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PERSONNEL MANAGEMENT AND SCHOOL PRODUCTIVITY: EVIDENCE FROM INDIA*

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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 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.

Developing countries have made impressive progress in expanding primary school enrolment 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

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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 sectors, 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 normalised cross-country comparison, we estimate that management quality in AP public schools is almost 2 SDs below the mean of six 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 1.36 SDs higher than in AP public schools (normalised relative to the 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 4.8 SDs 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 1-SD higher people management score is associated with ∼0.22-SD better teacher practices and ∼0.31-SD higher student value added. In private schools, these are ∼0.25 SDs and ∼0.12 SDs, 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 1 SD to student learning each year on average is paid about 28% higher wages. In contrast, we find no strong correlation between TVA and wages in public schools.

A key question for interpreting our results is to understand the sources of variation in management practices, and what it is correlated with. We examine correlations of management practices

[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 normalises management scores across countries since it makes cross-country comparisons.

with school, teacher and headteacher characteristics and do find some meaningful relationships—especially with parental education and employment in public schools, 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 residualised 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 Online 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 SEs 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 finalised 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; Chetty *et al.*, 2014; Kane *et al.*, 2014). Prior work in developing countries has 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.

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, matched WMS data for manufacturing with employer-employee datasets in Germany and Brazil (respectively) and found 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., Coelli and Green, 2012; Lavy and Boiko, 2017; Munoz and Prem, 2020; Walsh and Dotter, 2020; Akhtari *et al.*, 2022). 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 sectors (e.g., Rainey and Chun, 2007; Quinn and Scur, 2021). Specifically, we present novel evidence that combines measures of management quality, employee behaviours 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.

1. The Indian Primary School Institutional Context

The undivided state of Andhra Pradesh 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 organisations (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 the Young Lives dataset in Woldehanna *et al.,* 2018).

The universe of schools in our study comes from the APSC project and consisted of all villages that had at least one recognised private school in 2008.[8] Thus, while our sample does not include

[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.

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. Furthermore, 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 enrolment 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.

Online Appendix 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% versus 34%); however, these qualifications are not correlated with student value added (Muralidharan and Sundararaman, 2011). They are civil servants hired by the state government on permanent contracts and are paid over five times the average private school teacher salary (Rs. 14,286 versus 2,607 per month in data collected between 2008–12). However, teacher effort and accountability are significantly higher in private schools. Private schools have much lower rates of teacher absence (9% versus 24%), and higher rates of observed active teaching when measured by unannounced visits to schools (50% versus 35%). They also have a longer school year (11 more working days), longer school days (45 minutes longer per day) and lower levels of multi-grade teaching (where one teacher simultaneously teaches multiple grades) than public schools (24% versus 79%). Public schools have an average of 74 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] Online Appendix Table A2 presents equivalent summary statistics for the sample we use in this paper (for which we also collected D-WMS data).[11]

2. Data

2.1. *Measuring Management in LMICs: D-WMS*

The original 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 (headteacher or

[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 (Muralidharan and Kremer, 2008; Tooley, 2009; 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 Online Appendix Tables A1 and A2 reflect a combination of (*a*) sampling variation, (*b*) timing of data collection (2008–9 for the former and 2012–3 for the latter) and (*c*) restricting the figures in Online Appendix 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`.

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 used an enhanced measure of management quality for this paper—which we refer to as the Development WMS.[14] The 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.

2.1.1. *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 judgement that interviewers need to apply in coding responses.

The expansion enables a better characterisation 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.

2.1.2. *Expansion to capture greater variation across the scoring scale*

The scores in low- and middle-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

[13] A score of 1 means that there are no processes at all *or very little processes* in place, while a score of 2 means that 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 that 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 implementation 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 (Online Appendix Figure B2). When asked what they do with the report cards and the information, they showed us a storage spot where all the data were kept safely but, unfortunately, also not used or even usable. This is similar to findings reported by Muralidharan and Sundararaman (2010).

topics. By allowing for half scores to be awarded, we can distinguish between a school that has 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 Online Appendix B.

The value of using the D-WMS is seen most clearly in the distribution of people management scores 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 Online Appendix Figure B1). In addition to more precise measurement, using the D-WMS also improves inference on the results presented in Section 3 below, where some of the correlations would lose significance if implemented with the coarser WMS measures.

2.1.3. *Building comparable scores*

To build the comparable scores, we average the three sub-scores 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.

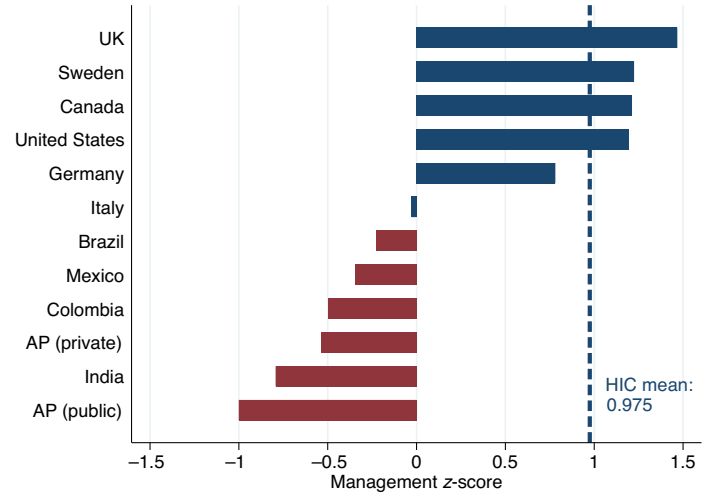
Thus, it is simple to take each half point score and round down to the nearest integer and mimic the original WMS scoring methodology. We use the WMS-comparable score only for the cross-country comparisons in Figure 1 and Online Appendix Figure A1, and normalise scores relative to the full global dataset. For the rest of the analysis in this paper, we use the D-WMS scores and normalise 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 analyse 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 six questions (see Tables B1 and B2 in Online 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.

