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PERSONNEL MANAGEMENT AND SCHOOL PRODUCTIVITY: EVIDENCE FROM INDIA

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ABSTRACT

This paper uses new data to study school management and productivity in India. We report four main results. First, management quality in public schools is low, and ~2σ below high-income countries with comparable data. Second, private schools have higher management quality, driven by much stronger people management. Third, people management quality is correlated with both independent measures of teaching practice, as well as school productivity measured by student value added. Fourth, private school teacher pay is positively correlated with teacher effectiveness, and better-managed private schools are more likely to retain more effective teachers. Neither pattern is seen in public schools.

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1 Introduction

Developing countries have made impressive progress in expanding primary school enrollment in the last couple of decades, but learning outcomes continue to be poor (World Bank; 2018). A growing body of evidence suggests that simply expanding schooling inputs may not be very effective without also improving the productivity of how these inputs are used — especially governance and pedagogy (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 developed to expand on the original WMS tool (Bloom and Van Reenen; 2007) to obtain comparable but 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 representative sample of rural public and private schools in the Indian state of Andhra Pradesh (AP).[1] The combination of these two datasets allows us to present the first detailed and comparable evidence of the types of management practices used in primary schools in a developing country, across the public and private sector, and also examine how they correlate with measures of school effectiveness.

We report four main results. First, public schools in AP have low management quality. Based on a normalized cross-country comparison, we estimate that management quality in AP public schools is almost 2σ below the mean of 6 high-income countries with comparable data.[2] However, the low management quality in AP is *not* an outlier after adjusting for log per-capita income (Figure 1). 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 1.36σ higher than in AP public schools (normalized relative to the distribution of AP public schools). Our management score can be decomposed into scores

[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 were collected as part of 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.

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 4.8σ 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 1σ higher people-management score is associated with 0.26σ better teacher practices and 0.34σ higher student value added. In private schools, these are 0.24σ and 0.16σ 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, and not in a causal sense).

Fourth, we find that better management is directly correlated with personnel policies that reward effective teaching on both the intensive (wage) and extensive (selection) margins. In private schools, more effective teachers, measured by teacher value-added (TVA), receive significantly higher wages even after controlling for observable teacher characteristics. A teacher who adds an extra 1σ to student learning each year on average is paid about 26% higher wages. We find no correlation between TVA and wages in public schools. Better managed private schools are also more effective at selecting and retaining more effective teachers, but we find no such relationship in public schools.

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

This residual variation most likely reflects idiosyncratic variation in school-level management practices. This is consistent with the management scores in our setting being below 2.5 for most schools on the D-WMS scale, which codes management quality on a 1-5 scale. On this scale, scores below 3 reflect variation in individual practices that are not formally codified in any school management policy. As such, the variation in management quality in our data is best interpreted as reflecting variation in management practices employed by individual school leaders rather than variation in formal policies.

Our first contribution is to better measurement of management practices in low and middle income countries (LMICs). Specifically, this paper presents the development and first use of the enhanced measurement tool (the D-WMS) designed for low-capacity contexts. The survey instruments along with detailed notes on administering and coding the surveys are included in Appendix B[3]. We recommend the use of these tools for future research on management in LMICs 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.[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.

Second, we show that management quality — especially the quality of personnel management — directly contributes to 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 and may not be a good measure of school productivity. The combination of independent measures of teaching practices and panel data on student learning allow us to present the first direct evidence on the correlation between school management quality and independent measures of school effectiveness and productivity in any setting (across high and low-income countries).[6]

Our results also 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" (Coelli and Green; 2012; Walsh and Dotter; 2020; Lavy and Boiko; 2017; Munoz and Prem; 2020). Yet, for the most part, this literature has not gotten into the "black box" of specific practices of effective school leaders. Thus, the main practical implication of this literature would be to focus on the selection margin of *identifying* effective school leaders. However, knowing that specific practices matter may

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

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

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

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

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).

Finally, we contribute to the broader literature on public-sector personnel economics (e.g. Lazear (1995); Finan et al. (2015)), and to the comparative analysis of management in the public and private sector (Rainey and Chun; 2007). Specifically, we present (to our knowledge) the first evidence that combines measures of management quality, employee behaviors, and productivity; with comparable data across public and private sector entities in any sector. This allows us to demonstrate the central role played by better personnel management in explaining the greater productivity in the private sector.

2 The Indian primary school institutional context

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

The private schools in our study sample are not elite schools. Rather, they represent a segment of schools that are referred to as "low-cost" or "budget" private schools. These low-cost private schools have substantially lower per-student expenditure than public schools, and the vast majority of enrollment in private schools in India is accounted for by this segment of schools (CSF; 2020). Similar trends are seen in Pakistan (Andrabi et al.; 2008). The main driver of the lower costs in these private schools is that they pay much lower teacher salaries. In our sample of schools, the average public-school teacher salary is over 5 times the average private school teacher salary (Rs. 14,286 vs. 2,607 per month).

Public school teachers are better qualified and are much more likely to have formal teacher training credentials (99% vs. 34%). However, teacher effort and accountability are significantly higher in private schools. Private schools have a longer school year (11 more working days), a longer school day (45 minutes longer per day), and much lower rates of teacher absence (9% vs. 24%). They also have significantly higher rates of active teaching when measured by unannounced visits to schools (50% vs. 35%). Private schools also have lower levels of multi-grade teaching (where one teacher simultaneously teaches multiple grades)

than public schools (24% vs 79%). Public primary schools in our sample have an average of 68 students and 3 teachers across grades 1-5. Private schools are substantially larger with over 300 students on average and about 14 teachers.[7] Though these private schools are low cost, they still charge fees, whereas public schools are free. Thus, students attending these private schools come from relatively more advantaged backgrounds, as measured by parental education, occupation, and assets.[8]

3 Data

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

The original World Management Survey (WMS) project started in 2002 and has since then collected over 30,000 data points on the quality of management practices in establishments in the manufacturing, retail, education and healthcare sectors across 39 countries. LMICs (and especially schools in LMICs) have much lower scores on average, often bunching at the minimum score of 1.[9] To better capture variation in this thick bottom tail, we developed and use an enhanced measure of management quality for this paper — which we refer to as the Development WMS (D-WMS). The D-WMS adds granularity to the measurement of management practices, while maintaining comparability with the original WMS 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.

