Why Public Schools Lose Teachers

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ABSTRACT

Many school districts experience difficulties attracting and retaining teachers, and the impending retirement of a substantial fraction of public school teachers raises the specter of severe shortages in some public schools. Schools in urban areas serving economically disadvantaged and minority students appear particularly vulnerable. This paper investigates those factors that affect the probabilities that teachers switch schools or exit the public schools entirely. The results indicate that teacher mobility is much more strongly related to characteristics of the students, particularly race and achievement, than to salary, although salary exerts a modest impact once compensating differentials are taken into account.

I. Introduction

Issues of teacher shortages have pervaded policy discussions for decades. Although the exact nature of the concerns—lack of trained teachers in specific subjects such as math or science, recruiting difficulties in urban centers, or elements of quality such as availability of fully certified teachers—has varied over time and

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across locations, the perceived need to act has not. In response, educators have offered a variety of compensation policies designed to attract more teachers into the profession and to retain more of those currently teaching. These include higher pay (typically across the board but sometimes targeted on specific communities or subjects), forgiveness of student loans in exchange for a commitment to teach (often in difficult to staff schools), housing reserved for teachers, and the expansion of alternative certification. The efficacy of any of these strategies depends crucially on the responsiveness of supply, and, as we demonstrate below, must be evaluated in terms of other powerful forces operating in teacher labor markets.

The lack of a comprehensive understanding of the determinants of teacher labor supply is a basic impediment to the development of effective teacher labor market policies. Teacher labor supply aggregates a variety of decisions made at different points in time based on different information and influences. The pre-teaching phase typically begins with a decision to train for teaching and with successful completion of teacher preparation and certification (or at least enough schooling to qualify for an emergency license). It then moves to the application and job matching process. Having been hired at a particular school, the career path is determined by continuation and retention decisions of both teachers and schools. These latter transitions relate much more directly to the circumstances and policies of specific schools and districts and are the focus of this paper.[1]

A number of papers including Murnane and Olsen (1989,1990) and Dalton and van der Klaauw (1995, 1999) have examined the link between duration in teaching and pay. These studies generally find that higher teacher pay reduces the probability that teachers leave the profession, particularly once differences in alternative earnings opportunities are taken into consideration.

One potential problem for these studies is the limited amount of information on working conditions that may be correlated with salary. While Murnane and Olsen attempt to account for differences in working conditions by including demographic information on school districts from U.S. Census data, the lack of direct information on public school students, availability of only a single year of data on student characteristics and other limitations inhibit the analysis of these factors. Not only does the lack of good information on student and school characteristics (such as class size) potentially bias the estimated effects of salary, it also masks the association between student characteristics and transitions.

We make use of matched student/teacher panel data on Texas public elementary schools to gain a better understanding of the ways that salary and other school factors affect teacher transitions. These data permit a detailed description of student demographic and school characteristics and pre- and post-move comparisons for teachers who switch public schools within Texas or leave the Texas public schools. Given the large number of teachers and teacher transitions in the data, we can divide teachers on the basis of experience, community type, ethnicity, gender, and other factors and examine differences in the responsiveness to salary and student characteristics for meaningful subcategories of teachers.

1. While many more teachers are certified each year than are needed to fill vacancies, the pre-teaching phase is important for consideration of some specialties such as the current shortages in advanced math and science, in special education, and in bilingual education. The policy discussions in these areas generally

From detailed longitudinal observations of teacher labor markets, we provide a new and richer picture than was previously possible of how transitions vary by teacher characteristics and their interactions with school and district factors. In particular, we provide a unified treatment of the interrelated decisions to switch schools or to exit public school teaching and are able to relate these transition decisions to aspects of sending schools and, in the case of switches, aspects of receiving schools and districts. Moreover, the detailed administrative data permit development of much more accurate information about salary *schedules*; most prior work has been unable to distinguish between a teacher's position on the schedule and variations in the schedule itself.

The results show that teacher transitions are much more strongly related to student characteristics than to salary differentials, and this is especially true for female teachers. Schools serving large numbers of academically disadvantaged, black or Hispanic students tend to lose a substantial fraction of teachers each year both to other districts and out of the Texas public schools entirely. An implication is that the supply curve faced by these districts differs markedly from that faced by middle and upper middle class communities in which a far lower proportion of teachers seek to improve their employment arrangement by switching to another public school.

To be sure, important questions about teacher labor markets remain, and we are still not certain that we have completely separated the decisions of teachers from those of the school districts. The available information provides a number of insights about the transition patterns but does not permit us to identify fully the district and teacher decision functions. Most importantly, teacher performance—as distinct from the objective characteristics included in administrative records—cannot be directly related to the observed labor market transitions. We discuss below how the current analysis and results can be extended to incorporate differences in teacher quality.

II. Determinants of Teacher Mobility

What determines the composition of the teaching force and the distribution of those teachers among schools? Answering this question would require detailed knowledge of the preferences and alternative opportunities of potential and current teachers and of the personnel policies of all schools and districts, a clearly daunting set of requirements. Because of shortcomings in our ability to model the decisions of schools and prospective teachers and severe data limitations, we are unable to trace out the entire process. Rather we take as given the prior decisions that led teachers to enter the profession and to choose a specific school and concentrate on subsequent decisions to change schools or to exit teaching.[2]

concentrate on issues of overall salary levels and of requirements for certification (for example, Murnane et al. 1991; Hanushek and Pace 1995).

2. Note, however, that initial choices could have lasting impacts. For example, Boyd et al. (2002) find that teachers tend to enter teaching careers at schools that are geographically very close to the high school they attended. If these preferences remain over time, it would lessen the effect of salaries and other characteristics on moves.

Consider a stylized one period school choice problem. From currently teaching in district d^*, individual i chooses school d from among the feasible opportunities in order to maximize the present value of expected utility such that:

$$(1)\quad \max_{d} pv[u^i(X_d, Z_i)]$$
$$\text{given } d \in \{d\}_i \text{ and}$$
$$c_d = c(z_i\ d^*)$$

where X are characteristics of the job in school d; Z captures other individual factors including family characteristics; $\{d\}_i$ describes the feasible set of districts at which i can obtain a job; and c_d traces moving costs for a move from $d^* \rightarrow d$ that depend in part on personal characteristics. At any point in time, the set of options might be small or include only the option outside of teaching, $d = 0$. If this problem is updated, say annually, the teacher recalculates Equation 1 based on a comparison of the costs of changing jobs and the difference in present value of utility at the current district, d^*, compared to other feasible districts (and alternatives outside of teaching).

Now consider a group of job changers who leave district d^* for other districts or for nonteaching alternatives. If, as is commonly understood, few teachers are involuntarily separated from their district, then it is usually the case that the expected utility gain of the move is sufficient to overcome costs. A detailed consideration of the various elements of the decision problem puts previous work into a more general context and frames our extensions to existing analyses.

The central focus of this work is the influence of job characteristics, X_d, so we begin with that. Next we consider how the choice set of alternative opportunities affects choices. Third we describe the role played by school personnel policies. Finally we discuss the importance of heterogeneity in preferences and skills among teachers.

A. Job characteristics—X_d

Job characteristics involve two key dimensions:

$$(2)\quad X_d = f(w_d, WC_d)$$

where w_d and WC_d are salaries and working conditions, respectively, in district d. While salaries are set at the district level, working conditions vary both within and between districts.