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.

[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.

(a) Rank of comparable management *z*-scores



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

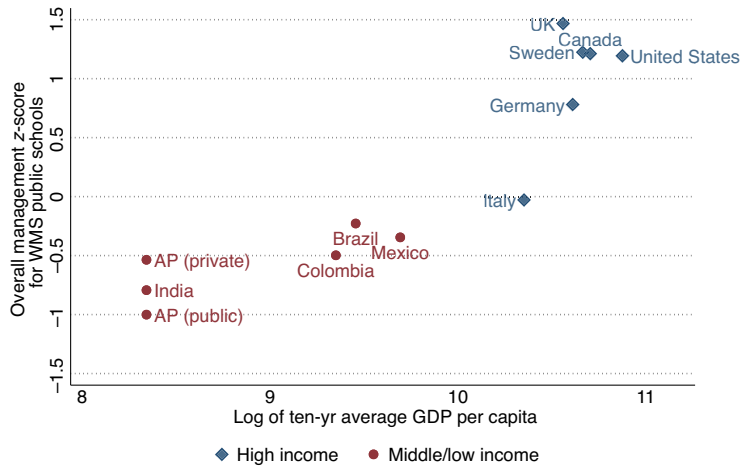


Fig. 1. *Global Benchmarks.*

Notes: Both (a) and (b) figures includes only public secondary schools from the WMS dataset (UK, Canada, Sweden, United States, 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 Online Appendix B for details on the weight construction). For both parts (a) and (b) of this figure, management scores are normalised relative to the cross-country sample. The numbers 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 2008–18. We used India's GDP as a stand-in for Andhra Pradesh's GDP in panel (b). AP private school 'raw' overall management score means are D-WMS = 2.15, WMS = 1.74. AP public school 'raw' overall management score means are D-WMS = 1.81, WMS = 1.48.

2.2. *School, Teacher and Student Data: The APSC Dataset*

The main school-teacher-student data we use is from the APSC project (Muralidharan and Sundararaman, 2015) and spans the four school years of the project in AP (2008–9 to 2011–2). We use this dataset to construct measures of student value added and teacher value added, and an index of teacher practices.

For student value added (SVA) and TVA, we use a panel of independently administered subject-specific test scores along with teacher assignments into these subjects.[17] Using standard value-added methods (see the 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 practice 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 16 items (14 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 is provided in Online Appendix Table B3 and we present simple correlations of each teaching practice with student value added in Online Appendix Figure B3.

We estimate the impact of management practices on SVA using a standard value-added specification with controls for lagged test scores (see Section 3.4 below). For analysis at the teacher level, we construct measures of TVA following Chetty *et al.* (2014).[20] The TVA measure is normalised to have a mean of zero and an SD of 1.

The combined dataset of APSC-DWMS data includes 299 schools, 190 private and 109 public schools. Our main analysis includes over 46,000 observations for Telugu and math test scores from over 12,600 students in private schools and over 2,650 students in public schools, with over 1,000 teachers in private schools and over 300 teachers 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]

[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 two years, it switched to testing treatment and control students outside school in a special testing session to minimise attrition in the experimental study sample. We focus on the core subjects, Telugu (language) and math, for the direct student value-added analysis and use the full dataset for estimating teacher value added.

[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 of 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'.

[20] See Online 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.

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 3.4 below.

3. Results

3.1. *Management Quality and Global Comparisons*

Figure 1(a) shows the comparable standardised scores of public school management across a set of countries surveyed using the WMS (UK, Sweden, Canada, United States, 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 standardisation were based on these comparable scores. The scores are standardised relative to the global distribution. The high-income country mean is 0.975 SDs, and the score for AP public schools is −1 SD. Thus, the average public school in AP has WMS management scores that are nearly 2 SDs below the average comparable score in high-income countries.

To place these scores in context, Figure 1(b) plots standardised management scores against the log of ten-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 labour-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 1(b) suggests

[22] In some cases, practices even revert to the mean within a year of improving after an experiment, as Dunsch *et al.* (2023) found.

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, labour 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 operation and people management, and the 10th and 90th percentile scores. Figure 2(a) 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 1.36 SDs above the public school mean. Figure 1(b) 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 that have ∼4 times greater GDP per capita than India.

This difference is especially pronounced in the area of people management. Figure 2(b) 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 an SD of 0.18. Private schools score 0.87 points higher in people management, which is nearly 4.8 SDs 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 follow-up 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 implemented uniformly. This variation will also be captured in our data.

