Police Shootings, Civic Unrest, and Student Achievement: Evidence from Ferguson

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Abstract
We document externalities of the police shooting of an unarmed black teenager and the resultant civic unrest experienced in Ferguson, MO. Difference-in-differences estimates compare Ferguson-area schools to neighboring schools in the greater St. Louis area and find that the unrest led to statistically significant, arguably causal declines in elementary school students' math and reading achievement. Attendance is one mechanism through which this effect operated, as chronic absence increased by five percent in Ferguson-area schools. Impacts were concentrated in the bottom of the achievement distribution and spilled over into majority black schools throughout the greater St. Louis area.

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1. Introduction

The August 2014 police shooting of Michael Brown, an unarmed black teenager, in Ferguson, MO prompted local protests against real and perceived racial inequities in police departments' treatment of citizens and communities in the Ferguson area northwest of St. Louis. These protests quickly attracted activists and media coverage from across the country. Similar protests, and accompanying civic unrest, spread to several major American cities during the latter half of 2014, both in response to the events in Ferguson and to similar incidents in which unarmed black males were killed by police. Notable examples include the killings of 43 year old Eric Garner in New York and 12 year old Tamir Rice in Cleveland. Unrest in Ferguson and in other parts of the country continued into 2015, when the officers involved in previous incidents were neither indicted nor formally charged. New, external events generated renewed unrest in Ferguson, such as the death of Freddie Gray while in police custody in Baltimore in April 2015.

Ensuing protests, demonstrations, civic unrest, riots, and growth of socio-political movements (e.g., Black Lives Matter) renewed public discussion of racial differences in citizens' exposure to, and interactions with, law enforcement and the criminal justice system.[3] Of course, whether these events and movements create long-run, permanent changes in policing practices, racial segregation, and living conditions in inner city, historically disadvantaged communities remains to be seen.

In the short run, however, episodes of civic unrest associated with protests potentially impose both direct and indirect costs on society. These knock-on costs are in addition to the direct effects (e.g., trauma and stress) of the shooting itself, though it is difficult, if not impossible, to disentangle the effects of each shock. This is not to say that demonstrations and protests associated with social movements are "bad" in the sense that they necessarily reduce social welfare. Indeed, they may be catalysts for change that alleviate social injustices, establish human rights, and create social benefits that far outweigh any associated costs. Rather, understanding the size, distribution, and burdens of these costs is crucial for policy makers and community leaders seeking to minimize short-run harm. For example, direct costs of the riots in Ferguson include upwards of $4 million in property damage (Unglesbee, 2014) and as much as

[3] See, for example, Mullainathan's (2015) piece in the New York Times. More recently, three police shootings of black men in Baton Rouge, LA, Dallas, TX, and St. Paul, MN in July 2016 have touched off another round of discussion and protests regarding black communities' relationships with law enforcement agencies and the criminal justice system.

$20 million in spending by local and state governments, mainly for overtime for first responders (Davis, 2014). Wenger (2015 a, b) reports similar direct costs of the 2015 Baltimore riots.

There are other potential short run costs that policy makers and institutions can potentially mitigate. However, such costs have received relatively little attention thus far, perhaps because they are inherently difficult to quantify. Doing so is important, as identifying the nature and magnitude of negative externalities is paramount to devising effective and efficient policy responses. The current study investigates one potential class of such indirect costs: the causal effect of a police shooting and the subsequent prolonged, acute civic unrest associated with the incident on schools and student achievement.

Identifying the impact of highly publicized, racially charged citizen-police interactions, and the ensuing civic unrest, on student outcomes is important for at least three reasons. First, there is likely room for schools and communities to intervene and mitigate the associated harms. Second, educational success is likely to play a key role in breaking cycles of poverty and violence in disadvantaged neighborhoods, given the well documented association between educational attainment and earnings (Blundell, Dearden, and Sianesi, 2005; Card, 1999), civic engagement (Dee, 2004; Milligan, Moretti, and Oreopoulos, 2004), and crime (Deming, 2011; Lochner and Moretti, 2004; Machin, Marie, and Vujic, 2011). Finally, in an era of consequential accountability in which schools are sanctioned for low aggregate performance on standardized tests (e.g., Figlio & Loeb, 2011), sanctions that result from shootings, civic unrest, and other community-wide shocks outside schools' control present additional hurdles that schools serving disadvantaged communities must overcome.

The police shooting of Michael Brown in Ferguson, MO provides an ideal natural experiment with which to analyze the impact of intense, prolonged civic unrest and attention to racial disparities in interactions with the criminal justice system following a racially-charged incident on student achievement: the shooting occurred on the eve of the 2014-15 school year and intermittent protests occurred throughout the subsequent 9 months (i.e., the entirety of the 2014-15 school year). While Ferguson schools were already relatively low performing and serving disproportionately large numbers of high-needs students compared to other schools in the St. Louis area, it is possible that the added stress and distractions associated with the shooting and subsequent protests, riots, violence, out of town visitors, and media attention further harmed student achievement, through some combination of causing student and teacher absences, shifting classroom time from curricular instruction to discussion of current events, changing home and parental behaviors, causing mental stress and concern for the safety of students' neighborhoods and family members, and by disrupting learning environments.

To account for preexisting differences between schools in the Ferguson area and schools in other parts of the state, we attempt to identify the impact of the events in Ferguson using difference-in-differences (DD) methods that explicitly control for preexisting differences (and differential trends) between schools.[4] We do so using school-level data on annual academic achievement and student attendance, both overall and for the subset of high-needs students, from 2010 to 2015.[5]

This paper contributes to a growing body of literature that investigates the effects of exposure to stressors such as acute violence, natural disasters, and community-wide violence (i.e., civil wars) on student achievement. Particularly relevant to the context of urban centers in the U.S., a series of papers by Patrick Sharkey and coauthors (Sharkey, 2010; Sharkey et al., 2012; Sharkey et al., 2014) estimate the effect of students' geographical proximity to homicides on various cognitive measures and standardized tests in inner city neighborhoods in Chicago and New York by exploiting arguably random temporal variation in homicides within neighborhoods. Beland and Kim (2016) estimate the impact of school shootings (i.e., homicides that occurred on school grounds) using a similar identification strategy. While these studies consistently find evidence of a short-run effect of exposure to one-off incidents of acute violence on student achievement, their implications for the harm attributable to unexpected, longer lasting neighborhood- or city-level disruptions is unclear. One of the few studies to investigate the impact of sustained exposure to a communitywide traumatic event in the U.S. context is Gershenson and Tekin (2015). The authors find that exposure to the "Beltway Sniper" attacks, which occurred during a three week period in October 2002, reduced primary school students' math achievement. They use a DD strategy that compares schools in the I-95 corridor that were within five miles of a sniper attack to those that were not, which is similar to the DD strategy applied in the current study.

[4] District-level synthetic control method (SCM) analyses (Abadie & Gardeazabal, 2003) yield qualitatively similar results.

[5] We henceforth refer to academic years by spring semester.

While Gershenson and Tekin (2015) provide evidence that less acute, longer term exposure to external stressors can harm student achievement, the stress and disruption attributable to the police shooting and resultant civic unrest in Ferguson was fundamentally different in at least two ways. First, it was sustained, with intermittent outbreaks of extreme disruption, over an entire academic year. Second, the source of the stress was not a random targeting, but rather a specific incident that caused long simmering racial and socioeconomic tensions in the community to erupt. Thus, the current study contributes to this literature by documenting the short-run impact of a police shooting and the subsequent, sustained civic unrest in a relatively segregated, disadvantaged community on students' educational outcomes. Additionally, we investigate some potential mechanisms through which such effects operate.

The paper proceeds as follows: Section 2 reviews the timeline of events in Ferguson, MO that precipitated and sustained the civic unrest throughout the 2015 academic year and describes the geography and district catchment areas used to define the treatment. Section 3 describes the data. Section 4 describes the identification strategy. The school-level DD results are presented in Section 5. Section 6 concludes.

