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Abstract: In 2013, the Chicago Board of Education closed 47 elementary schools, directly affecting 13,000 students and 900 teachers. The closures created employment uncertainty for closed-school teachers, and this paper investigates the labor market consequences for teachers. We employ a difference-in-differences approach that compares the exit rates of closed-school teachers to teachers in schools that only experienced threat of closure. We estimate that the closures resulted in a near doubling of teacher exit among teachers in closed schools, particularly among low-performing teachers. We also find that, among closed-school teachers, Black teachers were more likely to return than White teachers. Given the nationwide trend of school closures for budgetary or performance reasons, this paper has implications for strategic retention of effective teachers.

Keywords: Urban Education, Educational Policy, Elementary Schools, Retention, Teacher Characteristics, School/Teacher Effectiveness, Descriptive Analysis, Policy Analysis, Regression Analyses, Secondary Data Analysis

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School Closures in Chicago: What Happened to the Teachers?

I. Introduction

At the beginning of the 2012-13 school year, Chicago Public Schools (CPS) announced that it would close a record number of under-enrolled elementary schools that also had low accountability ratings, making it one of the biggest school closure events in the country. The board slated 47 elementary schools for closure and designated 48 “welcoming schools” for the displaced students. This round of closures affected about 900 teachers and 13,000 students in closed schools and another approximately 1,000 teachers and 15,500 students in welcoming schools. While the magnitude of the closures in CPS was unique, across the country, many other urban school districts such as Detroit, Philadelphia, Washington, DC, Memphis, St. Louis, and New York have opted to close under-enrolled schools as a way to consolidate resources into fewer schools and move students into higher-performing options. Some of these districts have also experienced rapidly declining student enrollment coupled with depopulating neighborhoods where school capacity exceeds demand for the seats. In the city of Chicago, for example, the school-aged population declined by 20 percent between 2000 and 2015¹. As urban districts are likely to continue facing financial and performance challenges in the future, understanding the wide range of effects of school closings on students and teachers is important.

The body of literature on the effects of closures on students is growing, but there is little research on what happens to teachers in the aftermath of closures. We offer new contributions to the literature on school closures by unpacking what happened to teachers. In particular, this paper examines the association between mass school closures and the short-term and longer-term exit rates of CPS teachers. We also provide evidence of differential effects of closures on exit among different types of teachers. Our study asks:

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- 2
- 3 1. How did closures affect teacher exit from the school district both immediately following
- 4 the closures and five years later?
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- 8 2. What were the characteristics of the closed-school teachers who were more likely to exit?
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- 10 Were there heterogeneous effects of the closures on exit for different groups of teachers
- 11 (e.g., Black versus non-Black teachers, low-rated versus high-rated teachers)?
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15 We first establish the relationship between school closures and subsequent teacher exit,

16 finding that the closures resulted in an increase in exit among teachers in closed schools relative

17 to teachers in comparison schools by about 11 percentage points with 23 percent of closed-

18 school teachers leaving the district that year. The rehired teachers were, on average, of higher

19 quality than the closed-school teachers who left – they typically had higher value-added

20 measures and higher classroom observation scores and were more likely to be National Board

21 certified. The rehired teachers were also more likely to be Black relative to the teachers who left,

22 which is important given that the student and teacher populations in the closed schools were

23 disproportionately Black. However, when we look at exit from the district five years later, in the

24 longer-run closed-school teachers were as likely to have exited as teachers in comparison

25 schools, suggesting that the closures may have accelerated the exit of teachers who would have

26 left over the next few years even in the absence of closures. Further research is needed to explore

27 the long-term implications of the policy on displaced teachers. While we find that the

28 composition of the teaching force is altered by closures in a way that may offset some of the

29 negative effects on students, the increased short-term exit rates may challenge the work of

30 sustaining school improvement efforts.

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II. Prior Literature

We review the literature on two topics that offer useful perspective for examining the effects of closures on public school teachers in Chicago. We first describe the research evidence on the impact of school closings on students. We then turn to papers that explore teacher layoffs and rehires in other districts, and how these policies affect teacher exit. While the mass school closures in Chicago involved layoffs and rehires, the context of our study differs from these other settings in significant ways.

School Closures Literature

Prior research has been focused on the effects of closures on students who attended closed schools. In many cases, students experience a transitory shock to achievement (i.e., test scores) during the year that closures were announced, though students on average return to their pre-closure achievement trajectories even if they do not make up the initial learning losses (Gordon, de la Torre, Cowhy, Moore, Sartain, & Knight, 2018; Barrow, Park, & Schanzenbach, 2011; Bross, Harris, & Liu, 2016; Brummett, 2014; Engberg, Gill, Zamarro, & Zimmer, 2012; Larsen, 2014; Sacerdote, 2012; Steinberg & MacDonald, 2018; de la Torre and Gwynne, 2009). In cases where closed school students go on to attend schools with much higher levels of performance, there is evidence to suggest that student achievement, on average, improves (Barrow et al., 2011; Brummet, 2014; Engberg et al., 2012; Kemple, 2015; Steinberg & MacDonald, 2018; de la Torre & Gwynne, 2009).

Test score outcomes, however, only provide part of the picture of the short- and long-term impact of closures on students. Gordon et al., 2018 find no immediate effects on GPA, attendance, or the likelihood of being suspended after the 2012-13 round of closings in Chicago discussed in this paper, whereas Steinberg and MacDonald (2018) find an increase in absences

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3 and suspensions among students from closed schools in Philadelphia, especially as the distance
4 travelled to new schools increased.
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8 Qualitative findings have illustrated how closures affect students' social connections.
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10 Although the loss of students from CPS the year of closures was no greater than previous years,
11 students were inevitably forced to attend new schools (Gordon et al., 2018). Students who went
12 on to designated welcoming schools were more likely to maintain relationships from their closed
13 schools as their peers and teachers were more likely to relocate the same welcoming schools.
14
15 However, one-third of displaced students who reenrolled in CPS ended up choosing to attend a
16 different CPS school (Gordon et al., 2018), which suggests that they likely encountered a new set
17 of peers and teachers. Lastly, displaced students, who were mostly from historically
18 marginalized communities, expressed experiencing a deep sense of loss, in terms of critical
19 social ties and institutional memory, when their schools closed (Ewing, 2018).
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30 **Teacher Layoff and Rehire Literature**

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33 In the 2013 Chicago school closure context, all teachers from closed schools were laid off
34 and had to be rehired from an application pool. Per the district-union contract, tenured teachers
35 with high evaluation ratings were automatically entered into the rehiring pool while other
36 teachers had to take more steps to enter the pool. (We provide more details on the policy in the
37 next section.) In this section, we summarize the impact of two different types of layoff policies
38 on teacher mobility that offer a point of comparison to our study's context in CPS. We first look
39 at the evidence from reduction-in-force (RIF) layoffs in Charlotte-Mecklenberg Schools (CMS),
40 Los Angeles Unified School District (LAUSD), and Washington State. In these cases, teachers
41 were laid off based on pre-defined qualifications (e.g., effectiveness measures, seniority), which
42 differed from what happened in Chicago where all teachers from schools slated for closures were
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3 laid off regardless of their qualifications. However, the criteria for rehiring in these other
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5 contexts appeared to be similar to that of Chicago, such that laid-off teachers were prioritized for
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7 rehiring based on their qualifications and available open positions. We then examine the impact
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9 of layoffs associated with school closures in New Orleans and North Carolina. These settings are
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11 more similar to the Chicago context, as all teachers from closed schools were laid off and had to
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13 reapply for new positions.
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17 The existing research on RIF teacher layoffs provides findings state and district contexts
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19 where teachers were targeted for layoff due to budgetary shortfalls. In CMS, the district
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21 prioritized layoffs in the following order with performance-based indicators considered first:
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23 those who had low or unsatisfactory evaluation ratings, a licensure deficiency, collected pension
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25 benefits, part-time/interim status, a yearly contract, and length of service in the district. In Los
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27 Angeles and Washington State, RIF policies differed from CMS in many ways, but, perhaps
28
29 most importantly, in most cases years of experience in the district was the sole or primary
30
31 determinant for layoffs.
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35 Previous studies on these RIF policies show that layoffs altered the composition of the
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37 teaching workforce differently across these settings, likely related to the rules regarding the
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39 qualifications related to RIF receipt (i.e., based on years teaching versus based on evaluations or
40
41 other criteria). In CMS, laid-off teachers had, on average, lower principal evaluation scores and
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43 value-added measures than those not laid off (Kraft, 2015). Unlike in CMS, in LAUSD and
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45 Washington, the propensity to receive RIF notifications or exit teaching did not vary
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47 significantly by teacher effectiveness (Goldhaber, Strunk, Brown, & Knight, 2016; Goldhaber &
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49 Theobald, 2013). Looking at teacher experience, in CMS, RIF layoffs during the Great
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51 Recession resulted in the exit of a higher proportion of non-tenured teachers (Kraft, 2015), and in
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3 Washington teachers with more years of experience were less likely to receive a RIF notice and
4 (Goldhaber & Theobald, 2013). In research from LAUSD and Washington, more experienced
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6 teachers were more likely to switch schools in the face of RIF layoffs (Goldhaber et al. 2016). In
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8 summary, the teachers who were most prone to layoffs were the groups prioritized in the RIF
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10 policies.
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14 To contrast with position-targeted RIF policies, in other settings entire teacher
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16 populations were laid off due to school closures with teachers rehired based on vacancies the
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18 following school year. The studies of teacher labor market responses to school closures are most
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20 closely related to this paper. In New Orleans, all schools were closed after Hurricane Katrina and
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22 reopened under a decentralized school system, and all teachers were laid off and had to reapply
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24 to positions after the school system was restructured. We note that the New Orleans context was
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26 much more disruptive than in other contexts since the entire workforce of the district was laid off
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28 at once. To contrast, under No Child Left Behind, North Carolina closed schools over an
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30 extended period from 2002 to 2013.
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34 In New Orleans, only about one-third of the previously employed teachers returned to the
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36 new system (Lincove, Barrett, & Strunk, 2018). Whereas in North Carolina where a much
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38 smaller share of schools experienced closure in any given year, Hill and Jones (2019) find that
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40 teachers were about 6 percentage points more likely to leave the profession than in prior years,
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42 though they also found that teacher likelihood to switch schools increased in the year prior to the
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44 closures, which suggests that some teachers were anticipating closures.
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49 Both studies looked at how various teacher groups may have been differentially affected.
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51 In New Orleans, Black and White teachers were rehired in similar proportions, though rehired
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53 Black teachers were more likely to continue employment in New Orleans in the longer run
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3 (Lincove et al. 2018). However, teachers newly hired in New Orleans were more likely to be
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5 White (Barrett & Harris, 2015), changing the overall racial composition of the teacher
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7 workforce. In North Carolina, Black teachers were twice as likely to leave as White teachers
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9 (Hill & Jones, 2019). Regarding experience, in New Orleans non-tenured teachers and teachers
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11 with 25-plus years of experience were most likely to exit (Lincove et al. 2018), and in North
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13 Carolina more experienced teachers were much more likely to exit teaching than less
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15 experienced teachers (Hill & Jones, 2019). Finally, in North Carolina, teachers with high and low
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17 value-added measures were more likely to exit teaching than more typical-performing teachers
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19 (Hill & Jones, 2019).
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24 This paper adds to the literature on teacher exit and rehiring within the school closures
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26 context in particular. The Chicago setting provides a good opportunity to broaden our
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28 understanding of teacher labor market responses in the face of closures. Both Louisiana and
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30 North Carolina are “right to work” states, whereas Chicago has a strong teacher union presence,
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32 potentially offering teachers employed in closed schools more employment protections. Further,
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34 unlike with RIF policies, all teachers in the Chicago closed schools were laid off, and rules for
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36 rehiring were outlined in the district-union contract for teachers primarily based on seniority and
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38 evaluations. We look at what happened to teachers within a district over time when many schools
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40 were abruptly closed in one year as a single event with little or no teacher knowledge in advance.
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43 As Chicago and school districts around the country continue to use school closings as a strategy
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45 to address budget shortfalls and declining student enrollments, it is important to understand how
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47 this policy affects the teacher workforce.
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III. School Closures and Teacher Rehiring in Chicago

In this section, we detail the closures policy and the process by which CPS teachers were laid off and considered for rehire, including the process for new applicants to the district. We also discuss the circumstances surrounding the process that may have influenced the laid-off teachers' decisions, or ability, to reapply.

