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Why these schools? Explaining school closures in Chicago, 2000-2013

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Executive Summary

Our study sheds light on the multiple, often conflicting interests that school districts must balance to plan for the capital needs of school-age populations. We investigate the factors that led to the closure of public schools in Chicago between 2000 and 2013. We reverse engineer the school closure decisions under two mayoral administrations by constructing a logit model that estimates the decision to close schools that were open as of 2000 as a function of physical, student, geographic, political, and neighborhood demographic factors. Our findings reveal that building utilization and student performance were predictors of these closures, but so was the race of students in each school. Specifically schools with larger shares of African American students had a higher probability of closure than schools with comparable test scores, locations, and utilization rates. Whether administrators explicitly considered the race of a school's students in planning decisions or whether race in our model was a proxy for other unmeasured characteristics, the cumulative effect of technical decisions interacting with a racially differentiated education environment forced African American students and their families to bear the burden of these administrative disruptions.

Introduction

In 2002, Jacob Riis Elementary School on Chicago's Near West Side was shuttered. The stated reason for closing the school was declining enrollment, leading to the underutilization of the facility. The school was located near a collection of public housing developments known as the ABLA Homes, and at the time, residents were being relocated from the units slated for demolition and redevelopment under the Chicago Housing Authority's "Plan for Transformation." As the population in the complex declined, so too did enrollments at the local schools.

After the closure of Riis, the Chicago Board of Education conveyed the property to the City of Chicago so the City could convert the area encompassing the ABLA homes and Riis Elementary into a mixed-income housing development dubbed "Roosevelt Square." Instead of preserving the structurally sound school for the anticipated residents of the 2,400 new units planned for the site, the City's Department of Planning and Development and Chicago Public Schools opted to demolish the historic structure. The City razed the school in 2004, claiming it was necessary to provide green space for the massive, 35-block development (Preservation Chicago 2003).

In planning for Roosevelt Square, neither planners nor school district administrators seemed concerned about the roles that schools play in neighborhood development. Families moving into the new townhomes, condos, and apartments were forced to send their children to schools located far away from their homes and many ended up moving out of Roosevelt Square when their young children came of school age -- in part, because of the lack of quality neighborhood schools (Riley 2013). Residents implored the City to build a new high school in the area, proposing underutilized parcels in the Roosevelt Square area as prospective sites and providing estimates for the cost of the new school. But due to a half billion-dollar deficit, the proposal was scuttled.

The demolition of Riis Elementary in the heart of a high-profile, new housing development reflects the history of educational facilities planning in the city. Major investment and disinvestment decisions in school buildings often appear uncoordinated and disconnected from other planning decisions and market trends(Chicago Educational Facilities Task Force 2014). Such behaviors are not unique to Chicago: the municipal planning field has largely ignored school planning, leaving these decisions to school districts who often operate in the dark as far as larger development trends are concerned (Vincent 2006).Despite classic works by Perry (1929) and Stein (1957) on the importance of schools in planning for the "neighborhood unit," there has been little recent empirical analysis on the siting or closing school facilities within the context of planning. This is disconcerting given the fact that the location and quality of schools have significant effects on the economic vitality, property values, population changes, transportation patterns, and quality of life in urban areas.

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This paper explores the topic of school planning in large, urban districts. It examines trends in thinking about schools as part of the infrastructure of cities and then turns to a specific case of educational capital planning. The city of Chicago garnered national attention for closing 49 public schools in 2013. The Chicago Public Schools (CPS) argued that these schools were "underutilized," i.e., student enrollments were below the classroom capacities of the school buildings. As the first major school district in decades to shutter a large number of schools in one year, CPS came under fire for closing some underutilized schools, particularly those in African-American neighborhoods, but not others. Critics saw the closures as yet another blow to struggling neighborhoods of color whose infrastructure had been poorly maintained for decades and where residents were forced to travel further distances to attend school than students from wealthier areas.
We reverse engineer CPS' school closure decisions looking not only at the 2013 round that occurred

under Mayor Rahm Emanuel but also at earlier closures that took place during Richard M. Daley's administration. We construct a logit model that estimates the decision to close schools that were open as of 2000 as a function of physical, student, geographic, political, and neighborhood demographic factors. We seek to quantitatively analyze the measurable factors behind CPS's decision to close these particular schools and not others, in the process answering the following empirical questions: did CPS close the most underutilized schools? Were the closures planned in the sense that they were spatially optimized and related to demand and supply conditions?

Multivariate analysis of the predictors of school closure suggests that seemingly technical planning criteria, such as utilization and changes in demand, influenced the complex decision to close schools in Chicago during this period. However these criteria are joined by others that point to some inherent biases in the capital planning process. The share of black students and student test scores were also predictive of closures.

Our findings are important because they shed light on the multiple and conflicting interests that school districts must balance to serve the needs of their school-age populations. They reveal some distance between the "official" rationale for closures and the realities of capital budgeting under austerity. Other urban school districts like those in Philadelphia and Boston have made similar decisions in recent years and have been confronted with similar degrees of parent and community outrage. Our findings can help inform debates around these issues in future cases.

Capital planning for K-12 education

In the immediate postwar years, the authority to site educational facilities rested with state governments, who handed down standards for school construction based primarily on suburban models (Seelig 1972). For example, state school boards dictated minimum land area requirements for different kinds of schools (Planning Advisory Service 1952). In subsequent years, school districts - as their own special-purpose units of government and taxing bodies - gained more autonomy with their decision-making powers, superseding even local zoning ordinances (although this varies across states; Vincent 2006).[3] School planners have mainly been left to their own devices in determining whether they should close or build schools in response to population shifts and fiscal exigencies (McDonald 2010).

What factors typically affect the decision to build or close schools in large school districts? Local governments and education advocates have long debated the proper location and physical types of educational facilities. They have disagreed about the degree to which large numbers of smaller schools should be sited in individual neighborhoods or whether larger, centralized schools should be accessible to students in multiple neighborhoods. The nineteenth and early twentieth century ideal was for schools to anchor the residential "neighborhood unit" (Perry 1929; Stein 1957). In the 1960s, however, the idea of an "education campus" caught on to generate efficiencies gained from concentrating different kinds of facilities in a central location of a city (So 1968). In recent years concerns about children's health and safety have emerged. For example some planners have suggested that elementary school students walk no more than half a mile, or ride a school bus for no more than 20 minutes to cut down on commuting and improve safety (Miles, Adelaja, and Wyckoff 2011; Yu 2015).

School planners have also debated whether facilities should be designed to privilege flexibility or durability. Older buildings were built according to architectural and engineering standards that are often difficult to retrofit to handle computers, air conditioning, and smaller classroom sizes. Modular classrooms with open floor plans, often separated by walls that could be moved as needed, and portable classrooms gained popularity in the 1960s as communities dealt with a sudden influx of students, and user-friendliness came to be seen as part of the educational experience (Moore 1991; Marks 2009). In more recent years, parents and advocates have urged attention to "natural light, indoor air quality, temperature, cleanliness, acoustics, and classroom size," which could "positively or negatively affect learning and productivity" (McKoy, Vincent and Makarawicz 2013, 185). Newer schools may be better able to deliver these amenities; even when controlling for socioeconomic differences, students in newer facilities outperform peers in older schools, and teacher retention is higher there as well (ibid.).

As school facilities have aged, they have fallen into disrepair. In many ways the obsolescence of older school buildings, like other urban infrastructures, is the result of their maintenance (or lack thereof) rather than a product of their original design. Earlier waves of school facilities were reaching an age when decisions about their future viability needed to be determined just as the budget cutbacks of the 1970s and 1980s were occurring. The result was a general deferment of basic facility maintenance such that by the 1990s a "crisis" in the nation's public school infrastructure was declared by the National Education Association and others.[4] Most of the deficient facilities were in urban areas primarily serving low-income and minority students – in stark contrast to suburban school districts and affluent communities in the same district and metropolitan areas (American Society of Civil Engineers 2005; Kozol 1991).

