

The Myth and Reality of Teacher Shortage in India: An Investigation Using 2019-20 Data

Sandip Datta and Geeta Gandhi Kingdon

Abstract

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 teacher vacancies cannot be equated with teacher shortages: while the number of teacher vacancies (in teacher-deficit schools) is 766,487, the number of teacher surpluses (in surplus-teacher schools) is 520,141, giving a net deficit of only 246,346 teachers in the country. Secondly, removing estimated fake student numbers from enrolment data greatly reduces the required number of teachers and raises the number of surplus teachers, converting the net deficit of 246,346 teachers into an estimated net surplus of 98,371 teachers. Thirdly, if we both remove estimated fake enrolment and also make a hypothetical change to the teacher allocation rule to adjust for the phenomenon of emptying public schools (which has slashed the national median size of public schools to a mere 63 students, and rendered many schools 'tiny'), the estimated net teacher surplus rises to 239,800 teachers. Fourthly, we show that if government does fresh recruitment to fill the supposed approximately one-million vacancies as promised in National Education Policy 2020, the already modest national mean pupil-teacher-ratio of 25.1 would fall to 19.9, at a permanently increased fiscal cost of nearly Rupees 637 billion (USD 8.7 billion) per year in 2019-20 prices, which is higher than the individual GDPs of 50 countries that year. The paper highlights the major efficiencies that can result from evidence-based policy on minimum viable school-size, teacher allocation norms, permissible maximum pupil teacher ratios, and teacher deployment.

JEL Classifications: I20, I21

Keywords: public elementary schools, pupil teacher ratio, teacher vacancies, teacher surplus, fake pupil enrolment, teacher absence, India

Note: This paper updates an earlier paper titled, "The myth of teacher shortage in India" which had used older (2017-18) data. The current paper uses recently available 2019-20 data.



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Sandip Datta
Delhi School of Economics, New Delhi

Geeta Gandhi Kingdon
Institute of Education, University College London

Acknowledgements:

We are grateful to Lant Pritchett for helpful comments on an earlier version.

Geeta Kingdon is also president of a K-12 non-profit independent school in India. She has been member of Indian education ministry's Joint Review Missions of *Sarva Shiksha Abhiyan* and *Rashtriya Madhyamik Shiksha Abhiyan*.

This is one of a series of working papers from "RISE"—the large-scale education systems research programme supported by funding from the United Kingdom's Foreign, Commonwealth and Development Office (FCDO), the Australian Government's Department of Foreign Affairs and Trade (DFAT), and the Bill and Melinda Gates Foundation. The Programme is managed and implemented through a partnership between Oxford Policy Management and the Blavatnik School of Government at the University of Oxford.

Please cite this paper as:

Datta, S. and Kingdon, G. 2021. The Myth of Teacher Shortage in India. RISE Working Paper Series. 21/072. https://doi.org/10.35489/BSG-RISE-WP_2021/072

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An Investigation using 2019-20 data

I. Introduction

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

The NEP is not alone in ruing a paucity of teachers in India. The belief of an acute teacher shortage is shared by many Indian experts and organisations, based on data circulated by the Ministry of Education, which have been cited in the Indian parliamentⁱⁱ. A study by 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). 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) permits a maximum pupil-teacher ratio (PTR) of 30:1 in elementary schoolsⁱⁱⁱ. Following the Act's implementation in 2010, average PTR in public elementary schools declined steeply from 33.4 to 25.1 pupils per teacher in the nine years to 2019. Notwithstanding this reduction in PTRs, learning levels fell over much of the period^{iv}. 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 (Banerjee et. al., 2009; Muralidharan and Sundararaman, 2013; Muralidharan et. al., 2017; and Datta and Kingdon, 2021)^v and those in the much larger international literature (e.g. summarised in a meta-analysis by Hanushek, 2002) generally do not find the expected negative relationship between PTR and student learning outcomes, or find support for an important threshold at PTR of 30^{vi}. Be that as it may, questioning the teacher allocation norms of the RTE Act which lead to a maximum PTR of 30 is not the subject of investigation in this paper. We take those norms as given.

The main question we address in this paper is whether India has enough teachers to fulfil the PTR and teacher allocation norms enshrined in the *Right to Education Act*. Firstly, we probe the education ministry's estimates of teacher vacancies, which are the basis for the perceived teacher shortage. Secondly, we examine teacher surpluses. Just as some schools have fewer teachers than the number required by the

RTE Act given their pupil enrolment (teacher vacancies or deficits), other schools have more teachers than the number mandated by the RTE Act based on their pupil enrolment (teacher surpluses). We calculate both teacher deficits and teacher surpluses in a state, and thus calculate the *net* teacher deficit or surplus in each state of India. We also do some within-district analysis of net deficits/surpluses, to see the scope for within-district re-deployment of teachers from teacher-surplus schools to teacher-deficit schools. Thirdly, we ask how the net teacher surplus/deficit in a state varies after removing estimated fake pupils from the enrolment data. Fourthly, we ask how net teacher surplus changes after altering the teacher allocation rule which currently allocates 2 teachers each to the numerous ‘tiny’ schools with ‘20 or fewer’ children (which have an average of 12.7 pupils per school). Fifthly, 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, fake enrolment and the existence of tiny schools. Finally, the paper examines the number of schools with an extreme surplus of teachers. The whole analysis is carried out only for public elementary schools in each of 21 major states of India.^{vii}

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

Table 1 last row 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 1.035 million^{viii}, but that the number of private unaided schools increased by 123,000. Between 2017 and 2019 however, while public school numbers fell by 56,937 (mostly due to school consolidation in Uttar Pradesh and Madhya Pradesh), private school numbers increased by another 10,837 (mainly in Uttar Pradesh, Madhya Pradesh and Bihar). Thus, over the nine year period to 2019, total number of public schools fell by 57,201 and the number of private schools rose by 133,444.

Table 2 shows that over the seven year period to 2017, total pupil enrolment in public schools fell by 24 million and but in private unaided schools enrolment rose by 21 million. In the two years between 2017 and 2019, public school enrolment further fell by 4.04 million and private school enrolment rose by 3.46 million. Thus, over the nine years to 2019, public school enrolment fell by 28 million and enrolment in private unaided schools rose by 25 million.

Table 3 shows the phenomenon of the minifying of public schools over time, by presenting data for 2010-11 and for nine years later i.e. 2019-20. We term schools that have ‘60 or fewer’ pupils as “small” schools, and we call schools with ‘20 or fewer’ pupils as “tiny” schools. Firstly, it is clear that even in 2010-11, the year in which the RTE Act was implemented in the country, 37% of all schools were ‘small’, i.e. had ‘60 or fewer’ students in them, and these 383,839 public schools had on average 34.7 pupils. By 2019-20, the proportion of such small schools had risen to 48% (or nearly half) of all public elementary schools, and these 469,754 small schools had on average merely 31 pupils, the result of the abandonment of public schools seen in Table 2. The last column shows that teacher-salary-expense-per-pupil in these ‘small’ schools was Rs. 3,717 per month in 2019. Table 4 suggests considerable variation across states in the percentage of ‘small’ schools (≤ 60 pupils), which ranges from 8.6% in Bihar to 88.1% in the hilly state of Himachal Pradesh.

Table 3 also shows the phenomenon of ‘tiny’ schools, i.e. schools with ‘20 or fewer’ pupils. It shows that while in 2010, 7% of public schools were ‘tiny’, by 2019, 13.2% of all public schools were in this category, again suggesting a minifying of public schools over time. However, there is significant variation across states, as seen in Table 4. Uttaranchal has the highest proportion of tiny schools (49%) followed by Himachal Pradesh and Jammu-Kashmir. Table 3 shows that average teacher-salary-expense-per-pupil in ‘tiny’ public schools was Rs. 7312 per month by 2019, though as the note to Table 3 says, this is likely to be an underestimate.

Table 4 column (g) suggests that 66.6% of all public elementary schools in the country (21 major states) had fewer than or equal to 100 pupils, but the average school size in such schools was 44.1 pupils. Since just over one third (36%) of all elementary schools go up to grade 8, there are on average 6 grades per elementary school^{ix}; therefore 44.1 pupils per school means 7.4 pupils per class, in two-thirds of all schools of the country. 92.6 per cent of schools in Uttarakhand had 100 or fewer pupils, and mean size of these was a mere 25.9 pupils, or about 4.3 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 by pupils (Tables 2 and 3) led to an increase in the number of small/tiny schools. However, fresh hiring of teachers continued despite falling pupil enrolment. The combination of these two factors led to a reduction in the pupil teacher ratio (PTR) from 33.4 in 2010 to 25.1 in 2019, in 21 major Indian states. Table 5 shows that by 2019, 74% of all public elementary schools had a pupil teacher ratio below 30; 47.3% (about 463,000 schools) had a PTR below 20; and 14.9% (or about 146,000 schools) had a PTR below 10 pupils per teacher. In the hilly states Himachal, Jammu-Kashmir, and Uttaranchal, and also Telangana, more than 70% of schools had PTR of ≤ 20 , and even Kerala, Tamil Nadu, Odisha, Punjab and Andhra Pradesh, Maharashtra and Karnataka had about 60% or more public schools with PTR ≤ 20 . In the hilly states, more than 50% schools had PTR below 10.

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 three or more teachers, i.e. the percentage of small schools that have surplus teachers.

Column (e) shows that 26.4% of ‘small’ schools (i.e. 124,015 small schools) had surplus teachers. The percentage of small schools with surplus teachers is 83.3% in Kerala, 52.7% in UP, 50.1% in West Bengal, 49% in Haryana, and is greater than 30% in seven states: Bihar, Assam, Kashmir, Odisha, Himachal, Chhatisgarh and Punjab. Surplus teachers lead to high PTRs and high per-pupil-cost, as we show later in the paper. As we know, the small schools (469,754 schools as per Table 3) had an average of 31 pupils per school. If each of these schools had the required number of teachers i.e. 2 teachers each, they would require 9,39,508 teachers but they had actually 1,090,965 teachers (Table 3), which implies a total of 151,457 surplus teachers overall. The fiscal cost of these surplus teachers is Rs. 9007 crore or Rs. 90.07 billion (US \$ 1.2 billion) per annum in 2019-20 prices.

Table 6 column (a) shows that nationally 11.3 per cent of all ‘tiny’ schools (with ≤ 20 pupils) had surplus teachers, i.e. had 3 or more teachers. The problem of ‘tiny’ schools with surplus teachers is the most acute in Kerala, where 52% of all tiny schools had 3 or more teachers, but in many other states too were in a situation of economic unviability – Uttar Pradesh, Bihar, West Bengal, Assam, Jammu & Kashmir, Himachal Pradesh, Haryana and Bihar 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 12.7 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 2019-20 pupil teacher ratios (PTR) by state, and shows how PTR changes with the definition of PTR. It is important to highlight that the elementary PTR of 25.1 in column (e) is the *prima-facie* PTR, being based on total *school-self-reported*^x 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 some 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, 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 penalties for over-reporting enrolments are rare.