In October 2012, CPS released a set of rough guidelines outlining the district's policy for school closures, consolidations, reassignments, and phase-outs. Soon after, the district formed an independent commission that established a set of criteria for school closures (Weber, Farmer, & Donoghue, 2016). Three hundred and thirty schools were initially identified for closure because of under-enrollment. High schools were then removed from the list, as were under-enrolled elementary schools with high district accountability ratings, leaving a narrowed list of 129 schools subject to closure by February 2013. After a period of public input and hearings, in May 2013, the Chicago Board of Education voted to close 47 elementary schools and one high school program, which impacted about 13,000 students and 900 teachers. For a more detailed description of the closure policy, see Gordon et al., 2018. In this paper, we identify four mutually exclusive groups of schools each facing a different threat of closure: (1) closed schools (the elementary schools closed at the end of the 2012-13 school year), (2) under-enrolled and low-performing schools (those most at risk of closure but ultimately remained open), (3) under-enrolled schools with adequate levels of performance (those initially threatened), and (4) at-capacity schools (those never threatened).²

All teachers from the final list of closed schools received layoff notices from the district in June and July of 2013. These notices communicated that "many" of the dismissed teachers would "follow" students to their welcoming schools but did not provide further details about the

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3 process (CPS Office of Communications, 2013). The contract agreement between the district and
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5 the Chicago Teachers Union (CTU), however, established that dismissed tenured teachers with
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7 top evaluation ratings (“Superior” or “Excellent”)³ who had no breaks in service exceeding two
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9 years would receive preferential treatment for rehiring (Agreement, 2012). Closed schools
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11 teachers who were laid off and who met this criteria were placed on the “Teacher Eligibility
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13 List” only if they had submitted an online application verifying their desire to be reconsidered
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15 for rehire and had not already found full-time employment elsewhere in the district (e.g., hired
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17 into a different school, accepted a different position within CPS), resigned, or retired
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19 (Agreement, 2012). Under the contract, all other dismissed teachers who did not initially qualify
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21 for the eligibility list (e.g., non-tenured teachers), but who wanted to be considered for rehire,
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23 had to obtain statements of support from two administrators familiar with their teaching practice,
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25 and then participate in a screening interview either at a selection event (e.g., job fair) or with
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27 Board-selected administrators over the phone (Chicago Teachers Union, 2013).
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33 Once teachers were placed on the eligibility list, they were eligible to apply for vacancies
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35 within the district. Placement on the eligibility list, however, did not guarantee a position for the
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37 following school year. Under the contract, principals at welcoming schools were granted
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39 discretion over hiring. Principals with vacancies were encouraged to hire from the list but could
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41 interview multiple eligible candidates for each vacancy and decide against hiring any eligible
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43 teacher interviewed “within reason” (Agreement, 2012).
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47 Additionally, rehiring depended, in part, on student enrollment numbers, which were
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49 uncertain following school closures. Although families of displaced students were encouraged to
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51 enroll at their designated welcoming schools as early as possible, there was no deadline for them
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53 to do so or to notify the district if they chose to enroll elsewhere. By June 3, only 78 percent of
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3 displaced students enrolled in a new school for the 2013-14 academic school year, and 65
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5 percent of displaced students were enrolled at their designated welcoming school (Chicago
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7 Public Schools, 2013). Thus, new student enrollment numbers remained unclear until or after the
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9 start of the 2013-14 school year. This likely delayed new hiring at designated welcoming schools
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11 because principals could not be sure of what their need was or how their budgets would change
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13 until enrollment counts were clear.
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17 While we recognize that the rehiring policy favored tenured teachers with high evaluation
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19 ratings, teachers with National Board certification, and teachers with strong administrative
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21 support or district connection, we are unable to factor in teacher choice in the mobility patterns,
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23 which presents a limitation to the study. In the data we have access to, we cannot differentiate
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25 between teachers who chose to leave the district, teachers who tried to stay but were not rehired,
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27 and teachers who tried to stay but eventually left because their prospects of being rehired into a
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29 full-time position seemed unlikely. However, we know that high-rated tenured teachers had an
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31 advantage of being rehired under the contract, and this understanding informs our analysis.
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35 **IV. Data and Methodology**

36 **Data Description**

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38 We use longitudinal administrative and survey data maintained by the University of
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40 Chicago Consortium on School Research provided by CPS.
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44 ***Personnel Data***

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46 Longitudinal teacher personnel datasets are used for the 2008-09 school year through the
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48 2017-18 school year. The data allow us to track teachers within the school district over time with
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50 unique identification numbers. The personnel data include background information about teacher
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52 demographics, certification including National Board certification, level of education attained,
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3 and years of experience in CPS. The data also provide information about teaching assignment,
4 such as where teachers are employed, allowing us to know when a teacher switches schools
5 within the district or leaves the district entirely. We do not know, however, if a teacher leaves
6 CPS to teach in another school district. Of the closed-school teachers who left the district, we
7 also do not know which teachers attempted to be rehired after the closures versus those who did
8 not apply.
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16 *Teacher Quality Data*

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19 We have data generated by the teacher evaluation system in 2012-13 to provide more
20 information about teacher quality. The measures that we use include value-added measures in
21 reading and math (available for all grade 3-8 teachers who taught reading or math) and
22 classroom observation scores (indices generated from multiple classroom observations over the
23 course of the school year). We standardize classroom observation scores. When characterizing
24 teacher quality in this paper, we use these evaluation measures as well as more traditional
25 measures of quality like having National Board certification or a graduate degree.
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35 *School-level Data*

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38 Using the student-level data, we also aggregate information to the school level to
39 construct measures of racial/ethnic composition, gender composition, the share of students with
40 IEPs, and average achievement. We also construct a count of the number of students in the
41 school in order to account for student enrollment (in log terms).
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47 *Information about School's Closure Status*

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49 Finally, we designate teachers as teaching in closed, under-enrolled and low-performing,
50 under-enrolled, or at-capacity schools. Teachers in at-capacity schools never experienced threat
51 of closure in 2012-13. Teachers at under-enrolled schools initially experienced threat of closure
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3 when the district first made the announcement at the beginning of 2012-13. Teachers at schools
4 there were under-enrolled and low-performing continued to experience threat of closure over the
5 course of the school year until May 2013 but ultimately remained open. Lastly, teachers at closed
6 schools worked in such schools until the end of the school year.
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11 **Methodology**

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14 In this paper, we describe what happened to CPS teachers in the immediate aftermath of
15 the largest single school closures event in the country. We first characterize the teacher
16 populations based on their school's threat of closure. We then show how exit rates differ
17 between teachers based on their school's closure status immediately following the mass closures
18 and five years afterward. We then examine the extent to which the school closures caused
19 changes in teacher exit from CPS. Finally, we examine the teacher characteristics that were
20 correlated with a closed schoolteacher's likelihood of exit, and whether or not the effects of
21 closures on exit was heterogeneous across teacher groups.
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32 *Analysis of Teacher Exit*

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35 To understand more formally how school closings influenced teacher exit from the
36 district, we implement two approaches. First, we use linear and non-linear multivariate
37 regression models to predict whether or not a teacher exited the district at the end of 2012-13 as a
38 function of the type of school a teacher worked in (e.g., closed; under-enrolled and low-
39 performing). We build that model to include teacher characteristics that might be related to the
40 type of school in which a teacher worked, such as teacher turnover. We then add school
41 characteristics to the model to account for differences across school types. We estimate
42 regressions using both linear and non-linear models and find our results to be consistent across
43 both types of specifications. The coefficients for the linear probability models (LPM) can be
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3 interpreted as changes in probability of exit relative to the omitted group. The full model is
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5 specified as:

$$6 \quad (1) \textit{Exit}_{isg} = \alpha + \delta_g' \mathbf{ClosureGroup}_{isg} + \phi' \mathbf{X}_i + \pi' \mathbf{S}_s + \varepsilon_{isg},$$

7
8 where \textit{Exit}_{isg} is an indicator variable that equals 1 if teacher i from school s belonging to closure
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10 group g exits the district at the end of 2012-13. The parameters of interest are in the vector δ_g and
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12 indicate the likelihood of exit by a teacher's school's closure status: schools ultimately closed,
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14 under-enrolled and low-performing schools, and under-enrolled schools. The omitted group
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16 includes teachers in schools that were never at risk of closure. We control for a vector of teacher
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18 characteristics, \mathbf{X} , to adjust for differences in teacher composition across the school closure
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20 groups, including gender, race/ethnicity, years of experience teaching in CPS, tenure status,
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22 National Board Certification attainment, and graduate degree attainment. We similarly include a
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24 vector of school characteristics, \mathbf{S} , including the racial and gender makeup of the student body,
25
26 the percent of students qualifying for free or reduced-price lunch, the number of students
27
28 enrolled, and the previous year's average student performance level in math. We only include
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30 prior performance in math as it is highly correlated with prior performance in reading and
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32 therefore do not include both subjects. The random error term is represented by ε_{isg} .
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41 Second, we take advantage of the panel nature of the data where we observe teachers,
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43 their school placements, and their exit decisions over multiple years prior to the closures
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45 beginning in 2008-09. We exploit the fact that teachers in closed schools were directly subject to
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47 the district's mass layoffs and rehiring, while teachers in other schools were not. We also take
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49 advantage of the fact that the closures were not known in advance and the final closure list was
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51 not announced until the end of the 2012-13 school year, suggesting that teachers could not be
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53 responding to the closures in the previous school years. Using a difference-in-differences
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strategy, we compare the likelihood of exit for teachers in different school types over time. This approach allows for teachers in schools at different risks of closure to have different likelihoods of exit, and we test for deflections from those likelihoods the year of the closures compare to years prior to the closures. The full model is estimated as a LPM:

$$(2) \text{Exit}_{isgt} = \alpha + \beta' \text{ClosureGroup}_{isg} + \theta' \text{Year}_t + \delta' \text{ClosureGroup}_{isg} * \text{Year}_t + \phi' \mathbf{X}_{it} + \pi' \mathbf{S}_{st} + \varepsilon_{isgt}$$

