Working Paper

THE PUSH AND PULL OF SCHOOL PERFORMANCE: EVIDENCE FROM STUDENT MOBILITY IN NEW ORLEANS

EDUCATION
RESEARCH ALLIANCE
FOR NEW ORLEANS

Spiro Maroulis, Arizona State University
Robert Santillano, Douglas N. Harris, Tulane University
Huriya Jabbar, University of Texas at Austin

May 17, 2016

EducationResearchAllianceNOLA.com

The Push and Pull of School Performance: Evidence from Student Mobility in New Orleans

Spiro Maroulis*
Arizona State University
spiro.maroulis@asu.edu

Robert Santillano
Tulane University
rsantil@tulane.edu

Huriya Jabbar
The University of Texas at Austin
jabbar@austin.utexas.edu

Douglas N. Harris
Tulane University
dharri5@tulane.edu

Working Paper: May 16, 2016

* Corresponding Author

ACKNOWLEDGEMENTS

This study was conducted through the Education Research Alliance for New Orleans at Tulane University. The authors thank the organization's funders: The John and Laura Arnold Foundation, William T. Grant Foundation, and at Tulane, the Department of Economics, Murphy Institute and School of Liberal Arts. We also thank Jane Lincove, Matt Larsen, and participants at the 2015 Association for Education Finance and Policy and ERA New Orleans National Research Team conferences for useful comments on prior versions of this paper. In addition, the authors wish to thank Joanna Sanchez for research assistance, and the Louisiana Department of Education for providing data.

The Push and Pull of School Performance: Evidence from Student Mobility in New Orleans

ABSTRACT

Economic theory suggests that choice-based school reforms lead to competition among schools that increases school performance. In this study, we analyze student mobility in a competitive environment, New Orleans, to better understand how that competition takes place and how it plays out differently across subgroups. In contrast to typical analyses of mobility, our approach distinguishes the effects of incumbent school characteristics ("push" factors) from those of the potential destination schools ("pull" factors). We find that school performance plays both a push and a pull role, but the push of low performance at incumbent schools is stronger than the pull of high performance at potential destination schools. Further, this asymmetry is driven by students in the lowest third of statewide achievement distribution. Although school performance is a significant push factor for both low and high achieving students, low achieving students display a much weaker tendency to move towards high performing schools. This has important implications for our understanding of how families make school choices and for the equity effects of the competitive process.

1. INTRODUCTION

Economic theory suggests that increasing choice increases pressure on low-performing schools to improve in order to compete for students (Hoxby 2000). Otherwise, a school risks losing funds tied to enrollment and, in more extreme cases, being closed. To the extent that families prefer schools with strong academic performance, schools have an incentive to compete on that basis (Harris and Larsen 2015, Sirer, et al. 2015). These pressures will be strongest in places with more choice (e.g., few attendance zones, open enrollment, independently-run schools, and easy transportation access).

Since student mobility reflects family choices among schools, it can serve an indicator of competitive pressures in choice-based systems. In particular, students leaving schools – even when they have a chance to stay for another year (i.e., "non-structural" moves) – suggests that the receiving school has desirable properties that the sending school does not. More precisely, such mobility reflects both a "push" effect of wanting to leave the current school, as families may be "quick to exit if their needs are not met" (Lauen 2007, p. 179), and a "pull" effect of attending a different, more desirable school. Existing research on student mobility focuses on either push or pull factors but not the two simultaneously (Martinez, Godwin, and Kemerer 1996; Lauen 2007), consequently, we know little about their relative weight. The distinction is important because the magnitude and mechanism related to each need not be the same, even for a single school-level characteristic such as academic performance. For example, to the extent that education is an experienced good, in that a family is better able to discern the performance of a school after they have enrolled in the school, we might expect mobility to correspond more strongly with a sender's, rather than a receiver's, performance level. A better empirical understanding of this distinction, especially with respect to school performance, can help inform policy interventions intended to remove barriers to choice and improve access to relevant schooling information.

Student mobility also has several implications for equity. Even if competition emerges, choice may result in a school system stratified by performance (Welsh Duque and McEachin, forthcoming; Fuller and Elmore 1996; Reay and Lucey 2000; Scott 2005). Families with fewer social and economic resources, for example, may be less able to engage with and navigate choice-based systems (Harris, Valant, and Gross 2015; Bell 2009a; Hastings and Weinstein 2008). It is also possible that families with students who have lower performance levels might have preferences for school types that are different from families with higher achieving students, or face differential constraints from formal or informal school admission policies (Sirer et al. 2015). It is therefore important to understand not only the extent to which school performance differences are associated with the push and pull of student movements between schools, but also if school performance plays a different role in the movement of low achieving students.[1]

As we describe in greater detail below, a clear comparison of push and pull effects would be extremely difficult in a conventional discrete choice framework given the large number of potential destination schools. Consequently, we utilize a different modeling approach in this study: We conceptualize student mobility as a network of inter-school flows and study these flows across each pair of schools where movement is possible. We then model these mobility flows as a function of the characteristics of the sending school, the characteristics of the receiving school, and the attributes of each pair (dyad) of schools. Conceptually and methodologically, this approach is similar to models used by social network analysts to investigate the factors related to the formation

[1] In addition to stratification, there is also substantial evidence suggesting that mobility has direct negative consequences for disadvantaged groups (e.g., Rumberger & Larson, 1998). For example, mobility has been linked to lower academic achievement and high school completion rates (e.g., Hanushek, Kain, & Rivkin, 2004; Rumberger, 2003; Rumberger & Larson, 1998; Schwartz, Stiefel, & Chalico, 2009).

of social and collegial relationships (Frank 2009; van Duijn and Huisman 2011) and to the "spatial interaction" models commonly used by geographers and transportation planners to identify the factors corresponding to the migration patterns between locations (Cliff and Ord 1973; Stewart 1948; Stouffer 1940 1960; Flowerdew and Aitkin, 1982). The particular strength of the strategy in this context, however, is that it allows for us to decompose the relationship between mobility and performance into its constituent push and pull components—a feature that is not shared amongst the statistical models generally used to study K–12 school mobility and enrollment decisions. While such an approach has been previously used in both the policy and economics literatures to model the inter-state migration of college-going high school graduates (Cooke & Boyle 2011; McHugh and Morgan 1984), this is the first application to student mobility in a K–12, choice-based school district.

More specifically, we study student mobility in arguably the most competitive schooling environment in the nation: New Orleans. We focus on non-structural mobility so that we can study push and pull factors simultaneously. With structural moves, all students are "pushed out," forcing an emphasis on pull factors alone.[2] Among school districts in the U.S., New Orleans has the highest percentage of students attending charter schools. After Hurricane Katrina, attendance zones were essentially eliminated, students were assigned mostly by lottery, and schools were required to provide transportation to any student assigned to the school (Harris et al. 2015). For the years included in this study, parents applied to schools individually, and charters managed their own admissions.[3] Oversubscribed charter schools usually held lotteries to determine admission.

[2] The reforms also led to a large expansion of grade offerings by individual schools and a blurring of historically understood definitions of the grade in which structural moves are supposed to occur.

[3] Through 2011-12, enrollment was decentralized and families applied to each school separately. Starting in 2012, parents applied to most schools using a central application form, the OneApp, where schools are ranked in order of preference. Seats are assigned by lottery, with some preferences built in, such as for siblings and broad catchment areas. Our data and analysis pre-dates the introduction of this system. There are also a small number of charter schools that

Compared with traditional school districts, these reforms greatly reduced the bureaucratic and financial costs of switching schools (Chubb and Moe 1990). Families can switch schools without residential relocation, and families are not restricted to choosing schools only during "structural" grade transitions (e.g., elementary to middle school, or middle to high school).

Existing research on post-Katrina student mobility suggests stratification by achievement (Welsh et al. forthcoming). Our modeling approach and data also allow us to expand on prior research in several ways. First, we move beyond the issue of market stratification by investigating an additional question about the extent to which student mobility encourages competition on the basis of achievement. Second, we are able to estimate the relative weight of the "push" and "pull" components of school performance on student mobility, as well as explicitly incorporate controls for spatial considerations such as the distance between schools and the "intervening opportunities" between two locations (Stouffer 1940, 1960). Third, our data allow us to compare factors related to mobility pre-Katrina and post-Katrina.

We find that the difference in performance between schools is a strong predictor of student mobility. However, the push of poor performance is more strongly associated with exit from an incumbent school than pull from good performance is with entry at a destination school. This asymmetry between push and pull is driven by students falling in the lowest third of the statewide achievement distribution, who display a much weaker tendency to move towards high performing schools. Therefore, although the observed student mobility patterns are consistent with those expected to promote performance-based competition, they may also reinforce inequities.

2. MODEL OF STUDENT MOBILITY

---

relied on selective admission criteria based on arts, languages, or academic achievement. These schools were usually magnet schools in the years preceding the storm.

We conceptualize student mobility as a network of inter-school flows and study these flows across each pair of schools (dyads) where movement is possible. We then model these mobility flows as a function of the characteristics of the origin school, the characteristics of the destination school, and the attributes of each pair, or dyad, of schools. That is, we are modeling the mobility process at the level of a pair of schools rather than the level of the student or family. This conceptualization differs from the more common approach of using discrete choice models to predict the observed movements of students. Our approach facilitates the simultaneous incorporation of the "push" and "pull" effects of academic performance, including the estimation of their relative weights. Doing so in a discrete choice framework is only partially possible, and given the large number of potential destination schools, a clear comparison of push and pull effects would be difficult. More specifically, it would require treating an incumbent school's academic performance as a student-level characteristic and then specifying a model that is a mixture of the conventional "characteristics of the chooser" (multinomial logit) and "characteristics of the choice" (conditional logit) models. In practice, this is accomplished by estimating a conditional logit model that interacts the characteristic of the chooser (in this case, their school's academic performance) with dummy variables for all but one of the potential choices facing the chooser (Agresti 2013). While this would result in a single estimate of a pull effect, the interpretation and comparison of effects would be problematic given the large number of potential destinations.

In the remainder of this section, we provide a description of the factors we include in our model.

School Academic Performance

Evidence for the relationship between mobility and school academic performance comes from a variety of sources. Surveys investigating family preferences for schools typically find that high academic achievement is an important consideration, though findings vary with respect to the weight placed on academic achievement relative to other factors (e.g., Schneider, Marschall, Teske, and Roch 1998; Armor and Peiser 1998; Lee, Croninger, and Smith 1996), as well as the extent to which a respondent's stated preferences match actual behavior (Weiher and Tedin 2002). In post-Katrina New Orleans, research suggests that school performance is an important factor in enrollment decisions, and moreover, that special attention should be paid to differences between low and high achieving students. A recent analysis of parents' rankings from the centralized application used to assign students to schools finds that academic performance of a potential destination is a significant predictor of parents' elementary, middle, and high school rankings, but the association is not as strong for low-income families (Harris and Larsen 2015). In an analysis of non-structural mobility in New Orleans using administrative enrollment data, Welsh et al. (forthcoming) find that the performance level of the incumbent school also plays a role in student mobility. For example, they show that a low achieving student in an average achieving school is less likely to move to a low achieving school than one already in a low achieving school.