The Mid-Day Meal Authority reports overstated enrolment in public schools (*Times of India*, 2015a, b). A performance audit of the Mid Day Meal (MDM) scheme in India by the Comptroller and Auditor General (CAG) in 2015 found that in Bihar, only 58% of children availed the mid-day meal on the day of the CAG survey team, and in Uttar Pradesh it was 49% (Table 2.2, page 22, CAG, 2015); the report concluded (page 22): “The fact that the reported figures are consistently higher in the test-checked cases renders the possibility of misreporting being rampant across all states. Thus, the possibility of misuse of foodgrains and cooking cost was apparent as was the system of institutionalised exaggeration of figures leading to leakages and defalcations”. It summarised its findings thus: “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).

CAG found 38% inflation in DISE pupil enrolment data in the public elementary schools in Bihar (CAG, 2014). Earlier, Kingdon and Banerji (2009) reported the presence of fake enrolment of 35% in Bihar^{xi}. An annual assessment by the Mid Day Meal Authority in the Araria district of Bihar in 2017 showed that 36% of reported enrolment was fake (reported in *Hindustan Times*, 2017): “out of 5.5 lakh students enrolled in 2080 primary schools of the district, two lakh were fake. The two lakh students, who were shown to be being served midday meal, had never attended schools. Most of them either did not exist or were pursuing studies somewhere else”.

In Uttar Pradesh, DISE enrolment data for the Lucknow district were reviewed by the District Magistrate in September 2015, 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 were “absent for long period” and the District Magistrate ordered that these children not be regarded as enrolled and removed from the enrolment register (*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^{xii} 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 likely to be 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 Uttar Pradesh, implying that there is large-scale over-reporting of school enrolments. Since there are no incentives for over-reporting enrolment by private schools (as they do not get any government handouts based on their enrolment numbers), and since in UP 53% of total enrolment is in private schools and 47% in government schools (DISE, 2017-18; ASER, 2016), this implies a 21.3% inflation/over-reporting in government school enrolment, i.e. just over 20% fake enrolment in government schools. More worryingly, the same CAG report – which surveyed 428 elementary schools in UP in 2016 – found an attendance rate of merely 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 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 presents the histogram of school size and it shows that schools' self-reported total enrolment is lognormally rather than normally distributed. We know from Table 3 that mean school size in the nearly one million public elementary schools in the country is 100.5 students but, when a quantity is lognormally distributed, median is the better measure of central tendency than the mean. The median size of the approximately one million public elementary schools is a mere 63 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 48 or 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 58, 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 101, presumably because in upper primary schools a headmaster is allocated to schools that have an enrolment above 100 or above; similarly, we see another conspicuous jump at enrolment above 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 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 25. Student absence rate – measured via

independent, non-official/non-DISE surveys – captures both fake enrolments as well as the real absence of genuine enrollees. 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). The long note to Table 7 shows how we have estimated the number of fake enrolments in each state.

To estimate the true PTR, column (j) of Table 7 first 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 25.1 (column e), the true PTR is 21.6, i.e. 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. The true PTR is around 20 or lesser in 13 out of India’s 21 major states. This speaks of a very 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.^{xiii}

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 (formerly ‘Ministry of Human Resource Development’ or MHRD). As mentioned in the Introduction above, the draft National Education Policy (NEP, 2019) identified pupil teacher ratios above 30 as an important factor behind poor learning levels (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 increase 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 1243 in parliament on 19.09.2020, the MHRD minister replied that total number of teacher vacancies in public elementary schools is 1.1 million teachers, of which 1,035,001 vacancies exist in our 21 major states/UTs (see endnote ii).

Column (b) of Table 8a reports the total number of teacher vacancies in public elementary schools in 2019-20 as per the education ministry, and column (c) reports our own estimate of vacancies in each state, based on each schools’ self-reported pupil enrolment and teacher numbers in the 2019-20 DISE data, and comparing that with the number of sanctioned teacher posts based on applying the RTE Act’s teacher allocation norms for the given pupil enrolment of the school. We have reported data from both sources (Ministry’s and our own) only on 21 major states of India^{xiv}. Against the total of 1,035,001 vacancies reported by the Ministry, our own estimates show only 766,487 vacancies in these 21 major states. It is not known why columns (b) and (c) differ, but figures given out by the state as part of the Annual Work Plan and Budget process often differ from the education ministry’s own estimates. Neither source gives a technical note on the method of calculation, the year of the used data, or the formula/programme used, and it is important in future to provide such a technical note in government reports.

Our vacancy figures reported in column (c) are based on a strict application of the RTE Act’s teacher allocation rules on each individual school’s self-reported enrolment in DISE data, as explained in the note to Table 8(a). The STATA code we used to estimate the vacancy numbers is given in Appendix 2. While the reasons for the discrepancy with education ministry figures are not known with certainty, anecdotally some education officials and knowledgeable others mentioned that several factors operate in the determination of teacher vacancy numbers in a district which may lead to over-estimating teacher vacancies^{xv}, but a part of the inflated vacancy numbers could also be due to a timing issue: some states calculate teacher vacancies only once every three years, for example, Madhya Pradesh, and estimates from three years ago could be higher than current estimates. One important contradiction that suggests over-

estimation in teacher-vacancy calculations is that despite total enrolment falling by 4.04 million between 2017 and 2019 (Table 2, column d), total teacher vacancies did not fall, but rather increased by 152,801 teachers (from 882,200 to 1,035,001) over these two years.

We are not aware of 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. Also, when the education minister shares statistics on teacher vacancies in parliament, she/he does not present any estimates of surplus teachers. We were curious to explore teacher surpluses in the various states.

Table 8a's column (d) presents our estimate of teacher surplus in each state, and it shows that the total number of surplus teachers in 21 major states was 520,141. In column (e) we present the net teacher surplus or deficit, this is equal to column (d) minus column (c); negative values show the actual number of teachers required (net vacancies) and positive values show the net excess teachers (net teacher surplus). The column (e) total shows that – at the all India level – there are 246,346 net teacher vacancies, i.e. only about a quarter of the 1.035 million vacancies reported by the education ministry (MHRD, 2020). It is conspicuous that Bihar is an outlier with 176,201 net vacancies in this one state alone. Without Bihar, there are 70,145 net vacancies.

This finding alters our perception of a severe teacher shortage. To be sure, in schools with fewer teachers than those mandated by the teacher-allocation norms, one can legitimately say there is a teacher shortage, but in speaking for a geographical aggregation – e.g. a district, a state or the country – one cannot equate teacher vacancies with teacher shortages if there an equal or larger number of surplus teachers in that geographical unit. To equate teacher vacancies with teacher shortages, there must be a presumption that teachers cannot be transferred or redeployed from nearby schools that have surplus teachers, e.g. within the district or a division within a state.

Re-deployment cannot usually occur across states due to language and cultural barriers, and because teachers are paid out of state government budgets. Thus, the appropriate unit of analysis is the state, rather than India as a whole. Table 8a is sorted by column (e), i.e. from the highest to the lowest net teacher surplus state. Closer inspection of column (e) shows that, in fact, in 12 of the 21 major states (Telengana is included with Andhra), there are net surpluses totalling to 188,085 net surplus teachers (according to MHRD estimates, these states together have 242,580 vacancies). Only seven states have net teacher vacancies, and these total to 356,630 net vacancies though about half of these are in the single state of Bihar – 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. Table 8b does the analysis separately by rural and urban area within each state. It repeats columns (c), (d) and (e) of Table 8a. The last row shows a net deficit of 265,950 teachers in rural areas and a net surplus of 19,604 teachers in urban areas, confirming the anecdotal belief. However, there are large inter-state variations.

In twelve 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, Tamil Nadu and Andhra have the biggest number of net surplus teachers, a large total of 109,044 net surplus teachers (38,455, 35,601 and 34,988 respectively) out of which 81,692 are surplus in rural areas and 27,352 are surplus in urban areas. When we bifurcate by rural-urban in the last eight states in Table 8b, the dominant story is one of fairly large net teacher deficits in rural areas, and of far smaller net teacher deficits in their urban areas.

In summary, Tables 8a and 8b show that teacher shortages exist mainly in seven states in India – Bihar, Uttar Pradesh, Jharkhand, Madhya Pradesh, Karnataka, Gujarat and Maharashtra – because they each have a net deficit of teachers. However, five states constitute 91% of these net deficits, namely Bihar, UP, Jharkhand, MP and Karnataka, and it is these five states then that need particularly close attention from a teacher shortage perspective.

Appendix 1 illustrates district level situation of teacher vacancies and surpluses for one state, namely Uttar Pradesh, which has 75 of India's 650 or so districts. Districts in a division are all in contiguous proximity and it is often feasible to commute across adjoining districts. The table shows the rural, urban and total (rural+urban) teacher vacancies, surpluses and net surplus/deficit teachers based on reported enrolments, without removing fake enrolment, and then in the final set of three columns, it shows the teacher vacancy, surplus and net excess teacher numbers after removing fake enrolments. The table is sorted by the last column. Results without removing fake enrolments (shown in columns G, H and I) show that in UP, there were 126,403 teacher vacancies and 64,224 surplus teachers. If the state were able to transfer/redeploy all 64,224 surplus teachers to deficit-teacher schools within the district or to nearby districts within the same division or in adjoining divisions, it would save Rs. 4457 crore rupees (US\$ 610 million) per annum, compared to fresh recruitment of 64,224 teachers. The government of UP is planning a recruitment of about 51,000 teachers in winter 2021.

In the last three columns of Appendix 1 Table, when fake enrolments are removed, the number of vacancies falls to 86,739 (column J), and the number of surplus teachers rises to 92,124 (column K), and there is a net surplus of 5,385 teachers in UP, instead of a net deficit of 65,763 teachers (column I). In 47 districts (highlighted in column, L), we find that against a total deficit of 36,787 teachers, there were 68,394 surplus teachers, giving a net surplus of 31,607 teachers. By within-district redeployment in these 47 districts, the UP state government can save the salary of 31,607 teachers, i.e. save Rs. 2193 crore or 21.93 billion Rupees (USD 300 million) per annum in 2019-20 rupee terms. This kind of analysis illustrates what is possible in terms of within-district teacher re-deployments.

VI. Net Teacher Surplus, after removing fake enrolments

All the analysis in Table 8a up to column (e) was done taking schools' self-reported pupil enrolment at face value, without removing any exaggerated (i.e. '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 (f), (g) and (h) of Table 8a, we re-computed the actual teacher vacancies and surpluses after removing ghost enrolment, and this led to a dramatic change. The total teacher vacancies in India (21 major states) fell from 766,487 (column c) to 538,782 (column f); Surplus teachers rose from 520,141 to 637,153, and net deficit of 246,346 teachers converts to a net surplus of 98,371 teachers.

In light of this net teacher surplus, appointing nearly one million teachers under the belief of a teacher shortage would impose a very high permanent fiscal burden, beyond that envisaged by the RTE Act. According to the literature on the effect of class-size on student learning (briefly summarised in Section IX), 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 176,201 to only 28,593 teachers. In Uttar Pradesh, before adjusting for fake enrolment, there were 65,763 net teacher vacancies but after adjustment, this converts to a net *surplus* of 5,385 teachers. These facts are more clearly seen in Figure 3.