Where Exit_{isgt} equals 1 if teacher i in school s , which is classified as belonging to one of the four groups of schools according to their threat of closure g , exits the district at the end of year t . The **ClosureGroup** vector indicates the school's threat of closure (g = closed, under-enrolled and low-performing, or under-enrolled) with the omitted group being at-capacity schools. This allows for different probabilities of exit for teachers in each group of schools. We also include a **Year** vector to allow for different labor market conditions each year, and in particular the year of the closures. The omitted year is always the 2011-12 school year, which is the year prior to the closures. The **ClosureGroup** and **Year** vectors are interacted to capture different rates of exit for teachers in the different groups of schools in each year. We include the same vectors of teacher and school characteristics as in equation (1), though we allow these to be time varying in equation (2). In a variation of equation (2), we include school fixed effects instead of school characteristics. In this specification, we do not estimate coefficients for variables that do not change overtime within school, particularly β . The random error term is represented by ε_{isgt} .

The $\hat{\delta}$ for 2012-13 are the estimated parameters of interest and represent the impact of closures on teacher likelihood of exit in 2012-13 for each threat-of-closure group. For instance, $\hat{\delta}_{\text{closed},2012-13}$ represents the estimated change in the likelihood of exit in 2012-13 for teachers in closed schools relative to teachers in at-capacity schools, after adjusting for any differences in

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3 teacher and school characteristics across those two groups of schools. There are additional
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5 comparisons that are of interest. First, testing whether $\hat{\delta}_{closed,2012-13}$ equals $\hat{\beta}_{closed}$ will tell us if the
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7 probability of exit for closed-school teachers differed in 2012-13 from the probability of exit for
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9 closed-school teachers in the years prior to the closures. Second, testing whether $\hat{\delta}_{closed,2012-13}$
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11 equals $\hat{\delta}_{under-enrolled/low-performing,2012-13}$ (or $\hat{\delta}_{under-enrolled,2012-13}$) will tell us whether or not the
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13 probability of exit for closed school teachers in 2012-13 differed from the probability of exit for
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15 teachers in under-enrolled and low-performing schools (or under-enrolled schools) in 2012-13.
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19 In order to interpret these comparisons as the causal effect of school closures on the
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21 probability of teacher exit, we must make assumptions that teachers in closed schools would
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23 have exited at similar rates to teachers in the under-enrolled and low-performing schools, for
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25 example, in the absence of closures after taking into account any baseline differences in the
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27 probability of exit for those two groups of teachers. The key test of this assumption in a
28
29 difference-in-differences strategy is that the trend in exit rates for closed-school teachers is
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31 parallel to the trend in exit rates for teachers in the under-enrolled and low-performing schools.
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33 We provide evidence that this test holds in Figure 1, which shows the trends in exit rates for
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35 teachers in schools at different risks of closure leading up to 2012-13. The exit rate for teachers
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37 in closed schools tends to follow the patterns in exit for teachers in all other types of schools, and
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39 the trend most closely follows the teachers in under-enrolled and low-performing schools that
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41 were not closed. Further, in all years prior to the closures there is not a statistically significant
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43 difference in the exit rate, or the change in exit rate, for teachers at schools that were ultimately
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45 closed and teachers at schools that were on the narrowed list. For these reasons, we believe the
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47 likelihood of exit for teachers in the under-enrolled and low-performing schools are a
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49 particularly good counterfactual for the predicted exit behavior of teachers in closed schools had
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they not been subject to closures, though the trends in teacher exits for the other groups of schools are also parallel leading up to the closures.⁴ We also want to acknowledge another potential threat to causality: if there was another policy change or disruption that occurred at the same time as the closures that disproportionately affected teacher exit decisions in closed schools, then we are at risk of overstating the role of closures on teacher exit. However, we are not aware of any such potential occurrence.

Finally, we describe the association between teacher characteristics and the likelihood of exit from the district. We start by restricting the sample to teachers employed in the closed schools in 2012-13, the year leading up to the closures. Then, we predict the likelihood of exit with a variety of teacher characteristics. We also explore heterogeneities in the effect of closures on the probability of teacher exit for different groups of teachers using the same model presented in equation (2). Specifically, we look at these different comparisons: Black vs. White teachers, tenured vs. non-tenured teachers, and teachers with the lowest evaluation ratings vs. other teachers. The model we estimate is:

$$(3) \quad \text{Exit}_{isgt} = \alpha + \mu_1 * \text{TeacherType}_i + \beta' \text{ClosureGroup}_{isg} + \theta' \text{Year}_t + \delta' \text{ClosureGroup}_{isg} * \text{Year}_t + \gamma' \text{TeacherType}_i * \{\beta' \text{ClosureGroup}_{isg} + \theta' \text{Year}_t + \delta' \text{ClosureGroup}_{isg} * \text{Year}_t\} + \phi' X_{it} + \pi' S_{st} + \varepsilon_{isgt}$$

where the variables are as described in equation (2) with the addition of TeacherType_i , which equals 1 if a teacher belongs to a group of interest (i.e., Black, non-tenured, low-performing, each in separate regressions). TeacherType_i is then interacted with the ClosureGroup , Year , and $\text{ClosureGroup} * \text{Year}$ vectors, allowing for different exit rates for specific types of teachers across school types and in different years. The estimated differential effect of closures on the exit of a specific type of teacher, compared to the omitted teacher type, is represented by $\widehat{\gamma} \delta_{\text{closed}, 2012-13}$. As in equation (2), the omitted year is 2011-12, the year prior to the closures.

V. Results

In this section, we present descriptive information about the composition of teachers in each school group the year leading up to the closures. We then provide results from the analyses aimed at addressing the research questions in this paper. Specifically, we present the exit rates of teachers by school group pre-closure, immediately post-closure, and five years post-closure. Finally, we show the difference-in-differences estimates of the effect of closures on teacher exit and whether or not these estimated effects varied across different teacher groups.

Sample Description

Table 1 includes descriptive statistics for the four mutually exclusive groups of teachers during the 2012-13 school year: (1) closed schools, (2) under-enrolled and low-performing schools, (3) under-enrolled schools, and (4) at-capacity schools. Teachers working in the closed schools generally looked similar to teachers in under-enrolled and low-performing schools, but vastly differed from teachers at the other elementary schools in the district. For example, 52 percent of teachers at closed schools were Black compared to 57 percent at the under-enrolled and low-performing schools, 38 percent at the under-enrolled schools, and 11 percent at the at-capacity schools. Whereas 6 percent of teachers at the at-capacity schools held National Board Certification, only 4 percent of teachers at closed schools and at under-enrolled and low-performing schools did. Over three-quarters of closed-school teachers were tenured (76 percent), which was very slightly lower but generally similar to the share of tenured teachers in other schools.

When looking at teacher quality measures from the evaluation system, value-added measures for math and reading were lower on average for teachers at closed schools than for teachers at the non-closed schools. On average, teachers in closed schools had math value-added

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3 measures that were about one-third of a standard deviation lower than teachers at under-enrolled
4 and low-performing schools. Their reading value-added measures were, on average, about two-
5 fifths of a standard deviation lower than teachers at under-enrolled and low-performing schools
6 and about one-half of a standard deviation lower than those at at-capacity schools. Further,
7 classroom observation scores were lower on average for teachers in closed schools than for
8 teachers at at-capacity schools, but higher on average than those at under-enrolled and low-
9 performing schools. While the differences in value-added measures are to be expected given that
10 the district identified schools for closure based on under enrollment and low academic
11 performance, the differences in observation scores may be because of variability in the
12 evaluation system or because the observation-based measures of teacher practice pick up on
13 different aspects of teacher quality than test score-based measures.
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28 Figure 1 illustrates teacher exit trends from the district by school closure status in the
29 years leading up to the closures and the year of the closures. Closed-school teachers and under-
30 enrolled and low-performing school teachers had similar exit rates pre-closure. Teachers at
31 under-enrolled and at-capacity schools had slightly lower exit rates. However, the trends in exit
32 rates for teachers in all four school groups were generally similar leading up to the closures.
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40 Figure 2 illustrates the proportion of teachers who exited the district after the 2012-13
41 closures by school closure status and for different groups of teachers. Overall, 23 percent of
42 closed-school teachers did not return compared to 14 percent of teachers in under-enrolled and
43 low-performing schools. When comparing across teacher groups, closed-school teachers who
44 were non-tenured and who received the lowest evaluation score exited CPS at the highest rates –
45 32 percent and 31 percent, respectively – whereas those who were tenured, assigned average or
46 high evaluation scores, and Black had the lowest rates of exit from the district at 20 percent.
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3 While Black teachers at closed schools left the district at a lower rate than non-Black teachers, it
4 is important to note that Black teachers made up a higher proportion of the teaching staff at both
5 closed schools and under-enrolled and low-performing schools (see Table 1) than districtwide.
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8 **Association between Schools Closures and Teacher Exit**