A fundamental issue in an analysis of teacher pay is which salary differences to look at and how they should be interpreted.[3] At any point in time, wages will vary across teachers within a district, reflecting different components of teacher salary contracts including experience, graduate education levels, coaching, additional duties, and a variety of other factors. Systematic observation of these wage differences provides information about movements along a supply schedule but not about movements in the entire salary schedule. Much of the analysis of achievement effects of salaries, for example, has considered differences in wages along a salary schedule or combined movements along schedules with changes in the overall salary structure

3. Fringe benefits are an important and growing share of compensation, and differences in the generosity of benefits is certainly not perfectly correlated with salary differences. Unfortunately, we, like all past researchers, lack information on fringe benefits.

(Hanushek 1977), while much of the policy debate focuses on the level of the entire salary schedule.[4]

We construct annual salary schedules for single years of experience in each district (over only teachers who do not have a graduate degree), which allow us to isolate the effects of both cross-sectional and intertemporal variations in overall salary levels.[5] Our analysis also provides preliminary information about possible effects of different slopes of the district salary schedule with respect to experience.

Much has been made of the fact that there is more to a teaching job than just the overall salary or compensation level. Some of the earliest work considered how teacher preferences might affect the selection of schools (Greenberg and McCall 1974; Murnane 1981). More generally, teachers might be willing to take lower salaries in exchange for better working conditions, a proposition first found in Antos and Rosen (1975) and subsequently pursued in a variety of other analyses (for example, Chambers 1977; Baugh and Stone 1982; Hanushek and Luque 2000). Some have interpreted the push for lower class sizes by teachers as reflecting an element of teacher compensation as opposed to an educational policy designed to improve student achievement (compare with Grissmer and Kirby 1992).

If differences in working conditions are not accounted for and if they are correlated with salaries, estimates of the relationship between teacher transitions and salaries will confound salary influences with those of other factors that affect teacher labor supply. For example, if salaries are higher in urban districts and teachers prefer suburban districts, estimates of teacher salary effects on labor supply confound the impacts of salary and community type unless adequate controls for community type are included. Loeb and Page (2000) in fact argue that the failure to account for differences in working and labor market conditions explains why many studies fail to identify the true relationship between salaries and student performance.

A central element of the empirical analysis here is the description of movements of teachers across different types of schools and student populations in order to study the preferences of teachers and the form in which compensating wage differentials are played out. Though it does not consider all potential aspects of working conditions, this analysis includes four measures of student characteristics that are likely related to teacher labor supply: percent low income, percent black, percent Hispanic, and average student achievement score.[6] Whether these specific characteristics directly affect teacher decisions or they serve as proxies for other factors cannot be determined. Regardless, the resulting estimates will identify those schools that experience the greatest difficulties in teacher labor markets.

B. Alternative opportunities—$\{d\}_i$

Another important determinant of the probability that a teacher chooses a specific school is the choice set of alternative opportunities both within and outside of the

4. There has also been a substantial amount of discussion about the use of teacher pay as a direct incentive for better performance (see Cohen and Murnane 1986 and Hanushek et al. 1994 for discussions of merit pay). There is little evidence of systematic variation in salaries based on performance in Texas schools, although a number of districts have considered such policies.

5. We have focused on salaries of teachers without post-bachelor schooling, because less than one third of Texas elementary school teachers possess a master's degree.

6. Unfortunately, data on other aspects of schools such as disciplinary actions or police incidents are unavailable.

public schools $\{d\}_t$. It has long been recognized that one must account for differences in alternative opportunities for teachers. This necessity is easiest to see in consideration of differential competition for specific teachers, say math and science teachers versus those in other specialties (for example, Kershaw and McKean 1962; Zarkin 1985; Murnane et al. 1991). It also comes into play in determining the districts that form the relevant decision set. If areas differ by prices or amenities or if labor markets are geographically confined, salaries must be considered in comparison to the relevant group of competing districts. This point, made by Chambers (1977) and Ferguson (1991), provides information on the specification of the wage and compensation comparisons. Important elements of the overall market factors are also highlighted in Flyer and Rosen (1997) and Boardman, Darling-Hammond, and Mullin (1982).

Existing empirical studies support the belief that alternative earnings opportunities affect teacher labor supply. In a series of papers, Dolton and van der Klaauw (1995, 1999) investigate the impact of alternative opportunities on teacher transitions. They find evidence that opportunity wages affect the probabilities of both entry and exit. These results are consistent with earlier work by Murnane and Olsen (1989, 1990), which found that opportunity wages affected duration in teaching in both Michigan and North Carolina.

In this paper, differences in alternative wage opportunities are accounted for in a very general way by the inclusion of dummy variables for each Texas Education Agency defined region of Texas, which implicitly removes overall region wages both inside and out of teaching. Our district salaries are therefore compared to those in other districts within the same local labor market. Because most teachers in our data possess at least a B.A. and teach elementary school age children, additional differences in alternative opportunities such as those considered by Dolton and van der Klaauw (1995) should not be very important in this analysis.

C. School personnel policies

District hiring and retention practices are an important element in the teacher labor market. This point has been made forcefully in a set of analyses (Ballou and Podgursky 1995, 1997 and Ballou 1996) that highlight the fact that the observed distribution of teachers reflects the decisions of districts as well as those of teachers. Perhaps most important, the authors raise doubts that schools systematically hire the most well-qualified applicants. Yet, the finding that higher salaries or better working conditions do not systematically raise the quality of measured teaching does not imply that these factors do not enter into teacher labor supply.

In terms of our analysis, the fact that we do not know whether a transition is initiated by a teacher or by a district affects the interpretation of the results. Since it is doubtful that pay increases or improvements in nonpecuniary factors would be as large for involuntary as for voluntary job changers, the changes in these observed characteristics for school changers should understate the gains of those who actively choose to change schools. Similarly, because the link between the probability of quitting and salaries should be more negative than that between the probability of being involuntary separated and salaries, the estimated link between quitting and salaries should underestimate the supply relationship.

To address these issues, we consider changes in transitions over time for individual districts. By introducing district fixed effects into the analysis of teacher adjustments, we eliminate district policies that are constant over our sample period. Thus, as long as any policy changes do not coincide with changes in salaries and other characteristics, we can obtain estimates of the supply responses.

D. Heterogeneity of Teacher Preferences—Z_i

It is important to recognize that the observed transitions depend upon the distributions of both teacher preferences and school policies in Texas public schools. For example, as a teacher gains more experience, the time to accumulate the gains from any move falls. Further the potential gains are frequently limited by restrictions on the transferability of experience credit across districts, affecting salary and other attributes of the job. Finally, heterogeneity in preferences and moving costs among teachers arises from differing family circumstances such as family structure, the job opportunities of a spouse, a desire to stay home with young children, absence or presence of home ownership or preferences for a specific location.[7] Any impact of salary on teacher decisions would then be a weighted sum of the reactions of teachers in different circumstances. As a simple example, consider a world in which single teachers make "independent" decisions and married teachers make "family-dependent" decisions. If teachers making "independent" decisions respond much more strongly to differences in salary than teachers making "family dependent decisions" for whom the costs of moving are likely to be much higher and if "family-dependent decisions" are more frequent for females than males, the average wage responsiveness for females should be less than that for males.

Unfortunately, we have no information on family structure, income other than salary, the location or type of housing, or whether and where a spouse works. Nonetheless, we can stratify teachers by gender, race/ethnicity, and years of teaching experience in order to control for much of the heterogeneity. Considerable heterogeneity undoubtedly remains—particularly that arising from joint family location decisions-but the observed transitions do provide important information on the choices made by clearly identified groups of teachers.

III. The Texas Database

The ability to understand the character and outcomes of teacher labor market activities derives from the unique database developed under the UTD Texas

7. Most direct analyses of teacher decisions have been based on administrative data of schools and have had relatively little data on family circumstances of teachers. Interestingly, while Boyd et al. (2002) rely on administrative data, they can link teacher location to where the teachers themselves went to high school. They find, for example, that most teachers accept jobs close to their own schooling location, regardless of where they go to college.

