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ABSTRACT

In response to widespread dissatisfaction with the schools, the 1988 Chicago School Reform Act decentralized school governance by forming elected local school councils (LSCs) responsible for principal hiring, evaluation, and contract renewal as well as other management functions. Subsequent legislation outlined circumstances in which the district could reclaim authority from the LSC, thereby limiting local control. This paper investigates the distribution of principal effectiveness under a system in which there is uncertainty over the locus of decision-making authority. We first establish the presence of significant variation in principal effectiveness based on both an analysis of variance approach and the estimation of principal fixed effects. Teacher survey responses support the findings based on the principal fixed effects, though the much smaller magnitude of the analysis of variance estimates suggest that unobserved shocks inflate many existing estimates of the variance in principal effectiveness. We next consider potential differences in LSC behavior that contribute to the variation. Following Aghion and Tirole (1997) we develop a model that highlights the tensions between formal and real authority and incorporates potential differences in LSC capacity and incentives to maximize school quality. Using proxies for managerial capacity and incentives we find evidence largely consistent with the theory, showing that LSCs with higher management capacity and stronger incentives to raise school quality experience larger gains in principal effectiveness following the end of contracts.

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I. Introduction

In response to a persistently high dropout rate and widespread dissatisfaction with the schools, the 1988 Chicago School Reform Act decentralized school governance by forming Local School Councils (LSCs). LSCs are elected groups of parents, community members, and school personnel who are responsible for the hiring, evaluation, and contract renewal decisions of principals, the school budget, and other management functions. Supporters of the reform expected the greater knowledge and interest of local decision-makers to elevate the quality of school leadership and management. In addition, the reform had the potential to amplify the benefits of competition among attendance zones, although the low rate of homeownership for many poor families with children in the schools would likely dampen any such effect.

Yet there are reasons to question the benefits of decentralization. First, the interests of LSC members may not align with those of school children and community members; such misalignment may be more likely in neighborhoods with less participation in the political process. Second, development of budgets, supervision of the principal (herself a member of the council), and the completion of other tasks in a manner that improves principal and school quality likely require a range of skills which many LSC members may lack, particularly those without a post-secondary degree or experience in a supervisory or management role. Consequently, it is likely that decentralization will produce heterogeneous effects that benefit some schools and not others and that the reform may be less beneficial in areas with a lower capacity to manage and weaker incentives to improve the quality of schooling

In an influential study, the Consortium on Chicago School Research surveyed LSC members about a number of issues including capacity to govern and the principal evaluation process (Ryan et al. 1997). The responses suggested that although highly productive LSCs did exist, inequality in governance practices led the decentralization reform to "produce highly varied outcomes across Chicago's school communities." Differences in reported principal evaluation practices were particularly striking. Responses suggested that just over half of LSCs had a formal evaluation process with explicit criteria the principal had to meet during her contract, while many of the remaining councils had minimal or even no evaluation procedures in place (Ryan et al. 1997).

Nonetheless, the survey responses do not provide evidence on the extent to which LSCs improve the quality of schools and school leaders. In fact, ongoing concerns that LSCs have not substantially raised the quality of schools and school leadership, especially in high poverty areas, likely contributed to subsequent legislation that restored some authority to the district. Over time, the district has assumed control over principal evaluation, hiring, and renewal decisions in a growing number of schools, although the majority of principals remain under the supervision of a local school council.

In this paper, we use Chicago Public School administrative data and information on principal contracts to investigate the distribution of principal effectiveness in a system of decentralized governance with the potential for central authority intervention. We pay particular attention to heterogeneity in managerial capacity and the incentives to maximize school quality in order to gain a better understanding of the distributional consequences of decentralization.

In the absence of differences in principal value added to achievement, neither LSC nor district actions will influence the quality of school leadership in that dimension. Therefore, we first estimate the variance of principal value added using two different approaches and use teacher survey responses to provide supporting evidence. The analysis of variance estimates that account most extensively for potential confounding factors indicate educationally and statistically meaningful differences that are roughly one third as large as typical estimates of the variance in teacher effectiveness. Importantly, the pattern of estimates suggests that time-varying factors tend to inflate variance estimates based on principal fixed effects.

We turn next to LSC decision-making and its relation to the distribution of principal quality. Following Aghion and Tirole (1997) we develop a model of LSC behavior that highlights the tension between formal and real authority in the district, incorporating potential variation in LSC managerial capacity and incentives and the possibility the District CEO intervenes. We estimate the extent to which LSC capacity and incentives relate to the change in principal effectiveness from one contract to the next as well as the determinants of principal transitions in LSC managed schools including those where the

CEO intervenes. Our analysis reveals that LSCs with higher management capacity and stronger incentives appear to experience larger average gains in principal effectiveness following the completion of contracts.

The absence of information on contract offers and firings inhibits the identification of differences in LSC personnel practices with respect to principal effectiveness. Although such information would be valuable, the ultimate effect of the LSC on principal quality involves both the renewal decision and the desirability of working in a given school for current and prospective principals of varying levels of effectiveness. In contrast, CEO intervention represents a clear case of removal in response to poor performance or some other transgression, though other steps, including school restructuring, often accompany CEO interventions. Therefore, analyses of both voluntary and involuntary transitions must be interpreted with care.

Because our sample begins after the 1988 reform, we cannot identify the effect of decentralization on the distribution of principal effectiveness. Persistently poor performance in many schools precipitated the reform, so the continued presence of low-performing schools and questionable personnel decisions does not constitute evidence the reform harmed the district. Rather, our aim is to provide a better understanding of the nature of principal transitions under decentralization and the efficacy of CEO interventions, enhancing the capacity to improve school governance and potentially illuminating areas of weakness.

II. Data

To describe the distribution of principal effectiveness and transition patterns we combine CPS administrative data for the period 1993-4 to 2013-4 with US Census and American Community Survey data, teacher survey responses, LSC election data, and information we collected on principal transitions and contracts using public online documents from the proceedings of CPS Board of Education (BOE) and LSC meetings. The administrative data contain extensive information on students including test scores, attendance, demographic characteristics, special education status, eligibility for a subsidized or free lunch, school attended, grade, and school characteristics. School switchers can be followed as long as they

remain in the district. We measure the socioeconomic status of the block group in which each student lives using Census information on education levels and share of employed adults. Prior to 2010, the measure is based on the 2000 Census while from 2010 forward it is based on the 2010 ACS.

We also use the administrative data to construct a panel data set of principals that we merge by school and year to the student data. Principals must be linked by name, as there is no unique ID number that spans the period. Therefore, we take great care to account for name changes following marriage or divorce, other name changes, and spelling or punctuation inconsistencies. The principal panel contains almost 1,500 principals in over 700 schools.

Principal contract approval records show BOE approval of principal selections by LSCs and BOE ratification of principal employment contracts. The records include contract start and end dates and school served. We also record any disciplinary action against a principal including remove and replace resolutions initiated by the CEO as well as school designations including under transformation or turnaround. In the case of remove and replace resolutions the LSC selected principal is removed and replaced with a principal appointed by the CEO, and until stated otherwise the CEO assumes authority over the hiring, evaluation, and contract renewal decisions of principals. Note that the data do not distinguish between a decision not to offer another contract and a decision not to accept a new contract.

The LSC election data contain the number of parent and community candidates and vote totals for each biennial election from 2002 to 2012. We focus on parental candidates and develop a measure of election voting intensity equal to the sum of votes cast for parent representatives divided by school enrollment in the election year. Table 1 reports mean values of our intensity measure by quartiles of parental socioeconomic status, revealing a strong, positive association between school average parental SES and election voting intensity.

