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

by

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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 shapes successful school management suggesting that possibly innate skills are central. We further find that the scope for principal discretion is larger among voucher schools and in areas with more school competition.

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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, make strategic pedagogical decisions, and represent the school in its contacts with education boards, trade unions and parents. In essence, principals provide management in a complex and knowledge intensive organisation. It is therefore understandable that the leadership by principals often is 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] We use Swedish register data to construct a principal-school panel data set covering all Swedish compulsory schools 1996-2008, which allows us to track individual principals as they move across schools. 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 of principals' influence on school level 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

[1] See for example Harris (2006).
[2] Recent work has set focus on the importance of 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.

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 (2014) find no effect of tenure; Grissom Kalegrides and Loeb (2015) compare estimated principal effects to external performance assessments (e.g. school district evaluations).

The contribution of our paper is that we (i) use a larger set of outcomes—from different domains of principal influence—from all Swedish compulsory schools; (ii) relate the different sets of principal fixed effects to each other and to very detailed data on principal characteristics, thus trying to characterize successful principals; (iii) relate the distribution of principal effects to different institutional features, assessing where principals have the largest impact.

Our findings indicate that principals have a substantive impact on our outcomes: student achievement (i.e. test scores, GPA's, share of students passing the grade), grade inflation, wage setting, teacher retention rates, teacher sick leave absence, and the types of teachers 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 those found by Branch, Hanushek and Rivkin (2012), Dhuey and Smith (2014), and Coelli and Green (2012).[4] Since a one standard deviation change in 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), also school managers can be viewed as having a substantial effect on student performance.

We find that principals who are more successful in improving student performance 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 relations are not simultaneously significant for all student achievement outcomes. We further do not

[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' achievement: 11 percent of a standard deviation in the specification most similar to ours. 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.

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

find any significant associations between managing practises that affect the work-environment and those that affect student performance. We conclude that the picture of what managing practices that associate with successful management for schools' final output is mixed.

Despite a large set of individual attributes, including measures of cognitive and leadership ability, as well as 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 principal's work experience or the quality of his undergraduate institution. 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 personal skills are central to successful school management.

The distributions of principal fixed effects are generally larger among voucher schools and in areas with strong competitive pressures, suggesting that voucher schools have more actual autonomy regarding school policy choices. Further, the findings suggest that competition is associated with larger between-principal dispersion.

2 How principals can affect schooling outcomes

Schools are headed by principals who have the ultimate responsibility for their school. 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.

2.1 The scope for principal discretion

The scope for principals to influence their schools depends on the degree to which they have decision making powers. School level autonomy in Sweden is well above the OECD average in most dimensions (OECD, 2010). 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, and 88 percent for the number of employees (given the size of the budget). 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 fixed term contracts. Public school principals are hired by the municipal school board while voucher schools have their own independent hiring practices. The hiring of assistant principals is, on the other hand, the responsibility of the principal. Public school principals with a permanent position usually have their employment at the municipality, which facilitates mobility across schools in the municipality.

What are the objectives of principals? In for-profit schools, the objective is presumably to educate as many students as possible at the lowest possible cost. However, most principals are in a non-profit milieu, and it is difficult to have an informed opinion on exactly what their objectives are. However, 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.

Under plausible assumptions regarding the informational and the contracting environment, quite standard agency issues will arise—with the principal as the agent. 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 have different interpretations. Either it may be due to conscious actions by the school board 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 starts at age seven and lasts for nine years. Thereafter, a non-compulsory three year upper-secondary program follows. The compulsory 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 with more or less 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.[6] Voucher schools are not allowed to charge any fees so their budget is indirectly set by the municipality.[7] Within the compulsory school system voucher schools are only allowed to screen students based on their non-academic merits (e.g. musical or athletic talent). Apart from this they are equally open to all, with waiting time being the main selection criterion.

The last year of compulsory school, students receive final grades which are used to sort them to upper-secondary school programs.[8] 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 which is used in the application to upper-secondary school. 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. Although no formal accountability measures are in place, it is reasonable to assume that failing students are a major concern among principals.