Socioeconomic Status and Demographic Variables

In addition to school academic performance, parents might switch schools because of their demographic makeup. Previous research has linked schooling decisions to the racial makeup of schools (Betts and Resch 2002; Bifulco and Ladd, 2007; Schneider and Buckley 2002; Howell and Peterson 2006; Lankford and Wykoff 2005). There is also evidence to suggest that even when parents say they are choosing based on school academic performance, their actual behaviors show that they value socioeconomic status more (Betts and Loveless 2005). The emphasis on socioeconomic status could be because parents value demographics and want their children to be among similar peers, or it could be because measures such as the percentage of students qualifying for free and reduced lunch are proxies for school quality, resource availability, or safety.

Program and Governance Features

School programs and governance features can also encourage or limit student mobility. One obvious feature is the admissions policy of a school, such as explicit achievement-based requirements. A less obvious feature is the difference in the maximum grade level available in the school, particularly the availability of high school grades. For example, families may elect to switch a rising 7th grader out of a school that only goes up to 8th grade in order to enroll that student in the 7th grade of a school that also includes high school grades, in order to have a more stable learning environment. Families who switch schools might prefer to remain in a familiar organization, such as the same charter management organization (CMO), charter authorizer or district, or school type (Furgeson, Gill, Haimson, and Killewald 2012; Welsh et al. forthcoming). Therefore, families who make non-structural moves may be more likely to end up in a receiving school that is part of a similar organization or district as the sending school.

Geography and Spatial Arrangement

The spatial arrangement of schools, particularly the distance between a potential sender and receiver, may also relate to the volume of student flows between them. Although schools in a choice setting are not required to serve students in designated catchment areas, parents may still have strong preferences for schools that are close to home (e.g., Harris and Larsen 2015). These preferences may be due to transportation costs or ties to certain communities (e.g., Bell 2009b).

Parents' choices are thus shaped by geography, and if they switch schools, they may select those that are closer. Therefore, even with the expansion of choice, the elimination of catchment areas, and the introduction of the requirement for schools to provide transportation for students (as is the case in New Orleans post-Katrina), we may observe students flowing to and from schools that are relatively close to one another in distance.

The flow between two schools may also depend on the extent to which a dyad is spatially isolated from other dyads. A spatially isolated dyad will have a greater flow than a dyad that faces many "intervening opportunities" (Stouffer 1940, 1960). That is, for any given dyad, when there are more schools between them, we would expect some of those other schools to "syphon off" part of the flow between any two schools.

3. DATA

Data on the universe of public school students and schools in New Orleans were obtained from the Louisiana Department of Education. We received data from 2000 to 2012, but on account of the tremendous amount of flux in the system in the years immediately following Hurricane Katrina, we focus our analysis on the latest two years of data available (2010-11 and 2011-12), and use the two academic years preceding the storm (2003-04 and 2004-05) as a point of comparison. These data include two types of files that we study here: (1) fall student enrollment from October of each school year, and (2) state test performance on English Language Arts (ELA) and math from the spring of each school year.[4] Our data also include two different measures of school performance – the state-issued School Performance Score (SPS), a publicly reported measure that is very highly

4 Preceding our analysis, we excluded 1.2 percent of the student observations from the enrollment file because they had already switched schools by the time of the October snapshot, as well as the few remaining students (0.1%) that were enrolled in more than one school.

correlated with average student performance on standardized tests;[5] and estimates of school-level value-added (VA) created from standardized student-level test scores. The value-added estimates were created at the grade-school-year-subject level for every school serving regularly tested students in grades 4 through 8, and were then aggregated to the school level by taking the student weighted average across grades and subjects.[6]

We measured mobility based on year-to-year enrollment according to the official October counts. Note that the data available did not allow us to separate intra-year moves from inter-year moves. Testing data from the spring of each year were used to augment the analysis when studying the characteristics of moves, but we were unable to assess the quality of that data for identifying intra-year movements. For ease of reference, we use the year in the spring to refer to each academic year (e.g. 2004 represents the 2003-04 academic year). Finally, consistent with previous work (Welsh et al. forthcoming; Harris and Larsen 2015), we separate the analysis of high school moves from those at the elementary and junior high school levels. The high school data were much more limited, so a majority of our analysis will focus on grades 1-7. We did not have student-level achievement data available to calculate value-added or disaggregate the high school sample. Only school-level SPS was available as a performance measure for high schools.

Mobility Types and Trends

A distinction is often made between two types of mobility, "structural" and "non-structural." Structural mobility refers to student departures arising because they have completed the final or

[5] SPS scores were obtained from the LDOE website: www.louisianabelieves.com. When including SPS in the models below, we use the value corresponding to the year in which a potential mover was enrolled in their incumbent school.
[6] The VAM estimates were derived from a student-level regression model that regresses a student's regular test scores on an indicator for each school, along with indicators for race, receipt of a lunch subsidy, English proficiency, special education status, indicators to adjust for missing demographic information, and cubics in pretest scores for math, ELA, science, and social studies. We required the existence of the same-subject pretest for all models, but used missing indicators when alternative-subject pretests were not available in order to maximize the number of students included.

terminal grade, e.g., 8th graders who must attend a different school because their junior high school does not offer a 9th grade. Non-structural mobility, which is the focus of this paper, refers to the mobility of students who switch schools even when their original school offered their next grade. The general ability for families to make these non-structural moves is a trademark of school-choice settings. It is also central here because it allows us to study both push and pull factors. In categorizing mobility, we also distinguish students retained in grade from "normally progressing" students who continue to the next grade. Grade retention, which is driven mostly by state policies outside the control of the school, may itself induce students to switch schools. This may provide a misleading picture of the role of the role of school performance in mobility.

We used these distinctions to place students into one of five enrollment statuses: (1) *stay*, normally progressing students enrolled in the same school in the following year, (2) *non-structural move*, normally progressing students enrolled in a different school in the following year even though their grade was offered at their original school, (3) *structural move*, normally progressing students forced to attend a different school due to grades offered or school closing,[7] (4) *retained*, students who were retained a grade attending any school, and (5) *other/exit*, non-normally progressing students or those who exited the public school system. The top panel of Figure 1 presents the distribution across these categories for New Orleans in 2004 and 2011 for grades 1-7. Note that the majority of students stay in their original schools, 60% in 2004 and 67% in 2011.[8] Note also that there was an across-the-board decrease in mobility, including a drop in the share of students making non-structural moves, from 16% in 2004 to 12% in 2011. This pattern did not follow at the high school level (Figure 1, bottom panel). For grades 9-11, 64% and 62% stayed in

[7] Unique schools were identified according to state assigned school IDs, so structural mobility also includes school takeovers, since new school IDs are assigned at this time.
[8] More precisely, administrative records indicated that they were enrolled in a given school in October, and remained enrolled in the same school, but in the next grade, the following October.

their high schools in 2004 and 2011, respectively. There was also a slight increase in the number of non-structural moves from 7% in 2004 to 8% in 2011.

For the remainder of this paper, the population of interest includes students in categories (1) and (2), that is, those that were promoted a grade and stayed at the same school, and those that were promoted and made a non-structural move. When focusing on these two groups of students, a school move was theoretically unnecessary, yet 21% in grades 1-7 and 10% in grades 9-11 switched schools in 2004 and 15% in grades 1-7 and 12% in grades 9-11 switched schools in 2011. We refer to this movement as non-structural mobility, which is the focus of our subsequent analysis.

[Figure 1 about here]

Non-structural mobility rates have always been higher in New Orleans compared to the rest of the state. To provide a sense of this, Figure 2 presents the share of students making a non-structural move for those in grades 1–7 for our full panel of data. We exclude the three years from 2005 to 2007 for New Orleans since these correspond to forced mobility because of Hurricane Katrina and the returning population had not yet stabilized. Figure 2 illustrates that the mobility gap was wider and increasing in the pre-Katrina years, but narrows after the hurricane.

[Figure 2 about here]

To provide a deeper understanding of who is moving in New Orleans over time, Table 1 presents non-structural mobility rates in grades 1-7 for various school sectors, student demographics, and levels of student academic performance. The final column of the table presents the average change in mobility for each specified group from before the storm in order to highlight general trends. The first thing to note is that mobility is decreasing for essentially every subgroup – although mobility gaps amongst groups still exist. For example, looking across sectors in New Orleans, schools that were always in OPSB have mobility rates that are essentially half as much as those that were eventually taken over by RSD. When looking at RSD schools after the storm, charters had lower levels of mobility relative to all RSD schools, showing important governance differences even within sectors.[9] When looking at males and special education students – both groups of historically more mobile students – the gaps in mobility essentially shrink to 0 by 2011. On the other hand, mobility rates for black students and those receiving a lunch subsidy are always higher, but the mobility gap for these groups has grown over time.[10] Finally, we calculated mobility rates for those in grades 3-7 according to performance on the end-of-year math exam. Those performing in the lowest third of the statewide test distribution were the most mobile, and, interestingly, this is the only subgroup to have increased mobility from before the storm. Those performing in the highest third had the lowest mobility rates across all years, which further decreased after the storm.

[Table 1 about here]

Datasets of Student Flows

Student-level enrollment data were used to create two different datasets of school-to-school student flows, one for 2004 and another for 2011. An observation in each dataset represents a pair of schools. We refer to the school that a student attended in the spring of that year as the "sender,"

[9] Note that the number of students in our sample attending RSD charter schools increases from 41% to 60% from 2008 to 2011 (see Appendix A, Table A-1).
[10] The share of white students in our sample had slightly increased from 4% to 6%, while the share of black students fell from 93% to 89% (see Appendix Table A-1).

and the school in which the student was enrolled in the following school year as the "receiver." Further, we refer to each pair of sending and receiving schools as a "dyad." Each pair observation contains information about its sender and receiver, such as the state-issued School Performance Score (SPS) of the school. Each dyad also contains pairwise information, such as the geographic distance between the schools, the number of non-structural moves from sender to receiver, the number of potential non-structural moves from sender to receiver, and the number of non-structural moves from sender to receiver in the previous year. Dyads that were unable to send students from one to the other were excluded from the dataset (e.g., grade offerings that made movement impossible). Dyads with greater than zero potential non-structural moves, but zero actual non-structural moves remained. Note that schools not associated with any potential non-structural moves as either a sender or receiver would not appear in our dataset (i.e., since we are focusing on grades 1-7, there are no potential moves to schools that served only grades 9-12).