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10 Table 2 compares the likelihood of exit for teachers in different school types immediately
11 after school closures and at any point within five years of the closures. Column (1) shows results
12 from a linear probability model where teachers in at-capacity schools serve as the omitted group.
13 Results in columns (2) and (3) adjust for teacher characteristics and then teacher and school
14 characteristics. The first three rows of each table compare the likelihood of exit between teachers
15 who experienced actual, or threat of, closure with teachers in at-capacity schools never
16 threatened. The likelihood of immediate exit from CPS after closures was significantly higher for
17 teachers at schools that experienced threat of, or actual, closure compared to those at at-capacity
18 schools. The model that includes both teacher and school characteristics shown in Column (3)
19 estimates that teachers at closed schools had a 9.7-percentage point greater likelihood of leaving
20 than teachers at at-capacity schools and an 8.5-percentage point greater likelihood of leaving
21 than teachers at under-enrolled and low-performing schools. Table 2 also shows the statistical
22 test that the change in exit among teachers in closed schools equals the change in under-enrolled
23 and low-performing and under-enrolled schools. We find that exit was higher among closed-
24 school teachers than for other groups of teachers, and those differences were statistically
25 significant. Appendix Table 1 shows parallel results using a Cox proportional hazards model.
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49 When looking at the likelihood of longer-term exit (i.e., exit at any point within five years
50 of the closures) in Columns (4)-(6) Table 2, a different pattern emerges. We find that closed-
51 school teachers were 4.9 percentage points more likely to exit after five years of closures than
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3 teachers in at-capacity schools. However, there is no longer a statistically significant difference
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5 between exit of teachers in closed schools and under-enrolled and low-performing or under-
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7 enrolled schools. This finding provides evidence that the closures may have accelerated the exit
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9 of teachers who would have ultimately left the district over the next five years even in the
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11 absence of closures. While interesting, we note that this evidence is suggestive because teachers
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13 in under-enrolled and low-performing schools may have been negatively affected by the closures
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15 in subsequent years to the extent that those schools were disrupted by influxes of new students
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17 and new teaching staff from the closed schools, as well as by the challenges of merging two
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19 populations.
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24 Table 3 shows the estimates of the effect of closures on teacher exit using the panel data
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26 approach. Teachers who worked in closed schools in 2012-13 serve as the treatment group, while
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28 teachers who worked in other types of schools serve as the comparison groups (with at-capacity
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30 schools serving as the omitted group). Column (1) presents the estimated effects using the basic
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32 model with no control variables. Columns (2) – (4) factor in teacher characteristics, teacher and
33
34 school characteristics, and then teacher characteristics and school fixed effects, respectively. The
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36 first three rows show the likelihood of teacher exit from CPS in the years prior to the closures,
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38 relative to teacher exit in at-capacity schools. For example, comparing the estimates in the rows
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40 labeled “Closed school” and “Under-enrolled and low-performing school,” suggests that teachers
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42 in these two types of schools had similar exit rates prior to the closures.
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47 The next set of rows includes the interaction effect of the school’s threat of closure and
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49 the year of closures, 2012-13. The analysis indicates that school closures increased the
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51 probability of exit from the district by about 13 percentage points relative to teachers in at-
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53 capacity schools and about 11 percentage points relative to teachers under-enrolled and low-
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3 performing schools. This effect is statistically significant and consistent in magnitude across all
4 variations of the model. Comparing exit rates among closed-school teachers over time, there is
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6 also a large and statistically significant difference in the likelihood that closed school teachers
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8 exited the year of the closures when compared to earlier years. That difference is similar in
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10 magnitude, a 10-12 percentage point increase, depending on the model specification.
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14 We implement various checks to ensure that our difference-in-differences estimates are
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16 robust to a number of assumptions and model specifications. The results from these robustness
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18 checks are presented in the appendix and described briefly here. Appendix Table 2 shows results
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20 of placebo regressions in which we compare the exit rates among teachers in the different school
21
22 closure groups in the three years prior to the closures, adjusting for differences in teacher and
23
24 school characteristics. In each year, we do not find statistically significant differences in the
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26 likelihood of exit for teachers in each of the different types of schools. Results from this table
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28 also suggest that, after adjusting for any differences in teacher and school characteristics, the pre-
29
30 closure exit rates across the school groups were similar. Appendix Tables 3-5 are similar to the
31
32 difference-in-differences estimates shown in Table 3 but provide different sample restrictions.
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34 Appendix Table 3 limits the sample to just teachers in closed schools and under-enrolled and
35
36 low-performing schools with the assumption that the other groups of teachers are less directly
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38 comparable. Appendix Table 4 presents results when the analysis is done at the school level,
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40 rather than the teacher level, and we restrict the analysis to schools that were open for the
41
42 complete period. We do this analysis to address concerns of any changes in the sample of
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44 schools and concerns that teachers were entering and exiting the sample prior to the closures.
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46 Appendix Table 5 uses alternative comparison groups, comparing exit of teachers in closed
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3 schools to teachers in the district’s designated welcoming schools and non-closed/non-
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5 welcoming schools.
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8 Importantly, we find very consistent estimates of the closures on teacher exit. Across all
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10 of the specifications and sample restrictions presented in the paper and the appendix, and in the
11
12 descriptive regressions and raw data, the effect of closures on teacher exit indicates an
13
14 approximately 50 percent increase in exit over years past and when compared to teachers in
15
16 various comparison schools.
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18 19 **Heterogeneous Effects on Teacher Exit** 20

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22 In this section, we describe which closed-school teachers returned to the district
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24 compared to those closed-school teachers who left and investigate whether the closures resulted
25
26 in differential exit for various groups of teachers. Table 4 illustrates where closed-school
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28 teachers went the year after school closures, specifically by placement status. Out of 866 closed-
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30 school teachers, 23 percent left the district, 44 percent were rehired into welcoming schools, and
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32 23 percent were rehired into non-welcoming schools. We see that teachers rehired into
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34 welcoming schools were relatively more likely to be Black (58 percent) compared to those who
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36 left (46 percent) and those who were hired into other CPS schools (44 percent). Rehired closed-
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38 school teachers at welcoming schools had, on average, more years of teaching experience (13.4
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40 years) than those rehired into non-welcoming schools and those who left the district (9.4 years
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42 and 9.0 years, respectively). We also find that those rehired into the district were of higher
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44 quality by a number of measures than those who left – closed school teachers who left CPS had,
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46 on average, lower value-added measures and classroom observation scores and were less likely
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48 to hold National Board certification than their peers who returned.
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3 We also model this statistically by predicting exit only among closed-school teachers
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5 with a variety of teacher characteristics to understand if some teachers were more or less likely to
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7 return to the district conditional on having been in a closed school in 2012-13. These results are
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9 shown in Table 5. Teacher race, tenure status, National Board Certification, and having low
10
11 performance ratings were all statistically significant predictors of the likelihood that a closed-
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13 school teacher left CPS. Specifically, Black teachers were 7 percentage points less likely to exit
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15 CPS compared to White/Asian/other teachers. Likewise, exit among tenured teachers was 9
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17 percentage points lower than among non-tenured teachers. As we saw in Table 4, there is
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19 evidence that lower-performing, or less-qualified, teachers were more likely to exit the district.
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21 Teachers with National Board certification were 12 percentage points less likely to exit than their
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23 non-certified peers, and teachers with low evaluations were 8 percentage points more likely to
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25 exit than other teachers.
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31 Finally, we apply the same difference-in-differences framework to estimate whether there
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33 was a causal effect of the closures on teacher exit that varied by teacher group. These results are
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35 shown in Table 6 where each column represents results from separate regressions focused on
36
37 different teacher group comparisons. While Black teachers in closed schools were 3.5 percentage
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39 points less likely to exit in 2012-13 compared to White teachers, this difference is not
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41 statistically significant. Similarly, tenured teachers in closed schools were 4.3 percentage points
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43 less likely to exit in 2012-13 compared to non-tenured teachers, but this difference is also not
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45 statistically significant. We do, however, find statistically significant evidence that the closures
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47 resulted in disproportionate exit among teachers with low evaluations. Closed-school teachers
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49 with low evaluation ratings were 9.4 percentage points more likely to exit than higher-rated
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51 teachers. Taken together, these findings suggest that the closures did not differentially induce
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3 Black teachers to exit the district, but the closures likely resulted in the increased exit of low-
4 performing teachers.
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7 8 **VI. Discussion** 9

10 In this paper, we empirically examine the relationship between mass school closures and
11 teacher attrition in a large, urban district. We find that the 2013 closure of 47 elementary schools
12 in Chicago increased the likelihood of teacher exit from the district, particularly among lower-
13 performing, less-qualified teachers. Rehired closed-school teachers had, on average, more years
14 of experience and higher classroom observation ratings than those who left, and they were also
15 more likely to hold National Board certification and graduate degrees. While the district-union
16 contract in Chicago favored rehiring teachers with more years of experience and higher
17 evaluation ratings, the retention of higher-quality teachers appears to be an unintentional
18 consequence rather than a strategic effort because the evaluation system used at the time
19 provided very little differentiation between higher- and lower-quality teachers. However,
20 retaining higher-quality teachers may have helped to ameliorate or minimize the negative effects
21 on students of closing schools and relocating students. As such, districts may want to consider
22 policies outlining preferential rehiring in order to have a better chance of retaining the most
23 effective teachers.
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42 This policy implication is backed up by the research on RIF layoffs, which shows that
43 policies prioritizing the layoff of less effective teachers rather than simply teachers with the
44 fewest years of service have the potential to retain higher-quality teachers (Kraft, 2015;
45 Goldhaber & Theobald, 2013). The ability of schools and districts to implement such policies is
46 likely even more promising following Race to the Top evaluation reforms that have led to the
47 inclusion of a wider array of teacher practice measures. Namely, these evaluation systems may
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3 now provide district and school-hiring decision makers with better evidence to inform layoff and
4 rehiring policies with the goal of retaining the most effective teachers in the face of these kinds
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6 of layoffs.
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10 A particular concern in Chicago was that school closures disproportionately affected
11 Black teachers and students. Indeed, closed schools served student populations that were
12 majority Black and were more likely to be staffed by Black educators. However, when looking at
13 closed-school teachers, we find that Black teachers were more likely to be rehired in CPS than
14 White teachers. A shortcoming to note is that we cannot differentiate teachers who sought new
15 positions in CPS and were not rehired from those who did not seek new positions in the district
16 or how that may have varied by teacher race. For example, our finding that Black teachers were
17 more likely than White teachers to be rehired in CPS could reflect that Black teachers were more
18 likely to seek reemployment in CPS, whereas White teachers were more likely to seek positions
19 in other districts or outside of teaching entirely. To contrast, if Black teachers and White teachers
20 sought reemployment at similar rates, then perhaps hiring principals were looking to staff their
21 schools with Black teachers who would likely better match the demographics of the student
22 body, particularly in welcoming schools. This hiring approach would be consistent with the
23 growing literature on the benefits of students having educators of the same race (Dee, 2004; Dee,
24 2005; Egalite & Kisada, 2018; Egalite, Kisida & Winters, 2015; Gershenson, Hart, Hyman,
25 Lindsay, & Papageorge, 2018; Lindsay & Hart, 2017).
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46 The evidence from other school closure research on the differential labor market effects
47 for Black and non-Black teachers may provide some insights as well. Lincove et al (2018)
48 hypothesized that White teachers in New Orleans were better positioned to escape the potential
49 instability of employment in a district undergoing major restructuring, whereas Hill and Jones
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3 (2019) suggest that Black teachers may have experienced discrimination in the North Carolina
4 teacher labor market and were more likely to be “first fired and last hired.” In the North Carolina
5 paper, the authors also find that Black teachers were more likely to leave increased with the
6 share of White student in the district. This may suggest that teachers themselves have
7 preferences over race congruence, so Black teachers in Chicago may have been more likely to
8 seek reemployment, particularly in the welcoming schools which were more likely to serve
9 Black student populations. Ultimately, districts may want to consider practices that maintain both
10 the diversity and quality of its teaching force in face of closures, and scholars should continue
11 raising questions about differences in available employment opportunities for educators of
12 different races.
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26 Questions remain about the stability of teacher employment after closures in the long run.
27 We find that teachers from closed schools were as likely to be in the district five years after the
28 closures as teachers in under-enrolled and low-performing schools that were threatened with
29 closure but remained open. On the one hand, this evidence suggests that closures may have
30 accelerated the exit of teachers who would ultimately have left the district over the next five
31 years anyway. On the other hand, the closures may have affected the stability of teachers in the
32 comparison group schools over the long term. If teachers in the schools that remained open felt
33 the aftermath of the closures due to changes in student populations or working conditions, the
34 effects of closures on teacher mobility may be greater than what is shown in this paper. Future
35 research should further explore the long-term effects of closures on teacher attrition and quality,
36 and faculty hiring and layoff policies that can help mitigate any negative effects of closures on
37 student achievement.
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3 The merging of closed and welcoming schools can result in tensions among teachers
4 (Gordon et al., 2018), as well as a shuffling of teachers that may be detrimental to both students
5 and the schools. Prior studies have found that changes in teaching assignments and persistent
6 churn can negatively affect student achievement, teacher perception of their schools and their
7 decision to stay, and the organizational capacity of schools (e.g., Atteberry, Loeb, & Wyckoff,
8 2017; Gordon et al., 2018; Ost & Schiman, 2015). Districts may therefore wish to implement
9 policies that would ease the transition for rehired teachers and minimize subsequent changes that
10 would negatively affect teachers' capacity to support students and contribute to their new
11 schools. For example, one consideration may be to match incoming teachers to similar teaching
12 assignments and/or to students they have worked with at their closed school. Although we do not
13 examine changes in teaching assignment associated with school closures in this paper, future
14 research should consider how such experiences may impact teacher effectiveness and mobility.
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30 Closing schools inevitably leads to a shuffling of teachers within and out of districts, as
31 well as uncertainty and anxiety about employment security. From the growing body of literature
32 on layoffs due to budgetary constraints, we know the policies and contracts that outline the
33 qualifications or characteristics of teachers who are the first to be laid off or who receive
34 preference for new placements matter. As districts face declining student enrollment and
35 consider the closure of schools or reduction in the teaching force as a strategy to consolidate
36 resources, special attention should be paid to layoff and rehire policies in order to retain the
37 teachers who are most likely to have positive effects on the lives of students.
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Endnotes