Teacher responses to questions about their principals form the final component of the data. These are available for a number of years, though the content of the survey changes over time. Teachers are asked whether they agree or disagree to a series of statements, and we focus on the three statements that seem particularly relevant to effects on value-added and appear in virtually all years of the data. The

teacher is asked if the principal (1) “makes clear to the staff his or her expectations for meeting instructional goals”; (2) “communicates a clear vision for our school”; and (3) “carefully tracks student academic progress.” We use responses to these questions to create a scale of principal effectiveness from the teacher’s perspective that we relate back to our value-added estimates of principal effectiveness.

The analysis focuses on principal transitions, and Table 2 reports the distribution of schools by the number of principals during the sample period. Approximately 85 percent of schools experience at least one transition in our sample while 41 percent experience three or more. Because some schools enter and exit the sample either through new construction or through closure, we also present the distribution limited to schools observed in all twenty years. In the sample of schools observed in all years, over 99 percent of schools experience at least one transition and 46 percent experience three or more.

III. The Variance in Principal Quality

The measurement of principal value added and the variance of principal effectiveness share many similarities but also some important differences with the estimation of teacher value added. On the one hand, the residential location and school-choice decisions of families in combination with school assignment policies and practices introduce substantial variation in student composition among schools and classrooms that must be addressed in studies of both principals and teachers. On the other hand, the widely discussed problems for the estimation of teacher value added associated with purposeful allocation of students to classrooms and test measurement error are far less important in the case of principals given the focus on school-wide performance and much larger number of test-takers in schools than classrooms.[1] However, the persistence of principal influences on the quality of instruction in the years after their departure and the absence of comparisons within a school at a single point in time present serious hurdles to the identification of principal effectiveness.

[1]Kane et al. (2013), Chetty, Friedman, and Rockoff (2014), and Rothstein (2010) investigate the presence and magnitude of biases introduced by nonrandom assignment to classrooms.

A comparison with the dynamics of teacher effects illuminates the problems introduced by the fact that many actions including teacher hiring, contract renewal decisions, mentoring and the establishment of a school climate will persist beyond a principal's tenure. In the case of teachers, many of the longer-term effects are captured by lagged achievement measures for observations in later years, and the teacher in the previous grade generally has little or no involvement with instruction in the current year. Even if lagged test scores do not fully account for prior teacher effects due to the dynamics of learning, it is possible to account directly for prior teacher effects in the model.[2] In the case of principals, however, it is clear that prior achievement does not account for effects of decisions such as teacher hiring that directly affect learning in future periods.

The presence of a single principal in each school at any point in time rules out within school and year comparisons. In contrast, teacher effects estimated on the basis of within school-year variation account fully for any school-wide shocks regardless of whether they persist over time or affect learning in a single year. Because the estimation of principal effects essentially involves the estimation of school value added during a principal's tenure, with perhaps controls for school resources and other factors not under the control of the principal, care must be taken in the interpretation of such estimates.

Similar to Branch, Hanushek, and Rivkin (2012), we estimate the variance in principal effectiveness using two distinct approaches. In our first approach, we estimate a value-added specification that includes principal-by-year fixed effects, which we use to calculate the variance in principal effectiveness both overall and within schools.[3] We then use teacher survey responses to provide evidence on the validity of the fixed-effect estimates, given the ambiguity introduced by the aforementioned equivalence of principal-by-year and school-by-year effects.

In our second approach, we take additional steps to mitigate bias introduced by unobserved time-varying factors and the persistence of principal influences. This method identifies the variance directly on

[2]Rothstein (2010)shows a relationship between previous teacher quality and achievement even in a value-added specification.
[3]The fixed-effect approach follows Bertrand and Schoar (2003), Grissom et al. (2012), Cannon, Figlio, and Sass (2013), and Branch, Hanushek, and Rivkin (2012).

the basis of year-to-year fluctuations in achievement growth around principal transitions. Essentially the year-to-year fluctuations within principal spells capture shocks that affect achievement, and larger fluctuations in value added around transitions would identify the effects of differences in principal effectiveness.

Importantly, recent evidence in Miller (2013) reveals a systematic decrease in value added in the year prior to the arrival of a new principal. This may reflect a reduction in principal health, effort, or authority over the school or the impacts of other factors associated with the decision to leave a principal position. Therefore, we estimate specifications that exclude the years immediately surrounding transitions in both our approaches. Because of the possibility that value added in the first year might be inflated by a recovery from the achievement dip in the final year, we must exclude both the last and first years of spells. Note that by focusing on years away from transitions we can account better for persistence, unobserved school trends, and the confounding effects of potentially large shocks that coincide with principal changes.

IIIa. Fixed Effect Estimates of Principal Effectiveness

In our first approach we estimate the following specification,

(1) $A_{igst} = f(A_{igs,t-1}) + \boldsymbol{X}_{igst} + \boldsymbol{S}_{sgt} + \delta_{gt} + \theta_{pt} + \varepsilon_{igst}$

where current achievement for student i in grade g in school s in year t (A_{igst}) equals a cubic function of prior-year achievement$f(A_{igs,t-1})$, a vector of student controls ($\boldsymbol{X}_{igst}$) including race, sex, special education status, and whether or not the student is new to a school, a vector of school-level controls ($\boldsymbol{S}_{sgt}$) including school-grade-year averages of the student control variables as well as enrollment and parental SES, a principal-by-year fixed effect (θ_{pt}), and a random error term (ε_{igst}). Regressions also include a full set of year-by-grade indicators (δ_{gt}) to account for test and other policy changes.

Year-to-year changes in value-added that occur during a principal's tenure are captured by the principal-by-year fixed effect (θ_{pt}). Of course, estimates of the principal-by-year fixed effects combine the true principal effect with any other fixed or time-varying influence not accounted for in the regression.

Because of the likely presence of unobserved school influences not captured by prior achievement, we also compute variance estimates based on deviations from the school average of the principal-by-year fixed effects. This eliminates all variation in principal effectiveness between schools.

The top row of Table 3 reports estimates of the overall (left column) and within school (right column) standard deviation of principal quality produced by averaging the principal-year effects over a spell at a school. The more compelling within-school results suggest that a one standard deviation increase in principal effectiveness raises school average test scores in a year by 0.078σ. To address the possibility of an Ashenfelter's dip in performance, we drop the last and first year of all spells and recalculate the standard deviation. If a performance dip is present, we would expect the standard deviation to decrease after removing the last and first years because we are removing extra, within-principal variability around transitions. After dropping these two years, we find that the standard deviation does in fact decline from 0.078 to 0.065.

The estimates reveal substantial variation in principal effectiveness, as a one standard deviation improvement in principal quality increases achievement by 0.065σ on average for all children in the school. Even if only half of the improvement persists in the long run, after 9 years (i.e. Kindergarten through 8th grade) in an elementary school such an improvement would increase average achievement by roughly 0.3σ.

We turn now to the teacher survey responses and examine whether teachers rate higher-value added principals more favorably. This would provide confirmatory evidence that the fixed effects do in fact capture differences in principal contributions to achievement. Table 4 reports average value added by the response to each statement, and the estimates reveal strongly positive and monotonic relationships between estimated value added and teacher ratings for all three questions.

In order to ensure that these results are not driven by other differences among schools, we use factor analysis that accounts for the categorical nature of the responses to compute a teacher rating index and then regress value added on the index in specifications with and without school fixed effects. The coefficients in Table 5 reveal a strong relationship between value added and teacher ratings both overall

and within schools. This supports the belief that the estimates of principal effectiveness capture differences in the contributions of principals to school quality, even if the fixed effects also capture time-varying shocks that inflate estimates of variance.

