# The headmaster ritual: The importance of management for school outcomes[a]

by

Anders Böhlmark,[b] Erik Grönqvist[c] and Jonas Vlachos[d]

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## Abstract

The role of school principals largely resembles that of corporate managers and the leadership they provide is often viewed as a crucial component for educational success. We estimate the impact of individual principals on various schooling outcomes, by constructing a principal-school panel data set that allows us to track individual principals as they move between schools. We find that individual principals have a substantive impact on school policies, working conditions and student outcomes. In particular, students who attend a school with a one standard deviation better principal improve their achievement by between 0.05 and 0.1 standard deviations. Despite having very rich background information on principals, it is difficult to determine which principal characteristics that shape successful school management suggesting that possibly innate skills are central. We further find that the scope for principal discretion—for better or for worse—is larger among voucher schools and in areas with more school competition.

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[b] Swedish Institute for Social Research (SOFI), Stockholm University, SE-106 91 Stockholm, Sweden. Email: anders.bohlmark@sofi.su.se.
[c] Institute for Labour Market Policy Evaluation (IFAU) P.O. Box 513, SE-751 20 Uppsala, Sweden. Email: erik.gronqvist@ifau.uu.se
[d] Department of Economics, Stockholm University and the Research Institute of Industrial Economics (IFN), SE-106 91 Stockholm, Sweden. Email: jonas.vlachos@ne.su.se

# 1 Introduction

The role of school principals largely resembles that of corporate managers. Principals hire teachers, decide how they are remunerated, provide support and encouragement for their staff, allocate teachers and students to classes, organize schedules and work groups, make strategic educational and pedagogical decisions, and represent the school in its contacts with educational boards, trade unions and parents. In essence, principals provide management in a complex and knowledge intensive organisation. It is therefore understandable that school principals and the leadership they provide are often viewed as a crucial component for educational success.[1] This interest in school leadership is reflected in the academic literature; numerous studies have attempted to assess the influence of principals on student achievement and related outcomes.[2] Surveys of this vast research (eg Hallinger and Heck 1996, 1998; Waters et al 2003; Witziers et al 2003; Leitwood et al 2004) all voice the concern, however, that previous studies are mainly of cross-sectional, non-experimental design.

In this paper we overcome many of the problems in the previous literature by using a principal-school panel strategy to estimate the impact of principals on three types of outcomes: (i) school level student achievement, (ii) working environment and (iii) strategic school choices.[3] For this purpose we use rich Swedish register data to construct a principal-school panel data set covering the full set of Swedish middle schools between 1996 and 2008, which allows us to track individual principals as they move across schools. Using this data we can apply the framework developed by Bertrand and Schoar (2003) in their seminal study of corporate management styles to assess the importance of principals. We regress school level outcomes on year and school fixed effects, a rich set of time varying school and student characteristics, and a vector of principal fixed effects. The estimates of principal effects give us the entire distribution

[1] See for example Harris (2006).
[2] Recent work has set focus on the importance of organization management: Grissom and Loeb (2011) using principal self-assessment find that organization management skills are related to growth in school grades, and Horng, Klasik and Loeb (2010) find that time spent on organization management activities is associated with positive school outcomes.
[3] Loeb, Kalogrides and Beteille (2012) stress the importance of recruiting and retaining good teachers which suggests that there is a scope for good leadership in these dimensions.

of the role of school management through principals on schooling outcomes, having controlled for observable and unobservable school heterogeneity.

Our paper is closely related to four concurrent papers that estimate principal fixed effects on student achievement utilizing principal switches: Branch, Hanushek and Rivkin (2012) focus on heterogeneities across schools and find that principals have a larger impact on schools with a worse socioeconomic gradient; Coelli and Green (2012) find that the impact of a principal increases with tenure while Dhuey and Smith (2012) find no effect of tenure; Grissom Kalegrides and Loeb (2012) compare estimated principal effects to external assessments of performance (e.g. school district evaluations).

The contribution of our paper is (i) that we use a larger set of outcomes—from different domains of principal influence—from the full set of Swedish middle schools; (ii) that we relate the different sets of principal fixed effects to each other and to very detailed data on principal characteristics including measures of cognitive and non-cognitive leadership ability, as well as educational and professional background, thus trying to characterize successful principals; (iii) that we relate the distribution of principal effects to different institutional features, assessing where principals have the largest impact. Our findings indicate that individual principals have a substantive impact on our outcomes: student achievement—in terms of test scores, GPA's, share of students passing the grade—and grade inflation, school level wage setting, teacher retention rates, teacher sick leave absence, and on what types of teachers that are being hired. The estimated effects are economically significant; in particular, a one standard deviation move within the distribution of principal fixed effects corresponds to a five to ten percent of a standard deviation change in student achievement. These effects are smaller than what has been found by Branch, Hanushek and Rivkin (2012), Dhuey and Smith (2012), and Coelli and Green (2012).[4] Since a one standard deviation change in

[4] Branch, Hanushek and Rivkin (2012) who estimate a set of different models find that a one standard deviation move in the distribution of fixed effects is associated with between 4-27 percent of a standard deviation change in students' academic achievement; in the specification most similar to ours the effect is 11 percent of a standard deviation. Dhuey and Smith (2012) find that a one standard deviation better principal is associated with 19-20 percent of a standard deviation better math and reading scores, while Coelli and Green (2012) find a third of a standard deviation higher graduation rates and one standard deviation better English exam scores (which corresponds to a 2.5-2.6 percentage points increase).

teacher ability has been estimated to correspond to approximately a ten percent of a standard deviation increase in student achievement (see eg Rockoff 2004; Rivkin Hanushek and Kain, 2005; Leigh 2010), school managers must be considered to have a substantial effect on student performance.

We find that principals who are more successful in improving student performance also tend to implement the policies of tougher grade setting standards,[5] low wage dispersion, to hire more female teachers and to hire certified teachers. However, these associations are not significant for all our student performance outcomes simultaneously. We further do not find any significant associations between work-environment managing practises and successful management for student performance. Hence, we conclude that the picture of what managing practices associate with successful management for schools' final output is mixed.

Despite having a large set of observable individual characteristics, including measures of cognitive and leadership skills and educational and professional background, it is difficult to account for principal fixed effects using observable factors. This result is well in line with Clark, Martorell and Rockoff (2009) who find little evidence of a relationship between schools performance and the selectivity of the principal's undergraduate institution and work experience of the principal. This echo well with the difficulties of attaching observable characteristics to teacher quality (see eg Rockoff 2004; Rivkin, Hanushek and Kain 2005; Rockoff et al 2011; Grönqvist and Vlachos 2008). Hence, it appears to be as difficult to account for principal quality using observable characteristics as it is for teacher quality. This suggests that–possibly innate–skills are central to successful school management.

We only find minor differences between the dispersion of principal fixed effects among small and large schools. The distributions of principal fixed effects are generally larger among voucher schools and in areas with strong competitive pressures. This suggests that voucher schools have more actual autonomy regarding school policy choices and that this autonomy may result in both good and bad outcomes. Further, the findings suggest that competition is associated with larger between-school dispersion.

[5] Figlio and Lucas (2004) and Betts and Grogger (2003) find that tougher grading standards are associated with higher student achievement.

While the literature on corporate managers is voluminous (Bertrand 2009), there has been a surprising lack of attention given to public sector management. This is potentially a serious omission as the constraints on public sector management differ substantially from those in private firms: competitive pressures, the objectives of the owners, and the interaction between "firms" and their "customers" all differ between the private and public sector. Bloom and van Reenen (2007) show that competitive pressures, both in the product market and in the market for corporate control, are associated with higher quality management in the private sector. Related to this, Giroud and Mueller (2009) demonstrate that the scope for managerial slack—and hence the impact of anti-takeover laws on firm management—is higher in non-competitive than in competitive industries. Under the assumption that public firms are more isolated from various forms of competitive pressures that private ones, these results square well with Bloom et al (2010) who find that competitive pressure faced by public hospitals is positively correlated to increased management quality.

Our paper is related to Besley and Machin (2008), who find that public sector principals in the UK are rewarded financially when the schools they head perform well on national tests, and that principal turnover is higher when they perform poorly. Even if our focus is not on principal pay, these results are interesting as they indicate that policy makers believe that principals are important for school results. Our findings show that this is indeed the case, even if there is a range of factors outside principals' control that matter.

# 2 How principals can affect schooling outcomes

Principals have different beliefs on how schools should be successfully run, and they possess different capacities to implement their desired policies. Even if principals are constrained by outside factors, these abilities and beliefs are likely to translate into different management practices that ultimately affect schooling outcomes. As suggested by Leithwood et al (2008), when summarizing evidence, school leaders particularly contribute by building a vision for the school, by motivating and developing the staff,

and by (re-)designing the organizational structure at the school level. What can loosely be described as "people skills" or leadership abilities would appear to be valuable characteristics for a principal.[6] In addition, the extents to which organizational talent, negotiating skills, curiosity, and openness to new ideas differ from such abilities they are also likely to affect how principals run their schools. How such differences translate into differences in school management to a large extent depends on constraints imposed by the institutional setting.

## 2.1 The scope for principal discretion

The scope for principals to have an impact on their schools depends on the degree to which they have decision making powers. In Sweden, 99 percent of municipalities state that their public school principals have complete or partial control over who gets hired (Skolverket, 2009). 100 percent of principals have control over decisions regarding on-the-job training, 96 percent for actions taken for special-needs students, 92 percent for wage setting, 97 percent for purchases of materials, and 88 percent for the number of employees (given the size of the budget). In an international perspective, school level autonomy in Sweden is well above the OECD average in all covered dimensions, except assessment policies and course offerings where Sweden is about average (OECD, 2010).[7] There thus seems to be ample scope for Swedish principals to influence their schools. There is no single type of employment contract for principals in Sweden; some are employed on a permanent position while others have a fixed term contracts. Principals for municipal schools are hired by the municipal school board while voucher schools have their own independent hiring practices. Those with a permanent position usually have their employment at the municipality (or school group), which facilitates mobility across schools in the municipality.