Importantly, in the aggregate, we see that after removing fake enrolment, in fourteen states (including Uttar Pradesh) there is a large total teacher surplus of 271,080 teachers, which is maintained at a cost to the public exchequer of Rs. 16,121 crore or Rs. 161.21 billion (approximately US\$ 2.2 billion) per annum in 2019-20 terms. Only seven states still have teacher deficits (see Figure 3 for a graphical analysis), and these total to 172,709 teachers. Indeed, the five states of Bihar, Madhya Pradesh, Jharkhand, Karnataka and Maharashtra have the bulk (93%) of all the net deficit of teachers. Our analysis implies that national policy makers need to focus particularly on teacher shortages in these five states.

It is useful to note that we have treated contract teachers as ‘teachers’, as also seems to have been done by the states. Studies show that although the educational qualification *requirements* for contract teachers are lesser than those for regular teachers, de facto, contract teachers are on average more educated than regular teachers (Kingdon and Sipahimalani-Rao, 2010). Studies also show that the learning levels of children taught by contract teachers are significantly higher than those taught by regular teachers, that contract teachers apply higher effort as measured by their lower absence rates (Muralidharan and Sundararaman, 2013; Goyal and Pandey, 2013; and Atherton and Kingdon, 2010).

Moreover, even if the posts in which 540,863 contract teachers are currently posted are all regarded as vacant, surely they will mostly be ‘filled’ by converting these self-same contract teachers into regular teachers (as has happened in many states thus far); in other words, there is little tenable logic for regarding the 540,863 posts occupied by contract teachers as ‘vacant’. If contract teachers who are teaching in schools are treated as teachers then, as shown in column (h) of Table 8(a), the true picture is of 98,371 net *surplus* teachers rather than 1 million teacher vacancies.

VII. Fiscal Cost of Surplus Teachers and Recruitment

In the previous section, we reported that there exist net surplus teachers in many states. Yet, due to not taking into account the surplus teachers, and measuring required teacher numbers without removing fake enrolments, these states show a substantial number of teacher vacancies. Thus state governments are faced with the expectation that they will appoint more teachers. Politicians may also face pressure from job seekers in their constituencies, so they (i) do not demand data on *surplus* teachers where they exist, (ii) do not ask for removal of ghost students before teacher vacancy numbers are calculated, (iii) do not ask for data on overall PTR (which could undermine the case for more teacher appointments), and (iv) do not seek redeployment of teachers from teacher-surplus to teacher-deficit schools, in order to justify fresh recruitment.

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 of the 21 major states, and there would be net surplus teachers in the remaining 13 states, as seen in column (e) of Table 8a, i.e. even when we do not remove fake enrolments. If instead of such redeployment, states recruit additional teachers to fill vacancies in the teacher-deficit schools, it creates an unwarranted additional fiscal burden, wastage and economic inefficiency.

Table 9 presents estimates of the fiscal burden on the public purse due to the presence of surplus teachers and due to the planned 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 3,911,290 existing teachers in public elementary schools, 506,720 (or 13% of all teachers) would be surplus in India in 2019-20, if PTR were maintained at 30. On top of these more than half a million surplus teachers, the National Education Policy asks state governments to fill about one million teacher vacancies “as soon as possible” (NEP 2019, p. 58), i.e. to recruit an additional 1,035,001 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 3.91 million to 4.95 million, and this would further reduce PTR from the current 25.1 to 19.9, i.e. a reduction of about 5.26 pupils per teacher (last row, columns f, g and h).

Table 9 also reports 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 source is the fiscal cost of maintaining the current PTR of 25.1, i.e. a PTR below 30, and column (i) estimates this cost to be Rs. 28,671 crore or Rs. 286.71 billion (US\$ 3.9 billion) per year in 2019-20 terms. The second source of excess cost is the fiscal burden of proposed new recruitment to fill the 1.035 million claimed teacher vacancies, which column (j) estimates to be another Rs. 63,674 crore or Rs. 636.74 billion (US \$ 8.7 billion) per year, which is the cost of reducing PTR by 5.26 pupils per teacher from the current PTR of 25.1 to a PTR of 19.9. Therefore, the total annual fiscal burden of surplus teachers and additional recruitment is Rs. 92,345 crore or Rs. 923.45 billion (US\$ 12.7 billion) per annum in 2019-20, which is higher than the entire GDP of Armenia or Nicaragua, and higher than the individual GDPs of 70 poorest countries of the world that year.

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 would raise learning levels much, or even at all. NCERT (2016) shows that between 2011 and 2015, pupil learning levels in grade 5 in public elementary schools *fell* even as PTR also fell sharply at much cost to the exchequer.

VIII. Fiscal Cost of Teacher Absenteeism and Fake Pupil Enrolment

Scarce public funds are wasted not only if there are surplus teachers but also if there is a high degree of 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 absence and due to fake enrolment. Nationally the pupil attendance rate is only 72% of enrolment which implies an absence rate of 28% (column d). Column (f) shows the proportion of total enrolment in a state that is estimated to be fake, and this is based on that portion of the ‘pupil absence’ which is due to ghost/fake enrolment. The table shows that the total cost of *ghost* pupil enrolment (column g) is Rs. 27,343 crore (Rs. 273.43 billion), and the cost of ghost enrolment in just three states (UP, Bihar, Madhya Pradesh) is Rs. 18,786 crore or Rs. 188 billion (USD 2.6 billion).

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 in 2019-20 terms is Rs. 333.97 billion (USD 4.6 billion) every year, nationally (column l). Adding this to the cost of ghost pupil enrolment gives the total fiscal cost due teacher absenteeism and fake pupil enrolment of Rs. 60,740 crore or 607.4 billion (US\$ 8.3 billion). The problem of fiscal wastage in education is the greatest in Uttar Pradesh, Bihar, Madhya Pradesh and Rajasthan.

IX. Sub-optimal choice of pupil teacher ratio

Underlying the RTE Act’s stipulation to fix PTR at a maximum of 30 would have been the belief that lowering PTR and class-sizes (raising teacher ‘input’) would raise pupil achievement. However, as stated in the Introduction, 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 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 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. In the literature, there is no evidence from any setting that there are ‘threshold’ effects of class size, i.e. that learning would be worse (non-linearly if not discretely) at class size $N+1$ than at a given threshold N , and there is no evidence that the N at which there is such a threshold is equal to 30. In other words, there is no discrete phase shift above a class size or PTR of 30. A mechanical application of the RTE law supposes that it is important that class sizes not exceed 30 when in fact (a) it is not clear that class-size matters at all, (b) it is not clear that 30 is not in the flat range, and (c) it is not clear that a PTR of 30 is a ‘threshold’.

If raising pupil teacher ratio from the current 25 to a PTR of 30 or even 40 does not lower student learning, large savings can be made on teacher salary costs without hurting learning. Table 11 explores the consequences for fiscal-spend on teacher salaries if PTR were maintained at given levels. It examines what government costs and savings would be at hypothetical PTRs of 30 and 40. Column (d) shows that the total cost of teacher salaries in 2019-20 when overall PTR nationally was 25.1, was Rs. 224,502 crore or Rs. 2245.02 billion annually (in 2019-20 rupees). However, if government maintained the (RTE Act permitted maximum) PTR of 30, total spending on teacher salaries would reduce to Rs. 1958.31 billion per annum (in 2019-20 prices), which means a saving of Rs. 28,671 crore or Rs.286.71 billion (about US \$ 3.9 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. 1468.73 billion vis-à-vis the current Rs. 2245.02 billion annually, and total savings would be Rs. 77,629 crore or Rs. 776.29 billion (about US \$ 10.6 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. While in the hilly states it may not be feasible to maintain PTR at 40, it is noticed that in many states which currently have low PTRs (such as Tamil Nadu, Rajasthan, Maharashtra, Haryana, Chattisgarh, Assam, Kerala etc.), the savings in total teacher salary cost will be substantial. 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

The decline in enrolment, emptying and minifying of public elementary schools by 2019 raises a question about the appropriateness of teacher allocation norms of the Right to Education (RTE) Act under the changed enrolment realities.

Table 2 showed that in the nine years since the implementation of RTE Act (in 2010), there was a substantial abandonment of public schools – about 28 million children left them – i.e. enrolment fell by 22 per cent. This has exacerbated the phenomenon of ‘small’ and ‘tiny’ public schools. As Table 3

showed, by 2019-20 nationally about 470,000 (i.e. 48% of all) public schools had a total enrolment of only '60 or fewer' (≤ 60) pupils, an average size of a mere 31 pupils per school, and 13 pupils per teacher.

When we look at the row for public schools that have a total enrolment of '20 or fewer' (≤ 20) students in Table 3, the emptying story becomes more extreme. In 2010, there were 72,527 such schools but by 2019, the number of such tiny schools nearly doubled to 129,424. In 2019, they constituted 13.2% of all public elementary schools, and that they had, on *average*, only 12.7 students per school and 6.8 pupils per teacher.

When setting the teacher-allocation rules, the RTE Act's framers could not have foreseen the exodus from public schools. As per the rules, all 'small' schools with a total enrolment of '60 or fewer' pupils are to be provided two teachers, which means that even the 129,424 tiny schools that have, on average, a total enrolment of only 12.7 pupils have to be provided two teachers each.

We consider the implications of a scenario in which government modifies its teacher allocation rules in light of the minifying of schools. 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 12.7 pupils per school), and as before, allocating two teachers in all schools with a total enrolment of 21 to 60 pupils. The remaining allocation rules also remain untouched, i.e. for schools with enrolment above 60.

Table 12 shows the consequences of applying such an alternative rule. Column (g) shows that if one teacher is allotted in any school with enrolment ≤ 20 , there will be nationally a net teacher deficit of 114,620 teachers^{xvi}, instead of the net deficit of 246,346 teachers under the current RTE teacher allocation norms. As seen in column (k), this would yield total savings of Rs. 8,594 crore or Rs. 85.94 billion or US\$ 1.2 billion^{xvii} per year (in 2019-20 terms), compared to the actual teacher salary expenditure in 2019-20.

If we take only 'true' enrolment i.e. we remove the ghost/fake students, then column (j) shows a net teacher surplus of 239,800 teachers (under the altered teacher-allocation rule), and this teacher surplus leads to an excess expenditure of Rs. 12,878 crore or Rs. 128.78 billion or US \$ 1.8 billion per year (in 2019-20 prices). Table 12 shows wide inter-state disparity.

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 26.7 pupils per teacher, compared to the current 25.1, i.e., well below 30 pupils per teacher.

XI. Small schools with extreme teacher surpluses

Tables 13 and 14 examine the cases of small schools that have an extreme surplus of teachers. Table 13 relates to all schools with '60 or fewer' (i.e. ≤ 60) reported students, which we call 'small' schools, and Table 14 relates to all schools with ≤ 20 students which we call 'tiny' schools. As in the rest of the paper, we consider only public elementary schools in 21 major states.

