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**Management Quality in Public Education:
Superintendents Value-Added, Students'
Outcomes and Mechanisms**

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Abstract

We present in this paper evidence about the effects of and mechanisms of value added of schools' superintendent in Israel's primary and middle schools. Superintendents in Israel and in many other countries are the CEOs of a cluster of schools within a school district or a local school authority. They have broad and extensive responsibilities through which they can affect schooling quality in their domain as they are the direct managers of school principals and draw their authority from the district or regional education director. In this study we extend the approach used in the recent literature to measure teachers' value added to the context of school superintendents. For identification of superintendents' value added we exploit a quasi-random matching of superintendent and schools that results from a formal Ministry of Education rule about reshuffling schools across superintendents' clusters every 3-5 years. This regulation is practically implemented through the process of superintendents turnover related mainly to retirement of superintends. Such exits lead to entry of new superintendents and to some reshuffling of schools across existing superintendents. We show evidence that support the random match of schools and superintendents. We estimate that superintendent value added have positive and significant effect on primary and middle school students' test scores in math, Hebrew, and English. One standard deviation improvement in superintendent value added increase test scores by about 0.04 standard deviation in the test score distribution. The effect is larger for students from lower socio-economic background, it is highly non-linear, increasing sharply for superintendents in the highest-quartile of the value added distribution and larger for female superintendents. We explore several mechanisms for these effects and find that superintendents with higher value added are associated with more focused school priorities, more clearly defined working procedures but no effect on school resources as funding is determined centrally at the Ministry of Education and no effect on total teachers' on the job and off school training though a significant effect on the composition of the former. Another important effect is that schools with higher quality superintendents are more likely to assess school climate, violence and bullying, and implement related interventions which lead to lower violence in school. A new superintendent is also associated with a higher likelihood that the school principal is replaced.

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1. Introduction

Recent studies examined the relationship between management quality and productivity in the public sector. Di Liberto (2013) and Bloom et al (2015) have extended the World Management Survey methodology to measure management-practices in schools across countries and present descriptive evidence on school principals' management quality and education outcomes in several countries. They show that higher management quality is strongly associated with better educational outcomes but they cannot establish causality in this relationship. Branch et al (2012) studies the leadership role of school principals and measure their correlation with school outcome. Bloom, Propper et al (2015), McCormack et al (2013), and Rasul and Rogger (2013), study management practices in public sector institutions in health and other government agencies. In this paper we focus on measuring and estimating the effect of superintendents in public education on educational outcomes of students and schools and the channels of these effects.¹ School superintendents are the CEOs of a cluster of schools within a school district or a local school authority. In Israel as in many other countries these CEOs have broad and extensive responsibilities through which they can affect schools' quality and output. For example, they are the direct managers of school principals and draw their authority from the district or regional education director. In recent years this model of superintendent as the CEO's of some schools has been criticized as inefficient, too procedural, anachronistic and not innovative and its impact on the quality of schools insignificant. Many countries have reacted to this perceived inefficiency with extensive management reform in supervision in public education.²

However, the link between management quality and the effectiveness/productivity of schools has not been studied as carefully as, for example, the impact of teachers' value added (Rivkin et al 2005, Rothstein 2010, Jacob et al 2010, 2016, Chetty et al 2014a, 2014b). Therefore, this paper's objective is

¹ Superintendent is the title used in the US and in some other countries. In the UK the title used is Chief Education Officer, in Canada it is Director of Education.

² For example, England, New Zealand, Finland and Chile introduced global transformation in the organization and regulation of their education system and in the role of supervision of schools (UNESCO 2007). In some countries a more profound structural changes has been introduced, for example, changing school structures (charter schools in the US and school academies in the UK), accountability measures (performance league tables and closure of failing schools as in the US No Child Left Behind), and programs that enhance school competition (voucher programs, free school choice, financial incentives to staff and students). Only few of these programs were expanded at scale, partly because of their lack of popularity among educational practitioners who believe that the current system of management and supervision in public education maintain proper motivation and quality in schools.

to provide empirical evidence about the causal effect of management quality in public education on students' cognitive and non-cognitive schooling outcomes and explore some of the relevant mechanisms. We measure superintendent quality by their value added in term of their students test scores and in a second step we estimate its effect on students' schools cognitive and behavioural outcomes.

The role and responsibilities of superintendents vary across countries but it is common that they set the tone, charts the course of the district or sub-district, and work closely with the school board or district board of trustees. Superintendents are responsible for hiring and supervising school principals and teachers, including the decision of granting tenure to novice teachers. It is the superintendent's job to evaluate school principals' performance and assure that they are effective leaders, working with the teachers at the school to serve the needs of students and meet the district goals. The superintendent must respond to demands of all other constituencies in the district or sub-district: the teachers, students, parents, staff and the community at large. In some countries superintendents can affect the allocation of the financial and human resources of the district. Therefore a high quality superintendent can have an important effect on schooling quality and on academic achievements of students.

Non-random matching of schools and superintendent can lead to biased measures of superintendents' value added. We address this concern by exploiting a quasi-random pairing of superintendent and schools that results from a Ministry of Education rule of changing every 3-5 years the 'supervision area' of superintendents, which leads to reshuffling of schools across superintendents' clusters. This regulation is stated in a Ministry of Education circular and its implementation is highly linked to the process of superintendents' retirement and sometime though not very often to promotion of superintendent within the ministry of education. Such exits lead to entry of new superintendents and to some reshuffling of schools across existing superintendents. Most often, the whole cluster of schools of a retiring superintendent are transferred as a group to a novice or veteran superintendent. Clearly there should no concern for sorting in such cases and we show evidence that support our claim of random match of schools and superintendents. We show that the probability of having a superintendent change is unrelated to school characteristics and outcomes. We show that a new superintendent's quality

is unrelated to school characteristics and outcomes. We also show that the quality of the new and old school's superintendents are not correlated.

We estimate superintendents' value added in two different ways. In the first, we measure superintendents' value added based on schools that did not switch superintendent during the study period. The value added is measured as a superintendent fixed effect in a regression of a school level education production function. In a second step we estimate the effect of superintendent value added on outcomes of schools that switched to a new superintendent. As an alternative approach we exploit superintendent turnover and measure value added based on schools that switched superintendent. Value added here is measured by a superintendent fixed effect in regression of the change in cognitive outcomes. In a second step we estimate the effect of superintendent value added based on the sample of schools that did not switch superintendent.

The ranking of superintendents obtained from these two methods are highly positively correlated and the estimated effect of these two alternative superintendents' value added measures on students' test scores are very similar. As learning outcomes we use test scores in national exams in primary and middle schools in Israel in math, Hebrew, and English. We also examine effects on students' behavioural outcomes, in particular measures of bullying and violence in school and students' social skills and behavior. As potential mechanisms for the effect of superintendents' quality we focus on several management practices of school principals.

The results presented in this paper show that the quality of superintendents has positive and significant effects on students' academic achievements. A one standard deviation improvement in management-supervision quality increases students test scores in math, English and Hebrew by 0.04 standard deviation. These positive within-school estimates are in contrast with the "naïve" OLS estimates which are actually negative, reflecting a negative selection pattern in the sorting of superintendents to schools. The effect is non-linear, being higher for the highest quality superintendents. The treatment effect is on the same scale when estimation is by subject. Interestingly, female superintendents have higher value added and higher impact on students' outcomes.

This paper also contributes to several literatures. First, we link to work on teachers' value added and its effect on students' academic achievement (Rockoff 2004, Rivkin et al (2005), Jacob (2010),

Rothstein (2010), Bacher-Hicks, Kane, and Staiger (2014), and Chetty et al. (2014)). Secondly, this paper is related to recent research on the effect of school principals and leadership (for examples see Branch, Hanushek, and Rivkin (2012), Clark, Martorell, and Rockoff (2009), Béteille, Kalogrides, and Loeb (2012), and Horng, Klasik, and Loeb (2010)). Finally and more generally, we contribute to the emerging literature investigating management practices in public sector institutions (For examples see McCormack, Propper, and Smith (2013), Rasul and Rogger (2013), and Bloom, Propper, Seiler and Van Reenen (2015)).

The rest of the paper is organized as follows. Section 2 presents background on the system of superintendents in Israel reform. Section 3 presents the data and section 4 presents our empirical strategy and results on the effect on students' outcomes. Section 5 present evidence on the mechanisms of the effect of managerial and supervision quality and section 6 presents the conclusions.

2. Context and Background

School supervision services exist in nearly all countries.³ Their key role is to monitor the quality of education, i.e. schools and teachers, and support their improvement. This role translates to two distinct but complementary tasks: on the one hand, to control and evaluate and, on the other hand, to advice and support teachers and head-teachers. To undertake these functions, superintendents (in some countries they are called supervisors) are based outside the school at a local or regional government body overseeing public schools. Each superintendent is assigned a number of schools, to which they make regular visits every year. The role and powers of the superintendent vary considerably between countries. However, their tasks cover to varying degrees the following tasks: supervise implementation of government education policy, regulations, and national curriculum, advise on teaching methods, supervise, guide and assess teachers on probation, liaise and advise headmasters, guide schools in formulating an action plan based on mapping of problem and needs, prepare periodical inspection reports. Some countries separate the administrative from the pedagogic tasks of supervisors, such as in Spain. Other countries tend to separate control tasks from support roles. This has been the case mainly

³ Much of the material in this section is based on "Reforming School Supervision for Quality Improvement", United Nations, International Institute for Educational Planning, UNESCO 2007.

in countries with strong school-based management practices such as New Zealand and in the UK. Some countries adopted a management-supervision approach directed toward the school as a whole and less on individual teachers. Noticeable example is the OSTED school audit system in the UK. In France, superintendents produce regular reports on specific issues based on specific fieldwork and special school visits. In few countries, self-assessment by schools is used instead of external supervision. Finland, for example followed this model, where quality control is entirely entrusted to teachers. Other countries use a model that combine internal school evaluation and assessment with external supervision (New Zealand, Wales, Australia, and Chile).

The school superintendent in Israel is a staff member of the Ministry of Education. While a school principal is responsible for the day-to-day administration of school, the school superintendent has a diverse range of activities and responsibilities, both at the macro and micro level of schools. At the 'macro' level he is responsible for overseeing that each school develops an annual strategic action plan in line with its school charter, which sets out the educational objectives for the school under the umbrella of the national curriculum framework. The superintendent is also responsible in seeing that this action program is implemented effectively. He should ensure that pupils continue to receive a quality education experience, being responsible for decisions about hiring of new teachers, placement and transfer of novice and veteran teachers. At the 'micro' level, he has to assess teachers' performance, provide pedagogic guidance and know how to school principals and teachers, he decides about tenure and dismissal of teachers and deals with extreme students' disciplinary violations, including the approval of temporary or permanent expelling students from school. To carry these tasks, the superintendent visits every school few times a year, meet with school principal and members of the school senior leadership team, attends classes, mainly of novice teachers, and hold confidential meeting with teachers and staff. He is expected to develop a safe and trusting relationship with his supervisees and use these meetings as an opportunity to talk about all elements of their practice, including emotional and psychological difficulties at work. It is the superintendent's responsibility to encourage teachers and school principals to find new and effective ways of developing their instruction in the classroom, and ensure that they work within the norm, policies, and codes of practice of the Ministry of Education and the law. The superintendent should monitor training and teaching progress and ensure the novice

teachers receive appropriate career guidance and planning. Following each school visit, the superintendent should submit a report to the school district director. Supervisees should receive relevant parts of the report and should be provided the opportunities to comment on their assessment and on the support provided and to discuss any problems that were identified.

The majority of school superintendents in Israel adopt a hierarchical approach, carrying their interaction with teachers and school principals as an educational authority, and the school staff view them as the highest pedagogical authority. In accordance with the State Education Law, the Ministry of Education is the superintendents' employer, navigate and guide them in their work. Most superintendents in their daily work are part of the staff of regional directors (there are seven regions in the country). Each superintendent is in charge of a number of schools. Every 3 to 5 years superintendents rotate to a different "supervision zone" or experience a large change in the list of schools they supervise.

3. Data

The data we use in this study are based on the Growth and Effectiveness Measures for Schools (GEMS - Meizav in Hebrew) datasets for the years 2002-2005. The GEMS was administered for the first time in 2002 and it includes a series of tests and questionnaires administered by the Division of Evaluation and Measurement of the Ministry of Education.⁴ The GEMS is administered towards the end (from mid-May to mid-June) of each school year to a representative 1-in-2 sample of all elementary and middle schools in Israel, so that each school participates in GEMS once every two years. The GEMS data include test scores of fifth- (primary school) and eighth- (middle school) grade students in math, science, Hebrew, and English. In principle, all students except those in special education classes are tested and the proportion of students tested is above 90 percent. The raw test scores used a 1-to-100 scale that we transform into z-scores to facilitate interpretation of the results. In this study we use only primary school data since the funding reform only affected primary level schools.

The test scores for the years 2002-2005 are linked to student administrative records collected by the Israel Ministry of Education. The administrative records include student demographics that we

⁴ The GEMS is not administered for school accountability purposes and only aggregated results at the district level are published. For more information on the GEMS see the Division of Evaluation and Measurement website (in Hebrew): <http://cms.education.gov.il/educationcms/units/rama/odotrampa/odot.htm>.

use to construct all measures of students' background characteristics. Using the linked datasets, we build a panel for elementary schools with test scores for the years 2002-2005. The sample is restricted to Jewish public schools that follow the same national curriculum and participate in the GEMS national testing. For these reasons we exclude the religious Orthodox Jewish schools and the Arab schools. There are 939 elementary schools with test score data. Since every school is sampled once in two years, we have two observations of the same school for more than 90 percent of the schools.

The GEMS also includes interviews with all teachers and the school principal. The questionnaire for 'home class' teachers⁵ of all classes included questions about classroom instructional time in each subject and the total instructional time per week. We use teachers' responses to these items to compute the school average for fifth-grade instructional time in each subject. Though there was very little difference between or among fifth-grade classes in a school in these time inputs, we still prefer to use the school-level mean per grade to avoid any biases that might be caused by sorting of students into certain classrooms and setting time allocations for given academic subjects according to those students' particular strengths and weaknesses. In any case, the grade- and class-level measures of these time inputs are very highly correlated.

The school principal questionnaire includes questions on pedagogical and management practices in school. We use the following questions: (1) "Did the school evaluate its environment and discipline?" and (2) "Does the school have interventions related to values, norms and discipline?".

We also use items from the GEMS student questionnaire that address various aspects of the school and their learning environment. We concentrate on the section of the questionnaire that provides information on student satisfaction in school and on the violent behaviour of other students. In this section students are asked to rate the extent to which they agree with a series of statements on a six-point scale ranging from "strongly disagree" to "strongly agree". These items include: (1) "There are many fights among students in my classroom"; (2) "Sometimes I'm scared to go to school because there are violent students"; (3) "This year I was involved in many fights"; (4) "When I have a problem at

⁵ A 'home class' teacher in primary school in Israel teaches most weekly sessions of his class, and has additional duties such as taking attendance registers, acting as intermediary in cases of conflict, collating other teachers' impressions of the class and of individual students in preparation for the quarterly report, liaising with parents and various other administrative tasks.

school there is always someone I can turn to (from the teaching staff)"; (5) "I am satisfied in school"; and (6) "I feel well-adjusted socially in my class". We transformed students' responses to these items into standardized z-scores.⁶

4. The Quasi-Random Pairing of Schools and Superintendents

The pairing of schools and superintendents may be non-random. For example, school authorities may place more proven and effective superintendents in weaker or failing schools. Or experienced superintendents may prefer to work in better schools. Therefore, the potential endogenous sorting of superintendents in schools have to be accounted for when measuring unbiased superintendents value added. The administrative structure of superintendents in Israel and the schools they manage offers a way to measure superintendents' value added that are not affected by endogenous sorting of superintendents. Israel public education system include seven geographical regions, each headed by a regional director that reports directly to the general director of the Ministry of Education. All schools within each of the seven regions are under the directorate of the regional director. Each region has several superintendents and each is in charge of a number of schools. Except for the large cities (Jerusalem, Tel Aviv, Haifa, Beer-Sheba, Rishon-Lezion), all other localities have only one superintendent who supervises over all schools in the locality. Each such superintendent will manage few localities that are close geographically. This is clearly evident from the information presented in Maps 1-7. Each map presents the geographical distribution of the schools by superintendent in each of the seven region in 2005. The spatial clustering of the schools of each superintendent clearly suggests matching of schools and superintendent are based on geographical considerations. About 77 percent of schools in our sample are in municipalities with a single superintendent and about 82 percent of these schools have a superintendent who oversees schools in more than one municipality. Every change of a superintendent in these municipalities involves all schools, minimizing in this context the scope for selective matching between superintendents and schools.