An important question is what objectives principals have. In for-profit schools, the objective is presumably to educate as many students as possible at the lowest possible

[6] In their influential article on star principals in urban schools, Haberman and Dill (1999) stress that such principals share a deeply engrained ideology of leadership, accountability, responsibility, and student focus that guides their work. According to Haberman and Dill, such an ideology can be acquired through personal experience, but not taught.

[7] Note that the Swedish schools covered by PISA are part of the compulsory school system while the schools in several other countries are part of the post-secondary school system. At the post-secondary level, the scope to choose course offerings is substantial in Sweden.

cost, but the bulk of principals are likely to have different objectives. Exactly what these objectives are is difficult to have an informed opinion about but they are likely to include the improvement of educational outcomes and general career concerns. Exactly which types of school policies principals pursue is therefore unclear, but two of the most important student outcomes are the school level Grade Point Average (GPA) and the share of students passing the minimum requirements.

Market conditions are potentially also important for the impact of individual principals and the policies they chose, albeit in subtle ways. If competition between schools is fierce, information is good, detailed contracts can be written, and all students (and their parents') demand the same final service, market constraints will in effect limit the scope for principal discretion. If, on the other hand, families have heterogeneous demands, they are going to want the principal who best satisfies these demands to be selected. Any heterogeneity in principal behaviour would then be due to principal selection, or different constraints being imposed on principals, rather than principal discretion. Under more plausible assumptions regarding the informational and the contracting environment, quite standard agency issues will arise—with the principal as the agent. The limits to external control then allow the school principal to run the school according to his or her personal beliefs and capacities.

A finding that principals matter for various schooling outcomes can thus have different interpretations. Either it may be due to conscious actions by the school board (or whoever is responsible for the hiring of the principal) giving them a principal they desire. Alternatively, it may be due to principals having few constraints on their management. Here we do not aim at distinguishing between these supply- and demand side explanations, but rather to document the importance of the principal for various outcomes.

## 2.2 The Swedish school system and its objectives

Compulsory schooling in Sweden usually starts at age seven and lasts for nine years. Five years of primary school are followed by four years of middle school (grades 6-9). Thereafter, a non-compulsory three year upper-secondary program follows. The middle school system is organized around public schools and students are formally free to apply to any school within their residential municipality. Actual admittance is in

practice highly regulated with priority given to students residing within a school's catchment area.

Sweden has a comprehensive school voucher system that more or less allows free entry of new schools. Voucher schools can be for-profit or non-profit, secular or religious, but are all subject to the same regulation as the public schools.[8] Voucher schools are not allowed to charge any fees so their budget is indirectly set by the municipality.[9] Within the compulsory school system voucher schools are allowed to screen students based on their non-academic merits only (such as musical or athletic talent), but apart from that they have to be equally open to all. Waiting time is the main selection criterion among voucher schools.

In the last year of middle school students receive final grades (school leaving certificates) that are used to sort students when applying to upper-secondary school.[10] These grades are given by the teacher in each subject, and should reflect how well the student lives up to certain nationally pre-defined standards. The subject grades are converted into a GPA used in the application process. This GPA can be seen as the most important summary measure for Swedish students and schools. In addition, the share of students passing the minimum requirements for further education is important and reported together with average GPA in official school level statistics. Students expected to fail these requirements are legally entitled to additional assistance, and which resources that are devoted for this purpose is ultimately determined by the principal. Although no formal accountability measures are in place, it is reasonable to assume that failing students are a major concern among principals. Grades are set by teachers and principals are not allowed to interfere in the grading of individual students. Further, teachers are aided in their grade setting by nation-wide standardized tests in Swedish, English, and Mathematics.

[8] The voucher system is described in more detail by Björklund et al. (2005).

[9] Municipalities are by law compelled to provide the same per-student funding to voucher and municipal schools. Some, but not all, municipalities also let the size of the voucher vary with socio-economic characteristics of the student body.

[10] Even if the GPA based on these final grades are not a binding constraint to enter upper-secondary schooling—basically all Swedish students move onto the next tier—they are effectively used to sort students into different programs and schools.

Both public and voucher schools are headed by a principal who has the ultimate responsibility for their school. In the public school system the principal is appointed by the municipal school board, consisting of local politicians, whereas in voucher schools the principal is employed by the owners. Principals at larger schools are often aided by assistant principals with certain areas of responsibility. A common, but by no means universal, arrangement is that the main principal is in charge of contacts with school boards and other outside interests, while assistant principals are in charge of everyday activities at the school. Appointing assistant principals and allocating them to different tasks is, however, the responsibility of the principal.

# 3 Empirical strategy and data

The methodological challenge when assessing the importance of individual principals on school outcomes is to convincingly separate the influence of principals from other factors such as characteristics of the schools, neighbourhood characteristics, or temporary effects by specific cohorts of students. For this purpose we have compiled a principal-school panel allowing us to track the influence of principals as they move across schools.

## 3.1 Empirical strategy

Our identification strategy follows the work on corporate management styles by Bertrand and Schoar (2003) closely. To estimate the impact of principals on, for example, student achievement we need to control for other factors affecting this outcome. We do so by controlling for average school level differences; general changes in the outcome over time; as well as for year-to-year variation in the student population. Having controlled for these factors, we relate the residual variation in student achievement to principal specific fixed effects. Formally, we estimate the following regression:

$$y_{it} = \alpha_i + \alpha_t + \beta X_{it} + \lambda_P + \lambda_{AP} + \varepsilon_{it}$$

where $y_{it}$ is the outcome of school $i$ in period $t$; $\alpha_i$ are school fixed effects, $\alpha_t$ are time period fixed effects; $X_{it}$ is a vector of time-varying school level control variables; and $\varepsilon_{it}$ is an error term. The set of variables of main interest is the vector of principal fixed effects, $\lambda_P$, and the vector of fixed effects for assistant principals, $\lambda_{AP}$. Principals and assistant principals are defined according to the last role we find them in. As the division of managerial tasks between principals and assistant principals differs across schools, we in most analyses will not distinguish between principals and assistant principals. Since the variation we are interested in is at the school level and in order to keep the estimation strategy consistent between outcomes at the student, teacher, and school level, we aggregate all data to the school averages.[11] In order to account for potential serial correlation we correct the standard errors for clustering at the school level by scaling with the estimated Moulton (1986) factor.

In this set up, we will only exploit principals that move across schools to identify principal fixed effects. That is, we identify principal fixed effects for those principals who move between schools.[12] As will be seen in the next section, mobility among Swedish principals is fortunately substantial. The $X_{it}$ vector is intended to keep the student body constant, separating principal influence from time-varying school characteristics. In a broader, perspective student selection to schools may also be affected by the principal, in the same way as we see teacher recruitment as a part of the principal effect. In some sensitivity analyses we therefore exclude the $X_{it}$ vector when estimating our model.

The main limitation to this framework is that principals are not randomly placed in different schools. For this reason we cannot fully separate the effect of principal selection from that of principal influence. While we account for mean differences in outcomes, our empirical strategy is still problematic if schools change principals in

[11] For one student level outcome (GPA), we have compared the estimates of principal effects using individual data and school level aggregates. The correlation between the two sets of fixed effects is 0.91 and the adjusted standard deviations of the principal effects are similar.

[12] The approach to use switchers goes back to Rivkin et al (2005) in their study of teacher effects. It would of course be possible to identify fixed effects for principals who are present only at one school, but for a sub-period of the time the school is in our data set. These principal fixed effects would, however, be sensitive to school level shocks in which case they merely would reflect school-period effects. Therefore, principals observed in only one school are not included in the estimation.

response to a dip in outcome and the new principal takes over just as the school is experiencing a mean reversion, or if a school is on a positive (or negative) trajectory and thereby falsely attributing improving school level outcomes to the principal. Similarly, our strategy is problematic if recruiting a new principal is associated with a whole set of school level policy changes. In the sensitivity analyses we therefore (i) test whether schools are systematically changing principal in response to dips in outcomes and (ii) also include school specific linear trends in our model.

## 3.2 The school-principal sample

In order to identify the effects of principals we construct a school level panel data set that allows us to track individual principals over time. We base our panel on the Swedish *Teacher register* which contains school codes and personal identifier codes for each teacher and principal.[13] Since individual schools can only be identified from 1996; we restrict our attention to the years 1996-2008. A further restriction is that we do not observe any characteristics of the student body prior to the last year of compulsory schooling (ie the 9$^{th}$ grade), when students' final grades are recorded. Therefore, we restrict our attention to middle schools with graduating students.

In our sample, we only retain schools in which at least one principal can be observed in at least one other school between 1996 and 2008. As it presumably takes a while for a principal to have an impact on the school they are managing, we also require each principal to have been at least two years at each school. We find 899 schools that fulfil these two conditions, and we keep all observations for these schools; in total 8 847 school-year observations. In these schools there are 673 principals and assistant principals who are observed for two years in at least two different schools. In our analysis we follow Bertrand and Schoar (2003) by estimating effects for these *switcher* principals. By imposing this restriction, we run the risk of underestimating the true variation in principal fixed effects since there is potentially a match specific relation between principals and schools. Not imposing the restriction, on the other hand, run the risk of inflating principal effects by confounding it with idiosyncratic school level shocks. We rather err on the side of caution and restrict our attention to *switcher*

[13] Principals are identified through the positional codes provided in the Teacher register.

principals and letting the principal effect be the same across all school they manage, thereby focusing on the component of principal quality that can be transferred between schools. On average, switcher principals spend 4.1 years at each school.

