# Katrina's Children:
# A Natural Experiment in Peer Effects from Hurricane Evacuees*

**Scott Imberman**
**University of Houston**

**Adriana Kugler**
**University of Houston, NBER, CEPR, IZA, CReAM, and**
**Stanford Center for the Study of Poverty and Inequality**

**Bruce Sacerdote**
**Dartmouth College and NBER**

* We are grateful to HISD for giving us access to the Houston data and to the Louisiana Department of Education's Division of Standards, Assessment and Accountability and to Data Recognition Corporation for allowing access to the Louisiana data. We are especially grateful to Ms. Luellan Bledsoe for answering our queries about the HISD data and to Dr. Fen Chou and Ms. Ann Payne for answering our queries about the Louisiana data. We are also grateful to Dr. Carla Stevens for her help in accessing the HISD data and for detailed comments on our work. We thank a number of anonymous principals and teachers who provided valuable insights about the process of absorption of the evacuees in the receiving schools. We are especially grateful to Josh Angrist for extensive discussions and advice. We also thank Eric Bettinger, Steven Craig, David Francis, Giacomo DeGiorgi, Peter Hinrichs, Andrea Ichino, Elaine Liu, Kevin Lang, Michael Lovenheim, Phil Oreopoulos, Paul Oyer, Douglas Staiger, and seminar participants at Stanford University, University of California at Merced, University of Houston, and University of Texas at Austin. Further, we thank participants at the American Economic Association, the American Education Finance Association, and the Society of Labor Economists meetings. Support for this research from the University of Houston New Faculty Research Grant program is gratefully acknowledged. This research was conducted independently and is neither endorsed by nor supported by the Houston Independent School District. Any views or opinions expressed here are solely those of the authors and do not reflect the views of HISD or its employees. E-mail addresses for correspondence are: simberman@uh.edu, adkugler@uh.edu and sacerdote@dartmouth.edu.

**Abstract**

In 2005, hurricanes Katrina and Rita induced the largest internal migration ever in the U.S. As a byproduct, a large number of children had to evacuate the Gulf coast areas of Louisiana, Mississippi and Alabama and relocate to schools across the southeast US. Many school districts strived to enroll the evacuees in their schools as quickly as possible. At the same time, families in the receiving districts worried about disruptions in the schools and decreased resources for non-evacuee students. Using data from Houston, TX and Louisiana we investigate the extent to which the arrival of Katrina and Rita evacuee peers adversely affected the academic performance and behavior of native students. On average, we find that increases in the share of evacuees moderately reduced elementary test scores for math in Houston and secondary reading test scores in Louisiana. Moreover, non-linear models show evidence of monotonicity in Houston and boutiquing in Louisiana. In Houston, the influx of low quality evacuees hurt all natives, while the entry of high quality evacuees helps all natives. By contrast, in Louisiana, the influx of low (high) quality evacuees has a bigger negative (positive) effect on natives as they get better. We also find that the influx of Katrina evacuees decreased attendance rates of native students, suggesting that peer effects are working through both cognitive as well as behavioral channels. Our results are robust to an instrumental variables strategy and a placebo experiment. We also see little evidence to suggest that these impacts are coming through changes in class size, per-student expenditures, teacher experience, or school switching amongst native students, suggesting that the impacts we see are indeed working through peer effects.

## 1. Introduction

On August 29, 2005, Hurricane Katrina made landfall in Southeast Louisiana. Katrina was one of the five deadliest hurricanes in the U.S. causing about 2,500 deaths. It was also the most destructive and costliest hurricane ever in the U.S., with a total estimated damage of over $80 billion (Knabb, Rhome and Brown, 2006). The storm surge caused flooding in 80% of New Orleans as well as large areas of the coasts of Mississippi and Alabama. Federal disaster declarations covered 90,000 square miles of the U.S. Just a few weeks later, Hurricane Rita hit Louisiana and East Texas. Rita was the most powerful storm ever recorded in the Gulf and while it hit a less populated area, there was still substantial damage as a result of the storm.

Katrina and Rita caused over a million people to evacuate from the Central Gulf coast to other areas of the U.S.; the greatest migration of children and their families in U.S. history (Ladd, Marzalek and Gill, 2008). Some areas of Louisiana received large numbers of evacuees. Baton Rouge received over 15,000 evacuees and Hammond received over 10,000 evacuees, nearly doubling its population. However, many evacuees left the affected states. Houston, Texas received 75,000 people, which was the largest number of evacuees received by any city (McIntosh, 2008).

As a result of the migration, many children were uprooted. Given that schools were probably the best way to bring back stability into children's lives, school districts mounted substantial efforts to enroll the evacuees in their schools as quickly as possible. Districts in Louisiana not affected by the hurricanes took in about 196,000 children. Houston area schools took nearly 20,000 evacuee children since hurricanes Katrina and Rita struck, with the Houston Independent School District enrolling over 5,000 students.

While Baton Rouge, Houston and other cities were seen as great examples of solidarity, the influx of large numbers of kids into the schools created concerns among the non-evacuee population. On the one hand, the evacuee children came from some of the worst-performing schools in the country and parents worried that their children would be negatively affected by the disruption caused by the influx of poor performing students. Disruption due to student turnover is a concern even under ordinary circumstances. For instance, Hanushek, Kain and Rivkin (2004) report that about a third of all students in Texas move at least once in elementary and middle school and that these moves adversely affect the academic performance of students in the receiving schools.[1] Moreover, the negative spillovers from disruptive behavior have been considered by Figlio (2005) and Carrell and Hoekstra (2008), who show that the presence of boys with female sounding names and children exposed to domestic violence decreases the academic achievement of their peers.

In this paper, we examine whether the influx of Katrina and Rita students adversely affected the academic performance, attendance and discipline of non-evacuee children. While much of the literature on peer effects for higher education finds modest positive peer effects on GPA (e.g., Carrell, Fullerton and West, 2008; Lyle, 2007; Sacerdote, 2001; Stinebrickner and Stinebrickner, 2006; and Zimmerman, 2006), results on peer effects for elementary and secondary education are more mixed with some studies finding little or no effects (e.g., Angrist and Lang, 2004; Burke and Sass, 2008; Hanushek et al., 2003; Vigdor and Nechyba, 2009) and others finding large effects (e.g., Hoxby, 2000; and Hoxby and Weingarth, 2006; Lavy and Schlosser, 2007). By contrast,

[1] Hanushek et al. (2004) also report that these moves are particularly prevalent among low income and minority students and that the adverse effects of turnover for black and Hispanic receiving students are about seven and five times larger, respectively, than the effect for whites.

evidence on peer effects on social outcomes shows larger effects both for elementary and secondary education as well as for post secondary education (e.g. Aizer, 2008; Carrell, Malmstrom and West, 2008; Case and Katz, 1991; Evans, Oates, and Schwab, 1992; Gaviria and Raphael, 2001; Lavy and Schlosser, 2007). Peer effects can also reflect externalities from the movement of students in and out of schools, which Hanushek, Kain and Rivkin (2004) find to be substantial.

An advantage of our study is that we can exploit the exogenous influx of new students into the Houston and Louisiana schools to examine peer effects. In fact, many evacuees were evacuated on buses without knowing where they were going. Others were able to drive and choose their destination but had very limited options, often residing in shelters, motels, or with friends and family. Thus, like the studies by Angrist and Lang (2004); Boozer and Cacciola (2001); Hoxby (2000), and Lavy and Schlosser (2007), we identify peer effects by exploiting an exogenous shock to peer group composition. Thus, the influx of Katrina evacuees into schools helps us to overcome the usual reflection and selection problems that are present in peer effects specifications.[2] While our study is closest to Angrist and Lang (2004), our natural experiment has two advantages. First, the incoming students in our quasi-experiment are more similar in racial composition and economic status to the receiving students than in bused students in the Metco study, which would show bigger spillovers in our context if peer effects are non-linear. Second, we have good measures of behavior (including discipline and attendance data), which allows us to examine the impacts of peers on behavior using administrative data rather than self-reported data as in other studies.

[2] On the other hand, like most of the literature, we will be capturing both endogenous and exogenous peer effects, as defined by Manski (1993).

We use data from the Houston Independent School District (HISD) as well as data from the Louisiana Department of Education collected by the Data Recognition Corporation to provide estimates of peer effects. We define peer effects broadly to include externalities from evacuee achievement, behavior, and disruption from entering and exiting schools mid-year. We first examine the impact on student academic performance and then turn to effects on discipline. Our findings show that a 10% increase in Katrina evacuees reduces math test scores of non-evacuee elementary school children by 0.09 of a standard deviation in Houston and that this result is mainly driven by drops in scores for girls and African-American children. Moreover, when we estimate non-linear models that allow effects to vary by the quality of evacuees and natives, we find that the arrival of high score evacuees benefits all native but generates a bigger benefit for those at the lower end of the ability distribution. On the other hand, the arrival of low score evacuees hurts mainly elementary students at the lower end of the distribution but mostly middle- and high-school students at the higher end of the distribution.

A concern is that since students may self-select into schools after some time in Houston, assignment to schools may be endogenous. Since initial residence and school assignment was mostly out of the control of the evacuees, we use the fraction of students who were evacuees on September 13, 2005 to instrument the fraction of students who were evacuees in October of each year, which is our measure of evacuee exposure. Our IV results are less precise but are not significantly different from the OLS estimates. In addition, to address potential self-selection into schools facing on-going bad trends, we estimate the regression of a placebo quasi experiment of the test scores before Katrina on the Katrina shares and we find that these are insignificant.

In Louisiana, we find that that a 10% increase in Katrina evacuees reduces Middle and High school language test scores by 0.03 of a standard deviation, mostly amongst boys. In addition, our non-linear models show evidence of boutiquing in Louisiana. In particular, we find that the influx of high quality evacuees is more likely to benefit high test score natives and that the influx of low-quality evacuees is less likely to hurt low test score natives. Like with the Houston data, the placebo experiment does not show any statistically significant effects of Katrina shares on the 2004-2005 test scores.

For Houston, we can also examine the impact of the influx of Katrina children a number of behavioral outcomes, including the number of disciplinary infractions and the absence rate. We find that a 10% increase in Katrina evacuees reduces the attendance rate of non-evacuee students by a fifth of a percentage point in elementary schools and by three quarters of a percentage point in middle-schools and high-schools. Black students, in particular, have a large reduction in attendance of 1.4 percentage points. While we find no overall effect on disciplinary infractions, we do find that the influx of Katrina evacuees increases the number of disciplinary infractions for girls and African-American secondary students. The results are also robust to the use of instruments and the placebo experiment does not show any statistically significant effects of increased Katrina shares on pre-Katrina absence rates and disciplinary actions. We also find evidence that the influx of evacuees with low attendance reduces attendance while the influx of evacuees with high attendance increases attendance most for natives with the worse attendance records pre-Katrina. These results on behavior suggest that the most substantial negative effects may be coming from disruptive peers and coincide with the results in Lavy and

Schlosser (2007), which show similar peer effects using self-reported measures of discipline.

A concern that remains is whether we are simply capturing the fact that evacuees were taking resources away from the native students, as school districts incurred millions of dollars in additional costs while absorbing the new children. We address this by looking at whether having a higher share of Katrina evacuees increased class size, reduced expenditures per student or reduced the quality of teachers hired by the schools. We do not find evidence of a relation between the share of Katrina evacuees and class size in Houston and, if anything, we find reduced class sizes in Louisiana. While school level financial data is not available for Louisiana, we do not find evidence of a relation between the share of Katrina evacuees and per student operating or instructional expenditures in Houston. Thus, it seems that schools mostly recovered the additional money they had to spend from the state and Federal governments. Moreover, another concern is that since class size did not change, schools were hiring less qualified teachers to absorb the evacuees. However, we do not find evidence of a relation between the share of Katrina evacuees and average teacher experience in a school. Also, these resource based explanations should affect better and worse natives similarly and should not depend on the quality of the evacuees and are more difficult to reconcile with the results from our non-linear models.

Finally, we look into weather we may be observing lower native test scores in schools receiving higher shares of Katrina evacuees simply because the best native students are leaving these schools. However, we find no evidence that students switch schools in response to the influx of Katrina kids in either Louisiana or Houston. Also, if anything, we find some evidence of less attrition from the Houston Independent School District from schools receiving from Katrina evacuees, although it is only marginally significant.

The rest of the paper proceeds as follows. Section 2 describes the absorption of Katrina evacuees into HISD and the non-affected school districts in Louisiana. Section 3 discusses the identification strategy. Section 4 describes the HISD data and the data from the Louisiana Department of Education. Section 5 presents the results on the impact of the influx of Katrina students on student achievement in math and language. Section 6 presents the results on the behavioral responses of non-evacuees to the influx of Katrina evacuees. Section 7 concludes.

## 2. Katrina's Children and School Responses

Hurricanes Katrina and Rita caused the largest displacement of children in the history of the U.S. About 400,000 students were forced to enroll in new schools as a result of these hurricanes (U.S. Department of Education, 2007). About 196,000 of these students moved within Louisiana (Pane et. al, 2007), but many others went outside of the state.

School districts across the country acted very quickly to open their doors to evacuated students. For example, by August 31, 2005, just two days after Hurricane Katrina made landfall, HISD was already admitting evacuees staying in shelters into the districts' schools. Education agencies in various states informed school district superintendants that displaced children were entitled to public school enrollment under the McKinney-Vento Homeless Assistance Improvements Act (Edwards, 2007). This Act places all responsibility on the districts to monitor homelessness and enroll homeless children in schools.

Within Louisiana, people mostly evacuated to places where they had family and friends. However, evacuees to East Baton Rouge were mainly living on FEMA assistance and went to cheap hotels and apartments. While some schools in areas of Louisiana not affected by the hurricanes received no evacuees at all, evacuee enrollment accounted for up to 27% of students in some schools. On average 3.1% of 2005-06 enrollment in schools outside the affected areas were evacuees. Figure 1 shows the map of the percentage of Katrina students in Louisiana schools that were not directly affected by the storms. This map also shows substantial variation across the state in terms of exposure to the evacuee children.