1. Author calculations from Census and American Community Survey data.
2. CPS designated welcoming schools were most often schools that experienced threat of closure, whereas unaffected schools - those that were neither designated to be closed or welcoming schools – were most often at-capacity schools.
3. During the year of the closure, CPS transitioned to a new evaluation system that established criteria for observations, required more classroom observations, and included student data in the evaluation of teacher performances. However, the evaluation score criterion for rehire eligibility defined in the contract looked only at the old evaluation system which was solely based on principal evaluations conducted without an observation rubric (Jiang & Spote, 2016). Teachers did not have access to the new evaluation data or ratings until well into the fall of 2013 after they had already made labor market decisions. According to Sartain, Stoelinga, & Brown (2011), almost all teachers under the old system, which provided little differentiation between teachers, received high marks. For the purposes of this paper, we use effectiveness measures from the new evaluation system, but the rehire policy used the old evaluation system. We do not have access to the evaluation ratings from the old system.
4. An alternative comparison is closed-school teachers to welcoming-school teachers. We are concerned that the exit of welcoming-school teachers in the wake of the closures might be endogenous, as they are also potentially affected by the closures since their schools were to absorb the closed-school students. However, we do not see graphical evidence of this concern (see Appendix Figure 1). Regardless, we include the estimates using the threat of closure groups in the main paper.

References

- Agreement between The Board of Education of the City of Chicago and Chicago Teachers Union Local 1, American Federation of Teachers, AFL-CIO (2012). Retrieved from https://www.ctunet.com/for-members/text/CTU_Contract_As_Printed_2012_2015.pdf
- Atteberry, A., Loeb, S., & Wyckoff, J. (2017). Teacher churning within schools: Impacts on student achievement. *Education Evaluation and Policy Analysis*, 3(1): 3-30.
- Barrett, N. & Harris, D. (2015). *Significant Changes in the New Orleans Teacher Workforce*. New Orleans, LA: Educational Research Alliance for New Orleans.
- Barrow, L., Park, K., & Schanzenbach, D.W. (2011). Assessing the impacts on students of closing persistently failing schools (Working Paper).
- Bross, W., Harris, D. N., & Liu, L. (2016). *The Effects of Performance-Based School Closoure and Charter Takeover on Student Performance*. New Orleans, LA: Educational Research Alliance for New Orleans.
- Brummet, Q. (2014). The effect of school closings on student achievement. *Journal of Public Economics*, 119: 108-124.
- Chicago Public Schools. (2013, June 3). Parents enroll 78 percent of students during early enrollment for new schools. Retrieved from https://cps.edu/News/Press_releases/Pages/PR1_06_03_2013.aspx
- Chicago Public Schools Office of Communications. (2013). *CPS Fact Check On Consolidating Underutilized Schools* (Press Release). Retrieved from http://blogs.edweek.org/edweek/District_Dossier/3.27.13%20CPS%20Fact%20Check%20On%20Consolidating%20Underutilized%20Schools.pdf
- Chicago Teachers Union. (2013, June). Teacher Quality Pool. Retrieved February 26, 2018, from <https://www.ctunet.com/rights-at-work/know-your-rights/teacher-quality-pool>
- Dee, T.S. (2004). Teachers, race and student achievement in a randomized experiment. *The Review of Economics and Statistics*, 86(1): 195-210
- Dee, T.S. (2005). A teacher like me: Does race, ethnicity, or gender matter? *The American Economic Review*, 95(2):158-165.
- Egalite, A. J., & Kisida, B. (2018). The effects of teacher match on students' academic perceptions and attitudes. *Educational Evaluation and Policy Analysis*, 40(1), 59-81.
- Egalite, A., Kisida, B., & Winters, M. (2015). Representation in the classroom: The effect of own-race teachers on student achievement. *Economics of Education Review*, 45, 44-52.

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3
4 Engberg, J., Gill, B., Zamarro, G., & Zimmer, R. (2012). Closing schools in a shrinking district:
5 Do student outcomes depend on which schools are closed? *Journal of Urban Economics*,
6 71(2):189–203.
7
8
9 Ewing, E. (2018). *Ghosts in the Schoolyard: Racism and School Closings on Chicago's South*
10 *Side*. Chicago and London: University of Chicago Press.
11
12
13 Gershenson, S., Hart, C., Hyman, J., Lindsay, C., & Papageorge, N. (2018). The long-run
14 impacts of same-race teachers. NBER Working Paper (No. 25254).
15
16
17 Goldhaber, D., Strunk, K.O., Brown, N., Knight, D.S. (2016). Lessons learned from the Great
18 Recession: Layoffs and the RIF-induced teacher shuffle. *Educational Evaluation and*
19 *Policy Analysis*, 38(3):517-548.
20
21
22 Goldhaber, D., & Theobald, R. (2013). Managing the teacher workforce in austere times: The
23 determinants and implications of teacher layoffs. *Education Finance and Policy*, 8, 494–
24 527.
25
26
27 Gordon, M.F., de la Torre, M., Cowhy, J.R., Moore, P.T., Sartain, L.S., & Knight, D. (2018).
28 School closings in Chicago: Staff and student experiences and academic outcomes.
29 Chicago, IL: University of Chicago Consortium on School Research.
30
31
32 Hill, A. J., & Jones, D. B. (2019). The effect of school closings on teacher labor market
33 outcomes and teacher effectiveness. Working paper retrieved from author's website.
34
35
36 Jiang, J.Y., & Spote, S.E. (2016). *Teacher Evaluation in Chicago: Differences in Observations*
37 *and Value-Added Scores by Teacher, Student, and School Characteristics*. Chicago, IL:
38 University of Chicago Consortium on School Research.
39
40
41 Kemple, J. (2015). *High School Closures in New York City: Impacts on Students' Academic*
42 *Outcomes, Attendance, and Mobility*. New York, NY: The Research Alliance for New
43 York City Schools.
44
45
46 Kraft, M. A. (2015). Teacher layoffs, teacher quality, and student achievement: Evidence from a
47 discretionary layoff policy. *Education Finance and Policy*, 10(4): 467-507.
48
49
50 Larsen, M. F. (2014). Does Closing Schools Close Doors? The Effect of High School
51 Closings on Achievement and Attainment. Retrieved from
52 http://www.tulane.edu/~mflarsen/uploads/2/2/5/4/22549316/mflarsen_schoolclosings.pdf
53
54
55 Lincove, J. A., Barrett, N., & Strunk, K. O. (2018). Lessons from Hurricane Katrina: The
56 employment effects of the mass dismissal of New Orleans Teachers. *Educational*
57 *Researcher*, 47(3): 191-203.
58
59
60

- 1
2
3 Lindsay, C., & Hart, C. (2017). Exposure to same-race teachers and student disciplinary
4 outcomes for black students in North Carolina. *Educational Evaluation and Policy*
5 *Analysis*, 39(3), 485-510.
6
7
8 Ost, B., & Schiman, J.C. (2015). Grade-specific experience, grade reassignments, and teacher
9 turnover. *Economics of Education Review*, 46, 112-126.
10
11 Sacerdote, B. (2012). When the saints go marching out: Long-term outcomes for student
12 evacuees from hurricanes Katrina and Rita. *American Economic Journal: Applied*
13 *Economics*, 4(1): 109-135.
14
15
16 Sartain, L., Stoelinga, S., Brown, E., et al. (2011). Rethinking Teacher Evaluation in Chicago:
17 Lessons Learned from Classroom Observations, Principal-Teacher Conferences, and
18 District Implementation. Chicago, IL: University of Chicago Consortium on School
19 Research
20
21
22 Steinberg, M.P., & MacDonald, J.M. (2018). The Effects of Closing Urban Schools on Students'
23 Academic and Behavioral Outcomes: Evidence from Philadelphia. Working paper.
24
25
26 de la Torre, M., & Gwynne, J. (2009). *When Schools Close: Effects on Displaced Students in*
27 *Chicago Public Schools*. Chicago, IL: University of Chicago Consortium on School
28 Research.
29
30
31 Weber, R., Farmer, S., & Donoghue, M. (2016). *Why these schools? Explaining school closures*
32 *in Chicago, 2000-2013*. Chicago, IL: University of Illinois at Chicago, Great Cities
33 Institute. Retrieved from [https://greatcities.uic.edu/2017/01/10/why-these-schools-](https://greatcities.uic.edu/2017/01/10/why-these-schools-explaining-school-closures-in-chicago-2000-2013/)
34 [explaining-school-closures-in-chicago-2000-2013/](https://greatcities.uic.edu/2017/01/10/why-these-schools-explaining-school-closures-in-chicago-2000-2013/)
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Figures & Tables

