Technical Report

THE EFFECTS OF SCHOOL CLOSURE ON THE TEACHER LABOR MARKET: EVIDENCE FROM PORTFOLIO MANAGEMENT IN NEW ORLEANS

EDUCATION RESEARCH ALLIANCE FOR NEW ORLEANS

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The Effects of School Closure on the Teacher Labor Market: Evidence from Portfolio Management in New Orleans

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Abstract

Literature on school closure typically focuses on contexts where the demand for teachers is shrinking due to declining enrollment. We examine the effect of accountability and market-driven school closure on the teacher workforce in a portfolio management district with growing enrollment. Employing an event study approach, we estimate effects of closure on teachers in New Orleans during a period of aggressive takeover and closure. We find that closure significantly increased the likelihood that teachers exit. For those who remained, it also boosted the likelihood of continued job switching, including entering a non-teaching position, with negative effects on pay. We discuss the implications of these findings for research and policy, with a particular focus on "portfolio" approaches to managing public schools.

Key words: school closure, school takeover, teachers, school reform, charter schools

1. Introduction

Historically, tenure policies and union contracts have protected public school teachers in the U.S. from many potential threats of job loss, including dismissal due to poor performance. Beginning in the late 1980s, critics of traditional public school systems began to argue that the lack of a credible threat of performance-related job loss contributed to a stagnant education system with little incentive for teachers to improve (Chubb and Moe, 1990). Over time, these critiques took root in education reform efforts at the federal, state, and local levels that incorporate market principles in an effort to incentivize improvement. No Child Left Behind infused information and accountability into public schools across the country. States enacted school choice policies—charter schools, private school vouchers, and others—that allowed families to "vote with their feet." Districts implemented teacher evaluation systems intended to identify and dismiss ineffective teachers, a strategy made possible by states rolling back their teacher tenure policies.

The steady proliferation of market-based reforms ultimately culminated in an approach to school system governance known as the portfolio model (Hill, Campbell, & Gross 2013; Hill & Jochim 2014). This approach incorporates many of the market principles reflected in earlier reform efforts, including choice, accountability, and at-will employment, but it goes beyond prior market-oriented reforms by leveraging the strategic use of school closures, takeovers, and openings with the goal of maintaining consistently high-quality schools. Although prior reform initiatives had raised the specter of using closures to drive school improvement, closures have historically been used with great reluctance and primarily in response to declining student enrollment rather than poor performance. Thus, the quality-driven closures occurring in portfolio systems—such as those in New Orleans, Chicago, Philadelphia, Cleveland, and other cities—are

a relatively recent phenomenon that, for teachers, represent a new form of potential performance-related job loss.

Given the historical rarity of quality-driven closures, we have limited understanding of their effects on various stakeholders in the educational environment. A growing set of studies estimate the effect of closures on student achievement (e.g. Brummet 2014; Bross, Harris, and Liu 2016; de la Torre and Gwynne 2009; Engberg et al. 2012; Carlson and Lavertu 2015, 2016; CREDO 2017; Bifulco and Schwegman 2019; Steinberg and MacDonald 2019), but there has been almost no work examining how closures affect parents, employees, or communities. While acknowledging the importance of all these stakeholders, and potentially others, our focus involves examining how school closures occurring in a portfolio system create new employment risks for teachers, who constitute the most important input in a successful school system (Chetty, Friedman, and Rockoff 2014; Hanushek and Rivkin 2010; Rivkin, Hanushek and Kain 2005; Rockoff 2004).

In this paper we analyze how churn in the supply of schools—specifically the closures and takeovers inherent in a large-scale portfolio approach—affects teachers' labor market decisions and outcomes. We examine how closures affect teachers' future employment positions and, for those who remain employed in the education sector, their pay in subsequent years. With this focus, our paper contributes to two literatures. First, it contributes to the growing body of research on portfolio strategies. Although a closure-driven approach to systemwide improvement is based in established market principles, it also has the potential to disrupt the educational ecosystem, and this paper provides the first evidence on potential disruption to the teacher labor market. Such evidence is critical for testing the underlying theory of portfolio strategies, which is often predicated on the assumption that chronically low-performing teachers can be readily

replaced with superior candidates (Chubb and Moe, 1991; Hanushek and Rivkin, 2010). In reality, this process can be constrained by the supply-side of the teacher labor market (Rothstein, 2015; Barrett, Carlson, Harris, & Lincove, 2019), with constraints likely increasing in the degree of disruption of the teacher labor market. This paper provides evidence on the degree of such disruption. Second, this work contributes to the literature on school closure, where a growing number of studies estimate the effects on student achievement (e.g. Brummet 2014; Bross, Harris, and Liu 2016; de la Torre and Gwynne 2009; Engberg et al. 2012; Carlson and Lavertu 2015, 2016; CREDO 2017; Bifulco and Schwegman 2019; Steinberg and MacDonald 2019) but none estimate the effects on teachers.

Empirically, our analyses leverage the substantial school churn that occurred in New Orleans' portfolio system in the wake of Hurricane Katrina, where more than 50 schools experienced some form of closure between 2006-07 and 2014-15. We estimate the effects of these closures using an event study approach, which allows us to depict pre-closure trends while providing annual estimates of the effect of closure for each of the first four post-closure years. Further, in addition to estimating the overall effect of school closure on teachers' labor market outcomes (employment and pay), we also examine whether the impact of full closure differs from cases where a school re-opened under new management with the potential to rehire teachers. We also assess whether closures are more disruptive to teachers when schools previously taken over by the state are shut down, compared to cases where existing charter schools are closed. Finally, we investigate whether closures influenced the distribution of teacher quality by estimating differential effects on teachers with low and high estimated value-added scores.

We find that accountability-based closure affects teachers in several different ways.

First, exposure to any type of closure significantly increases the likelihood that teachers exited Louisiana's public education sector in the immediate post-closure time period, with full closures having a particularly pronounced effect. Second, despite a significant increase in exit probabilities, the majority of teachers affected by closure returned to employment somewhere in the public education sector the following year. For re-employed teachers, closure affects the nature of subsequent employment positions, including a higher likelihood of moving to a different school district. Third, our results suggest that closure in a system without established teacher contracts results in reduced salaries for reemployed teachers, with exposure to full closures resulting in larger subsequent pay declines than exposure to management changes. Finally, we find no evidence that closure selectively exits teachers with lower indicators of performance. Together, these results suggest that policymakers considering a transition to a portfolio system must consider the unintended consequences of closure for teachers, both in the context of labor market disruptions and the reality that many teachers will be rehired given the stable demand for teachers.

We proceed by first providing background and context for our analysis, depicting how the portfolio strategy defines the educational landscape in New Orleans, and describing how school takeovers and closure are an intrinsic feature of that landscape. Next, we situate our work in the literatures on both school closure and teacher labor markets. We then outline our data and empirical strategies. We present the results of our analysis before closing the paper with a discussion of their implications for portfolio strategies, as well as for research on those initiatives.

2. School Churn and Teacher Employment in New Orleans

2.1 School Reform in New Orleans

Hurricane Katrina had many profound effects on the city of New Orleans, including abrupt implementation of the portfolio-style approach to managing the city's schools and a number of accompanying market-based school reforms. In the pre-Katrina era, New Orleans public schools were governed by the Orleans Parish School Board (OPSB) and administered by a central district office, but the system was characterized by chronic low performance and financial mismanagement. Hurricane Katrina made landfall in New Orleans just as the 2005-06 school year was getting underway, forcing approximately 65,000 public school students, along with their families and teachers, to evacuate the city. All public schools were shut down through the end of 2005, and all employees of OPSB were officially terminated the following spring.[1] During this time, state Board of Elementary and Secondary Education (BESE) classified New Orleans as "Academically in Crisis" and empowered the state's Recovery School District (RSD) to take over more than 100 OPSB schools, while OPSB retained control of fewer than 10 schools.

Beginning in fall 2006, RSD was responsible for the vast majority of New Orleans schools. By law, RSD was required to divest itself of all these schools either through closure or chartering by 2015. This goal set the stage for the significant level of school churn that occurred over the next eight years. Many school buildings were never reopened. For those that were opened, the first wave of post-Katrina closures consisted of RSD fully closing or contracting out its portfolio of schools. In subsequent years, poor performance or financial mismanagement at some charter schools led to additional churn, where many charter schools were either closed or re-contracted to new management. In a small number of cases, RSD re-

[1] OPSB received no state per-pupil funds with which to pay teachers during the evacuation. Employees were initially put on a temporary leave that allowed them to collect unemployment benefits during the evacuation. Subsequently, all employees were formally dismissed in spring 2006 (Lincove, Barrett, and Strunk, 2017).

asserted direct control over previously chartered schools.

The post-Katrina portfolio period brought several different types of closure, each of which created a different context for teacher dismissal. These different closures can be usefully organized along two dimensions: school type and closure type. With respect to school type, we distinguish between two different forms—takeover and charter. State takeover of failing schools was designed as a temporary intervention, so RSD-run takeover schools were destined for eventual closure through RSD's legislative mandate. Teachers employed at takeover schools during the period we study were fully aware that their employment situation was temporary. Charter schools were not intended to close but were always at risk of closure due to contracts with RSD that enforced standards for management and performance. Teachers employed at charter schools knew that the school's continued existence was contingent on its performance.

Our second organizing dimension is closure type, and we distinguish between two different forms of closures—full closure and management change. Teachers at fully-closed schools must seek employment at another school. Management changes, where current school management is fully replaced either by a different charter management organization (CMO) or a takeover school district like the RSD, might offer selective reemployment to the current teaching staff. Although these various forms of churn are motivated by different considerations, they are all potentially disruptive to students, parents, staff, and communities affected by decisions to shut down or transition a school. For New Orleans teachers, they all represent a threat to continued employment at their school and, perhaps, the education sector more generally.

In many areas, teachers' employment risks associated with school closure are mitigated

by employment protections for tenured teachers (Goldhaber, Lavery, & Theobald 2014), but such protections did not exist in New Orleans. In addition to portfolio management, the market-based reforms in New Orleans removed most teacher employment protections, placing all teachers at risk for dismissal. Specifically, in the years after Katrina, there were no collective bargaining agreements or long-term contracts for any teachers in New Orleans. Charter school teachers were at-will employees for private, non-profit CMOs, and salary and employment conditions were set at the CMO level. Louisiana charter schools are exempt from most teacher employment regulations, and therefore have substantial autonomy in teacher hiring, firing, and salary-setting. They are also exempt from requirements to hire certified teachers and, in most cases, participation in the state's teacher retirement system. The RSD also employed teachers without contracts and made clear that seniority had no bearing on job security, but they did publish a district salary schedule that rewarded past experience in OPSB or other public school districts and compensation included state pension contributions. A small number of teachers continued to be employed by OPSB to work at the remaining district-run schools. These positions also rewarded seniority with a salary schedule and pension contributions but offered no guaranteed employment. Thus, following a closure or management change in any type of school, all affected teachers would have to compete for new positions.