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[3] Most states no longer require acreage minimums that are unfeasible in urban areas (McDonald, Salvesen, Kuhlman, and Combs, 2014).
[4] In 2000, nearly one-third of all public school buildings in the country were in a serious state of disrepair, requiring at least $322 billion to bring to operative standards (National Education Association, 2000).

Some school districts responded by renovating and retrofitting older schools. Others closed schools with habitual maintenance problems, either consolidating students in other older schools or building new facilities. In making these decisions, school planners may consider demographic changes across neighborhoods – all weighed against their, mostly shrinking, budgets. Which direction school districts move in may be determined by the formulas states use to determine obsolescence and cost recovery;[5] forecasts about student enrollments; and their district's attitude toward charters and other privatized forms of public education.

School districts talk of "right sizing" their aging inventories to meet the changing numbers and needs of students while at the same time seeking to accommodate different pedagogies. For example, "small school" formats were touted in the 2000s as better for student learning outcomes, given the individual attention students could receive from teachers (Meier 2002; Lipman 2011). However this educational strategy directly conflicts with the notion of design utilization, which sets a bar for the "efficient" use of classroom space and encourages more students per classroom to provide economies of scale. Moreover city support for new charter schools is intended to increase the choices of parents but works at cross purposes with the desire for effective facility utilization, as charters cannibalize enrollments from public schools.

Whereas in the early 2000s school closures were largely linked to academic performance, budget realities coupled with a politically influential "reform" movement have shifted the commonly cited reasons for them to underutilization and fiscal concerns (Johnson 2012). Between 2001 and 2010, six major U.S. cities closed 197 school buildings while restructuring their school systems to include more new-build charter and selective enrollment schools.[6] The older schools were closed because of enrollment declines, building deterioration and obsolescence, general budgetary pressures, poor academic performance, and the rise of charter schools and other alternatives that lowered the demand for traditional public schools (Pew Charitable Trust 2013).

The shift to right-sizing and efficiency is a seemingly technocratic response by decision makers to community opposition, which has been strong.[7] In all cities experiencing closures, protest groups have challenged the seemingly arbitrary nature of these decisions, particularly in light of the fact that the closed schools are often located in high poverty neighborhoods.[8] These apparent disparities raise questions of bias and equity, such that it is important to determine empirically the factors influencing these important decisions.

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[5] Vincent (2006) describes a system by which states subsidize new school construction if the cost of renovating an older school exceeds 60 percent of the cost of a new school. However, the new school cost estimate rarely takes into account the costs of site acquisition, water and sewer connections, and transportation infrastructure – making the cost of building a new school appear artificially low.

[6] This included 44 schools in Chicago, 59 in Detroit, 29 in Kansas City, Missouri, 20 in Milwaukee, 22 in Pittsburgh, and 22 in Washington, D.C. (Pew Charitable Trusts 2013).

[7] Planners and geographers developed various engineering-based, multifactorial models to assist districts in optimizing school locations and selecting schools for closure and consolidation. These models take into account constraints such as how many schools the district can afford to support, how far students will need to commute to access their assigned schools, attendance areas, maintaining racial "balance," the number of students that will be disrupted by school reassignment, and the level of utilization at each school that remains open. See, for example, Church and Murray (1993) who refine Diamond and Wright's (1987) model.

[8] In a study of New York City's 1980 school closings, Dean (1983) determined that the closures primarily impacted communities that were worse off than the control group in terms of hosting a higher percentage of residents on public aid, less educated residents, and housing with higher building code violations.

School capital planning in Chicago

An examination of recent school planning in Chicago reveals a history of fragmented authority, perpetual fiscal strain, and alternating philosophies for educational reform. In 1979, with the Chicago Public Schools on the verge of bankruptcy, the State of Illinois negotiated a relief package on the condition that the district surrender financial control to the state. The State formed the Chicago School Finance Authority (CSFA) to manage CPS' affairs and impose fiscal discipline over the system. In order to reduce the district's debt, the CSFA prohibited CPS from issuing bonds for capital improvements, opting instead to defer maintenance on aging buildings over the next fifteen years. By the early 1990s, audits of school facilities found them to be in abominable condition (Heard 1994). Parents protested holding fallen bricks from their childrens' schools in hand (Interview with Jackie Leavy 2010).

In order to restore municipal control over its public schools, Mayor Richard M. Daley and the Chicago business community successfully lobbied the legislature to pass the 1995 Chicago School Reform Amendatory Act (Lipman 2011). The 1995 reform influenced three areas pertinent to school capital planning: mayoral control, bonding authority, and accountability through school actions.

First, the Act recentralized control over the schools in the mayor's office, empowering Daley to appoint school board members and the CEO of Chicago Public Schools (a position he gave to his budget director Paul Vallas). These appointments gave the Mayor leeway to prioritize new school construction, a real estate-oriented response to socio-economic problems that was in keeping with many of his other political and policy moves (Weber 2015).

Second, the Act restored fiscal authority and bonding power to CPS, enabling it to repair school facilities and build new ones through debt financing. Vallas and the Chicago Board of Education (CBOE) immediately issued $2.5 billion in school bonds to renovate aging buildings across Chicago, improve existing operating systems, provide new laboratories and playgrounds, and construct new school buildings. Most of new schools were built to either relieve overcrowding in majority-Latino neighborhoods or to expand the number of "high performing" schools: i.e., Montessori and gifted elementary schools and International Baccalaureate, magnet and selective enrollment high schools (see Table 1). As they were intended to reach a city-wide market, most of the selective enrollment high schools were centrally located and massive, with the capacity to accommodate over 1,500 students each.

Third, CPS was given more power to monitor and intervene with schools that exhibited poor academic performance. Using standardized tests as well as graduation and attendance rates as indicators, Vallas implemented a punitive system of "school actions" for low-performing schools (see Table 2). Problematic schools were first put on a warning list, and if standards were not raised, the school would be put on probation and subject to additional centralized control. Finally, if a school could not demonstrate improvement, it would either be phased out or reconstituted with new administrators and teachers. During this new era of accountability, over Parent and community groups assailed school actions as a form of "shock therapy" that disciplined poor children of color (Johnson 2012; Peck and Reitzug 2013).

The roll out of high performing schools along with punitive school reform efforts coincided with the early stirrings of a

Table 1: Types, Number, and Percentage of CPS Schools (2015)

School Type	Definition	Number of Schools in CPS system	Percentage of CPS schools*
Neighborhood	School assigned to a local attendance boundary. Generally, all students who live within the boundary may attend the school.	502	86% of all elementary schools 49% of all high schools
Selective Enrollment High Schools	Schools that offer a rigorous curriculum with mainly honors and Advanced Placement (AP) courses. Acceptance based on application and entrance exam. No attendance boundary as students are selected from a city-wide application process.	11	6% of all CPS high schools
Magnet	Specialized schools that focus curriculum on one particular subject area, such as math/science, humanities, or world language.	43	9% of all elementary schools 3% of all high schools
Regional Gifted Elementary	Schools that provide an accelerated instructional program that emphasize thinking, reasoning, problem solving and creativity. Acceptance based on application and entrance exam.	13	3% of all elementary schools
Charter	Public-private partnerships managed by a non-profit or for-profit charter school operator that has some degree of autonomy from the Chicago Board of Education, CPS Central Office mandates, and public accountability standards. They receive tax dollars to fund their operations and admit children across the city who apply, occasionally using a lottery system.	130	12% of all elementary schools 40% of all high schools
Contract	Contract schools are operated by private entities under contract with CPS to provide an additional education option for students, such as alternative high schools or open enrollment turnaround schools.	11	5% of all high schools

Table 2: School Action Definitions

School Action	Term used by Chicago Public Schools to refer to the consolidation, closure, phase-out, or "turnaround" of schools with low enrollment or poor academic performance.
Consolidation	When two or more schools are combined into a single school. Students from the closed school are reassigned to the consolidated school facility.
Closing or Closure	When a school is shuttered and students are reassigned to one or more designated receiving neighborhood schools.
Phase-out	The gradual cessation of enrollment in certain grades each school year until a school closes or is consolidated with another school.
Reconstitution/Turnaround	The principal, staff, and teachers are dismissed and a new set of professionals is hired to reorganize the school and curriculum. The school is reopened as the open-enrollment attendance boundary public school, serving the same children.

downtown development boom centered on corporate headquarters, business services, and the financial sector (Weber 2015). Starting in the late 1990s, the city added millions of square feet in office, housing, and retail space to the Central Area. Schools were seen as instrumental in anchoring the professional and middle class families who would work or live downtown in the face of pressure to relocate to the suburbs (Lipman 2011). Scholars observed patterns of building selective enrollment schools and closing neighborhood schools, only to reopen those facilities as high performing schools, in the "zone of transition"[9] surrounding the Central Area (see Smith and Stovall 2008; Lipman, Smith, and Gutstein 2012; Farmer and Poulos 2015).