Our final analysis sample for grades 1-7 in 2004 contains complete information on 94 senders, 110 receivers, and 7,218 dyads; in 2011, 46 senders, 55 receivers, and 2,399 dyads.[11] The number of non-structural moves associated with the dyads ranged from 0 to 34, but note that the typical dyad value is low. In both 2004 and 2011, approximately 75% of the dyads had zero moves, and the median value of the dyads with moves was 1. Collectively, however, the moves across all dyads can add up to substantial enrollment gains and losses for individual schools. For example, in 2004, 15 schools experienced a net student gain greater than 10% (relative to the number of initial potential movers at the school), and 13 schools experienced a net loss greater than 10%. Similarly,

[11] The number of senders and receivers differ for two reasons. One is on account of grade offerings. For example, a school that offered grades 8 to 12 would be considered a receiver but not a sender since they did not have grade 1-7 students to send. Another is that new schools will appear in the dyadic data as receiver one year earlier than they will as sender (since they have no students to send initially). This leads to a situation where dyads containing second year schools as senders are dropped from the dataset on account of missing prior year moves, but those containing the same school as a receiver are not missing that value and not dropped.

in 2011, 13 schools experienced a net student gain greater than 10%, and 8 schools experienced a net loss greater than 10%. The high school sample was much smaller. In 2004 it contained 20 senders, 21 receivers, and 396 dyads with non-missing data; in 2011, 19 senders, 21 receivers, and 369 dyads.

4. MODEL ESTIMATION

We estimate student flows as the quantity of non-structural moves made between a sender and a receiver. This quantity was specified as the dependent variable of a statistical model that treated each school as a sender to each of the other schools. Hence, it was a cross-classified, multilevel model, with pairs of schools nested within both senders and receivers. Its particular strength in this context is that it naturally accommodates characteristics at the level of a sender, a receiver, or of the pair. It is this feature that allows us to compare the relative strength of push/pull characteristics as they relate to observed student mobility. In standard analyses of K-12 student mobility, the probability of movement is modeled as a function of student attributes and push-only factors (i.e., characteristics of the incumbent school). For example, Welsh et al. (forthcoming) estimate a multinomial logit that predicts the performance tercile of the destination school as a function of student characteristics and the performance tercile of the sending school. This approach enables the researchers to nicely examine the mobility of similarly performing students in differently performing schools. However, it does not allow for the estimation of the relative push and pull effects of school performance. It also precludes an examination of within tercile movements which are important if one is examining moves for consistency with generating market-based pressure for improvement.

All models included controls at the pair level for the logged number of potential movers (PMOVERS) and the number of non-structural movers between a pair of schools in the previous year (MOVESM1).[12] We accounted for the highly skewed nature of the outcome variable by estimating a Poisson model with overdispersion. The standard Poisson model assumes that the mean of the outcome variable equals its variance. Violations of this assumption can lead to inefficient parameter estimates and downward biased standard errors (Long 1997, p. 230). Allowing for overdispersion relaxes this assumption, which is more appropriate for our data. The model was fitted using the "hierarchical general linear model" functionality of the HLM7 software (Raudenbush, Bryk, and Congdon 2011).

More formally, we estimated versions of the following base model for dyad *i* nested within sender *j* and receiver *k*:

Level-1 (Dyad)

$$E(MOVES_{ijk}|\pi_{jk}) = \lambda_{ijk}$$
$$\log[\lambda_{ijk}] = \eta_{ijk}$$
$$\eta_{ijk} = \pi_{0jk} + \pi_{1jk}*(DIST_{ijk}) + \pi_{2jk}*(SAMELEA_{ijk}) + \pi_{3jk}*(PMOVERS_{ijk}) + \pi_{4jk}*(MOVESM1_{ijk})$$

Level-2 (Sender/Receiver)

$$\pi_{0jk} = \theta_0 + b_{00j} + c_{00k}$$
$$+ (\gamma_{01})*MDIST_j + (\gamma_{02})*Performance_j + (\gamma_{03})*FRPL_j + (\gamma_{04})*WHITE_j + (\gamma_{05})*SELECT_j + (\gamma_{06})*CHARTER_j$$
$$+ (\beta_{01})*MDIST_k + (\beta_{02})*Performance_k + (\beta_{03})*FRPL_k + (\beta_{04})*WHITE_k + (\beta_{05})*SELECT_k + (\beta_{06})*CHARTER_k$$
$$+ (\beta_{07})*HS_k,$$

where *Performance* is either the state-issued School Performance Score or the value-added measure, DIST is the straight-line distance between a sender and receiver, MDIST is the mean distance of the school from all other schools, FRPL is the fraction of students in the school receiving free or reduced price lunch, WHITE is the fraction of white students in the school, SELECT is an indicator for a school having a selective admissions policy, CHARTER is an

[12] MOVESM1 was included to help control for unobserved factors that might influence the flow on a dyad. In the results that follow, removing it as a control typically lead to performance-based coefficients (e.g. SPSDIFF, sender SPS, and receiver SPS) with slightly higher magnitudes, but did not alter the primary pattern of results.

indicator for being a charter school, HS is an indicator for whether the school contained high school grades, and SAMELEA is a variable indicating whether a pair of schools belonged to the same district or charter management organization. The level one variance is modeled as a function of λ_{ijk} and a parameter that allows for overdispersion, and b_{00j} and c_{00k} are assumed to be normally distributed with mean zero and variances to be estimated. In some specifications *Performance* will be included as a level-1 variable that captures the difference between the receiver and sender.

5. RESULTS

Our primary results for grades 1-7 are presented in Table 2, which include coefficient estimates for four specifications that vary the measure of school performance. All continuous variables in Table 2 are mean-centered and standardized so that a one-unit increase in the variable represents a two standard deviation change. While one standard deviation unit changes are more common (i.e., effect sizes), the two standard deviation approach makes each variable not only comparable to each other but also roughly comparable to the binary predictors (Gelman 2008).

Model 1 of Table 2 models academic performance as a dyadic property between two schools, using the difference in academic performance between the receiver and sender as the predictor of interest (SPSDIFF). A positive coefficient on SPSDIFF would indicate that students flowed in the direction consistent with promoting performance-based competition, that is, from lower-performing schools to higher-performing ones. SPSDIFF was among the strongest predictors of non-structural student mobility, with a two standard deviation difference in SPS between the receiver and sender corresponding to a 2.6 times increase ($e^{0.94}$) in non-structural moves. In comparison, a two standard deviation decrease in distance (6.2 miles) corresponded to a 1.9 times increase in non-structural moves ($e^{0.64}$); the existence of one or more high school grades at the receiver (HS) corresponded to a 2.4 times increase ($e^{0.86}$); and being in the same district or charter management organization (SAMELEA) resulted in a 2.6 times increase ($e^{0.95}$).[13]

In Model 2 of Table 2 we tested for "push" and "pull" differences with respect to the role of performance by replacing SPSDIFF with separate coefficients for the SPS of the sender and receiver. A negative coefficient on the sender SPS would be consistent with the prediction of economic theory, indicating that the lower the SPS of the incumbent school, the more students flowed away from the school. Similarly, a positive coefficient on the receiver SPS would indicate that the higher the SPS of the receiving school, the more students flowed to it. Additionally, if school performance played a symmetric role in school exit and entry, then we would expect coefficients equal in size, but opposite in sign, on sender and receiver SPS.

As expected, we find that the sender SPS coefficient is negative and statistically significant (-0.86) indicating that the lower the SPS of the school, the more students flow away from the school. The receiver SPS coefficient was positive (0.27) but not statistically significant from zero. We confirm that there is an asymmetry in performance by conducting a Wald test that rejects the hypothesis that the sender and receiver coefficients are equal in magnitude and opposite in sign ($p \approx 0.01$). That is, low SPS is more strongly associated with school exit, than high SPS is with school entry.

Models 3 and 4 are re-estimations of Models 1 and 2 using school-level value-added instead of SPS as the measure of performance. Using value-added as the measure of performance resulted in a similar pattern of results, but with smaller estimated coefficients and reduced precision (Models

[13] The following hypothetical example provides another way to consider the magnitude of the 2011 SPSDIFF coefficient: The number of predicted moves between a pair of schools 2 miles apart is 1.4 times greater than a pair of otherwise identical schools 5 miles apart from each other. The number of predicted moves between a pair of schools one SPS letter grade apart (e.g., a "C" sending school and a "B" receiving school, which is approximately 2/3 standard deviations of the SPS scaled score) is 1.4 times greater than for a pair of schools with the same SPS score. Therefore, a one letter grade difference between a pair of schools is roughly equivalent to a 3 mile difference in distance.

3 and 4). This is not surprising for two reasons. First, there is considerably more measurement error in value-added estimates compared to level-type metrics like SPS (Harris 2011). Also, value-added measures are not publicly available. Therefore, we would expect less responsiveness, especially as a characteristic of the potential receiving schools, where publicly available information may be the only school quality information available to parents.

[Table 2 about here]

Comparison to Pre-Katrina

To examine whether the relative role of school performance in determining student mobility changed after the hurricane and implementation of the reforms, we estimated the same set of models using data from 2004.[14] Our results suggest a similar role for performance before and after the reforms. Table 3 summarizes the SPS coefficient estimates for 2004 and 2011. The 2011 column in Table 3 simply reproduces the estimates from Models 1 and 2 of Table 2. The top panel of Table 3 corresponds to Model 1, where the difference in SPS between schools (SPSDIFF) was included as the primary predictor of interest. Panels 2 and 3 correspond to Model 2, where SPSDIFF was replaced with separate predictors for the SPS of the sender and the SPS of the receiver. Note that the estimates in 2011 are all larger in magnitude than those in 2004 (0.94 vs. 0.60 for SPSDIFF, -1.18 vs. -0.86 for SPS sender, and 0.27 vs. -0.02 for SPS receiver). While this provides evidence that student mobility was more closely associated with school academic performance post-Katrina, the differences between the estimates are generally insignificant or

[14] The 2004 models did not include SAMELEA as a predictor because almost all New Orleans public schools in the pre-storm period were in the locally-elected governing agency: OPSB.

marginally significant.[15] Note also that as in 2011, the magnitude of the sender SPS coefficient in 2004 was larger than the magnitude of the receiver SPS coefficient (-0.88 vs. -0.02; $p < 0.01$). That is, the difference between the sender and receiver SPS pre-dates the reforms and therefore may reflect something about school markets generally.

