deterministic components of utility and ε_1 and ε_0 represents the random components of utility. We observe the dependent variable y equal to one if the utility of leaving, U1, is higher than the utility of staying U_0. Because of the random component of utility, the probability of leaving (y=1) is a random event where F is the cumulative density function of $(\varepsilon_0 - \varepsilon_1)$. Assuming ε_0 and ε1 are normally distributed and normalizing of the variance of $(\varepsilon_0 - \varepsilon_1)$ to unity gives the probit model:

(2) $$\begin{aligned}\Pr[y=1] &= \Pr[U_1 > U_0] \\ &= \Pr[V_1+\varepsilon_1 > V_0+\varepsilon_0] \\ &= \Pr[\varepsilon_0-\varepsilon_1 < V_1-V_0] \\ &= F(V_1-V_0).\end{aligned}$$

As to the deterministic component of the model, there are many factors that may potentially affect the difference between utility in teaching and in other occupations and thus impact a teacher's decision to

[11] Cameron and Trivedi (2005).

leave. In general, the staying/leaving decision depends on individual tastes, geographic preferences, wages in the present job and in alternative employment, the non-pecuniary job characteristics of both teaching and alternative employment and the extent of human capital that is specific to the present job[12].

In order to make the model operational it is necessary to relate specific observable variables to the broad categories of factors determining the difference in utility between teaching and non-teaching employment. While tastes/preferences are not directly observable, I shall use teacher demographics, including age, gender, race and ethnicity to proxy the preferences of teachers. There are of course no apriori predictions for the impact of these variables on teacher attrition. Educational attainment, in particular receipt of an advanced degree, will likely raise the alternative wage (holding teaching salary constant) and thus is expected to increase the likelihood a teacher will exit. I employ two indicator variables to capture teaching-specific investments in human capital: professional certification and special education teachers. Both of these factors are expected to represent higher levels of teaching-specific skills and thus be associated with a reduced likelihood of exit. In contrast, middle and high-school teachers in general, and math teachers in particular, are expected to have more general job skills that are transferable to non-teaching positions and thus more likely to exit, all else equal. Monetary compensation is measured by a teacher's current salary and general non-teaching wages are captured by a set of county dummy variables.[13] Finally, non-pecuniary aspects of teaching are captured by a vector of school and classroom characteristics, including measures of student ability, disability status, English proficiency and student behavior.[14] Presumably high-ability and well-behaved students are easier and more enjoyable to teach and thus would decrease the likelihood a teacher would exit. While some past studies of teacher attrition have included school-level average student characteristics, my analysis will be the first large scale study to consider the characteristics of the specific students in a teacher's classes.

Given the assumptions above, the empirical model can be summarized by:

(3) $\Pr[\text{Exit}] = f(D, T, S, C)$

Where D = a vector of teacher demographic characteristics,

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[12] See Farber(1999) for more details on job-specific human capital and job mobility.

[13] Since all Florida school districts are countywide, the county dummies will also serve to capture differences in hiring and firing policies and cost-of-living differences.

[14] I am not controlling for the home environment, particularly parental inputs. Students who receive significant support at home may be easier to teach and less disruptive. Hopefully LEP and poverty status can proxy for a students' home environment.

T = teachers' individual characteristics, such as certification, possession of an advanced degree, and grade level/subject matter taught (e.g. high-school math),

S = school characteristics, such as school size, mean achievement test score, average student demographics and disciplinary incidents,

C = characteristics of the classes a teacher is assigned, such as student demographics, achievement test scores, class size and student disciplinary incidents

4 Data

A number of previous studies have investigated teacher turnover using datasets at the state level (e.g. Imazeki (2004), Theobald and Gritz (1996), Hanushek et al. (2004), Podgursky et al. (2004), Brewer (1996), Murnane and Olsen (1989b, 1990)). A potential drawback of these single-state studies is that they cannot distinguish between teachers who take a teaching job in another state or in a private school and those who exit the profession entirely. Also, there is the issue of whether findings in a particular state are relevant to the rest of the nation.

Teacher turnover has also been studied using nationally representative datasets such as the Schools and Staffing Survey (SASS) and the associated teacher follow-up surveys (TFS) (e.g. Arnold et al. (1993), Ingersoll (2001), Shen (1997), Smith and Ingersoll (2004)). While national in scope, the SASS data has more limited information than some state administrative databases and only follows teachers for one year.

For the current study I employ both a national dataset, the 1999-2000 SASS and associated TFS, as well as a statewide administrative dataset from Florida, known as the Florida Education Data Warehouse (FL-EDW). The combination of these two datasets will overcome many of the data limitations experienced in previous studies. I describe both of these datasets in more detail below.

Overview of the 1999-2000 SASS Data

The Schools and Staffing Survey (SASS) and Teacher Follow-up Survey (TFS) is the nation's largest sample survey of America's elementary and secondary schools and is conducted every four years. All elementary and secondary schools are divided into four exclusive categories, public schools, public charter schools, Bureau of Indian Affairs schools, and private schools. For each type of school, three sets of surveys are administered covering teachers, principals and the school. For public schools, their corresponding school district is also interviewed. The most recent survey is SASS-TFS 1999-2000. The

1999-2000 SASS surveys teachers during the 1999-2000 school year and the TFS surveys a partial list of those teachers one year later. TFS includes all former teachers but only a sub-sample of current teachers.