Despite these policies, performance levels in the majority of schools on probation did not budge. Vallas resigned his post in 2001, after which Arne Duncan was appointed CEO. Duncan came to CPS preaching a "school choice" philosophy. According to this perspective, parents should be empowered to choose the school that is the best fit for their child. Duncan encouraged the expansion of charter and contract schools. The emphasis on choice formed the foundation of the Renaissance 2010 ("Ren10") school reform initiative, which advocated the closure of persistently low performing schools in order to allow a new set of school operators to manage schools where CPS failed. When the initiative was introduced, administrators called for the closure of 60 to 70 low-performing neighborhood schools and the opening of 100 new "choice" schools (a combination of one-third neighborhood and high-performance public schools and two-thirds privatized charter and contract schools). Duncan also reinvigorated Vallas' reconstitution policy, renaming it a "turnaround" strategy and contracting with a private school operator, the Academy of Urban School Leadership, to operate 32 of the turnaround schools.

[9] Part of the concentric zone model of urban form developed by the Chicago School of sociology, this area is located between the central business district and outer rings of working-class and middle-class residence. Burgess (1923) believed this area contained slum housing because it was always at risk of being annexed by CBD expansion.

In order to accelerate the pace at which Ren10 schools could be operationalized, the Daley Administration unveiled a billion-dollar school construction program, Modern Schools across Chicago (MSAC). MSAC aimed to build 24 schools, and renovate and modernize several others using tax increment financing (TIF) revenues to offset the cost of new construction (Farmer and Poulos 2015). TIF enabled the city to finance school construction outside of and in addition to the normal channels. TIF revenue also empowered the City Council's 50 aldermen to influence facilities planning decisions as they worked with CPS to bring new schools and improvement funds to their wards. To cover their portion of the MSAC program, CPS floated auction rate securities whose interest rates were swapped to hedge any increases. Although initially cheaper than fixed rate debt, the auction market collapsed in 2008. This triggered millions in penalties, a credit rating downgrade, and exceedingly high borrowing costs for CPS (Grotto and Gillers 2014).

Between 2001 and 2009, when Duncan left office to become the U.S. Secretary of Education, CPS closed 73 public schools and opened 87 new schools, 62 of them charters. Ninety percent of school closures for low academic performance impacted majority low-income and working class African-American communities, and to a lesser extent, Latino communities on the city's South and West Side neighborhoods (Caref et al. 2012). The closures encountered substantial resistance from parents, who often cited students crossing gang lines, the burden a shuttered school on families and neighborhoods already in decline, and the inconsistency of the policy (some low performing school were closed while others remained opened) as the sources of their frustration.

When Rahm Emanuel was elected Mayor in 2011 he took a different approach to school planning than his predecessor. Rather than focus solely on performance, the Mayor vowed to "right size" the system by shuttering underutilized schools and shifting this cost savings to schools that had higher enrollments relative to the physical capacity of the school. The intent was to "move students to higher performing options, consolidate into fewer buildings, and keep our better buildings in operation, where feasible" (Chicago Public Schools 2013). Instead of closing a handful of low-performance schools each year, Emanuel proposed closing a large number of schools in one fell swoop. The CEOs he appointed, first Jean-Claude Brizard and then Barbara Byrd-Bennett, pinned the problem on exogenous population decline, declaring that public school enrollments had shrunk by over 100,000 students since 2000. Critics charged that choice schools, especially the 140 new charter and contract schools opened throughout the 2000s, and the demolition of public housing units throughout the city contributed to enrollment declines in public schools (Farmer 2012). Regardless of the cause, Emanuel took a financial feasibility approach to facilities planning, legitimizing the closures by pointing to the system's inability to operate low-enrollment schools in the face of CPS' billion-dollar deficit (Ahmed-Ullah 2011; Chicago Public Schools 2013).

Complying with the state's school closure process, the Chicago Board of Education established guidelines for utilization, determining thirty students as the ideal number of students for a fourth grade classroom. Using this student-classroom ratio as the benchmark, the Board determined that school buildings were "efficient" if their enrollments were in the range between 20 % below or 20 % above the ideal enrollment. Schools categorized as "underutilized" had enrollments below the efficient range (i.e., less than 24 students per classroom). Employing this standard, CPS determined that 330 of its elementary and high schools were underutilized.

The Board then formed an independent, nine-member Commission on School Utilization to conduct a community engagement process and, based on public input, to narrow the criteria for closing underutilized schools. The Commission decided to exclude high schools (due to the risk of gang violence), high performing schools, and schools with recent school actions from the list of proposed school closures (Commission on School Utilization 2013).

As a result of these exceptions, the list was whittled down to 129 schools in December 2012. After a deliberation process concluding in March 2013, CPS released a list of 54 elementary schools that would be closed, consolidated or phased-out plus the closure of one high school program (co-located in a facility where the elementary school section remained opened) or approximately ten percent of all CPS schools.

The closure list was subject to another round of public hearings where administrators encountered vehement public resistance. To shore up its case, CPS provided information sheets, which included the estimated costs to repair each facility. A radicalized and resurgent Chicago Teachers Union, emboldened by a successful strike in 2012, joined disgruntled parent groups by vocalizing their opposition to CPS' school closings decisions at the public hearings and staged massive street protests throughout the decision-making process (Uetricht 2014).

Despite the protests, CPS submitted the final list of the 54 schools to be closed to the Board on May 2013. The CBOE approved the closure of fifty schools, withdrawing four from the list (one school slated for closure was later removed from the list). In response to the public fallout, Byrd-Bennett committed CPS to a subsequent five-year moratorium on facility closures of district-operated schools due to performance or underutilization. CPS also created an Educational Facilities Master Plan, which sought to balance future school facilities planning with current and projected enrollment trends.[10]

When the school year concluded, 49 schools permanently shut their doors. Taking into account receiving schools (the neighborhood school assigned to children from closed schools), the school closings impacted 133 schools serving more than 47,000 students (Radinsky and Waitoller 2013). Like previous waves of school closings, nearly 90 % of the students impacted were African-American, leading many observers to question whether utilization was the primary factor influencing CPS' decision (de la Torre et al. 2015). In addition, Radinsky and Waitoller (2013) found that nearly 15 % of impacted students had learning disabilities and were enrolled with an individualized education program.

The closures also profoundly transformed the role of school facilities as community anchors. After 2013 more than half of Chicago students did not attend their assigned neighborhood school (Smith, Richards and Perez 2016). Such changes disproportionately impacted educational access for students living in disadvantaged neighborhoods. Burdick-Will (2015) found the average commute time of children from low-income neighborhoods was 2.7 miles, with a quarter of children traveling distances greater than four miles. In contrast higher-income students traveled, on average, 1.7 miles to school, and almost none of them traveled more than four miles.

The City was quick to reposition the closed school facilities as assets and opportunities for redevelopment. Mayor Emanuel created the Advisory Committee for School Repurposing and Community Development, composed of a group of civic and real estate leaders. The Committee developed an implementation plan for repurposing the sites.[11] As of 2015, CPS had sold or repurposed 11 of the shuttered facilities.