3.1.1 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, there are three broad types of questions that interviewers use: first they ask about the existence of the

[7] All figures reported in this section are based on Tables 3, 4, and 5 of Muralidharan and Sundararaman (2015). We present a comparison of key metrics in Table A1.

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

[9] For a review of the latest WMS public dataset, see Bloom et al. (2014). For the first paper on WMS measurement in schools, see Bloom et al. (2015)

practice (for example, does the school even have performance indicators and which ones), then they ask about the usage of the practice (how is it implemented, how often it is used) and finally they ask about the monitoring of the practice itself (how do they keep track that it is being understood and used effectively). In the original WMS these three factors were embedded in each score, while in the D-WMS they are explicit and require separate scores. This approach reduces measurement error by providing a much tighter scoring rubric and limiting the amount of judgment that interviewers need to apply in coding responses. This is especially important for LMIC settings, where high quality interviewers may not be available or affordable (the original WMS was coded by MBA students from leading universities).

The expansion enables a better understanding 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.[10] Using survey instruments that capture this distinction will be especially useful for research on the effectiveness of management interventions in LMICs.

3.1.2 Expansion to capture greater variation across the scoring scale

The expanded survey instrument measures the level of adoption of management practices on a scale of 1 to 5, in increments of 0.5 for each of the 20 topics. In the original WMS, a score of 1 means there are no processes at all *or very little processes* in place, while a score of 2 means there are *some informal* processes in place mainly adopted by the headteacher herself (as opposed to some formal "school policy"). A score of 3 means there is a formal process in place, though it has weaknesses such as not being followed all the time or properly. Scores of 4 and 5 indicate increasing levels of adherence and "embeddedness" of the practices such that they are part of the culture of the school.

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. The scores in low and middle income income countries, however, rarely span beyond 3. In AP public schools, the distribution of the comparable WMS people-management scores would have a mode of 1. 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

[10]For example, a headteacher that we visited in AP during the pilot showed us a great report card that they use to measure student achievement (Figure B1). When asked what they do with the report cards and the information, they showed us a storage spot where all the data was kept safely but unfortunately also not used or even usable. This is similar to findings reported in Muralidharan and Sundararaman (2010).

that they are still rather ad-hoc (score of 1.5). We can also distinguish between schools that have an informal practice in place (score of 2) and a "good" informal practice in place that is almost like "formal school policy" (score of 2.5). We provide a more detailed example of the scoring of management practices in Appendix B.

3.1.3 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.[11] To build comparable metrics to the WMS, we recast 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. This means that it is simple to take each half point score and round down to the nearest integer and mimic the original WMS scoring methodology.

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

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

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.

[11] 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.

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 a one-week intensive D-WMS training session prior to field work.

3.2 School, teacher and student data: the APSC dataset

The main school-teacher-student data from the APSC project is explained in Muralidharan and Sundararaman (2015) and spans the 4 school years of the project in AP (2008-09 to 2011-12). We use several variables to build measures from this dataset: student value added, teacher value added, an index of teacher practices, teacher wages, and a measure of teacher selection and retention.

For student value added (SVA) and teacher value added (TVA), we use a panel of subject-specific test scores from tests administered by the APSC project team for Telugu (language) and Math, along with teacher assignments into these subjects. We estimate SVA by using the residuals of a regression of the end of year test score on the previous year's test score for each student, and estimate TVA using the Chetty et al. (2014) method. This method yields a TVA estimate for each teacher and year, using information from all years and subjects taught by each teacher.

We construct a teacher practices index using the set of questions in the teacher questionnaires that related to classroom practices, along with audit data from classroom observation visits. These were collected independent of the student tests and the D-WMS management survey. We aggregated the sixteen items (fourteen self-reported practices and two audit-based measures of teacher presence and likelihood of being found teaching) into a single index using the Anderson (2008) method.[12] A full description of each measure of teaching practice is provided in Appendix B.3; we also present simple correlations of each teaching practice with student value added in Figure B2.

Data on teacher wages are based on self-reports by teachers for all 4 years. Data on teacher turnover and retention is from the second year only. The APSC project collected data on the full roster of teachers, that tracked which teachers had moved out and which ones had transferred in, only in the first two years of the project. For each school, we identify the *highest and lowest* value added teacher within the school using our measure of TVA and construct a measure of "good HR outcome" based on the transfer information between years 1 and 2. The variable takes a value of 1 when the highest value added teacher is retained

[12]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".

in the school or transferred into the school, or the lowest value added teacher is transferred out of the school. It takes a value of zero otherwise.

The combined dataset of APSC-DWMS data includes 299 schools, 190 private and 109 public schools. Our main analysis includes data for Telugu and Math tests for 15,305 students; 12,661 from private schools and 2,665 from public schools.[13] There are a total of 1,171 teachers in our sample; 864 in private schools and 307 in public schools.

4 Results

4.1 Management quality and global comparisons

Figure 1a shows the comparable standardized scores of public school management across a set of countries surveyed using the WMS (UK, Sweden, Canada, US, Germany, Italy, Brazil and India) and the D-WMS (Mexico, Colombia, and Andhra Pradesh).[14] The D-WMS scores were re-scaled to match the WMS scoring convention: all half points were rounded down to the next lowest whole point for each survey question (for example, all scores of 2.5 were re-cast to 2) and the management indices and standardization were based on these comparable scores. The scores are standardized relative to the global distribution. The high-income country mean is 0.975σ, and the score for AP public schools is -1σ. Thus, the average public school in AP scores almost two standard deviations below the average in the high income countries in the WMS.