When comparing the 2004 and 2011 results with respect to other predictors, the most notable finding was the difference in the size of the distance coefficient. In 2004 a two standard deviation decrease in distance corresponded to a 4 times increase in non-structural moves, as opposed to the 2.6 times increase in 2011 ($p \approx 0.000$ for difference). That is, distance was a relatively stronger factor in 2004 than 2011. In interpreting this result, it is important to keep in mind that the post-Katrina reforms included the requirement that schools provide transportation for students throughout the city. There was no such requirement in 2004. (See Appendix B, Tables B-2 for full 2004 results.)

[Table 3 about here]

Comparisons by SES and Achievement Levels

Prior research suggests that market-based policies, such as school choice, may benefit more advantaged students and families over others. Of particular concern in a choice-based system is the achievement stratification that may occur, perhaps because of the more constrained choice sets of

[15] Although the pre- and post-Katrina samples from the two years are both from New Orleans, they are quite different. Only ten of the schools and 68 of the dyads existed in both datasets used in our analysis. Consequently, we treated the samples from the two years as independent, and calculated the standard error for the difference between coefficients as $\sqrt{\left(SE_{\beta_{2004}}\right)^2 + \left(SE_{\beta_{2011}}\right)^2}$ (Cohen et. al., 2003, p. 46). If one alternatively assumes a positive covariance between years, then the standard errors would be smaller and our approach is conservative. We should also note that the 2004 to 2011 SPS-related comparisons were slightly sensitive to whether MOVESM1 was included in the model. Removing MOVESM1 increased the number of dyads available for analysis and also slightly altered the SPS-related coefficient estimates. This resulted in SPSDIFF and SPS sender differences that were significant at the 5% level. However, dropping MOVESM1 also likely introduce some bias to those estimates, which we confirmed comparing models estimated with and without MOVESM1 on the exact same set of dyads. See Appendix B, Table B-1 for details.

lower-achieving students (e.g., Bell 2009a), or because of limited access to information and networks that would facilitate transfer to higher-achieving schools (Kerbow, Azcoitia, and Buell 2003; Lauen 2007; Welsh et al. forthcoming).

To investigate differences among students, we conducted two analyses. One was an analysis that disaggregated the students by free or reduced priced lunch status (FRPL). Coefficient estimates for sender SPS, receiver SPS, and SPSDIFF for the non-FRPL students were all slightly larger in magnitude than for the FRPL students, but none of the differences were statistically significant. However, it is important to note that the sample largely represents a low SES study population: over 84% of the students are free or reduced price lunch eligible (FRPL). That is, as might be expected given that FRPL students constitute such a large proportion of the data, the performance-related coefficients for the FRPL students were very similar to those estimated across the entire population.

The second analysis involved dividing students into two groups based on their placement in the distribution of math achievement in the state of Louisiana. Students in the lowest third of state achievement form one group (LOW), and students in the remaining two thirds form the second group (MED/HIGH). The LOW group accounts for 62% of the non-structural moves in 2004, and 49% of the non-structural moves in 2011.[16] We estimated the 2004 and 2011 models separately for each achievement group. That is, the number of potential and actual non-structural movers for each dyad included only the total for that group. The remaining variables remained the same. Since we do not have a more fine-grained measure of SES, disaggregating the sample in this manner not only represents a stratification on the basis of achievement, but likely also on unobserved socioeconomic factors related to student mobility.

Our primary finding is that the positive association between performance and non-structural

[16] As percentages of the student population, the LOW group accounts for 55% of all students in our sample students in 2004 and 43% in 2011.

mobility is stronger for the MED/HIGH group, and that this difference is largely due to differences in the "pull" component of performance for each group. To illustrate, Table 4 compares the estimates of the SPS-related coefficients from four different models for 2011. The two estimates in the top row of Table 4 come from models where the difference in SPS between schools (SPSDIFF) was included as the primary predictor of interest. The four estimates in the bottom two rows of Table 3 come from models where SPSDIFF was replaced with separate predictors for the SPS of the sender and the SPS of the receiver. (See Appendix B, Tables B-3 and B-4 for full 2004 and 2011 results).

[Table 4 about here]

Comparing the MED/HIGH and LOW columns in Table 4, the SPSDIFF coefficient estimate is 1.03 for the MED/HIGH groups as compared to 0.30 for the LOW group. The difference between these two coefficient estimates is statistically significant at the 5% level.[17] Furthermore, examining the separate sender ("push") and receiver ("pull") coefficients reveals that this difference is largely due to differences with respect to the pull component of performance. For the MED/HIGH group, the SPS receiver coefficient estimate is 0.91 as compared to -0.31 for the LOW group. The difference between these two coefficient estimates is statistically significant at the 5% level. In contrast, the estimates for the SPS sender coefficients reveal a smaller difference (-1.11 vs. -0.60) that is not statistically significant.

Non-structural Mobility between High Schools

Although we did not have student-level achievement data for potential non-structural moves

---

[17] We calculated the standard error for the difference between coefficients under the assumption that $Cov(B_{LOW}, B_{M/H}) = 0$. Since the estimates come from two different regressions, we do not have a readily available estimate with which to check this assumption. However, note that to the extent that the estimates from the two groups are not independent, $Cov(B_{LOW}, B_{M/H})$ is likely to be positive, which would in turn result in a smaller standard error for the difference between coefficients (and correspondingly lower z-values). Consequently, our calculation results in a conservative test for the difference between the coefficients from each group.

in grades 9-11, we were able to estimate a subset of the models above using a high school sample. The results are presented in Table 5. As in the previous models, all continuous variables in Table 5 are mean-centered and standardized so that a one-unit increase in the variable represents a two standard deviation change, and all models include the logged number of potential non-structural movers and the number of non-structural moves the previous year as dyad-level controls.

Similar to the lower grades, the main finding is that the difference in SPS between the receiving and sending schools strongly predicts non-structural mobility post-Katrina. The coefficient on SPSDIFF was significant and positive in 2011, with a two standard deviation difference in SPS between the receiver and sender corresponding to a 3 times increase ($e^{1.09}$) in non-structural moves (Model 1, Table 5). When replacing SPSDIFF with separate coefficients for the SPS of the sender and receiver, we find that the sender SPS coefficient is negative, the receiver SPS coefficient is positive, and both are statistically significant (Model 2, Table 5). Again, similar to the lower grades, the estimate of the sender coefficient is larger than that of the receiver, though in this case we cannot reject the hypothesis the sender and receiver coefficients are equal in magnitude and opposite in sign.

We also estimated similar models for 2004, however the results were not very informative with respect to the relationship between performance and mobility. The standard errors for the SPS-related coefficients are three to four times as large as the standard errors for those same coefficients in all the other models. See Appendix B, Table B-5 for full results.

[Table 5 about here]

6. DISCUSSION AND CONCLUSION

By modeling student mobility as a network of inter-school student flows, this study makes both methodological and substantive contributions to the study of education markets.

Methodologically, this study demonstrates the application of an approach for decomposing the push and pull effects of school characteristics thought to be associated with student mobility. This approach could also be used to analyze other flows of people or resources between schools, including teachers, where studies also normally focus on push factors only (e.g., Allensworth, Ponisciak, and Mazzero 2009; Boyd, Grossman, Lankford, Loeb, and Wyckoff 2008; Ingersoll 2001; Kukla-Acevedo 2009).

Substantively, this study characterizes the role of school performance in student mobility within a choice-based system in the country that has gone "to scale." In line with choice-based theories, we find that school performance is a strong predictor of the volume of student moves between schools. For both elementary/middle school students and high school students, the greater the difference in performance between a potential receiver and sender (SPSDIFF), the greater the flow of students. This is consistent with the idea that choice-based systems can lead to performance-based competition.

We also disaggregate these results to explore whether school performance plays a different role in the movement of low achieving students or those qualifying for free or reduced price lunch (FRPL). While we do not find statistically significant differences for FRPL students, we do find that low achieving students display a weaker tendency to migrate to higher performing schools through non-structural mobility relative to higher achieving students. Specifically, we found statistically significant differences in the school performance coefficients when running our model on samples disaggregated by student achievement. The SPSDIFF coefficient for students that fall in the lowest third of Louisiana's mathematics achievement distribution (43% of students in 2011) was much lower than the one estimated for the students in the upper two thirds (Table 4). Moreover, allowing the association of school performance to vary by sending and receiving schools points to one of the key findings of this study: the "pull" component of performance is much more strongly associated with mobility for the medium/high achieving group than it is for the low achieving group.

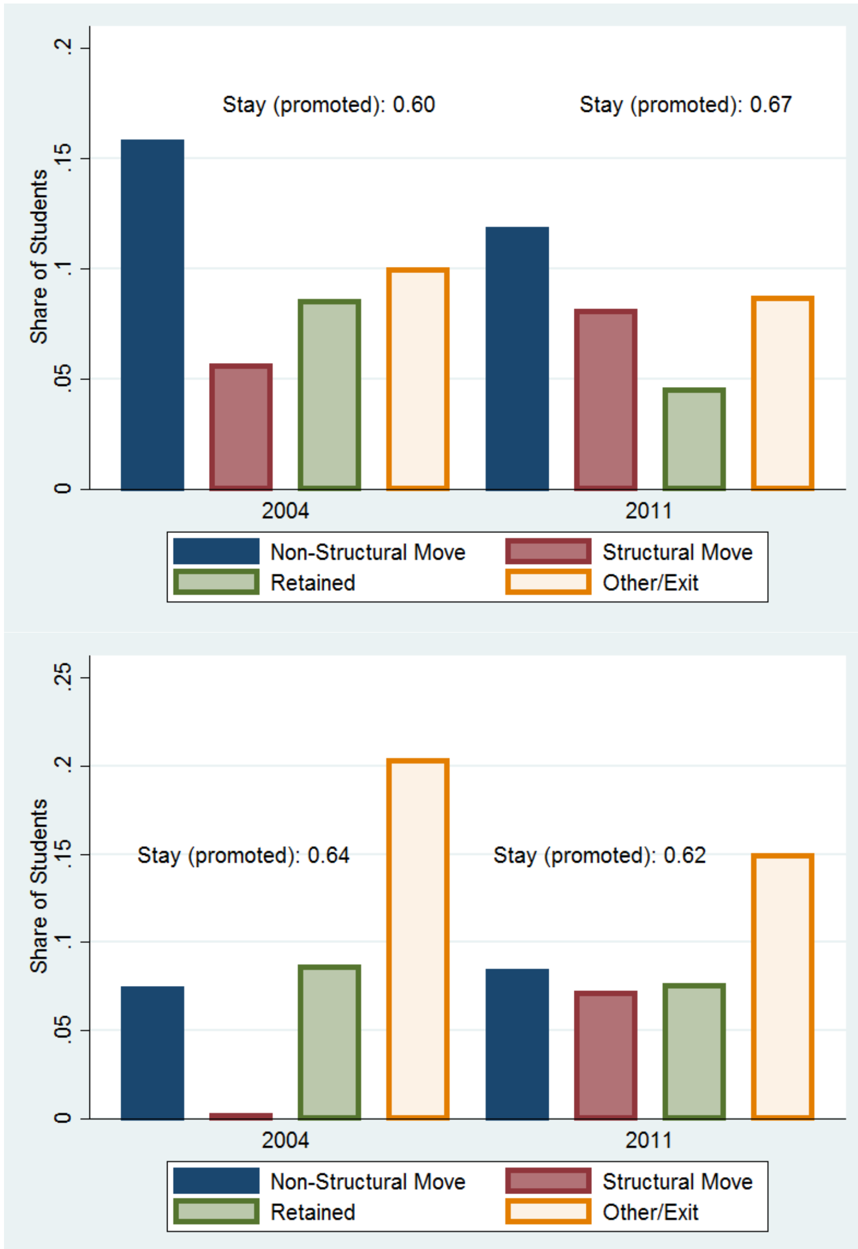
We considered three explanations for why we did not observe a "pull" component for low achieving students. One possibility is that families of the lowest achieving students value destination school performance differently from others. Our results suggest this is a possible but only partial explanation, as it would not explain the asymmetry between push and pull observed in the data. That is, it would be puzzling to have a situation where families who do seem to value performance when deciding to leave a school do not also value it in the destination school. Relatedly, it could be that there are unaccounted for characteristics of destination schools related to performance that low-achieving students value more than others, and not performance *per se* (Harris and Larsen and 2015). While it is possible that this is partially the cause of the difference between the groups, all our models include a control for the number of prior year moves between schools which, to some extent, helps control for other unobserved factors likely to be relevant, such as the number of and type of extracurricular activities available at a potential destination school.