SASS data include details on the demographics of a teacher, such as age, sex, and race. In addition, SASS has information on the student racial composition of a school and district salary information. But SASS only includes the following classroom-level information: average class size, percent of students with an Individualized Education Plan (ie. students with disabilities), and percent of students with Limited English Proficiency.

Overview of the Florida Education Data Ware-house (FL-EDW) data

Previous research on teacher turnover has focused on the general characteristics of a teacher's school. For example, Hanushek et al. (2004) uses average test scores, the percentage of students eligible for subsidized lunch programs, the percentage of black students, and the percentage of Hispanic students. However, a teacher's work environment is most closely tied to the abilities and behavior of the students in her/his classroom rather than the school as a whole. The data from the FL-EDW allows matching of students and teachers to specific classrooms. Thus the FL-EDW data provides a unique opportunity to observe the impact of classroom-level variables, including class size, the behavior of students (measured by discipline incidents), and student achievement on the underlying dynamics of teacher exit decisions.

In addition to the comprehensive nature of the data available in Florida, there are two additional factors that make Florida particularly attractive as a laboratory for analyzing the determinants of teacher turnover. First, Florida is relatively isolated from neighboring states. Florida is bordered on three sides by water and the northern border area is relatively sparsely populated compared to the central and southern parts of the state. This reduces the problem of teachers teaching in border states. Second, because Florida has in place a constitutional amendment that limits class size, class sizes are less likely to be a function of teacher ability, mitigating possible endogeneity bias.

For all teachers who were teaching in a Florida public school during school year 2001-2002 and 2002-2003, the FL-EDW provides a record for each class he or she taught in October of the relevant year. Every spring the State of Florida administers the Florida Comprehensive Assessment Tests in reading and in math to students in grades 3 through 10.[15] Two types of tests are administered. The first one is the FCAT Norm Referenced Test (NRT), a version of the Stanford-9 achievement test. This is a vertically scaled exam where students making normal progress will achieve higher scores in each successive grade level. The second test, the FCAT Sunshine State Standards Test (SSS), is a criterion-referenced test where the mean score is equivalent across grade levels. Thus a student making normal progress would earn the same FCAT-SSS score in successive years. To avoid complications with differing grade-level mean scores I employ the FCAT-SSS score as my metric of student ability.

For each class, I determine the average classroom characteristics such as mean student test scores, number of disciplinary incidents per student, proportion of gifted students, proportion of students eligible for free or reduced lunch, proportion of Limited English Proficiency students, and the shares of students who are black and who are Hispanic. Lagged test scores and lagged discipline incidents are employed to avoid possible simultaneity between a teacher's ability and the behavior and performance of her students. I then match each teacher to all of the classes she taught in October 2001 and I average the individual classroom characteristics across all of her classes.[16]

To compare the current study with earlier studies which use school-level information on student characteristics (Hanushek, Kain, Rivkin(2004), Scafidi, Sjoquist, and Stinebrickner(2003), Boyd, Lankford, Loeb, Wyckoff(2005)), I also include school average measures of student demographics, behavior and test scores in the analysis.

In terms of sample selection, I only include regular full-time teachers teaching in traditional (non-charter) public schools. I also restrict the sample to teachers aged 19 through 70 and eliminate teachers simultaneously teaching in more than one school. The later restriction is imposed in order to positively link each teacher to school characteristics. In addition, therapists and substitute teachers are also excluded from the sample.[17] Additionally only teachers who actually taught one or more classes are included.[18] Appendix 1 provides a list of variable names and definitions.

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[15] For details of the Florida Comprehensive Assessment Test, see the following website: http://www.firn.edu/doe/sas/fcat/handbk/fcathandbook.html

[16] Other than test scores and the average number of disciplinary incidents per student, all other classroom measures are in percentage terms.

[17] Therapists include the following: occupation therapist, speech-language pathologist, physical therapist, music therapist, recreation therapist, and therapy assistants.

[18] It is possible that a teacher may be engaged in supervisory or administrative duties and not be the primary instructor for any particular class.

5. Results

Descriptive Statistics

Since the Florida Education Data Warehouse only tracks teachers as long as they are teaching in a Florida public school, teachers who move to private schools or who leave the state to teach in another state are classified as "leavers". In order to assess the impact of possible misclassification, I use data from the 1999-2000 SASS and 2000-2001 TFS to investigate the extent of possible misclassification. Since SASS-TFS is a nationally representative sample, it is able to track teachers who leave public schools to teach in private schools or teachers who left the state but still were teaching.

From Table 1, the percent of teachers who leave public schools is about 8.3% while the percent of teachers who no longer teach at all is 7.3%. Therefore about one-eighth of teachers departing public schools in a given state move to private schools or take a teaching job in another state. For Florida, the percentage of teachers leaving public schools in a given year is 11.5%, about three percentage points higher than the national average. This percentage is consistent with a 2003 report on Florida's teacher retention which indicated 13.9% teachers aged between 20-29 left classrooms after a year in 1997.[19]

Consistent with earlier studies (Hanushek, et al. (2004)), teachers with fewer years of experience are more likely to leave teaching than their more experienced counterparts. Table two shows that for teachers with 0-2 years of experience, the percentage of teachers who left teaching is about 5.3% while teachers with 11-30 years of experience, the percentage of teachers who left teaching is only 2.3%. [20]

Table 3 shows that on average teachers who left Florida public schools tend to have students who scored lower on both the Norm-Referenced test and the Sunshine Standards test. For example, the average student performance on the math portion of the Sunshine State Standards test for teachers who left is 9 points lower than the average student performance on the same test for teachers who stayed in teaching. On average, teachers who left have a higher proportion of black students in their classroom, about four percentage points greater than their counterparts who stayed in teaching. For teachers who

[19] Florida Department of Education (2003).
[20] As noted in Table 2, there are a significant number of missing values for teacher experience in the dataset. I am working on a program to impute experience data based on values for the same teacher in other years.

stayed in teaching, they tend to have more gifted students,[21] slightly more Limited English Proficient Students, and fewer students with a history of disciplinary problems in their classrooms.