To place these scores in context, Figure 1b plots the standardized management scores against the log of the 10-year average GDP per capita for these countries. We see that there is 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 that the quality of human capital produced per year of schooling is significantly higher in richer countries (Schoellman; 2011). However, there is very little evidence on the drivers for this fact or their relative importance. One likely explanation is that higher-income countries' education systems have more inputs per

[13] Overall, our sample has 35,964 observations over four years (unbalanced panel).

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

student (including having more educated parents). However, it is also possible that there is variation in the productivity of these inputs across countries. As such, to the extent that the quality of school management is correlated with the productivity of school systems (as we show below), Figure 1b suggests that poorer management quality may be an important contributor to the lower productivity of education systems in lower-income countries.

The discussion above is analogous to the "growth accounting" literature that has aimed to decompose variation in cross-country GDP per capita into variation in inputs (land, labor, and capital — both physical and human) and variation in total factor productivity (TFP) (Caselli; 2005). Given the growing interest in understanding the comparative productivity of education systems across countries (Pritchett; 2015; Singh; 2019), and investments in comparable data on learning outcomes across countries (Filmer et al.; 2020), it may be useful to conduct a similar accounting exercise to explain variation in the effectiveness of education systems. Since management quality is likely to be an important component of TFP, the D-WMS can be a useful measurement tool for such an exercise. This would be analogous to the approach taken by Bloom et al. (2016) for manufacturing.

Turning from cross-country comparisons to AP-specific facts, Table 1 presents management scores for public and private schools for each of the 20 management practices in the survey. It also presents scores on operations and people management, and the 10-90 percentile range of scores. Figure 3a shows the distribution of the AP D-WMS management scores for public and private schools.

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

This difference is especially pronounced in the area of people management. Figure 3b shows the distributions of operations and people management scores for each type of school. The mean difference in the operations-management index across public and private schools is 0.12 points, which is relatively small. However, people-management scores in public schools are very low — with a mean of 1.26, and a standard deviation of 0.18. Private schools score 0.87 points higher in people management, which is nearly 4.8σ higher (relative to the distribution of people-management scores in public schools).[15]

[15]We replicate the two cross-country figures using the people-management score in Figure A1, and see

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 the headteacher from identifying effective and ineffective performers, and following up in a personal capacity.

4.2 Correlates of school management practices

Having documented the variation in management practices across schools, we now examine the correlates of this variation. Table 2 presents the coefficients of binary regressions between student, teacher and school characteristics and school management scores. Each cell reports coefficients from a single regression. Table A2 presents the multiple regression analogue.

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

In private schools, management quality is strongly positively correlated with teacher education and training and also with the education level of the headteacher. It is negatively correlated with the fraction of parents who are manual laborers and (somewhat surprisingly) positively correlated with the fraction of students who belong to historically disadvantaged scheduled castes.[16] Management quality is also positively correlated with school size and with average school fees, which is not surprising.

The relationships above are correlations and purely descriptive. However, what is important for interpreting our results below is that there continues to be considerable variation in the residualized management scores (after controlling for all the variables in Table 2) as in the raw distributions of management scores. We plot these in Figure 4 and see that the residualized distribution (especially for people management) shifts leftward for private schools and rightward for public schools (reflecting the greater socioeconomic advantage of students attending private schools). But, the shape of the distribution is virtually unchanged.[17]

that people management quality in AP private schools are higher than those in public schools in Brazil, Colombia, and Mexico, and comparable to those in public schools in Italy (a country that is nearly seven times richer than India on PPP adjusted GDP per capita).

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

[17] The raw (and residualized) standard deviations of the distributions are as follows. Private schools

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 D-WMS exercise is best thought of as providing a systematic way of getting into the "black box" of school leaders' management practices with a coding schematic that may be useful for designing and testing future interventions to improve school management.

4.3 School management and teacher practices

To explore the relationship between teacher practices and school management, we build a teacher practices index and 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 sixteen teaching practices (described in Appendix B.3) for teacher i, teaching subject j, at school s, at time t. M_s is the z-score of each management index, the set of controls included are those described in Table 2: T_j are the teacher and headteacher controls, S_s are the school controls including the school averages of student characteristics in Table 2. η_j and ψ_t are subject and year fixed effects. Standard errors are clustered at the school level.

Table 3 reports the results separately for public and private schools; for overall, operations, and people-management scores; and with and without the controls listed above. We see a strong and highly significant correlation ($p < 0.01$) in all 6 columns in Panel A (with no controls). Coefficients are slightly smaller but substantively unchanged and still significant after including a full set of controls (Panel B). Thus, the quality of overall, operations, and people management are all strongly correlated with *independently* recorded measures of teaching practice in both public and private schools.

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

operations management: 0.93σ (0.85σ); private schools people management: 0.55σ (0.61σ); public schools operations management: 1.02σ (0.99σ); public schools people management: 0.39σ (0.53σ).

scores and measures of employee behavior in their core tasks in the same data set.

4.4 School management and student value added

Next, we examine the correlations between management scores and school productivity, measured by student value added. We do so by running the following specification for public and private schools, separately:

$$ValueAdded_{pjst} = \alpha + \beta M_s + \theta_1 X_p + \theta_2 T_{js} + \theta_3 S_s + \eta_j + \psi_t + \varepsilon_{pjst} \quad (2)$$

where $ValueAdded_{pjst}$ is the student value added for student p, subject j, at school s in year t. M_s is the z-score of each management index. We estimate Equation 2 both with and without controls. The set of controls included are those described in Table 2: X_p are the individual student controls, T_j are the teacher and headteacher controls, S_s are the school controls including the school averages of student characteristics in Table 2. η_j and ψ_t are subject and year fixed effects. Standard errors are clustered at the school level.

