Personnel Management and School Productivity: Evidence from India*

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November 24, 2022

Abstract

This paper uses new data to study school management and productivity in India. We report five main results. First, management quality in public schools is low, and ∼2 standard deviations below high-income countries with comparable data. Second, private schools have higher management quality, driven by much stronger people management. Third, people management quality is correlated with both independent measures of teaching practice, as well as school productivity measured by student value added. Fourth, better-managed schools have lower variation in within-school teacher effectiveness and higher levels of minimum teacher effectiveness. Fifth, consistent with better people management, teacher pay in private schools is positively correlated with teacher effectiveness, whereas we find no such correlation in public schools.

JEL Codes: I21, M5, O1

Keywords: school effectiveness, management practices, school leadership, TFP, teacher value added, teacher pay, public and private schools

*Acknowledgements: We thank the editor Sule Alan, three anonymous referees, Nick Bloom, Cesi Cruz, Alex Eble, Deon Filmer, Bob Gibbons, Dan Honig, Julien Labonne, Clare Leaver, Lant Pritchett, Simon Quinn, Arman Rezaae, Abhijeet Singh, Margaret Stevens, John Van Reenen and several seminar participants at the CSAE, Empirical Management Conference, NEUDC, Oxford, and SIOE for very useful comments and suggestions. We are deeply grateful to M. Srinivasa Rao, B. Srinivasulu, S. Ramamurthy, and staff of the Azim Premji Foundation for their support in setting up and overseeing the data collection that this paper is based on. The World Management Survey has had IRB approval from the London School of Economics since its inception. For our projects in India, approval was granted on 20 October 2011 and re-affirmed on 6 August 2013. The most recent WMS IRB "renewal" was on 24 May 2021 (Ref#25114). Approval was also granted by Cornell University's IRB on 27 May 2021, Protocol #2105010336.

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1 Introduction

Developing countries have made impressive progress in expanding primary school enrollment in the last couple of decades, but learning outcomes continue to be poor (World Bank; 2018). A growing body of evidence suggests that simply expanding schooling inputs may not be very effective without also improving the productivity of how these inputs are used (Glewwe and Muralidharan; 2016). One possible contributor to school productivity is the quality of its management, and there is growing interest in studying and improving school management. Yet, there is little evidence on the extent to which school management quality is correlated with either teaching practices or school productivity.

In this paper, we examine this question using data from two projects in India, the Development World Management Survey (D-WMS) and the Andhra Pradesh School Choice (APSC) project. The D-WMS is a new measurement tool that we first developed for this project to expand on the original WMS tool (Bloom and Van Reenen; 2007) to obtain comparable yet more granular measures of management quality in a low-capacity setting. The APSC project studied in Muralidharan and Sundararaman (2015) collected four years of rich panel data on schools, students, and teachers in a near-representative sample of rural public and private schools in the Indian state of Andhra Pradesh (AP).[1] The combination of these two datasets allows us to present the first detailed and comparable evidence of the types of management practices used in primary schools in a developing country, across the public and private sector, and also examine how they correlate with measures of school effectiveness.

We report five main results. First, public schools in AP have low management quality. Based on a normalized cross-country comparison, we estimate that management quality in AP public schools is almost 2 standard deviations (henceforth, sd) below the mean of 6 high-income countries with comparable data.[2] However, the low management quality in AP is *not* an outlier after adjusting for log per-capita income. Thus, the income gradient in school management quality across countries could be one reason that education systems in higher income countries add more human capital for each year of schooling, as shown by Schoellman (2011).

Second, within AP, private schools are much better managed with an average management score that is 1.36sd higher than in AP public schools (normalized relative to the

[1]The original state of AP was divided into two states (AP and Telangana) on June 2, 2014. Since this division took place after our data collection, we use the term "AP" to represent the original undivided state.

[2]School management scores for other countries are part of the World Management Survey or the D-WMS global datasets (see Bloom et al. (2015)) and are comparable with the AP data because they were collected based on the same measurement scale. We include only public schools from the WMS dataset in this exercise. The figure normalizes management scores across countries since it makes cross-country comparisons.

distribution of AP public schools). Our management score can be decomposed into scores on both operations and people management, and we see that the public school disadvantage is driven primarily by very low scores on people management: private schools scored nearly 4.8sd higher than public schools on this index. Relative to global benchmarks, the comparable scores for AP private schools are in line with those of public school systems in Brazil, Italy, and Colombia. This suggests that the private sector in India is able to achieve measures of management quality comparable to public school systems in much richer countries.

Third, we find that school management quality (and especially people management) is significantly correlated with *independent* measures of teaching quality as well as student value-added. In public schools, a 1sd higher people-management score is associated with 0.26sd better teacher practices and 0.34sd higher student value added. In private schools, these are 0.24sd and 0.16sd respectively. We also find that a large portion of the differences in value-addition across public and private schools can be explained by differences in the quality of people management (in an accounting sense, but not necessarily in a causal sense).

Fourth, we find that better-managed schools have lower variation in within-school teacher effectiveness – measured both by teaching practices, and by teacher value added (henceforth TVA). Consistent with this, we find a strong positive correlation between school management scores and the effectiveness of the *least* effective teacher in the school; that is, in better managed schools, their least effective teacher is better in teaching practices as well as value added relative to the least effective teacher in a worse managed school.

Fifth, consistent with private schools having better personnel management, we find that private schools pay more effective teachers (measured by TVA) significantly higher wages even after controlling for observable teacher characteristics. A teacher who adds an extra 1sd to student learning each year on average is paid about 26% higher wages. In contrast, we find no correlation between TVA and wages in public schools.

A key question for interpreting our results is to understand where the variation in management practices comes from and what it is correlated with. We examine correlations of management practices with school, teacher, and head-teacher characteristics and do find some meaningful relationships — especially with parental education and employment, and teacher qualifications and school size in private schools. However, we still find considerable variation in management quality after controlling for all these characteristics, and all the results above hold even with the residualized measure of management quality.

This residual variation most likely reflects idiosyncratic variation in school-level management practices. This is consistent with the management scores in our setting being below 2.5 for most schools on the D-WMS scale, which codes management quality on a 1-5 scale.

On this scale, scores below 3 reflect variation in individual practices that are not formally codified in any school management policy. As such, the variation in management quality in our data is best interpreted as reflecting variation in management practices employed by individual school leaders (and senior teachers) rather than variation in formal policies.

Our first contribution is to the measurement of management practices in low and middle income countries (LMICs). Specifically, this paper presents the development and first use of the enhanced measurement tool (the D-WMS) designed for low-capacity contexts. The survey instruments along with detailed notes on administering and coding the surveys are included in Appendix B.[3] We recommend the use of these tools for future research on management in LMICs (wherever feasible) for three reasons. First, it allows for a more precise and granular understanding of management practices and their relationship with productivity — especially in the lower end of the distribution where management practices in LMICs are concentrated.[4] Second, the greater precision in measurement will improve power for detecting changes in management quality in response to interventions to improve management, and also to study the impacts of improved management on ultimate outcomes of interest.[5] Third, the D-WMS maintains comparability with the original WMS that has been deployed in several settings and allows cross-country comparisons of the sort shown in this paper.[6]

Second, we show that management quality — especially the quality of personnel management — is strongly correlated with school productivity. Prior work has documented the correlation between school management quality and *levels* of test scores across secondary schools in (primarily) OECD countries (Bloom et al.; 2015). However, differences in test-score levels across schools could reflect omitted variables such as student selectivity, making value-added a better measure of school productivity. The combination of independent measures of teaching practices and panel data on student learning allow us to present direct evidence on the correlation between school management quality and independent measures of school effectiveness and productivity.[7]

[3]All survey materials are available on the WMS/D-WMS website: www.developingmanagement.org

[4]For instance, using the WMS comparable scores, 81% of the public schools in AP would have a people-management score of 1, which is the lowest possible score and would generate considerable floor effects in measurement. With the D-WMS scoring grid, only 6% of schools scored the minimum score of 1.

[5]For instance, using the WMS scales to study the relationship between management quality and school productivity in our setting would have yielded directionally similar findings, but with larger standard errors and more insignificant results due to the greater coarseness of the coding relative to the D-WMS.

[6]Since the time we developed, piloted, refined, and finalized the D-WMS tool for this project, we have shared the D-WMS instrument and methodology with research teams in Brazil, Colombia, Haiti, Indonesia, Mexico, Mozambique, Pakistan, Tanzania and Puerto Rico.

[7]Several studies have found that estimates of the impact of education interventions using value-added methods that control for lagged test scores are comparable to those obtained from experimental studies. (e.g., Kane and Staiger; 2008; Kane et al.; 2014; Chetty et al.; 2014). Prior work in developing countries has

These results are important beyond schooling, because the empirical management literature typically does not have direct measures of employee-level productivity, and often infers individual productivity from wages. Thus, while there are several studies on the relationship between management quality and *firm* productivity, it is seldom possible to explore the relationship between the left-tail of the (directly-measured) employee performance distribution and management quality. Other work has shown a strong correlation between management practices and worker quality at the firm level: Bender et al. (2018) and Cornwell et al. (2021), for example, match WMS survey data for manufacturing with employer-employee datasets in Germany and Brazil (respectively) and find that better management is linked with better hiring, firing and retention, but do so using wages as proxies of worker productivity. Studying the education sector is helpful in this regard as teacher value added is a direct measure of productivity, which is not easily available in other settings.

Third, we complement the literature on school leadership where multiple papers have studied the impact of changes in principals and superintendents on school quality, and shown that school leaders "matter" (e.g. Akhtari et al.; 2022; Coelli and Green; 2012; Walsh and Dotter; 2020; Lavy and Boiko; 2017; Munoz and Prem; 2020). Yet, for the most part, this literature has not consistently measured specific practices of school leaders. Our results showing that variation in management practices measured by the D-WMS are also correlated with independent measures of teacher value-added and practices suggest that differences in school productivity that may otherwise be attributed to school "leadership" can be accounted for by specific management practices. This knowledge may help in designing programs whereby school leaders could be coached to implement better practices and become more effective, as shown in the United States (Fryer; 2014, 2017). In contrast, the main practical implication of simply knowing that school leaders "matter" would be to focus on the selection margin of *identifying* effective school leaders.

Finally, we contribute to the broader literature on public-sector personnel economics (e.g. Lazear; 1995; Finan et al.; 2017), and to the comparative analysis of management in the public and private sector (e.g. Rainey and Chun; 2007; Quinn and Scur; 2021). Specifically, we present novel evidence that combines measures of management quality, employee behaviors, and productivity; with comparable data across public and private sector entities in any sector. This allows us to demonstrate the central role played by better personnel management in explaining the greater productivity in the private sector.

documented the correlation between intermediate outcomes of management quality (such as teacher absence or time-on-task) and value-added (e.g., Duflo et al.; 2012; Romero et al.; 2020), but has not directly measured management practices or correlated them with school and teacher productivity.

2 The Indian primary school institutional context

The undivided state of Andhra Pradesh (AP) would be India's fifth largest state, with a population of 85 million. At the time of this study, AP had similar averages to the rest of India on measures of human development, primary school enrolment, literacy, infant mortality and teacher absence (Muralidharan and Sundararaman; 2011). In this context, public schools are owned and run by the government, and private schools are owned and run by private individuals or organizations (including religious and charitable ones). At the time of the study, an estimated 3.2 million children in AP attended public schools and 2.1 million attended private schools (see Young Lives dataset in Woldehanna et al. (2018)).

The universe of schools in our study comes from the AP School Choice (APSC) project and consisted of all villages that had at least one recognized private school in 2008.[8] Thus, while our sample does not include public schools in villages that did not have a private school, the sample is representative of villages with both types of schools, and the relevant one for comparing public and private schools in rural markets where they both exist. Further, the private schools in our study sample are not elite schools. Rather, they represent a segment of schools that are referred to as "low-cost" or "budget" private schools. These low-cost private schools have substantially lower per-student expenditure than public schools, and the vast majority of enrollment in private schools in India is accounted for by this segment of schools (CSF; 2020). Similar trends are seen in Pakistan (Andrabi et al.; 2008). The main driver of the lower costs in these private schools is that they pay much lower teacher salaries.

Table A1 reports key summary statistics on public and private schools in our setting. Public school teachers are much more likely to have formal teacher training credentials (99% vs. 34%); however, these qualifications have been shown to be poor predictors of better student performance (Muralidharan and Sundararaman; 2011). They are civil servants hired by the state government on permanent contracts and are paid over 5 times the average private school teacher salary (Rs. 14,286 vs. 2,607 per month in data collected between 2008-2012). However, teacher effort and accountability are significantly higher in private schools. Private schools have much lower rates of teacher absence (9% vs. 24%), and higher rates of observed active teaching when measured by unannounced visits to schools (50% vs. 35%). They also have a longer school year (11 more working days), longer school days (45 minutes longer per day), lower levels of multi-grade teaching (where one teacher simultaneously teaches multiple grades) than public schools (24% vs 79%). Public schools have an average of 74

[8]This choice of study sample reflected the goals of the APSC project, which was to study the impact of providing students in public schools with a voucher that gave them the option of attending a private school in the same village.

students whereas private schools are larger with 296 students on average.[9] Though these private schools are low cost, they still charge fees, whereas public schools are free. Thus, students attending private schools come from relatively more advantaged backgrounds, as measured by parental education, occupation, and assets.[10] Table A2 presents equivalent summary statistics for the sample we use in this paper (for which we also collected D-WMS data).[11]

3 Data

3.1 Measuring management in low and middle-income countries (LMICs): the Development WMS (D-WMS)

The original World Management Survey (WMS) project started in 2002 and has since then collected over 30,000 data points on the quality of management practices in establishments in the manufacturing, retail, education and healthcare sectors across over 40 countries.[12] The methodology involves an interview lasting approximately one hour with the senior-most manager at the establishment (head teacher or principal for schools). Highly trained analysts score the responses on a set scale of 1 to 5 based on a common scoring rubric.[13]

The distribution of scores for schools in high income countries span almost the entire range of the WMS scores, from 1 to a little above 4. However, schools in LMICs have much lower scores on average, often bunching at the minimum score of 1. To better capture variation in this thick bottom tail, we developed and use an enhanced measure of management quality for this paper — which we refer to as the Development WMS (D-WMS).[14] The

[9] All figures reported above are based on Tables 3, 4, and 5 of Muralidharan and Sundararaman (2015).

[10] In addition to being true in our sample, this fact is also seen in several other studies (Tooley; 2009; Muralidharan and Kremer; 2008; Vennam et al.; 2014; Singh; 2015).

[11] The schools included in the D-WMS sample are a random sample of schools from the APSC project. Differences in summary statistics across Tables A1 and Table A2 reflect a combination of (a) sampling variation, (b) timing of data collection (2008-09 for the former, and 2012-13 for the latter), and (c) restricting the figures in Table A2 to those for primary grades (1-5). However, all the qualitative comparisons across public and private schools noted above hold in both samples (and tables).

[12] For a review of the latest WMS public dataset, see Scur et al. (2021). For the first paper on WMS measurement in schools, see Bloom et al. (2015). More information on the WMS project can be found at www.worldmanagementsurvey.org.

[13] A score of 1 means there are no processes at all *or very little processes* in place, while a score of 2 means there are *some informal* processes in place mainly adopted by the headteacher herself (as opposed to some formal "school policy"). A score of 3 means there is a formal process in place, though it has weaknesses such as not being followed all the time or properly. Scores of 4 and 5 indicate increasing levels of adherence and embeddedness of the practices such that they are part of the culture of the school.

[14] This paper supersedes the note in Lemos and Scur (2016), which describes the protocols for implemen-

D-WMS maintains comparability with the original WMS, while adding granularity to the measurement of management practices in two ways: first, it expands the number of questions in each domain by a factor of three to separately capture the existence, use, and monitoring of various management practices. Second, it expands the scoring grid to allow for half points between 1 and 5, relative to the original WMS that only allowed integer scores. Put together, it enables a six-fold increase in the granularity of measurement of management quality. We discuss each innovation below.

Expansion to improve measurement of management quality. The WMS measures 20 "topics" that each include a set of questions that help the interviewer gather the appropriate information to score based on a set rubric. For each topic, interviewers ask about (i) the existence of the practice (for example, does the school even have performance indicators and which ones), (ii) the usage of the practice (how is it implemented, how often it is used) and, (iii) the monitoring of the practice (how do they keep track that it is being understood and used effectively). In the original WMS these three factors were embedded in each score, while in the D-WMS they are explicit and require separate scores. This approach reduces measurement error by providing a much tighter scoring rubric and limiting the amount of judgment that interviewers need to apply in coding responses.

The expansion enables a better characterization of management practices, and the gaps between existence and use of tools and techniques. As shown by Muralidharan and Singh (2020), public schools in India often have good policies on paper, but these are not matched by actual practice. We found evidence of similar gaps in our field pilots, and adapted the survey instrument accordingly to capture distinctions between the existence and use of various management practices.[15] Using survey instruments that capture this distinction will be especially useful for research on the effectiveness of management interventions in LMICs.

Expansion to capture greater variation across the scoring scale. The scores in low and middle income income countries in the original WMS rarely go beyond 3. To capture finer variation in the lower tail, our expanded survey instrument measures the level of adoption of management practices on a scale of 1 to 5, in increments of 0.5 for each of the 20 topics. By allowing for half scores to be awarded, we can distinguish between a school that has

tation of the D-WMS but does not validate the instrument by correlating the resulting management scores with independent measures of teaching practices and school productivity (which this paper does).

[15]For example, a headteacher that we visited in AP during the pilot showed us a very detailed report card that they use to measure student achievement (Figure B2). When asked what they do with the report cards and the information, they showed us a storage spot where all the data was kept safely but unfortunately also not used or even usable. This is similar to findings reported in Muralidharan and Sundararaman (2010).

absolutely no practices in place (score of 1) and one that has some semblance of practices in place but that they are still rather ad-hoc (score of 1.5). We provide a more detailed example of the scoring of management practices, and examples of the precision added by the D-WMS in Appendix B.

The value of using the D-WMS is seen most clearly in the distribution of people-management scores distribution in the public sector, where under WMS scoring guidelines, 80% of schools would have the lowest score of 1. In contrast, the D-WMS provides much more granular information with only 6% of schools having a score of exactly 1 (see Figure B1). In addition to more precise measurement, using the D-WMS also improves inference on the results presented in Section 4, where some of the correlations would lose significance if implemented with the coarser WMS measures.

Building comparable scores. To build the comparable scores, we average the three subscores for each of the 20 topics and take the average across these topics to construct scores for overall management, operations management, and people management.[16] We then re-cast the averages for each of the topics into the next lowest whole number. This is because the WMS scoring guidelines are to score in a strictly increasing gradient, such that if a school does not have processes that are good enough to reach a score of 3, then they would have to be given a 2 (regardless of how close they would be to a 3). In the D-WMS grid, they would be awarded a 2.5.

Thus, it is simple to take each half point score and round down to the nearest integer and mimic the original WMS scoring methodology. We use the WMS-comparable score only for the cross-country comparisons in Figures 1 and A1, and normalize scores relative to the full global dataset. For the rest of the analysis in this paper, we use the D-WMS scores and normalize relative to only the AP sample (since those comparisons are within the state).

Consistent with the broader literature based on WMS surveys, we present and analyze both the overall management score, and the component scores on operations and people management. The operations-management score is based on the first 14 questions on the D-WMS, and the people-management score is based on the last 6 questions (see Tables B1 and B2 in Appendix B for the full list of 20 questions). Throughout this paper, we use the term "people management" to refer to the score obtained on the D-WMS survey, and the term "personnel management" to refer to broader personnel related actions taken by school leaders.

[16]The questions and training are identical, and the *information gathered* that forms the basis of the scoring is consistent with WMS tools. The main contribution of the D-WMS is to enable a *systematically* more granular coding of the same information.