The first 5 columns of Table 13(a) repeat the findings of Table 3 that in 2019-20, there were 469,754 small schools (≤ 60 pupils), which constituted 48% (i.e. nearly half) of all schools, and that they had an average of 31 students per school, 2.3 teachers per school and a PTR of 13.3 pupils per teacher. The difference compared to Table 3 is that the figures here are state-wise.

Columns (g) onwards shows that among all 'small' schools (≤ 60 pupils), 2.1% schools had zero teachers, 15.3% had one teacher (teacher deficit schools), 56.2% schools had the (mandated) two teachers, and the remaining 26.4% of small schools had teacher surpluses, i.e. 3 or more teachers: 13.9%

had three teachers, 6.6% had four teachers and 5.9% of all small schools had ‘5 or more’ teachers, and it is this last category we focus on in Table 13(b).

Table 13(b) shows the average PTRs in the ‘small’ schools: in small schools with one teacher, PTR was 24.5; with two, three and four teachers, PTR was 14.6, 12.7 and 10.1 respectively. In small schools with five or more teachers, PTR was merely 6.6 pupils per teacher. The remaining columns show that there were 27,619 such ‘small’ schools with 5 or more teachers, that they had 171,055 teachers (i.e. a mean of 6.2 teachers per school), a pupil teacher ratio of 6.6 pupils per teacher, and a per-pupil-expenditure on teacher salary alone of Rs. 89,947 in 2019-20, which was equal to 67% of the national per capita income or 1.8 times the per capita income of Bihar that year^{xviii}. This implies a total teacher salary cost of Rs. 10,173 crore (Rs. 101.73 billion) per annum in 2019-20 on these 27,619 ‘small’ public schools with an extreme teacher surplus. This was higher than the entire GDP of Rwanda or Kyrgyzstan that year. If these schools each had the mandated two teachers each, they would have in total 55,238 teachers. Since these schools had 171,055 teachers, they have a total *surplus* of 115,817 teachers. The cost of these surplus teachers is Rs 6,888 crore (Rs. 68.88 billion or USD 0.94 billion) per annum.

Table 14(a) shows that there were 129,424 ‘tiny’ public schools in the country in 2019-20, i.e. schools with a total reported enrolment of 20 or fewer (≤ 20 pupils), which constituted 13.2% of all public schools. These had on average 12.7 students per school, an average of 1.9 teachers per school, and thus a PTR of 6.7 pupils per teacher. While 4% of these tiny schools had zero teachers, and 24.9% had one teacher (which seems perhaps not unreasonable, given an average enrolment of only 12.7 students per school), in further columns we see that 59.8% of these schools had two teachers, 6.9% had three teachers, and 4.3% had four or more teachers (2.3% had four teachers and 2% had five or more teachers). While nationally there were only 2% of tiny schools with ≥ 5 teachers, in some states that figure is much higher, e.g. in Haryana and Kerala the figure is more than 12 to 13.5%, and in Kashmir, it is 7%.

Table 14(b) shows that among the tiny schools, those with one teacher had a PTR of 10.9, 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 3.7 pupils per teacher. The last row of Table 14(a) in columns (i), (j) and (k) showed that 11.2% of all tiny schools had ≥ 3 teachers, which is equal to 14,573 schools. Table 14(b) shows that these 14,573 tiny schools with ≥ 3 teachers had a total of 55,137 teachers, 3.8 teachers per school, and a per pupil salary expenditure of Rs. 160,088 in 2019-20, which was 1.2 times India’s and 3.2 times Bihar’s per capita income, and which implies a total expenditure of Rs. 32.79 billion (US\$ 449 million) per year on these ‘tiny’ public schools with an extreme teacher surplus.

XII. Summary

This paper questioned the Indian 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 (understandably) been uncritically accepted by the framers of the National Education Policy (NEP 2020). We asked whether the vacancy estimates are supported by evidence, and explored teacher surpluses and fake student enrolment, and the implications of these for pupil teacher ratios (PTRs). The paper also calculated the fiscal savings of the exchequer if PTR were maintained at the levels prescribed in NEP 2020 and the Right to Education (RTE) Act 2009. We restricted analysis to public elementary schools only, in 21 major states of India which constitute 97% of the country’s population.

We calculated the teacher vacancies for each individual school based on the its self-reported pupil enrolment and seeing whether its current number of teachers falls short of (or exceeds) the teacher-allocation norms of the RTE Act. We totalled the vacancy (or surplus) numbers across all schools within

a state to arrive at the total number of teacher vacancies in the state. The STATA programme lines for calculating teacher vacancies/surpluses are given in Appendix 2 of the paper.

The analysis of DISE 2019-20 data shows that national average PTR in public elementary schools is 25.1, i.e. lower than the permitted maximum of 30. Moreover, the true PTR (after removing estimated fake enrolment) is 21.6 pupils per teacher. *Prima facie* this suggests a 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.

The paper has several key findings. Firstly, while the paper broadly confirms (Table 8a) that there are a large number of teacher vacancies, it shows that applying the same teacher-allocation norms, there are a larger number of surplus teachers too, so that there is a *net* deficit of 246,346 teachers, i.e. only about a quarter of the widely publicised one-million teacher vacancies. If we remove the outlier state of Bihar – which alone reports a total of 176,201 teacher vacancies – the national net deficit is 70,145 teachers in the 20 major states of India.

State-wise analysis of this total net national deficit shows that only seven states have net teacher deficits (i.e. net vacancies) and that 94 per cent of these net vacancies are in five states (Bihar, Uttar Pradesh, Jharkhand, Madhya Pradesh and Karnataka), and thus it is mainly these five states that need close attention from a teacher shortage perspective. Fourteen states have net teacher surpluses; in these states large savings can result from reducing surplus teachers, e.g. via re-deployment to teacher-deficit schools, attractive voluntary retirement schemes and/or stopping fresh recruitment, etc. While in the net teacher-surplus states there is much scope for within-district re-deployment of teachers (from teacher-surplus to deficit-teacher schools), we also illustrated in Appendix 1 how re-deployment within districts can help fill many teacher shortages even in a net-teacher-deficit state.

Secondly, we find that it is important to adjust for estimated fake/exaggerated pupil enrolment numbers as reported by bodies such as the *Mid Day Meal Authority* and the *Comptroller and Auditor General*, and as seen clearly in the histogram of Figure 1. Adjusting for over-reported enrolment greatly reduces the number of required teachers (teacher vacancies) compared with the government's one million vacancies estimate, and it raises the tally of surplus teachers. If government ignores fake enrolment, and fills its claimed one million teacher vacancies, the already modest mean PTR of 25.1 would fall to 19.9, at an additional teacher salary cost of nearly Rs. 63,674 crore per year, i.e. Rs. 636.74 billion or USD 8.7 billion per annum (in 2019-20 prices), creating a very large permanent fiscal burden.

Thirdly, combining both ideas (Table 8a, column h) – i.e. for each state first removing fake enrolments and second estimating additional teachers required to fill only *net* teacher vacancies (that remain after redeploying surplus teachers) – would imply a national *net surplus* of 98,371 teachers. Inter-state analysis of this net surplus shows that in 14 states including Uttar Pradesh there is a sobering net surplus of 271,080 teachers (maintained at a public cost of Rs. 161.21 billion or approx. US\$ 2.2 billion per annum (in 2019-20 terms). Only seven states still have teacher deficits totalling 172,709 teachers, of which 93% of the teacher deficits are in only five states (Bihar, Jharkhand, Karnataka, Madhya Pradesh and Maharashtra).

Fourthly, we show that the annual fiscal burden of surplus teachers is due to two factors: first, maintaining the current PTR of 25.1 rather than the permitted maximum PTR of 30 costs the exchequer Rs. 286.71 billion; second, the additional teachers recruited to fill the supposed 1 million vacancies that the National Education Policy 2020 promises to fill, would cost Rs. 636.74 billion per annum. This implies an annual fiscal burden of Rupees 923.45 billion or US\$ 12.7 billion per annum (in 2019-20 prices) which was higher than the entire GDP of Armenia or Nicaragua, and higher than the individual GDPs of 70 poorest countries of the world that year.

Fifthly, the paper shows how the RTE Act's rule of providing two teachers to any school with '60 or fewer' students, leads to two teachers being allocated even to 'tiny' schools, those with '20 or fewer' total students. There were 129,424 such 'tiny' public schools (Table 3) and these had, on average, merely 12.7 pupils per school, so here the RTE-mandated rule of appointing two teachers leads to an average PTR of a mere 6.8 pupils per teacher. The paper shows that if the rule were modified, and only *one* teacher was allocated to schools with ≤ 20 students, there would be a national net deficit of only 114,620 teachers without adjusting for fake enrolment, but after removing the estimated fake students, there is a net teacher surplus of 239,800 teachers, which implies an excess expenditure of Rs. 128.78 billion or US \$ 1.8 billion per year (in 2019-20 prices).

Sixthly, the paper examines schools that have an extreme teacher surplus, to quantify this aspect of economic wastage of scarce educational resources (Tables 13b and 14b). There were 27,619 small schools with a total enrolment of ≤ 60 pupils and with five or more teachers; these schools each had on average 40.9 pupils, 6.2 teachers, a PTR of 6.6 pupils per teacher; they had a total annual teacher salary bill of Rs. 101.73 billion (US\$ 1.4 billion per year) in 2019-20, and a per-pupil-teacher-salary-expense of Rs. 89,947 in 2019-20, which was 1.8 times the per capita income of Bihar that year. If these schools had the mandated two teachers each, they would have 55,238 teachers but they actually had 171,055 teachers, i.e. had a surplus of 115,817 teachers, which cost Rs. 6,888 crore (Rs. 68.88 billion, or USD 944 million) per annum.

Similarly, there were 14,573 tiny schools which had a 'total enrolment of ≤ 20 pupils and three or more teachers'; they had on average 14 pupils, 3.8 teachers, an extremely low PTR of 3.7 pupils per teacher, a total salary expenditure of Rs. 32.79 billion (US\$ 449 million) per year, and a per-pupil-teacher-salary-expense of Rs. 160,088 per year in 2019-20 prices, which was 1.2 times India's per capita income (and 3.2 times the per capita income of Bihar state) in that year.

Seventhly, the paper shows (Table 10) that about Rs. 607.40 billion (US\$ 8.3 billion) expenditure on teacher salaries is wasted each year due to teacher absenteeism and ghost pupil enrolments, suggesting areas of scope for greater efficiency. The wastage due to estimated ghost/fake enrolments is Rs. 273.43 billion (US\$ 3.8 billion) per annum, and that due to teacher absence is Rs. 333.97 billion (US\$ 4.6 billion) per annum.

Eighthly, we estimated (Table 11) that maintaining a permitted PTR of 30 instead of the current 25.1 would save Rs. 286.71 billion (US\$ 3.9 billion) per annum in teacher salary costs; maintaining a PTR of 40 would save Rs. 776.29.16 billion (US \$ 10.6 billion) per year, in 2019-20 prices.

