TEACHER LOCATION CHOICE AND THE DISTRIBUTION OF QUALITY: EVIDENCE FROM NEW YORK CITY

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This article studies the distribution of teacher quality measures across the New York City school system. Because teachers are paid along a fixed salary schedule and they have the option to transfer schools, this analysis measures the degree to which environmental factors affect teacher location choice. Both school-based and neighborhood-based effects are measured, and both types are significant. Furthermore, this article finds that the location of the school in relation to the suburban borders is an important determinant of teacher location choice. (*JEL* I29, J24, J61)

I. INTRODUCTION

This article investigates the distribution of teacher quality across the New York City school system. Because teachers with seniority are often able to choose the location where they teach and salary is paid along a fixed wage schedule, I can investigate the degree to which teachers are able to improve their utility by locating to more agreeable environments.

The theory of compensating wage differentials for quality-of-life factors in location views geographic places as interrelated bundles of wages, land rents, and amenities with differing bundles for different locations. If migration across regions is relatively cheap, then households, employees, and firms will compete for a fixed number of sites across locations, with agents seeking to maximize their pay-offs (utility or profit) through their location choice. In equilibrium, wages and land rents will vary across locations to equate household utility (Gabriel et al. 2003; Rosen 1979).

If two regions, for example, have the same exact bundle of amenities, except one location has a relatively milder climate, then the theory predicts that this location would have a lower wage because, all else equal, the milder climate would compensate utility in exchange for a lower wage. Studies in this vein have generally looked at urban wages across regions as a measure of the value of different locations (Bloomquist et al. 1988; Roback 1988).

This theory also applies to employment choice in neighborhoods within a region as well. Workers, for example, would need to be compensated to work in dangerous neighborhoods or areas without available parking or other local amenities. In a special case, where wages are held constant across a particular area, one would expect to see an uneven distribution of worker quality.

In particular, schoolteachers in the New York City school system are paid along a fixed salary schedule based on the number of years of service in the system and the number of graduate credits. Because schools cannot offer wage differentials based on the nature of the working environment, and teachers with seniority can transfer to districts of their choosing, I can directly measure the degree to which working environment and neighborhood characteristics affect the distribution of quality across both schools and neighborhoods.[1]

This study uses data provided by the New York City school system plus other New York City–level data to investigate the relationship

1. The New York City school system (district) is divided into 34 subdistricts, which will be simply referred to as districts in this article.

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ABBREVIATIONS

AFDC: Aid to Families with Dependent Children
BOE: Board of Education
SURR: School Under Registration Review
UFT: United Federation of Teachers
OLS: Ordinary Least Squares

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between school and neighborhood quality and teacher quality. Here, three measures of teacher quality are used: the percentage of teachers in each school with greater than five years of teaching experience, the percentage of teachers with a master's degree, and the percentage of teachers who have been in their particular school for more than two years. Teacher experience and teacher education levels are common measures of quality. Furthermore, length of school tenure is an important quality measure because the longer a teacher stays within in a school, the better the teacher will have adapted to teaching to a particular student body, within a particular organizational framework, and with a particular curriculum. These measures of quality are not mutually exclusive.

There is still a debate, though, regarding these measures of quality because economists have found mixed findings of the effects of these measures on student performance (Hanushek 1986). However, this does not mean they are not important measures to investigate. With regard to education, they are still used by schools, school districts, departments of education, parents, and policy makers as measures of quality because they are commonly accepted labor market inputs (Ehrenberg and Smith 2003). Furthermore, the mixed findings on standardized test performance does not mean that they are unimportant in the overall education of students, the effects of which might not be directly captured in the regressions.

Though in many regards, the measures used here may be more accurately described as teacher qualifications, this article retains the use of the word *quality*, because these variables relate to the notion that having higher levels of experience, tenure, and education increase the level of teacher human capital and productivity for the school, all else equal. In light of the debate of the effect of these teacher variables on student performance, the results presented here can be viewed as a measurement of the degree to which teacher mobility, combined with a fixed salary schedule, affects the distribution of human capital within a particular geographic region.

Ideally, a panel data set at the teacher level would help explain the location decisions of teachers across areas and over time. Using school-level data only looks at the aggregate impact across schools, not the decisions of teachers themselves. As well, this kind of data precludes investigating the impact of different kinds of options available to teachers, such as whether to transfer to another school within the city, to a school in another town, or to exit the teaching profession. Nonetheless, using school-level data can shed light on the effects of environmental variables on labor market outcomes. Because each school is an organization unto itself, I can look at the effects of both internal and external features related to that organization that affect its ability to attract and retain experienced workers.

The bulk of the literature on the labor market for teachers has focused on the effects of wages on attracting higher quality teachers (Hanushek et al. 1999). The available evidence shows that the link is mixed. Hanushek et al. (1999) find that salary is a relatively unimportant determinant of teacher mobility compared to other environmental factors that teachers face. Figlio (2002) finds that whether a district is unionized affects the relationship between salary and the probability of hiring better qualified teachers. Stinebrickner (2001) finds that a female teacher's decision to stop teaching is related to marital status and number of children, as well as wage. However, Baugh and Stone (1982) find that teachers are responsive to not only interoccupational wage differentials but also interdistrict differentials. They find that the interdistrict salary differential has a relatively larger effect on teacher mobility than the interoccupational differential.

In terms of teacher mobility, Greenberg and McCall (1974) study teacher flows within the San Diego school district and find that relatively wealthy schools (i.e., students with higher socioeconomic status) have teachers with relatively greater experience and educational obtainment. More recently, work by Boyd et al. (2003a, 3b) and Lankford et al. (2002) have investigated the effects of location in the labor market for teachers. Lankford et al. (2002) study the variation of teacher qualifications across New York state and find that urban districts and low-income districts have attracted the least qualified teachers in the state. In addition Boyd et al. (2003b) investigate the localness and sorting of labor markets for teachers across New York state. They find that the distance of a teacher to his or her hometown is an important determinant of where a teacher chooses to work. Furthermore, teachers with hometowns in urban locations are more likely to take a first job in that urban district relative to its suburbs, and teachers from the suburbs are more likely to work in the suburbs. This is a problem for urban districts, including New York City, because they tend to be net importers of teachers from surrounding areas.

This article is, in some sense, complementary to the work of Boyd et al. (2003b) in that it looks at both the internal and external conditions that affect the distribution of teachers; however, the focus here is on teachers only within the City of New York. As Boyd et al. (2003b) discuss, there is little research on the geography of labor markets, and this article seeks to investigate the nature and degree of teacher sorting within a school district.