Many students, however, went outside of the state. Texas received 50,000 students, with the Houston Area receiving about 20,000 and the Houston Independent School District receiving 5,000 students in the 2005-2006 school year. In Houston, many students and their families were housed in shelters, which included 30,400 residents housed in the Reliant Park complex (Reliant Center, News Release), the largest evacuation shelter in U.S. history. An additional 1,300 individuals were housed in the George R. Brown Convention Center and many more resided in Red Cross shelters throughout the city. These shelters had HISD school bus stops to pick up the children and send them to various schools and information was spread letting parents know that those temporarily housed within HISD’s borders could enroll their children in the neighborhood school.

Initially, displaced students in the stadium complex and convention center were placed in schools close to the shelters and with available spots, including two elementary schools, Douglass and Ryan Elementary, which were reopened to help absorb the evacuees. Students residing in other locations were mostly sent to the school zoned to their address. In 2005, some schools in Houston received no evacuees at all, while in others evacuees comprised of up to 25% of the student population. The mean percentage of evacuees in HISD at the time was 2.5%. Figure 2 shows the map of Houston ISD and indicates the percent of Katrina students in the non-evacuee population on October 28, 2005. As in Louisiana, the map shows substantial variation in the influx of Katrina students across the district.

While the receiving school districts made a great effort to accommodate the thousands of new students, some worried about the financial burden on the taxpayers of the receiving areas. For example, it was predicted that HISD would face an extra $20 million in costs over the 2005-2006 school year (Klein, 2006). Given that districts were enrolling homeless students, they were eligible for federal education grants, but these took some time to be disbursed. It also took three months before Congress passed the Hurricane Education Recovery Act (HERA) to provide impact aid for districts enrolling displaced students and provide aid to restore educational facilities which had been damaged by the hurricanes. It was claimed that while the amount per student from HERA was supposed to cover $6,000 per displaced student, the allocation per student only reimbursed a fourth of this amount (Radcliffe, 2006). With regards to reduced resources, a main concern was that schools receiving many evacuees would experience a sharp rise in the student/teacher ratio. However, below we present evidence showing that evacuees generated no statistically significant increase in class sizes or expenditures per student.

In addition to funding issues, teachers and parents of non-evacuee students were concerned that some evacuees were years behind in terms of academic achievement. In interviews with teachers and principals of affected schools, many indicated that Katrina students were on average one or several years below grade level. Aside from issues related to academic performance, many worried about the inability to foster goodwill between some of Houston's students and the new arrivals. In middle and high-school, there were reports that feuds between students became more common after the arrival of the evacuees. In response to this, in the 2006-2007 school year, police presence was increased by 10% in 18 secondary schools. It was because of these types of concerns that Senators Kay Bailey Hutchison and John Cornyn from Texas attempted to introduce a bill that would allow districts across the country to introduce separate schools for displaced students (Scherer, 2006).

In what follows, we discuss the strategy we use to estimate peer effects of Katrina and Rita evacuees on the academic performance and discipline of non-evacuee students.

## 3. Identification Strategy

Given the unexpected influx of Katrina and Rita evacuees in Louisiana's and Houston's schools, we estimate the direct impact of this influx on native students as follows,

$$Y_{igjt} = \alpha + \beta Katrina\_Fraction_{jt} + \Omega X_{igjt} + \Pi Grade_g + \Gamma Year_t + \Phi Grade_g \times Year_t + \kappa_j + \varepsilon_{igjt}, \tag{1}$$

where $Y_{igjt}$ is the academic or disciplinary outcome of individual i in grade g attending school j at time t, $Katrina\_Fraction_{jt}$ is the number of Katrina and Rita evacuees divided by the total number of non-evacuee students in school j in March of year t+1 for Louisiana and in October of year t for Houston, where this fraction is zero before the 2005-2006 academic year.[3] $X_{igjt}$ are observable characteristics of individual i in grade g attending school j at time t, including indicators for whether the student is female, non-Hispanic white, non-Hispanic Black, Hispanic, Asian, Native American, and whether the student gets free-lunch, reduced-priced lunch or is classified as being otherwise economically disadvantaged.[4] $Grade_g$ and $Year_t$ are grade and year effects and $\kappa_j$ are school-fixed effects. Note that the addition of the school and year effects effectively makes this a difference-in-differences specification where changes in outcomes before and after the storm for schools that received a lot of evacuees are compared to changes for schools that receive few evacuees. Thus, we refer to this as a difference-in-differences specification throughout the rest of the paper.

The influx of Katrina evacuees could be capturing negative externalities of the evacuees on native kids, but it could also well be capturing the fact that the influx of Katrina evacuees reduced resources per student or drove the best students away from these schools. To check whether the effects of the evacuees on academic and disciplinary outcomes are due to reduced resources or attrition of the best students, we run a similar specification to regression (1) for the probability of moving to other schools within the district or out of the school district one year later as well as for class size, expenditures per student, and teacher experience at the school level.

[3] Louisiana results are limited to Katrina evacuees, while for Houston we include both Katrina and Rita evacuees which cannot be distinguished.
[4] The other economic disadvantage and Native American categories are only available for HISD.

In addition to estimating the reduced-form models as in equation (1), we follow an approach similar to Hoxby and Weingarth (2006) to examine non-linear peer effects. Since our data has less variation we use within-grade test score quartiles rather than deciles. For native students in both Houston and Louisiana, along with evacuees in Louisiana, we classify students by their pre-Katrina test-score quartiles. We do not have pre-Katrina test scores for Houston evacuees, thus we use their 2005-2006 score. We estimate specifications in which we regress fully saturated models of the test score of students in each quartile, $Q_{2004}$=1,2,3,4, where the quartile is based on their test scores in 2004-2005, on the percentages of evacuees in their school who fall in each quartile on the basis of their test scores in 2004-2005 as follows,[5]

$$E(Y_{igjt}|Q_{2004}) = \alpha + \beta_1 Katrina\_Fraction_{Q1\_2004jt} + \beta_2 Katrina\_Fraction_{Q2\_2005jt}$$
$$+ \beta_3 Katrina\_Fraction_{Q3\_2005jt} + \beta_4 Katrina\_Fraction_{Q4\_2005jt}$$
$$+ \Omega Xigjt + \Pi Grade_g + \Gamma Year_t + \Phi Grade_g \times Year_t + \kappa_j + \varepsilon_{igjt}. \qquad (2)$$

This specification allows us to compare the differential effects of the influx of Katrina evacuees in different quartiles on natives from different quartiles. Thus, we are able to compare if the influx of Katrina evacuees at the lower end of the distribution have a bigger negative effect on natives higher up in the distribution or lower in the distribution. Similarly we can see if the influx of evacuees in higher quartiles benefits natives at the higher or lower end of the distribution more. Thus, we will be able to examine whether

[5] Since our pre-Katrina data in Louisiana is limited to grades 4, 8, and 10 in 2003-04 and 2004-05, we use pre-Katrina test-scores for whichever of those two years the student is observed to identify the student's quartile for all years.

homogeneity of peers is better, or whether on the contrary heterogeneity of peers is more beneficial.

Since we have less variability in terms of the quality of the evacuees in Houston, we estimate a similar regression but only divide the fraction of natives by whether they fall above or below the median in terms of test scores or attendance. Also, because we do not observe test scores or attendance for evacuees before Katrina, we divide evacuees as being above or below the mean in terms of the 2005-2006 data. Thus, for Houston we estimate fully saturated models of test scores or attendance for native students in each quartile, $Q_{2004}$=1,2,3,4, where the quartile is based on their test scores in 2004-2005, on the percentages of evacuees in their school who fall below or above the median on the basis of their test scores in 2005-2006 as follows,

$$E(Y_{igjt}|Q_{2004})= \alpha + \beta_1 Katrina\_Fraction_{BelowMedian\_2005jt} + \beta_2 Katrina\_Fraction_{AboveMedian\_2005jt} + \Omega Xigjt + \Pi Grade_g + \Gamma Year_t + \Phi Grade_g \times Year_t + \kappa_j + \varepsilon_{igjt}, \tag{3}$$

Given the initial chaos and uncertainty facing the evacuees, the initial assignment to schools was plausibly exogenous, so we interpret the coefficient on "Katrina_Fraction" as capturing the causal effect of the influx of Katrina children on non-evacuee students. However, after a few months some evacuees moved to apartment complexes and more permanent residences and may have also moved schools. While this would generate endogenous selection into schools, many students remained in temporary residences and those that found permanent residences often moved to places that would allow their children to attend their initially assigned schools. Given that we are exploiting within school variation over time, we use the initial fraction of Katrina/Rita evacuees in a school on September 13, 2005 as an instrument for the fraction of Katrina evacuees in the last week of October in Houston which may be contaminated by self-selection of students to schools over time.[6] Using this instrumental variable strategy, the first-stage is

$$\text{Katrina\_Fraction}_{jt} = \delta_0 + \delta_1 \text{Initial\_Katrina\_Fraction}_{j2005} \tag{4}$$

$$+ CX_{igjt} + P\text{Grade}_g + T\text{Year}_t + У\text{Grade}_g \times \text{Year}_t + \lambda_j + \nu_{igjt},$$

And where the second stage is as in equation (1), but the fraction of Katrina evacuees is substituted for the predicted fraction of Katrina evacuees based on initial assignment to schools. The exclusion restriction imposes that, conditional on school fixed-effects and student characteristics, academic performance and disciplinary measures are independent of the initial fraction of displaced students.

Also, since one may worry that Katrina evacuees may be moving to school with pre-existing negative trends in the academic performance of the native kids, we perform a placebo experiment in which we regress pre-Katrina test scores and attendance on the future share of Katrina evacuees in a school.

## 4. Data Description

We rely on administrative data from the Department of Education in Louisiana and from the Houston Independent School District.

### 4.1. Louisiana Department of Education Data

The Louisiana data comes from the Department of Education Division of Standards, Assessment and Accountability and covers all students in the state who took the Louisiana Assessment of Educational Progress (LEAP and iLEAP) exam from the

[6] "Initial_Katrina_Fraction" excludes students who were residing at the stadium complex or convention center, as almost all of these students switched to new schools within two weeks. Unfortunately, we do not have similar instruments for Louisiana, so the IV analysis is limited to HISD data.

2003-2004 to the 2007-2008 academic year. The data is at the student-level includes information on gender, race/ethnicity, and free lunch status as well as data on test scores. While scores are available for grades 3 - 10 after Katrina, prior to Katrina only grades 4, 8 and 10 are available.  In total, there are 1.02 million student-year observations, including 104,489 Katrina evacuees.  In our analysis sample, we limit to schools that are outside of Greater New Orleans and have fewer than 30% evacuees, leaving 923,396 observations including 21,683 evacuee observations.[7]

The Louisiana data allows us to describe where evacuees came from and where they went. The parishes most affected by Hurricane Katrina are Orleans, Jefferson, Plaquemines, and Saint Bernard. These parishes comprise most of the Greater New Orleans Metropolitan Statistical Area. Ninety percent of the students in the affected parishes become evacuees and, of the Katrina evacuees, ninety-three percent come from the most affected parishes. Even after the hurricanes, the bulk of Katrina evacuees who remain in Louisiana attended a school in one of the four most affected parishes. The percentage of evacuees who attend schools in the affected parishes is 93% in the 2003-2004 and 2004-2005 school years, before the hurricanes. However, the following academic year, this dips to 68% in the spring, but rises back to 76% by the 2006-2007 school year. Many of the evacuees move from Orleans Parish to Jefferson. Pre-hurricane, the vast majority of these evacuees are located in Jefferson and Orleans Parishes, with an additional 700 to 800 evacuees in each of St. Tammany, Plaquemines, and St. Bernard in 2005. Post-hurricane, the count of evacuees (in grades 4, 8, and 10) in Jefferson Parish grows by about 1,200 and East Baton Rouge School District gains about 1,000 of these

[7] We exclude schools with more than 30% of evacuees to avoid focusing on schools in other parishes affected by the hurricanes or so close to the affected parishes so that the schools essentially became schools with evacuee children.

evacuees. This implies that East Baton Rouge gained roughly 3,300 student evacuees in all grades. The remaining school districts in the state each gain 0 - 150 evacuees. The number of evacuees in Orleans itself shrinks dramatically post-Katrina. The Recovery School District (RSD) in Orleans was set up to administer most of the schools in the former Orleans Parish School District. The RSD has roughly 1,100 4th , 8th , and 10th graders by the 2006-2007 school year.

Table 1 shows descriptive statistics for evacuees and non-evacuees in Louisiana excluding Greater New Orleans and schools with more than 30% evacuees, our analysis sample. Both groups are fairly evenly divided by gender, but evacuees are more likely to be Black. Non-evacuees are 43% African-American while evacuees are 62% African-American. Also, evacuees are more likely to be economically disadvantaged. Of the evacuees 80% are eligible for free lunch, while 55% of non-evacuees qualify.

Our main outcome measures are test results for math and English language arts (ELA) which combines reading and language.[8] Under Louisiana's accountability program, students in grades 4, 8, and 10 were tested in March of each year prior to 2005. These tests are known as the LEAP or Louisiana Educational Assessment Program (grades 4 and 8) and the GEE or Graduation Exit Examination (grade 10). In addition to math and ELA, students take an additional subject exam that varies by grade. The LEAP and GEE tests are high stakes tests with the following set of rules. To be promoted to the next grade, students in grades 4 and 8 must score “Basic” on at least one of the math and ELA tests and at least “Approaching Basic” on the other exam. In order to be eligible for a standard high school diploma, high school students must receive “Approaching Basic” or better on both the ELA and math exams and “Approaching Basic” or better on either

[8] Science and social studies are tested as well, however we only consider math and reading.

of the science or social studies exams. High stakes testing policies were suspended for all 4th and 8th grade students during the 2005-2006 school year due to the hurricanes.

In 2005-06, in response to the No Child Left Behind Act of 2003, Louisiana expanded the testing regime to include grades 3, 5, 6, 7 and 9 for math and English Language Arts.[9] Unlike LEAP these exams are based on the Iowa Test of Basic Skills and with questions added to align the test to criterions required by state and Federal law. In addition, while the iLEAP contributes to determining whether the school meets "adequate yearly progress" under the NCLB act, it is a "low-stakes" exam for students in that their scores do not affect grade advancement. We include LEAP, iLEAP, and GEE in our analysis.