This paper has tried to provide evidence based on the government's official DISE data collected from all the nearly one million public elementary schools in 21 major states of the country. One caution is that while DISE follows data validation, consistency checks and a 5% sample check, and is widely used by researchers and by the education ministry as the basis for its Annual Work Plan and Budget process, it has some data quality issues as noted by some researchers (e.g. Ramachandran, 2015). Another 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, estimates are not available for other states and we have imputed fake enrolment estimates from these states to other states based on an arbitrary assumption. Ideally states need to re-do 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.

XIII. Conclusions and policy directions

Our first policy two pointers relate to data integrity. Teachers are the most expensive resource in education, and prudence requires that teacher vacancies are estimated accurately as they have serious fiscal consequences. Currently, the vacancy estimation method seem not to be consistent across states, and the vacancy figures provided by the education ministry which are also cited in parliament, are significantly higher than those obtained by a strict application of the teacher-allocation norms of the Right to Education Act 2009. Thus, the first policy pointer is that the education ministry provides states a suggested common methodology for the estimation of teacher vacancies, and that state governments – as a matter of good practice – provide in their reports a technical note on the methodology, formulae, program lines used, any assumptions made, and data sources used, in generating any educational data tables. Using a common method consistently across states will also help to keep states accountable for the integrity of their teacher vacancy estimates.

Another data integrity point is that, to reduce wastage, it is important to have data on actual enrolment in schools, so that teacher allocation is not based on inflated / over-reported pupil enrolment numbers. Some states have encouraged removal of fake enrolment from schools' self-reported enrolment numbers by requiring all pupils to give their Adhaar card (unique national ID) numbers, e.g. Haryana, and lately Uttar Pradesh has required public school pupils to give their Adhaar card numbers in order to receive Direct Benefit Transfers (DBT) for school uniform, bag, shoes, etc. However, more progress is needed nationally.

Some policy implications arise from the key fact that, due to a long term trend of the emptying of public elementary schools and migration to private schools, student enrolment in public elementary schools has fallen greatly and school size has become very small. By 2019-20, median size of the country's about 1 million public elementary schools was a mere 63 pupils, and as Table 3 shows, 48% of all public schools (approx.. 470,000 schools) had a total enrolment of '60 or fewer' pupils, and an average of merely 31 pupils per school.

Firstly, this minifying of schools raises questions about their pedagogic viability, and their scope for offering children adequate socialisation opportunities. This suggests the need for a policy on minimum viable school size. Some states have reduced their number of schools and thus raised average school size by merging/consolidating nearby schools, e.g. Madhya Pradesh and Uttar Pradesh (Table 1, column D). To ensure that access is not jeopardised when schools are merged and some children have to travel further, states could assist with defraying the transport costs, perhaps by providing parents Direct Benefit Transfers (cash transfers) for transport to school.

Secondly, the minifying of schools calls for a review of the teacher allocation rules enshrined in the Right to Education Act 2009 which mandate two teachers even for tiny schools – that have on average merely 12.7 pupils – whose numbers have rapidly grown in recent years. A review would be desirable to make the teacher allocation rules more evidence-based, in light of the available literature on the impact of class size (or pupil teacher ratio) on pupil learning, and the lack of a known 'threshold' at a PTR of 30.

Lastly, the governments of the fourteen states with net teacher surpluses need to consider how much of the problem of teacher shortage in some schools should be solved by net new hiring and how much by reallocation of teachers from surplus-teacher-schools. In principle, a number of ways can be used to rationalise surplus teachers, e.g. incentivising teachers to accept re-deployment to teacher-deficit schools, putting a freeze on fresh recruitment, and voluntary retirement schemes etc. District wise analysis within each state would be fruitful to see the scope intra-district or intra-division redeployment of teachers from surplus to deficit schools. The National Education Policy (NEP 2020) para 5.2 promises that to encourage redeployment to less desirable locations, "incentives will be provided for teachers to take up

teaching jobs in rural areas...A key incentive will be the provision of local housing or increased housing allowances”, so this lever could be used to actually implement redeployment.

While in practice transferring teachers may be administratively and politically challenging, yet the state needs to consider how fair it would be for the citizen/taxpayer to pay for the ‘hedonic rent’ that a large number of individual teachers get from assignments near home with few students to teach, and whether it is legitimate to incur large fiscal costs not because the state has too few teachers but because it cannot or will not reassign teachers from very small schools or teacher-surplus schools, and hence not reach the permitted upper limit of class-sizes and pupil-teacher-ratios.

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Table 1: Change over time in the number of public and private elementary schools in India (21 major states): 2010-11 to 2019-20

State	Public schools				Private schools			
	2010-11	2017-18	2019-20	Change 2017-2019	2010-11	2017-18	2019-20	Change 2017-2019
	A	B	C	D=C-B	E	F	G	H=G-F
Andhra Pradesh*	79,314	73,856	74,142	286	24,823	25,724	25,494	-230
Assam	44,371	49,446	46,289	-3,157	13,144	12,724	12,538	-186
Bihar	68,293	70,252	69,667	-585	1,053	13,855	15,905	2,050
Chhattisgarh	46,389	44,452	43,962	-490	4,552	6,735	7,155	420
Gujarat	33,521	33,788	33,560	-228	6,396	10,579	11,118	539
Haryana	14,955	14,413	14,482	69	5,513	8,552	9,192	640
Himachal Pradesh	15,126	15,465	15,392	-73	2,285	2,810	2,766	-44
Jammu-Kashmir	22,180	23,393	23,550	157	4,915	5,418	5,793	375
Jharkhand	40,123	38,957	35,263	-3,694	2,817	8,292	8,128	-164
Karnataka	46,520	45,256	44,983	-273	10,259	14,470	15,125	655
Kerala	4,870	4,570	4,792	222	890	4,921	4,359	-562
Madhya Pradesh	111,943	114,041	94,227	-19,814	23,710	29,453	32,716	3,263
Maharashtra	68,961	66,519	65,625	-894	9,775	17,536	17,797	261
Odisha	57,171	54,766	52,001	-2,765	4,347	6,399	6,767	368
Punjab	20,236	19,502	19,365	-137	10,113	8,711	8,703	-8
Rajasthan	77,528	66,872	67,586	714	26,760	38,428	38,476	48
Tamil Nadu	36,066	37,625	37,558	-67	10,622	12,429	12,970	541
Uttar Pradesh	151,419	161,544	136,045	-25,499	41,961	94,700	99,996	5,296
Uttaranchal	17,343	17,341	16,467	-874	4,820	5,915	5,820	-95
West Bengal	79,314	83,280	83,445	165	10,212	14,530	12,200	-2,330
India (21 states)	1,035,643	1,035,338	978,401	-56,937	218,967	342,181	353,018	10,837

Source: Authors' analysis of raw DISE 2010-11 data from www.dise.in (accessed 2015) and raw u-DISE 2019-20 data from <https://src.udiseplus.gov.in/udise-share/getLogin> (accessed July 2021). DISE is the District Information System on Education. The prefix in u-DISE stands for universal DISE data.

Note: Andhra Pradesh includes Telengana in this and most tables below. In the 7 years between 2010-11 and 2017-18, the number of public schools remained very nearly the same, but the number of private schools increased by 123,214. In the further two years 2017-18 to 2019-20, the total stock of private schools further increased by 10,837 but the number of public schools fell by 56,937 (of these, the greatest fall was in two states Uttar Pradesh and Madhya Pradesh, by 45,313 public schools). Thus, in the nine years between 2010 and 2019, the number of private schools increased by 133,444 while the number of public schools fell by 57,242.

Table 2: Change in enrolment in public and private elementary schools: 2010-11 to 2019-20

States	Public schools				Private schools			
	2010-11	2017-18	2019-20	Change	2010-11	2017-18	2019-20	Change
	A	B	C	D=C-B	E	F	G	H=G-F
Andhra Pradesh*	6,188,546	5,072,962	5,059,388	-13,574	4,593,593	5,113,308	5,444,137	330,829
Assam	4,097,714	3,828,109	3,880,173	52,064	994,790	1,232,447	1,406,428	173,981
Bihar	19,651,531	17,787,806	15,893,345	-1,894,461	315,605	2,999,608	3,770,815	771,207
Chhattisgarh	3,807,498	3,082,746	2,829,468	-253,278	755,343	1,164,751	1,251,866	87,115
Gujarat	5,913,926	5,456,424	5,076,434	-379,990	2,013,071	3,210,515	3,380,360	169,845
Haryana	2,087,253	1,542,191	1,482,951	-59,240	1,299,915	2,350,774	2,555,595	204,821
Himachal Pradesh	746,331	533,388	502,244	-31,144	283,986	395,957	411,088	15,131
Jammu-Kashmir	1,213,365	937,825	853,470	-84,355	784,773	788,807	848,280	59,473
Jharkhand	5,571,148	4,164,893	3,833,896	-330,997	911,508	1,658,151	1,781,383	123,232
Karnataka	4,623,406	3,816,438	3,708,052	-108,386	2,329,891	3,399,727	3,777,494	377,767
Kerala	1,056,360	844,947	901,798	56,851	370,702	1,473,101	1,388,128	-84,973
Madhya Pradesh	10,647,566	7,217,655	6,675,747	-541,908	4,635,389	4,796,127	5,163,497	367,370
Maharashtra	7,420,883	5,499,126	5,217,260	-281,866	2,437,749	4,493,775	4,766,619	272,844
Odisha	5,653,530	4,690,160	4,331,906	-358,254	600,016	1,088,662	1,162,098	73,436
Punjab	2,169,490	1,652,599	1,593,060	-59,539	1,640,756	2,006,753	2,086,921	80,168
Rajasthan	7,103,962	6,224,446	6,138,970	-85,476	4,735,083	6,040,497	6,172,684	132,187
Tamil Nadu	4,269,687	3,140,559	2,981,337	-159,222	3,246,854	3,930,920	4,028,919	97,999
Uttar Pradesh	19,684,004	15,723,078	16,285,187	562,109	10,300,949	16,647,313	16,630,124	-17,189
Uttaranchal	941,188	681,848	615,818	-66,030	616,909	928,773	977,771	48,998
West Bengal	13,480,839	10,424,158	10,422,554	-1,604	1,349,049	1,712,506	1,883,655	171,149
India (21 states)	126,328,227	102,321,359	98,283,058	-4,038,301	44,215,931	65,432,470	68,887,862	3,455,392

Source: Same as in Table 1.

Note: In the 9 years to 2019, pupil enrolment in public schools fell by 27.9 million and that in private schools rose by 24.6 million. The difference of 3.3 million may have gone to aided schools or to 'unrecognised' private schools that are not covered in DISE data.