We collected D-WMS data for a random sample of schools in the APSC project sample from January to May 2013 through face-to-face interviews with school headteachers. Each interview lasted approximately 1.5 hours and was carried out by two enumerators — a primary interviewer and secondary note-taker — who reviewed their notes immediately after the interview and scored the practices according to the scoring manual and grid. The enumerators passed an intensive one-week D-WMS training session prior to field work.

3.2 School, teacher and student data: the APSC dataset

The main school-teacher-student data we use is from the AP School Choice (APSC) project (Muralidharan and Sundararaman; 2015) and spans the 4 school years of the project in AP (2008-09 to 2011-12). We use this dataset to construct measures of student value added, teacher value added, and an index of teacher practices.

For student value added (SVA) and teacher value added (TVA), we use a panel of independently-administered subject-specific test scores for Telugu (language) and Math, along with teacher assignments into these subjects.[17] Using standard value-added methods (see next section), we estimate TVA for each teacher and year, using information from all years and subjects taught by each teacher. Since we focus on the relationship between D-WMS scores and variation in TVA *across* teachers, rather than annual variation in TVA *within* teachers, we use a single measure of TVA for each teacher averaged across all years for which we have data.[18] Data on teacher wages come from teacher interviews, and are also averaged across years in cases where we have multiple observations over time.

We construct a teacher practices index using the set of questions in the teacher interviews that related to classroom practices, along with audit data from classroom observation visits. These were collected *independently* of the student tests and the D-WMS management survey. We aggregated the sixteen items (fourteen self-reported practices and two audit-based measures of teacher presence and likelihood of being found teaching) into a single index.[19] Examples of teaching practices include having a lesson plan, having a textbook/workbook for the class and time spent on active teaching. A list of each measure of teaching practice

[17] While we have four years of student test-score data, our estimates of SVA and TVA primarily reflect scores in the first two years where we have the most data. This is because the APSC project originally tested all students in their schools, but after 2 years, it switched to testing treatment and control students outside school in a special testing session to minimize attrition in the experimental study sample.

[18] This focus is a function of our data. Since we only have D-WMS scores at one point in time, our paper does not focus on changes within schools over time.

[19] To do this, we used the method in Anderson (2008). This methodology weights the impact of the included variables by the sum of their rows in the inverse variance-covariance matrix, thereby assigning greater weight to questions that carry more "new information".

is provided in Table B3 and we present simple correlations of each teaching practice with student value added in Figure B3.

We estimate the impact of management practices on student value added (SVA) using a standard value-added specification with controls for lagged test scores (see Section 4.4). For analysis at the teacher level, we construct measures of teacher value added (TVA) following Chetty et al. (2014).[20] The TVA measure is normalized to have a mean of zero and standard deviation of 1. We focus our analysis on the two main focus subjects in primary school - Our data includes subjects in primary school - Math and Telugu (native language).

The combined dataset of APSC-DWMS data includes 300 schools, 191 private and 109 public schools. Our main analysis includes data for Telugu and Math tests for 15,444 students; 12,770 from private schools and 2,674 from public schools. There are a total of 1,287 teachers in our sample; 1,053 in private schools and 234 in public schools. The relatively larger sample of private school teachers and students reflects the fact that private schools on average are much larger than public schools in our setting.[21]

Note that we only measure management quality once in each school, at the end of the study period, and assign this score to the school for all years of student and teacher data. Thus, our analysis treats management as a "fixed characteristic" of the school throughout the study period and does not aim to study inter-temporal variation in management quality within schools. We justify this assumption in three ways. First, prior research suggests that management practices are slow-moving and difficult to change even with interventions, so this is a reasonable assumption in this context (e.g., Gibbons and Henderson; 2012; Bloom et al.; 2020). Second, evidence from other settings where there is panel data on school management (and no experiment or "upheaval" that changes the management practice at the school) also shows that management practices are stable over time (e.g. Leaver et al.; 2022).[22] Finally, since we have data on headteacher tenure in our study sample, we test the robustness of our results by repeating our main analysis using only schools that have principals with tenure greater than or equal to three years. Results in this restricted sample are similar, as discussed in Section 4.4.

[20] See Appendix B.3 for a brief summary of the Chetty et al. (2014) method.

[21] The APSC project required voucher-winning students to attend a private school in the same village, and therefore sampled villages that had both public and private schools. However, the private schools themselves often attracted students from further away by providing a school bus service, and hence had considerably larger enrolment.

[22] In some cases, practices even revert to the mean within a year of improving after an experiment, as Dunsch et al. (2022) found.

4 Results

4.1 Management quality and global comparisons

Figure 1a shows the comparable standardized scores of public school management across a set of countries surveyed using the WMS (UK, Sweden, Canada, US, Germany, Italy, Brazil and India) and the D-WMS (Mexico, Colombia, and Andhra Pradesh). The D-WMS scores were re-scaled to match the WMS scoring convention: all half points were rounded down to the next lowest whole point for each survey question (for example, all scores of 2.5 were re-cast to 2) and the management indices and standardization were based on these comparable scores. The scores are standardized relative to the global distribution. The high-income country mean is 0.975sd, and the score for AP public schools is -1sd. Thus, the average public school in AP has WMS management scores that are nearly two standard deviations below the average comparable score in high-income countries.

To place these scores in context, Figure 1b plots standardized management scores against the log of 10-year average GDP per capita for these countries. We see a robust positive correlation between countries' GDP per capita and the quality of school management. Though public school management scores in AP are substantially lower than high-income country averages, their scores are not an outlier after controlling for log per-capita income.

These facts are directly relevant for understanding the variation in education system productivity across countries. There is evidence from comparable cross-country assessment data that students from richer countries perform better than those from poorer countries of the same age (OECD; 2019). There is also evidence that the labor-market returns to each year of schooling is higher for students educated in richer countries (Schoellman; 2011). However, we have only a limited understanding of the drivers behind this fact or their relative importance. One likely explanation is that higher-income countries' education systems have more inputs per student (including more educated parents). But it is also possible that there is variation in the productivity of these inputs across countries. As such, to the extent that the quality of school management is correlated with the productivity of school systems (as we show below), Figure 1b suggests that poorer management quality may be an important contributor to the lower productivity of education systems in lower-income countries.

The discussion above is analogous to the "growth accounting" literature that has aimed to decompose variation in cross-country GDP per capita into variation in inputs (land, labor, and capital — both physical and human) and variation in total factor productivity (TFP) (Caselli; 2005). Given the growing interest in understanding the comparative productivity of education systems across countries (e.g. Pritchett; 2015; Singh; 2019), and investments

in comparable data on learning outcomes across countries (e.g. Filmer et al.; 2020), it may be useful to conduct a similar accounting exercise to explain variation in the effectiveness of education systems. Since management quality is likely to be an important component of TFP, the D-WMS can be a useful measurement tool for such an exercise. This would be analogous to the approach taken by Bloom et al. (2016) for manufacturing.

Turning from cross-country comparisons to AP-specific facts, Table 1 presents management scores for public and private schools for each of the 20 management practices in the survey. It also presents scores on operations and people management, and the 10th and 90th percentile scores. Figure 2a shows the distribution of the AP D-WMS management scores for public and private schools.

The average public school has a D-WMS management score of 1.81 while a school at the 90th percentile has a score of 2.05, suggesting weak management practices throughout the support of the distribution. Private schools, in contrast, are significantly better managed, scoring 0.34 points higher, or 1.36sd above the public-school mean. Figure 1b provides another way to benchmark this difference and shows that the quality of management in private schools in AP is comparable to that in public schools in middle-income countries like Brazil, Colombia, and Mexico which have ∼4 times greater GDP per capita than India.

This difference is especially pronounced in the area of people management. Figure 2b shows the distributions of operations and people management scores for each type of school. The mean difference in the operations-management index across public and private schools is 0.12 points, which is relatively small. However, people-management scores in public schools are very low — with a mean of 1.26, and a standard deviation of 0.18. Private schools score 0.87 points higher in people management, which is nearly 4.8sd higher (relative to the distribution of people-management scores in public schools).[23]

The public school distribution of people management in AP is also informative because we observe a distribution of scores despite official policies being identical across public schools. The D-WMS score, however, captures variation not just in official policies but also *de facto* variation in practices that may be in place at the school. For example, there may be institutional constraints to hiring and firing teachers, but they do not prevent headteachers from identifying effective and ineffective performers, and taking informal followup actions at their own level without relying on official processes or directives to do so. Conversely, official rules may have some provisions for effective personnel management, but these may not be

[23]We replicate the two cross-country figures using the people-management score in Figure A1, and see that people management quality in AP private schools are higher than those in public schools in Brazil, Colombia, and Mexico, and comparable to those in public schools in Italy (a country that is nearly seven times richer than India on PPP adjusted GDP per capita).

implemented uniformly. This variation will also be captured in our data.

4.2 Correlates of school management practices

Having documented the variation in management practices across schools, we now examine the correlates of this variation. Table 2 presents the coefficients of binary regressions between student, teacher and school characteristics and school management scores. Each cell reports coefficients from a single regression. Table A3 presents the multiple regression analogue.

In public schools, management quality is significantly correlated with parental socioeconomic status — positively with parental education, and negatively with the fraction of parents who are manual laborers. There is also suggestive evidence of positive correlations with teacher education and training, though these relations are not typically significant.

In private schools, management quality is strongly positively correlated with teacher education and training and also with the education level of the headteacher. It is negatively correlated with the fraction of parents who are manual laborers and (somewhat surprisingly) positively correlated with the fraction of students who belong to historically disadvantaged scheduled castes.[24] Management quality is also positively correlated with school size and with average school fees, which is not surprising.

The relationships above are correlations and purely descriptive. However, what is important for interpreting our results below is that there continues to be nearly as much variation in the residualized management scores (after controlling for all the variables in Table 2) as in the raw distributions of management scores. We plot these in Figure 3 and see that the residualized distribution (especially for people management) shifts leftward for private schools and rightward for public schools (reflecting the greater socioeconomic advantage of students attending private schools). But, the shape of the distribution is virtually unchanged.[25]

This is consistent with most of the variation we observe in management scores being driven by variation in *de facto* practices of individual school leaders. Indeed, the meaning of D-WMS scores below 3 (which is the range where almost all schools in our sample score) is that management practices are informal and driven by *individual headteachers more than*

[24] One possible explanation is that religious or missionary private schools may disproportionately locate in the most disadvantaged areas and may be better managed. We are unfortunately not able to test this directly since we do not have data on whether the school is run by a missionary organization.

[25] The raw (and residualized) standard deviations of the distributions are as follows. Private schools: operations management: 0.93sd (0.85sd); people management: 0.55sd (0.61sd). Public schools: operations management: 1.02sd (0.99sd); people management: 0.39sd (0.53sd). Figure A3 shows the cumulative distribution of the residualized scores and reports the p-value of the Kolmogorov-Smirnov test of equality of distributions. While the people management residualized distribution for private schools stochastically dominates the distribution for public schools, this is not true for operations management.

policy. Thus, the correlations presented below should not be interpreted as the causal effect of any specific management practice. Rather, the results below are best thought of as connecting the literatures on school leadership and school management by providing a systematic way of getting into the "black box" of school leadership and coding specific practices of school leaders that may be correlated with variation in their effectiveness.

4.3 School management and teacher practices

To explore the relationship between teacher practices and school management, we build a teacher practices index combining sixteen teaching practices, as described in Section 3.2.

We then estimate the specification:

$$TeacherPractice_{ijst} = \alpha + \beta M_s + \delta_1 T_j + \delta_2 S_s + \eta_j + \psi_t + \varepsilon_{ijst} \quad (1)$$

where $TeacherPractice_{ijst}$ is the index of teacher practices for teacher i, teaching subject j, at school s, at time t. M_s is the z-score of each management index, the set of controls included are those described in Table 2: T_j are the teacher and headteacher controls (share of teachers with a degree, share with teacher training, average teaching experience (in years), average number of work days, head teacher teaching experience and head teacher education), S_s are the school controls (log number of students, average share of female students, average number of students from scheduled castes, average number of students with laborer and literate parents). η_j and ψ_t are subject and year fixed effects. Standard errors are clustered at the school level.

Table 3 reports the results separately for public and private schools; for overall, operations, and people-management scores; and with and without the controls listed above. We see a strong and highly significant correlation in all 6 columns in Panel A (with no controls). Coefficients are slightly smaller but substantively unchanged and still significant after including a full set of controls (Panel B). Thus, the quality of overall-, operations-, and people-management are all strongly correlated with *independently* recorded measures of teaching practice in both public and private schools.

This result helps to validate the content of the D-WMS measurement tools as capturing elements of management quality that are able to meaningfully predict classroom teaching practices. It is also a contribution to the management literature more broadly where it has typically not been possible to observe (and correlate) both WMS-comparable management scores and measures of employee behavior in their core tasks in the same data set.

4.4 School management and student value added

Next, we examine the correlations between management scores and school productivity. We do so by estimating the role of management quality on student value addition using a lagged test-score specification, where the outcome variable is test scores (TS_{pjst}) in year t and we include lagged test scores on the right-hand side ($TS_{pjs,t-1}$). We estimate:

$$TS_{pjst} = \alpha + \beta M_s + \theta_0 TS_{pjs,t-1} + \theta_1 X_p + \theta_2 T_{js} + \theta_3 S_s + \eta_j + \psi_t + \varepsilon_{pjst} \quad (2)$$

where TS_{pjst} is student p's endline test score in subject j, at school s in year t. M_s is the z-score of each management index. We estimate Equation 2 both with and without controls. The set of controls included are those described in Table 2 and the same used in Equation 1. X_p are the individual student controls, T_j are the teacher and headteacher controls, S_s are the school controls. η_j and ψ_t are subject and year fixed effects. Standard errors are clustered at the school level.[26]

Table 4 presents these results without controls (Panel A) and with the full set of controls (Panel B), and for public schools (columns 1-4) and private schools (columns 5-8). We also estimate a version of this specification where we first estimate the student value added (using the residuals from a regression of baseline on endline scores) and use this estimate as the outcome variable. Since the results are very similar across approaches, we present those from Equation 2 in the main tables, and provide the results from the alternate approach in the Appendix Table A4.

Starting with public schools, we see a strong and significant correlation between all management practice indices (overall, operations, and people) and student value-added (SVA). However, variation in people management seems to matter much more (around 3 times more) for explaining variation in school effectiveness. We see this both by comparing columns 2 and 3 in Table 4, and in column 4 when we include both component scores as regressors. The results are practically unchanged when we include a full set of controls (Panel B): both magnitudes and significance of coefficients are very similar across Panels A and B.

While these results are based on correlations, they provide strong suggestive evidence that better management practices — especially personnel management practices — are likely to matter for school productivity. The value-added specification mitigates several omitted variable concerns, and the robustness to inclusion of a wide variety of controls provides additional reassurance on this front. Further, since official policies are identical across all

[26] We do not include a control for a student's voucher-winning status in Equation 2 to keep the set of controls consistent across public and private schools. Results are unchanged if we include this control.

public schools, the variation in management practices reflect *de facto* practices that are implemented at the school level. Thus, the appropriate way to interpret our results is not as the causal impact of specific practices, but as getting into the "black box" of variation in school leaders' effectiveness by codifying their practices and identifying common patterns in the practices of effective school leaders. In particular, school leaders who implement better personnel management practices appear to be able to deliver greater value addition.

Turning to private schools (Table 4, columns 5-8), we see that the correlations are smaller and not significant between value added and either overall or operations management scores. People-management scores are significantly correlated with value added even in private schools (in both columns 7 and 8), but the magnitude is smaller than in the case of public schools. Results are similar both without and with controls, and in the specification where we first estimate student value added and use it as the outcome variable (Table A4).

These results provide consistent evidence that the quality of personnel management may matter for productivity both across public and private schools. However, one reason that the variation in personnel management quality may matter more in explaining variation in public school productivity is that the average level of personnel management is higher in private schools to begin with. Thus, given the very low base levels of personnel management in public schools, the marginal returns to even modest improvements may be high. The same reasoning may explain why overall and operations management scores are significantly correlated with value added in public schools but not in private schools.

Since there is a 2-3 year lag between the time we measure management practices (2012-13) and the period in which we measure teacher practices and value added (primarily using data from 2008-10), we repeat the analysis above using a restricted sample of schools where head-teachers have had a tenure of at least 3 years at the time of answering the D-WMS survey questions. 84% of schools in our sample (77% of public and 88% of private schools) meet this restriction. We report these results in Tables A11 (for teaching practices) and A12 (for value-addition), and see that the results are mostly unchanged. This finding is consistent with evidence from other settings that school management quality tends to be quite stable over time (as noted in Section 3.2).

4.5 School management and variation in teacher effectiveness

Next, we examine whether better managed schools have lower within-school variability in teacher practices and effectiveness. We plot the relationship between the D-WMS score and the difference between the highest and lowest values of the teacher practice index for

each teacher within a school, and do the same for the estimated TVA.[27] We see that better managed schools appear to have lower variability in both the teacher practices index, and in teacher effectiveness within the school (Figure 4). We formally test this relationship and find a significant negative correlation between better operations management and the range of within-school variation in teacher practices as well as value addition. The relationship with personnel management is also negative but not significant.[28]

This reduction in variation suggests that a key channel by which better managed schools are more effective is not just by hiring and retaining good teachers (which, by itself would increase variation), but also by improving the performance of weaker teachers. We test for this possibility by correlating D-WMS scores with the teacher practices index and TVA for the *lowest* scoring teacher in the school, and see a clear positive correlation between the two (Figure 4). This correlation is also strongly statistically significant (both with and without controls), and is seen in the pooled data (Table 6), as well as in both public and private schools separately (Tables A7 and A8).

This relationship could be driven by actions on both the extensive margin (better managed schools may be more likely to let go of weaker teachers) and on the intensive margin (better managed schools may invest more in coaching weaker teachers). While we cannot quantify the relative importance of the two channels, we present two pieces of evidence that the intensive margin channel is likely to matter. The first is the significant correlation between operations management scores and the minimum level of teacher effectiveness. This is consistent with the operations management score picking up intensive margin channels such as standardization of processes and monitoring their implementation. The second is the strong positive correlation between management scores and minimum teacher effectiveness in *public* schools (Table A8). This also speaks to the importance of intensive margin channels because public schools have no ability to fire poorly performing teachers, and very limited ability to transfer them out. While the extensive margin channel may play a more important role in private schools, we do not have the data to test this channel adequately.[29]

[27] We use this metric because public schools have under 3 primary-school teachers on average (see Table A4), which would yield noisy estimates of within-school standard deviations in teacher practices and TVA.

[28] Note that we pool the sample across public and private schools for this analysis (and include a private school dummy) to increase power. Unlike in the case of teacher and student-level regressions where we have over 2,000 and 35,000 observations respectively, we have only 300 observations for school-level analysis. If we conduct the analysis separately by public and private schools, we find similar magnitudes and cannot reject equality across public and private school coefficients, but the results are less likely to be statistically significant due to the smaller sample sizes (see Table A5 and A6).

[29] In an earlier draft of this paper, we included suggestive evidence that private schools with better people management scores are more effective on the extensive margin of teacher quality – defined as being more likely to attract and retain their most effective teacher or let go of their least effective teacher (Lemos et al.;

4.6 School management and the private school premium

Next, we examine the extent to which variation in student value added across public and private schools is correlated with management quality. We do so by pooling the student data from public and private schools and estimating the following equation:

$$TS_{pjst} = \alpha + \beta M_s + \lambda_0 TS_{pjs,t-1} + \lambda_1 PRI_s + \lambda_2 SCO_p + \theta_1 X_p + \theta_2 T_{js} + \theta_3 S_s + \eta_j + \psi_t + \varepsilon_{pjst} \quad (3)$$

where TS_{pjst} is student p's endline test score in subject j, at school s in year t. M_s is the z-score of each management index. PRI_s is a private school indicator, and SCO_s is an indicator for whether a student was a scholarship recipient in the Muralidharan and Sundararaman (2015) AP School Choice Experiment. The set of controls included match those in prior specifications but with additional student-level controls as described in Table 2: X_p are the student controls (indicators for female student, scheduled caste, parents are literate, parents are manual laborers and household assets index), T_j are the teacher and head-teacher controls, S_s are the school controls including the school averages of student characteristics. η_j and ψ_t are subject and year fixed effects. Standard errors are clustered at the school level.