An alternative approach, using a national survey of workers in the labor market, finds that the majority of exiting female teachers do so to leave the labor market altogether (Stinebrickner 2001, 2002). Interestingly, this analysis also suggests that teachers are less likely to change jobs or occupations in early career than are nonteachers. These analyses, however, are based on data for the high school class of 1972 (NLS72) with teaching experiences for the late 1970s and early 1980s, and more recent observations are not available.

Schools Project. Working with the Texas Education Agency (TEA), this project has combined different data sources to create matched panel data sets of students and teachers. The panels include all Texas public school teachers and students in each year, permitting accurate descriptions of the schools of each teacher's employment.

The Public Education Information Management System (PEIMS), TEA's statewide educational database, reports key demographic data including race, ethnicity, and gender for both students and teachers as well as student eligibility for a subsidized lunch. PEIMS also contains detailed annual information on teacher experience, salary, education, class size, grade, population served, and subject. Importantly, this database can be merged with information on student achievement by campus, grade, and year (although actual student-teacher matches are not available). Beginning in 1993, the Texas Assessment of Academic Skills (TAAS) was administered each spring to eligible students enrolled in grades three through eight.[8] These criterion referenced tests, which assess student mastery of grade-specific subject matter, are merged with the student and teacher information.[9]

The teacher microdata for the years 1993 to 1996 were used to construct empirical salary schedules for the first ten single years of experience for each school district. These identify shifts in entire salary schedules over time. These schedules are based on regular pay for teachers without advanced degrees and exclude extra pay for coaching or other activities.[10] The detailed panel data for each district and for individual teachers permit an unusual opportunity to address concerns about measurement error.[11]

IV. Teacher Mobility, Salaries, and Student Demographics

This section begins with a description of teacher transitions within districts, between districts, and out of teaching. It considers all teachers combined

8. Many special education and limited English proficient students are exempted from the tests. In each year roughly 15 percent of students do not take the tests, either because of an exemption or because of repeated absences on testing days.

9. Reading and math tests each contain approximately 50 questions, although the number of questions and average percent correctly answered varies across time and grades. We transform all test results into standardized scores with a mean of zero and variance equal to one for each grade and year. Thus, our achievement measures describe students in terms of their relative position in the overall state performance distribution.

10. More than 85 percent of teachers receive no extra pay, and the median extra pay for those who receive it is roughly $1,000 per year.

11. The panel data enable us to detect and correct errors in ways not generally possible in prior work. We employ median salaries because of concerns about coding errors leading to extreme values in salary. Further, we examined each district that experienced nominal median salary decreases either over time at any level of experience or across higher experience categories in any given year. We excluded individual teachers whose salary observations appeared to be unreflective of base salaries, but, if we were unable to detect obvious errors in those instances, we coded the district/experience/year cell as missing. There was also substantial error in the teacher experience variable, exemplified by inconsistencies in reported experience for individual teachers tracked annually. When a single year did not conform to an otherwise consistent string for an individual teacher, we corrected the reported experience for that year. Error was also introduced by inconsistencies in district adjustments for part time teachers, and obvious mistakes were corrected. The cells for graduate degrees and for years of experience above ten become too thin in many districts to provide reliable salary information.

Table 1
Year-to-year Transitions of Teachers by Experience, 1993–96

Teacher Experience	Percent Of Teachers Who				Number Of Teachers
	Remain In Same School	Change Schools Within District	Switch Districts	Exit Texas Public Schools	
0–2 years	73.6	7.5	9.3	9.6	73,962
3–5 years	77.7	7.2	6.6	8.5	56,693
6–10 years	82.4	6.8	4.5	6.3	75,284
11–30 years	86.9	5.7	2.5	4.9	165,873
>30 years	77.0	4.0	0.7	18.3	6,978
All	81.8	6.5	4.8	6.9	378,790

and divisions by experience and community type. Next the analysis describes changes in salary and student demographic characteristics for those moving within and between districts. The final part of the section reports the results of regression analysis that seeks to isolate the separate contribution of each factor on the probabilities of switching schools and exiting the Texas public schools.

A. Teacher Transitions: 1993–96

A primary goal of our mobility analysis is to identify the importance of salary and other determinants of job attractiveness to potential movers. Each year large numbers of teachers move within or between districts or leave Texas public schools entirely. The fact that we have information about salaries and student characteristics for both the sending and receiving schools for each transition provides insight into the contributions of these factors to job change decisions.

Overall, 82 percent of teachers remain in the same school, while 7 percent exit Texas public schools, 6.5 percent change schools within districts, and 5 percent switch districts each year. This mobility is remarkably close to national averages, which show that 86 percent of all teachers remained in the same school, while 6.6 percent left teaching between 1994 and 1995 (U.S. Department of Education 2002). The similarity of Texas and U.S. rates holds even though our calculations for those exiting from Texas public schools combine people leaving teaching and those teaching either in private schools or outside of the state. Moreover, the rapid growth over this period of the Texas student population and the Texas economy in general would be expected to influence teacher movements.

Similar to job turnover patterns for the labor market as a whole, transitions differ sharply by teacher experience.[12] Table 1 indicates that mobility is much higher among probationary teachers (0–2 years of experience), who are almost twice as likely as

12. Stinebricker (2002) provides comparisons across occupations and finds that teacher job and occupational changes are below those elsewhere in the economy but that teachers are much more likely to exit entirely from the labor force.

prime age teachers (11–30 years experience) to exit Texas public schools and almost four times as likely to switch districts. As expected, mobility picks up again as teachers near retirement age, and almost one-fifth of teachers with over thirty years of experience leave the Texas public schools each year. The national patterns of mobility across experience categories follow a similar pattern to that in Texas.

The next table disaggregates the transitions of district switchers by origin and destination community type. Table 2 provides only weak support for the belief that teachers commonly leave urban districts for suburban positions, that is, that urban districts are a "training ground" for suburban districts. Though most urban teachers who switch districts do relocate to suburban schools, annually less than two percent of all teachers in large urban school districts switch to suburban districts. The absolute number moving into urban districts is moreover only slightly smaller than the number moving out, and that also holds for the subgroup of probationary teachers (bottom panel of Table 2).[13] Consistent with the aggregate data in Table 1, probationary teachers are more likely than older teachers to switch districts but a smaller portion of new teachers move from large urban districts than from each of the other types of districts.

Though not shown in the tables, probationary urban and suburban teachers are equally likely to remain in the same school as probationary suburban teachers (76 percent). Probationary urban teachers are one percentage point (roughly 10 percent) more likely to exit the Texas public schools.

The data about the relatively small movements from urban centers does not reflect a lack of openings for teachers in other districts. For example, suburban districts employed 9,042 first year teachers during the period 1994 to 1996 when, as shown in Table 2, only 2,042 (779 probationary) urban teachers switched districts. Thus, this does not appear to be a demand constrained outcome.

Movement from rural districts follows a very distinct pattern. The majority of movers go to a different rural district. Significantly fewer rural teachers move to urban districts than is the case for teachers initially in urban or suburban districts.

Though some of these transitions are driven by school administrator decisions, most appear to be initiated by teachers. A fundamental issue in the study of teacher labor markets is the importance of salary and other factors in determining the attractiveness of a specific teaching job. Tables 3, 4, and 5 report in increasing detail the relationship between pre-move and post-move salaries and student characteristics for teachers who switch schools and districts. Each table reports the average changes in characteristics for specific types of moves. For example, the average change in a characteristic (C) for teachers switching districts (from d^* to d) is

$$(3)\quad \Delta C_{d,d^*} = \overline{C_t^d - C_t^{d^*}}$$

where year t is the first year in the new district. In other words, ΔC is the change in characteristics between sending and receiving schools, where both are calculated in the year of the move.