A second explanation is that groups differ in their ability to access usable information (e.g., Bell 2009a). For the decision to leave a school, families of both low- and high-achieving students may have similar information based on their firsthand experience of school performance. The evaluation of a potential destination school, however, may require information that goes beyond published ratings that families of higher-achieving students are more able to access, perhaps because they have other unobserved socio-economic advantages. This could include information from broader social networks, visits to the school, or personal meetings with school leaders.

A third explanation pertains to the policies and actions of the destination schools instead of the demand-side factors mentioned above. While we control for schools that have explicit selective enrollment policies, it is possible that our finding is due to efforts to recruit higher achieving students or informal selective admissions policies at higher performing schools (e.g., Jabbar 2015; Jennings 2010; Lacireno-Paquet, Holyoke, Moser, and Henig 2002). Unfortunately, our data do not allow us to determine whether the difference between low-achieving students and others is on account of unobserved "cream-skimming" policies of schools, or differences in demand-side factors such as access to information needed to evaluate the quality of a school. If the cream-skimming explanation were primarily responsible for the difference in mobility patterns between low-achieving students and others, then requiring school participation in a centralized enrollment system—such as the OneApp system that is now used in New Orleans—may address these equity concerns. Alternatively, if information-related reasons were predominately responsible, then policymakers might consider the development of programs that go beyond the provision of quantitative performance data that enable students from low achieving schools to gain greater firsthand "experience" with other schools in the district. Such programs may promote school visits through open houses or "shadow days," or perhaps even facilitate meetings with current parents of the school. Regardless of the underlying reason, our current analysis and findings underscore the importance of focusing future research on better understanding how low-achieving students learn about and evaluate potential destination schools.

Finally, it is important to keep several considerations about the data and analysis in mind. First, we did not have information on the capacity constraints of the schools in our sample. If higher performing schools are also the ones more fully subscribed, then our results are likely underestimating the role academic performance plays in student mobility. Second, on the basis of this study alone, we cannot assess whether competition has taken hold in post-Katrina New Orleans. Doing so requires coupling our analysis of student mobility with supply-side considerations. That is, we also have to consider how school leaders think about and respond to competition (Jabbar 2015) and how charter authorizers decide which schools to open and close. Indeed, like many other markets, schooling markets can generate complex responses. By modeling student mobility as a network of student flows in a choice-based setting, our study provides a distinctive way of understanding the functioning of competitive processes in complex schooling markets. On the demand side, this complements analyses of what families prefer when applying to schools (Harris and Larsen 2015; Armor and Peiser 1998; Schneider et al. 1998) as well as analyses of student movements in other districts (Sirer et al. 2015). More generally, it highlights how behaviors within schooling markets can include actions that are unexpected or problematic for equity purposes.

Figure 1. Two-Year Student Enrollment Categories for Grades 1-7 (top) and Grades 9-11 (bottom) in New Orleans, 2004 and 2011



Notes: Top panel, grades 1-7; bottom panel grades 9-11. Data are from LDOE and classify students in New Orleans according to their October enrollment from the 2003-04 and 2010-11 academic years to the October of the following years. The categories are defined as follows: (1) Stay – normally progressing students enrolled in the same school in the following year; (2) Non-Structural Move – normally progressing students enrolled in a different school in the following year even though their grade was offered at their original school; (3) Structural Move – normally progressing students forced to attend a different school due to grades offered or school closing; (4) Retained – students who were retained a grade attending any school; (5) Other/Exit – non-normally progressing students or those who exited the public school system.

Figure 2. Share of Non-Structural Moves over Time

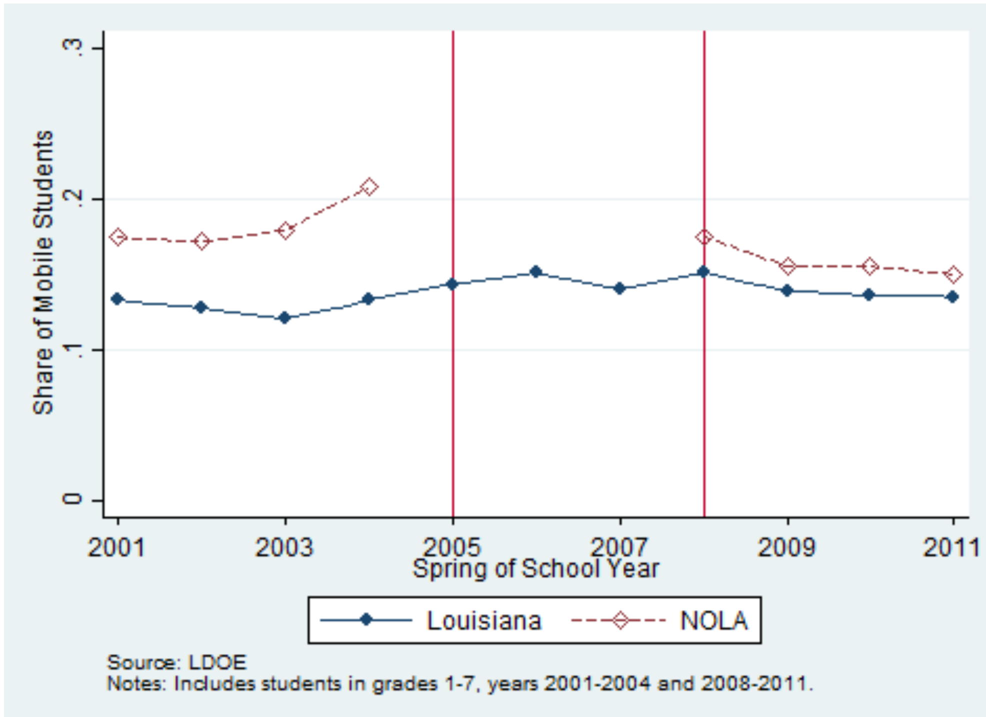


Table 1. Share of Grade 1-7 Students Making Non-Structural Moves in New Orleans, by Group and Year

	Pre-Reform Years				Post-Reform Years				
	2001	2002	2003	2004	2008	2009	2010	2011	Post/Pre Change[a]
New Orleans Sector									
All	0.17	0.17	0.18	0.21	0.17	0.16	0.15	0.15	-0.03***
OPSB	0.17	0.17	0.18	0.21	0.08	0.06	0.06	0.06	-0.12***
OPSB: always	0.09	0.09	0.09	0.11	0.08	0.06	0.06	0.06	-0.03***
OPSB to RSD[b]	0.19	0.18	0.20	0.22	0.21	0.19	0.18	0.18	-0.01***
OPSB: Charter	0.09	0.08	0.08	0.11	0.08	0.06	0.06	0.05	-0.03***
RSD: Charter	N/A	N/A	N/A	N/A	0.15	0.13	0.15	0.16	N/A
Student Demographic Characteristics									
Male	0.19	0.18	0.18	0.22	0.18	0.15	0.16	0.16	-0.03***
Female	0.16	0.16	0.17	0.20	0.17	0.16	0.15	0.15	-0.02***
White	0.10	0.10	0.09	0.12	0.04	0.04	0.05	0.05	-0.06***
Black	0.18	0.18	0.19	0.21	0.19	0.17	0.17	0.16	-0.02***
Other Ethnicity	0.11	0.12	0.12	0.10	0.14	0.09	0.07	0.12	-0.01**
Lunch Subsidy	0.18	0.18	0.19	0.22	0.18	0.16	0.17	0.16	-0.02***
No Subsidy	0.16	0.13	0.11	0.16	0.13	0.11	0.09	0.09	-0.04***
Special Ed	0.20	0.19	0.18	0.21	0.16	0.17	0.16	0.15	-0.03***
Not Special Ed	0.16	0.16	0.17	0.20	0.17	0.16	0.15	0.15	-0.01***
Student Academic Achievement (Math Thirds, Grades 3-7)[c]									
Math: Low third	0.18	0.18	0.20	0.22	0.21	0.19	0.20	0.19	0.01**
Math: Mid third	0.16	0.15	0.16	0.19	0.15	0.15	0.15	0.15	-0.02***
Math: High third	0.12	0.11	0.11	0.18	0.11	0.10	0.09	0.10	-0.03***

Source: LDOE, October Enrollment Files and Spring Test Files

Notes: Universe of students include those promoted a grade in schools that also provide the next grade. Post/pre change column aggregates across all post and pre years respectively

[a] Post/pre change column aggregates across all post and pre years respectively. Significance levels on pre-post t-tests: * = p < 0.1, ** = p < 0.05, *** = p < 0.01.

[b] This group of schools includes those that were OPSB in the pre-reform years, but either closed or became an RSD school in the post-reform years.

[c] Thirds are based on the distribution of test scores at the state. Because the distribution of New Orleans students tends to be relatively low in the state, there is not an even share of students in each third.