Test scores are measured as standard deviation within a grade and year, including all those tested which also include the evacuees. Table 1 shows that evacuees are about one-quarter of a standard deviation below the non-evacuees. Table 2 reports differences in test scores in the 2005-2006 academic year, after controlling for individual characteristics and school effects. Math and ELA test scores of evacuees in primary schooling are 0.15 and 0.13 of a standard deviation lower than those of non-evacuees. In middle-school and high-school, test scores of evacuees are 0.11 and 0.10 standard deviations lower than those of non-evacuees. Evacuees not only lag behind in terms of average test scores, but the influx of evacuees also shifted the distribution of test scores in Louisiana's schools towards the left. Figure 3 shows the position of evacuees relative to natives in the same schools in 2004-2005. This figure shows that evacuees are much more likely to be in the first decile compared to their native counter-parts, while they are

[9] Grades 3, 5, 6, and 7 were also added for science and social studies

as likely or less likely to be in deciles 2 through 10. This is important especially when we consider the non-linear models below.

### 4.2. Houston Independent School District Data

HISD provided us with student-level administrative records from 2003-2004 to 2006-2007. The data includes basic demographic characteristics, including race, gender, free or reduced-price lunch status, and immigration status, and whether they qualify as gifted and talented, as having limited English proficiency, or require special education. In addition, we have information on math and reading scores from the Texas Assessment of Knowledge and Skills (TAKS) Exam, which is the exam used in Texas for accountability purposes. Moreover, we have information for each student on the number of disciplinary infractions and the absence rate.

Table 3 presents descriptive statistics for evacuees and non-evacuees in HISD in 2005. As in Louisiana students are fairly balanced by gender. However, the majority of non-evacuee students are Hispanic and African-American, with these two groups accounting for 88% of the student population and White and Asian students accounting for the remainder. By contrast, about 90% of the evacuees are African-American, and only 10% White, Hispanic and Asian combined. This is important to keep in mind if one believes that displaced students are more likely to interact and generate peer effects on non-evacuees of their same race/ethnicity. About 80% of the HISD native students are identified as receiving free or reduce-priced lunch. This fraction contrasts with about 95% of the evacuees who qualify for free lunch and are identified as being at risk.[10] Also, about 27% of native students are identified as having limited English proficiency. By

[10] At risk status is defined as being over-aged for your grade, having a difficult situation at home (e.g., pregnant, foster child) or having low academic performance (below the 40th percentile).

contrast, limited English proficiency is not an issue among the evacuees. However, only about 10% of native students are identified as requiring special education and only 12% of native students are identified as gifted and talented. Among non-evacuees there are hardly any students who qualify as G&T and only a little over 6% as needing special education. Thus, displaced students were much more likely to be African-American and to be economically disadvantaged compared to the non-evacuee student population.

Students in HISD take the Texas Assessment of Knowledge and Skills (TAKS). This exam is given in grades 3 - 11 in math and reading and students must achieve proficiency in both subjects to advance to the next grade, thus it is a "high stakes" exam. Test scores are measured in standard deviations within grade and year using information on all non-evacuee test-takers during that year and cover grades 3 through 11. Both reading and math test scores of evacuees are substantially below those of natives. Similarly, the average attendance rate of natives is around 95%, while the average attendance rate of evacuees is in excess of 84%. We can also look at disciplinary infractions, which are the number of infractions resulting in an in-school suspension or a more severe punishment. As with absences, disciplinary infractions are considerably higher amongst evacuees. Table 4 presents formal tests of whether evacuees had significantly lower academic performance,[11] higher absenteeism and more disciplinary problems, after controlling for observable characteristics and school effects. These results show that the test scores of evacuees are one-fifth to two-fifths of a standard deviation lower in elementary and about half a standard deviation lower in middle and high school compared to native students in the same schools. Controlling for school effects and

[11] It is interesting to point out that the differences between evacuee and non-evacuee test scores were a lot bigger in Houston than in Louisiana.

observables, the attendance rate is 6 percentage points and 13 percentage points lower among primary and secondary evacuee students, respectively. In terms of disciplinary infractions, evacuees tend to do better initially but worse the subsequent year. This is likely due to school officials initially being more lenient with students who were viewed as going through a process of adaptation in 2005-2006. Thus, evacuees have on average lower math and reading test scores as well as attendance compared to natives. Moreover, the influx of evacuees did not simply reduce average test scores but also increased heterogeneity within schools. Figure 4 shows the evacuees position relative to natives in the same school in 2005-2006. This figure shows that evacuees are greatly over-represented in the three lowest deciles of the test-scores distributions and attendance distribution and under-represented in the upper deciles.

## 5. Effects on Academic Performance

We begin by examining the effect of the influx of Katrina and Rita students on the academic performance of their peers. This is a reduced form regression, since there are a number of possible reasons why the academic performance of the non-evacuees may be affected by the arrival of evacuees at a school. The first is a peer effect story, where one's classmates influence the learning process of each student. We consider peer effects to encompass an achievement effect that works through peer test scores; a behavior effect that works through peers' disruptive behavior in the classroom as in Figlio (2005) and Carrell and Hoekstra (2008), and a disruption effect from students entering and exiting the classroom as in Hanushek, Kain, and Rivkin (2004). Thus, a peer effect may occur if an evacuee, who is disruptive and worse in terms of discipline or worse in terms of academic performance, consumes more of the teacher's attention and disturbs the learning process of other students. A peer effect can also occur if evacuees are heavily mobile and new students need more time and attention to help them adapt to their new schools. Also, peer effects can occur if a classmate is disruptive or disrespectful to the teacher and native students start copying this behavior and become disruptive themselves. The lower achievement of evacuees could also force teachers to teach at a lower pace to all students. Note that his could be potentially beneficial to lower ability native students and later we will provide some evidence that suggests that indeed low-ability natives fared well from the evacuees, especially in Houston.

The second reason why the influx of evacuees may reduce native performance is if the entry of new kids takes resources away from the non-evacuee kids. Third, it could be that schools hired new teachers to help absorb the evacuees and that these teachers were of lower quality than the existing teachers. Finally, native kids may respond to the influx of evacuees by moving to another school or leaving the school district and this would change average test scores by simply changing the composition of the remaining students. In this section, we present reduced form results that could capture any of these four channels through which the influx of evacuees may affect native academic performance. However, in Section 7 we show results from regressions of class size, expenditures per student, teacher experience and the probability of moving schools or leaving the district on the share of Katrina evacuees in a school to try to disentangle whether the effects we are capturing here can be interpreted as peer effects or are due to changes in resources or changes in the composition of native students in receiving schools.

## 5.1. Reduced Form Models: Overall Results and Results by Race

We use both HISD and Louisiana data to estimate equation (1). Table 5 presents the estimates of the evacuee share on the math and language scores of non-evacuee students. Panel A presents the results for Louisiana and Panel B presents the results for HISD. The results for Louisiana show that the evacuees have a negative effect on the ELA test scores of both elementary and middle-school and high-school students, but they are for the most part not statistically significant. Only the results in Column (4) for ELA test scores shows that an increase of 10% in the fraction of Katrina kids reduced test scores of non-evacuees by 0.03 of a standard deviation for secondary school, although this is only marginally significant. We also report results of fully saturated models for African-American and Hispanic non-evacuee students in Columns (2), (3), (5) and (6). The results do not show bigger effects on African-American children in Louisiana, where evacuees were much more diverse in terms of racial composition than in Houston.

The results for Houston, reported in Panel B, instead show negative effects on match test scores for elementary students. The results in Column (1) for the elementary schools show that an increase of 10% in the influx of Katrina students reduced math test scores for all non-evacuee children by 0.09 of a standard deviation. Similarly, the reading test scores of non-evacuee elementary school children decrease with the influx of Katrina children but the decrease is not significant. By contrast, the results in Column (4) show that the test scores of middle- and high-school students are not affected by the entry of evacuees into their schools. Interestingly, the reduction of math test scores for elementary school children is driven by the effects on African-American children, which is what we would expect if African-American native kids have more interaction with the evacuee kids. Column (2) shows that an increase of 10% in Katrina evacuees reduces the math test scores of African-American elementary school children by over a tenth of a standard deviation, while Column (3) shows that there is no effect on Hispanic children.

### 5.2. Reduced Form Models: Results by Gender

Table 6 presents the results for fully saturated models for boys and girls. Panel A presents the results for Louisiana and Panel B present the results for HISD. The results show that the estimates for academic performance at the elementary school level are driven by the effects on girls. Column (2) of Panel A shows that the negative effect on girls' ELA test scores is greater than the effect found in Table 5 for the overall sample. In particular, a 10% increase in Katrina kids reduces ELA test scores for girls by 0.03 of a standard deviation compared to an insignificant 0.02 for the entire sample. Similarly, we find that the reduction in math test scores in Houston is driven by the large effect on girls. Column (2) of Panel B shows that an increase of 10% in the share of Katrina/Rita children in Houston reduces math test scores by a tenth of a standard deviation for girls, in comparison to a reduction of 0.09 of a standard deviation for the entire sample. By contrast, the results for Louisiana for middle and high school show that the results on ELA test scores are mainly driven by boys. Column (3) in Panel A shows that an increase of 10% in the influx of Katrina evacuees reduces language test scores for boys by 0.04 of a standard deviation in contrast to 0.03 for the entire sample.

### 5.3. Non-Linear Models

Table 7 reports results of non-linear models as in equation (2) Louisiana and Table 8 reports results of non-linear models as in equation (3) for Houston.

Panel A and B of Table 7 report results for math and language test scores, respectively. Results in Panels A and B show that in Louisiana the arrival of low academic performance Katrina evacuees hurt natives in all quartiles of the distribution prior to the storm in terms of their math and language scores. Curiously, the results also show that the ones hurt the most by the presence of low achieving evacuees were those at the higher end of the distribution, while natives at the lower end of the ability distribution were hurt the least by the arrival of low achieving peers. A likely explanation is that the arrival of low achieving evacuees forced teachers to focus their teaching time to help low achieving students and this hurt high ability more than low ability students.

By contrast, the arrival of evacuees in the top quartile of the academic distribution benefits natives regardless of their previous performance, but that the results are bigger as natives move up in the ability distribution. Thus, these results suggest complementarities between peers. A likely explanation for this is that the increase in high achieving evacuees in the class forced teachers to raise the level of the class more towards high-ability students. This would thus be consistent with a "boutique" model of peer effects as described by Hoxby and Weingarth (2006) where peers benefit from having similar students in their class-room regardless of the students' ability. Nonetheless, the fact that low ability natives benefited more from having high-ability evacuees than low-ability suggests that a "single crossing" model where peer impacts are increasing in peer ability is also occurring at the same time.

Table 8 shows results for math and language in Panels A and B for Houston. The results for Houston are somewhat different and suggest a monotonicity story. In Houston, the arrival of low achieving peers hurts all native students, but this effect is more negative for low ability natives in elementary while it is more negative for high ability peers in secondary schools. By contrast, the arrival of high achieving evacuees benefits everyone, though the biggest benefit is for the low ability natives. Thus, this results are consistent with a bad apple and shining star interpretation of peer effects, where one disruptive student hurts all and one excellent student provides a great example for all, but where the low achieving students are most susceptible to peer influences.

## 5.4. Robustness Checks

### 5.4.1. IV Results: Houston

Since there is some movement across schools as evacuees settle into more permanent residences, one may be concerned about the potential selection of evacuees into different schools. As mentioned in Section 3, we address this concern by exploiting the initial exogenous allocation and the fact that many people stayed in their initially assigned schools. We believe that, even if there is resorting, this initial allocation is exogenous conditional on school fixed-effects because of the uncertainty and chaos under which evacuees found housing. Indeed, a large proportion of evacuees were living in shelters and many continued to live in shelters months after the storm.

Table 9 reports second-stage results of equation (4), where the instrument used is the Katrina/Rita share on September 13, 2005 excluding students from the stadium complex and convention center. The first-stage results show that the Katrina/Rita share on September 13, 2005 is significant at the 1% level. An increase in Katrina/Rita children of 10% on September 13, 2005 increases the share Katrina/Rita on October 28, 2005 by 9.8% in elementary and by 9.6% in middle-school and high-school. As with the difference-in-difference results presented above, the second-stage results in Table 9 only show a negative effect of the influx of Katrina children on the math test scores of elementary school children in Houston. The IV estimate is bigger in magnitude and, like the differences-in-differences estimate, significant at the 5% level, suggesting that the worse evacuees may be the ones moving schools. Nonetheless, these two estimates are not statistically significantly different from each other, as are all of the other difference-in-differences and 2SLS test score estimates.

### 5.4.2. Placebo Experiment: Pre-Katrina Impacts

In Table 10 we present the results from a falsification test in the spirit of Angrist and Krueger (1999) by regressing the pre-Katrina outcomes on the post-Katrina shares of evacuees in the schools as if these shares corresponded to 2004-2005. The idea is that if we are simply capturing pre-existing trends in the schools, then the coefficients in the share of evacuees should show up as being significant. The results from this falsification test show that the coefficients on the evacuee shares are not significant for elementary nor for middle-school and high-school in either Louisiana or Houston, suggesting that we are not simply capturing pre-existing differences in trends before the actual influx of the evacuees.

## 6. Behavioral Effects

Aside from the impact that kids may have on others' academic performance, they may also affect their behavior and their willingness to accept and follow rules. Our interviews with principals and teachers in Houston, indicated that even basic rules such as showing up to school on time or at all were problematic with some of the evacuees. News reports at the time indicated that while many evacuee students may have been enrolled in schools, they may not have been attending regularly (Garza, 2006) and, indeed, our results in Tables 3 and 4 suggest this. Moreover, news reports as well as our own interviews pointed to bigger behavioral problems related to the evacuees. For example, in our interviews with elementary school teachers, some indicated that the evacuees were more likely to “talk back to the teachers” and that some of the non-evacuee children were likely to imitate this behavior. At the secondary school level, the differences in behavior between evacuee and non-evacuee students, according to the teachers, manifested more in terms of truancy, fighting and engaging in risky behaviors.