2.2 Identifying School Closures in New Orleans

Identifying school closure is key to our analysis. Our first step in generating this measure involved longitudinal review of school identifiers in administrative records from the Louisiana Department of Education (more details below). Focusing on the post-Katrina period from spring 2007 to spring 2015, we consider a school to be operational when there were both teachers in LDOE's employment records and students in enrollment records associated with a particular

school identifier. When a school identifier disappeared from either set of records we classify that as an instance of school closure and document the final year of operation as the closure year.

In cases of management transition, the administrative changeover entails issuance of a new school identifier and, unfortunately, there is no indication in administrative data that the old and new identifiers reflect the same school under two management regimes. This required us to perform additional investigation to document each closure as either a full closure or a change in management. To do this, we reviewed several sets of documents that directly or indirectly reported annual school transitions in the systems, including media reports, research reports, and materials published by the school district and local nonprofits to help parents understand the changing school system.[2] Each of these sources provided different pieces of information which, when combined, allowed us to identify the nature of each closure in our data. We identify 56 closures over this time period—32 full closures and 24 management changes.[3]

Figure 1 illustrates, by closure type, the annual number of school closures that occurred in New Orleans during the period of study. It also depicts the number of teachers affected by closure each year.[4] During this period, the number of operating schools fluctuated from 79 to 93 per year, and 56 schools experienced a closure event over this period. There were no closures in 2007-08, followed by between 3 and 12 per year in subsequent years. The number

[2] Sources include: New Orleans Parents' Guide, which is a catalogue of schools published annually to facilitate school choice for parents; the OneApp Information Packet, which lists school available in the city's annual school choice lottery -- known as OneApp; annual School Governance Charts published the Cowen Institute, a Tulane University research center focused on the city's schools; and the LDOE school directory, which lists id numbers and contact information for all school open each year.

[3] In 23 cases, closure with new management involved chartering an RSD school or existing charter school to a new CMO. In one case, the closure involved RSD taking over an existing charter school and directly running the school.

[4] The data in Figure 1 include teachers in RSD direct-run schools and RSD-contracted charter schools, as well as small number of OPSB direct-run schools, OPSB-contracted charter schools, and BESE-contracted charter schools. In further analysis, we omit OPSB direct-run schools because none of these schools were closed (or threatened to be closed) during the analysis period. Thus, teachers in OPSB direct-run schools faced no risk of dismissal due to accountability-based closure.

of teachers directly affected by closure in a year ranged from 67 to 277, or 2.4% to 10.5% of the teacher labor force in Orleans Parish. More schools were fully closed (32) than underwent management changes (24), but a greater number of teachers were affected by the management changes (644) than by the full closures (577). In New Orleans system of school choice, fully closed schools likely had lower enrollment as they neared closure, and therefore smaller teaching faculties.

[Figure 1 about here]

It is important to highlight the population dynamics of New Orleans during this period of intense school churn. The population of New Orleans dropped considerably in the immediate aftermath of Hurricane Katrina, and then grew over time as families returned. In 2007, student enrollment was about 37% of pre-Katrina levels, but it subsequently doubled to about two-thirds of pre-storm levels by 2014. Thus, our analysis focuses on school churn in a setting where the number of students, and therefore the demand for teachers, was growing. Unlike settings where school closures or consolidations are necessitated by declining enrollments, school churn in New Orleans has the potential to shift where teachers are employed without decreasing the overall demand for teachers. This is particularly true for schools opening under new management with the immediate need to hire a full teaching faculty.

As a final note on context, we reiterate that school churn in New Orleans was somewhat predictable and built into the system of RSD school takeover and charter school oversight. Teachers employed by RSD would have known that their schools would be either closed or chartered by a target date of fall 2014, and teachers in failing charter schools often had 1-2 years of warning prior to a full closure or re-chartering process. Overall, the employment setting studied here is substantially higher risk than a typical teacher labor market but also

offers greater opportunities for re-employment due to the absence of teacher contracts specifying seniority as the basis for rehiring.

3. School Churn and Teacher Labor Market Behavior

Teacher turnover, and its attendant causes and consequences, is the subject of a large literature, with multiple reviews of early studies on the topic (e.g. Guarino, Santibanez, and Daley 2006; Borman and Dowling 2008). This early work focuses primarily on the role of personal and organizational factors in teacher attrition, finding that mobility is broadly shaped by considerations of compensation, working conditions, and intrinsic reward. Indeed, early studies conclude that teachers will be more likely to leave their position for an alternative—either inside or outside the teaching profession—that provides an improvement on one or more of these dimensions. These improvements may take the form of higher salaries, better fringe benefits, more appealing peers, higher-quality school or district leadership, or myriad other considerations documented by prior work (see Guarino, Santibanez, and Daley (2006) or Borman and Dowling (2008) for a review of the teacher turnover literature).

Recent reform efforts have focused heavily on using policy to increase the quality of the teaching force. These efforts have been wide-ranging, addressing teacher preparation programs, recruitment strategies, and evaluation processes. Most relevant to our work, however, are turnaround policies that are explicitly designed to reconstitute the teaching faculty in struggling schools. For example, President Obama's Department of Education promoted models of school turnaround that required the replacement of the school principal and at least half the teaching faculty (Kutash et al., 2010). Several evaluations have estimated the effect of Obama-era school turnarounds on teacher attrition, reaching mixed conclusions. For example, two studies of North

Carolina's school turnaround efforts return competing results, with work based on a regression discontinuity (RD) design concluding that the turnaround initiative increased teacher turnover two years after implementation (Heissel and Ladd 2018) while analysis based on a difference-in-differences design found no significant effects (Henry, Guthrie, and Townsend 2015). Evaluation of the school turnaround efforts in Ohio, as part of the federal School Improvement Grant program, also found no effect on teacher turnover (Carlson and Lavertu 2018), with the lack of effect attributable to fact that both treated and non-treated schools exhibited very high turnover rates. Together, existing literature suggests that school turnarounds—and perhaps school churn more generally—does not necessarily induce changes in the teacher workforce, and that the nature of local labor markets or details of the policies and programs producing school churn are important contextual factors.

Although no work has focused specifically on the relationship between school closure and teacher labor market behavior in New Orleans' portfolio system, prior studies show that after the mass dismissal of OBSB employees in 2006, fewer than half of the dismissed teachers returned to teach in the city's reformed system (Lincove, Barrett, and Strunk, 2017). However, it is unclear how many of these teacher exits were due to post-evacuation residential relocation, the reduced student enrollment in New Orleans, or the policy changes related to teacher employment. There is descriptive evidence that, during the immediate post-Katrina period, New Orleans experienced accelerated exit among experienced teachers (Lincove, Barrett, and Strunk, 2017), a demographic shift from a majority black, highly experienced labor market to younger, white teachers (Barrett and Harris, 2016), and elevated teacher turnover rates (Barrett and Harris, 2016).

A core assumption of the theory of churn-driven school improvement is that closures

and restarts will induce substantial improvement in the quality of the teaching faculty. Such improvements would require either a reduction in the demand for teachers (due to reduced student enrollment) or an adequate supply of replacement teachers. The portfolio strategy is particularly reliant on the latter because closures are motivated by accountability and performance rather than declining enrollment. In this context, we examine how school closures in New Orleans influenced future teacher employment outcomes.

4. Data and Measures

Our analysis uses deidentified administrative records provided by the Louisiana Department of Education (LDOE), specifically personnel and student files. Personnel data contain annual, de-identified records for all employees at public schools in Louisiana (traditional and charter schools), including position held, demographics, teaching certificates, college degrees, salary, school assignments, and district hire dates. These records allow us to observe teachers as they move across any public schools in the state, and we are also able to observe exits from positions, schools, parishes, and the Louisiana public education system. Our core analysis covers teachers employed during the post-Katrina period from the 2007-08 school year through the 2014-15 school year.

We use information in student records to construct aggregate school-level measures of student demographics and educational needs that might influence both the demand for teachers and a teacher's propensity to exit, including students' race and ethnicity, English proficiency, special education status, gifted status, and free or reduced price lunch eligibility. Other school descriptors include grades served, charter status, and a state-reported school performance score (SPS). The SPS aggregates student proficiency rates on state standardized tests and is used to determine the school's accountability status and potential for closure or takeover. SPS

calculations changed across the time period we analyze, so we standardized SPS scores by year.

Although our main analysis spans the 2007-08 to 2014-15 school years, the subset of our analyses using teacher value-added estimates only begins in 2009-10, when Louisiana initiated collection of the necessary teacher-students links. There is no measure of teacher quality in the administrative data, so this set of analyses is based on a researcher-constructed measure. Specifically, we leveraged teacher-student links in the data to estimate a teacher fixed effect that reflects each teacher's value-added effect on student growth on standardized tests. See Appendix 1 for a detailed description of this metric. Our data allows us to estimate value-added for teachers in grades 4-8 who are linked to students in four core subject areas (language arts, math, science, and social studies). As noted above, student-teacher links were not collected before spring 2010, so our value-added analysis excludes the 2007-08 and 2008-09 teacher cohorts. From 2009-10 forward, we calculate a pre-closure value-added score for each teacher by averaging all available value-added estimates for that teacher across subjects in all pre-closure years. We then identify, within each cohort, "high value-added" teachers as those in the top quintile and "low value-added" teacher as those in the bottom quintile.

5. Empirical Strategy

5.1. Data Structure and Treatment Identification

Our empirical strategy exploits the large number of closures that occurred in Orleans Parish between 2008 and 2015 to estimate the effect of these events on teacher employment outcomes over time. To facilitate this analysis, we apply an annual cohort structure to our data. As the first step in generating these "closure cohorts," for each year from (spring) 2008 to 2015 we identify all schools that were operating in Orleans Parish. We then use the approach described above to determine whether each school remained in operation the following fall and

consider those remaining in operation to be "untreated" while considering those no longer in operation to be "treated." For example, if a school operated in 2007-08 and 2008-09 but did not reopen in fall 2009, we consider it "untreated" in the 2008 closure cohort, "treated" in the 2009 closure cohort, and not included in the 2010 to 2015 cohorts.

After identifying the treated and untreated schools in each closure cohort, we turn to identifying the teachers who will comprise our analytic sample. For reasons described below, we create two analytic samples of teachers, each based on a different definition of membership in treated and untreated schools for a given closure cohort. In the first sample, for a given closure cohort, we start with all teachers who were employed in full-time teaching positions on a single campus in Orleans Parish during that school year. Within this set of teachers, we consider a teacher to be in the treatment group if she taught in a treated school in its final year of operation. We consider untreated teachers as those who, in a given closure cohort year, worked in an Orleans Parish school unaffected by closure.