[Table 1]

In order to characterize the type of principal transitions we identify the principal effects on, *Table 1* is useful. Panel A displays the transitions between the first and last positions that we observe these 673 switching school managers in: 10 percent are assistant principals when first observed and remain in this position throughout the observations window; 39 percent make a career from being an assistant principal to a principal; 5 percent start off as principals but are observed as assistant principals in the last period; and 46 percent remain principals throughout the period we observe them. Panel B reports the position a school manager leaves and gets when s/he moves between schools: 15 percent of the moves include assistant principals switching school to become assistant principal also in the new school; 23 percent are promoted from an assistant to main principal when switching schools; 6 percent of the switches in our sample are cases when a principal move to a new school to become an assistant principal; and 56 percent of the switches are principals keeping the same position as they move across schools. The career pattern thus depicted by these switcher principals is that most assistant principals are promoted to become main principal and that this often involves a change of school, and also that main principals move across school as a part of their career.

### 3.3 School level outcomes

The school level outcomes are chosen to reflect (i) students' academic achievement, (ii) school policies, and (iii) teacher working conditions. Our first outcome variable is the average results on standardized nationwide tests in Swedish, English, and Mathematics taken by all students in the $9^{th}$ grade. When calculating this average, we first convert the individual test results to z-scores for each subject on an annual basis. We then convert the sum of these z-scores into a school average on an annual basis. As these test scores are only available from 2003 to 2008 there will be fewer principals (observed for two

years in at least two schools) than the other outcomes when using test scores as outcome measure. Another outcome capturing academic achievement is the average grades in English and Mathematics on the school level (GPA).[14] Screening for upper-secondary education is based on the final grades and this is therefore the most important outcome variable for students; the grades are also a broader measure of performance than are test scores. As grades are set by teachers, this variable is admittedly not a fully reliable measure of schooling output or productivity. Even if the grades in English and Mathematics can be inflated by the teacher, the grade setting in these subjects is aided by the standardized exams. The Swedish National Agency for Education also goes through considerable pain making grade criteria unified across schools. Although this is hardly perfect, comparisons between the results on national tests and grades in the same subjects show little systematic variation; for example Björklund et al. (2010) find that the secular trend in Swedish, English and Mathematics grades is only a fourth of that in practical-aesthetic subjects not aided by standardized nationwide exams. Again, individual GPAs are converted into z-scores on an annual basis before averaging at the school-year level. As a third output measure on academic achievement we use the share of students who have fulfilled the minimum requirements in English and Mathematics.[15] While test scores and final grades capture the average performance of the school, this measure is aimed at capturing the performance in the lower parts of the achievement distribution.

Our next set of outcomes is related to strategic school policy choices; more precisely, grade setting behaviour, the within school wage dispersion; the share of female teachers; and the share of non-certified teachers. As schools indirectly compete for students, the grade setting behaviour is a margin that can be used to increase the attractiveness of a school. The scope for discretionary grade inflation is substantially larger in practical-aesthetic subjects not anchored by a national exam, than in theoretical

[14] We do not use the final grade in Swedish when calculating our GPA measure since approximately half of the students with foreign background take a different Swedish course (Swedish as a second language) than native students. A comparison of grades between these two courses is difficult. All students however take the same standardized exam.

[15] We could have included other subjects as well, but as there are national tests in English and Mathematics, grades in these subjects are less open to manipulation. Swedish is excluded since immigrant and non-immigrant students generally take different courses.

subjects in which some external monitoring is possible. The grades in practical-aesthetic subjects are important as they are included in the GPA used for sorting students to upper-secondary education. As a first outcome measure of school level policy we therefore use a measure of grade inflation; specifically the difference between the grades in practical-aesthetic subjects and the grades in English and Mathematics.[16] Next, the wage dispersion between teachers is quite low in Sweden (OECD, 2008), but the norm is for wages to be determined at the school level. Principals are of course constrained by their budgets when setting wages, but formally they have substantial discretion to reward teachers on an individual level. As principals are likely to have differing attitudes towards remunerating skilful teachers, the within school wage dispersion—measured as the coefficient of variation—constitutes a second school policy outcome.[17] Principals may also have differing opinions on the importance of a gender balanced teaching staff.[18] Hence, we use the share of female teachers as a third outcome variable in this category. Finally, principals may have differing opinions on the value of teacher certification, not the least since research on this is not conclusive.[19] The hiring of certified or non-certified teachers can therefore be viewed as a strategic policy choice by the principal, especially since non-certified teachers on average fair lower wages; Hensvik (2012) has for example shown that voucher schools are more likely to hire non-certified teachers with high cognitive skills.

Poor human resource management in public organizations can have negative effects on productivity, as shown, for example, for UK hospitals by Bloom et al (2010). The third set of outcome variables are therefore related to workplace conditions, arguably

[16] A deviation between grades in practical-aesthetic and theoretical subjects need not always be due to grade inflation; a specific school can for example have a profile in practical-aesthetic subjects. However, the results by Björklund et al. (2010) showing that grades in Swedish, English and Mathematics increased with 10 percent between 1989 and 2007, while grades in practical-aesthetic subjects increased with almost 45 percent, strongly supports the interpretation of such deviations as grade inflation.

[17] We use the coefficient of variation in monthly full-time equivalent wages as our measure of wage dispersion.

[18] Dee (2005) finds that girls learn more when having a female teacher. Swedish evidence is less conclusive; Holmlund and Sund (2008) find no support for the hypothesis that same-sex teachers affect student outcomes. Lindahl (2007) finds that same-sex teachers affect student test scores positively in Mathematics, but not in other subjects.

[19] Kane et al (2008) find at best small effects of teacher certification in the USA, and Rivkin, Hanushek and Kain (2005) find no correlation between teacher fixed effects and teacher certification. In Sweden, Andersson, Johansson and Waldenström (2011) find substantive positive effects of certification when using grades (rather than test scores) as the outcome variable. Results on teacher certification are difficult to compare between jurisdictions as the certification process may differ substantially.

something principals can have a strong impact upon. Within this outcome dimension we first use an indicator of teacher retention, defined as the share of teachers who were teaching at a school at time *t* who are also teaching at time *t*+1. In the Swedish context of strict employment laws, most teacher turnover is due to voluntary teacher mobility or work shortages. To the extent that our controls for the student population pick up changes in teacher demand, we expect turnover to be mainly voluntary and hence reflect workplace conditions relative to outside options. The second measure in this category is the share of teachers who have been on long-term sick leave (i.e. more than two consecutive weeks) during a certain year.[20]

### 3.4 School and principal level characteristics

The time varying school level controls include a rich set of student background characteristics; variables for students and their parents are matched to the school-principal panel and aggregated by school-year. Parental variables are recorded separately for mothers and fathers and include their educational attainment, annual income, age, and immigrant status. Student characteristics, in turn, are gender, birth year, birth month, immigrant status, and age of immigration.[21] We also include the number of 9$^{th}$ grade students at the school as a control variable.

Once we have estimated the principal fixed effects, we correlate these with various observable principal characteristics. These characteristics include gender and birth year, measures of cognitive ability and non-cognitive leadership ability (for males only), upper-secondary school performance and educational attainment, and wage earnings. In addition we have information on whether the principal has a military background. The indicators of principals' cognitive ability and a measure of non-cognitive leadership ability are available for males from the military draft at age 18. These data are assessable for essentially all Swedish men born between 1951 and 1981. During the enlistment, their cognitive ability was tested using an IQ-type test, and their capacity to

[20] Long-term sick leave might seem as a somewhat strange outcome since it can be questioned if principals and employees have discretion over illnesses. However, even within age groups, sick-leave absence in Sweden varies substantially over time and between regions, suggesting that the scope for discretion is substantial (Försäkringskassan, 2011). Social norms at the workplace have also found to be a likely explanation for sick leave behavior (Hesselius et al, 2010).

[21] We also control for the share of missing data for each of those variables.

lead a group under stressful circumstances was estimated by a certified psychologist. Both these measures have a strong predictive power on future earnings, and draftees who later ended up in management positions scored substantially better on the leadership evaluation than those in other types of high-skilled jobs (see Lindqvist and Vestman, 2011). In order to account for minor changes in the draft procedure over the years, these indicators are percentile ranked on an annual basis. [22]

In Sweden, the GPA from upper-secondary education is used for the application to higher education. This information is available for principals graduating from upper-secondary school in 1970 and later; graduation age is usually the year one turns 19.[23] For higher education, in turn, we construct indicator variables for whether or not the principal (i) has a degree in pedagogics; (ii) has a Bachelor's or Master's degree; (iii) is a certified subject teacher (ie is certified to teach in at least one theoretical subject); (iv) and the number of years of post-secondary education that the principal has completed.

We also have information on the CPI deflated log wage earnings (base year 2005) for all principals. Finally we use an indicator of whether the principal has a military background. In the 1990s a large number of army regiments were closed and many officers had to search for a civilian alternative career. Some of these former officers ended up in school management.

### 3.5 Summary statistics

*Table 2* shows the summary statistics for the school level control variables and *Table 3* for the outcome variables that we use. In order to get an idea of how representative the switcher principals are, we compare them to the non-switching principals in our school-principal panel; we present all variables separately for switcher and non-switcher principals.