2. Background

2.1 Ferguson Timeline

The civic unrest in Ferguson, MO began shortly after Michael Brown, an 18 year old black male, was shot and killed by a white police officer on August 9, 2014.[6] Brown was unarmed and some witnesses claimed that he was surrendering at the time he was shot. Shortly thereafter, crowds gathered at the scene, and later that evening some rioting and looting occurred on nearby West Florissant Avenue. For the next ten days or so, the Ferguson area witnessed several tense standoffs and encounters between protestors and police. There was a heavy media presence as well. A strong police response, which included militaristic vehicles and arms, may have escalated the tension. Tensions eased as Brown's funeral was held on August 25, though a series of sporadic protests, arrests, and announcements from the authorities occurred throughout September and October.

[6] Detailed timelines are available from numerous media outlets, including The Telegraph and The New York Times (part 1, part 2).

A second round of intense violence, riots, and standoffs between protestors and police occurred in the second half of November 2014, this time due to a grand jury's failure to indict the police officer involved in the shooting of Michael Brown. This series of protests and rioting lasted for about one week. Protests spread to other cities across the country in response to the grand jury's decision. Smaller outbreaks of violence in Ferguson occurred in March and April of 2015, in response to the Ferguson police chief's resignation and the death of Freddie Gray in police custody in Baltimore, respectively.

The cycle of civic unrest came full circle when additional looting and shootings occurred in concert with demonstrations and protests commemorating the one year anniversary of Brown's death in August 2015. Thus, from the time of the shooting two weeks before school was scheduled to start, throughout the entire 2014-15 academic year and into the subsequent summer vacation, residents of Ferguson experienced a persistent, elevated state of civic unrest, disruption, stress, and violence. This is in addition to the initial trauma caused by the shooting of an unarmed black graduate of an area high school. Viewed through the lens of a natural experiment, the disruptions experienced in Ferguson throughout the 2014-15 academic year provide leverage with which to identify their impacts on short-run student outcomes.

2.2 Ferguson Geography

The St. Louis Metropolitan Statistical Area (MSA) straddles the Mississippi River and includes counties in both Missouri and Illinois.[7] According to the 2010 U.S. Census, the MSA was home to about 2.8 million individuals and was about 77% white, 18% black, 2.5% Hispanic, and 2.1% Asian. St. Louis County, in which Ferguson is located, is the most populous county in the MSA. We restrict our analysis to the St. Louis MSA because its labor market and demographics are quite different from those in other parts of Missouri. We further restrict our analytic sample to schools and districts on the Missouri side of the MSA, because the Missouri and Illinois tests are not directly comparable.

Defining the "treated group" is not straightforward for several reasons. First, media reports and discussion of the unrest frequently refer to the city of Ferguson, which is technically

[7] The six St. Louis MSA counties in Missouri are Lincoln, Warren, St. Charles, Franklin, Jefferson, and St. Louis County (which contains Ferguson). St. Louis is an independent city in Missouri in the MSA. Appendix Figure A.1 shows a map of the entire MSA.

accurate as this is the jurisdiction in which the shooting of Michael Brown and much of the looting and protests occurred. However, Ferguson-Florissant School District is not synonymous with Ferguson City. In fact, Ferguson City proper contains several smaller school districts, notably Riverview Gardens District, whose catchment area includes the specific sites of Brown's shooting and the initial protests on West Florissant Ave. Moreover, Brown himself actually completed high school in the Normandy District, which is adjacent to the South of both the Ferguson and Riverview Gardens districts. A fourth independent school district, Jennings, is surrounded by these three districts, and by St. Louis City District to the East. Thus, as the map in Figure 1 makes clear, it is potentially misleading to consider Ferguson as the sole "treated" district. In the baseline school-level DD models, we therefore consider schools in the geographically contiguous block of four districts (Ferguson, Jennings, Normandy, and Riverview Gardens) as treated. We also estimate models that allow the treatment effect to vary across these four districts and investigate the sensitivity of the main results to using a broader definition of treatment that adds three additional geographically contiguous districts to the treatment group: St. Louis City, University City, and Hazelwood. The main results are robust to these, and to alternative configurations, of the treatment group, as well as to including all MO schools in the control group. We also use a triple-difference specification to test whether majority-black schools in the MSA, but outside the immediate vicinity of Ferguson, were affected by the racial tensions exacerbated by fear of police interactions, discussions, and protests associated with the shooting of Michael Brown.

3. Data

We analyze school-level data from 2010-2015 made available by Missouri's Department of Elementary and Secondary Education via their Comprehensive Data System.[8] Achievement data comes from school-level aggregate performance on Missouri Assessment Program (MAP) standardized tests that are administered in grades 3-8 and in certain high school subjects between March and May of each academic year. Exact testing dates vary by district and by grade level. For example, in Ferguson in 2015, the grade-3 tests were administered in the first two weeks of April and the grade-5 tests were administered in the second two weeks of April.

[8] See http://mcds.dese.mo.gov/Pages/default.aspx.

The state codes student performance on these exams into four mutually exclusive performance categories: advanced, proficient, basic, and below basic. The percent of all schools' and districts' students that fit in each category are publicly released. The empirical analysis focuses on the top and bottom categories, as we find that changes in advanced are approximately offset by changes in proficient, and changes in below basic are approximately offset by changes in basic.[9]

In addition to aggregate performance measures, in accordance with the No Child Left Behind Act (NCLB), the state also reports aggregate performance measures separately by student subgroups. Specifically, the state reports results for what it calls "Super Subgroup" students, who are high-needs students who are in at least one of the following specific subgroups: black, Hispanic, students with disabilities, English language learners, or low income students.[10] Because many students in the Ferguson area qualify for Super-Subgroup status, we report results both overall and for the Super Subgroup, as the latter ensures that the DD analyses compare the performance of high-needs students in treated and control schools.[11]

Missouri's Comprehensive Data System also provides a wealth of information about schools in the state, which we summarize along with the academic performance data in Table 1.[12] We report means separately by treatment status for schools in the St. Louis MSA, which highlights baseline differences between Ferguson-area schools and other schools in the MSA.[13] There are 53 schools in the four treated districts and 439 schools elsewhere in the MSA. Several stark differences emerge. First, in both reading and math, Ferguson-area schools perform significantly worse than control schools: on average, students in Ferguson-area schools are about twice as likely to score "Below Basic" and less than half as likely to score "Advanced" as students in other districts in the MSA.

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[9] Specifically, see Appendix Table A.1, which reports the estimated impact on the percent of students scoring in each of the four mutually exclusive achievement categories. In any given column (specification), the four point estimates sum to approximately zero, as these categories are both mutually exclusive and inclusive of all students.

[10] Low-income is measured by students' eligibility for free/reduced price school lunches (FRL).

[11] We focus on the Super-Subgroup designation rather than race-specific results because there is insufficient within-school variation in race with which to make valid comparisons between treatment and control schools.

[12] Appendix Table A.2 similarly summarizes the subset of elementary schools.

[13] As described in section two, the baseline "treatment" group includes schools in four districts: Ferguson, Jennings, Normandy, and Riverview Gardens.

Second, there is also an attendance differential between treated and control schools, for both male and female students, that is less pronounced among low-income (FRL) students.[14] The attendance rates reported in Missouri refer to the percentage of a school's students who were absent fewer than 10 percent of school days. Being absent more than 10 percent of school days is a common definition of chronic absence (Balfanz & Byrnes, 2012), so the reported attendance rates are best interpreted as the percentage of students who are *not* chronically absent. These are informative measures of school attendance, which is an important input in the education production function: chronically absent students score about 0.12 test-score standard deviations lower than students who are rarely absent (Gershenson et al., 2017). Attendance is an intermediate educational outcome that may have been affected by the civic unrest in Ferguson, and therefore a possible channel through which the unrest in Ferguson harmed academic achievement.