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[10] The Chicago Educational Facilities Task Force, created by the Illinois State Board of Education to review and assess school facilities, found the plan lacking in transparency and public participation. They found insufficient coordination in capital planning with other agencies, in particular, the Chicago Housing Authority. CHA's demolition of public housing had serious implications for the relocation of school children across the city but CPS failed to accommodate these population shifts with its programming and capital plans.

[11] The Advisory Committee reviewed recommendations from various existing community planning efforts, including the Community Action Councils' plans and LISC Chicago's Quality of Life plans, as well as citywide plans like Sustainable Chicago 2015, Chicago Neighborhoods Now, the City's Five-Year Housing Plan, and the Chicago Housing Authority's Plan Forward. The City of Chicago and various sister agencies, such as the Chicago Park District, were asked to review the properties and identify those with repurposing potential.

Methodology and data description

The acrimony surrounding the school closures in Chicago and in other large, urban districts as well as the general lack of knowledge about the drivers of school capital planning led us to scrutinize the factors administrators may have taken into consideration when they made these difficult decisions. With a statistical model such as ours, we can also identify patterns or empirical regularities that reflect the unintentional or unstated inputs into their decisions. Although we cannot capture the historical dynamics that may have led to patterns during our circumscribed study period or the reasoning behind parents' decisions to send their children to one school and not another during that time, this kind of spatial analysis allows us to control for many of the factors that are quantifiable and that were likely in play during the period in question.

Based on justifications provided by administrators and elected officials, we hypothesize that, all else being equal, the probability of closure increases as a school's utilization decline. In other words, a school building with low occupancy relative to capacity is a candidate for closure. We also acknowledge the counter-arguments provided by parents, the Chicago Teacher's Union, and watchdogs by including variables that measure the demographic composition of both the students in each school, student attributes, and the neighborhood in which the school is located. We also include political variables to capture the politicized nature of CPS and City expenditure decisions.

We test these hypotheses by looking at all public elementary, middle, and high schools that were open in Chicago as of January 1, 2000. We compare those that were closed any time between 2000 and 2013 to those that remained open throughout this period. We constructed and estimated a model that treats each closure as a decision made by administrators in response to myriad building, student, political, geographic, and neighborhood characteristics.

Dependent variables: Measuring school closures

While straightforward on its surface, measuring the dichotomous outcome variable of closed/not closed is challenging because schools operate as either organizations or as a physical facilities, or as both. Many of the "school actions" (see Table 2) that occurred during this fourteen-year period eliminated one of these identities but not the other. As such the broad terminology of "closure" could be used to describe any of the following: a school organization that completely exited the market and whose building was shuttered; two or more school organizations that merged into one facility ("consolidation" where students from one school are reassigned to another); a school building that was closed, sold to a charter school and operated under a new name; a school building that was damaged (by fire, extreme maintenance issues) and closed; a branch of a larger school organization that was closed but other divisions of the school remained intact; a school building that was renamed, signaling a new organization as an occupant; or a school organization that was closed and then re-opened as a different kind of organization but stayed in the same building.

Because of the potential for confusion due to the dual identities of schools, we developed criteria for classifying schools as closed. School actions had to meet two of the three criteria in order to be considered a closure: 1) the organizational integrity of the school was compromised; 2) the school building was shuttered, taken out of active duty, or demolished; 3) the school building or organization became accessible to a different student population. As such, we would consider a neighborhood school to have closed if it changed its name (criteria 1: its organizational integrity changed) and was converted to a selective enrollment school (criteria 3: a radical change in admissions procedures would impact the composition of the student population) - even if the "new" school operated out of the same physical facility and maintained the same address.

While these criteria allowed us to classify most school actions, the case of the "turnaround" schools remained problematic. Turnarounds were motivated by poor student performance and involved the removal of the majority of teachers and administrators and their replacement with a new cohort of both. A turnaround meets the first criteria in that a complete change in employees constitutes a compromise of the school's organizational integrity. However most schools that went through this process stayed in their pre-turnaround facility and if the school remained an attendance area school, the same neighborhood children could enroll in it.[12] Between 2000 and 2014, CPS conducted a turnaround in 37 schools, with most occurring during the Daley era. Data on turnaround schools was provided by CPS and crosschecked with data from the Chicago Teacher's Union and WBEZ.[13] To deal with this "in-between" yet sizeable group of school actions, we treat turnarounds in some of the model runs as closures while in others, we consider them to be schools that remained open for the duration of the study period.

The data set used in the estimation of this model contained one record per school. Data on the individual schools that existed in 2000 were obtained from the CPS website, the Neighborhood Capital Budget Group archives, and the Illinois State Board of Education, which assigns a unique identifier ("school ID") to each school (as opposed to the "unit number" that makes the issue of classifying schools with multiple branches or addresses easier). We confirmed the address of each school using the CPS School Locator application. Because of the unique nature of their student bodies or governance structure, we excluded charter, pre-kindergarten, alternative, special education, and contract schools (See Table 1). However we retained career, classical, magnet, career academies, military, neighborhood, regional, and selective enrollment schools in the database. This brought the sample down to 541 (from 662), of which 458 were elementary schools, 16 were middle schools, and 67 were high schools.[14]

Of the 541 schools in our sample, 97 (17%) were closed during the 2000-2013 study period. When including the 37 turnaround schools, 134 (24.3%) of the sample could be considered closures and closure-like school actions. In other words, without controlling for any variables, the probability of closure was about .244 or 1 in 4 and the odds of closure about .32 (the probability divided by one minus the probability). An almost equal number were closed or turned around during the Daley and Emanuel administrations: 67 (Daley) and 65 (Emanuel). Of the total closed schools, 14 % were high schools and 86 % were elementary schools.

Model specification

Multinomial logit models predict the probability of an event occurring as a linear combination of predictor variables. When there is a severe split or imbalance in the outcome variable (for example, a 1 in 10 probability of closure), performing a logistic regression is not appropriate. However the distribution of the outcome variable in our sample (closer to 1 in four or five, depending on whether turnarounds are included) makes predicting such an outcome less of an issue. Moreover with 541 observations, our dataset meets accepted standards for the minimum number of cases (see, for example, Long 1997).

In our model, each school that existed in 2000 has a probability of experiencing closure during the 2000-2013 period as defined by P_i. We do not assume, as Burdick-Will, Keels and Schuble (2013) do, that only those schools that were put on a CPS probation list for poor performance were candidates for closure because our data covers not only a larger period of time but also a wave of school actions where building utilization was likely prioritized over

[12] After a turnaround, enrollments are almost always lower than they were before the action – indicating that not all students return. Thanks to Dave Stovall for pointing this out.
[13] See https://www.wbez.org/shows/wbez-news/the-history-of-school-closings-in-chicago-200212/cdfc0755-27b9-48de-b5be-bce992124048
[14] Many elementary schools go through eighth grade, which explains the paucity of middle schools.

performance. To estimate the probability of a closure occurring, we take the natural log of the odds of experiencing the event (the ratio of P_i to $1-P_i$) or logit and regress it on different categories of independent variables. The model can be specified as:

Equation (1) $\ln (P_i/(1-P_i))= \beta_0 + \beta_1 * x_1 + ... + \beta_k * x_k + \varepsilon$

when x_1, .., x_k are a set of predictor variables, and the regression coefficients (β_k) represent the relationship of each predictor variable (x_k) to the odds that a school would be closed during this period. The exponentiated coefficients can be interpreted as the percentage change in the odds of a closure occurring per unit of change in each covariate.

Independent variables

Our sample of public schools was merged with data from various sources to provide additional information about the characteristics of each school. For the final models, we winnowed the number of independent variables down to only those that were highly correlated with the probability of closure. To avoid potential multicollinearity, however, we did not include in the same model those variables that were highly correlated ($r = \pm .70$) with each other. As such we dropped variables such as the percent Hispanic residents in a census tract in 2000 (which was highly and inversely related to the percent black residents in the same tract in 2000) and home ownership rates by tract in 2000 (which was highly correlated with median family income in 2000). Means and standard deviations for our independent variables can be found in Table 3.