[Table 2]

[22] We refer the interested reader to Lindqvist and Vestman (2011) for a thorough description of the Swedish draft procedure and these ability evaluations.
[23] The GPA scores are percentile ranked (in the whole population) on an annual basis.

Looking at the school characteristics reported in *Table 2*, we see that differences between the switcher and non-switcher principals are small. The only exception being that non-switchers appear to be located at somewhat larger schools. Regarding the outcome variables in *Table 3*, there is some indication that switchers are on average present at lower-performing schools, even if differences are not statistically different. This is in line with findings from the US showing that lower performing schools have difficulties retaining teachers (Hanushek, Kain and Rivkin 2004).

[Table 3]

In *Table A.1* in the Appendix we also display descriptive statistics for schools managers. Again we see that differences between switchers and non-switchers are small; the only significant difference being that switcher principals have longer experience—seniority—in their role as a school manager.

# 4 Results

In this section we start by presenting our estimates of principal fixed effects and some specification tests; these results show that both principals and assistant principals are important for all our outcome dimensions: student performance, strategic school choices and working environment. We thereafter discuss how these fixed effects relate to each other.

## 4.1 Principal fixed effects

The core results of our analysis are reported in *Table 4* providing evidence on the statistical and economically significance of the school manager fixed effects. As the number of assistant principals is so small we do not report the influence of the different types of school managers separately in the forthcoming analyses; ie both types of principals are included in all analyses, and henceforth we use the terms principal and school manager interchangeably.

In the first column we report p-values of *F*-tests for the joint significance of the school manager fixed effects. For all outcomes we find that school manager fixed effects as jointly significant.

Having established that the variation in the performance of school managers is significantly related to various school level outcomes in a statistical sense, we next inquire whether these effects also are economically significant. We compare the impact of school management for our outcomes when moving along the distribution of fixed effects; in essence, comparing the importance of having a principal in the upper part of the distribution instead of in the lower part. To this end, *Table 4* also reports the median and the distribution of the school manager fixed effects. Even if the estimated school manager fixed effects are unbiased, they are still estimated with a sampling error, and the observed distribution of fixed effects will therefore overstate the true distribution of school manager effects. We therefore apply a "shrinkage estimator" to obtain the true variance of the school manager fixed effects thus accounting for the sampling error, see for example (Rockoff 2004). We follow the iterative procedure used by Leigh (2010) and outlined by Thompson and Sharp (1999) where the true distribution of principal effects is estimated from the principal effects and their standard errors.[24] In *Table 4* we both report the adjusted and the unadjusted standard deviations. We also report bootstrapped standard errors (500 reps) of the adjusted and unadjusted distribution of fixed effects.

[Table 4]

For final grades the shrinkage procedure reduces the variation by half; the adjusted standard error is 0.052. Remember that the unit of measurement is school level averages of z-scored GPAs for each student, so a one standard deviation move within the distribution of principal fixed effects corresponds to about a five percent change of a standard deviation in student achievement. For test scores the impact of the principal is

[24] The Shrinkage estimator is based on the assumption that the principal fixed effects are normally distributed with mean zero and an additive variance equal to the sampling variance plus the true between-principal variance: $\lambda_i \sim N(0, \sigma_i^2 + \tau^2)$. By using information on the estimated principal fixed effects and their standard errors, the true between-principal variance can be estimated with a random effects strategy employed in meta-analysis (se for example Harbord and Higgins, 2008). To estimate $\tau^2$ we implement the empirical Bayes estimator described in Thompson and Sharp (1999), where $\hat{\tau}^2$ is found by iterating the following equation: $\hat{\tau}^2 = (n(n-1))\,\Sigma_i\{{\lambda_i}^2/(\sigma_i^2 + \hat{\tau}^2) - \sigma_i^2\}/\Sigma_i(\sigma_i^2 + \hat{\tau}^2)^{-1}$, with $\hat{\tau}^2 = 0$ in the first iteration. The process is then repeated until the difference in $\hat{\tau}^2$ between successive iterations is less than 0.0001. This empirical Bays procedure is easily implemented in Stata (Harbord and Higgins, 2008).

substantially larger: Students who attend a school with a one standard deviation better principal receives 0.119 standard deviations higher test scores. Unfortunately, test scores are only available for years 2003-2008, forcing us to identify the principal effects on relatively few principals. When using the same time window as for test scores, the principal effect on GPA is 0.092 of a standard deviation compared to 0.052 for the full time period.[25] It is therefore likely that the short time window leads us overstate the impact on test scores. A plausible effect size on student achievement is therefore between 0.05 and 0.1 standard deviations. This corresponds to a reduction of class size, as estimated using Swedish data, of between 2 and 4 students per class (Fredriksson et al, 2013).

When instead looking at the share of students who passes the minimum requirements in English and Mathematics, we see that moving one standard deviation in the distribution of school managers corresponds to a two percentage points increase in the share of students passing the requirements; a 2.1 percent change. With the between school standard deviation in the share of students passing being 0.15, this corresponds to about fourteen percent change of a standard deviation in student outcomes.

Turning next to school policies in the hand of principals, we first look at our measure of grade inflation; that is, the grades in practical-aesthetic subjects relative to grades in English and Mathematics: Grades in practical-aesthetic subjects are inflated with 12 percent of a standard deviation if the school has a principal who is one standard deviation more prone to promote grade inflation. These results are in line with the larger impact on test scores than final grades. In fact, we find that grades in practical-aesthetic subjects to a larger extent are related to principals than are grades in theoretical subjects.

When it comes to wage dispersion we first note that in our sample the coefficient of variation in wages is 0.124 on average with a school level standard deviation of 0.028. Hence, a school with a principal who is one standard deviation higher up in the principal-wage-dispersion distribution (0.008) will have a 6.5 percent higher wage dispersion relative to the mean wage dispersion. This amounts to 0.29 of a standard deviation in the school level wage dispersion. Adding controls of the age and gender

[25] This result is available upon request.

composition does not affect the results for the impact of principals on the wage distribution or on other teacher outcomes discussed below.

Principals also differ in their propensity to hire female teachers and non-certified teachers. The adjusted standard deviation of principal fixed effects when using the propensity to hire female teachers and the share non-certified teachers as outcomes is 0.038 and 0.041, respectively. A school having a principal being one standard deviation more likely to hire female teachers will on average have six percent more female teachers; the average is 66.9 percent. Similarly, if the principal is one standard deviation more likely to hire non-certified teachers the school will, on average, have 21 percent more teachers without certification; the average is 19.4 percent. For both these outcomes this corresponds to about 0.4 of a standard deviation. This large influence reflects the large autonomy of the principal in the hiring decision. As for the principal fixed effects estimated using indicators of workplace conditions as the dependent variable, a change with one standard deviation corresponds to an increase in the teacher retention rate by 5 percentage points. This is 6.6 percent more compared to the mean (0.775) and 0.3 of a standard deviation. Finally, a one standard deviation move in the distribution of the fixed effects based on long term sick leave is associated with a 2.1 percentage point increase in sick leave rates. As the mean of this variable is 0.144 with a standard deviation of 0.068 this again is substantial. To sum up, we find that the relation between school manager fixed effects and our various measures of academic achievement is substantial but smaller than the influence of teachers found in the previous literature (eg Rockoff, 2004; Rivkin, Hanushek and Kain 2005; Leigh 2010). One thing to note is that one pathway of principal influence may well be trough the selection of teachers. The large relative influence of principals on school policies and working conditions may reflect that the variation across schools, for example when it comes to wages, is small despite a large nominal autonomy of principals. It can also be that the scope for influence is large in these domains.

The size distributions of the school manager fixed effects are relatively insensible to the exact formulation of the model. When excluding the time-varying covariates from the baseline model the estimated principal influence becomes slightly larger, potentially capturing endogenous changes in the student population (see *Table A.2* in the

Appendix). Similarly, when adding a school specific linear trend the estimated principal influence is only slightly smaller (see *Table A.3* in the Appendix). The same is true when we add county-by-time fixed effects to the baseline specification (*Table A.4* in the Appendix). [26] As an additional robustness test, we have added controls for fathers' cognitive and leadership abilities from the military draft but the principal fixed effects are hardly affected.

## 4.2 Robustness of the principal fixed effects

One worry at this stage is that a new principal initially may be exposed to a *honeymoon*-effect; that the change of principal in a school is preceded by poor performance and that the entering principal may be gaining from a mean reversion in outcome, or that the change of principal coincides with a set of school level policy changes from the school board improving the school's performance. In *Table 5* we test for such a systematic component by estimating the baseline model and including indicators capturing systematic deviations in outcomes at schools the two years preceding a change of principal or assistant principal. While we find that grade inflation on average is slightly higher two years before a change of school manager and that teacher retention is higher the year before a change of school manager, the overall picture does not suggest that a change of school manager is systematically related to pre-switch changes in outcome. The estimated school manager fixed effects captures manager influence rather than mean-reversion in outcomes or school level policy changes.

[Table 5]

An alternative way to address the *honeymoon*-effect is to assess whether school managers fair better or worse with tenure at a school. In *Table A.5*, in the Appendix, we therefore estimate our baseline model and include indicators for whether the school manager is at his first or second year at the school. We only find that teacher retention is slightly lower during the first two years at a new school, which could imply that new

[26] There are 21 counties in Sweden. This approach controls for unobservable regional shocks that potentially could bias the results. The drawback is that some of the identifying variation is lost, in particular among the less densely populated areas of Sweden.

principals influence their schools through personnel decisions. The impact of such staff changes—as well as other changes—on student achievement will take some time to materialize and it is therefore not surprising that the overall pattern neither suggests that a school manager is doing better nor worse the first two years at a school. This is in line with Dhuey and Smith (2012) who find no evidence the years of experience at the school matters for principal performance.