In particular, after accounting for the within school factors, the external environmental factors that affect teacher location choices are measured. Specifically, I look at the characteristics of the neighborhoods themselves: business and population density, crime, socioeconomic characteristics of the residents, and the distance of the neighborhood from the city center. That teachers sort themselves based on the quality of their work environment and location to their homes is not a new or surprising result, but to the best of my knowledge, this article is the first to directly measure the magnitude of how environmental conditions affect the distribution of teacher human capital levels within a city and how proximity to suburban districts affects this distribution.

The measured effects of neighborhood characteristics on the distribution of teacher quality measures are quite large, with a range across neighborhoods of roughly 40–50% for the three quality measures. The findings also show that experienced teachers are more likely to work in schools that are closer to the suburbs and are less likely to travel to the urban core. For example, for school districts that are 10 miles away from the city center (i.e., the Empire State Building), all else equal, there is an approximate increase of 3–5% of teachers with more than five years of teaching experience. The effect is even greater for the percentage of teachers within each school who have been in that school for more than two years. The reason for this effect is that a large proportion of New York City teachers (30%) live outside of the city borders.

The rest of the article is organized as follows. Section II discusses the relevant facts about the New York City school district and the data set employed. Section III discusses details about the teacher quality measures. Next, section IV presents the results of regressions that measure the school-level effects on teacher quality. Then section V presents the results of regressions that measure the neighborhood effects on teacher quality. Finally, section VI presents some concluding remarks.

II. THE NEW YORK CITY SCHOOL DISTRICT

The New York City school system is the largest school system in the nation. It has an enrollment of approximately 1.1 millions students, with roughly 550,000 elementary school students and over 200,000 middle school students. There are some 80,000 teachers, of which about 49,000 are employed in elementary schools. The school system encompasses the five boroughs of New York City: the Bronx, Brooklyn, Manhattan, Queens, and Staten Island. In 2001 there were 34 separate school districts within the city (3 of which were extraregional) and a total of 911 elementary and middle schools.[2] In 2001, 34.8% of the student population identified as African American, 37.8% as Hispanic, 15.5% as white, and 12.1% as Asian, American Indian, or other race (Board of Ed. 2003; Dept. of Education 2004).

The City of New York and the Board of Education (BOE) collectively bargain with the teacher's union, the United Federation of Teachers (UFT), over wages, benefits, and work rules. In each year, teachers are paid according to a salary schedule, which is a function of the number of years of service in the system and educational attainment, which ranges from a bachelor's degree to a master's degree plus 30 additional graduate school credit hours.

One benefit given to teachers is the right to apply for and obtain a seniority transfer, which allows the more experienced teachers to

2. As of July 2002, the New York City school system undertook a reorganization plan, whereby the controlling authority of Board of Education was dissolved and replaced by the mayor, who chose a new chancellor as his representative. As a result, the office that administers the schools is now the Department of Education. The current Board of Education only has an advisory function. The data used for the analysis were collected before the reorganization, thus when referring to the controlling authority, I shall refer to it as the Board of Education (BOE).

TABLE 1
Descriptive Statistics for New York City School System, 2001–02, School-Level Data (n = 880)

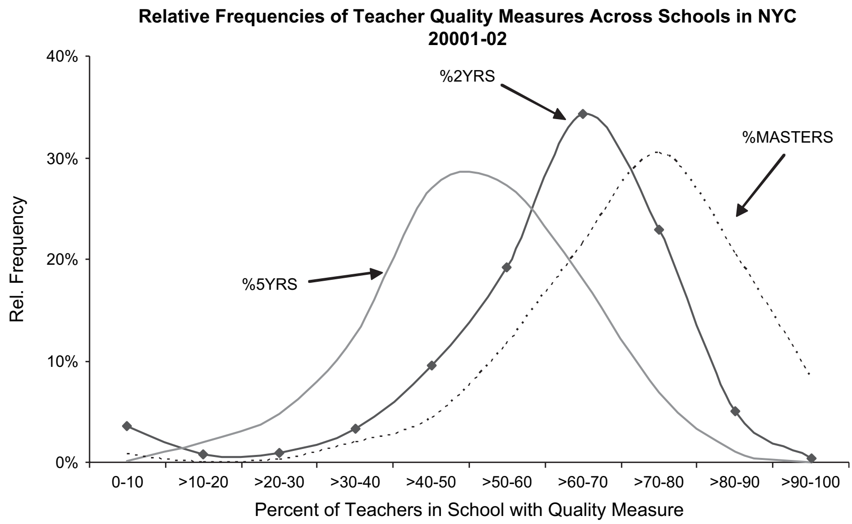
Variable	Description	Mean	Std. Dev.	Min.	Max.
School Variables					
%2YRS	% of teachers in same school for more than 2 yrs.	62.2	15.0	0.0	100.0
%5YRS	% of teachers with more than 5 yrs. teaching exper.	51.9	12.9	11.1	88.9
%MASTERS	% of teachers with masters degree	72.5	13.3	0.0	100.0
TEACH	Number of teachers	53.5	22.6	5.0	146.0
ΔLnTEACH	Difference in LnTEACH from 2000–01 to 2001–02	−0.1	0.2	−1.2	1.2
EPP	Expenditures per pupil ($0,000)	1.00	0.3	0.5	5.9
%CRI	% of expenditures for classroom instruction	60.3	5.2	13.7	74.8
%SUPSUP	% of expenditures for supervisory support	8.7	2.1	1.7	29.4
Student Variables					
%ATTEND	Average % student attendance	92.1	2.2	75.2	97.5
ENROLL	Total student enrollment	833.2	386.3	84.0	2532
%WHITE	% White students	15.7	22.8	0.0	93.7
%BLACK	% Black students	34.7	30.4	0.0	97.5
%HISP	% Hispanic students	38.0	26.3	1.5	98.5
%ASIAN	% Asian students	11.6	16.0	0.0	92.1
%MALE	% male students	51.0	3.1	27.5	73.7
%RFL	% of students receiving reduced or free lunch	72.6	24.3	6.3	100.0
%FTSPED	% students in full time special ed.	5.0	4.5	0.0	43.2
%IMM	% of students who emigrated to U.S. within last 3 yrs.	6.6	4.7	0.0	25.0
%LEP	% of students with limited English proficiency	12.1	9.5	0.2	46.8
School Dummy Variables					
HG <= 6	Dummy var. if highest grade is 6 or lower	0.69			
HG 7, 8, 9	Dummy var. if highest grade is 7, 8 or 9	0.29			
HG 10, 11, 12	Dummy var. if highest grade is 10, 11, or 12	0.02			
SURR	Dummy var. if school is 'under review'	0.06			