Table 3: Public school enrolments, pupil-teacher-ratio (PTR) and per-pupil-expenditure, by school size, India (21 major states), 2019-20 (number of 'small' and 'tiny' public schools)

Total number of pupils in the school as a whole:	Number of schools	Percentage of total govt. 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	4,350	0.4	13,371	0	0.0	0.0	459	-	-
5 or Less	8,625	0.8	20,376	15,477	1.8	0.8	699	451,882	37,657
10 or Less	21,247	2.0	42,262	120,870	5.7	2.9	1,451	120,012	10,001
20 or Less	72,527	7.0	138,637	940,670	13.0	6.8	4,759	50,587	4,216
60 or Less	383,839	37.1	793,723	13,335,072	34.7	16.8	27,243	20,430	1,702
<= 100 pupils	598,060	57.8	1,406,356	30,234,327	50.6	21.5	48,271	15,966	1,330
All govt. schools	1,035,643	100.00	3,779,041	126,328,227	122.0	33.4	129,710	10,268	856
2019-20									
Zero	5,193	0.5	4,345	0	0.0	0.0	258	-	-
5 or Less	15,985	1.6	21,409	38,885	2.4	1.8	1,273	327,423	27,285
10 or Less	40,618	4.2	64,832	241,577	5.9	3.7	3,856	159,599	13,300
20 or Less	129,424	13.2	242,388	1,642,714	12.7	6.8	14,415	87,749	7,312
60 or Less	469,754	48.0	1,090,965	14,545,317	31.0	13.3	64,879	44,605	3,717
<= 100 pupils	651,628	66.6	1,758,328	28,718,169	44.1	16.3	104,567	36,411	3,034
All govt. schools	978,401	100.00	3,911,290	98,283,058	100.5	25.1	232,603	23,667	1,972

Source: Same as in Table 1 (For 21 major states. Andhra and Telangana are counted as two separate states).

Note: Data on govt. school teachers' (take-home) salary is taken from Ramchandran (2015), where mean govt. primary school teacher salary (averaged across new and experienced teachers) was 40,623 per month in 2014-15. For 2019-20, this has been inflated by 8.5%, assuming a salary inflation rate of 8.5% per annum, based on actual salary escalation in one state (Uttar Pradesh), see Annex Table 2 in Kingdon (2017). Thus, average primary teacher salary is taken as Rs. 49,558 in 2019-20. In an earlier version, we had taken average teacher salary in 2017-18 to be Rs. 51,887 per month, which was a *simple* average of salaries across states, but for the current paper with 2019-20 data, we have used the *weighted* average of salaries across states. Note that about one third of all public elementary schools are middle/junior schools, and their teachers earn salaries that are about 30% higher than primary school teachers, but we have assumed that all schools are primary and thus we have taken only primary teacher salary rates to calculate the per pupil salary expenditure. Thus, average salary level used here is under-estimated for this reason. However, we do not have available the salaries of contract teachers, which are significantly lower than those of regular teachers, and about 12% of all public teachers are contract teachers, so for this reason our average teacher salary figure will be an over-estimate. The salary figures for both years are in nominal not real terms. All enrolment data in DISE is schools' self-reported enrolment, which is known to be inflated. * Note that average PTR in the biggest 21 states differs somewhat from that for *all* states. Total public elementary schools in 21 biggest states were 978,401 but were 1,006,293 if we take all states. In secondary and higher secondary schools that have elementary (class 1 – 8) classes, we have excluded teachers that teach only secondary or higher secondary classes, i.e. taken only those that teach elementary classes.

Table 4: Percentage of public schools with ‘total student enrolment’ below given levels, 2019-20

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)
Uttarakhand	49.0	65.0	74.5	80.5	84.3	89.7	92.6	25.9	37.4
Himachal Prad.	43.2	63.4	76.1	83.5	88.1	93.9	96.5	28.0	32.6
Jammu Kashmir	41.7	58.1	69.3	77.2	83.0	90.3	94.5	29.7	36.2
Karnataka	26.8	38.7	47.1	53.5	58.2	66.5	72.1	35.3	82.4
Telangana	25.6	39.6	49.4	56.4	62.4	72.2	78.5	36.4	68.6
Maharashtra	21.6	38.8	50.2	56.4	59.9	68.1	73.8	36.0	79.5
Andhra Pradesh	20.2	39.7	52.4	59.8	64.6	73.3	80.0	37.3	68.0
Tamil Nadu	17.7	32.5	43.1	50.0	54.8	65.4	72.9	40.9	79.4
Assam	15.7	28.1	38.7	47.3	54.3	65.8	73.2	42.8	83.8
Chhattisgarh	13.7	27.2	40.0	51.4	60.4	73.9	82.6	45.1	64.4
Madhya Pradesh	13.1	28.4	42.1	52.7	59.8	72.4	79.3	43.2	70.8
Odisha	12.8	28.5	40.9	49.7	56.0	65.9	72.5	42.4	83.3
Punjab	11.4	23.4	34.7	44.5	52.1	65.2	73.5	46.2	82.3
Kerala	10.2	17.4	24.1	30.8	36.9	47.8	54.4	46.7	188.2
Rajasthan	9.7	23.3	33.5	40.8	47.2	58.0	65.0	44.7	90.8
West Bengal	7.5	17.2	27.0	36.4	44.9	57.4	66.7	49.5	124.9
Haryana	7.2	15.5	24.1	31.1	40.6	54.0	63.6	51.2	102.4
Jharkhand	5.6	14.5	26.0	36.3	45.3	57.4	64.9	49.2	108.7
Gujarat	5.5	12.6	20.4	26.2	30.3	39.8	45.6	48.5	151.3
Uttar Pradesh	1.9	5.3	10.9	17.2	24.3	39.5	50.3	60.3	119.7
Bihar	0.5	1.1	2.3	5.1	8.6	16.7	24.9	68.2	228.1
India	13.2	24.5	34.1	41.8	48.0	59.1	66.6	44.1	100.5

Note: To illustrate how to interpret this table, Column (a) last row shows that in India, 13.2 per cent of all public elementary schools had a total enrolment of ‘20 or fewer’ students; column (d) shows that 41.8% of all public schools had ‘50 or fewer’ pupils, and so on. In the hilly states of Uttarakhand 84.3%, Himachal 88.1% and Kashmir, about 83% 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 66.6% 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). Primary schools have 5 grades (classes 1 to 5) and upper primary schools/sections have 3 grades (grades 6, 7 and 8), but there are only one-third as many upper primary schools as primary schools; therefore, the average number of grades in elementary schools is 6 grades. Thus, if a school has a total enrolment of exactly 60 students, this implies 10 students per grade, on average.

Source: Authors’ calculations from DISE 2019-20 data.

Table 5: Percentage of public schools with pupil teacher ratio (PTR) below given levels, 2019-20

% 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)
Jammu & Kashmir	53.8	74.2	84.6	89.7	92.7
Himachal Pradesh	52.0	73.0	85.2	92.1	95.3
Uttarakhand	45.5	62.7	72.9	80.0	85.2
Telangana	30.5	54.1	70.7	81.6	87.6
Kerala	28.0	49.8	68.1	81.2	87.9
Karnataka	25.3	43.7	59.2	72.4	81.2
Assam	21.3	37.4	51.7	64.1	73.9
Tamilnadu	21.1	46.6	66.5	82.5	91.4
Maharashtra	20.3	40.5	59.2	80.0	91.5
Odisha	17.5	39.6	60.6	77.8	88.6
Punjab	16.7	37.6	58.1	73.8	81.2
Haryana	16.1	31.5	50.3	71.8	85.0
Chhattisgarh	15.0	32.6	51.3	68.5	80.6
Rajasthan	11.9	30.8	54.3	72.8	84.4
Andhra Pradesh	11.6	36.9	58.4	74.2	82.6
West Bengal	11.6	29.1	48.7	65.8	77.1
Madhya Pradesh	11.3	26.7	42.4	57.7	68.4
Gujarat	6.6	16.9	33.6	58.7	79.8
Uttar Pradesh	4.2	13.8	28.4	45.0	59.9
Jharkhand	3.4	10.8	21.9	34.3	47.3
Bihar	0.7	2.9	7.6	15.9	26.7
Total	14.9	30.9	47.3	62.7	73.7

Source: Authors' calculations from DISE 2019-20. Note: Sorted by column (a).

Table 6: Percentage of all public schools with ‘total enrolment’ below given levels AND 3 or more teachers, 2019-20

	In schools with given enrolment, % of schools with excess teachers				
	Total Enrolment <=20	Total Enrolment <=30	Total Enrolment <=40	Total Enrolment <=50	Total Enrolment <=60
	(a)	(b)	(c)	(d)	(e)
Kerala	52.1	68.5	76.1	80.4	83.3
Uttar Pradesh	34.5	41.2	45.5	49.2	52.7
West Bengal	25.3	30.8	37.6	44.2	50.1
Assam	23.9	26.8	29.1	31.6	34.2
Jammu & Kashmir	22.1	27.7	33.1	37.5	40.7
Bihar	21.1	23.1	23.7	25.4	30.2
Haryana	20.7	26.6	33.2	40.3	49.0
Himachal Pradesh	20.7	25.6	29.2	31.9	33.9
Odisha	18.4	21.9	24.7	27.9	31.4
Chhattisgarh	15.4	19.4	23.6	27.4	31.4
Gujarat	12.1	13.8	16.0	20.0	25.1
Uttarakhand	11.9	14.1	15.5	16.7	17.7
Punjab	9.2	16.4	24.3	31.6	37.2
Telangana	6.8	11.7	16.8	22.1	27.3
Karnataka	5.6	9.6	14.7	19.3	23.3
Madhya Pradesh	5.4	6.9	8.8	11.0	13.6
Rajasthan	3.7	4.5	7.1	10.0	14.8
Maharashtra	2.7	3.9	5.6	7.9	10.3
Tamilnadu	2.5	3.3	5.2	8.2	12.5
Jharkhand	2.3	2.8	4.0	5.3	6.8
Andhra Pradesh	0.9	2.1	4.1	6.7	10.0
All India	11.3	14.3	18.1	22.1	26.4

Source: Authors’ calculations from DISE 2019-20 data.