The results in Table 4 indicate that principals have an impact on all included outcomes, and the robustness checks in *Table 5* (and *Table A.5*) do not lead us to believe that the estimated effects capture mean reversions in outcomes as a results of prinicipal switches occuring when schools suffer from temporary dips in outcomes or that switches coincide with other school level changes; eg in resources. Still, we may worry that there is something intrinsic in the empirical strategy that generates a significant impact of principals for all outcomes.

For this reason, we perform a placebo test where all principal spells are randomly assigned to schools; that is, all spells for switcher principals are kept intact in time but instead of matching these spells to the principals' actual schools, we match them with randomly selected schools (including all school by year-level outcomes and control variables). We then estimate the same regression as in our main analysis and repeat this exercise 100 times. Columns 1 and 2 in Appendix Table A.6 display the mean and standard deviation of the unadjusted standard deviation of fixed effects based on placebo placement of principals. The unadjusted distribution of fixed effects consists of the sum of the sampling variance and the between-principal variation, where only the latter component would be zero in the placebo. Comparing the distribution of placebo effects (column 1) with calculated sampling bias in our main results (based on the difference between unadjusted and adjusted standard deviations in Table 4) which we display in column 5, we see that they are similar, albeit not identical. In column 3, we see that the $H_0$ of placebo effects being jointly significant is on average rejected for all outcomes. Moreover, in column 4 we display the mean of the adjusted standard

deviation of the placebo effects, as calculated with the shrinkage procedure detailed in footnote 24. The adjusted standard is zero for all repetition and outcomes.[27]

### 4.3 Correlations between principal effects

The next step is to analyze how the different sets of fixed effects are related to each other. Instead of just correlating the fixed effects we regress fixed effects corresponding to one outcome variable on a vector of fixed effects that corresponds to a different one. The error-term in the regressions takes account of the measurement error of the left hand side variable. As the right hand side variable is also measured with error, this leads to a downward bias of an OLS estimator. However, we have an estimate of the precision with which each fixed effect is observed, so we weigh the regression by the inverse of the estimated standard error of each right-hand-side fixed effect. In *Table 6,* we present the results from this exercise. Each cell in the table refers to a different regression where the column variable is the dependent variable and the row variable the independent. Even if the observed patterns are indicative we would like to caution against a causal interpretation.

[Table 6]

The relations between fixed effects based on student achievement are positive, as expected. In addition, principals associated with high student achievement are also those who induce their teachers to implement a tougher grade setting regime in core subjects such as mathematics and English. This indicates that some school managers may be using lenient grading standards to compensate poor average performance in theoretical subjects. Regarding the fixed effects based on other outcomes, it is difficult to draw any strong conclusions from the patterns revealed in *Table 6* What constitutes a good school management regime is thus an open question.

[27] The shrinkage is carried out with the STATA's metareg routine. In some instances, the estimated adjusted variance of the placebo effects converges to negative numbers, which metareg approximates to zero.

# 5 Accounting for principal fixed effects

Having established that individual school principals can have an impact on various school policies and student outcomes, the next step is to ask to what extent we can account for these fixed effects. We start by relating the different school manager effects to observable characteristics of the principal. We thereafter relate the distribution of the principal effects to the institutional environment that the principal is working in; i.e. assessing whether the scope for the principal to make a difference is larger in some contexts.

## 5.1 Observable principal characteristics

It is natural to ask which personal traits and background characteristics that are shared by successful school managers. In order to provide an answer to this we regress the set of principal effects on observable characteristics of the principal. Two caveats should be kept in mind. First, not all sets of fixed effects have an unambiguous normative interpretation; while having a larger share of students passing the minimum requirements easily can be described as "good", this does not necessarily hold true for having a larger share of certified teachers. Second, we do not claim to have a theoretically well-founded model of which factors that should correlate with the principal effects. In *Table 7* we therefore only report the results from bivariate regressions of the fixed effects on observable characteristics, caution must therefore be observed before giving these results a causal interpretation.

[Table 7]

In the first three rows of Table 7, we find some indication that principals who have a background as subject teachers and/or who have a longer post secondary education tend to be better at improving GPA's and helping a larger share of students passing the minimum requirement. Principals with a Master's or Bachelor's degree—not given at Teacher College—or longer tenure at their schools also have a larger share of passed students. There is however no relation between observable characteristics and test score results. Apart from educational background there is no clear pattern indicating that

principals' personality traits—either male principals' cognitive or leadership abilities—or their professional background—experience in military management or seniority in the role as a principal—are important for their ability of managing well performing schools. With respect to the fixed effects related to school policy outcomes and work environment, there are a few scattered significant relations but not more than would be expected by chance.[28]

The conclusion from this analysis is that it is difficult to identify "good" principals either in terms of student performance or working environment, or principals making a difference for strategic school level policies, based on their cognitive or leadership abilities, their length of schooling or educational profile, or whether they have a background in military management. The only exception is some dimensions of principles' educational background that appear to be related to students' grades. Hence, it appears to be as difficult to account for principal quality using observable characteristics as it is for teacher quality.[29] It can also be noted from the last column of Table 7 that good leadership in Swedish middle schools is not rewarded in terms of higher wage earnings.

## 5.2 Institutional factors

It is further plausible that the discretion a principal has to his disposal to affect the school is constrained by a number of institutional factors. In this section we therefore analyze how the institutional setting affects the distribution of principal fixed effects. More specifically, we ask the question if the distribution of principal effects is wider in some institutional settings than in others.

First we hypothesise that an individual principal can have a larger influence in small schools than in large ones. We therefore divide the sample of principals based on whether or not the last school where we observe them is above or below the median in number of students. While we do expect principals to have a larger influence in small schools, this influence can be for better or for worse.

[28] Since a large number of bivariate regressions (117) are run, we expect a number of significant relations to occur purely by chance.
[29] See Rockoff (2004) and Rivkin, Hanushek and Rivkin (2005) on teacher quality.

Our second institutional indicator is a dummy for whether or not the last school we observe the principal at is a voucher or a public school. Voucher schools are relatively independent from political and legal constraints and to that extent we expect principals to have more discretion. On the other hand, voucher schools are subject to market pressures that can both increase and decrease principal influence. Further, it is theoretically ambiguous whether public or private school boards are better at picking a good principal. The findings in Bloom et al (2010), however, indicate that private hospitals in the UK are better managed than public, something that could also apply to Swedish schools. It should here be noted that only six percent of the principals in our sample are observed at voucher schools.

Finally, we divide the sample depending on whether the municipality where principals were last observed has a below or above median share of voucher students. The share of voucher students is taken to proxy for competitive pressures, but clearly it can correlate with other important municipal characteristics.

To judge whether principals in different institutional settings have a larger discretion, we evaluate if the distribution of fixed effects is affected by institutional factors. More specifically, we divide the fixed effects by institutional category of interest and calculate the adjusted standard deviation; ie. the between-principal variation obtained by the shrinkage procedure described in footnote (24). *Table 8* reports the difference in adjusted standard deviation between categories. The standard errors are bootstrapped (500 reps).

[Table 8]

The results in the first column of *Table 8* do not indicate any difference in principals' opportunity to influence large and small schools: for most outcomes the difference in adjusted standard deviation is not statistically significant. Principals in small schools only appear to have a larger opportunity to influence the grade setting standards (the difference in negative and statistically significant).

The results in column two indicate that principals at voucher school have more influence over student performance in the lower end of the skill distribution in terms of

the share of passed students. We also see that principals at voucher schools have larger opportunities to direct school level policies regarding grade setting standards, and a larger discretion in wage setting and hiring decision. Hence, in voucher schools principals are provided with opportunities to influence both student performance as well as the generosity of grades. It should be noted that voucher schools, on average, are smaller than public schools, but given that school size does not appear to influence principal discretion these differences likely stem from organizational autonomy.

The last column shows that competitive pressure have an impact on student achievement in terms of final grades and the share of students passing the minimum requirement. When it comes to school level policies competitive pressures appears to be more important for wage setting.

# 6 Conclusions

Management in the public sector faces a different set of constraints compared to the private sector in terms of competitive pressure, the objectives of the organization, and the interaction with customers and clients. While there is a large literature documenting the importance of leadership in the private sector, public sector management has received considerably less attention. One reason for this is that public sector performance, in general, is more difficult to measure and gauge.

In this paper we assess the importance of management in Swedish middle schools by estimating principal fixed effects. The benefit of analysing management in a school setting is that we can directly observe the primary outcome of the organization; ie, students' academic achievement. In addition, we have information on a number of indirect outcomes capturing strategic school level choices and working environment.

We find that a one standard deviation move in the distribution of principal fixed effects is associated with a five to ten percent of a standard deviation change in student achievement. This corresponds to a class size reduction of two to four teachers (Fredriksson et al, 2013) and is somewhat smaller than what Branch, Hanushek and Rivkin (2012) find in concurrent work. Even if the effects are somewhat smaller than what has been found for teachers (Rockoff, 2004; Rivkin, Hanushek and Kain 2005;

Leigh 2010), school managers must be considered to have a substantial effect on student achievement. We also find that a one standard deviation change in principal effects corresponds to a two percent of a standard deviation change in the share of students reaching the minimum requirements.