The HISD data allows us to measure some of the behavioral responses. Table 11 presents difference-in-differences as well as IV results of the effects of the influx of Katrina students on the attendance rate and on the number of disciplinary infractions. Panel A presents results for elementary students and Panel B presents the results for middle and high school students. The results in Table 11 show a clear increase in absenteeism both in elementary school as well as in middle and high-school. An increase in the influx of Katrina students reduces attendance in primary schools by 0.2 percentage points and in secondary schools by 0.7 percentage points. Interestingly, contrary to the results on academic performance, these results are driven by boys in elementary school and by girls in middle- and high-school. In addition, attendance becomes more of a problem for African-American native students after the influx of Katrina students, with a 10% influx of Katrina students generating a reduction in the attendance rate of between 1.4 and 1.7 percentage points in middle and high-schools. Comparing Columns (1) and (2) allows us to see that these results are robust to the use of an instrumental variable strategy, as the coefficients from the IV strategy which uses the initial evacuee assignment to schools are not statistically significantly different from the difference-in-difference results.

Table 11 also shows results for disciplinary infraction counts. An infraction shows up in our data if the student is given an in-school suspension or more severe punishment. In spite of the anxiety at the time about fights between Houston and New Orleans students, we do not find evidence of a change in disciplinary infractions following the influx of Katrina students for the overall sample, although this could be due to schools being more lenient with native students as they adapt to the evacuee influx. However, when we estimate fully saturated models by gender and race, we do find marginally significant increases in disciplinary problems among girls and African-American students in secondary schools. A 10% increase in fraction of Katrina evacuees raises the number of disciplinary infractions by between 0.2 and 0.3 for girls and by between 0.2 and 0.6 for African-Americans.

Column (7) of Table 11 does a similar falsification test to the one described in Section 5.4. but in which we regress the pre-Katrina absence rate and disciplinary infractions on the Katrina evacuee share for 2005-2006 imputed for 2004-2005. As before, the coefficients on the evacuee shares are not statistically significant for elementary school or for middle school and high schools. This suggests that the increase in absenteeism we find after Katrina is not simply the reflection of pre-existing trends in the schools that received evacuees.

Table 12 reports results of non-linear models for the attendance rate as in equation (3). The results show that  the arrival of evacuees with attendance below the median hurts all native students, while the arrival of evacuees with better than median attendance helps all natives. However, as with test scores in Houston's elementary schools, these effects are more pronounced for natives with below average attendance. This is consistent with a rotten apple and shining star interpretation where there is monotonicity and bad students are hurt more by the presence of evacuees with bad behavior but also benefit most from evacuees with good behavior.

## 7. Effects of Katrina Evacuees on Resources and Student Attrition

Above, we reported reduced-form results of the impact of the influx of Katrina evacuees on test-scores and absenteeism. While one plausible interpretation of these results is that evacuees generate externalities on native students, it could also be that the influx of evacuees reduced the resources available for natives or that the best native students were leaving the schools and districts with evacuees.

### 7.1. Effects on Resources

The influx of evacuees could had affected the resources available to evacuees by increasing class-size, reducing operating and instructional expenditures per employee and reducing teacher quality if the composition of teachers changed.

Table 13 reports results of regressions like equation (1), but where the dependent variable is class size and with the school as the unit of observation.[12] Panel A reports results for Louisiana while Panel B reports results for Houston. For Louisiana we do not have the exact average class-size in each school but rather an indicator of whether the average class-size is between 1 and 20 or between 21 and 26. These results for Louisiana

[12] Since we cannot include grade fixed effects in these regressions, as schools span multiple grades, in Houston we include the percent of students in the school in each grade as covariates and interact these with the year. We also include the percent black, Hispanic, Asian, Native American, and economically disadvantaged as covariates. These variables are not available for Louisiana.

suggest that, if anything, the average class size fell in elementary schools. For middle school and high school there is a positive effect on the indicator for large classes but it is only marginally significant. By contrast, for Houston we have the exact average class size per grade in elementary school and by subject for middle school and high school. These results show no effect of the fraction of evacuees on class-size in elementary. In middle and high school there is little evidence that the influx of evacuees increased class-size, except for class-sizes in social studies which seem to increase though the effect is only marginally significant.

Table 14 shows results of regressions of operating and instructional expenditures per student and average teacher experience on the evacuee share in Houston.[13] The results once again show no statistically significant effect of the influx of evacuees on either operating or instructional expenditures per student. This is likely because the Federal and State Governments seemed to have reimbursed schools and districts almost fully. Also, interviews with principals in Houston, suggested that schools received substantial aid from a number of foundations around the country.

Since class-size did not seem to increase in response to the evacuees, it is likely that new classes were being created as students came in. Indeed, principals in Houston indicated that they hired new teachers in response to the influx of evacuees. These new teachers were mostly evacuees themselves. This means that the quality of teachers could have changed as a result. Unfortunately, our measures of teacher quality are limited. Nonetheless, we are able to look at how evacuees affected average teacher experience and do not find any impact. Moreover, one may worry that evacuees were all assigned to the same classes together so that there may had been little room for spillovers. However,

[13] This data is not available for Louisiana.

looking at the distribution of the number of evacuees by class, we see that most evacuees were either alone with another evacuee and that at most there were 5 or 6 evacuees in a given class.

**7.2. Effects on Native Student Mobility**

Another reason why test scores and behavior could had changed in response to the influx of Katrina evacuees is if the best students moved in response to the arrival of evacuees. To consider this we run a regression like equation (1) but in which the dependent variable is the probability of switching school the following year and the probability of leaving the district.[14]

Panel A of Table 15 shows results of mobility in grades 4 and 10th in Louisiana, while Panels B and C of Table 15 show results of mobility in elementary and middle school and high school for Houston. The results suggest no statistically significant change in the mobility of students from schools with a high share of evacuees to schools with a low share of evacuees in either Louisiana or Houston. Similarly, we find no effect on mobility out of the district for middle school and high school students in Houston, We do find a marginally significant reduction in district leavers at the elementary level which is only marginally significant.

Overall we find little evidence that the influx of Katrina evacuees is likely to have worked either through reduced resources or through changes in the composition of the native students. Moreover, if the arrival of evacuees was affecting native students through reduced resources it is not clear why reduced resources should impact natives of different abilities differently depending on the arrival of different types of evacuees.

---

[14] To avoid switching and leaving due to normal progression to middle and high school and due to graduation, we limit the school switching estimates to students who are not in the maximum grade for their school. We also limit the district leaver regressions to students in grades 1 - 11.

## 8. Conclusion

In this paper we examine the impact of an exogenous influx of low-socio-economic background students on the academic performance and behaviors of their peers. We exploit the influx of Hurricanes Katrina and Rita evacuees into school districts in Louisiana that were unaffected by the storms and into the Houston Independent School District to estimate their impact on non-evacuee (native) peers.

We use student-level data from Louisiana's Department of Education and from the Houston Independent School District to estimate the impact on math and language test scores. We also look at absenteeism and disciplinary infractions in the case of Houston. The results show negative and significant effects of the influx of Katrina students on language test scores for secondary schooling in Louisiana. In addition, we find negative effects on math test scores in primary schools in Houston. Interestingly, these results seem largely driven by the effect on African-American non-evacuee students. There are also interesting differences by gender. Girls seem more susceptible to experiencing negative peer-effects in terms of academic outcomes at the elementary school level but boys seem more susceptible to experiencing negative peer-effects in terms of their academics in secondary schooling.

The influx of Katrina evacuees increases absenteeism in both primary and secondary schools in Houston, with the results for secondary schooling being driven mainly by African-Americans. Contrary to the results on academic outcomes, the results for absenteeism show that elementary school boys are more likely to be influenced in terms of attendance by their Katrina peers, while secondary school girls are more likely to have their attendance affected by the presence of Katrina students. In accordance with this, there is also some evidence of increased disciplinary problems among girls and African-Americans in Houston middle-schools and high-schools.

We also find important non-linearities in Louisiana and Houston, though they work differently in Louisiana and Houston probably because the composition of evacuees differed in the two places. In Louisiana we find that the influx of high ability evacuees benefits all natives but that the effect is larger for higher ability natives and that the influx of low ability evacuees helps those at lowest quartile of the ability distribution but hurts others. This is consistent with peer effects working through both boutiquing and single-crossing models. Since the evacuees in Houston were mostly low achieving, we are not able to consider the interaction of the place of native students in the test score distribution with the place of the evacuees. Nonetheless, we find that low-achieving natives responded much more positively to the arrival of high-achieving evacuees than high-achieving natives, but that they also responded more negatively to the arrival of low-achieving evacuees.

We interpret these results as being largely due to peer effects, since we find no effects of the influx of Katrina evacuees on class size, expenditures per student, average teacher quality or mobility of students, which would be the other potential explanations.

## References


Aizer, Anna. 2008. "Peer Effects and Human Capital Accumulation: The Externalities of ADD." NBER Working Paper No. 14354.

Angrist, Joshua and Kevin Lang. 2004. "Does Schooling Integration Generate Peer Effects? Evidence from Boston's Metco Program," *American Economic Review*, 94(5): 1613-1634.

Boozer, Michael and Stephen Cacciola. 2001. "Inside the Black Box of Project Star: Estimation of Peer Effects," Economic Growth Center Discussion Paper No. 832.

Burke, Mary and Tim Sass. 2008. "Classroom Peer Effects and Student Achievement," Calder Urban Institute Working Paper No. 18.

Carrell, Scott, Richard Fullerton and James West. 2008. "Does Your Cohort Matter? Measuring Peer Effects in College Achievement," NBER Working Paper No. 14032.

Carrell, Scott, and Mark Hoeksta. 2008. "Externalities in the Classroom: How Children Exposed to Domestic Violence Affect Everyone's Kids," mimeo.

Carrell, Scott, Frederick Malmstrom and James West. 2008. "Peer Effects in Academic Cheating," *Journal of Human Resources*, 43: 173-207.

Case, Anne and Lawrence Katz. 1991. "The Company You Keep: The Effects of Family and Neighborhood on Disadvantaged Youths," NBER Working Paper No. 3705.

Dewan, Shaila. 2006. "Storm Evacuees Found to Suffer Health Setbacks," *New York Times*, April 18.

Edwards, George E. 2006. "International Human Rights Law Violations Before, During and After Hurricane Katrina: An International Law Framework for Analysis," *Thurgood Marshall Law Review*, 31(353).

Evans, William, Wallace Oates and Robert Schwab. 1992. "Measuring Peer Effects: A Study of Teenage Behavior," *Journal of Political Economy*, 100: 966-991.

Figlio, David. 2005. "Boys Named Sue: Disruptive Children and Their Peers," NBER Working Paper No. 11277.

Foster, Gigi. 2006 "It's not your peers, and it's not your friends: Some progress toward understanding the educational peer effect mechanism," *Journal of Public Economics*, 90 (8/9): 1455-1475.

Gaviria, Alejandro and Steven Raphael. 2001. "School-Based Peer Effects and Juvenile Behavior," *Review of Economics and Statistics*, 83: 257-268.

Hanushek, Eric, John Kain, Jacob Markman, and Steven Rivkin. 2003. "Does Peer Ability Affect Student Achievement?," *Journal of Applied Econometrics*, 18(5): 527-544.

Houston Independent School District. 2005. "State of the Schools," Annual Report.

Hoxby, Caroline. 2000. "Peer Effects in the Classroom: Learning from Gender and Race Variation," Working Paper No. 7867.

Hoxby, Caroline and Gretchen Weingarth. 2006. "Taking Race Out of the Equation: School Reassignment and the Structure of Peer Effects." Presented at the 2006 American Economics Association Annual Meetings at http://www.aeaweb.org/annual_mtg_papers/2006/0108_1300_0803.pdf.

Klein, Alyson. 2006. "Schools Get Katrina Aid, Uncertainty: $645 Million May Not Cover Costs of Displaced Students," *Education Week*, March 29 at http://www.edweek.org/ew/articles/2006/03/29/29impact.h25.html?qs=katrina.

Knabb, Richard, Jamie Rhome and Daniel Brown. 2005. "Tropical Cyclone Report: Hurricane Katrina: 23-30 August 2005 at National Hurricane Center's website, http://www.nhc.noaa.gov/pdf/TCR-AL122005_Katrina.pdf.

Ladd, Anthony, John Marszalek and Duane Gill. 2008. "The Other Diaspora: New Orleans Student Evacuation Impact and Response Surrounding Hurricane Katrina," at http://www.ssrc.msstate.edu/katrina/publications/katrinastudentsummary.pdf.

Lavy, Victor, Daniele Paserman and Analia Schlosser. 2007. "Inside the Black Box of Ability Peer Effects: Evidence from Variation in High and Low Achievers in the Classroom," mimeo.

Lavy, Victor and Analia Schlosser. 2007. "Mechanisms and Impacts of Gender Peer Effects at School," NBER Working Paper No. 13292.

Lazear, Edward. 2001. "Educational Production," *Quarterly Journal of Economics*, 116: 777-803.

Lefgren, Lars. 2004. "Educational Peer Effects and the Chicago Public Schools," *Journal of Urban Economics*, 56(2): 169-191.

McIntosh, Molly. 2008. "Measuring the Labor Market Impacts of Hurricane Katrina Migration: Evidence from Houston, Texas," *American Economic Review Papers and Proceedings*, 98(2): 54-57.

Lyle, David. 2007. "Estimating and Interpreting Peer and Role Model Effects from Randomly Assigned Social Groups at West Point," *Review of Economics and Statistics,* 89: 289-299.

Manski, Charles F, 1993. “Identification of Endogenous Social Effects: The Reflection Problem,” *Review of Economics and Statistics*, 60: 531-542.

Marmaros, David and Bruce Sacerdote. 2006. “How Do Friendships Form,” *Quarterly Journal of Economics*, 121: 79-119.

National Geographic News. 2005. “Eye on the Storm: Hurricane Katrina Fast Facts,” September 6 at http://news.nationalgeographic.com/news/pf/31460799.html.

Paxson, Christina and Cecilia Rouse. 2008. “Returning to New Orleans after Hurricane Katrina,” *American Economic Review Papers and Proceedings*, 98(2): 38-42.

