Disruption versus Tiebout Improvement: The Costs and Benefits of Switching Schools

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Abstract

Most students change schools at some point in their academic careers, but some change very frequently and some schools experience a great deal of turnover. Many researchers, teachers, and administrators argue that mobility harms students, particularly disadvantaged students in high turnover, inner city schools. On the other hand, economists emphasize the importance of Tiebout type moves to procure better school quality. Empirical research on mobility has yielded inconclusive results, no doubt in part because of small sample sizes and the difficulty of separating mobility effects from other confounding factors. This paper develops a general theoretical modeling that identifies school quality changes resulting from moving. The empirical analysis, which exploit the rich longitudinal data of the UTD Texas Schools Project, is able to disentangle the disruption effects associated with moves from changes in school quality. The results suggest that there is a small average increase in school quality for district switchers, while those switching schools within district appear to gain little in school quality. Perhaps most important for policy, the results also show a significant externality from moves: students in schools with high turnover suffer a disadvantage, and the cost is largest for lower income and minority students who typically attend much higher turnover schools.

Disruption versus Tiebout Improvement: The Costs and Benefits of Switching Schools

by Eric A. Hanushek, John F. Kain, and Steven G. Rivkin*

Switching schools is a common occurrence for children in the United States. In Texas public schools, for example, almost 50 percent of children switch schools at least once between grades four and seven even excluding changes due to the transition from elementary to middle school. Common perceptions of the implications of school moves, however, differ dramatically by the underlying perspective. Moves dictated by divorce, job loss, or similar events would be expected to disrupt academic progress, while "Tiebout" mobility, with parents changing districts in pursuit of higher quality schools or better matches for their children, would generally be thought of as achievement-enhancing. Frequent school changers, such as children of migrant workers and those who live in economically disadvantaged families, evoke particular concern. The combination of school instability with the pressures of economic disadvantage and limited community roots might be expected to diminish seriously prospects for academic success.

Prior evidence tends to suggest mobility is on average harmful to students, although the evidence is mixed. In many studies the relationship is not statistically significant, and some papers report a positive relationship between achievement and mobility (see Alexander, Entwisle and Dauber 1996). Kerbow (1996) suggests that most students recover fully two years following a move but that frequent movers lose ground relative to other students. Yet interpretation of these results is complicated by the fact that movers and non-movers appear to differ along a number of dimensions related to school performance. Movers, particularly those who move multiple times, tend to have lower family income, to be Black or Hispanic,

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and to have lower initial achievement. Thus several recent studies unsurprisingly show that controls for family background and pre-move achievement levels reduce the magnitude and statistical significance of moving effects, often to the point that hypotheses of no mobility effects cannot be rejected.[1]

There is even less evidence on the change in school quality following a move despite the emphasis on school quality differences in many theoretical models of neighborhood and school choice (e.g., Fernandez and Rogerson 1997; Epple and Romano 1998; Nechyba 2000). One problem is the difficulty of disentangling the effects of switching schools per se from concurrent changes in school quality. Kain and O'Brien (1999) suggest that moves that ultimately benefit students might appear costly if achievement is measured only in the year following the move. A recent study by Cullen, Jacobs and Levitt (2000) does examine the change in school quality for students who choose to take advantage of open enrollment and opt out of their neighborhood school in Chicago. Except for students attending a trade school, the there is little or no evidence that students systematically procure better school quality by choosing to travel to a non-neighborhood school.

Finally, a less discussed aspect of mobility is its effect on other students. Large student turnover can disrupt orderly teaching and curriculum development, implying potentially serious externality aspects of mobility. Because movers are more likely to attend schools with higher turnover, it is important to separate the direct effects of moving from the effects of high turnover in the school

This paper investigates the heterogeneous effects of different kinds of moves on students and their schoolmates using longitudinal information on students found in the extraordinarily rich data set constructed under the UTD Texas Schools Project. The large number of movers in this data set, which follows several entire cohorts of Texas elementary school students for a number of grades, permits detailed investigation of different types of moves and their implications for specific demographic groups.

[1]Alexander, Entwisle and Dauber (1996) and Ingersoll, Scamman and Eckerling (1989) both find that controls for family socio-economic status diminish estimated moving effects, and Alexander *et al.* find that control for initial academic achievement generally produces estimated moving effects that are not significantly different from zero. Kain and O'Brien (1998), however, find significant negative impacts of all kinds of mobility, even after conditioning on initial achievement.

Most importantly, mobility effects are identified by comparisons of academic performance before and after a move for the same student, a superior approach to relying just on comparisons between movers and non-movers.

The effects of moves that take place at various times during the year are considered, as are the consequences of moving multiple times during a single year. Movers who switch school districts are compared with those who remain in the same district with particular attention given to differences by race, ethnicity, and income because of the heterogeneity in mobility propensity, family circumstances and school quality.

The empirical model highlights the inherent difficulty in identifying pure school quality effects as distinct from correlated changes in family circumstances or from normal disruptions following a transfer to a new school. The estimation of school quality relies on long run effects on achievement gains that minimize contamination by short run costs. By comparing different types of moves, it is then possible to sort out students who tend to be hurt from those who tend to be helped.

The results suggest that on average there is a small but consistent increase in academic achievement for district switchers, because they are able to procure improved school quality or a better school match. In contrast, those switching schools within district and especially those moving more than once in a school year appear to suffer short run losses and obtain no significant improvements in school quality. Perhaps most important for policy, the results also show that students in schools with high turnover suffer a disadvantage, and the cost is largest for lower income students who typically attend much higher turnover schools.

A National Portrait of Student Mobility[2]

While the large amount of residential mobility in the U.S. has been recognized, its translation into school movements is less well understood. To provide an overview of student mobility, we begin with a

[2] We are indebted to Pat Reagan and Qing Liu for constructing the necessary data set and for producing the tabulations from the NLYS that we report in this section.

national picture of the amount of mobility for children age 9-14, the relevant age group for our subsequent analysis. This picture, derived from the NLSY79 database, describes residential moves over the two year period of 1994-96.

Table 1 shows that 45 percent of young students will undergo a residential move during this two year period. Of the movers, 70 percent will remain in the same school district, but 30 percent will find a different district.[3] Most of the time, the new district will be within the same metropolitan area, although 17 percent originally reside outside of a Metropolitan Statistical Area (MSA) and 10 percent of the movers originating in MSAs will go to a new MSA (not shown). The mobility rates of disadvantaged students (family income < 175 percent of the poverty level in 1996) are nine percentage points higher than advantaged students during this period.

Movers also tend to have a variety of other factors changing concurrent to the move. As shown in Table 2, changes in family status – divorce or marriage – are more frequent for movers than nonmovers, particularly for disadvantaged students.[4] Employment changes for mothers also frequently accompany moves, although the rate of employment change is not much different for movers than for nonmovers.[5] On the other hand, employment changes of fathers (actually spouses of mothers) are much more likely for movers than non-movers, particularly for disadvantaged families.

The higher incidence of changes in family structure and employment for movers highlights the fact that mobility is not a random event. Without detailed information on family decision-making, it is difficult to know whether a desire to move precipitates a job switch or visa versa or whether a change in family structure leads to relocation of the family. This complicates a study of school mobility, because it is difficult to disentangle the effects of the move per se on a child's academic performance from the effects of the events surrounding the move. On average Table 2 suggests that events associated with

[3] These data do not permit identifying moves within a district where the school does not change. The subsequent data for Texas track students across individual schools.