To illustrate this definition, consider the 2010 closure cohort. Within this cohort, treated teachers are those who spent the 2009-10 school year working in a school that did not reopen in the 2010-11 school year. We compare these teachers to their peers employed in an Orleans Parish school that operated in both 2009-10 and 2010-11. We assume that all treated teachers were dismissed in the spring and that reemployment decisions were made during the summer, and thus code employment outcomes based on personnel data for the following fall. For example, a teacher in the 2010 closure cohort is coded as exiting teaching in 2009-10 if she does not appear as employed in the fall 2010 data.

Defining our first treatment group to include teachers in a school's final year of operation is a natural starting point for estimating the effects of closure, but it also has

significant limitations. School closures are often predictable—sometimes even formally announced—years in advance of the event itself, potentially creating a situation where teachers make labor market decisions in anticipation of future closures. For example, consistently low academic performance may lead a teacher to believe that his school will be shut down in the near future and, rather than wait until that comes to pass, he leaves the school and, potentially, the profession. This is a more complex embodiment of the closure mechanism than sudden dismissal at the time the school is shut down. In response to such possibilities, our second analytic sample includes teachers employed at a school *two years prior to* the cohort closure year. For example, in sample two, a teacher is included in the 2011 cohort if she met the employment conditions in 2009, and is considered "treated" if her 2009 school was closed in 2011. This second approach has the advantage of allowing us to estimate responses to anticipated closure, but it necessarily excludes teachers who were hired by closing schools in the last two years before closure.

With these definitions of cohort membership and treatment assignment, we compiled longitudinal observations from 2007-08 to 2014-15 of annual teacher employment and re-employment for each member of each closure cohort. We perform this exercise for each of the eight cohorts, and then compile each cohort—and its associated observations—into a single dataset structured in a cohort-by-teacher-by-year manner. Thus, we pool 8 panel data sets, each identifying a different cohort year (2008 to 2015) when closure could occur. This structure enables us to estimate the effect of a school closure relative to the teacher's employment behavior in all other years observed, observing teachers up to seven years prior to closure, and up to seven years post-closure. It also allows teachers with employment before and after closure events to serve as treatment group members in cohorts where they experienced closure,

and comparison group members in cohorts where they were employed by schools that remained open. This analysis necessarily omits some groups of teachers including those who only taught for one year in the system, those who exited earlier due to the state takeovers in 2006, and teachers were employed at more than one school at a time.

5.2 Descriptive Statistics

In total, we identify 1,227 total ever-treated teachers and 19,021 ever-untreated teachers, resulting in more than 20,000 unique teacher-by-cohort observations. Table 1 provides summary statistics for the full sample as well as separately for the treatment and comparison groups. We also present separate means for teachers in schools that underwent a management change and those in schools that were fully closed. Among untreated teachers, 81% returned to public school employment somewhere in Louisiana in the next year, with 78% returning to teaching positions, but only 65% returning to teaching in the same school. This suggests substantial teacher turnover and transfer even among teachers whose schools were unaffected by closure. Among treated teachers, 71% of teachers at fully closed schools returned to employment in the Louisiana public education sector, with only 65% returning to full-time teaching—by definition none of these teachers returned to the same school. At schools with management changes, 78% returned to employment but only 28% returned to full-time teaching at the previous school under new management. The summary statistics illustrate that closures disproportionately affect some teacher and student demographic groups. Black teachers were disproportionately affected by closure, as were teachers with more than 16 years of experience. Finally, the table shows that teachers directly affected by closure taught at schools with lower enrollment, lower school performance scores, and higher proportions of black students and students eligible for free or reduced-price lunch.

[Insert Table 1 about here]

5.3. Statistical Model

Our empirical strategy exploits the timing of closures across longitudinal observations of New Orleans teachers' annual employment outcomes. Using an event study approach, we leverage the annual closures reported above to gain insight into the effects of closure on multiple employment outcomes. Because closures occur each year for several years, we use a teacher-by-closure cohort approach where employment outcomes are a function of the timing of school closure. A cohort-based approach is appropriate in New Orleans' highly mobile setting because it accounts for the common case where a single teacher was employed in closing and non-closing schools in different years. Specifically, we estimate:

$$Y_{iscrt+1} = \sum_{r\leq -4}^{r\geq 3} \delta_r L_{isc} + \psi_t + \rho_{ic} + \gamma_r + O_{st}\beta + E_{it}\zeta + \vartheta_{iz} + \varepsilon_{iscrt} \qquad (1)$$

where *i*, *s*, *c*, *r*, *t*, and *z* index teachers, schools, closure cohorts, years relative to the closure cohort year, academic years, and district of initial employment, respectively. Y_{t+1} is a measure indicating employment in the next school year. The treatment specification $\sum_{r\leq -4}^{r\geq 3} \delta_r L_{isc}$ indicates a teacher's membership in the treatment group at a school that is *r* years from undergoing a closure event. For years $r < 0$, $L_{isc} = 1$ indicates that a teacher is a member of the treatment group at a school that will experience closure in $|r|$ years. For years $r \geq 0$, $L_{isc} = 1$ indicates that a teacher is a member of the treatment group at a school that closed *r* years previously. The model also includes fixed effects γ_r to reflect time relative to the cohort closure year for all teachers in the cohort. It also contains teacher-by-cohort fixed effects, ρ_{ic}, that control for fixed teacher characteristics that might influence exit. To ensure that we are comparing similar teachers under similar conditions, we include school year fixed effects ψ_t, time-varying observable characteristics for both teachers and the schools in which they teach,

represented by *E* and *O*, and fixed effects for the teacher's first place of public school employment in Louisiana (ϑ_{iz}). Thus, we compare treated and untreated teachers, controlling for both career pathways and school characteristics. To account for the fact that a given teacher can be a member of multiple churn cohorts, we cluster standard errors by teacher when estimating equation (1).

In this model, δ_r are the parameters of interest that represent the difference between the treatment and comparison group in the probability of a teacher exit. Our specification estimates this parameter separately for each year relative to closure. This structure allows for the possibility that the effects of closure are dynamic in nature. For example, a closure in year *r* could influence some incremental exit before, during, and after *r,* or a sudden group of exits concentrated in *r+1*. Our dynamic model and use of two analytic samples will detect these different possible scenarios. We estimate equation (1) for the primary outcome of teacher exit from public school employment, and then, conditioned on returning to employment several additional outcomes that describe employment conditions including job type (teacher or non-teaching), job location, and pay.

We first estimate equation (1) for teacher exit over the full sample of teachers who meet the conditions for membership in either the treatment or comparison group. Here $Y_{iscrt+1} = 1$ if teacher *i* exited public school employment after year *r.* We then repeat this estimation for five subgroups with clear policy relevance. First, we estimate the model for teachers in RSD schools. Given the stated intent of either closing or chartering out RSD schools, teachers may have entered these jobs with the expectation that it would be a short-term position, thus resulting in a smaller effect on their labor market behaviors and outcomes. Second, we estimate the model for teachers across all charter schools. As charter schools have the most leverage to hire and

compensate teachers based on performance, this analysis is directly relevant to understanding how deregulation and accountability-driven closure combine to influence teacher labor markets. Our third and fourth analyses examine different forms of closure by estimating equation (1) separately for teachers in schools that underwent a management change and for teachers in schools that were fully closed. It is possible that management changes have a smaller effect on teachers if new managers are willing to rehire current teachers. Finally, we disaggregate by teacher value-added (see appendix for details of this measure) to see if closure, as expected by theory, exits low-performing teachers from the profession, while retaining and rewarding high-performers.

Along with examining how school closure shapes teachers' likelihood of retention in the profession, we also analyze several additional employment outcomes. The economic literature on dislocated workers provides evidence that firm closures can be quite disruptive (Couch and Placzek 2010). Even dislocated workers who remain employed in their same sector are often forced to accept positions that are less desirable, either because those positions involve less fulfilling tasks or reduced compensation (or both). Empirical work consistently shows that displacement generates sustained earnings declines and that these declines can be substantial, with different studies pegging them anywhere from 10 (Stevens 1997) to 25% (Jacobson, Lalonde, and Sullivan 1993). In our context, some teachers may be forced to either part-time status or an alternative, lower-paying position such as a classroom aide. Such scenarios could lead to school closure exerting a negative effect on teachers' future earnings, with the size of that effect depending upon the frequency with which teachers accept lower-paying positions. Finally, closure events could influence some teachers to exit Orleans Parish for other school districts, thus thinning the local labor market while enhancing neighboring

districts.

We test how closure affects the job type of teachers who remain employed in the post-closure period by estimating eq (1) for the following dichotomous outcomes (Y_{t+1}): 1) teaching in a different school, 2) teaching in a different parish, 3) transferring to any non-teaching position, and 4) transferring to an administrative position. Additionally, we examine how closure shapes teachers' subsequent earnings by estimating a variant of equation (1) where we specify Y_{t+1} as a teacher's logged total salary—inclusion in the analytic sample is again contingent upon remaining in Louisiana's public education sector in the post-closure time period. To gain insight into whether any observed closure-induced earnings declines are attributable to position changes, as opposed to lower-paying full-time teaching positions, we also estimate logged salary for the subset of closure-affected teachers who remain employed as full-time teachers in post-closure years. Together, this set of analyses paints a detailed ppenlabor market decisions and outcomes.

6. Results

For each specification of eq (1), we report δ_r, which represents the year-specific difference in exit probability between the treatment and comparison groups, ceteris paribus. Importantly, our two analytic samples provide different insights into the effects of closure. For the first sample, our treatment group includes all teachers at closing schools in the final year of operation. For this sample, we observe the full effects of closure in the closure year and subsequent years, but comparison to prior years is limited by the requirement of teaching when $r=0$. We report coefficients and robust standard errors for sample one relative to exits one year prior to the closure year ($r=-1$). These estimates are reported in Panel A of each results table, and trends over time for treatment and comparison teacher are depicted in corresponding figures.

Because closure can also induce exits in anticipation of the closure year, we also report results for sample two in Panel B of each table. As described above, sample two is selected on working two years prior to closure (*r=-2),* and we observe exit in anticipation of closure by reporting coefficients relative to two years prior to the closure year (*r=-2).*

6.1 Effects on Teacher Exit

Table 2 reports coefficient estimates for the effect of closure on the probability of complete teacher exit from employment in Louisiana's public education sector. Figure 2 illustrates the over-time trends in these effects. In Panel A of Table 2, we estimate that teachers exposed to closure are 6.4 percentage points more likely to exit in the closure year, and 4.2 percentage points more likely to exit in the first post-closure year. In subsequent years, gaps in exit probability between teachers who were and were not affected by closure are not statistically significant, but the point estimates are generally positive. Panel B allows us to observe pre-closure year exit for teachers with a longer attachment to a closing school. Compared to two years prior to the closure event, we observe no statistically significant difference in exit rates in anticipation of closure in *r*=-1, but, consistent with Panel A, we see a statistically significant increase in the exit probability of nearly seven percentage points in the closure year.

