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ABSTRACT

Teacher Shortage in India: Myth or Reality? The Fiscal Cost of Surplus Teachers, Fake Enrolment and Absences

This paper examines the widespread perception in India that the country has an acute teacher shortage of about one million teachers in public elementary schools, a view repeated in India's National Education Policy 2020. Using official DISE data, we show that there is hardly any net teacher deficit in the country since there is roughly the same number of surplus teachers as the number of teacher vacancies. Secondly, we show that measuring teacher requirements after removing the estimated fake students from enrolment data greatly reduces the required number of teachers and increases the number of surplus teachers, yielding an estimated net surplus of about 342,000 teachers. Thirdly, we show that if we both remove fake enrolment and also make a suggested hypothetical change to the teacher allocation rule to adjust for the phenomenon of emptying public schools (which has slashed the national median public-school size to a mere 64 students), the estimated net teacher surplus is about 764,000 teachers. Fourthly, we highlight that if government does fresh recruitment to fill the supposed nearly one-million vacancies, the already modest national mean pupil-teacher-ratio (PTR) of 22.8 would fall to 15.9, at a permanent fiscal cost of nearly Rupees 48,000 crore (USD 6.6 billion) per year in 2017-18 prices, which is higher than the individual GDPs of 56 countries in that year. The paper also highlights the volume of schools with extreme PTRs, and estimates the cost of teacher absence, pupil absence and fake enrolments. Overall, the paper highlights the major economic efficiencies that can result from an evidence-based approach to education policy making.

JEL Classification: I20, I21

Keywords: public elementary schools, pupil-teacher-ratios, teacher surpluses, fake enrolment, teacher absence, student absence, India

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Teacher Shortage in India: Myth or Reality?

The fiscal cost of surplus teachers, fake enrolment and absences

I. Introduction

There is a widespread perception in India that an important reason for the pitiable learning levels in public elementary schools is a great paucity of teachers. India's National Education Policy (NEP 2020) acknowledges the learning crisis (Section 2, p.8) and apportions blame for it partly on high pupil teacher ratios (PTRs) which it says arise from a shortage of one million teachers,[i] and on page 8 it promises that "teacher vacancies will be filled at the earliest".

The NEP is not alone in rueing a paucity of teachers in India. The belief of an acute teacher shortage is shared by many Indian experts and organisations. A study co-authored by the education advisor to India's NITI Ayog (Planning Commission) stated that "India today suffers from the twin challenges of unviable sub-scale schools and a severe shortage of teachers" (*Times of India*, 2020). A Senior Fellow at Centre for Policy Research – probably India's best known think tank – when commenting on the Indian budget 2018 stated that not much can be achieved "without addressing the huge shortage of teachers" (Bhatti, 2018). Newspaper headlines citing "severe shortage of teachers in public schools" (*Indian Express*, 2018), "India faces an acute shortage of educators across states" (*Forbes India*, 2019), and "Acute shortage of primary teachers in India" (*Hindustan Times*, 2014) are common, and a UNESCO (2016) report states that "74 countries face an acute teacher shortage; while Nigeria tops this list, India is second". A former Director of the National Council of Educational Research and Training (NCERT) said that "estimates suggest that India needs 1.3 million teachers" (Kumar, 2016).

India's *Right to Education Act 2009* (RTE Act) mandates a maximum pupil-teacher ratio (PTR) of 30:1 in elementary schools[ii]. Following the Act's implementation in 2010, average PTR in public elementary schools declined steeply from 31.2 to 22.8 pupils per teacher in the seven years to 2017. Notwithstanding this reduction in PTRs, learning levels fell over the same period[iii]. This suggests simplistically a perverse positive temporal relationship between PTR and pupil learning, rather than the expected negative one on which the advocacy to reduce PTRs is usually based. The RTE Act establishes the norms for the allocation/appointment of teachers to schools, based on its stipulated PTRs.

Ultimately, behind any norms for the allocation of teachers to schools is the rationale of pedagogic desirability, subject to economic affordability, i.e. the question: would the PTR resulting from the given teacher-allocation norms be conducive to student learning? While it is not the central object of this paper to judge whether the RTE Act's teacher-allocation norms and resulting permitted maximum PTR of 30:1 are 'right', it is worth noting briefly that there is an applied literature that addresses this question. Studies on the impact of PTR (or class-size) on student learning in India generally do not find the expected negative relationship between PTR and student learning outcomes (Banerjee et. al., 2009; Muralidharan and Sundararaman, 2013; Muralidharan et. al., 2017; and Dutta and Kingdon, 2021)[iv]. Thus the literature for India does not support giving a learning-related rationale for reducing PTR to a maximum of 30.

In the much larger international literature too, there is no consistent relationship between PTR and pupil learning (Hanushek, 2002). The studies that do show the expected negative relationship find that the size of the relationship is very small[v]. Given these findings, the prescription of India's RTE Act 2009 to set a maximum PTR of 30, the advocacy of India's National Education Policy (NEP, 2020) to urgently fill the nearly one million teacher vacancies (when the national PTR is already as low as 22.8), and the widespread perception of an acute teacher shortage, seem not to be evidence-based.

The main questions we address are: whether India has enough teachers to fulfil the PTR norms enshrined in the *Right to Education* Act. We probe the education ministry's estimates of teacher vacancies, which are the basis for the perceived acute teacher shortage. We explore teacher surpluses, fake enrolment, and student and teacher absences, and consider the implications of these for *effective* pupil teacher ratios (PTRs). We ask whether and how the estimates of net teacher surpluses vary with changes to the teacher allocation rules and after removing fake pupils from the enrolment data. Finally, since resources are scarce, the paper evaluates the fiscal cost of maintaining the PTR at prescribed levels, and the permanent fiscal burden on states due to additional recruitment, teacher absence, student absence, fake enrolment and the existence of tiny schools. The analysis is carried out only for public elementary schools (grades 1 to 5; or 1 to 8; or 6 to 8) in each of 21 major states of India.[vi]

II. The Small School Phenomenon: Implications for Pupil Teacher Ratio

Table 1 shows that in the seven year period between 2010 and 2017, the number of public elementary schools remained roughly constant in the country, at around 10.35 lakh (1.035 million)[vii], but that the number of private unaided schools increased by 123,000. Table 2 shows that over the same seven year period, total pupil enrolment in public schools fell by 24 million (2.4 crore) and but in private unaided schools enrolment rose by 21 million. Table 3 is an update of a table from Kingdon (2020) which shows that the phenomenon of 'small' schools (<=50 pupils) and 'tiny' schools (<=20 pupils) has grown over time : the percentage of 'small' schools rose from 30.2% in 2010 to 41.2% by 2017-18, i.e. the emptying of public schools has led to an increase in the small public schools phenomenon, creating pedagogic and economic non-viability. The last column of Table 3 shows that government's teacher-salary-expense-per-pupil in its 'small' schools increased from Rs. 1952 per month in 2010 to Rs. 4,326 per month in 2017. Table 4 suggests considerable variation across states in the percentage of 'small' schools (<=50 pupils), which ranges from 3.8% in Bihar to 78.8% in the hilly state of Himachal Pradesh.

Similarly, the phenomenon of 'tiny' schools also increased over time. Table 3 shows that in 2010 they constituted about 6% of all public schools but by 2017, 12.3% of all public schools were 'tiny' (<=20 pupils), though there is significant variation across states, as seen in Table 4. Uttaranchal has the highest proportion of tiny schools (46.2%) followed by Himachal Pradesh and Jammu-Kashmir. Table 3 shows that average teacher-salary-expense-per-pupil in 'tiny' public schools rose to Rs. 8,111 per month by 2017.

Table 4 column (g) suggests that 67.6% of all public elementary schools in the country had fewer than or equal to 100 pupils, but the average school size in such schools was 45.3 pupils, which means fewer than 9 students per primary grade. Average school size in Uttaranchal was a mere 26.9 pupils, which means fewer than 6 students per grade.

NEP 2020 recognises the fact of numerous very small schools and it also acknowledges that "small school sizes have rendered it economically suboptimal and operationally complex to run good schools, in terms of deployment of teachers as well as the provision of critical physical resources" (NEP 2020, p.28).

The abandonment of public schools (Table 2) led to an increase in the number of small/tiny schools and also to a *sharp reduction in pupil teacher ratio (PTR) from 31.2 in 2010 to 22.8 in 2017*. Table 5 shows that by 2017 about 70% of all public elementary schools had a pupil teacher ratio below 30; 46% (about 476,000 schools) had a PTR below 20; and 15.4% (about 160,000 schools) had a PTR below 10 pupils per teacher. In the hilly states Jammu-Kashmir, Himachal Pradesh and Uttaranchal, and in Kerala, more than 75% of schools had PTR of <=20, and even Telangana, Tamil Nadu, Punjab and Andhra Pradesh had more than 60% public schools with PTR <=20. In the hilly states, more than 50% schools had PTR below 10, raising questions about their viability.

III. Surplus teachers in small and tiny schools

Table 6 shows that a high percentage of small schools have surplus teachers. The Right to Education (RTE) Act mandates that two teachers shall be appointed in any school with up to 60 enrolled children. Thus, if a school with up to 60 pupils has more than two teachers, it is said to have surplus teachers. We define schools with up to 60 pupils as 'small schools' for the remainder of this paper. Table 6 shows the percentage of 'small' schools with given levels of enrolment and more than two (>2) teachers, i.e. the percentage of small schools that have surplus teachers.

Column (f) shows that 30.8% of 'small' schools had surplus teachers. This column is based on actual enrolment, after adjusting for fake enrolments in the way given in the Note to Table 7. The percentage of small schools with surplus teachers is 94.2% in Kerala and 59.6% in West Bengal, and is greater than 40% in Bihar, Assam, Kashmir, Haryana and Punjab. Surplus teachers lead to high PTRs and high per-pupil-cost, as we show later in the paper.

Table 6 column (a) shows that nationally 12.7 per cent of all tiny schools had surplus teachers, i.e. 12.7% of schools that were 'tiny' (<=20 pupils) had >2 teachers. The problem of 'tiny' schools with surplus teachers is the most acute in Kerala, where 82% of all tiny schools had >2 teachers, but in many other states too, a high percentage of public schools were in a situation of grave economic unviability – Uttar Pradesh, Bihar, West Bengal, Assam, Jammu & Kashmir and Himachal Pradesh were among the top contributors to such economically non-viable schools. We know from Table 3 that *average* size of schools that had a total enrolment of <=20 pupils was only 12.6 pupils, so having 3 teachers (i.e. 1 surplus teacher) implies a PTR of about 4.2 pupils per teacher!

IV. Adjustment for Fake Enrolment, and Different Concepts of Pupil Teacher Ratio

Table 7 examines the 2017-18 pupil teacher ratio (PTR) by state, and shows how PTR changes with the definition of PTR. It is important to highlight that the elementary PTR of 22.8 in column (e) is the *prima-facie* PTR, being based on total *self-reported*[viii] pupil enrolment (column a) divided by the total number of appointed teachers (column d). This uncritically uses what are known to be inflated enrolment numbers based on fake/ghost names entered by the school to show a higher than actual enrolment. The District Information System on Education (DISE) is collected via a Data Capture Format sent to schools and thus, *it is school-returns data*. Questions have been raised from time to time about the veracity and trustworthiness of self-filled enrolment data from DISE.

There are economic incentives for public schools to over-report enrolments since grains for mid-day meals, cloth for school uniforms, scholarship money for SC/ST students, and even the number of teachers appointed, all increase with the self-reported number of enrolled children in a school, and there appear to be no explicit penalties for over-reporting enrolments.

The Comptroller and Auditor General (CAG) of India found 20% inflation in DISE pupil enrolment data in the public elementary schools in Uttar Pradesh (CAG, 2017) and 38% inflation in Bihar (CAG, 2014). Similarly in Uttar Pradesh and Bihar[ix] Kingdon and Banerji (2009) reported the presence of fake enrolment of 16% and 35% respectively. The Mid-Day Meal Authority reports overstated enrolment in public schools (*Times of India*, 2015) too. A performance audit of the Mid Day Meal (MDM) scheme in India by CAG in 2015 stated that: "The mechanism in place for assimilating data on the number of children availing MDM was seriously compromised. The percentage of actual number of children availing MDM as gathered from various sources was consistently lower than that furnished by the states to the Ministry for claiming cost of foodgrains and cooking cost. Audit evidenced an institutionalised

exaggeration of figures regarding students availing MDMs" (page vi); it concluded that "Audit observed mismatch in the data relating to the number of children availing MDM as reported vis-a-vis the number of children actually availing MDM during the day of visit to sampled schools by the monitoring institutions" (page viii); and it went on to recommend that "The data submitted by states should be carefully examined through independent checks. A system of obtaining consent in respect of children availing MDM may be incorporated to check manipulation of figures" (page viii, Report No. 36, CAG, 2015).

In September 2015, the DISE enrolment data for the Lucknow district were reviewed by the District Magistrate who ordered for a survey to be carried out by the district Basic Education Officer (*Basic Shiksha Adhikari*). The survey showed that 18% of students in Lucknow were "absent for long period" and the District Magistrate ordered that these children not be regarded as enrolled (*Times of India*, 2015a). This is fairly consistent with the findings of the SchoolTELLS survey of 80 rural primary schools in 5 districts of Uttar Pradesh[x] where each school was visited 4 times in the year 2007-08, and it was found that 16% of students in the enrolment registers were never present in the school in any of the four survey visits, i.e. 16% of the total primary school enrolment was fake (Kingdon and Banerji, 2009). A joint survey by CAG and the Mid Day Meal Authority (*Times of India*, 2015b) showed that there is widespread over-reporting of enrolments in the enrolment registers of public schools in Uttar Pradesh, with "over 10% students mentioned in class register being absent all through the year in nearly every government school".

Finally, a recent CAG report (CAG, 2017) showed that there were about 10% more students in elementary school than there are children in the state, implying that there is large-scale over-reporting of school enrolments. Secondly, and more worryingly, the same CAG report – which surveyed 428 elementary schools in UP in 2016 – found that the attendance rate was a mere 27% (CAG 2017, p. 26 and Appendix 2.1.18), showing that a very high proportion of so-called 'enrolled' children in fact have a tenuous connection with the school, representing no meaningful school participation, and the CAG report remarked that the UP state officials had reported an attendance rate of 61% to 91% at the AWP&B (Annual Work Plan and Budget) process in Delhi. This large discrepancy (27% versus 61%-91%) suggests that officials may have some incentive to inflate pupil enrolments just as they felt compelled to inflate pupil attendance rates. Finally, this CAG report also said that 20 lakh (2 million) children drop out of school each year, which implies that they are shown as admitted and enrolled at the start of the school year, but are not found in school later in the school year.

The above evidence on inflated/fake enrolment seems to be corroborated when we look at the distribution of school enrolment. Figure 1 shows the histogram of school size and it shows that schools' self-reported total enrolment is lognormally rather than normally distributed. We know from Table 4 that mean school size in public elementary schools in the country is 99 students but, when a quantity is lognormally distributed, median is the better measure of central tendency than the mean. Median school size is a mere 64 students, and the mode occurs at a school size of 30 pupils. Another striking feature of the histogram is that at multiples of 5 and especially of 10, reported enrolment jumps, so the distribution is not smooth but jagged. Firstly, it appears that school respondents are reporting rounded-up enrolment numbers around the multiples of 10, because immediately before there is a pronounced dip. For example, immediately before school size 50, there is an unexpected low frequency of schools that report having exactly 49 pupils, and similarly around 20, 30, 40 and 80, etc. Secondly, the most pronounced jumps are at the enrolment levels where a major benefit exists, the biggest jump being at enrolment 61 (and an accompanying dip at enrolment of 59 and 60) with an unnaturally high frequency of schools reporting an enrolment of 61 and a bit above: it is known that as per the RTE Act, two teachers are given to schools whose total enrolment is up to 60 pupils, but three teachers are allotted for enrolment of 61 to 90 pupils, hence there is an incentive to over-report enrolment of 61 or immediately above. The next biggest jump is at an enrolment of 100, presumably because in upper primary schools a headmaster is allocated to

schools that have an enrolment of 100 or above; similarly, we see another conspicuous jump at enrolment of 150, at which the RTE Act mandates that primary schools will get a headmaster. To illustrate from one large north Indian state, the jump at a reported enrolments of 60 and of 100 is far more pronounced in Uttar Pradesh and the phenomenon of rounded reporting of enrolment is more accentuated there (Figure 2). In summary, there is evidence that a good number of schools are reporting inflated student enrolment numbers, and this appears to be related to the creation of teacher or head-teacher posts, but is partly also due to reporting rounded-up enrolment numbers, rather than exact numbers.

Given such widespread official acknowledgment of inflated/fake enrolment numbers, the de-facto or real PTR is likely to be lower than the observed *prima facie* PTR of 22.8. Student absence rate – measured via independent, non-official/non-DISE surveys – captures both fake enrolments as well as the absence of genuine enrolees. Table 7 column (f) reports that student attendance rate is 72% at all India level, and that it is as low as 55-56% in Bihar, Madhya Pradesh and West Bengal, and as high as 91% in Tamil Nadu (ASER 2018 report).

To estimate the true PTR, first column (j) of Table 7 reports the total enrolment of public elementary schools in a state after removing the estimated ghost/fake enrolment. Based on that, column (k) reports the 'true' PTR after removing fake enrolment. Compared to the prima facie national PTR of 22.8 (column e), the true PTR is 19.6, i.e. very substantially lower than the mandated maximum of 30 in the RTE Act. The true PTR is much lower than 30 in all states except Jharkhand and Bihar, whose true PTR hovers around 30. This speaks of an extremely large number of surplus teachers in relation to the teacher-allocation norms of the RTE Act, and it calls into question the notion that there is an acute teacher shortage in the country.