Principals significantly—both statistically and economically—appear to affect strategic school level variables in terms of grade setting standards, school level wage setting, the share of certified teachers and female teachers, and schools' working environment in terms of teacher retention rates and sick leave absence. It is however difficult to characterize a successful principal either by correlating principal fixed effects for different outcomes to each other, or by correlating principal fixed effects to a large set of observable individual characteristics. This result is well in line with Clark, Martorell and Rockoff (2009) who find little evidence that the selectivity of the principal's undergraduate institution and pre-principal work experience affect school performance, as well as the difficulties of attaching observable characteristics to teacher quality (see eg Rockoff 2004; Rivkin, Hanushek and Kain 2005; Rockoff et al 2011; Grönqvist and Vlachos 2008). What constitutes a good principal—both regarding their personal characteristics and their strategic policy choices—is thus still left in the dark.

Our results further suggest that principals in smaller schools have a larger influence on grade setting standards but apart from this there are no significant differences between large and small schools. Compared to principals at public schools, we find that voucher school principals have a stronger influence over the share of passed students, grade setting standards, wage dispersion, and hiring decisions. This is consistent with the notion that voucher schools are more autonomous than publicly managed schools, but this autonomy can be for better or for worse. Competitive pressures are associated with a wider distribution of principal fixed effects in terms of final grades, the share of students passing the minimum requirement, and wage dispersion among teachers. If anything, increased competition hence appear to result in wider between-school dispersion.

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# Appendix

**Table A.1.** Descriptive statistics of school manager observables

| | Principal level sample | | | |
|---|---|---|---|---|
| | Switchers | | Non-switchers | |
| | Mean | St.dev. | Mean | St.dev. |
| Male | .579 | .494 | .447 | .497 |
| Year of birth | 1951 | 6.951 | 1952 | 9.406 |
| Seniority | **8.409** | **2.624** | **3.659** | **2.685** |
| Tenure | 4.110 | 2.157 | 3.336 | 2.637 |
| Cognitive ability | 65.676 | 22.456 | 62.781 | 23.793 |
| Leadership ability | 64.374 | 28.527 | 62.865 | 28.119 |
| High school GPA | 68.147 | 25.744 | 66.619 | 25.253 |
| Pedagogical education | .750 | .433 | .8259 | .379 |
| Bachelor's/Master's degree | .391 | .488 | .334 | .472 |
| Subject teacher | .153 | .360 | .177 | .382 |
| Years of post-secondary edu | 1.93 | .61 | 1.87 | .69 |
| Former army officer | .024 | .152 | .027 | .163 |
| Wage | 7.898 | .526 | 7.677 | .830 |

Note: The "Principal level sample" refers to the set of principals who are observed in the matched sample, and where "Switchers" are observed in multiple schools with at least a two-year stay in at least two schools. t-ratio tests are used to test the null of equal means in the Switcher and Non-switchers distributions. Numbers in bold typeface indicate that this hypothesis is rejected at the 10 percent level.

**Table A.2.** Size distribution of school manager fixed effects when excluding time-varying controls

| | Median | Adjusted standard deviation | Unadjusted standard deviation |
|---|---|---|---|
| Test scores | -.0061 | .160 | .234 |
| Final grades | -.0024 | .075 | .121 |
| Students passed | -.0009 | .027 | .042 |
| Grade inflation | .0121 | .128 | .172 |
| Wage dispersion | .0018 | .009 | .015 |
| Female teachers | .0002 | .037 | .043 |
| Non certified teachers | .0005 | .041 | .049 |
| Teacher retention | -.0028 | .052 | .102 |
| Long term sick absence | .0035 | .021 | .037 |

Note: The school manager fixed effects are retrieved from fixed effects panel regressions. For each dependent variable (reported in columns) the regressions include school, year, principal and assistant principal fixed effects, but without school level controls. Column 2 reports the standard deviation of the fixed effects adjusted for estimation error, whereas column 3 reports the unadjusted standard error for the fixed effects.

**Table A.3.** Size distribution of school manager fixed effects adding a school specific linear trend

| | Median | Adjusted standard deviation | Unadjusted standard deviation |
|---|---|---|---|
| Test scores | .0152 | .093 | .289 |
| Final grades | .0014 | .085 | .129 |
| Students passed | -.0001 | .030 | .046 |
| Grade inflation | .0090 | .074 | .143 |
| Wage dispersion | .0020 | .005 | .016 |
| Female teachers | -.0015 | .033 | .040 |
| Non certified teachers | .0012 | .027 | .045 |
| Teacher retention | -.0046 | .106 | .133 |
| Long term sick absence | -.0011 | .023 | .044 |

Note: The school manager fixed effects are retrieved from fixed effects panel regressions. For each dependent variable (reported in columns) the regressions include school, year, principal and assistant principal fixed effects, and school level controls and in addition a school specific linear trend. Column 2 reports the standard deviation of the fixed effects adjusted for estimation error, whereas column 3 report the unadjusted standard error for the fixed effects.

**Table A.4.** Size distribution of school manager fixed effects including county-by-year fixed effects

| | P-value (on F-test) | Median | Adjusted standard deviation | Unadjusted standard deviation |
|---|---|---|---|---|
| Final grades | <0.0001 | -.0018 | .043 | .127 |
| Students passed | <0.0001 | -.0017 | .020 | .045 |
| Wage dispersion | <0.0001 | .0011 | .007 | .017 |
| Female teachers | <0.0001 | .0018 | .035 | .046 |
| Non certified teachers | <0.0001 | -.0001 | .040 | .053 |
| Teacher retention | <0.0001 | .0002 | .080 | .119 |
| Long term sick absence | <0.0001 | .0043 | .024 | .044 |

Note: The fixed effects are retrieved from the baseline regression model (described in Section 3.1) with added county by year FE. We have only performed this sensitivity analysis for the outcomes that we observe for the full period 1996-2008. Column 1 reports the P-values of F-tests for joint significance of the school manager fixed effects. Column 2 reports the median fixed effect for each outcome variable. Column 3 reports the standard deviation of the fixed effects adjusted for estimation error, whereas column 4 reports the unadjusted standard error for the fixed effects. Data cover the years 1996-2008. Standard errors are corrected for clusters on school level.

**Table A.5.** Effects of school manager tenure

| | (1) Test scores | (2) Final grades | (3) Students passed | (4) Grade inflation | (5) Wage dispersion | (6) Female teachers | (7) Non-cert teachers | (8) Teacher retention | (9) Long-term sick absence |
|---|---|---|---|---|---|---|---|---|---|
| 1st year | 0.007 | 0.004 | 0.001 | 0.003 | 0.001 | -0.002 | 0.003 | -0.006 | 0.002 |
| | (0.012) | (0.006) | (0.002) | (0.005) | (0.001) | (0.001) | (0.002)+ | (0.004) | (0.002) |
| 2nd year | 0.024 | 0.005 | 0.000 | 0.000 | -0.000 | -0.002 | 0.002 | -0.010 | 0.000 |
| | (0.014)+ | (0.005) | (0.002) | (0.006) | (0.001) | (0.001)+ | (0.002) | (0.005)* | (0.002) |
| Obs | 2474 | 8847 | 8847 | 7902 | 8847 | 8847 | 8847 | 8847 | 8089 |
| Adj R2 | 0.77 | 0.77 | 0.87 | 0.60 | 0.44 | 0.81 | 0.80 | 0.28 | 0.50 |

Note: Reported in the table are the results from fixed effects panel regressions. For each dependent variable (reported in columns) the regressions include school, year, principal and assistant principal fixed effects, as well as school level controls. In addition indicators for the school managers first and second at a school are included. Robust standard errors correcting for clusters on the school level are reported in parenthesis. +/*/** significant at 10/5/1 percent level

**Table A.6.** Placebo estimates of school manager fixed effects when randomly allocating principal spells to schools (100 repetitions)

| | Mean of Unadjusted standard deviation | Std. dev. of Unadjusted standard deviation | Mean (std. dev.) of p-value of joint significance of the manager fixed effects | Mean of adjusted standard deviation | Calculated sampling bias (Unadjusted-Adjusted std. dev. of main est. of Tab.4) |
|---|---|---|---|---|---|
| Test scores | .127 | .006 | .46 (.32) | .000 | .092 |
| Final grades | .063 | .004 | .87 (.26) | .000 | .053 |
| Students passed | .021 | .001 | .97 (.11) | .000 | .017 |
| Grade inflation | .072 | .002 | .90 (.16) | .000 | .032 |
| Wage dispersion | .009 | .000 | .89 (.23) | .000 | .007 |
| Female teachers | .019 | .000 | .92 (.13) | .000 | .006 |
| Non certified teachers | .022 | .001 | .87 (.16) | .000 | .008 |
| Teacher retention | .064 | .002 | .79 (.23) | .000 | .051 |
| Long term sick absence | .021 | .001 | .94 (.11) | .000 | .016 |

Note: Reported in the table are the results from fixed effects panel regressions where principal spells are randomly allocated to schools. This is repeated 100 times. Column 1, reports the mean of the unadjusted standard deviations of the resulting principal fixed effects and column 2 the standard deviation of the unadjusted standard deviation. Column 3 reports the mean (standard deviation) of F-tests of joint significance of the principal fixed effects. Column 4 reports the mean of the adjusted standard deviation of the placebo school manager fixed effects when randomly allocating principal spells to schools. Column 5 shows the calculated sampling bias in main estimates based on the difference between unadjusted and adjusted principal effects in Table 4. The statistics reported in the first row are based on data from 2003-2008 and the other statistics are based on data from 1996-2007 since data on sick absence are not yet available for 2008. Standard errors are corrected for clusters on school level.