[Insert Table 2 and Figure 2 about here]

Columns 2-5 (and 7-10) of Table 2 present estimates for the four policy-relevant subgroups identified above: teachers at takeover schools vs. charter schools teachers, and those affected by full closure vs. management change. Two major findings emerge from this subgroup analysis. First, it is clear that the closure-induced exit from the education sector seen in the full-sample results is primarily attributable to charter school teachers, rather than takeover teachers. Charter school teachers (column 3) are 9.1 percentage points more likely to exit after closure,

compared to a 3.3 percentage point differential for takeover teachers (column 4). For sample two, the difference is even pronounced, with a 12.5 percentage point gap for charter teachers, and a statistically insignificant 3.2 percentage percent gap for takeover teachers. Thus, we see that an unplanned, accountability-based closure event at a charter school is more disruptive to the teacher labor market than the planned transition of takeover schools, regardless of the type of closure.

Second, columns 4-5 of Table 2 demonstrate that teachers whose school is fully closed are much more likely to exit the education sector than their peers in schools that undergo a management change. Across all post-churn time periods, teachers whose school was fully closed were significantly more likely to exit than teachers unaffected by closure, with annual coefficients ranging from 5.4 to 9.2 percentage points. The estimated effects of management changes were statistically significant in the closure year, but insignificant in each subsequent year. Together, these results make clear that both forms of closure induce teacher immediate exit from the education sector, but that the effects of full closure are larger in magnitude and continue to manifest in subsequent years, compared to the effects of reconstituted management.

6.2 Effects on Subsequent Employment

[Insert Table 3 and Figure 3 about here]

Table 3 presents the estimated effect of closure on the probability of teachers exhibiting each of the following four changes in employment position: 1) working at a different school, 2) working at a school outside of Orleans Parish, 3) working in a non-teaching position, and 4) working in an administrative position. As noted above, the sample for this analysis only contains those teachers who remain employed in the education sector following the closure event at their school. As with Table 2, we present results for both of our analytic samples.

All teachers from closing schools must change schools to remain employed, and we estimate that closure leads to a substantial 23.1 percentage point increase in the probability of changing schools in the closure year. Perhaps more surprisingly, though, the increased rate of school switching continues throughout all subsequent post-closure years, with differentials ranging from 6.9 to 12.5 percentage points. This suggests that exposure to closure triggers a longer period of temporary employment at different schools. These effects are corroborated by the results in Panel B (column 5), which also provide evidence of substantial school switching in the year prior to closure. Column 2 of Table 3 illustrates that churn does not just result in teachers changing schools, but also changing the parish where they work. In panel A, teachers affected by closure are 7.1 percentage points more likely than their unaffected peers to work outside Orleans Parish in the closure year, relative to the same difference in the year before closure. The effects in subsequent years are smaller in magnitude but remain statistically significant. These effects are also smaller in our second analytic sample (see Panel B, column 6). Figure 3 displays the over-time trends for job characteristics relative to time-to-closure. Finally, we note that neither analytic sample provides evidence that closure-affected teachers are more likely to move to different positions, either non-teaching or administration, in the post-closure period (Table 3, columns 3-4 and 7-8).

The results in Table 4, however, provide evidence that closure affects teacher pay. The table displays the coefficients on the closure indicators when the outcome is specified as logged teacher pay. The coefficients here reflect elasticities, specifically the percent change in pay for teachers affected by closure, relative to comparison teachers. While teachers under CBAs are typically guaranteed predictable pay increases over time, even if they change schools within a district, New Orleans teachers exposed to closure see an estimated 4 percent decrease in pay

(relative to comparison teachers) in the closure year (column 1), a gap that is generally sustained in subsequent years. Subgroup estimates by school type and closure type (columns 2-5) suggest that pay reductions were concentrated among takeover school teachers and were larger if a teacher experienced full closure than management change.

[Insert Table 4 and Figure 4 about here]

To gain insight into whether pay reductions could be attributable to job changes, we replicate Table 4 with an analytic sample containing only observations when cohort members were employed as full-time teachers (see Table 5). Here, we see no effects overall of closure on teacher pay, suggesting that the pay reductions seen in Table 4 came primarily from teachers who left full-time teaching.

[Insert Table 5 and Figure 5 about here]

Figure 4 illustrates the trends in teacher pay relative to time-to-closure for any job (Panel A) and full-time teaching only (Panel B). They add to our interpretation of Tables 4 and 5 by illustrating a substantial pay gap by closure status for charter school teachers, both before and after closure. In particular, the figure shows that teachers in closing charter schools are paid approximately 10 percent less than similar teachers in non-closing schools. Interestingly, this gap does not appreciably change in the post-closure time period, when affected teachers obtain employment at other schools. Figure 4 further illustrates that teachers at takeover schools received similar pay regardless of closure status across the full time period we examine.

These results led us to investigate whether the effects of closure on the probability of changing employment vary systematically by school type, specifically employment in a charter school versus an RSD school slated for takeover. We present these results in Appendix 2. The results demonstrate that the effect of closure on switching schools and, in some years, parishes, is

significantly larger for charter school teachers than for their peers in RSD schools that are taken over. However, the results also show that closure leads to teachers at schools scheduled for takeover to transfer to both non-teaching positions and administrative positions, at least in the year of closure. Such effects are not apparent for teachers employed by non-RSD charter schools.

6.3 Heterogeneity by Teacher Value-Added

In our final analysis, we investigate whether closures lead to the exit of relatively lower-performing teachers from Louisiana's public education sector. Because only one-third of teachers taught in tested grades and subjects, we begin by estimating the effects of closure separately for teachers in tested (column 1) and untested (column 2) subjects. Those results make clear that the positive effect of closure on teacher exit from Louisiana's public education sector was driven by teachers in untested subjects. Next, we compare teachers with top quintile value-added (column 3) to bottom quintile value-added (column 4). The results suggest that the effects of closure are larger for low-performing teachers than their high-performing peers, but the imprecision of our estimates prevent these results from reaching statistical significance.

[Insert Table 6 and Figure 6 about here]

Together, the results in Tables 2-6 and Figures 2-6 tell a clear story. First, closure significantly increases the likelihood that teachers are absent from Louisiana's public education sector in subsequent years. Teachers exposed to full closures and those employed in charter schools are particularly likely to exhibit closure-induced absence from public education. Second, among teachers who remain in the sector in subsequent years, closure obviously increases the likelihood that teachers are employed in a different school, but it also increases the probability of employment in an entirely different parish. This is a long-term effect that beings in anticipation of closure and continues over time. Closure is also associated with pay reductions among those

who remain employed in Louisiana's public education sector, particularly in non-teaching positions. Finally, closure effects are concentrated among teachers in untested grades and subjects and do not measurably vary by performance for tested teachers.

7. Discussion and Conclusion

The growing number of cities and school districts turning to the portfolio strategy of managing their public schools places increased importance on understanding how accountability driven school closures and management changes – perhaps the defining feature of portfolio systems – affects various aspects of the educational landscape. Existing literature is limited to examining how full closure affects a narrow set of student outcomes, typically reading and math achievement (e.g. Brummet 2014; Bross, Harris, and Liu 2016; de la Torre and Gwynne 2009; Engberg et al. 2012; Carlson and Lavertu 2015, 2016; CREDO 2017; Bifulco and Schwegman 2019; Steinberg and MacDonald 2019). In this paper we build on prior work in two main ways. First, we assess the effects of multiple forms of closure, considering not just closures but also school takeovers and their attendant management changes. Second, we move the focus from students to teachers. Building on work analyzing how churn in the supply of schools affects student achievement, we examine the underlying mechanism of how it shapes teachers' labor market decisions and outcomes. Together, this paper provides among the first evidence as to how this defining feature of the portfolio model affects the most important input to any educational system -- teachers.

Our results make clear that accountability-driven closure affects teachers in several different ways. First, exposure to closure significantly increases the likelihood that teachers exit public education sector in the post-closure time period, with full closures having a particularly pronounced effect in this respect. Second, among those who remain in the public education

sector, closure affects the nature of teachers' subsequent employment positions. Closure obviously increases the probability that teachers are employed in a different school immediately after the event, but it also boosts the likelihood that teachers move to a different school system and increases the probability that some teachers are subsequently employed in a non-teaching position. Closure also appears to trigger a longer-than expected period of employment instability where reemployed teachers continue to change schools and districts for several years after a closure event. Third, our results illustrate that school closure results in pay reductions among those who remain employed in Louisiana's public education sector. Further analysis indicates that these reductions are likely driven by movement to lower-paying, non-teaching positions, rather than accepting a pay reduction while remaining a full-time teacher. Together, these conclusions have important implications for policymakers considering implementation of a portfolio system, as well as for research into those systems.

Our results provide strong evidence that the school churn inherent in portfolio systems alters the composition of the teaching force. Advocates of portfolio systems often tout that as a feature, as an opportunity to eliminate low-quality teachers from the system and replace them with superior ones (Rivkin, Hanushek, and Kain 2005). Crucially, though, this viewpoint depends upon the existence of an untapped supply of better teachers, and there is evidence that systems with many struggling schools typically face a limited supply of alternative teachers (Rothstein 2015). Evidence from New Orleans strongly indicates that entering teachers do not contribute more to student test score growth than exiting teachers, even though the market mechanism on New Orleans appears to selectively exit low-performing teachers (authors, 2018). And, this is likely to be the case in many low-performing, urban school districts. Policymakers need to have a sense of how this dynamic is likely to play out in their context and whether a

portfolio system in their city will actually be able to replace exiting teachers with superior ones. And future research would do well to empirically examine the relative quality of teachers who exit and enter portfolio systems.

Existing discussions and debates over portfolio systems implicitly treat all forms of closure as equivalent by assuming they all contribute to the broader goal of curating a set of uniformly high-quality schools. Our analysis provides evidence, however, that the different forms of closure we examine exert meaningfully different effects on teachers' labor market decisions and outcomes. In general, our results suggest that full closures are much more disruptive than school takeovers—full closures generate greater teacher exit rates from the education sector and larger pay declines in post-closure years. This suggests that policymakers considering implementation of the portfolio strategy might work to design a system that encourages one form of closure over another, with the specific nature of the encouraged shuttering depending upon the goals and needs of the specific context.

On the research side, scholars should consider devoting significantly more attention to analyzing how different forms of closure affect different stakeholders and actors within the education system. As noted above, existing work focuses almost exclusively on how full closure affects a narrow set of student achievement outcomes. Future work should strive to broaden analysis of different forms of churn, as well as the set of outcomes examined.

Finally, our discussion thus far focuses almost exclusively on how the effects of closure on teachers' labor market decisions and outcomes play out in the context of a single portfolio system. It is worth considering more broadly how the nationwide shift toward portfolio systems, particularly in large urban areas, might affect factors related to teacher supply. Historically, part of the appeal of teaching stemmed from the certainty and stability inherent in the profession.