⁶ We experimented with binary versions of these variables denoting above median answers and also using them linearly and the results were not different, reassuring that the evidence regarding these variables is not a feature of this particular transformation of the data.

The large cities noted above have more than one superintendent, the first three have 3 superintendents and the other two cities have 2. The distribution of schools of each superintendent in these large cities are also clustered geographically as evident in Maps 8-10. The schools that are included in superintendent cluster are mostly the same over time, particularly when experiencing a change in a superintendent.

The Ministry of Education reassign superintendents every 3-5 years.⁷ This policy is often implemented in conjunction with departures of superintendents to retirement, rarely due to promotion. Our panel data for the period 2002-2005 includes 771 schools that appear in the sample each of the four years. There are three potential transition points, one for every two adjacent years and 402 (52%) schools switched superintendent at least once within this period. This transition rate implies that a school will indeed have a new superintendent every 5-6 years. Very often, the whole cluster of schools of a retiring superintendent are transferred as a group to a novice or veteran superintendent. Fifteen percent of the changes in the pairing of schools and superintendents result from such reassignment and 61 more percent of the transitions result from a transfer of at least 5 schools from a retired or promoted superintendent to a novice or veteran superintendent. Clearly when the reassignment involves such large number of schools as in these cases, we can confidently rule out any scope for endogenous sorting that can lead to selection bias in measure of superintendent value added and in the treatment effects estimates. The reassignment of one or two schools to a new or veteran superintendent accounts for only 9 percent of all reassignments (40 out of 459). The reassignment of three schools or more schools to a new or veteran superintendent accounts for 91 percent of all reassignments. Clearly there should be little concern for endogenous sorting in these transitions.

Some evidence for the lack of endogenous sorting of superintendents can be seen in Figures 1-3 which are representative examples of patterns of turnover of superintendents following a retirement of one or more superintendents. Figure 1 presents the changes in the Central educational district following the retirement of two superintendents. All of Ruth's (this and other names in the paper are fictitious) schools were transferred to Rebecca (a new superintendent) and all of Amalia's schools were

⁷[https://he.wikipedia.org/wiki/%D7%9E%D7%A4%D7%A7%D7%97_\(%D7%97%D7%99%D7%A0%D7%95%D7%9A\)](https://he.wikipedia.org/wiki/%D7%9E%D7%A4%D7%A7%D7%97_(%D7%97%D7%99%D7%A0%D7%95%D7%9A))

transferred to Hannah (a veteran superintendent). Rebecca received also ten schools from Johanna. The transfer on block of such large number of schools between pairs of superintendents clearly suggest that there was no sorting involved. However, Figure 1 show transfers of smaller number of schools between superintendents, in most cases 1 or 2 schools, which may involve sorting. In Figure 2 Judith, a superintendent in South district, retired and her 13 schools were distributed between 4 other superintendents. Figure 3 shows transitions in the Haifa district in 2003-2004. There are 8 pairwise transfers, five of them involving a move 5 or 6 schools. In most cases the number of outgoing and incoming schools of a superintendent are equal or almost equal.

5. Measuring Superintendents Value Added

We estimate superintendents' value added in two different ways. In the first method (I), using the sample of schools that did not change their superintendent during the study period ('the non-switchers') we estimate an education production function with a superintendents' fixed effect and use these fixed effects as measures of superintendents' value added. In a second step we estimate the effect of these superintendents' value added on outcomes of schools that did change their superintendents (the 'switchers'). Using two different samples in the two steps of this procedure guarantees that the superintendent fixed effect does not reflect specific characteristics of the schools that are included in the sample in the second step. This 'out of sample' procedure of estimating the superintendent fixed effect is crucial even though we estimate the role of CEOs of education districts in a framework where we can control for observable and unobservable differences across schools. For this purpose, we construct a superintendent-school matched panel data set, where we track superintendents across different schools over time. This allows us to estimate how much of the unexplained variation in schools average outcomes can be attributed to superintendent value added (fixed effects), after controlling for schools fixed effects and time-varying school characteristics. The second method (II) reverses the role of 'switchers' and 'non-switchers': We exploit superintendents' turnover, using schools that were assigned a new superintendent ('switchers') and measure value added as the superintendent 'fixed effect' in a regression of the change in schools' mean test scores as a dependent variable. In a second step, we estimate the effect of the value added of these superintendents on mean test scores of the sample

of the 'non-switchers', the schools that were not assigned a new superintendent. Both method relies on the assumption that schools that are part of a superintendent's cluster of schools, do not share any other common factors that can correlate with their residual growth in test scores (method I) or their residual test scores (method II). Both methods are similar in spirit to the models that is used to estimate the effect of individual managers on corporate behavior and performance (Bertand and Schohar 2003).

We will show below that the percentile ranking of superintendents value added derived from these alternative methods are highly correlated. We will also show that the two series of value added, based on the second method (one for each year) are also highly correlated. Finally we will observe that the estimated treatment effects obtained from value added I and value added II are very similar.

We specify an education production function that includes an input that captures superintendent quality or value added in addition to the standard school and student level inputs:

$$Y_{js} = \alpha_j + \gamma O_s + \beta X_j + \Lambda LA_j + u_{js} \quad (1)$$

where Y_{js} is the average learning outcomes of students in school j that is assigned to superintendent s . We use test scores in national exams in primary (5th grade) and middle school (8th grade) in Israel in math, Hebrew, and English as measures of learning outcomes. We also examine effects on students' behavioural outcomes, in particular measures of bullying and violence in school and students' social skills and behavior. As potential mechanisms for the effect of superintendents' quality we focus on several management practices of school principals. α_j is a school fixed effect, O_s captures the value added of superintendent s , X_j is a set of potentially time varying covariates of school j (including students' characteristics, school enrolment, number of classes), LA_j is a vector of lagged test scores in Hebrew and math and u_{js} is a mean zero residual.

The parameter of interest is γ but O_s is unobserved and therefore has to be estimated. Since superintendent value-added might be measured with error, it can be correlated with u_{js} and therefore with school specific outcomes shocks which are part of the error term in equation (1). To avoid this problem we adopt the same approach that is used in recent studies of teachers' value added, for example Jacob et al (2010), where estimation of the value-added of a student's teacher does not incorporate information from that student's cohort. In our case this approach implies that the estimation of the value-

added of a school's superintendent does not incorporate information from that school. Stated differently, the value added of a school's superintendent is estimated out of sample for every school for every period. For example, in the first method we measure value added based on 'switchers' and in a second step estimate its effect using the sample of 'non-switchers'.

Method I: Measuring Superintendents Value Added Based on 'Non-Switchers'

Based on the non-switchers' sample (schools that stayed with the same superintendent during the study period), we estimate equation (1) while including a dummy variable for each superintendent. The practical representation of this specification is that a vector of superintendents fixed effects is included in equation (1) and the estimates of these fixed effects are the measure of superintendents' value added.⁸ We estimate this regression separately for each of the sub-periods: 2002-03 and 2004-05. Each school is included once in each of these regressions because the test scores data is available for each school in one of the two years of each of these two periods. Here as well, the interpretation of the superintendent fixed effect as a value added measure rests on the assumption that all schools that share the same superintendent do not share any other common factor that might affect their learning outcomes. Including many students' and school level controls in equation (1), in particular lagged school level means test scores, as done in the above referenced studies on teachers' value added, reassures that the superintendents' fixed effects picks up only the superintendent's value added.

Table 2 presents the estimates of these two regressions from which we recover the estimated superintendents fixed effects. The X_j vector includes an indicator for male students, number of siblings, an immigrant indicator, father's and mother's years of schooling, six student's ethnicity indicators, school enrolment and number of classes. The means and standard deviations for these variables are presented in columns 1 and 3 for each of the two periods.⁹ The 1991 schools standardized test scores

⁸ This approach is identical to the method used in Rivkin et al (2005) and Jacob (2010) who measured teachers' value added and also very similar to the method used in Rothstein (2010) and Chetty et al. (2014) in a teachers' value added context as well.

⁹ It is important to note that these student and school's characteristics are the main determinant of school government funding. In 2002 and 2003 the school budget was mainly a function of number of classes in school and on a school level deprivation index (which was function of a school's mean of student characteristics). In 2004 and 2005 school funding was based on school enrolment and the school deprivation index. See Lavy (2017) for more details on the funding rules in the two periods – a reference is missing.

means of 4th and 5th in Hebrew and math are also included in these regressions. The point estimates of the control variables have the expected signs: boys have 0.10- 0.13 standard deviation lower test scores than girls, number of siblings is negatively correlated with test scores, immigrants and students from Asia-Africa and Ethiopian ethnic background have negative correlation with test scores, and parental schooling and ethnicity from Europe, America, Israel and the previous Soviet Union has positive correlation with test scores. The school average lagged test score in Hebrew has significant positive effect on current outcomes but the estimate of the lagged math test score is zero. These estimates are much weaker because the school test score means are highly correlated with the school means of students' characteristics that are also included in these regressions.

We standardized the superintendents fixed effects as z-scores distribution with mean zero and standard deviation one. Figure 6 displays the two distributions (first and second period) of the standardized value added measure of 47 superintendents that are in charge of 497 schools. The two distributions look identical, and their equality is not rejected in a two-sample KS test. The correlation coefficient between these two value-added measures of each superintendent is 0.62.

The use of lagged scores as controls is meant to ensure that the superintendent fixed effect does not capture some unobserved school-specific characteristics. Although short lags would be ideal to do so, the 1991 scores which are available to us perform just as good. Figure 7 displays the distributions of student-level estimated standardized value added of the 2004-2005 period using alternative lagged scores sets as controls. The distribution of value added using the 1991 lagged scores as controls and the value added distributions using 2002-2003 lagged look identical, and equality of any distribution pair cannot be rejected by a two-sample KS test. This provides important support to the validity of our value added estimates.

Method II: Measuring Superintendents Value Added Based on Switchers

We specify a school level value added regression:

$$Y_{j1} - Y_{j0} = \gamma O_{sj1} + \beta (X_{j1} - X_{j0}) + \delta (S_{j1} - S_{j0}) + \mu Y_{j1} + u_{j1} \quad (2)$$

when the dependent variable is the change in test score between period 0 and period 1. \hat{O}_{js1} is the new superintendent j in period 1 of school s . X_{j0} and S_{j0} are the students' and school's mean characteristics

in the first period and X_{j1} and S_{j1} are the respective means in the second period. $(X_{j1} - X_{j0})$ and $(S_{j1} - S_{j0})$ are the changes in students' and school's characteristics. Superintendent fixed effect O_j is the mean residual change in test scores (value added) of the schools that are part of the cluster of superintendent j . Y_{jt} is the lagged test scores in math, English and Hebrew. As lagged test scores we use the earliest test scores data available for all schools from a national testing program in 1991 and 1992. The 1991 data include test scores in Hebrew and math in 4th and 5th grade and the 1992 data include test scores of 3rd graders in the same subjects. Even though these data are from over a decade ago, they are strong and precise predictors of the 2002-2005 test scores. For example, the R^2 of a regression of the 2002-2003 stacked test score in Hebrew and math on the 2004-05 respective test scores is 0.42. The R^2 when the 1991 test scores replace the 2002-2003 is 0.41. Furthermore, when the 1991 test score are included jointly with the 2002-2003 test score in a regression of the 2004-05 test scores, both lagged sets of test scores have positive and similar coefficients.¹⁰

We combine all observed data throughout the study period, 2002-2005, for the estimation of superintendent's value added. Table 3 presents the estimates of equation (2). The X_j vector includes an indicator for male students, number of siblings, an immigrant indicator, father's and mother's years of schooling, six student's ethnicity indicators, school enrolment and number of classes. The means and standard deviations for these variables are presented in columns 1 of Table 3.¹¹ Most of the estimated coefficients of the right-hand side variables are different from zero except for the two parental education variables. This pattern is most likely a result of the stability of the characteristics of a school within this short period. From this regression we recover the superintendents fixed effects. These are then standardized as z-scores distribution with mean zero and standard deviation one. Figure 8 displays the distribution of the standardized value added measure of 44 superintendents that are in charge of 226

¹⁰ We don't present these results in the paper and they are available from the authors upon request.

¹¹ It is important to note that these student and school's characteristics are the main determinant of school government funding. In 2002 and 2003 the school budget was mainly a function of number of classes in school and on a school level deprivation index (which was function of a school's mean of student characteristics). In 2004 and 2005 school funding was based on school enrolment and the school deprivation index. See Lavy (2017) for more details on the funding rules in the two periods – a reference is missing.

schools.¹² It is clear that there is large variation in superintendent quality which we can use to estimate its impact on school's academic and non-academic outcomes.

The correlation coefficient of superintendent value added I and II (the average of two values available for each superintendent), based on the sample that include all superintendents for which we value added I and II 0.61. It is very re-assuring that these two alternative measures, based on very different methods and samples, are highly correlated.

Are Switching Schools and Superintendents Quasi-Randomly Matched?: In this section we present evidence that show that the likelihood that a school experienced a change in superintendent is unrelated to the superintendent's value added or to the school characteristics. This is an expected result given the details provided in section 2 clarifying that that changes in superintendent-school pairing is related to personal and geographical considerations and not to relationship between the school and its superintendent quality.

Are schools that changed or remained with the same superintendent observationally equivalent? In Table 4, we present summary statistics for the variables used in the analysis. Column 1 presents the means for the sample of all schools that did not change a superintendent during the period of study and column 2 presents the respective means for the school that did change superintendent during this period. Panel A includes 13 school mean of its students and other characteristics (gender, number of siblings, immigrant status, mother and father years of education, and 6 ethnic origin indicators, enrolment and number of classes). Panel B includes school means of its students' test scores in national standardized exams in math, Hebrew and English. The 497 schools that stayed with the same superintendent during the study period had 63,979 students and 47 superintendents. The 82 schools that switched superintendent between 2002 and 2004 or between 2003 and 2005 had 10,293 students and 29 superintendents.

In column 3 we present the balancing tests between the columns 1 and 2 which is a test of a correlation between the probability of a school changing superintendent and its observable

¹² We also estimated the value added regression where student-individual data replaces school means in outcome test scores and student characteristics. The distribution of the superintendents value added values look identical to that displayed in Figure 2.

characteristics. There are 16 parameter estimates and one of them are statistically different from zero. With respect to the proportion of Asia-Africa ethnicity, the difference is larger and more significant. However, it should be noted that the two groups are statistically indistinguishable in terms of their parental years of schooling and in terms of the average test scores in each of the three subjects, both in terms of the absolute differences and their statistical significance. We view this evidence as suggestive of no particular pattern of selection in the probability of changing superintendent, definitely no correlation with students' socio-economic background and test scores.