Results from Equation 3 are reported in Table 7. Without any controls (Panel A), we see that the average private school appears to have an annual value added of 0.35sd higher (column 1). This is *not* a causal estimate. Our goal is simply to provide an accounting decomposition of the extent to which this private school "premium" can be accounted for by stronger management practices.[30] We see that including overall or operations management scores reduce the private school premium slightly but do not meaningfully change the results (columns 2-3). However, including a control for people-management scores sharply reduces the private school premium and renders it insignificant (columns 4-5).

Patterns of results are similar with controls (Panel B). The private school premium is larger with controls, likely reflecting the lower average teacher education, experience, and training in the private schools (Table A1). Thus, the pure private school productivity

2021). However, this result is based on a small sample of teacher exits and our data is not designed to answer this question adequately. This question can be answered by future research with larger administrative data sets that combine data on teacher value-added, teacher entry and exits, and management scores.

[30]The significant negative coefficient on the "scholarship" variable suggests that the average voucher-winning student in the APSC study did not benefit from this private school "premium", which is consistent with the experimental evaluation of the voucher program that found modest to no test-score gains from winning a voucher to attend a private school (Muralidharan and Sundararaman; 2015). Possible reasons include switch in medium of instruction, and mismatch between the level of instruction and voucher-winning students' learning levels.

premium may be even larger after accounting for their lower input quality. The key result for this paper is that, as in Panel A, including people-management scores significantly reduces the estimated private school premium: the magnitude falls by more than half (columns 4-5). Taken together, the significantly greater quality of personnel management appears to be a key driver of the private school premium in this setting. Results in the restricted sample of schools where headteachers have been in their post for at least three years are very similar (Table A15).

4.7 Personnel management across public and private schools

We now examine a direct measure of effective personnel management in schools — which is the extent to which teachers are rewarded for being more productive, measured by their value added. We study the relationship between teacher pay and productivity using the following specification:

$$LnWages_{js} = \alpha + \beta_1 M_s + \beta_2 PRI_s + \beta_3 TVA_{js} + \beta_4 PRI_s \times TVA_{js} + \theta_1 T_{js} + \theta_2 S_s + \varepsilon_{js} \quad (4)$$

where $LnWages_{is}$ is the average log of wages of teacher j in school s over all years the teacher taught at each school. PRI_s is an indicator for private school. TVA_{is} is the teacher value added measure (estimated as in Chetty et al. (2014)), averaged across the years the teacher taught at the school.[31] The TVA measure is normalized to have a mean of zero and standard deviation of 1. T_j are the teacher and headteacher controls, S_s are the school controls including the school averages of student characteristics from Table 2. Standard errors are clustered at the school level.

Results are presented in Table 8. Panel A reports the raw correlations without controls, and Panel B includes the controls listed above. Columns (1) to (3) include only public school teachers and Columns (4) to (6) include only private school teachers. Column (7) includes both teachers across public and private schools.

We find no correlation between pay and productivity in public schools, with or without controls, reflecting a rigid compensation schedule that is mainly based on qualifications and seniority.[32] If anything, pay and productivity appear (insignificantly) negatively correlated

[31] We do so because we are less interested in testing whether wages move with annual variation in effectiveness (which would be quite difficult to pick up in the data), and more interested in whether more effective teachers on average are paid more.

[32] This is also consistent with evidence from the health sector where Das et al. (2016) show that there is no correlation between doctor pay and quality of care provided in public clinics in India.

in public schools. This is consistent with other studies finding evidence of lower effort among older and more senior teachers (who are paid more).[33] Unsurprisingly, there is also no correlation between management quality and teacher pay in the public sector given that headteachers have no authority over teacher pay.

In contrast, teacher pay in private schools is strongly positively correlated with TVA. Without any controls, a teacher who is able to improve average student test scores by one additional standard deviation earns about 42% higher wages (Panel A, Column 4). This relationship is positive and significant even after including all controls listed in Table 2, and we estimate that such a teacher earns about 25% higher wages (Panel B, Column 4). This wage premium is seen even after controlling for observable characteristics such as education, experience, and training suggesting that private school managers are able to identify and reward effective teachers. Doing so is a core feature of effective personnel management and we see that the superior people-management scores in private schools are reflected in this independent metric.

Turning to management scores, we see that teachers in better managed schools are paid a wage premium (Panel A, Columns 5 and 6) over and above getting paid more for being more effective. This may reflect selection: management quality is positively correlated with school size and school fees (Table 2) which may directly affect teacher wages. Indeed, we see that this correlation is not significant in Panel B after including the full set of controls in Table 2, whereas the relationship between teacher pay and productivity continues to be so. A selection channel is also consistent with results in Bender et al. (2018) and Cornwell et al. (2021), who find that better managed firms are more likely to hire and retain more effective workers and managers.[34]

Combining the data across public and private schools, we see that the levels of teacher salaries are much lower in private schools, but more effective teachers are paid more in private schools (Column 7).[35] Our results are similar to and consistent with those found in Pakistan by Bau and Das (2020). They also find no significant relationship between teacher wages and TVA in the public sector, but find a significant positive correlation in the private sector.

[33]For instance, Kremer et al. (2005) find that older and more senior teachers in public schools in India are significantly more likely to be absent, and are also likely to be paid more.

[34]We also examine whether better managed private schools have a stronger positive relationship between TVA and teacher wages by including an interaction between management score and teacher value added in the teacher wage equation. However, while the levels of management scores in private schools are significantly correlated with higher wages (as noted above), the interaction coefficients are not significant (Table A10).

[35]The F-test on the sum of the TVA and Private x TVA coefficients yields a p-value of 0.0002 for the specification in Panel A and 0.0076 for the specification in Panel B, lending further support to this point.

5 Discussion and Conclusion

There is a growing recognition that the quality of management practices may be an important determinant of productivity differences across firms and countries (Syverson; 2011; Bloom et al.; 2014, 2016; Scur et al.; 2021). In this paper, we measure management quality of public and private schools in a low-capacity setting; plot these against global benchmarks (with and without income adjustments); study the correlations between management quality and both teacher practices and school productivity; and examine correlations between teacher pay and productivity across public and private schools.

Our results strongly suggest that management quality — and especially the quality of personnel management — is likely to be an important component of school productivity. Better-managed schools have better teaching practices, add more value to student learning, and also have lower variation in teacher effectiveness within a school. Extrapolating from this micro-evidence using school-level variation, the plots of management scores across countries suggest that cross-country differences in school management quality may play a role in explaining the documented differences in school productivity across countries.

More generally, our results contribute to a better understanding of public sector personnel economics and to the comparative study of management and productivity across the public and private sectors. In particular, our data highlight that the quality of personnel management in the public sector is especially poor and we directly show the lack of correlation between pay and productivity for public sector workers.[36] In contrast, private schools have much higher personnel management scores and pay more effective teachers more (even after controlling for several observable characteristics). Our results suggest that even modest improvements in public-school management practices may be highly effective at improving teacher effort and effectiveness.

Consistent with this view, there is considerable interest among donors, policy makers, and private organizations (both for and non profit) in designing and implementing programs to improve school management in LMICs. The belief that such interventions can be effective is also supported by evidence of success in the US (Fryer; 2014, 2017). At the same time, organizational change is notoriously difficult (Gibbons and Henderson; 2012) and recent evidence suggests that improving management quality in public schools at scale in LMICs is indeed not easy. For instance, a large-scale randomized evaluation of a flagship school quality

[36]These findings are consistent with a growing body of experimental evidence from developing countries, which find that the default patterns of common across-the-board pay increases in public schools may not be effective (de Ree et al.; 2017), and that even modest amounts of performance-linked pay in public schools can be highly effective (Leaver et al.; 2021; Muralidharan and Sundararaman; 2011).

improvement program in India found that it had no impact on either teaching practices or learning outcomes, despite the program design reflecting several global "best practices" (Muralidharan and Singh; 2020). Thus, much more research is needed to learn about effective and cost-effective ways of improving school management at scale.

There are two promising directions for such interventions. The first consists of specific interventions to directly improve school management. These could include components of effective interventions studied in the context of manufacturing firms by Anderson and McKenzie (2022) and Bloom et al. (2013) as well as interventions to improve the soft skills of school leaders with regard to how they interact with their employees, which have been shown to be effective in recent studies in firm contexts ranging from India (Adhvaryu et al.; 2022) to Turkey (Alan et al.; 2022).

The second consists of complementary reforms that can improve school management in the public sector. Based on existing literature and our data, we note three reform possibilities that may be worth considering. The first is to reduce political interference and corruption in the hiring and posting of headteachers in the public sector.[37] The second (and related) reform is to increase the tenure and stability of headteachers.[38] The third is to increase the amount of autonomy given to public school headteachers to make operational and personnel decisions. Improved autonomy has been shown to improve school quality in other settings (e.g. Clark; 2009) and we see in our data that (a) school management quality is positively correlated with head-teachers' self-reported amount of autonomy, and (b) that public schools report much lower levels of autonomy than private schools, suggesting considerable room for increasing their autonomy (Figure A5).[39]

The D-WMS tools developed for this paper can be a useful complement to such reform efforts by enabling researchers to use a common and comparable scale across studies to (a) measure baseline levels of management, (b) measure improvements in management practice from various reforms, and (c) to experimentally study the relationship between changes in school management practices and changes in teaching practices and student outcomes.[40]

[37] While political turnover is associated with teacher and headteacher turnover (and lower student test scores in other LMIC settings as well (Akhtari et al.; 2022), political influence in teacher postings and transfers in India is widespread even during the tenure of any given government (Beteille; 2015)

[38] In our data, the average tenure of headteachers in public schools was 5.2 years compared to 9.8 in the private schools, and headteacher tenure is positively correlated with management quality (Figure A4).

[39] Note that autonomy is measured using a different question from those used to construct the management quality scores, and is hence not mechanically correlated with the D-WMS score.

[40] In their evaluation of a scaled-up school management reform in India, Muralidharan and Singh (2020) find that the program led to changes on paper but not in practice. Thus, the additional granularity of the D-WMS — that distinguishes between the existence, use, and monitoring/follow-up of various management practices — may be especially relevant for studying future school management interventions in LMICs.

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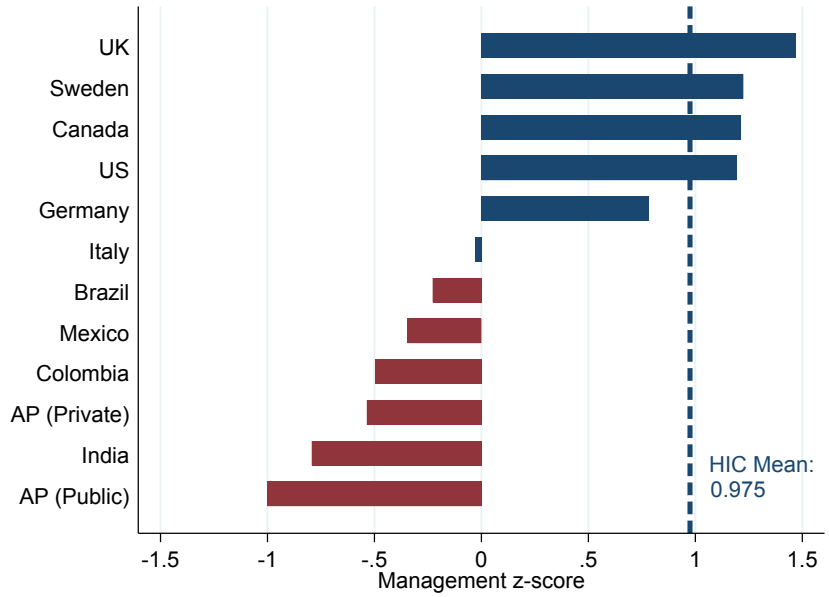
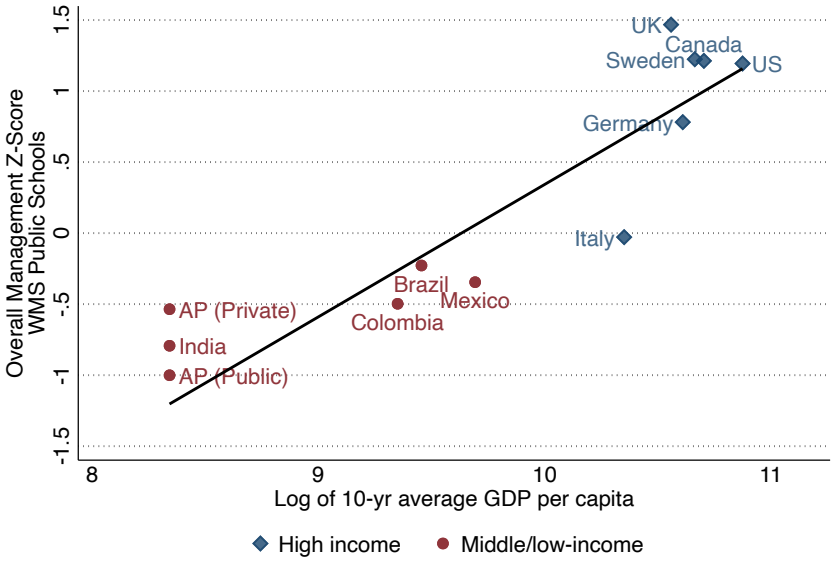
Figure 1: Global benchmarks

(a) Rank of comparable management z-scores



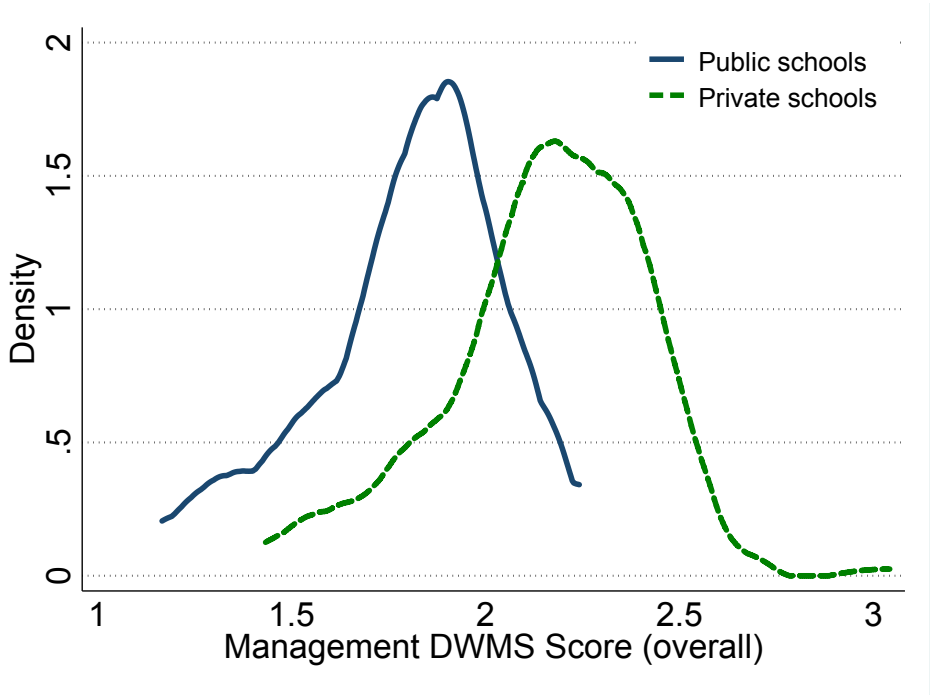
(b) Comparable management z-scores and GDP per capita



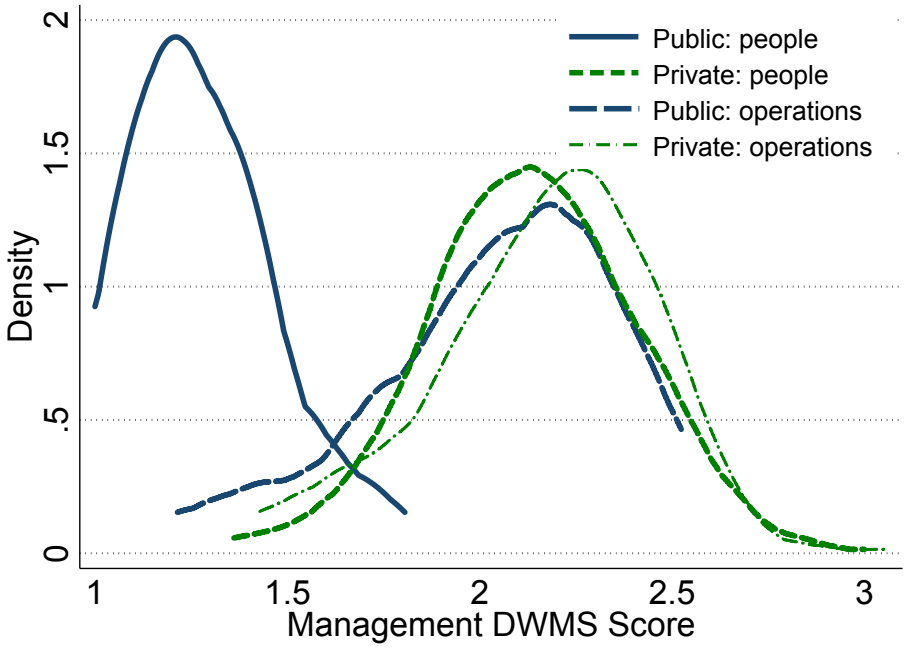
Note: This figure includes only public secondary schools from the WMS dataset (UK, Canada, Sweden, US, Germany, Italy, Brazil and India) and public primary schools from the Development WMS dataset (Andhra Pradesh, Mexico and Colombia). The Development WMS scores were re-scaled to match the WMS scoring convention: all half points were downgraded to the next lowest whole point for each survey question (for example, all scores of 2.5 were re-cast to 2) before indices were built. Country averages for WMS countries were estimated using sampling weights (see Appendix B for details on the weights construction). For this figure, management scores are normalized relative to the cross-country sample. Number of WMS observations are as follows: Brazil = 373, Canada = 113, Colombia = 447, Great Britain = 78, Germany = 91, India = 130, Italy = 222, Mexico = 178, Sweden = 85, United States = 193. The 10-year average GDP per capita comes from the IMF world tables, and include 2008-2018. We used India's GDP as a stand-in for Andhra Pradesh's GPD in Panel (b). AP private school "raw" overall management score means are: DWMS = 2.15; WMS = 1.74. AP public school "raw" overall management score means are: DWMS = 1.81; WMS = 1.48.