We use two other different concepts of the de-facto PTR: (a) the 'Effective PTR' and (b) the 'Cost-conscious PTR'. We define the Effective PTR as the number of attending students divided by the number of attending teachers[xi].

$$\text{Effective PTR} = \frac{(Reported\ Enrolment) * (student\ attendance\ rate)}{(Number\ of\ appointed\ teachers) * (teacher\ attendance\ rate)}$$

$$\text{Cost-conscious PTR} = \frac{(Reported\ Enrolment) * (student\ attendance\ rate\ (after\ adjusting\ the\ ghost\ enrolment))}{(Number\ of\ appointed\ teachers)}$$

We define the 'Cost-conscious PTR' as the number of attending actual pupils (after adjusting the ghost/fake enrolment) divided by the number of *appointed* teachers, which highlights the actual cost incurred by the public education system for the pupils that it is able to actually teach.

Based on the numbers in Table 7, in elementary public schools in 2017-18, the overall national prima facie PTR was 22.8, the 'true' PTR (after removing fake enrolment) was 19.6, the effective PTR was 19.4, and the cost-conscious PTR was 16.4 pupils per teacher. The 'true' PTR is 20 or lesser in 15 out of India's 21 major states. This does not support the notion of an acute teacher shortage in the country.

V. Teacher Vacancies, Surpluses, and the Net Teacher Surplus

In this section we examine the number of teacher vacancies reported by the ministry of education (which was hitherto named the Ministry of Human Resource Development, MHRD). As mentioned in the Introduction above, the draft National Education Policy (NEP, 2019) identified pupil teacher ratios above 30 as a major cause of lack of learning (page 63, section 2.14), stated that the country faces one

million teacher vacancies (page 115), and suggested that the government's education budget should increased by 1.05 percentage points for filling teacher vacancies and better teacher resourcing (page 417, Table A1.4). If done, this additional recruitment of teachers would create a permanent fiscal liability for government. While answering the unstarred question number 1953 in parliament on 30.07.2018, the MHRD minister replied that total number of teacher vacancies in public elementary schools is 900,316 in all states/UTs[xii].

Column (c) of Table 8a reports the total number of teacher vacancies in public elementary schools as per Ministry, and column (d) reports our own estimates of vacancies based on prima facie (i.e. reported) pupil enrolment and number of teachers for each school in the 2017-18 DISE data, after applying the RTE Act's teacher allocation norms. We have reported data from both sources (Ministry and our own) only on 21 major states of India[xiii]. As against the total of 882,200 vacancies reported by the Ministry, our own estimates show only 761,730 vacancies in these 21 major states[xiv].

We are not aware of any journalistic or policy discussion on teacher *surpluses* in schools, i.e. on whether there are more teachers in schools than the number based on RTE Act's teacher allocation norms, and we were curious to see to what extent there were any teacher surpluses in the various states. Examining this would reveal whether there would be an overall net teacher deficit or a net teacher surplus in the state.

Table 8a's column (e) presents our estimate of teacher surplus in each state, and column (f) shows the net teacher surplus/deficit. Column (e) shows that the total number of surplus teachers in 21 major states was 735,067. In column (f) negative values show the actual number of teachers required (net vacancies) and positive values show the net excess teachers (net teacher surplus). This analysis shows – at the all India level – there are only 26,660 net teacher vacancies in the country, as opposed to 882,200 vacancies shown in the government report (MHRD, 2018). This is a major finding, and it alters our perceptions of a severe teacher shortage.

Aggregate national analysis masks interstate variation. Table 8a is sorted by column (f), i.e. from the highest to the lowest net teacher surplus. Closer inspection of column (f) shows that, in fact, in 13 of the 21 major states, there are net surpluses, totalling to 421,158 net surplus teachers (according to MHRD estimates, these states together have 271,949 vacancies!). Only eight states have net teacher vacancies, and these total to 447,818 net vacancies (these facts are more clearly visible in Figure 3). However, it is impractical to have interstate redeployment, so state-wise analysis is necessary.

It is anecdotally believed that urban areas have a glut of teachers and rural areas have teacher shortages since teachers prefer urban postings. If this is the case, we could simply redeploy teachers from urban to rural areas, instead of fresh appointments. Table 8b does the analysis separately by rural and urban area within each state. It repeats columns (d), (e) and (f) of Table 8a. The last row of Table 8b shows that indeed there was a net deficit of 119,220 teachers in rural areas and a net surplus of 92,565 teachers in urban areas (national net deficit of 26,665), which seems to support the anecdotal belief of rural shortages and urban gluts. However, since it is infeasible to redeploy teachers across states, we must consider separately for each state.

Table 8b shows that in thirteen states, there was net teacher surplus in both rural and urban areas, so that there is no issue of urban to rural redeployment in these states, it is an unambiguous net surplus within rural areas and also within urban areas, though district-wise rural-urban analysis by each state government would be useful for planning purposes. West Bengal has the biggest number of net surplus teachers (87,187) out of which 63,702 are surplus in rural areas and 23,485 are surplus in urban areas. Tamil Nadu has a total of 75,430 net surplus teachers, 49,740 in rural areas and 23,485 in urban. Apart from these thirteen states, i.e. in the remaining eight states, there is a net deficit of teachers as seen in column (c) of Table 8b. When we bifurcate by rural-urban in the remainder of the table, the dominant story is one of

fairly large net teacher deficits in rural areas of these eight states, with few net surplus teachers in their urban areas. Thus, it is these eight states (Bihar, Jharkhand, Madhya Pradesh, Uttar Pradesh, Karnataka, Gujarat, Odisha and Maharashtra) that need close attention from a teacher shortage perspective.

Appendix Tables 2a and 2b illustrate district level analysis for 14 districts across three divisions of one state, namely Uttar Pradesh (there are 75 districts in UP and 650 districts in India). Districts in a division are all in contiguous close proximity and it is often feasible to commute across adjoining districts. The first of these tables shows the net surplus/deficit teachers based on reported enrolments, and the second table shows the estimated surplus/deficit teachers after removing fake enrolment. The first of these shows that in the Meerut Division, Meerut and Hapur districts had a surplus of 373 and 151 teachers respectively but that several districts in the Division had teacher deficits. It may be possible to redeploy teachers across these adjoining districts. We see that in rural Ghaziabad, 181 teachers are surplus but that in urban Ghaziabad there is a deficit of 228 teachers, suggesting a rural to urban redeployment to fix much of the teacher deficit. Overall within this Division, there is a rural surplus of 339 teachers and an urban deficit of 557 teachers, and redeployment can fix about 60% of the teacher deficit (339 teachers), rather than recruiting 557 teachers for urban Meerut Division.

VI. Net Teacher Surplus, after removing fake enrolments

All the analysis in Table 8a up to column (f) was done taking reported enrolment at face value, without removing any fake enrolments. As shown in section IV, according to the Comptroller and Auditor General of India, and also according to the Mid Day Meal Authority of India, schools' self-reported enrolment is *institutionally exaggerated* or inflated, i.e. there is much fake/ghost enrolment. In columns (g), (h) and (i) of Table 8a, we recomputed the actual teacher vacancies and surpluses after adjusting the ghost enrolment, and this led to a dramatic change in teacher vacancies, surpluses and 'net vacancies'. The total teacher vacancies in India (21 major states) fell from 761,727 (column d) to 518,515; Surplus teachers rose from 735,067 to 860,456, and net vacancies of 26,660 teachers converts to a surplus of 341,941 teachers.

In light of this large teacher surplus, appointing nearly one million teachers in the erroneous belief of a teacher shortage would impose an extremely high permanent fiscal burden, beyond that envisaged by the RTE Act. According to the literature on the effect of class-size on student learning, such an increase would also not lead to learning gains either.

Considering inter-state variation, we see that the impact of removing fake pupils is dramatic in Bihar where net vacancies fall from 204,778 to only 40,975 teachers, because in Bihar 35% of reported enrolment is fake (CAG, 2014). In Uttar Pradesh, before adjusting for fake enrolment, there were 51,530 net teacher vacancies but after adjustment, this converts to a net surplus of 20,274 teachers. These facts are clearly seen in Figure 3.

Importantly, in the aggregate, we see that after removing fake enrolment, in fourteen states there is a very substantial teacher surplus, which totals to 5,15,704 teachers, which is maintained at a cost to the public exchequer of Rs. 26,490 crore (approximately US $ 3.63 billion) per annum in 2017-18 terms. It is only in seven states that there is still a teacher deficit, and it is a total deficit of 173,763 teachers, compared to the education ministry's figure of 882,200 vacancies (see Figure 3 for a graphical analysis). Indeed, only the four states of Karnataka, Madhya Pradesh, Bihar and Jharkhand have the bulk of net teacher deficit of a total of 149,825 teachers. Our analysis implies that national policy makers need to focus on teacher shortages mainly in these four states.

Doing the analysis separately for rural and urban areas after removing ghost students (data not shown due to space considerations), we find that the overall net teacher surplus of 341,941 is made up of 220,109 net

surplus teachers in rural India and of 121,837 net surplus teachers in urban India. In 14 states' rural areas, there are net surplus teachers totalling 400,471 and in seven states there is a net deficit of 180,362 teachers. In urban areas, there are hardly any net teacher deficits.

VII. Fiscal Cost of Surplus Teachers and Recruitment

In the previous section, we reported that there exist net surplus teachers in many states and, on top of that, due to a perception of widespread teacher vacancies, state governments are faced with the expectation that they will appoint more teachers. Politicians may also face pressure (i) not to demand data on surplus teachers where they exist, (ii) not to ask for removal of ghost students before teacher vacancy numbers are calculated, (iii) not to ask for data on overall PTR (which could undermine the case for more teacher appointments), and (iv) not to seek redeployment of teachers from teacher-surplus to teacher-deficit schools so that they would need to fill only *remaining* vacancies.

If the RTE Act's teacher deployment norms are followed properly, with any surplus teachers (in teacher-surplus schools) being first redeployed to teacher-deficit schools before recruiting to fill the remaining genuine vacancies, then there would be actual teacher vacancies in only 8 out of 21 major states, and there would be net surplus teachers in the remaining 13 states, as seen in column (f) of Table 8a. If states with surplus teachers do not redeploy them to teacher-deficit schools and, instead, recruit additional teachers to fill vacancies in the teacher-deficit schools, it creates an unwarranted additional fiscal burden, wastage and economic inefficiency.

The last two columns of Table 8(a) estimate the savings from a rational and efficient deployment of teachers, i.e. by strictly following the RTE Act's teacher allocation norms. Column (i) shows that the cost of filling all 882,200 teacher vacancies (inefficiently, without doing any redeployment) would be Rs. 47,879 crore. However, filling only the *net* vacancies would cost a mere Rs. 2,333 crore. That is, if states with net surplus dispense with their surplus teachers, and states with net deficit teachers first redeploy their teachers from surplus-teacher schools to deficit-teacher schools, before recruiting additional teachers to fill the remaining vacancies, the government would save Rs. 45,546 crore every year (US$ 6.2 billion).

Table 9 presents estimates of the fiscal burden on the public purse due to the presence of surplus teachers and additional recruitment. Column (c) shows the total surplus teachers in different states if government maintained a PTR of 30 rather than the current lower PTR. It shows that out of 4,481,978 existing teachers in public elementary schools, 1,071,299 (or 24% of all teachers) would be surplus in India in 2017-18, if PTR were maintained at 30. Only Bihar and Jharkhand would have a net deficit of teachers as per RTE norms. On top of this over 1 million surplus teachers, state governments are asked in the National Education Policy to fill teacher vacancies "as soon as possible" (NEP 2019, p. 58), i.e. to recruit an additional 882,200 teachers, and the Appendix of NEP (2019, p. 417) gives the percentage increase in the budget that will be required to recruit these additional teachers.

If governments go ahead with this proposed additional recruitment, the total stock of elementary teachers will rise from 4.4 million to 5.4 million, and this would further reduce PTR from the current 22.8 to 15.9, i.e. a reduction of about 7 pupils per teacher (see column (g) of Table 9). We report two sources of 'excess costs', i.e. salary costs due to surplus teachers that are not warranted by the teacher-allocation norms of the RTE Act. The first excess cost is the fiscal cost of maintaining the current PTR of 22.8, i.e. a PTR below 30, and column (i) estimates this to be Rs. 55,169 crore per year (in 2017-18 terms). The second concept is the fiscal burden of the proposed additional/new recruitment to fill the 882,200 claimed teacher vacancies (which exist mostly due to fake enrolment and non-redeployment), which column (j) estimates to be another Rs. 47,879 crore per year, which is the cost of reducing PTR by seven pupils per teacher, to a PTR of 15.9. Therefore, the total annual fiscal burden of surplus teachers and

additional recruitment is Rupees 103,048 crore (US $ 14.1 billion), which is higher than the total GDP of Mongolia or Mauritius and about double the GDP of Malawi. The international and Indian literature on the effect of PTR or class-size on student learning does not lend support to the idea that reducing PTR from 30 or 22.8 to 15.9 would raise learning levels much, or even at all. NCERT (2016) shows that children's learning levels in grade 5 in public elementary schools fell over the period 2011 to 2015, a period over which PTR fell sharply from 30 to 24 at great cost to the exchequer.

VIII. Fiscal Cost of Teacher and Student Absenteeism and Fake Enrolment

The public exchequer's scarce funds are wasted not only if there are surplus teachers but also due to a high degree of student absence, teacher absence and fake/ghost student enrolment. In this section we calculate the cost of these factors.

Table 10 presents the annual fiscal cost due to teacher and student absence and due to fake enrolment. In column (k) of Table 10, the total cost of student absence for any state is the difference between the total salary cost of the teachers appointed based on pupil *enrolment* in the state, and what the total salary cost would be if teachers were appointed based on pupil *attendance* in the state. Nationally the pupil absence rate is 28% (column f), which implies an attendance rate of only 72% of enrolment. Column (j) is based on that portion of the 'pupil absence' which is due to ghost/fake enrolment, and column (i) is based on pupil absence among genuine enrolees. Table 10 shows that the total cost of pupil absence among genuinely enrolled students (named "pure absence" in column i) in public elementary schools nationally is Rupees 39,766 crore, and the cost of *ghost* pupil enrolment (column j) is Rs. 26,514 crore, so that the total cost of student absence is Rs. 66,280 crore or US$ 9.1 billion (column k). The cost of pure absence in just three states (UP, Madhya Pradesh, West Bengal) is Rs. 18,855 crore and the cost of ghost pupil enrolment in just three states (UP, Bihar, West Bengal) is Rs. 15,163 crore.

The cost of teacher absence for any given state is calculated by taking the total teacher salary cost in the state and multiplying that with the teacher absence rate in the state. The cost of teacher absence is Rs. 36,242 crore every year, nationally. Adding this to the cost of student absence (pure absence and ghost enrolment) gives the total fiscal cost due pupil and teacher absenteeism and fake enrolment of Rs. 1,02,522 crore (US$ 14.0 billion). The problem of fiscal wastage in education is the greatest in Uttar Pradesh, Bihar, Madhya Pradesh and West Bengal.

IX. Sub-optimal choice of pupil teacher ratio

Underlying the RTE Act's stipulation to fix PTR at a maximum of 30 was the well-intentioned policy framer's belief that lowering PTR and class-sizes would raise pupil achievement. However, as mentioned in the Introduction, the Indian and international literature generally shows either no relationship or a perverse positive relationship between class size and pupil learning, and in the few studies where it shows a negative effect from PTR onto learning, the size of the effect is very small. In India, while studies by Muralidharan and Sundararaman (2013) and Banerjee et. al. (2009) examined the relationship between class-size and pupil achievement at the primary school level, Datta and Kingdon (2021) examined it for the secondary school level. Datta and Kingdon (2021) found that in the class-size and learning relationship, there exists a flat region where raising the class size does not reduce student achievement. This flat part of the relationship ranges from a class size of 27 to 40 students in science subjects, and between a class size 27 to 51 in non-science subjects. This finding suggests that raising class sizes in these ranges would not lower pupil achievement levels. It is not known to what extent the idea of the flat range applies at the elementary school level, but Banerji et. al. (2009) find that reducing class size (which is

closely related to PTR) did not improve learning levels at the primary school level. If raising PTR from its current 22.8 pupils per teacher to a PTR of 30 or even 40 does not lower student learning, government could make extremely large savings on teacher salary costs.

Table 11 explores the consequences for government spending on teacher salaries if PTR were maintained at given levels. It examines what government costs and savings would be at various hypothetical PTR levels. Column (f) shows that the total cost of teacher salaries in 2017-18 when overall PTR nationally was 22.8, was Rs. 206,989 crore annually (in 2017-18 rupees) in public elementary schools. It shows that if government maintained the (RTE Act mandated maximum) PTR of 30, total spending on teacher salaries would reduce to Rs. 178,137 crore per annum (in 2017-18 prices), which means a saving of Rs. 28,852 crore (about US $ 4 billion) per year.

The 12th-century rabbinic scholar Maimonides argued that class size should be maintained at 40 pupils, which is generally known as the Maimonides rule (Angrist and Lavy, 2002). If the government maintained a PTR of 40 in elementary schools, that would cost Rs. 133,602 crore vis-à-vis the current Rs. 206,989 crore annually, and consequently total savings would be Rs. 73,386 crore (about US $ 10 billion) per year. As per the extant Indian literature on the impact of class size, it seems that such a PTR policy would not lower student achievement levels. The final column of Table 11 shows the ratio of hypothetical savings to costs if government were to maintain a PTR of 40 in its elementary schools. While in the hilly states it may not be feasible to maintain PTR at 40, it is noticed that in states such as Kerala and Tamil Nadu, the savings will be about twice the current total teacher salary cost, because of the low current PTR in these states which is around 13 pupils per teacher. In 9 out of 21 states, the savings (at PTR 40) will be higher than the current total cost of teacher salary, and this type of scenario building can help to think about whether and how economic efficiencies could be gained without compromising pupil learning.