[6] The voucher system is described in more detail by Björklund et al. (2005).
[7] Municipalities are by law compelled to provide the same per-student funding to voucher and municipal schools. Some, municipalities let the size of the voucher vary with socio-economic characteristics of the student body.
[8] 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.

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 school and 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). 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:

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

where y_{it} is the outcome of school i in period t; γ_i are school fixed effects, α_t are time period fixed effects; X_{it} is a vector of time-varying school level control variables; and ε_{it} is an error term. The variables of main interest are the vectors of principal fixed effects, λ_P, and assistant principals fixed effects, λ_{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 will in most analyses 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.[9] In order to account for potential serial correlation we

[9] 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.

correct the standard errors for clustering at the school level by scaling with the estimated Moulton (1986) factor.

In our set up, we will only identify principal fixed effects for those principals who move between schools. 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 allocated to schools. Therefore, 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 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 trajectory, and thereby falsely attributing improving school level outcomes to the principal. Our strategy is also problematic if the recruitment of a new principal is associated with a 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) include school specific linear trends to our model.

3.2 The school-principal sample

In order to identify principals effects 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.[10] 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 student characteristics before the last year of compulsory school (i.e. the 9th grade), when students' final grades are recorded. Therefore, we restrict our attention to schools with graduating students.

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

In our sample, we only retain schools in which at least one principal can be observed in at least one other school 1996-2008. As it presumably takes some time 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. We follow Bertrand and Schoar (2003) and Rivkin et al (2005) in 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* 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]

Table 1 shows the type of principal transitions we observe in the data. Panel A displays the transitions between the first and last positions that we observe the 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 becomes demoted to an assistant principal; and 56 percent of the switches are principals

keeping the same position as they move across schools. The career patterns depicted by these switcher principals indicate 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 schools during 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 9th 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 2003-2008 there will be fewer principals when using this outcome. Another outcome capturing academic achievement is the average grades in English and Mathematics on the school level (GPA).[11] The grades are a broader measure of performance than are test scores, but as they are set by teachers this variable is admittedly not a fully reliable measure of schooling output. Even if the grades in English and Mathematics can be inflated by the teacher, the grade setting in these subjects is aided by 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 where grad setting is 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

[11] 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 take the same standardized exam, however.

requirements in English and Mathematics.[12] While test scores and GPAs 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 larger in practical-aesthetic subjects not aided by standardized tests, than in theoretical 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.[13] Next, the wage dispersion between teachers is quite low in Sweden (OECD, 2008), but the wages are determined through individual wage bargaining 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.[14] Principals may also have different opinions on the importance of a gender balanced teaching staff.[15] Hence, we use the share of female teachers as a third outcome variable in this category. Finally, principals may have different opinions on the

[12] 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.

[13] 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, supports the interpretation of such deviations as grade inflation.

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

[15] Dee (2005) finds that girls learn more when having a female teacher. Swedish evidence is less conclusive; Holmlund and Sund (2008) find no support 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.

value of teacher certification, not the least since research on this is not conclusive.[16] 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 have 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 schools by Bloom et al (2014). The third set of outcome variables are therefore related to workplace conditions, arguably something principals can have a strong impact on. Within this outcome dimension we first use an indicator of teacher retention, defined as the share of teachers teaching at a school at time *t* who are also teaching at the same school in *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.[17]

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

[16] 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.

[17] 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).

year, birth month, immigrant status, and age of immigration.[18] We also include the number of 9th 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 non-cognitive leadership ability are available for males from the military draft at age 18, and are available for almost all Swedish men born between 1951 and 1981. Both these measures have a strong predictive power on future earnings, and draftees with better leadership ability had a larger chance of later ending up in a management positions (see Lindqvist and Vestman 2011 for details). In order to account for minor changes in the draft procedure over the years, these indicators are percentile ranked on an annual basis.

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.[19] 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.

[18] We also control for the share of missing data for each of those variables.
[19] The GPA scores are percentile ranked (in the whole population) on an annual basis.

3.5 Summary statistics

Table 2 shows the summary statistics for the school level control variables and *Table 3* for the outcome variables. 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]

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 is 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 online Appendix we also display descriptive statistics for principals. Again we see that differences between switchers and non-switchers are small. The only significant difference is 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 school managers 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. As the number of assistant principals is 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.