Regression Results – Full Sample of Florida Teachers

For the rest of the discussion, unless otherwise specified, I present probit estimates of the probability of not teaching in 2002-2003 based on teacher, classroom and school characteristics observed in 2001-2002. The regressions include district fixed effects and account for clustering of errors at the school level.

Table 4 shows the main results of this paper. There are three sets of results presented. First I estimate a baseline model (model 1.) that is similar to those estimated in previous research. This baseline model includes school characteristics, teacher characteristics and interactions between teacher race/ethnicity and the racial/ethnic composition of students. This baseline model is very similar to those estimated by Hanushek, Kain and Rivkin (2004) for Texas teachers and by Scafidi, Sjoquist, and Stinebrickner (2003) with Georgia teachers. However, I add a new variable, not available in the Texas and Georgia data, the average number of disciplinary incidents at the school level. This variable captures another non-pecuniary aspect of the working condition for teachers. To measure student performance I only use the score from the mathematics portion of the statewide exam to avoid multicollinearity that would arise because of the high correlation between reading and mathematics scores.

Contrary to Hanushek, Kain, and Rivkin's (2004) results for Texas teachers, higher average student achievement at the school level is not significantly correlated with teacher exit. Similar to what is found in both Texas and Georgia, the higher the percentage of black students at a school, the more likely teachers are to leave the public schools. However, the interaction between black teacher and black students is not statistically significant, suggesting that teaching students of one's own race does not affect a teacher's decision to leave teaching. Generally speaking, they are less likely to leave teaching than non-Hispanic white teachers. However, their employment decision is not affected by the proportion of Hispanic students at the school.

Unlike what is found for Georgia teachers (Scafidi, Sjoquist, and Stinebrickner(2003)), holding the student racial composition constant, Florida teachers tend to leave schools with a higher proportion of

[21] In Florida, admission to gifted programs is based on IQ scores, not previous academic achievement.

poor students. Teachers with a bachelor's degree only and teachers with regular certification are less likely to leave teaching, all else equal. Consistent with Imazeki (2004) and Murnane and Olsen(1989b), higher salaries reduces the probability of exit.

The significance of the estimated effects of student characteristics are likely biased downward because they are based on school-wide averages, not the characteristics of a teacher's own classroom. If there is significant variation in the makeup of classrooms within a school, then use of school average characteristics generates significant measurement error. To correct for this I estimate a model with teacher-specific student characteristics.

Column (2.) in Table 4 presents the estimated effects of classroom characteristics on the leaving decision. Examining each teacher's classes I find that increases in lagged mean student achievement are associated with a reduced probability of teacher exit. In addition, the lagged average number of discipline incidents for students a teacher taught is positively correlated with the likelihood of leaving.[22] Additionally, having more economically disadvantaged students (indicated by free/reduced-price lunch eligibility) also increases the probability of leaving.

In order to test the relative importance of the school characteristics and classroom characteristics, I also estimate a model that includes both school-level and teacher-specific student characteristics. The results are presented in column (3.) of Table 4. Both class-level student achievement and discipline remain statistically and quantitatively significant.[23] while the only statistically significant school-level characteristic is the school-wide average number of discipline incidents. If student discipline serves as a proxy for the safety of the campus environment then the result has a straightforward interpretation; teachers care about the ability and behavior of students they teach, they aren't affected by the ability of students taught by others, but they do care about safety outside of their own classroom.

One interesting and somewhat unexpected result is that the average size of classes taught does not significantly effect the probability of exit. This suggests that the small sample of New York teachers studied by Mont and Rees (1996) may not be representative or that their class-size measure was capturing

[22] The class-level achievement and discipline-incident variables are measured in the previous year for the current group of students (ie. last-year's test scores of this year's students) and thus avoid potential bias arising from the simultaneity between unmeasured teacher quality and student performance and behavior.
[23] Holding other factors constant, a one-standard deviation in average class-level test scores above the overall mean is associated with a reduction in the probability of leaving from 0.095 to 0.089 or over a five-percent reduction in the attrition rate. Similarly, a one-standard-deviation reduction in the lagged number of discipline incidents per student reduces the probability of exit from 0.095 to 0.091.

the effects of other classroom characteristics left unmeasured in their model.[24] It may be that class composition is much more important to teachers than the total number of students. If this is indeed the case then efforts to reduce class size, while potentially improving student achievement, will not significantly impact the problem of teacher attrition.

Results for Subpopulation of Young Florida Teachers

As noted above, attrition is especially high among teachers early in their careers. To see if the determinants of exit are the same for young teachers as for teachers as a whole I re-estimate the exit model using only the sub-set of teachers with zero to five years of experience.[25] Focusing on young teachers also addresses another potential problem with the current research design. Since the current analysis only spans two school years, I am implicitly assuming that the October 2001-02 class assignments are representative of the classes a teacher has been assigned in the past (and expects to be assigned in the future). This assumption is more tenable for teachers early in their careers since 2001-2002 will represent a large fraction of their entire teaching history.