X. Savings from adjusting RTE teacher allocation norms to current enrolment realities

Table 12 presents estimates of total savings to the public purse if an adjustment were made to the teacher-allocation norms of the RTE Act in light of the changed realities of enrolment in public elementary schools.

Table 2 had shown that in the seven years since the implementation of the Act (in 2010), there was a substantial abandonment of public schools and a migration to private schools, and Table 3 showed that this led to an increase in the phenomenon of 'small' and 'tiny' public schools. Table 4 shows that by 2017-18, nationally 47.7% of all public elementary schools had a total enrolment of 60 or fewer (<=60) pupils. Later in the paper, Table 14(a) shows that these 493,848 (out of the total 1,035,338) 'small' schools had on *average* only 31.6 pupils per school and 13.2 pupils per teacher. When we look at public schools with a total enrolment of 20 or fewer (<=20) students, the story becomes more alarming. Table 3 shows that there were 126,864 such schools in the country, i.e. 12.3% of all public elementary schools, and that they had, on *average,* only 12.6 students per school and 6.3 pupils per teacher, manifestly both pedagogically and economically unviable.

It is likely that, when setting the teacher-allocation rules, the RTE Act's framers did not envisage the unprecedented exodus from public schools that would happen, which has led to average school enrolment being so low. As per the RTE Act's teacher allocation rule, all schools with up to a total enrolment of 60 are to be provided two teachers.

However, in line with new enrolment realities, government might find it prudent to consider modifying the teacher allocation rule to a more reasonable one. We consider a hypothetical rule of allocating one teacher in all schools that have a total enrolment of <=20 (which have an *average* enrolment of 12.6 pupils

per school), and allocating two teachers in all schools with a total enrolment of 21 to 60 pupils. The remaining allocation rules remain untouched, i.e. for schools with enrolment above 60.

Table 12 shows the consequences of applying this alternative rule. Column (g) shows that if one teacher is allotted per school with enrolment <=20, there will be nationally a net teacher surplus of 303,471 teachers[xv], instead of the net vacancies of 26,660 under the current RTE teacher allocation norms. As seen in column (k), this would yield total savings of Rs. 14,753 crore or US $ 2 billion[xvi] per year (in 2017-18 terms), compared to the actual teacher salary expenditure in 2017-18.

If we take only 'true' enrolment i.e. we remove the ghost/fake students, then column (j) shows that net teacher surplus increases to 763,735 teachers, and this massive teacher surplus leads to an excess expenditure of Rs. 38,845 crore or US $ 5.3 billion per year (in 2017-18 prices).

Although in the interests of space and brevity, we do not show a separate table, the PTR under the above modified teacher allocation rule would be 24.5 pupils per teacher, compared to the current 22.8, i.e., well below 30 pupils per teacher.

XI. Decomposition of Change in PTR

The pupil teacher ratio (PTR) in public elementary schools declined dramatically by 8.4 from 31.2 in 2010-11 to 22.8 in 2017-18. This drastic reduction in PTR can be attributed to a 'double-whammy', i.e. both a sharp reduction in enrolment and a concomitant strong increase in the number of teachers. We decompose the reduction in PTR into these two components.

$PTR_0 = E_0/T_0$

$PTR_t = E_t/T_t$

where PTR_0 and PTR_t are pupil teacher ratio at time 0 and at time t respectively. E and T represent enrolment and teacher respectively.

$$\Delta PTR = (PTR_t - PTR_0)$$

$$= E_t/T_t - E_0/T_0$$

$$= (E_0 + \Delta E)/T_t - E_0/T_0 \qquad [E_t = E_0 + \Delta E \text{ and } T_t = T_0 + \Delta T]$$

$$= \Delta E/T_t + \{-(\Delta T * E_0)/(T_t * T_0)\} \text{ [where } \Delta E \text{ and } \Delta T \text{ are the rise in enrolment and teachers respectively]}$$

$\mathbf{(\Delta E/T_t)}$ = effect due to enrolment change (1)

$\mathbf{(\Delta T * E_0)/(T_t * T_0)}$ = effects due to change in number of teacher. (2)

Table 13(a) Panel A presents the actual PTRs in the two time periods 2010 and 2017 and shows that PTR fell by 8.4 students per teacher over this short seven year period. Table 13(a) Panel B presents the decomposition of the temporal 'reduction in PTR' into its two components, and it shows that 63.6% of the total reduction of PTR was due to the reduction in actual student enrolment in public elementary schools over this seven year period, and 36.4% of the reduction in PTR was due to a rise in the total number of teachers due to fresh teacher appointments. Thus, just under two-thirds of the reduction in PTR over time was due to a fall in student enrolment, and just over one-third was due to the appointment of more teachers.

We have computed two counterfactual scenarios.

Scenario 1: When there is no change in the actual number of teachers during this period.

Scenario 2: When there is no change in the total enrolment during this period.
Our analysis suggests that if there was no change in total number of teachers, then PTR would have declined only by 5.92 students per teacher, vis-à-vis a decline of 8.4 students per teacher in reality. Similarly, if there was no change in total enrolment and only a rise in the number of teachers, then PTR would have reduced only by 3.06 students per teacher.

Table 13(b) shows the state-wise PTR decomposition in 21 major Indian states. The final column of Table 13(b) shows that in 6 out of 21 major states, more than 50% of the responsibility for the reduction in Pupil Teacher Ratio is due to increase in the number of teachers. In many of the states declining number of teachers is offset by the ubiquitous reduction in enrolment.

XII. Small schools with extreme teacher surpluses

Tables 14 and 15 examine the cases of 'small' schools that have an extreme surplus of teachers. Table 14 relates to all schools with less than or equal to 60 (i.e. <=60) students, which for the purposes of this section we shall call 'small' schools, and Table 15 relates to all schools with <=20 students which we shall call 'tiny' schools. As in the whole of the rest of the paper, we are only considering public elementary schools.

Table 14(a) shows that there were 493,848 small schools (<=60 pupils), that they constituted 47.7% (i.e. nearly half) of all schools, that they had an average of 31.6 students per school, an average of 2.4 teachers per school and thus a PTR of 13.2 pupils per teacher. In other words, roughly half of all public schools in the country had an average PTR of 13.2 pupils per teacher !

While column (g) shows that l.7% of small schools had zero teachers and 13.6% had one teacher (teacher deficit schools) and 57% schools had the (desired) two teachers, the remaining 27.6% of small schools had teacher surpluses. 15% had three teachers, 6.5% had four teachers and 6.1% of all schools had 5 or more teachers, and it is this last category we focus on, here.

Table 14(b) shows the average PTRs in the 'small' schools: in small schools with one teacher, PTR was 25.7; with two, three and four teachers, PTR was 14.9, 12.8 and 10.1 respectively. In small schools with five or more teachers, PTR was merely 5.4, a case of extreme teacher surplus. The remaining columns indicate that there were 30,246 such profligate 'small' schools, that they had 224,107 teachers (i.e. a mean of 7.4 teachers per school), a pupil teacher ratio of 5.4 pupils per teacher, and a per-pupil-expenditure on teacher salary alone of Rs. 94,939 in 2017-18, which was equal to 82.3% of the national per capita income[xvii] that year ! This implies a total teacher salary cost of Rs. 11,512 crore or about US$ 1.6 billion in 2017-18 on these 30,246 'small' public schools with an extreme teacher surplus. This was higher than the entire GDP of Gambia or Belize that year.

Table 15(a) shows that there were 126,864 'tiny' public schools in the country in 2017-18, i.e. schools with a total enrolment of 20 or fewer (<=20 pupils), which constituted 12.3% of all public schools. These had on average 12.6 students per school, an average of 2 teachers per school, and thus a PTR of 6.3 pupils per teacher ! While 4.2% of these tiny schools had zero teachers, and 22.6% had one teacher (which seems perhaps not unreasonable, given an average enrolment of only 12.6 students per school), in the latter columns we see that 60.4% of these schools had two teachers, 7.5% had three teachers, and 5.3% had four or more teachers (2.6% had four teachers and 2.7% had five teachers). While nationally there were only 2.7% of tiny schools with >=5 teachers, in some states that figure is much higher, e.g. in Bihar and Kerala the figure is more than 10%, and in Assam and Kashmir, it is more than 8%.

Table 15(b) shows that among the tiny schools, those with one teacher had a PTR of 11.3, those with (the RTE Act mandated) two teachers had a PTR of 6.8, those with three or more teachers had a PTR of mere 3.2 pupils per teacher! The last row of Table 15(a) columns (i), (j) and (k) showed that 12.8% of all tiny schools had >=3 teachers, which is equal to 16,151 schools. Table 15(b) shows that these 16,151 tiny schools with >=3 teachers had a total of 67,689 teachers, 4.2 teachers per school, and a per pupil salary expenditure of Rs. 161,218 in 2017-18, which implies a total expenditure of Rs. 3477 crore (US$ 476 million) per year on these 'tiny' public schools with an extreme teacher surplus.

XIII. Conclusions

. This paper questions the education ministry's estimate of one million teacher vacancies in public elementary schools which is the basis for the widely-perceived acute teacher shortage, and which has been uncritically accepted by the framers of the National Education Policy (NEP 2020). We ask whether the vacancy estimates are supported by evidence, and we explore teacher surpluses, fake student enrolment and student and teacher absences, and consider the implications of these for pupil teacher ratios (PTRs). The paper also calculates the fiscal cost to the exchequer of maintaining PTR at the levels prescribed in the NEP 2020 and the Right to Education (RTE) Act 2009. The paper restricts analysis to public elementary schools only, in 21 major states of India which constitute 97% of the country's population.

We find that compared to the published national PTR of 22.8, the true PTR (after adjusting for fake enrolment) is 19.6, i.e. very substantially lower than the mandated maximum of 30 in the RTE Act. *Prima facie* this suggests a very large number of surplus teachers in relation to the teacher-allocation norms, and calls into question the notion of an acute teacher shortage in the country, which has motivated the current paper.

The paper has several key findings. Firstly, while the paper broadly confirms the government-estimated large number of teacher vacancies (calculated in relation to the RTE Act's teacher-allocation norms), it shows that (applying the same norms) there are also roughly the same number of surplus teachers, so that there is hardly any *net* deficit of teachers, i.e. a deficit of only 26,660 teachers, compared to the widely publicised one-million teacher vacancies.

To analyse this net national deficit of 26,660 teachers, we did state-wise analysis. This shows that eight states have net teacher deficits (i.e. net vacancies) and thirteen states have net teacher surpluses. It shows that 84 per cent of all net vacancies are in four states of Bihar, Jharkhand, Madhya Pradesh and Uttar Pradesh and thus it is mainly these four states that need close attention from a teacher shortage perspective (illustration for Uttar Pradesh shows how district level analysis can help fill teacher shortages through redeployment). We show that 73% of all net teacher surpluses in the country are in West Bengal, Tamil Nadu, Assam, Punjab, Rajasthan, and Kerala, where large savings can result from reducing surplus teachers, e.g. via attractive voluntary retirement schemes and/or stopping fresh recruitment, etc.

Secondly, we find that official teacher vacancy estimates are based on taking schools' self-reported pupil enrolments at face value, but that adjusting for the well-known fake enrolments i.e. over-reported pupil numbers, nearly halves the number of teacher vacancies. The fake enrolments are clearly visible in the histogram in Figure 1. If government continues to use reported (inflated) enrolment to estimate teacher vacancies, and fills its claimed nearly one million teacher vacancies based on these *prima facie* (unadjusted) enrolment numbers, the already modest mean PTR of 22.8 would fall further to 15.9 nationally, at a cost of nearly Rs. 48,000 crore (USD 6.6 billion) per year in 2017-18 prices, creating a huge permanent fiscal burden.

Thirdly, we show that combining both ideas – i.e. first removing fake enrolments and second estimating additional teachers required to fill only *net* teacher vacancies (that remain after removing surplus teachers) – would imply that instead of a deficit of nearly one million teachers, there would be 341,900 net surplus teachers ! Inter-state analysis shows that in fourteen states there is a sobering net surplus of 515,704 teachers (maintained at a cost to the public exchequer of Rs. 26,490 crore or approx. US $ 3.63 billion per annum in 2017-18 terms), wastage which needs to be reduced, e.g. via voluntary retirement schemes and/or a freeze on fresh recruitment. There is a net teacher deficit in only seven states, totalling 173,763 teachers, of which 86% is in only four states (Bihar, Jharkhand, Karnataka, Madhya Pradesh), implying that national policy makers need to focus on teacher shortages mainly in these four states.

Fourthly, the paper shows the total annual fiscal burden of surplus teachers due to two factors: first, maintaining the current PTR of 22.8 rather than the permitted maximum PTR of 30, costs the exchequer Rs. 55,169 crore; second, the fiscal burden of additional recruitment to fill the supposed (882,200) teacher vacancies that the National Education Policy 2020 says will be urgently filled, would be Rs. 47,879 crore per annum. This adds up to an annual fiscal burden of Rupees 103,048 crore (US$ 14.1 billion) per annum in 2017-18, which was roughly equal to the total GDP of Madagascar or Mongolia that year, and was higher than the individual GDPs of 86 countries!

Fifthly, the paper shows how the RTE Act's rule of providing two teachers to any school with up to 60 students, leads to two teachers being allocated even to 'tiny' schools (those with 20 or fewer total students) whose numbers have been swelling every year due to the emptying of public schools. Given that in the nearly 127,000 'tiny' public schools with <=20 pupils, there were on average merely 12.6 pupils per school, the RTE-mandated appointment of two teachers leads to an average PTR of a mere 6.3 pupils per teacher, a seriously unviable situation. The paper shows that if this rule were modified, with only one (rather than two) teacher being allocated to schools with <=20 students, there would be a net surplus of 303,471 teachers even without adjusting for fake enrolment, and if we remove the estimated fake students, net teacher surplus increases to 763,735 teachers, which leads to an excess expenditure of Rs. 38,845 crore or US $ 5.3 billion per year (in 2017-18 prices).

Sixthly, the paper examines schools that have an extreme teacher surplus, to quantify this aspect of economic wastage of scarce educational resources. We find that there were 30,246 small schools with a total enrolment of <=60 pupils and with 'five or more' teachers; these 'small' schools had on average 40 pupils, 7.4 teachers, a PTR of 5.4 pupils per teacher; they had a total annual teacher salary bill of Rs. 11,512 crore (US$ 1.6 billion per year) in 2017-18, and a per-pupil-teacher-salary-expense of Rs. 94,939 in 2017-18, which was more than 82% of the per capita income of India (and 2.5 times the per capita income of Bihar state) that year! Similarly, there were 16,151 tiny schools which had a total enrolment of <=20 pupils and had 'three or more teachers'; these tiny schools had on average 13.4 pupils, 4.2 teachers, an extremely low PTR of 3.2 pupils per teacher, a total salary expenditure of Rs. 3,477 crore (US$ 476 million) per year, and a per-pupil-salary-expense of Rs. 161,218 in 2017-18, which was 140% of (or 1.4 times) India's per capita income (and 4.2 times the per capita income of Bihar state) in that year!

Seventhly, the paper shows that about Rs. 102,522 crore expenditure on teacher salaries is wasted each year due to teacher and student absenteeism and ghost enrolments, suggesting areas of scope for greater efficiency. The wastage due to estimated ghost/fake enrolments alone is Rs. 26514 crore (US$ 3.6 billion).

Eighthly, India stipulated a maximum PTR of 30 in primary schools but – in the international and Indian literature that is cited above – there is little empirical support for the idea that reducing PTR raises pupil learning. We estimated that maintaining a PTR of 40, compared to the current PTR of 22.8, would save Rs. 73,386 crore (US $ 10 billion) per year, in 2017-18 prices.

This paper has tried to provide evidence based on the government's official DISE data. An important caveat is that while fake enrolment estimates were available for some states from the Comptroller and Auditor General, the Mid Day Meal Authority and some research studies, and we have also shown evidence of the presence of fake enrolment through Figures 1 and 2. Nevertheless, we have imputed fake enrolment estimates from these states to other states (making some assumptions) which may not be accurate, and ideally states need to repeat the analysis based on their own estimates of fake enrolment through surveys. There is also no well-established methodology for estimating fake enrolments, so the extent of fake enrolment may be contested.

District wise analysis within each state would be fruitful to see the scope intra-district or inter-district intra-Division redeployment of teachers from teacher-surplus to teacher-deficit areas.

Policy thought is needed on adapting the current generous teacher allocation rules, given that abandonment of public elementary schools had slashed median public school size to a mere 64 pupils by 2017-18, which meant that about 127,000 public schools have 20 or fewer pupils and an average of 12.6 pupils; the altered rules need to be based on both pedagogic considerations and economic constraints. Thought it also needed on the best compensation policies to incentivise teachers to accept redeployment where needed, and on other measures (such as voluntary retirement schemes) for rationalising the estimated half a million surplus teachers in fourteen states, in order to promote economic efficiency in Indian school education.