Portfolio systems and the attendant churn in the supply of schools upends part of that certainty and stability, and it remains to be seen how these changes might affect schools' ability to attract high-quality teachers over the long term. More generally, the relative youth of portfolio systems means that we are only in the beginning stages of gaining an understanding of their operations and effects. This paper advances our understanding of one important dimension, but there is still much work left to be done.

Table 1. Summary Statistics by Closure Type

	All	No Closure	Any Closure	Management Change	Full Closure
school type					
Takeover teacher (employed by RSD)	0.22	0.19	0.68	0.72	0.65
Charter teacher (employed by CMO)	0.78	0.81	0.32	0.28	0.35
employement outcomes					
works next year	0.82	0.83	0.74	0.78	0.71
full-time teacher next year	0.78	0.78	0.69	0.72	0.65
works at same school	0.57	0.60	0.16	0.31	0.00
Total salary	47817.76	47641.20	50554.78	50526.94	50584.36
	(8723.16)	(8484.32)	(11486.31)	(10291.54)	(12641.04)
Next year's total salary	49370.71	49403.70	48799.93	49460.98	48028.71
	(9994.45)	(9934.82)	(10965.39)	(10795.27)	(11123.85)
Teacher Demographics					
Black	0.50	0.49	0.64	0.62	0.66
Other race	0.06	0.06	0.04	0.06	0.03
Female	0.74	0.74	0.74	0.78	0.70
Years of teaching experience	9.72	9.60	11.58	11.75	11.40
	(11.55)	(11.50)	(12.28)	(12.33)	(12.23)
First-year teacher	0.15	0.15	0.14	0.14	0.14
Louisiana college graduate	0.59	0.59	0.66	0.68	0.65
TNTP or TFA participant	0.16	0.16	0.15	0.16	0.15
eligible to retire	0.13	0.13	0.16	0.17	0.15
high-demand certificate	0.33	0.33	0.33	0.33	0.33
ma degree or above	0.31	0.31	0.29	0.27	0.31
School Charaacteristics					
Enrollment	557.78	570.15	365.95	439.41	287.92
	(316.54)	(320.24)	(156.54)	(141.77)	(131.87)
Percent on free/reduced lunch	0.81	0.80	0.89	0.90	0.88
	(0.20)	(0.21)	(0.10)	(0.09)	(0.10)
Percent Black	0.86	0.86	0.95	0.96	0.95
	(0.22)	(0.22)	(0.08)	(0.10)	(0.07)
Percent SPED	0.09	0.09	0.10	0.11	0.10
	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
Percent gifted	0.05	0.06	0.02	0.02	0.02
	(0.10)	(0.11)	(0.02)	(0.02)	(0.02)
Enrolls grades K to 8	0.80	0.79	0.83	0.89	0.77
Enrolls grades 9-12	0.34	0.34	0.30	0.24	0.36
School performance score	78.64	79.34	53.54	59.16	49.57
	(29.98)	(29.98)	(16.21)	(20.24)	(11.04)
F-graded school	0.22	0.21	0.39	0.43	0.36
Student return rate (lagged)	0.84	0.85	0.71	0.75	0.67
	(0.14)	(0.13)	(0.16)	(0.11)	(0.20)
Teacher x cohort observations	20248	19021	1227	632	595
Unique teachers	6709	5482	1227	632	595

Notes: Author calculations of mean (standard deviations) from LDOE adminsitrative data. Includes full-time teachers from 2008 to 2015 cohorts who were employed at a single school site in Orleans Parish in the cohort year.

Table 2. Estimated Effects of Closure on Exit from Teaching

	Panel A: Post-Closure vs. 1 Year Prior Teachers Employed in Year 0 (closure year)					Panel B: Post-Closure vs. 2 Years Prior Teachers Employed in Year -2 (two year before closure)				
	All Schools	Takeover Schools	Charter Schools	Mgmt Change	Full Closure	All Schools	Takeover Schools	Charter Schools	Mgmt Change	Full Closure
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Years relative to closure										
-2 years						reference year				
-1 year	reference year					-0.011	-0.014	0.006	-0.018	-0.001
						(0.007)	(0.011)	(0.010)	(0.009)	(0.010)
0 (closure year)	0.064*	0.033*	0.091*	0.037*	0.092*	0.067*	0.032	0.125*	0.065*	0.061
	(0.012)	(0.015)	(0.024)	(0.017)	(0.019)	(0.020)	(0.028)	(0.036)	(0.026)	(0.032)
+1 year	0.042*	0.005	0.097*	0.020	0.069*	0.008	-0.022	0.040	-0.015	0.030
	(0.015)	(0.018)	(0.031)	(0.018)	(0.024)	(0.016)	(0.022)	(0.036)	(0.020)	(0.026)
+2 years	0.027	0.002	0.045	0.008	0.054*	0.010	-0.008	0.009	-0.013	0.041
	(0.015)	(0.019)	(0.031)	(0.018)	(0.026)	(0.018)	(0.024)	(0.030)	(0.022)	(0.029)
+3 or more years	0.022	-0.016	0.055	-0.011	0.066*	0.010	-0.040	0.039	-0.004	0.024
	(0.014)	(0.017)	(0.030)	(0.016)	(0.024)	(0.016)	(0.022)	(0.032)	(0.020)	(0.027)
Observations	101503	23487	78016	98611	98146	59349	10888	48461	57302	56651
Teacher x cohort count	20248	4420	15828	19652	19616	9464	1726	7738	9102	9002
Unique teacher count	6709	1816	5648	6629	6664	3547	872	2956	3465	3433

* $p<0.05$

Notes: Coefficients (standard errors) from linear probability estimation of teacher exit at the end of the school year based on eq (1). Table diplays the estimated effect of a closure on the probability of exit. Sample is selected on employment in year 0 for Panel A and year -2 for Panel B. Closures occur at the conclusion of year 0. Teacher exit is defined as full exit from Louisiana public school employment. Models also include fixed effects for time relative to cohort closure year, school year fixed effects, teacher's initial school of employment in Louisiana, and teacher-by-cohort and time-vary covariates for student demographics (number of students, % FRL, % black, % SPED, % gifted, and elementary or high school grades served), teacher qualifications (advanced degree, extra certifications, and retirement eligible), and school performance (state report card score, failed state accountability, and student re-enrollment rate). All standard errors are clustered at the teacher level.

Table 3. Estimated Effects of Closure on Job Characteristics

	Panel A: Post-Closure vs. 1 Year Prior Teachers Employed in Year 0 (closure year)				Panel B: Post-Closure vs. 2 Years Prior Teachers Employed in Year -2 (two years before closure year)			
	Changed School	Changed Parish	Non-Teaching Position	Admin Position	Changed School	Changed Parish	Non-Teaching Position	Admin Position
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Years relative to closure								
-2 years					reference year			
-1 year	reference year				0.094*	0.018	-0.000	0.001
					(0.022)	(0.012)	(0.010)	(0.007)
0 (closure year)	0.231*	0.071*	0.011	-0.005	0.348*	0.058*	-0.030*	-0.006
	(0.020)	(0.011)	(0.009)	(0.005)	(0.028)	(0.019)	(0.015)	(0.010)
+1 year	0.125*	0.042*	-0.007	-0.006	0.122*	0.022	-0.031*	0.000
	(0.022)	(0.011)	(0.011)	(0.006)	(0.023)	(0.014)	(0.014)	(0.009)
+2 years	0.069*	0.028*	-0.003	-0.003	0.098*	0.000	-0.016	0.003
	(0.023)	(0.011)	(0.013)	(0.008)	(0.026)	(0.014)	(0.014)	(0.010)
+3 or more years	0.118*	0.031*	-0.031*	-0.015*	0.148*	0.017	-0.040*	-0.007
	(0.021)	(0.010)	(0.012)	(0.006)	(0.026)	(0.015)	(0.016)	(0.009)
Observations	90407	90407	90407	90407	55354	55354	55354	55354
Teacher x cohort count	19180	19180	19180	19180	9434	9434	9434	9434
Unique teacher count	5670	5670	5670	5670	3519	3519	3519	3519

* $p<0.05$

Notes: Coefficients (standard errors) from linear probability estimation of job characteristics in the next school year school year based on eq (1). Table diplays the estimated effect of a closure on next year's job location or type, conditioned on employment. Sample is selected on employment in year 0 for Panel A and year -2 for Panel B. Closures occur at the conclusion of year 0. Non-teaching positions (columns 3 and 7) include any positions other than full-time classroom teacher. Admin positions (columns 4 and 8) include supervision of instruction. Models also include fixed effects for time relative to cohort closure year, school year fixed effects, teacher's initial school of employment in Louisiana, and teacher-by-cohort and time-vary covariates for student demographics (number of students, % FRL, % black, % SPED, % gifted, and elementary or high school grades served), teacher qualifications (advanced degree, extra certifications, and retirement eligible), and school performance (state report card score, failed state accountability, and student re-enrollment rate). All standard errors are clustered at the teacher level.

Table 4. Estimated Effects of Closure on Pay (logged) - Any Position

	Panel A: Post-Closure vs. 1 Year Prior Teachers Employed in Year 0 (closure year)					Panel B: Post-Closure vs. 2 Years Prior Teachers Employed in Year -2 (two year before closure)				
	All Schools	Takeover Schools	Charter Schools	Mgmt Change	Full Closure	All Schools	Takeover Schools	Charter Schools	Mgmt Change	Full Closure
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Years relative to closure										
-2 years						reference year				
-1 year	reference year					0.006	-0.001	0.062*	0.015	-0.008
						(0.012)	(0.016)	(0.019)	(0.016)	(0.019)
0 (closure year)	-0.040*	-0.037*	-0.000	-0.027*	-0.056*	-0.027	-0.005	-0.013	-0.009	-0.050*
	(0.011)	(0.014)	(0.023)	(0.013)	(0.020)	(0.015)	(0.021)	(0.034)	(0.018)	(0.025)
+1 year	-0.033*	-0.025	-0.023	-0.027*	-0.039	0.001	0.034*	0.016	0.008	-0.008
	(0.012)	(0.015)	(0.020)	(0.013)	(0.022)	(0.013)	(0.017)	(0.029)	(0.015)	(0.022)
+2 years	-0.018	-0.000	0.005	-0.010	-0.029	0.008	0.019	0.055*	0.015	0.003
	(0.011)	(0.014)	(0.020)	(0.012)	(0.021)	(0.014)	(0.016)	(0.026)	(0.015)	(0.028)
+3 or more years	-0.047*	-0.023	-0.006	-0.042*	-0.052*	-0.014	0.004	0.017	-0.013	-0.006
	(0.013)	(0.016)	(0.022)	(0.016)	(0.022)	(0.016)	(0.020)	(0.036)	(0.018)	(0.028)
Observations	77081	19274	57807	75133	74331	55354	9902	45452	53473	52886
Teacher x cohort count	14983	3687	11296	14582	14470	9434	1716	7718	9075	8975
Unique teacher count	5148	1514	4221	5101	5107	3519	862	2936	3438	3408

* p<0.05

Notes: Coefficients (standard errors) from linear estimation of total pay (logged) in the next school year school year based on eq (2). Table diplays the estimated effect of a closure on next year's total pay as an elasticity. Sample is selected on employment in year 0 for Panel A and year -2 for Panel B. Closures occur at the conclusion year 0. Estimates in Panels A and B are conditioned on continued employment in any position. Models also include fixed effects for time relative to cohort closure year, school year fixed effects, teacher's initial school of employment in Louisiana, and teacher-by-cohort and time-vary covariates for student demographics (number of students, % FRL, % black, % SPED, % gifted, and elementary or high school grades served), teacher qualifications (advanced degree, extra certifications, and retirement eligible), and school performance (state report card score, failed state accountability, and student re-enrollment rate). All standard errors are clustered at the teacher level.