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

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	1.80	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	2.20	1.67	2.83
Data-driven planning and student transition	1.93	1.50	2.50	2.07	1.50	2.67
Personalisation of instruction and learning	1.98	1.50	2.50	2.25	1.67	2.75
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	1.75	2.83
Review of performance	2.45	1.83	3.33	2.38	1.83	3.00
Performance dialogue	2.23	1.50	2.67	2.11	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	2.03	1.50	2.50
Interconnection of goals	2.11	1.50	2.50	2.20	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	1.42	2.33
Clarity of goals	1.73	1.33	2.33	1.99	1.50	2.50
People average index	1.26	1.03	1.56	2.13	1.83	2.46
Instilling a talent mindset	1.14	1.00	1.50	2.47	2.00	3.00
Incentives and appraisals	1.51	1.00	1.83	1.99	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	1.95	1.50	2.33
Retaining talent	1.14	1.00	1.33	1.97	1.67	2.33
Observations	109			190		

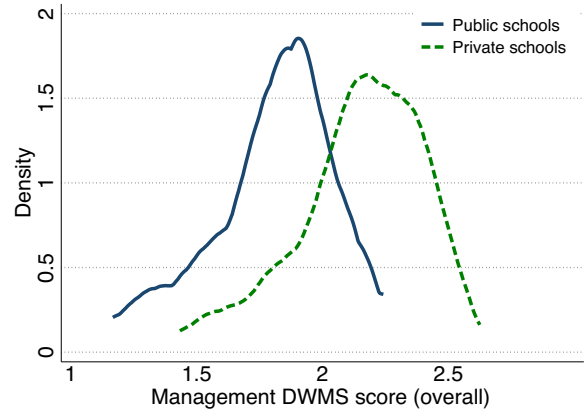
Notes: The summary statistics in this table report the average and distributional statistics for the D-WMS scores. The D-WMS survey instrument measures the quality of management on a scale of 1 to 5, in increments of 0.5 for each of the 20 topics. The expanded survey instrument measures the level of adoption of management practices on a scale of 1 to 5, in increments of 0.5. A score of 1 means that there are no processes at all *or very little processes* in place, while a score of 2 means that there are *some informal* processes in place, mainly adopted by the principal (as opposed to some formal 'school policy'). A score of 3 means that 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 indicates 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 that performance data are not be recorded systematically with a range of tools that would allow for a more thorough understanding of a student's strengths and weaknesses. Furthermore, it is not integrated or easy to use or shared with a range of stakeholders. See Online Appendix B for a full set of questions and explanations of the survey tool.

3.2. *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. Online Appendix Table A3 presents the multiple regression analogue.

In public schools, management quality is significantly correlated with parental socio-economic status—positively with parental literacy, and negatively with the share of parents who are manual labourers. There is also suggestive evidence of positive correlations with teacher education and training, though these relations are not significant.

(a) Overall management scores



(b) People and operations management

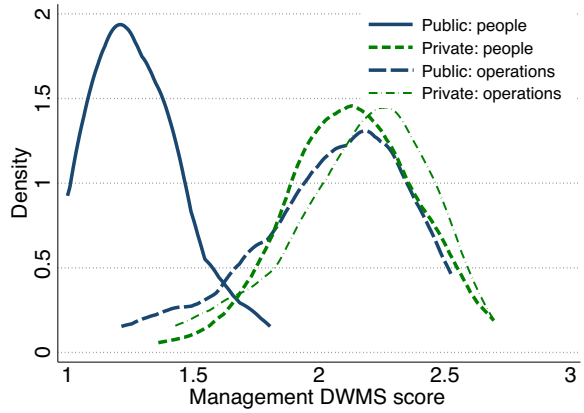


Fig. 2. *Distribution of Management Scores in Andhra Pradesh.*
Notes: This figure shows the distribution of the D-WMS overall management *z*-score index for public and private schools in panel (a) and operations and people management *z*-score indices in panel (b). Standardisation is relative to the full dataset, including public and private schools. Data for AP are from the Development World Management Survey, with potential scores ranging from 1 to 5 in increments of 0.5. The D-WMS AP data include 109 public schools and 190 private schools. The average D-WMS overall management score for AP private schools is 2.15 (SD = 0.25). The average D-WMS overall management score for AP public schools is 1.81 (SD = 0.25).

In private schools, management quality is strongly positively correlated with teacher education, and positively correlated with teacher training and the education level of the headteacher, though again these are not typically significant. It is not significantly correlated with student characteristics in general, though it is (somewhat surprisingly) positively correlated with the fraction of students who belong to historically disadvantaged scheduled castes.[24] Management

[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 organisation.

Table 2. *Correlates of Management Quality: Student, Teacher and School Characteristics.*