switch to a different school. This benefit has important implications for the distribution of quality because presumably more senior teachers can move to schools that increase their overall utility. In general, regularly appointed teachers with three years of satisfactory ratings can apply for a transfer. The teacher makes a list of six preferred location choices, and the transfers are granted based on seniority and availability. There are limits to the number of teachers that can transfer from any one school at a given time. On average, roughly 500–800 teachers transfer each year under the seniority-based system (Ballou 1999). More information about the teacher's contract, including salary schedule and teacher transfer rules, can be found at the UFT Web site, www.uft.org/member/rights/contracts/current_teachers_contract.

The Data

The data used in this article are from the 2001–2002 Annual School Report Card data assembled by the BOE. It is a rich data set that captures the different facets of education, including mean standardized test scores, teacher quality and experience measures, and other school-level information. Table 1 presents the summary statistics for the relevant variables, which are placed in one of three categories to make reading the table easier. As discussed, there are three measures of teacher quality: the percent of teachers in each school that have more than five years teaching experience (anywhere), the percent of teachers who hold a master's degree, and the percent of teachers who have been in a school for more than two years. For student-related data there are variables for race, attendance, immigrant status, and English language proficiency. For school measures, there are the student–teacher ratio, school expenditures, enrollment, the grade levels of the school, and whether a school is a School Under Registration Review (SURR), which is a poorly performing school designation given by the state of New York. The sample includes both elementary and middle

FIGURE 1
Histograms of Teacher Quality Measures



schools. Note that there is complete data for 880 schools out of a possible 911 schools.

III. THE DISTRIBUTION OF QUALITY

Measures of teacher quality show a wide variation across schools. For example, the average school has only 51.9% of teachers with more than five years experience, with a standard deviation of 12.9%; the average value for master's degrees is 72.5% with a standard deviation of 13.3%. Figure 1 presents a histogram of the three quality measures.

Furthermore, Table 2 shows how the variables correlate. As would be expected, there are large pairwise correlations between the three variables, but there is by no means a one-to-one relationship between them.

To demonstrate the importance of the distribution of quality in terms of student performance, Figures 2 and 3 show the relationship between the needs of the school and teacher quality, and student performance for elementary school students. The needs level is based on the New York City School Board's definition, which is determined by three variables: the percentage of students eligible for the Reduced or Free Lunch Program, the percent of students tested for special education, and the percent of students who are in the English Language Learners program (Dept. of Education 2003). As the figures demonstrate, in general, lower needs schools perform better on standardized tests, and, in general, the distribution of teacher quality favors the lower need schools.

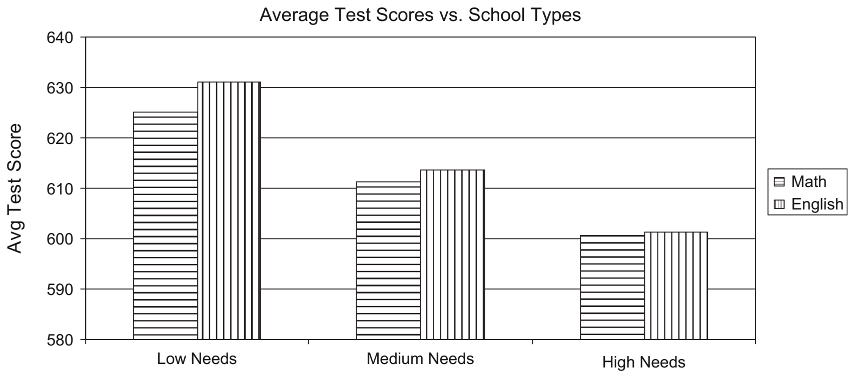
TABLE 2
Pairwise Correlation Coefficients of Teacher Quality Measures

	%5YRS	%MASTERS	%2YRS
%5*YRS*	1.000		
%*MASTERS*	0.659	1.000	
%2*YRS*	0.627	0.497	1.000

IV. AN ECONOMETRIC MODEL

The wide variation in teacher quality measures leads to the questions: what determines the relative distribution of teachers in schools, and are teachers going to the schools where they are most needed, that is, the schools that tend to do worse on student performance measures? The extent to which a school can attract and retain high-quality teachers is a function of both push and pull factors. A positive working environment, for example, is a pulling factor, as well as a short commuting time from home, whereas difficult working conditions, for example, can push teachers out of a school. Because salary is only a function years of service and educational obtainment, schools cannot recruit based on the prospect

FIGURE 2
Average Test Scores for 4th Grade General Education Math and English Versus Needs Level of School, 2001–2002



of higher salaries.[3] Thus the nonmarket factors such as working conditions and types of positions available will determine the distribution of teachers in different schools.

To study the effects on the teacher quality distributions, the following two equation model is posited:

$$(1) \qquad y_{ij}^{q} = \alpha_0^q + \mathbf{X}_{ij}\boldsymbol{\alpha}_1^q + \mathbf{Z}_{ij}\boldsymbol{\alpha}_2^q + nd_j^q + \mu_{ij}^q,$$

$$(2) \qquad nd_j^q = \beta_0^q + \mathbf{W}_j\boldsymbol{\beta}_1^q + \varepsilon_j^q,$$

where y_{ij}^q is the value of teacher quality measure q in school i in neighborhood j. $\mathbf{X}$ is the vector of variables that measure the relative working conditions within the school itself, such as expenditures, the grade levels in the school, and so on; $\mathbf{Z}$ is the vector of variables that measures the nature and composition of students, such as race and income, and the degree to which there are special education students. nd_j^q is the measurable neighborhood effect, and μ_{ij}^q is the purely random component of the quality measure.

Equation (2) measures the neighborhood component of the quality measures. $\mathbf{W}$ is a vector of variables that measures the neighborhood characteristics, such as crime rates, business activity, and the location of the school in relation to the city center. ε_j^q is the random, unobservable part of nd_j^q. The nature of the neighborhood effects is discussed in more detail in section V. In the vein of Card and Krueger (1992), a two-equation system is specified to highlight the two separate types of effects on teacher quality and to demonstrate the different functional forms for equation (2) that relate to the quality measures. The second equation is estimated using weighted least squares; the weights are the inverse of squared standard errors of the neighborhood coefficients, estimated in equation (1).