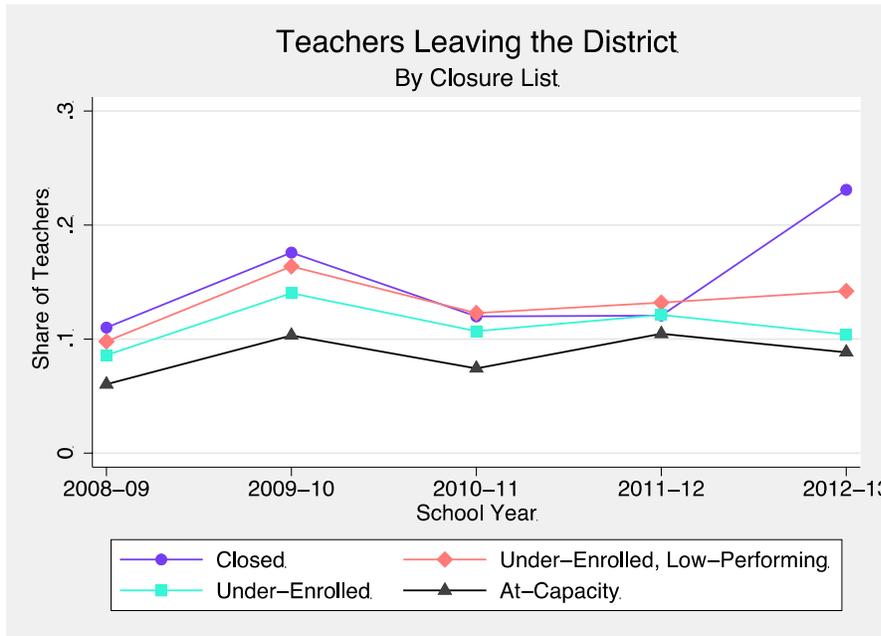


Figure 1. Share of teachers leaving CPS by school type

Notes: Each point represents the share of teachers leaving CPS at the end of the school year. For example, the points at 2012-13 represent the share of teachers leaving after 2012-13 and not returning for 2013-14. It is possible for a teacher to leave CPS but still be teaching in another district, but we cannot distinguish these teachers from teachers who leave the classroom entirely.

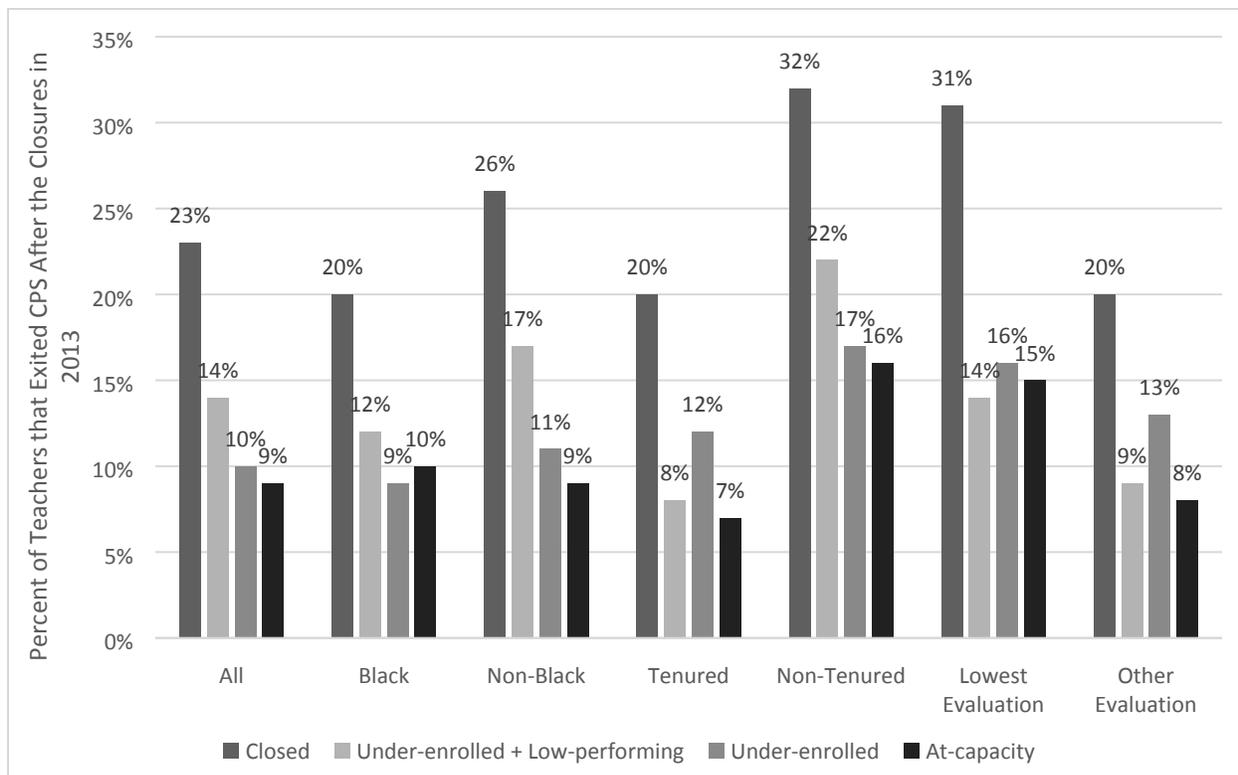


Figure 2. Percent of teachers that exited CPS after the closures in 2013 by school closure status

Notes: Each bar represents the percent of teachers who left CPS at the end of the school year by their school closure status and teacher group. For example, 20 percent of Black teachers who worked in closed schools exited, whereas 12 percent of Black teachers at under-enrolled and low-performing schools did. It is possible for a teacher to leave CPS but still be teaching in another district.

Table 1. Teacher characteristics by school closure status, 2012-13

Teacher characteristic	All teachers (<i>N</i> =14,703)	Closed school (<i>N</i> =866)	Under- enrolled and low- performing school (<i>N</i> =1,758)	Under-enrolled school (<i>N</i> =3,257)	At-capacity school (<i>N</i> =8,822)
Black	25%	52%	57%	38%	11%
Latino	21%	9%	7%	16%	27%
White	48%	34%	31%	41%	55%
Asian	3%	2%	2%	2%	4%
Other/Missing Race	3%	4%	4%	4%	3%
Male	16%	18%	15%	18%	16%
Graduate Degree	59%	60%	59%	60%	59%
National Board Certification	6%	4%	4%	6%	6%
CPS Years of Experience	10.6 years (7.8)	10.5 years (8.0)	11.1 years (8.4)	10.7 years (8.0)	10.5 years (7.6)
Tenured	77%	76%	77%	77%	78%
Math Value-Added (s.d. units)	0.04 (0.92) (<i>n</i> =3,557)	-0.28 (0.93) (<i>n</i> =196)	0.06 (1.12) (<i>n</i> =435)	0.04 (0.98) (<i>n</i> =773)	0.07 (0.84) (<i>n</i> =2,153)
Reading Value-Added (s.d. units)	0.00 (0.85) (<i>n</i> =4,070)	-0.43 (1.01) (<i>n</i> =219)	-0.05 (0.99) (<i>n</i> =499)	-0.06 (0.95) (<i>n</i> =866)	0.08 (0.75) (<i>n</i> =2,486)
Observation Score (s.d. units)	0.00 (1.00) (<i>n</i> =13,236)	-0.21 (0.98) (<i>n</i> =799)	-0.51 (0.98) (<i>n</i> =1,621)	-0.19 (1.01) (<i>n</i> =2,893)	0.20 (0.95) (<i>n</i> =7,923)
Exited CPS at the end of 2012-13	11%	23%	14%	10%	9%
Exited CPS within 5 years of the closures	37%	47%	45%	40%	33%

Notes: Table 1 illustrates the characteristics of teachers by school closure status for the 2012-13 school year. CPS years of experience denotes years teaching at a CPS school. The value-added measures and observation score are collected as part of the teacher evaluation system. Value-added measures are standardized with mean 0, standard deviation 1. Observation score is constructed by averaging across a number of observations and a number of components for each observation; it is standardized with mean 0, standard deviation 1.

Table 2. Linear probability model estimates of the probability of exit from CPS after school closures immediately following closures and within five years of closures

Independent Variable	Outcome: Exit immediately after closures (at the end of 2012-13)			Outcome: Exit within five years of closures (by 2017-18)		
	(1)	(2)	(3)	(4)	(5)	(6)
Closed school	0.142*** (0.016)	0.139*** (0.016)	0.097*** (0.018)	0.140*** (0.022)	0.117*** (0.021)	0.049* (0.025)
Under-enrolled and low-performing school	0.053*** (0.012)	0.051*** (0.012)	0.012 (0.014)	0.120*** (0.016)	0.091*** (0.015)	0.028 (0.018)
Under-enrolled school	0.015** (0.007)	0.014* (0.007)	-0.008 (0.009)	0.068*** (0.007)	0.053*** (0.012)	0.016 (0.014)
P-value of test: Closed = UL	0.000***	0.000***	0.000***	0.447	0.265	0.381
P-value of test: Closed = Under-enrolled	0.000***	0.000***	0.000***	0.003***	0.005***	0.164
Teacher Characteristics		X	X		X	X
School Characteristics			X			X
N Observations	14,664	14,664	14,664	14,664	14,664	14,664

Notes: Table 2 estimates the probability of exit from CPS for teachers based on their school's pre-closure status. Teachers who worked in at-capacity schools serve as the omitted group. Columns (1) – (3) present estimates of the likelihood of exit immediately following the closures (at the end of 2012-13), whereas columns (4) – (6) present estimates of the likelihood of exit at any point in the five years following the closures (by the 2017-18 school year). The first column in each set presents estimates using the basic model, the second column in each set includes teacher characteristics in the model, and the third column in each set factors in both teacher and school characteristics. The coefficient for teachers from closed schools is tested against the coefficient for teachers from schools that experienced only threat of closure: under-enrolled and low-performing schools (UL) and under-enrolled schools. The average exit rate for teachers in at-capacity schools was 0.089 in 2012-13 and 0.328 over the five-year period following closures. Standard errors are clustered at the school level. *** indicates statistical significance at the p<0.01 level, ** indicates statistical significance at the p<0.05 level, and * indicates statistical significance at the p<0.10 level.