4.1 Principal fixed effects

The main results from our analysis of principal fixed effects are reported in *Table 4*. 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 the school manager fixed effects are 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. We thereby compare the importance of having a principal in the upper part of the distribution instead of in the lower part. To this end, we report the median and the standard deviation of principal fixed effects. The estimated school manager fixed effects are unbiased but they are estimated with a sampling error stemming from sampling uncertainty in both the realization of the outcome in a particular year—e.g. average GPA's for a specific student cohort—and from the particular draw of base case principals. 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.[20] In *Table 4* we both report the adjusted and the unadjusted standard deviations.[21]

[20] 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 τ^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 Bayes procedure is easily implemented in Stata (Harbord and Higgins, 2008).

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 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. 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, a one standard deviation move in the distribution of school managers corresponds to a two percentage points increase in the share of students passing the requirements. With the between school standard deviation in the share of students passing being 0.15, this corresponds to a 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

[21] In *Table A.2* of the online appendix we report the size distribution of school manager fixed effects when standard errors are not clustered. In general the distribution of fixed becomes slightly smaller.

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.

Regarding wage dispersion, we first note that 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 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 or 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 being 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 being 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 insensitive 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 (*Table A.3*in the online Appendix). Similarly, when adding a school specific linear trend the estimated principal influence is only slightly smaller (*Table A.4* in the online Appendix). The same is true when we add county-by-time fixed effects to the baseline specification (*Table A.5* in the online Appendix).[22] As an additional robustness test, we have added controls for school averages of 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. It may also be that the change of principal coincides with a set of school level policy changes from the school board changing 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

[22] 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.

suggest that a change of school manager is systematically related to pre-switch changes in outcome.

[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.6* in the online Appendix, we therefore estimate our baseline model and include indicators for whether the school manager is at his/her 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 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 (2014) 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.6*) do not lead us to believe that the estimated effects capture mean reversions or broader changes, for example in resource allocation, coinciding with principal switches. 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. In this procedure, 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 online Appendix *Table A.7* 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. We compare the distribution of placebo effects (column 1) with the calculated sampling bias in our main results (based on the difference between unadjusted and adjusted standard deviations in Table 4), displayed in column 5. We conclude that these 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 using the shrinkage procedure detailed in footnote 20. The adjusted standard is zero for all repetitions and outcomes.[23]

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 such vector. 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 of each fixed effect, 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. This indicates that some school managers may be using lenient grading standards to compensate poor average performance in theoretical subjects. There are also indications that the fixed

[23] 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.

effects based on the share of female teachers and the share of certified teachers are positively related to student outcomes. However, we find no association between student outcomes and work environment fixed effects.

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 first estimate principal effects using principal attributes as outcomes, and then regress principal fixed effects for outcomes (e.g. grades) on principal fixed effects for attributes (e.g. tenure). This procedure ensures that both the outcomes and the measures of principal attributes are measured relative to the same non-switcher principals. The regressions are weighted by the inverse of the estimated standard error of each right-hand-side fixed effect. 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 and caution must therefore be observed before giving these results a causal interpretation.

[Table 7]

In Table 7 we find that about 14 percent of estimated relations are statistically significant at the 10 percent level. There is no clear pattern indicating that principals' cognitive or leadership abilities (at age 18), professional background (experience in military management or seniority in the role as a principal), or educational background are important for their ability of managing high-achieving schools. With respect to the fixed effects related to school policy outcomes and work environment, there are scattered significant relations only slightly above what would be expected by chance.

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 using a rich set of observable characteristics. This finding is in line with previous research on teacher quality.[24] It can also be noted from the last column of Table 7 that good leadership in Swedish compulsory schools is not rewarded in terms of higher wage earnings.

5.2 Institutional factors

It is plausible that the discretion a principal has to his/her disposal 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.

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 stronger

[24] See Rockoff (2004) and Rivkin, Hanushek and Rivkin (2005) on teacher quality.

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 (2014) also indicate that voucher schools in Sweden have better management practices than public 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 20. *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 less attention. In this paper we assess the importance of management in Swedish compulsory 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 using observable 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). However, we do find indications that principals hiring a large share of female teachers and teachers with teaching credentials are associated with higher student achievement. Apart from this, it is difficult to draw any strong conclusions regarding which school policies that good principals tend to pursue.