IIIb. Principal Turnover-Based Estimates

Our second approach to estimate the variation in principal effectiveness uses a method similar to Rivkin, Hanushek, and Kain (2005) and extended to principals by Branch, Hanushek, and Rivkin (2012) and Coelli and Green (2012). Importantly, we take additional steps to account for persistent and not persistent time-varying shocks, performance dips in the transition years, and the persistence of principal effects on school quality. To illustrate the approach we draw heavily on Branch, Hanushek, and Rivkin (2012):

Equation (2) relates the average gain in achievement (current score minus prior year score) in school s, in year y as an additive function of principal quality (θ), the quality of other school and community factors including student composition not under the control of the principal (γ), a school fixed effect (δ), and the school by year average error that includes unobserved student influences:

$$(2) \qquad \overline{\Delta A_s^y} = \overline{\theta_s^y} + \overline{\gamma_s^y} + \delta_s + \overline{\upsilon_s^y}$$

Consider the difference between successive years y and y' in average gain in achievement. This eliminates all school effects that do not vary across the two years, leaving only year-to-year differences in principal quality, other school influences and other unobserved time-varying factors as determinants of the difference in achievement gain. Squaring this difference yields a natural characterization of the observed achievement differences between years as a series of terms that reflect the variances and covariances of the principal and school effects plus a catchall component *e* that includes all random error and cross product terms between principal and other year specific effects.

$$(3) \quad \left(\overline{\Delta A_s^y} - \overline{\Delta A_s^{y'}}\right)^2 = \overline{\theta_s^y}^2 + \overline{\theta_s^{y'}}^2 - 2\overline{\theta_s^y}\,\overline{\theta_s^{y'}} + \overline{\gamma_s^y}^2 + \overline{\gamma_s^{y'}}^2 - 2\overline{\gamma_s^y}\,\overline{\gamma_s^{y'}} + e$$

Taking the expectation of Equation 3 and assuming principals are drawn from common distributions at each school over the restricted time period of the observations yields:

$$(4)\ \ E(\overline{\Delta A_s^y} - \overline{\Delta A_s^{y\prime}})^2 = 2\left(\sigma_{\theta_s}^2 - \sigma_{\theta_s^y \theta_s^{y\prime}}^2\right) + 2\left(\sigma_{\gamma_s}^2 - \sigma_{\gamma_s^y \gamma_s^{y\prime}}^2\right) + E(e_s)$$

where $\sigma_{\theta_s}^2$ ($\sigma_{\gamma_s}^2$) is the variance of principal quality (other school influences) in school s and $\sigma_{\theta_s^y \theta_s^{y\prime}}^2$ $(\sigma_{\gamma_s^y \gamma_s^{y\prime}}^2)$ is the covariance in principal quality (other school influences) across years.(Branch, Hanushek, and Rivkin 2012)

As Branch, Hanushek, and Rivkin (2012) describe, the three primary assumptions for this approach are "1) the effect of a principal is fixed (no change over time); 2) principals are drawn from a common distribution during this time period; and 3) principal turnover is orthogonal to other school changes that affect achievement gain." If satisfied, the within-school variance in principal effectiveness can be uncovered from comparisons between annual fluctuations in achievement gains around transitions and fluctuations within the tenure of a single principal. Absent a transition, the covariance in principal quality between years y and y' equals the variance given the assumption that principal quality remains constant. By comparison, if the principal changes between years y and y', the covariance equals zero within schools given the assumption that principals are drawn from a common distribution.

Consequently, if principal turnover is orthogonal to other changes that affect achievement gains, the within school variance in principal quality can be identified from a regression of the squared difference in average gains on a dummy variable indicating that the school had a different principal in years y and y'. Specifically, the parameter on the principal turnover dummy variable equals two times the within school variance in principal quality under these assumptions. Annual achievement gain fluctuations in years without a leadership change capture differences resulting from both random and systematic changes.

As noted above, the systematic value-added decline in the final year of a spell means that variance estimates that include this year do not strictly capture fixed differences in principal skill or effectiveness. Therefore, some specifications exclude the final year of a departing principal's tenure in a school and also the first year of the incoming principal's tenure, since the average gain in the first year

may be inflated by the dip in the prior year. Exclusion of these years also mitigates bias introduced by additional turbulence associated with a transition.

Excluding these years increases the gap around transitions from one to three years, and this has two potentially offsetting effects on the estimates. One the one hand, measurement error that increases achievement and therefore achievement gain in year y will tend to decrease achievement gain in year $y + 1$, because the positive error in year y will tend to decrease the difference between achievement in years $y + 1$ and y. This, in turn, will tend to amplify the squared difference in gains based on adjacent-year comparisons. Therefore, in specifications that use adjacent years to compute squared differences in gains within spells but nonadjacent years to compute squared differences in gains across transitions, such measurement error will tend to attenuate the estimates.

On the other hand, underlying achievement trends would tend to amplify differences computed over longer periods. This would likely increase the squared difference calculations around transitions based on gains three years apart relative to those within spells based on adjacent years and therefore introduce upward bias into the estimate of the variance. Consequently the direction of bias cannot be signed *a priori*, and computations across transitions and within spells should be comparable in terms of distance between years. Note that this restriction substantially decreases the sample size and therefore reduces the precision of the estimates.

Table 6 reports coefficients on the transition indicator for a series of specifications that differ according to whether or not the first and last years of spells are included and the number of years between calculations within a principal spell. The final column reports the estimate for the preferred specification in which squared differences both across transitions and within spells come from gains that are three years apart, and the estimate is slightly smaller than that from the specification that includes all observations, though it just misses significance at the 10 percent level.

The three estimates from specifications that exclude the first and last years are consistent with both measurement error induced attenuation bias in specifications that use adjacent-year differences within spells and unobserved trends that introduce upward bias in specifications that calculate squared

differences within spells across fewer than three years. First, the insignificant estimate of 0.0015 in Column 2 based on adjacent year calculations within principal spells that likely amplify the effects of measurement error is much smaller than the estimate of 0.0037 in Column 3 based on differences two years apart. Second, the Column 4 estimate of 0.0029 based on within spell differences calculated across the same three years as the differences across transitions is smaller than 0.0037, consistent with the notion that widening the gap tends to increase the counterfactual variance. Taken as a whole the results highlight the importance of using non-adjacent years and the same size gaps both across transitions and within spells.

Not surprisingly and similar to the pattern found in Branch et al. (2012), the Column 4 estimate of the standard deviation in principal effectiveness of 0.0383 is roughly half as large as those produced by the direct estimates of principal fixed effects. It is likely that the true magnitude lies somewhere between the two estimates.

Although the estimates of the standard deviation based on the principal fixed effects may be inflated by changes over time in other factors, the turnover estimate makes the quite strong and unrealistic assumption of fixed principal effects within spells. Not only is the principal's influence likely to grow over time as more of the teachers hired, school practices adopted, and climate reflect the work of the incoming principal, principals may improve as they gain a better understanding of how to lead a school. Regardless, even the smaller estimates are educationally significant in magnitude, as they suggest an improvement of almost 0.2 σ in average achievement from 9 years of attendance at an elementary school with a one σ more effective principal, assuming that half of the annual effect persists.