Finally, Table 1 summarizes numerous school characteristics. Teachers and administrators have higher salaries in treated schools, on average, than their counterparts in control schools. Ferguson-area teachers are also slightly more experienced than their counterparts elsewhere in the MSA. However, student-teacher ratios are larger in treated districts. Finally, the socio-demographic composition of the enrollments in Ferguson-area schools is quite different from the rest of the MSA: these schools are 90 percent black and 82 percent FRL, on average, while control schools are only 27 percent black and 45 percent FRL. This concentration of low income, racial minority students has been a focus of many discussions of the events that precipitated the civic unrest in Ferguson (e.g., Goodman, 2014 a; Kneebone, 2014). These differences underscore the importance of accounting for pre-existing differences between treated and control schools in the econometric analysis and the value of the Super-Subgroup performance measures, which facilitate comparisons of high-needs students in and outside Ferguson.

Figures 2 and 3 motivate the empirical analysis by providing suggestive evidence of a departure from trend in Ferguson-area schools in 2015 that is unlikely to be due to chance. Figure 2 plots the average school's deviance from the MSA-wide school average in percent below basic in math in each year, separately for control and treated schools. We report these figures relative to the MSA-wide, year-specific mean to account for MSA-wide changes to the

[14] Unfortunately, attendance is not reported at the Super-Subgroup level.

tests and make the results comparable over time. Two aspects of Figure 2 are worth noting. First, trends in overall and Super-Subgroup math achievement in both treated and control schools are similar in the pre-treatment period (2010-2014). This suggests that any effects of the events in Ferguson are not driven by pre-existing differential trends between treated and control groups, though we formally test this assumption below. Second, the trend line for control schools continues to be flat in 2015, the treatment year, while there is a notable uptick in the frequency of below-basic scores in treated schools in 2015, both overall and among Super-Subgroup students. Indeed, Figure 2 shows that what was approximately a ten percentage point gap between treated and control schools in percent below basic in math roughly doubled to a 20 percentage point gap in 2015, both overall and among high-needs students.[15] Appendix Figure A.2 shows a similar pattern in the doubling of the treatment-control gap in the percent of students scoring below basic in reading. Accordingly, for brevity, the main analyses focus on math achievement.

Figure 3 addresses the stylized fact that test scores are noisy and prone to mean reversion by plotting the full distribution of within-school, year-to-year changes in percent below basic in math for the 2012-2013, 2013-2014, and 2014-2015 transitions. Treated Ferguson-area schools are shaded black and control schools are shaded gray. Panel A shows a preponderance of black

[15] It is also possible to use the Synthetic Control Method (SCM) (Abadie, Diamond, & Hainmueller, 2010; Abadie & Gardeazabal, 2003) to identify a "synthetic" Ferguson school district to serve as the control group. As a robustness check, we implement a SCM using Ferguson as the sole treated district. We exclude the other six Ferguson-area districts that comprise the "broad treatment" from the donor pool, which consists of all other districts in the St. Louis MSA. The SCM identifies a "synthetic Ferguson" that is a weighted average of two districts: Ritenour and Maplewood-Richmond Heights. Both are nearby Ferguson and visible in the map in Figure 1. The SCM results are plotted in Appendix Figure A.3. The top panel plots the percent below basic in math in the real and synthetic Ferguson districts, relative to the statewide mean, from 2010 to 2015. From 2010 to 2014, Ferguson and its synthetic control follow the same pattern and are nearly overlapping. This is consistent with the raw data plotted in Figure 2 and indicates that the SCM matching algorithm identified a valid synthetic control. In 2015, there is an increase in the percentage of students scoring below basic in math in both the actual and synthetic Ferguson districts. However, the increase in the real Ferguson is noticeably steeper than that in the synthetic control. This difference indicates an impact of more than ten percentage points, which is similar in size to the impacts identified in the school-level DD analyses. The smaller uptick in the synthetic Ferguson is consistent with spillover effects of the acute unrest in the Ferguson area on neighboring, majority-black districts. The bottom panel plots the annual difference between Ferguson and its synthetic control in each year. Prior to treatment, this difference fluctuates around zero. The departure from this trend in 2015 can be interpreted as the impact of the unrest on math achievement in the district.

in the distribution's right tail, indicating that most Ferguson-area schools exhibited relatively large increases in percent below basic. Specifically, more than half of the top 5 percent declines and 60 percent of the top 1 percent declines occurred in the Ferguson area, despite Ferguson schools representing only about 11 percent of all schools. This is in stark contrast to panels B and C of Figure 3, which present analogous figures for the two transitions prior to the unrest in Ferguson. Here, Ferguson-area schools constitute only 20 percent of the top 1 percent declines and only 26 to 33 percent of top 5 percent declines. As in Figure 2, Figure 3 suggests that while Ferguson-area schools were underperforming relative to other schools in the St. Louis MSA, they experienced a pronounced departure from trend in 2015, the year following the shooting.

4. Identification Strategy

As suggested by Figures 2 and 3, Ferguson-area (treated) schools are systematically different from other schools in the MSA and there may have been secular statewide changes in student performance over the period 2010-2015. We address these confounding factors by using school-level data to estimate a variety of difference-in-differences (DD) style regressions that control for school fixed effects (FE), year FE, time-varying observed school characteristics, and school-specific time trends. The preferred baseline model conditions on time-varying school characteristics, school FE, year FE, and school-specific linear time trends. Specifically, we estimate models of the form

$$Y_{st} = \tau Ferguson_s \times 1\{t = 2015\} + \beta X_{st} + \theta_s + \delta_t + \gamma t \theta_s + \varepsilon_{st}, \quad (1)$$

where s and t index schools and academic years, respectively; Y is a school-level outcome; *Ferguson* is a binary indicator equal to one if the school was in one of the four districts in the immediate vicinity of the protests, and zero otherwise; $1\{\cdot\}$ is the indicator function; X is a vector of the time-varying school characteristics summarized in table 1; θ and δ are school and year FE, respectively; and ε is an idiosyncratic error. Equation (1) will also be augmented to condition on quadratic school time trends. The parameter of interest is τ, which represents the departure from trend of Ferguson-area schools in the 2015 academic year. Standard errors are clustered at the district level, which makes inference robust to arbitrary serial correlation within schools and districts, as schools are nested in districts.

The key identifying assumption for OLS estimation of equation (1) is a variant of the parallel slopes assumption: i.e., conditional on school-specific linear time trends, schools in and outside the Ferguson area were trending similarly prior to the 2015 school year. We provide two pieces of empirical evidence that suggest this assumption holds. First, we estimate versions of equation (1) that either restrict $\beta = 0$, restrict $\gamma = 0$, replace the linear school time trends with linear district time trends, or augment the model to include quadratic school time trends. Importantly, if estimates of τ are similar across these alternative specifications, the baseline results are unlikely to be the result of differential pre-existing trends between "treated" and "control" schools. Second, we estimate event study versions of equation (1) that interact *Ferguson* with each year indicator, which provides a direct test for "effects" of the events in years prior to their occurrence in 2015. If the event study analysis yields significant "effects" in Ferguson in the years prior to 2015, we would be concerned that the DD estimates of equation (1) are biased by pre-existing differential trends in the treated schools. As shown in section 5.4, the results of these sensitivity analyses corroborate a causal interpretation of OLS estimates of τ in equation (1).

5. Results

This section presents the results. Section 5.1 presents estimates of the baseline DD model (equation 1). Section 5.2 investigates whether the effects persisted into the 2016 school year. Section 5.3 tests for heterogeneous responses to the events in Ferguson. Finally, Section 5.4 probes the robustness of the DD estimates and tests the "parallel slopes" identifying assumption.