Figure 2: Distribution of management scores in Andhra Pradesh

(a) Overall management scores



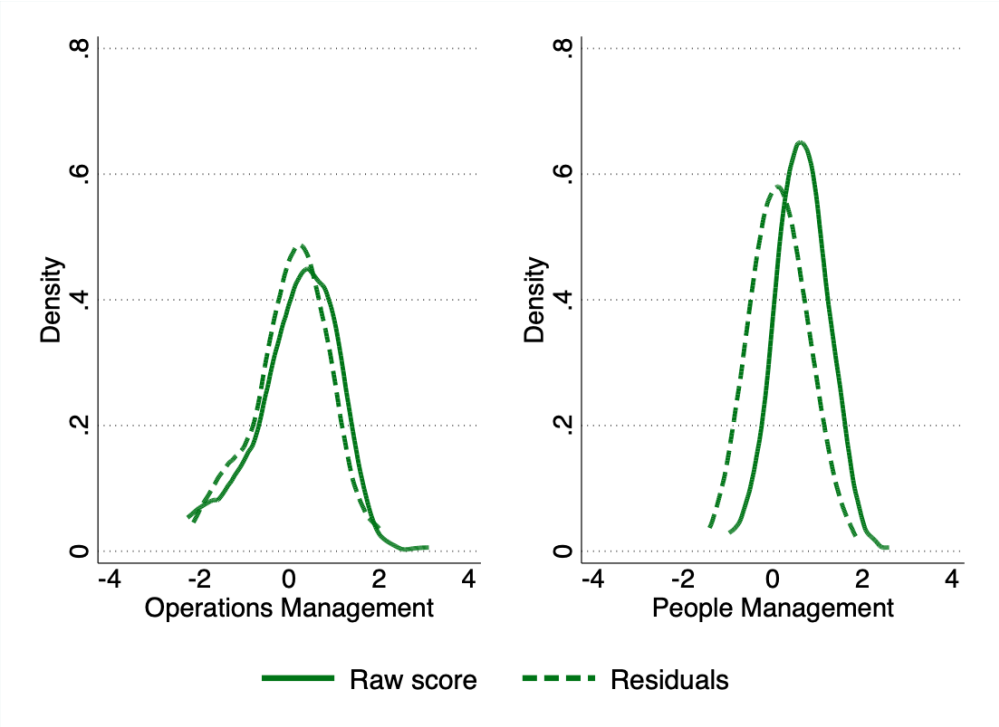
(b) People and operations management



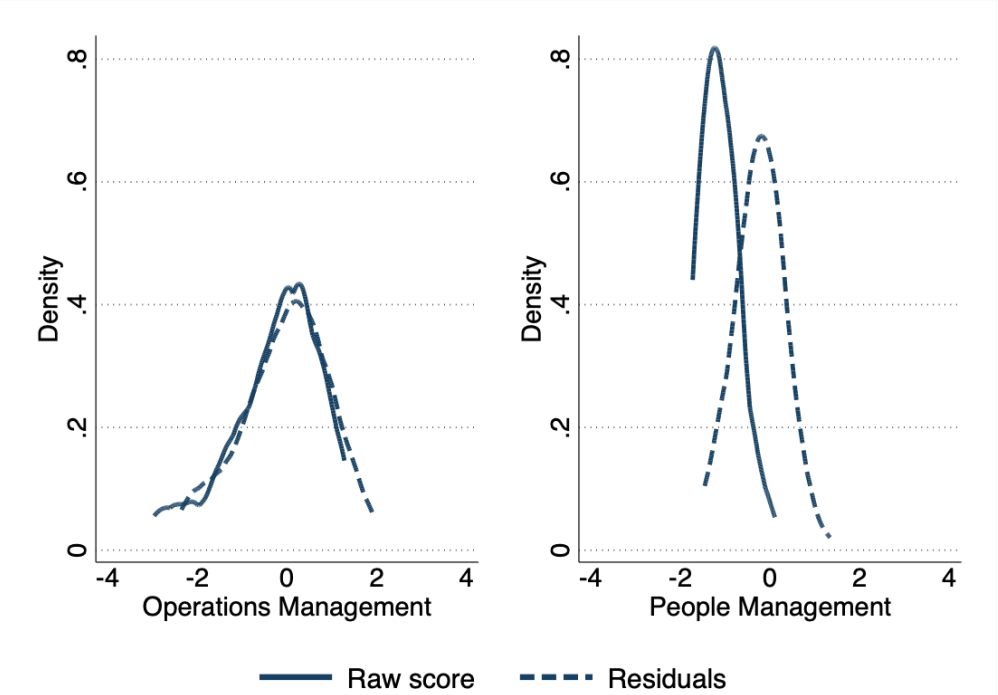
Note: This figure shows the distribution of the D-WMS overall management z-score index for public and private schools in Panel A and operations and people management z-score indices in Panel B. Standardization is relative to the full dataset, including public and private schools. Data for Andhra Pradesh (AP) is from the Development World Management Survey, with potential scores ranging from 1 to 5 in increments of 0.5. The D-WMS AP data includes 109 public schools and 190 private schools. The average D-WMS overall management score for AP private schools is 2.15 (SD = 0.26). The average D-WMS overall management score for AP public schools is 1.81 (sd = 0.25).

Figure 3: Distribution of management: raw vs residual

(a) Private



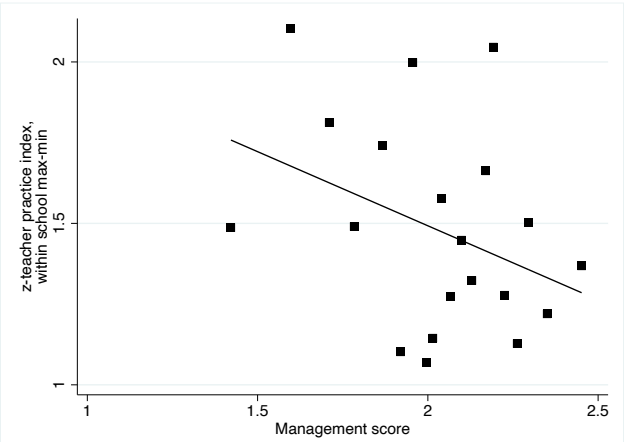
(b) Public



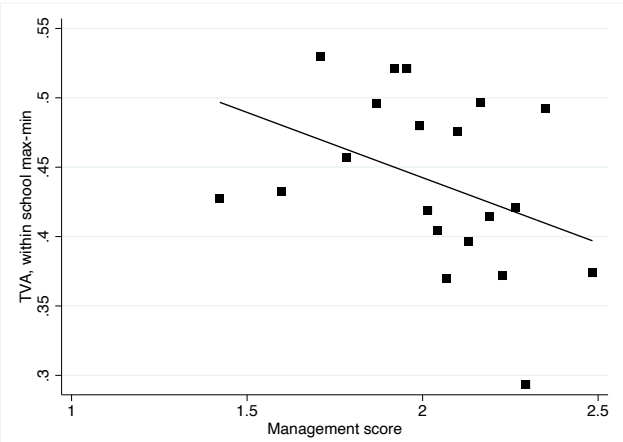
Note: This figure plots the distribution of operations and people management D-WMS scores for private schools in Panel (a) and public schools in Panel (b). The "raw" score is the D-WMS score standardized relative to the full distribution. The residuals are from regressions of the standardized management indices on a set of student, teacher and school controls listed in Table 2. Standard deviations of each distribution are as follows. Private schools: operations raw score SD = 0.93; operations residual score SD = 0.85; people raw score SD = 0.55; people management residual score SD = 0.61. Public schools: operations raw score SD = 1.02; operations residual score SD = 0.99; people raw score SD = 0.39; people residual score SD = 0.53.

Figure 4: School management and variation in within-school teacher practices/effectiveness

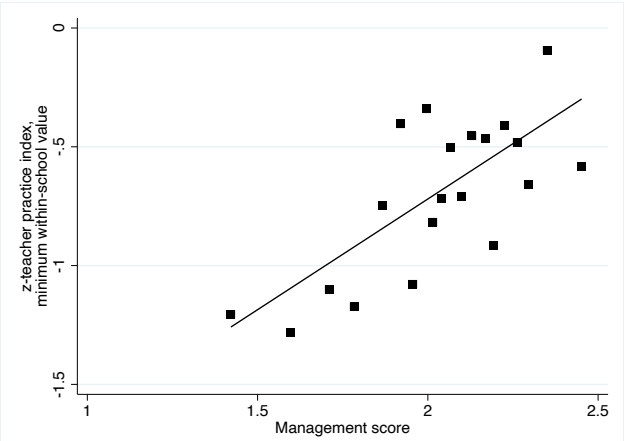
(a) Practices: max - min



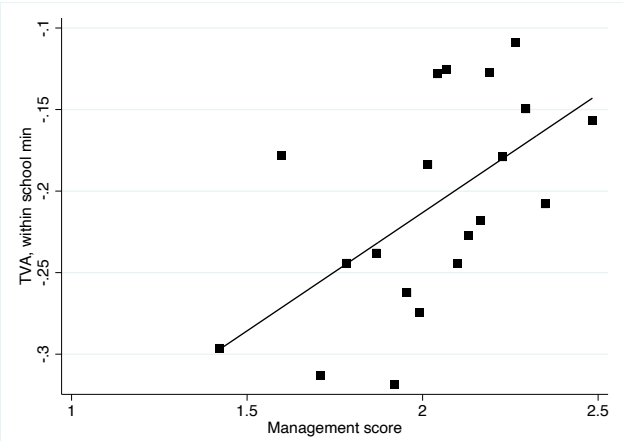
(b) Value Added: max - min



(c) Practices: min only



(d) Value Added: min only



Note: This figure plots the binned scatterplot of the pooled raw relationship between the within-school difference between maximum and minimum teacher practice index values (Panel a) and TVA values (Panel b), relative to management practices. As this is using pooled data, it includes a dummy control for private schools. As the number of teachers in public and private schools is considerably different, we focus on the difference between the best and worst teachers rather than on a measure like within-school standard deviation.

Table 1: Management scores in Andhra Pradesh public and private schools

	Public Schools			Private Schools		
	Mean	10th pct	90th pct	Mean	10th pct	90th pct
Overall management index	1.81	1.42	2.05	2.15	1.81	2.45
Operations average index	2.04	1.58	2.38	2.16	1.76	2.46
Standardisation of instructional processes	1.87	1.50	2.33	2.21	1.67	2.83
Data driven planning and student transition	1.93	1.50	2.50	2.08	1.50	2.67
Personalization of instruction and learning	1.98	1.50	2.50	2.25	1.67	2.83
Adopting educational best practices	2.22	1.33	3.17	2.12	1.67	2.67
Continuous improvement	1.89	1.50	2.33	2.16	1.83	2.67
Performance tracking	2.24	1.67	2.67	2.32	1.83	2.83
Review of performance	2.45	1.83	3.33	2.39	1.83	3.00
Performance dialogue	2.23	1.50	2.67	2.12	1.67	2.50
Consequence management	2.05	1.50	2.50	2.23	1.67	2.83
Type of targets	1.87	1.17	2.17	2.04	1.50	2.50
Interconnection of goals	2.11	1.50	2.50	2.21	1.50	2.67
Time horizon	2.10	1.17	3.17	2.22	1.67	2.83
Goals are stretching	1.90	1.17	2.33	1.91	1.50	2.33
Clarity of goals	1.73	1.33	2.33	2.00	1.50	2.50
People average index	1.26	1.03	1.56	2.13	1.83	2.47
Instilling a talent mindset	1.14	1.00	1.50	2.48	2.00	3.00
Incentives and appraisals	1.51	1.00	1.83	2.00	1.50	2.50
Making room for talent	1.32	1.00	1.83	2.31	1.83	2.83
Developing talent	1.41	1.00	2.00	2.09	1.50	2.67
Distinctive employee value	1.05	1.00	1.17	1.96	1.50	2.33
Retaining talent	1.14	1.00	1.33	1.97	1.67	2.33
Number of schools	109			191		

Notes: The summary statistics in this table report the average and distributional statistics for the Development WMS (D-WMS) scores. The D-WMS survey instrument measures the quality of management on a scale of 1 to 5, in increments of 0.5 for each of the 20 topics. The expanded survey instrument measures the level of adoption of management practices on a scale of 1 to 5, in increments of 0.5. A score of 1 means there are no processes at all *or very little processes* in place, while a score of 2 means there are *some informal* processes in place mainly adopted by the principal (as opposed to some formal "school policy"). A score of 3 means there is a formal process in place, though it has weaknesses such as not being followed all the time, or properly. A score of 4 indicate increasing levels of adherence and a score of 5 includes "grassroots" engagement with the practices such that they are part of the culture of the school. For example, in the question regarding data-driven planning and student transitions, a score of a 3 or below for this topic means performance data is not be recorded systematically with a range of tools that would allow for a more thorough understanding of a student's strengths and weaknesses. Further it is not integrated or easy to use or shared with a range of stakeholders. See Data Appendix B for a full set of questions and explanations of the survey tool.

Table 2: Correlates of management quality: student, teacher and school characteristics

Table of coefficients: each cell is a bi-variate regression

	Public			Private		
	(1) z-mgmt	(2) z-ops	(3) z-people	(4) z-mgmt	(5) z-ops	(6) z-people
Panel A: Student characteristics						
Share female	0.486	0.577	0.153	-0.114	-0.105	-0.092
	(0.365)	(0.455)	(0.178)	(0.392)	(0.421)	(0.239)
Share scheduled caste	-0.145	-0.147	-0.092	0.726**	0.753**	0.434**
	(0.225)	(0.275)	(0.101)	(0.299)	(0.314)	(0.205)
Share literate parents	0.623**	0.699**	0.273**	0.124	0.141	0.050
	(0.259)	(0.317)	(0.117)	(0.278)	(0.294)	(0.172)
Share laborer parents	-0.565**	-0.684***	-0.154	-0.329*	-0.387**	-0.112
	(0.219)	(0.255)	(0.127)	(0.171)	(0.184)	(0.114)
Average household assets index	0.185	0.222	0.054	0.044	0.065	-0.009
	(0.136)	(0.166)	(0.065)	(0.114)	(0.123)	(0.073)
Panel B: Teacher characteristics						
Share with a degree	0.241	0.224	0.193*	0.656***	0.718***	0.323***
	(0.317)	(0.385)	(0.112)	(0.180)	(0.195)	(0.119)
Share with teacher training	0.410	0.449	0.200	0.453*	0.501**	0.213
	(0.544)	(0.669)	(0.185)	(0.230)	(0.245)	(0.148)
Average teaching experience	0.009	0.017	-0.007	-0.007	-0.009	-0.001
	(0.015)	(0.018)	(0.006)	(0.021)	(0.023)	(0.013)
Average number of workdays	-0.008	-0.009	-0.002	0.000	-0.000	0.001
	(0.008)	(0.009)	(0.005)	(0.006)	(0.007)	(0.003)
Head teacher teaching experience	0.003	0.008	-0.007	0.003	0.001	0.006
	(0.014)	(0.017)	(0.005)	(0.027)	(0.028)	(0.018)
Head teacher has degree	-0.172	-0.235	0.004	0.809***	0.875***	0.414**
	(0.238)	(0.291)	(0.102)	(0.273)	(0.281)	(0.188)
Panel C: School characteristics						
School size (# students)	-0.114	-0.128	-0.050	0.296***	0.304***	0.184***
	(0.135)	(0.160)	(0.065)	(0.077)	(0.085)	(0.048)
Log of total school fees				0.186**	0.203***	0.094**
				(0.073)	(0.078)	(0.044)
Number of schools	109	109	109	191	191	191

Notes: Standard errors are clustered by school. z-mgmt is the overall standardized management score. z-ops is the standardized index of operations questions and z-people is the standardized index of people management questions. Headteacher refers to the teacher formally appointed as headteacher or the most senior teacher at the school.

Table 3: School management practices and teacher practices

Panel A: no controls	**Public schools**			**Private schools**		
	(1) teacher practice index	(2) teacher practice index	(3) teacher practice index	(4) teacher practice index	(5) teacher practice index	(6) teacher practice index
z-management	0.291***			0.208***		
	(0.060)			(0.051)		
z-operations		0.244***			0.189***	
		(0.049)			(0.046)	
z-people			0.329***			0.269***
			(0.118)			(0.085)
Observations	740	740	740	1367	1367	1367
# schools	109	109	109	190	190	190
Outcome variable SD	0.89	0.89	0.89	1.06	1.06	1.06
R-squared	0.117	0.118	0.0665	0.0502	0.0500	0.0412

Panel B: with controls	**Public schools**			**Private schools**		
	(1) teacher practice index	(2) teacher practice index	(3) teacher practice index	(4) teacher practice index	(5) teacher practice index	(6) teacher practice index
z-management	0.260***			0.189***		
	(0.061)			(0.059)		
z-operations		0.218***			0.168***	
		(0.049)			(0.052)	
z-people			0.259**			0.238**
			(0.112)			(0.097)
Observations	740	740	740	1367	1367	1367
# schools	109	109	109	190	190	190
Outcome variable SD	0.89	0.89	0.89	1.06	1.06	1.06
R-squared	0.136	0.138	0.0989	0.0743	0.0739	0.0682

Notes: Standard errors are clustered by school. **Teacher practice index** is an index of two audited indicators (whether the teacher was present and whether the teacher was actively teaching at the time of the audit), and fourteen self-reported classroom practices. The fourteen practices include: makes lesson plans, has textbook/workbook, checks hygiene daily, % time teaching, % time on teaching activities, % time "on task", and a series of indicators if the teacher spends above average time on a set of remedial class activities (remedial attention in class, outside class, helping arrange private tuition, helping at home, and other type of help). The teacher practice index is a standardized measure, built using the Anderson (2008) weighted average method. z-management is the standardized overall management index. z-operations and z-people are the standardized average scores of the operations questions and people management questions. Controls include those listed in Table 2: **teacher controls** (share of teachers with a degree, share with teacher training, average teaching experience, average number of work days, head teacher teaching experience and head teacher education) and **school controls** (log of number of students, average share of female students, of students from scheduled castes, of literate parents and of laborer parents). Includes subject and year fixed effects.

Table 4: School management practices and student value added in each type of school (lagged test score specification)

Panel A: no controls	**Public schools**				**Private schools**			
	(1) endline score	(2) endline score	(3) endline score	(4) endline score	(5) endline score	(6) endline score	(7) endline score	(8) endline score
z-management	0.183***				0.041			
	(0.037)				(0.028)			
z-operations		0.143***		0.078*		0.028		-0.018
		(0.032)		(0.041)		(0.026)		(0.035)
z-people			0.381***	0.264***			0.099**	0.119**
			(0.069)	(0.090)			(0.041)	(0.056)
Baseline score	✓	✓	✓	✓	✓	✓	✓	✓
Observations	7157	7157	7157	7157	28807	28807	28807	28807
# schools	109	109	109	109	190	190	190	190
R-squared	0.154	0.149	0.154	0.158	0.128	0.127	0.130	0.130

Panel B: with controls	**Public schools**				**Private schools**			
	(1) endline score	(2) endline score	(3) endline score	(4) endline score	(5) endline score	(6) endline score	(7) endline score	(8) endline score
z-management	0.170***				0.042			
	(0.045)				(0.028)			
z-operations		0.132***		0.083**		0.022		-0.029
		(0.037)		(0.040)		(0.025)		(0.033)
z-people			0.336***	0.223**			0.124***	0.153***
			(0.087)	(0.097)			(0.041)	(0.055)
Baseline score	✓	✓	✓	✓	✓	✓	✓	✓
Observations	7157	7157	7157	7157	28807	28807	28807	28807
# schools	109	109	109	109	190	190	190	190
R-squared	0.171	0.168	0.169	0.174	0.140	0.140	0.143	0.143

Notes: Standard errors are clustered by school. The dependent variable, student value added, is estimated by using the residuals of a regression of the end-line test score on the baseline test score for each student. z-management is the standardized overall management index. z-operations and z-people are the standardized average scores of the operations questions and people management questions. Controls include those listed in Table 2: **student controls** (indicators for female student, scheduled caste, parents are literate, parents are manual laborers, and a household assets index), **teacher controls** (share of teachers with a degree, share with teacher training, average teaching experience, average number of work days, head teacher teaching experience and head teacher education) and **school controls** (log of number of students, average share of female students, of students from scheduled castes, of literate parents and of laborer parents). Includes subject and year fixed effects.