Table 5. Estimated Effects of Closure on Pay (logged) - Full-time Teaching Positions Only

	Panel A: Post-Closure vs. 1 Year Prior Teachers Employed in Year 0 (closure year)					Panel B: Post-Closure vs. 2 Years Prior Teachers Employed in Year -2 (two year before closure)				
	All Schools	Takeover Schools	Charter Schools	Mgmt Change	Full Closure	All Schools	Takeover Schools	Charter Schools	Mgmt Change	Full Closure
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Years relative to closure										
-2 years								reference year		
-1 year			reference year			0.000	0.007	0.020*	0.000	-0.000
						(0.004)	(0.005)	(0.007)	(0.004)	(0.006)
0 (closure year)	-0.001	-0.000	0.023*	0.005	-0.009	-0.002	0.015	0.022*	0.006	-0.012
	(0.003)	(0.004)	(0.007)	(0.005)	(0.006)	(0.005)	(0.008)	(0.011)	(0.007)	(0.010)
+1 year	-0.004	0.001	-0.007	-0.002	-0.005	0.002	0.008	0.002	0.009	-0.008
	(0.004)	(0.005)	(0.007)	(0.005)	(0.006)	(0.005)	(0.007)	(0.009)	(0.006)	(0.008)
+2 years	0.006	0.012*	0.012	0.005	0.008	0.009	0.007	0.026*	0.014*	0.002
	(0.004)	(0.006)	(0.008)	(0.005)	(0.008)	(0.005)	(0.007)	(0.011)	(0.006)	(0.008)
+3 or more years	-0.011*	-0.002	0.002	-0.009	-0.012	-0.016*	-0.012	-0.002	-0.013	-0.014
	(0.005)	(0.006)	(0.008)	(0.005)	(0.009)	(0.006)	(0.008)	(0.010)	(0.008)	(0.009)
Observations	59719	14292	45427	58337	57587	41142	7258	33884	39774	39347
Teacher x cohort count	13975	3446	10529	13614	13492	8842	1629	7213	8497	8431
Unique teacher count	4359	1300	3622	4339	4337	3146	790	2620	3071	3061

* $p<0.05$

Notes: Coefficients (standard errors) from linear estimation of total pay (logged) in the next school year school year based on eq (2). Table diplays the estimated effect of a closure on next year's total pay as an elasticity. Sample is selected on employment in year 0 for Panel A and year -2 for Panel B. Closures occur at the conclusion year 0. Estimates in Panels A and B are conditioned on continued employment as a full-time teacher. Models also include fixed effects for time relative to cohort closure year, school year fixed effects, teacher's initial school of employment in Louisiana, and teacher-by-cohort and time-vary covariates for student demographics (number of students, % FRL, % black, % SPED, % gifted, and elementary or high school grades served), teacher qualifications (advanced degree, extra certifications, and retirement eligible), and school performance (state report card score, failed state accountability, and student re-enrollment rate). All standard errors are clustered at the teacher level.

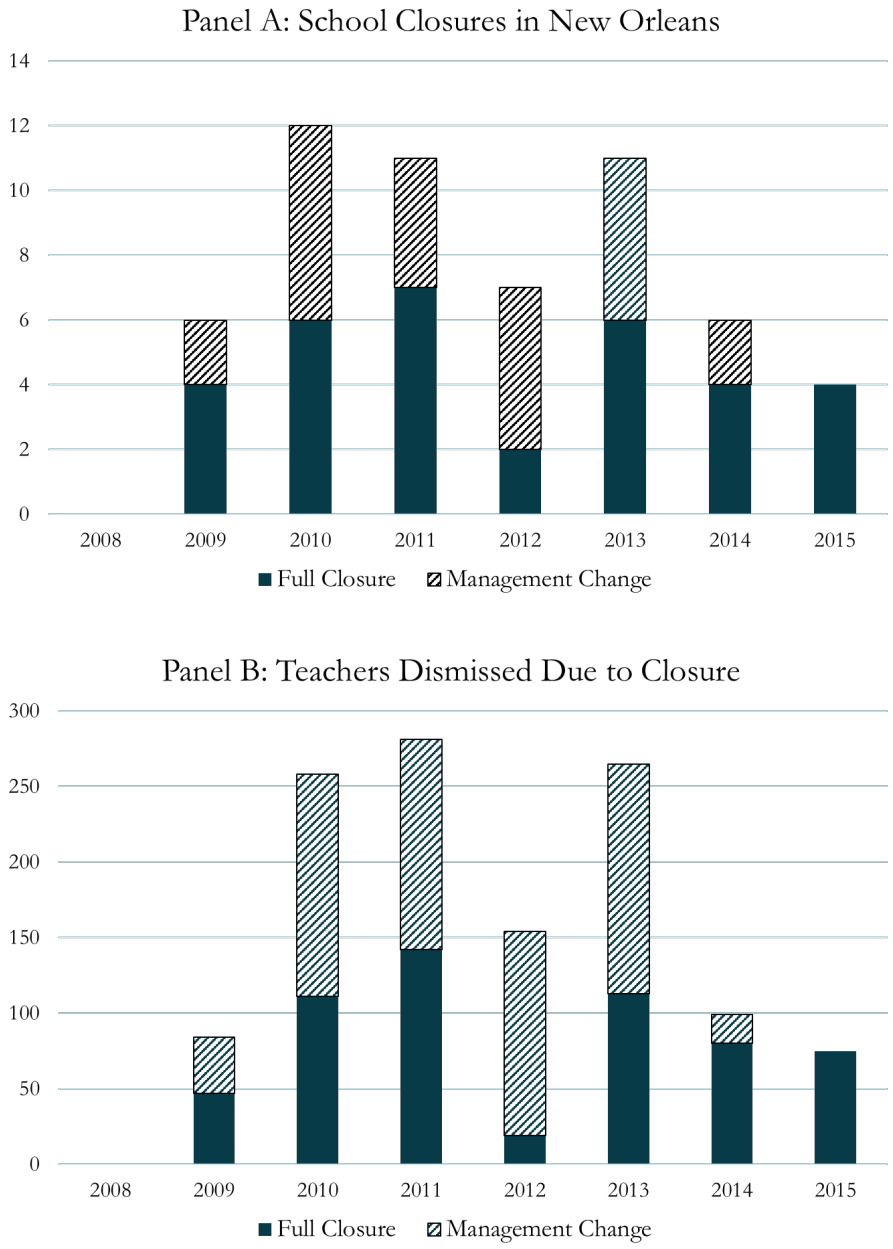
Table 6. Estimated Effects of Closure on Exit - Disaggregated by Teacher Value-Added

	Panel A: Post-Closure vs. 1 Year Prior Teachers Employed in Year 0 (closure year)				Panel B: Post-Closure vs. 2 Years Prior Teachers Employed in Year -2 (two years before closure year)			
	Tested Teachers	Untested Teachers	High-VAM Teacher	Low-VAM Teacher	Tested Teachers	Untested Teachers	High-VAM Teacher	Low-VAM Teacher
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Years relative to closure								
-2 years						reference year		
-1 year		reference year			0.008	-0.004	0.032	0.005
					(0.011)	(0.014)	(0.027)	(0.026)
0 (closure year)	0.005	0.064*	-0.037	0.033	0.063	0.067*	-0.057	0.115
	(0.022)	(0.018)	(0.072)	(0.034)	(0.036)	(0.028)	(0.030)	(0.069)
+1 year	0.025	0.051*	-0.053	0.014	0.001	0.021	-0.070	0.000
	(0.025)	(0.020)	(0.091)	(0.034)	(0.027)	(0.022)	(0.041)	(0.043)
+2 years	0.031	0.039	-0.082	0.071	0.018	0.042	-0.096*	0.100
	(0.026)	(0.021)	(0.066)	(0.042)	(0.028)	(0.025)	(0.043)	(0.053)
+3 or more years	-0.004	0.050*	-0.114	0.001	0.087*	0.021	0.049	0.111*
	(0.027)	(0.021)	(0.065)	(0.038)	(0.036)	(0.026)	(0.114)	(0.055)
Observations	23552	57310	4473	4981	17048	30048	3617	3078
Teacher x cohort count	5523	13944	988	1237	3352	6095	685	632
Unique teacher count	2064	5011	418	641	1295	2399	271	334