Next we estimate whether quality of the incoming superintendent is correlated with observable school characteristics and outcomes. We use the value added based on method I and method II. These balancing are presented in columns 4-5 of Table 4. In column 4 we present the estimates based on value added I. The sample includes only the 82 schools (10,249 students and 29 superintendents) that switched superintendent between 2002 and 2004 or between 2003 and 2005. Four of the 16 estimates in column 4 are statistically different from zero: Ethnicity Israel and ethnicity Europe-America are positively and negatively correlated, respectively, with superintendent quality. These two ethnic groups have higher socio-economic background than the other ethnic groups so we expect that they will have the same direction of selection. But we see that these two ethnic indicators have opposite sign of their correlation with superintendent value added, one positive and the other negative, suggesting perhaps that their significance imbalance does not reflect systematic selection pattern in the assignment of schools to superintendents. The evidence is a clear indication that overall this value added measure is not systematically correlated with students' and schools' observed background variables. Particularly reassuring is the lack of any correlation with student's parental education and with lagged test scores in panel B. Another point that underscore the relatively marginal importance of these imbalances is that our model of estimating the effect of value added II on school outcomes include a school fixed effect that is feasible because we observe each school with two different superintendent. In column 5, we present estimates based on value added II. The sample includes 301 schools that did not change superintendent. Only one of the 16 estimates is statistically different from zero, Ethnicity Ethiopian.

6. Estimated Impact of Superintendents Value Added

We estimate equation (1) twice, first using school level means for all variables and secondly with student's level data. Using student micro data allow of course estimation with much larger sample, leading to more precise estimates. It also allows to estimate treatment heterogeneity by students' characteristics, particularly important in this context is the heterogeneity of the effect of superintendent value added by students' socio-economic background.

The first row of Table 6 presents estimation with school level data of effect of superintendent value added on students' achievement in math, English, and Hebrew. In columns 1-4 we present the estimates of effect of value added based on the first measure. Here we use the sample of 'switchers', schools that changed superintendent between two periods. These schools will have a different superintendent in each period and so their superintendent \hat{O}_{jst} value added will be period (t) specific. The GEMS data provides a panel data on schools where each school participates in two rounds of national testing between which it experiences a change in its superintendent. Schools that participate in the 2002 testing round are also included in 2004. Similarly schools included in the 2003 testing are also included in 2005. We stack this panel data so that α_j can be estimated as a school fixed effect. The advantage of this school fixed effect model (which is equivalent to a difference equation at the school level) is that it controls for omitted time-invariant variables biases that could potentially be correlated superintendents' value added. We report results from four different specifications. In column 1 the regression includes year effect as controls, in column 2 subject fixed effects are added as control, in column 3 schools' and mean students' characteristics are added as well, and in the fourth reported in column 4 we also include school fixed effects. The estimates in columns 1-3 are negative but small and not significantly different from zero. The within school estimate (regressions with schools fixed effect) presented in column 4 is however positive, 0.038, and significantly different from zero at the 5 percent level of significance, suggesting that one standard deviation increase in superintendent value added increases test scores in the three subjects by 3.8 percent of a standard deviation of the test score distribution. In the second row of Table 6 we present the estimates based on the students' sample. Standard errors are therefore clustered at the superintendent level by year level. The estimates in this row are similar to those presented in the first row. The respective estimate in this sample is 0.040 (se=0.015).

In columns 5-7 we report results based on the second value added measure from three different specifications identical to those in columns 1-3. The unit of observation is the student but the level of treatment is at the school level. The estimates in columns 5-7 are positive but only the estimate in column 7, 0.061, is significantly different from zero at the 5 percent level of significance. Since both the superintendent value added and the test scores are standardized to mean zero and a unit standard deviation, this estimated effect implies that one standard deviation increase in superintendent value added increases test scores in the three subjects by 6.1 percent of a standard deviation of the test score distribution. The respective estimate based on using student level data is 0.053 and it is only significant at the 10 percent level of significance. This effect implies that one standard deviation increase in superintendent value added increases test scores in the three subjects by 5.3 percent of a standard deviation in the test score distribution.

Remarkably the two measures of superintendent value added yield similar estimated effect size, especially when comparing the estimates when using the micro students' data: 0.053 versus 0.040. Both are statistically different from zero but their confidence intervals overlap.

As a robustness check of our results we also estimated the effect of superintendent's quality measure using two alternative estimation strategies. In the first strategy we implement a Bayes shrinkage estimation strategy and construct an unbiased measure of superintendent value added that accounts for noise in the measurement. Using this approach the noisy measure of a superintendent value added is multiplied by an estimate of its reliability, where the reliability of a noisy measure is the ratio of signal variance to signal variance plus noise variance. Thus, less reliable measures are shrunk back toward the mean of the distribution of superintendent value added measure.¹³ In the second strategy we

¹³ Following Morris (1983) and the teacher value added literature (for example, Kane and Staiger 2008) we construct the EB shrinkage factor for superintendent i by the ratio of signal variance to signal variance plus noise variance of superintendent i . Similarly to the teacher value added literature, we assume that the measure of superintendent bias includes an error component. Thus, estimating superintendents' effects on students' test scores enables to separate between the signal variance (variance of superintendents' effects) and noise variance of superintendent i (variance of the residuals for superintendent i). The EB estimate for each superintendent is a weighted average of the superintendent estimated effect and the mean of superintendent estimates, where the weight is the EB shrinkage factor. Implementing this methodology, the less reliable estimates of superintendent value added (those with a large variation in estimated residuals) are shrunk towards the mean of superintendent estimates.

use a two-step bootstrapping algorithm to account for the estimation of superintendents' value added as a first step and adjust their estimated standard errors¹⁴.

In both of these alternative estimation strategies we use both measures of value added based on method I and II and we focus on the specification that includes school fixed effects. The results are presented in Table 7. The two alternative estimation strategies yield similar results to the respective estimates presented in Table 6. The standard errors of the bootstrapping algorithm are almost identical to those of the preferred specification, and accounting for the fact that empirical Bayes estimates are smaller in absolute values than the initial estimates because of the shrinkage procedure (before standardization, the pre-shrinkage mean value of superintendent value added is -0.17 while its post-shrinkage value is 0.013), we compare the elasticities of superintendent value added effects at their mean values which yields comparable outcomes.

It is useful to benchmark the effect sizes presented in columns 4 and 7 of Table 6 against the effect of teachers' value added. For example, the findings of Rockoff (2004) and Rivkin, Hanushek, and Kain (2005) both suggest a one standard deviation increase in teacher quality improves student math scores around 0.1 standard deviations. Aaronson, Barrow, and Sander (2007) find similar results using high school data. Branch et al (2012) report that a one standard deviation increase in principal leadership (i.e., a principal in the top 16 percent of the quality distribution) leads to 0.05 standard deviation gain in test scores of all students in the school. Chetty (2014b) find that one standard deviation improvement in teacher value added in a single grade in primary school in NY City raises the probability of college attendance at age 20 by 0.82 percentage points, relative to a sample mean of 37%. In comparison to other schooling intervention, it would require an additional one hour of instruction per week in math, Hebrew and English (a 25 percent increase) in order to achieve the same effect as a one standard deviation increase in superintendent value-added (Lavy 2015).

¹⁴ The bootstrap estimates of the standard errors are constructed as follows. In a first step, a random sample with replacement is drawn from each superintendent schools. A new measurement of superintendent bias for each superintendent is created, based on the new sample of schools. In a second step, the effect of these new value added measures on student test scores in 5th grade are estimated (based on the preferred specification presented in Table 6) and the coefficients are stored. This process of two-step bootstrap sampling and estimation is repeated 1,000 times. The standard deviations in the sample of 1,000 observations of coefficients estimates from the second step are the bootstrap standard errors of the estimated effects of superintendent value added.

Since 80 percent of the superintendents in our sample are female, we report in Panel B, third and fourth rows of Table 6, the estimates from regressions when the sample is restricted to schools with female superintendents. The estimated effect based on the school level means is 0.048 (se=0.022) when using the first value added measure and 0.063 (se=0.032) when using the second value added measure, both larger than the full sample estimates but not significantly different from it. The two respective estimates obtained from the students' sample level regressions are 0.053 and 0.055.

In Panel C we present evidence based on sub-samples of students by parental education. Father's or mothers years of schooling are good proxies for student's socio-economic background. Research on the causal impact of school inputs suggest that students from poorer background benefit more from factors such lower class size, remedial education, higher quality peers and also teachers' quality.¹⁵ Our estimates show no such differences with respect to the effect of management quality in public education.

To check for potential non-linearity in the effect of superintendent value added we report in Table 8 estimates where we divide the distribution to ranges from low to high. First we split the range to above and below the median of superintendent's value added. Using value added I, the estimate for the indicator of above median quality is 0.065 (se=0.036) and using value added II yields a marginally lower estimate, 0.082 (se=0.036). Secondly, we divide the distribution to quartiles of superintendent's value added. The estimates for three upper quartile value added indicators are increasing monotonically: with value added I the estimates are 0.031, 0.055, and 0.130. With value added II they are 0.080, 0.099, and 0.135, suggesting non-linear effect of superintendent value added with a monotonically increasing effect. The estimated effect of the upper quartile of ability is statistically significantly different from zero for both value added estimates but only the first of the two is measured precisely enough to significantly larger than the second quartile estimate.

Clearly the effect of superintendents' value added is non-linear and it increases sharply with value added. It is natural and interesting to compare this pattern of non-linear effect with that of the effect of teachers' value added but we did not find studies that provide such evidence.

¹⁵ For example.

Since the middle school system in Israel (grades 7-9) share the same model of superintendents as that of primary schools, we replicated the analysis presented above with the data for middle schools. We relied on value added I as the measure of superintendent quality because the sample of schools is much smaller than the primary schools sample, only 15 schools had changed their superintendent from 2002-2003 to 2004-2005 and during the two periods 13 different superintendents were the CEO's of these schools. Using the students' level data, the estimated effect of value added I for middle schools are presented in Table 9. The point estimates are negative in the first three column but change sign when a school fixed effect is added to the regression as a control. The estimated effect is 0.048, very close the respective estimate based on the sample of primary schools (0.040, $se=0.016$) but much less precisely estimated ($se=0.055$), probably due to the much smaller sample of schools, 15 versus 82.

5. Identifying Mechanisms of Effect of Superintendents' Value Added

The results reported above show that schools exhibit higher achievement when they have a higher value added superintendent. In this section, we explore several potential mechanisms through which superintendent value added may affect their students' academic achievement. We use a rich set of school practices and outcomes based on responses to questionnaires of primary school principals, teachers and students.¹⁶ We focus on items that relate to the classroom and school environment (student questionnaire), on school activities and programs in the area of improving school climate and students' norms and on school resources (principal questionnaire), school procedures and teachers' on and off the job training (teacher questionnaire). To obtain a more general picture of the possible mechanisms and to gain statistical power, we also group outcomes into eight categories. We analyse each category by creating category-specific average effect. This allows us to control for the potential problem of over-rejection of the null hypothesis due to multiple inference. Because different outcomes have different data scales, simply averaging the estimators for the treatment effect is not likely to produce a meaningful statistic. To address this concern, we follow the summary-index approach per Kling et al. (2007). The

¹⁶ See H. Jerome Freiberg (1999) and J. Barry Fraser (1998) for recent reviews of the educational research literature about the validity of students' and teachers' assessments of the classroom environment and their associations with students' achievements.

average effect of multiple outcomes is the average of z-scores of each outcome variable. This summary index is a special case of the z-score and is identical to the mean effect size of treatment if there is no missing value.¹⁷ In general, the sign of the summary index reveals information on the direction of the aggregate impact of a class of outcomes, and the more the summary index deviates from zero, the stronger is the implied aggregate effect.

We are aware, of course, that we are not able to measure all the relevant mechanisms, and we cannot rule out the possibility that other mechanisms are in place, but the analysis presented in this section provides important insights regarding the possible mediating factors that drive the positive effect of the school superintendent on students' achievements.¹⁸ Our hypothesis is that if the effects of the superintendent value added is partially being driven by a particular mediating factor, observing a significant effect of the superintendent value added on this factor provides some evidence for the validity of this hypothesis.¹⁹ We use in this section value added I as our measure of superintended quality because it is based on sample that is twice larger than the one use to estimate value added II (497 schools versus 226 schools).

¹⁷ In the regression specification this approach yields standardized estimators as follows: the treatment effects for K outcomes are aggregated and reflected in a single standard normal statistic,

$$\tau = \frac{1}{K} \sum_k \frac{\beta_{1k}}{\sigma_{kC}}, \quad k = 1, \dots, K$$

where β_{1k} indicates the average treatment effect for outcome k and σ_{kC} denotes the standard deviation of the k^{th} control outcome. Having included the covariates, the K average treatment effects (β_1) and sample variances can be easily acquired through a linear regression. By doing so, the above equation can be thought of as a point estimator representing a collection of standardized treatment effects. However, this paper also takes into account the covariance of effects and therefore adapt a seemingly uncorrelated regression (O'Brien 1984, Kling et al. 2007):

$$\mathbf{Y} = \mathbf{I}_K \otimes (\mathbf{T} \quad \mathbf{X}) \boldsymbol{\beta} + \mathbf{v}$$

where \mathbf{T} is the treatment indicator(s), and \mathbf{X} consists of controlled regressors as well as a constant term.

¹⁸ A further limitation is that we cannot identify the causal effect of the mechanisms on outcomes because the former are numerous and we have only one potential instrument.

¹⁹ Lavy and Schlosser (2011) show in online Appendix Table 5 that all indicators of the quality of the classroom environment, as described by the students, are highly correlated with students' academic performances even after controlling for school fixed effects and students' background characteristics. For example, they report that lower levels of classroom disruption and violence, better inter-student relationships, and a higher quality of interaction between teachers and students are all positively associated with students' test scores. Though they do not provide a casual interpretation to these correlations, their results suggest that students' assessments of their classroom environment have a high informational content and that these mechanisms, as pointed out in the educational literature, might play an important role in student's learning process.

School Priorities, Working Procedures and Resources: In Table 10 we present evidence on two potential channels for the effect of superintendent value added, school priorities setting and working procedures and school resources. Three items in the teacher’s questionnaire (“school has clearly defined priorities”, teachers’ are involved in setting school priorities”, and “school has clearly defined working procedures”) reflect management practices that can affect the allocation and use of school resources and therefore be conducive or harmful to learning and achievement. Clearly the scope, responsibilities and management directives of superintendent can affect these school factors by the frequent interaction with school principals and teachers. In panel A we present treatment effect estimates for these outcomes, the mean of which are very high, over 5 in a scale of 1-6. The within school estimates show that a higher superintendent value added improves only the first outcome which reflect student-teacher relationship but not the other. The estimates of the social and school satisfaction are positive but they are small and not statistically different from zero and so is the average effect.

School climate programs and outcomes: From two items in the school principal questionnaire we define an indicator of whether the school assessed this year the school climate and norms and an indicator of whether the school had in the current year interventions aiming at improving norms, values, and discipline of students. In panel A of Table 11 we report estimates from regression when each of these two indicators is the dependent variable. We use three different specifications identical to the three specifications used in Table 6. Seventy one percent of the schools in the sample had in the current year an assessment of discipline, violence and norms in school and 29 percent of schools had interventions targeted at improving these aspects of school environment. Superintendents’ value added has a positive and statistically significant effect on both of these outcomes. The average effect shows similar positive.

In panel B of Table 11 we present estimates of the effect of superintendents’ value added on classroom and school violence. This analysis is based on the following items from the student’s questionnaire: (1) “There are many fights among students in my classroom.”; (2) "This year I was involved in many fights" (3) “Sometimes I’m scared to go to school because there are violent students.” The estimates reported in panel B columns 2–4 of Table 11 suggest that a higher superintendent value

added significantly lowers the level of violence in school. This effect is evident in each of the three items and also in their average effect. For example, the estimate for the effect of superintendent value added on students' reports regarding the level of violence in the classroom is -0.035 ($se = 0.019$). The average effect of these three items is more precise than the estimates for the individual items. The average estimate is -0.033 ($se = 0.013$). Overall, these results suggest that having higher quality superintendent improves the safety climate in school by lowering the incidence of fights, increasing the safety of students, and lowering their anxiety about attending school.