5.1 Baseline Difference-in-Differences Estimates

Table 2 reports estimates of the baseline DD regression model specified in equation (1). Each cell of Table 2 reports the DD estimate of τ from a unique regression. The models estimated in column 1, which pool all schools, document practically large, statistically significant effects on the percentage of students scoring "below basic" in math. Overall, there was a 16.9 percentage point increase in the share of students who scored "below basic," which constitutes a substantively large doubling of the previous year's share. The effect on the fraction of Super-Subgroup students scoring below basic is smaller, yet still statistically and economically significant: among this high-needs population, the share of students scoring below basic increased by 10.9 percentage points (68%). These point estimates are consistent with the patterns observed in Figure 2. There are also modest, negative effects on "Percent Advanced" in math, though the point estimate is not statistically significant for Super-Subgroup students. While these point estimates are smaller in magnitude and less precisely estimated than those for "Below Basic," in the treated Ferguson-area districts, only a small base of students ever score "Advanced." These results are troubling, as they suggest that many marginal students fell further behind while some high achievers were harmed as well.[16]

Of course, assuming that elementary, middle, and high schools were affected in the same ways is unrealistic, as the school contexts differ substantially and older students have more agency over intermediate inputs such as attendance. Accordingly, columns 2-4 of Table 2 show that the overall effects reported in column 1 were primarily driven by the response in elementary schools, which is consistent with the results of Gershenson and Tekin (2015) and Sharkey et al. (2014).[17] The estimated effects in high schools are generally in the same direction, but smaller in magnitude and never statistically significant. Sharkey et al. (2014) hypothesize that this could be because older students, who have grown up in disadvantaged neighborhoods, are more resilient to unexpected shocks and disruption. Alternatively, this result could be due to cognitive ability being more malleable at younger ages (e.g., Cunha, Heckman, Lochner, & Masterov, 2006).

Table 3 investigates a potential channel through which the events in Ferguson might have harmed student achievement. The absence of student- or teacher-level data limits the channels that we can investigate, but school data on the percentage of students who were not chronically absent is reported. Specifically, this variable measures the percent of students who are absent less than 10 percent of school days. The causal link between attendance and achievement is well established (e.g., Aucejo & Romano, 2016; Gershenson et al., 2017; Goodman, 2014 b), and it is plausible that the civic unrest in Ferguson affected student attendance by creating safety concerns over the commute to school, causing students to disengage from school more generally, or distracting parents from ensuring that students attended school on a regular basis. Column 1 of Table 3 reports baseline DD estimates of the impact of the events in Ferguson on Ferguson-area schools' overall attendance rates and

[16] Appendix Table A.3 shows that the main results presented in Table 2 are robust to weighting by school enrollments (Solon, Haider, & Wooldridge, 2015) and to using a broader definition of "treatment" that includes three additional nearby school districts.

[17] Appendix Table A.4 shows that this interpretation is robust to instead looking separately at performance on end-of-year math tests in third, fifth, and eighth grades, and in high school Algebra 1 exams. Specifically, the effects are concentrated on third- and fifth-grade tests.

attendance rates for specific socio-demographic groups. Columns 2-4 do the same separately for elementary, middle, and high schools. Thus each cell in Table 3 reports the DD estimate of τ for a unique regression.

Overall, the first entry in column 1 shows that the events in Ferguson led to a 3.1 percentage point decrease in the attendance measure, which means that chronic-absence rates increased by this amount. This effect is strongly statistically significant and represents an approximate decline of four percent in treated schools. The effect was similar for both male and female students, and IEP students. The elementary school estimates in column 2 are quite similar to those in column 1, while the estimates for middle and high schools in columns 3 and 4, respectively, tend to be smaller and are imprecisely estimated. This is the same pattern observed for math achievement in Table 2. Overall, the absence results presented in Table 3 are consistent with a causal interpretation of the main result of Table 2: that the events in Ferguson prior to and during the 2015 school year harmed student achievement in area elementary schools. Moreover, these results suggest that increased absenteeism was an important channel through which the events in Ferguson harmed student achievement in area elementary schools. Because the impacts on both achievement and attendance are concentrated almost entirely in elementary schools, subsequent analyses focus exclusively on elementary schools.

5.2 Persistence

Having uncovered arguably causal effects of the disruptions experienced in the Ferguson area during the 2014-15 school year on student attendance and spring-2015 test scores, a natural, policy-relevant question arises: did student achievement recover or remain depressed in subsequent school years? The models estimated in Table 4 address this question by utilizing an additional year of data and an augmented version of the baseline model (equation 1) that allows for such effects to persist in 2016. Generally, the "long-run" effects in 2016 are in the same direction, but smaller in magnitude and less precisely estimated, than the immediate effects in 2015. In only one instance is the long-run effect in 2016 individually statistically significant: column 1 shows that the overall increase in percent below basic persisted into 2016, though this effect is only half as large as the immediate impact in 2015. Still, the effects on percent below basic in 2016 are significantly smaller than those in 2015. The long-run impacts on percent advanced and attendance rates in 2016 are not statistically significant.

Overall, the results in Table 4 suggest that the disruptions experienced in Ferguson during the 2014-15 school year had modest, if any, lasting impact on elementary school students' academic performance and attendance habits in the 2015-16 school year. The lack of strongly persistent effects is consistent with previous research on the impact of similar community traumatic events: for example, Gershenson and Tekin (2015) find no evidence that exposure to the Beltway Sniper attacks harmed student achievement in the following school year.

This could be due to parents and school administrators responding in the following academic year to reverse the immediate negative effects observed in 2015. Unfortunately, data limitations prohibit testing these hypotheses. However, this is not an implausible scenario given the considerable national attention received by these schools and neighborhoods in the aftermath of the shooting. Of course, even if the effects on test scores faded out, effects on socio-emotional and attitudinal outcomes might persist in ways that affect long-run socioeconomic outcomes (e.g., Chetty et al. 2011). Nonetheless, it is comforting that the negative impacts on test scores and attendance associated with the unrest in Ferguson appear to be short-lived. The reason that this lack of persistence is comforting is that while reversing the harmful impacts of community traumatic events on student achievement may be possible, doing so would require the reallocation of scarce resources.

5.3 Heterogeneity

The racially charged events and conversations in Ferguson might well have affected predominantly black schools and communities across the St. Louis MSA, even those not in close proximity to the shooting and subsequent unrest in the Ferguson area. For example, stress, fear, and concern caused by the highly publicized shooting of an unarmed black teenager could easily distract students in other parts of the MSA, especially given the amount of national media attention that Ferguson received. Accordingly, we estimate a triple-difference version of equation (1) that allows the racially-charged events in Ferguson to affect all majority-black schools in the MSA, and for this effect to differ in Ferguson-area schools, which themselves are uniformly majority black. Estimates of these triple-difference models are reported in Table 5.

Before estimating the full triple-difference model, column 1 of Table 5 simply changes the treatment indicator in the baseline model from "Ferguson area" to "majority black." The resulting point estimate in column 1 is smaller than the analogous estimate in column 2 of Table

2, but is similarly positive and statistically significant. Intuitively, this suggests that the impact of the events in Ferguson was not isolated to the four "treated" districts in the immediate vicinity of the shooting and subsequent unrest, though the effects were larger in magnitude in districts physically closer to the epicenter of the unrest. Column 2 formalizes this idea by estimating a triple-interaction model that allows the response of majority-black schools to vary by proximity to Ferguson. As expected, the triple interaction term shows that the effects were significantly larger in magnitude in Ferguson-area schools. Columns 3 and 4 repeat this exercise for the subset of super-subgroup students, where a similar pattern is observed: the impact of the events in Ferguson was significantly larger in the majority-black schools in the Ferguson-area than in other majority-black schools in the St. Louis MSA. Specifically, the overall and super-subgroup effects of the civic unrest in Ferguson on percent below basic in math were 66% and 125% larger, respectively, in Ferguson-area elementary schools than in majority-black elementary schools elsewhere in the MSA. Similarly, column 6 shows that the effects of the events in Ferguson on elementary school attendance rates were 86% larger in the Ferguson area than in majority-black schools elsewhere in the MSA. These results are consistent with a causal impact of the events in Ferguson on student achievement in Ferguson-area elementary schools. Moreover, these results suggest that attendance was an important, but not the only, mechanism through which student learning was affected.

One interpretation of the triple-difference estimates reported in Table 5 is that the psychic costs of stress and changes in the allocation of instructional time away from academic topics covered by MAP tests and towards conversations about race, social and criminal justice, and inequality were more important channels through which achievement was affected than direct disruptions to schools, households, and neighborhoods in the Ferguson area. That the impact spread to other parts of the MSA, state, and nation is plausible, as the nightly news coverage of the events in Ferguson, New York, Baltimore, Cleveland, and elsewhere made racial inequities in the U.S. salient and a topic of conversation in majority-black schools.[18] Together with the effect on student attendance, these findings reinforce the main result of the baseline school-level DD analyses: the police shooting and subsequent civic unrest experienced in Ferguson, MO had

[18] Another possible interpretation of the triple interaction terms in Table 5 is that they represent lower bounds of the impact of the civic unrest in Ferguson on math achievement. This would be the case if, for example, some other event or policy shock disproportionately affected majority-black schools in the St. Louis MSA in 2015.

a nontrivial, arguably causal impact on elementary school students' academic achievement, which occurred at least partly due to an increase in chronic absenteeism, and was concentrated at the bottom of the achievement distribution.