Judging from the pseudo R-squared, the model has greater explanatory power for the sub-sample of teachers early in their careers relative to the entire population of teachers. This is consistent with the notion that the classroom in October of 2001 is more representative of a teacher's entire history for young teachers.

For all models, the classroom achievement score loses its significance, suggesting that young teachers are less sensitive to the ability level of the students they teach than their more senior colleagues. Comparing the model with both school-level and classroom-level characteristics (column 3.) with the comparable model for all teachers presented in column 3 of Table 4, we see that student misbehavior continues to increase the likelihood of teacher departure. For teachers early in their careers, increases in the proportion of students with limited English proficiency also heightens the probability of exit.

[24] The lack of an effect of class size on teacher employment decisions is not a result of class-size limitations in Florida. Implementing legislation for Florida's class size initiative was not signed into law until June 2003, after the current period of study.
[25] Unfortunately, due to some gaps in the data, I do not currently have complete information on experience for all teachers. Those teachers with missing experience information are disproportionally teachers who left teaching. As shown in Table 2, 52% of them left teaching. It is quite likely that many young teachers are included in this missing experience category. In a future draft I will inpute experience based on pre- and post experience information therefore mitigating this problem.

Results for Subpopulation of Florida Teachers with SAT Scores

In addition to sheer numbers, there is concern that teacher attrition may reduce overall teacher quality by draining away the best teachers. If teaching ability is correlated with the value of non-teaching employment opportunities, than one would expect superior teachers to be more likely to leave unless there is differential pay or other compensation.[26] To determine the affect of a teacher's general ability on the probability of leaving, I re-estimate my exit model with the addition of a variable representing the Scholastic Aptitude (SAT)-equivalent college entrance exam score of future teachers.[27] The data on college entrance exam scores comes from the student records of Florida public universities and community colleges, which are only available from 1995 forward. Thus the sample is limited to teachers who entered a Florida public university or community college in the 1996-1996 school year and had a valid test score. Thus the sample is not representative sample of all Florida public school teachers. On average they are younger, with an average age of 27 while the average age for the full sample is 44. In addition, the percentage of leavers for this sample is 4.5% whereas the sample used in the baseline model is 10.25%.[28]

The results from Table 6 indicate that college exam scores are positively correlated with the likelihood of exit, though the estimates are only marginally significant (t=1.62). The lack of precision is likely due to the relatively small sample of teachers with college entrance exam information. Data for the 2003-2004 school year has recently become available, so that future analysis can look at Florida teachers who taught in 2002-2003. This later sample should contain a much larger number of teachers with pre-service information and will thus likely yield more precise estimates of the relationship between the aptitude of teachers and their decisions to stay or leave public schools.

Results for Teachers Nationwide Using the SASS-TFS

The results from Florida suggest that teachers care about their classroom assignments, particularly the ability and behavior of the students they must teach. To check the robustness of these

[26] For example, if the non-pecuniary psychic benefits of teaching are higher for more able teachers, this could outweigh their higher value in alternative employment.
[27] In Florida, high-school entrants to four-year universities may take either the American College Test (ACT) or SAT exam. High school graduates initially entering community colleges predominately take a computerized placement test or CPT. Scores on the CPT and ACT have been converted to SAT-equivalent scores based on concordance scales provided by the Florida Department of Education.
[28] The differential is due in part to missing experience data, which is currently being rectified. See note 24 above.

findings I analyze data from the nationally representative 1999-2000 SASS-TFS survey. The SASS-TFS data are weighted to account for the fact that the TFS includes all former teachers but only a sub-sample of current teachers. Due to the limited number of classroom-level variables available in SASS-TFS, I compare the SASS-TFS results with a re-formulation of the Florida model that only uses covariates contained in SASS-TFS.

The results, presented in Table 7, indicate some similarities and differences between the estimates from Florida versus the nation as a whole. Across both data sets, teachers who are older, un-certified, and hold an advanced degree are more likely to exit public schools. Surprisingly, the probability of exit is not correlated with teacher pay in the SASS-TFS data whereas the expected negative correlation is found in the Florida data. Larger classes are found to increase the probability of departure in the SASS-TFS data but not for Florida teachers. Increases in the proportion of economically disadvantaged students are positively correlated with exit of Florida teachers, but not for the U.S. as a whole.

6. Summary, Conclusions and Future Research

With the increasing demand for teachers in the United States, now more than ever it is important to understand why teachers are exiting the profession. Previous analyses of teacher attrition rarely control for all of the important pecuniary and non-pecuniary factors that affect the employment decisions of teachers. In particular, the present study is the first large-scale analysis to link teachers to the students they teach and evaluate the impact of classroom environment on teacher attrition.

I find that Florida public school teachers with higher achieving students (measured by lagged achievement test scores) and with a smaller proportion of students with a history of disciplinary problems are more likely to remain in the classroom. This suggests that the classroom assignments of new teachers, who are inherently more likely to exit, can be a significant element in policies designed to promote teacher retention. In contrast, I find mixed evidence on the impact of class size. For Florida teachers, there is no statistically significant relationship between the size of a teacher's classes and her likelihood of continuing to teach in a public school. A negative relationship between class size and teacher retention is found for the nation as a whole based on data from the Schools and Staffing Survey.

In addition to the classroom environment, I find that exit is negatively correlated with teacher pay, indicating that recent initiatives in many states to boost teacher pay may in fact help ameliorate the problem of teacher attrition. Further, there is some evidence that more able teachers (measured by college entrance exam scores) are more likely to leave public school teaching, suggesting that reducing teacher attrition may also aid in promoting teacher quality.