Three items in the student's questionnaire ("When I have a problem at school there is always someone I can turn to (from the teaching staff)", "I feel well-adjusted socially in my class," and "I am satisfied in school") reflect school environment and climate, in particular the relationships between students and teachers and the quality of inter-student. These factors can be conducive or harmful to learning and achievement. Being well-adjusted and accepted socially among classroom peers may improve a student's self-confidence, self-image, motivation, and other non-cognitive attributes that might be essential for effective learning. In panel C we present treatment effect estimates for these outcomes, the mean of which are very high, over 5 in a scale of 1-6. The within school estimates show that a higher superintendent value added improves only the first outcome which reflect student-teacher relationship but not the other. The estimates of the social and school satisfaction are positive but they are small and not statistically different from zero and so is the average effect.

Scholastic Programs and Teachers Training: In Table 12 we present evidence on three additional potential channels for the effect of superintendent's value added: school scholastic programs in Hebrew, math and English, and two forms of teachers' training in each of these three subjects, in service on the job training and off school courses. The subject specific programs include additional instructional resources for a given subject or improvements of teaching methods and practices. The effect of superintendent value added is positive and significant in English but not in programs for the other two subjects.

The effect of superintendent quality on teachers training outside of schools is practically zero, as seen by the estimated effect on off school training in each of the three subjects. The estimated effect

on the job training is positive and significant, in math it is positive but not precisely measured and in English it is negative but not different from zero. The average effect is positive but imprecise suggesting that the overall effect is negligible but the effect on composition of the in school training is meaningful. Angrist and Lavy (2001) estimated large effect of such in school training on students test scores.

Changing School's Principal: In Table 13 we present evidence on another important channel for the effect of superintendent value added, changing the school principal. About 15 percent of the schools change every year their principal, implying that the mean duration of a school principal is 6-7 years. In columns 1-3 we present estimates of the effect of an indicator of change in the school superintendent on the probability of a school changing its principal. This likelihood is lower by about 6 percent in the year a new superintendent steps in and it is 9 percent higher the following year. When both the contemporaneous and one year lagged effect are included jointly the estimates change marginally though the pattern is the same. In columns 4-9 we present the estimates for each year separately. Most interesting are the results for the academic year 2004-2005 because we can estimate the contemporaneous effect and the one and two year lag effects. The pattern that emerge is striking: the likelihood of a change in school principal in the first year the new superintendent steps in is lower by 7.6 percent, it is higher by 14 percent in the second year and it is zero in the third year. These estimates clearly suggest that a change in school management is associated with an engagement with a new superintendent.

6. Concluding Remarks

This is the first paper that measure the causal effect of quality of management-supervision in public education. The structure of the education system in Israel, as in many other countries, includes a superintendent who is the CEO's of a group of about 15 schools over of which she/he has extensive responsibility and authority. We exploit quasi-random turnover of superintendents over time to measure their value added in terms of test scores gains in English, Hebrew and math in primary schools in Israel. This turnover is largely dictated by a routine in the system to rotate superintendents across schools every 3-5 years and by other naturally occurring events such as retirement of superintendents. We show that geographical considerations determine largely which schools are included in a superintendent's cluster

of schools. We further demonstrate that the turnover of superintendents is unrelated to schools or students potential outcomes. We measure superintendents' value added similarly to recent measures of teachers' value added, including controls for school level lagged outcomes as well. We construct two alternative value added measures: first based on the common academic achievement level of all schools that share the same superintendent, second based on the common growth in academic achievement shared by all schools that were assigned to the same new superintended. We than show that both measures of superintendents' value added are uncorrelated with the probability that superintendents experience turnover of schools.

We estimate that superintendent value added have positive and significant effect on primary students' test scores in math, Hebrew, and English. Based on the first value added measure, one standard deviation improvement in superintendent value added increases test scores by about 0.04 standard deviation in the test score distribution. The effect is similar for students from lower and higher socio-economic background, it is highly non-linear, increasing sharply for superintendents in the highest quartile of the value added distribution and larger but not statistically significantly so for female superintendents. We obtain similar results when using the second measure of value added. We explore several mechanisms for these effects and find that superintendents with higher value added are associated with more focused school priorities, more clearly defined working procedures but no effect on school resources as funding is determined centrally at the Ministry of Education and no effect on teachers' on the job and off school training. Schools with higher quality superintends are more likely to assess school climate, violence and bullying, and implement related interventions which lead to lower violence in school and higher social school satisfaction among students.

Two additional remarks point to relevancy of our findings for public policy. First we note that the effect size of superintendent's value added is particularly cost effective because an increase in the quality of one manager can improve the outcomes of thousands of students. Therefore, investing in quality of these 'CEO's' of schools is very compelling resource wise relative to investment in other schools inputs, for example teachers' quality. Secondly, about 70 percent of all superintendent are women, very much different from the relative scarcity of women in leadership roles in other public sector management and as CEO's in the corporate private sector. Our findings suggest that the quality

of women as superintendents does not fall short of that of men in the same position, raising the policy concern of why there are so few women in leading roles even in the public sector and how allocative efficiency can be improved in this regard in the labor market.

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Table 1: Number of Schools and Number of Superintendents

	Year			
	2002	2003	2004	2005
A. All Superintendents				
Number of Superintendents	54	56	57	54
Number of Schools	810	807	803	797
Number of Schools per Superintendent	16.1 (4.92)	15.5 (5.67)	15.1 (5.52)	15.9 (6.10)
Male Sample				
Number of Superintendents	14	15	13	10
Number of Schools	163	163	150	108
Number of Schools per Superintendent	13.9 (4.43)	12.9 (5.11)	13.6 (4.72)	13.5 (4.20)
Female Sample				
Number of Superintendents	40	41	44	44
Number of Schools	647	644	653	689
Number of Schools per Superintendent	16.9 (4.90)	16.4 (5.64)	15.5 (5.71)	16.4 (6.38)
B. Superintendents with Turnover of Schools				
Number of Superintendents	-	35	21	26
Number of Schools	-	563	309	448
Number of Schools per Superintendent	-	16.7 (5.24)	15.8 (3.95)	18.4 (5.35)
C. Superintendents with Net Turnover of Schools > 0				
Number of Superintendents	-	15	9	11
Number of Schools	-	277	135	234
Number of Schools per Superintendent	-	18.9 (4.03)	16.0 (3.64)	22.1 (4.48)
D. Superintendents with Net Turnover of Schools < 0				
Number of Superintendents	-	18	10	11
Number of Schools	-	238	142	135
Number of Schools per Superintendent	-	14.1 (4.76)	15.0 (4.22)	14.3 (3.69)
E. Final Analysis Sample of Superintendents				
Number of Superintendents	27	29	29	26
Number of Schools	428	461	461	445
Number of Schools per Superintendent	16.7 (5.40)	16.6 (5.24)	16.7 (4.75)	18.0 (5.72)
F. Retirement of Veteran Superintendents and Introduction of New Superintendents				
Number of New Superintendents	8	6	5	4
Number of Schools per New Superintendent	13.1 (6.53)	12.5 (6.72)	11.5 (6.94)	13.9 (7.36)
Number of Retiring Superintendents (at year's end)	4	4	7	-
Number of Schools per Retiring Superintendent	13.6 (3.69)	12.3 (6.00)	13.7 (5.91)	-
Average number of New SIs' Schools from Retired SIs	-	2.5 (3.02)	5.6 (4.83)	12.0 (7.57)

Notes: Standard deviations are presented in parenthesis. The sample includes all schools in the jewish non-religious primary school system.

Table 2: Regressions for Estimating Superintendents' Value Added Method I

	Period 0: 2002-2003		Period 1: 2004-2005	
	Mean (SD)	Regression Coefficient	Mean (SD)	Regression Coefficient
	(1)	(2)	(3)	(4)
School Average Characteristics				
Male	0.508 (0.500)	-0.130 (0.013)	0.504 (0.500)	-0.106 (0.012)
Number of Siblings	2.115 (1.194)	-0.050 (0.004)	2.114 (1.204)	-0.049 (0.006)
Immigrant	0.147 (0.354)	-0.093 (0.083)	0.118 (0.322)	-0.219 (0.120)
Father's Education	12.625 (3.542)	0.033 (0.002)	12.613 (3.641)	0.026 (0.003)
Mother's Education	12.968 (3.067)	0.048 (0.003)	12.965 (3.271)	0.035 (0.003)
Ethnicity - Asia Africa	0.146 (0.353)	-0.031 (0.013)	0.096 (0.295)	-0.045 (0.019)
Ethnicity - Europe America	0.159 (0.365)	0.063 (0.016)	0.154 (0.361)	0.082 (0.014)
Ethnicity - Ethiopia	0.019 (0.137)	-0.223 (0.074)	0.017 (0.130)	-0.130 (0.045)
Ethnicity - Former USSR	0.109 (0.312)	0.011 (0.099)	0.086 (0.281)	0.252 (0.125)
Ethnicity - Other	0.032 (0.176)	0.101 (0.088)	0.027 (0.163)	0.239 (0.126)
Number of classes in the school	15.757 (3.837)	0.001 (0.009)	15.846 (3.983)	0.001 (0.009)
Number of students in the school	461.931 (144.421)	0.000 (0.000)	458.217 (147.471)	0.000 (0.000)
School Average Lagged Z-Score				
1991 4th Grade Math	0.017 (0.876)	0.013 (0.031)	0.018 (0.863)	-0.008 (0.031)
1991 4th Grade Verbal	0.002 (0.864)	0.018 (0.030)	0.009 (0.852)	0.048 (0.034)
1991 5th Grade Math	0.028 (0.882)	-0.044 (0.023)	0.029 (0.876)	0.003 (0.023)
1991 5th Grade Verbal	0.005 (0.869)	0.041 (0.027)	0.009 (0.860)	0.013 (0.029)
Year FE	-	Yes	-	Yes
Subject FE	-	Yes	-	Yes
District FE	-	Yes	-	Yes
Superintendent FE	-	Yes	-	Yes
Number of Students	32,805	32,805	31,174	31,174
Number of Schools	497	497	497	497
Number of Superintendents	47	47	47	47

Notes : In columns (1) and (3) standard deviations are presented in parenthesis. In columns (2) and (4) standard errors in parenthesis are clustered at the superintendent level. Schools characteristics include number of classes, number of students and the number of schools under the school's superintendent. Students' characteristics include gender, ethnic origin, parents' education, number of siblings and immigrant status. All schools are in the jewish non-religious primary school system. Sample includes stacked math, hebrew and english tests scores. Test scores are standardized with 0 mean and unit sd.

Table 3: Regressions for Estimating Superintendents' Value Added Method II

	Mean (SD)	Regression Coefficient
	(1)	(2)
School Characteristics		
Δ Male	0.001 (0.105)	-0.019 (0.189)
Δ Number of Siblings	-0.034 (0.380)	0.026 (0.081)
Δ Immigrant	-0.031 (0.078)	0.236 (2.618)
Δ Father's Education	-0.037 (0.872)	0.048 (0.027)
Δ Mother's Education	-0.024 (0.716)	-0.082 (0.041)
Δ Ethnicity - Asia Africa	-0.052 (0.072)	-3.287 (13.185)
Δ Ethnicity - Europe America	-0.013 (0.089)	-3.244 (13.122)
Δ Ethnicity - Ethiopia	-0.002 (0.021)	-2.939 (13.266)
Δ Ethnicity - Former USSR	-0.027 (0.071)	-3.169 (13.702)
Δ Ethnicity - Other	-0.004 (0.034)	-4.088 (13.627)
Δ Number of classes in the school	-0.416 (2.364)	0.021 (0.018)
Δ Number of students in the school	-13.633 (67.449)	0.000 (0.001)
School Average Lagged Z-Score		
1991 4th Grade Math	-0.113 (0.900)	-0.012 (0.041)
1991 4th Grade Verbal	-0.079 (0.936)	0.036 (0.047)
1991 5th Grade Math	-0.130 (0.907)	0.007 (0.037)
1991 5th Grade Verbal	-0.077 (0.939)	-0.041 (0.038)
Year FE	-	Yes
Subject FE	-	Yes
District FE	-	Yes
Superintendent FE	-	Yes
Number of Students (Period 1)	13,605	13,605
Number of Schools	226	226
Number of Superintendents	44	44

Notes : In column (1) standard deviations are presented in parenthesis. In column (2) standard errors in parenthesis are clustered at the superintendent level. Schools characteristics include number of classes, number of students and the number of schools under the school's superintendent. Students' characteristics include gender, ethnic origin, parents' education, number of siblings and immigrant status. All schools are in the jewish non-religious primary school system. Sample includes stacked math, hebrew and english tests scores. Test scores are standardized with 0 mean and unit sd.

Table 4: Balancing Tests on Probability of Schools Changing Superintendent and on Superintendents' Value Added

	Changing Superintendent			Superintendent Value Added	
	Mean of Schools that did not change Superintendent	Mean of Schools that did change Superintendent	Probability of Changing Superintendent	Method I	Method II
	(1)	(2)	(3)	(4)	(5)
A. Student and School Characteristics					
Male	0.506 (0.500)	0.502 (0.500)	-0.004 (0.004)	0.009* (0.005)	0.009 (0.006)
Number of siblings	2.115 (1.199)	2.127 (1.164)	0.013 (0.035)	0.008 (0.031)	0.032 (0.092)
Immigrant	0.133 (0.339)	0.139 (0.346)	0.006 (0.010)	-0.007 (0.017)	0.004 (0.012)
Mother's years of education	12.966 (3.168)	13.033 (3.184)	0.067 (0.114)	0.153 (0.179)	-0.262 (0.224)
Father's years of education	12.619 (3.591)	12.680 (3.654)	0.061 (0.129)	0.202 (0.223)	-0.301 (0.233)
Ethnicity - Israel	0.576 (0.494)	0.587 (0.492)	0.011 (0.013)	0.036* (0.020)	-0.027 (0.022)
Ethnicity - Asia Africa	0.122 (0.327)	0.114 (0.318)	-0.007 (0.005)	-0.006 (0.009)	0.006 (0.007)
Ethnicity - Europe America	0.157 (0.363)	0.154 (0.361)	-0.003 (0.006)	-0.020* (0.006)	0.000 (0.014)
Ethnicity - Ethiopia	0.018 (0.134)	0.010 (0.097)	-0.009* (0.003)	-0.002 (0.003)	0.018* (0.006)
Ethnicity - Former USSR	0.098 (0.297)	0.099 (0.299)	0.001 (0.010)	0.000 (0.014)	0.007 (0.015)
Ethnicity - Other	0.030 (0.170)	0.036 (0.187)	0.007 (0.003)	-0.008 (0.008)	-0.004 (0.004)
School's Number of Students	460.121 (145.927)	451.097 (152.871)	-9.022 (13.432)	-24.821* (14.677)	29.176 (19.242)
School's Number of Classes	15.800 (3.909)	15.668 (4.185)	-0.132 (0.357)	-0.638 (0.423)	0.714 (0.537)
B. Tests' Z-scores 2002-2005					
Math	-0.001 (1.004)	0.010 (0.986)	0.011 (0.025)	0.002 (0.017)	0.052 (0.077)
Hebrew	0.006 (0.998)	-0.005 (0.998)	-0.011 (0.026)	-0.035 (0.041)	-0.009 (0.053)
English	-0.002 (0.999)	0.011 (1.005)	0.013 (0.034)	-0.028 (0.074)	0.000 (0.089)
C. Correlation Between Previous and Current School's Superintendent Value Added Based on Method II					
	$SI(VA)_{t+1} = -0.153 + 0.0916 * SI(VA)_t$ <div style="display: flex; justify-content: center; gap: 20px;"> (0.197) (0.222) </div>				
	$R^2 = 0.005$				
Number of Schools	497	222	719	301	82
Number of Superintendents	47	55	67	30	29

Notes: In columns (1)-(2) standard deviations are presented in parenthesis. In column (3) standard errors in parenthesis are adjusted for school level clustering. In columns (4)-(6) standard errors in parenthesis are adjusted for superintendent level clustering. All regressions include district dummies. In Panel C standard errors in parenthesis are adjusted for superintendent level clustering. Number of schools and superintendents refer to Panels A-B. All schools are in the Jewish non-religious primary school system. Superintendents VA are standardized with 0 mean and unit sd. * indicates significant level at 10% or lower.