Table 3: Descriptive Statistics - Means (Standard Deviations)

Table 3: Descriptive Statistics - Means (Standard Deviations)	Not Closed Schools	Closed Schools and Turnarounds
Building & Facilities Variables		
Apples 2 Apples Utilization Rate	1.054 (0.025)	0.584 (0.021)
Age of Building in 2000 (years)	58.963 (1.655)	58.602 (2.691)
Gross Floor Area (Sq Feet)	107665.50 (4033.963)	129591.477 (9180.718)
Student Variables		
Change in Enrollment 1999-2006	-0.026 (0.014)	-0.238 (0.028)
Percent Meet or Exceed Test Standards, 2001	0.416 (0.010)	0.227 (0.009)
Percent Black, 2000	0.477 (0.024)	0.887 (0.021)
Percent Low-Income, 2012	0.835 (0.012)	0.949 (0.009)
Percent English Language Learners, 2000	0.337 (0.012)	0.235 (0.018)
Neighborhood Demographics		
Median Family Income in 2000 (2010 dollars)	48191.845 (901.605)	31063.232 (1293.456)
Median Home Value in 2000 (2010 dollars)	193229.077 (4974.91)	155740.380 (7433.22)
Change in Median Home Value, 2000-2010	0.467 (0.037)	0.576 (0.046)
Change in School Age Population, 1990-2000	0.099 (0.017)	-0.084 (0.023)
Black Population in 2000	0.411 (0.022)	0.817 (0.026)
Change in Black Population, 2000-2010	0.015 (0.015)	-0.042 (0.007)
Spatial Variables		
Distance to Nearest Charter School (miles)	1.017 (0.040)	0.609 (0.041)
Distance to Nearest New CPS School (miles)	1.182 (0.043)	1.400 (0.066)
Distance to Central Business District (miles)	7.298 (0.166)	6.076 (0.262)
Political Variables		
Alderman on Finance Committee	0.677 (0.023)	0.797 (0.035)
Within TIF District	0.218 (0.021)	0.263 (0.038)
N=541		

Even though these explanatory variables are correlated with the decision to close a school, we do not believe that reverse causation is a serious concern. In other words, the expected closure of a school is not likely to have affected the probability that attendance dropped, utilization declined, or that student performance decreased in advance of this decision; these factors are likely exogenous variables influencing the closure decision instead of vice versa. The timing of most of the independent variables predates the closure decision for that school, with percent change variables defined for the year before the school action occurred whenever possible. For example, for a school closure that occurred in 2010, explanatory variables that measured percent change were defined for the period between 2000 and 2009. Moreover, while parents would know their schools were on probation, the final list of schools to be closed was kept under lock and key during the Emanuel round of closures. As such it would be unlikely that anticipatory knowledge of a closure would have influenced the explanatory variables.

Our explanatory variables can be grouped into five categories that might influence closures: a school building's structural characteristics, a school's student population, the local demographic characteristics in the area surrounding the school building, the school building's geographic proximity to other schools and areas of population density, and political factors. These characteristics alter the likelihood of a school building being perceived as underutilized and hence enter into the closure probability function.

Building We considered several measures of building quality and utilization. Recognizing that the "wide variability among building types and ratios of non-instructional spaces to instructional spaces does not render an equitable or reliable measure of space utilization" (Chicago Educational Facilities Task Force 2014), CPS devised generic measures that could be applied across schools. For elementary schools, CPS measured utilization based on the number of students per homeroom classroom, where home rooms were estimated at 76 % of the total classrooms available in the facility (the remaining classrooms were assumed to be dedicated to sciences labs, music, art, and special education instruction) and for high schools, the "total instructional classrooms" was used. For CPS an average of 30 students per classroom meant the school was adequately utilized.

To determine a utilization rate, each school's "design capacity" (sometimes called "maximum capacity") was identified as the total number of homerooms multiplied by 30. This number was then compared to the number of students enrolled in the school during the 2012-2013 school year (or during the last year the school was opened, if closed prior to 2013). CPS considered a school to be at "efficient enrollment" if its actual population fell in the range between 20 % below to 20 % above its maximum capacity. Anything above or below were considered overutilization or underutilization, respectively. The utilization rate formula set the actual student population over the maximum capacity.

Many parents and advocates were critical of the 30-student measure of utilization. Two Chicago-based parent and community research organizations, Raise Your Hand and Apples to Apples, jointly published a report criticizing CPS' one-size-fits-all measure for failing to account for the actual physical size and use of individual schools and classrooms (Apples to Apples 2013; Raise Your Hand 2012).

For example schools with larger concentrations of special needs students were likely to require more breakout and activity rooms,[15] and "community" schools tended to have more classrooms to accommodate the many non-school activities by community members, such as political meetings, work readiness programs, and childcare. Moreover, on pedagogical and legal grounds, these organizations argued that few classrooms could "safely and comfortably" accommodate 30 or more students. Because filling classrooms with 30 students could impede learning outcomes, CPS' own contract with the teacher's union stated that the maximum number of students in K-3 grades was 28 students per classroom and in grades 4-12 was 31 students (Apples to Apples 2013). As such, they argued for a lower standard -- of 25 students -- as the "ideal program enrollment" for measuring maximum capacity, with 30 students as the recommended maximum. Using the standard of 25 students reduced the number of schools considered "underutilized" to 178 schools from the 330 schools CPS had first identified as underutilized.

We used both Apples to Apples and CPS utilization rates, although not in the same model. Of the schools that were closed during the Daley administration, 34 were missing a utilization rate. For these schools we estimated the number of classrooms from the current school building (based on CPS Facilities Reports), comparing actual enrollment in the year before the school closed to CPS ideal enrollment from the classroom count.[16] Using this blunt measure of spatial efficiency, schools that closed had a 58 % utilization rate on average, falling well below CPS's ideal utilization range of 80 to 120 % enrollment. Schools that were not closed were better utilized in that, on average, they were 105 % percent occupied.

From CPS Energy Star and Facilities Reports, we know that 73 % (485 of 662) of public school buildings in Chicago were constructed before 1970. Each building reflects different and historically-specific design philosophies of how to best educate school-aged children and the role that schools should play in neighborhoods (and in the larger society). Older schools are often denigrated for lacking structural integrity, adequate amenities, and efficient building systems although these features are determined less by age than by the degree of maintenance and investment the building has received over time. Nonetheless because age is often perceived as a parsimonious representation of quality, we include "years between date of delivery and 2000" as an explanatory variable. On average, closed and open schools has the same mean age in 2000 (59 years old, which means they were built around 1941).

Student Demand for school services is represented by enrollment change by school for 2000-2013. ISBE and CPS provided information on average daily attendance and registered students. We expect that declining demand for education in the school's service area would lead to closures. We evaluated other measures of demand– including change in student-age population of a census tract – but found that because so many children attend school outside their neighborhood "attendance area" actual school enrollment was a superior indicator.

Particularly during the Daley administration, schools could be shut or turned around because of poor performance. CPS uses its own performance rankings but these changed several times over the study period (for example, in 2013 they moved from a three-tiered rating system to a five-tiered one). As such, we use a school's average scores from the obligatory Prairie State Achievement Examination (PSAE; which measures achievement of grade 11 students in reading, mathematics, science, and writing) and Illinois Standards Achievement Test (ISAT; which measures the achievement of students in reading and mathematics in grades three through eight) from 2001 as measures of

[15] Thank you to Federico Waitoller for pointing this out.
[16] We were unable to find classroom or enrollment data for five schools

student performance. Data on the percent of student test-takers who met or exceeded expectations for the school was provided from ISBE School Report Cards. Schools with higher test scores are less attractive candidates for closure as utilization issues are likely outweighed by a desire to keep classes small if students are thriving.