Although the present analysis sheds new light on the factors affecting teacher attrition, much work remains to be done. The present analysis suggests that class assignments are important to teachers' occupational choices. I intend to further explore this avenue by considering the impacts of variation in student abilities (e.g. the standard deviation in test scores within a class) and the subject-matter assignment (in-field versus out-of-field) on the likelihood a teacher exits the public school system. I also intend to extend the time period of analysis to obtain more precise estimates of the relationship between the scholastic aptitude of teachers and their likelihood of exiting the teaching profession. I also plan to consider other elements of teachers' pre-service background, such as their college coursework and major.

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Table 1. Comparison of Percentage of Leavers in Florida with National Sample from SASS

	FL teachers	*SASS teachers*
Percentage of Leavers of the Public School System in Florida	11.5%	8.3%
Percentage of True Leavers Who Left Teaching	NA	7.3%

Table 2. Numbers and Percentage of Teachers Leaving Teaching by Experience Level

	Florida Teachers 2001-02 to 2002-03		
	Numbers of Teachers Left Teaching	Total Numbers of Teachers	Percentage of Teachers Left Teaching
Experience 0-2 years	932	17,577	5.3%
Experience 3-5 years	542	17,485	3.1%
Experience 6-10 years	590	19,046	3.1%
Experience 11-30 years	1,074	46,716	2.3%
Experience 30 or more years	94	4,456	2.1%
Experience missing	11,503	22,121	52.0%
All Experience Levels	14,655	127,434	11.5%

Table 3. Classroom Characteristics for Florida Teachers, 2001-2002

Average Characteristics of Classes Taught in 2001-2002	*Status in 2002-03*	
	Left Teaching	Still Teaching
Percent Limited English Proficiency Students	11.9%	12.0%
Percent of Special Education Students	27.8%	24.6%
Class Size	19.95	21.47
Discipline Incidents per Pupil	0.53	0.43
Percent Black Students	28.2%	24.2%
Percent Hispanic Students	20.3%	21.3%
Percent Gifted Students	4.1%	4.9%
Percent Students Receiving Free/Reduced-Price Lunch	50.0%	46.7%
Norm-Referenced Test Math Score	662	668
Norm-referenced Test Reading Score	660	665
Sunshine State Standards Test Math Score	283	292
Sunshine State Standards Reading Score	275	283

Table 4. Probit Estimates of the Determinants of the Probability a Teacher Leaves the Florida Public Schools, 2001/2002 – 2002/2003

	(1)	(2)	(3)
Teacher's Age	0.0054	0.0047	0.0046
	[0.0011]***	[0.0013]***	[0.0013]***
Male Teacher	0.02666	0.01502	0.01425
	[0.01666]	[0.01740]	[0.01749]
Black Teacher	0.0006	0.0186	0.0126
	[0.0338]	[0.0386]	[0.0396]
Hispanic Teacher	-0.0798	-0.0829	-0.0677
	[0.0447]*	[0.0534]	[0.0548]
Teacher Holds Advanced Degree	0.2973	0.3051	0.3060
	[0.0350]***	[0.0393]***	[0.0393]***
Certified Teacher	-0.3632	-0.3498	-0.3487
	[0.0233]***	[0.0264]***	[0.0264]***
High School Teacher	0.0022	-0.0455	-0.0199
	[0.0262]	[0.0264]*	[0.0303]
Special Education Teacher	0.0233	-0.0801	-0.0568
	[0.0206]	[0.0479]*	[0.0486]
Middle School Teacher	0.0115	-0.0263	-0.0020
	[0.0246]	[0.0261]	[0.0271]
High School Math Teacher	0.0213	0.0278	0.0333
	[0.0323]	[0.0331]	[0.0333]
Middle School Math Teacher	-0.0616	-0.0494	-0.0483
	[0.0378]	[0.0379]	[0.0379]
Log of Teacher Salary	-0.7637	-0.7403	-0.7389
	[0.0690]***	[0.0818]***	[0.0816]***
School Size	-0.0000		-0.0000
	[0.0000]		[0.0000]
School-Level Mean Math Score	-0.0003		-0.0004
	[0.0005]		[0.0006]
School-Level Mean Discipline	0.0008		-0.0600
Incidents per Student	[0.0147]		[0.0208]***
School-Level Percent Free-Lunch	0.1188		0.0672
Students	[0.0583]**		[0.0981]
School-Level Percent Black	0.1304		-0.0213
Students	[0.0652]**		[0.1141]
School-Level Percent Hispanic	0.0073		0.0312
Students	[0.0764]		[0.1240]
Black Teacher x School-Level	-0.0032		0.1969
Percent Black Students	[0.0726]		[0.1917]
Hispanic Teacher x School-Level	0.0837		-0.2732
Percent Hispanic Students	[0.0917]		[0.1984]
Teacher-Specific Mean Class Size		-0.0004	-0.0004
		[0.0003]	[0.0003]
Black Teacher x Teacher-Specific		-0.0497	-0.2171
Mean Percent Black Students		[0.0762]	[0.1751]
Hispanic Teacher x Teacher-Specific		0.0593	0.2646
Mean Percent Hispanic Students		[0.0985]	[0.1717]
Teacher-Specific Mean Math Score		-0.0007	-0.0007