IV. School Reforms and the Structure of School Governance in Chicago

Two institutions are charged with the task of overseeing Chicago's public schools: the Board of Education (BOE), which is headed by a chief-education officer (CEO), and Local School Councils

(LSCs).[4] These LSCs—one for each public school in the city—were introduced as part of the landmark 1988 Chicago School Reform Act. This Act shifted much authority including the hiring and evaluation of the principal away from the BOE to the LSC.[5]

Each LSC includes the principal of the school together with a periodically elected membership that includes teachers, parents, and other interested members of the community with each constituency holding a fixed number of seats on the council. Importantly, the self-interests of LSC members may diverge from the welfare of the students. For example, a parent member could push for reallocation toward her child; a member of the Council could attempt to influence the hiring process to favor a friend or relative; and, of course, the school principal—a key player in each LSC—may use her position on the council to further her career

With the potential hazards of decentralization in mind, the 1995 Chicago School Reform Amendatory Act gave the mayor the right to appoint a Public Schools CEO and restored elements of the decision-making authority to the BOE. In particular, the 1995 amendment gave the CEO the authority to remove and replace a principal under certain circumstances including persistent low achievement.

Using the terminology developed in Aghion and Tirole(1997), the 1995 Act endowed the BOE with all of the *formal authority* concerning the administration of each the city's public schools. It gave the CEO the right to place a public school on probation. Once on probation, the principal has one year to remedy performance issues. If the principal fails to do so, the CEO has the power to assume control over decisions regarding the school principal—authority that otherwise rests with an LSC. Furthermore, the CEO can, in effect, dissolve the current LSC by mandating that new elections be held. In addition, she has the power to close educational programs, and she even has the power to shut down a school and then

[4] In fact, there are three institutions, if one includes the Office of the Mayor. The BOE is under the direct formal control of the Mayor. Nevertheless, in practice, the role of the Office of the Mayor is limited to setting the annual school budget, appointing the CEO, and appointing members to the BOE. In particular, it has delegated all of its real authority in the practical business of running the CPS to the BOE and by extension the CEO.
[5] Haney (2011) offers a valuable discussion of the 1995 Chicago School Reform Amendatory Act.

reopen it by hiring new staff altogether or by selectively rehiring some of those who were dismissed from the school in question.[6] In each of these cases the BOE assumes *real* as well as *formal authority*.

Despite the considerable formal power possessed by the Board, the *real authority* concerning the practical day-to-day business of running the vast majority of the city's public schools rests with local school councils. Here, the economic substance of *real authority* is that the LSC is responsible for selecting the principal, renewing the principal's contract, determining the allocation of the budget, and crafting a School Improvement Plan. Although the CEO effectively rubber stamps the majority of LSC principal contract decisions, the process of monitoring and the possibility of intervention constrain LSC and principal behavior.

V. Model of LSC Behavior

Next, we construct a model that draws on Aghion and Tirole (1997) and is designed to capture the salient features of the Chicago public school system (CPS) as they pertain to principal effectiveness and transitions. We begin with a description of the environment and then describe the behavior of LSCs and potential variation by capacity and election pressure.

V.a. The Environment

We first describe the technology that governs school quality, the objectives of each LSC, the means whereby the CEO monitors the schools and the determinants of its decision of whether to overrule the LSC. Subsequently, we consider the relationship between the CEO and the LSCs.

V.a.1. Technology

We envisage a school as a production function that takes the following as its primary inputs: students, the labor of the principal, teachers, and staff, together with other resources, such as the quality of

[6] An illustration of the institutional mechanics underlying the practical process whereby the CEO removes a school principal is given in 01-0822-AR11. This document also provides the guidelines used for the replacement of principals of those schools on probation. See http://www.cpsboe.org/content/actions/2001_08/01-0822\-AR11.pdf (accessed 3 September 2014). Further description is provided here: http://www.ilga.gov/legislation/ilcs/fulltext.asp?DocName=010500050K34-8.3 (accessed 16 May 2015).

the library, buildings, and other educational capital. A school uses these inputs to produce educational value added, as measured by school quality, q.[7]

For the moment, put to one side issues pertaining to the *quality* of the administrative decisions made by an LSC or the principal. Consider a school with a resource endowment k. We assume *potential* value added, $\hat{Q}$, is given by

$$\hat{Q} = F(x; k) = x \cdot k. \tag{5}$$

The term $x \in [0,1]$ is an index that captures the (endogenous) efficacy with which the resource endowment available to the school, k, is allocated to the production of educational value added. The case in which $x = 1$ corresponds to the highest possible potential value added, which we denote $\hat{Q}_m \equiv F(1; k) = k$.

As will be clear later, the allocation of resources, x, plays an important role in our analysis. In anticipation, we assume each LSC also has an *independent* interest over the way resources are allocated within the school and, as a result, its preferences over x may be not fully aligned with the goal of maximizing value added, Q. The main economic substance of this structure is that it generates a potential conflict between the interests of the CEO and the LSC. In settings with less voting intensity/participation or low capacity to govern, the principal likely plays a more dominate role in resource allocation which may or may not ameliorate the potential conflict. Next, we consider the issue of authority and control.

Let $\theta \in [0, 1]$ represent the given managerial or organizational capacity/quality of the institution that exercises real authority over the running of a specific public school. If the school is administered by an LSC, θ is a reduced-form measure of the LSC's overall managerial capacity. In practice, it depends jointly on the abilities of its members and, most important, the ability of the current school principal. This

[7] In practice, practice, each school draws the large part of its student body from the geographic community in which it is located. This, in conjunction with the widespread socioeconomic disparities across Chicago's neighborhoods, induces considerable variation in the composition of students who attend it. Therefore, certain neighborhoods draw students primarily from high income households and others draw them from economically challenged ones, especially those with high recent immigrant populations. To provide a veracious measure of value added by a school in general and assay the effectiveness of the principal in particular, it is necessary to control for these factors, which we do in the subsequent empirical analysis.

is because the organizational structure is one in which the principal is a member—often the most influential member—of the LSC. This renders challenging the task of explicitly modeling the link between abilities of the committee members and the efficacy of the committee itself: one of the primary functions of the LSC is assaying the performance of the school principal, and the principal herself has considerable indirect influence over the assessment of her performance by virtue of her membership of the LSC.[8]

We assume that *actual* value added by the school, denoted Q, depends on the managerial quality parameter, θ, and potential value added, $\hat{Q}$,according to

(6) $$Q = \theta \cdot \hat{Q}.$$

We can think of θ as an X-efficiency parameter a la Leibenstein: The effectiveness with which a given set of inputs are used to produce outputs. Here, $\theta = 1$ corresponds to the frictionless ideal that represents the perfect management of resources. For intermediate cases of θ, the term $(1 - \theta) * \hat{q}$ represents the degree of X-*in*efficiency—the loss of value added resulting from poor administrative decisions.

Next, we consider the determinants of θ for each of the city's schools. To this end, consider a public school that is administered by a LSC. We assume the managerial quality of those schools controlled by LSCs, θ, is distributed on the support $[\theta_0, 1]$ according to the distribution function $G(\theta)$, with mean $\bar{\theta} \in [\theta_0, 1]$, where $\theta_0 > 0$ represents some minimal managerial capacity.[9]

To capture the potential benefits of decentralized local control, we assume that those public schools over which the Board of Education exercises real authority each have an organizational capacity $\theta_B \in (0, M]$, where $M < 1$. Though simple, this formulation is rich enough to capture, on the one hand,

[8]Indeed, these concerns are the primary motivation for our use of a stochastic representation of the educational value-added production technology, described shortly. This approach allows us to adopt an agnostic approach concerning the explicit link between the abilities of the LSC committee members and the overall managerial capacity of the LSC. More specifically, it is inconsequential (to our model) whether the LSC's capacity, θ, is governed by the strength of the weakest link (the ability of the least able member), the sum of the parts (the simple sum of ability members), or some more complicated sub- or super-modular function of these abilities.