Regression Results

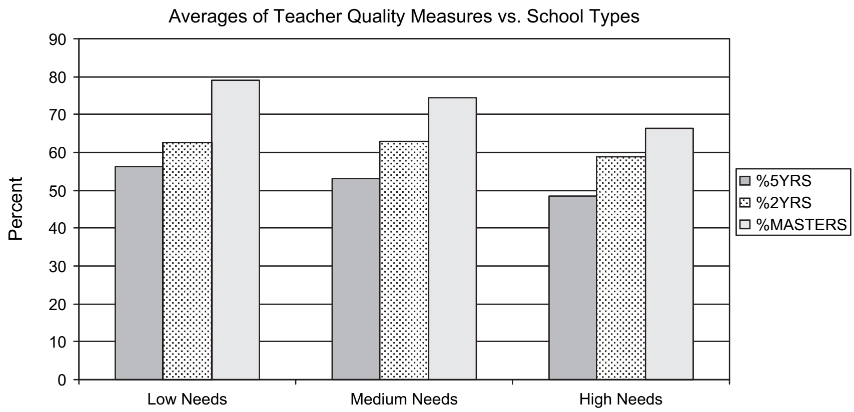
Table 3 presents the results of the ordinary least squares (OLS) regressions.[4] Each of these regressions includes dummy variables to capture the neighborhood effects, and in all cases they are jointly statistically significant.[5] For each dependent variable, two equations are presented, and each contains measures of school characteristics, such as expenditure levels, expenditure composition, and the size and

3. One caveat to this rule is the existence of a program to offer grants to teachers who elect to teach in SURR schools, which are so designated by New York state, due to exceptionally low performance. Starting in the 2001–2002, grants of up to $3,400 for student loan forgiveness and tuition reimbursement. A dummy variable for SURR schools is included to control for this effect.

4. In addition to OLS, regressions using a logistic specification via weighted least squares were estimated. The results are not presented here because they were similar to the OLS regressions, and the OLS predicted values are all within the range of 0 to 1. See Chaloupka et al. (1993) for an example of a logistic specification. Also note that because all three equations have the same set of regressors, OLS provides the same coefficient estimates and standard errors as a seemingly unrelated regression (Greene 2003).

5. For example, for %5*YR*, equation (2), the F–statistic is $F(165, 696) = 1.71$, p–value $= 0.00$. For %*MASTERS*, equation (2), $F(165, 696) = 1.80$, $p = 0.00$. For %2*YR*, equation (2), $= 1.65$, $p = 0.00$.

FIGURE 3
Average Teacher Quality Measures Versus Needs Level of School, 2001–2002



type of school; student characteristics include race, poverty, and special education measures. Also included is the difference in the log of the number of teachers from 2000–2001 to 2001–2002. The inclusion of this variable is meant to capture the effect of teacher turnover on teacher quality levels. For New York City, the higher the school turnover, the lower the quality of the workforce because, all else equal, replacements tend to be younger and less experienced. Turnover measures the degree to which teachers are leaving the schools for reasons such as taking jobs in other schools or leaving the school system all together.

Equation (1) uses actual values for expenditure per pupil (*EPP*) and the percent of school expenditures on classroom instruction (%*CRI*). The problem, however, with these variables is that they are in part determined by the composition of the teacher workforce in each school. For example, if there are many senior teachers in a school then *EPP* and %*CRI* will be relatively large, merely due to salary expenditures.

Because of the lack of suitable instruments for *EPP* and %*CRI*, proxy variables are used by removing that part of each variable that is due to salary expenditures. To do this, we have the following regression functions:

$$
\begin{aligned}
EPP &= \alpha_0 + \alpha_1(\%5YRS) + \alpha_2(\%MASTERS) \\
&\quad + \alpha_3(\%2YRS) + \alpha_4(\%LIC) + \varepsilon_{EPP}, \\
\%CRI &= \alpha_0 + \alpha_1(\%5YRS) + \alpha_2(\%MASTERS) \\
&\quad + \alpha_3(\%2YRS) + \alpha_4(\%LIC) + \varepsilon_{\%CRI}.
\end{aligned}
$$

%*LIC* is the percentage of teachers in each school that have full New York State teaching licenses. The residuals, $\widehat{EPP} = \hat{\varepsilon}_{EPP}$ and $\widehat{\%CRI} = \hat{\varepsilon}_{\%CRI}$, are used to measure that part of these variables that remain after taking into account the salary effect.[6] Because I only have the percentages of teachers who have more than five years experience, he cannot capture the effect of different levels of experience on spending. This may be important because salaries tend to rise relatively dramatically as teachers acquire more years of service.

%5*YRS*

In general, the variables in the regressions have the expected signs. Just to review a few, one can see that expenditures per pupil and percent attendance have positive effects. Furthermore, lower grade schools tend to have more teachers with experience compared to the intermediate grades. Interestingly, the percent male and percent supervisory support

6. The OLS equations are:

$$
\begin{aligned}
\widehat{EPP} = \underset{(0.06)}{0.96} + \underset{(0.001)}{0.0015}(\%5YRS) - \underset{(0.001)}{0.012}(\%MASTERS) \\
- \underset{(0.008)}{0.0002}(\%2YRS) + \underset{(0.001)}{0.01}(\%LIC),
\end{aligned}
$$

$R^2 = 0.10, N = 880$.

$$
\begin{aligned}
\widehat{\%CRI} = \underset{(1.2)}{56.4} + \underset{(0.02)}{0.02}(\%5YRS) - \underset{(0.10)}{0.04}(\%MASTERS) \\
+ \underset{(0.015)}{0.05}(\%2YRS) + \underset{(0.02)}{0.03}(\%LIC),
\end{aligned}
$$

$R^2 = 0.03, N = 880$. Standard errors below estimates.

TABLE 3
Zip Code Dummies Included in All Regressions. Standard Errors Below Estimates.