		[0.0003]***	[0.0003]**
Teacher-Specific Mean Discipline Incidents Per Student		0.0190 [0.0093]**	0.0439 [0.0127]***
Teacher-Specific Mean Percent Limited English Proficiency Students		0.0852 [0.0524]	0.0840 [0.0580]
Teacher-Specific Mean Percent Black Students		0.0916 [0.0577]	0.1043 [0.0895]
Teacher-Specific Mean Percent Hispanic Students		-0.0934 [0.0671]	-0.1066 [0.0987]
Teacher-Specific Mean Percent Gifted Students		0.1059 [0.0721]	0.0793 [0.0734]
Teacher-Specific Mean Percent Special Education Students		0.0099 [0.0599]	-0.0043 [0.0605]
Teacher-Specific Mean Percent Free-Lunch Students		0.0972 [0.0499]*	0.0178 [0.0778]
Observations	75,474	56,150	56,091
Pseudo R2	0.0540	0.0559	0.0564

NOTES: Dependent variable equals one if a teacher has left teaching between school year 2000-01 and 2001-02. Robust standard errors corrected for clustering at the school level are in brackets (* significant at 10%; ** significant at 5%; *** significant at 1%). All models include school district (county) fixed effects.

Table 5. Probit Estimates of the Determinants of the Probability a Teacher Leaves the Florida Public Schools, 2001/2002 – 2002/2003 (Teachers with Five or Fewer Years of Experience)

	(1)	*(2)*	*(3)*
Teacher's Age	0.0033	0.0019	0.0016
	[0.0019]*	[0.0022]	[0.0022]
Male Teacher	0.01625	0.01168	0.01435
	[0.05060]	[0.05302]	[0.05352]
Black Teacher	0.0838	0.0773	0.0554
	[0.0913]	[0.1080]	[0.1087]
Hispanic Teacher	-0.2779	-0.4006	-0.3678
	[0.1197]**	[0.1490]***	[0.1507]**
Teacher Holds Advanced Degree	0.0263	-0.0189	-0.0193
	[0.0820]	[0.0942]	[0.0943]
Certified Teacher	-0.0815	-0.0517	-0.0482
	[0.0430]*	[0.0497]	[0.0496]
High School Teacher	-0.0198	-0.1778	-0.0988
	[0.0808]	[0.0774]**	[0.0884]
Special Education Teacher	0.0596	-0.1688	-0.1203
	[0.0556]	[0.1599]	[0.1587]
Middle School Teacher	0.0303	-0.0701	-0.0210
	[0.0634]	[0.0654]	[0.0675]
High School Math Teacher	-0.1975	-0.2046	-0.1875
	[0.1149]*	[0.1225]*	[0.1218]
Middle School Math Teacher	-0.3819	-0.3425	-0.3425
	[0.1227]***	[0.1226]***	[0.1229]***
Log of Teacher Salary	-0.0439	0.1124	0.1235
	[0.0789]	[0.1087]	[0.1125]
School Size	-0.0001		-0.0001
	[0.0000]**		[0.0000]
School-Level Mean Math Score	-0.0004		-0.0005
	[0.0015]		[0.0018]
School-Level Mean Discipline	-0.0232		-0.0845
Incidents per Student	[0.0408]		[0.0561]
School-Level Percent Free-Lunch Students	-0.1029		0.0546
	[0.1746]		[0.2879]
School-Level Percent Black Students	0.4284		0.0691
	[0.1774]**		[0.3080]
School-Level Percent Hispanic	0.2053		0.3899
Students	[0.2190]		[0.3599]
Black Teacher x School-Level	0.0120		0.2380
Percent Black Students	[0.1739]		[0.4411]
Hispanic Teacher x School-Level	0.6342		-0.3046
Percent Hispanic Students	[0.2604]**		[0.4990]
Teacher-Specific Mean Class Size		-0.0008	-0.0006
		[0.0009]	[0.0007]
Black Teacher x Teacher-Specific		0.0337	-0.1498
Mean Percent Black Students		[0.1889]	[0.4087]
Hispanic Teacher x Teacher-Specific		0.8666	1.0214
Mean Percent Hispanic Students		[0.2642]***	[0.4238]**
Teacher-Specific Mean Math Score		-0.0001	-0.0002
		[0.0008]	[0.0008]

Teacher-Specific Mean Discipline Incidents		0.0168	0.0536
Per Student		[0.0247]	[0.0293]*
Teacher-Specific Mean Percent Limited		0.2368	0.2726
English Proficiency Students		[0.1510]	[0.1628]*
Teacher-Specific Mean Percent Black		0.3436	0.3096
Students		[0.1629]**	[0.2444]
Teacher-Specific Mean Percent Hispanic		-0.1479	-0.3140
Students		[0.2014]	[0.2807]
Teacher-Specific Mean Percent Gifted		0.0690	-0.0005
Students		[0.2545]	[0.2581]
Teacher-Specific Mean Percent Special		0.1568	0.1382
Education Students		[0.1962]	[0.1961]
Teacher-Specific Mean Percent Free-Lunch		0.0856	-0.0679
Students		[0.1592]	[0.2465]
Observations	17,832	13,249	13,241
Pseudo R2	0.0582	0.0764	0.0780

NOTES: Dependent variable equals one if a teacher has left teaching between school year 2000-01 and 2001-02. Robust standard errors corrected for clustering at the school level are in brackets (* significant at 10%; ** significant at 5%; *** significant at 1%). All models include school district (county) fixed effects.