[4] Divorce and job loss lead to increased poverty rates, implying that some of the differences measured by poverty at the end of the period reflect the impact of these factors on poverty.
[5] The one exception is a noticeably lower rate of employment change for spouses of disadvantaged mothers in the nonmover category.

moves have a negative impact due to the fairly high incidence of divorce, though the degree of disruption likely varies a great deal from family to family and many movers, such as those who procure much better employment, experience positive changes in family life.

An Empirical Model of Mobility Effects

Most studies of moving simply compare the academic achievement of movers and non-movers without attempting to separate the change in school quality from the disruptive effects of moving. Recent work has given more attention to potential differences between movers and non-movers (see Alexander *et al.*1996), but the potential for unobserved factors to contaminate estimates of mobility effects is quite real even in studies that control for observable differences between movers and nonmovers. In this section we describe a theoretical framework that attempts to disentangle the various aspects of mobility and generates an empirical model that can distinguish changes in school quality from other consequences of mobility.

Theoretical Framework

We begin with a general model of the educational process that highlights important ways through which mobility may affect achievement. Much of the past work on mobility has been correctly criticized for just looking at simple relationships between moving and current achievement, but even the inclusion of a variety of contemporaneous measures of family and school characteristics will not permit identification of the effects of moving. Because achievement depends upon the entire past history of family, community and school inputs including mobility, the data requirements to model the entire achievement process are generally prohibitive. Our development here considers how longitudinal data on achievement and mobility can be used to identify parameters of interest.

Consider a value-added model of achievement growth in which annual learning (ΔA) for student i in school s in year t is a function of individual, family and school factors. To emphasize how school mobility enters, we write this to highlight the distinction between fixed factors and time varying factors such as:[6]

Eq. 1
$$\begin{aligned}\Delta A_{ist} &= A_{ist} - A_{i,s-1,t-1} \\ &= SQ_{ist} + \gamma_i + \delta_{it} + \varepsilon_{ist}\end{aligned}$$

where SQ incorporates school quality, γ captures all fixed family and individual influences on achievement, and δ captures influences that vary over time.

A key element of our analysis centers on school quality and its relationship to moving. School quality (SQ) can be thought of as being composed of a common component across all students in the school (ω) and a component that varies within schools (θ) and is a function of individual student mobility status (m_{it}):

Eq. 2
$$SQ_{ist} = \omega(\tilde{\omega}_s, \overline{m}_{st}) + \theta(\overline{m}, m_{ist})$$

While there is considerable heterogeneity in education quality within schools (Rivkin, Hanushek, and Kain 2001), we think of the common component (ω) as capturing the overall school quality differences that will enter into any school choice/moving decisions of families. The key elements of ω, which we refer to as "effective school quality," are a fixed overall quality ($\tilde{\omega}$) and the level of mobility in the

[6] Some value added models put lagged test score on the right hand side which allows its coefficient to differ from one. However, the inclusion of an endogenous variable on the right hand side that is a noisy measure of achievement introduces a number of statistical problems. In any event, preliminary work showed that coefficients on variables of interest were not sensitive to the form of the value added model. See Rivkin, Hanushek, and Kain (2001) for the development of a comprehensive model of education production.

school ($\overline{m}$).[7] The fixed component incorporates the quality of the staff, the resources available, peers, and the curriculum. The mobility component of effective quality incorporates the possibility that aggregate mobility rates affect the quality of education for all students. As there is more turnover of students, the overall instructional program may suffer as increased time is spent bringing all students to the same point in the curriculum, developing normal procedures, integrating parents into the school programs, and so forth. While we think of parents making school choices on the basis of effective school quality that combines both the fixed and the mobility driven components, we separate these because they have different policy implications and because our subsequent empirical approach makes it possible to distinguish the two.

Equation 2 also makes explicit the fact that school quality for new entrants may differ from school quality for incumbent students, as denoted by θ which is a function of both individual and aggregate mobility. Schools may assign new entrants to worse (better) teachers (θ_{ist}), and schools likely vary in the time it takes for new entrants to assimilate academically (possibly a function of the aggregate entry rate, $\overline{m}$).

Importantly, mobility also affects achievement independent of school quality. Students must establish themselves in a new community, make new friends, and learn new "operating procedures" at school. This has the character of school-specific human capital that is acquired on the task. In our framework, the time varying individual component (δ) is in part a function of mobility, but it is not directly related to the level of school quality.

From an individual family's decision viewpoint, equation 1 can now be manipulated to describe the net effect on school achievement associated with a move in year t:

[7] Our previous analyses of within school heterogeneity in teacher quality (Rivkin, Hanushek, and Kain 2001) is entirely consistent with this description of school quality where the fixed quality component ($\widetilde{\varpi}$) is the stable fixed component incorporating average teacher quality, resources, curriculum, and the like and individual classrooms deviate around this according to teacher quality. In the analysis below, we will assume that the expected deviation around the fixed component is zero for students who have not moved during the past year.

Eq. 3 $$\frac{\partial(\Delta A)}{\partial m_{it}} = \underbrace{\frac{\partial \omega}{\partial \tilde{\omega}}\frac{\partial \tilde{\omega}}{\partial m_{it}} + \frac{\partial \omega}{\partial \overline{m}}\frac{\partial \overline{m}}{\partial m_{it}}}_{pure\,Tiebout} + \underbrace{\frac{\partial \theta}{\partial \overline{m}}\frac{\partial \overline{m}}{\partial m_{it}} + \frac{\partial \theta}{\partial m_{it}}}_{school\ assimilation} + \underbrace{\frac{\partial \delta}{\partial m_{it}}}_{disruption}$$

The first four terms on the right hand side capture the impact of mobility via school quality. The first is the choice of different overall quality that comes with residential location and mobility choices. The second represents the coupled choice of overall school mobility level ($\overline{m}$) that accompanies a move and that works through its affect on effective school quality. The next two terms reflect the ability of the school to assimilate movers. The final term represents the "pure" disruptive effect of mobility on the individual component of learning, part of which is the loss of school specific capital built up prior to the move. The first two terms form the "pure Tiebout" effect, which indicates how a move relates to changes in overall school quality determined by school operations, peers and turnover; the third and fourth terms capture a school's treatment of new students; and the final term reflects disruptive effects on achievement that are independent of the level of school quality.

The signs on the respective derivatives determine the change in learning following a move. As we emphasize throughout the paper, students switch schools for a variety of reasons, only some of which are related to school quality. Some will experience a severe disruption; for others it will be minor. Some movers will transfer to better schools, others to worse schools. The sign and magnitude of a mobility coefficient estimated over the entire sample will reflect the relative frequencies of particular changes in school quality, the treatment of new entrants, and the magnitudes of disruptions. Not only do we attempt to separate the average change in school quality from other aspects of moving, but we also divide movers on the basis of move timing, frequency, distance and student demographics, all of which may be related to the change in school quality and degree of disruption.

Prior to discussing the estimation and identification of parameters, one final aspect of mobility is important. The previous descriptions were derived from the perspective of the potential mover. We have portrayed $\partial\overline{m} / \partial m_{it}$ as the difference in aggregate mobility rates between the old and the sending and receiving school. There is, nonetheless, a direct effect also, since the addition of another mover will increase $\overline{m}_{ist}$, which in turn will affect school quality and the ability of the school to assimilate other movers. This latter effect, presumably ignored by families in making their mobility decisions, involves a central externality. We explicitly consider such externalities in the estimation and evaluation below.