It is also possible that the four distinct districts that comprise the "Ferguson Area" treatment group were differentially affected. Table 6 tests this hypothesis by estimating an augmented version of the baseline model (equation 1) in which the treatment indicator is disaggregated into four separate district indicators. In all models, the four interaction terms (district-specific treatments) are jointly statistically significant. While the main result of a positive, sizable, and statistically significant effect on the percent Below Basic is upheld in all four "treated" districts, the effect is about twice as large in Ferguson and Normandy as it is in Jennings and Riverview Gardens. This is perhaps unsurprising, as Ferguson was the name mentioned in most media accounts of the events and home to much of the violence that occurred along W. Florissant Ave and Normandy is the district that Michael Brown graduated from. Thus, for different reasons, it is intuitive that the impact on achievement was more severe in these districts. Column 5 shows that the impact on attendance was fairly constant across districts.

5.4 Sensitivity Analysis

This section presents evidence that the key identifying "parallel trends" assumption made by the difference-in-differences (DD) identification strategy is valid, and thus that the OLS estimates of equation (1) and its variants presented in sections 5.1-5.3 can be given causal interpretations. We begin by showing that estimates of τ are robust to conditioning on time-varying school characteristics, linear school and district time trends, and quadratic school time trends. Specifically, column 1 of Table 7 reports estimates of parsimonious specifications that condition only on school and year fixed effects (FE). Moving from left to right, each column of Table 7 augments the model estimated in column 1 to include a richer conditioning set: column 2 adds time-varying school controls, column 3 adds linear district-specific time trends, column 4 adds linear school-specific time trends (which subsume the district trends), and column 5 adds quadratic school-specific time trends. Panels A and B of Table 7 report the DD estimates for percent below basic in math and percent advanced in math, respectively, both for all students and for Super Subgroup students. Each cell of Table 7 therefore reports the DD estimate of τ from a unique regression. Appendix Table A.5 reports analogous results for reading (ELA) achievement, which are similarly robust to model specification.

Importantly, the estimates are remarkably stable across columns, within rows of Table 7. In other words, the baseline DD estimates are robust to controlling (or not) for time-variant school characteristics and various school and district time trends. This stability strongly suggests that the DD estimates are not biased by pre-existing differential trends (i.e., failure of the parallel trends assumption) (Angrist & Pischke, 2009). We address this issue further by estimating event-study specifications, which are presented in Table 8.

The robustness of the baseline results to controlling for school and district-specific time trends, and for time-varying school observables, suggests that the DD estimates are not driven by pre-existing differential trends in the treated (Ferguson-area) schools. In Table 8, we formally test this assumption using an event study version of equation (1) that fully interacts the Ferguson indicator with the full set of year FE. Relative to the omitted 2010 reference group, the other 2011-2014 pre-treatment interactions tend to be statistically insignificant and small in magnitude. In fact, they are often the opposite sign of the actual 2015 treatment effect, which itself remains similar in magnitude to the baseline estimates reported in Table 2 and strongly statistically significant for three of the four outcomes. Coupled with the results in Table 7, the event study estimates reported in Table 8 provide further evidence that the main identifying assumption holds and, as a result, that the baseline DD estimates can be given a causal interpretation.

6. Conclusion

This paper documents the negative impact of a police shooting, and the many months of civic unrest that followed, on student achievement in Ferguson, MO. While we cannot separately identify the impacts of the shooting and the subsequent unrest, we find statistically significant, arguably causal effects of the bundle of treatments on students' math and reading achievement in Ferguson-area elementary schools relative to other schools in the St. Louis MSA. Smaller negative effects are found in majority-black schools elsewhere in the MSA. These difference-in-difference (DD) and triple-difference estimates are not driven by pre-existing differential trends in treated schools and are robust to controlling for time-varying school characteristics and linear and quadratic school-specific time trends. Effects are relatively large, particularly at the lower end of the math-score distribution. For example, a conservative estimate suggests that the fraction of high-needs students scoring “below basic” in math increased by about 10 percentage points following the unrest.

Reductions in achievement were concentrated in elementary schools, and were at least partly driven by corresponding increases in student absences: the rate of chronic absence increased by about four percentage points (5%) in Ferguson-area elementary schools. However, attendance is unlikely the sole mechanism through which the events in Ferguson affected student achievement in the area, as smaller, but statistically significant, declines in achievement occurred in other majority-black school districts farther away from the physical unrest. For example, the events in Ferguson might have affected schools through other channels, such as creating stress and causing teachers and parents to reallocate instructional time away from math and reading skills and towards non-tested topics such as race, inequality, and the criminal justice system. Of course, without objective data on these intermediate outcomes, it is impossible to definitively say to what extent the disruptions in Ferguson affected student achievement through these channels, in Ferguson or elsewhere in the MSA, state, and country.

Because decreased attendance and lost instructional time are likely mechanisms through which the events in Ferguson may have affected achievement, we contextualize our results by comparing them to those from similar analyses of the impact of disruptions to school schedules on school-level proficiency rates. For example, Marcotte and Hemelt (2008) find that ten unscheduled, weather-related school closings reduced third and fifth grade math proficiency rates by between 5 and 7 percentage points in Maryland. Similarly, Gershenson and Tekin (2015) find that proximity to the 2002 Beltway Sniper Attacks reduced schools’ fifth-grade math proficiency rates by about 5 percentage points in schools serving black and low-income communities. These effects are similar in size to the conservative triple-difference estimates reported in Table 5 and smaller than the baseline estimates in Table 2 of the current study. That the effects of the events in Ferguson are larger than those of the beltway sniper attacks is intuitive, since even if the two events created similar levels of stress and safety concerns, the unrest in Ferguson played out over an entire school year while those in the sniper case lasted about three weeks, early in the school year. Still, these impacts are large enough to change schools’ standings under consequential accountability regimes such as No Child Left Behind (Gershenson & Tekin, 2015; Marcotte and Hemelt, 2008). The attendance results in the current study further our understanding of the mechanisms through which external disruptions to school environments and school schedules can affect student achievement and highlight the importance of attendance in the education production function (Gershenson et al. 2017; Goodman, 2014 b).

More generally, these results highlight the potential benefits of local and state interventions that respond to community traumatic events, civic unrest, and related distractions and disruptions to schools. For example, providing additional resources, support, and guidance to affected schools and communities might reduce the harm to achievement associated with such events. Weems et al. (2009) describe one school-based intervention that reduced test anxiety in a predominantly black sample of students who were exposed to Hurricane Katrina. This type of reactive policy and support would be further justified by the fact that the police shooting and subsequent civic unrest in Ferguson occurred in what were already relatively disadvantaged and under-resourced schools and communities.