Table of coefficients: each cell is a bi-variate regression						
	Public			Private		
	z-mgmt (1)	z-ops (2)	z-people (3)	z-mgmt (4)	z-ops (5)	z-people (6)
Panel A: student characteristics						
Share female	0.552	0.658	0.171	−0.229	−0.226	−0.159
	(0.366)	(0.457)	(0.179)	(0.334)	(0.365)	(0.202)
Share scheduled caste	−0.179	−0.191	−0.097	0.669**	0.726**	0.340
	(0.226)	(0.275)	(0.100)	(0.309)	(0.319)	(0.213)
Share literate parents	0.557**	0.627*	0.241**	0.244	0.262	0.129
	(0.258)	(0.317)	(0.117)	(0.245)	(0.265)	(0.145)
Share labourer parents	−0.751***	−0.869***	−0.281**	−0.204	−0.263	−0.026
	(0.249)	(0.302)	(0.113)	(0.257)	(0.273)	(0.165)
Average household assets index	0.185	0.223	0.053	0.016	0.030	−0.015
	(0.136)	(0.165)	(0.065)	(0.111)	(0.121)	(0.067)
Panel B: teacher characteristics						
Share with a degree	0.233	0.213	0.192*	0.603***	0.671***	0.275**
	(0.317)	(0.384)	(0.113)	(0.180)	(0.196)	(0.118)
Share with teacher training	0.402	0.439	0.200	0.334	0.391*	0.117
	(0.539)	(0.661)	(0.187)	(0.207)	(0.227)	(0.129)
Average teaching experience	0.009	0.016	−0.007	−0.012	−0.013	−0.004
	(0.015)	(0.018)	(0.006)	(0.021)	(0.022)	(0.013)
Average number of workdays	−0.007	−0.009	−0.002	0.001	0.000	0.001
	(0.008)	(0.009)	(0.005)	(0.006)	(0.007)	(0.003)
Headteacher teaching experience	0.008	0.015	−0.009	0.005	0.004	0.007
	(0.015)	(0.018)	(0.006)	(0.011)	(0.012)	(0.007)
Headteacher has degree	0.023	−0.029	0.112	0.298*	0.300	0.195*
	(0.280)	(0.334)	(0.110)	(0.176)	(0.193)	(0.108)
Panel C: school characteristics						
School size (# students)	−0.113	−0.126	−0.049	0.286***	0.293***	0.178***
	(0.136)	(0.161)	(0.066)	(0.078)	(0.087)	(0.048)
Log of total school fees				0.159*	0.173*	0.080
				(0.085)	(0.089)	(0.055)
Number of schools	109	109	109	190	190	190

Notes: $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$. SEs are reported in parentheses, clustered by school. Data is at the school level. Outcome variables: z-mgmt is the overall standardised management score, z-ops is the standardised index of operations questions and z-people is the standardised index of people management questions. Headteacher refers to the teacher formally appointed as headteacher or the most senior teacher at the school.

quality is also positively correlated with school size and weakly correlated 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 residualised 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 residualised distribution (especially for people management) shifts leftward for private schools and rightward for public schools (reflecting the greater socio-economic advantage of students attending private schools). But, the shape of the distribution is virtually unchanged.[25]

[25] The raw (and residualised) SDs of the distributions are as follows. Private schools: 0.91 SDs (0.85 SDs) for operations management and 0.53 SDs (0.58 SDs) for people management. Public schools: 1.02 SDs (0.95 SDs) for

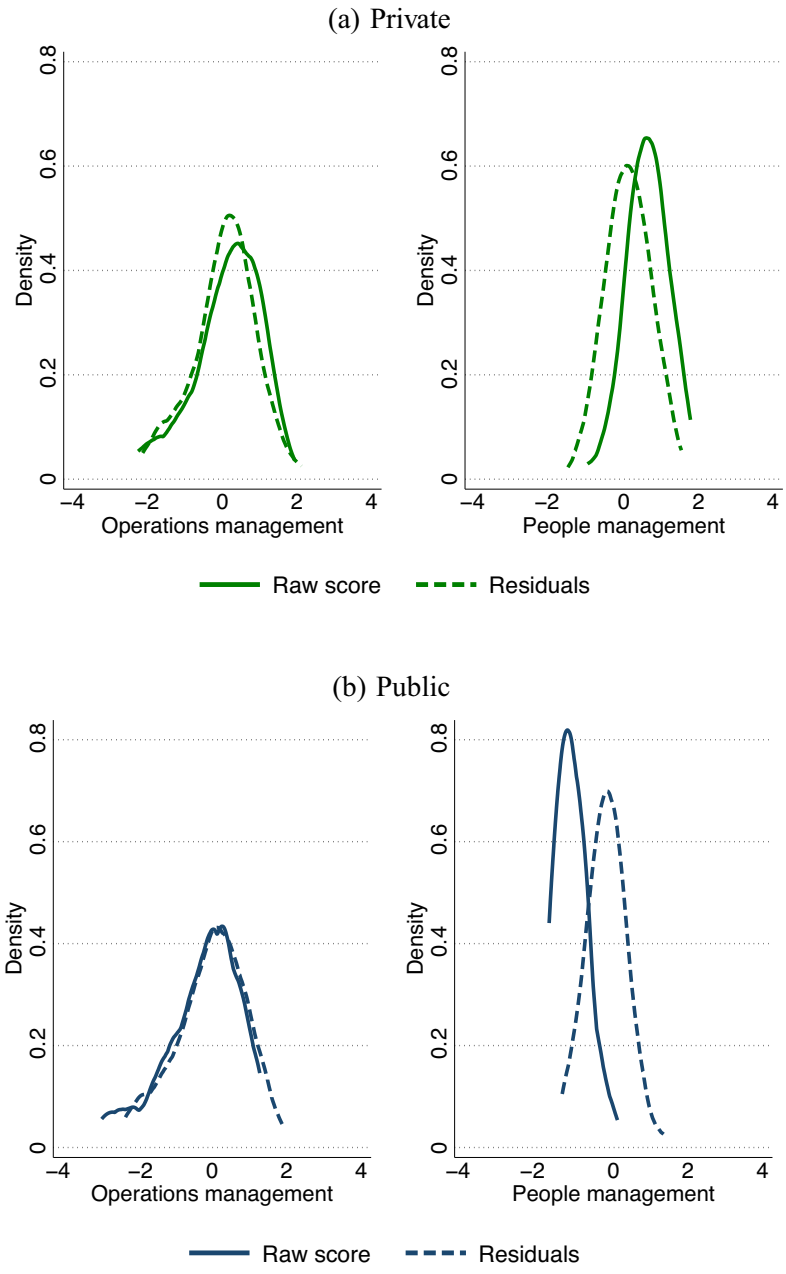


Fig. 3. *Distribution of Management: Raw versus Residual.*

Notes: 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 standardised relative to the full distribution. The residuals are from regressions of the standardised management indices on a set of student, teacher and school controls listed in Table 2. The raw (and residualised) SDs of the distributions are as follows. Private schools: 0.91 SDs (0.85 SDs) for operations management and 0.53 SDs (0.58 SDs) for people management. Public schools: 1.02 SDs (0.95 SDs) for operations management and 0.39 SDs (0.52 SDs) for people management.