Table 5: Distribution of the Change of Superintendent Value Added Within Schools, Method II

	Mean Change (1)	SD (2)	Min (4)	Median (5)	Max (6)	Schools (7)
Full Sample	0.091 (0.154)	1.341	-3.467	0.228	2.213	82
Female Superintendents Subsample	0.383 (0.177)	1.342	-3.467	0.572	2.213	64

Notes : Robust standard errors are presented in parenthesis. All schools are in the jewish non-religious primary school system. The sample includes stacked math, hebrew and english tests scores. Superintendents value added is standardized with 0 mean and unit sd.

Table 6: The Effect of Superintendent Value Added on Tests Z-Scores

	Value Added Method I				Value Added Method II		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
A. Full Sample							
Schools' Sample Regressions	-0.002 (0.026)	-0.002 (0.026)	-0.010 (0.017)	0.038 (0.019)	0.037 (0.041)	0.037 (0.041)	0.058 (0.030)
Students' Sample Regressions	0.003 (0.025)	0.003 (0.025)	-0.013 (0.018)	0.040 (0.016)	0.035 (0.041)	0.035 (0.041)	0.051 (0.032)
B. Female Superintendents Sample							
Schools' Sample Regressions	0.010 (0.029)	0.010 (0.029)	-0.007 (0.020)	0.048 (0.022)	0.035 (0.043)	0.035 (0.043)	0.061 (0.032)
Students' Sample Regressions	0.019 (0.028)	0.019 (0.028)	-0.007 (0.019)	0.053 (0.011)	0.034 (0.043)	0.034 (0.043)	0.053 (0.034)
C. Full Sample - By Parental Education (Student Level)							
Below Median Father's Years of Schooling	-0.016 (0.024)	-0.016 (0.024)	-0.023 (0.029)	0.047 (0.027)	0.046 (0.042)	0.046 (0.042)	0.050 (0.036)
Above Median Father's Years of Schooling	0.010 (0.023)	0.010 (0.023)	0.001 (0.017)	0.031 (0.012)	0.066 (0.028)	0.066 (0.028)	0.060 (0.028)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Subject FE	No	Yes	Yes	Yes	No	Yes	Yes
Schools' and Students' Characteristics	No	No	Yes	Yes	No	No	Yes
School FE	No	No	No	Yes	No	No	No
Number of Students	10,249	10,249	10,190	10,190	39,915	39,915	39,852
Number of Schools	82	82	82	82	301	301	301
Number of Superintendents	29	29	29	29	30	30	30

Notes : Standard errors in parenthesis are clustered at the superintendent-by-year level. Schools characteristics include number of classes, number of students and the number of schools included in a superintendent's cluster. Students' characteristics include gender, ethnic origin, parents' education, number of siblings and immigrant status. All schools are in the jewish non-religious primary school system. Sample includes stacked math, hebrew and english tests scores. Test scores and superintendents value added are standardized with 0 mean and unit sd.

Table 7: The Effect of Superintendent Value Added on Tests Z-Scores

	Bayes Corrected Estimates		Two-Step Bootstrapped Standard Errors	
	Method I (1)	Method II (2)	Method I (3)	Method II (4)
A. Full Sample				
Students' Sample Regressions	0.038 (0.017)	0.050 (0.034)	0.040 (0.015)	0.051 (0.018)
B. Female Superintendents Sample				
Students' Sample Regressions	0.053 (0.012)	0.052 (0.036)	0.053 (0.017)	0.053 (0.018)
C. Full Sample - By Parental Education (Student Level)				
Below Median Father's Years of Schooling	0.043 (0.029)	0.049 (0.038)	0.047 (0.022)	0.050 (0.019)
Above Median Father's Years of Schooling	0.032 (0.013)	0.063 (0.029)	0.031 (0.020)	0.060 (0.018)
Year FE	Yes	Yes	Yes	Yes
Subject FE	Yes	Yes	Yes	Yes
Schools' and Students' Characteristics	Yes	Yes	Yes	Yes
School FE	Yes	No	Yes	No
Number of Students	10,190	39,852	10,190	39,852
Number of Schools	82	301	82	301
Number of Superintendents	29	30	29	30

Notes: Standard errors used to calculate bayes estimates at the VA estimation regression are clustered at the superintendent level. Standard errors in columns (1)-(2) are clustered at the superintendent-by-year level. Standard errors in columns (3)-(4) bootstrapped using the following two-step procedure: First, for each school in each period, we draw a random sample of students with replacement (In method I we draw a random sample of schools with replacement). The VA estimation regression is estimated on this random sample, and the corresponding VA estimates are obtained. The second stage regression is then estimated on a random sample of students with replacement. This process is repeated a 1,000 times, and the bootstrap standard errors are computed using the sample of these 1,000 second-stage coefficient estimates. Schools characteristics include number of classes, number of students and the number of schools under the school's superintendent. Students' characteristics include gender, ethnic origin, parents' education, number of siblings and immigrant status. All schools are in the jewish non-religious primary school system. Sample includes stacked math, hebrew and english tests scores. Test scores and superintendents value added are standardized with 0 mean and unit sd.

Table 8: Non Linear Effects of Superintendent's Value Added

	Value Added Method I	Value Added Method II
	(1)	(2)
A. Median		
Above Median VA	0.065 (0.036)	0.082 (0.036)
B. Quartiles		
2nd VA Quartile	0.031 (0.038)	0.080 (0.051)
3rd VA Quartile	0.055 (0.039)	0.099 (0.056)
4th VA Quartile	0.130 (0.045)	0.135 (0.057)
Year FE	Yes	Yes
Subject FE	Yes	Yes
Schools' and Students' Characteristics	Yes	Yes
School FE	Yes	No
Number of Students	10,190	39,852
Number of Schools	82	301
Number of Superintendents	29	30

Notes : Standard errors in parenthesis are clustered at the superintendent-by-year level. Schools characteristics include number of classes, number of students and the number of schools included in the superintendent's cluster. Students' characteristics include gender, ethnic origin, parents' education, number of siblings and immigrant status. All schools are in the jewish non-religious primary school system. Sample includes stacked math, hebrew and english tests scores. Test scores and superintendents VA are standardized with 0 mean and unit sd.

Table 9: The Effect of Superintendent Value Added I on Tests Scores - Middle Schools Sample

	Specification			
	(1)	(2)	(3)	(4)
A. Full Sample				
Students' Sample Regressions	-0.073 (0.096)	-0.073 (0.096)	-0.046 (0.040)	0.048 (0.055)
Above Median VA	-0.118 (0.081)	-0.118 (0.081)	0.046 (0.065)	0.193 (0.037)
C. By Parental Education				
Below Median Father's Years of Schooling	-0.020 (0.101)	-0.020 (0.101)	-0.019 (0.051)	0.041 (0.051)
Above Median Father's Years of Schooling	-0.142 (0.088)	-0.142 (0.088)	-0.080 (0.042)	0.027 (0.080)
Year FE	Yes	Yes	Yes	Yes
Subject FE	No	Yes	Yes	Yes
Schools' and Students' Characteristics	No	No	Yes	Yes
School FE	No	No	No	Yes
Number of Students	5,172	5,172	5,169	5,169
Number of Schools	15	15	15	15
Number of Superintendents	13	13	13	13

Notes : Standard errors in parenthesis are clustered at the superintendent-by-year level. Schools characteristics include number of classes, number of students and the number of schools included in a superintendent's cluster. Students' characteristics include gender, ethnic origin, parents' education, number of siblings and immigrant status. All schools are in the jewish non-religious middle school system. Sample includes stacked math, hebrew and english tests scores. Test scores and superintendents value added are standardized with 0 mean and unit sd.

Table 10: The Effect of Superintendent Value Added I on Working Procedures and School Resources

	Mean	Specification		
	(1)	(2)	(3)	(4)
A. School's Priorities and Working Procedures (Rank 1-6)				
Clearly Defined Priorities	5.419 (0.462)	0.231 (0.122)	0.199 (0.101)	0.230 (0.103)
Teachers Involved in Setting School Priorities	4.657 (0.635)	0.095 (0.076)	0.107 (0.085)	0.330 (0.173)
Clearly Defined Working Procedures	5.461 (0.494)	0.179 (0.140)	0.149 (0.122)	0.102 (0.121)
<i>Average Effect</i>	5.229 (0.456)	0.159 (0.101)	0.145 (0.087)	0.144 (0.115)
B. School's Resources (Weekly Instruction Hours)				
Instruction Budget per Class	44.981 (6.364)	-0.048 (0.131)	-0.090 (0.055)	-0.015 (0.055)
Length of the School Week	33.931 (3.062)	-0.057 (0.124)	-0.024 (0.061)	-0.082 (0.047)
Instruction Hours of Math, Science and English	14.186 (1.937)	-0.012 (0.135)	-0.017 (0.098)	-0.038 (0.088)
<i>Average Effect</i>	31.032 (3.397)	-0.039 (0.125)	-0.044 (0.057)	-0.045 (0.046)
Year FE		Yes	Yes	Yes
Student and School Characteristics		No	Yes	Yes
School FE		No	No	Yes
Number of Schools	82	82	82	82
Number of Superintendents	29	29	29	29

Notes: In column (1) standard deviations are presented in parenthesis. In columns (2)-(5) standard errors in parenthesis are adjusted for superintendent level clustering. An average effect is an equally weighted average of the rest of its panel's questions' values in column (1), and z-scores in columns (2)-(4). Panel A is drawn from principals' survey data and non-index variables originally take value of 0 or 1, with the exception of Use of Ministry Tools for Internal Evaluation which is a summary index of use of ministry tools questions. Panel B is drawn from teachers' survey data and non-index variables are originally on a scale of 1-6. Panel C is drawn from administrative data on school funding. Schools characteristics include number of classes, number of students and the number of schools included in the superintendent's cluster. Students' characteristics include gender, ethnic origin, parents' education, number of siblings and immigrant status. All schools are in the jewish non-religious primary school system. Superintendents value added is standardized with 0 mean and unit sd. Outcomes and students' characteristics are school means. The dependent variable is a standardized transformation (mean zero, unit standard deviation) of the raw variable.

Table 11: The Effect of Superintendent Value Added I on School Environment and Climate

	Mean	Specification		
	(1)	(2)	(3)	(4)
A. School Climate and Norms Indicators (0/1)				
School Evaluates its Environment, Climate and Discipline	0.707 (0.456)	0.267 (0.070)	0.264 (0.093)	0.250 (0.074)
Interventions Related to School Environment and Discipline	0.291 (0.456)	0.097 (0.075)	0.335 (0.099)	0.493 (0.224)
<i>Average Effect</i>	0.549 (0.385)	0.203 (0.054)	0.253 (0.070)	0.262 (0.077)
B. Violence in School based on Students' Assessment (Rank 1-6)				
"There are many fights among students in my classroom"	3.593 (1.497)	-0.040 (0.023)	-0.042 (0.022)	-0.035 (0.018)
"This year I was involved in many fights"	1.941 (1.389)	0.014 (0.021)	0.006 (0.016)	-0.034 (0.016)
"Sometimes I'm scared to go to school because there are violent students"	1.938 (1.483)	-0.012 (0.019)	0.002 (0.013)	-0.024 (0.012)
<i>Average Effect</i>	2.492 (1.031)	-0.013 (0.014)	-0.012 (0.010)	-0.033 (0.012)
C. Students' Satisfaction (Rank 1-6)				
"There's someone in the teaching staff I can turn to"	5.091 (1.324)	0.012 (0.017)	0.007 (0.016)	0.036 (0.008)
"I am satisfied in school"	5.252 (1.147)	0.003 (0.019)	0.010 (0.017)	0.011 (0.017)
"I'm socially satisfied in school"	5.246 (1.195)	-0.001 (0.009)	-0.002 (0.009)	0.004 (0.013)
<i>Average Effect</i>	5.193 (0.926)	0.005 (0.017)	0.006 (0.016)	0.019 (0.014)
Year FE		Yes	Yes	Yes
Student and School Characteristics		No	Yes	Yes
School FE		No	No	Yes
Number of Schools	82	82	82	82
Number of Superintendents	29	29	29	29

Notes: In column (1) standard deviations are presented in parenthesis. In columns (2)-(5) standard errors in parenthesis are adjusted for superintendent level clustering. An average effect is an equally weighted average of the rest of its panel's questions' values in column (1), and z-scores in columns (2)-(4) Panel A is drawn from principals' survey data, outcomes and students' characteristics are school means and non-index variables originally take value of 0 or 1. Panels B and C are drawn from students' survey data, outcomes and students' characteristics are individual level data and non-index variables are on a scale of 1-6. Schools characteristics include number of classes, number of students and the number of schools included in the superintendent's cluster. Student and school characteristics also include share of boys in the class in the violence related dependent variables. Students' characteristics include gender, ethnic origin, parents' education, number of siblings and immigrant status. All schools are in the Jewish non-religious primary school system. Superintendents value added is standardized with 0 mean and unit sd. The dependent variable is a standardized transformation (mean zero, unit standard deviation) of the raw variable.

Table 12: The Effect of Superintendent Value Added I on School Scholastic Programs and Teachers' In and Out of School Training

	Mean	Specification		
	(1)	(2)	(3)	(4)
A. School has an Academic Program (0/1) in:				
Hebrew	0.333 (0.473)	-0.123 (0.104)	0.047 (0.129)	0.274 (0.294)
Math	0.265 (0.443)	-0.220 (0.098)	-0.063 (0.111)	-0.116 (0.432)
English	0.222 (0.418)	-0.116 (0.100)	-0.116 (0.147)	0.472 (0.297)
<i>Average Effect</i>	0.274 (0.363)	-0.153 (0.085)	-0.044 (0.094)	0.210 (0.294)
B. Teachers Receive Out of School Training (0/1) in:				
Hebrew	0.465 (0.201)	0.030 (0.078)	0.087 (0.092)	0.043 (0.149)
Math	0.372 (0.191)	0.096 (0.062)	0.096 (0.092)	0.021 (0.106)
English	0.183 (0.259)	0.099 (0.150)	-0.022 (0.113)	0.035 (0.083)
<i>Average Effect</i>	0.342 (0.134)	0.075 (0.053)	0.064 (0.055)	0.050 (0.077)
C. Teachers Receive In-School Training (0/1) in:				
Hebrew	0.507 (0.259)	0.037 (0.084)	0.064 (0.079)	0.313 (0.120)
Math	0.380 (0.259)	0.033 (0.079)	0.117 (0.104)	0.192 (0.122)
English	0.188 (0.347)	-0.044 (0.080)	-0.172 (0.078)	-0.151 (0.102)
<i>Average Effect</i>	0.358 (0.162)	-0.008 (0.014)	-0.005 (0.016)	0.024 (0.020)
Year FE		Yes	Yes	Yes
Student and School Characteristics		No	Yes	Yes
School FE		No	No	Yes
Number of Schools	82	82	82	82
Number of Superintendents	29	29	29	29
Number of Teachers	2,236	2,236	2,236	2,236