Table 6. Probit Estimates of the Determinants of the Probability a Teacher Leaves the Florida Public Schools, 2001/2002 – 2002/2003 (Teachers with College Entrance Exam Information)

	(1)	*(2)*	*(3)*
Teacher's Age	0.0177	0.0185	0.0184
	[0.0065]***	[0.0082]**	[0.0081]**
Male Teacher	0.14978	0.16608	0.16929
	[0.13842]	[0.15171]	[0.15540]
Black Teacher	0.3435	0.2312	0.2892
	[0.2899]	[0.4381]	[0.4311]
Hispanic Teacher	-0.4229	-0.3448	-0.5106
	[0.3051]	[0.3461]	[0.3548]
Teacher Holds Advanced Degree	-0.1258	-0.3034	-0.3458
	[0.3395]	[0.4402]	[0.4188]
Certified Teacher	-0.2915	-0.1139	-0.1400
	[0.1220]**	[0.1506]	[0.1522]
High School Teacher	-0.1419	-0.1988	-0.0836
	[0.2005]	[0.2491]	[0.2609]
Special Ed. Teacher	0.1178	-0.6074	-0.5608
	[0.1494]	[0.4173]	[0.4176]
Middle School Teacher	-0.0651	-0.2256	-0.1983
	[0.1914]	[0.2033]	[0.2080]
High School Math Teacher	-0.0863	-0.1953	-0.1745
	[0.3214]	[0.3349]	[0.3366]
Middle School Math Teacher	-0.2612	-0.0234	0.0032
	[0.3317]	[0.3230]	[0.3193]
Log of Teacher Salary	0.2824	0.5113	0.6835
	[0.2798]	[0.5831]	[0.6271]
Teacher's SAT Score	0.0003	0.0007	0.0007
	[0.0003]	[0.0004]	[0.0004]
School Size	-0.0001		-0.0002
	[0.0001]		[0.0001]
School-Level Mean Math Score	0.0026		0.0041
	[0.0033]		[0.0051]
School-Level Mean Discipline	0.0804		0.0853
Incidents per Student	[0.1153]		[0.1460]
School-Level Free Lunch Eligibility	0.4509		-0.5803
	[0.4258]		[0.8422]
School-Level Percent Black	0.6171		1.6712
Students	[0.4290]		[0.8273]**
School-Level Percent Hispanic	-0.5230		-1.0410
Students	[0.5694]		[1.2554]
Black Teacher x School-Level	-0.5377		-0.4222
Percent Black Students	[0.5184]		[1.6637]
Hispanic Teacher x School-Level	1.4903		1.8675
Percent Hispanic Students	[0.6153]**		[1.5147]
Teacher-Specific Mean Class Size		-0.0007	-0.0006
		[0.0024]	[0.0021]
Black Teacher x Teacher-Specific		-0.3178	-0.0383
Percent Black Students		[0.6751]	[1.5907]
Hispanic Teacher x Teacher-Specific		1.5459	0.2409
Percent Hispanic Students		[0.6938]**	[1.3352]

Teacher-Specific Mean Math Score		0.0019	0.0014
		[0.0030]	[0.0030]
Teacher-Specific Discipline Incidents		0.1043	0.0898
		[0.0528]**	[0.0584]
Teacher-Specific Percent Limited		-0.2847	-0.6683
English Proficiency Students		[0.4882]	[0.5917]
Teacher-Specific Percent Black		0.2964	-0.7786
Students		[0.4274]	[0.7155]
Teacher-Specific Percent Hispanic		-0.6445	0.2683
Students		[0.6525]	[0.9787]
Teacher-Specific Percent Gifted		-2.0279	-2.5293
Students		[1.7379]	[1.7797]
Teacher-Specific Percent Special		0.3992	0.4173
Education Students		[0.5239]	[0.5157]
Teacher-Specific Percent Free-Lunch		0.8556	1.0939
Eligibility		[0.4353]**	[0.7038]
Observations	2103	1301	1301
Psudo R2	0.0872	0.1258	0.1456

NOTES: Dependent variable equals one if a teacher has left teaching between school year 2000-01 and 2001-02. Robust standard errors corrected for clustering at the school level are in brackets (* significant at 10%; ** significant at 5%; *** significant at 1%). All models include school district (county) fixed effects.

Table 7. Probit Estimates of the Determinants of the Probability that a Public School Teacher Exits (Florida Teachers and Teachers Nationwide)