Large urban school districts have historically filtered resource allocation decisions through the prism of race (Baum 2004). Cost savings and investment have never been distributed equally, with higher-income white students disproportionately benefiting. For example mobile classrooms, dubbed "Willis Wagons" after Chicago Schools Superintendent Benjamin Willis, were set up for black students in the early 1960s despite available classroom space in white schools (Gyure 2011). In contrast, the City's attempts to hold onto middle class households may have disinclined CPS toward closing schools where parents earned higher incomes. We take into account the percent black students and percent low income students in each school. On average, schools that were closed had almost twice the share of black students (88.7 %) as the schools that remained open (47.7 %). Closed schools had 11.4 % percent more low-income students than schools that stayed open.[17]

Neighborhood demographics As neighborhood characteristics have been shown to influence student outcomes like academic performance and mental health (for literature review, see Formoso, Weber, and Atkins 2013), it is not surprising that CPS may take the demographics of a school's host neighborhood into account when making planning decisions. The nature and number of schools may be differently assigned across micro-geographies depending on a neighborhood's attributes and changes occurring there. For example, more English as a Second Language services would be needed in neighborhood schools where the immigrant population is increasing. CPS has been accused of closing and reopening schools as selective enrollments in gentrifying areas (that often have fewer and more affluent children) and of permanently closing schools in those neighborhoods that are majority black (Smith and Stovall 2008).

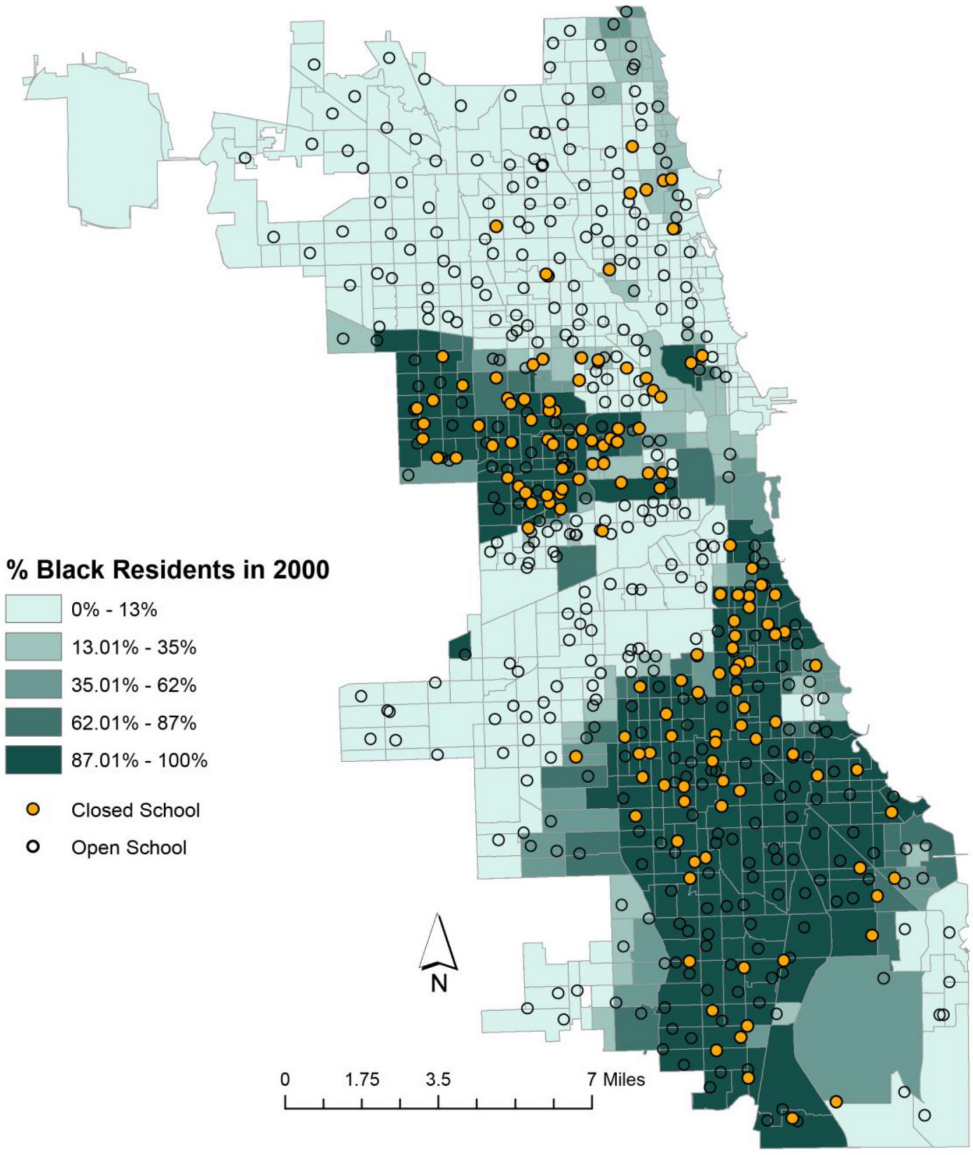
Choosing a spatial unit of analysis is difficult because of the potential for bias due to the unit's relationship with other factors (e.g., census tracts are drawn according to population size, which may interact with the independent and dependent variables). Burdick-Will, Keels and Schuble (2013) overlay uniformly-sized quadrats on census tracts to avoid this issue. We alternated different geographies – namely, census tracts and zip codes – and compared results to control for this potential issue. We did not find a significant different when using one or the other despite the fact that census tracts generally cover smaller geographies than zip codes.

CPS uses five socio-economic indicators (single parent households, median family income, education attainment score, percent of population speaking a language other than English, and home ownership rates) to develop its own index of socioeconomic status. Burdick-Will Keels and Schuble (2013) also use an index of neighborhood disadvantage that measures education levels, poverty, and unemployment in the areas surrounding elementary schools. Given that these factors are likely to have separate effects on the closure decision, we disaggregated the index into separate variables, pulled directly from the 2000 and 2010 Census. The Longitudinal Tract Database provided a crosswalk that allowed 2000 geographies to be compared to the same geography in 2010 despite the fact that census tract boundaries changed substantially between the two census counts (see Logan et al. 2014). This allowed us to account for the level and changes in relevant neighborhood characteristics. We included economic (median household income and percent owner-occupied housing units) and demographic variables (percent black change in black population 2000-2010)

[17] CPS defines "economically disadvantaged" students as those whose families are below 185 % of the federal poverty line.

that may affect either CPS' planning decisions or the relative political power of neighborhood residents to resist administrative decisions, attract public investment, or suffer privation. Burdick-Will et al. (2013) found that their index of current neighborhood disadvantage affected the probability of closure until they accounted for school characteristics, at which point these variables became insignificant. However it is important to note that they look only at elementary schools, where attendance areas and neighborhoods are more likely to overlap.

Figure 1: School Closures by Percent Black Residents in Census Tract 2000



Spatial Measures of competing supply are provided by variables reflecting the spatial distance (in miles) from each school address to the closest charter and newly-constructed schools. Although we recognize that distance is not the same as access (e.g., it doesn't take into account the quickest way to walk, drive or take transit to the school), proximity to these alternatives is likely to influence not only student demand for public school services, but also how administrators value existing schools in their vicinity. In Chicago charter schools are located in neighborhoods near, but not in, those that are the highest-poverty (LaFleur 2016) and tend to "cream" higher performing students from nearby public schools, weakening the sending school's performance and depleting it of students (Institute on Metropolitan Opportunity 2014).[18] The majority (54 %) of the charter schools in Chicago are high schools so this effect may be more pronounced in public high schools that compete with them for students. As such, we measured distance from same-school-type charter so this variable captures the distance of public elementary schools to the closest charter elementary school and the same for high schools.[19] Charter school addresses were found through the CPS School Locator website. On average, the school buildings in our sample that were closed were about .61 of a mile from the closest same-type charter school, while those that remained open were 1.017 miles from the nearest charter (with a standard deviation of about 0.040 of a mile).

A similar kind of cannibalization could occur when a new public school is opened in the vicinity of an older one. During our study period 43 new public schools were constructed in the city. These schools were located in areas that had, on average, a large share of Latino residents and experienced population growth (8 %) between 2000 and 2010.