* $p<0.05$

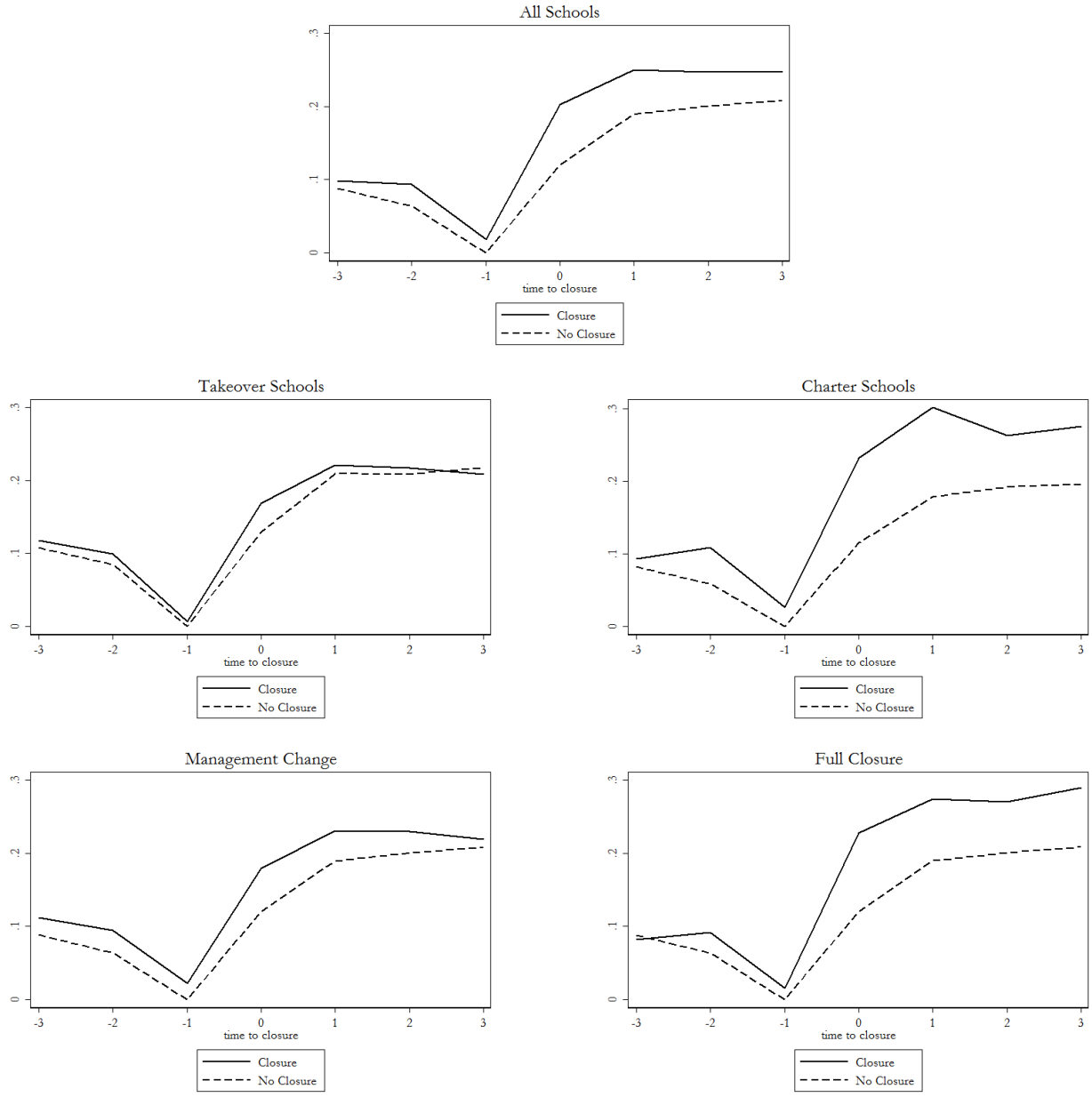
Notes: Coefficients (standard errors) from linear probability estimation of teacher exit at the end of the school year based on eq (1). Table diplays the estimated effect of a closure on the probability of exit. Sample is selected on employment in year 0 for Panel A and in year -2 for Panel B. Closures occur at the conclusion year 0. The teacher valued-added measure (VAM) was estimated by the researchers (see appendix 1). Teacher subsamples include teachers in tested subjets and grades (Columns 1 and 4), teachers not in tested subjects and grades (Columns 2 and 5), teachers in tested subjects and grades whose average VAM in years prior to year 0 was in the top quartile among cohort members (Columns 3 and 7), and teachers who average VAM in years prior to 0 was in the bottom quartile among cohort members (Columns 4 and 8). Teacher exit is defined as full exit from Louisiana public school employment. Models also include fixed effects for time relative to cohort closure year, school year fixed effects, teacher's initial school of employment in Louisiana, and teacher-by-cohort and time-vary covariates for student demographics (number of students, % FRL, % black, % SPED, % gifted, and elementary or high school grades served), teacher qualifications (advanced degree, extra certifications, and retirement eligible), and school performance (state report card score, failed state accountability, and student re-enrollment rate). All standard errors are clustered at the teacher level.

Figure 1. Annual School Closure in New Orleans



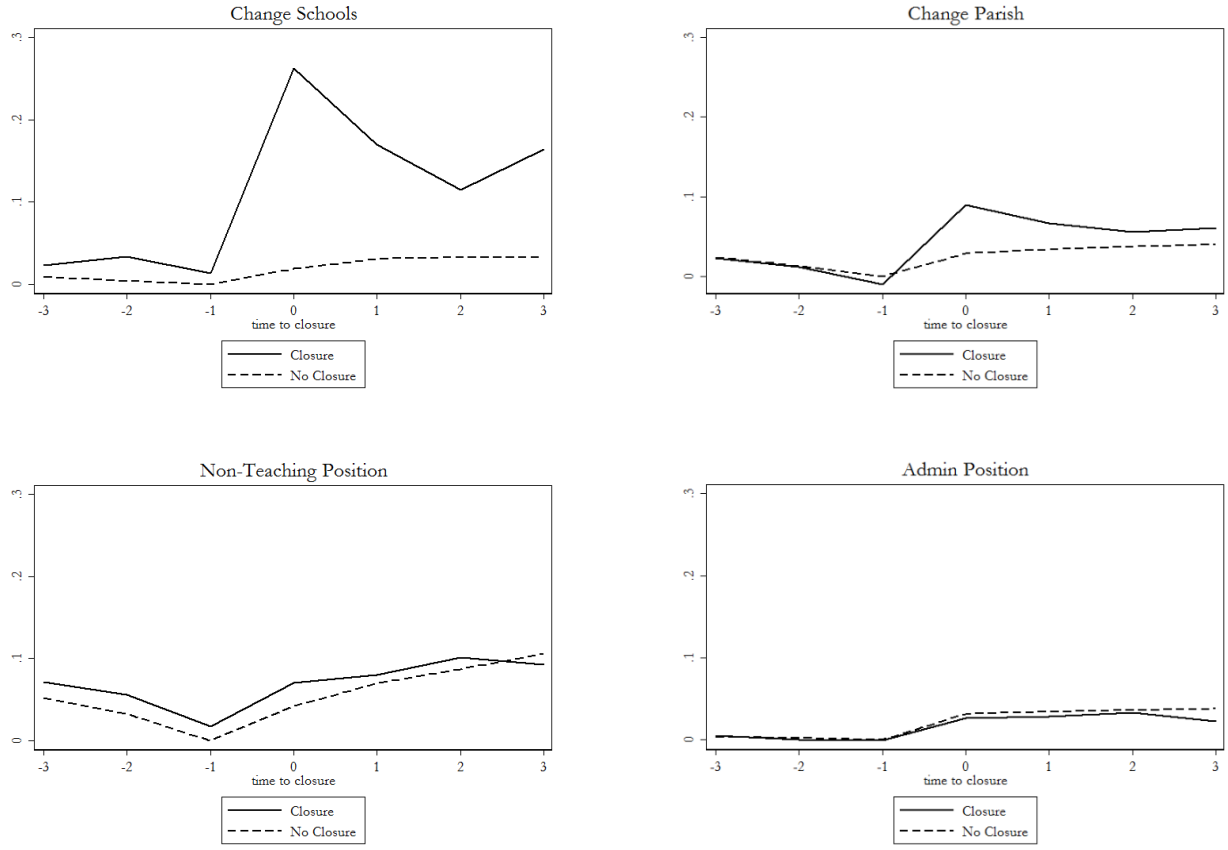
Notes: Author calculations from LDOE administrative data and supplementary documents.

Figure 2. Probability of Exit over Time-to-Closure



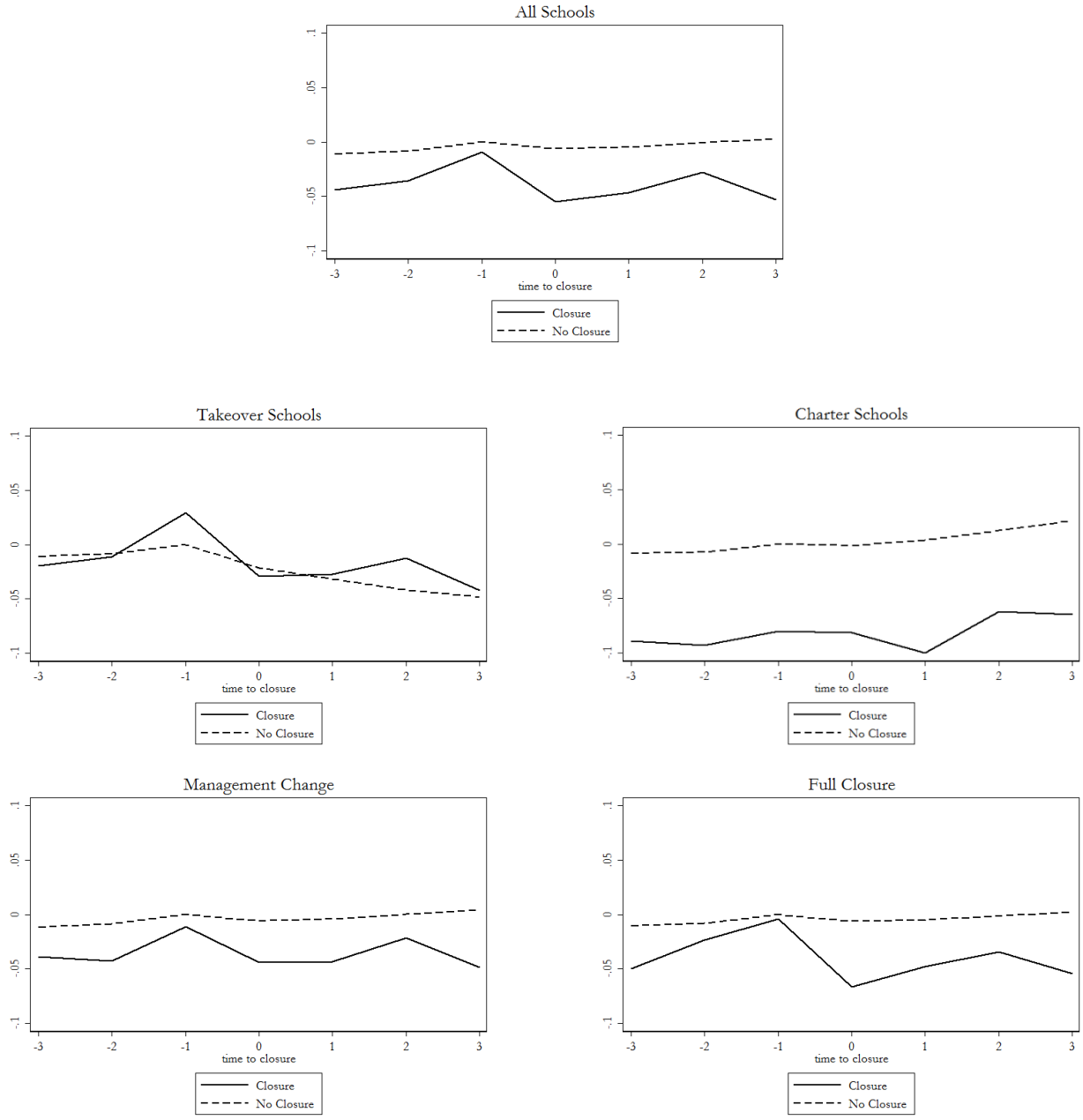
Notes: The y-axis displays estimated exit probability relative to an untreated teacher at time=-1. The sample is selected on teaching at time=0, and treated schools are closed at the end of time=0. The dependent variable is exit for employment in Louisiana public schools. Corresponding coefficients and statistical significance are reported in Table 2.