We also estimate the relationship between management quality and student value addition using a lagged test-score specification, where the outcome variable is test scores (TS_{pjst}) in year t and we include lagged test scores on the right-hand side ($TS_{pjs,t-1}$). We estimate:

$$TS_{pjst} = \alpha + \beta M_s + \theta_0 TS_{pjs,t-1} + \theta_1 X_p + \theta_2 T_{js} + \theta_3 S_s + \eta_j + \psi_t + \varepsilon_{pjst} \quad (3)$$

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). Table A4 presents the results from the lagged test-score specification. Since the results are very similar across both approaches, we present those from Equation 2 in the main tables, and Equation 3 in the Appendix.

Starting with public schools, we see a strong and significant correlation ($p < 0.01$) between all management practices (overall, operations, and people) and student value-added (SVA). However, variation in people management seems to matter much more (around 3 times more) for explaining variation in school effectiveness. We see this both by comparing columns 3 and 2, and in column 4 when we include both component scores as regressors. The results are practically unchanged when we include a full set of controls (Panel B): both magnitudes and significance of coefficients are very similar across Panels A and B. Results from the lagged test-score specification are also very similar (Table A4).

While these results are based on correlations, they provide strong suggestive evidence

that better management practices — especially personnel management practices — are likely to matter for school productivity. The value-added specification mitigates several omitted variable concerns, and the robustness to inclusion of a wide variety of controls provides additional reassurance on this front. Further, since official policies are identical across all public schools, the variation in management practices reflect *de facto* practices that are implemented at the school level. Thus, the appropriate way to interpret our results is not as the causal impact of specific practices, but as getting into the "black box" of variation in school leaders' effectiveness by codifying their practices and identifying common patterns in the practices of effective school leaders. In particular, school leaders who implement better personnel management practices appear to be able to deliver greater value addition.

Turning to private schools (Table 4: columns 5-8), we see that the correlations are smaller and not significant between SVA and either overall or operations management scores. People-management scores are significantly correlated with SVA even in private schools (in both columns 7 and 8), but the magnitude is much smaller than in the case of public schools. Results are very similar both without and with controls, and in the lagged test-score specification (Table A4).

These results provide consistent evidence that the quality of personnel management seems to 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 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 SVA in public schools but not in private schools.

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

$$ValueAdded_{pjst} = \alpha + \beta M_s + \lambda_1 PRI_s + \lambda_2 SCO_p + \theta_1 X_p + \theta_2 T_{js} + \theta_3 S_s + \eta_j + \psi_t + \varepsilon_{pjst} \quad (4)$$

where $ValueAdded_{pjst}$ is the student value added for student p, 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 are those described in Table 2: X_p are the student controls, T_j are the teacher and headteacher

controls, S_s are the school controls including the school averages of student characteristics. η_j and ψ_t are subject and year fixed effects. Standard errors are clustered at the school level. We also estimate these relationships using the lagged test-score specification below:

$$TS_{pjst} = \alpha + \beta M_s + \lambda_0 TS_{pjs,t-1} + \lambda_1 PRI_s + \lambda_2 SCO_p + \theta_1 X_p + \theta_2 T_{js} + \theta_3 S_s + \eta_j + \psi_t + \varepsilon_{pjst} \quad (5)$$

Results from Equation 4 are reported in Table 5. Without any controls (Panel A), we see that the average private school appears to have an annual value added of 0.35σ 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.[18] We see that including overall or operations management scores reduce the private school premium slightly but do not meaningfully change the results (columns 2-3). However, including a control for people-management scores sharply reduces the private school premium and renders it insignificant (columns 4-5).

Patterns of results are similar with controls (Panel B). The private school premium is larger with controls, likely reflecting the lower average teacher education, experience, and training in the private schools (Table A1). Thus, the pure "private" school effect may be even larger after accounting for their lower input quality. 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. We see the same results from estimating the lagged test-score specification in Equation 5 (Table A5).

4.5 Personnel management across public and private schools

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

[18] 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). Readers are referred to that paper for a discussion of potential reasons for this result.

$$LnWages_{is} = \alpha + \beta_1 M_s + \beta_2 PRI_s + \beta_3 TVA_{is} + \beta_4 PRI_s \times TVA_{js} + \theta_1 T_{js} + \theta_2 S_s + \varepsilon_{is} \quad (6)$$

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

Results are presented in Table 6. Panel A reports the raw correlations without controls, and Panel B includes all 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 the full sample of teachers across public and private schools.

We find no correlation between pay and productivity in public schools, with or without controls, reflecting a rigid compensation schedule that is mainly based on qualifications and seniority.[19] If anything, pay and productivity appear (insignificantly) 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).[20] Unsurprisingly, there is also no correlation between management quality and teacher pay in the public sector given that headteachers have no authority over teacher pay.

In contrast, teacher pay in private schools is strongly positively correlated with TVA. Without any controls, a teacher who is able to improve average student test scores by one additional standard deviation earns about 42% higher wages (Panel A, Column 4)). This relationship is positive and significant even after including all controls listed in Table 2, and we estimate that such a teacher earns about 26% 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.

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

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

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 is not causal and may also reflect selection: management quality is positively correlated with school size and school fees (Table 2) which may directly affect teacher wages.[21] Indeed, we see that this correlation is not significant in Panel B after including the full set of controls in Table 2. However, the relationship between teacher pay and productivity continues to remain significant. Overall, the levels of teacher salaries are much lower in private schools, but more effective teachers are paid more (Column 7).

Our results are similar to and consistent with those found in Pakistan by Bau and Das (2020). They also find no significant relationship between teacher wages and TVA in the public sector, but do find a significant relationship in the private sector.

Turning to the extensive margin, we estimate:

$$HRoutcome_{is} = \alpha + \beta_1 M_s + \beta_2 PRI_s + \zeta S_s + \varepsilon_{is} \tag{7}$$

where $HRoutcome_{jst}$ equals 1 ("good") if a high value added teacher is transferred into or retained in the school, or if a low value added teacher is transferred out. It takes a value of 0 otherwise. M_s is the management index of interest (operations or people), and PRI is a private school indicator. S_s are the school controls including the school averages of student characteristics from Table 2. Standard errors are clustered at the district level.