We also measure a school's distance to the central business district of Chicago (located at the intersection of State and Madison Streets, the base point for Chicago's street numbering system). This variable captures the relative spatial isolation of a school address. We would imagine that more isolated schools are less visible and therefore easier to close without serious political fallout. However, on average, closed schools were located slightly closer to the CBD: 6.07 miles away versus 7.2 miles for schools that were not closed.

Political Chicago is divided into 50 legislative units or "wards", each of which elects an alderman to represent it in City Council. Because of the politicized nature of the closure decision, we hypothesized that the power of an alderman might prevent a school in their ward from closing. We identify each school address with a ward and use aldermanic membership in the important Finance Committee as a proxy for this kind of political power.

Because tax increment financing (TIF) districts have been associated with gentrification (Weber, Bhatta and Merriman 2007), we employed variables that measure two dimensions of TIF district characteristics: whether a school fell within a TIF district's boundaries and how much funding that school received from the TIF program. Many new schools and several preexisting schools received TIF assistance to undertake building construction and modernization, and the schools selected reflect both the political power of the aldermen and the priority they were given by city administrators (Farmer and Poulos 2015). One would expect that those schools that received funding from the City through this off-budget program be less likely to be subsequently shuttered. We obtained shapefiles of the TIF districts from the City's Department of Planning and Development and used mapping software to plot the location of each school against the TIF boundaries.

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[18] Charters enroll students who are a good fit for their school culture and performance metrics. With city-wide enrollment, charter schools are required to open the application process to any student. However, schools may deter high-cost students from applying (e.g., by failing to offer English as a Second Language classes or services for students with disabilities). Charters can also ignore central office mandates and can expel students for more minor disciplinary infractions than traditional CPS schools. Charters also "counsel out" students with poor academic records or disciplinary issues, encouraging them to leave the school (Karp & Lutton 2010; Institute on Metropolitan Opportunity 2014; Waitoller, Radinsky, Trzaska & Maggin 2014).

[19] Charter middle schools (up to 8th grade) were compared to elementary schools, due to many CPS elementary schools enrolling students through 8th grade. K-12 charter schools were compared to both elementary and high schools

Findings

While the descriptive evidence is consistent with the notion that CPS closed schools in high poverty, majority African-American neighborhoods, it also provides support for the idea that it was specific kinds of schools (underutilized) and students (low-performing) that affected the closure decision. Because of the potential for interactive effects and contradictory conclusions, we conduct a logit analysis to determine which factors were more influential in the decisions to close schools in different administrative era.

Table 4 presents logistical regression estimates based on equation (1). We present five alternative specifications to allow for the possibility that: the factors influencing turnaround schools are different than for closed schools; closures under different political regimes were catalyzed by different factors; and that highly selective schools are exceptional and less likely to be considered for closure.

Table 4: Exponentiated coefficients (standard errors) for models with Closed/Not Closed as dependent variable

	Table 4: Exponentiated coefficients (standard errors) for models with Closed/Not Closed as dependent variable				
	Closed schools and turnarounds	No turnarounds	No selective enrollments	Only Daley closures and turnarounds	Only Emanuel closures and turnarounds
Utilization Rate A2A	.212 (.582)**	.123 (.695)**	.262 (.643)*	1.029 (.778)	.082 (.890)**
Building Age	1.008 (.005)	1.007 (.005)	1.007 (.005)	1.015 (.007)*	1.002 (.005)
Change in Enrollment 99-06	.105 (.575)**	.045 (.707)**	.142 (.628)**	.020 (.854)**	.390 (.804)
Percent Meet or Exceed Test Score 2001	.944 (.014)**	.967 (.015)*	.942 (.015)**	.902 (.023)**	.969 (.018)
Change in Median Home Value 2000-2010 by CT	.411 (.639)	.361 (.650)	.397 (.682)	1.156 (.856)	.253 (.780)
Percent Black by CT 2000	.822 (.671)	.865 (.723)	.863 (.700)	.871 (.900)	.599 (.811)
Percent Black Students 2000	5.487 (.611)**	2.89 (.671)	7.08 (.659)**	8.29 (.838)*	4.221 (.755)*
Median Family Income 2000 by CT	1.00 (.000)	1.00 (.000)	1.000 (.000)*	1.00 (.000)	1.00 (.000)*
Distance to Same-kind Charter School	.796 (.386)	.587 (.433)	.672 (.427)	.579 (.558)	1.156 (.489)
Distance to CBD	.890 (.058)*	.876 (.065)*	.899 (.063)	.872 (.082)	.920 (.074)
Distance to New School	1.562 (.204)**	1.717 (.224)**	1.605 (.217)*	2.00 (.280)*	1.252 (.261)
Alderman in Finance Committee?	.974 (.334)	1.002 (.397)	1.003 (.347)	1.841 (.553)	.848 (.395)
In TIF District?	1.351 (.326)	1.361 (.364)	1.252 (.342)	1.429 (.468)	.984 (.404)
N	541	541	479	467	474
Nagelkerke R^2	.518	.462	.52	.573	.432

** $p < 0.01$; * $p < 0.05$

Our logit model reveals several statistically significant determinants of school closures. The logistic regression coefficients provide the change in the log odds of closure for a unit increase in the corresponding predictor variable, holding other factors constant at a certain value. Interpreting the exponentiated coefficient (also known as the "odds ratio") is more straightforward as it is the probability of closure divided by the probability of the school remaining open.

The coefficient on *utilization rate (Apples-to-Apples)* is negative and consistently significant. Negative coefficients lead to odds ratios less than one so our results indicate that the lower the utilization rate, the greater the chances of closure and vice versa. Indeed if our utilization rate is increased to the maximum threshold for "efficient" utilization (1.2 %), the chance of closure decreases to .17 (from .24). This finding holds even when we filter out selective enrollment schools from our sample. Conforming to our interpretation of changes in school planning during the different mayoral administrations, this variable is not significant when we only look at the closures occurring under the Daley administration. In other words, during the earlier era, building-related factors – like the efficient use of a facility – were weighted less than other factors, like student performance. *Building age* was only marginally significant in the specifications, implying that while older buildings were more likely to be shuttered, age was not always a strong predictor of building quality.

Student characteristics were also highly predictive of closures. The greater the *change in enrollment between 1999 and 2006* (or the year predating closure if schools were closed before 2006), the less likely a school was to be shut or turned around. Conversely, shrinking demand during this period often triggered a closure. Scores on standardized tests were also inversely related to school actions, although – as expected -- this variable became less significant when turnarounds were not treated as closures. Turnarounds were set in motion by low test scores more so than "traditional" closures. These two results remained the same for every specification other than for that which limited closures to those undertaken under the Emanuel administration. Student performance and prior changes in demand appear to have been less important than building utilization during the 2013 wave of closures.

The only exception to this finding – and a troubling one at that -- is the *percent black students in 2000*: this variable remained consistently significant and positive despite the change in administration. This means that if a school was 95 % black in 2000 (about 40 percentage points higher than the average school for the entire sample, which was about 57 % black), its probability of closure would be .38. This is more than fifty percent higher than the .24 chance a school had of being closed without controlling for any of the other independent variables. In contrast a school that was 5 % black would have only a .15 chance of closure. When we eliminate selective enrollment schools from our sample, the coefficient on the *percent black students* variable remains significant.

When the model is run using a stricter definition of closures (i.e., when turnaround schools are treated as "open" instead of "closed" schools), the *percent black students* variable loses its significance. This finding suggests that the turnaround decision was more racially motivated than the closure one – at least during the Daley administration. However, even when taking into account the *percent low income students* in a school (in 2012) for the sample of schools that closed and stayed open during the Emanuel era, those schools with a greater proportion of black students were still more likely to be closed. In other words, accounting for class did not lessen the impact of race.