Note: The table is sorted by column (a). The India row in column (f) shows that nationally 29% 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, 53.0% of all schools with total enrolment<=60 have >2 teachers, but when we take actual/true enrolment in column (f) we conclude that 54.8 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: Fake enrolment estimates and different concepts of pupil teacher ratio (PTR), 2019-20

States	Total students (reported)	Total teachers (regular)	Total teachers (contract)	Total teachers (reported)	Pupil teacher ratio (reported)	Student attendance rate ^s	Teacher attendance rate ^s	Imputed national proportion of ghost enrolment [#]	Pupil 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
Jammu Kashmir	853470	81711	1285	82996	10.3	0.77	0.82	0.07	0.83	793727	9.6	9.7	7.9
Himachal Pradesh	502244	23394	22084	45478	11.0	0.83	0.76	0.05	0.88	477132	10.5	12.1	9.2
Uttaranchal	615818	35696	1062	36758	16.8	0.83	0.86	0.05	0.88	585027	15.9	16.2	13.9
Tamil Nadu	2981337	157923	14412	172335	17.3	0.91	0.92	0.03	0.94	2891897	16.8	17.1	15.7
Rajasthan	6138970	308415	5163	313578	19.6	0.75	0.85	0.08	0.81	5647852	18.0	17.3	14.7
Andhra Pradesh	3033331	125138	27229	152367	19.9	0.79	0.83	0.07	0.85	2820998	18.5	18.9	15.7
Odisha	4331906	158269	50916	209185	20.7	0.82	0.94	0.06	0.87	4071992	19.5	18.1	17.0
Haryana	1482951	55386	15557	70943	20.9	0.78	0.88	0.16##	0.92	1245679	17.6	18.5	16.3
Maharashtra	5217260	239638	4238	243876	21.4	0.86	0.88	0.04	0.90	5008570	20.5	20.9	18.4
Chhattisgarh	2829468	130230	1828	132058	21.4	0.75	0.84	0.08	0.81	2603111	19.7	19.1	16.1
Assam	3880173	130845	49322	180167	21.5	0.73	0.87	0.08	0.80	3569759	19.8	18.1	15.7
Kerala	901798	37511	4208	41719	21.6	0.83	0.86	0.05	0.87	856708	20.5	20.9	17.9
Punjab	1593060	54939	16704	71643	22.2	0.80	0.86	0.06	0.86	1497476	20.9	20.7	17.8
Karnataka	3708052	161127	1000	162127	22.9	0.88	0.90	0.04	0.91	3559730	22.0	22.4	20.1
Gujarat	5076434	194323	1585	195908	25.9	0.88	0.90	0.04	0.92	4873377	24.9	25.3	22.8
Madhya Pradesh	6675747	254981	370	255351	26.1	0.56	0.86	0.14	0.65	5741142	22.5	17.0	14.6
West Bengal	10422554	298059	82881	380940	27.4	0.55	0.77	0.14	0.64	8963396	23.5	19.5	15.0
Uttar Pradesh	16285187	393467	174999	568466	28.6	0.60	0.85	0.16##	0.71	13679557	24.1	20.2	17.2
Jharkhand	3833896	41769	65983	107752	35.6	0.65	0.92	0.11	0.73	3412167	31.7	25.1	23.1
Bihar	15893345	359138	37	359175	44.2	0.56	0.69	0.35##	0.87	10330674	28.8	35.9	24.8
Major 21 States	98,283,058	3,370,427	540,863	3,911,290	25.1	0.72	0.85	0.14	0.84	84,523,430	21.6	21.3	18.1

Source: ^s- Source of student and teacher attendance rates in columns (f) and (g) is ASER (2018). Note: The table is sorted by column (e). All other data is from DISE 2019-20.

Note: A national pupil attendance of 72% (column f) 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. ** Column ‘i’ is computed as (attendance rate/(1-ghost enrolment rate)) The difference of columns (a) and (j) gives the estimated ghost enrolment.

Table 8a: Teacher vacancies and teacher surpluses, 2019-20

States	Teacher Vacancies		Teacher Vacancies calculated by the authors after applying RTE Act's teacher-allocation norms on each school's enrolment data from DISE 2019-20						Fiscal Cost (Rupees Crore)	
	As Per Ministry's Report		Without removing ghost enrolment			After removing ghost students**			of filling vacancies	
	2017-18	2019-20	Teacher vacancies	Surplus teachers	Net-Surplus teachers	Teacher vacancies	Surplus teachers	Net-Surplus teachers	of column (b)	of column (e)
	(a)	(b)	(c)	(d)	(e=d-c)	(f)	(g)	(h=g-f)	(i)	(j)
West Bengal	87,781	72,220	43816	82271	38455	30184	100672	70488	3,381	1800
Tamil Nadu	3,788	3,298	6965	42566	35601	6364	43879	37515	167	1804
Andhra Prad*	27,256	52,788	38391	73379	34988	35561	78233	42672	3,129	2074
Rajasthan	36,589	47,666	26216	45740	19524	21824	50813	28989	2,825	1157
Assam	20,105	13,247	26815	41691	14876	21952	44833	22881	785	882
Haryana	11,931	10,349	3930	17586	13656	2619	21806	19187	613	809
Kerala	1,400	1,926	1959	12338	10379	1673	13055	11382	114	615
Himachal Pradesh	1,632	5,386	3025	10752	7727	2924	10974	8050	319	458
Punjab	18,175	3,017	10328	15941	5613	9527	17158	7631	318	592
Jammu And	7,208	21,806	9848	14613	4765	9544	14754	5210	1,292	282
Odisha	-	10,877	21400	23901	2501	18583	26145	7562	513	118
Chhattisgarh	48,506	51,830	17034	16181	-853	14390	18518	4128	3,072	-51
Uttarakhand	7,578	18,620	9496	3304	-6192	9185	3527	-5658	1,104	-367
Gujarat	4,039	5,830	18918	6196	-12722	16164	9078	-7086	346	-754
Maharashtra	18,671	2,892	29815	9041	-20774	26554	11885	-14669	171	-1231
Karnataka	14,492	32,644	43914	6546	-37368	41563	7224	-34339	1,625	-1860
Jharkhand	78,265	95,897	54557	2596	-51961	44709	3408	-41301	7,042	-3815
Madhya Pradesh	66,523	91,972	80053	17456	-62597	65895	24832	-41063	5,451	-3710
Uttar Pradesh	224,327	217,481	129988	64225	-65763	86739	92124	5385	15,091	-4563
Bihar	203,934	275,255	190019	13818	-176201	72828	44235	-28593	16,315	-10444
Grand Total	8,82,200	10,35,001	766,487	520,141	-246,346	538,782	637,153	98,371	63,674	-16203
									\$ 8.7 b	\$ 2.2 b

Note: The table is sorted by column (e). *-includes Telangana. The teacher vacancies in column (c) are calculated by strictly applying the teacher allocation norms of the *Right to Education (RTE) Act* for each individual public elementary school, and then totalled for the state as a whole. These norms say that for classes 1 to 5, in a school with total enrolment of up to 60 pupils, two teachers will be allotted; in a school with 61 to 90 pupils, 3 teachers, and so on, up to a total enrolment of 150, after which a head master is given, i.e. a total of six teachers (including headmaster). Beyond enrolment 200, a pupil teacher ratio (PTR) of 40 is to be maintained, plus a head teacher. For classes 6 to 8, three teachers are required for a total enrolment up to 100, and beyond that a PTR of 35:1 along with a separate head teacher. In column (e), in the first 12 states (Andhra includes Telangana), there is a net surplus of teachers totalling 188,085, and in the next nine states (with a negative sign, Chhattisgarh to Bihar), there is a total net deficit of 434,431 teachers (Bihar is an outlier); adding these makes net deficit of 246,346 teachers (column e total) but without Bihar it is a net deficit of 70,145 teachers. ** Ghost enrolment estimate is taken from Table 7. The last row in columns i & j also reports costs in terms of billions of US dollars.

Source: For column (a), Unstarred question no. 1953, Lok Sabha, on 30.07.2018. For (b), Lok Sabha, Unstarred Question No. 1243, Answered on 19th Sept, 2020.

Table 8b: Teacher vacancies and surpluses: For rural and urban areas separately, (based on reported enrolment, i.e. without removing fake enrolment) 2019-20

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=d+g)	(b=e+h)	(c=b-a) (c =f+i)	(d)	(e)	(f=e-d)	(g)	(h)	(i=h-g)
West Bengal	43816	82271	38455	36349	65301	28952	7467	16970	9503
Tamil Nadu	6965	42566	35601	5535	31725	26190	1430	10841	9411
Andhra Pradesh**	38391	73379	34988	32939	59489	26550	5452	13890	8438
Rajasthan	26216	45740	19524	23007	42919	19912	3209	2821	-388
Assam	26815	41691	14876	25842	35890	10048	973	5801	4828
Haryana	3930	17586	13656	3424	14954	11530	506	2632	2126
Kerala	1959	12338	10379	1386	10062	8676	573	2276	1703
Himachal Pradesh	3025	10752	7727	2953	10202	7249	72	550	478
Punjab	10328	15941	5613	9059	12440	3381	1269	3501	2232
Jammu And Kashmir	9848	14613	4765	9239	11512	2273	609	3101	2492
Odisha	21400	23901	2501	20116	20434	318	1284	3467	2183
Chhattisgarh	17034	16181	-853	15756	14017	-1739	1278	2164	886
Uttarakhand	9496	3304	-6192	8674	3023	-5651	822	281	-541
Gujarat	18918	6196	-12722	16150	5006	-11144	2768	1190	-1578
Maharashtra	29815	9041	-20774	24268	6056	-18212	5547	2985	-2562
Karnataka	43914	6546	-37368	38164	4653	-33511	5750	1893	-3857
Jharkhand	54557	2596	-51961	51792	2285	-49507	2765	311	-2454
Madhya Pradesh	80053	17456	-62597	76827	12163	-64664	3226	5293	2067
Uttar Pradesh	129988	64225	-65763	119718	62528	-57190	10270	1697	-8573
Bihar	190019	13818	-176201	181824	12413	-169411	8195	1405	-6790
Total	766,487	520,141	-246,346	703,022	437,072	-265,950	63,465	83,069	19,604

Note: Same as Table 8a. ** Telengana is included in Andhra Pradesh.

Table 9: Fiscal cost of surplus teachers and additional recruitment, 2019-20

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 current PTR < 30 (Rs. Crore)	Cost due to additional planned recruitment [§] (Rs. Crore)	Total spend 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)
Jammu And Kashmir	853470	82996	54547	21,806	104,802	10.3	8.1	2.14	3233	1292	4526
Himachal Pradesh	502244	45478	28737	5,386	50,864	11.0	9.9	1.17	1703	319	2023
Uttarakhand	615818	36758	16231	18,620	55,378	16.8	11.1	5.63	962	1104	2066
Tamil Nadu	2981337	172335	72957	3,298	175,633	17.3	17.0	0.32	3698	167	3865
Rajasthan	6138970	313578	108946	47,666	361,244	19.6	17.0	2.58	6457	2825	9283
Odisha	4331906	209185	64788	10,877	220,062	20.7	19.7	1.02	3055	513	3567
Haryana	1482951	70943	21511	10,349	81,292	20.9	18.2	2.66	1275	613	1888
Maharashtra	5217260	243876	69967	2,892	246,768	21.4	21.1	0.25	4147	171	4318
Chhattisgarh	2829468	132058	37742	51,830	183,888	21.4	15.4	6.04	2237	3072	5309
Assam	3880173	180167	50828	13,247	193,414	21.5	20.1	1.48	3013	785	3798
Kerala	901798	41719	11659	1,926	43,645	21.6	20.7	0.95	691	114	805
Punjab	1593060	71643	18541	3,017	74,660	22.2	21.3	0.90	1956	318	2274
Karnataka	3708052	162127	38525	32,644	194,771	22.9	19.0	3.83	1918	1625	3543
Gujarat	5076434	195908	26694	5,830	201,738	25.9	25.2	0.75	1582	346	1928
Madhya Pradesh	6675747	255351	32826	91,972	347,323	26.1	19.2	6.92	1946	5451	7397
West Bengal	10422554	380940	33522	72,220	453,160	27.4	23.0	4.36	1569	3381	4950
Uttar Pradesh	16285187	568466	25626	217,481	785,947	28.6	20.7	7.93	1778	15091	16870
Andhra Pradesh**	5059388	152367	-16279	52,788	205,155	33.2	24.7	8.54	-965	3129	2164
Jharkhand	3833896	107752	-20045	95,897	203,649	35.6	18.8	16.75	-1472	7042	5570
Bihar	15893345	359175	-170603	275,255	634,430	44.2	25.1	19.20	-10112	16315	6203
Major 21 States	98,283,058	3,911,290	506,720	1,035,001	4,946,291	25.1	19.9	5.26	28,671	63,674	92,345
									\$ 3.9 b	\$ 8.7 b	\$ 12.6 b