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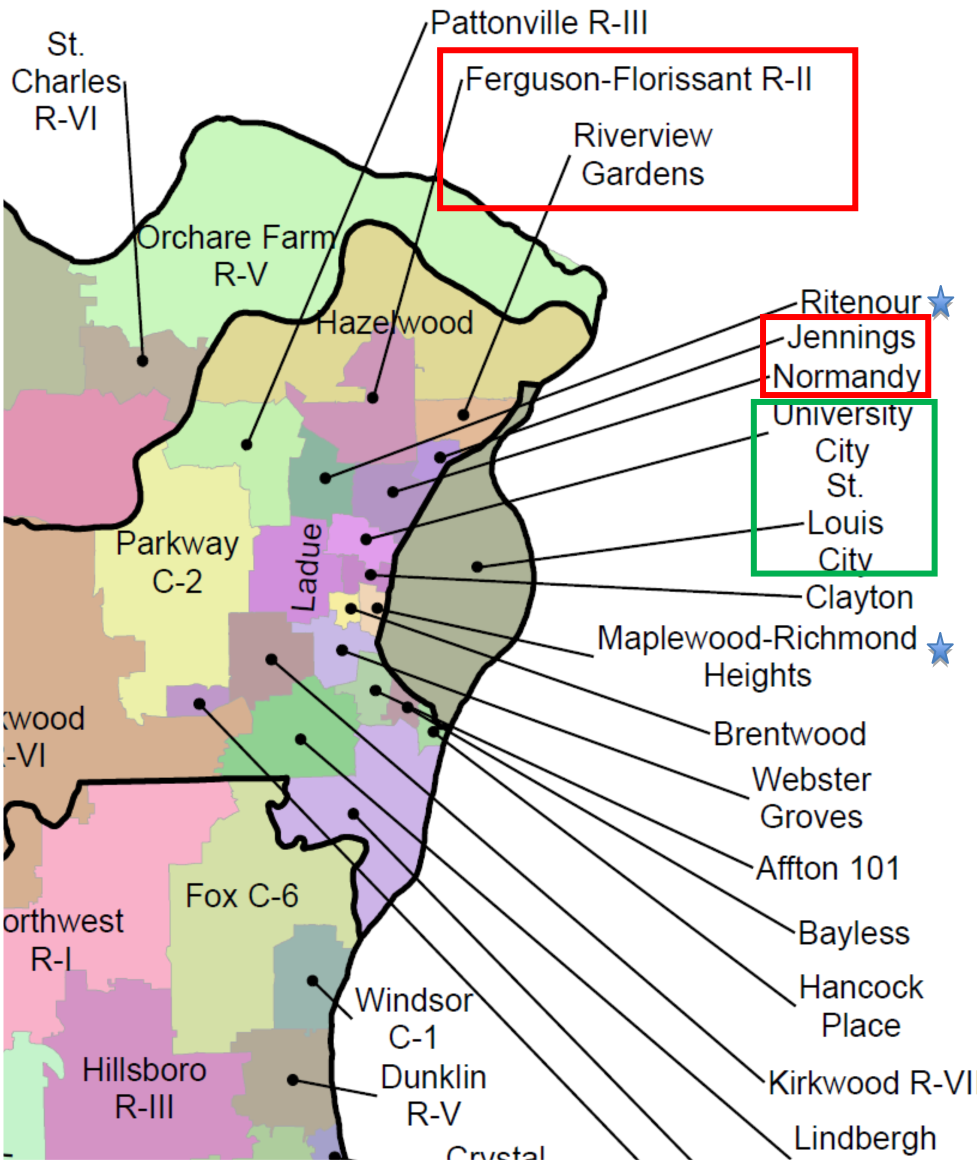
Figure 1. Map of Ferguson Area Districts



Notes: Baseline treatment districts are circled in red and include Ferguson, Jennings, Normandy, and Riverview Gardens. Extended treatment districts include Hazelwood, University City, and St. Louis City, which are circled in green. Stars indicate the districts that comprise Ferguson's synthetic control (Ritenour and Maplewood-Richmond Heights). The Eastern border is the Mississippi River, which separates Missouri from Illinois. Hazelwood's Northern border is the Missouri River. All bold black lines demarcate counties. Appendix Figure A.1 shows all counties in the St. Louis MSA. Source: Missouri Department of Elementary and Secondary Education.

Figure 2. School Average "Percent Below Basic" in Math Rates

Figure 2.A. Percent Below Basic in Math, All Students

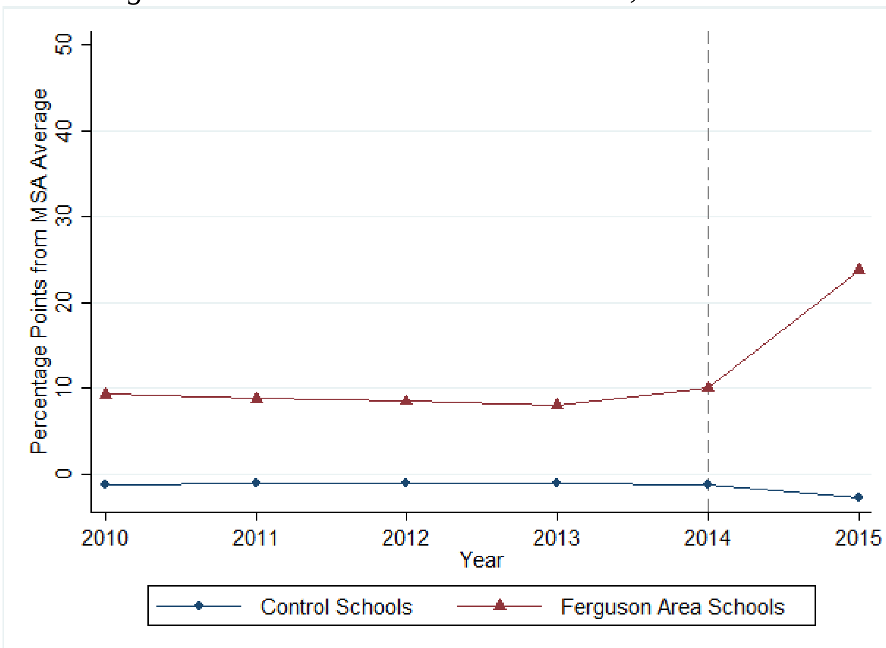
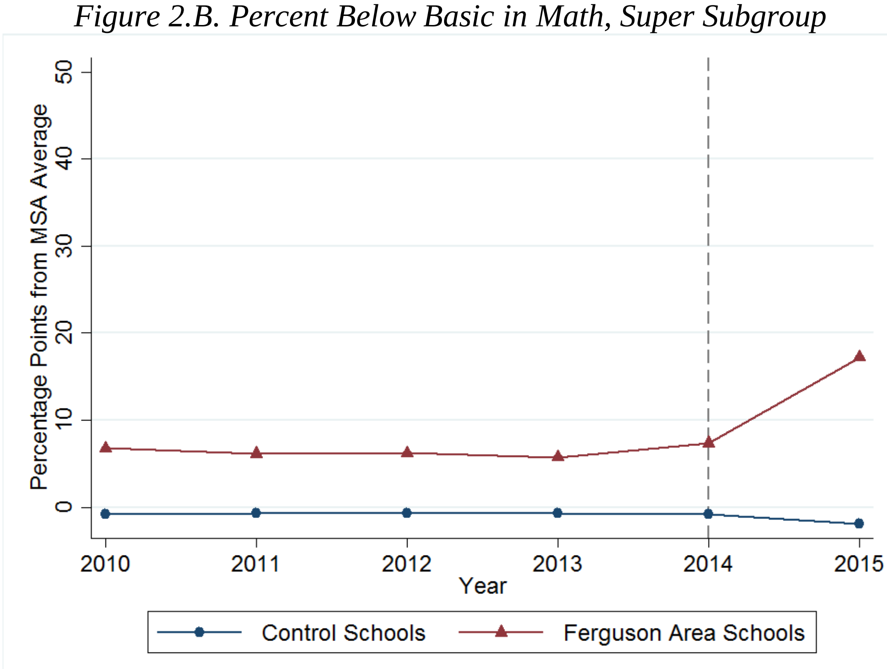


Figure 2.B. Percent Below Basic in Math, Super Subgroup



Notes: Ferguson-area Schools include all schools in four Missouri school districts including Ferguson, Jennings, Normandy, and Riverview Gardens. Control schools include all other public schools in the St. Louis MSA. Each dot represents the annual school average deviation from the MSA, year-specific mean.

Figure 3. Distribution of Annual Within-School Changes in “Percent Below Basic” in Math

Figure 3.A: Changes from 2014 to 2015.