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 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.

3.3. *School Management and Teacher Practices*

To explore the relationship between teacher practices and school management, we build a teacher practice index combining 16 teaching practices, as described in Section 2.2.

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 and the set of controls included are those described in Table 2: the T_j are the teacher and headteacher controls (teacher has a degree, teacher has teacher training, teaching experience in years, number of work days, headteacher teaching experience and headteacher education); the S_s are the school controls (log of the number of students, share of female students, share of students from scheduled castes, share of students with labourer and literate parents and an average household asset index). Here η_j and ψ_t are subject and year fixed effects. SEs 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 six 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 behaviour in their core tasks in the same data set.

3.4. *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

operations management and 0.39 SDs (0.52 SDs) for people management. Online Appendix Figure A3 shows the cumulative distribution of the residualised scores and reports the p-value of the Kolmogorov–Smirnov test of equality of distributions. While the people management residualised distribution for private schools stochastically dominates the distribution for public schools, this is not true for operations management.

Table 3. *School Management Practices and Teacher Practices.*

	Dependent variable: teacher practice index					
	Public schools			Private schools		
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: no controls						
z-management	0.290***			0.221***		
	(0.060)			(0.051)		
z-operations		0.246***			0.200***	
		(0.048)			(0.045)	
z-people			0.300**			0.286***
			(0.118)			(0.085)
Observations	1,045	1,045	1,045	2,001	2,001	2,001
# schools	109	109	109	190	190	190
# teachers	310	310	310	1,068	1,068	1,068
Outcome variable SD	0.90	0.90	0.90	1.05	1.05	1.05
R^2	0.117	0.119	0.0635	0.0561	0.0558	0.0455
Panel B: with controls						
z-management	0.265***			0.206***		
	(0.063)			(0.052)		
z-operations		0.228***			0.186***	
		(0.048)			(0.046)	
z-people			0.218*			0.254***
			(0.121)			(0.092)
Observations	1,045	1,045	1,045	2,001	2,001	2,001
# schools	109	109	109	190	190	190
# teachers	310	310	310	1,068	1,068	1,068
Outcome variable SD	0.90	0.90	0.90	1.05	1.05	1.05
R^2	0.161	0.164	0.118	0.0988	0.0985	0.0903

Notes: $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$. SEs are reported in parentheses, clustered by school. Data is at the school-teacher-subject-year level. Subjects include math and Telugu. The *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 14 self-reported classroom practices. The 14 practices include makes lesson plans, has textbook/workbook, checks hygiene daily, percentage of time teaching, percentage of time on teaching activities, percentage of 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 types of help). The teacher practice index is a standardised measure, built using the Anderson (2008) weighted average method. z-management is the standardised overall management index. z-operations and z-people are the standardised 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, headteacher teaching experience and headteacher education) and *school controls* (log of the number of students and the average shares of female students, of students from scheduled castes, of literate parents and of labourer parents). All regressions include subject and year fixed effects.

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 class subject j, at school s in year t and M_s is the z-score of each management index. We estimate (2) both with and without controls. The set of controls included are those described in Table 2 and are the same as those used in (1). The X_p are the individual student controls, the T_j are the teacher and headteacher controls and the S_s are the

Table 4. *School Management Practices and Student Value added in each Type of School (Lagged Test-Score Specification).*

	Dependent variable: endline test score							
	Public schools				Private schools			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A: no controls								
z-management	0.172***				0.058**			
	(0.044)				(0.029)			
z-operations		0.134***		0.070		0.044		−0.001
		(0.039)		(0.053)		(0.027)		(0.038)
z-people			0.372***	0.264**			0.117***	0.117*
			(0.072)	(0.104)			(0.043)	(0.062)
Baseline score	✓	✓	✓	✓	✓	✓	✓	✓
Observations	7461	7461	7461	7461	38,784	38,784	38,784	38,784
# schools	109	109	109	109	190	190	190	190
# students	2,665	2,665	2,665	2,665	12,661	12,661	12,661	12,661
R^2	0.146	0.142	0.147	0.150	0.121	0.120	0.122	0.122
Panel B: with controls								
z-management	0.160***				0.065**			
	(0.045)				(0.029)			
z-operations		0.125***		0.083*		0.050*		0.009
		(0.039)		(0.048)		(0.027)		(0.035)
z-people			0.312***	0.193**			0.120***	0.110**
			(0.079)	(0.097)			(0.039)	(0.053)
Baseline score	✓	✓	✓	✓	✓	✓	✓	✓
Observations	7,461	7,461	7,461	7,461	38,784	38,784	38,784	38,784
# schools	109	109	109	109	190	190	190	190
# students	2,665	2,665	2,665	2,665	12,661	12,661	12,661	12,661
R^2	0.187	0.185	0.184	0.188	0.145	0.145	0.147	0.147