Regression Model

The task of identifying the pathways through which mobility affects learning is quite difficult, and it is complicated by the fact that moving is not a random event. Rather it involves an active decision process that can be precipitated by a number of factors, some of which may be related to achievement. In the context of equation (1), a change in family circumstances (δ) may both cause a move and affect achievement directly. Consequently, it is quite easy to confound the mobility effect with that of divorce, job loss, or other factors that precipitate a move.

Our approach takes advantage of the availability of multiple test score observations per student. Consider regression equation (4) in which achievement growth is regressed on an indicator variable for whether the student moved prior to or during year t, an individual fixed effect (γ_i^*), time varying individual factors (x_{it}), and a random error.

Eq. 4 $$\Delta A_{ist} = m_{ist}\lambda + x_{it}\beta + \gamma_i^* + \nu_{ist}$$

The estimate of γ_i^* incorporates all of the fixed inputs to achievement growth over the time period analyzed. For nonmovers it is easy to see that γ_i^* includes individual fixed factors in equation 1 (stable influences of family, peers, and neighborhoods) *plus* school quality. Any time varying components of achievement growth not included in x_{it} will be incorporated in the error term, ν. For a mover in year t, $\lambda = E(\partial \Delta A / \partial m_{it})$, which is found by taking the expectation of equation 3 across movers. Thus, λ is a measure of expected deviations in performance for the individual mover over the performance expected without a move, and its net magnitude involves not only induced changes in overall school quality but also disruption costs associated with the move.

While this formulation is a noticeable improvement over many of the existing estimates of mobility effects, it suffers from two major problems.[8] First, unless confounding influences that precipitate moves are fully accounted for, the coefficient on m_{it} will not provide a consistent estimate of the causal effect of moving on achievement. Second, without information about the separate components of λ, both the interpretation and the relevance for policy purposes will be quite limited.

An important objective is the identification of the change in school quality following a move. There is abundant evidence that observable variables such as expenditures, class size, teacher experience and education or even peer group quality capture little of the actual variation in school quality, meaning that we cannot simply add these characteristics to the specification and examine the change in the mobility coefficient to determine the average change in school quality. Moreover, non-movers provide no information on school quality, because the student fixed effect captures all fixed differences in schools.

By using information on achievement gains for more than two years, however, it is possible to disentangle the change in school quality from the other components of mobility. Equation (5) adds an additional mobility term (m_{ist}^*) equal to one for students who moved to school s in a previous year and zero otherwise:

Eq. 5 $$\Delta A_{ist} = m_{ist}\lambda + m_{ist}^*\lambda^* + x_{it}\beta + \gamma_i^* + \nu_{ist}$$

[8] Two fundamental limitations of existing estimates are apparent from equation 4. First, common estimates typically attempt to use cross-sectional information instead of the achievement growth formulation here. This approach entangles moving effects with current and past influences of family and schools. Second, when value added formulations are employed, the estimation typically relies on explicit measures of family and school circumstances instead of the fixed effect approach here. The validity of such analysis depends crucially on having adequate explicit measures, something that has proved elusive in past work.

The estimate of λ* reflects the average difference in learning between years following a move and the year prior to the move.[9] What factors contribute to this difference? In terms of equation (3), we argue that only the two "pure Tiebout" factors associated with differences in school quality systematically determine the size of λ*. This argument assumes that all assimilation and disruption costs including the acquisition of school specific human capital occur in the first school year (i.e., $E[\partial\delta/\partial m^*]=0$) and that movers are treated as incumbent students after the first year (i.e., $E[\partial\theta/\partial m^*]=0$). What remains is the persistent difference in school quality.

The largest concern about this interpretation surrounds the assumption that extraneous disruptions – divorce or job losses, for example – could have lingering effects that last more than a year. To the extent that they last across the entire period of observation for students, they would be absorbed into the individual fixed effect, γ_i^*, and would not contaminate the estimate of the change in school quality. If they are isolated in the period during and after the move, however, they can lead to some misestimation of school quality effects. The common candidates for such longer lasting disruptions tend to be negative effects, implying, if anything, that the estimates of school quality differences derived from λ* will be underestimates of the true differences.

While we can estimate the magnitude of transitory costs by λ-λ*, it is very difficult to separate this into the underlying factors described in equation (3). The components involve both adjustments in school and those unrelated to school. Even data on timing of events such as divorce or job loss – which we do not have available – present problems since the events per se might not adequately indicate the time periods of any disruption. Therefore we emphasize the general size of disruption effects rather than the precise magnitudes or the attribution to different causes.

To this point we have focused on the identification of the effects of moving for students who switch schools, but it is also possible to identify the impact of average turnover on learning for movers and nonmovers alike. Specifically, using the entire sample of students, we can estimate the impact of $\overline{m}_{st}$

[9] Note that when m*=1, m=0 and vice versa. If the person never moves, both always equal zero.

on effective school quality.[10] Because turnover is undoubtedly correlated with other determinants of school quality, simply including $\overline{m}_{st}$ into equation (5) as an additional regressor will not generate a consistent estimate of the effect of average turnover. Rather, we also remove school by grade fixed effects and use within school differences in outcomes for different cohorts in different grades to identify the effect of average turnover. Additionally, while the prior development has ignored the timing of moves, it is possible to divide entrants into those who arrive prior to the start of the school year and those who arrive during the year in order to see if midyear arrivals are more disruptive than students who arrive prior to the start of the year.

One final interpretative issue is important. The preceding development has not been explicit about the underlying causes and motivations for moving. Undoubtedly, individuals differ widely in the decisions to move. For simplicity, assume that there are two types of families: those motivated to move largely because of nonschool factors and those motivated largely by Tiebout school quality concerns. For the former group, such as those moving to accommodate a new job location, the change in school quality may be entirely incidental, and one might not expect to see much relationship between moving and school quality. For the latter, the opposite would hold. For example, it has frequently been asserted that disadvantaged students, particularly those moving within the same school district, are more likely to face disruptive moves. Moves within the same district, even if predicated on observed school quality differences, probably involve more uncertainty about future school quality differences.[11] It is also asserted that more advantaged students and particularly those changing school districts are more likely to be looking for better school quality. Finally, families changing to an entirely new metropolitan area are more likely to be driven by pure job location decisions and typically will not have access to especially

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[10] As discussed previously, nonmovers contribute nothing to estimation of the fixed school quality term, since this is included in the individual fixed effect, γ_i^*. Since $\overline{m}_{st}$ varies across time and cohorts, however, nonmovers can be used to estimate the mobility impacts on effective school quality.

[11] Black (1999) and Weimer and Wolkoff (2001) do show, however, that within district school quality differences appear to be capitalized into house prices.

detailed information about schools such as would come from living in a given metropolitan area for a number of years.

Our estimation of equation 5 can be thought of as estimating the weighted average of effects across the different types found in the sample of movers.[12] We do not know the motivation for any observed moves by students, but we can distinguish between types of moves and between families with differing income or racial backgrounds. If these factors are correlated with move motivations, the weighted averages of changes in school quality will vary according to the differing proportions in the population. Thus, common assertions about mobility can be tested in terms of the weighted average outcomes for alternative groupings of student moves.

The UTD Texas Schools Microdata Panel

The cornerstone of this research is the analysis of a unique microdata set of school operations constructed by the UTD Texas Schools Project, a project conceived of and directed by John Kain. The database tracks elementary students as they progress through school; it measures student performance each spring; and it contains detailed information about their school services.