	%5YRS		%MASTERS		%2YRS	
Variable	**(1)**	**(2)**	**(1)**	**(2)**	**(1)**	**(2)**
EPP	4.07 (2.3)*		1.38 (2.0)		3.49 (2.6)	
$\widehat{EPP}$		6.40 (2.3)***		14.60 (2.0)***		8.58 (2.6)***
%*CRI*	0.36 (0.09)***		0.23 (0.08)***		0.28 (0.10)***	
$\widehat{\%CRI}$		0.12 (0.09)		0.08 (0.08)		−0.07 (0.10)
%*SUPSUP*	−0.77 (0.24)***	−0.78 (0.25)***	−0.33 (0.21)	−0.42 (0.20)**	−0.58 (0.27)**	−0.59 (0.27)**
ln (*TEACH*)	2.25 (2.97)	1.12 (2.96)	7.65 (2.58)***	−0.16 (2.47)	14.24 (3.36)***	11.29 (3.32)***
Δ ln *TEACH*	−11.65 (2.69)***	−11.54 (2.71)***	−10.29 (2.33)***	−7.01 (2.26)***	−29.62 (3.04)***	−28.61 (3.03)***
ln (*ENROLL*)	0.98 (2.87)	3.07 (2.84)	−6.84 (2.49)***	2.59 (2.37)	−6.11 (3.24)*	−1.75 (3.19)
SURR	0.63 (1.66)	1.06 (1.67)	5.82 (1.44)***	6.10 (1.39)***	−1.86 (1.87)	−1.36 (1.87)
HG 7, 8, 9	−3.33 (0.98)***	−3.18 (0.99)***	−6.76 (0.85)***	−6.22 (0.82)***	−8.06 (1.11)***	−7.65 (1.11)***
HG 10, 11, 12	0.13 (3.69)	−0.04 (3.72)	−7.37 (3.20)***	−7.71 (3.10)**	7.04 (4.17)*	6.69 (4.17)*
%*FTSPED*	0.28 (0.13)**	0.10 (0.14)	−0.09 (0.12)	−0.46 (0.11)***	−0.14 (0.15)	−0.43 (0.15)***
%*LEP*	−0.11 (0.09)	−0.09 (0.09)	−0.20 (0.08)***	−0.21 (0.08)***	−0.14 (0.10)	−0.11 (0.10)
%*IMM*	0.27 (0.14)*	0.28 (0.14)***	0.44 (0.12)***	0.49 (0.12)***	0.09 (0.16)	0.11 (0.16)
%*ATTEND*	0.50 (0.28)*	0.50 (0.28)*	0.75 (0.24)***	0.70 (0.23)***	0.91 (0.32)***	0.89 (0.32)***
%*RFL*	−0.02 (0.03)	−0.02 (0.03)	−0.05 (0.03)*	−0.05 (0.03)*	0.07 (0.04)*	0.07 (0.04)*
%*BLACK*	−0.14 (0.04)***	−0.14 (0.04)***	−0.12 (0.03)***	−0.11 (0.03)***	−0.15 (0.04)***	−0.14 (0.04)***
%*HISP*	−0.10 (0.05)**	−0.10 (0.05)**	−0.08 (0.04)**	−0.08 (0.04)**	−0.12 (0.05)**	−0.12 (0.05)**
%*ASIAN*	−0.03 (0.06)	−0.02 (0.06)	−0.01 (0.05)	0.00 (0.05)	−0.07 (0.06)	−0.07 (0.06)
%*MALE*	−0.40 (0.15)***	−0.39 (0.15)***	−0.51 (0.13)***	−0.65 (0.13)	−0.06 (0.17)	−0.07 (0.17)
CONSTANT	1.07 (30.51)	17.49 (30.38)	44.27 (26.45)*	41.16 (25.30)*	−40.64 (34.48)	−34.68 (34.02)
N	880	880	880	880	880	880
R^2	0.51	0.50	0.65	0.67	0.53	0.54
$\bar{R}^2$	0.38	0.37	0.56	0.59	0.41	0.41

*Sig. at 90% level, **Sig. at 95% level, ***Sig. at 99% level.

have negative effects. As expected, the teacher turnover effect is negative. The interpretation of the attendance coefficient should be made with caution, though, because of a possible endogenous relationship with the teacher quality measures.

%*MASTERS*

Looking at the percentage of teachers with master's degrees shows some similarities as the experience equation. Expenditures per pupil and attendance are both positive. Intermediate and high school grades have a harder time keeping teachers with a master's degree. Increases in limited English proficiency students shows a reduction in master's teachers, similarly for the amount spent on supervisory support. Master's teachers, though, are more likely to be in SURR schools. Because SURR schools specifically recruit fully licensed teachers and master's teachers are also likely to be fully licenced (the correlation between across schools is 0.82), this coefficient may also be capturing this effect. Interestingly, the master's and teacher tenure equations have a higher effect for attendance than for experience. As with experience, master's teachers are positively related to the number of immigrant students.

%2*YRS*

To highlight a few results, one can see that attendance is also positive. Interestingly, being a lower grade school increases the tenure rate compared to schools with intermediate grades, but schools with higher grades have a positive effect on tenure rates. Contrary to expectations, poverty, as measured by the reduced and free lunch rate, appears to be a small and positive determinant of teacher tenure, whereas there is no apparent effect on experience, and it is negative for master's teachers. Tenure rates appear to be lower in schools with large full-time special education populations.

V. NEIGHBORHOOD EFFECTS

In this section, the analysis turns to the measurement of the neighborhood effects. In each of the regressions presented in Table 3, dummy variables for each of the zip codes were included to control for the neighborhood factors that affect the distribution of teacher quality. Here these effects are studied in more detail to see how they influence this distribution. If teachers have a choice of where to locate, and they are not compensated for working in worse neighborhoods, then one is likely to see higher quality teachers working in better neighborhoods, all else equal. Tables 4 and 5 give the information and summary statistics for the neighborhood variables. For each of the three dependent variables, nd_j^q, $q = \{\%5YRS, \%MASTERS, \%2YRS\}$, the estimates from the second equation for each variable from Table 3 are used. Note that in Table 5 the variation in the measured neighborhood effect is quite large. For example, the range for experience is 39.43%, 37.78% for master's teachers, and 48.29% for tenure.

Here the I use a zip code area as a measure of a neighborhood. The average neighborhood is 1.7 square miles, with a standard deviation of 1.6 square miles. Seventy-five percent of zip codes are two square miles or less. The average zip code has a population of 49,391, with a standard deviation of 25,242 persons. Furthermore, on average there are 4.1 elementary schools per zip code, with a standard deviation of 2.5.