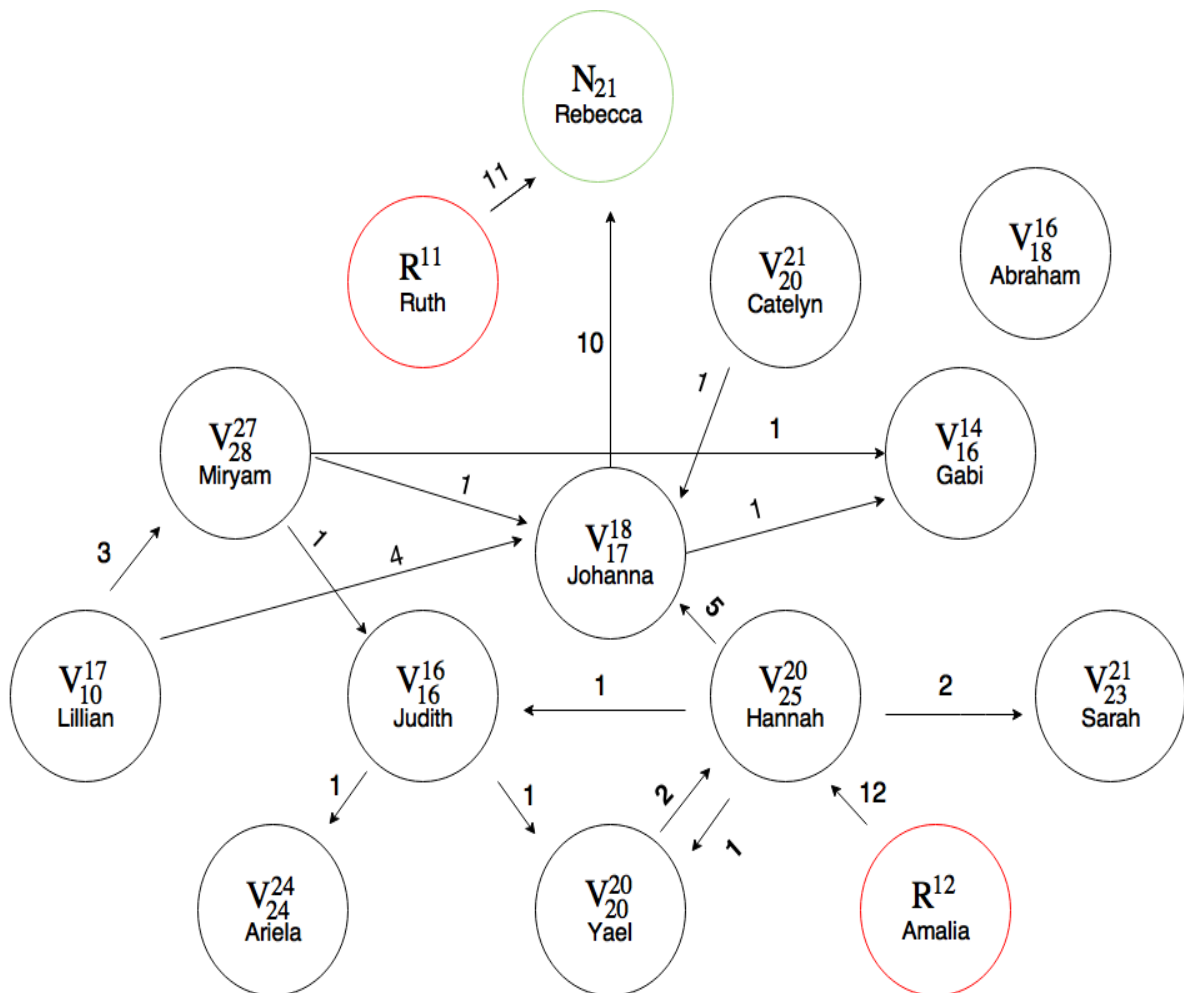
Notes: In column (1) standard deviations are presented in parenthesis. In columns (2)-(5) standard errors in parenthesis are adjusted for supintendent level clustering. An average effect is an equally weighted average of the rest of its panel's questions' values in column (1), and z-scores in columns (2)-(4) Both panels are drawn from teachers' survey data and non-index variables originally take value of 0 or 1. Schools characteristics include number of classes, number of students and the number of schools included in the superintendent's cluster. Students' characteristics include gender, ethnic origin, parents' education, number of siblings and immigrant status. All schools are in the jewish non-religious primary school system. Superintendents value added is standardized with 0 mean and unit sd. Outcomes and students' characteristics are school means. The dependent variable is a standardized transformation (mean zero, unit standard deviation) of the raw variable.

Table 13: The Effect of Change of Superintendent on Change of School Principal

Years Since Change of Superintendent	Full Sample Period			2002-2003	2003-2004		2004-2005		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
First Year	-0.044 (0.021)		-0.061 (0.028)	0.001 (0.033)	-0.049 (0.055)		-0.076 (0.032)		
Second Year		0.091 (0.028)	0.081 (0.028)			0.062 (0.035)		0.139 (0.050)	
Third Year									0.007 (0.033)
Share of Schools Changing Superintendent	0.15	0.15	0.15	0.15	0.17	0.17	0.14	0.14	0.14
Number of Schools	738	721	721	723	721	714	716	708	701

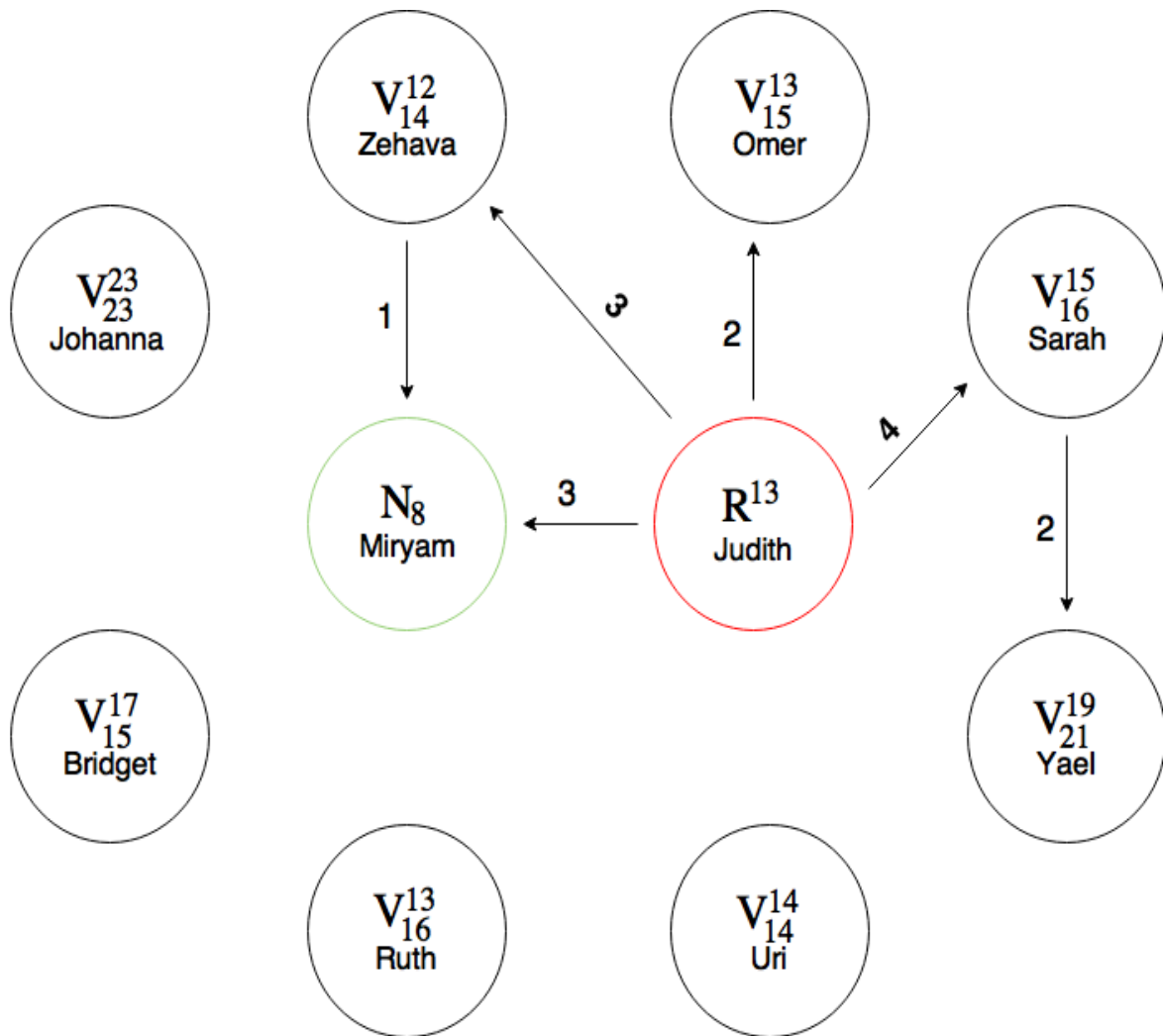
Notes: The sample includes schools that changed superintendent once or less throughout the sample period (~90% of all schools). Standard errors are presented in parenthesis. All schools are in the Jewish non-religious primary school system. In column 4 the change of school principal is between 2002-2003. In columns 5-6 the change in school principal is between 2003-2004. In columns 7-9 the change in school principal is between 2004-2005.

Figure 1: Superintendents' Turnover: Central District 2004-05



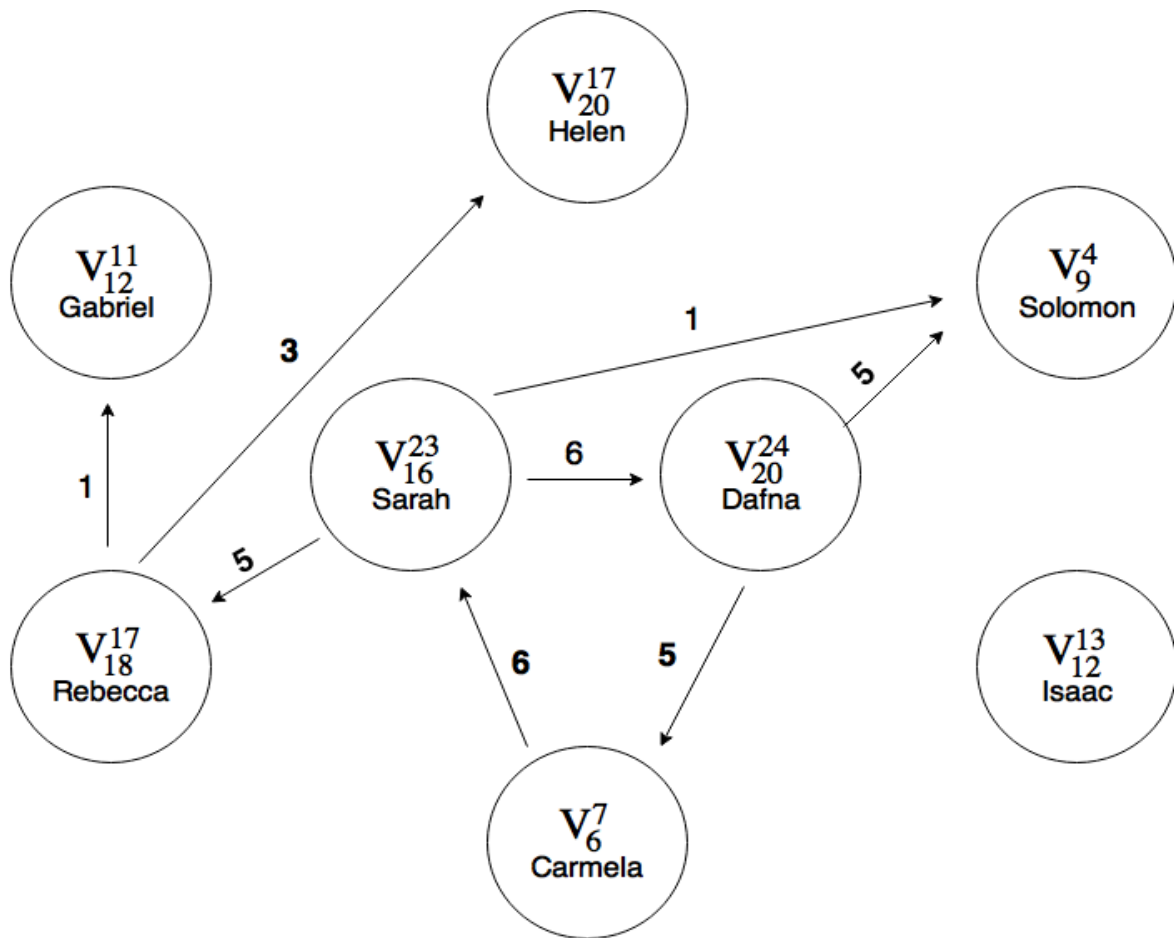
Notes: One of Miryam's 2005 schools is new. Two of Abraham's 2005 schools are new. One of Johanna's 2004 schools closed at the end of the year. One of Ariela's 2004 schools closed at the end of the year.

Figure 2: Superintendents' Turnover: South District 2002-03



Notes: Miryam had one middle school in 2002 and 4 middle schools in 2003. Uri had 2 middle schools in both years. One of Sarah's 2002 schools closed at the end of the year. Bridget had one middle school in 2002 and one of her 2002 schools closed at the end of the year. Ruth had 5 middle schools in 2002 and 8 middle schools in 2003.

Figure 3: Chart of Superintendents' Schools Turnover in Haifa District 2003 - 2004



Notes: One of Sarah's 2003 schools closed at the end of the year. Isaac had 6 middle schools in 2003 and 5 middle schools in 2004. Solomon had one Arabic school in 2003 and none in 2004.

Figure 4: Distribution of Superintendents' Number of Schools

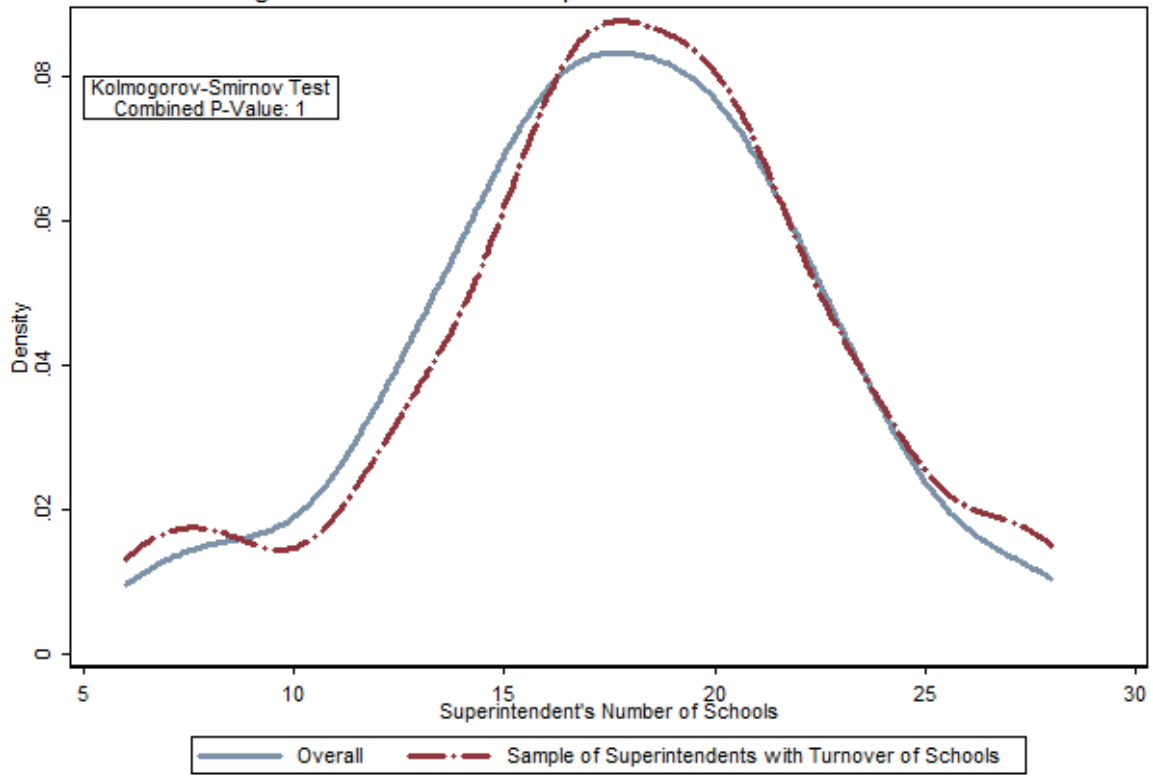
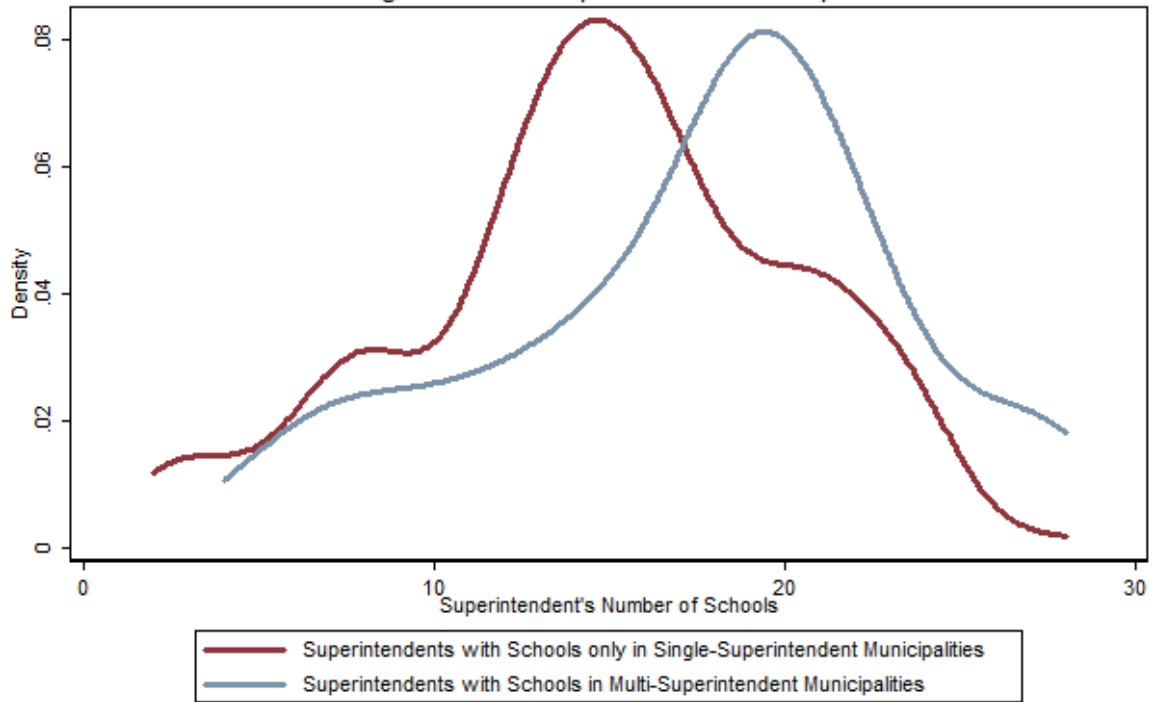