Beginning in 1993, the Texas Assessment of Academic Skills (TAAS) was administered each spring to eligible students enrolled in grades three through eight. Unique IDs link the student records with the test data.[13] The criteria referenced tests evaluate student mastery of grade-specific subject matter and provide our measure of student outcomes. We use mathematics test scores in this paper, although the results are qualitatively quite similar for reading achievement. Each math test contains approximately 50

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[12] The weighted average nature of the mobility coefficients helps to reconcile some of the previous variation in results across studies. Most of the prior studies rely on nonrepresentative samples and restrict attention to specific subsets of moves.

[13] One important data consideration is the possibility that schools miscode student IDs, which would tend to depress the number of movers within the public schools and overstate the percentage who exit Texas public schools. While there is no sure check for coding errors, the evidence suggests that other types of coding problems are quite minimal. Less than one percent of observations in 4th grade and less than one half of one percent of observations in 5th thru 7th grades did not have unique IDs in each cohort; note that a small number of duplicate records were deleted.

questions. Because the number of questions and average percent right varies across time and grades, we transform all test results into standardized scores with a mean of zero and variance equal to one and included dummy variables for each grade/year combination. The regression results are robust to a number of transformations including the raw percentage correct.

The TAAS data are merged with a school attendance data set that provides information on school attended for each of six six-week periods during the school year, permitting us to identify the approximate timing of all school switches and along with those students who move multiple times during an academic year. For each cohort there are over 200,000 students in over 3,000 public schools. The large numbers of students who change schools and school districts are especially important for the methodology pursued here, as are the multiple cohorts which permit tracking of students who fall as far back as two grade levels behind their 4th grade classmates or who move ahead as many as two grade levels.

While the data contain a limited number of student, family and program characteristics including race, ethnicity, gender and eligibility for a free or reduced price lunch, the panel feature can be exploited to account implicitly for time invariant individual effects on achievement. Importantly, students who switch schools can be followed as long as they remain in a Texas public school.

School transitions (m_{it}) are defined as changes other than those that result from the structure of school districts.[14] In other words, the transitions from elementary to middle and middle to junior high schools for students who remain in the same attendance zones are not considered moves, and the dummy variables for highest and lowest grade in a campus capture the effects of such transitions.

Student Mobility in Texas

Texas schools mirror those in other parts of the nation: Switching schools is a regular part of academic life for many elementary school students. Table 3 presents the distribution of students by the

[14] Because information on change of residence is not available, a school change was considered a structural change if the transition was to a school attended by more than 30 percent of previous classmates. Such structural transitions combine transitions between middle school and junior high with changes in attendance zones including the opening of new schools.

number of moves during a three-year time frame for students who remain in the Texas public schools for the entire period.[15] About one-third move at least once, though move frequencies vary by ethnicity and income. Only 25 percent of students never eligible for a subsidized lunch move even once, and only 5 percent move multiple times. In contrast, 40 percent of students eligible for a subsidized lunch in at least one period move at least once, 10 percent move twice, and 7 percent move three or more times. The bottom three rows reveal similar differences by race and ethnicity.

Tables 4 through 7 focus on annual transitions.[16] Table 4 examines differences by grade, Table 5 reports differences by timing and location of moves, and Tables 6 and 7 document mobility rates by origin and destination school community type.

The transitions reported in Table 4 reveal that exit rates from the Texas public school system tend to decline as students age, falling from 7.6 percent in 4th grade to 6.1 percent in 7th grade.[17] A similar pattern holds for all demographic groups. In contrast, there is no strong grade pattern for school changes that holds for all demographic groups despite the existence of large differences across groups: the income and Black/White gap in annual transition rates are approximately 10 percentage points or 50 percent. The incidence of mobility and the differences by income level appear very consistent with those described previously for the nation as a whole.

Table 5 divides moves into within and between district changes and by timing and frequency. On average 8.4 percent of students transfer within the same district and another 13 percent switch districts annually. (A final 1.4 percent enters a school that did not previously exist, making it similar to a structural move between elementary and middle school). While Black and low income students are

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[15] The three year period runs from the final 4th grade attendance census to the final 7th grade attendance census for two cohorts and from the final 3rd grade census to the final 6th grade census for the other cohort. As discussed below, during each year, approximately 7 percent of students leave the Texas public schools.

[16] Note that the annual rates in these tables do not sum to the total number of moves reported in Table 3, because these tables include the mobility of students not in the Texas public schools at some point during the three year period.

[17] Exits combines two heterogeneous groups: those who leave the state entirely and those who leave the public schools for private schools within the state. We are unable to distinguish between these in our data. Moreover, while we do not consider the achievement effects, exiting from the sample clearly involves a school move.

somewhat more likely to switch districts, the most pronounced differences by income and ethnicity occur in the probability of a within district switch. Blacks are almost three times as likely as Whites (14.7% to 5.7%) to change schools within district and Hispanics are almost twice as likely as Whites. Similarly, lower income students are roughly twice as likely to change schools within districts as higher income students. Though the national data do not distinguish between within district moves that did and did not result in school transfers, the patterns in Texas are qualitatively similar to those for the nation as a whole. In terms of timing, a substantial percentage (almost 10 percent) of students switch schools at least once during the school year, and the probabilities of multiple transfers within a year and moving during the school year present the largest differences by demographic group. Minority and lower income students are much more likely to move multiple times in a year and much more likely to move during the year.

The income and ethnic differences in within district changes in part reflect the fact that minorities and low income students are much more likely to attend public school in urban districts where within district moves are much more common. Almost fifty percent of Black and Hispanic students attend urban schools while only 20 percent of Whites attend public school in urban districts. There is also a 15 percentage point gap in urban attendance by income. Table 6 confirms that within district transfers are much more prevalent in urban districts, particularly large districts in major urban centers. Annually over 14 percent of students in urban schools transfer to another school within the same district; the corresponding figure for rural districts is only 2.5 percent (reflecting the fact that many have no within district alternative). Not surprisingly, rural and suburban students are somewhat more likely than urban students to change districts, though regardless of the origin community type there is a pronounced trend toward moving to suburban and rural districts. Among students who leave urban districts, almost 85 percent move to a suburban or rural district, while less than 30 percent of suburban students and 15 percent of rural students who switch districts move to an urban school.

Table 7 takes a more detailed look at mobility rates by destination community type, income and ethnicity for students attending large urban districts. While there are substantial income and ethnic differences in the probability of moving within district, the probabilities of switching districts are much more similar. Hispanics are somewhat less likely to move to the suburbs, and Hispanics and Blacks are less likely to move to rural districts.

These five tables reveal a great deal about school transition rates along a number of dimensions. Even so, we lack detailed information on family circumstances, so we cannot adequately distinguish between cases of "distress" (such as job loss or divorce), Tiebout moves in search of better schools, and the majority of moves that result from employment changes or other factors. But the NLSY data make it clear that moving, whether within or across districts, is correlated with a variety of family changes.

Mobility Effects on Mathematics Achievement

This section presents the results of the analysis of mobility effects on mathematics achievement. Two sets of estimates are reported for most specifications. The first subsumes all types of moves into a single variable, while the second divides moves on the basis of timing and location. Students who move a single time in a year are divided between district switchers who change regions, district switchers who remain in the same region, and those who move to a new school but remain in the same district. An additional variable indicates those who moved during the school year.[18] Finally, those who switch multiple times in a year regardless of school location are grouped together. All specifications include indicators for the first grade in a campus, the final grade in a campus, subsidized lunch eligibility, and year by grade. Separate estimates are computed by ethnicity and income in order to investigate differences by demographic group. Following the discussion of the mobility estimates we consider the external effect of mobility on schoolmates.