The measure of the degree of poverty in the neighborhood is the number of Aid to Families with Dependent Children (AFDC) recipients per 10,000 residents. As a measure of distance, I use the location of the neighborhood relative to the center of the city, that is, the Empire State Building. This measure is important due to the fact that of the over 80,000 teachers in the New York City school system, roughly 24,000, approximately 30%, reside outside of the borders of the City of New York (Human Resources, 2004). The distance of neighborhood (zip code) j is calculated using the Euclidean distance formula,

$$d_j = \sqrt{(lat_j - lat_{ESB})^2 + (long_j - long_{ESB})^2},$$

where lat_j is the degrees latitude of neighborhood j, and $long_j$ is the degrees longitude. The Empire State Building has its own zip code, 10118. Given the location of New York City on the planet, 1° latitude is about 52 miles and 1° longitude is about 69 miles.

Business density (thousands of businesses per square mile) is included to measure the economic activity of a neighborhood, as well as congestion. Also included is the number of violent crimes committed per 10,000 youths between the ages of 10 and 20, and the racial make-up of the residents.

Two other neighborhood quality measures are included: the percent of residents that use public transportation to commute to work, and the percent of residents 16 or older in white-collar employment, which is the percentage of residents in one of three major census categories: information; finance, insurance and real estate, rental and leasing; and professional, scientific, management, administrative

TABLE 4
Neighborhood Data By Zip Code for New York City

Variable	Description	Source
%5YRS-ND[a]	Neighborhood effect	Section 3
%2YRS-ND[a]	Neighborhood effect	Section 3
%MASTERS-ND[a]	Neighborhood effect	Section 3
ELEM SCHOOLS	# of elementary schools	NYC DOE Report Card Data
VCRIMES	Violent crimes per 10,000 youths 10–20, 1998	NY Ofc. Alc. & Subs. Abuse Srvcs.
DISTANCE	Distance in degrees from Empire State Bldg.	U.S. Census Bureau
LATITUDE	Degrees Latitude	U.S. Census Bureau
LONGITUDE	Degrees Longitude	U.S. Census Bureau
AFDC	AFDC recipients per 10,000 residents, 1997	NY Ofc. Alc. & Subs. Abuse Srvcs.
AREA	Square Miles	U.S. Census Bureau
POPULATION	# of residents	U.S. Census Bureau
POPDENSE	Thousands of people per square mile, 2000	U.S. Census Bureau
BIZDENSE	Thousands of business per square mile, 1997	U.S. Census Bureau
%WHITE COLL	% of residents in "white collar" professions, 2000[b]	U.S. Census Bureau
%PUBTRANS	% of residents that commute via pub. trans., 2000	U.S. Census Bureau
%WHITE	% of White residents, 2000	U.S. Census Bureau
%BLACK	% of Black residents, 2000	U.S. Census Bureau
%ASIAN	% of Asian residents, 2000	U.S. Census Bureau
%NATAM	% of Native American residents, 2000	U.S. Census Bureau
%HISP	% of Hispanic residents, 2000	U.S. Census Bureau
BRONX	Dummy var. for the Bronx	
BROOKLYN	Dummy var. for Brooklyn	
MANHATTAN	Dummy var. for Manhattan	
QUEENS	Dummy var. for Queens	
STATEN ISLAND	Dummy var. for Staten Island	

[a]Zip code 10001 is the base zip code.
[b]"White Collar" professions are Information; Finance, Insurance and Real Estate; Professional, Scientific, Management, Administrative, and Waste Management Services.

and waste management services.[7] These categories are meant to capture the degree to which a neighborhood is comprised of middle- and upper-class professionals. Public transportation use is included to capture both access to the neighborhood via public transportation, and as a measure of the type of residents that live there, because presumably public transportation is an inferior good, and, therefore, usage rates are another measure of socio-economic status. Tables 6 to 8 present the regression results.[8]

7. The 2000 Census Summary File 3, table P49, lists 13 job categories: agriculture, construction, manufacturing, wholesale trade, retail trade, transportation, information, finance and real estate, professional and management, education and social services, arts and recreation, other services, and public administration. The white-collar categories were chosen by the author.

8. Note that in the first-stage regression there are 169 zip code neighborhoods; this is reduced to 151 in the second stage due to lack of data for 18 zip codes.

Discussion of Results

%5YRS-ND. For *%5YRS-ND* I have four regression models. Equation (1) looks at the neighborhood effects without controlling for the borough. Equations (2) through (4) include dummy variables for the boroughs (with the Bronx as the base group).

In equation (3), one can see a negative and significant coefficient on business density and a positive interaction effect between the poverty measure and business density. However, even with the positive interaction effect, business density has a negative effect. This indicates that all else equal, high business density is seen as a negative. This may be for two possible reasons: high density means higher traffic congestion, and further more, high-density neighborhoods are generally more expensive to live and shop in, making them relatively less attractive.

TABLE 5
Descriptive Statistics for Zip Code Data. # obs = 155
(152 for AFDC and 153 for VCRIMES)

Variable	Mean	Std. Dev.	Min.	Max.
Neighborhood Effects				
%5YRS-ND	8.06	7.20	−14.36	25.07
%MASTERS-ND	−2.99	5.97	−23.72	14.06
%2YRS-ND	0.12	7.43	−29.23	19.06
Geography Variables				
DISTANCE	0.14	0.07	0.01	0.34
LATITUDE	40.72	0.09	40.51	40.90
LONGITUDE	−73.91	0.10	−74.24	−73.70
AREA	1.72	1.57	0.117	11.99
BIZDENSE	0.62	1.24	0.025	7.30
ELEM SCHOOLS	4.1	2.5	1.00	14.0
Population Variables				
POPULATION	49,391	25,242	3,143	106,154
POPDENSE	42.64	30.04	1.25	152.39
VCRIME	33.20	33.17	0.00	325.20
ADFC	741.23	675.95	8.52	2582.91
%WHITE COLL	26.69	8.87	16.06	66.82
%PUBTRANS	51.87	15.37	14.12	77.65
%WHITE	46.60	27.63	1.74	95.33
%BLACK	25.95	28.39	0.26	93.45
%HISP	24.85	20.02	3.51	79.55
%ASIAN	9.86	10.64	0.39	53.93
%NAT AM	0.49	0.37	0.02	1.74
Borough Dummies				
BRONX	0.15			
BROOKLYN	0.23			
MANHATTAN	0.18			
QUEENS	0.35			
STATEN ISLAND	0.08			

Equation (4) includes the population density of the neighborhoods. The reason this is included is to test whether the distance variable is really a proxy for population density, because density tends to diminish farther away from the city center. Looking at all four equations, one can see that the distance measure is statistically significant and positive, indicating that teachers with greater experience prefer to work closer to the suburbs all else equal. Including population density has very little effect on the distance coefficient.