Radcliffe, Jennifer. 2005. “Evacuee Parents Enroll Hundreds in HISD, Where Students Will Begin Classes Today, A change for Youth to Return to Routine,” *Houston Chronicle*, September 8.

Radcliffe, Jennifer. 2006. “Texas Schools Taking a Hit On Katrina Aid / First Federal Installment Cut in Half; TEA Plans to Keep Much of it to Repay Itself,” *Houston Chronicle*, March 3.

Radcliffe, Jennifer. 2006. “Displaced Katrina Students Fall Behind,” *Houston Chronicle*, October 26.

Reliant Center (Joint Information Center). 2005. “Hurricane Katrina, Houston Response,” News Release, September 5, 2005, 3:00 p.m.

Thaddeus, Harrick. 2005. Teen Tension Trails Hurricane Evacuees Into Houston School,” *Wall Street Journal*, December 5.

Sacerdote, Bruce. 2009. “Peer Effects in Education: How Might They Work, How Big are They and How Much do we Know thus Far?,” forthcoming in the *Journal of Economic Perspectives.*

Sacerdote, Bruce. 2008. “When the Saints come Marching In: Effects of hurricanes Katrina and Rita on Student Evacuees,” NBER Working Paper No. 14385.

Sacerdote, Bruce. 2001. “Peer Effects with Random Assignment: Results from Dartmouth’s Roommates,” *Quarterly Journal of Economics*, 116.

Scherer, Michael. 2005. “Separate Schools for Katrina Students?,” in http://dir.salon.com/sotry/news/feature/2005/09/19/schools.

Stein, Annie. 2007. “Ensuring Quality Public Education for Displaced Students: In-Place Funding for Local School Districts Impacted by Natural Disasters,” Mimeo, University of Houston Law Center.

Stinebrickner, Todd and Ralph Stinebrickner. 2006. "What Can be Learned about Peer Effects using College Roommates? Evidence from New Survey Data of Students from Disadvantaged Backgrounds," Mimeo.

U.S. Census Bureau (U.S. Government Accountability Office). 2006. "Gulf Coast hurricanes: Lessons Learned from Protecting and Educating Children," at http://www.gao.gov/new.items/d06680r.pdf.

U.S. Department of Education. 2007. "Hurricane Help for Schools," in http://hurricanehelpforschools.gov/0916-factsheet.html.

Vigdor, Jacob. 2008. "The Economic Aftermath of Hurricane Katrina," *Journal of Economic Perspectives*, 22(4): 135-154.

Vigdor, Jacob and Thomas Nechyba. 2009. "Peer Effects in Carolina Public Schools," forthcoming in L. Woessmann and P. Peterson, eds., *Schools and the Equal Opportunity Problem*. Cambridge: MIT Press.

Zimmerman, David. 2003. "Peer Effects in Academic Outcomes: Evidence from A Natural Experiment," *Review of Economics and Statistics*, 85(1): 9-23.

## Data Appendix

Louisiana Data:

The Louisiana data set consists of student level test scores and demographics for Louisiana public school students during 2003-2007. Under Louisiana's accountability program, students in grades 4, 8, and 10 are tested in March of each year. These tests are known as the LEAP or Louisiana Educational Assessment Program (grades 4 and 8) and the GEE or Graduation Exit Examination. The subjects tested include math and English language arts (ELA) for grades 4, 8 and 10. Science and social studies are tested in grades 4, 8 and 11.

In spring 2006 tests known as the ILEAP (Integrated Louisiana Educational Assessment of Progress) were added for grades 3, 5, 6, 7, and 9. While the Iowa Test of Basic Skills was previously used for these students, we do not have the Iowa test scores. Students in these five grades are tested in both math and English language arts. Students in grades 3, 5, 6, and 7 are tested in science and social studies. Unlike LEAP, the tests in the ILEAP grades do not have a high stakes component at the student level.

We have randomly generated ID numbers which allows us to link a given student across years in the data set. For the spring of 2006, we also have a field which tells us which students are evacuees and whether they were displaced from a public school or private school and whether they were displaced by Katrina or Rita. This was collected by teachers and principals and then reported to the state at the time the exams were taken. For each year, we have information on the student's school and district, race, gender, and free lunch status.

The sample is limited to data for students observed in the school year 2005-2006 since that is the year during which the Louisiana required schools to provide information on a student's evacuee status. Student evacuees are classified as displaced by Katrina or Rita and also as displaced from a public or private school or out of state school. This reduces the number of observations from 1.3 million to 1.0 million.

The parishes most affected by Hurricane Katrina are Orleans, Jefferson, Plaquemines, and Saint Bernard. These parishes comprise most of the Greater New Orleans Metropolitan Statistical Area. Ninety percent of the students in the affected parishes become evacuees. And, of the Katrina evacuees, ninety-three percent come from the most affected parishes.

Even after the hurricanes, the bulk of Katrina evacuees who remain in Louisiana remain in a school in one of the four most affected parishes. The percentage of eventual evacuees who attend school in one of the affected parishes is 93 percent in 2003-2004 and 2004-2005 school years. This dips to 68% in the spring following Katrina but rises back to 76% by 2006-2007. Many of the evacuees move from Orleans Parish to Jefferson. After excluding schools in the parishes in Greater New Orleans, we are left with 930,852 observations on students, of which 24,286 are Katrina evacuees.

Not surprisingly, Katrina evacuees are more likely to disappear from the Louisiana public school sample relative to non-evacuees. If we take the set of evacuees from Orleans Parish who was in the 8th grade in 2004-2005, we find that only roughly 50% of the evacuees remain in the sample versus roughly 80% for all other students.

Pre-hurricane, the vast majority of eventual evacuees were located in Jefferson and Orleans Parishes, with an additional 700-800 evacuees in each of St. Tammany, Plaquemines, and St. Bernard in 2005. Post-hurricane, the count of evacuees (in grades 4, 8 and 10) in Jefferson Parish grows by about 1200 evacuees and East Baton Rouge School District gains about 1,000 of these evacuees. Since we are only counting three grades, this implies that East Baton Rouge gained roughly 3300 student evacuees in all grades. The remaining school districts in the state each gain 0-150 evacuees. The number of evacuees in Orleans itself shrinks dramatically post-Katrina. The Recovery School District (RSD) in Orleans was set up to administer most of the schools in the former Orleans Parish School District. The RSD has roughly 1100 4th ,8th ,and 10th graders by 2007.

HISD Data:

Data for Houston ISD comes from student records from the 2003-04 through the 2006-07 school year and includes demographics, test scores, attendance, and discipline records for all students in HISD. The data covers all grades, however we only consider grades 1 - 12 since testing does not begin until first grade.

Demographic data and the school the student attends is identified in the data as of the last Friday in October each year, thus the data is restricted to students who are enrolled in HISD as of that date. Demographic information includes race, gender, whether the student is a recent immigrant, whether the student's has a parent who is a migrant worker, free lunch status, reduced-price lunch status, and whether a student does not qualify for free/reduced lunch but qualifies for another anti-poverty program. The data also includes indicator for whether a student participates in LEP, bilingual education, ESL, gifted & talented education, special education, and career and technology education. Each student enrolled in HISD at some point in 2005-06 is also given an indicator for whether he or she is an evacuee due to Hurricanes Katrina or Rita. Overall, 5,717 evacuees (2.7% of all students) were enrolled as of October 28, 2005. In all, we have demographic information on 833,267 student-year observations from 2003-04 through 2006-07.

Testing data covers both the Stanford Achievement Test 10 and the Texas Assessment of Knowledge and Skills (TAKS). In this paper we focus on the TAKS exams. Stanford exams are administered by HISD and given in math, reading, and language in grades 1 - 11, and in science and social studies in grades 3 - 11. The math and reading exams in grades 1 - 8 are "medium stakes" in that students need to score above a certain level to advance to the next grade but the exams do not contribute to the schools' accountability requirements. All other Stanford exams are "low stakes" and thus do determine grade placement and do not contribute to accountability rules, although the average scores by grade and school are reported to the public.

TAKS exams are administered by the state of Texas to students in grades 3 - 11. Each year students must take a reading/English Language Arts and a math exam while writing is given in grades 4 and 7, science in grades 5 and 11, and social studies in grades 8 and 11. The math and reading portions are “high stakes” in that they count towards accountability in all grades and towards grade advancement in grades 3 - 8. In grade 11 the TAKS is an exit exam where student must pass all 4 subjects to graduate. In this paper we only consider the math and reading tests as these give the widest coverage across grades. Since students who fail the exam take it a second time and we do not know which score was first, we assume that the lowest score is the students’ first score and thus we use that one. After compiling each student’s lowest score in a given academic year we standardize the scale scores within grade and year to have mean zero and standard deviation one. We exclude Katrina and Rita evacuees from the standardization. In total we have 460,804 observations for math and 464,448 observations for reading.

Our behavioral measures include both attendance and disciplinary records. For attendance we divide the percent of days a student is present by the percent of days the student is enrolled to get an attendance rate. In regressions we report the negative of the coefficients to provide an absenteeism rate for easier interpretation. For discipline, our data includes records on any disciplinary incidence that results in an in-school suspension, out-of-school suspension, and referral to disciplinary alternative education, referral to court for truancy proceedings, or placement in juvenile detention. Our measure of discipline is the number of incidences each student has resulting in one of these punishments. In total we have 831,651 observations with attendance data and 833,267 observations with discipline data.

Table 1: Characteristics of Evacuees and Native LA Students - 2005-06

| | Natives | Evacuees |
|---|---|---|
| A. Demographics | | |
| Female | 0.492 | 0.491 |
| | (0.500) | (0.500) |
| White | 0.550 | 0.344 |
| | (0.497) | (0.475) |
| Hispanic | 0.014 | 0.017 |
| | (0.118) | (0.132) |
| Black | 0.426 | 0.622 |
| | (0.494) | (0.485) |
| Asian | 0.010 | 0.016 |
| | (0.099) | (0.127) |
| Free Lunch Status | 0.553 | 0.805 |
| | (0.497) | (0.396) |
| Fraction Katrina Evacuee in School | 0.033 | 0.080 |
| | (0.038) | (0.060) |
| N | 382,662 | 13,798 |
| B. Louisiana Educational Assessment Program (LEAP) Exam | | |
| Math (Standard Deviations) | 0.030 | -0.273 |
| | (0.994) | (1.042) |
| N | 325,588 | 9,482 |
| English & Language Arts (Standard Deviations) | 0.025 | -0.243 |
| | (0.994) | (1.054) |
| N | 325,242 | 9,472 |

Standard deviations in parentheses. Includes students in grades 3 - 10. The sample is limited to schools where there are < 30% evacuees and those not in the Greater New Orleans MSA.

Table 2: Regressions of Native Test Scores on Katrina Evacuee Status - Louisiana

| | Elementary | | |
|---|---|---|---|
| | 2005-06 (lagged score) | 2005-06 (current score) | 2006-07 |
| LEAP Exams (std deviation units) | (1) | (2) | (3) |
| Math | -0.13*** | -0.15*** | -0.10*** |
| | (0.03) | (0.02) | (0.02) |
| N | 44,240 | 128,278 | 79,386 |
| English Language Arts | -0.15*** | -0.13*** | -0.09*** |
| | (0.03) | (0.02) | (0.02) |
| N | 44,250 | 128,279 | 79,389 |
| | Middle / High | | |
| | 2005-06 (lagged score) | 2005-06 (current score) | 2006-07 |
| LEAP Exams (std deviation units) | (4) | (5) | (6) |
| Math | -0.08*** | -0.11*** | -0.011*** |
| | (0.02) | (0.01) | (0.01) |
| N | 142,927 | 205,788 | 186,680 |
| English Language Arts | -0.13*** | -0.10*** | -0.09*** |
| | (0.02) | (0.01) | (0.01) |
| N | 142,089 | 206,431 | 186,571 |

Standard errors are provided in parentheses and clustered by school. Regressions include student's race, gender, free/reduced price lunch status, and school fixed-effects. LEAP scores are standard deviations of scale scores within grade and year for all students. For Louisiana we use only the evacuees from Hurricane Katrina. *, **, and *** reflect significance at the 10%, 5%, and 1% levels, respectively.

Table 3A: Demographics of Evacuees and Native HISD Students - 2005-06

| | Native | Evacuees |
|---|---|---|
| Female | 0.490 | 0.493 |
| | (0.500) | (0.500) |
| White | 0.093 | 0.039 |
| | (0.290) | (0.195) |
| Hispanic | 0.590 | 0.039 |
| | (0.492) | (0.195) |
| Black | 0.285 | 0.903 |
| | (0.451) | (0.297) |
| Asian | 0.033 | 0.018 |
| | (0.177) | (0.135) |
| Limited English Proficiency | 0.268 | 0.009 |
| | (0.443) | (0.095) |
| Gifted & Talented | 0.124 | 0.003 |
| | (0.330) | (0.058) |
| At-Risk | 0.675 | 0.942 |
| | (0.468) | (0.234) |
| Special Education | 0.102 | 0.063 |
| | (0.303) | (0.243) |
| Free Lunch | 0.693 | 0.968 |
| | (0.461) | (0.176) |
| Reduced Price Lunch | 0.097 | 0.001 |
| | (0.297) | (0.031) |
| Fraction Katrina/Rita Evacuee in School | 0.027 | 0.067 |
| | (0.031) | (0.054) |
| N | 188,194 | 5,408 |

Standard deviations in parentheses.

Table 3B: Outcomes for Evacuees and Native HISD Students - 2005-06

| | Native | Evacuees |
|---|---|---|
| **A. Texas Assessment of Knowledge & Skills (TAKS) Exam** | | |
| Math (Standard Deviations) | 0.000 | -0.743 |
| | (1.000) | (1.026) |
| N | 112,254 | 2,151 |
| Reading (Standard Deviations) | 0.000 | -0.582 |
| | (1.000) | (1.063) |
| N | 113,989 | 2,307 |
| **B. Discipline & Attendance** | | |
| Attendance Rate (%) | 94.64 | 83.53 |
| | (8.64) | (17.88) |
| N | 188,140 | 5,408 |
| Disciplinary Infractions | 0.577 | 0.828 |
| | (1.634) | (1.924) |
| N | 188,194 | 5,408 |

Standard deviations in parentheses. TAKS exams cover only grades 3 - 11.