Mobility Estimates

[18] Preliminary work that allowed fully interacted the timing and location variables showed that the difference between pre year and during year move effects was very similar for both district switchers and those who moved within district. Subsequently we restricted the effects of within year moves to be the same for all students

Table 8 reports baseline estimates of the effects of different types of moves on achievement level in the highest grade and on annual achievement gains. The levels specification in the first pair of columns provides a direct comparison with other studies that utilize cross-sectional data. The second pair provides a benchmark for the basic value added specifications, but each undoubtedly confounds mobility effects and a variety of other selection factors. All standard errors (here and subsequently) are adjusted for the grouping of cohorts of students in schools, and the sample is restricted to students with valid test scores for four consecutive grades. Each pair of columns contains two separate estimating equations: the first aggregates all types of moves while the second separates moves by location and frequency.

Not surprisingly given the observed transition patterns, the estimates in the first column show that movers have significantly lower test scores and test score gains than nonmovers, particularly those who move multiple times. On average, for example, movers have math scores 0.16 standard deviations lower than nonmovers. Simple consideration of lower achievement before the move (achievement gains), however, dramatically lowers the average estimate of moving costs to 0.024 standard deviations. Moreover, the disaggregated estimates suggest that different types of moves have different effects.

We now turn to the preferred specifications that include an indicator for a move in a previous year and student fixed effects. As we described above, the coefficients on the indicator for a previous move (λ^*) in Table 9 captures the change in school quality for movers (the "Tiebout effect"), while the coefficients on current mobility conflate the change in school quality with the loss of school specific capital, other costs of disruption, school efforts to assimilate new entrants and the confounding influences of changes in family income or structure that may be associated with the move. Subtracting the coefficient on past mobility from the current mobility coefficient provides an estimate of the transitory components of the cost of moving, though we are unable to disentangle the specific underlying factors.

Ignoring differences in move timing or location, the average mover does not appear to obtain any change in school quality (as indicated by a quite small and statistically insignificant coefficient on prior mobility, $\hat{\lambda}^*$). Achievement gains are significantly lower in the year of the move, though the extent to which that reflects a causal effect of mobility cannot be determined. However, assuming that mobility related factors such as divorce or income change on average exert a negative impact on achievement, the estimates suggest that the average transitional cost of moving is small, less than two one hundredths of a standard deviation. Moreover, while low income and minority students suffer somewhat above average short run costs, no subset obtains any significant improvement in average school quality.

As hinted at in the previous table, however, the pattern of mobility effects clearly varies by type of move. Table 9 displays direct estimates of disaggregated costs and benefits associated with moving. The hypothesis that average school quality does not change for those who switch regions, move to a new school in the same district, or move multiple times cannot be rejected at any conventional level. But, those who move to a new district in the same region experience a significant average increase in school quality of 0.02 standard deviations, a lasting effect that remains each year in the new district. Importantly, because this estimate is computed over students whose families moved for a variety of reasons (including divorce), only some of which are associated with a search for better schooling, the magnitude 0.02 likely provides a lower bound estimate of the average improvement in school quality for `Tiebout' movers who switch districts to procure higher quality schooling.

The coefficients on current mobility suggest that those who move within districts and those who move multiple times experience the largest academic setbacks. Subtracting the past mobility coefficient from the coefficient on current mobility shows that academic gains for within district movers are reduced by roughly 0.02 standard deviations independent of the change in school quality and the academic gains of multiple movers decline somewhat more. Moves within districts or across metropolitan areas are associated with no significant changes in overall average school quality. Surprisingly, the hypothesis that the timing of the move has no effect on the cost of moving cannot be rejected at any conventional level. Though we expected students who moved during the school year to experience larger transition costs, that was not the case.

One important question is whether the mobility estimates in general and average change in school quality in particular are contaminated by unobserved changes over time in family circumstances. For example, families may experience a strong negative shock prior to the move, and the subsequent recovery might be wrongly attributed to improved school quality. Though such shocks cannot be observed, we can look at the pattern of test score gains in the years prior to moving in order to examine the likelihood that temporary negative (or positive) family shocks confound the estimates. For the sample of movers who were in the same district for the two years prior to moving, we cannot reject the hypothesis of equal average achievement gains in the two prior years (Appendix Table A1). In addition, the point estimate for between district movers is positive (average gains were higher immediately prior to moving than in the previous year), providing no support for the belief that such movers experienced a temporary negative shock on average in the year prior to the move.

Another important issue is whether mobility effects vary systematically among demographic groups. The second and third columns report results for students ever classified as economically disadvantaged and those never classified respectively, and the final three columns present the findings for Blacks, Hispanics, and Whites respectively.

The estimates by income reveal some differences in the transitional costs associated with moving but little difference in the average change in school quality. Both higher and lower income students who switch districts within region enjoy an average improvement in school quality of roughly 0.02 standard deviations per year, though lower income students incur a larger cost in the initial year following the move. Lower income students who move multiple times and those who move within district also incur higher costs on average than higher income students for the same type of move. This does not imply that transition costs of moving are higher for lower income students, because the estimates cannot separate the transition costs from contemporaneous changes associated with the move. Lower income students may experience larger negative move-related shocks on average, perhaps because of the higher incidence of divorce reported in Table 2.

As would be expected given the strong link between income and ethnicity, the pattern of mobility estimates is fairly similar across demographic groups. Again, only those who switch districts within region experience an average increase in school quality. (Although the point estimates of change in school quality are very similar across groups, only the estimate for the larger white sample is statistically significant). Blacks who move within districts incur somewhat larger transition costs than Hispanics who in turn incur somewhat larger costs than Whites, while among those who make multiple moves in a year it is Hispanics who incur the higher average costs.

Two main findings emerge from the investigation of the cost of moving. First, district switchers tend to experience an improvement in school quality, but average school quality is largely unchanged following other types of moves. Given that school quality considerations probably play a minor role in most decisions to relocate to a different region and knowledge of schools in the new region may be quite limited, it is not surprising that average school quality remains largely unchanged following such a move. It is also not surprising that within district movers experience no systematic gain in school quality. This result is consistent with Cullen, Jacobson and Levitt (2000), and likely reflect the fact that all schools within a district share a common central administration, financing system, and other factors. Moreover, in comparison to district switches, within district moves are less costly for the family and may be undertaken with lower expected benefits.

Second, the transitional costs of moving are small on average for all demographic groups and all types of moves. Despite the inability to disentangle the various components of transition costs, the total cost is small on average, particularly in comparison to the average achievement differences between movers and non-movers. While moving might impose severe burdens on some students, overall the costs of moving per se do not appear to impose a major impediment to academic success.

Externalities of Mobility

Even if the transition cost of moving is small, school quality may be adversely affected by high student turnover. New students may disrupt the classroom because of differences in skills and institutional knowledge. This may be a particular problem for high turnover schools in which there is substantial variation in academic preparation and large numbers of students who enter during the school year. The possibility that turnover effects non-movers as well as movers is raised by many including Alexander, Entwisle, and Dauber (1996) and Kerbow (1996), though neither attempts to estimate the impact of turnover on non-movers.