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Table 1 : Change over time in the number of public and private elementary schools: 2010-11 to 2017-18

State	Public schools			Private schools		
	2010-11	2017-18	Change	2010-11	2017-18	Change
Andhra Pradesh*	79,314	73,856	-5,458	24,823	25,724	901
Assam	44,371	49,446	5,075	13,144	12,724	-420
Bihar	67,930	70,252	2,322	1,423	13,855	12,432
Chhattisgarh	46,390	44,452	-1,938	4,552	6,735	2,183
Gujarat	33,531	33,788	257	6,405	10,579	4,174
Haryana	14,955	14,413	-542	5,549	8,552	3,003
Himachal Pradesh	15,126	15,465	339	2,285	2,810	525
Jammu-Kashmir	22,180	23,393	1,213	4,915	5,418	503
Jharkhand	40,517	38,957	-1,560	2,949	8,292	5,343
Karnataka	46,522	45,256	-1,266	10,259	14,470	4,211
Kerala	4,958	4,570	-388	906	4,921	4,015
Madhya Pradesh	111,943	114,041	2,098	23,710	29,453	5,743
Maharashtra	68,691	66,519	-2,172	9,775	17,536	7,761
Odisha	57,171	54,766	-2,405	4,347	6,399	2,052
Punjab	20,238	19,502	-736	10,139	8,711	-1,428
Rajasthan	77,529	66,872	-10,657	26,760	38,428	11,668
Tamil Nadu	36,120	37,625	1,505	10,622	12,429	1,807
Uttar Pradesh	151,448	161,544	10,096	41,961	94,700	52,739
Uttaranchal	17,345	17,341	-4	4,823	5,915	1,092
West Bengal	79,323	83,280	3,957	10,227	14,530	4,303
India (21 states)	**1,035,602**	**1,035,338**	**-264**	**219,574**	**342,181**	**122,607**

Source: DISE (2017-18)
Note: Andhra Pradesh includes Telengana in this and most tables below.

Table 2: Change in enrolment in public and private elementary schools: 2010-11 to 2017-18

	Public schools			Private schools		
	2010-11	**2017-18**	**Change**	**2010-11**	**2017-18**	**Change**
Andhra Pradesh*	6,186,492	5,072,962	-1,113,530	4,592,255	5,113,308	521,053
Assam	4,082,132	3,828,109	-254,023	998,944	1,232,447	233,503
Bihar	19,495,910	17,787,806	-1,708,104	404,132	2,999,608	2,595,476
Chhattisgarh	3,808,619	3,082,746	-725,873	755,632	1,164,751	409,119
Gujarat	5,901,456	5,456,424	-445,032	2,017,575	3,210,515	1,192,940
Haryana	2,093,700	1,542,191	-551,509	1,304,015	2,350,774	1,046,759
Himachal Pradesh	745,712	533,388	-212,324	284,026	395,957	111,931
Jammu-Kashmir	1,213,246	937,825	-275,421	786,400	788,807	2,407
Jharkhand	5,591,346	4,164,893	-1,426,453	928,935	1,658,151	729,216
Karnataka	4,624,287	3,816,438	-807,849	2,328,793	3,399,727	1,070,934
Kerala	1,075,886	844,947	-230,939	375,084	1,473,101	1,098,017
Madhya Pradesh	10,634,585	7,217,655	-3,416,930	4,623,450	4,796,127	172,677
Maharashtra	7,418,628	5,499,126	-1,919,502	2,433,975	4,493,775	2,059,800
Odisha	5,659,929	4,690,160	-969,769	599,886	1,088,662	488,776
Punjab	2,165,466	1,652,599	-512,867	1,642,518	2,006,753	364,235
Rajasthan	7,132,668	6,224,446	-908,222	4,736,520	6,040,497	1,303,977
Tamil Nadu	4,262,160	3,140,559	-1,121,601	3,250,332	3,930,920	680,588
Uttar Pradesh	19,688,240	15,723,078	-3,965,162	10,280,445	16,647,313	6,366,868
Uttaranchal	936,630	681,848	-254,782	617,344	928,773	311,429
West Bengal	13,484,910	1,0424,158	-3,060,752	1,349,964	1,712,506	362,542
India (21 states)	**126,202,002**	**102,321,359**	**-23,880,643**	**44,310,225**	**65,432,470**	**21,122,245**

Source and notes same as in Table 1.

Table 3: Public elementary school enrolments, pupil-teacher-ratio (PTR) and per-pupil-expenditure, by school size, 2010 to 2017 (Change over time in the number of 'small' and 'tiny' public schools)

Total number of pupils in the school as a whole:	Number of public schools	Percentage of public schools	Number of teachers	Total enrolment	Average pupils per school	Pupil teacher ratio	Teacher salary expenditure (Rs. Crore)	Govt. annual per-pupil salary expense (Rupees)	Govt. monthly per-pupil salary expense (Rupees)
2010-11									
Zero	4,435	0.4	14,304	0	0	0	503	-	-
5 or Less	8,675	0.8	21,277	15,333	2.5	0.7	748	488,101	40,675
10 or Less	21,008	2.0	42,843	118,166	5.6	2.8	1,507	127,530	10,628
20 or Less	71,189	6.9	138,033	920,254	12.9	6.7	4,855	52,760	4,397
50 or Less	313,169	30.2	633,323	9,510,902	30.4	15.0	22,277	23,422	1,952
<= 100 pupils	594,340	57.4	1,426,416	30,133,038	50.7	21.1	50,173	16,656	1,388
All public schools	1,036,187	100.0							
2017-18									
Zero	7,505	0.7	10,767	0	0	0	670	-	-
5 or Less	17,073	1.6	27,805	34,699	2.0	1.2	1,731	498,937	41,578
10 or Less	40,421	3.9	71,603	227,261	5.6	3.2	4,458	196,176	16,348
20 or Less	126,864	12.3	249,676	1,597,272	12.6	6.4	15,546	97,328	8,111
50 or Less	426,789	41.2	992,463	11,902,679	27.9	12.0	61,795	51,917	4,326
<= 100 pupils	700,244	67.6	2,003,358	31,729,969	45.3	15.8	124,738	39,312	3,276
All public schools	1,035,338	100.0	4,481,978	102,320,384	98.8	22.8	279,067	27,274	2,273

Source: www.statereportcards/rawdata/201011 Data here is for 20 major states in 2010-11 and (counting Telengana as a separate state) for 21 major states in 2017-18.
Note: Data on public school teachers' salary is taken from Ramchandran (2015), where the simple mean of public primary school teacher salary in six states (averaged across new and experienced teachers) was 40,623 per month in 2014-15. For 2017-18/2010-11, it has been inflated/deflated by 8.5%, assuming a salary inflation rate of 8.5% per annum, based on salary escalation in one state i.e. Uttar Pradesh, see Annex Table 2 in Kingdon (2017). Thus, average primary teacher salary is taken as Rs. 29,312 in 2010-11 and 51,887 in 2017-18. Note that about one third of all public elementary schools are middle schools, and their teachers earn salaries that are about 30% higher, but we have assumed that all schools are primary, and thus taken only primary teacher salary rates to calculate the per pupil salary expenditure. Thus, average salary level used here therefore is under-estimated; however, at the same time, we have imputed the regular teacher salary to all teachers even though about 13% of all teachers are contract teachers whose salary rate is lower than regular teachers'. Among schools with <=100 pupils, while mean pupils per school is 45.3, median pupils per school is 41.0. This is based on schools' self-reported enrolment, which is known to be inflated, i.e. the true mean and median school size are even lower.

Table 4: Percentage of public schools with 'total student enrolment' below given levels, 2017-18

State	Percentage of schools with 'Total student enrolment' of:							Average school size (among all schools with enrolment<=100)	Average school size
	<=20	<=30	<=40	<=50	<= 60	<=80	<=100		
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
Uttaranchal	46.2	62.7	72.8	78.8	83.0	88.8	92.0	26.9	39.3
Himachal Pradesh	40.2	60.1	73.7	81.6	86.5	93.0	96.0	29.5	34.5
Jammu-Kashmir	36.5	53.5	65.0	73.7	79.8	88.1	93.0	32.2	40.1
Karnataka	24.9	36.8	45.5	52.4	57.4	65.8	71.6	36.5	84.3
Telangana	23.2	37.3	46.9	54.1	59.6	69.8	76.9	37.9	71.9
Maharashtra	20.4	37.2	48.3	55.0	58.7	66.8	72.5	36.5	82.7
Andhra Pradesh	19.1	39.8	53.0	59.9	64.5	73.7	80.6	37.7	66.6
Tamil Nadu	16.2	30.3	40.9	48.0	52.5	63.5	71.3	41.9	83.5
Assam	15.8	28.2	39.8	48.9	56.4	68.0	76.2	43.3	77.4
Chhattisgarh	12.4	24.7	36.6	47.2	56.2	70.1	79.4	46.4	69.4
Madhya Pradesh	12.3	26.6	40.5	52.1	60.5	75.1	83.0	44.7	63.3
Odisha	12.3	26.8	38.9	47.8	54.4	64.5	71.6	43.2	85.6
Rajasthan	9.4	21.9	32.9	40.5	46.9	57.4	64.8	45.4	93.1
Punjab	9.3	21.8	32.6	42.0	49.0	63.0	71.6	47.3	84.7
Kerala	7.5	14.8	22.2	29.3	35.8	47.7	55.0	49.5	184.9
West Bengal	6.6	15.3	25.1	34.5	42.7	56.2	66.0	51.0	125.2
Haryana	6.3	13.8	22.2	28.6	36.4	50.3	60.6	52.7	107.0
Jharkhand	5.7	15.7	27.7	38.6	47.0	58.7	66.4	48.7	106.9
Gujarat	5.2	12.5	19.4	24.9	28.4	38.1	44.1	49.1	161.5
Uttar Pradesh	2.9	7.5	14.4	22.3	30.4	47.2	59.5	58.9	97.3
Bihar	0.3	0.8	1.9	3.8	6.2	12.9	20.7	70.4	253.2
India (21 major states)	**12.3**	**23.3**	**33.2**	**41.2**	**47.7**	**59.4**	**67.6**	**45.3**	**98.8**

Note: To illustrate how to interpret this table, Column (a) last row shows that in India, 12.3 per cent of all public elementary schools had a total enrolment of '20 or fewer' students; column (d) shows that 41.2% of all public schools had '50 or fewer' pupils, and so on. In the hilly states of Uttaranchal 83%, Himachal 86.5% and Kashmir, about 80% (79.8%) of all public schools have '60 or fewer students'. 'Average school size' in column (h) shows the average number of students per school among all public schools where the enrolment is fewer than 100 (i.e. in the 67.6% of all public schools in the country). The India row here and in all tables below represents the above listed 21 major states constituting 97% of the population. The table is sorted by column (a).
Source: Authors' calculations from DISE 2017-18 data.

Table 5: Percentage of public schools with pupil teacher ratio (PTR) below given levels, 2017-18

	% of public schools with pupil-teacher-ratio below given levels				
state	**% below PTR 10**	**% below PTR 15**	**% below PTR 20**	**% below PTR 25**	**% below PTR 30**
	(a)	(b)	(c)	(d)	(e)
Himachal Pradesh	56.3	74.2	84.8	89.9	92.1
Jammu & Kashmir	55.4	74.2	84.2	89.3	91.7
Uttarakhand	50.2	66.4	76.2	82.8	86.8
Kerala	38.6	59.6	76.5	87.8	93.4
Telangana	28.0	51.6	67.4	78.7	84.5
Tamil Nadu	28.0	48.3	65.9	81.3	88.6
Assam	25.8	41.9	55.8	67.3	76.1
Punjab	25.5	46.6	62.7	76.5	85.0
Karnataka	24.3	42.4	56.9	68.3	76.2
Haryana	23.4	38.3	53.3	73.3	84.9
Maharashtra	19.4	37.4	54.4	73.7	84.8
Chattisgarh	15.5	32.2	51.2	68.1	78.4
Andhra Pradesh	13.7	44.4	66.6	79.9	84.6
Odisha	13.7	32.0	49.6	64.9	76.1
Rajasthan	13.1	30.4	49.3	64.5	74.2
West Bengal	12.2	30.4	51.5	69.5	80.3
Madhya Pradesh	9.6	23.0	37.2	52.4	62.5
Gujarat	6.8	16.4	30.5	55.0	73.6
Uttar Pradesh	5.9	15.9	29.6	44.6	57.8
Jharkhand	3.5	10.9	21.3	33.0	43.7
Bihar	0.7	2.3	5.8	12.4	21.5
India (21 major states)	**15.4**	**30.6**	**45.6**	**59.9**	**69.8**

Source: Authors' calculations from DISE 2017-18.

Table 6: Percentage of all public schools with 'total enrolment' below given levels AND more than 2 teachers, 2017-18

	In schools with given total enrolment, % of schools with more than 2 teachers						Reported total enrolment at which, after adjusting for fake pupils, true total enrolment comes to 60 pupils
	Total Enrolment <=20	Total Enrolment <=30	Total Enrolment <=40	Total Enrolment <=50	Total Enrolment <=60	*Actual* Total Enrolment <=60**	
	(a)	(b)	(c)	(d)	(e)	(f)	
Kerala	82.2	88.6	91.5	93.2	94.1	94.2	(64)
Uttar Pradesh	38.8	41.4	44.2	47.0	49.8	53.6	(70)
Bihar	32.2	28.8	28.3	29.1	31.8	40.1	(81)
West Bengal	31.1	34.9	42.2	49.2	55.3	59.6	(69)
Assam	29.8	33.1	36.2	38.9	41.5	43.2	(66)
Jammu & Kashmir	24.4	29.2	33.9	38.3	41.6	43.1	(65)
Himachal Pradesh	20.4	26.1	30.6	34.1	36.9	38.0	(64)
Chattisgarh	18.3	22.2	26.1	31.0	36.0	38.5	(65)
Haryana	16.4	22.1	28.7	35.1	44.6	52.2	(70)
Punjab	13.7	21.7	29.3	35.9	41.3	45.9	(64)
Uttarakhand	12.7	16.3	18.8	21.1	23.3	25.9	(64)
Gujarat	11.2	14.9	18.0	22.5	27.8	32.8	(63)
Karnataka	9.5	15.5	22.2	27.3	31.3	32.5	(63)
Odisha	9.5	10.5	12.9	15.6	18.7	20.3	(64)
Madhya Pradesh	6.7	8.4	10.7	13.1	15.7	16.2	(69)
Telangana	4.7	7.6	12.1	17.8	22.9	30.1	(64)
Jharkhand	4.3	4.0	4.7	5.9	7.1	8.4	(67)
Rajasthan	4.2	4.2	7.0	9.9	14.1	14.5	(65)
Maharashtra	3.0	3.9	5.5	7.6	10.0	12.5	(63)
Tamil Nadu	2.7	3.7	5.5	9.0	13.4	17.9	(62)
Andhra Pradesh	0.9	2.0	3.7	6.2	10.0	12.8	(64)
All India	**12.7**	**15.4**	**19.3**	**23.4**	**27.6**	**30.8**	**(69)**

Source: Authors' calculations from DISE 2017-18 data.
Note: The table is sorted by column (a). The India row in column (f) shows that nationally 30.8% of all schools with a total enrolment of <=60 have >2 teachers, i.e. have surplus teachers, as per the teacher-allocation norms. Columns (a) to (e) use the schools' reported total enrolment at face value (as genuine students) but it is well known that a part of total enrolment is over-reported, consisting of ghost/fake students. To illustrate, in Uttar Pradesh, a reported total enrolment of 70 when deflated by removing its ghost enrolment (16%), comes to an actual/true enrolment of 60 students. When we take reported enrolment in column (e) we conclude that in UP, 49.8% of all schools with total enrolment<=60 have >2 teachers, but when we take actual/true enrolment in column (f) we conclude that 53.6 per cent of all schools with total enrolment<=60 have >2 teachers. Evidence on ghost/fake enrolments is discussed in the Note to Table 7.

Table 7: Different concepts of pupil teacher ratio (PTR)

States	Total students (reported)	Total teachers (regular)	Total teachers (contractual)	Total teachers (reported)	Pupil teacher ratio (reported)	Students attendance rate$	Teacher attendance rate$	Imputed national proportion of ghost enrolment#	Students attendance rate after adjusting ghost enrolment*	Total enrolment after removing ghost enrolment	PTR after removing ghost enrolment	Effective pupil teacher ratio (EPTR)	Cost-conscious pupil teacher ratio (CPTR)
	(a)	(b)	(c)	(d)	(e=a/d)	(f)	(g)	(h)=(1-f)*0.31	(i)	(j=a*(1-h))	(k=j/d)	l=(a*f)/(d*g)	m=(a*f)/d
Himachal Pradesh	533,388	47,246	20,676	67,922	7.9	0.83	0.76	0.05	0.88	506,719	7.5	8.6	6.5
Jammu Kashmir	937,825	89,093	10,117	99,210	9.5	0.77	0.82	0.07	0.83	872,177	8.8	8.8	7.3
Uttaranchal	681,848	57,010	3,458	60,468	11.3	0.83	0.86	0.05	0.88	647,756	10.7	10.8	9.4
Kerala	844,947	62,500	2,225	64,725	13.1	0.83	0.86	0.05	0.87	802,700	12.4	12.6	10.8
Tamil Nadu	3,140,559	209,070	29,924	238,994	13.1	0.91	0.92	0.03	0.94	3,046,342	12.7	13.0	12.0
Punjab	1,652,599	82,727	34,753	117,480	14.1	0.80	0.86	0.06	0.86	1,553,443	13.2	13.2	11.3
Andhra Pradesh	5,072,962	318,028	14,029	332,057	15.3	0.79	0.83	0.07	0.85	4,717,855	14.2	14.5	12.1
Haryana	1,542,191	83,471	13,759	97,230	15.9	0.78	0.88	0.16##	0.92	1,295,440	13.3	14.1	12.4
Assam	3,828,109	189,614	32,992	222,606	17.2	0.73	0.87	0.08	0.80	3,521,860	15.8	14.3	12.6
Rajasthan	6,224,446	338,550	4,503	343,053	18.1	0.75	0.85	0.08	0.81	5,726,490	16.7	15.9	13.6
Chhattisgarh	3,082,746	150,035	835	150,870	20.4	0.75	0.84	0.08	0.81	2,836,126	18.8	18.2	15.3
Maharashtra	5,499,126	257,155	4,464	261,619	21.0	0.86	0.88	0.04	0.90	5,279,161	20.2	20.6	18.1
West Bengal	10,424,158	376,865	101,912	478,777	21.8	0.55	0.77	0.14	0.64	8,964,776	18.7	15.6	12.0
Karnataka	3,816,438	173,895	703	174,598	21.9	0.88	0.90	0.04	0.91	3,663,780	21.0	21.4	19.2
Odisha	4,690,160	118,796	94,299	213,095	22.0	0.82	0.94	0.06	0.87	4,408,750	20.7	19.1	18.0
Madhya Pradesh	7,217,655	279,654	1,115	280,769	25.7	0.56	0.86	0.14	0.65	6,207,183	22.1	16.7	14.4
Gujarat	5,456,424	204,309	1,223	205,532	26.5	0.88	0.90	0.04	0.92	5,238,167	25.5	26.0	23.4
Uttar Pradesh	15,723,078	504,125	73,395	577,520	27.2	0.60	0.85	0.16##	0.71	13,207,386	22.9	19.1	16.3
Jharkhand	4,164,893	46,261	69,831	116,092	35.9	0.65	0.92	0.11	0.73	3,706,755	31.9	25.5	23.3
Bihar	17,787,806	322,262	62,087	384,349	46.3	0.56	0.69	0.35##	0.87	11,562,074	30.1	38.2	25.9
Major 21 States	**102,320,384**	**3,905,678**	**576,300**	**4,481,978**	**22.8**	**0.72**	**0.85**	**0.14**	**0.84**	**87,995,530**	**19.6**	**19.4**	**16.4**

Source: $- Source of student and teacher attendance rates in columns (f) and (g) is ASER (2018). Note: The table is sorted by column (e).