Table 3. Difference-in-differences estimates of the probability of exit from CPS after school closures

Independent Variable	(1)	(2)	(3)	(4)
Closed school	0.013 (0.013)	0.007 (0.013)	-0.023* (0.014)	-
Under-enrolled and low-performing school	0.030*** (0.010)	0.020** (0.009)	-0.009 (0.010)	-
Under-enrolled school	0.015** (0.008)	0.009 (0.007)	-0.007 (0.007)	-
Closed X 2012-13	0.129*** (0.016)	0.128*** (0.016)	0.126*** (0.016)	0.128*** (0.016)
Under-enrolled and low-performing X 2012-13	0.024* (0.014)	0.023* (0.013)	0.022 (0.014)	0.020 (0.014)
Under-enrolled X 2012-13	0.000 (0.010)	0.001 (0.010)	0.000 (0.010)	0.000 (0.010)
P-value of test: Closed 2012-13 = UL 2012-13	0.000***	0.000***	0.000***	0.000***
P-value of test: Closed 2012-13 = Under-Enrolled 2012-13	0.000***	0.000***	0.000***	0.000***
P-value of test: Closed 2012-13 = Closed (pre-closure years)	0.000***	0.000***	0.000***	-
Teacher Characteristics		X	X	X
School Characteristics			X	
School Fixed Effects				X
N Schools	470	470	470	470
N Teachers	19,484	19,484	19,484	19,484
N Observations	57,812	57,812	57,812	57,812

Notes: Table 3 shows estimates of the differential effect of school closures on teachers based on their school's pre-closure status. Column (1) presents the estimated effect using the basic linear probability model. Columns (2) – (4) factor in teacher characteristics, school characteristics, and/or school fixed effects. The second row includes the possible interaction effect of working in a closed school in 2012-13 into the model, whereas the first row does not. The base exit rate for teachers in at-capacity schools (omitted group) in 2012-13 was 9%. Standard errors are clustered at the school level. *** indicates statistical significance at the $p < 0.01$ level, ** indicates statistical significance at the $p < 0.05$ level, and * indicates statistical significance at the $p < 0.10$ level.

Table 4. Closed-school teacher characteristics by placement status, 2013-14

Teacher Characteristic	All Closed-school Teachers (<i>N</i> =866)	Left CPS (<i>N</i> =200 or 23%)	Rehired at Welcoming (<i>N</i> =382 or 44%)	Rehired at Non-Welcoming (<i>N</i> =196 or 23%)
Black	52%	46%	58%	44%
White	34%	45%	29%	36%
Latino/Asian/Other/Missing Race	14%	9%	13%	20%
Male	18%	23%	12%	24%
Graduate Degree	60%	52%	76%	74%
National Board Certification	4%	<5%	7%	7%
CPS Years of Experience	10.5 years (8.0)	9.0 years (8.3)	13.4 years (7.9)	9.4 years (7.1)
Tenured	76%	67%	87%	73%
Math Value-Added (s.d. units)	-0.28 (0.93) (<i>n</i> =196)	-0.70 (0.73) (<i>n</i> =33)	0.08 (1.21) (<i>n</i> =103)	0.06 (0.99) (<i>n</i> =45)
Reading Value-Added (s.d. units)	-0.43 (1.01) (<i>n</i> =219)	-0.86 (0.89) (<i>n</i> =44)	-0.03 (1.06) (<i>n</i> =111)	-0.15 (1.36) (<i>n</i> =45)
Observation Score (s.d. units)	-0.21 (0.98) (<i>n</i> =799)	-0.60 (1.11) (<i>n</i> =163)	-0.03 (0.94) (<i>n</i> =365)	-0.12 (0.85) (<i>n</i> =188)

Notes: Table 4 illustrates the characteristics of teachers, who were at closed schools during the 2012-13 school year, by their placement status in the 2013-14 school year. The second column represents closed-school teachers who left the district at the end of the 2012-13 school year, the third column represents closed-school teachers who switched to welcoming schools the following school year, and the last column represents closed-school teachers who switched to unaffected schools. Latino/Asian/Other/Missing combined given the small cell size. Also, we report the percent of National Board teachers who left CPS as <5% to mask small cell size. CPS years of experience denotes years teaching at a CPS school. The value-added measures and observation score are collected as part of the teacher evaluation system. Value-added measures are standardized with mean 0, standard deviation 1. Observation score is on a scale of 1-4 and is averaged across a number of observations and a number of components for each observation.

Table 5. Predictors of exit from CPS among closed-school teachers

Outcome: Exit immediately after closures (at the end of 2012-13)		
Teacher Characteristic	(1)	(2)
Black	-0.063** (0.029)	-0.068* (0.034)
Latino	-0.072 (0.049)	-0.087 (0.053)
Male	0.029 (0.045)	0.021 (0.047)
Tenured	-0.068* (0.039)	-0.087* (0.044)
Graduate degree	-0.031 (0.030)	-0.035 (0.034)
National Board Certification	-0.103** (0.041)	-0.118*** (0.036)
Low evaluations	0.096** (0.039)	0.081* (0.042)
School Fixed Effects		X
Observations	866	866

Notes: Table 5 predicts exit among closed-school teachers using a variety of teacher characteristics to understand if some teachers were more or less likely to return to the district conditional on having been in a closed school in 2012-13. The second column includes school fixed effects in the model. The average exit rate in 2012-13 for closed-school teachers was 23.1%. For teacher race/ethnicity, the omitted group is non-Black, non-Latino teachers. Standard errors are clustered at the school level. *** indicates statistical significance at the $p < 0.01$ level, ** indicates statistical significance at the $p < 0.05$ level, and * indicates statistical significance at the $p < 0.10$ level.

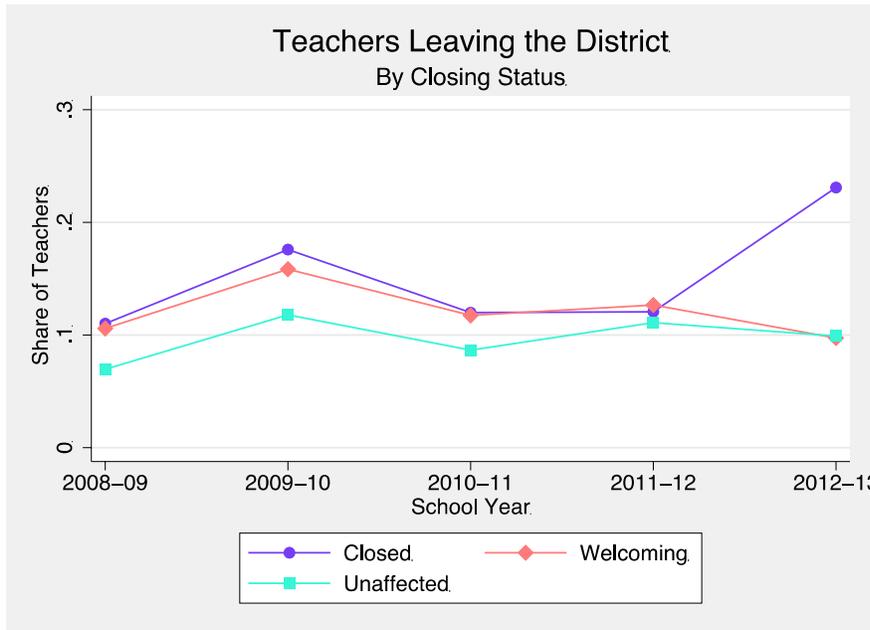
Table 6. Heterogeneity in the difference-in-differences estimates of the probability of exit from CPS after school closures

Independent Variable	Black vs. White	Tenured vs. Non-Tenured	Low Evaluation vs. Others
Black X Closed X 2012-13	-0.035 (0.035)	-	-
Black X UL X 2012-13	-0.017 (0.024)	-	-
Black X Under-enrolled X 2012-13	-0.001 (0.019)	-	-
Tenured X Closed X 2012-13	-	-0.043 (0.042)	-
Tenured X UL X 2012-13	-	0.030 (0.033)	-
Tenured X Under-enrolled X 2012-13	-	0.007 (0.019)	-
Low Eval X Closed X 2012-13	-	-	0.094** (0.037)
Low Eval X UL X 2012-13	-	-	0.039 (0.025)
Low Eval X Under-enrolled X 2012-13	-	-	0.009 (0.018)
P-value of test: Char X Closed 2012-13 = Char X UL 2012-13			
	0.638	0.152	0.200
P-value of test: Char X Closed 2012-13 = Char X Under-enrolled 2012-13			
	0.333	0.239	0.028**
Teacher Characteristics	X	X	X
School Characteristics	X	X	X
N Schools	470	470	470
N Teachers	19,982	19,982	19,982
N Observations	57,812	57,812	57,812

Notes: Table 6 shows estimates of the differential effect of school closures on teachers by teacher groups. Each row includes a different set of interaction variables in the model. The comparison is to exit among White teachers, non-tenured teachers, and higher-performing teachers at the end of 2012-13, in each of the respective columns. Standard errors are clustered at the school level. *** indicates statistical significance at the $p < 0.01$ level, ** indicates statistical significance at the $p < 0.05$ level, and * indicates statistical significance at the $p < 0.10$ level.

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Appendix



Appendix Figure 1. Share of teachers leaving CPS by school type

Notes: Each point represents the share of teachers in each school group leaving CPS at the end of the school year. For example, the points at 2012-13 represent the share of teachers leaving after 2012-13 and not returning for 2013-14. It is possible for a teacher to leave CPS but still be teaching in another district, but we cannot distinguish these teachers from teachers who leave the classroom entirely.

NOT FOR CIRCULATION OR CITATION**Appendix Table 1.** Cox proportional hazards model estimates of the probability of exit from after school closures immediately following closures and within five years of closures

Independent Variable	Relative likelihood of exit immediately following closures (after 2012-13)			Relative likelihood of exit within five years of closures (by 2017-18)		
	(1')	(2')	(3')	(4')	(5')	(6')
Closed school	2.601*** (0.201)	2.601*** (0.201)	2.601*** (0.201)	1.462*** (0.070)	1.345*** (0.065)	1.125* (0.069)
Under-enrolled and low-performing school	1.601*** (0.144)	1.601*** (0.144)	1.601*** (0.144)	1.366*** (0.054)	1.262*** (0.044)	1.071 (0.050)
Under-enrolled school	1.172* (0.086)	1.172* (0.086)	1.172* (0.086)	1.207*** (0.043)	1.161*** (0.038)	1.050 (0.040)
P-value of test: Closed = UL	0.000***	0.000***	0.000***	0.444	0.225	0.344
P-value of test: Closed = Under-enrolled	0.000***	0.000***	0.000***	0.002***	0.004***	0.197
Teacher Characteristics					X	X
School Characteristics						X
N Observations	14,664	14,664	14,664	14,664	14,664	14,664

Notes: Appendix Table 1 estimates the probability of exit from CPS for teachers based on their school's pre-closure status. Teachers who worked in at-capacity schools serve as the omitted group, using a Cox proportional hazards model. Columns (1) – (3) present estimates of the likelihood of exit immediately following the closures (at the end of 2012-13), whereas columns (4) – (6) present estimates of the likelihood of exit at any point in the five years following the closures (by the 2017-18 school year). The first column in each set presents estimates using the basic model, the second column in each set includes teacher characteristics in the model, and the third column in each set factors in both teacher and school characteristics. The coefficient for teachers from closed schools is tested against the coefficient for teachers from schools that experienced only threat of closure: under-enrolled and low-performing schools (UL) and under-enrolled schools. The average exit rate for teachers in at-capacity schools was 0.089 in 2012-13 and 0.328 over the five-year period following closures. Standard errors are clustered at the school level. *** indicates statistical significance at the p<0.01 level, ** indicates statistical significance at the p<0.05 level, and * indicates statistical significance at the p<0.10 level.