The salary changes are computed by single years of experience. For example, the salary change for a teacher with four years of experience equals the district average

13. During this period the share of Texas teachers in urban districts increased, implying that the small net outflow of teachers from urban districts is not simply driven by changes in the distribution of teaching positions across community types.

Table 2
Destination Community Type for Teachers Changing Districts, by Origin Community Type and Teacher Experience Level

Origin Community	Percent of Teachers Who Move to				Number Teachers Changing Districts	Percent of origin teachers	Change in share of teachers 1993–96
	Rural	Large Urban	Small Urban	Suburban			
I. All teachers							
Large urban	22.6	11.7	8.4	57.4	2,040	3.0	-1.3%
Small urban	33.1	8.3	11.2	47.4	1,832	4.0	0.0%
Suburban	26.8	12.1	12.1	49.1	5,861	4.3	3.2%
Rural	65.9	4.5	7.2	22.4	8,491	6.6	-1.8%
II. Probationary teachers (0–2 years experience)							
Large urban	19.3	11.0	8.6	61.1	779	6.1	
Small urban	29.9	8.2	11.1	50.8	742	8.0	
Suburban	23.7	13.2	12.0	51.1	2,152	7.7	
Rural	61.2	5.2	7.4	26.2	3,210	13.3	

salary of fifth year teachers in the new district minus the district average salary of fifth year teachers in the old district, as calculated in the year of the change. Because consistent salary schedule information is only available for teachers with ten or fewer years of experience, all teachers with more experience are excluded from these tables. (Roughly three-fourths of teachers switching districts have fewer than 10 years of experience).

Table 3 reports change in salaries and district average student demographic characteristics for district switchers by experience and gender. The top panel indicates that on average probationary teachers who move improve their salaries relative to what they would have earned in the initial district. Men gain 1.2 percent in salary with a move, while women gain 0.7 percent.[14] The average salary gain for district switchers declines with experience for both women and men and is actually negative (roughly −0.1 percent) for women with three to nine years of experience.[15] The annual salary gain averaged across all movers with less than ten years of experience is slightly more than 0.4 percent of annual salary or roughly $100.

Because compensating differentials could conceal the true change in salary holding other factors constant, we attempt to control for other determinants of teacher labor supply. Log salary at each experience level is regressed on 19 region dummies, three community-type dummies, the district average achievement score, and the district average percentages of Black, Hispanic, and low income students.[16] The residuals from these regressions thus provide salary measures adjusted for differences in working conditions, amenities and local labor markets. Consistent with the existence of compensating differentials, the second row of Table 3 shows that average adjusted salaries increase by 25 percent more than raw salaries (0.5 percent versus 0.4 percent), though there is substantial variation in the pattern of results across experience and gender.

In contrast to the modest changes in salary, the bottom panel of Table 3 provides strong evidence that teachers systematically favor higher achieving, nonminority, nonlow-income students. The findings for achievement are the clearest and most consistent across gender and experience categories, showing that the district average achievement rises by roughly 0.07 standard deviations, or three percentile points on the state distribution, for the average mover. The percentages black, Hispanic and eligible for a subsidized lunch also decline significantly for movers. Although there is variation across experience categories, black and Hispanic compositions of districts decline by 2 and 4.4 percent, respectively, and the percent eligible for free or reduced lunch falls by almost 6 percent.

Importantly, the average changes of district movers mask considerable heterogeneity, some of which appears to be systematically related to origin and destination community types. For example, the strongest support for presence of compensating

14. As noted previously, because women are more likely to be married or have children than men of the same age, the smaller gains of women may reflect the fact that more transitions are precipitated by family considerations. However, we have no explicit information on reason for moving or family status.

15. We present the analysis in terms of teacher experience, but tenure within the district may also have separate implications for salary and other factors that affect satisfaction and mobility.

16. The achievement score is the average of math and reading scores. These regressions explain about 60 percent of the raw variance in log salaries, and the district student characteristics are significantly related to salaries. Standard errors in the tables have not been adjusted for the fact that these are residuals.

Table 3

Average Change in Salary and District Student Characteristics (and Standard Deviations) for Teachers Changing Districts, by Gender and Experience

	Men by Experience Class			Women by Experience Class			All Teachers
	0–2 Years	3–5 Years	6–9 Years	0–2 Years	3–5 Years	6–9 Years	0–9 Years
Base year salary (log)	0.012	0.007	0.006	0.007	-0.001	-0.001	0.004
	(0.003)	(0.003)	(0.004)	(0.001)	(0.001)	(0.002)	(0.001)
Adjusted salary[a] (log)	0.010	0.007	0.005	0.007	0.005	0.000	0.005
	(0.002)	(0.003)	(0.003)	(0.001)	(0.001)	(0.002)	(0.001)
District average student characteristics							
Average test score[b]	0.05	0.05	0.02	0.08	0.08	0.07	0.07
	(0.008)	(0.011)	(0.011)	(0.004)	(0.006)	(0.006)	(0.003)
Percent Hispanic	−4.8%	−3.4%	−2.4%	−4.8%	−4.6%	−3.9%	−4.4%
	(0.6%)	(1.0%)	(0.9%)	(0.3%)	(0.5%)	(0.5%)	(0.2%)
Percent Black	−0.7%	−0.9%	0.2%	−2.6%	−2.5%	−2.3%	−2.0%
	(0.4%)	(0.5%)	(0.5%)	(0.2%)	(0.3%)	(0.3%)	(0.1%)
Percent subsidized lunch	−4.7%	−3.8%	−2.6%	−7.0%	−5.8%	−5.5%	−5.8%
	(0.6%)	(0.9%)	(0.8%)	(0.3%)	(0.4%)	(0.5%)	(0.2%)

Notes: a. Adjusted salary is residual of log salary by district and experience level on 19 regional indicators, three community-type indicators, the district average test score, and the district average percentage black, Hispanic, and low income.

b. District average of mathematics and reading score on TAAS exams, normalized to mean zero and standard deviation one.

Table 4

Average Change in Salary and in District and Campus Student Characteristics (and Standard Deviations) for Teachers with 0-9 Years of Experience Who Change Districts, by Community Type of Origin and Destination District

	District Average Characteristics		Campus Average Characteristics	
	Large Urban to Suburban	Suburban to Suburban	Large Urban to Suburban	Suburban to Suburban
Base year salary (log)	−0.007	0.002	—	—
	(0.002)	(0.002)		
Adjusted log salary[a]	0.014	0.006	—	—
	(0.002)	(0.001)		
Average student characteristics				
Average test score[b]	0.35	0.10	0.34	0.13
	(0.01)	(0.01)	(0.02)	(0.01)
Percent Hispanic	−20.1%	−6.4%	−20.8%	−7.3%
	(0.7%)	(0.5%)	(1.3%)	(0.7%)
Percent Black	−14.4%	−3.2	−15.2%	−4.4%
	(0.5%)	(0.3%)	(1.1%)	(0.5%)
Percent subsidized lunch	−25.0%	−8.4%	−26.0%	−10.4%
	(0.7%)	(0.5%)	(1.2%)	(0.7%)

Notes: a. Adjusted salary is residual of log salary by district and experience level on 19 regional indicators, three community-type indicators, the district average test score, and the district average percentage black, Hispanic, and low income.

b. District average of mathematics and reading score on TAAS exams, normalized to mean zeroand standard deviation one.

differentials comes from teachers who move among urban and suburban districts. Table 4, which characterizes moves by different types, shows that teachers who move from large urban to suburban schools experience average nominal salary *losses* of 0.7 percent but average adjusted salary *increases* of 1.4 percent.[17] Similarly, the adjusted salary increase is three times as large as the raw salary increase for teachers who switch among suburban districts.