Table 4: Regressions of Student Outcomes on Katrina/Rita Evacuee Status - Houston

| | | Elementary | | Middle / High | |
|---|---|---|---|---|---|
| | | 2005-06 | 2006-07 | 2005-06 | 2006-07 |
| Outcome | | (1) | (2) | (3) | (4) |
| TAKS Exams (standard deviation units) | Math | -0.41*** | -0.19*** | -0.49*** | -0.29*** |
| | | (0.05) | (0.05) | (0.06) | (0.04) |
| | N | 43,890 | 42,357 | 70,515 | 67,984 |
| | Reading | -0.22*** | -0.22*** | -0.53*** | -0.42*** |
| | | (0.05) | (0.07) | (0.08) | (0.07) |
| | N | 45,077 | 43,339 | 71,219 | 68,796 |
| Attendance | Rate (%) | -6.00*** | -2.46*** | -12.90*** | -5.26*** |
| | | (0.33) | (0.27) | (1.17) | (0.59) |
| | N | 83,455 | 80,981 | 93,190 | 89,319 |
| Discipline | Disciplinary Infractions | -0.03 | 0.05* | -0.12* | 0.40*** |
| | | (0.03) | (0.03) | (0.07) | (0.11) |
| | Substance Abuse | -0.0002 | 0.0000 | 0.0070 | 0.0031 |
| | | (0.0001) | (0.0001) | (0.0045) | (0.0061) |
| | Criminal Infractions | -0.0008 | -0.0007*** | 0.0148*** | 0.0141* |
| | | (0.0006) | (0.0003) | (0.0050) | (0.0084) |
| | Fighting | -0.007 | -0.003 | 0.014* | 0.053*** |
| | | (0.006) | (0.005) | (0.008) | (0.013) |
| | N | 83,465 | 81,020 | 93,232 | 89,626 |

Standard errors are provided in parentheses and clustered by school. Regressions include student's race, gender, free/reduced price lunch status, and school fixed-effects. TAKS scores standard deviations of scale scores within grade and year excluding evacuees. When students have multiple scores for a single subject in a given year we use the lowest score. The Houston data does not differentiate between Katrina and Rita evacuees and thus we use both categories in our evacuee measures. *, **, and *** reflect significance at the 10%, 5%, and 1% levels, respectively.

Table 5: Difference in Differences Estimates of Evacuee Share of Enrollment on Native Test Scores, All Students and By Race

| | Elementary | | | Middle / High | | |
|---|---|---|---|---|---|---|
| | All | Black | Hispanic | All | Black | Hispanic |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| | | | A. Louisiana - LEAP Exams | | | |
| Math | -0.16 | 0.16 | - | -0.18 | -0.04 | - |
| | (0.14) | (0.17) | - | (0.18) | (0.24) | - |
| N | 321,743 | 142,303 | - | 659,623 | 274,230 | - |
| English & Language Arts | -0.18 | 0.19 | - | -0.30* | -0.30 | - |
| | (0.12) | (0.19) | - | (0.18) | (0.24) | - |
| N | 321,763 | 142,303 | - | 657,048 | 271,925 | - |
| | | | B. Houston - TAKS Exams | | | |
| Math | -0.87** | -1.19* | -0.07 | 0.29 | 0.03 | 0.41 |
| | (0.43) | (0.71) | (0.50) | (0.37) | (0.61) | (0.39) |
| N | 174,603 | 47,429 | 106,735 | 282,774 | 84,261 | 158,889 |
| Reading | -0.37 | -0.68 | -0.02 | 0.01 | -0.28 | -0.16 |
| | (0.28) | (0.51) | (0.39) | (0.37) | (0.49) | (0.47) |
| N | 175,569 | 49,507 | 105,224 | 285,252 | 84,770 | 160,564 |

Standard errors are provided in parentheses and clustered by school. Regressions cover 2003-04 - 2006-07 for Houston and 2003-04 - 2007-08 for Louisiana and include student's race, gender, free/reduced price lunch status, and school fixed-effects. TAKS scores are standard deviations of scale scores within grade and year excluding evacuees. When students have multiple scores for a single subject in a given year we use the lowest score. LEAP scores are standard deviations of scale scores within grade and year for all students. For Louisiana we use only the evacuees from Hurricane Katrina. The Houston data does not differentiate between Katrina and Rita evacuees and thus we use both categories in our evacuee measures. Elementary is defined as any student in grades 3 - 5. Middle/High is any student in grade 6 - 11 for Houston or 6 - 10 for Louisiana. Prior to 2005 only grades 4, 8, and 10 were tested in Louisiana. *, **, and *** reflect significance at the 10%, 5%, and 1% levels, respectively.

Table 6: Difference in Differences Estimates of Evacuee Share of Enrollment on Native Test Scores, By Gender

| | Elementary | | Middle / High | |
|---|---|---|---|---|
| | Boys | Girls | Boys | Girls |
| | (1) | (2) | (3) | (4) |
| | A. Louisiana - LEAP Exams | | | |
| Math | 0.24 | 0.06 | -0.27 | -0.11 |
| | (0.17) | (0.17) | (0.18) | (0.19) |
| N | 165,123 | 156,620 | 327,135 | 332,488 |
| English & Language Arts | -0.09 | -0.27* | -0.44*** | -0.18 |
| | (0.14) | (0.15) | (0.18) | (0.21) |
| N | 165,126 | 156,637 | 327,389 | 329,659 |
| | B. Houston - TAKS Exams | | | |
| Math | -0.68 | -1.03** | 0.42 | 0.13 |
| | (0.45) | (0.45) | (0.46) | (0.33) |
| N | 87,593 | 87,010 | 140,286 | 142,488 |
| Reading | -0.36 | -0.39 | 0.04 | -0.06 |
| | (0.35) | (0.28) | (0.45) | (0.32) |
| N | 88,797 | 86,772 | 141,505 | 143,747 |

Standard errors are provided in parentheses and clustered by school. Regressions cover 2003-04 - 2006-07 for Houston and 2003-04 - 2007-08 for Louisiana and include student's race, gender, free/reduced price lunch status, and school fixed-effects. TAKS scores standard deviations of scale scores within grade and year excluding evacuees. When students have multiple scores for a single subject in a given year we use the lowest score. LEAP scores are standard deviations of scale scores within grade and year for all students. For Louisianna we use only the evacuees from Hurricane Katrina. The Houston data does not differentiate between Katrina and Rita evacuees and thus we use both categories in our evacuee measures. Elementary is defined as any student in grades 3 - 5. Middle/High is any student in grade 6 - 11 for Houston or 6 - 10 for Louisiana. Prior to 2005 only grades 4, 8, and 10 were tested in Louisiana. *, **, and *** reflect significance at the 10%, 5%, and 1% levels, respectively.

Table 7 - Nonlinear Models of Evacuee Share and Evacuee Achievement on Native Achievement - Louisiana

| | Elementary | | | | Middle/High | | | |
|---|---|---|---|---|---|---|---|---|
| 2003 or 2004 LEAP Quartile | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 4 |
| | | | | A. Math | | | | |
| Katrina Share in Quartile 1 | -0.54* | -0.53 | -2.06** | -1.95* | -0.16 | -1.17** | -1.40** | -1.91** |
| | (0.32) | (0.42) | (0.81) | (1.03) | (0.32) | (0.52) | (0.65) | (0.80) |
| Katrina Share in Quartile 2 | -0.40 | -1.86** | -1.25 | -2.76** | 0.12 | -0.86 | -1.46* | -0.44 |
| | (0.57) | (0.92) | (1.04) | (1.40) | (0.50) | (0.66) | (0.82) | (0.98) |
| Katrina Share in Quartile 3 | -0.04 | 1.06 | 0.72 | 1.10 | -1.36** | 0.32 | 1.04 | 1.52 |
| | (0.98) | (1.03) | (1.15) | (1.35) | (0.69) | (0.79) | (0.96) | (0.98) |
| Katrina Share in Quartile 4 | 0.29 | 1.51 | 2.95** | 3.26*** | 1.14 | 2.58** | 2.62** | 2.33** |
| | (1.08) | (1.10) | (1.28) | (1.18) | (0.80) | (1.04) | (1.33) | (0.91) |
| N | 32,283 | 32,105 | 32,669 | 29,596 | 85,145 | 93,870 | 94,984 | 98,649 |
| | | | | B. ELA | | | | |
| Katrina Share in Quartile 1 | -0.05 | -1.15** | -2.41*** | -2.73*** | -0.37 | -0.98** | -2..81*** | -3.33*** |
| | (0.33) | (0.50) | (0.77) | (0.79) | (0.37) | (0.41) | (0.64) | (0.67) |
| Katrina Share in Quartile 2 | -0.85 | -0.09 | -0.69 | 0.50 | 1.04 | -2.25*** | -1.77** | -0.58 |
| | (0.57) | (0.71) | (0.78) | (0.82) | (0.71) | (0.64) | (0.78) | (0.83) |
| Katrina Share in Quartile 3 | -1.27 | -1.42* | -3.09*** | -1.61 | -0.99 | -0.50 | 0.67 | 1.87** |
| | (0.86) | (0.80) | (1.01) | (1.06) | (0.82) | (0.61) | (0.92) | (0.90) |
| Katrina Share in Quartile 4 | 0.30 | -0.05 | 1.88* | 2.60** | 0.16 | 2.39*** | 1.82** | 1.13** |
| | (0.78) | (0.89) | (1.00) | (1.00) | (0.97) | (0.69) | (0.78) | (0.54) |
| N | 34,264 | 32,144 | 29,438 | 30,830 | 83,488 | 91,826 | 96,187 | 97,854 |

Standard errors are provided in parentheses and clustered by school. Regressions cover 2003-04 - 2007-08 and include student's race, gender, free lunch status, and school fixed-effects. LEAP scores are standard deviations of scale scores within grade and year for all students. Elementary is defined as any student in grades 3 - 5. Middle/High is any student in grade 6 - 11 for Houston or 6 - 10 for Louisiana. Quartiles for both evacuees and natives are within grade across the state data and determined from their 2003-04 or 2004-05 score depending on which is available since prior to 2005-06 only grades 4, 8, and 10 were tested. *, **, and *** reflect significance at the 10%, 5%, and 1% levels, respectively.

Table 8 - Nonlinear Models of Evacuee Share and Evacuee Achievement on Native Achievement in Houston

| | | Elementary | | | | Middle/High | | | |
|---|---|---|---|---|---|---|---|---|---|
| 2004 Quartile | | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 4 |
| | | | | | A. Math | | | | |
| Katrina/Rita Share | Below Median | -0.90 | -1.22** | -1.28* | -0.13 | -1.86 | -0.83 | -0.83 | -1.42 |
| | | (0.89) | (0.52) | (0.69) | (0.37) | (1.76) | (0.94) | (0.60) | (0.92) |
| Katrina/Rita Share | Above Median | 3.20 | 2.47 | -0.90 | -0.43 | 30.22*** | 10.73** | 9.34*** | 10.24*** |
| | | (7.22) | (4.25) | (5.29) | (4.79) | (9.67) | (4.47) | (3.30) | (3.64) |
| Obs | | 29,917 | 30,606 | 30,723 | 27,891 | 55,320 | 62,149 | 61,402 | 62,563 |
| | | | | | B. Reading | | | | |
| Katrina/Rita Share | Below Median | -1.10 | -0.87* | -0.09 | 0.31 | -1.55 | -0.93 | -2.48*** | -2.71*** |
| | | (1.44) | (0.45) | (0.47) | (0.76) | (2.05) | (0.71) | (0.55) | (0.67) |
| Katrina/Rita Share | Above Median | 3.98 | 5.97*** | 4.51 | 0.72 | 17.47 | 8.75*** | 10.86*** | 9.36*** |
| | | (5.35) | (2.13) | (2.75) | (5.68) | (11.64) | (2.59) | (1.85) | (2.53) |
| Obs | | 28,053 | 31,133 | 28,077 | 24,699 | 55,582 | 64,333 | 62,068 | 61,225 |

Standard errors are provided in parentheses and clustered by school. Regressions cover 2003-04 - 2006-07 and include student's race, gender, free/reduced price lunch status, and school fixed-effects. TAKS scores are standard deviations of scale scores within grade and year excluding evacuees. When students have multiple scores for a single subject in a given year we use the lowest score. Quartiles for natives are from 2004-05. Above and below medians for evacuees are calculated from 2005-06 data based on the district-wide distribution within each grad Elementary is defined as any student in grades 1 - 5. Middle/High is any student in grade 6 - 12. *, **, and *** reflect significance at the 10%, 5%, and 1% levels, respectively.

Table 9 - Instrumental Variables Estimates of Native Outcomes on Evacuee Shares in Houston

| | A. Elementary | | | |
|---|---|---|---|---|
| | Diff in Diff (tables 5 - 7) (1) | 2SLS (2) | P-Value for Test of (1) vs. (2) | Observations |
| TAKS - Math | -0.87** (0.43) | -1.06** (0.61) | 0.65 | 174,603 |
| TAKS - Reading | -0.37 (0.28) | 0.04 (0.45) | 0.23 | 175,569 |
| | **B. Middle/High** | | | |
| | Diff in Diff (tables 5 - 7) (1) | 2SLS (2) | P-Value for Test of (1) vs. (2) | Observations |
| TAKS - Math | 0.29 (0.37) | 0.47 (0.63) | 0.74 | 282,774 |
| TAKS - Reading | 0.01 (0.37) | 0.39 (0.59) | 0.40 | 285,252 |

TAKS - Math and TAKS - Reading are standard deviations of scale scores within grade and year excluding evacuees. When students have multiple scores for a single subject in a given year we use the lowest score. Standard errors are provided in parentheses and clustered by school. Regressions cover 2003-04 - 2006-07 and include student's race, gender, free/reduced price lunch status, and school fixed-effects. 2SLS estimates use Katrina/Rita share on 9/13/05 excluding students living at the stadium complex or covention center as the excluded instrument. Elementary is defined as any student in grades 3 - 5. Middle/High is any student in grade 6 - 11. *, **, and *** reflect significance at the 10%, 5%, and 1% levels, respectively.