Table 5: School management practices and variation in teacher practices/effectiveness

Panel A: no controls	**Teacher Practices**			**Teacher Value Added**		
	(1) Max-Min	(2) Max-Min	(3) Max-Min	(4) Max-Min	(5) Max-Min	(6) Max-Min
z-management	-0.142			-0.028**		
	(0.097)			(0.014)		
z-operations		-0.144*			-0.027**	
		(0.083)			(0.012)	
z-people			-0.041			-0.020
			(0.164)			(0.027)
Private = 1	0.843***	0.759***	0.775**	0.236***	0.219***	0.243***
	(0.171)	(0.137)	(0.320)	(0.026)	(0.023)	(0.052)
# schools	299	299	299	300	300	300
R-squared	0.0824	0.0854	0.0736	0.197	0.199	0.189
Panel B: with controls	**Teacher Practices**			**Teacher Value Added**		
	(1) Max-Min	(2) Max-Min	(3) Max-Min	(4) Max-Min	(5) Max-Min	(6) Max-Min
z-management	-0.161			-0.030**		
	(0.099)			(0.015)		
z-operations		-0.154*			-0.027**	
		(0.084)			(0.013)	
z-people			-0.099			-0.028
			(0.168)			(0.027)
Private = 1	0.009	-0.080	0.015	0.171***	0.153***	0.188***
	(0.339)	(0.316)	(0.458)	(0.050)	(0.048)	(0.065)
# schools	299	299	299	300	300	300
R-squared	0.162	0.164	0.153	0.246	0.247	0.239

Notes: Standard errors are clustered by school. Teacher practices are an index of sixteen practices, as describe in Section 3.2. Teacher value added is estimated using the Chetty et al. (2014) method and `vam` Stata command. Min-Max is the difference between the highest and lowest teacher practice index (Columns 1-3) and teacher value added (Columns 4-6) within schools. Controls include those listed in Table 2: **teacher controls** (share of teachers with a degree, share with teacher training, average teaching experience, average number of work days, head teacher teaching experience and head teacher education) and **school controls** (log of number of students, average share of female students, of students from scheduled castes, of literate parents and of laborer parents). Data is collapsed across all years of data to build teacher averages.

Table 6: School management practices and minimum teacher practices/effectiveness

Panel A: no controls	**Teacher Practices**			**Teacher Value Added**		
	(1) Min	(2) Min	(3) Min	(4) Min	(5) Min	(6) Min
z-management	0.288***			0.043***		
	(0.066)			(0.011)		
z-operations		0.266***			0.038***	
		(0.056)			(0.009)	
z-people			0.273**			0.057***
			(0.121)			(0.019)
Private	-0.575***	-0.394***	-0.772***	-0.160***	-0.133***	-0.219***
	(0.129)	(0.107)	(0.239)	(0.024)	(0.020)	(0.041)
# schools	299	299	299	300	300	300
R-squared	0.0956	0.102	0.0452	0.122	0.121	0.107
Panel B: with controls	**Teacher Practices**			**Teacher Value Added**		
	(1) Min	(2) Min	(3) Min	(4) Min	(5) Min	(6) Min
z-management	0.283***			0.045***		
	(0.064)			(0.012)		
z-operations		0.256***			0.038***	
		(0.055)			(0.010)	
z-people			0.285**			0.062***
			(0.117)			(0.020)
Private	-0.067	0.098	-0.260	-0.115***	-0.087**	-0.177***
	(0.227)	(0.223)	(0.282)	(0.039)	(0.037)	(0.049)
# schools	299	299	299	300	300	300
R-squared	0.184	0.188	0.144	0.208	0.206	0.197

Notes: Standard errors are clustered by school. Teacher practices are an index of sixteen practices, as describe in Section 3.2. Teacher value added is estimated using the Chetty et al. (2014) method and `vam` Stata command. Min-Max is the difference between the highest and lowest teacher practice index (Columns 1-3) and teacher value added (Columns 4-6) within schools. Controls include those listed in Table 2: **teacher controls** (share of teachers with a degree, share with teacher training, average teaching experience, average number of work days, head teacher teaching experience and head teacher education) and **school controls** (log of number of students, average share of female students, of students from scheduled castes, of literate parents and of laborer parents). Data is collapsed across all years of data to build teacher averages.

Table 7: School management practices and student value added — pooled across public and private schools (lagged test score specification)

Panel A: no controls	**Public and private schools**				
	(1) endline score	(2) endline score	(3) endline score	(4) endline score	(5) endline score
Private = 1	0.353***	0.255***	0.317***	0.061	0.105
	(0.059)	(0.060)	(0.056)	(0.084)	(0.099)
Scholarship = 1	-0.245***	-0.259***	-0.253***	-0.278***	-0.274***
	(0.079)	(0.080)	(0.082)	(0.075)	(0.076)
z-management		0.090***			
		(0.025)			
z-operations			0.071***		0.026
			(0.022)		(0.030)
z-people				0.162***	0.131***
				(0.037)	(0.050)
Baseline score	✓	✓	✓	✓	✓
Observations	35964	35964	35964	35964	35964
# schools	299	299	299	299	299
R-squared	0.155	0.162	0.160	0.163	0.163

Panel B: with controls	**Public and private schools**				
	(1) endline score	(2) endline score	(3) endline score	(4) endline score	(5) endline score
Private = 1	0.501***	0.406***	0.467***	0.211**	0.241**
	(0.087)	(0.087)	(0.085)	(0.099)	(0.108)
Scholarship = 1	-0.258***	-0.278***	-0.271***	-0.295***	-0.294***
	(0.078)	(0.077)	(0.078)	(0.073)	(0.074)
z-management		0.092***			
		(0.026)			
z-operations			0.070***		0.022
			(0.023)		(0.028)
z-people				0.170***	0.146***
				(0.036)	(0.046)
Baseline score	✓	✓	✓	✓	✓
Observations	35964	35964	35964	35964	35964
# schools	299	299	299	299	299
R-squared	0.167	0.173	0.171	0.175	0.175

Notes: Standard errors are clustered by school. The dependent variable student value added is estimated by using the residuals of a regression of the end-line test score on the baseline test score for each student. z-management is the standardized overall management index. z-operations and z-people are the standardized average scores of the operations questions and people management questions. Private refers to an indicator for private school, and scholarship is an indicator for whether the student received a scholarship in the Muralidharan and Sundararaman (2015) school choice experiment. Controls include those listed in Table 2: **student controls** (indicators for female student, scheduled caste, parents are literate, parents are manual laborers, and a household assets index), **teacher controls** (share of teachers with a degree, share with teacher training, average teaching experience, average number of work days, head teacher teaching experience and head teacher education) and **school controls** (log of number of students, average share of female students, of students from scheduled castes, of literate parents and of laborer parents). Includes subject and year fixed effects.

Table 8: School management practices and teacher wages

Panel A: No controls	**Public**			**Private**			**All**
	(1) ln(wages)	(2) ln(wages)	(3) ln(wages)	(4) ln(wages)	(5) ln(wages)	(6) ln(wages)	(7) ln(wages)
Value added							
Teacher value added	-0.227	-0.218	-0.124	0.424***	0.353***	0.378***	-0.227
	(0.222)	(0.222)	(0.235)	(0.119)	(0.117)	(0.118)	(0.222)
Private=1							-1.917***
							(0.047)
Private=1 × TVA							0.651**
							(0.251)
Management							
z-operations		-0.005			0.101***		
		(0.032)			(0.031)		
z-people			-0.154			0.125**	
			(0.115)			(0.063)	
# Teachers	234	234	234	1059	1059	1059	1293
# Schools	104	104	104	190	190	190	294
Mean wages (Rs)	14097	14097	14097	2655	2655	2655	6334
R-squared	0.00508	0.00521	0.0214	0.0119	0.0338	0.0226	0.613

Panel B: With controls	**Public**			**Private**			**All**
	(1) ln(wages)	(2) ln(wages)	(3) ln(wages)	(4) ln(wages)	(5) ln(wages)	(6) ln(wages)	(7) ln(wages)
Value added							
Teacher value added	-0.312	-0.306	-0.294	0.248**	0.236**	0.247**	-0.260
	(0.190)	(0.187)	(0.196)	(0.100)	(0.100)	(0.100)	(0.205)
Private=1							-1.535***
							(0.075)
Private=1 × TVA							0.525**
							(0.226)
Management							
z-operations		-0.004			0.025		
		(0.025)			(0.027)		
z-people			-0.036			0.003	
			(0.097)			(0.049)	
# Teachers	234	234	234	1059	1059	1059	1293
# Schools	104	104	104	190	190	190	294
Mean wages (Rs)	14097	14097	14097	2655	2655	2655	6334
R-squared	0.355	0.355	0.356	0.292	0.293	0.292	0.714

Notes: Standard errors are clustered by school. Teacher value added is estimated using the Chetty et al. (2014) method and `vam` Stata command. Private refers to an indicator for private school. Private x TVA is an interaction between the private indicator and the teacher value added measure. z-operations and z-people are the standardized average scores of the operations questions and people management questions. Controls include those listed in Table 2: **teacher controls** (share of teachers with a degree, share with teacher training, average teaching experience, average number of work days, head teacher teaching experience and head teacher education) and **school controls** (log of number of students, average share of female students, of students from scheduled castes, of literate parents and of laborer parents). Data is collapsed across all years of data to build teacher averages.

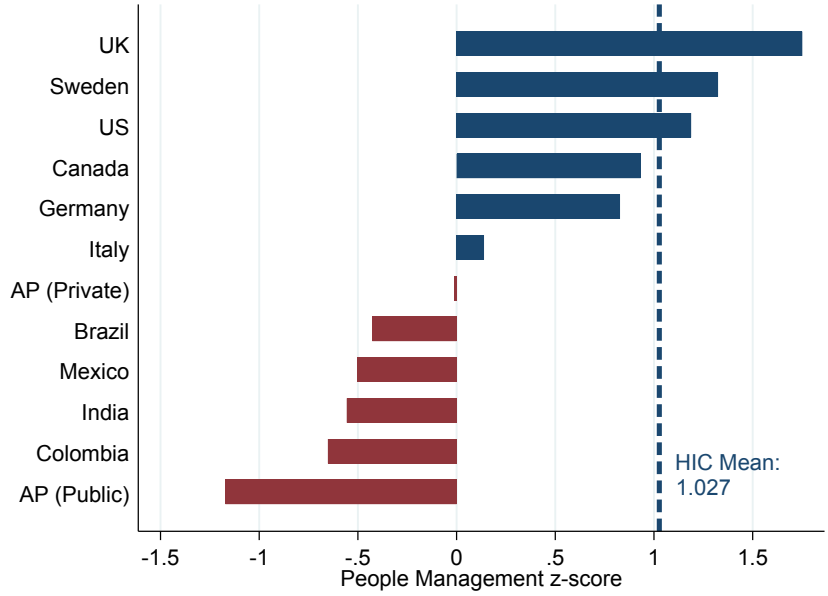
ONLINE APPENDIX
"Personnel Management and School Productivity: Evidence from India,"
November 24, 2022

A Supplmentary figures and tables

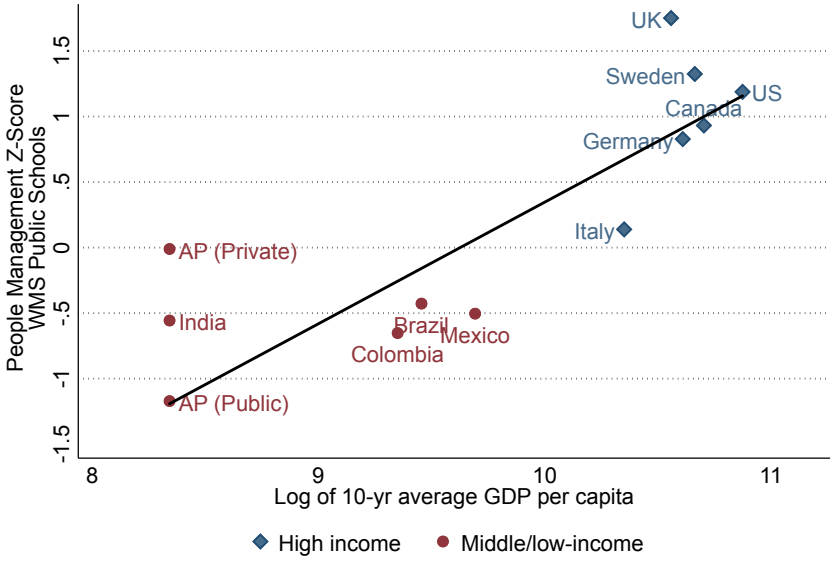
A.1 Additional Figures

Figure A1: Global benchmarks

(a) Rank of comparable people management z-scores



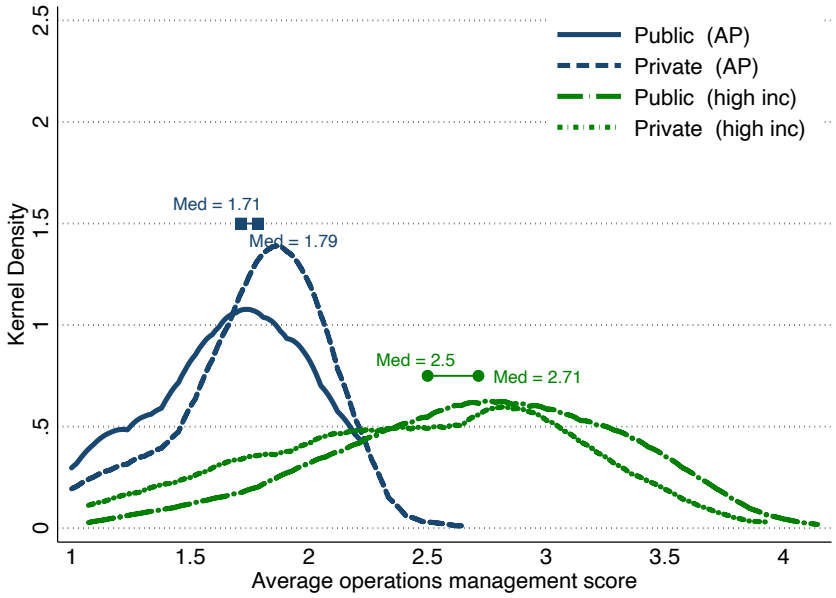
(b) Comparable management z-scores and GDP per capita



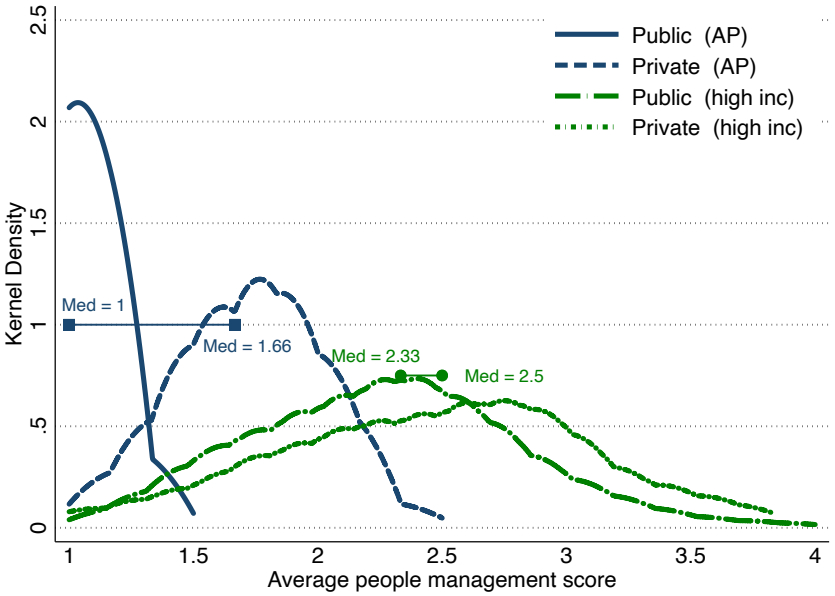
Note: This figure includes only public secondary schools from the WMS dataset (UK, Canada, Sweden, US, Germany, Italy, Brazil and India) and public primary schools from the Development WMS dataset (Andhra Pradesh, Mexico and Colombia). The Development WMS scores were re-scaled to match the WMS scoring convention: all half points were downgraded to the next lowest whole point for each survey question (for example, all scores of 2.5 were re-cast to 2) before indices were built. Data for the WMS for all countries except for Mexico and Colombia can be found at www.worldmanagementsurvey.org. Distribution of overall management indices standardized within countries. Country averages for all other countries were estimated using sampling weights (see Appendix B for details on the weights construction). Number of WMS observations are as follows: Brazil = 373, Canada = 113, Colombia = 447, Great Britain = 78, Germany = 91, India = 130, Italy = 222, Mexico = 178, Sweden = 85, United States = 193. The 10-year average GDP per capita comes from the IMF world tables, and include 2008-2018. We used India's GDP as a stand-in for Andhra Pradesh's GPD in Panel (b).

Figure A2: Difference between and across public and private: India vs OECD

(a) Operations management



(b) People management

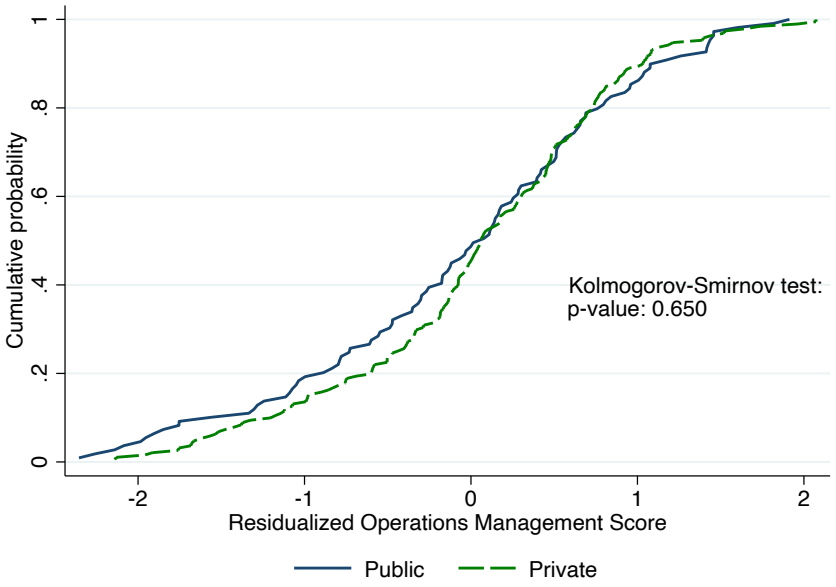


Note: This figure includes only public secondary schools from the WMS dataset (UK, Canada, Sweden, US, Germany, Italy) and public primary schools from the Development WMS dataset (Andhra Pradesh). The Development WMS scores were re-scaled to match the WMS scoring convention: all half points were downgraded to the next lowest whole point for each survey question (for example, all scores of 2.5 were re-cast to 2) before indices were built. Data for the WMS for all high income countries can be found at www.worldmanagementsurvey.org. Country averages for WMS countries were estimated using sampling weights (see Appendix B for details on the weights construction). Number of WMS observations are as follows: Brazil = 510, Canada = 129, Colombia = 468, Great Britain = 89, Germany = 102, Italy = 284, Mexico = 157, Sweden = 85, United States = 263. Number of AP observations = 300. Squares mark the median point of the AP distributions, and circles mark the median points of the high-income countries distribution.