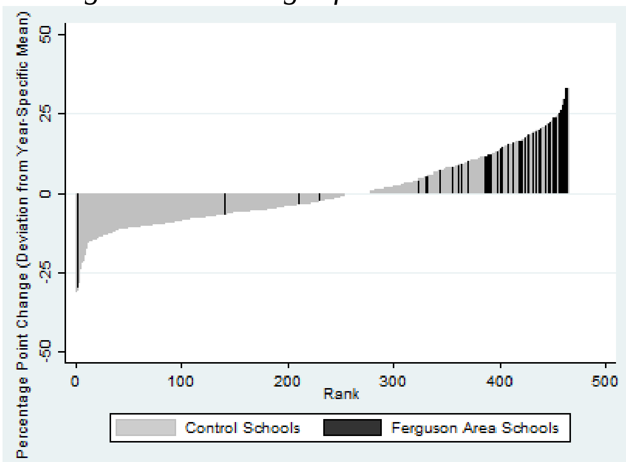


Figure 3.B: Changes from 2013-2014.

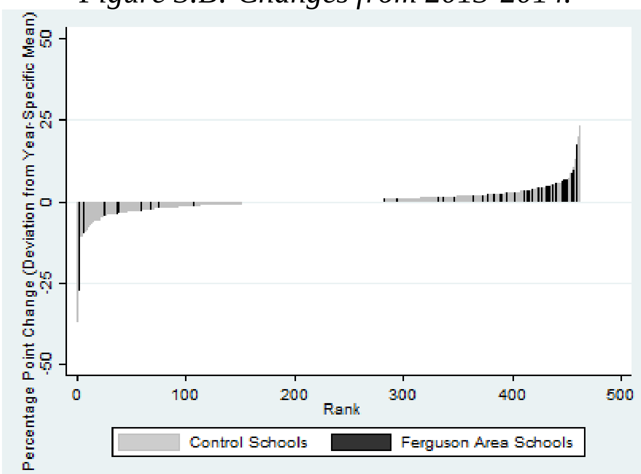
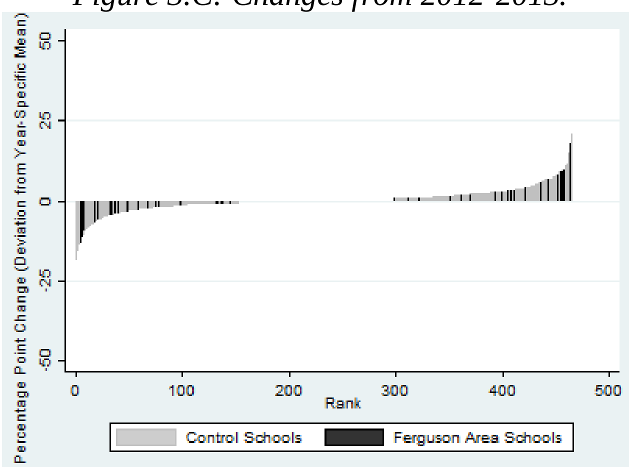


Figure 3.C: Changes from 2012-2013.



Notes: In panel A, Treatment = 54.5% of top 5% schools and 60.0% of top 1% schools. In panel B, Treatment = 33.3% of top 5% schools and 20.0% of top 1% schools. In panel C, Treatment = 26.1% of top 5% schools and 20% of top 1% schools.

Table 1. Descriptive Statistics for St. Louis MSA Public Schools

	Ferguson Area Schools		Control Schools	
	Mean	SD	Mean	SD
Reading Achievement				
% Below (All Students)	19.0	11.6	9.0	10.4
% Advanced (All Students)	7.5	5.3	23.3	13.4
% Below (Super Subgroup)	19.4	11.5	12.7	10.2
% Advanced (Super Subgroup)	6.7	4.4	14.5	8.7
Math Achievement				
% Below (All Students)	23.7	15.8	23.7	15.8
% Advanced (All Students)	5.2	4.6	5.2	4.6
% Below (Super Subgroup)	24.1	15.9	24.1	15.9
% Advanced (Super Subgroup)	4.7	4.3	4.7	4.3
Attendance				
All Students	80.8	11.3	89.8	7.6
Male Students	79.3	11.7	89.5	7.7
Female Students	82.5	11.4	90.0	7.8
IEP Students	75.1	12.9	85.0	9.8
FRL Students	79.8	11.5	84.6	8.6
School Characteristics				
Average Admin Salary	$94,656	18,753	$92,612	21,489
# of FTE Teachers	29.5	17.6	39.7	24.1
Average Teacher Salary	$57,696	4,998	$53,127	7,371
Average Teacher Experience	13.9	2.8	12.2	2.5
% Teachers w/ Masters	63.4	12.8	65.7	16.4
Total Enrollment	474.6	319.4	585	406.5
Student to Teacher Ratio	15.8	2.3	14.3	2.3
% White Students	6.9	10.2	64.5	32.5
% Black Students	89.5	13.3	27.2	33.3
% Hispanic Students	1.4	2.8	3.3	3.3
% Asian Students	0.4	0.6	3.2	4.1
% Multiracial Students	1.7	2.4	1.5	2
% Other Race Students	0.5	0.6	3.5	4.1
% LEP Students	0.7	2.6	3.5	6.2
% FRL Students	82	14.7	44.6	27.7
N (School Years)	300		2,513	
N (Unique Schools)	53		439	
N (Unique Districts)	4		46	
N (Years)	6		6	

Notes: Ferguson-area (control) schools are schools in the following school districts: Ferguson, Normandy, Jennings, and Riverview Gardens. Control schools are all other schools in the St. Louis Metropolitan Statistical Area (MSA) on the Missouri side of the Mississippi River. Super Subgroup includes high needs students who are black, Hispanic, low-income, or have an Individualized Education Plan (IEP). Attendance rates are the percentage of a school's students who were absent fewer than ten percent of school days (i.e., who were *not* chronically absent).

Table 2. Baseline School-Level DD Estimates of Effects on Student Math Achievement

	All Schools	School Type: Elementary	Middle	High
	(1)	(2)	(3)	(4)
A. Math Achievement, Below Basic				
All Students	16.9***	18.4***	16.2***	11.3
	(4.6)	(4.1)	(4.9)	(12.2)
Super Subgroup	10.9**	12.8***	8.0*	6.6
	(4.4)	(3.8)	(4.3)	(12.8)
B. Math Achievement, Advanced				
All Students	-6.2***	-9.9***	-1.9	-1.0
	(2.1)	(2.9)	(4.4)	(2.9)
Super Subgroup	-1.6	-4.1	-1.2	2.2
	(2.1)	(2.8)	(4.2)	(2.5)
N (school years)	2,813	1,744	495	574

Notes: Each cell reports the estimate of τ for a unique regression that controls for school and year fixed effects, linear school time trends, and time-varying school characteristics. Outcomes are school performance rates for both all students and for super-subgroup (high needs) students who are black, Hispanic, eligible for free or reduced-price lunch (FRL), have an individual education plan (IEP), or English language learners (ELL). Each panel represents a different dependent variable: percent below basic or percent advanced. Standard errors are clustered by school district. DD = difference-in-difference. *** p<0.01, ** p<0.05, and * p<0.1.

Table 3. Baseline School-Level DD Estimates of Effects on Student Attendance

		School Type		
	All Schools	Elementary	Middle	High
Outcome	(1)	(2)	(3)	(4)
Total Attendance Rate	-3.1***	-4.2***	-1.8	-1.0
	(0.8)	(0.5)	(2.3)	(4.9)
Male Attendance Rate	-2.8***	-3.9***	-2.9	0.6
	(0.5)	(0.7)	(2.0)	(4.9)
Female Attendance Rate	-3.5***	-4.8***	-0.4	-2.5
	(1.0)	(0.5)	(2.6)	(4.9)
IEP Attendance Rate	-2.8***	-3.8*	-4.5	-0.0
	(0.9)	(1.9)	(3.5)	(5.1)
FRL Attendance Rate	-0.8	-2.3**	0.8	1.2
	(0.6)	(1.0)	(2.1)	(4.1)
N (school years)	2,813	1,744	495	574

Notes: Each cell reports the coefficient estimate on the interaction between the "treated school" and 2015 indicators from a unique regression that controls for school and year fixed effects, linear district time trends, and time-varying school characteristics. The dependent variable, attendance rate, is the percentage of a school's students who were absent fewer than 10 percent of school days (i.e., who were not chronically absent). Standard errors are clustered by school district. IEP = Individualized Education Plan. FRL = Free or reduced price lunch. *** $p<0.01$, ** $p<0.05$, and * $p<0.1$.