Note: A national student attendance of 72% implies an absence rate of 28%, but this represents partly genuine absence of enrolled children, and partly ghost enrolment, i.e. children who are not enrolled in school but which are shown to be enrolled. ## These are the actual percentage of ghost enrolment in the marked states, based on studies. For all other states, ghost enrolment is calculated as 0.31*(1-f), where the quantity in column (f) is the attendance rate and (1-f) is pupil absence rate. For Uttar Pradesh CAG (2017) estimates ghost enrolment to be 20% of total enrolment, and Kingdon and Banerji (2009) estimate it to be 16%; For Bihar, CAG (2014) reports a ghost enrolment of 38% of total enrolment, and Kingdon and Banerji (2009) report it to be 35%. For these two states, we take fake enrolment to be 16% and 35% respectively, i.e. take the lower of the fake enrolment estimates of the two studies. For Haryana, Vasudeva (2017) estimates that 16% of enrolment was fake. For every other state (other than UP, Bihar and Haryana) we calculate the ghost enrolment proportion as follows: Fake enrolment is some sub-set of total absence rate. In Bihar the pupil attendance rate is 56%, i.e. absence rate is 44%. Out of total enrolment, 35% is fake, so 35/44 or 79.5% of total *absence* is ghost enrolment. In Uttar Pradesh, attendance rate is 60%, and absence rate 40%. 16% of total pupil enrolment is fake, i.e. 16/40 or 40% of the total absence is fake enrolment. In Haryana, total pupil attendance is 78%, so absence rate is 22%. Of this, 16 points is fake (Vasudeva, 2017), i.e. 16/22 or 72.7% of the pupil absence is due to fake enrolment. Taking the weighted average of these three (UP 40.0%; Bihar 79.5% and Haryana, 72.7%) shows that fake enrolment is about 62% of total pupil absence in a state. However, these figures are for the educationally less well performing states. We conservatively assume that only half that i.e. 31% of the reported absence rate in any state is due to ghost enrolments (though this may underestimate fake enrolment in Jharkhand and some other north Indian states). Thus (1-f)*0.31 gives the ghost enrolment rate estimate for each state. The All-India ghost enrolment estimate of 14% is the weighted mean of all the states' ghost enrolments. ** Column "i" is computed as (attendance rate/(1-ghost enrolment rate))

Table 8a: Teacher vacancies and teacher surpluses, 2017-18

States	As Per MHRD Report for 2017-18[$]			Using DISE 2017-18, and applying the RTE Act's teacher-allocation norms			Using DISE 2017-18, and removing ghost students** and applying the RTE Act's teacher allocation norms			Fiscal Cost of filling teacher vacancies (Rs. crores)	
	Sanctioned posts	Teachers in position	Teacher vacancies	Teacher vacancies	Excess teacher	Net-surplus teachers	Vacancies	Excess teacher	Net-excess teachers	Cost of filling vacancies (of col. c)	Cost of filling net vacancies (of col. f)
	(a)	(b)	(c = a - b)	(d)	(e)	(f = e - d)	(g)	(h)	(i = h – g)	(j)	(k)
West Bengal	454,860	367,079	87,781	27,977	115,164	87,187	17,680	138,993	121,313	3,562	-3,537
Tamil Nadu	147,982	144,194	3,788	4,276	79,706	75,430	3,708	81,278	77,570	166	-3,314
Assam	204,607	184,502	20,105	17,494	57,607	40,113	13,686	60,598	46,912	1,033	-2,061
Punjab	95,249	77,074	18,175	2,771	39,928	37,157	2,080	41,636	39,556	1,662	-3,397
Andhra Pradesh*	246,292	219,036	27,256	26,764	62,077	35,313	24,903	65,919	41,016	1,400	-1,814
Rajasthan	283,416	246,827	36,589	39,297	73,175	33,878	34,032	77,308	43,276	1,880	-1,740
Kerala	126,382	124,982	1,400	327	33,321	32,994	264	33,966	33,702	72	-1,695
Haryana	70,090	58,159	11,931	3,509	31,625	28,116	2,264	36,324	34,060	613	-1,444
Himachal Pradesh	49,578	47,946	1,632	2,238	24,422	22,184	2,177	24,852	22,675	84	-1,140
Chhattisgarh	200,429	151,923	48,506	15,148	26,099	10,951	12,616	29,187	16,571	2,492	-563
Uttarakhand	46,053	38,475	7,578	5,794	14,967	9,173	5,519	15,306	9,787	389	-471
Jammu & Kashmir	101,301	94,093	7,208	5,867	14,529	8,662	5,552	14,544	8,992	370	-445
Maharashtra	314,938	296,267	18,671	27,892	15,488	-12,404	24,457	18,325	-6,132	959	637
Odisha	229,006	229,006	0	31,194	16,107	-15,087	27,102	17,428	-9,674	0	775
Gujarat	217,106	213,067	4,039	21,759	6,581	-15,178	18,187	10,055	-8,132	208	780
Karnataka	203,824	189,332	14,492	41,025	11,917	-29,108	38,692	12,724	-25,968	625	1,256
Uttar Pradesh	759,828	535,501	224,327	126,009	74,482	-51,527	83,384	103,658	20,274	13,491	3,099
Madhya Pradesh	363,099	296,576	66,523	81,720	22,013	-59,707	66,905	32,255	-34,650	3,417	3,067
Jharkhand	192,144	113,879	78,265	63,462	3,433	-60,029	52,415	4,183	-48,232	4,981	3,820
Bihar	592,541	388,607	203,934	217,204	12,426	-204,778	82,892	41,917	-40,975	10,476	10,519
Major 21 States	**4,898,725**	**4,016,525**	**882,200**	**761,727**	**735,067**	**-26,660**	**518,515**	**860,456**	**341,941**	**47,879**	**2,333**

Note: The table is sorted by column (f). *-includes Telangana. The teacher vacancies in column (d) are calculated by applying the teacher requirement norms given in the Schedule of the RTE Act (2009) for each and every public elementary school, and then totalled for the state as a whole. These norms state that for classes 1 to 5, in a school of up to a total enrolment of 60 pupils, two teachers are required; in a school with 61 to 90 pupils, 3 teachers are required, and so on, up to a total enrolment of 150, after which a head master is required i.e. a total of six teachers (including the headmaster). Beyond enrolment of 200, a pupil teacher ratio of 40 is to be maintained, plus a head teacher. For classes 6 to 8, minimum three teachers are required for a total enrolment upto 100, and beyond that maintaining a pupil-teacher ratio of 35:1 along with a separate head teacher. If 'Net Excess teachers' is negative, it represents teacher vacancies. Ghost enrolment figures are based on column (h) in Table 7 above. The cost calculations in the last two columns are in Rupees crore, and they are based on reported enrolment; If we adjusted for ghost enrolments, i.e. if the calculations were based on column (i), the estimated teacher vacancies would be lower (in fact in most states it would be teacher surpluses) and the cost savings would be far bigger.
Source: For columns a, b, and c: MHRD (2018) - Unstarred question no. 1953, Lok Sabha, on 30.07.2018.

Table 8b: Teacher vacancies and teacher surpluses: For rural and urban areas separately, 2017-18

States	All (rural + urban)			Rural			Urban		
	Teacher vacancies	Excess teachers	Net surplus teachers	Teacher vacancies	Excess teachers	Net surplus teachers	Teacher vacancies	Excess teacher	Net surplus teachers
	(a)	(b)	(c=b-a)	(d)	(e)	(f=e-d)	(g)	(h)	(i=h-g)
West Bengal	27,977	115,164	87,187	24,394	88,096	63,702	3,583	27,068	23,485
Tamil Nadu	4,276	79,706	75,430	3,524	53,264	49,740	752	26,442	25,690
Assam	17,494	57,607	40,113	17,087	47,906	30,819	407	9,701	9,294
Punjab	2,771	39,928	37,157	2,335	30,082	27,747	436	9,846	9,410
Rajasthan	39,297	73,175	33,878	35,639	62,861	27,222	3,658	10,314	6,656
Kerala	327	33,321	32,994	280	25,443	25,163	47	7,878	7,831
Haryana	3,509	31,625	28,116	3,084	24,812	21,728	425	6,813	6,388
Himachal Pradesh	2,238	24,422	22,184	2,215	22,220	20,005	23	2,202	2,179
Andhra Pradesh	15,653	37,013	21,360	13,920	29,655	15,735	1,733	7,358	5,625
Telangana	11,111	25,064	13,953	9,494	19,201	9,707	1,617	5,863	4,246
Chattisgarh	15,148	26,099	10,951	13,724	23,358	9,634	1,419	2,741	1,322
Uttarakhand	5,794	14,967	9,173	5,284	13,232	7,948	510	1,735	1,225
Jammu & Kashmir	5,867	14,529	8,662	5,667	11,749	6,082	200	2,780	2,580
Maharashtra	27,892	15,488	-12,404	22,891	9,488	-13,403	5,001	6,000	999
Odisha	31,194	16,107	-15,087	30,011	12,693	-17,318	1,183	3,414	2,231
Gujarat	21,759	6,581	-15,178	19,032	5,201	-13,831	2,727	1,380	-1,347
Karnataka	41,025	11,917	-29,108	37,462	8,393	-29,069	3,563	3,524	-39
Uttar Pradesh	126,009	74,482	-51,527	117,166	69,891	-47,275	8,843	4,591	-4,252
Madhya Pradesh	81,720	22,013	-59,707	76,557	17,001	-59,556	5,163	5,012	-151
Jharkhand	63,462	3,433	-60,029	60,443	2,701	-57,742	3,019	732	-2,287
Bihar	217,204	12,426	-204,778	207,195	10,937	-196,258	10,009	1,489	-8,520
All India	**761,727**	**735,067**	**-26,660**	**707,404**	**588,184**	**-119,220**	**54,318**	**146,883**	**92,565**

Note: Same as Table 8a.

Table 9: Fiscal cost of surplus teachers and additional recruitment, 2017-18

State	Total students (reported)	Existing total teachers	Surplus teachers @ PTR 30	Claimed vacancies (planned recruitment)	Planned total teachers (after filling vacancies)	Existing pupil teacher ratio (PTR)	PTR based on planned total teachers	Resulting reduction in PTR	Additional fiscal cost$ due to PTR less than 30	Cost due to additional planned recruitment$	Total spending due to surplus teachers$ (Rs. Crore)
	(a)	(b)	(c=b-(a/30))	(d)	(e=b+d)	(f=a/b)	(g=a/e)	(h=f-g)	(i=c*RTMS*12)	(j=d*RTMS*12)	(k=i+j)
Himachal Pradesh	533,388	67,922	50,142	1,632	69,554	7.9	4.5	3.4	2,576	84	2,660
Jammu-Kashmir*	937,825	99,210	67,949	7,208	106,418	9.5	5.4	4.1	3,491	370	3,861
Uttaranchal	681,848	60,468	37,740	7,578	68,046	11.3	6.4	4.8	1,939	389	2,328
Kerala	844,947	64,725	36,560	1,400	66,125	13.1	8.2	4.8	1,878	72	1,950
Tamil Nadu	3,140,559	238,994	134,309	3,788	242,782	13.1	8.3	4.8	5,900	166	6,066
Punjab	1,652,599	117,480	62,393	18,175	135,655	14.1	8.3	5.7	5,705	1,662	7,367
Andhra Pradesh*	5,072,962	332,057	162,958	27,256	359,313	15.3	9.7	5.6	8,371	1,400	9,771
Haryana	1,542,191	97,230	45,824	11,931	109,161	15.9	10.0	5.9	2,354	613	2,967
Assam	3,828,109	222,606	95,002	20,105	242,711	17.2	11.3	5.9	4,880	1,033	5,913
Rajasthan	6,224,446	343,053	135,571	36,589	379,642	18.1	12.1	6.1	6,964	1,880	8,844
Chhattisgarh	3,082,746	150,870	48,112	48,506	199,376	20.4	12.5	8.0	2,472	2,492	4,963
Maharashtra	5,499,126	261,619	78,315	18,671	280,290	21.0	15.3	5.7	4,023	959	4,982
West Bengal	10,424,158	478,777	131,305	87,781	566,558	21.8	14.9	6.8	5,327	3,562	8,889
Karnataka	3,816,438	174,598	47,383	14,492	189,090	21.9	16.1	5.7	2,044	625	2,670
Odisha	4,690,160	213,095	56,756	0	213,095	22.0	17.4	4.6	2,916	0	2,916
Madhya Pradesh	7,217,655	280,769	40,181	66,523	347,292	25.7	18.6	7.1	2,064	3,417	5,481
Gujarat	5,456,424	205,532	23,651	4,039	209,571	26.5	23.4	3.2	1,215	208	1,422
Uttar Pradesh	15,723,078	577,520	53,417	224,327	801,847	27.2	18.4	8.8	3,213	13,491	16,704
Jharkhand	4,164,893	116,092	-22,738	78,265	194,357	35.9	24.3	11.6	-1,447	4,981	3,534
Bihar	17,787,806	384,349	-208,578	203,934	588,283	46.3	46.8	-0.6	-10,715	10,476	-239
Major 21 States	**102,320,384**	**4,481,978**	**1,071,299**	**882,200**	**5,369,166**	**22.8**	**15.9**	**7.0**	**55,169**	**47,879**	**103,048**

Note: **$-** All Figures are in Indian Rupees (INR) crore (one crore equals ten million). *- includes Telangana. The table is sorted by column (f). RTMS is Regular Teacher Monthly Salary. State wise salary of regular public-primary-school teachers with 15 years of experience (taken as mean salary, averaging across new and experienced teachers) has been obtained from Ramachandran (2015) who provides salary data for seven major states for July 2014. We have inflated that to 2017-18 using the inflation rate, and added to it mean primary-teacher salary rate for West Bengal, and then taken the weighted mean of these eight states as the Regular Teacher Mean Salary (RTMS) figure for India, which comes to Rs. 42,808 per month in 2017-18. We have imputed that as the 2017-18 monthly salary rate in all the other states. Note that this RTMS used in Table 9 onwards here is lower than that used by Kingdon (2020) which is reproduced in Table 3 above. The reason is that Kingdon (2020) used the simple rather than weighted mean of salaries across the states from Ramachandran (2015) and because the current paper also adds data for West Bengal where teacher salaries are significantly lower than in the states covered in Ramachandran (2015). We have not taken into account the salaries of upper primary public school teachers, which are about 30% higher than those of primary teachers, and about one-third of all public elementary schools are upper primary schools. Thus, our national mean teacher salary figure of Rupees 42,808 per month is if anything an underestimate of regular public elementary school teachers' salaries.

Column i shows 'Wastage' due to maintaining a PTR of 22.8 instead of 30.

Column j shows cost of planned future recruitment to fill 882200 teacher vacancies estimated by the MHRD as per RTE norms (column d). This is the same as in column (j) of Table 8(a).