# Tables

**Table 1.** Transitions between positions and schools among school managers who switch schools 1996-2008

| | to: | Ass. principal | Principal | *Percent (row)* |
|---|---|---|---|---|
| | from: | | | |
| A. First & last position | Ass. principal | 10 | 39 | *49* |
| | Principal | 5 | 46 | *51* |
| | | *15* | *85* | *100* |
| B. All switches between schools | Ass. principal | 15 | 23 | *38* |
| | Principal | 6 | 56 | *62* |
| | *Percent (col)* | *21* | *79* | *100* |

Note: Panel A shows the percentage of school managers who stay in the same or switch position between the first and last position in which we observe them. Panel B shows the percentage of school managers who stay in the same or switch position when they switch school. There are 673 school managers in our sample who switch schools between 1996 and 2008**.** In sum we observe 973 switches between schools.

**Table 2.** Descriptive statistics of covariates

| | School-principal matched sample | | Principal level sample | | | |
|---|---|---|---|---|---|---|
| | | | Switchers | | Non-switchers | |
| | Mean | St.dev. | Mean | St.dev. | Mean | St.dev. |
| Mother's years of schooling | 12.61 | 1.04 | 12.60 | 0.78 | 12.61 | 1.07 |
| Father's years of schooling | 11.37 | 1.19 | 11.41 | 0.82 | 11.40 | 1.14 |
| Immigrant | 0.107 | 0.111 | 0.110 | 0.089 | 0.116 | 0.115 |
| $2^{nd}$ generation immigrant | 0.139 | 0.161 | 0.146 | 0.138 | 0.155 | 0.168 |
| Age at immigration | 0.833 | 0.967 | 0.833 | 0.723 | 0.912 | 0.989 |
| Log wage father | 6.80 | 0.68 | 6.79 | 0.54 | 6.77 | 0.69 |
| Log wage mother | 6.59 | 0.60 | 6.58 | 0.48 | 6.57 | 0.63 |
| Mother' s age | 43.5 | 1.58 | 43.6 | 0.96 | 43.6 | 1.42 |
| Father' s age | 45.7 | 1.94 | 45.7 | 1.08 | 45.7 | 1.64 |
| Female students | 0.484 | 0.079 | 0.483 | 0.039 | 0.484 | 0.055 |
| Student's birth year | 1983 | 20.76 | 1984 | 6.97 | 1981 | 19.44 |
| Student's birth month | 6.27 | 0.47 | 6.29 | 0.21 | 6.27 | 0.33 |
| No wage observation father | 0.083 | 0.065 | 0.084 | 0.046 | 0.087 | 0.061 |
| No wage observation mother | 0.059 | 0.063 | 0.060 | 0.048 | 0.063 | 0.066 |
| No edu observation mother | 0.023 | 0.028 | 0.022 | 0.016 | 0.025 | 0.026 |
| No edu observation father | 0.088 | 0.059 | 0.086 | 0.035 | 0.092 | 0.049 |
| No age observation mother | 0.017 | 0.022 | 0.017 | 0.011 | 0.018 | 0.017 |
| No age observation father | 0.034 | 0.034 | 0.034 | 0.020 | 0.036 | 0.028 |
| Number of students | 94.6 | 45.3 | 93.26 | 32.6 | 100.0 | 42.4 |
| Sample size | 8847 | | 673 | | 4058 | |

Note: The "School-principal matched sample" refers to the set of school-year observations for schools that have at least one principal observed in multiple schools with at least a two-year stay in each school. This sample includes observations for these schools in years for which they have other principals that we do not observe in multiple schools (see section 3.2 for details). The "Principal level sample" refers to the set of principals who are observed in the matched sample, and where "Switchers" are observed in multiple schools with at least a two-year stay in at least two schools. t-ratio tests are used to test the null of equal means in the Switcher and Non-switchers distributions. The null-hypothesis of equal means was never rejected at the 10 percent level.

**Table 3.** Descriptive statistics of outcome variables

| | School-principal matched sample | | Principal level sample | | | |
|---|---|---|---|---|---|---|
| | | | Switchers | | Non-switchers | |
| | Mean | St.dev. | Mean | St.dev. | Mean | St.dev. |
| Test scores | -0.029 | 0.403 | -0.044 | 0.306 | 0.009 | 0.378 |
| Final grades | 0.000 | 0.324 | -0.005 | 0.247 | 0.009 | 0.310 |
| Students passed | 0.852 | 0.152 | 0.857 | 0.093 | 0.838 | 0.144 |
| Grade inflation | 0.001 | 0.261 | 0.004 | 0.174 | 0.004 | 0.215 |
| Wage dispersion | 0.124 | 0.028 | 0.123 | 0.015 | 0.123 | 0.022 |
| Female teachers | 0.669 | 0.100 | 0.675 | 0.077 | 0.678 | 0.092 |
| Non certified teachers | 0.192 | 0.115 | 0.198 | 0.090 | 0.191 | 0.109 |
| Teacher retention | 0.775 | 0.178 | 0.764 | 0.077 | 0.759 | 0.156 |
| Long term sick absence | 0.144 | 0.068 | 0.149 | 0.039 | 0.142 | 0.054 |

Note: The "School-principal matched sample" refers to the set of school-year observations for schools that have at least one principal observed in multiple schools with at least a two-year stay in each school. This sample includes observations for these schools in years for which they have other principals that we do not observe in multiple schools (see section 3.2 for details). The "Principal level sample" refers to the set of principals who are observed in the matched sample, and where "Switchers" are observed in multiple schools with at least a two-year stay in each school. There are no statistically significant differences in the means between the Switcher and Non-switcher distributions of these outcome variables.

Table 4**.** Size distribution of school manager fixed effects

| | P-value (on F-test) | Median | Adjusted standard deviation (std. err.) | Unadjusted standard deviation (std. err.) |
|---|---|---|---|---|
| Test scores | <0.0001 | -.0020 | .119 (.028) | .211 (.012) |
| Final grades | <0.0001 | -.0024 | .052 (.019) | .105 (.008) |
| Students passed | <0.0001 | .0001 | .021 (.004) | .038 (.002) |
| Grade inflation | <0.0001 | .0036 | .118 (.020) | .150 (.011) |
| Wage dispersion | <0.0001 | .0018 | .008 (.001) | .015 (.001) |
| Female teachers | <0.0001 | .0004 | .038 (.004) | .044 (.002) |
| Non certified teachers | <0.0001 | .0003 | .041 (.005) | .049 (.003) |
| Teacher retention | <0.0001 | -.0036 | .051 (.008) | .102 (.003) |
| Long term sick absence | <0.0001 | .0037 | .021 (.002) | .037 (.001) |

Note: The school manager fixed effects are retrieved from the regression model described in Section 3.1, and the standard errors of these fixed effects are corrected for clusters on school level. Data cover the years 1996-2008, except test scores which are only available from 2003 and sick-leave absence which is not available for 2008. Column 1 reports the P-values of F-tests for joint significance of the fixed effects. Column 2 reports the median fixed effect for each outcome variable. Column 3 reports the standard deviation of the fixed effects adjusted for estimation error, whereas column 4 reports the unadjusted standard deviation for the fixed effects. The standard errors of the standard deviation estimates were obtained by bootstrapping (500 reps).

**Table 5.** Estimates of effects before changing principal

| | (1) Test scores | (2) Final grades | (3) Students passed | (4) Grade inflation | (5) Wage dispersion | (6) Female teachers | (7) Non-cert teachers | (8) Teacher retention | (9) Long-term sick absence |
|---|---|---|---|---|---|---|---|---|---|
| 1 year before | -0.020 | 0.005 | 0.000 | 0.002 | 0.001 | 0.002 | 0.000 | 0.030 | 0.002 |
| | (0.015) | (0.004) | (0.001) | (0.005) | (0.001)+ | (0.001)+ | (0.002) | (0.004)** | (0.002) |
| 2 years before | 0.005 | -0.002 | -0.001 | 0.014 | 0.000 | 0.002 | -0.002 | 0.000 | -0.000 |
| | (0.018) | (0.005) | (0.002) | (0.005)* | (0.001) | (0.001) | (0.002) | (0.005) | (0.002) |
| Obs | 2474 | 8847 | 8847 | 7902 | 8847 | 8847 | 8847 | 8847 | 8089 |
| Adj R2 | 0.77 | 0.77 | 0.87 | 0.60 | 0.44 | 0.81 | 0.80 | 0.29 | 0.50 |

Note: Reported in the table are the results from fixed effects panel regressions. For each dependent variable (reported in columns) the regressions include school, year, principal and assistant principal fixed effects, as well as school level controls. In addition indicators at the school level for the year before, and two years before the, the change of principal are included. Robust standard errors correcting for clusters on the school level are reported in parenthesis. +/*/** significant at 10/5/1 percent level.