We examine the external effects of mobility using a model that removes student as well as school-by-grade fixed effects. The methodological problem that must be overcome in identifying turnover effects is perhaps even more difficult than that for simple mobility effects, because sorting on the basis of school turnover rates may be even more systematic than differences between movers and nonmovers. In fact all investigations of peer group effects share this concern.

Our approach is to use differences across cohorts in the change in turnover rates from one grade to the next to identify the effects of turnover. Consider a stylized school that offers both the 5^{th} and 6^{th} grade. Assume twenty percent of this year's 6^{th} grade class are new to the school, while only 15 percent of the students were new last year when the students were in 5^{th} grade. In comparison, last year's 6^{th} grade class had only 15 percent new students in 6^{th} grade but 23 percent new students in 5^{th} grade. It is the within school difference in the change in percent new (20 percent minus 15 percent for the first cohort, 15 percent minus 22 percent for the second cohort) that we use to identify the external effects of turnover. Controlling for individual fixed effects in gains and mobility, we believe that these cross cohort differences are orthogonal to most other factors that systematically affects achievement gains and therefore identify the actual impact of school turnover. Even a systematic moving pattern as students age that is related to achievement will not contaminate the estimates. For example, consider a school in a high poverty area in which mobility increases as students age while at the same time relative performance declines. Controlling for only student and school fixed effects will leave the estimates susceptible to contamination by those factors evolve over time and affect both mobility and achievement, such as a greater difficulty attracting teachers as students age. However, the removal of school-by-grade fixed effects eliminates even systematic influences that evolve over time.

There are confounding school factors that may not be eliminated by the removal of school-by-grade fixed effects. One is average class size. If additional entrants tend to increase average class size, the negative effects of turnover may be confounded with the negative effects of larger average class sizes.

A second is peer group quality. If new entrants tend to reduce peer average quality, the omission of information on peer quality may bias upward the estimated effect of turnover. Finally, teacher turnover and inexperience may be positively correlated with student turnover, and their exclusion may also bias upward the estimated effect of turnover. We examine these factors below.

Table 10 reports two sets of turnover effects. The first groups all new students into a single category, while the second separates students who enter prior to the start of the school year from those who enter during the year. The possibility that turnover affects movers and nonmovers differentially, perhaps because the effectiveness with which schools assimilate new entrants is a function of turnover, is also examined. We also considered the possibility of nonlinear effects, but quadratic specifications provided no support for such nonlinearities.

Again we begin with simple levels and gains specifications. Not surprisingly higher turnover is strongly associated with a lower level of achievement, particularly the proportion of students who enter during the year. As expected, however, the estimates decrease substantially as additional controls are included.

The well-controlled estimates that include both student and school-by-grade fixed effects reveal a strong negative relationship between achievement and turnover. From the final column, there is little evidence that turnover hurts movers differentially from nonmovers. This finding implies that the term for the effect of aggregate turnover on a school's ability to assimilate movers in equation 3 is unimportant.

The magnitude of the coefficient in Column three suggests that a one standard deviation increase in the proportion of students who are new to the school (an 11 percent change) would reduce achievement by almost 0.015 standard deviations. While a single year effect of this magnitude is not large, the sum total of ten or twelve years of high turnover will have a substantial cumulative effect on learning for those students who attend high turnover schools year after year.

The bottom panel of Table 10 shows that all turnover is not alike, as the negative effect of entrants during the school year is twice as large as the effect of entrants at the beginning of the school year. This pattern of estimates conforms with expectations that mid-year entrants are more disruptive to the education process.

Table 11 examines the sensitivity of these results to the inclusion of teacher characteristics and peer achievement. Specifically, high turnover at a school could simply be a proxy for other factors that affect achievement, such as more teacher turnover or poorer peers. To investigate the impact of student mobility per se we include both a set of potentially important teacher factors (class size, proportion of new teachers, and the school's teacher turnover rate) and peer factors (average achievement of classmates).[19] The estimates on the turnover variables remain virtually unchanged from those observed in Table 11 when the teacher and peer variables are added. This provides strong support for the interpretation that we have identified the impact of student turnover per se.

We also investigated the possibility that the sensitivity to turnover varies by demographic group. The estimates in Table 12 do not show that turnover affects Blacks more than Whites, though the estimates for Hispanics are somewhat larger than those for Whites. On the other hand, differences by income level – particularly for midyear turnover – are somewhat larger. Poor kids are more affected by the externalities of school mobility.

An important question is whether turnover can account for a substantial portion of the ethnic or income academic achievement differential through its adverse effect on school quality. Differences in the rates of moving per se cannot provide much explanation of racial gaps, because the disruption costs of moving are small and isolated in the year of the move. But low income and minority students can be hurt by the externality portion, given that they end up in schools with more turnover and that they can experience these negative forces as long as they remain in high turnover schools. Appendix Table A2 reveals that school turnover rates are distinctly higher for lower income and nonwhite students. The

[19] Hanushek, Kain and Rivkin (forthcoming) describe the estimation of peer group effects using the Texas data. We use peer average achievement of classmates lagged two years to break the potential link due to unobserved differences in teacher quality and to the simultaneous affect students have on one another. As a result, a number of observations including all those for fourth grade are dropped. Constructing average peer achievement based on test scores for the previous grade (the average achievement of peers at the start of the school year) generates virtually identical results.

proportion of students who enter during the year is more than 25 percent higher for Hispanics than for Whites and over 40 percent higher for Blacks than for Whites. While there is only a small gap between Hispanics and Whites in the proportion of students who are new entrants at the beginning of the year, the Black/White gap is substantial.

These differentials suggest that turnover accounts for noticeable portions of the racial or ethnic gaps in achievement. Based on the turnover coefficients in the bottom panel of Table 10, the racial differences in turnover reduce academic achievement for Blacks relative to Whites by 0.007 standard deviations per year. Eight years of such turnover differences would widen the racial achievement gap by 0.06 standard deviations, or about 10 percent of the Black/White mathematics achievement differential in 7^{th} grade.

Moreover, the impact of turnover on those who attend high turnover schools year in year out is far from trivial, because these effects cumulate over time. A student who attends school with a turnover rate of 50 percent rather than 20 percent for 12 years will lose one half of a standard deviation in mathematics achievement.

A final consideration is the contribution of turnover to the costs of moving. Appendix Table A2 shows that students who move within district arrive at schools with much higher turnover than those they left. The differential of 0.09 means that turnover alone reduces achievement by 0.006 standard deviations on average, which exceeds 20 percent of the total achievement drop in the year of the move.

Conclusions

Consideration of school mobility has split between those emphasizing the disruption and harm to students and those emphasizing Tiebout choice of schools as a way that families can improve school quality. These opposing views have led to widely differing policy perspectives. At the same time, prior evidence on mobility effects has not reach a consensus on achievement implications, in large part we believe because the existing research has not identified or estimated the same parameters.

We develop a model of achievement growth that highlights the various avenues by which mobility can affect student achievement. Most existing empirical approaches are shown to estimate a net effect of moving that combines any changes in school quality with short run disruption costs. Moreover, the estimates almost certainly capture the effects of other changes such as divorce or job loss are frequently associated with moving. With panel data of sufficient length, however, it is possible to develop a consistent estimate of school quality changes.