Figure A3: Cumulative distribution of residualized management scores: public vs private

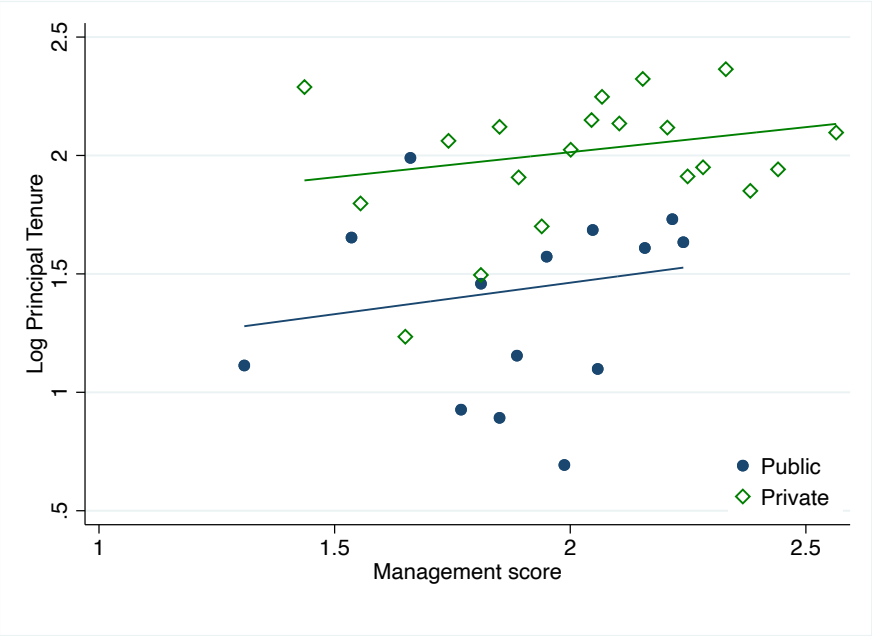
(a) People management

(b) Operations management



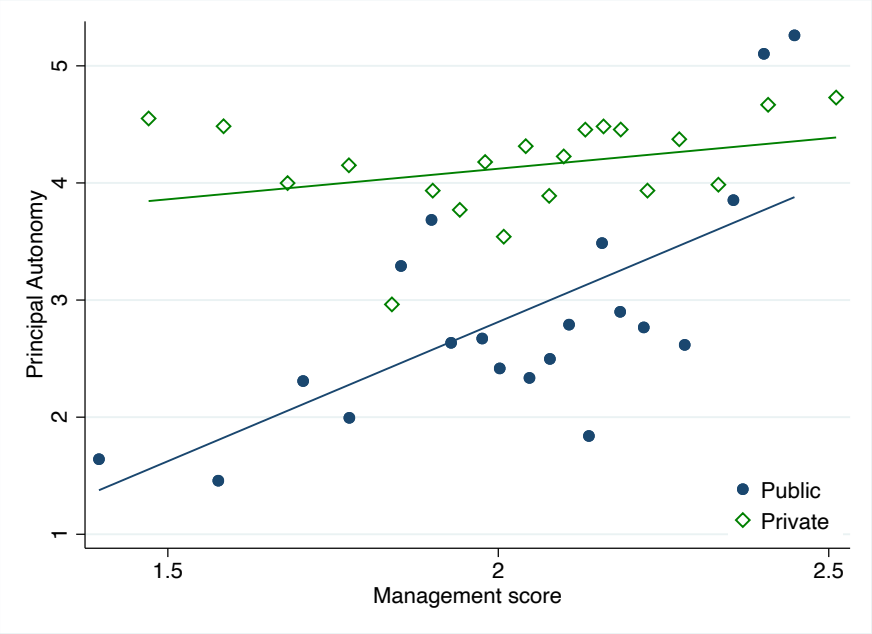
Note: This figure plots the cumulative density function of the residualized operations and people management scores for public and private schools. The exact p-values from a Kolmogorov-Smirnov test of equality of distributions are reported in the figure.

Figure A4: Principal Tenure and Management Practices



Note:
This figure plots the binned scatterplot of the relationship between principal tenure and management practices.

Figure A5: Principal Autonomy and Management Practices



Note:
This figure plots the binned scatterplot of the relationship between principal autonomy (as measured by the WMS) and management practices.

A.2 Additional Tables

Table A1: Public and private schools are different on observables

	(1) Private schools	(2) Public schools	(3) Difference	(4) Table reference
Panel A: School characteristics				
Total enrollment	296.21	74.04	222.17***	Table 3
Total working days	229.81	218.66	11.15***	Table 3
Pupil-teacher ratio	17.62	25.28	-7.67***	Table 3
Observations	289	346		
Annual cost per child (Rs/child)	1,848.88	8,390.00	-6,542***	Table 3
Observations	211	325		
Student time spent in school (minutes)	423.53	380.25	43.28***	Table 4
Observations	652	1,839		
Multi-grade teaching	0.24	0.79	-0.55***	Table 5
Observations	2,738	2,784		
Panel B: Teacher characteristics				
Male	0.24	0.46	-0.21***	Table 3
Age	27.58	40.00	-12.42***	Table 3
Years of teaching	5.14	14.96	-9.82***	Table 3
Completed at least college or masters	0.69	0.88	-0.19***	Table 3
Teacher training completed	0.34	0.99	-0.65***	Table 3
Come from the same village	0.44	0.13	0.32***	Table 3
Current gross salary per month (Rs)	2,606.66	14,285.94	-11,679.27***	Table 3
Observations	2,000	1,358		
Teacher is absent	0.09	0.24	-0.15***	Table 4
Teacher is actively teaching	0.50	0.35	0.15***	Table 4
Observations	6,577	5,552		

Notes: Table reproduced from Muralidharan and Sundararaman (2015), Tables 3, 4 and 5.

Table A2: Difference in means between public and private schools in the D-WMS sample

	(1) Private schools	(2) Public schools	(3) Difference
Student characteristics			
Female	0.48	0.53	-0.05**
Scheduled Caste	0.17	0.38	-0.21***
Both Parents Are Literate	0.67	0.53	0.14***
Household Asset Index	3.64	3.25	0.39***
Normalized test score	0.50	0.04	0.46***
Observations	*12,770*	*2,674*	
Teacher characteristics			
Male	0.25	0.48	-0.23***
Age	27.84	38.94	-11.10***
Teaching experience	5.44	13.56	-8.12***
Completed degree	0.64	0.87	-0.23***
Completed teacher training	0.33	0.99	-0.66***
Monthly wage (000 Rs)	2,631	14,355	-11724***
Observations	*1,053*	*234*	
School characteristics			
Number of students	169.84	58.68	111.16***
Number of primary teachers	9.79	2.60	7.19***
Total working days	228.90	216.91	12.00***
Student-teacher ratio	17.45	22.42	-4.97***
Principal characteristics			
Monthly wage (000 Rs)	2.94	13.93	-10.99***
Teaching experience	7.24	14.60	-7.36***
Tenure in school (years)	9.80	5.22	4.58***
Tenure >=3yrs (share)	0.88	0.77	0.11*
Years of education	15.00	15.94	-0.94***
Completed teacher training	0.37	0.98	-0.60***
Age	30.28	39.79	-9.51***
Male	0.33	0.47	-0.14**
Observations	*191*	*109*	

Notes: This table reports the means and difference in means of key student, teacher, head teacher and school characteristics in the sample of schools for which we have management data. The sampling frame is from the schools in the AP School Choice experiment detailed in Muralidharan and Sundararaman (2015).

Table A3: Correlates of management quality: teacher and student observables, multiple regression

	Public			Private		
	(1) z-mgmt	(2) z-ops	(3) z-people	(4) z-mgmt	(5) z-ops	(6) z-people
Student characteristics						
Share female	0.246	0.301	0.062	-0.318	-0.259	-0.324
	(0.696)	(0.840)	(0.373)	(0.834)	(0.899)	(0.536)
Share scheduled caste	0.156	0.225	-0.024	3.405***	3.526***	2.043***
	(0.414)	(0.518)	(0.197)	(0.749)	(0.813)	(0.513)
Share literate parents	0.968**	1.145**	0.315	-0.793	-0.920	-0.291
	(0.455)	(0.555)	(0.219)	(0.646)	(0.698)	(0.404)
Share laborer parents	-1.379***	-1.592***	-0.522**	-1.446*	-1.470*	-0.917**
	(0.456)	(0.565)	(0.231)	(0.750)	(0.834)	(0.427)
Average household assets index	-0.264	-0.290	-0.127	0.342	0.376	0.164
	(0.261)	(0.319)	(0.111)	(0.307)	(0.333)	(0.201)
Teacher characteristics						
Share with a degree	1.133**	1.330*	0.387	0.310	0.344	0.142
	(0.566)	(0.678)	(0.307)	(0.236)	(0.261)	(0.150)
Share with teacher training	0.070	-0.002	0.182	0.160	0.180	0.069
	(0.543)	(0.671)	(0.203)	(0.203)	(0.222)	(0.133)
Average teaching experience	-0.009	-0.005	-0.015	-0.015	-0.014	-0.013
	(0.035)	(0.042)	(0.017)	(0.032)	(0.037)	(0.015)
Average # workdays	-0.008	-0.011	-0.000	0.003	0.003	0.002
	(0.009)	(0.011)	(0.004)	(0.006)	(0.006)	(0.003)
Head teacher teaching experience	0.031	0.035	0.012	0.020	0.018	0.019
	(0.041)	(0.050)	(0.019)	(0.037)	(0.041)	(0.022)
Head teacher has degree	-1.042**	-1.269**	-0.271	0.557	0.582	0.325
	(0.515)	(0.621)	(0.260)	(0.368)	(0.398)	(0.235)
School characteristics						
School size (# students)	-0.246	-0.271	-0.118	0.337***	0.340***	0.219***
	(0.156)	(0.190)	(0.075)	(0.079)	(0.086)	(0.053)
Observations	109	109	109	191	191	191
R-squared	0.201	0.191	0.171	0.237	0.219	0.219

Notes: Standard errors are clustered by school. z-mgmt is the overall standardized management score. z-ops is the standardized index of operations questions and z-people is the standardized index of people management questions. Headteacher refers to the teacher formally appointed as headteacher or the most senior teacher at the school.

Table A4: School management practices and student value added in each type of school

Panel A: No controls	**Public schools**				**Private schools**			
	(1) student value added	(2) student value added	(3) student value added	(4) student value added	(5) student value added	(6) student value added	(7) student value added	(8) student value added
z-management	0.181***				0.044			
	(0.036)				(0.0283)			
z-operations		0.142***		0.077*		0.030		-0.017
		(0.032)		(0.040)		(0.026)		(0.035)
z-people			0.381***	0.265***			0.103**	0.123**
			(0.069)	(0.089)			(0.041)	(0.057)
Observations	7157	7157	7157	7157	28807	28807	28807	28807
# schools	109	109	109	109	190	190	190	190
Panel B: with controls	**Public schools**				**Private schools**			
	(1) student value added	(2) student value added	(3) student value added	(4) student value added	(5) student value added	(6) student value added	(7) student value added	(8) student value added
z-management	0.169***				0.044			
	(0.044)				(0.0277)			
z-operations		0.130***		0.081**		0.024		-0.029
		(0.037)		(0.039)		(0.025)		(0.034)
z-people			0.336***	0.225**			0.127***	0.156***
			(0.087)	(0.096)			(0.042)	(0.056)
Observations	7157	7157	7157	7157	28807	28807	28807	28807
# schools	109	109	109	109	190	190	190	190

Notes: Standard errors are clustered by school. The dependent variable, student value added, is estimated by using the residuals of a regression of the end-line test score on the baseline test score for each student. z-management is the standardized overall management index. z-operations and z-people are the standardized average scores of the operations questions and people management questions. Controls include those listed in Table 2: **student controls** (indicators for female student, scheduled caste, parents are literate, parents are manual laborers, and a household assets index), **teacher controls** (share of teachers with a degree, share with teacher training, average teaching experience, average number of work days, head teacher teaching experience and head teacher education) and **school controls** (log of number of students, average share of female students, of students from scheduled castes, of literate parents and of laborer parents). Includes subject and year fixed effects.

Table A5: School management practices and variation in teacher practices, public and private

Panel A: no controls	**Public**			**Private**		
	(1)	(2)	(3)	(4)	(5)	(6)
Teacher Practices	Max-Min	Max-Min	Max-Min	Max-Min	Max-Min	Max-Min
z-management	-0.157*			-0.134		
	(0.094)			(0.142)		
z-operations		-0.134*			-0.151	
		(0.079)			(0.130)	
z-people			-0.151			-0.006
			(0.186)			(0.207)
# schools	109	109	109	190	190	190
R-squared	0.0253	0.0269	0.00512	0.00665	0.0101	0.00000621
Panel B: with controls	**Public**			**Private**		
	(1)	(2)	(3)	(4)	(5)	(6)
Teacher Practices	Max-Min	Max-Min	Max-Min	Max-Min	Max-Min	Max-Min
z-management	-0.097			-0.208		
	(0.104)			(0.165)		
z-operations		-0.086			-0.215	
		(0.084)			(0.149)	
z-people			-0.030			-0.106
			(0.190)			(0.229)
# schools	109	109	109	190	190	190
R-squared	0.254	0.256	0.247	0.0877	0.0913	0.0764

Notes: Standard errors are clustered by school. Teacher practices are an index of sixteen practices, as describe in Section 3.2. Teacher value added is estimated using the Chetty et al. (2014) method and `vam` Stata command. Min-Max is the difference between the highest and lowest teacher practice index (Columns 1-3) and teacher value added (Columns 4-6) within schools. Controls include those listed in Table 2: **teacher controls** (share of teachers with a degree, share with teacher training, average teaching experience, average number of work days, head teacher teaching experience and head teacher education) and **school controls** (log of number of students, average share of female students, of students from scheduled castes, of literate parents and of laborer parents). Data is collapsed across all years of data to build teacher averages.

Table A6: School management practices and variation in teacher effectiveness, public and private

Panel A: no controls	**Public**			**Private**		
	(1)	(2)	(3)	(4)	(5)	(6)
Teacher Value Added	Max-Min	Max-Min	Max-Min	Max-Min	Max-Min	Max-Min
z-management	-0.028			-0.028		
	(0.019)			(0.019)		
z-operations		-0.026*			-0.027	
		(0.016)			(0.017)	
z-people			0.004			-0.027
			(0.041)			(0.032)
# schools	109	109	109	191	191	191
R-squared	0.0231	0.0298	0.0001	0.0104	0.0116	0.0040
Panel B: with controls	**Public**			**Private**		
	(1)	(2)	(3)	(4)	(5)	(6)
Teacher Value Added	Max-Min	Max-Min	Max-Min	Max-Min	Max-Min	Max-Min
z-management	-0.025			-0.038*		
	(0.022)			(0.020)		
z-operations		-0.025			-0.034*	
		(0.018)			(0.018)	
z-people			0.019			-0.047
			(0.045)			(0.033)
# schools	109	109	109	191	191	191
R-squared	0.0578	0.0641	0.0445	0.104	0.104	0.0987

Notes: Standard errors are clustered by school. Teacher practices are an index of sixteen practices, as describe in Section 3.2. Teacher value added is estimated using the Chetty et al. (2014) method and `vam` Stata command. Min-Max is the difference between the highest and lowest teacher practice index (Columns 1-3) and teacher value added (Columns 4-6) within schools. Controls include those listed in Table 2: **teacher controls** (share of teachers with a degree, share with teacher training, average teaching experience, average number of work days, head teacher teaching experience and head teacher education) and **school controls** (log of number of students, average share of female students, of students from scheduled castes, of literate parents and of laborer parents). Data is collapsed across all years of data to build teacher averages.

Table A7: School management practices and minimum teacher practices, public and private

Panel A: no controls	**Public**			**Private**		
	(1)	(2)	(3)	(4)	(5)	(6)
Teacher Practices:	Min	Min	Min	Min	Min	Min
z-management	0.279***			0.293***		
	(0.090)			(0.090)		
z-operations		0.232***			0.289***	
		(0.077)			(0.080)	
z-people			0.345*			0.250*
			(0.183)			(0.149)
# schools	109	109	109	190	190	190
R-squared	0.0802	0.0807	0.0269	0.0707	0.0820	0.0205
Panel B: with controls	**Public**			**Private**		
	(1)	(2)	(3)	(4)	(5)	(6)
Teacher Practices:	Min	Min	Min	Min	Min	Min
z-management	0.260***			0.368***		
	(0.095)			(0.092)		
z-operations		0.212***			0.354***	
		(0.079)			(0.082)	
z-people			0.322*			0.331**
			(0.179)			(0.154)
# schools	109	109	109	190	190	190
R-squared	0.229	0.228	0.192	0.210	0.220	0.153

Notes: Standard errors are clustered by school. Teacher practices are an index of sixteen practices, as describe in Section 3.2. Teacher value added is estimated using the Chetty et al. (2014) method and `vam` Stata command. Min-Max is the difference between the highest and lowest teacher practice index (Columns 1-3) and teacher value added (Columns 4-6) within schools. Controls include those listed in Table 2: **teacher controls** (share of teachers with a degree, share with teacher training, average teaching experience, average number of work days, head teacher teaching experience and head teacher education) and **school controls** (log of number of students, average share of female students, of students from scheduled castes, of literate parents and of laborer parents). Data is collapsed across all years of data to build teacher averages.

Table A8: School management practices and minimum teacher effectiveness, public and private

Panel A: no controls	**Private**			**Public**		
	(1)	(2)	(3)	(4)	(5)	(6)
Teacher Value Added:	Min	Min	Min	Min	Min	Min
z-management	0.058***			0.035**		
	(0.015)			(0.014)		
z-operations		0.048***			0.031**	
		(0.013)			(0.013)	
z-people			0.074**			0.052**
			(0.032)			(0.023)
# schools	109	109	109	191	191	191
R-squared	0.118	0.118	0.0422	0.0216	0.0196	0.0192
Panel B: with controls	**Public**			**Private**		
	(1)	(2)	(3)	(4)	(5)	(6)
Teacher Value Added:	Min	Min	Min	Min	Min	Min
z-management	0.061***			0.044***		
	(0.017)			(0.016)		
z-operations		0.052***			0.037**	
		(0.014)			(0.015)	
z-people			0.047			0.072***
			(0.035)			(0.025)
# schools	109	109	109	191	191	191
R-squared	0.254	0.261	0.164	0.132	0.127	0.134

Notes: Standard errors are clustered by school. Teacher practices are an index of sixteen practices, as describe in Section 3.2. Teacher value added is estimated using the Chetty et al. (2014) method and `vam` Stata command. Min-Max is the difference between the highest and lowest teacher practice index (Columns 1-3) and teacher value added (Columns 4-6) within schools. Controls include those listed in Table 2: **teacher controls** (share of teachers with a degree, share with teacher training, average teaching experience, average number of work days, head teacher teaching experience and head teacher education) and **school controls** (log of number of students, average share of female students, of students from scheduled castes, of literate parents and of laborer parents). Data is collapsed across all years of data to build teacher averages.

Table A9: School management practices and student value added in public and private schools

Panel A: no controls	**Public and private schools**				
	(1) student value added	(2) student value added	(3) student value added	(4) student value added	(5) student value added
Private = 1	0.348***	0.250***	0.311***	0.059	0.101
	(0.057)	(0.059)	(0.054)	(0.083)	(0.098)
Scholarship = 1	-0.234***	-0.245***	-0.239***	-0.262***	-0.258***
	(0.076)	(0.077)	(0.078)	(0.073)	(0.074)
z-management		0.089***			
		(0.024)			
z-operations			0.070***		0.026
			(0.022)		(0.030)
z-people				0.160***	0.129**
				(0.036)	(0.050)
Observations	35964	35964	35964	35964	35964
# schools	299	299	299	299	299

Panel B: with controls	**Public and private schools**				
	(1) student value added	(2) student value added	(3) student value added	(4) student value added	(5) student value added
Private = 1	0.490***	0.395***	0.455***	0.203**	0.233**
	(0.086)	(0.086)	(0.084)	(0.098)	(0.106)
Scholarship = 1	-0.242***	-0.258***	-0.252***	-0.273***	-0.272***
	(0.074)	(0.073)	(0.074)	(0.070)	(0.071)
z-management		0.090***			
		(0.025)			
z-operations			0.068***		0.022
			(0.022)		(0.028)
z-people				0.166***	0.142***
				(0.036)	(0.046)
Observations	35964	35964	35964	35964	35964
# schools	299	299	299	299	299

Notes: Standard errors are clustered by school. The dependent variable student value added is estimated by using the residuals of a regression of the end-line test score on the baseline test score for each student. z-management is the standardized overall management index. z-operations and z-people are the standardized average scores of the operations questions and people management questions. Private refers to an indicator for private school, and scholarship is an indicator for whether the student received a scholarship in the Muralidharan and Sundararaman (2015) school choice experiment. Controls include those listed in Table 2: **student controls** (indicators for female student, scheduled caste, parents are literate, parents are manual laborers, and a household assets index), **teacher controls** (share of teachers with a degree, share with teacher training, average teaching experience, average number of work days, head teacher teaching experience and head teacher education) and **school controls** (log of number of students, average share of female students, of students from scheduled castes, of literate parents and of laborer parents). Includes subject and year fixed effects.