Table 7 reports the results. We see that private schools on average are less likely to have a good HR outcome on the extensive margin (Column 1). This reflects the fact that they have much higher rates of teacher turnover, and so they are more likely to lose high-performing teachers. However, we see that better managed private schools are significantly more likely to have a positive HR outcome, again consistent with patterns found in manufacturing firms from Bender et al. (2018) and Cornwell et al. (2021). When we include the full set of controls, only the people-management score is significant, consistent with the outcome variable being more relevant to personnel management. There is no meaningful correlation between management quality and teacher selection or retention in public schools.

Note that detailed teacher roster data (including on transfers and new entrants) was collected only in the first 2 years of the APSC project and so our HR outcomes are defined using only the second-year teacher roster. This limits the sample size and the results above should therefore be treated only as suggestive. We present them for completeness since we are not aware of any prior evidence on this question. Testing for this result in larger samples

[21] A channel of selection is consistent with results in Bender et al. (2018) and Cornwell et al. (2021), who find that better managed firms are more likely to hire and retain more effective workers and managers.

and over longer time periods is an important area for future research.

5 Discussion and Conclusion

There is a growing recognition that the quality of management practices may be an important determinant of productivity differences across firms and countries (Syverson; 2011; Bloom et al.; 2014, 2016). 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. We do so by developing and deploying a new measurement tool (the D-WMS) that permits both greater granularity of measurement of management practices in low capacity settings and comparability with the widely used WMS surveys; and by combining this D-WMS data with panel data on student test scores across public and private schools and a rich dataset of school and teacher characteristics.

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 also have better teaching practices, and add more value to student learning. 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 (Schoellman; 2011; Singh; 2019).

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.[22] 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 at the level of school leaders may be highly effective at improving teacher effort and effectiveness.

Consistent with this view, there is considerable interest among donors, policy makers,

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

and private organizations (both for and non profit) in designing and implementing programs to improve school management in LMICs. The belief that such interventions can be effective is also supported by evidence of success in the US (Fryer; 2014, 2017).

At the same time, recent evidence suggests that improving management quality in public schools at scale in LMICs is not easy. For instance, a large-scale randomized 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. The D-WMS measurement tools developed for this paper can be a useful complement to such 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 interventions, and (c) to experimentally study the relationship between changes in school management practices and changes in teaching practices and student outcomes.[23]

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

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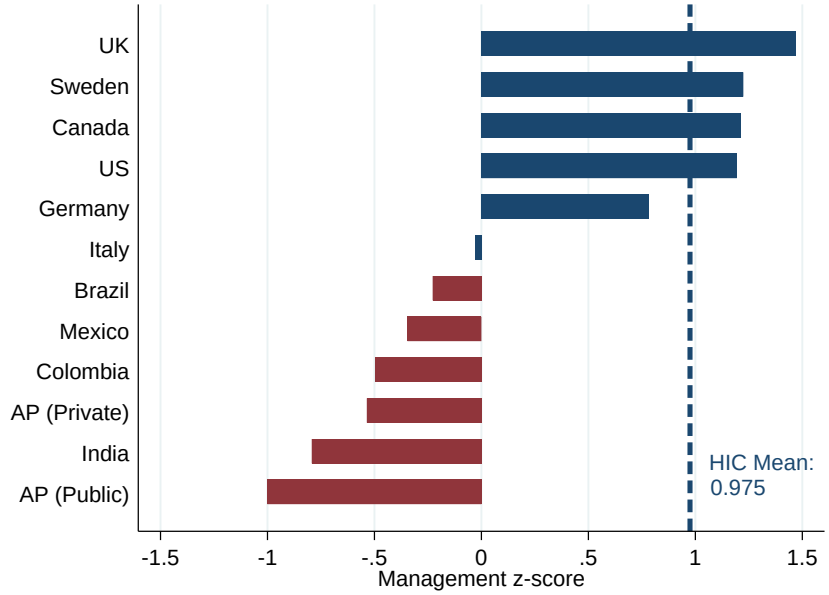
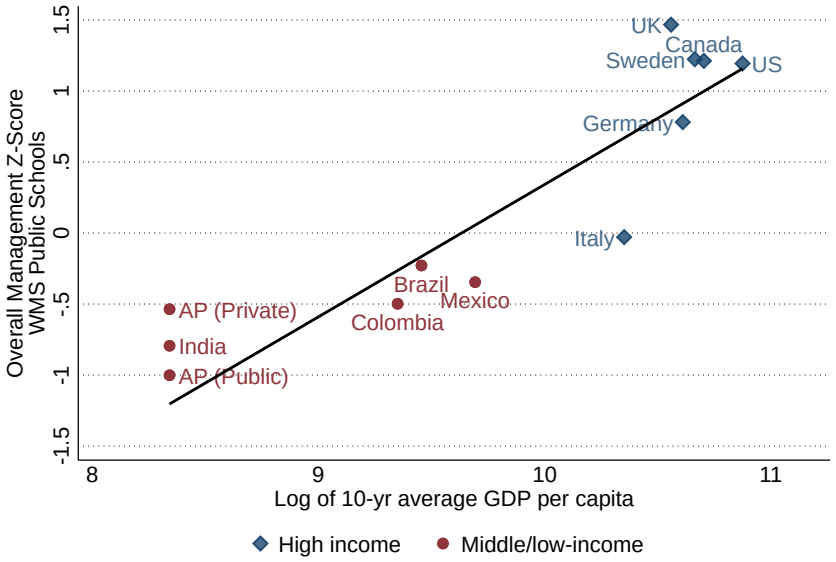
Figure 1: Global benchmarks