Table 10: Fiscal cost due to student absence, teacher absence and fake enrolment, 2017-18

State	Total students (reported)	Total teachers (reported)	Pupil teacher ratio (reported)	Student absence rate	Teacher absence rate	Proportion of ghost enrolment	Effective PTR (present pupils/ present teachers)	Fiscal Cost (Rs. Crore)				
								Cost of student absence			Cost of teacher absence$	Total fiscal cost$
								Pure absence$	Ghost enrolment$	Total		
	(a)	(b)	(c=a/b)	(d)	(e)	(f)	g={a*(1-d)}/ {b*(1-e)}	(i)	(j)	(k=i+j)	(l)	(m=k+l)
Himachal Pradesh	533,388	67,922	7.85	0.17	0.24	0.05	8.6	399	180	579	844	1,424
Jammu-Kashmir*	937,825	99,210	9.45	0.23	0.18	0.07	8.8	810	367	1,177	897	2,074
Uttaranchal	681,848	60,468	11.28	0.17	0.14	0.05	10.8	366	166	531	429	960
Kerala	844,947	64,725	13.05	0.17	0.14	0.05	12.6	396	179	575	472	1,048
Tamil Nadu	3,140,559	238,994	13.14	0.09	0.08	0.03	13.0	648	293	942	820	1,762
Punjab	1,652,599	117,480	14.07	0.20	0.14	0.06	13.2	1,457	659	2,116	1,558	3,674
Andhra Pradesh*	5,072,962	332,057	15.28	0.21	0.17	0.07	14.5	2,465	1,116	3,581	2,843	6,424
Haryana	1,542,191	97,230	15.86	0.22	0.12	0.16	14.1	317	799	1,116	621	1,737
Assam	3,828,109	222,606	17.20	0.27	0.13	0.08	14.3	2,133	966	3,099	1,441	4,540
Rajasthan	6,224,446	343,053	18.14	0.25	0.15	0.08	15.9	3,063	1,386	4,449	2,624	7,073
Chhattisgarh	3,082,746	150,870	20.43	0.25	0.16	0.08	18.3	1,323	599	1,922	1,225	3,147
Maharashtra	5,499,126	261,619	21.02	0.14	0.12	0.04	20.6	1,249	565	1,814	1,572	3,387
West Bengal	10,424,158	478,777	21.77	0.45	0.23	0.14	15.6	6,031	2,730	8,761	4,526	13,287
Karnataka	3,816,438	174,598	21.86	0.12	0.10	0.04	21.4	632	286	919	776	1,695
Odisha	4,690,160	213,095	22.01	0.18	0.06	0.06	19.1	1,357	614	1,971	613	2,584
Madhya Pradesh	7,217,655	280,769	25.71	0.44	0.14	0.14	16.7	4,399	1,991	6,390	2,061	8,451
Gujarat	5,456,424	205,532	26.55	0.12	0.10	0.04	26.0	861	390	1,251	1,060	2,311
Uttar Pradesh	15,723,078	577,520	27.23	0.40	0.15	0.16	19.1	8,425	5,523	13,948	5,051	18,999
Jharkhand	4,164,893	116,092	35.88	0.35	0.08	0.11	25.5	1,755	794	2,550	591	3,141
Bihar	17,787,806	384,349	46.28	0.44	0.31	0.35	38.2	1,680	6,910	8,590	6,217	14,808
Major 21 States	**102,320,384**	**4,481,978**	**22.83**	**0.28**	**0.15**	**0.14**	**19.4**	**39,766**	**26,514**	**66,280**	**36,242**	**102,522**

Source: DISE data 2017-18. The public elementary school regular teachers' salary data (with which the fiscal cost figures are estimated) is from Ramachandran (2015).
Note: Same as Table 9. The definition and calculation of ghost enrolment (GE) are shown in the note to Table 7. In column (k), the total cost of student absence for any state is the difference between the total salary cost of the teachers appointed based on pupil *enrolment* in the state, and what the total salary cost *would be* if teachers were appointed based on pupil *attendance* in the state. Nationally the absence rate is 28% (see column f), which implies an actual attendance rate is only 72% of enrolment. Column (j) is based on that portion of the 'pupil absence' which is due to ghost/fake enrolment, and column (i) is based on the pupil absence among genuine enrolees. The cost of teacher absence for any given state is calculated by taking the total teacher salary cost in the state and multiplying that with the teacher absence rate in the state.

Table 11: Teacher salary cost at current PTRs and the projected costs and savings at alternative hypothetical PTRs, 2017-18

State	Total students	Total teachers (regular)	Total teachers (contract)	Total teachers	PTR	Actual cost	Hypothetical cost (Rs crore)			Hypothetical savings (Rs crore)			Ratio of (hypothetical) savings to costs at PTR 40
						At current PTR (Rs. crore)	If Govt. had maintained the following PTR						
							30	35	40	30	35	40	
	(a)	(b)	(c)	(d = b+c)	(e = a/d)	(f)	(g)			(h = f – g)			
Himachal Pradesh	533,388	47,246	20,676	67,922	7.85	2,665	913	783	685	1,752	1,882	1,980	2.89
Jammu-Kashmir	937,825	89,093	10,117	99,210	9.45	4,613	1,606	1,376	1,204	3,007	3,237	3,409	2.83
Uttaranchal	681,848	57,010	3,458	60,468	11.28	2,983	1,168	1,001	876	1,815	1,982	2,107	2.41
Kerala	844,947	62,500	2,225	64,725	13.05	3,229	1,447	1,240	1,085	1,783	1,989	2,144	1.98
Tamil Nadu	3,140,559	209,070	29,924	238,994	13.14	9,364	4,599	3,942	3,449	4,765	5,422	5,915	1.71
Punjab	1,652,599	82,727	34,753	117,480	14.07	8,732	5,037	4,317	3,778	3,695	4,415	4,954	1.31
Andhra Pradesh*	5,072,962	318,028	14,029	332,057	15.28	16,455	8,687	7,446	6,515	7,769	9,009	9,940	1.53
Haryana	1,542,191	83,471	13,759	97,230	15.86	4,526	2,641	2,263	1,981	1,885	2,263	2,545	1.29
Assam	3,828,109	189,614	32,992	222,606	17.20	9,808	6,555	5,619	4,916	3,253	4,189	4,891	0.99
Rajasthan	6,224,446	338,550	4,503	343,053	18.14	17,417	10,658	9,136	7,994	6,759	8,281	9,423	1.18
Chhattisgarh	3,082,746	150,035	835	150,870	20.43	7,726	5,279	4,525	3,959	2,448	3,202	3,767	0.95
Maharashtra	5,499,126	257,155	4,464	261,619	21.02	13,248	9,416	8,071	7,062	3,831	5,176	6,185	0.88
West Bengal	10,424,158	376,865	101,912	478,777	21.77	16,074	14,098	12,084	10,573	1,977	3,991	5,501	0.52
Karnataka	3,816,438	173,895	703	174,598	21.86	7,511	5,488	4,704	4,116	2,022	2,806	3,395	0.82
Odisha	4,690,160	118,796	94,299	213,095	22.01	6,691	8,031	6,884	6,023	-1,340	-193	668	0.11
Madhya Pradesh	7,217,655	279,654	1,115	280,769	25.71	14,397	12,359	10,593	9,269	2,038	3,803	5,128	0.55
Gujarat	5,456,424	204,309	1,223	205,532	26.55	10,501	9,343	8,008	7,007	1,158	2,492	3,493	0.50
Uttar Pradesh	15,723,078	504,125	73,395	577,520	27.23	30,627	31,520	27,017	23,640	-893	3,610	6,987	0.30
Jharkhand	4,164,893	46,261	69,831	116,092	35.88	3,422	8,835	7,573	6,626	-5,413	-4,151	-3,205	-0.48
Bihar	17,787,806	322,262	62,087	384,349	46.28	17,001	30,458	26,107	22,844	-13,457	-9,106	-5,842	-0.26
Major 21 States	**102,320,384**	**3,905,678**	**576,300**	**4,481,978**	**22.83**	**206,989**	**178,137**	**152,689**	**133,602**	**28,852**	**54,300**	**73,386**	**0.55**

Note: Cost and Savings figures are salary costs in INR crore. RTMS=Regular Teacher Monthly Salary. CTMS=Contract Teacher Monthly Salary, f=(b*RTMS+c.CTMS)*12, g=(a/Hypothetical PTR)*(RTMS)*12. State wise contract teacher's remuneration is obtained from Ramachandran (2015) and from the All India Para Teacher Association.

The cost of teachers in column (g) has been estimated at the public *regular* teacher salary rate which is much higher than the contract teacher salary rate. In Uttar Pradesh, where current PTR is 27.2, increasing the PTR to 30 should lower the number of teachers and thus lower the teacher salary cost, but it does not, it slightly raises it (from 30, 627 crore in column (f) to Rs. 31,520 crore (column g, under the heading PTR 30). The reason for this is that many teachers in UP (and indeed in Bihar and Jharkhand particularly) were contract teachers in 2017-18, so for these states, assessing teacher salary cost at the regular teacher rate greatly increases the total cost of teachers when we move from column f to column g, under the heading PTR 30).

Teacher's salary rate is taken from Ramachandran (2015) which presents data for 5 states (Tamil Nadu, Punjab, Karnataka, Uttar Pradesh and Jharkhand) and for West Bengal average salary data is taken from pay-roll of selected schools. For the remaining states, the monthly salary data is obtained by taking the weightage average of the salary of the above six states. The salary data of Ramachandran (2015) paper is for 2014-15, so the salary estimate for 2017-18 is obtained by taking an annual 8.5% growth rate of salary every year, based on the actual salary escalation rate in Uttar Pradesh shown in Appendix Table 2 in Kingdon (2017).

Table 12: Hypothetical total savings in 2017-18 if the RTE Act's teacher allocation norms are modified

States	Total reported enrolment	'True' enrolment (after removing ghost students)	Under existing RTE norms of teacher allocation		Under a modified norm of teachers allocation (One teacher for <=20 pupils & two teachers for 21-60 pupils#. Other norms remain unchanged)							
					Based on reported enrolment (of column a)			Based on 'true' enrolment i.e. after removing ghost students (i.e. based on column b)			Excess expenditure ('wastage') (Rs. crore)	
			Net-surplus teachers based on reported enrolment	Net-surplus teachers based on 'true' enrolment	Teacher vacancies	Excess teachers	Net-surplus teachers	Teacher vacancies	Excess teachers	Net-surplus teachers	Due to net surplus teachers (based on reported enrolment)	Due to net surplus teachers (based on 'true' enrolment*)
	(a)	(b)	(c)	(d)	(e)	(f)	(g = f - e)	(h)	(i)	(j = i – h))	(k)	(l)
Andhra Pradesh	5,072,807	4,743,075	35,313	41,016	16,194	116,109	99,915	13,968	127,679	113,711	5,133	5,841
Assam	3,828,057	3,506,500	40,113	46,912	16,051	79,921	63,870	12,221	86,656	74,435	3,281	3,824
Bihar	17,787,537	11,561,899	-204,778	-40,975	217,070	14,675	-202,395	82,694	54,421	-28,273	-10,397	-1,452
Chhattisgarh	3,082,843	2,845,464	10,951	16,571	14,126	29,901	15,775	11,549	34,969	23,420	810	1,203
Gujarat	5,456,516	5,254,625	-15,178	-8,132	20,830	9,011	-11,819	17,260	17,360	100	-607	5
Haryana	1,542,145	1,295,402	28,116	34,060	3,276	40,809	37,533	2,083	47,365	45,282	1,928	2,326
Himachal	533,340	505,606	22,184	22,675	1,352	36,813	35,461	1,265	37,425	36,160	1,822	1,858
Jammu & Kashmir	937,733	870,216	8,662	8,992	3,915	42,428	38,513	3,516	43,619	40,103	1,978	2,060
Jharkhand	4,164,849	3,715,045	-60,029	-48,232	61,801	7,325	-54,476	50,418	11,202	-39,216	-3,467	-2,496
Karnataka	3,816,520	3,671,492	-29,108	-25,968	35,546	22,108	-13,438	33,226	25,310	-7,916	-580	-342
Kerala	844,940	799,313	32,994	33,702	293	35,363	35,070	230	36,850	36,620	1,802	1,881
Madhya Pradesh	7,218,123	6,222,022	-59,707	-34,650	77,669	30,809	-46,860	62,186	47,479	-14,707	-2,407	-755
Maharashtra	5,499,127	5,268,164	-12,404	-6,132	24,883	31,062	6,179	21,456	38,802	17,346	317	891
Odisha	4,689,960	4,427,322	-15,087	-9,674	29,751	36,135	6,384	25,620	41,833	16,213	328	833
Punjab	1,652,611	1,551,802	37,157	39,556	2,531	51,761	49,230	1,870	55,027	53,157	4,501	4,860
Rajasthan	6,224,179	5,732,469	33,878	43,276	36,283	106,575	70,292	30,681	118,223	87,542	3,611	4,497
Tamil Nadu	3,140,427	3,052,495	75,430	77,570	3,663	105,794	102,131	3,097	110,584	107,487	4,486	4,722
Uttar Pradesh	15,722,519	13,222,638	-51,527	20,274	125,454	77,026	-48,428	82,778	115,232	32,454	-2,913	1,952
Uttarakhand	681,815	645,679	9,173	9,787	3,386	25,209	21,823	3,073	26,003	22,930	1,121	1,178
West Bengal	10,424,190	8,954,379	87,187	121,313	27,366	126,077	98,711	16,934	163,821	146,887	4,005	5,959
All India	**102,320,238**	**87,845,608**	**-26,660**	**341,941**	**721,440**	**1,024,911**	**303,471**	**476,125**	**1,239,860**	**763,735**	**14,753**	**38,845**

Note: Columns (e) to (j) are based on a proposed modified teacher-allocation norm for schools. The Right to Education (RTE) Act's norm is to allocate two teachers for all schools with a total enrolment of up to 60 pupils. The modified norm used here is to allocate one teacher for all schools with a total enrolment of up to 20 pupils, and to allocate two teachers for schools with 21 to up to 60 pupils. # the norm is being modified ONLY for the case of 'primary only' schools. * i.e. after removing Ghost students. Cost (or expenditure) figures are in INR crore.

Table 13(a): Decomposition of the temporal 'change in pupil teacher ratio' (PTR)

Panel A	**Change in pupil teacher ratio (PTR)**		
	Pupil enrolment	**Number of teachers**	**Pupil teacher ratio**
	(a)	(b)	(c = a/b)
2010-11	126,270,264	4,047,070	31.20
2017-18	102,321,358	4,486,966	22.80
Change	**- 23,948,906**	**439,896**	**- 8.4**
Panel B	**Decomposition of 'Change in PTR'**		
	Change in PTR	**The part of the change in PTR due to change in enrolment**	**The part of the change in PTR due to change in no. of teachers**
	(d = e + f)	(e)	(f)
Absolute change	- 8.40	- 5.34	- 3.06
Contribution of each component	100.0%	63.6%	36.4%

Note: Calculations are as follows: Change in Enrolment = (102291394-126270264)/4451953; using the formula 1.
Change in Teacher = {126270264*(4451953-4047070)}/(4451953*4047070); using formula 2.

Table 13(b): Decomposition of the temporal change in Pupil Teacher Ratio (PTR), between 2010 and 2017, by State
(into the part that is due to temporal change in the number of pupils, and the part that is due to temporal change in the number of teachers)

State	2010-11			2017-18			Change in PTR	Decomposition of 'g' i.e. of Change (Δ) in PTR		% Contribution	
	Pupils	Teachers	PTR	Pupils	Teachers	PTR	2010-2017	Δ in PTR due to Δ in pupil no.	Δ in PTR due to Δ in teacher no.	of Δ in pupils (%)	of Δ in teachers (%)
	(a)	(b)	(c) = a/b	(d)	(e)	(f) = d/e	(g)=f – c	(h)	(i)	(j)	(k)
Andhra Pradesh*	6,191,110	347,875	17.80	5,072,962	332,057	15.28	-2.52	-3.37	0.85	133.7	-33.7
Assam	4,097,714	167,161	24.51	3,828,109	222,606	17.20	-7.32	-1.21	-6.11	16.6	83.5
Bihar	19,564,714	336,359	58.17	17,787,806	384,349	46.28	-11.89	-4.62	-7.26	38.9	61.1
Chhattisgarh	3,807,603	155,573	24.47	3,082,746	150,870	20.43	-4.04	-4.80	0.76	118.9	-18.9
Gujarat	5,916,978	198,584	29.80	5,456,424	205,532	26.55	-3.25	-2.24	-1.01	69.0	31.0
Haryana	2,087,364	77,980	26.77	1,542,191	97,230	15.86	-10.91	-5.61	-5.30	51.4	48.6
Himachal Pr.	746,331	48,507	15.39	533,388	67,922	7.85	-7.53	-3.14	-4.40	41.6	58.4
J & Kashmir	1,213,365	97,732	12.42	937,825	99,210	9.45	-2.96	-2.78	-0.18	93.8	6.2
Jharkhand	5,598,510	135,690	41.26	4,164,893	116,092	35.88	-5.38	-12.35	6.97	229.4	-129.4
Karnataka	4,625,327	195,929	23.61	3,816,438	174,598	21.86	-1.75	-4.63	2.88	264.9	-164.9
Kerala	1,075,902	54,976	19.57	844,947	64,725	13.05	-6.52	-3.57	-2.95	54.8	45.2
Madhya Pradesh	10,653,880	267,846	39.78	7,217,655	280,769	25.71	-14.07	-12.24	-1.83	87.0	13.0
Maharashtra	7,421,942	288,914	25.69	5,499,126	261,619	21.02	-4.67	-7.35	2.68	157.4	-57.4
Orissa	5,653,997	192,119	29.43	4,690,160	213,095	22.01	-7.42	-4.52	-2.90	61.0	39.0
Punjab	2,168,656	105,930	20.47	1,652,599	117,480	14.07	-6.41	-4.39	-2.01	68.6	31.4
Rajasthan	7,104,179	271,205	26.19	6,224,446	343,053	18.14	-8.05	-2.56	-5.49	31.9	68.2
Tamil Nadu	4,273,526	150,820	28.34	3,140,559	238,994	13.14	-15.19	-4.74	-10.45	31.2	68.8
Uttar Pradesh	19,689,829	491,455	40.06	15,723,078	577,520	27.23	-12.84	-6.87	-5.97	53.5	46.5
Uttarakhand	941,232	45,782	20.56	681,848	60,468	11.28	-9.28	-4.29	-4.99	46.2	53.8
West Bengal	13,438,105	416,633	32.25	10,424,158	478,777	21.77	-10.48	-6.30	-4.19	60.1	39.9
INDIA	**126,270,264**	**4,047,070**	**31.20**	**102,321,358**	**4,486,966**	**22.80**	**-8.40**	**-5.34**	**-3.06**	**63.6**	**36.4**