	(1) U.S. (SASS Data)	*(2) U.S. (SASS Data)*	*(3) U.S. (SASS Data)*	*(4) Florida (FL-EDW)*
Teacher's Age	0.0099	0.0142	0.0160	0.0053
	[0.0038]**	[0.0043]***	[0.0045]***	[0.0011]***
Male Teacher	-0.09518	-0.10489	-0.11650	0.02899
	[0.08884]	[0.08290]	[0.08928]	[0.01656]*
Black Teacher	0.3055	-0.0320	0.2662	-0.0016
	[0.2333]	[0.1395]	[0.2800]	[0.0337]
Hispanic Teacher	0.2249	-0.3383	0.0237	-0.0790
	[0.3149]	[0.2036]	[0.2967]	[0.0447]*
Teacher Holds Advanced Degree	0.1679	0.2712	0.2566	0.2980
	[0.0737]**	[0.0957]***	[0.0892]***	[0.0348]***
Certified Teacher	-0.3319	-0.4009	-0.4094	-0.3629
	[0.1251]***	[0.1534]**	[0.1697]**	[0.0233]***
High School Teacher	0.2778	0.1254	0.2681	0.0096
	[0.0833]***	[0.0932]	[0.1018]**	[0.0245]
Middle School Teacher	-0.1464	-0.2655	-0.1337	0.0206
	[0.1760]	[0.2109]	[0.2340]	[0.0234]
Special Education Teacher	0.0865	0.5445	0.6272	-0.0375
	[0.2158]	[0.4180]	[0.3476]*	[0.0355]
High School Math Teacher	0.0469	0.0253	0.0144	0.0215
	[0.1439]	[0.1445]	[0.1519]	[0.0323]
Middle School Math Teacher	0.6304	0.5869	0.7890	-0.0586
	[0.5021]	[0.5087]	[0.5428]	[0.0377]
Log of Teacher Salary	0.0994	-0.0804	-0.0865	-0.7600
	[0.1576]	[0.1678]	[0.1884]	[0.0682]***
School Size	-0.0001		-0.0001	-0.0000
	[0.0001]		[0.0001]	[0.0000]
School-Level Percent Limited English Proficiency Students			0.0107 [0.0077]	0.0789 [0.1341]
School-Level Percent Free Lunch Students	-0.0015 [0.0019]		-0.0030 [0.0024]	0.1112 [0.0534]**
School-Level Percent Black Students	0.0021		0.0021	0.1483
	[0.0026]		[0.0026]	[0.0604]**
School-Level Percent Hispanic Students	-0.0059		-0.0099	-0.0182
	[0.0031]*		[0.0041]**	[0.0832]
Black Teacher x School-Level Percent Black Students	-0.0076 [0.0045]*		-0.0054 [0.0049]	0.0049 [0.0724]
Hispanic Teacher x School-Level Percent Hispanic Students	0.0026 [0.0070]		-0.0036 [0.0066]	0.0781 [0.0911]
Teacher-Specific Mean Class Size		0.0032	0.0088	-0.0004
		[0.0043]	[0.0051]*	[0.0002]
Teacher-Specific Mean Percent Special Education Students		-0.0047 [0.0039]	-0.0045 [0.0030]	0.0828 [0.0394]**
Teacher-Specific Mean Percent Limited English Proficiency Students		0.0026 [0.0026]	0.0043 [0.0035]	0.0363 [0.0406]
Observations	4156	4156	4156	76226

NOTES: Robust standard errors corrected for clustering at the school level are in brackets (* significant at 10%; ** significant at 5%; *** significant at 1%). For SASS data, schools are classified into three categories: elementary school, secondary school, and combined school while FL-EDW schools are classified into three categories: elementary school, middle school, and high school. Models using SASS data include state fixed effects while the model using Florida data includes school district (county) fixed effects.

Appendix 1. Variable Names and Definitions

Variable Names	*Definition*
Leaver	Dummy variable equal to one if the teacher has left Florida public school system in year 2002-2003
Age	Teacher's age in 2001
Male Teacher	Dummy variable equal to one if the teacher is male
Black Teacher	Dummy variable equal to one if the teacher is non-Hispanic Black
Hispanic Teacher	Dummy variable equal to one if the teacher is Hispanic
Certified Teacher	Dummy variable equal to one if the teacher is certified in teaching
Advanced Degree	The teacher holds a masters degree or above
High School Teacher	Dummy variable equal to one if the teacher is a high school teacher
Middle School Teacher	Dummy variable equal to one if the teachers is a middle school teacher
High School Math Teacher	Dummy variable equal to one if the teacher is a high school math teacher
Middle School Math Teacher	Dummy variable equal to one if the teacher is a middle school math teacher
Log of Salary	Teacher base year salary in log terms
School Size	School enrollment
School Level Math Score	School average student performance on the math portion of the Sunshine State Standards
School Level Disciplinary Incidents	School average number of disciplinary incidents per student
School Level Free Lunch	Percentage of students eligible for free and reduced lunch program
School Level Percent Black	Percent of Black students at a school
School Level Percent Hispanic	Percentage of Hispanic students at a school
Hispanic Teacher x School Level Percent Hispanic	The interaction term between Hispanic teacher and percent of Hispanic students
Black Teacher x School Level Percent Black	The interaction term between black teacher and percent of black students
Teacher-Specific Mean Class Size	Number of Students per Class averaged over all classes taught during October 2001
Teacher-Specific Mean Math Test Score	Class mean student performance on the math portion of the Sunshine State Standards test averaged over all classes a teacher taught during October 2001
Teacher-Specific Mean Disciplinary Incidents per Student	Class mean discipline incidents per student averaged over all classes a teacher taught during October 2001
Teacher-Specific Mean Percent Free-Lunch Students	Class-level percentage of students eligible for free and reduced lunch program averaged over all classes a teacher taught during October 2001
Teacher-Specific Mean Percent Black Students	Class-level percent black students averaged over all classes a teacher taught during October 2001
Teacher-Specific Mean Percent Hispanic Students	Class-level percent Hispanic students averaged over all classes a teacher taught during October 2001
Hispanic Teacher x Teacher-Specific Mean Percent Hispanic Students	The interaction term between Hispanic teacher and percent of Hispanic students at class level
Black Teacher x Teacher-Specific Mean Percent Black Students	The interaction term between black teacher and percent of black students at class level
Teacher-Specific Percent Limited English Proficiency Students	Class-level percent of students with Limited English Proficiency averaged over all classes a teacher taught during October 2001
Teacher-Specific Percent Gifted Students	Class-level percent of students classified as gifted averaged over all classes a teacher taught during October 2001
Class Level Percent Special Education Students	Class-level percent exceptional education students (excluding gifted students) averaged over all classes a teacher taught during October 2001