Our results further suggest that principals in smaller schools have a larger influence on grade setting standards but for other outcomes 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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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.	.0595	.0016	-.0135	-.0113	-.0002	.0007	.0005	**-.0826**	.0377	.0012	-.0041	.0742	.0082
	s.e.	.0414	.0024	.0098	.0135	.0009	.0009	.0008	**.0450**	.0402	.0511	.0278	.0939	.0259
	N	294	294	294	294	97	97	123	**293**	293	293	287	294	293
Final grades	coef.	**-.0227**	-.0003	.0028	**.0043**	-.0001	-.0001	.0004	.0175	-.0075	.0165	**.0192**	-.0306	-.0009
	s.e.	**.0130**	.0009	.0021	**.0026**	.0003	.0003	.0003	.0138	.0133	.0169	**.0101**	.0422	.0122
	N	**669**	669	672	**672**	182	182	217	672	672	672	**663**	672	672
Students passed	coef.	-.0022	.0003	.0009	.0013	.0000	.0000	.0001	-.0037	.0073	.0071	**.0065**	.0018	-.0017
	s.e.	.0046	.0003	.0007	.0009	.0001	.0001	.0001	.0049	.0048	.0060	**.0036**	.0151	.0043
	N	669	669	672	672	182	182	217	672	672	672	**663**	672	672
Grade inflation	coef.	.0026	.0020	**-.0088**	-.0042	.0002	.0005	-.0001	.0178	-.0151	.0090	-.0098	-.0034	-.0247
	s.e.	.0189	.0013	**.0034**	.0043	.0004	.0003	.0003	.0216	.0196	.0264	.0153	.0576	.0162
	N	636	636	**640**	640	182	182	217	639	639	639	632	640	641
Wage dispersion	coef.	-.0014	-.00015	-.0004	-.0005	-.00003	.00004	-.0000	-.0016	-.0009	**-.0045**	-.0007	-.0050	-.0015
	s.e.	.0018	.00012	.0003	.0004	.00004	.00004	.0013	.0019	.0019	**.0024**	.0014	.0059	.0017
	N	669	669	672	672	182	182	217	672	672	**672**	663	672	672
Female teachers	coef.	-.0075	-.0003	-.0003	-.0008	.00014	.00005	.0001	**.0105**	**-.0092**	.0026	.0025	.0063	-.0024
	s.e.	.0054	.0004	.0009	.0011	.00016	.00001	.0001	**.0058**	**.0056**	.0071	.0042	.0176	.0051
	N	669	669	672	672	182	182	217	**672**	**672**	672	663	672	672
Non certified	coef.	.0003	-.0001	**-.0026**	**-.0034**	-.0001	**-.00029**	-.0001	-.0048	.0055	.0024	-.0044	.0070	**-.0121**
teachers	s.e.	.0060	.0004	**.0010**	**.0012**	.0002	**.00017**	.0001	.0064	.0062	.0078	.0047	.0197	**.0056**
	N	669	669	**672**	**672**	182	**182**	217	672	672	672	663	672	**672**
Teacher retention	coef.	.0184	-.0000	.0023	**.0077**	.0001	-.00037	-.0003	.0011	.0183	.0265	.0100	.0096	.0014
	s.e.	.0127	.0009	.0020	**.0026**	.0003	.00030	.0003	.0137	.0131	.0167	.0100	.0414	.0119
	N	669	669	672	**672**	182	182	217	672	672	672	663	672	672
Long term sick	coef.	-.0060	-.0001	-.0000	-.0013	-.0001	-.0001	-.0000	.0067	-.0019	.0035	.0040	**-.0353**	**-.0068**
absence	s.e.	.0044	.0003	.0007	.0009	.0001	.0001	.0001	.0047	.0046	.0058	.0034	**.0143**	**.0041**
	N	669	669	672	672	182	182	217	672	672	672	663	**672**	**672**

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 fixed effects of the observable principal characteristics. Observations in these regressions are weighted by the inverse of the standard errors on the independent (column) variable. 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.