[9]We can think of θ as a stochastic representation of technology, similar to that proposed in Eaton and Kortum(2002). The lower bound θ_0 ensures that for all vaues of x and k,$Q \geq \theta_0 \cdot x \cdot k > 0$, thereby ensuring no school is so bad as to generate zero value added.

the potential benefits of decentralization, $\theta_B \leq M < 1$, and, on the other, the possibility that some schools would benefit by having important decision making rights taken away from the LSC and assigned to the CEO, $\theta_0 < \theta_B$.

In what follows, it is convenient to work with the intensive form of educational value added. That is, value added per dollar of resource endowment, k. Therefore, let $\hat{q} \equiv \hat{Q}/k$ denote potential educational value added per dollar and let $q \equiv Q/k$ denote actual educational value added per dollar. Therefore equation (5) becomes

(7) $\hat{q} = F(x;k)/k = x,$

and (6) becomes

(8) $q = \theta \cdot \hat{q} \leq 1.$

In the interest of brevity, in what follows we refer to the intensive measure, q, as educational value added and to Q as aggregate educational value added by the school, as we do for $\hat{q}$ and $\hat{Q}$ – their potential value added counterparts.

The principal advantage of using the intensive forms of the value-added measures is that they allow for meaningful comparisons of relative performance, in view of the realistic and practical heterogeneity in resource endowments that are available to different schools in the city. More specifically, consider two schools, $i \in \{0,1\}$, with endowments $k_0 < k_1$. It may well be the case that total value added is greater in the latter school than in the former, $Q_0 < Q_1$. Nevertheless, if, for example, $q_0 = \frac{Q_0}{k_0} = 1 > q$, then school $i = 0$ has attained the greatest possible output with the resources available to it, whereas school $i = 1$ has not.

V.a.2. Preferences

Consider first, the various LSC's that control Chicago's public schools. We assume the objectives of each LSC are described by the following utility function of the representative committee member:

(7) $V = v(q, c),$

where q is the value added by the school under its control, and $c \equiv 1 - x$ represents the consumption-equivalent value arising from the *distortion* in the allocation of resources, as measured by $1 - x$. We assume $v_q > 0$, $\lim_{q \to 0} v_q = \infty$,$v_c \geq 0$, and that q and c are substitutes.

With the inclusion of c in the utility function, each LSC has a direct interest over the manner in which resources are allocated. For instance, as one of its members, the principal may lobby the LSC to renew his or her contract, despite the fact that another candidate would be better suited for the position and so generate greater value added. Alternatively, a committee member may lobby in favor of hiring a friend or relative to fill an open position.

Despite its simplicity, this framework is rich enough to capture the cases of greatest interest to us. If $v_c = 0$, then the LSC purely is interested in maximizing school quality. Alternatively, if $v_c > 0$, there is an imperfect alignment of the preferences of the LSC with its core (stated) mission of maximizing the quality of the school. Most important, this misalignment of incentives potentially creates a conflict of interest between the objectives of the LSC and those of the Board, an issue we consider shortly.

Finally, if the CEO assumes authority over school governance, we normalize the LSC's utility to zero and, for simplicity, assume the Board eliminates any transparent allocative distortions by setting $x = 1$.

V.a.3. Monitoring and the Information Structure

Monitoring depends upon both the timing of information and actions and the structure of information. Assume the timing of events within a given period is as follows: (1) At the beginning of a period, each LSC chooses the values of c and q; (2) these choices generate a noisy signal of school performance, s; (3) the CEO monitors each LSC with probability $m \in (0,1)$, and observes the performance signal, s, for those schools that are monitored; (4) on the basis of signal, s, the CEO decides whether to intervene in the affairs of the LSC; (5) the election for LSC seats is held; (6) the events just described occur in negligible time. During the remainder of the period, the LSC members derive utility

$v(q, c)$ provided that neither the LSC members lose the election nor the CEO intervenes in LSC affairs. Otherwise, the LSC derives (normalized) zero utility, $v_0 = 0$.

Assumption 5.1 describes the information structure.[10]

Assumption 5.1 (Information)

(a) The performance signal, s, is observed by members of the local community

(b) The signal, s, depends on actual educational value added, q, and a random disturbance $z \geq 0$ according to $s = q * z$. The value of z is governed by an $i.i.d$ draw from the exponential distribution: $z \sim 1 - \exp[-z/\lambda]$.

(c) Each LSC knows its own managerial capacity, θ. Furthermore, the distributions, signal generating process, and technological relationships are common knowledge

Part (a) is the root of the inherent informational advantage of decentralized versus centralized control: the community is aware of substantive issues pertinent to its own well-being, whereas the CEO only becomes privy to this information through an imperfect monitoring process.

The posited exponential distribution implies the disturbance z has a mean λ and variance λ^2. The parameter λ governs the *informativeness* of the signal, s, and lower values of λ reflect greater informational content. The expected value of the signal, $\bar{s}$, generated by a school with quality q is $\bar{s}(q) = q * \lambda$. Each LSC recognizes the expected value of s depends positively on actual value added, q, of the school under its control. The significance of this fact is that the LSC—through its choice of c—can influence s and so the likelihood that the CEO will intervene. Hence each LSC faces a non-trivial decision concerning the choice of c. On the one hand, it derives a direct benefit from c and, on the other, it has an incentive to temper its choice of c because it can reduce the likelihood the CEO will abrogate its power.

[10]Our results would hold for any distribution function for the disturbance, that satisfies the monotone-likelihood ratio property; the exponential distribution considered here, obviously is a particularly tractable member of this family.

If the actual quality of the school in question is q, Assumption 5.1 implies that, if monitored, the probability the LSC will lose its authority is $1 - \exp[-\hat{s}/(q * \lambda)]$, for this is the probability that s falls below the critical threshold, $\hat{s}$. As a corollary, the probability that the LSC retains its real authority is $\exp[-\hat{s}/(q * \lambda)]$.Those schools that are not monitored and those that are monitored—but for which the observed performance signal, s, exceeds the threshold, $\hat{s}$—are deemed satisfactory, and the CEO delegates the real authority over decision making to the LSC.[11]

Even if the incumbent LSC survives the CEO's monitoring process with its authority intact, the next hurdle it face is the mandated electoral process. The probability it survives the re-election process is $\hat{\mu}(s, \rho)$, where ρ indexes the intensity of local political involvement. We assume this is increasing and concave in the observed performance of the school under its stewardship, s, with $\hat{\mu}(0, \rho) = 0$ and $\hat{\mu}(1, \rho) = 1$. In addition, we suppose that $\hat{\mu}(.)$ exhibits a single crossing property, in which for each ρ there is a unique $s(\rho)$ such that $\hat{\mu}_\rho > 0$ if $s > s(\rho)$; $\hat{\mu}_\rho < 0$ if $s < s(\rho)$; and $s(\rho)_\rho > 0$. This formulation captures in the simplest way that a community with a high level of involvement demands high performance for their LSC (i.e. $s(\rho)_\rho > 0$) and the notion that the electoral process runs both ways. Specifically, an already outstanding incumbent LSC ($s > s(\rho)$) is more likely to be re-elected the greater the degree of involvement, ρ, whereas exactly the opposite is true for a substandard one ($s < s(\rho)$).

V.b. The Behavior of the LSC

We assume that at the beginning of the period, the Committee chooses feasible values of x and c to maximize its expected utility. The structure of the model offers a parsimonious framework for studying the behavior of LSCs. Although formally a static problem, the sequence of events is such that the Committee anticipates that its choices of c and q have subsequent consequences for its well-being.