Table 10: Regressions of Evacuee Share on Test Scores
Applying 2005-06 Evacuee Share to 2004-05 Observations

| | Louisiana | |
|---|---|---|
| | LEAP Math (1) | LEAP ELA (2) |
| Elem | -0.21 | -0.12 |
| (4th Grade Only) | (0.25) | (0.27) |
| N | 54,347 | 54,357 |
| Middle/High | 0.18 | 0.18 |
| (8th & 10th Grades) | (0.32) | (0.33) |
| N | 55,375 | 53,493 |
| | **Houston** | |
| | TAKS Math (3) | TAKS Reading (4) |
| Elem | -0.22 | 0.03 |
| | (0.56) | (0.47) |
| N | 89,220 | 88,101 |
| Middle/High | 0.01 | -0.30 |
| | (0.37) | (0.34) |
| N | 146,082 | 147,155 |

Standard errors are provided in parentheses and clustered by school. Regressions cover 2003-04 - 2004-05 and include student's race, gender, free/reduced price lunch status, and school fixed-effects. TAKS scores are standard deviations of scale scores within grade and year excluding evacuees. When students have multiple scores for a single subject in a given year we use the lowest score. LEAP scores are standard deviations of scale scores within grade and year for all students. For Louisianna we use only the evacuees from Hurricane Katrina. The Houston data does not differentiate between Katrina and Rita evacuees and thus we use both categories in our evacuee measures. Elementary is defined as any student in grades 1 - 5. Middle/High is any student in grade 6 - 12. LEAP scores are only availble for grades 4, 8 and 10. TAKS are available for grades 3 - 11. *, **, and *** reflect significance at the 10%, 5%, and 1% levels, respectively.

Table 11 - Estimates of Evacuee Share of Enrollment on Native Absenteeism Rates and Disciplinary Infractions in Houston

| | All | | Boys | Girls | Black | Hispanic | Placebo Test |
|---|---|---|---|---|---|---|---|
| | Diff-in-Diff | 2SLS | | | | | |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| A. Elementary | | | | | | | |
| Attendance Rate | -1.79* | -0.05 | -2.68** | -0.82 | -2.91 | -0.54 | -0.40 |
| | (0.96) | (1.45) | (1.31) | (0.83) | (2.00) | (0.86) | (0.78) |
| | | [0.12] | | | | | |
| N | 332,010 | 332,010 | 170,601 | 161,409 | 91,689 | 202,586 | 170,092 |
| Disciplinary Infractions | -0.04 | 0.15 | -0.04 | -0.05 | -0.73 | 0.22 | -0.15 |
| | (0.26) | (0.32) | (0.44) | (0.11) | (0.57) | (0.14) | (0.32) |
| | | [0.32] | | | | | |
| N | 332,101 | 332,101 | 170,653 | 161,448 | 91,734 | 202,616 | 170,135 |
| B. Middle/High | | | | | | | |
| Attendance Rate | -7.36** | -6.43 | -6.94 | -7.64** | -14.19*** | -3.66 | -4.85 |
| | (3.73) | (6.20) | (4.58) | (3.27) | (4.18) | (6.21) | (2.92) |
| | | [0.84] | | | | | |
| N | 363,140 | 363,140 | 183,658 | 179,482 | 112,673 | 200,457 | 184,408 |
| Disciplinary Infractions | 1.69 | 2.89 | 1.42 | 1.89* | 2.94* | 0.95 | -0.75 |
| | (1.27) | (2.47) | (1.64) | (0.96) | (1.57) | (1.53) | (1.41) |
| | | [0.48] | | | | | |
| N | 363,550 | 363,550 | 183,885 | 179,665 | 112,820 | 200,665 | 184,474 |

Standard errors are provided in parentheses and clustered by school. Brackets contain p-values of a test of differnce between the diff-in-diff and 2SLS models. Disciplinary infractions are the number of times in a year the student was given an in-school suspension or more severe punishment. Regressions cover 2003-04 - 2006-07 and include student's race, gender, free/reduced price lunch status, and school fixed-effects. 2SLS estimates use Katrina/Rita share on 9/13/05 excluding students living at the stadium complex or covention center as the excluded instrument. The placebo test in column (7) include 2003-04 and 2004-05 only and apply 2005-06 Katrina/Rita share to 2004-05 observations. Elementary is defined as any student in grades 1 - 5. Middle/High is any student in grade 6 - 12. *, **, and *** reflect significance at the 10%, 5%, and 1% levels, respectively.

Table 12 - Nonlinear Models of Evacuee Share and Evacuee Attendance Rate on Native Attendance Rate in Houston

| | A. Elementary | | | |
|---|---|---|---|---|
| 2004 Quartile | 1 | 2 | 3 | 4 |
| Katrina/Rita Share Below Median | -7.89** | -4.90** | -3.20*** | -0.45 |
| | (3.18) | (1.76) | (0.82) | (0.83) |
| Katrina/Rita Share Above Median | 30.2* | 13.83** | 2.09 | -5.08 |
| | (17.20) | (6.99) | (5.48) | (6.18) |
| N | 71,768 | 71,922 | 87,524 | 68,724 |
| | **B. Middle/High** | | | |
| 2004 Quartile | 1 | 2 | 3 | 4 |
| Katrina/Rita Share Below Median | -24.61* | -22.59*** | -15.56*** | -5.44* |
| | (12.55) | (7.20) | (5.75) | (3.22) |
| Katrina/Rita Share Above Median | 56.8 | 33.38 | 17.31 | -2.28 |
| | (67.21) | (43.66) | (28.31) | (19.36) |
| N | 72,648 | 83,058 | 75,458 | 93,328 |

Standard errors are provided in parentheses and clustered by school. Regressions cover 2003-04 - 2006-07 and include student's race, gender, free/reduced price lunch status, and school fixed-effects. Quartiles for natives are from 2004-05. Above and below medians for evacuees are calculated from 2005-06 data based on the district-wide distribution within each grade. Elementary is defined as any student in grades 1 - 5. Middle/High is any student in grade 6 - 12. *, **, and *** reflect significance at the 10%, 5%, and 1% levels, respectively.

Table 13: Effect of Evacuee Share on Class Sizes

| | A. Louisiana - % of Classes in Given Size Range | | | |
|---|---|---|---|---|
| | Elementary - 1 to 20 | Elementary 21 - 26 | Mid/High - 1 to 20 | Mid/High 21 - 26 |
| Katrina Fraction | 0.50** | -0.66*** | -0.21 | 0.26* |
| | (0.20) | (0.20) | (0.18) | (0.14) |
| Obs | 2200 | 2109 | 1546 | 1474 |
| | B. Houston - Average Class Size By Grade or Subject | | | |
| | Kindergarten | Grade 1 | Grade 2 | Grade 3 |
| Katrina/Rita Fraction | 0.30 | -12.77 | -0.39 | -13.61 |
| | (9.11) | (7.78) | (8.17) | (10.33) |
| Obs | 695 | 706 | 713 | 713 |
| | Grade 4 | Grade 5 | Grade 6 (Elem) | Mid/High English |
| Katrina/Rita Fraction | 0.94 | -14.69 | 1.08 | 48.83 |
| | (8.84) | (14.20) | (33.04) | (33.23) |
| Obs | 713 | 701 | 273 | 327 |
| | Mid/High Math | Mid/High Science | Mid/High Social Studies | Mid/High Foreign Lang |
| Katrina/Rita Fraction | 19.40 | 23.17 | 34.99* | -34.71 |
| | (18.29) | (20.62) | (19.72) | (36.15) |
| Obs | 328 | 326 | 318 | 265 |

Unit of observation is the school-year. Regressions cover 2003-04 - 2005-06 and include school fixed-effects and year dummies. Houston regressions also include % of school at each grade level as well as % black, Hispanic, asian, Native American, and economically disadvantaged. Elementary is defined as any school covering at least one of grades KG - 5. Middle/High is any covering at least one of grades 6 - 12. *, **, and *** reflect significance at the 10%, 5%, and 1% levels, respectively.

Table 14: Effect of Evacuee Share on School Resources and Staffing in Houston

| | Elementary | | |
|---|---|---|---|
| | Per-Student Operating Expenditures | Per-Student Instructional Expenditures | Average Teacher Experience |
| Katrina/Rita Fraction | -1,787 | 342 | -2.74 |
| | (5,087) | (3,856) | (5.32) |
| Obs | 791 | 791 | 766 |
| | **Middle/High** | | |
| | Per-Student Operating Expenditures | Per-Student Instructional Expenditures | Average Teacher Experience |
| Katrina/Rita Fraction | 12,748 | 8,411 | -4.99 |
| | (13,717) | (9,764) | (11.50) |
| Obs | 492 | 492 | 470 |

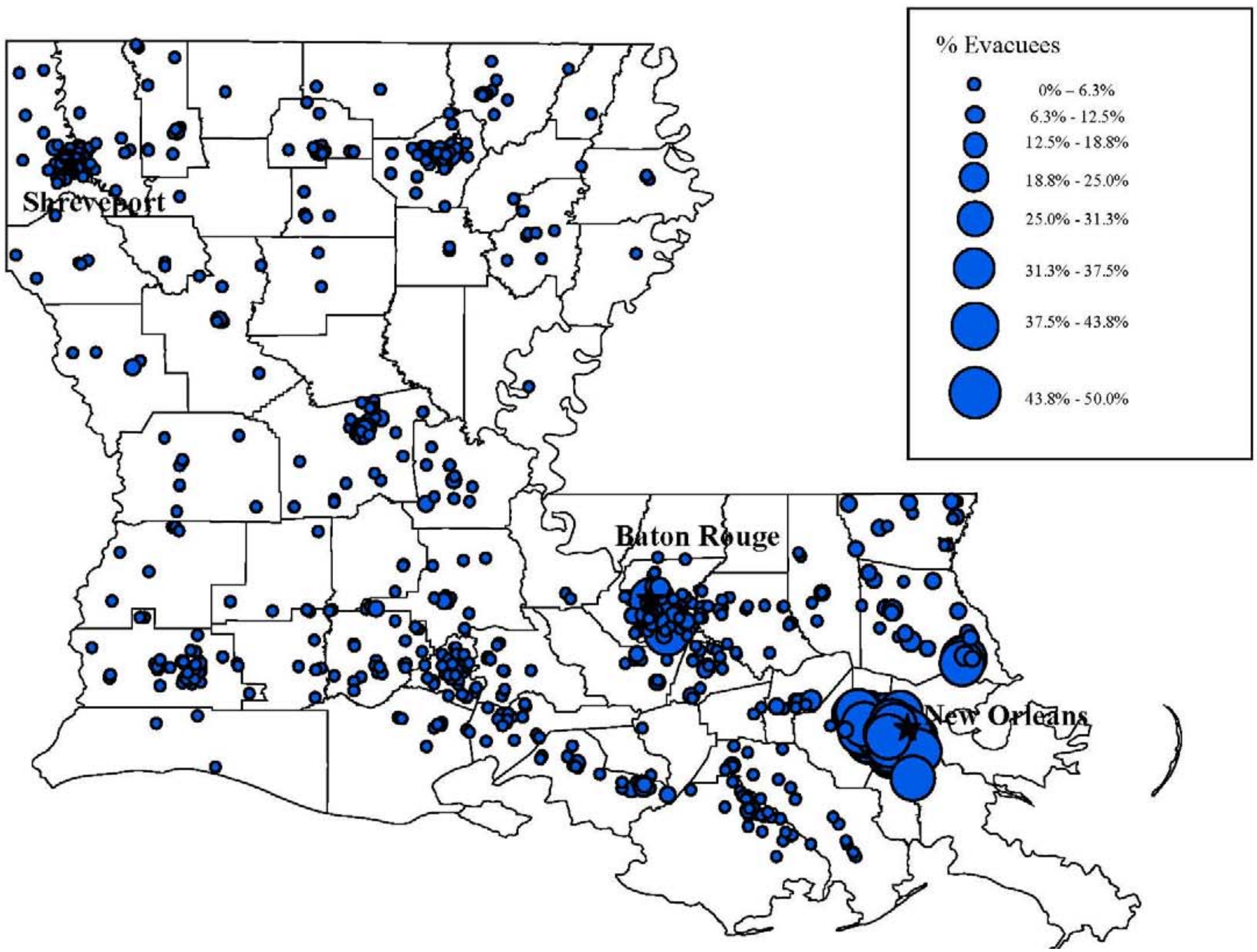
Unit of observation is the school-year. Regressions cover 2003-04 - 2005-06 and include school fixed-effects and year dummies, % of school at each grade level as well as % black, Hispanic, asian, Native American, and economically disadvantaged. Elementary is defined as any school covering at least one of grades KG - 5. Middle/High is any covering at least one of grades 6 - 12. *, **, and *** reflect significance at the 10%, 5%, and 1% levels, respectively.