Table A10: School management practices and teacher wages

Panel A: No controls	**Public**			**Private**			**All**
	(1) ln(wages)	(2) ln(wages)	(3) ln(wages)	(4) ln(wages)	(5) ln(wages)	(6) ln(wages)	(7) ln(wages)
Value added							
Teacher Value Added	-0.407	-0.311	-0.646	0.398***	0.357***	0.661***	0.246**
	(0.331)	(0.266)	(0.818)	(0.111)	(0.116)	(0.203)	(0.105)
Private=1							-2.003***
							(0.055)
z-management	-0.025			0.107***			0.081***
	(0.040)			(0.034)			(0.031)
Management							
z-operations		-0.009			0.100***		
		(0.032)			(0.031)		
z-people			-0.147			0.127**	
			(0.111)			(0.061)	
TVA × z-management	-0.242			-0.171			0.008
	(0.218)			(0.152)			(0.121)
TVA × z-operations		-0.175			-0.126		
		(0.180)			(0.126)		
TVA × z-people			-0.426			-0.461	
			(0.608)			(0.314)	
# Teachers	234	234	234	1059	1059	1059	1293
# Schools	104	104	104	190	190	190	294
Mean wages (Rs)	14097	14097	14097	2655	2655	2655	6334
R-squared	0.0106	0.00844	0.0244	0.0342	0.0346	0.0258	0.616

Panel B: With controls	**Public**			**Private**			**All**
	(1) ln(wages)	(2) ln(wages)	(3) ln(wages)	(4) ln(wages)	(5) ln(wages)	(6) ln(wages)	(7) ln(wages)
Value added							
Teacher Value Added	-0.356	-0.330	-0.465	0.286***	0.240**	0.499***	0.168*
	(0.266)	(0.221)	(0.587)	(0.095)	(0.099)	(0.179)	(0.091)
Private=1							-1.550***
							(0.076)
z-management	-0.009			0.022			0.015
	(0.032)			(0.030)			(0.026)
Management							
z-operations		-0.005			0.024		
		(0.026)			(0.027)		
z-people			-0.034			0.007	
			(0.095)			(0.048)	
TVA × z-management	-0.063			-0.186			-0.024
	(0.165)			(0.137)			(0.103)
TVA × z-operations		-0.044			-0.141		
		(0.136)			(0.114)		
TVA × z-people			-0.142			-0.410	
			(0.445)			(0.290)	
# Teachers	234	234	234	1059	1059	1059	1293
# Schools	104	104	104	190	190	190	294
Mean wages (Rs)	14097	14097	14097	2655	2655	2655	6334
R-squared	0.355	0.355	0.356	0.294	0.294	0.294	0.714

Notes: Standard errors are clustered by school. Teacher value added is estimated using the Chetty et al. (2014) method and `vam` Stata command. Private refers to an indicator for private school. Private x TVA is an interaction between the private indicator and the teacher value added measure. z-operations and z-people are the standardized average scores of the operations questions and people management questions. Controls include those listed in Table 2: **teacher controls** (share of teachers with a degree, share with teacher training, average teaching experience, average number of work days, head teacher teaching experience and head teacher education) and **school controls** (log of number of students, average share of female students, of students from scheduled castes, of literate parents and of laborer parents). Data is collapsed across all years of data to build teacher averages.

A.3 Robustness to restricted sample

Note that we only measure management quality once in each school, at the end of the study period, and assign this score to the school for all years of student and teacher data. Thus, our analysis treats management as a "fixed characteristic" of the school throughout the study period and does not aim to study inter-temporal variation in management quality within schools. Since we have data on headteacher tenure in our study sample, we test the robustness of our results by repeating our main analysis using only schools that have principals with tenure greater than or equal to three years. Results in this restricted sample are similar.

Table A11: School management practices and teacher practices, >=3yr tenure

Panel A: no controls	**Public schools**			**Private schools**		
	(1)	(2)	(3)	(4)	(5)	(6)
	Dependent variable: teacher practice index					
z-management	0.258***			0.228***		
	(0.073)			(0.053)		
z-operations		0.221***			0.202***	
		(0.058)			(0.048)	
z-people			0.283*			0.316***
			(0.167)			(0.089)
Observations	553	553	553	1222	1222	1222
# schools	84	84	84	168	168	168
Outcome variable SD	0.89	0.89	0.89	1.05	1.05	1.05

Panel B: with controls	**Public schools**			**Private schools**		
	(1)	(2)	(3)	(4)	(5)	(6)
	Dependent variable: teacher practice index					
z-management	0.215***			0.208***		
	(0.071)			(0.061)		
z-operations		0.184***			0.180***	
		(0.057)			(0.053)	
z-people			0.226			0.279***
			(0.148)			(0.102)
Observations	553	553	553	1222	1222	1222
# schools	84	84	84	168	168	168
Outcome variable SD	0.89	0.89	0.89	1.05	1.05	1.05

Notes: Standard errors are clustered by school. **Teacher practice index** is an index of two audited indicators (whether the teacher was present and whether the teacher was actively teaching at the time of the audit), and fourteen self-reported classroom practices. The fourteen practices include: makes lesson plans, has textbook/workbook, checks hygiene daily, % time teaching, % time on teaching activities, % time "on task", and a series of indicators if the teacher spends above average time on a set of remedial class activities (remedial attention in class, outside class, helping arrange private tuition, helping at home, and other type of help). The teacher practice index is a standardized measure, built using the Anderson (2008) weighted average method. z-management is the standardized overall management index. z-operations and z-people are the standardized average scores of the operations questions and people management questions. Controls include those listed in Table 2: **teacher controls** (share of teachers with a degree, share with teacher training, average teaching experience, average number of work days, head teacher teaching experience and head teacher education) and **school controls** (log of number of students, average share of female students, of students from scheduled castes, of literate parents and of laborer parents). Includes subject and year fixed effects.

Table A12: School management practices and student value added in each type of school, >=3yr tenure

Panel A: No controls	**Public schools**				**Private schools**			
	(1) student value added	(2) student value added	(3) student value added	(4) student value added	(5) student value added	(6) student value added	(7) student value added	(8) student value added
z-management	0.173***				0.058*			
	(0.046)				(0.032)			
z-operations		0.143***		0.112**		0.040		-0.015
		(0.038)		(0.049)		(0.029)		(0.038)
z-people			0.310***	0.121			0.129***	0.145**
			(0.095)	(0.120)			(0.044)	(0.059)
Observations	5250	5250	5250	5250	25816	25816	25816	25816
# schools	84	84	84	84	168	168	168	168
Panel B: with controls	**Public schools**				**Private schools**			
	(1) student value added	(2) student value added	(3) student value added	(4) student value added	(5) student value added	(6) student value added	(7) student value added	(8) student value added
z-management	0.140***				0.053			
	(0.050)				(0.032)			
z-operations		0.114***		0.095*		0.028		-0.029
		(0.043)		(0.052)		(0.030)		(0.038)
z-people			0.233**	0.084			0.146***	0.171***
			(0.101)	(0.122)			(0.046)	(0.058)
Observations	5250	5250	5250	5250	25816	25816	25816	25816
# schools	84	84	84	84	168	168	168	168

Notes: Standard errors are clustered by school. The dependent variable, student value added, is estimated by using the residuals of a regression of the end-line test score on the baseline test score for each student. z-management is the standardized overall management index. z-operations and z-people are the standardized average scores of the operations questions and people management questions. Controls include those listed in Table 2: **student controls** (indicators for female student, scheduled caste, parents are literate, parents are manual laborers, and a household assets index), **teacher controls** (share of teachers with a degree, share with teacher training, average teaching experience, average number of work days, head teacher teaching experience and head teacher education) and **school controls** (log of number of students, average share of female students, of students from scheduled castes, of literate parents and of laborer parents). Includes subject and year fixed effects.

Table A13: School management practices and variation in teacher practices/effectiveness, >=3yr tenure

Panel A: no controls	**Teacher Practices**			**Teacher Value Added**		
	(1) Max-Min	(2) Max-Min	(3) Max-Min	(4) Max-Min	(5) Max-Min	(6) Max-Min
z-management	-0.063			-0.026*		
	(0.101)			(0.016)		
z-operations		-0.076			-0.026**	
		(0.085)			(0.013)	
z-people			0.068			-0.016
			(0.183)			(0.031)
Private = 1	0.789***	0.756***	0.610*	0.236***	0.220***	0.239***
	(0.174)	(0.145)	(0.347)	(0.029)	(0.025)	(0.060)
# schools	252	252	252	253	253	253
R-squared	0.0769	0.0784	0.0759	0.191	0.193	0.183
Panel B: with controls	**Teacher Practices**			**Teacher Value Added**		
	(1) Max-Min	(2) Max-Min	(3) Max-Min	(4) Max-Min	(5) Max-Min	(6) Max-Min
z-management	-0.118			-0.032*		
	(0.103)			(0.016)		
z-operations		-0.116			-0.030**	
		(0.086)			(0.014)	
z-people			-0.057			-0.027
			(0.188)			(0.031)
Private = 1	-0.124	-0.193	-0.120	0.181***	0.162***	0.200***
	(0.325)	(0.322)	(0.455)	(0.056)	(0.054)	(0.074)
# schools	252	252	252	253	253	253
R-squared	0.157	0.159	0.152	0.243	0.244	0.234

Notes: Standard errors are clustered by school. Teacher practices are an index of sixteen practices, as describe in Section 3.2. Teacher value added is estimated using the Chetty et al. (2014) method and `vam` Stata command. Min-Max is the difference between the highest and lowest teacher practice index (Columns 1-3) and teacher value added (Columns 4-6) within schools. Controls include those listed in Table 2: **teacher controls** (share of teachers with a degree, share with teacher training, average teaching experience, average number of work days, head teacher teaching experience and head teacher education) and **school controls** (log of number of students, average share of female students, of students from scheduled castes, of literate parents and of laborer parents). Data is collapsed across all years of data to build teacher averages.

Table A14: School management practices and minimum teacher practices/effectiveness, >=3yr tenure

Panel A: no controls	**Teacher Practices**			**Teacher Value Added**		
	(1) Min	(2) Min	(3) Min	(4) Min	(5) Min	(6) Min
z-management	0.284***			0.046***		
	(0.074)			(0.013)		
z-operations		0.262***			0.041***	
		(0.062)			(0.011)	
z-people			0.273*			0.055**
			(0.139)			(0.023)
Private = 1	-0.663***	-0.483***	-0.872***	-0.174***	-0.144***	-0.227***
	(0.137)	(0.113)	(0.272)	(0.027)	(0.023)	(0.049)
# schools	252	252	252	253	253	253
R-squared	0.109	0.116	0.0624	0.131	0.131	0.112
Panel B: with controls	**Teacher Practices**			**Teacher Value Added**		
	(1) Min	(2) Min	(3) Min	(4) Min	(5) Min	(6) Min
z-management	0.282***			0.047***		
	(0.072)			(0.013)		
z-operations		0.255***			0.041***	
		(0.062)			(0.012)	
z-people			0.290**			0.061***
			(0.129)			(0.024)
Private = 1	-0.088	0.079	-0.337	-0.121***	-0.091**	-0.185***
	(0.258)	(0.257)	(0.314)	(0.041)	(0.040)	(0.054)
# schools	252	252	252	253	253	253
R-squared	0.214	0.217	0.177	0.221	0.220	0.206

Notes: Standard errors are clustered by school. Teacher practices are an index of sixteen practices, as describe in Section 3.2. Teacher value added is estimated using the Chetty et al. (2014) method and `vam` Stata command. Min-Max is the difference between the highest and lowest teacher practice index (Columns 1-3) and teacher value added (Columns 4-6) within schools. Controls include those listed in Table 2: **teacher controls** (share of teachers with a degree, share with teacher training, average teaching experience, average number of work days, head teacher teaching experience and head teacher education) and **school controls** (log of number of students, average share of female students, of students from scheduled castes, of literate parents and of laborer parents). Data is collapsed across all years of data to build teacher averages.

Table A15: School management practices and student value added in public and private schools, >=3yrs tenure

	Public and private schools				
	(1) student value added	(2) student value added	(3) student value added	(4) student value added	(5) student value added
Private = 1	0.286***	0.194***	0.257***	-0.005	0.036
	(0.063)	(0.064)	(0.060)	(0.089)	(0.105)
Scholarship = 1	-0.253***	-0.276***	-0.268***	-0.291***	-0.290***
	(0.087)	(0.086)	(0.088)	(0.080)	(0.081)
z-management		0.092***			
		(0.027)			
z-operations			0.072***		0.025
			(0.024)		(0.033)
z-people				0.163***	0.134**
				(0.039)	(0.054)
Observations	31066	31066	31066	31066	31066
# schools	252	252	252	252	252

	Public and private schools				
	(1) student value added	(2) student value added	(3) student value added	(4) student value added	(5) student value added
Private = 1	0.440***	0.361***	0.418***	0.173	0.194*
	(0.094)	(0.094)	(0.092)	(0.107)	(0.115)
Scholarship = 1	-0.250***	-0.273***	-0.265***	-0.286***	-0.287***
	(0.085)	(0.082)	(0.083)	(0.078)	(0.078)
z-management		0.084***			
		(0.028)			
z-operations			0.062**		0.015
			(0.025)		(0.032)
z-people				0.156***	0.140***
				(0.039)	(0.050)
Observations	31066	31066	31066	31066	31066
# schools	252	252	252	252	252

Notes: Standard errors are clustered by school. The dependent variable student value added is estimated by using the residuals of a regression of the end-line test score on the baseline test score for each student. z-management is the standardized overall management index. z-operations and z-people are the standardized average scores of the operations questions and people management questions. Private refers to an indicator for private school, and scholarship is an indicator for whether the student received a scholarship in the Muralidharan and Sundararaman (2015) school choice experiment. Controls include those listed in Table 2: **student controls** (indicators for female student, scheduled caste, parents are literate, parents are manual laborers, and a household assets index), **teacher controls** (share of teachers with a degree, share with teacher training, average teaching experience, average number of work days, head teacher teaching experience and head teacher education) and **school controls** (log of number of students, average share of female students, of students from scheduled castes, of literate parents and of laborer parents). Includes subject and year fixed effects.

B Data Appendix

B.1 World Management Survey sampling weights

The World Management Survey average scores used in this paper include survey weights. These are calculated as the inverse probability of being interviewed on log of number of students, public status, and population density by state, province, or NUTS 2 region as a measure of location). Samples include both public and private schools, with the exception of Colombia where data is only available to public primary schools.

B.2 The Development World Management Survey methodology

In original WMS, the survey is administered by highly trained interviewers who ask a series of scripted and unscripted questions until they gather all the information they need to score the practices. The interviewers are generally graduate students in business and economics programs from highly ranked institutions, and undergo a week-long intensive WMS training program. This program teaches them how to ask the WMS questions in open-ended format, and how to arrive at a score that combines the various facets of a manager's answer into one score. In the D-WMS, however, we remove a large portion of the discretion interviewers have by separating the three types of questions and requiring separate scores for each sub-question. This reduces measurement error as the interviewers have an almost-checkbox style grid, and is more appropriate for settings where very high quality interviewers are not available or not feasible due to budget constraints. Below we include all the original WMS topics and the three factors (implementation, usage, monitoring) along with the example questions asked by the interviewers.

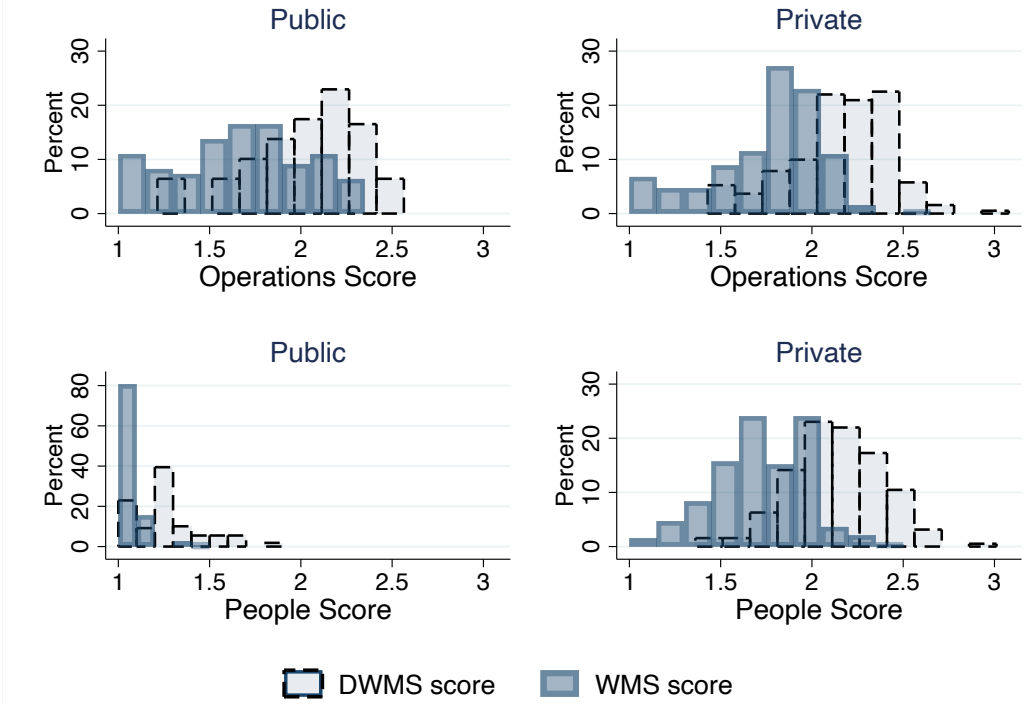
Figure B1 shows the difference between the D-WMS scores and the WMS-comparable versions of the scores. The D-WMS distribution captures a mechanical shift to the right relative to the WMS equivalent (due to the rounding down of scores under the WMS rubric). However, the D-WMS also captures meaningful new variation between scores of 1 and 2, and 2 and 3 that change the *shape* of the distributions. This is seen most clearly in the distribution of people-management scores distribution in the public sector, where under WMS scoring guidelines, 80% of schools would have the lowest score of 1. In contrast, the D-WMS provides much more granular information with only 6% of schools having a score of exactly 1.[41]

B.2.1 Scoring example and interpretation

We use an example to illustrate the type of information included in the interviews and codified in the survey, and how the expansions aid in identifying bottlenecks. On the topic of data-driven student transition to higher grades, principals are asked open-ended questions such as "What type of information about the individual students is available to teachers at the beginning of the academic year?" and "What do you think are the main points of

[41] Note that the binning in the histogram in Figure B1 makes it appear that around 20% of schools have a score of 1 under the D-WMS as well. However, this bin includes values up to 1.1 and only 6% of schools score at the actual lower bound of 1.

Figure B1: Distributions of the DWMS and the re-cast WMS scores in Andhra Pradesh



Note: This figure shows the distribution of operations and people management scores for public and private schools in our AP sample. The dashed line bars correspond to the Development WMS indices, which allows for the awarding of half scores for each measured topic. The blue solid bars correspond to the re-cast scores for each topic in the "original WMS" convention, where half scores are not allowed and thus half scores were downgraded to the next lowest integer. For example, scores of 2.5 were replaced with 2. See the Data sections and Data Appendix for more details. Note that the binning in the histogram makes it appear that around 20% of schools have a score of 1 under the D-WMS as well. However, this bin includes values up to 1.1 and only 6% of schools score at the actual lower bound of 1.

transition/promotion for students and how is this communicated to your teachers?". Higher scores are awarded to principals who can discuss an array of data relevant in their school and context, and ensure the information is collected regularly, communicated to teachers well, and used to inform student transitions.