Notes: $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$. SEs are reported in parentheses, clustered by school. Data is at the student-subject-class level. z-management is the standardised overall management index. z-operations and z-people are the standardised 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 labourers and a household asset index), *teacher controls* (share of teachers with a degree, share with teacher training, average teaching experience, average number of work days, headteacher teaching experience and headteacher education) and *school controls* (log of the number of students and the average shares of female students, of students from scheduled castes, of literate parents and of labourer parents). All specifications include subject and year fixed effects.

school controls. Here η_j and ψ_t are subject and year fixed effects. SEs 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 (2) in the main tables, and provide the results from the alternate approach in the Online 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. However, variation in people management seems to matter much more (almost three times more) for ex-

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

Table 5. *School Management Practices and Variation in Teacher Practices/Effectiveness.*

	Dependent variable: within-school maximum value − minimum value					
	Teacher pratice index			Teacher value added		
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: no controls						
z-management	−0.134			−0.024**		
	(0.092)			(0.011)		
z-operations		−0.134*			−0.024**	
		(0.079)			(0.009)	
z-people			−0.047			−0.007
			(0.161)			(0.019)
Private	1.007***	0.928***	0.958***	0.110***	0.096***	0.099**
	(0.166)	(0.135)	(0.313)	(0.021)	(0.018)	(0.039)
# schools	299	299	299	299	299	299
R^2	0.120	0.123	0.113	0.0799	0.0848	0.0652
Panel B: with controls						
z-management	−0.185*			−0.031***		
	(0.099)			(0.011)		
z-operations		−0.169**			−0.029***	
		(0.084)			(0.009)	
z-people			−0.174			−0.023
			(0.170)			(0.019)
Private	0.125	0.017	0.246	0.039	0.021	0.050
	(0.276)	(0.262)	(0.381)	(0.033)	(0.032)	(0.044)
# schools	299	299	299	299	299	299
R^2	0.223	0.225	0.214	0.237	0.240	0.218

Notes: $^*p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$. Standard errors are reported in parentheses, clustered by school. Data is at the school level. The teacher practice index includes 16 practices, as described in Section 2.2. Teacher value added is estimated using the Chetty *et al.* (2014) method and vam Stata command. Max − Min is the difference between the highest and lowest average teacher practice index (columns (1)–(3)) and average teacher value added (columns (4)–(6)) of teachers within each school. 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, headteacher teaching experience and headteacher education) and *school controls* (log of the number of students and the average shares of female students, of students from scheduled castes, of literate parents and of labourer parents). Data are collapsed across all years of data to build teacher averages.

plaining variation in school effectiveness. We see this both by comparing columns (2) and (3) of 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 the magnitudes and significance of the coefficients are quite 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. Furthermore, since official policies are identical across all 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 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 (Online Appendix 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 (2012–3) 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 headteachers have had a tenure of at least three years at the time of answering the D-WMS survey questions. Of schools in our sample, 84% (77% of public and 88% of private schools) meet this restriction. We report these results in Online Appendix 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 2.2).

3.5. *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 practice index and 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 (Table 5).[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

[27] We use this metric because public schools have under four teachers on average (see Online Appendix Table A4), which would yield noisy estimates of within-school SDs 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 1,000 and 45,000 observations, respectively, we have only 299 observations for the 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 Online Appendix Tables A5 and A6).