[11]In practice, there are significant costs incurred by the CEO whenever she exercises her formal authority by overruling the decisions made by a given LSC that temper her office's behavior. First, if the LSC's managerial capacity exceeds the Board's, then (all else equal) centralized control results in a direct efficiency loss because the LSC has the greater of the two managerial capacities. Second, she must devote scarce resources to managing newly acquired schools—in particular, costs in evaluating the school principal and deciding whether to terminate his or her contract. Finally, because each LSC is an elected body, there is a potential political cost incurred should her behavior run counter to the community's wishes.

Given that $s = q * z$ and $z \sim 1 - \exp[-z/\lambda]$, $s \sim (1/q) * \exp[-s/\lambda q]$. Therefore the ex ante probability the LSC anticipates surviving the re-election contest is $u = \int \hat{\mu}(s, \rho) \exp[-s/(\lambda q)]\, ds \equiv \mu(q; \rho)$. Since the LSC's normalized payoff in the event of CEO intervention is zero, its expected payoff, denoted $\hat{V}(q, c; \hat{s}, m)$, is

(8) $$\hat{V}(q, c; \hat{s}, m) = \mu(q; \rho) * \sigma(q;\ \hat{s}, m) * v(q, c),$$

where $\sigma(q;\ \hat{s}, m) \equiv (1 - m) + m * (\exp[-\hat{s}/(q * \lambda)])$ is the probability that the LSC survives the CEO's monitoring process, with its control rights intact. The term $(1 - m)$ is the probability it is *not* monitored, and $m * \exp(-\hat{s}/(q * \lambda)]$ is the probability that it *is* monitored but retains its control rights because it generates a performance measure, s, that exceeds the given threshold $\hat{s}$.

By using the constraints $q = \theta * x$ and $c = 1 - x$, each LSC's problem takes the simple form

(9) $$V(\hat{s}, m, \theta) \equiv \max_{c,q \in [0,1]} \hat{V}(q, c;\ \hat{s}, m, \rho)$$

$$\text{s.t.,} \quad \frac{1}{\theta} * q + c \leq 1$$

By expressing the problem in this manner, it is immediate from inequality (9) that $1/\theta$ is the (implicit) price of school quality q in terms of foregone c. It follows from this that, well-managed schools—those with a high θ—face a lower effective price of providing school quality than do poorly managed ones. Since both c and q are valued by the LSC, the resource constraint binds at the optimum. Therefore we can use this constraint to write the LSC's problem in terms of school quality alone.

(10) $$V(\hat{s}, m, \theta) \equiv \max_{q \in [0,1]} \{\pi(q; \hat{s}, m, \rho) * v\left(q, 1 - \left(\frac{q}{\theta}\right)\right)\}$$

Assuming an interior solution, the optimal choice of q, denoted $q^* = q(\hat{s}, m, \theta, \rho)$, is governed by the following first-order condition:

(11) $$0 \equiv \left[\pi * v_q + \pi_q * v\right] - (\pi * v_c)/\theta,$$

where subscripts represent partial derivatives and the FOC is evaluated at the maximum.

The first term in square brackets in equation (11), is the marginal benefit of an increase in school quality q. More specifically, provided it survives with its authority intact, which occurs with probability

π, the LSC derives a direct benefit from the increase in school quality valued at v_q at the margin. Furthermore, an increase in q raises the probability that the LSC does indeed survive to see another day by π_q, which in turn allows it to derive utility, v.

The term $-(\pi * v_c)/\theta$ represents the marginal cost of raising school quality, q, in terms of foregone c. Again, the committee survives (CEO intervention and the electoral process) with probability π and (provided it does) suffers a marginal loss in utility of v_c/θ from the increase in q. For the reasons just described, those schools that are most effectively managed—their managerial ability, θ, is high—bear *lower* cost, in terms of foregone c, than do poorly managed schools. Finally, it follows immediately from equation (11) that if $v_c = 0$, then $c^* = 0$: If an LSC values only school quality, it will not distort the resource allocation of the school under its stewardship.

In what follows, let $q^* = q(\hat{s}, 0, \theta_0) > 0$ denote the value added by the school confronted with the least auspicious of circumstances: the given LSC is not monitored (and so has no fear the CEO will intervene based on its performance), and it possesses the lowest possible managerial capacity, θ_0. (Since $m = 0$, q_0^* is independent of $\hat{s}$.) The expected signal generated by such a school is $s_0 = q_0^*/\lambda$. Consider Condition 1 where we assume that the performance threshold, $\hat{s}$, satisfies $m/(1-m) > [\hat{s} - \bar{s}_0] * \exp[(\hat{s}/\bar{s}_0)]$. Given our technological assumptions, the maximum expected performance signal is $\bar{s}(1) = 1/\lambda$. In essence, Condition 1 ensures that the threshold $\hat{s}$ is not set so high that every school—including the best of the best—expected that it would be taken over in the event it were monitored.

Proposition 5.1 (The Optimal Behavior of LSC's)]

Lettingq^* and $c^* = 1 - q^*/\theta$ denote the Committee's optimal choices, we show

(a) $q_m^* > 0$, $q_{\hat{s}}^* > 0$, $q_\lambda^* > 0$, $q_\rho^* \lesseqgtr 0$, and (b) $q_\theta^* > 0$, $c_\theta^* < 0$

Proof: All proofs are presented in an Appendix available from the authors.

Part (*a*), describes the impact of the effect of the joint *threats* on the behavior of the LSC that, on the one hand, the CEO will intervene and exercise her real and formal authority, and on the other the LSC may

not win re-election. A greater audit probability, m, or a tougher performance standard, $\hat{s}$,induces the LSC to raise the school's performance level, q^*, to reduce the likelihood the CEO will intervene in its affairs. The effect of an increase in community participation, ρ, is theoretically ambiguous. In particular, a high performing LSC that anticipates it will draw $s > s(\rho)$ (the single crossing point threshold) anticipates that a marginal increase in ρ only will increase the probability of its re-election. As a result, it anticipates it can marginally increase c, thereby marginally reducing performance, q, and still survive re-election. An increase in λ corresponds to an increase in the informativeness of the signal, s; it results in an increase in quality, since it is easier for the CEO to distinguish good from bad performance.

One implication of the threat effect just described is that it is insufficient to evaluate the overall effectiveness of the CEO by examining just the change in performance of those schools in which she intervenes directly (for example, via a before-and-after comparison of each school's performance). More specifically, even were this set of schools to experience little discernable improvement in performance, the *prospect* of intervention by the CEO and the LSC's fear of the loss of its control rights may already have increased substantially the performance of each school in the city. Another implication of the threat effect is that it reduces the extent of any room for the ex post observed improvement of any school under the management of a new school principal after being taken over and reorganized by the CEO.

Part (*b*) of the Proposition describes the effect of the LSC's own managerial capacity θ on the value added by the school under its control. The fact that better managed schools have higher value added, q_θ^* perhaps is not too surprising. The interesting part of the Proposition is that $c_\theta^* < 0$—or equivalently $x_\theta^* > 0$. Therefore, a greater managerial capacity, θ, raises school quality directly (because $q = \theta * x$) and *indirectly* because the LSC responds to its own intrinsic higher ability by choosing a better resource allocation. Of course, this means that poorly managed schools generate a low educational value added because they *are* poorly managed *and* because they respond in part to their *own* ineffectiveness by pursuing goals other than maximizing quality as captured by the term c^*. In other words, they respond to

their inherent low managerial capacity, θ, by substituting away from the relatively high cost provision of quality, q, toward c.