Table 2. Characteristics Related to Number of Students Moving from Sender to Receiver (Grades 1-7, 2011)

	1	2	3	4
Academic Performance				
SPS difference, receiver minus sender	0.94***			
	(0.16)			
SPS, sender		-1.18***		
		(0.19)		
SPS, receiver		0.27		
		(0.29)		
Value-added difference, receiver minus sender			0.35***	
			(0.12)	
Value-added, sender				-0.41***
				(0.15)
Value-added, receiver				0.19
				(0.23)
Spatial Arrangement				
Distance between sender and receiver	-0.64***	-0.64***	-0.64***	-0.64***
	(0.09)	(0.09)	(0.09)	(0.09)
Mean distance between sender and others	0.24*	0.24*	0.25	0.26
	(0.10)	(0.10)	(0.13)	(0.13)
Mean distance between receiver and others	0.01	0.04	0.04	0.04
	(0.22)	(0.21)	(0.21)	(0.21)
SES / Demographic				
Fraction free or reduced price lunch, sender	0.48	0.38	0.81**	0.79**
	(0.28)	(0.29)	(0.34)	(0.34)
Fraction free or reduced price lunch, receiver	-0.28	-0.37	-0.32	-0.36
	(0.49)	(0.47)	(0.47)	(0.48)
Fraction white, sender	-0.17	-0.21	-0.01	-0.01
	(0.27)	(0.28)	(0.33)	(0.33)
Fraction white, receiver	-0.78	-0.74	-0.76	-0.76
	(0.46)	(0.44)	(0.45)	(0.45)
School Type / Sector				
Selective school, sender	0.69	0.83**	0.24	0.24
	(0.36)	(0.36)	(0.41)	(0.41)
Selective school, receiver	-0.82	-0.34	-0.15	-0.14
	(0.65)	(0.65)	(0.62)	(0.62)
Charter school, sender	0.07	0.13	-0.02	-0.01
	(0.13)	(0.14)	(0.16)	(0.17)
Charter school, receiver	0.31	0.37	0.25	0.30
	(0.25)	(0.24)	(0.24)	(0.25)
Contains a grade > 8, receiver	0.86***	0.92***	1.06***	1.02***
	(0.31)	(0.29)	(0.30)	(0.31)
Same district or CMO	0.95***	0.97***	0.91***	0.91***
	(0.11)	(0.11)	(0.11)	(0.11)

All models include the logged number of potential non-structural movers and the number of non-structural moves the previous year as dyad-level controls. Number of observations: 46 senders, 55 receivers, 2,399 dyads. Significance levels: * = $p < 0.1$, ** = $p < 0.05$, *** = $p < 0.01$.

Table 3. SPS Coefficient Estimates by Year (Grades 1-7)

	2004	2011	z-value for differences
SPS Difference			
coefficient	0.60***	0.94***	1.58
(std. err.)	(0.14)	(0.16)	
$e^{coefficient}$	1.82	2.56	
SPS, Sender			
coefficient	-0.88***	-1.18***	-1.22
(std. err.)	(0.16)	(0.19)	
$e^{\lvert coefficient \rvert}$	2.36	3.25	
SPS, Receiver			
coefficient	-0.02	0.27	0.77
(std. err.)	(0.24)	(0.29)	
$e^{coefficient}$	0.99	1.31	

Significance levels: * = $p < 0.1$, ** = $p < 0.05$, *** = $p < 0.01$. See Table 2 and Appendix B, Table B-2 for full results.

Table 4. SPS Coefficient Estimates by Student Achievement Level (Grades 3-7, 2011)

	Low	Med/High	z-value for differences
SPS Difference			
coefficient	0.30	1.03***	2.18**
(std. err.)	(0.27)	(0.20)	
$e^{coefficient}$	1.35	2.80	
SPS, Sender			
coefficient	-0.60*	-1.11***	-1.24
(std. err.)	(0.32)	(0.26)	
$e^{\lvert coefficient \rvert}$	1.82	3.03	
SPS, Receiver			
coefficient	-0.31	0.91***	2.17**
(std. err.)	(0.47)	(0.31)	
$e^{coefficient}$	0.73	2.48	

Significance levels: * = $p < 0.1$, ** = $p < 0.05$, *** = $p < 0.01$. See Appendix B, Table B-3 for full results.

Table 5. Characteristics Related to Number of Students Moving from Sender to Receiver (Grades 9-11, 2011)

	1	2
Academic Performance		
SPS difference, receiver minus sender	1.09***	
	(0.25)	
SPS, sender		-1.31***
		(0.35)
SPS, receiver		0.85**
		(0.36)
Spatial Arrangement		
Distance between sender and receiver	-0.20	-0.21
	(0.17)	(0.17)
Mean distance between sender and others	0.07	0.06
	(0.17)	(0.17)
Mean distance between receiver and others	0.22	0.17
	(0.24)	(0.24)
SES / Demographic		
Fraction free or reduced price lunch, sender	-1.29**	-1.25**
	(0.48)	(0.49)
Fraction free or reduced price lunch, receiver	-0.61	-0.64
	(0.67)	(0.65)
Fraction white, sender	-1.79	-1.66
	(1.04)	(1.05)
Fraction white, receiver	-1.09	-1.04
	(1.50)	(1.46)
School Type / Sector		
Selective school, sender	1.33	1.35
	(1.55)	(1.57)
Selective school, receiver	-1.80	-1.67
	(2.12)	(2.07)
Charter school, sender	0.53**	0.62**
	(0.21)	(0.23)
Charter school, receiver	-0.11	-0.02
	(0.32)	(0.33)
Same district or CMO	0.54***	0.56***
	(0.18)	(0.18)

All models include the logged number of potential non-structural movers and the number of non-structural moves the previous year as dyad-level controls. Number of observations: 20 senders, 21 receivers, 369 dyads. Significance levels: * = $p < 0.1$, ** = $p < 0.05$, *** = $p < 0.01$.

REFERENCES

Allensworth, E., Ponisciak, S., & Mazzeo, C. (2009). *The Schools Teachers Leave: Teacher Mobility in Chicago Public Schools*. Consortium on Chicago School Research. Retrieved from http://eric.ed.gov/?id=ED505882

Armor, David J., and Brett M. Peiser. (1998). Interdistrict choice in Massachusetts. In Paul E. Peterson and Bryan C. Hassel (Eds.), Learning from school choice. Washington, DC: Brookings Institution Press.

Bell, C. (2009a). All Choices Created Equal? The Role of Choice Sets in the Selection of Schools. *Peabody Journal of Education*, *84*(2), 191–208.

Bell, C. (2009b). Geography in parental choice. *American Journal of Education*, 115(4), 493-521.

Betts, J. R., & Resch, A. M. (2002). Is there "white flight" into private schools? Evidence from the National Educational Longitudinal Survey. *Review of Economics and Statistics* 84(1), 21-33.

Betts, J. & Loveless, T. (Eds.), *Getting Choice Right: Ensuring Equity and Efficiency in Education Policy*. Washington, DC: Brookings Institution

Bifulco, R., & Ladd, H. F. (2007). School choice, racial segregation, and test-score gaps: Evidence from North Carolina's charter school program. *Journal of Policy Analysis and Management*, *26*(1), 31-56.

Boyd, D., Grossman, P., Lankford, H., Loeb, S., & Wyckoff, J. (2008). *Who Leaves? Teacher Attrition and Student Achievement* (Working Paper No. 14022). National Bureau of Economic Research. Retrieved from http://www.nber.org/papers/w14022

Chubb, J., & Moe, T. (1990). *Politics, Markets, and America's Schools*. Washington, D.C.: The Brookings Institution.

Cliff, A. D. and J. K. Ord. (1973). *Spatial Autocorrelation*. London: Pion.

Cohen, J., Cohen, P., West, S. G., & Aiken, L. S. (2013). *Applied multiple regression/correlation analysis for the behavioral sciences*. Routledge.

Cooke, T. J., & Boyle, P. (2011). The migration of high school graduates to college. *Educational Evaluation and Policy Analysis*, 33(2), 202-213.

Cowen Institute (2011). Transforming public education in New Orleans: The Recovery School District, 2003–2011. New Orleans, LA: Tulane University.

Flowerdew, R., & Aitkin, M. (1982). A Method of Fitting the Gravity Model Based on the Poisson Distribution. *Journal of Regional Science*, *22*(2), 191–202.

Frank, K. A. (2009) Quasi-Ties: Directing Resources to Members of a Collective *American Behavioral Scientist*. 52: 1613-1645.

Fuller, B. F., & Elmore, R. (1996). *Who Chooses? Who Loses? Culture, Institutions and the Unequal Effects of School Choice.* ERIC. Retrieved from http://eric.ed.gov/?id=ED414628

Furgeson, J., Gill, B., Haimson, J., & Killewald, A. (2012). Charter-School Management Organizations: Diverse Strategies and Diverse Student Impacts." Mathematica Policy Research, Inc., and Center on Reinventing Public Education.

Gelman, A. (2008). Scaling regression inputs by dividing by two standard deviations. *Statistics in Medicine*, *27*(15), 2865–2873.

Hanushek, E. A., Kain, J. F., & Rivkin, S. G. (2004). Disruption versus Tiebout Improvement: the Costs and Benefits of Switching Schools. *Journal of Public Economics*, 88 (2004), pp. 1721 - 1746.

Harris, D. N. (2011). *Value-Added Measures in Education: What Every Educator Needs to Know*. Cambridge, MA: Harvard Education Press.

Harris, D. & Larsen, M. (2015). What schools do families want (and why)? School demand and information before and after the New Orleans post-Katrina school reforms. *Education Research Alliance*.

Harris, D. N., Valant, J. & Gross, B. (2015). The New Orleans OneApp: Centralized enrollment matches students and schools of choice. *Education Next*, *15*(4), 17–22.

Hastings, J. S., & Weinstein, J. M. (2008). Information, School Choice, and Academic Achievement: Evidence from Two Experiments. *The Quarterly Journal of Economics*, *123*(4), 1373–1414. http://doi.org/10.1162/qjec.2008.123.4.1373

Howell, W. & Peterson, P. (2006). The Education Gap. Washington, DC: Brookings Institution Press.

Hoxby, C. M. (2000). Does competition among public schools benefit students and taxpayers? *American Economic Review*, 1209–1238.

Ingersoll, R. (2001). Teacher Turnover and Teacher Shortages: An Organizational Analysis. *American Educational Research Journal*, *38*(3), 499–534.

Jabbar, H. (2015). "Every kid is money": Market-like competition and school leader strategies in New Orleans. *Educational Evaluation and Policy Analysis*, 37(4), 638–659.

Jennings, J. (2010). School choice or schools' choice?: Managing in an era of accountability. *Sociology of Education*, 83(3), 227–247.