Figure 5: Distribution of Superintendents' Number of Schools in Single and Multi-Superintendent Municipalities



Number of Superintendents X Year with Schools only in Single-Superintendent Municipalities: 179
Number of Superintendents X Year with Schools in Multi-Superintendent Municipalities: 51

Figure 6: Distribution of Superintendents Value Added I by Period

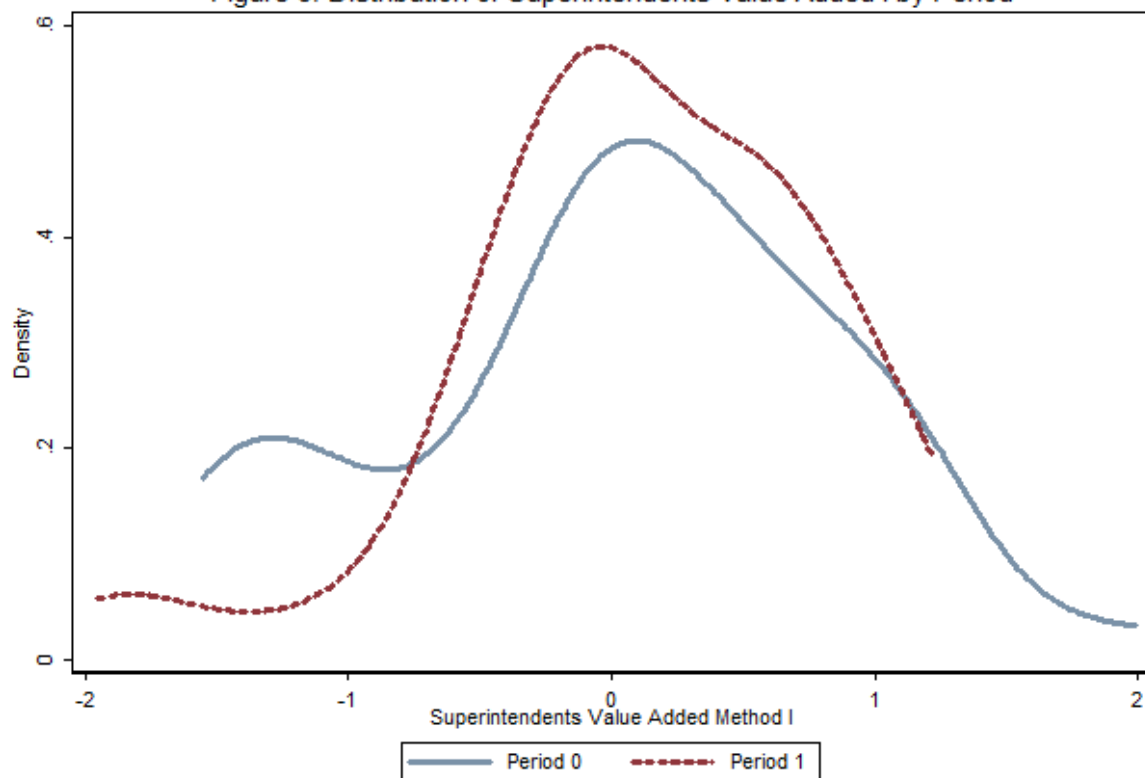


Figure 7: Distribution of Superintendents Value Added I with Different Controls for Lagged Test Scores

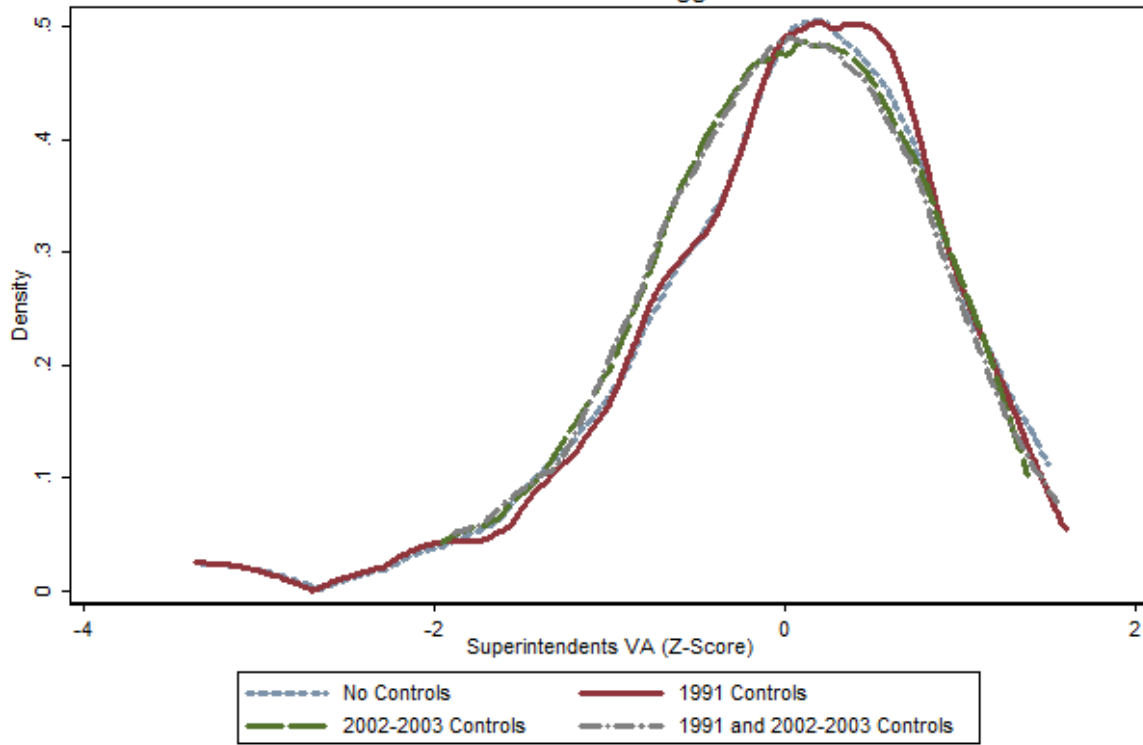
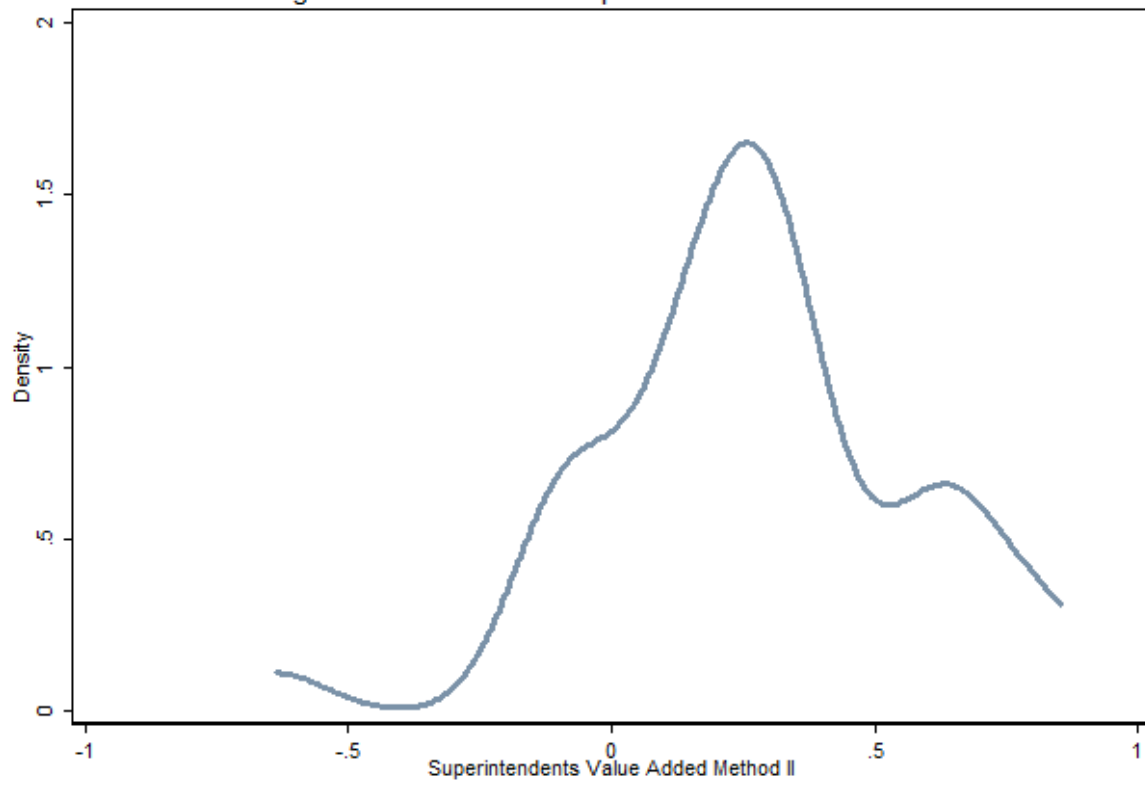
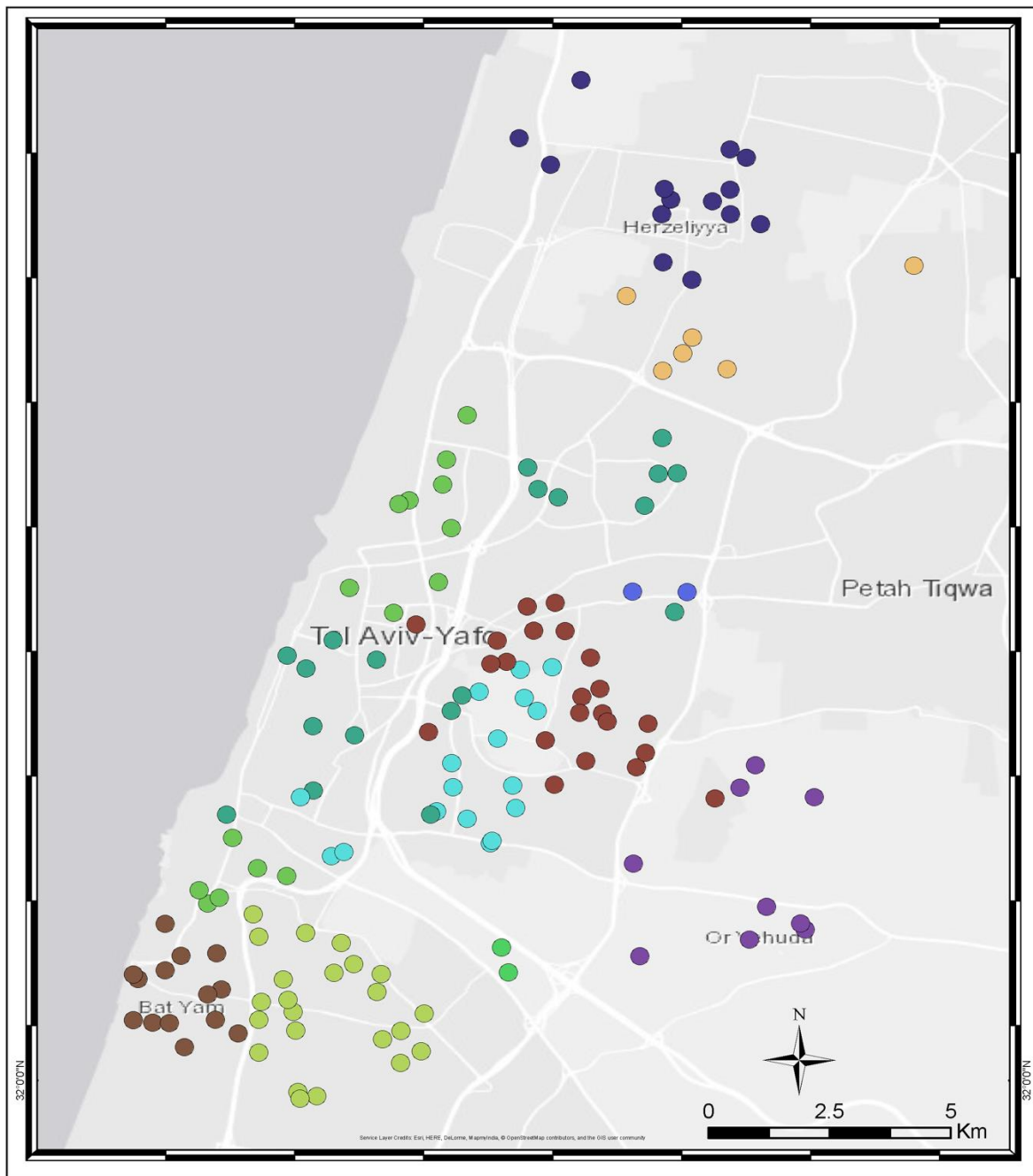