VI. Empirical Analysis of LSC Heterogeneity

The formal model provides the structure under which we evaluate how LSC and CEO decisions affect principal quality as measured by value added. The initial empirical analysis examines the relationship between principal quality following a contract event and proxies for LSC capacity and pressure to focus on school quality. Given the uncertainty in quality at the time of hiring, more effective LSCs would be expected to make better contract renewal decisions with respect to realized principal performance and the observed trajectory of school quality. In addition, a change in political participation would be expected to induce a larger change in school quality for a more effective LSC; as effectiveness approaches zero behavioral responses lead to little perceptible effect. Finally, the model highlights the uncertainty in the effect of political participation. Note that these regressions control for principal effectiveness prior to the end of the contract.

Estimates of the relationships between the changes in effectiveness and LSC characteristics combine the effects of principal transitions initiated by the principal, transitions initiated by the LSC, CEO interventions and contract renewals. Therefore the subsequent component of the analysis examines the relationship between the probability of a specific transition and principal effectiveness prior to the contract event using multinomial logit. We classify transitions into three types of contract events: contract renewal (48.8%), principal departure during or at the end of the contract (48.2%), and principal removal by the CEO (3%).

The absence of information on contract offers limits the analysis, as LSC decisions not to renew and principal decisions not to return are indistinguishable. Nevertheless, the estimates provide information on the relationship between the LSC characteristics and the net effect of contract offer and acceptance decisions. Moreover, CEO removals of a principal do not suffer from the same ambiguity as LSC decisions. However, when the CEO intervenes and removes the principal they may also change other

aspects of the school. Therefore, comparisons of principal effectiveness prior to a CEO intervention to effectiveness prior to a transition at a school managed by an LSC must be interpreted with care.

The analysis requires proxies for both capacity and pressure, and we use census block group average parent SES computed over students in the school as the proxy for LSC capacity and election participation intensity as the proxy for awareness of school performance. Based on information from the US Census and American Community Survey, the SES index is a function of adult education and adult employment in managerial positions. In the case of the SES index, we assume that formal education elevates the capacity to comprehend information on school performance, and white collar occupations enhance the capacity to manage and supervise. In the case of the voting intensity measure, we assume that higher intensity reflects higher awareness of and interest in school performance.

SES and voting intensity are likely related to factors that affect achievement, raising the possibility that they influence principal value added directly. Yet because we focus on the change in principal effectiveness following a contract event and the principal transitions conditional on performance, we believe that they provide valid proxies for factors that affect LSC capacity and behavior. Moreover, the inclusion of variables that capture changes in demographic characteristics has virtually no effect on the SES or voting intensity coefficients.

Table 7 illustrates the joint distribution of SES and voting intensity. Although the table shows that the fraction in the top voting intensity quartile is much higher for the schools in the top SES quartile than for the others, there is substantial variation in voting intensity in all SES quartiles.

Table 8 reports estimates of the relationship between the change in principal effectiveness following a contract event and both SES and voting intensity using the following specification:

(12) $$\Delta E_s^{1,2} = \alpha + \gamma LSC_s^{1\prime} + \beta SES_s^{1\prime} + \Delta \boldsymbol{X}_s^{1,2} + \delta_y + \varepsilon_s^2$$

where the change in principal effectiveness (effectiveness under contract 2 minus effectiveness under contract 1) is a function of LSC voter intensity ($LSC_s^{1\prime}$) and parental SES ($SES_s^{1\prime}$), each measured in the nearest year prior to the end of the contract, a vector measuring the change in student demographics and

school characteristics between the first and second contract ($\Delta \boldsymbol{X}_s^{1,2}$), year fixed effects ($\delta_y$), and a random error. The change in principal effectiveness following the contract event equals VA measured during the 2nd year following the contract event minus VA measured during the second year of the initial contract period prior to the event. Note that the second specification includes the interaction between SES and voting intensity and the third specification also adds the interaction between voting intensity and effectiveness in order to examine potential heterogeneity in the responsiveness to voter participation by initial principal effectiveness as suggested by the theory.

The estimates in Table 8 support the predictions of a positive relationship between the change in principal effectiveness and both capacity and incentives. Both the SES and voter intensity coefficients in the left column are positive and significant at the 10 percent level despite the small sample size. Moreover, the interaction term coefficient in the middle column is consistent with the notion that higher capacity amplifies effects of voting intensity. However, the prediction that the effect of voter intensity should weaken with initial principal effectiveness is not supported by the estimates reported in Column 3. Rather, the interaction term is positive although not significant.

Principal productivity is likely to change through two primary channels: hiring and contract renewal. Because most new principals were not previously principals in CPS, it is difficult to evaluate the hiring decision. Therefore we focus on principal transitions out of a school and investigate whether systematic differences between the probability of exiting and principal effectiveness emerge by both SES and LSC election participation. To do so, we estimate the following multinomial specification,

(13) $$CONTRACT_{pst'} = \alpha + f(E_{pst}) + f(E_{pst}) * SES_{st} + f(E_{pst}) * LSC_{pst} + \varepsilon_{pst'}$$

where $CONTRACT_{pst'}$ measures how the contract ends for principal p in school s at time t' and takes on three values: renewal (omitted category), exit, and removal by CEO. The basic specification reported in Column 1 models the contract event as a function of principal effectiveness during the contract $f(E_{pst})$, the interaction of effectiveness and socioeconomic status of the parents $f(E_{pst}) * SES_{st}$, the interaction of effectiveness and the voting intensity in the election nearest the end of the contract $f(E_{pst}) * LSC_{pst}$,

and an error $\varepsilon_{pst'}$. Column 2 adds the interaction between voting intensity and parental SES and the full three-way interaction between SES, voting intensity and effectiveness.

The coefficients in the top panel of Table 9 reveal a strong, negative relationship between principal value added prior to the contract event and the probability of exiting that appears to strengthen as parental SES increases but weaken as voting intensity increases. Inclusion of the triple interaction in the third column strengthens the negative effect of SES on the relationship between effectiveness and the probability of exit at lower but not higher levels of participation.

The bottom panel of Table 9 reveals a negative though only marginally significant relationship between value added and the probability of leaving by CEO removal relative to continuation. CEO removals comprise only three percent of outcomes, and given the inclusion of interaction terms the imprecision of the estimates is not a surprise. Nonetheless, the magnitude of the main effect suggests that moving from the 90th to the 10th percentile of the effectiveness distribution roughly doubles the probability if the values of voting intensity and SES are set to zero; the difference is much larger for schools near the middle of the SES and intensity distributions.

VI. Conclusions

The devolution of authority over principals to local school councils constituted a major change in the structure of school governance. Whether this had a substantial effect on the distribution of principal effectiveness depends on both the underlying variance and the extent to which LSC heterogeneity amplified or contracted the existing distribution at the time of the reform.

The results reveal meaningful differences in principal effectiveness, confirming the importance of the LSC responsibility over principal hiring and contract renewal. Not only is there significant variation in principal effects that is strongly correlated with teacher survey responses regarding principal performance, but an analysis of variance approach based on principal turnover that goes to great extent to account for time-varying school differences and the dynamics of principal effects also shows substantial variation in principal effectiveness.

The analysis of LSC effects on the distribution of principal quality provides evidence consistent with the notion that higher LSC management capacity improves decision-making and principal effectiveness. There is also evidence of larger improvement in principal effectiveness following the end of a contract in schools with higher voter participation and SES.

The results provide reason to be concerned that decentralization may generate smaller improvements and may even harm schools serving the least advantaged students in terms of parental SES and election participation. Given the strong negative associations between school poverty and both SES and voter intensity, this suggests that decentralization may be least beneficial for some of the highest poverty schools.