Lee, V.E., Croninger, R.G., & Smith, J.B. (1996). Equity and choice in Detroit. In B. Fuller & R.E Elmore (Eds.), Who chooses, who loses? Culture, institutions, and the unequal effects of school choice (pp. 70-94). New York: Teachers' College Press.

Kerbow, D., Azcoitia, C., & Buell, B. (2003). Student Mobility and Local School Improvement in Chicago. *The Journal of Negro Education*, 72(1), 158–164.

Kukla-Acevedo, S. (2009). Leavers, Movers, and Stayers: The Role of Workplace Conditions in Teacher Mobility Decisions. *The Journal of Educational Research*, *102*(6), 443–452.

Lacireno-Paquet, N., Holyoke, T. T., Moser, M., & Henig, J. R. (2002). Creaming versus cropping: Charter school enrollment practices in response to market incentives. *Educational Evaluation and Policy Analysis*, *24*(2), 145–158.

Lankford, H. & Wyckoff, J. (2005). Why are schools racially segregated? In Scott, J. (Ed.). *School Choice and Diversity: What the Evidence Says*. New York: Teachers College Press.

Lash, A. A., & Kirkpatrick, S. L. (1990). A classroom perspective on student mobility. *The Elementary School Journal*, 91(2), 177–191.

Lauen, D. L. (2007). Contextual Explanations of School Choice. *Sociology of Education*, 80(3), 179–209.

Long, J.S. (1997). *Regression Models for Categorical and Limited Dependent Variables*. Thousand Oaks, California: Sage Publications.

Lubienski, C., Gulosino, C., & Weitzel, P. (2009). School Choice and Competitive Incentives: Mapping the Distribution of Educational Opportunities across Local Education Markets. *American Journal of Education*, *115*(4), 601–647.

McHugh, R., & Morgan, J. N. (1984). The determinants of interstate student migration: A place-to-place analysis. *Economics of Education Review*, 3(4), 269–278.

Martinez, V.R., Godwin, R.K., & Kemerer, ER. (1996). Public school choice in San Antonio: Who chooses and with what effects? In B. Fuller & R.E Elmore (Eds.), Who chooses, who loses? Culture, institutions, and the unequal effects of school choice (pp. 50-69). New York: Teachers' College Press.

Raudenbush, S.W., Bryk, A.S, & Congdon, R. (2011). HLM 7 for Windows [Computer software]. Skokie, IL: Scientific Software International, Inc.

Reay, D., & Lucey, H. (2000). Children, school choice and social differences. *Educational Studies*, *26*(1), 83–100.

Rumberger, R. W. (2003). The Causes and Consequences of Student Mobility. *The Journal of Negro Education*, 72(1), 6–21.

Rumberger, R. W., & Larson, K. A. (1998). Student Mobility and the Increased Risk of High School Dropout. *American Journal of Education*, 107(1), 1–35.

Schneider, M. & Buckley, J. (2002). What do families want from schools? Evidence from the internet. *Educational Evaluation and Policy Analysis* 24(2), 133-144.

Schneider, M., Marschall, M., Teske, P., & Roch, C. (1998). School choice and culture wars in the classroom: What different parents seek from education. *Social Science Quarterly*, 489–501.

Schwartz, A., Stiefel, L., & Chalico, L. (2009). The Multiple Dimensions of Student Mobility and Implications for Academic Performance: Evidence from New York City Elementary and Middle School Students. New York Education Finance Research Consortium.

Scott, J. (Ed.). (2005). *School Choice and Diversity: What the Evidence Says*. New York: Teachers College Press.

Sirer, I., Maroulis, S., Guimera, R., Wilensky, U., Amaral, L.A.N. (2015) "The Currents Beneath the 'Rising Tide' of School Choice: Student Enrollment Patterns in Chicago Public Schools," *Journal of Policy Analysis and Management*, 34(2), 358–377.

Stewart, J. W. (1948). Demographic gravitation: Evidence and applications. *Sociometry*, 11, 31–47.

Stouffer, S. A. (1940). Intervening opportunities: A theory relating mobility and distance. *American Sociological Review*, 5, 845–867.

Stouffer, S. A. (1960). Intervening opportunities and competing migrants. *Journal of Regional Science*, 2(1), 2–26.

Thompson, S. M., Meyers, J., & Oshima, T. C. (2011). Student Mobility and Its Implications for Schools' Adequate Yearly Progress. *The Journal of Negro Education*, 80(1), 12–21.

Weiher, G. & Tedin, K. (2002). Does Choice Lead to Racially Distinctive Schools? Charter Schools and Household Preferences. *Journal of Policy Analysis and Management, 21,* 79-92.

Welsh, R., Duque, M., & McEachin, A. (forthcoming). School choice, student mobility, and school quality: Evidence from post-Katrina New Orleans. *Education Finance and Policy*.

van Duijn, M., & Huisman, M. (2011). Statistical Models for Ties and Actors. In J. Scott, & P. J. Carrington (Eds.), *The SAGE Handbook of Social Network Analysis Handbook of Social Network Analysis*. (pp. 459-483). London: Sage publishers.

APPENDIX A: Share of Grade 1-7 Students in New Orleans, by Group and Year

Table A-1. Share of Grade 1-7 Students in New Orleans, by Group and Year

	Pre-Reform Years				Post-Reform Years				
	2001	2002	2003	2004	2008	2009	2010	2011	Post/Pre Change[a]
New Orleans Sector									
All	1	1	1	1	1	1	1	1	0.00
OPSB	1	1	1	0.98	0.26	0.23	0.24	0.22	-0.76***
OPSB: always	0.14	0.14	0.14	0.14	0.26	0.23	0.24	0.22	0.09***
OPSB to RSD[b]	0.86	0.86	0.85	0.84	0.71	0.72	0.72	0.74	-0.13***
OPSB: Charter	0.12	0.12	0.12	0.12	0.21	0.19	0.19	0.18	0.07***
RSD: Charter	0	0	0	0	0.41	0.44	0.52	0.6	0.50***
Student Demographic Characteristics									
Male	0.49	0.5	0.5	0.5	0.51	0.51	0.51	0.51	0.01***
Female	0.51	0.5	0.5	0.5	0.49	0.49	0.49	0.49	-0.01***
White	0.05	0.04	0.04	0.04	0.06	0.06	0.06	0.06	0.02***
Black	0.92	0.93	0.93	0.93	0.89	0.9	0.9	0.88	-0.04***
Other Ethnicity	0.03	0.03	0.03	0.03	0.05	0.05	0.04	0.06	0.02***
Lunch Subsidy	0.83	0.85	0.86	0.85	0.85	0.87	0.86	0.87	0.01***
No Subsidy	0.17	0.15	0.14	0.15	0.15	0.13	0.14	0.13	-0.01***
Special Ed	0.06	0.06	0.09	0.1	0.07	0.06	0.06	0.06	-0.02***
Not Special Ed	0.56	0.58	0.6	0.61	0.62	0.63	0.62	0.62	0.04***
Student Academic Achievement (Math Thirds, Grades 3-7)[c]									
Math: Tercile 1	0.52	0.55	0.54	0.5	0.48	0.45	0.4	0.39	-0.10***
Math: Tercile 2	0.29	0.28	0.28	0.31	0.3	0.32	0.32	0.33	0.03***
Math: Tercile 3	0.19	0.17	0.18	0.19	0.21	0.23	0.28	0.27	0.07***

Source: LDOE, October Enrollment Files and Spring Test Files

Notes: Universe of students include those promoted a grade that had have their next grade available in their current school in the next year.

[a] Post/pre change column aggregates across all post and pre years respectively. Significance levels on pre-post t-tests: * = p < 0.1, ** = p < 0.05, *** = p < 0.01.

[b] This group of schools includes those that were OPSB in the pre-reform years, but either closed or became an RSD school in the post-reform years.

[c] Thirds are based on the distribution of test scores at the state. Because the distribution of New Orleans students tends to be relatively low in the state, there is not an even share of students in each third.

APPENDIX B: SUPPLEMENTAL RESULTS

This appendix provides regression estimates supplementing those provided in the main text. As with the estimates in Table 2, the results presented in this Appendix correspond to the following overdispersed Poisson model for dyad *i* nested within sender *j* and receiver *k*:

Level-1 (Dyad)

$E(MOVES_{ijk}|\pi_{jk}) = \lambda_{ijk}$

$\log[\lambda_{ijk}] = \eta_{ijk}$

$\eta_{ijk} = \pi_{0jk} + \pi_{1jk}*(DIST_{ijk}) + \pi_{2jk}*(SAMELEA_{ijk}) + \pi_{3jk}*(PMOVERS_{ijk}) + \pi_{4jk}*(MOVESM1_{ijk})$

Level-2 (Sender/Receiver)

$\pi_{0jk} = \theta_0 + b_{00j} + c_{00k}$

$+ (\gamma_{01})*MDIST_j + (\gamma_{02})*SPS_j + (\gamma_{03})*FRPL_j + (\gamma_{04})*WHITE_j + (\gamma_{05})*SELECT_j + (\gamma_{06})*CHARTER_j$

$+ (\beta_{01})*MDIST_k + (\beta_{02})*SPS_k + (\beta_{03})*FRPL_k + (\beta_{04})*WHITE_k + (\beta_{05})*SELECT_k + (\beta_{06})*CHARTER_k$

$+ (\beta_{07})*HS_k$

where SPS is the state-issued School Performance Score; MDIST, the mean distance of the school from all other schools; FRPL, the fraction of students in the school receiving free or reduced price lunch; WHITE, the fraction of white students in the school; SELECT, an indicator variable for a selective admissions policy; CHARTER, an indicator variable for being a charter school; HS, an indicator variable whether the school contained high school grades; PMOVERS, the logged number of potential movers between a pair of schools; MOVESM1, the number of non-structural moves in the previous year (MOVESM1). The level one variance is modeled as a function of λ_{ijk} and a parameter that allows for overdispersion, and b_{00j} and c_{00k} are assumed to be normally distributed with mean zero and variances to be estimated.

For estimates that are disaggregated by achievement tercile, the MOVES, PMOVERS, and MOVESM1 correspond to the number of students in that tercile only. SAMELEA, a variable indicating whether a pair of schools belonged to the same district or charter management organization, was only included in the 2011 estimates because almost all New Orleans public schools were in the same single OPSB in the pre-storm period.

Note that not all specifications will look exactly like the one presented above. In some models, SPS will be included as a level-1 variable that captures the difference between the receiver and sender (SPSDIFF). In other models, the previous number of moves (MOVESM1) will not be included as a control.