Our empirical analysis, conducted using the rich stacked panel data of the UTD Texas Schools Project, allows quite precise estimates of the effects of mobility. The results indicate that moves across districts yield a small but significant improvement in average school quality and that these effects are very consistent across income and racial/ethnic subgroups. At the same time, moves within a district are associated with no significant changes in school quality but tend to involve noticeable short run costs – costs that are generally higher for poor and minority students. Since estimates of move effects are weighted averages across families moving for both school and nonschool reasons, the different estimated effects in part reflect the proportions of families motivated by different forces and likely underestimate the school quality gains for `Tiebout' movers seeking a higher quality education.

School mobility also involves a clear externality. Schools with higher student turnover are shown to have significantly lower achievement than schools with lower turnover, all other things equal. Moreover, the effects are stronger when more students enter during a school year as opposed to at the beginning of the year. Blacks and Hispanics on average attend schools with higher mobility rates both overall and during the year, subjecting them to a disadvantage that can accumulate to substantial losses in achievement. These differences by themselves can explain a portion of the racial gap in achievement.

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Table 1. Aggregate U.S. Moving Outcomes from Students age 9-14, 1994-96 by poverty status

	Nonmovers	Movers	
		within district	across districts
all	55.4%	31.3%	13.3%
disadvantaged	50.5%	34.7%	14.9%
not disadvantaged	59.3%	28.7%	12.1%

Source: NLSY79

Table 2. Concomitant Family Changes for Students age 9-14, 1994-96 by poverty status (percents)

	Nonmovers	Movers	
		within district	across districts
Disadvantaged			
Family status changed	19.6	20.2	27.5
Got divorced/separated	10.6	15.5	22.2
Employment status of mother changed	25.7	27.4	29.8
Became unemployed	6.6	8.2	18.1
Employment status of spouse changed	17.2	27.5	32.1
Became unemployed	8.0	12.5	25.0
Not disadvantaged			
Family status changed	12.5	19.1	28.0
Got divorced/separated	8.7	10.7	14.0
Employment status of mother changed	16.5	15.6	20.4
Became unemployed	5.5	5.5	6.8
Employment status of spouse changed	9.9	12.1	10.0
Became unemployed	4.0	7.0	6.7

Source: NLSY79

Table 3. Distribution of Texas Public School Students by the Number of School Changes between 4th and 7th Grade, by Income and Ethnicity

	Number of School Changes						
	0	1	2	3	4	5+	Number of students
All Students	66.1%	21.8%	7.6%	2.7%	1.0%	0.8%	701,311
ever low income	59.6%	23.5%	10.0%	4.0%	1.6%	1.2%	406,843
never low income	75.0%	19.5%	4.2%	0.9%	0.2%	0.1%	294,458
Black	52.4%	27.5%	12.2%	4.8%	1.9%	1.3%	96,699
Hispanic	64.7%	22.3%	8.0%	3.0%	1.1%	0.8%	247,771
White	70.9%	19.7%	6.0%	2.0%	0.8%	0.6%	341,041

Note: Sample restricted to students in sample three complete years and in the final period in the prior year. School changes exclude structural changes of going from elementary to middle school or going to a newly constructed school.

Table 4. Average Annual Probabilities of Switching Schools and Exiting the Texas Public School System Between Grades 4 and 7, by Grade, Income and Ethnicity

	Ever Low Income		Ethnicity			
	Yes	No	Black	Hispanic	White	**All**
School Switches						
All Grades	26.4%	17.6%	30.2%	24.0%	19.6%	22.8%
Grade 4	28.1%	18.1%	31.2%	24.7%	21.1%	23.9%
Grade 5	25.6%	16.3%	27.8%	22.6%	19.3%	21.7%
Grade 6	27.2%	18.6%	32.6%	24.9%	19.9%	23.6%
Grade 7	25.6%	17.8%	30.0%	24.2%	18.7%	22.4%
Exit Texas Public Schools						
All Grades	7.2%	6.2%	7.2%	6.9%	6.6%	6.8%
Grade 4	7.7%	7.4%	8.8%	7.5%	7.3%	7.6%
Grade 5	7.1%	6.1%	7.1%	6.8%	6.5%	6.7%
Grade 6	6.9%	6.5%	6.8%	6.6%	6.8%	6.7%
Grade 7	6.7%	5.3%	6.6%	6.2%	5.9%	6.1%

Table 5. Average Annual Probabilities of Switching Schools Between Grades 4 and 7, by Type of Move, Income and Ethnicity

	Ever Low Income		Ethnicity			
	Yes	No	Black	Hispanic	White	**All**
All School Switches	26.4%	17.6%	30.2%	24.0%	19.6%	22.8%
By Timing						
Prior to school year	14.9%	12.4%	18.4%	14.1%	12.2%	13.9%
During school year	7.1%	3.9%	7.0%	6.4%	5.0%	5.8%
Multiple moves	4.4%	1.2%	4.8%	3.4%	2.4%	3.1%
By School Location						
Same district	10.7%	5.3%	14.7%	9.7%	5.7%	8.4%
New district, same region	13.7%	11.7%	12.2%	11.4%	10.6%	11.2%
New region	13.7%	11.7%	1.4%	1.3%	2.3%	1.8%
Move to new schools both in and out of district	2.0%	0.6%	2.1%	1.6%	1.0%	1.4%

Table 6. Destination School Community Type by Origin School Community Type
(computations based on school enrollment at time of test administration)

Origin Community	no move	new school same district	Destination in new district				Number of Observations
			large urban	small urban	suburban	rural	
Large Urban	77.6%	15.0%	0.9%	0.3%	4.8%	1.3%	477,873
Small Urban	80.4%	13.8%	0.4%	0.6%	3.0%	1.8%	298,095
Suburban	84.6%	7.5%	1.5%	0.8%	3.8%	1.8%	898,898
Rural	89.7%	2.5%	0.5%	0.6%	1.7%	5.0%	697,812

Table 7. Destination School Community Type for Students in Large Urban Districts, by Income and Ethnicity
(computations based on school enrollment at time of test administration)

Origin Community	no move	new school same district	Destination in new district: large urban	small urban	suburban	rural	Number of Observations
Ever low income							
Yes	76.0%	16.4%	1.0%	0.3%	4.9%	1.3%	367,726
No	82.9%	10.5%	0.4%	0.4%	4.4%	1.4%	110,110
Ethnicity							
Black	70.4%	22.2%	0.4%	0.3%	5.6%	1.1%	117,095
Hispanic	80.2%	13.5%	1.2%	0.3%	3.9%	0.9%	258,444
White	79.3%	10.5%	0.6%	0.5%	6.0%	3.0%	93,336

Table 8. Estimated Effects of Moving (λ) on Mathematics Achievement Test Score and Test Score Gain during Grades 4, 5, 6, and 7, By Type and Timing of Move (absolute value of Huber-White adjusted t statistics in parentheses)

	Score in Highest Grade		Annual Gain	
All Moves Combined				
move to new school	-0.161		-0.024	
	(21.74)		(9.71)	
Location				
move to new district		-0.098		-0.004
in same region		(10.44)		(1.02)
move to new region		0.027		0.011
		(2.42)		(2.25)
move within district		-0.052		-0.029
		(4.13)		(7.27)
move during year		-0.270		-0.017
		(22.72)		(3.27)
More Than One Move		-0.423		-0.055
		(34.32)		(10.71)
observations	491,806	491,806	1,475,643	1,475,643

Note: All specifications in all tables include indicator variables for highest and lowest grades in a campus, new schools, student eligible for a subsidized lunch, and a vector of grade by year dummy variables. All but the school fixed effect specifications also include community type dummies.