(a) Rank of comparable management z-scores

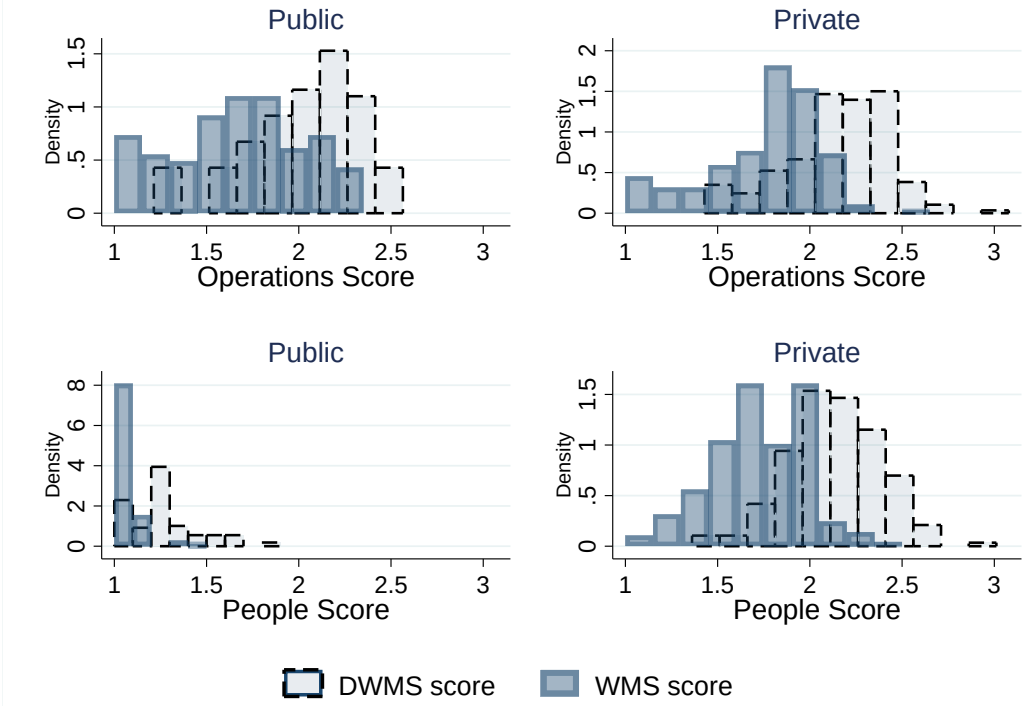


(b) Comparable management z-scores and GDP per capita



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

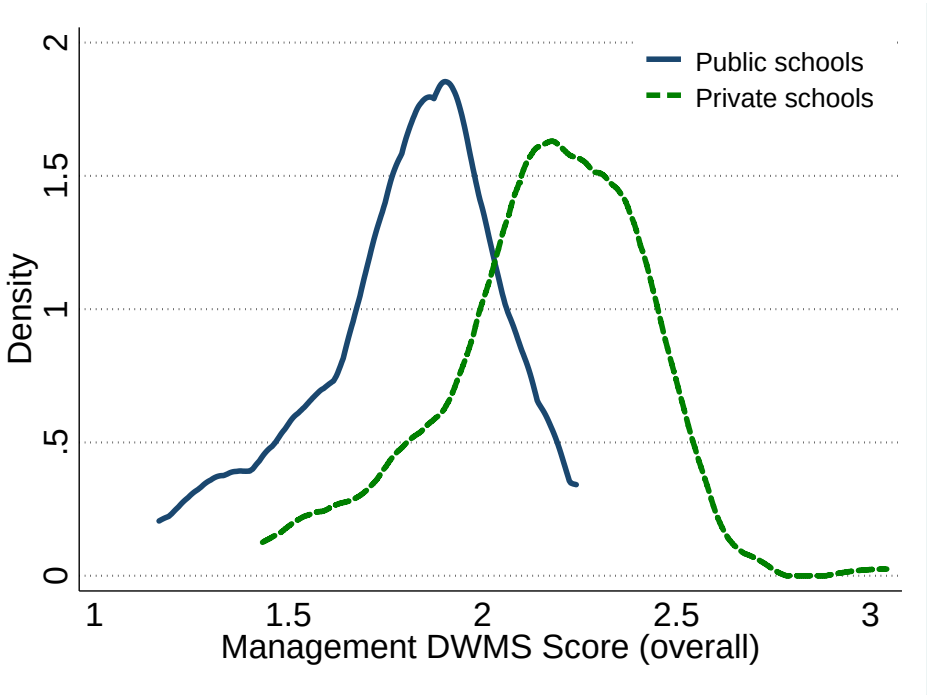
Figure 2: Distributions of the DWMS and the re-cast WMS scores in Andhra Pradesh



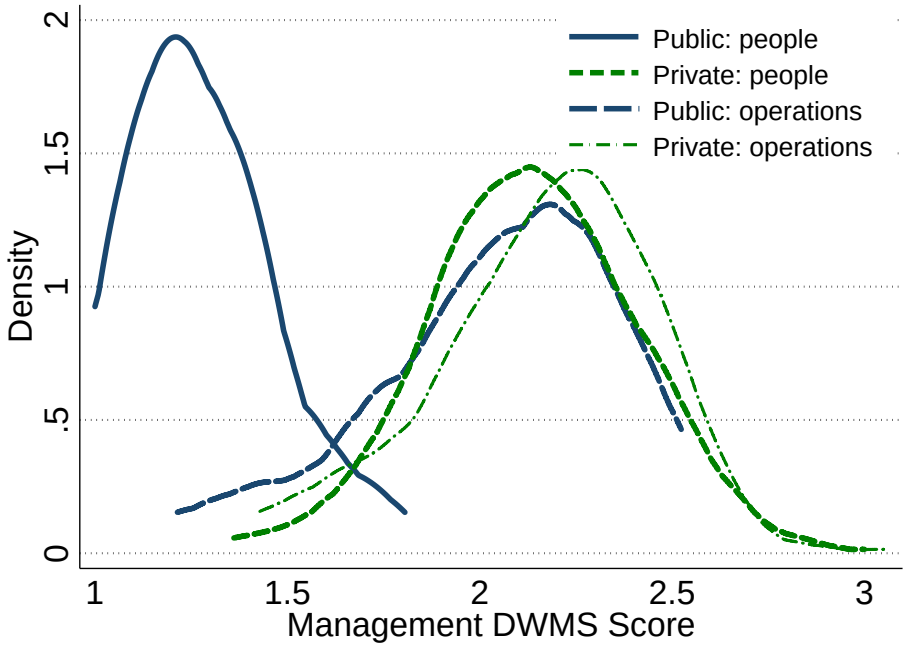
Note: This figure shows the distribution of operations and people management scores for public and private schools in our AP sample. The dashed line bars correspond to the Development WMS indices, which allows for the awarding of half scores for each measured topic. The blue solid bars correspond to the re-cast scores for each topic in the "original WMS" convention, where half scores are not allowed and thus half scores were downgraded to the next lowest integer. For example, scores of 2.5 were replaced with 2. See the Data sections and Data Appendix for more details.