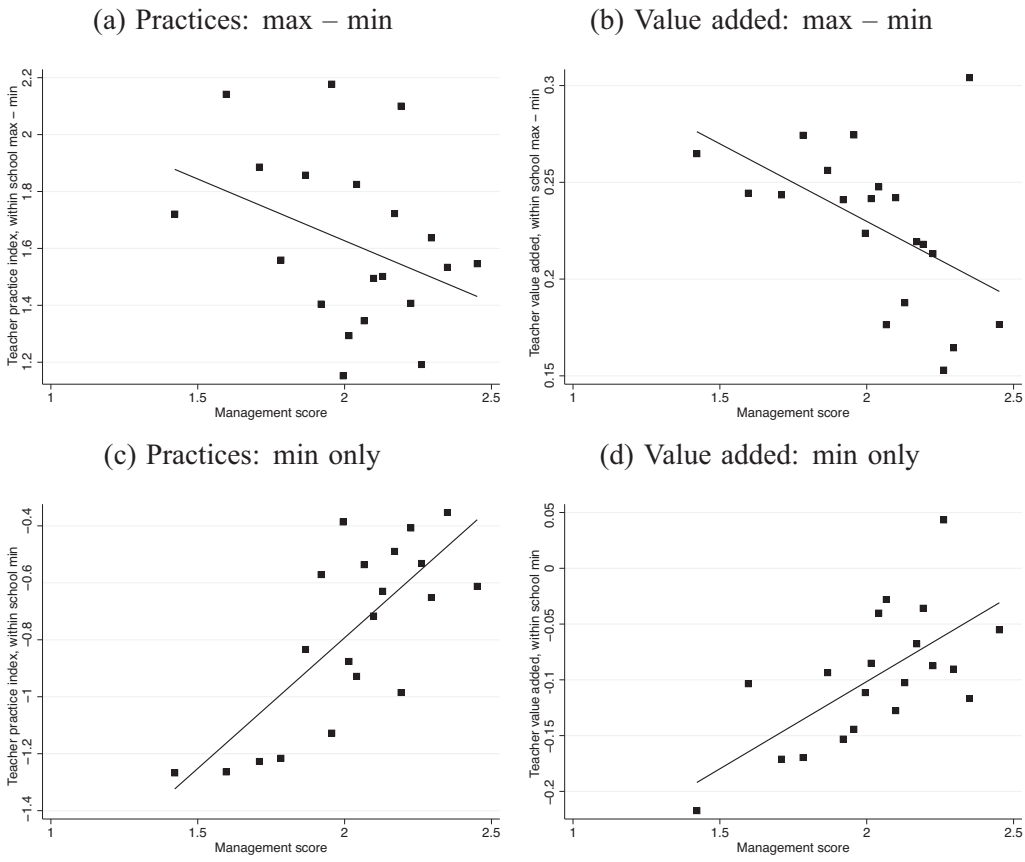


Fig. 4. *School Management and Variation in Within-School Teacher Practices/Effectiveness.*
Notes: This figure plots the binned scatterplot of the pooled raw relationship between the within-school difference between maximum and minimum teacher practice index values (panel (a)) and TVA values (panel (b)), and the pooled raw relationship between the minimum teacher practice index values (panel (c)) and TVA values (panel (d)) relative to management practices. As this analysis uses pooled data, it includes a dummy control for private schools. As the numbers of teachers in public and private schools are considerably different, we focus on the difference between the best and worst teachers rather than on a measure like the within-school SD.

increase variation), but also by improving the performance of weaker teachers. We test for this possibility by correlating D-WMS scores with the teacher practice 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 (Online Appendix 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

Table 6. *School Management Practices and Minimum Teacher Practices/Effectiveness.*

	Dependent variable: within-school minimum value					
	Teacher practice index			Teacher value added		
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: no controls						
z-management	0.283***			0.047***		
	(0.068)			(0.011)		
z-operations		0.260***			0.042***	
		(0.058)			(0.009)	
z-people			0.276**			0.052***
			(0.124)			(0.017)
Private	−0.651***	−0.473***	−0.859***	−0.095***	−0.066***	−0.141***
	(0.131)	(0.108)	(0.243)	(0.022)	(0.019)	(0.036)
# schools	299	299	299	299	299	299
R^2	0.105	0.111	0.0591	0.0788	0.0811	0.0449
Panel B: with controls						
z-management	0.257***			0.046***		
	(0.071)			(0.012)		
z-operations		0.232***			0.042***	
		(0.061)			(0.010)	
z-people			0.266**			0.050***
			(0.124)			(0.018)
Private	−0.376**	−0.220	−0.558**	−0.056*	−0.027	−0.093**
	(0.190)	(0.178)	(0.265)	(0.033)	(0.032)	(0.040)
# schools	299	299	299	299	299	299
R^2	0.186	0.189	0.154	0.202	0.204	0.171

Notes: $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$. Standard errors are reported in parentheses, clustered by school. Data is at the school level. Teacher Practice Index includes 16 practices, as described in Section 2.2. Teacher value added is estimated using the Chetty *et al.* (2014) method and vam Stata command. Min is the minimum value of 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, headteacher teaching experience and headteacher education) and *school controls* (log of the number of students and the average shares of female students, of students from scheduled castes, of literate parents and of labourer parents). Data are collapsed across all years of data to build teacher averages.

management scores and the minimum level of teacher effectiveness. This is consistent with the operations management score picking up intensive margin channels such as standardisation of processes and monitoring their implementation. The second is the strong positive correlation between management scores and minimum teacher effectiveness in *public* schools (Online Appendix 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]

[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.*, 2021). However, this result is based on a small sample of teacher exits and our data are 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.

3.6. *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 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 class 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: the X_p are the student controls (indicators for female student, scheduled caste, parents are literate, parents are manual labourers and a household asset index), the T_j are the teacher and headteacher controls and the S_s are the school controls including the school averages of student characteristics. Here η_j and ψ_t are subject and year fixed effects. SEs are clustered at the school level.

Results from (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 0.33 SDs 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 private schools (Online Appendix Table A1). Thus, the pure private school productivity 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 (Online Appendix Table A15).

3.7. *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.

[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.

Table 7. *School Management Practices and Student Value Added—Pooled across Public and Private Schools (Lagged Test-Score Specification).*

	Dependent variable: endline test score				
	Public and private schools				
	(1)	(2)	(3)	(4)	(5)
Panel A: no controls					
Private = 1	0.328***	0.232***	0.295***	0.029	0.084
	(0.062)	(0.064)	(0.059)	(0.089)	(0.107)
Scholarship = 1	−0.257***	−0.274***	−0.268***	−0.290***	−0.287***
	(0.076)	(0.077)	(0.078)	(0.072)	(0.074)
z-management		0.094***			
		(0.026)			
z-operations			0.076***		0.031
			(0.023)		(0.033)
z-people				0.169***	0.130**
				(0.038)	(0.056)
Baseline score	✓	✓	✓	✓	✓
Observations	46,245	46,245	46,245	46,245	46,245
# schools	299	299	299	299	299
# students (private)	12,661	12,661	12,661	12,661	12,661
# students (public)	2,665	2,665	2,665	2,665	2,665
R^2	0.143	0.150	0.149	0.151	0.151
Panel B: with controls					
Private = 1	0.461***	0.375***	0.438***	0.194**	0.265**
	(0.083)	(0.081)	(0.081)	(0.093)	(0.106)
Scholarship = 1	−0.256***	−0.280***	−0.273***	−0.291***	−0.289***
	(0.070)	(0.069)	(0.070)	(0.066)	(0.067)
z-management		0.100***			
		(0.025)			
z-operations			0.081***		0.044
			(0.023)		(0.030)
z-people				0.162***	0.112**
				(0.035)	(0.046)
Baseline score	✓	✓	✓	✓	✓
Observations	46,245	46,245	46,245	46,245	46,245
# schools	299	299	299	299	299
# students (private)	12,661	12,661	12,661	12,661	12,661
# students (public)	2,665	2,665	2,665	2,665	2,665
R^2	0.167	0.174	0.172	0.173	0.174