Similar to the pattern for salaries, Table 4 reveals dramatic changes in district average student characteristics for teachers who move from urban to suburban districts, including a 0.35 standard deviation (14 percentile) increase in average achievement and decreases in percentages black and Hispanic in the range of 14–20 percent-

17. The residual salaries control for interregional price differences but not for intraregional differences such as commonly observed housing price gradients. Thus, these estimates quite likely understate the fully compensated differences in salary.

age points.[18] Perhaps more surprising, teachers who move among suburban districts also experience similar, albeit smaller, changes in student characteristics than found in the urban-suburban moves: district average achievement rises by more than one tenth of a standard deviation, and the percentages Black, Hispanic, and eligible for a subsidized lunch all decline.

The right hand side of Table 4 calculates the changes in campus average student characteristics rather than district averages. Changes in campus characteristics provide information on the extent to which district switchers tend to move to schools in particular parts of the district achievement or student demographic distributions. There is little evidence that teachers who move from urban to suburban districts experience changes that exceed the differential between district averages. In other words, urban-suburban movers appear to retain their same relative position in the two districts.

On the other hand, teachers who move within urban districts experience a substantial increase in average achievement (0.11 standard deviations) and a decline in percent minority and percent eligible for a subsidized lunch (not shown). Those who choose to change schools within urban districts appear to seek out schools with fewer academically and economically disadvantaged students. These patterns are consistent with the frequently hypothesized placement of new teachers in the most difficult teaching situations within urban districts coupled with an ability to change locations as they move up the experience ranks (compare Raymond, Fletcher, and Luque 2001 and Raymond and Fletcher 2002).

An important question is whether teacher preferences differ systematically on the basis of race, ethnicity, or other factors. Table 5 shows distinct differences in the transition patterns of black and Hispanic teachers. Black teachers tend to move to schools with higher black enrollment shares than the schools they left, regardless of whether or not they change districts. On the other hand, the average change in percent Hispanic for Hispanic teachers is quite similar in direction and magnitude to the changes experienced by teachers as a whole.[19] In addition, the change in average test scores is much smaller for black and Hispanic teachers.

It is difficult to disentangle the possible underlying mechanisms for this race/ethnic pattern in mover outcomes. It may reflect differences in teacher preferences, it may emanate from very different preferences for factors related to race or ethnicity, or it may indicate aspects of school policies. For example, if there is extensive residential segregation and teachers prefer to work closer to where they live, blacks may rank predominantly black schools much more highly than Hispanic and white colleagues, other things equal. Of course differences by teacher ethnicity may not be driven entirely by teacher preferences. There is no way to quantify the extent to which district personnel policies contribute to the systematic differences observed in Table 5. For example, if school and district opportunities for black teachers were

18. We can also calculate changes in characteristics for within district moves. For example, on average achievement increases by 0.05 within districts. We do not concentrate on these because of our underlying emphasis on salary relationships compared to other factors.

19. We look at annual changes, but Kain and Singleton (1996) show that these moving patterns accumulate and interact with new hiring to produce significant differences in teacher characteristics for Black and white students, even across campuses within individual districts.

Table 5

Average Change in District and Campus Student Characteristics (and Standard Deviations) for Black and Hispanic Teachers with 0–9 Years of Experience who Change Campuses

	Between District Moves		Within District Moves	
	Black Teachers	Hispanic Teachers	Black Teachers	Hispanic Teachers
Average test score[a]	0.00	0.02	−0.01	0.01
	(0.03)	(0.01)	(0.02)	(0.01)
Percent Hispanic	−4.5%	−5.7%	−6.9%	−1.6%
	(1.7%)	(0.9%)	(1.2%)	(0.5%)
Percent Black	3.5%	−0.2%	5.7%	−0.9%
	(2.1%)	(0.4%)	(1.4%)	(0.3%)
Percent subsidized lunch	−2.6%	−5.4%	−2.9%	−3.8%
	(1.6%)	(0.8%)	(0.9%)	(0.6%)
Number of teachers	350	1,325	682	1,430

Note: a. District average of mathematics and reading score on TAAS exams, normalized to mean zero and standard deviation one.

dependent on their willingness to teach in schools with higher proportions of black students, patterns such as these could easily result. We return to this below.

To summarize the effects on students, Table 6 reports simple school average transition rates at different points in the distributions of school and district characteristics weighted by the number of teachers in a school. The table shows that teachers in schools in the top quartile of adjusted salaries are more than one percentage point less likely to switch districts and almost one percentage point less likely to exit Texas public schools than teachers in the bottom quartile schools in terms of adjusted salary.

The most dramatic differences in school transition rates are related to student achievement. Teacher transition rates for schools in the bottom achievement quartile are much higher than those in the top quartile. Almost 20 percent of teachers in the bottom quartile schools leave each year, while in the top quartile schools only slightly more than 15 percent leave, with the largest difference found in the probability of switching schools within a district. These differences imply that the lowest achieving students are more likely to have teachers new to the school and to the profession, and evidence from Texas strongly suggests that this will adversely affect achievement (Rivkin, Hanushek, and Kain 2001).[20]

20. Note that a portion of the observed differential could reflect the fact that schools with a lot of teachers exiting tend to have more probationary teachers (who on average do worse in the classroom). The magnitude of these effects, however, is insufficient to lead to the overall results here (Rivkin, Hanushek, and Kain 2001).

Table 6

School Average Transition Rates by Distribution of Residual Teacher Salary and Student Demographic Characteristics (data weighted by number of teachers in school)

Quartile of Distribution	Probability Teachers Move to New School Within District	Probability Teachers Move to New District	Probability Teachers Exit Public Schools
Residual salary			
Highest	—	3.5%	7.3%
3rd	—	4.4%	7.3%
2nd	—	4.4%	7.0%
Lowest	—	4.7%	6.5%
Average test score			
Highest	5.2%	3.3%	6.9%
3rd	5.4%	4.3%	6.9%
2nd	6.1%	4.8%	7.0%
Lowest	6.9%	4.6%	7.9%
Percent eligible for reduced price lunch			
Highest	7.0%	4.2%	7.3%
3rd	5.7%	4.8%	7.3%
2nd	5.3%	4.8%	6.9%
Lowest	5.7%	3.2%	7.2%
Percent Black			
Highest	6.3%	4.5%	7.8%
3rd	5.7%	4.0%	7.0%
2nd	5.6%	3.6%	6.9%
Lowest	6.0%	5.0%	6.9%
Percent Hispanic			
Highest	6.8%	4.4%	7.1%
3rd	5.7%	4.5%	7.4%
2nd	5.9%	4.2%	7.2%
Lowest	5.3%	4.0%	6.9%

Note: The quartile divisions are calculated using the number of teachers as weights for the size of each school. Differences in average class sizes imply that these weights do not exactly capture enrollment differences, but data on enrollment were not available for all schools in all years.