Table 15: School Switching in Response to Evacuees

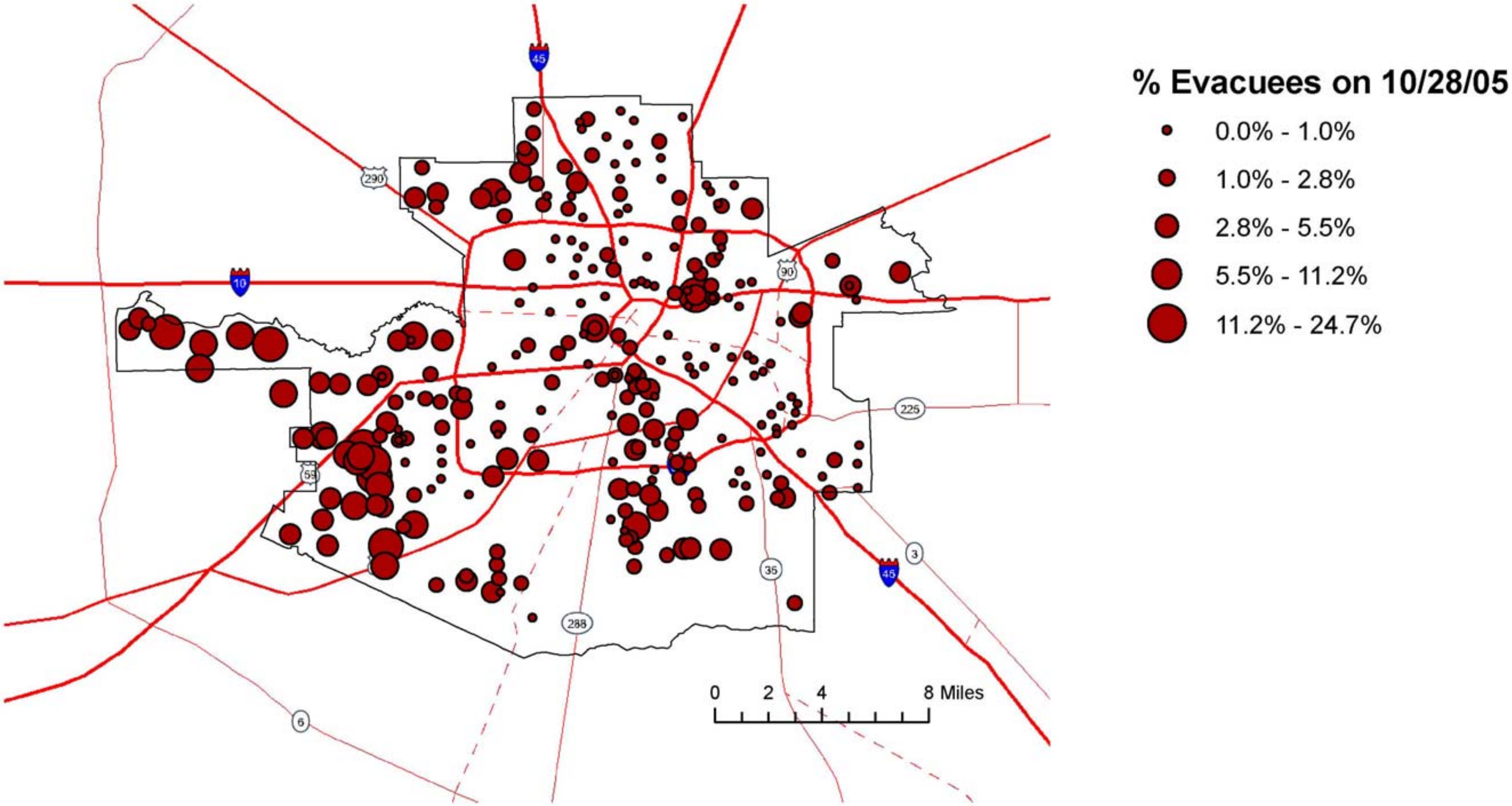
| | Louisiana | |
|---|---|---|
| | Grade 4<br>Student switches school in year t + 1 | Grades 10<br>Student switches school in year t + 1 |
| Katrina Fraction | -0.13<br>(0.14) | -0.07<br>(0.10) |
| Obs | 140,105 | 136,058 |
| | **Houston** | |
| | **Elementary** | |
| | Student switches school in year t + 1 (limited to students not in maximum grade of school in year t) | Student leaves HISD in year t + 1 (excluding grade 12) |
| Katrina/Rita Fraction | 0.295<br>(0.235) | -0.095*<br>(0.055) |
| Obs | 209,344 | 252,292 |
| | **Middle/High** | |
| | Student switches school in year t + 1 (limited to students not in maximum grade of school in year t) | Student leaves HISD in year t + 1 (excluding grade 12) |
| Katrina/Rita Fraction | 0.064<br>(0.073) | -0.028<br>(0.088) |
| Obs | 206,269 | 248,525 |

Standard errors are provided in parentheses and clustered by school. Regressions cover 2003-04 - 2006-07 and include student's race, gender, free/reduced price lunch status, and school fixed-effects. Elementary is defined as any student in grades 1 - 5. Middle/High is any student in grade 6 - 12. *, **, and *** reflect significance at the 10%, 5%, and 1% levels, respectively.

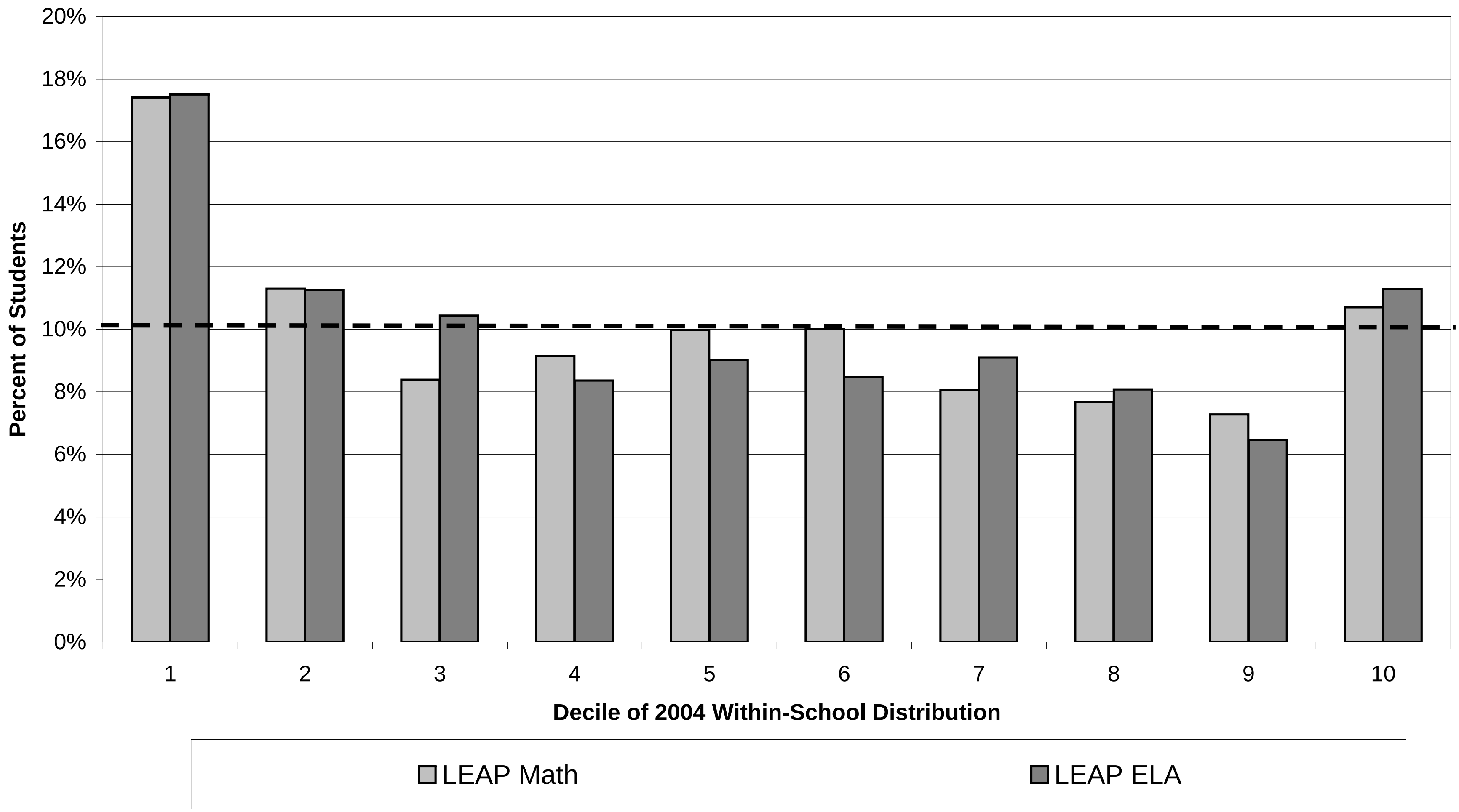
Figure 1: Hurricane Katrina Evacuees in Louisiana by School, 2005-06



# Figure 2: Hurricane Katrina Evacuees in HISD by School, 2005-06

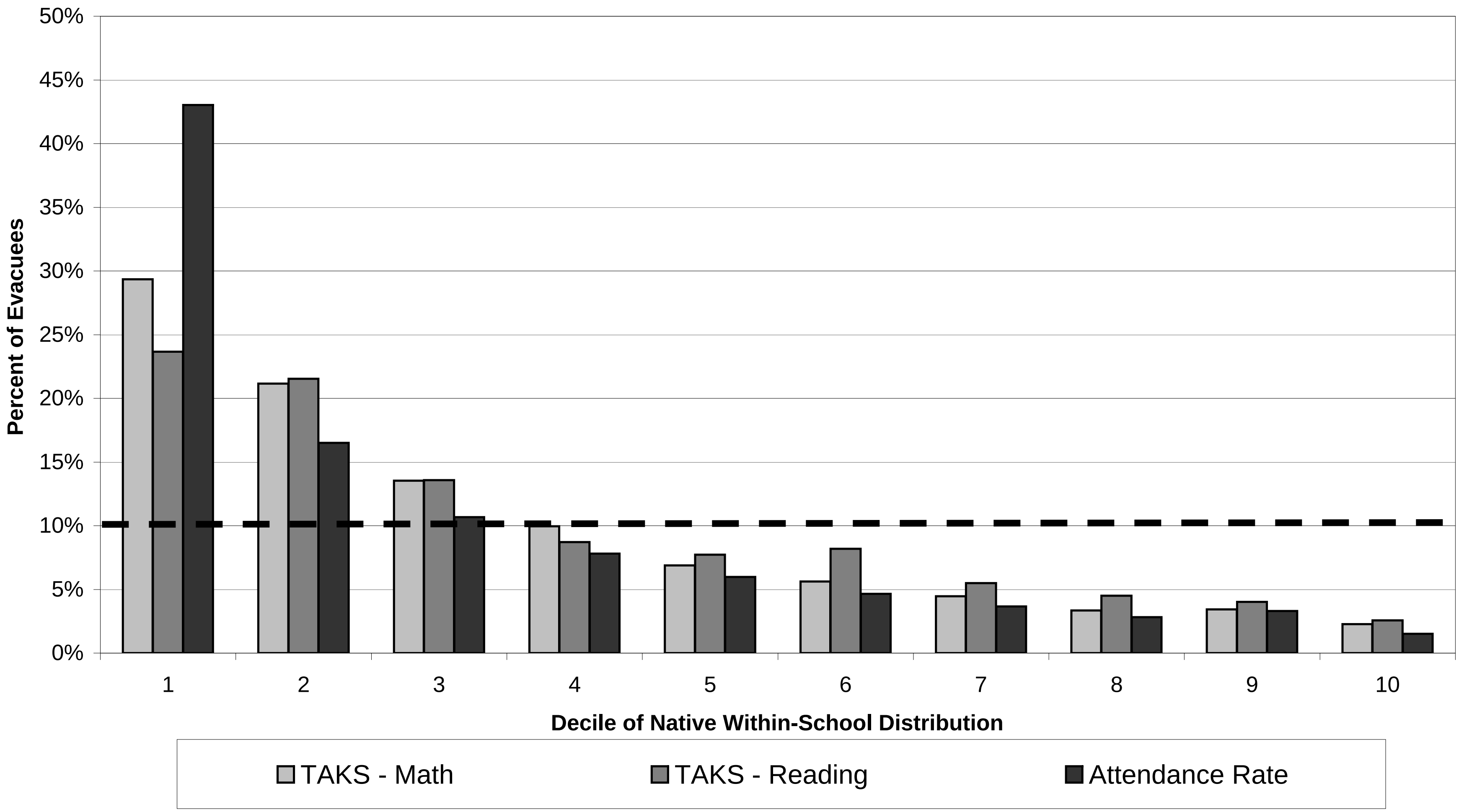


## Figure 3: Distribution of Evacuees's Lagged Test Scores in Same School Native Distribution - Louisiana, 2005-06




Each bar shows the percent of evacuee students in 2005 who's 2004-05 test scores are in the listed decile of the native distribution of 2004-05 test scores in the 2005-06 school.

**Figure 4: Position of Evacuees in Within-School Native Test score and Attendance Distributions - Houston, 2005-06**




Each bar shows the percent of native or evacuee students in 2005-06 who are in the listed decile of the within-school native students' distribution in their 2005-06.

Appendix Table 1 - Nonlinear Models of Classroom Level Evacuee Share and Evacuee Achievement and Attendance on Native Achievement and Attendance - Houston, Elementary

| 2004 Quartile | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| | | Math | | |
| Katrina/Rita Share Below Median | 0.22 | -0.65*** | -0.63** | -0.35 |
| | (0.25) | (0.21) | (0.29) | (0.33) |
| Katrina/Rita Share Above Median | 2.54*** | 0.39 | -0.34 | 0.01 |
| | (0.84) | (0.80) | (0.71) | (0.70) |
| Obs | 29,917 | 30,606 | 30,723 | 27,891 |
| | | Reading | | |
| Katrina/Rita Share Below Median | -0.22 | 0.18 | -0.33* | 0.08 |
| | (0.38) | (0.24) | (0.20) | (0.26) |
| Katrina/Rita Share Above Median | 1.13** | 1.03** | 1.40*** | 1.26** |
| | (0.54) | (0.40) | (0.41) | (0.61) |
| Obs | 28,053 | 31,133 | 28,077 | 24,699 |
| | | Attendance Rate | | |
| Katrina/Rita Share Below Median | 0.57 | -1.21** | -0.75** | -0.60 |
| | (0.76) | (0.55) | (0.37) | (0.44) |
| Katrina/Rita Share Above Median | 6.59* | 4.12** | 2.31* | 0.07 |
| | (3.46) | (2.08) | (1.23) | (1.00) |
| Obs | 71,768 | 71,922 | 87,524 | 68,724 |

Standard errors are provided in parentheses and clustered by school. Regressions cover 2003-04 - 2006-07 and include student's race, gender, free/reduced price lunch status, and school fixed-effects. Student fixed effects are added to address potential sorting across classrooms. TAKS scores are standard deviations of scale scores within grade and year excluding evacuees. When students have multiple scores for a single subject in a given year we use the lowest score. Quartiles for natives are from 2004-05. Above and below medians for evacuees are calculated from 2005-06 data based on the district-wide distribution within each grade. Elementary is defined as any student in grades 1 - 5. Middle/High is any student in grade 6 - 12. *, **, and *** reflect significance at the 10%, 5%, and 1% levels, respectively.