In equation (4), one can see that a 1° change from the city center is associated with a 25.5% increase in the percentage of teachers with more than five years experience. For example, the northmost neighborhood in the Bronx, zip code 10466, is 0.207° from the Empire State Building, which is about 16 miles away. Thus, for this neighborhood, I would predict an increase in teacher experience by 5.3%. The easternmost zip code in Queens, 11004, is 0.287° from the city center, which is about 16.7 miles away. This translates into a 7.3% increase of teachers with more than five years experience.

The variable for crime does not appear to be a significant determinant of neighborhood choice, though racial variables do seem to be important.[9] Finally, one can see that neighborhoods with a large white-collar presence attract teachers, while interestingly neighborhoods

9. Note that the raw correlation coefficient between *PCRIME* and *AFDCPERCAP* is 0.375, which would suggest there is not a multicollinearity problem between the two. In addition, because there is no information on the race of the teachers, I can't measure the relationship between the race of the teachers and the racial composition of the neighborhoods, but it would seem likely that teachers are attracted to neighborhoods that have a high proportion of residents that are the same race, all else equal.

TABLE 6
The Dependent Variable is the Estimated Neighborhood Effect from Section IV. Estimates obtained using weighted least squares; weights were the inverse of the square of the standard errors of the dependent variable. Standard errors are below estimates.

Dep. Var: %5YRS-ND				
Variable	**(1)**	**(2)**	**(3)**	**(4)**
AFDC	0.001	−0.0001	−0.001	−0.001
	(0.002)	(0.002)	(0.002)	(0.002)
BIZDENSE	−2.25	−2.07	−3.65	−3.61
	(0.6)***	(0.6)***	(0.8)***	(0.8)***
DISTANCE	15.53	26.14	25.49	25.52
	(14.08)***	(15.2)*	(14.9)*	(14.9)*
VCRIMES	−0.01	−0.005	−0.005	−0.005
	(0.02)	(0.02)	(0.02)	(0.02)
%*WHITE COLL*	0.38	0.36	0.44	0.43
	(0.11)***	(0.11)***	(0.11)***	(0.12)***
%*PUBTRANS*	−0.15	−0.11	−0.13	−0.12
	(0.07)**	(0.07)*	(0.07)**	(0.08)
%*BLACK*	0.07	0.09	0.095	0.09
	(0.03)**	(0.03)***	(0.03)***	(0.03)***
%*HISP*	0.03	0.08	0.08	0.07
	(0.06)	(0.06)*	(0.06)	(0.06)
%*ASIAN*	0.24	0.27	0.30	0.30
	(0.06)***	(0.07)***	(0.06)***	(0.06)***
%*NAT AM*	2.15	1.64	1.40	0.89
	(2.7)	(2.7)	(2.6)	(2.6)
BROOKLYN		3.44	2.98	2.88
		(1.8)*	(1.8)*	(1.8)
MANHATTAN		3.34	3.83	4.02
		(2.1)	(2.0)*	(2.1)*
QUEENS		1.47	0.623	0.55
		(1.8)	(1.7)	(1.7)
STATEN ISLAND		6.15	5.12	5.08
		(2.4)***	(2.3)**	(2.4)**
AFDC × *BIZDENSE*			0.003	0.003
			(0.001)***	(0.001)**
POPDENSE				−0.01
				(0.03)
CONSTANT	−1.14	−7.76	−8.22	−8.11
	(5.75)	(6.3)	(6.1)	(6.1)
N	151	151	151	151
R^2	0.30	0.35	0.39	0.39
$\bar{R}^2$	0.25	0.28	0.32	0.31

*Sig. at 90% level, **Sig. at 95% level, ***Sig. at 99% level.

with high public transportation use repel teachers. This is probably due to the fact that public transportation use is more common in older, more built-up neighborhoods, where congestion and lack of off-street parking may be a problem, as well as the fact that residents that use public transportation are more likely to be of lower socioeconomic status.[10]

10. The correlation coefficient between %*PUB TRANS* and *AFDC* is 0.481.

%*MASTERS-ND*. For the %*MASTERS-ND* equations, the poverty measure, the Staten Island dummy, and %*ASIAN* have statistically significant effects. Interaction effects are not significant, and distance, though positive, does not appear to be a large factor in neighborhood choice. Business density coefficients, though negative, are not statistically significant. Furthermore, employment composition, population density, and public transportation use do not seem to be significant determinants. The

TABLE 7
The Dependent Variable is the Estimated Neighborhood Effect from Section IV. Estimates obtained using weighted least squares; weights were the inverse of the square of the standard errors of the dependent variable. Standard errors are below estimates.

Dep. Var: %MASTERS-ND				
Variable	**(1)**	**(2)**	**(3)**	**(4)**
AFDC	−0.002	−0.003	−0.003	−0.003
	(0.001)*	(0.001)**	(0.001)**	(0.001)**
BIZDENSE	−0.28	−0.18	−0.70	−0.73
	(0.5)	(0.5)	(0.6)	(0.7)
DISTANCE	13.98	9.64	9.42	9.40
	(12.3)	(12.4)	(12.3)	(12.4)
VCRIMES	0.005	0.001	0.001	0.002
	(0.02)	(0.02)	(0.02)	(0.02)
%*WHITE COLL*	0.18	0.08	0.12	0.12
	(0.09)**	(0.09)	(0.09)	(0.10)
%*PUBTRANS*	−0.10	−0.01	−0.02	−0.02
	(0.6)*	(0.06)	(0.06)	(0.06)
%*BLACK*	0.0001	0.01	0.01	0.01
	(0.03)	(0.03)	(0.03)	(0.03)
%*HISP*	0.073	0.07	0.07	0.07
	(0.05)	(0.05)	(0.05)	(0.05)
%*ASIAN*	0.082	0.11	0.12	0.12
	(0.05)	(0.05)**	(0.05)**	(0.05)**
%*NAT AM*	−0.80	−1.34	−1.44	−1.39
	(2.3)	(2.2)	(2.10)	(2.17)
BROOKLYN		−0.16	−0.31	−0.24
		(1.5)	(1.5)	(1.5)
MANHATTAN		1.45	1.61	1.48
		(1.7)	(1.7)	(1.8)
QUEENS		1.52	1.25	1.30
		(1.4)	(1.4)	(1.5)
STATEN ISLAND		9.95	9.61	9.64
		(1.9)***	(1.9)***	(2.0)***
AFDC × *BIZDENSE*			0.001	0.001
			(0.001)	(0.01)
POPDENSE				0.007
				(0.002)
CONSTANT	−4.73	−7.88	−8.02	−8.10
	(5.0)	(5.0)*	(5.1)	(5.1)
N	151	151	151	151
R^2	0.33	0.46	0.46	0.46
$\bar{R}^2$	0.28	0.40	0.40	0.40

*Sig. at 90% level, **Sig. at 95% level, ***Sig. at 99% level.

results of this equation probably reflect the fact that teachers with master's degrees will often specialize in a subfield, such as reading, bilingual education, or special education, and will be more likely to go to those districts with these needs.