Figure 3: Distribution of management scores in Andhra Pradesh

(a) Overall management scores



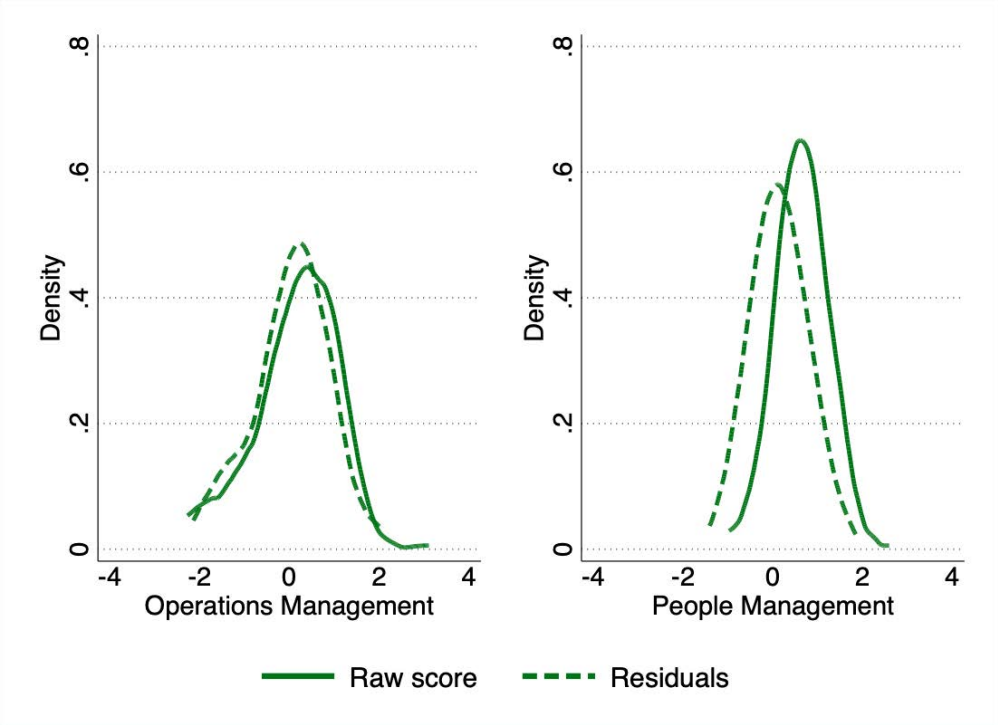
(b) People and operations management



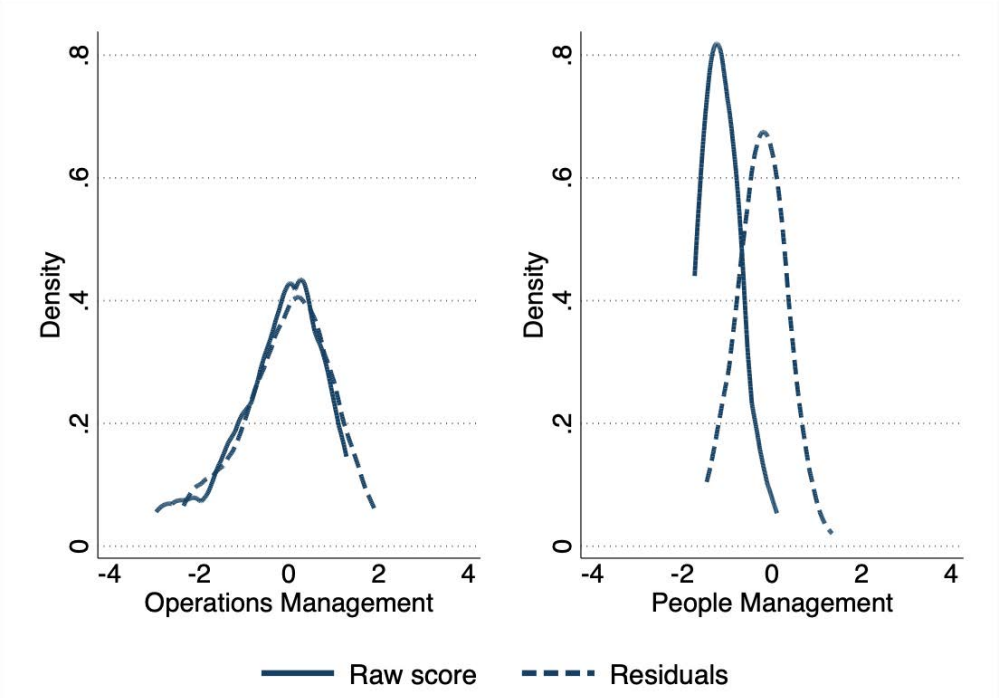
Note: This figure shows the distribution of the D-WMS overall management z-score index for public and private schools in Panel A and operations and people management z-score indices in Panel B. Standardization is relative to the full dataset, including public and private schools. Data for Andhra Pradesh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