B. Transition Regressions

The previous descriptive information on moves does not take into account the joint effects of the various influences, since district salaries and school characteristics tend to be correlated. Table 7 presents reduced form estimates for linear probability models of the probability of leaving a district (either switching districts or exiting from the Texas public schools) as a function of the combined teacher and district characteristics. Separate estimates are computed by experience categories in order to allow for differences in preferences, family circumstances, and job security. In particular, those at higher experience levels have chosen for the most part to remain in their current district for a number of years regardless of district characteristics, which would tend to reduce the link between transition probabilities and the included district characteristics. In addition, the estimated relationship between transitions and percentages black and Hispanic are allowed to vary by teacher race and ethnicity. Finally, the effects of salary are permitted to vary by gender. This allows for the possibility that women are less sensitive to salary because they are more likely to be secondary earners in a family than are men. (Preliminary work found little evidence that the effects of the student characteristics varied systematically by gender, therefore there are no gender interaction terms for those variables).

The estimates in Table 7 are qualitatively similar to the previously presented univariate statistics. Higher salaries significantly reduce the probability that male teachers leave a district up until retirement age, and the magnitude of the effect at first increases and then tend to decline with experience.[21] In contrast, the magnitudes of the effects for women teachers are much smaller by statistically significant amounts for less experienced teachers. While females through five years of experience respond some to salaries, this falls to zero after six years of experience. Preliminary work showed that the substitution of sixth year salaries for starting salaries made little difference, and there was not enough variation in the gradient of the salary structure across districts to estimate separate effects for the growth rate in salary and for the base year level with any reasonable degree of precision.

The teacher transition rate is also significantly related to a number of student characteristics including average achievement, percent black and percent Hispanic. Higher average student achievement significantly reduces the probability of moving or exiting Texas public schools at all levels of experience. Nonblack and non-Hispanic teachers are more likely to transition the higher are the Black and Hispanic enrollment shares, and these effects are generally statistically significant. Exactly the opposite is true for black and Hispanic teachers, who tend to be less likely to transition the higher the enrollment share of their race/ethnic group. There is little evidence of an independent effect of percent eligible for a subsidized lunch.

21. The estimates in Tables 7–9 are parameterized such that the coefficient for salary indicates the responsiveness of male teachers, while the interaction with the indicator for female gives the difference between male and female responsiveness. The magnitude of the female response to salaries is simply the sum of the two coefficients. The models also include an indicator of female teachers. A similar form of this parameterization is employed to estimate the effects of race and ethnicity of students on the behavior of black and Hispanic teachers (including having indicators for black and Hispanic teachers). The estimated models also include year dummy variables, a quadratic in experience, community type, fourth grade enrollment, and class size.

Table 7

Estimated Effects of Starting Teacher Salary and Student Demographic Characteristics on the Probability that Teachers Leave School Districts, by Experience (linear probability models; absolute value of Huber-White adjusted t statistics in parentheses)

	Teacher Experience				
	0–2 years	3–5 years	6–10 years	11–30 years	>30 years
First year base salary (log)	−0.29	−0.38	−0.19	−0.12	0.26
	(5.32)	(6.51)	(3.80)	(3.78)	(1.55)
First year base salary (log)* female	0.14**	0.29*	0.22	0.12	0.05*
	(3.14)	(5.35)	(4.60)	(4.61)	(0.40)
Campus average student characteristics					
Test score	−0.02	−0.02	−0.02	−0.02	−0.07
	(2.69)	(3.00)	(3.53)	(5.00)	(2.70)
Percent eligible for subsidized lunch	0.00	−0.03	−0.02	0.01	−0.05
	(0.03)	(1.92)	(1.74)	(0.75)	(0.94)
Percent Black	0.13	0.09	0.05	0.02	−0.10
	(7.31)	(4.82)	(3.33)	(2.46)	(1.60)
Percent Hispanic	0.04	0.06	0.02	0.01	−0.07
	(2.20)	(3.10)	(1.52)	(0.68)	(1.21)
Interactions					
Black *percent Black	−0.22**	−0.15	−0.12*	−0.06*	0.07
	(7.79)	(5.07)	(5.12)	(5.08)	(1.16)
Black *percent Hispanic	−0.10	−0.07	−0.07*	−0.04*	0.10
	(2.59)	(1.83)	(3.26)	(3.66)	(1.67)
Hispanic *percent Black	−0.13	−0.05	−0.03	−0.02	0.19
	(2.91)	(0.87)	(0.66)	(0.57)	(0.70)
Hispanic *percent Hispanic	−0.12**	−0.08	−0.05	−0.05**	0.12
	(5.52)	(3.48)	(2.48)	(2.48)	(1.01)
Observations	56,696	42,591	55,859	124,151	5,319

Note: Models include indicators for female, black, and Hispanic teachers, year, and community type along with a quadratic in experience, fourth grade enrollment, and class size. * indicates p>.05 and ** indicates p>.01 for test that subgroup response (for example, for females or blacks) equals 0.

Finally, (not shown) there is little or no evidence that the probability of moving or exiting by teachers is systematically related to average class size in any specification, raising doubts about the frequently hypothesized impact of smaller classes on teacher decisions.

Because there are likely to be important determinants of teacher transitions not captured by the included variables, the specifications in Table 8 include district fixed effects. The specifications producing the estimates in Table 7 do not include district fixed effects, meaning that most of the variation in salary and other characteristics comes from differences among districts. By eliminating the unobserved district differences that may be correlated with the included covariates, the fixed effect specifications are much more likely to identify the link between the probability of exit and the included variables. Moreover, they also eliminate all constant differences in school district personnel policies, thus bringing the interpretation of the estimates closer to individual supply decisions. One potential downside of the fixed effect estimates is that they rely entirely on intertemporal changes within districts over a relatively short time period. This both limits the variation in the regressors and increases the influence of any unobserved changes over time that both affect transition probabilities and lead to changes in one or more of the variables.

After removing the influences of time invariant district factors (Table 8), the estimated salary effects maintain the previously seen pattern by gender but decline in magnitude and become statistically insignificant with the exception of male teachers with three to five years of experience. Perhaps this age group of teachers does in fact respond most to financial opportunities, but we also suspect that the decline in coefficient magnitudes arise largely from an inability to identify the true salary effects from year-to-year salary changes. It is quite plausible that the small year-to-year salary variations provide a noisy measure of the longer term salary shifts that would affect decisions to quit or change schools, particularly because base year salary is a noisy representation of the entire salary structure.

On the other hand, the student racial and ethnic composition coefficients remain qualitatively unaffected by removing district fixed effects. Importantly, the campus proportion of students who are Hispanic or black still raises the probability of exiting for less experienced nonblack and nonHispanic teachers. And, the inclusion of district fixed effects has little impact on the estimates of differential effects for black and Hispanic teachers.[22] This latter finding is particularly important because the fixed effects would remove any general personnel practices that placed minority teachers in more heavily minority schools. Finally, the estimated effects of average student test score on the probability of leaving a district tend to fall slightly following the inclusion of the fixed effects. Nonetheless, schools with higher achieving students continue to have significantly less teacher turnover.

The estimates reported in Tables 7 and 8 restrict the salary, student, and classroom characteristics to have the same effects on the probability of switching schools as

22. The inclusion of fixed effects also raises the magnitude and significance of the coefficient on eligibility for a subsidized lunch, but the direction of the effect is inconsistent with a labor supply story in which teachers prefer districts with higher income children. More likely, the negative relationship for subsidized lunch reflects institutional changes at schools related to Texas school finance reform efforts. Schools with less wealthy student populations experienced revenue increases during this period, money which may have been used to make teaching more attractive (in ways not measured here).