%2*YRS-ND*. The %2*YRS-ND* equations show similar results as the %5*YRS-ND* equations. The distance variable is even larger than in the %5*YRS-ND* equations. Using equation (4) I would predict, for example, that the northmost neighborhood in the Bronx, zip code 10466, would have about 6% more teachers who have been in their schools for more than two years, all else equal, than in the center city. For the easternmost neighborhood in Queens, the prediction would be about 8.2%. In general, population density, race (except %*ASIAN*) and crime do not appear to be significant; business density, employment composition, and public transportation use are significant.

TABLE 8
The Dependent Variable is the estimated Neighborhood Effect from Section IV. Estimates obtained using weighted least squares; weights were the inverse of the square of the standard errors of the dependent variable. Standard errors are below estimates.

	Dep. Var: %2YRS-ND			
Variable	**(1)**	**(2)**	**(3)**	**(4)**
AFDC	0.002 (0.002)	−0.0001 (0.002)	−0.001 (0.002)	−0.001 (0.002)
BIZDENSE	−2.43 (0.06)***	−1.99 (0.06)***	−3.55 (0.08)***	−3.40 (0.08)***
DISTANCE	4.76 (15.7)	29.00 (16.2)*	28.36 (15.86)*	28.47 (15.87)*
VCRIMES	−0.003 (0.02)	0.009 (0.02)	0.009 (0.02)	0.007 (0.02)
%*WHITE COLL*	0.113 (0.12)	0.264 (0.12)**	0.346 (0.12)***	0.314 (0.124)**
%*PUBTRANS*	−0.087 (0.07)	−0.119 (0.07)*	−0.136 (0.07)*	−0.096 (0.08)
%*BLACK*	0.007 (0.03)	0.045 (0.03)	0.053 (0.03)*	0.048 (0.03)
%*HISP*	−0.057 (0.07)	0.072 (0.07)	0.068 (0.07)	0.060 (0.067)
%*ASIAN*	0.164 (0.07)**	0.24 (0.07)***	0.268 (0.07)***	0.268 (0.07)***
%*NAT AM*	0.782 (3.0)	0.940 (2.8)	0.700 (2.8)	0.520 (2.8)
BROOKLYN		7.11 (1.9)***	6.66 (1.9)***	6.32 (1.9)***
MANHATTAN		1.32 (2.2)	1.81 (2.2)	2.43 (2.3)
QUEENS		−0.51 (1.9)	−1.35 (1.8)	−1.58 (1.9)
STATEN ISLAND		2.01 (2.5)	0.994 (2.5)	0.856 (2.5)
AFDC × *BIZDENSE*			0.003 (0.001)***	0.004 (0.001)***
POPDENSE				−0.03 (0.03)
CONSTANT	1.00 (6.4)	−11.12 (6.7)*	−11.57 (6.5)*	−11.22 (6.5)*
N	151	151	151	151
R^2	0.24	0.35	0.38	0.39
$\bar{R}^2$	0.18	0.28	0.32	0.32

*Sig. at 90% level, **Sig. at 95% level, ***Sig. at 99% level.

In summary, looking at all the dependant variables, %*MASTERS-ND* seems the least responsive to environmental factors. For %5*YRS-ND* and %2*YRS-ND*, distance from suburbs, employment composition, and neighborhood congestion are important. Surprisingly, crime rates do not appear to have an effect for all three variables; poverty and the transportation use of residents have mixed effects across regressions.

VI. CONCLUSION

This article has presented a regression analysis of the distribution of teacher quality measures in the New York City school system using a two-stage procedure. First the school-based effects on teacher quality are measured, holding constant the neighborhood effects. Next, the measured neighborhood effects are used as a dependent variable to measure those factors, at the zip code level, that determine the distribution of teachers across the city.

The results show that both school and neighborhood characteristics are significant determinants of the level of teacher quality in a school. In particular, higher quality teachers are attracted to schools with higher attendance, higher expenditures, and schools that are purely elementary schools (grade 5 and lower). On the other hand, higher quality teachers avoid schools that have relatively high expenditures on supervisory support and have large minority student populations. There is some evidence that higher quality teachers avoid schools with large male populations and with many limited English students. In terms of neighborhood characteristics, regression analysis shows the degree to which business density, neighborhood socioeconomic composition, and distance from the center of the city affect teacher location choices. For example, an increase of 10 miles from the city center is associated with a 3–5% increase of teachers with more than five years' experience, all else equal.

When given the choice to relocate, many teachers move to districts that present better working environments, better neighborhoods, and lower commute times. This would suggest that the fixed salary schedule does not present the correct incentives to teachers. If the goal of the system is to reallocate teacher quality such that the worse schools, all else equal, have at least the same proportion of higher quality teachers as compared to the better schools, then a new compensation system should be put in place.

Because this article has studied neither the dynamics of teacher mobility nor location choice within the larger, regional labor market, policy recommendations must be made with caution. In addition, given the current debate on which teacher quality measures have a significant impact on student performance, a policy designed to redistribute teachers within the school system needs to target the most effective measures of quality. That said, some potential policy remedies can include the payment of location differentials, which pay a higher salary to high-quality teachers willing to work in worse schools or neighborhoods. Another possible policy alternative would be for the school system to provide housing subsidies for top-notch teachers to give them the incentive to live near and remain at a particular school.

Further research in regards to the location choices of teachers needs to investigate the dynamics of teacher turnover and transfers not only within New York City but within the New York metropolitan area. In addition, more work needs to be done on the general equilibrium effects that look at both the supply and demand factors that determine quality measures across the region.

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