Confirming Burdick-Will et al.'s findings, we see little evidence that neighborhood factors exerted a strong pull on the closure decision when other school and student-based attributes were taken into account. We ran the model with variables measuring *median family income, percent households below the federal poverty line, median house value,* and *percent* and *change in percent black* -- both by census tract and zip code geographies. As Chicago is a city that is highly segregated by race, ethnicity, and class, we could not include many variables in the same models to avoid multicollinearity. For example, because the percent black and Hispanic variables were so highly (and negatively) correlated, we kept percent black in the model while dropping percent Hispanic so as not to sacrifice the precision of our estimates. None of the demographic variables were significant in any of the models. Neighborhood conditions, regardless of whether they provided a positive or negative signal for redevelopment, do not appear to have figured into the closure decisions during the period in question.

Spatial variables may interact with the demographic ones. At first glance, the result on *distance to central business district* seems implausible. We had assumed that schools that were more isolated and located deep in neighborhoods would be more likely to close. However, it appears that the further away from the CBD, the lower the likelihood of closure. Holding the other variables at a fixed rate, a school located 10 miles from the intersection of State and Madison would have a probability of closure of .18 (compared to .24 for a school located the average distance from downtown or 6 miles). The map in Figure 1 visually represents concentrated areas of closures located, on average, six miles from the city's core. Such a finding supports the notion that schools moderately close to the CBD with more redevelopment potential (i.e., many of these neighborhoods were previously home to public and subsidized housing that was converted to market rate units) were closed – possibly to make way for charter schools or new public schools in those areas (Smith and Stovall 2008; LaFleur 2016). However, this variable becomes insignificant when running separate estimations for the closures occurring under the two mayors.

Distance to new school could also be substituting for omitted demographic variables given the somewhat counterintuitive finding. The further away from a new public school, the greater the chance of closure. Most new public schools were built in majority Latino neighborhoods coping with overcrowding. The coefficient on this variable may not reflect a process of cannibalization (whereby new schools poach students from older ones nearby) as much as it does the fact that Latino-serving schools were generally not closed. Despite the fact that closed schools were closer to charter schools on average than schools that remained open, in none of our models was *distance to closest charter school* significant. This may be the case because most of the schools closed during this period were elementary schools while the majority of charters were high schools. Although this finding implies that locational distance between the two types of school is less relevant to closures than other factors, we cannot measure how the City's roll out of pro-charter policy on a citywide basis has cut into the population of students at public schools and led to their underutilization.

Compared to the anecdotes, evidence from the model is not consistent with the notion that politics during this period influenced closures. The political variables are never statistically significant in any of our specifications. Although our variables were proxies of complicated processes, this finding leads us to conclude that the decision to close schools was a more techno-rational one or that political power was distributed in a way that our model could not reproduce. Although the location of the closed schools shows that they fall within the area that the City has targeted for redevelopment (primarily through the CHA's Plan for Transformation), the closure decisions appear to be uncoordinated with the City's primary economic development strategy, Tax Increment Financing. Neither TIF location nor TIF funds per school determined the fate of a school building.

While there is no universally accepted goodness-of-fit measure for logit models, the Cox and Snell statistic is the ratio of the likelihoods and reflects the improvement of the full model over the intercept model (so the smaller the ratio, the greater the improvement). The Nagelkerke statistic adjusts the Cox & Snell ratio so that the range of possible values extends to 1. Both act as pseudo R^2s. The Nagelkerke statistic oscillates around 50 %, indicating model fit is, overall, quite good. This statistic decreases in size when looking only at the closures that occurred during the Emanuel administration. It is either harder to model the decision-making process under Mayor Emanuel because the factors influencing it were more random or the variables we include in our models were already "dated" and had less predictive power by 2013.

Conclusion

We modeled the likelihood that a CPS public school would be closed during the 2000-2013 period, basing our analysis on the factors that the decision makers themselves said were determinative: utilization, obsolescence, and performance. Our model results demonstrate some distance between the "official" rationale for closures found in planning and policy documents and the realities of capital budgeting in the context of perpetual budget shortfalls. Traditional facilities planning criteria like obsolescence (proxied in our model by building age and size variables) were not highly predictive of school closures when other factors were considered.

However, in line with the justification provided by the Emanuel administration, poor utilization was strongly predictive of the decision to close a school. Our study did not specifically investigate the cause of this underutilization. It could plausibly have resulted from secular declines in student-age population. It could have resulted from earlier waves of housing policies and school reforms that left African American parents with few options other than to leave the city, send their children to one of the many charter schools springing up across the city, or join the queue of hopeful families trying to get their children admitted to the new, selective enrollment schools. Quantitative models such as ours restrict one's ability to understand how decisions made in one era reverberate to future ones. The two administrations publicly stated two separate criteria for closures – performance (Daley) and utilization (Emanuel). It is possible that the closure policies enacted during the Daley era subsequently impacted public perceptions and discouraged parents from sending their children to public schools. This in turn may have created the enrollment drops and underutilization of buildings that became central to the school closings conducted in the Emanuel era.

Building utilization alone, however, was not enough to seal the fate of a school. Closures occurred when students in low enrollment schools also exhibited poor academic performance and more concerning, when they happened to be African American. Turnarounds in particular (more so than the restrictively-defined building closures) overwhelmingly impacted black students. Legacies of racism – from the broader interactive effects between *de jure* and *de facto* residential segregation and labor market discrimination to prior CPS plans and practices like the fact that the district often built new schools rather than redraw boundaries that would put black and white students in the same schools -- shape contemporary capital investment policies in Chicago. As such even the seemingly technical, race-neutral metrics used to justify school closures – like utilization and performance – will interact with institutionalized racial inequities and result in racialized outcomes in facility accessibility and planning. Whether administrators during the 2000-2013 period explicitly considered the race of a school's students in planning decisions or whether race in our model was a proxy for other unmeasured characteristics, the cumulative effect of technical decisions interacting with a racially differentiated education environment forced African American students and their families to bear the bulk of the burden of these administrative disruptions. As a consequence of aggressive interventions like turnarounds and closures, the district rendered school facilities serving a majority African American student body as more disposable, precarious, and insecure.

Our models provide mixed support for the arguments made by critics who claimed that CPS was intentionally driving students toward more privatized education options. Although our descriptive statistics revealed that closed and turnaround schools were physically closer in distance to charter school, the distance-to-nearest-charter variable was never significant in our logit models. This finding does not necessarily imply that CPS' policy of encouraging the spread of charter schools was incidental to the closures. Instead it is likely that school choice is less neighborhood-bound in that parents may choose charter schools in places that have little relationship to where their (closed) neighborhood schools were located. This too is likely the effect of a long history of policy and market behavior that has resulted in a city that is highly polarized and segregated by race and class.

Considering the neighborhood, demographic, spatial, and political variables together, our results provide mixed evidence about the relationship between school closures and gentrification. On the one hand, neighborhood factors were relatively weak in predicting school closures. The fact that these variables lacked significance could indicate that because so many CPS students attend school outside of their neighborhood attendance boundaries, neighborhood attributes feature only weakly in school planning decisions. On the other hand, there are clear spatial patterns: where a school was located influenced the probability that it would close. Although CPS may not have been actively speculating on the future of the local property market when they made their decisions, the location of the band of school closures an average of six miles from the city center and in predominantly African-American neighborhoods places them in what sociologists and urban scholars have called the "zone of transition" on the perimeter of the central business district. Closing schools in this visible and highly dynamic zone could have been part of the City's "shock therapy" used to transform public perceptions of the school district in hopes of both attracting more affluent households there and keeping them from moving to the suburbs.

Our study sheds light on how closures intersect with school facilities planning more generally. School districts are caught between a desire to maintain legacy infrastructures that anchor communities and also be flexible enough to accommodate changes in educational policies, enrollments, and student needs. These processes move at different paces, causing friction in the planning process. For example, education reform movements like the marketized "school choice" one popular with both the Daley and Emanuel administrations may encourage the construction of new schools (including charters) to increase the number of options for parents. In the process, however, this policy devalues the existing stock of schools. The spatial embeddedness of school buildings often clashes with the quick-changing fads in educational policy. While school districts draft educational facilities master plans to solve space puzzles and optimize school facilities, these plans are often disconnected from the waves of education reform that have their own, often deleterious, spatial implications.

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