Note:* Includes Telengana

Table 14(a): Proportion of public schools with total enrolment of <=60 AND 'total teachers' equal to given levels, 2017-18

States	Total no. of schools with <= 60 pupils	% of schools with <=60 pupils	Mean enrolment per such school	Mean no. of teachers per such school	Mean PTR in such schools	% of schools with zero pupils	Of all the 493848 public schools with <=60 enrolment, percentage with the following levels of 'total teachers'					
							0 teacher	1 teacher	2 teachers	3 teachers	4 teachers	>=5 teachers
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)
Himachal Pradesh	13,378	86.5	24.5	3.4	7.2	0.0	0.0	11.0	52.2	16.3	6.0	14.6
Uttarakhand	14,385	83.0	21.5	2.7	8.0	2.4	2.0	19.7	55.1	10.7	4.1	8.5
Jammu & Kashmir	18,672	79.8	24.8	3.5	7.1	2.5	0.3	9.1	49.0	12.0	5.6	24.0
Andhra Pradesh	28,669	64.5	27.7	2.0	13.9	0.4	2.6	26.7	60.8	4.5	1.4	4.1
Madhya Pradesh	68,967	60.5	32.8	1.9	17.3	2.5	6.6	17.2	60.5	12.6	2.3	0.8
Telangana	17,510	59.6	26.3	2.5	10.5	3.1	2.4	25.1	49.7	7.4	2.4	13.1
Maharashtra	39,040	58.7	26.7	2.1	12.7	0.1	0.1	7.9	82.0	3.7	4.8	1.5
Karnataka	25,977	57.4	26.2	2.2	11.9	0.7	5.4	16.3	46.9	18.0	10.0	3.4
Assam	27,900	56.4	31.1	2.9	10.7	1.0	1.1	8.0	49.5	21.4	8.0	12.1
Chattisgarh	24,997	56.2	33.4	2.4	13.9	1.1	1.5	9.5	53.0	22.6	9.3	4.1
Odisha	29,805	54.4	32.2	2.3	14.0	0.2	0.0	3.9	77.4	11.3	3.9	3.5
Tamil Nadu	19,762	52.5	29.0	2.5	11.6	0.1	0.0	4.7	81.9	4.2	1.4	7.7
Punjab	9,563	49.0	33.5	3.0	11.2	0.0	0.0	1.6	57.1	23.0	7.9	10.4
Jharkhand	18,298	47.0	36.7	1.8	20.4	0.3	0.1	33.4	59.4	5.0	1.4	0.7
Rajasthan	31,382	46.9	32.9	2.1	15.7	0.3	0.3	29.0	56.6	4.5	3.5	6.0
West Bengal	35,584	42.7	36.1	2.9	12.4	0.5	0.4	5.2	39.2	32.2	16.4	6.7
Haryana	5,246	36.4	35.5	3.6	9.9	0.2	1.2	3.7	50.5	15.5	8.6	20.5
Kerala	1,637	35.8	34.5	5.6	6.2	0.1	0.2	2.6	3.1	8.4	54.5	31.2
Uttar Pradesh	49,106	30.4	40.0	2.7	14.8	0.1	0.2	9.9	40.0	32.2	12.3	5.3
Gujarat	9,583	28.4	33.5	2.4	14.0	0.0	0.3	5.2	66.8	11.4	13.3	3.1
Bihar	4,387	6.2	44.7	2.4	18.6	0.1	0.3	16.0	51.9	19.4	7.5	4.8
All India	**493,848**	**47.7**	**31.6**	**2.4**	**13.2**	**0.7**	**1.7**	**13.6**	**57.0**	**15.0**	**6.5**	**6.1**

Note: This table is sorted by column (b).

Table 14(b): Pupil Teacher Ratio (PTR) in public elementary schools with <=60 enrolment and 'total teachers' equal to given levels, 2017-18

	PTR in public schools with <=60 enrolment AND 'total teachers' equal to given levels					Total No. of schools with <=60 pupils and >=5 teachers	Total no. of teachers in such schools (with >= 5 teachers)	Total no. of students in such schools (with >= 5 teachers)	Per pupil salary cost in 2017-18 in such schools (Rupees)
	1 teacher	2 teachers	3 teachers	4 teachers	>=5 teachers				
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
Punjab	25.71	14.37	12.55	10.63	5.92	997	7,592	44,939	154,469
Himachal	17.87	10.37	9.57	7.63	3.37	1,950	20,530	69,095	152,633
Uttarakhand	13.68	10.53	9.18	7.05	3.48	1,221	12,556	43,679	147,667
Jharkhand	33.31	19.02	14.21	10.87	5.11	120	807	4,121	124,623
Kerala	19.33	10.49	9.55	8.32	4.17	511	5,028	20,953	123,269
Assam	24.01	14.88	11.41	8.85	4.69	3,367	25,510	119,518	109,644
Jammu & Kashmir	15.42	10.25	7.67	8.12	4.75	4,485	34,437	163,670	108,084
Haryana	28.29	14.96	15.01	9.85	5.12	1,076	8,998	46,037	100,403
Andhra Pradesh*	15.30	14.57	14.54	10.92	5.84	3,450	25,236	147,255	88,035
Tamil Nadu	24.56	13.40	14.69	10.41	5.30	1,529	12,923	68,505	82,868
Bihar	43.00	22.40	15.56	11.65	6.20	212	1,366	8,470	82,846
Rajasthan	28.95	16.10	14.43	10.98	6.32	1,893	13,319	84,138	81,318
Uttar Pradesh	36.56	19.45	13.75	10.58	7.54	2,627	14,808	111,605	79,797
Maharashtra	18.17	12.95	13.09	10.34	6.58	602	3,633	23,899	78,089
Odisha	24.95	15.46	12.56	10.79	6.64	1,052	6,337	42,098	77,327
Chattisgarh	26.83	15.44	13.01	10.17	7.12	1,023	5,942	42,288	72,181
Madhya Pradesh	33.79	16.02	13.39	10.39	7.43	579	3,229	23,980	69,171
West Bengal	25.74	15.64	13.22	10.69	6.26	2,381	15,290	95,728	64,803
Gujarat	28.27	15.36	13.51	10.09	8.28	297	1,678	13,895	62,035
Karnataka	19.21	10.84	11.23	10.33	7.92	874	4,888	38,730	54,450
All India	**25.65**	**14.88**	**12.79**	**10.14**	**5.41**	**30,246**	**224,107**	**1,212,603**	**94,939**

Source: DISE 2017-18 data.

Note: Table is sorted by column (i). The total teacher salary cost of educating the 12.12 lakh children (column h) who are studying in public schools that have <=60 pupils and which have 5 or more teachers was just over Rs. 11,512 crore in 2017-18 (not shown in the table); that amount divided by 12.12 lakh pupils gives Rupees 94,939 per pupil.

Table 15(a): Proportion of public schools with total enrolment of <=20 AND 'total teachers' equal to given levels, 2017-18

States	Total no. of schools with <= 20 pupils	% of all schools with <=20 pupils	Mean enrolment per school	Mean no. of teachers	Mean PTR	Of all 126864 public schools with <=20 enrolment, percentage with the following levels of 'total teachers'					
						0 teacher	1 teacher	2 teachers	3 teachers	4 teachers	>=5 teachers
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)
Uttarakhand	8,007	46.2	11.0	2.0	5.5	3.4	27.9	55.9	7.4	2.6	2.7
Himachal	6,213	40.2	12.6	2.3	5.5	0.0	15.5	64.0	11.5	4.0	5.0
Jammu & Kashmir	8,537	36.5	11.3	2.6	4.3	0.6	14.1	60.9	13.1	3.1	8.2
Karnataka	11,252	24.9	12.2	1.8	6.8	7.2	23.9	59.3	7.4	1.7	0.5
Telangana	6,833	23.2	10.8	1.6	6.8	5.4	49.8	40.1	1.1	0.3	3.2
Maharashtra	13,595	20.4	12.4	1.9	6.5	0.2	14.3	82.4	1.4	1.0	0.6
Andhra Pradesh	8,477	19.1	12.7	1.2	10.6	6.4	68.1	24.6	0.5	0.1	0.2
Tamil Nadu	6,111	16.2	13.8	2.0	6.9	0.1	6.8	90.3	1.3	0.4	1.1
Assam	7,809	15.8	12.5	2.5	5.0	3.7	13.2	53.3	15.8	5.6	8.4
Chhattisgarh	5,529	12.4	12.8	2.0	6.4	5.4	16.5	59.9	12.6	4.1	1.5
Madhya Pradesh	14,034	12.3	11.4	1.6	7.1	17.3	15.6	60.4	5.4	0.9	0.4
Odisha	6,739	12.3	15.3	2.1	7.3	0.0	7.8	82.6	6.3	0.9	2.3
Rajasthan	6,298	9.4	14.1	1.7	8.3	0.6	38.4	56.8	1.4	1.1	1.7
Punjab	1,819	9.3	14.3	2.1	6.8	0.0	3.1	83.2	11.9	1.2	0.7
Kerala	342	7.5	13.8	4.1	3.4	0.9	8.2	8.8	13.2	58.8	10.2
West Bengal	5,458	6.6	13.3	2.6	5.1	1.7	13.1	54.0	18.2	7.2	5.7
Haryana	905	6.3	13.3	2.3	5.8	4.4	7.6	71.6	5.6	4.8	6.0
Jharkhand	2,238	5.7	14.4	1.6	9.0	1.0	50.5	44.1	2.1	0.8	1.5
Gujarat	1,759	5.2	14.9	2.1	7.1	0.7	8.8	79.3	5.8	4.7	0.7
Uttar Pradesh	4,682	2.9	14.1	2.4	5.9	1.1	16.4	43.7	25.3	9.2	4.3
Bihar	227	0.3	12.0	2.8	4.3	2.2	23.3	42.3	12.3	5.7	14.1
All India	**126,864**	**12.3**	**12.6**	**2.0**	**6.3**	**4.2**	**22.6**	**60.4**	**7.5**	**2.6**	**2.7**

Note: This table is sorted by column (b).

Table 15(b): Pupil Teacher Ratio (PTR) in public elementary schools with <=20 enrolment, at different levels of 'total teachers'

	PTR in public schools with <=20 enrolment AND 'total teachers' equal to given levels			Total No. of Schools with <=20 pupils and >=3 teachers	Total no. of teachers in such schools (with >= 3 teachers)	Total no. of students in such schools (with >= 3 teachers)	Per pupil salary cost in such schools in 2017-18 (Rupees)	Total salary expenditure on such schools (Rs. Crore)
	1 teacher	2 teachers	>=3 teachers					
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h) = (f)*(g)
Jharkhand	14.2	7.7	1.8	97	482	865	354,616	30.67
Bihar	13.2	6.8	1.9	73	385	723	273,545	19.78
Jammu & Kashmir	9.0	5.8	2.4	2,083	10,339	25,268	210,191	531.11
Andhra Pradesh*	10.8	7.3	2.5	395	2,254	5,655	204,752	115.79
Rajasthan	14.0	7.2	2.6	266	1,343	3,480	198,245	68.99
Punjab	13.8	7.1	4.8	249	816	3,944	189,174	74.61
Uttarakhand	8.8	6.1	3.0	1,016	4,512	13,477	171,982	231.78
Tamil Nadu	12.3	7.0	2.6	164	924	2,396	169,407	40.59
Kerala	10.3	5.5	3.1	281	1,325	4,115	165,406	68.06
Assam	11.1	6.6	3.1	2,324	9,904	31,089	163,648	508.76
Odisha	13.7	7.9	3.2	642	2,613	8,231	163,077	134.23
Himachal	10.8	6.3	3.2	1,269	5,490	17,394	162,136	282.02
Haryana	11.6	6.7	3.3	148	681	2,238	156,312	34.98
Uttar Pradesh	13.8	7.3	3.9	1,816	6,453	25,434	152,589	388.09
Maharashtra	10.5	6.3	3.5	411	1,660	5,843	145,941	85.27
Madhya Pradesh	12.8	6.8	3.6	937	3,149	11,422	141,624	161.76
West Bengal	10.9	7.2	3.0	1,699	7,371	22,225	134,558	299.06
Chhattisgarh	11.5	6.9	4.0	1,010	3,517	14,115	127,996	180.67
Gujarat	13.0	7.6	4.0	197	745	3,005	127,356	38.27
Karnataka	10.6	6.5	4.0	1,074	3,726	14,761	108,904	160.75
All India	**11.3**	**6.8**	**3.2**	**16,151**	**67,689**	**215,680**	**161,218**	**3,477.16**

Note: Table is sorted by Column (g).

Appendix Table 1 : Teacher vacancies in public elementary schools – Comparison of Ministry of Education estimates for 2017-18 and 2020-21

		For 2017-18*		For 2020-21		Rise in vacant posts from 2017 to 2020	Fiscal cost of filling the extra posts (Rs. crore)
		Sanctioned posts (a)	Vacant posts (b)	Sanctioned posts (c)	Vacant posts (d)	(e)= d - b	(f) = e*RTMS
1	Andhra Pradesh**	246,292	27,256	387,454	52,788	25,532	1,312
2	Assam	204,607	20,105	254,262	13,247	-6,858	-352
3	Bihar	592,541	203,934	688,157	275,255	71,321	3,664
4	Chhattisgarh	200,429	48,506	238,561	51,830	3,324	171
5	Gujarat	217,106	4,039	221,581	5,830	1,791	92
6	Haryana	70,090	11,931	106,263	10,349	-1,582	-81
7	Himachal Pradesh	49,578	1,632	71,069	5,386	3,754	193
8	Jammu And Kashmir	101,301	7,208	131,319	21,806	14,598	750
9	Jharkhand	192,144	78,265	238,708	95,897	17,632	1,122
10	Karnataka	203,824	14,492	228,887	32,644	18,152	783
11	Kerala	126,382	1,400	66,762	1,926	526	27
12	Madhya Pradesh	363,099	66,523	469,644	91,972	25,449	1,307
13	Maharashtra	314,938	18,671	336,736	2,892	-15,779	-811
14	Odisha	229,006	0	268,486	10,877	10,877	559
15	Punjab	95,249	18,175	131,897	3,017	-15,158	-1,386
16	Rajasthan	283,416	36,589	408,572	47,666	11,077	569
17	Tamil Nadu	147,982	3,788	220,714	3,298	-490	-22
18	Uttar Pradesh	759,828	224,327	752,839	217,481	-6,846	-412
19	Uttarakhand	46,053	7,578	76,576	18,620	11,042	567
20	West Bengal	454,860	87,781	637,414	72,220	-15,561	-631
	Grand Total	**4,898,725**	**882,200**	**5,935,901**	**1,035,001**	**152,801**	**7,421**

Source: Ministry of Education, Government of India (2020) Lok Sabha, Unstarred Question No. 1243, Answered on 19th Sept, 2020. The Ministry's reply to the parliamentary question included its justification for increased teacher vacancies. It said: "The recruitment of teachers is a continuous process and the vacancies keep arising due to retirement and additional requirements on account of enhanced students' strength".

Note: *As in Table 8 above. ** Telengana is included under Andhra Pradesh, thus the table is effectively for 21 major states.

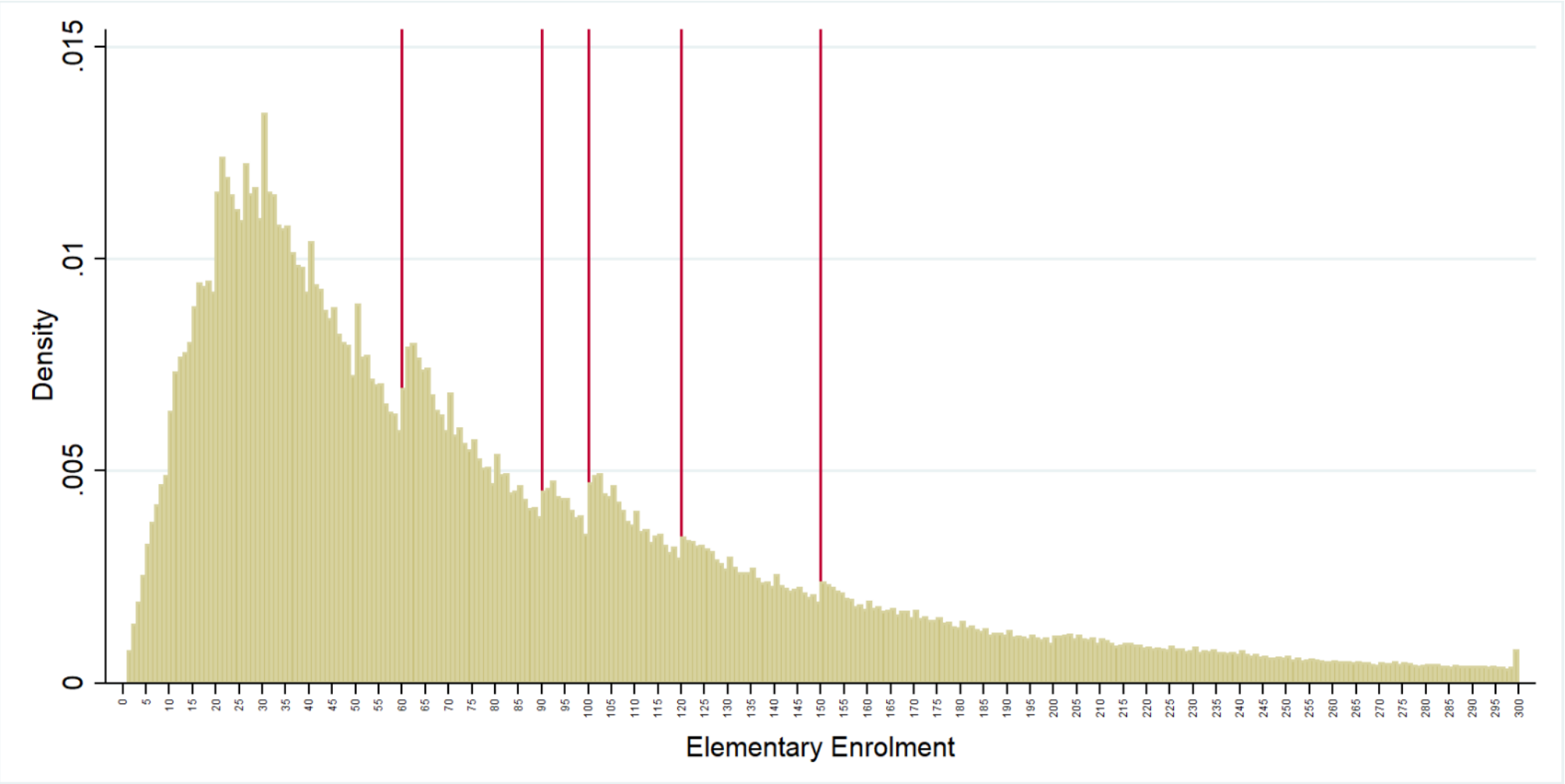
Appendix Table 2a: Teacher vacancies and surpluses in public elementary schools across some districts of Uttar Pradesh, (DISE 2017-18): An Illustration