Figure 4: Distribution of management: raw vs residual

(a) Private



(b) Public



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

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

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

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

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

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

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

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

Table 3: School management practices and teacher practices

Panel A: no controls	**Public schools**			**Private schools**		
	(1)	(2)	(3)	(4)	(5)	(6)
	Dependent variable: teacher practice index					
z-management	0.291***			0.208***		
	(0.060)			(0.051)		
z-operations		0.244***			0.189***	
		(0.049)			(0.046)	
z-people			0.329***			0.269***
			(0.118)			(0.085)
Observations	740	740	740	1367	1367	1367
# schools	109	109	109	190	190	190
Management SD	0.89	0.89	0.89	1.06	1.06	1.06
Panel B: with controls	**Public schools**			**Private schools**		
	(1)	(2)	(3)	(4)	(5)	(6)
	Dependent variable: teacher practice index					
z-management	0.260***			0.189***		
	(0.061)			(0.059)		
z-operations		0.218***			0.168***	
		(0.049)			(0.052)	
z-people			0.259**			0.238**
			(0.112)			(0.097)
Observations	740	740	740	1367	1367	1367
# schools	109	109	109	190	190	190
Management SD	0.89	0.89	0.89	1.06	1.06	1.06

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

Table 4: School management practices and student value added in each type of school

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

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

Table 5: School management practices and student value added in public and private schools

Panel A: no controls	**Public and private schools**				
	(1) student value added	(2) student value added	(3) student value added	(4) student value added	(5) student value added
Private = 1	0.348***	0.250***	0.311***	0.059	0.101
	(0.057)	(0.059)	(0.054)	(0.083)	(0.098)
Scholarship = 1	-0.234***	-0.245***	-0.239***	-0.262***	-0.258***
	(0.076)	(0.077)	(0.078)	(0.073)	(0.074)
z-management		0.089***			
		(0.024)			
z-operations			0.070***		0.026
			(0.022)		(0.030)
z-people				0.160***	0.129**
				(0.036)	(0.050)
Observations	35964	35964	35964	35964	35964
# schools	299	299	299	299	299
Panel B: with controls	**Public and private schools**				
	(1) student value added	(2) student value added	(3) student value added	(4) student value added	(5) student value added
Private = 1	0.490***	0.395***	0.455***	0.203**	0.233**
	(0.086)	(0.086)	(0.084)	(0.098)	(0.106)
Scholarship = 1	-0.242***	-0.258***	-0.252***	-0.273***	-0.272***
	(0.074)	(0.073)	(0.074)	(0.070)	(0.071)
z-management		0.090***			
		(0.025)			
z-operations			0.068***		0.022
			(0.022)		(0.028)
z-people				0.166***	0.142***
				(0.036)	(0.046)
Observations	35964	35964	35964	35964	35964
# schools	299	299	299	299	299

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

Table 6: School management practices and teacher wages

Panel A: No controls	**Public**			**Private**			**All**
	(1) ln(wages)	(2) ln(wages)	(3) ln(wages)	(4) ln(wages)	(5) ln(wages)	(6) ln(wages)	(7) ln(wages)
Value added							
Teacher value added	-0.227	-0.218	-0.124	0.424***	0.353***	0.378***	-0.217
	(0.222)	(0.222)	(0.235)	(0.119)	(0.117)	(0.118)	(0.230)
Private=1							-1.912***
							(0.049)
Private=1 × TVA							0.681***
							(0.260)
Management							
z-operations		-0.005			0.101***		
		(0.032)			(0.031)		
z-people			-0.154			0.125**	
			(0.115)			(0.063)	
# Teachers	234	234	234	1059	1059	1059	1245
# Schools	104	104	104	190	190	190	277
Mean wages (Rs)	14097	14097	14097	2655	2655	2655	6334
Panel B: with controls	**Public**			**Private**			**All**
	(1) ln(wages)	(2) ln(wages)	(3) ln(wages)	(4) ln(wages)	(5) ln(wages)	(6) ln(wages)	(7) ln(wages)
Value added							
Teacher value added	-0.285	-0.289	-0.272	0.258**	0.246**	0.257**	-0.267
	(0.197)	(0.197)	(0.205)	(0.102)	(0.101)	(0.102)	(0.207)
Private=1							-1.522***
							(0.078)
Private=1 × TVA							0.538**
							(0.228)
Management							
z-operations		0.002			0.028		
		(0.026)			(0.027)		
z-people			-0.025			0.003	
			(0.096)			(0.049)	
# Teachers	227	227	227	1018	1018	1018	1245
# Schools	99	99	99	178	178	178	277
Mean wages (Rs)	14097	14097	14097	2655	2655	2655	6334

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

Table 7: School management practices and teacher flows

Panel A: no controls	**All**	**Public**		**Private**	
Dependent variable: good HR outcome	(1)	(2)	(3)	(4)	(5)
Private = 1	-0.213***				
	(0.043)				
Management					
z-operations		-0.009*		0.039**	
		(0.004)		(0.014)	
z-people			0.001		0.058**
			(0.009)		(0.015)
# Teachers	543	53	53	490	490
Panel B: with controls	**All**	**Public**		**Private**	
Dependent variable: good HR outcome	(1)	(2)	(3)	(4)	(5)
Private = 1	-0.214***				
	(0.038)				
Management					
z-operations		-0.013		0.031	
		(0.009)		(0.015)	
z-people			-0.015		0.046**
			(0.021)		(0.015)
# Teachers	514	51	51	463	463

Notes: Standard errors are clustered by school. The sample uses only schools which had data about teacher transfers during year 2 of the Muralidharan and Sundararaman (2015) experiment (2009). The dependent variable, "good HR outcome", is a binary outcome. It takes a value of 1 if a high value added teacher was transferred in or retained in the school, or if a low value added teacher is transferred out of the school. It takes a value of 0 otherwise. Teacher value added is estimated using the Chetty et al. (2014) method and `vam` Stata command. A teacher is coded as "high value added" when their year 1 value added is the highest within their school. A teacher is coded as "low value added" when their year 1 value added is the lowest within their school. Private refers to an indicator for private school. z-operations and z-people are the standardized average scores of the operations questions and people management questions. Controls include **school controls** listed in Table 2: log of number of students, average share of female students, of students from scheduled castes, of literate parents and of laborer parents.