Table 4. Persistence of Effects on Elementary Student Achievement and Attendance

Outcome:	Below Basic, Math		Advanced, Math		Attendance	
Students:	All	Super Subgroup	All	Super Subgroup	All	FRL
	(1)	(2)	(3)	(4)	(5)	(6)
2015×Treated	17.6***	13.4***	-9.8***	-6.0***	-3.1***	-1.9*
	(4.0)	(4.0)	(2.3)	(1.5)	(0.7)	(1.0)
2016×Treated	8.5**	4.1	-7.0	-3.5	-1.9	-0.8
	(3.4)	(3.1)	(5.0)	(3.7)	(1.3)	(1.7)
Diff. (p value)	0.00	0.00	0.53	0.55	0.27	0.36
N (school years)	2,002	1,992	1,968	1,934	2,031	1,990

Notes: Each column reports coefficient estimates from a unique regression that controls for school and year fixed effects, linear district time trends, and time-varying school characteristics. Attendance is the percentage of a school's students who were absent fewer than 10 percent of school days (i.e., who were not chronically absent). The super-subgroup (high needs) classification includes students who are black, Hispanic, eligible for free or reduced-price lunch (FRL), have an individual education plan (IEP), or English language learners (ELL). Standard errors are clustered by school district. *** $p<0.01$, ** $p<0.05$, and * $p<0.1$.

Table 5. School-Level DDD Estimates of Effects on Student Achievement and Attendance

Outcome:	Below Basic, Math				Attendance	
Students:	All Students		Super-Subgroup		All Students	
	(1)	(2)	(3)	(4)	(5)	(6)
2015×Black	14.9***	12.2***	8.7***	6.1***	-2.7***	-2.1***
	(2.3)	(2.3)	(2.2)	(2.1)	(0.5)	(0.6)
2015×Black×Ferguson		8.1**		7.6*		-1.8**
		(3.5)		(3.9)		(0.8)

Notes: The analytic sample contains 1,744 unique school-year observations, 50 unique districts, 302 unique elementary schools, and six academic years (2010-2015). Black is a binary indicator equal to one if the school's enrollment is more than 50% black, and zero otherwise. All Ferguson-Area schools are more than 50% black. Each column reports coefficient estimates from a single regression, in which indicators for each of the four "treated" districts are interacted with the 2015 indicator. Each regression controls for school and year fixed effects, linear school time trends, and time-varying school characteristics. Outcomes are school performance rates for both all students and for super-subgroup (high needs) students who are black, Hispanic, eligible for free or reduced-price lunch (FRL), have an individual education plan (IEP), or English language learners (ELL). Attendance reflects the percentage of a school's students who were absent fewer than 10 percent of school days. Standard errors are clustered by school district. *** $p<0.01$, ** $p<0.05$, and * $p<0.1$.

Table 6. Geographic Heterogeneity in Effect of Unrest on Student Outcomes

	Below Basic, Math		Advanced, Math		Attendance
	All Students (1)	Super Subgroup (2)	All Students (3)	Super Subgroup (4)	All Students (5)
2015×Ferguson	23.3***	17.9***	-11.6***	-4.0	-3.0***
	(2.9)	(2.4)	(3.0)	(2.9)	(0.6)
2015×Jennings	12.4***	8.0***	-10.9***	-8.5***	-3.8***
	(2.3)	(1.1)	(1.6)	(0.9)	(0.6)
2015×Normandy	18.0***	12.6***	-6.1**	-3.4**	-3.8***
	(3.5)	(2.2)	(2.3)	(1.4)	(0.8)
2015×Riverview Gardens	14.6***	7.0**	-7.7**	0.3	-4.5***
	(3.5)	(2.8)	(3.6)	(3.6)	(0.6)
Tests of Equality (p-values)					
Ferguson = Jennings	0.00	0.00	0.72	0.13	0.11
Ferguson = Normandy	0.00	0.00	0.01	0.81	0.31
Ferguson = Riverview Gardens	0.00	0.00	0.00	0.00	0.00
Jennings = Normandy	0.00	0.00	0.00	0.00	0.99
Jennings = Riverview Gardens	0.16	0.64	0.23	0.02	0.15
Normandy = Riverview Gardens	0.00	0.00	0.50	0.24	0.30

Notes: The analytic sample contains 1,744 unique school-year observations, 50 unique districts, 302 unique elementary schools, and six academic years (2010-2015). Each column reports coefficient estimates from a single regression, in which indicators for each of the four "treated" districts are interacted with the 2015 indicator. Each regression controls for school and year fixed effects, linear school time trends, and time-varying school characteristics. Outcomes are school performance rates for both all students and for super-subgroup (high needs) students who are black, Hispanic, eligible for free or reduced-price lunch (FRL), have an individual education plan (IEP), or English language learners (ELL). Standard errors are clustered by school district. *** p<0.01, ** p<0.05, and * p<0.1.

Table 7. School Level Difference-in-Difference Estimates

	(1)	(2)	(3)	(4)	(5)
A. Math Achievement, Below Basic					
All Students	18.6***	19.1***	17.9***	18.4***	17.7***
	(3.5)	(3.6)	(3.6)	(4.1)	(4.3)
Super Subgroup	14.2***	13.5***	12.4***	12.8***	12.6***
	(3.4)	(3.4)	(3.3)	(3.8)	(4.3)
B. Math Achievement, Advanced					
All Students	-9.8***	-10.1***	-9.6***	-9.9***	-11.6***
	(1.9)	(2.7)	(3.1)	(2.9)	(4.1)
Super Subgroup	-5.6***	-4.0*	-3.8	-4.1	-4.4
	(1.1)	(2.1)	(2.9)	(2.8)	(3.2)
School & Year FE	√	√	√	√	√
School Controls		√	√	√	√
Linear District Trends			√		
Linear School Trends				√	√
Quadratic School Trends					√

Notes: The analytic sample contains 1,744 unique school-year observations, 50 unique districts, 302 unique elementary schools, and six academic years (2010-2015). Each cell reports the estimate of τ for a unique regression. Outcomes are school performance rates for either all students or for super-subgroup (high needs) students who are black, Hispanic, eligible for free or reduced-price lunch (FRL), have an individual education plan (IEP), or English language learners (ELL). Each panel represents a different dependent variable: percent below basic or percent advanced, in either math or reading. Standard errors are clustered by school district. FE = fixed effects. *** $p<0.01$, ** $p<0.05$, and * $p<0.1$.

Table 8. School Level Math Achievement Event Study Estimates

	Below Basic		Advanced	
	All Students	Super Subgroup	All Students	Super Subgroup
	(1)	(2)	(3)	(4)
2011×Treated	0.5	0.9	-0.1	0.1
	(0.5)	(0.5)	(1.0)	(0.9)
2012×Treated	0.1	1.2	0.2	-0.1
	(0.7)	(0.9)	(1.1)	(1.0)
2013×Treated	-0.6	0.1	1.2	1.3
	(0.6)	(0.7)	(1.5)	(1.6)
2014×Treated	1.1	1.5*	0.8	0.5
	(0.8)	(0.9)	(1.2)	(1.1)
2015×Treated	19.4***	14.3***	-9.7***	-3.6*
	0.5	0.9	-0.1	0.1

Notes: The analytic sample contains 1,744 unique school-year observations, 50 unique districts, 302 unique elementary schools, and six academic years (2010-2015). Each column reports the coefficient estimates on the interactions between the "treated school" and year indicators from a unique event-study regression that controls for school and year fixed effects and time-varying school characteristics. Outcomes are school performance rates for both all students and for super-subgroup (high needs) students who are black, Hispanic, eligible for free or reduced-price lunch (FRL), have an individual education plan (IEP), or English language learners (ELL). Each row represents a different dependent variable: percent below basic or percent advanced, in math. Standard errors are clustered by school district. *** p<0.01, ** p<0.05, and * p<0.1.