Table 9. Estimated Effects of Moving on Mathematics Achievement Test Score Gain during Grades 4, 5, 6, and 7, by Type and Timing of Move, Income and Ethnicity (absolute value of Huber-White adjusted t statistics in parentheses)

		Ever low income		Race/ethnicity		
	All	Yes	No	Black	Hispanic	White
Location						
new district, same region*	0.008	0.000	0.019	0.003	-0.014	0.023
year of move (λ)	(1.23)	(0.06)	(2.14)	(0.16)	(1.19)	(2.86)
new district, same region*	0.023	0.022	0.024	0.020	0.023	0.026
subsequent years (λ*)	(2.82)	(1.93)	(2.28)	(0.84)	(1.44)	(2.69)
move to new region*	0.008	0.000	0.014	-0.012	-0.009	0.019
year of move (λ)	(0.99)	(0.02)	(1.38)	(0.42)	(0.50)	(2.00)
move to new region*	-0.013	-0.021	-0.005	0.012	0.005	-0.019
subsequent years (λ*)	(1.22)	(1.30)	(0.38)	(0.29)	(0.21)	(1.53)
move within district*	-0.026	-0.031	-0.019	-0.044	-0.024	-0.012
year of move (λ)	(4.19)	(3.81)	(2.59)	(3.21)	(2.48)	(1.60)
move within district*	-0.004	-0.006	-0.006	-0.001	-0.012	-0.010
subsequent years (λ*)	(0.58)	(0.54)	(0.60)	(0.05)	(0.93)	(1.06)
move during year*	-0.006	-0.013	0.009	0.010	-0.015	-0.014
year of move (λ)	(0.88)	(1.52)	(0.85)	(0.61)	(1.23)	(1.56)
move during year*	0.005	0.005	0.003	0.032	0.002	-0.004
subsequent years (λ*)	(0.46)	(0.43)	(0.19)	(1.32)	(0.10)	(0.32)
More Than One Move*	-0.034	-0.041	-0.020	-0.030	-0.048	-0.026
year of move (λ)	(3.87)	(4.08)	(1.15)	(1.50)	(3.31)	(2.14)
More Than One Move*	0.021	0.017	0.007	0.022	0.040	-0.002
subsequent years (λ*)	(1.63)	(1.17)	(0.32)	(0.72)	(1.85)	(0.15)
Observations	1,475,643	710,038	765,475	192,418	435,757	814,363

Note: All specifications estimated with student fixed effects and include indicator variables for highest and lowest grades in a campus, new schools, student eligible for a subsidized lunch, and grade-by-year dummy variables.

Table 10. Estimated Effects of Proportions of Students Who Are New to the Class on Achievement Gain, By timing of entry (absolute value of Huber-White adjusted t statistics in parentheses)

	Score in highest grade		Annual achievement gains				
					with student and school-by-grade fixed effects		
proportion new entrants	-0.34 (7.68)		-0.17 (9.10)		-0.13 (4.62)		-0.13 (4.35)
proportion new entrants*moved							0.01 (0.33)
proportion of students entering at start of year		-0.07 (1.38)		-0.16 (7.94)		-0.06 (1.98)	
proportion of students entering during year		-0.86 (7.30)		-0.04 (0.77)		-0.12 (2.49)	

Note: Except for the last column, all specifications include indicator variables for highest and lowest grades in a campus, new schools, student eligible for a subsidized lunch, and grade-by-year dummy.

Table 11. Estimated Effects of Proportions of Students Who Are New to the Class on Achievement Gain Controlling for Teacher and Peer Characteristics (absolute value of Huber-White adjusted t statistics in parentheses)

	With no teacher or peer characteristics		With teacher characteristics		With teacher and peer characteristics	
Proportion new entrants	-0.14 (4.28)		-0.14 (4.12)		-0.14 (4.04)	
proportion of students entering at start of year		-0.08 (2.06)		-0.06 (1.72)		-0.06 (1.65)
proportion of students entering during year		-0.11 (1.75)		-0.12 (1.95)		-0.12 (1.95)

Note: All specifications include indicator variables for highest and lowest grades in a campus, new schools, student eligible for a subsidized lunch, and grade-by-year dummy. Peer achievement calculations use achievement two years in the past; consequently 4th grade is dropped. Teacher characteristics include class size, proportion teachers with zero years experience, and teacher turnover rate in the school.

Table 12. Estimated Effects of Proportions of Students Who Are New to the Class on Achievement Gain, By timing of entry, Income, and Ethnicity (absolute value of Huber-White adjusted t statistics in parentheses)

	Ever low income		Race/ethnicity		
	Yes	No	Black	Hispanic	White
proportion new entrants	-0.16 (4.66)	-0.09 (2.86)	-0.09 (1.59)	-0.15 (3.55)	-0.12 (3.62)
proportion of students entering at start of year	-0.07 (1.73)	-0.06 (1.75)	0.02 (0.25)	-0.07 (1.43)	-0.07 (2.07)
proportion of students entering during year	-0.21 (4.44)	0.01 (0.12)	-0.14 1.84	-0.23 (3.45)	-0.06 (0.87)

Note: All estimated models include individual student and school-by-grade fixed effects along with indicator variables, student eligible for a subsidized lunch, and grade-by-year dummy.

Appendix Table A1. Student Fixed Effect Estimates of the Change in Achievement Gains in Year Two for Students Who Do not Move in Years One or Two, By Timing and Type of Move in Year Three (absolute value of Huber-White adjusted t statistics in parentheses)

All Moves Combined		-0.004
		(0.46)
Location		
	move to new district in same region	0.018
		(1.33)
	move to new region	-0.016
		(0.87)
	move within district	-0.010
		(0.76)
	move during year	0.002
		(0.13)
More Than One Move		-0.018
		(0.80)

Appendix Table A2. Mean proportion of students who are new, by ethnicity and income (standard deviations in parentheses)

	Ever low income		Ethnicity			
	yes	no	Black	Hispanic	White	All
proportion new entrants	0.23	0.20	0.26	0.22	0.20	0.22
	(0.12)	(0.10)	(0.13)	(0.11)	(0.10)	(0.11)
Proportion of students entering at start of year	0.17	0.15	0.20	0.16	0.15	0.16
	(0.11)	(0.10)	(0.13)	(0.10)	(0.09)	(0.10)
Proportion of students entering during year	0.09	0.07	0.10	0.09	0.07	0.08
	(0.06)	(0.04)	(0.07)	(0.05)	(0.04)	(0.05)

Appendix Table A3. Average Proportion of Students Who Are New to the Class and Change in Proportion New, by Type and Timing of Move

	proportion new entrants	change in proportion new entrants
All students		
Nonmovers	0.21	-0.02
Movers	0.29	0.05
Mover Outcome by Location		
New district, same region	0.25	0.00
New region	0.23	0.00
Move within district	0.35	0.09
Move during year	0.27	0.04
Move more than once	0.30	0.05

Appendix Table A4. Average Changes in Teacher and Peer Characteristics, by Type and Timing of Move

	class size	% teachers 0 years experience	% teachers same as prior year	peer average achievement
All students				
Nonmovers	0.3	1.2	-0.6	0.00
Movers	0.3	1.3	-1.2	0.04
Mover Outcome by Location				
New district, same region	0.2	1.2	0.2	0.04
New region	0.1	1.1	-2.5	0.03
Move within district	0.4	1.3	-1.8	0.04
Move during year	0.2	1.4	-0.9	0.01
Move more than once	0.2	1.3	-0.6	0.01