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Table 1
Average Voting Intensity in LSC Election Cycles by Quartile of Socioeconomic Status

Quartile of Socioeconomic Status	Average Voting Intensity
1st(Lowest)	0.84
2nd	0.82
3rd	0.92
4th(Highest)	1.60

Note. The quartile of socioeconomic status is based on Census measures of education levels and share of adults employed in managerial positions in the census block group where each student lives. Prior to 2010, the measure is based on the 2000 Census while from 2010 on it is based on the 2010 ACS. Higher quartiles of socioeconomic status indicate higher status. Voting intensity is calculated as the number of votes cast for parents running for an LSC seat divided by total school enrollment. Therefore, voting intensity may exceed 1.

Table 2
The Distribution of Principal Transitions Experienced by Schools

	Number of Principal Transitions					
	0	1	2	3	4+	Total
Share of schools (observed in any years)	14.63	18.75	25.71	21.59	19.31	100%
Share of schools (observed in all years)	0.68	20.95	32.43	26.01	19.94	100%

Note. The estimates are based on a school-level sample of all available schools (704 in total) between 1993-94 and 2013-14 schools years.

Table 3

Estimates of the Standard Deviation of Principal Effectiveness Based on Regressions with Principal by Year Fixed Effects

σ of average effectiveness during entire principal spell	0.110	0.078
$\sigma$of average effectiveness dropping last and first years of spell	0.098	0.065
Removes school average	N	Y

Notes. All regressions control for student race, sex, special education status, and socioeconomic status of the student's block group, whether the student is new to the school, school-grade averages of these characteristics, share of grade repeaters, school enrollment, and year-by-grade fixed effects.

Table 4

Average Principal Value Added, by Teacher Responses to Survey Questions on the Principal

	Teacher Response			
	Strongly Disagree	Disagree	Agree	Strongly Agree
The principal…				
Makes clear expectations	-0.025	-0.017	-0.008	0.002
Communicates clear vision	-0.025	-0.018	-0.006	0.002
Tracks student progress	-0.023	-0.015	-0.007	0.003

Notes. Here we plot average value added by teacher's responses to a series of questions about their principal, asked in 11 of the years between 1994 and 2013. Teachers are asked if the principal "makes clear to the staff his or her expectations for meeting instructional goals"; (2) "communicates a clear vision for our school"; and (3) "carefully tracks student academic progress."

Table 5

Relationship between Teacher Ratings and Estimated Principal Value Added

	(1)	(2)
Teacher's principal rating index	0.017***	0.013***
	(0.002)	(0.002)
School fixed effect	N	Y

Notes. We regress estimated principal value added on an index of teacher's rating of their principal. The index is based on responses to the three questions in Table 4. Each regression controls for school averages of student race, sex, special education, enrollment, share new students, parental SES, and year effects. Both regressions are based on 4,004 school-year level observations. Standard errors clustered by school are in parentheses. * p<0.10, ** p<0.05, *** p<0.001

Table 6
School Fixed Effect Estimates of the Variance in Principal Effectiveness

	(1)	(2)	(3)	(4)
Coefficient on principal transition indicator	0.0034**	0.0015	0.0037**	0.0029
	(0.0015)	(0.0022)	(0.0019)	(0.0019)
Standard deviation	0.0414	0.0276	0.0429	0.0383
Exclude last and first years of spell	N	Y	Y	Y
Number of years between observations within spells	n.a.	1	2	3
Number of School-Year Observations	8,514	6,139	5,062	4,141

Notes. The regressions correspond to the approach described in section *IIIb. Principal Turnover Based Estimates.* The outcome is the squared difference in test scores between *t* and *t-n, where n is the number of years between observations*, and the principal transition variable is an indicator equal to one if there is a new principal in year *t.* The regressions also control for the squared difference in student race, sex, special education, and mobility, school enrollment, and parental SES. Standard errors clustered by school are in parentheses. * p<0.10, ** p<0.05, *** p<0.001

Table 7
Distribution of Voting Intensity Conditional on Parental SES

	Quartiles of Voting Intensity					
Quartiles of Parental SES	1st (Lowest)	2nd	3rd	4th (Highest)	All	Observations
1st (Lowest)	0.32	0.25	0.24	0.19	1.00	318
2nd	0.23	0.29	0.32	0.16	1.00	312
3rd	0.26	0.29	0.23	0.22	1.00	320
4th (Highest)	0.18	0.17	0.21	0.44	1.00	308
Observations	314	317	314	313		1,258

Table 8

The Effects of Parental SES and Voting Intensity in LSC Elections on the Change in Principal Effectiveness

	(1)	(2)	(3)
Parental SES	0.0074*	0.0013	0.0016
	(0.0043)	(0.0047)	(0.0048)
Voting intensity	0.0067*	0.0024	0.0017
	(0.0038)	(0.0045)	(0.0045)
Prior contract VA	0.309***	0.308***	0.280***
	(0.046)	(0.046)	(0.060)
Voting intensity*prior contract VA	-	-	0.0249
			(0.0341)
Parental SES*voting intensity		0.0051**	0.0047**
		(0.0024)	(0.0024)
Sample size	767	767	767

Notes. We measure principal effectiveness as the change in value added from $t+1$ to $t+2$ from the first contract to the second contract. LSC managerial capacity is measured by parental SES, which captures the share of adults working managerial jobs in each student's home census block. The strength of LSC incentives is measured by the voting intensity during the election (i.e. total number of votes cast divided by school enrollment). Both capacity and incentives are measured during the end of the previous contract. Each regression controls for the principal effectiveness at the same point during the previous contract, the change in school average demographics and program characteristics, and year fixed effects. Standard errors clustered by school are in parentheses. * p<0.10, ** p<0.05, *** p<0.001

Table 9

Multinomial Logit Estimates of the Effects of Principal Effectiveness, SES, and Voter Intensity on the Probability of a Principal Transition in an LSC Managed School and the Probability of a CEO Removal

	Relative to Continuation	
	(1)	(2)
Left Mid or End of Contract		
Value Added	-3.619***	-3.567***
	(0.795)	(0.798)
Voting Intensity	0.170***	0.120
	(0.057)	(0.074)
Parental SES	0.023	0.028
	(0.080)	(0.097)
Value Added*Voting Intensity	0.982**	0.712
	(0.461)	(0.467)
Value Added*Parental SES	-1.021	-2.326**
	(0.745)	(0.959)
Voting Intensity*Parental SES	-	-0.007
		(0.043)
Value Added*Voting Intensity*Parental SES	-	0.902**
		(0.410)
Left by CEO Removal		
Value Added	-4.025*	-4.443
	(2.372)	(2.740)
Voting Intensity	-1.420	-1.461
	(1.182)	(1.089)
Parental SES	-0.295	-0.590
	(0.641)	(0.919)
Value Added*Voting Intensity	-4.792	-4.207
	(3.691)	(3.707)
Value Added*Parental SES	-3.100	-4.143
	(3.936)	(4.342)
Voting Intensity*Parental SES	-	0.668
		(0.877)
Value Added*Voting Intensity*Parental SES	-	1.834
		(3.006)
Sample Size	1,104	1,104

Notes. The outcome takes on three possible values related to how the principal's contract ends. We compare principals who leave mid or end contract and those who leave by CEO removal to those who have their contract renewed (the base outcome). Each regression also controls for school averages of student race, sex, special education, enrollment, and share new students. Standard errors clustered by school are in parentheses. * p<0.10, ** p<0.05, *** p<0.001