Notes: $^{**}p < 0.05$, $^{***}p < 0.01$. SEs are reported in parentheses, clustered by school. Data is at the student-subject-class level. The dependent variable student value added is estimated by using the residuals of a regression of the endline test score on the baseline test score for each student. z-management is the standardised overall management index. z-operations and z-people are the standardised 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 labourers and a household asset index), *teacher controls* (share of teachers with a degree, share with teacher training, average teaching experience, average number of work days, headteacher teaching experience and headteacher education) and *school controls* (log of the number of students and the average shares of female students, of students from scheduled castes, of literate parents and of labourer parents). All regressions include subject and year fixed effects.

We study the relationship between teacher pay and productivity using the specification

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

where $LnWages_{js}$ 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 normalised to have a mean of zero and an SD of 1. The T_j are the teacher and headteacher controls and the S_s are the school controls including the school averages of student characteristics from Table 2. SEs 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 effectively 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 negatively correlated 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 SD earns about 48% 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 29% 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 the results of Bender *et al.* (2018) and Cornwell *et al.* (2021), who found 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

[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) showed that there is no correlation between doctor pay and quality of care provided in public clinics in India.

[33] For instance, Kremer *et al.* (2005) found 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 (Online Appendix Table A10).

Table 8. *School Management Practices and Teacher Wages.*

	Dependent variable: ln(wages)						
	Public			Private			All
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Panel A: no controls							
Value added							
Teacher value added	−0.194	−0.183	−0.106	0.486***	0.409***	0.436***	−0.194
	(0.191)	(0.191)	(0.205)	(0.132)	(0.127)	(0.129)	(0.190)
Private = 1							−1.922***
							(0.046)
Private = 1 × teacher value added							0.679***
							(0.231)
Management							
z-operations		−0.007			0.091***		
		(0.031)			(0.029)		
z-people			−0.152			0.114*	
			(0.115)			(0.061)	
Observations	242	242	242	1,086	1,086	1,086	1,328
# Unique teachers	236	236	236	1,059	1,059	1,059	1,295
# Schools	105	105	105	190	190	190	295
Mean wages (Rs)	14,237	14,237	14,237	2,596	2,596	2,596	4,717
Panel B: with controls							
Value added							
Teacher value added	−0.279*	−0.275*	−0.266	0.294***	0.266**	0.281***	−0.232
	(0.157)	(0.156)	(0.165)	(0.107)	(0.106)	(0.105)	(0.170)
Private = 1							−1.515***
							(0.078)
Private = 1 × teacher value added							0.549***
							(0.203)
Management							
z-operations		−0.003			0.033		
		(0.025)			(0.025)		
z-people			−0.036			0.031	
			(0.092)			(0.053)	
Observations	242	242	242	1,086	1,086	1,086	1,328
# Unique teachers	236	236	236	1,059	1,059	1,059	1,295
# Schools	105	105	105	190	190	190	295
Mean wages (Rs)	14,237	14,237	14,237	2,596	2,596	2,596	4,717

Notes: $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$. SEs are reported in parentheses, clustered by school. Data is at the school-teacher level. 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 × TVA is an interaction between the private indicator and the teacher value-added measure. z-operations and z-people are the standardised 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, headteacher teaching experience and headteacher education) and *school controls* (log of the number of students and the average shares of female students, of students from scheduled castes, of literate parents and of labourer parents). Data are collapsed across all years of data to build teacher averages.

(column (7)).[35] Our results are similar to and consistent with those found in Pakistan by Bau and Das (2020). They also found no significant relationship between teacher wages and TVA in the public sector, but found a significant positive correlation in the private sector.

[35] The *F*-test on the sum of the TVA and private x TVA coefficients yields p-values below 0.01, lending further support to this point.

4. 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 organisations (both for profit 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 United States (Fryer, 2014; 2017). At the same time, organisational 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 randomised evaluation of a flagship school quality 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 Bloom *et al.* (2013) and Anderson and McKenzie (2022) 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.*, 2023) to Turkey (Alan *et al.*, 2023).

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

[36] These findings are consistent with a growing body of experimental evidence from developing countries, which finds 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 (Muralidharan and Sundararaman, 2011; Leaver *et al.*, 2021).

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 headteachers' self-reported amount of autonomy and that (*b*) public schools report much lower levels of autonomy than private schools, suggesting considerable room for increasing their autonomy (Online Appendix 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 to (*c*) experimentally study the relationship between changes in school management practices and changes in teaching practices and student outcomes.[40]

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Additional Supporting Information may be found in the online version of this article:

Online Appendix
Replication Package

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[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 about five years compared to about ten in private schools, and headteacher tenure is positively correlated with management quality (Online Appendix 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) found 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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