Table B-1. SPS Coefficient Estimates by Year without MOVESM1 (Grades 1-7)

	Including new observations			Using existing observations		
	2004	**2011**	**z-value for diff**	**2004**	**2011**	**z-value for diff**
Nbr. of dyads	7970	2877		7218	2399	
Nbr. of Senders	96	55		94	46	
Nbr. of Receivers	110	55		110	55	
SPS Difference						
coefficient	0.43***	0.99***	2.47**	0.62***	1.08***	2.08**
(std. err.)	(0.16)	(0.16)		(0.15)	(0.16)	
$e^{coefficient}$	1.53	2.69		1.87	2.96	
SPS, Sender						
coefficient	-0.49**	-1.24***	-2.86***	-0.90***	-1.35***	-1.79*
(std. err.)	(0.19)	(0.18)		(0.17)	(0.19)	
$e^{\|coefficient\|}$	1.63	3.44		2.44	3.86	
SPS, Receiver						
coefficient	0.29	0.05	-0.54	-0.10	0.20	0.85
(std. err.)	(0.29)	(0.33)		(0.26)	(0.24)	
$e^{coefficient}$	1.33	1.06		1.11	1.22	

This presents estimates from models identical to those of Table 3 in the main text, except that the previous number of moves on a dyad, MOVESM1, was not included as a control. Not all dyads had a value for MOVESM1, therefore removing it from the models allows for new observations to enter the data. Results including those new observation (7970 and 2877 dyads), as well as results using the same dataset as in Table 3 (2718 and 2399 dyads), are presented in this table.

Significance levels: * = $p < 0.1$, ** = $p < 0.05$, *** = $p < 0.01$.

Table B-2. Cross-Classified Multilevel Poisson Regression Estimates (2004)

	1	2	3	4
Academic Performance				
SPS difference, receiver minus sender	0.60**			
	(0.14)			
SPS, sender			-0.88***	
			(0.16)	
SPS, receiver			-0.02	
			(0.24)	
Value-added difference, receiver minus sender		0.27**		
		(0.08)		
Value-added, sender				-0.45***
				(0.10)
Value-added, receiver				-0.16
				(0.14)
Spatial Arrangement				
Distance between sender and receiver	-1.39***	-1.39***	-1.38***	-1.39***
	(0.06)	(0.06)	(0.06)	(0.06)
Mean distance between sender and others	0.26***	0.22***	0.29***	0.23***
	(0.08)	(0.08)	(0.08)	(0.08)
Mean distance between receiver and others	0.36***	0.40***	0.43***	0.43***
	(0.13)	(0.13)	(0.13)	(0.13)
SES / Demographic				
Fraction free or reduced price lunch, sender	0.19	0.41*	0.16	0.46**
	(0.20)	(0.21)	(0.20)	(0.20)
Fraction free or reduced price lunch, receiver	-0.60	-0.74*	-0.58*	-0.57*
	(0.32)	(0.32)	(0.30)	(0.31)
Fraction white, sender	0.03	-0.04	0.13	0.03
	(0.16)	(0.17)	(0.16)	(0.16)
Fraction white, receiver	-0.67*	-0.56*	-0.41	-0.39
	(0.27)	(0.27)	(0.27)	(0.26)
School Type / Sector				
Selective school, sender	-0.24	-0.46*	-0.07	-0.36
	(0.21)	(0.21)	(0.22)	(0.21)
Selective school, receiver	-0.92**	-0.61*	-0.38	-0.31
	(0.31)	(0.30)	(0.34)	(0.30)
Charter school, sender	-0.74*	-0.75*	-0.71**	-0.67*
	(0.33)	(0.34)	(0.33)	(0.34)
Charter school, receiver	0.75	-0.41	0.76*	0.84*
	(0.46)	(0.31)	(0.44)	(0.44)
School contains a grade > 8	-0.35	0.77	-0.50*	-0.48
	(0.30)	(0.47)	(0.29)	(0.29)

All models include the logged number of potential non-structural movers and the number of non-structural moves the previous year as dyad-level controls. Number of observations: 94 senders, 110 receivers, 7,218 dyads. Significance levels: * = $p < 0.1$, ** = $p < 0.05$, *** = $p < 0.01$.

Table B-3.
Cross-Classified Multilevel Poisson Regression Estimates, by Achievement Tercile (2011)

	1	2	3	4
	LOW	MED/HIGH	LOW	MED/HIGH
Academic Performance				
SPS difference, receiver minus sender	0.30	1.03***		
	(0.27)	(0.20)		
SPS, sender			-0.60*	-1.11***
			(0.32)	(0.26)
SPS, receiver			-0.31	0.91***
			(0.47)	(0.31)
Spatial Arrangement				
Distance between sender and receiver	-0.87***	-0.71***	-0.87***	-0.71***
	(0.11)	(0.11)	(0.11)	(0.11)
Mean distance between sender and others	0.37**	0.32**	0.37**	0.32**
	(0.14)	(0.13)	(0.14)	(0.13)
Mean distance between receiver and others	-0.06	0.15	-0.03	0.15
	(0.31)	(0.22)	(0.31)	(0.22)
SES / Demographic				
Fraction free or reduced price lunch, sender	0.46	0.38	0.38	0.36
	(0.42)	(0.33)	(0.41)	(0.34)
Fraction free or reduced price lunch, receiver	-0.52	-0.01	-0.55	-0.04
	(0.72)	(0.49)	(0.71)	(0.49)
Fraction white, sender	-1.20**	-0.33	-1.17	-0.34
	(0.59)	(0.31)	(0.59)	(0.31)
Fraction white, receiver	-3.16**	-0.59	-2.91**	-0.59
	(1.37)	(0.45)	(1.33)	(0.45)
School Type / Sector				
Selective school, sender	1.73**	0.79**	1.72**	0.84**
	(0.79)	(0.39)	(0.80)	(0.40)
Selective school, receiver	-2.29*	-0.38	-1.63	-0.29
	(1.36)	(0.64)	(1.40)	(0.66)
Charter school, sender	-0.26	0.32*	-0.18	0.32*
	(0.19)	(0.17)	(0.19)	(0.17)
Charter school, receiver	0.47	0.37	0.54	0.38
	(0.36)	(0.26)	(0.36)	(0.26)
School contains a grade > 8	0.89*	1.35***	0.95**	1.36***
	(0.46)	(0.30)	(0.46)	(0.30)
Sender and receiver in same district or CMO	0.22	1.19***	0.22	1.20***
	(0.18)	(0.14)	(0.18)	(0.14)

All models include the logged number of potential non-structural movers and the number of non-structural moves the previous year as dyad-level controls. Number of observations: 46 senders, 55 receivers, 2,399 dyads. Significance levels: * = $p < 0.1$, ** = $p < 0.05$, *** = $p < 0.01$.

Table B-4.
Cross-Classified Multilevel Poisson Regression Estimates, by Achievement Tercile (2004)

	1 LOW	2 MED/HIGH	3 LOW	4 MED/HIGH
Academic Performance				
SPS difference, receiver minus sender	0.01	0.60***		
	(.19)	(0.18)		
SPS, sender			-0.57**	-0.63***
			(0.23)	(0.23)
SPS, receiver			-0.90***	0.56*
			(0.29)	(0.29)
Spatial Arrangement				
Distance between sender and receiver	-1.58***	-1.07***	-1.57***	-1.07***
	(0.08)	(0.08)	(0.08)	(0.08)
Mean distance between sender and others	0.36***	0.22*	0.43***	0.22*
	(0.09)	(0.11)	(0.09)	(0.11)
Mean distance between receiver and others	0.44***	0.37**	0.55***	0.37**
	(0.16)	(0.16)	(0.15)	(0.16)
SES / Demographic				
Fraction free or reduced price lunch, sender	0.32	0.12	0.23	0.12
	(0.24)	(0.28)	(0.23)	(0.29)
Fraction free or reduced price lunch, receiver	-0.77**	-0.67*	-0.69**	-0.67*
	(0.37)	(0.37)	(0.34)	(0.37)
Fraction white, sender	-0.35	0.18	-0.19	0.19
	(0.28)	(0.21)	(0.28)	(0.22)
Fraction white, receiver	-1.06***	-0.53*	-0.61*	-0.52
	(0.34)	(0.32)	(0.34)	(0.33)
School Type / Sector				
Selective school, sender	-0.37	-0.14	-0.15	-0.12
	(0.34)	(0.28)	(0.34)	(0.30)
Selective school, receiver	-1.76***	-0.36	-1.05**	-0.33
	(0.43)	(0.37)	(0.44)	(0.41)
Charter school, sender	-0.74**	-0.79	-0.62*	-0.79
	(0.34)	(0.48)	(0.33)	(0.48)
Charter school, receiver	0.55	1.09**	0.54	1.09**
	(0.52)	(0.51)	(0.48)	(0.51)
School contains a grade > 8	-0.89**	-0.25	-1.17***	-0.26
	(0.36)	(0.36)	(0.35)	(0.37)

All models include the logged number of potential non-structural movers and the number of non-structural moves the previous year as dyad-level controls. Number of observations: 94 senders, 110 receivers, 7,218 dyads. Significance levels: * = $p < 0.1$, ** = $p < 0.05$, *** = $p < 0.01$.

Table B-5.
Cross-Classified Multilevel Poisson Regression Estimates (Grades 9-11, 2004)

	1	2
Academic Performance		
SPS difference, receiver minus sender	0.15	
	(0.98)	
SPS, sender		1.26
		(1.46)
SPS, receiver		1.03
		(1.20)
Spatial Arrangement		
Distance between sender and receiver	-0.42***	-0.43***
	(0.16)	(0.16)
Mean distance between sender and others	0.12	-0.02
	(0.30)	(0.31)
Mean distance between receiver and others	0.40	0.34
	(0.24)	(0.24)
SES / Demographic		
Fraction free or reduced price lunch, sender	0.19	-0.16
	(0.72)	(0.75)
Fraction free or reduced price lunch, receiver	-0.48	-0.67
	(0.53)	(0.55)
Fraction white, sender	-0.16	-1.04
	(0.90)	(1.11)
Fraction white, receiver	-1.46	-2.01*
	(0.86)	(0.97)
School Type / Sector		
Selective school, sender	0.20	-1.23
	(1.08)	(1.53)
Selective school, receiver	-0.08	-0.95
	(1.06)	(1.26)
Charter school, sender	-0.13	0.17
	(0.63)	(0.65)
Charter school, receiver	-0.44	-0.25
	(0.53)	(0.54)

All models include the logged number of potential non-structural movers and the number of non-structural moves the previous year as dyad-level controls. Number of observations: 20 senders, 21 receivers, 396 dyads. Significance levels: * = $p < 0.1$, ** = $p < 0.05$, *** = $p < 0.01$.