Table 8

Estimated Effects of Starting Teacher Salary and Student Demographic Characteristics on the Probability that Teachers Leave School Districts with District Fixed Effects, by Experience (linear probability models; absolute value of Huber-White adjusted t *statistics in parentheses)*

	Teacher Experience				
	0–2 years	3–5 years	6–10 years	11–30 years	>30 years
First year base salary (log)	−0.01	−0.32	−0.11	−0.02	0.38
	(0.12)	(4.22)	(1.59)	(0.37)	(1.22)
First year base salary (log)*female	0.10	0.28	0.16	0.11*	0.05
	(2.25)	(5.05)	(3.39)	(4.31)	(0.30)
Campus average student characteristics					
Test score	−0.01	−0.02	−0.01	−0.01	−0.08
	(1.27)	(2.25)	(1.95)	(3.40)	(3.38)
Percent eligible for subsidized lunch	−0.03	−0.05	−0.05	−0.01	−0.17
	(1.58)	(2.89)	(3.17)	(0.77)	(2.73)
Percent Black	0.16	0.11	0.09	0.03	−0.04
	(6.79)	(4.25)	(4.57)	(3.34)	(0.56)
Percent Hispanic	0.07	0.08	0.07	0.02	0.02
	(2.49)	(3.03)	(3.58)	(1.62)	(0.24)
Interactions					
Black *percent Black	−0.23*	−0.15	−0.11	−0.06*	0.10
	(7.99)	(4.95)	(4.71)	(4.70)	(1.35)
Black *percent Hispanic	−0.11	−0.07	−0.07	−0.04	0.10
	(2.68)	(1.83)	(3.08)	(3.93)	(1.37)
Hispanic *percent Black	−0.13	−0.04	−0.04	−0.01	0.00
	(2.99)	(0.71)	(0.74)	(0.47)	(0.01)
Hispanic *percent Hispanic	−0.13	−0.07	−0.05	−0.05	0.02
	(5.52)	(2.94)	(2.36)	(3.94)	(0.23)
Observations	56,696	42,591	55,859	124,151	5,319

Note: Models include indicators for female, black, and Hispanic teachers, and year along with a quadratic in experience, fourth grade enrollment, and class size. *indicates $p>.05$ for test that subgroup response (for example, for females or blacks) equals 0.

on the probability of leaving the Texas public schools entirely. It may be the case, however, that effects differ for these two transitions. In particular, teachers knowledgeable at entry of the generally low level of salaries in the profession may be much more sensitive to salary differences among districts than between teaching and other alternatives. Consequently we divide district leavers into those teachers who move to a new district and those who exit the Texas public schools entirely and estimate multinomial logit specifications. Again separate estimates are computed for the five experience categories.

The results in Table 9 indicate that teacher salary is much more strongly related to the probability of switching districts than to the probability of exiting the Texas public schools (both relative to remaining in their current district). On the other hand, student achievement appears to be a much more important determinant of the probability of exiting the public schools entirely. The results for salary and achievement hold across the experience distribution. In the case of salary, the effects on the probability of switching districts are roughly twice as large for men as for women. Because the multinomial logit coefficients do not convey the magnitude of effects, we have calculated the marginal effects of salary changes for women and men by experience. For men, the average of the estimated change in the probability of switching districts for a 10 percent increase in salary is 2.6 percentage points for teachers with fewer than three years of experience prior to the school year, 3.4 percentage points for teachers with 3 to 5 years of experience, trailing off to 2.4 percentage points for teachers with 6 to 10 years of experience, 1.4 percentage points for teachers with 11 to 20 years of experience and only 0.05 percentage points for those with more than 20 years of experience. The corresponding numbers for women are again less than half the size for males: 1.2, 1.1, 0.7, 0.3, and 0 percentage points for the five experience categories, respectively.

Table 9 also shows that student racial composition is an important determinant of both the probability of leaving the public schools entirely and the probability of switching districts. For white teachers, the influence on switching districts holds across the experience distribution, while the influence on exiting the public schools is concentrated in the earlier years. For black teachers, the reactions to varying concentrations of black students are almost exactly the opposite than for whites in both sign and magnitude. Importantly, the interpretation of this differential racial effect throughout has been heavily conditioned by the possibility of explicit school district personnel policies to place minority teachers in schools with higher concentrations of minority students. But, the fact that exiting teaching—a decision much more closely related to the individual teacher than to the district—follows the same pattern suggests that the minority composition effects are more deeply rooted in individual teacher decisions.

V. Conclusions

The results in this paper confirm the difficulty that schools serving academically disadvantaged students have in retaining teachers, particularly those early in their careers. Teaching lower achieving students is a strong factor in decisions to leave Texas public schools, and the magnitude of the effect holds across

Table 9

Multinomial Logit Estimated Effects of Teacher Salary and Student Demographic Characteristics on the Probabilities that Teachers Switch School Districts or Exit Teaching Relative to Remaining in Same District (absolute value of Huber-White adjusted t statistics in parentheses)

	Teacher Experience				
	0–2 years	3–5 years	6–10 years	11–30 years	>30 years
I. Switch Districts					
Base year salary (log)	−2.93	−4.83	−3.93	−4.20	−3.26
	(6.75)	(8.28)	(6.78)	(7.13)	(0.85)
Base year salary (log)* female	1.19	2.72	2.12	2.37	3.88
	(3.08)	(5.13)	(4.02)	(5.19)	(1.19)
Campus average student characteristics					
Test Score	−0.14	−0.37	−0.22	−0.31	−2.20
	(1.94)	(4.09)	(2.12)	(2.95)	(3.49)
Percent eligible for subsidized lunch	0.03	−0.06	0.04	−0.06	0.37
	(0.23)	(0.30)	(0.22)	(0.26)	(0.26)
Percent Black	1.05	0.68	0.74	0.99	−3.02
	(6.35)	(3.54)	(3.36)	(4.12)	(1.75)
Percent Hispanic	0.32	0.53	0.44	0.34	−3.20
	(1.93)	(2.49)	(2.06)	(1.41)	(1.53)
Interactions					
Black * percent Black	−1.98	−1.54	−2.01	−2.23	0.36
	(6.21)	(3.66)	(4.87)	(5.26)	(0.14)
Black * percent Hispanic	−0.37	−0.39	−0.65	−1.28	−1.11
	(1.01)	(0.74)	(1.46)	(3.01)	(0.40)
Hispanic * percent Black	−1.23	−0.73	−0.34	−0.35	0.24
	(2.73)	(1.24)	(0.59)	(0.57)	(0.08)
Hispanic * percent Hispanic	−0.96	−0.96	−0.75	−1.22	−0.80
	(4.57)	(4.04)	(2.84)	(4.10)	(0.38)

II. Exit Teaching					
Base year salary	−0.34	−0.55	1.01	0.57	2.09
(log)	(0.80)	(1.04)	(1.81)	(1.10)	(1.83)
Base year salary	−0.13	0.83	0.49	0.19	0.15
(log)* female	(0.39)	(1.73)	(0.95)	(0.54)	(0.17)
Campus Average Student Characteristics					
Test score	−0.15	−0.06	−0.26	−0.29	−0.44
	(2.28)	(0.83)	(3.41)	(4.44)	(2.51)
Percent eligible	−0.01	−0.30	−0.39	0.16	−0.38
	(0.05)	(2.05)	(2.48)	(1.19)	(1.12)
Percent Black	0.62	0.65	0.35	0.06	−0.56
	(4.68)	(3.95)	(2.03)	(0.43)	(1.36)
Percent Hispanic	0.19	0.38	0.12	−0.06	−0.36
	(1.20)	(2.18)	(0.69)	(0.43)	(0.96)
Interactions					
Black * percent Black	−1.42	−1.33	−1.20	−0.68	0.46
	(5.52)	(4.41)	(3.04)	(3.20)	(1.05)
Black * percent Hispanic	−0.98	−0.73	−1.09	−0.53	0.70
	(2.63)	(1.87)	(2.79)	(2.54)	(1.78)
Hispanic * percent Black	−0.16	0.04	−0.26	−0.10	1.44
	(0.37)	(0.10)	(0.39)	(0.22)	(0.72)
Hispanic * percent Hispanic	−0.57	−0.36	−0.48	−0.53	1.07
	(2.51)	(1.45)	(1.59)	(1.98)	(1.17)

Note: Models include indicators for female, black, and Hispanic teachers, year, and community type along with a quadratic in experience, fourth grade enrollment, and class size.