**Table 6.** Correlations between fixed effects

| | Dependent variable: | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Test scores | Final grades | Passed students | Grade infl. | Wage disp. | Female teacher | Non-cert. teachers | Teacher retention |
| **Independent variable:** | | | | | | | | |
| Test scores | | **.213** | | | | | | |
| | | **(0.033)** | | | | | | |
| Final grades | **0.588** | | **1.861** | | | | | |
| | **(0.093)** | | **(0.081)** | | | | | |
| Passed students | **1.023** | **0.238** | | | | | | |
| | **(0.230)** | **(0.010)** | | | | | | |
| Grade inflation | -0.103 | **-0.102** | 0.005 | | | | | |
| | (0.070) | **(0.030)** | (0.012) | | | | | |
| Wage dispersion | **-2.168** | -.005 | 0.015 | **-0.686** | | | | |
| | **(0.715)** | (0.005) | (0.015) | **0.363** | | | | |
| Female teachers | 0.045 | **0.057** | **0.200** | **0.604** | 0.051 | | | |
| | (0.327) | **(0.016)** | **(0.044)** | **0.108** | (0.115) | | | |
| Non certified | -0.303 | **-0.056** | **-0.054** | -0.172 | **0.805** | **-0.213** | | |
| teachers | (0.204) | **(0.018)** | **(0.050)** | 0.113 | **(0.125)** | **(0.042)** | | |
| Teacher retention | -0.027 | 0.040 | 0.164 | **0.143** | **-0.819** | **0.208** | **-0.265** | |
| | (0.066) | (0.038) | (0.106) | **0.048** | **(0.271)** | **(0.091)** | **(0.081)** | |
| Long -term sick | -0.024 | 0.020 | 0.057 | 0.016 | -0.040 | **0.075** | 0.007 | **-0.036** |
| leave | (0.276) | (0.013) | (0.037) | 0.136 | (0.095) | **(0.032)** | (0.028) | **(0.013)** |

Note: Each entry in the table comes from a different regression, and corresponds to the coefficient from a weighted regression of the fixed effects from the row variable on the fixed effects from the column variable. Observations in these regressions are weighted by the inverse of the standard errors on the independent (column) variable. Coefficients that are significant at the 10 percent level are highlighted in bold.

**Table 7.** Correlations between fixed effects and school manager observables

| | | Observable school manager characteristics | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Male | Year of birth | Seniority | Tenure | Cognitive ability | Leadership ability | High school GPA | Pedagogical education | BA/ Master | Subject teacher | Yrs of post second education | Former army officer | Wage |
| **School manager fixed effects** | | | | | | | | | | | | | | |
| Test scores | coef. | .0493 | .0030 | -.0067 | -.0073 | .00097 | .00024 | -.0035 | -.0545 | .0445 | .0322 | .0084 | .0059 | .0390 |
| | s.e. | .0301 | .0020 | .0101 | .0121 | .00123 | .00096 | .0035 | .0375 | .0310 | .0383 | .0234 | .0789 | .0242 |
| | N | 292 | 292 | 292 | 292 | 96 | 96 | 19 | 292 | 292 | 292 | 286 | 292 | 291 |
| Final grades | coef. | -.012 | -.00085 | .00083 | .0032 | .00075 | -.000059 | **.00087** | .0093 | .005 | **.023** | **.014** | -.026 | .0066 |
| | s.e. | .0094 | .00067 | .0018 | .0021 | .00041 | .00033 | **.0003** | .011 | .0095 | **.013** | **.0077** | .03 | .0094 |
| | N | 669 | 669 | 672 | 672 | 182 | 182 | **217** | 672 | 672 | **672** | **663** | 672 | 669 |
| Students passed | coef. | -.0015 | -.000029 | .00032 | **.0014** | .00025 | .000041 | .00019 | -.0017 | **.0063** | **.0083** | **.0047** | -.0042 | .0016 |
| | s.e. | .0034 | .00024 | .00064 | **.00077** | .00015 | .00012 | .0001 | .0038 | **.0034** | **.0046** | **.0028** | .011 | .0036 |
| | N | 669 | 669 | 672 | **672** | 182 | 182 | 217 | 672 | **672** | **672** | **663** | 672 | 669 |
| Grade inflation | coef. | .0149 | .0006 | -.0043 | -.0029 | -.0002 | .0004 | .0019 | -.0200 | .0113 | -.0090 | -.0066 | .0141 | -.0192 |
| | s.e. | .0137 | .0010 | .0031 | .0036 | .0004 | .0003 | .0014 | .0168 | .0146 | .0196 | .0115 | .0451 | .0146 |
| | N | 638 | 638 | 642 | 642 | 182 | 182 | 27 | 642 | 642 | 642 | 634 | 642 | 637 |
| Wage dispersion | coef. | -.00078 | -.00000 | .000052 | .00009 | -.00000 | .000022 | .00000 | -.0007 | -.00093 | **-.0031** | -.00072 | -.0034 | .00076 |
| | s.e. | .0013 | .00009 | .00024 | .00029 | .00005 | .000036 | .00005 | .0014 | .0013 | **.0017** | .001 | .0041 | .0014 |
| | N | 669 | 669 | 672 | 672 | 182 | 182 | 217 | 672 | 672 | **672** | 663 | 672 | 669 |
| Female teachers | coef. | .0041 | -.000033 | -.00073 | **-.0016** | .00027 | .000055 | .000095 | .0047 | -.0034 | .0032 | -.00063 | .013 | .0017 |
| | s.e. | .0039 | .00028 | .00073 | **.00089** | .0002 | .00016 | .00013 | .0044 | .0039 | .0053 | .0032 | .013 | .0043 |
| | N | 669 | 669 | 672 | **672** | 182 | 182 | 217 | 672 | 672 | 672 | 663 | 672 | 669 |
| Non certified | coef. | -.0031 | -.00037 | -.0021 | -.0012 | -.00016 | **-.00032** | -.00012 | -.0029 | -.0022 | -.0085 | -.0033 | -.014 | **-.0086** |
| teachers | s.e. | .0044 | .00031 | .00082 | .001 | .00023 | **.00018** | .00016 | .005 | .0044 | .006 | .0036 | .014 | **.0047** |
| | N | 669 | 669 | 672 | 672 | 182 | **182** | 217 | 672 | 672 | 672 | 663 | 672 | **669** |
| Teacher retention | coef. | .014 | .00015 | -.0019 | -.0024 | .00025 | -.00035 | -.00014 | .01 | .00051 | .014 | .0024 | -.0035 | -.006 |
| | s.e. | .0094 | .00067 | .0018 | .0021 | .00038 | .0003 | .0003 | .011 | .0095 | .013 | .0076 | .03 | .01 |
| | N | 669 | 669 | 672 | 672 | 182 | 182 | 217 | 672 | 672 | 672 | 663 | 672 | 669 |
| Long term sick | coef. | -.0031 | -.000075 | -.00025 | -.00059 | -.000097 | -.00006 | -.00000 | .0028 | -.0035 | -.0032 | .00061 | **-.018** | -.0043 |
| absence | s.e. | .0031 | .00022 | .00057 | .0007 | .00013 | .0001 | .0001 | .0035 | .0031 | .0042 | .0025 | **.0099** | .0033 |
| | N | 669 | 669 | 672 | 672 | 182 | 182 | 217 | 672 | 672 | 672 | 663 | 672 | 669 |

Note: Each block of entries in this table comes from a different regression, and corresponds of the *coefficient* (top)/*standard error* (middle)/*number of observations* (bottom) from a regression of the estimated principal fixed effects on observable principal characteristics. Regressions using cognitive ability and leadership ability are only run for male principals. Coefficients that are significant at the 10 percent level are highlighted in bold.

**Table 8.** Difference in the size distribution of school manager fixed effects by institutional variables

| | | Observable school and municipality characteristics | | |
|---|---|---|---|---|
| | | "Large schools" minus "Small schools" | "Voucher schools" minus "Public School" | Many voucher schools" minus "Few voucher schools" |
| **Principal fixed effects** | | | | |
| Test scores | Dif. of Adjusted SD | 0.024 | -0.079 | -0.013 |
| | s.e. | 0.060 | 0.063 | 0.056 |
| | N | 292 | 292 | 292 |
| Final grades | Dif. of Adjusted SD | -0.016 | 0.156 | **0.084** |
| | s.e. | 0.037 | 0.120 | **0.027** |
| | N | 672 | 672 | **672** |
| Students passed | Dif. of Adjusted SD | -0.012 | **0.038** | **0.032** |
| | s.e. | 0.009 | **0.016** | **0.008** |
| | N | 672 | **672** | **672** |
| Grade inflation | Dif. of Adjusted SD | **-0.127** | **0.147** | 0.022 |
| | s.e. | **0.033** | **0.064** | 0.038 |
| | s.e. | **672** | **672** | 672 |
| Wage dispersion | Dif. of Adjusted SD | -0.003 | **0.018** | **0.001** |
| | s.e. | 0.003 | **0.008** | **0.003** |
| | N | 642 | **642** | **642** |
| Female teachers | Dif. of Adjusted SD | 0.003 | 0.003 | 0.012 |
| | s.e. | 0.007 | 0.012 | 0.007 |
| | N | 672 | 672 | 672 |
| Non certified teachers | Dif. of Adjusted SD | -0.002 | **0.042** | 0.011 |
| | s.e. | 0.011 | **0.017** | 0.010 |
| | N | 672 | **672** | 672 |
| Teacher retention | Dif. of Adjusted SD | -0.026 | -0.018 | -0.017 |
| | s.e. | 0.018 | 0.026 | 0.017 |
| | N | 672 | 672 | 672 |
| Long term sick absence | Dif. of Adjusted SD | -0.003 | -0.014 | -0.004 |
| | s.e. | 0.004 | 0.009 | 0.004 |
| | N | 672 | 672 | 672 |

Note: Each block of entries in this table comes from a comparison of the size distribution of school manager fixed effects, and corresponds to the difference in adjusted standard deviation of the distribution of fixed effects between the categories of interest (top)/bootstrapped standard error with 500 repetitions (middle)/number of observations (bottom). The standard deviation of the distributions is adjusted for estimation error. Large (Small) schools in column 1 is defined as above (below) median medial number of pupils; Many (Few) voucher schools in column 3 is defined as schools situated in municipalities with an above (below) the median number of voucher schools. Results that are significant at the 10 percent level are highlighted in bold.