Figure 8: Distribution of Superintendents Value Added II



Map 2: Tel Aviv District 2005



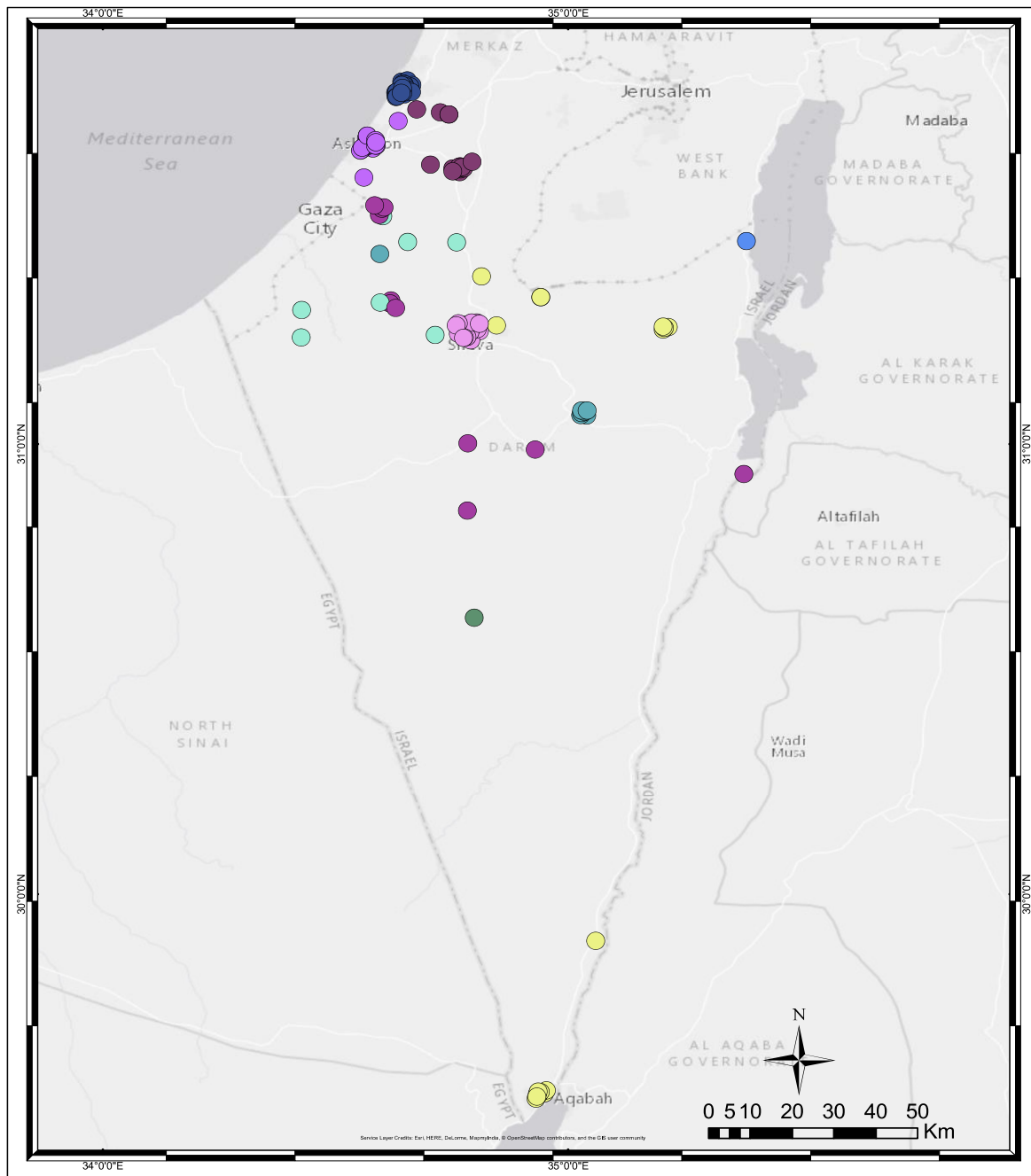
Superintendents of 2005

Tel Aviv District

Legend
Superintendent (Schools Count)

9 (9)	45 (2)	69 (2)
30 (6)	47 (15)	70 (22)
33 (23)	63 (14)	75 (19)
43 (14)	66 (17)	

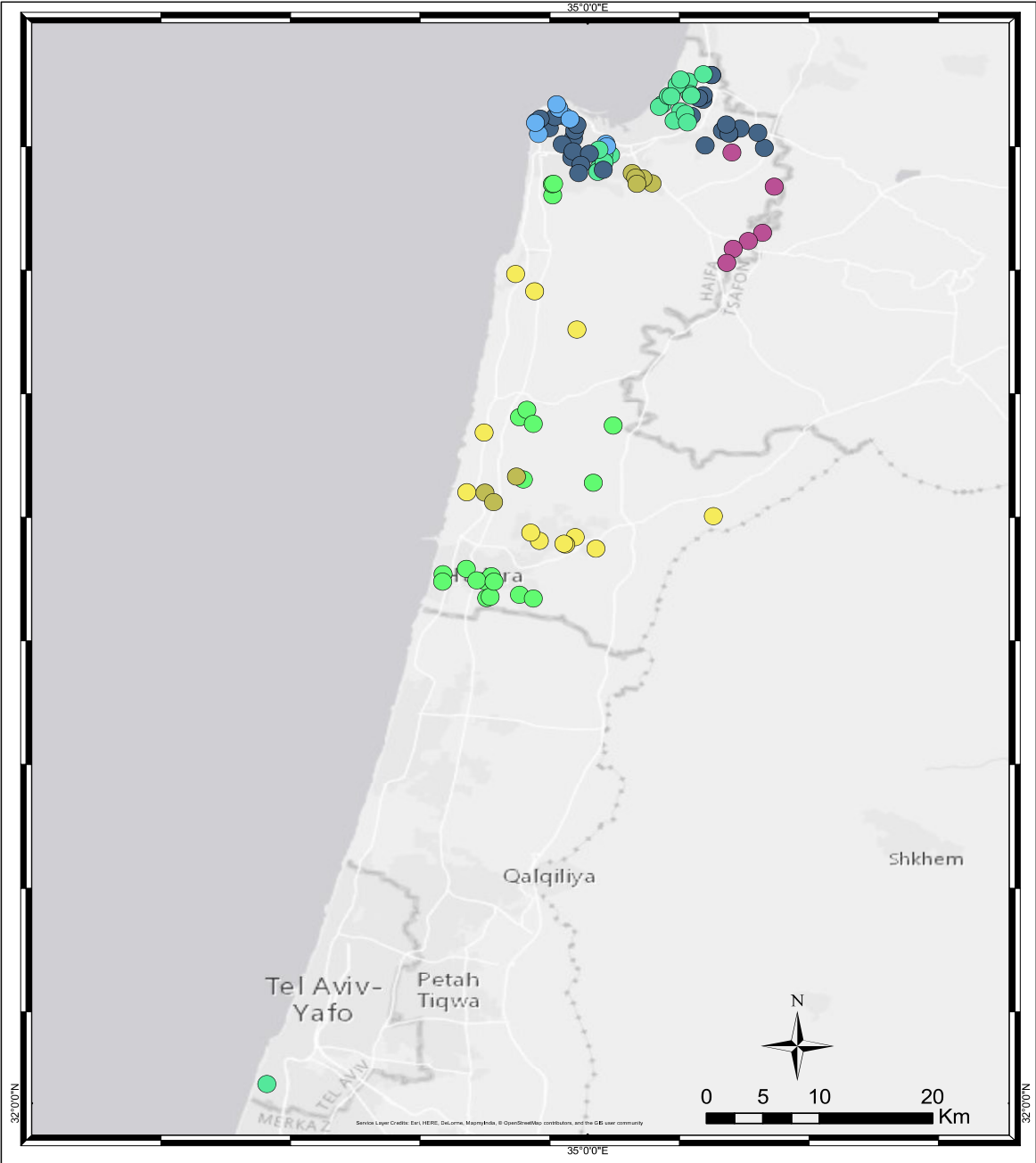
Map 3: South District 2005



Superintendents of 2005
South District

Legend	
Superintendent (Schools Count)	
7 (22)	17 (16)
8 (18)	26 (28)
16 (1)	36 (8)
52 (15)	67 (12)
	68 (1)

Map 4: Haifa District 2005

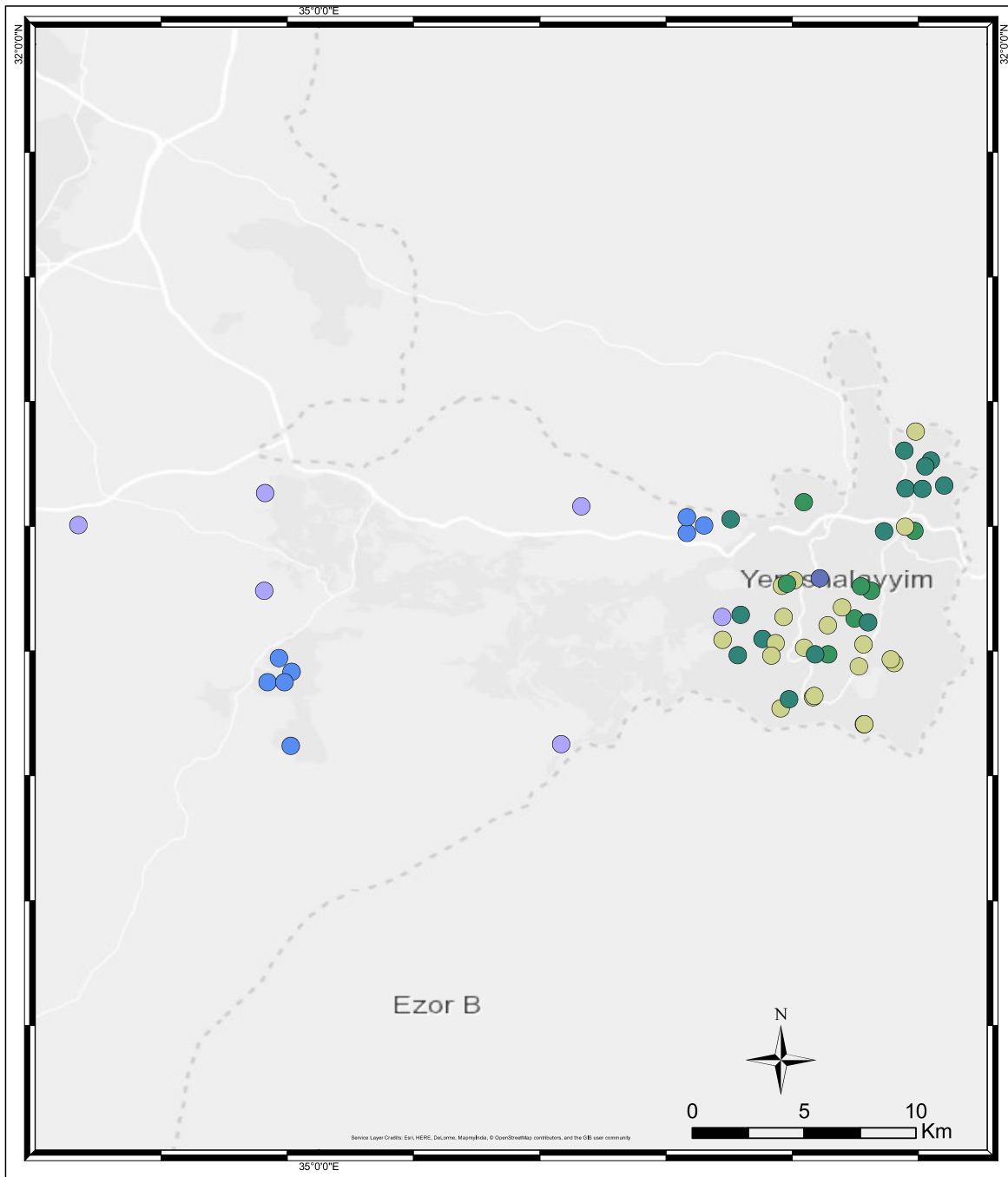


Superintendents of 2005

Haifa District

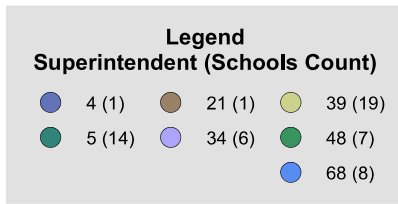
Legend			
Superintendent (Schools Count)			
Yellow dot	3 (12)	Green dot	50 (20)
Blue dot	40 (9)	Olive dot	46 (8)
Dark blue dot	42 (27)	Light green dot	55 (21)
Pink dot	65 (6)		

Map 5: Jerusalem District 2005

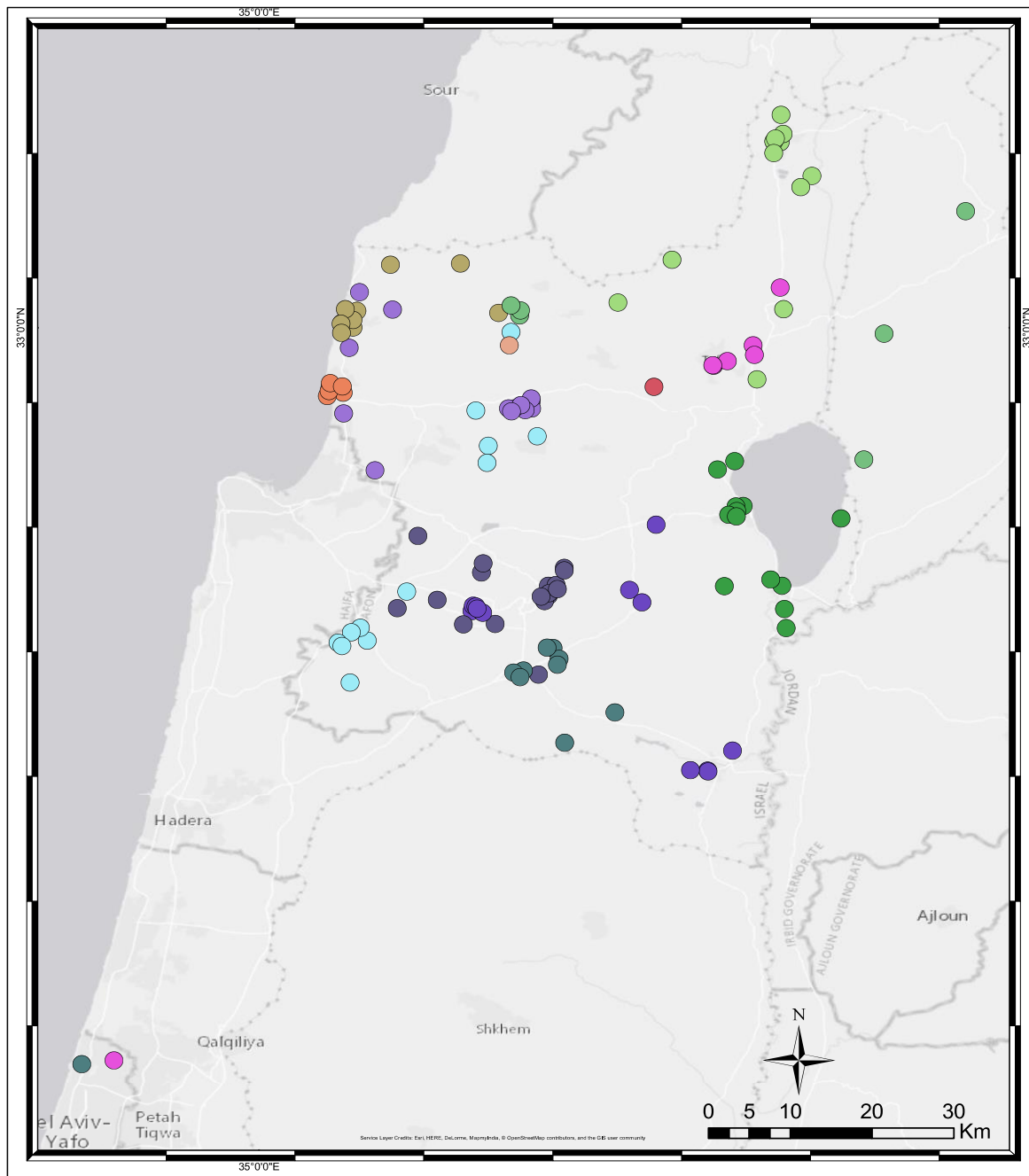


Superintendents of 2005

Jerusalem District



Map 6: North District 2005



Superintendents of 2005

North District

Legend Superintendent (Schools Count)

12 (6)	22 (13)	38 (10)
15 (6)	24 (13)	54 (7)
18 (10)	27 (12)	61 (12)
20 (17)	28 (1)	71 (12)
		72 (1)