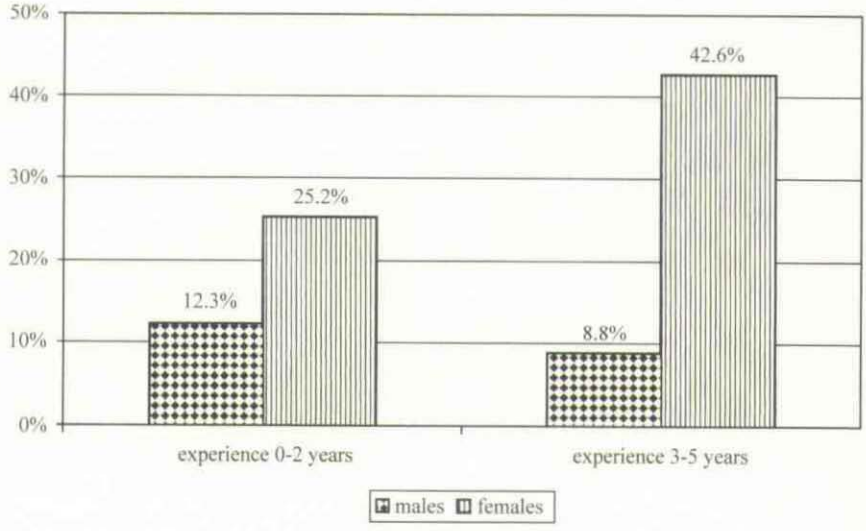

Figure 1
Salary Premia Required to Neutralize Turnover Effects for Nonminority Teachers of Differences in Student Characteristics Between Large Urban and Suburban Districts, by Gender and Experience Class of Teacher

the full range of teacher experience. There is also strong evidence that a higher rate of minority enrollment increases the probability that white teachers exit a school. In contrast, increases in percent black and percent Hispanic tend to reduce rather than increase the probability of transitions for black and Hispanic teachers, respectively.

A key issue is the magnitude of the additional compensation required to offset the disadvantages some schools must overcome in order to compete for teachers. We examined the possibility that the impact of salaries varied with student characteristics and the possibility that the effects of student characteristics were nonlinear. We found little or no evidence of such nonlinearities. Therefore, the salary coefficients in the tables provide the best estimates of the compensating differentials needed to offset the labor market disadvantages of certain schools.

The estimated exit equations provide a way of assessing the relative importance of salary and other school characteristics. The dominant group of nonminority females provides the starkest comparisons. Table 7 suggests that a school with 10 percent more black students would require about 10 percent higher salaries in order to neutralize the increased probability of leaving. Similarly, a one standard deviation decrease in school average achievement equates to 10–15 percent higher salaries to hold exit rates constant. Many large urban schools, however, display a combination of achievement deficits and concentrations of minority students, implying that the salary premia required to offset the turnover effects of student characteristics can be very large. Figure 1 displays the estimated salary differentials that would be needed to neutralize the typical differences found between large urban and suburban

districts (according to the estimated turnover effects in Table 7).[23] For these less experienced females, the average salary differential would be 25–40 percent.

As Figure 1 also shows, women are clearly much less responsive to salary differences than men in determining whether to transition out of a school, and thus smaller salary differentials are required by male teachers to offset disadvantaged school populations. Texas public schools currently have relatively few males in the lower grades (14 percent), though pay increases would likely increase the share of male teachers.[24] The availability of black or Hispanic teachers may also substantially reduce the costs of hiring for these schools, but they remain underrepresented (20 percent) relative to the student population.[25]

A variety of policy discussions highlights the possibility of paying bonuses, or "combat pay," for teachers in the most disadvantaged urban schools. The prior estimates provide an indication of the salaries required to neutralize the higher turnover of the average large urban school, not the most disadvantaged. Additionally, while we estimate the salary premia required for the lowest experience classes of teachers, it is unlikely that a policy would target just these teachers, as opposed to all of the teachers in identified schools. Thus, the overall cost of providing such bonuses almost surely exceeds the amounts typically considered in most policy discussions.

Importantly, the pattern of multinomial logit estimates suggests that across the board salary increases are unlikely to compensate for the high exit rates out of some schools. It appears that salaries relative to other districts rather than the absolute level of teacher salaries is the important determinant of teacher transitions, as salaries appear to have a larger impact on the probability of switching districts rather than exiting teaching altogether. These findings are consistent with Scafidi, Sjoquist, and Stinebrickner (2002), who find that very few teachers leave teaching to accept higher wages in other employment. Of course salaries may have an important effect on the decision to enter teaching, but this analysis does not consider the job-taking patterns of entering teachers.

An alternative to raising salaries may be addressing specific working conditions that are associated with the schools serving particular types of students. If the results capture teacher preferences for student race or ethnicity, then districts possess few policy options. But, we might speculate that these estimates at least partially proxy for more general working conditions (even though our analysis does not permit disentangling the various potential aspects of working conditions). For example, if schools with high minority concentrations have more disciplinary problems, rigid bureaucracies, poor leadership, high student turnover, and general safety concerns, improvement in such directions may reduce teacher turnover. (And, improvement in these dimensions may simultaneously have a direct benefit for student performance.) In addition, improvements in academic preparation, such as through better preschools

23. Notice that the district fixed effect estimates in Table 8 would virtually rule out the use of salary as a means to retain women teachers, though as mentioned earlier these estimates may be downward biased.
24. These calculations also do not take into account the initial hiring by schools. Females are only slightly more represented in suburban schools and slightly less represented in rural schools than would be expected from their proportions in the teacher population.
25. The ability to attract minority teachers over time has diminished (U.S. Department of Education 2002) and has been the subject of previous attention to teacher supply (Murnane et al. 1991; Hanushek and Pace 1995).

or child care services, may well have the indirect benefit of making schools more appealing to prospective teachers. Learning more about the precise sources of the relationship between teacher labor supply and the specific student characteristics would provide important, policy relevant information.

Finally, this paper focuses solely on the quantity of teacher transitions with little or no attention paid to quality. Our prior work on student outcomes (Rivkin, Hanushek, and Kain 2001) indicates that new teachers are on average lower performing than more experienced teachers. If exit rates increase when schools have larger concentrations of disadvantaged and low achieving populations, these schools are likely to have higher proportions of new teachers—thus magnifying their difficulties. Yet, inexperience is only one element of teacher quality, and the variation in teacher quality even within schools is generally significantly larger than just the impact of inexperience.

Any salary adjustments designed to reduce teacher turnover will affect both high quality teachers and low quality teachers, tending to increase the retention of both. If schools serving disadvantaged populations tend to have concentrations of poorer teachers (other than that resulting from inexperience), reducing turnover may not be unambiguously good. Spending the substantial sums implied by our estimates solely to reduce turnover without explicitly considering the much more important issue of quality would make for bad policy.

The actual cost of improving the quality of instruction depends crucially on the details of district hiring, retention, and other personnel policies. Ballou (1996) raises serious doubts that districts systematically hire the best candidates available (in terms of measurable characteristics), suggesting that instructional quality could possibly be improved at little or no cost in terms of higher salary. Nonetheless, the supply function for teacher quality measured in terms of effectiveness in the classroom is currently completely unknown.

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