NOT FOR CIRCULATION OR CITATION**Appendix Table 2.** Estimates of the probability of exit from CPS in the three years prior to closures

Independent Variable	Linear probability model estimates		
	2009	2010	2011
Closed school	0.015 (0.015)	0.007 (0.013)	0.001 (0.015)
Under-enrolled and low-performing school	0.003 (0.013)	0.010 (0.010)	0.001 (0.011)
Under-enrolled school	-0.001 (0.009)	0.008 (0.007)	0.002 (0.008)
P-value of test: Closed = UL	0.408	0.779	0.967
P-value of test: Closed = Under-enrolled	0.252	0.943	0.899
Teacher Characteristics	X	X	X
School Characteristics	X	X	X
Exit rate for teachers at never threatened schools	0.103	0.074	0.105
N Observations	15,032	14,068	14,048

Notes: Appendix Table 2 shows estimates of the probability of exit from CPS using pre-closure data to illustrate that teachers had similar exit rates in the years prior to closure, after controlling for teacher and school characteristics. Standard errors are clustered at the school level. *** indicates statistical significance at the $p < 0.01$ level, ** indicates statistical significance at the $p < 0.05$ level, and * indicates statistical significance at the $p < 0.10$ level.

NOT FOR CIRCULATION OR CITATION**Appendix Table 3.** Difference-in-differences estimates of the probability of exit from CPS after school closures, sample limited to closed school and under-enrolled and low-performing schools

Independent Variable	Linear probability model estimates			
	(1)	(2)	(3)	(4)
Closed School	-0.016 (0.015)	-0.015 (0.015)	-0.019 (0.014)	-
Closed School X 2012-13	0.105*** (0.020)	0.106*** (0.020)	0.102*** (0.020)	0.109*** (0.020)
P-value of test: Final 2012-13 = Final (pre-closure years)	0.000***	0.000***	0.000***	-
Teacher Characteristics		X	X	X
School Characteristics			X	
School Fixed Effects				X
N Schools	126	126	126	126
N Teachers	4,321	4,321	4,321	4,321
N Observations	10,830	10,830	10,830	10,830

Notes: Appendix Table 3 presents the differential effect of school closures on the likelihood of exit for closed-school teachers relative to the omitted group, teachers in under-enrolled and low-performing schools. Base rate of exit for teachers at under-enrolled and low-performing schools in 2012-13 was 14%. Standard errors are clustered at the school level. *** indicates statistical significance at the $p < 0.01$ level, ** indicates statistical significance at the $p < 0.05$ level, and * indicates statistical significance at the $p < 0.10$ level.

NOT FOR CIRCULATION OR CITATION**Appendix Table 4.** Difference-in-differences estimates of the probability of exit from CPS after school closures (school-level analysis)

Independent Variable	(1)	(2)	(3)	(4)
Closed school	0.012 (0.013)	-0.005 (0.013)	-0.021 (0.014)	-
Under-enrolled and low-performing school	0.033*** (0.010)	0.014 (0.010)	0.001 (0.010)	-
Under-enrolled school	0.019** (0.009)	0.005 (0.008)	-0.003 (0.009)	-
Closed school X 2012-13	0.128*** (0.018)	0.129*** (0.019)	0.127*** (0.019)	0.127*** (0.022)
Under-enrolled and low-performing school X 2012-13	0.012 (0.015)	0.01 (0.014)	0.010 (0.014)	0.015 (0.016)
Under-enrolled school X 2012-13	-0.005 (0.011)	-0.003 (0.011)	-0.004 (0.011)	-0.002 (0.012)
P-value of test: Closed 2012-13 = UL 2012-13	0.000***	0.000***	0.000***	0.000***
P-value of test: Closed 2012-13 = Under-enrolled 2012-13	0.000***	0.000***	0.000***	0.000***
P-value of test: Closed 2012-13 = Closed (pre-closure years)	0.000***	0.000***	0.000***	-
Teacher Characteristics		X	X	X
School Characteristics			X	
School Fixed Effects				X
N Schools	449	449	449	449
N Observations	1,796	1,796	1,796	1,796

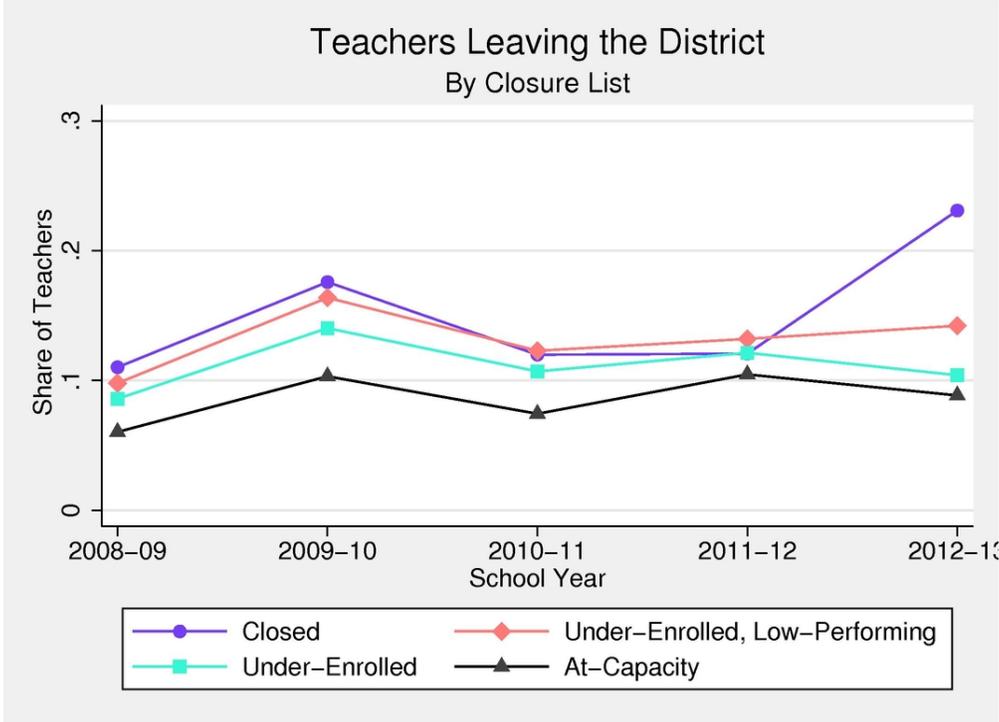
Notes: Appendix Table 4 presents the differential effect of school closures on the likelihood of teacher exit at the school level. Base rate of exit for teachers at at-capacity schools in 2012-13 was 9%. Standard errors are clustered at the school level. *** indicates statistical significance at the p<0.01 level, ** indicates statistical significance at the p<0.05 level, and * indicates statistical significance at the p<0.10 level.

NOT FOR CIRCULATION OR CITATION**Appendix Table 5.** Difference-in-differences estimates of the probability of exit from CPS after school closures with alternative comparison groups

Independent Variable	(1)	(2)	(3)	(4)
Closed School	0.007 (0.013)	-0.001 (0.013)	-0.023* (0.013)	-
Welcoming School	0.013 (0.013)	0.004 (0.012)	-0.006 (0.012)	-
Closed School X 2012-13	0.125*** (0.016)	0.124*** (0.015)	0.122*** (0.016)	0.124*** (0.016)
Welcoming School X 2012-13	-0.015 (0.016)	-0.012 (0.015)	-0.013 (0.016)	-0.012 (0.015)
P-value of test: Closed 2012-13 = Welcoming 2012-13	0.000***	0.000***	0.000***	0.000***
P-value of test: Closed 2012-13 = Closed (pre-closure years)	0.000***	0.000***	0.000***	-
Teacher Characteristics		X	X	X
School Characteristics			X	
School Fixed Effects				X
N Schools	470	470	470	470
N Observations	57,812	57,812	57,812	57,812

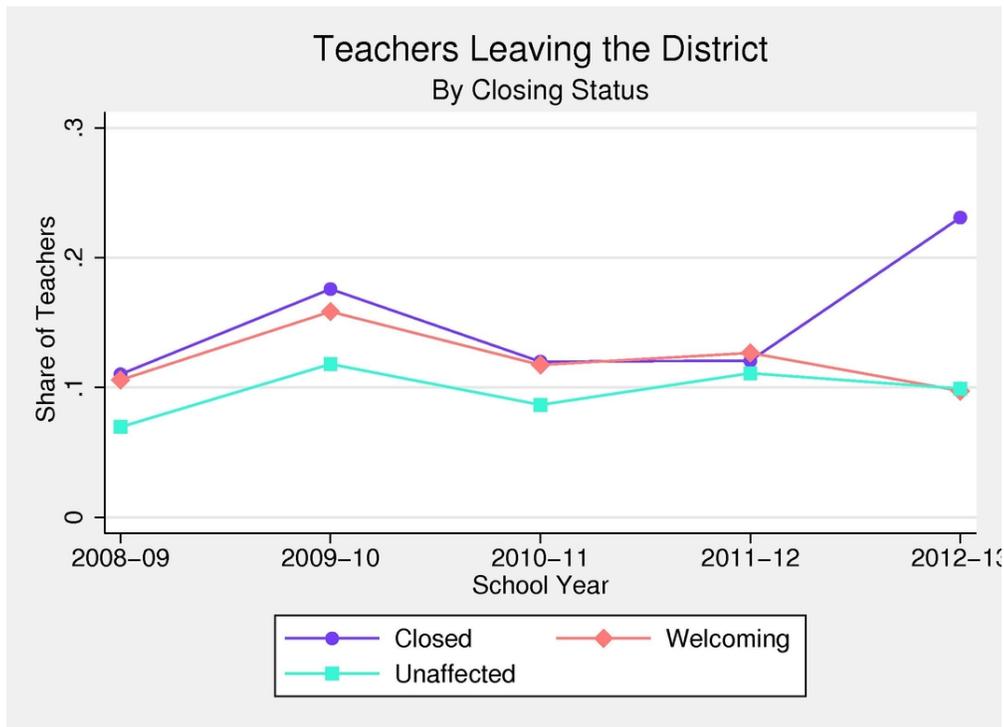
Notes: Appendix Table 5 presents the differential effect of school closures on the likelihood of exit for closed-school teachers relative to the omitted group, unaffected schools (i.e., non-closed, non-welcoming schools). Base rate of exit for teachers at under-enrolled and low-performing schools in 2012-13 was 10%. Standard errors are clustered at the school level. *** indicates statistical significance at the $p < 0.01$ level, ** indicates statistical significance at the $p < 0.05$ level, and * indicates statistical significance at the $p < 0.10$ level.

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