Figure 3. Probability of Changes in Job Characteristics over Time-to-Closure



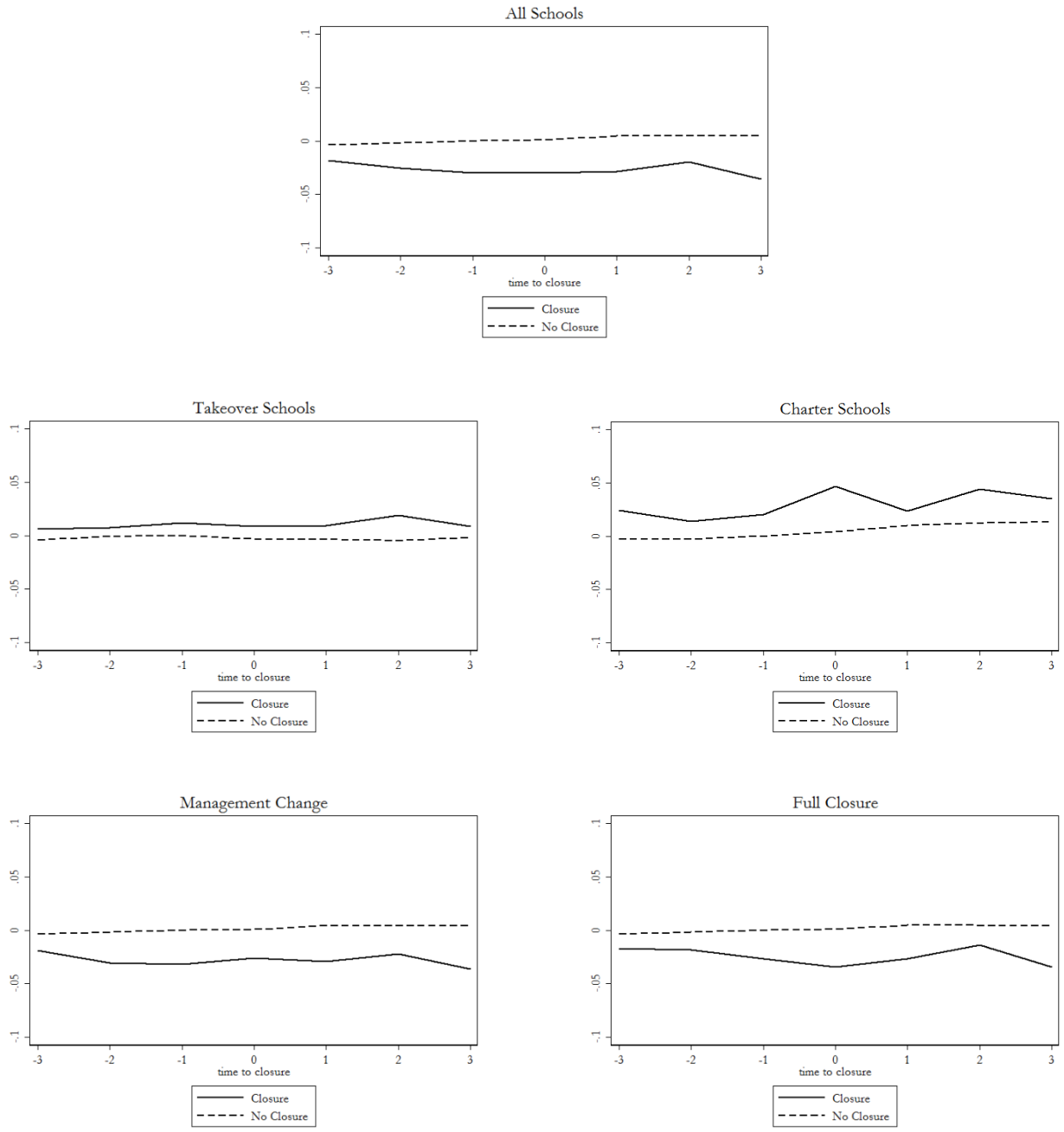
Notes: The y-axis displays estimated probability of job changes, conditioned on continued employment, relative to an untreated teacher at time=-1. The sample is selected on teaching at time=0, and treated schools are closed at the end of time=0. Corresponding coefficients and statistical significance are reported in Table 3.

Figure 4. Changes in Total Salary over Time-to-Closure – Any Position



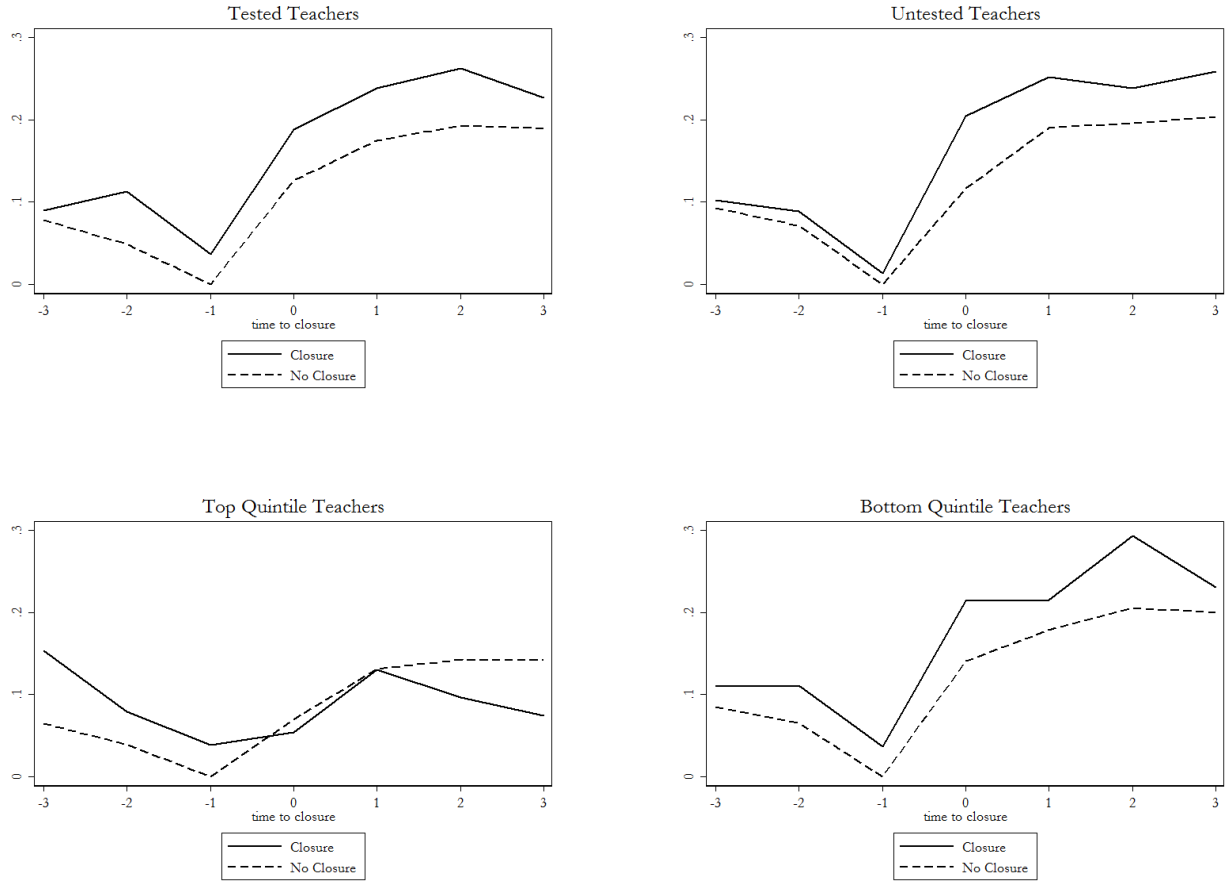
Notes: The y-axis displays estimated changes in salary, conditioned on continued employment, as elasticities relative to an untreated teacher at time=-1. The sample is selected on teaching at time=0, and treated schools are closed at the end of time=0. The dependent variable is logged total salary. Corresponding coefficients and statistical significance are reported in Table 4.

Figure 5. Changes in Total Salary over Time-to-Closure – Full-Time Teaching Positions Only



Notes: The y-axis displays estimated changes in salary, conditioned on continued employment as a full-time teacher, as elasticities relative to an untreated teacher at time=-1. The sample is selected on teaching at time=0, and treated schools are closed at the end of time=0. The dependent variable is logged total salary. Corresponding coefficients and statistical significance are reported in Table 5.

Figure 6. Probability of Exit over Time-to-Closure – Subgroups by Value-Added



Notes: The y-axis displays estimated exit probability relative to an untreated teacher at time=-1. The sample is selected on teaching at time=0, and treated schools are closed at the end of time=0. The dependent variable is exit from employment in Louisiana public schools. The teacher value-added score estimates are described in Appendix 1. Top and bottom quintile bins are determined based on the average of all years and subjects in year prior to closure relative to all cohort members. Corresponding coefficients and statistical significance are reported in Table 6.

Appendix 1: Teacher Value-Added Model

For a given teacher j, student i, classroom c and school year t, we estimate a standard value-added model:

$$A_{it} = \mu + \alpha A_{it-1} + \beta X_{it} + \rho C_{ct} + \theta_{jt} + \varepsilon_{it}$$

- A_{it}: post-score
- A_{it-1}: pre-score
- X_{it}: student characteristics
- C_{it}: classroom characteristics
- θ_{jt}: value-added of teacher j in year t
- ε_{it}: error term for student i in year t

The model is estimated by year (2009-2015) and subject (math, ELA, science, social studies).

Following Guarino et al. (2015), the above value-added model can be re-written as:

$$y = X\gamma + Zb + u$$

X includes student demographics and prior test scores. Z includes course taking dummies. u contains the unobserved student-specific effects. b is the vector of teacher effects.

The shrunken value-added estimate for teacher j is then:

$$\hat{b}_j = \left(\frac{\sigma_b^2}{\sigma_b^2 + (\sigma_u^2/N_j)}\right)(\bar{y}_j - \bar{x}_j\hat{\gamma})$$

Let $c \equiv \frac{\sigma_b^2}{\sigma_b^2+(\sigma_u^2/N_j)}$. It represents the shrinkage factor. σ_b^2 is the variance of the teacher effects, b_j. σ_u^2 is the variance of the student-level error, u. N_j is the number of students taught by teacher j. $\bar{y}_j - \bar{x}_j\hat{\gamma}$ is the unshrunken estimate.

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