Division/Mandal	District	All			Rural			Urban		
		Vacancies	Excess teachers	Net-surplus teachers	Vacancies	Excess teachers	Net-surplus teachers	Vacancies	Excess teacher	Net-surplus teachers
Meerut	BAGHPAT	572	377	-195	529	353	-176	43	24	-19
	BULANDSHAHR	1771	1500	-271	1562	1451	-111	209	49	-160
	GAUTAM BUDDH NAGAR	577	348	-229	572	328	-244	5	20	15
	GHAZIABAD	747	700	-47	402	583	181	345	117	-228
	MEERUT	529	902	373	304	774	470	225	128	-97
	HAPUR	414	565	151	324	543	219	90	22	-68
	Total	4610	4392	-218	3693	4032	339	917	360	-557
Moradabad	BIJNOR	960	2052	1092	812	1976	1164	148	76	-72
	AMROHA	856	960	104	766	931	165	90	29	-61
	MORADABAD	924	1112	188	834	962	128	90	150	60
	RAMPUR	1709	369	-1340	1502	306	-1196	207	63	-144
	SAMBHAL	3005	313	-2692	2804	291	-2513	201	22	-179
	Total	7454	4806	-2648	6718	4466	-2252	736	340	-396
Saharanpur	MUZAFFARNAGAR	1070	679	-391	917	637	-280	153	42	-111
	SAHARANPUR	969	1520	551	789	1410	621	180	110	-70
	SHAMLI	545	417	-128	421	408	-13	124	9	-115
	Total	2584	2616	32	2127	2455	328	457	161	-296

Appendix Table 2b: Teacher vacancies and surpluses in public elementary schools across some districts of Uttar Pradesh, after removing fake enrolments (DISE 2017-18): An Illustration

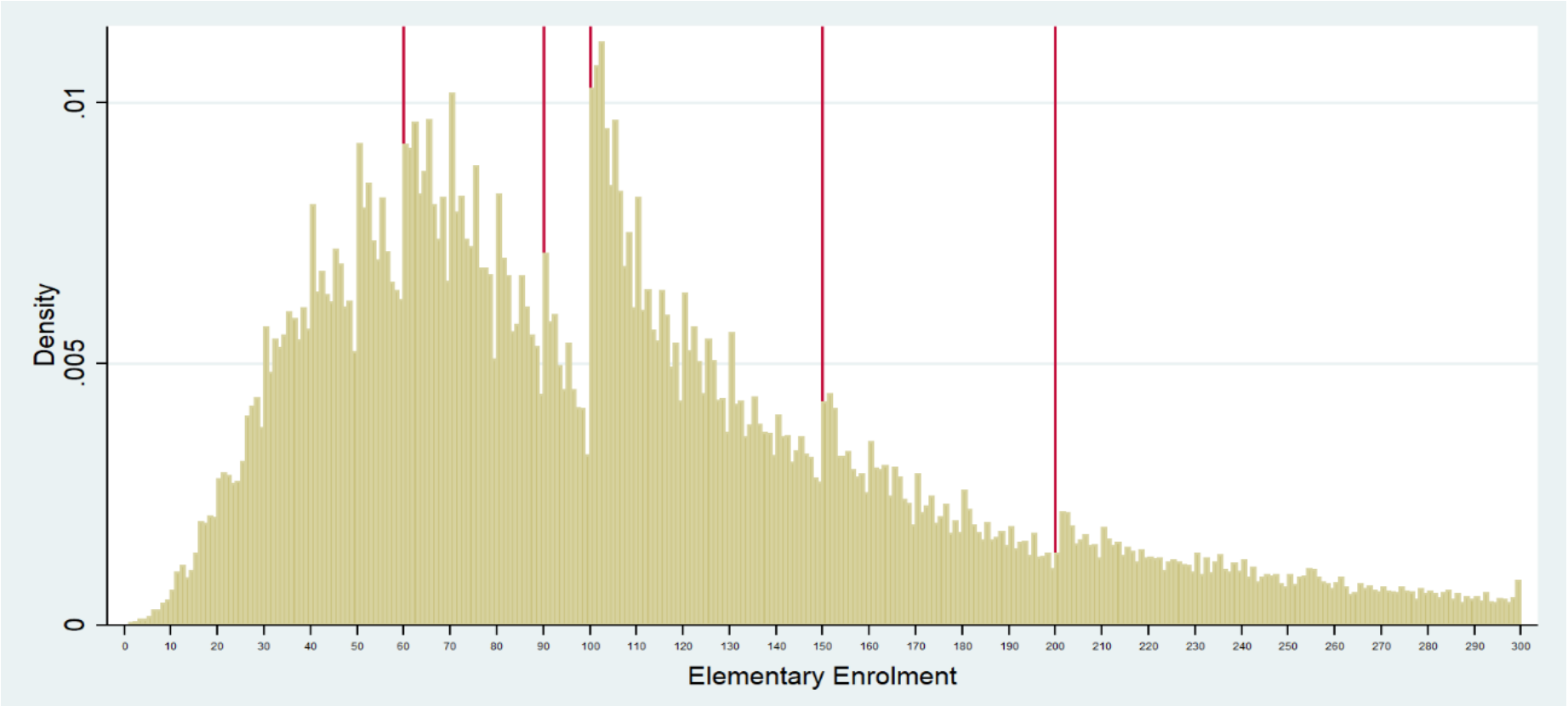
Division/Mandal	District	All			Rural			Urban		
		Vacancies	Excess teacher	Net-surplus teachers	Vacancies	Excess teacher	Net-surplus teachers	Vacancies	Excess teacher	Net-surplus teachers
Meerut	BAGHPAT	382	536	154	351	507	156	31	29	-2
	BULANDSHAHR	1257	1885	628	1091	1829	738	166	56	-110
	GAUTAM BUDDH NAGAR	374	471	97	372	446	74	2	25	23
	GHAZIABAD	524	875	351	283	720	437	241	155	-86
	MEERUT	362	1265	903	198	1107	909	164	158	-6
	HAPUR	295	700	405	230	677	447	65	23	-42
	Total	**3194**	**5732**	**2538**	**2525**	**5286**	**2761**	**669**	**446**	**-223**
Moradabad	BIJNOR	657	2445	1788	552	2349	1797	105	96	-9
	AMROHA	610	1127	517	533	1093	560	77	34	-43
	MORADABAD	606	1530	924	551	1348	797	55	182	127
	RAMPUR	1193	611	-582	1038	540	-498	155	71	-84
	SAMBHAL	2209	482	-1727	2055	456	-1599	154	26	-128
	Total	**5275**	**6195**	**920**	**4729**	**5786**	**1057**	**546**	**409**	**-137**
Saharanpur	MUZAFFARNAGAR	726	910	184	617	861	244	109	49	-60
	SAHARANPUR	642	1925	1283	516	1802	1286	126	123	-3
	SHAMLI	384	547	163	293	538	245	91	9	-82
	Total	**1752**	**3382**	**1630**	**1426**	**3201**	**1775**	**326**	**181**	**-145**

Figure 1: Histogram of total enrolment in public elementary schools, 2017-18



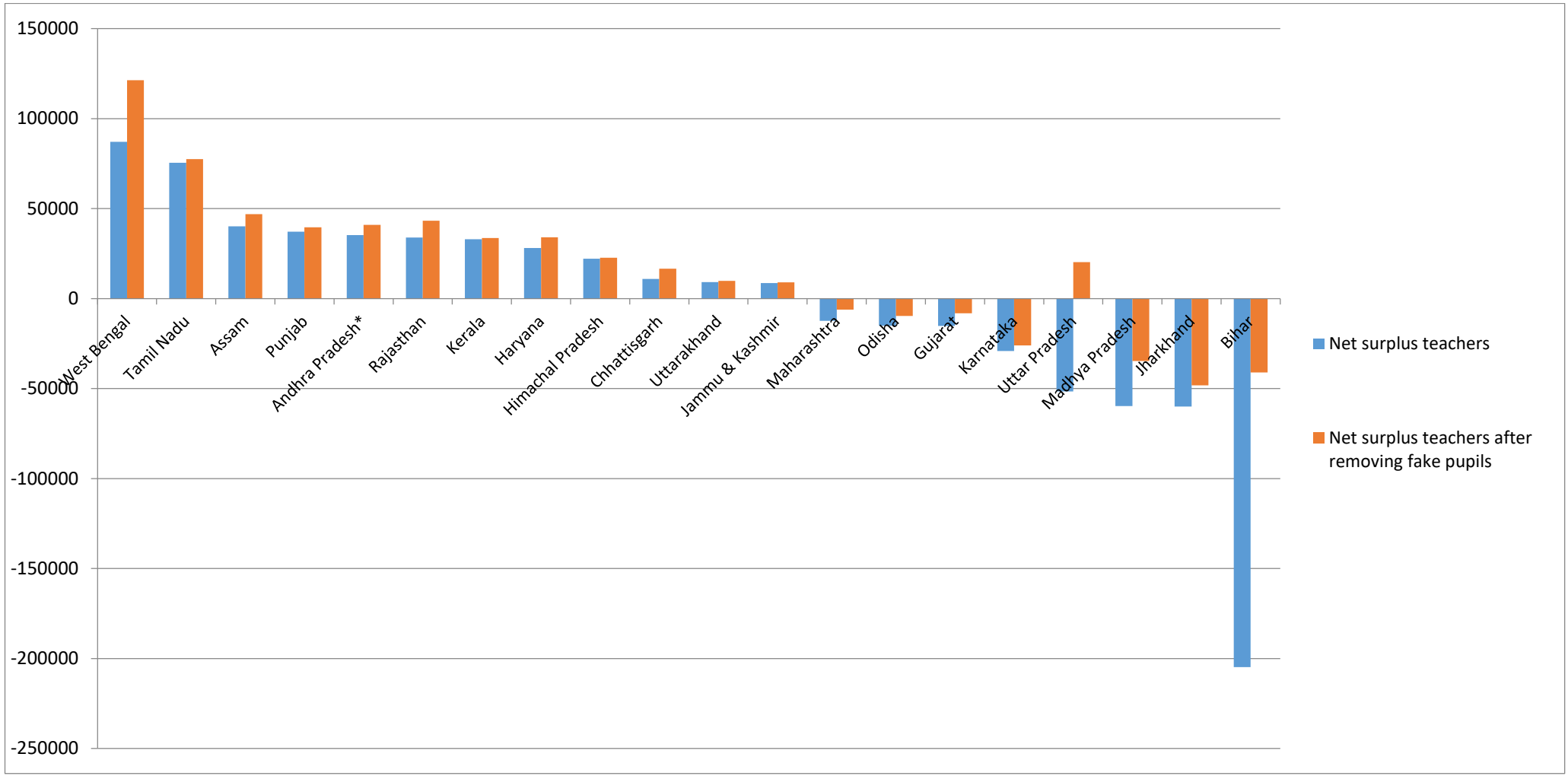
Note: The histogram shows the distribution of all public elementary schools by school size, i.e. by total enrolment. It shows that many schools report enrolment that is rounded to some desirable total, e.g. there are sudden peaks at a total enrolment of 20, 25, 30, 40, 50, etc. The trough at enrolment of 57, 58, 59 and 60 is made up by impressive spikes at 61, 62, etc. which is presumably because – as per the teacher allocation norms – up to a total enrolment of 60, a school gets two teachers but with a total enrolment of 61 to 90, it gets three teachers. Above enrolment of 100, a junior school gets a head-teacher and that is likely to explain the sudden spike in the number of schools that report an enrolment just above 100.

Figure 2: Histogram of total enrolment in public elementary schools, Uttar Pradesh, 2019-20



Note: See the note to Figure 1.

Figure 3: Histogram of net teacher surplus, and net teacher surplus after removing estimated fake enrolment



Note: The net teacher surplus is based on column (f) of Table 8(a); The net teacher surplus after removing estimated fake pupils is based on column (i) of Table 8(a).

[i] The draft NEP (NEP, 2019 p.56) states that "A further factor in the [learning] crisis in many areas relates to ... the PTR, which … often exceeds 30:1, making learning for all much more difficult", and (on p. 58) it asks "What can be done to reverse this crisis, and urgently? ….. Teacher vacancies will be filled as soon as possible". On page 115 it cites that "according to government data, the country faces over 10 lakh [over 1 million] teacher vacancies" and on page 417, it advocates increasing the total government budget by 1.05 percentage points for increased staffing.

[ii] At upper primary level, RTE Act provides for at least three teachers, one each for Language, Science/Maths and Social Studies. Schools with primary or upper primary classes or with both primary and upper primary classes constitute an 'elementary' school. An 'elementary school' may be a 'primary only' school, or an 'upper primary only' school, or it may be a school that has both primary and upper primary classes, i.e. has grades 1 to 8.

[iii] This concomitant deepening of the learning crisis is attested in the government's National Achievement Surveys of Grade V in 2011 and 2015 (NCERT, 2016), and is also corroborated by non-governmental annual learning surveys (ASER, 2010 to 2016).

[iv] From an experimental (randomised control trial) evaluation in Gujarat, Banerjee, Cole, Duflo, and Linden (2007) show that reducing class size has no impact on student achievement. In a panel data setup, Muralidharan et al. (2017) do not find any correlation between changes in mean PTR in a village and changes in normalized test scores, and they also find that reducing PTR is highly positively correlated with teacher absence. This finding is consistent with the findings of Muralidharan and Sundararaman (2013). Finally, Dutta and Kingdon (2021) using a student fixed-effects estimation approach, find a non-decreasing relationship between class size and student learning in secondary schools.

[v] Krueger, 1999; Case and Deaton, 1999; Angrist and Lavy, 1999; Woessman and West, 2006; Altinok and Kingdon, 2012; Shen and Konstantopoulos, 2019). Hattie's meta-analysis (2005) demonstrated a typical effect-size that was considered "tiny" or "small" relative to other educational interventions.

[vi] Telangana and Andhra Pradesh are considered one state, and are included here as Andhra Pradesh, since in 2010 they were one undivided state. Thus, in fact we show 20 states but the data is actually for 21 major states which together constitute 97% of the population of the country.

[vii] One lakh is one hundred thousand; Ten 'lakh' is equal to one million; one 'crore' is equal to ten million.

[viii] The District Information System on Education (DISE) survey format goes to each and every elementary school and is self-completed by the school, i.e. it gives the school's self-reported data. This is aggregated at the level of the district and state and then nationally.

[ix] Hindustan Times (2017) reported 2.0 lakh fake enrolment out of 5.5 reported enrolment in 2080 primary schools of Araria district. If we extrapolate this number to the state level, this figure is close to 40% which is in the vicinity of the reported number of 35% in Bihar by Kingdon et al (2009) and of 38% reported by CAG (2014).

[x] Rural parts of districts Agra, Shrawasti, Mahoba, Bijnor and Lucknow.

[xi] Muralidharan et. al. (2017) showed that due to significant teacher absence rates in primary schools in India, the effective PTR is higher than the reported PTR, but he takes student enrolment at face value. We take into consideration the pupil absence rates as well, as this draws attention towards the number of pupils the public school system is able to attract to attend school on a typical school day.

[xii] A similar parliamentary question was asked in August 2020 and the vacancy estimates given by the minister in reply are included here as Appendix Table 1. The Ministry's reply to parliament included its justification for increased teacher vacancies. It said: "The recruitment of teachers is a continuous process and the vacancies keep arising due to retirement and additional requirements on account of enhanced students' strength". We use the ministry's 2018 estimates as those are close to the DISE data available to us, which is for the year 2017-18.

[xiii] This explains the discrepancy between the MHRD estimate of 900,316 vacancies in the country as a whole, and the figure reported in the last row in column (c) of Table 8(a), which shows that for these 21 major states (Andhra included Telengana here), the MHRD's total estimated vacancies were 882,200. That is, the vast bulk of national teacher vacancies are captured by the vacancies in these 21 major states.

[xiv] If we presume the Ministry's sanctioned posts are decided as per the RTE Act's allocation rules, it is not known why columns (c) and (d) differ.

[xv] Due to space constrains, we did not report the values of vacancies and excess teachers under either rule.

[xvi] We have used an exchange rate of Rs. 73 per US dollar. On 30th Sept. 2018, the rate was Rs. 72.5 per dollar.

[xvii] The per capita income of India is from Table 11 in https://www.esopb.gov.in/static/PDF/GSDP/Statewise-Data/statewisedata.pdf which takes data from the Central Statistical Organisation, Govt. of India, New Delhi.