For the first factor, implementation, a school would receive a score of 1 if there is no data available. A score of 1.5 means that the school has some limited information for students, and while it may be of lower quality relative to official examinations, still constitutes a better practice than having nothing at all. A score of a 2 means there is some data is available, such as end-of-year examinations and teacher impressions. A score of a 3 means the schools uses a range of data, including results for quarterly, mid-year and end of-the year examinations plus health information, teacher impressions and baseline tests. The score of 2.5 would sit somewhere in the middle, if the school has a range of academic and behaviour data (an improvement on simply collecting end-of-year examinations or teacher impressions) but not quite a large enough range collected over multiple instances with different instruments.

For the second factor, usage, a score of 1 means that the principal does not understand basic transition points for students (such as progress between units). A score of 1.5 recognizes that the principal has a personal understanding of these points but does not communicate with teachers about these points. A score of 2 means that the principal internalizes the important transition points but also communicates with teachers to build shared understanding, though very informally and infrequently. A score of 2.5 means that this communication is more regular, albeit still informal. For a score of 3 or above, the understanding of critical transitions needs to be formally acknowledged and understood by the principal as well as the main teaching staff.

For the third factor, monitoring, a score of 1 would imply teachers have no knowledge of prior achievement, and thus cannot consider this data in critical transitions. A score of 1.5 means teachers are at least given progress cards, but no real action is taken. A score of 2 means teachers are made aware of past performance and there is an expectation that issues should be addressed, but the approach is unstructured. A score of 2.5 is awarded when there is an informal communication structure in place to link prior teachers and inform critical transition moments. For a score of 3 or above, the school needs to have a process to formally verify student outcomes at critical stages, regularly, and have a structured way to address weaknesses.

Overall, a score of a 3 or below for this topic means performance data is not be recorded systematically with a range of tools that would allow for a more thorough understanding of a studentâs strengths and weaknesses. Further it is not integrated or easy to use or shared with a range of stakeholders. The importance of the D-WMS for measurement in our context stems from nearly all public schools having scores below 3.

Table B1: **Survey questions: Operations management questions**

	Process implementation	**Process usage**	**Process monitoring**
Topic	**Questions**		
1. Standardization of Instructional Planning Processes	How do you ensure that all students of a given grade are learning the same topics in the same way within a similar timeframe?	Why did you and the teachers decide on the current curriculum, textbooks and other materials and lesson plans used throughout the year?	How do you keep track of what teachers are doing in the classrooms?
2. Personalization of Instruction and Learning	How much does the school try to identify individual student needs and accommodate these needs within in the classroom?	How do you make sure students and parents are engaged in the students' learning?	How do you keep track of what teachers are doing in the classrooms to ensure that different student needs are taken care of?
3. Data-driven Planning and Student Transitions	What type of information about the individual students is available to teachers at the beginning of the academic year?	What do you think are the main points of transition/promotion for students and how is this communicated to your teachers?	Does the school use any data to consider student promotions through critical transitions (such as grade promotions or unit progressions)?
4. Adopting Educational Best Practices	How do you encourage the teachers to incorporate new teaching practices into the classroom?	How do you make sure the teachers are using the new techniques you are trying to introduce?	By what means and how often are these learnings shared across teachers and subjects and how often?
5. Continuous Improvement	When you have a problem in the school, how do you come to know about them and what are the steps you go through to fix them?	Who is involved in improving/suggesting improvements to the process so these issues do not happen again?	Who is involved in resolving these issues, that is, in deciding what course of action will be taken to resolve the issue?
6. Performance Tracking	What kind of main parameters do you use to track school performance and what documents are you using to inform this tracking?	How often are these main parameters measured?	If I were to walk through your school, how could I tell how it is doing compared to its main parameters?
7. Performance Review	How often do you have meetings to review the parameters?	Who is involved in these meetings and who gets to see the results of these meetings?	After reviewing these parameters, what is the action plan, that is what steps do people take after leaving the meeting?
8. Performance Dialogue	Can you tell me about a recent review meeting you have had?	What kind of data or information about the parameters do you normally have with you?	What type of feedback do you get during these meetings and how do you get to solving the problems raised?
9. Consequence Management	After a review meeting, how are people aware of their responsibilities and actions that must be taken?	How would you make sure this problem does not happen again?	How long does it typically go between when a problem starts and you realize this and start solving it?
10. Balance of Targets/Goal Metrics	What goals do you have set for your school?	Can you tell me about any specific goals for departments, teachers and staff?	How are your school goals linked to student outcomes and to the goals of the school board system (government/ICSE/CBSE)?
11. Interconnection of Targets/Goals	How do you learn of the goals the school system expects of you?	If I were a teacher or another member of the school, what kind of goals would I have?	How do you communicate to your teachers and staff what their goals are?
12. Time Horizon of Targets/Goals	Which goals would you say get the most emphasis?	What kind of time-scale are you looking at with your goals?	Could you meet all your short term goals but miss your long-run goals?
13. Stretch of Targets/Goals	How are your goals benchmarked?	Do you feel that all the departments/areas have goals that are just as hard or would some areas/departments get easier targets?	On average, how often would you say that the school meets their goals?
14. Clarity and Comparability of Goals	What are the goals based on?	If I asked one of the teachers directly about their individual goals, what would they tell me?	How do people know about their own performance when compared to other people's performance?

Table B2: **Survey questions: People management questions**

	Process implementation	**Process usage**	**Process monitoring**
	formulating, adopting and putting into effect management practices	carrying out and using management practices frequently and efficiently	monitoring the appropriateness and efficient use of management practices
Topic	**Questions**		
1. Building a High Performance Culture/ Rewarding High Performers	Can you tell me about the criteria that you use in your appraisal (evaluation) system?	What types of monetary or non-monetary rewards are given to teachers and how are these linked to the ranking teachers get?	By what means and how often do you evaluate and rate your teachers?
2. Making Room for Talent/ Removing Poor Performers	What criteria do you use and how often do you identify your worst teachers?	If you had a teacher who is struggling or who could not do their job properly, what would you do? What if you had a teacher who would not do their job, as in slacking off, what would you do then?	How long does it take to address the issue once you come to know that a teacher is performing badly?
3. Promoting High Performers	What criteria do you use and how often do you identify your best teachers?	What types of career and teacher development opportunities are provided?	How do you make decisions about promotion/progression of teachers and additional opportunities within the school, such as performance, years of service, etc.?
4. Managing Talent	Who decides how many and which teachers (full-time regular members of staff) to hire?	Where do you seek out and find teachers and how do you ensure you have the teachers you need for the subjects you have?	How do you decide which teachers should be hired?
5. Retaining talent	When one of your best teachers wants to leave the school, what do you do?	Could you give me an example of what you would be able to offer to try and keep that best teacher in your school?	How would you know if your best teachers are happy working in this school?
6. Creating a Distinctive Employee Value Proposition	What are the professional benefits of working at your school?	How do teachers come to know that working at your school is better than others?	How do you check to see if teachers are aware of the benefits of working at your school?

Figure B2: Sample report card from an AP school

Note: Report card from an AP school produced to us during a field visit.

B.3 Teacher Value Added

We reproduce here the essence of the statistical model underlying the teacher value added model from Chetty et al. (2014) in Equation 5, below. It shows how the authors suggest estimating teacher value added to extract the teacher effect, μ_{jt} from a panel of student-level data. $A_{i(t)}$ and $A_{i(t-1)}$ are the standardized end-of-year test score for student i in years t and $t-1$. Controlling for students' prior year test scores (or, lagged test scores) captures "most of the sorting of students to teachers that is relevant for future test achievement."[42] Further, there is some consensus in the literature that including a student's prior test scores is the best proxy available for the cumulative learning and other characteristics (such as parent's input and individual motivation) up to the point where the "new" teacher is matched with the student.[43] Our data includes subject-specific test scores administered by the APSC project team for English, Telugu, Science and social studies and Hindi. As only Math and Telugu tests are administered in all the primary school grades (1 through 5 in Andhra Pradesh), we focus on these two subjects. The vector X_{it} includes student and classroom characteristics as controls, namely gender, caste, religion, whether parents are labourers and whether parents are literate. Each student can be matched to a teacher, year, class and subject. The equation is as follows:

$$\begin{aligned} A_{i(t)} &= \alpha A_{i(t-1)} + \beta X_{it} + \quad \nu_{it} \\ &\text{where} \quad \nu_{it} = \mu_{jt} + \theta_c + \varepsilon_{it} \end{aligned} \tag{5}$$

and the residual term ν_{ijt} is expressed by Chetty et al. (2014) as a composite of teacher value added (μ_{jt}), exogenous class shocks (θ_c) and idiosyncratic student-level variation (ε_{it}).[44] The individual "teacher effect" is not assumed to be fixed over time but rather is allowed to fluctuate stochastically over time. They do not place restrictions on the stochastic process except that they must follow a stationary process.[45]

In short, Chetty et al. (2014) predict each teacher's value added in a school year based on the mean test scores of students she taught in other (prior and later) years. However, their innovation is that they allow teacher quality to vary over years by essentially regressing student scores in year t on the average scores in other years, "allowing the coefficients to vary across different lags." They then estimate the autocovariance of scores across classrooms

[42] Chetty et al. (2014)

[43] For example, Guarino et al. (2014)

[44] Chetty et al. (2014) note that their approach is similar to Kane and Staiger (2008), except that it accounts for drift. In Kane and Staiger (2008), the authors use "the student residuals ν to form empirical Bayes estimates of each teacher's value added." Essentially, this approach uses the noisy estimate of teacher value added multiplied by an estimate of its reliability, that is, the mean residual multiplied by ratio of (signal)-variance to (signal + noise)-variance. In a simulation exercise, however, Guarino et al. (2014) found that empirical Bayes estimates were not the most reliable estimators among the six most common studied. Another common approach is to treat two of the components of ν_{it}, namely the teacher and classroom effects as fixed effects, for example, as in Gordon et al. (2006), Rockoff (2004).

[45] As Chetty et al. (2014) explain, it thus requires an assumption that mean teacher quality does not vary across calendar years and that the correlation of teacher quality, class shocks and student shocks across pairs of years depends only on the time elapsed between the years. Formally: $\mathbb{E}[\mu_{jt}|t] = \mathbb{E}[\varepsilon it] = 0$, $Cov(\mu_{jt}, \mu_{j(t+s)}) = \sigma_{\mu s}$, $Cov(\varepsilon_{it}, \varepsilon_{i(t+s)}) = \sigma_{\varepsilon s}$ $\forall t$.

taught by each teacher non-parametrically and use that information to account for "drift" in teacher quality.

They construct the estimator in three steps: The first is to run the regression in Equation 5 to recover the residuals, ν_{ijt}. They use variation across students taught by the same teacher, which is a departure from previous techniques that used both within-teacher and between-teacher variation. The second step is to estimate mean test score residuals in classrooms in year t based on mean test score residuals in prior years. If we let the mean residual test score in the class teacher j teaches in year t be $\overline{A}_{jt} = \frac{1}{n}\Sigma_{i\in\{i:j(i,t)=j\}}\nu_{it}$, and $\mathbf{A}_j^{-t} = (\overline{A}_{j1}, ..., \overline{a}_{j(t-1)})'$ is the vector of mean residual scores prior to year t in classes taught by teacher j, then a regression of $\overline{A}_{jt}$ on $\mathbf{A}_j^{-t}$ results in a set of coefficients that are the best linear predictors of $\overline{A}_{jt}$ based on prior scores.[46] The third step is using the coefficients recovered from the "best linear predictor" to predict the teachers' value added for year t, using a leave-year-out approach.

Their results using US data suggest that a 1 standard deviation improvement in teacher quality leads to higher test scores of approximately 0.14 SD for maths and 0.1 SD in English. In their measure, they scale teacher value added such that "the average teacher has value added $\mu_{jt} = 0$ and the effect of a 1 unit increase in teacher value added on end-of-year test scores is 1."[47] It is this methodology that we use to calculate teacher value added in the context of the data available for this paper.[48]

B.4 Teacher classroom practices

We use a set of fourteen indicators related to classroom practices in self-reported teacher questionnaires administered to all teachers by enumerators, along with two indicators in audit data from classroom observation visits. These were collected independent of the student tests and the D-WMS management survey.

Survey questions: The fourteen self-reported indicators include information on classroom preparedness (teacher makes lesson plans, has textbook and/or workbook, checks hygiene daily), time spent teaching (the % time teaching, % time on teaching activities, % time "on task"), and time spend on remedial activities (time spent on remedial activities as well as above average time spent remedial attention in class, outside class, helping arrange private tuition, helping at home, and other type of help). The two audit indicators include whether the teacher was present in the school and whether they were actively teaching in class. We describe each teacher practice and how it is coded below.

[46] We mention the OLS equivalent here for ease of exposition, but the technique used by Chetty et al. (2014) is analogous to the OLS regression method and describe it in detail in their paper.

[47] Chetty et al. (2014)

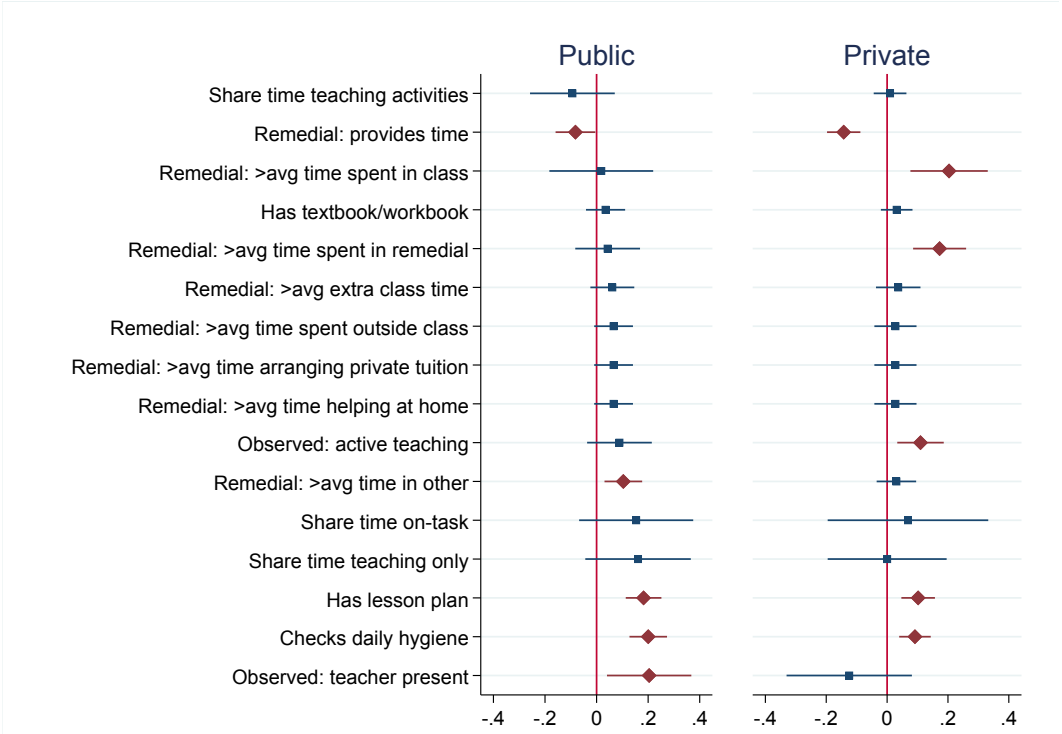
[48] To implement their method we used the accompanying Stata command `vam`.

Table B3: Teacher practices index

Variable	Question	Coding
Has lesson plan	Do you prepare a lesson plan (teaching plan) before teaching? (1) Yes, (2) No	= 1 if (1)
Has textbook/workbook	Do you have a copy of the textbook for each class you teach? Do you have a copy of the workbook for each class you teach? For each question: (1) All, (2) Some, (3) None	= 1 if (1) in both questions
Checks daily hygiene	How often are the children observed for health/hygiene related habits, like cleanliness of nails, teeth and washing hands before meals, of the children by you? (1) Daily, (2) Few times a week, (3) Few times a month, (4) Few times a year, (5) Never	= 1 if (1)
Share time teaching activities	How much time do you spend in a typical day on each of the following activities? (A) Teaching Activity, (B) Preparing for Classes, (C) Correcting Homework, (D) Maintaining Order and Discipline, (E) Administrative/Paper work, (F) Breaks during School, (G) Getting children to attend school, (H) Mid-day meals, (I) Extra Classes, (J) Others	share of total time spent in (A), (B), (C), and (I).
Share time on task	How much time do you spend in a typical day on each of the following activities? (A) Teaching Activity, (B) Preparing for Classes, (C) Correcting Homework, (D) Maintaining Order and Discipline, (E) Administrative/Paper work, (F) Breaks during School, (G) Getting children to attend school, (H) Mid-day meals, (I) Extra Classes, (J) Others	share of total time spent in (B), (C), (I) .
Share time teaching only	How much time do you spend in a typical day on each of the following activities? (A) Teaching Activity, (B) Preparing for Classes, (C) Correcting Homework, (D) Maintaining Order and Discipline, (E) Administrative/Paper work, (F) Breaks during School, (G) Getting children to attend school, (H) Mid-day meals, (I) Extra Classes, (J) Others	share of total time spent in (A) .
Remedial time attention	Do you get time to provide remedial teaching to the students? (1) Yes, (2) No	= 1 if (1)
Time spent in remedial attention:	Do you get time to provide remedial teaching to the students?	
... taking extra class time	If yes, mention time in hours per week for this topic	= 1 if time spent is above average of distribution
... paying extra attention in the class itself	If yes, mention time in hours per week for this topic	= 1 if time spent is above average of distribution
... paying extra attention outside the class	If yes, mention time in hours per week for this topic	= 1 if time spent is above average of distribution
... help children by arranging private tuition	If yes, mention time in hours per week for this topic	= 1 if time spent is above average of distribution
... helping children in studies at home	If yes, mention time in hours per week for this topic	= 1 if time spent is above average of distribution
... others	If yes, mention time in hours per week for this topic	= 1 if time spent is above average of distribution
Observed: Active Teaching	What is the teacher doing when you look for him/her? (A) Actively Teaching or engaged with the children, (B) Passive teaching, (C) In the class, but not teaching, (D) Out of class, and not teaching, (E) Doing administrative/ paper work, (F) Talking to/accompanying the MC, (G) Cannot find the teacher (absent)	= 1 if (A)
Observed: Teacher Present	What is the teacher doing when you look for him/her? (A) Actively Teaching or engaged with the children, (B) Passive teaching, (C) In the class, but not teaching, (D) Out of class, and not teaching, (E) Doing administrative/ paper work, (F) Talking to/accompanying the MC, (G) Cannot find the teacher (absent)	=0 if (G), =1 otherwise

Index construction: We aggregated all sixteen items into a single index using the Anderson (2008) method. This methodology weights the impact of the included variables by the sum of their row in the inverse variance-covariance matrix, thereby assigning greater weight to questions that carry more "new information". Figure B3 shows the correlation between each individual teacher practice we have in our survey and student value added. We included all practices in our index.

Figure B3: Coefficient plot: teacher practices and correlation with student value added



Note: This figure plots the coefficient of the simple relationship between each teaching practice and average student value added (SVA). SVA for each student is the residual from a regression of endline test score on baseline test scores for all years of available APSC data. The data is collapsed at the school-teacher-year level, such that each teacher is assigned an average of their students' value added for each year. The coefficients reported here are from a simple regression of each practice on student value added within each type of school (public on the left panel and private on the right panel), clustering standard errors at the school level. Statistically significant coefficients at the 90 percent level are marked in red diamonds, while coefficients that are not statistically significant are marked by blue squares.