Note: [§]- All cost/spending Figures in the last three columns are in INR crore, except the last row in those columns, which also reports costs in terms of billions of US dollars. ** includes Telangana. The Table is sorted by column (f). RTMS-Regular Teacher Monthly Salary of the state. For six major states (Uttar Pradesh, Punjab, Jharkhand, Odisha, Rajasthan and Tamil Nadu), we have actual take home salary of public primary school teachers with 15 years' experience (we take that as *mean* salary, averaged across new and old teachers) from Ramachandran (2015) which we have inflated to 2019-20, and for West Bengal we have the 2019-20 average public primary teacher salary available from the state. Therefore, for these 7 states, we have used the average public primary salary rate of 2019-20 for each state individually. This is Rs. 39010 pm for West Bengal; Rs. 39289 for Odisha, Rs. 41483 for Karnataka, Rs. 42238 for Tamil Nadu, Rs. 57827 for Uttar Pradesh, Rs. 61190 for Jharkhand, and Rs. 87915 for Punjab. Weighted mean of average salary for these 7 states is Rs 49,558, as shown in the note to Table 3, and this has been ascribed to all remaining major states above. Column (i) shows 'Wastage' due to maintaining a PTR of 25.1 instead of 30. Column (j) shows cost of planned future recruitment to fill 1,035,001 teacher vacancies estimated by the MHRD (column d).

Table 10: Fiscal cost due to student absence, teacher absence and fake enrolment, 2019-20

State	Total students (reported)	Total teachers (reported)	Pupil teacher ratio (reported)	Student attendance rate	Teacher attendance rate	Proportion of total enrolment that is fake	Effective PTR (present pupils/ present teachers)	Fiscal Cost (Rs. Crore)				
								Cost of student absence			Cost of teacher absence ^s	Total fiscal cost ^s
								Pure Absence ^s	Ghost enrolment ^s	Total		
(a)	(b)	(c=a/b)	(d)	(e)	(f)	$g = \frac{a*(1-d)}{b*(1-e)}$	(i)	(j)	(k=i+j)	(l)	(m=k+l)	
Jammu And Kashmir	853470	82996	10.28	0.77	0.82	0.07	9.60	1136.3	354.1	1490.4	865.8	2356.2
Himachal Pradesh	502244	45478	11.04	0.83	0.76	0.05	12.15	447.5	139.4	586.9	652.3	1239.2
Chhattisgarh	2829468	132058	21.43	0.55	0.77	0.14	15.34	3530.1	1100.0	4630.0	1823.7	6453.8
Uttarakhand	615818	36758	16.75	0.83	0.86	0.05	16.11	372.6	116.1	488.6	300.7	789.3
Tamil Nadu	2981337	172335	17.30	0.80	0.86	0.06	16.25	1720.8	536.2	2256.9	1266.6	3523.5
Madhya Pradesh	6675747	255351	26.14	0.56	0.86	0.14	16.99	6705.4	2089.4	8794.8	2162.2	10957.0
Rajasthan	6138970	313578	19.58	0.78	0.88	0.16	17.36	4151.7	2973.8	7125.5	2310.7	9436.2
Odisha	4331906	209185	20.71	0.75	0.84	0.08	18.49	2445.8	762.1	3208.0	1558.2	4766.2
Assam	3880173	180167	21.54	0.75	0.85	0.08	18.92	2695.9	840.0	3535.9	1590.1	5126.0
Haryana	1482951	70943	20.90	0.79	0.83	0.07	19.82	882.8	275.1	1157.9	700.9	1858.8
Uttar Pradesh	16285187	568466	28.65	0.60	0.85	0.16	20.06	15841.0	6272.1	22113.1	5736.1	27849.2
Maharashtra	5217260	243876	21.39	0.86	0.88	0.04	20.96	1951.4	608.0	2559.4	1691.2	4250.6
Kerala	901798	41719	21.62	0.91	0.92	0.03	21.35	221.8	69.1	290.9	193.2	484.1
Punjab	1593060	71643	22.24	0.83	0.86	0.05	21.44	1307.2	407.3	1714.5	1073.8	2788.3
Karnataka	3708052	162127	22.87	0.88	0.90	0.04	22.39	984.4	306.7	1291.1	831.6	2122.7
West Bengal	10422554	380940	27.36	0.82	0.94	0.06	23.77	3210.1	1000.3	4210.4	998.8	5209.2
Jharkhand	3833896	107752	35.58	0.65	0.92	0.11	25.33	2730.5	850.8	3581.3	633.3	4214.6
Gujarat	5076434	195908	25.91	0.88	0.90	0.04	25.39	1375.7	428.6	1804.3	1166.2	2970.5
Andhra Pradesh**	5059388	152367	33.21	0.73	0.87	0.08	27.70	2447.4	762.6	3210.0	1137.9	4347.9
Bihar	15893345	359175	44.25	0.56	0.69	0.35	36.49	9262.2	7451.0	16713.3	6703.8	23417.1
Major 21 States	98,283,058	3,911,290	25.13	0.72	0.85	0.14	21.38	63,420.4	27,342.7	90,763.1	33,397.2	124,160.3
								\$ 8.7 b	\$3.7 b	\$ 12.4 b	\$ 4.6 b	\$ 17.0 b

Source: DISE data 2019-20. Salary data (with which the fiscal cost figures are estimated) is calculated in the way shown in the note to Table 3.

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 enrollees. 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 last row shows costs in terms of billions of US dollars.

Table 11: Teacher salary cost at current PTRs and the projected costs and savings at alternative hypothetical PTRs, 2019-20

State	Total Students	Total Teachers	PTR	Actual Cost	Hypothetical Cost (Rs crore)		Hypothetical Savings (Rs. crore)	
				(Rs. Crore)	If govt. maintains a		If govt. maintains a	
				At Current PTR	PTR of 30	PTR of 40	PTR of 30	PTR of 40
(a)	(b)	(c=a/b)	(d)	(e)		(f=d-e)		
Jammu Kashmir	853,470	82,996	10.3	4919	1686	1265	3233	3655
Himachal Pradesh	502,244	45,478	11.0	2696	992	744	1703	1951
Uttarakhand	615,818	36,758	16.8	2179	1217	913	962	1266
Tamil Nadu	2,981,337	172,335	17.3	8735	5037	3778	3698	4957
Rajasthan	6,138,970	313,578	19.6	18586	12129	9097	6457	9490
Odisha	4,331,906	209,185	20.7	9862	6808	5106	3055	4756
Haryana	1,482,951	70,943	20.9	4205	2930	2197	1275	2007
Maharashtra	5,217,260	243,876	21.4	14455	10308	7731	4147	6724
Chhattisgarh	2,829,468	132,058	21.4	7827	5590	4193	2237	3635
Assam	3,880,173	180,167	21.5	10679	7666	5750	3013	4929
Kerala	901,798	41,719	21.6	2473	1782	1336	691	1136
Punjab	1,593,060	71,643	22.2	7558	5602	4202	1956	3357
Karnataka	3,708,052	162,127	22.9	8071	6153	4615	1918	3456
Gujarat	5,076,434	195,908	25.9	11612	10030	7522	1582	4090
Madhya Pradesh	6,675,747	255,351	26.1	15135	13189	9892	1946	5243
West Bengal	10,422,554	380,940	27.4	17833	16264	12198	1569	5635
Uttar Pradesh	16,285,187	568,466	28.6	39447	37669	28252	1778	11195
Andhra Pradesh**	5,059,388	152,367	33.2	9031	9996	7497	-965	1534
Jharkhand	3,833,896	107,752	35.6	7912	9384	7038	-1472	874
Bihar	15,893,345	359,175	44.2	21289	31400	23550	-10112	-2262
Major 21 States	98,283,058	3,911,290	25.1	224,502	195,831	146,873	28,671	77,629
				\$ 30.8 b	\$ 26.8 b	\$ 20.1 b	\$ 3.9 b	\$ 10.6 b

Note: This table is sorted by column (c). See the note to Tables 3 and 9 for the calculation of teacher's salary rate. In columns (d) to (f) in the last row, we have given the cost in billion US dollars.

Table 12: Hypothetical total savings in 2019-20 if the RTE Act's teacher allocation norms are modified

States	Total of (schools' self-reported) enrolment	'True' enrolment (after removing ghost students)	Under existing RTE norms of teacher allocation, Net surplus teachers		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 due to net surplus teachers	
			based on reported enrolment	based on 'true' enrolment	Teacher vacancies	Excess teachers	Net-surplus teachers (g = f - e)	Teacher vacancies	Excess teachers	Net-surplus teachers (j = i - h)	of column (g)	of column (j)**
(a)	(b)	(c)	(d)	(e)	(f)	(g = f - e)	(h)	(i)	(j = i - h)	(k)	(l)	
West Bengal	10422554	8963396	38455	70488	42610	86484	43874	28671	105631	76960	2054	3603
Tamil Nadu	2981337	2891897	35601	37515	5697	48209	42512	5092	49227	44135	2155	2237
Andhra Pradesh	5059388	4705231	34988	42672	27407	79112	51705	23982	83043	59061	3065	3501
Rajasthan	6138970	5647852	19524	28989	23436	50362	26926	18723	56202	37479	1596	2221
Assam	3880173	3569759	14876	22881	24975	46980	22005	19991	49918	29927	1304	1774
Haryana	1482951	1245679	13656	19187	3792	18242	14450	2448	22093	19645	856	1164
Kerala	901798	856708	10379	11382	1746	12641	10895	1458	13381	11923	646	707
Himachal Pradesh	502244	477132	7727	8050	1982	15017	13035	1840	15410	13570	773	804
Punjab	1593060	1497476	5613	7631	10328	18053	7725	9417	19396	9979	815	1053
Jammu Kashmir	853470	793727	4765	5210	6143	23114	16971	5738	23726	17988	1006	1066
Odisha	4331906	4071992	2501	7562	20597	30382	9785	17683	33342	15659	461	738
Chhattisgarh	2829468	2603111	-853	4128	15805	20004	4199	13072	22727	9655	249	572
Uttaranchal	615818	585027	-6192	-5658	6908	7374	466	6562	7785	1223	28	72
Gujarat	5076434	4873377	-12722	-7086	18110	7540	-10570	15356	10422	-4934	-626	-292
Maharashtra	5217260	5008570	-20774	-14669	25885	20186	-5699	22624	23005	381	-338	23
Karnataka	3708052	3559730	-37368	-34339	37739	14083	-23656	35379	14756	-20623	-1178	-1027
Jharkhand	3833896	3412167	-51961	-41301	53471	3568	-49903	43349	4696	-38653	-3664	-2838
Madhya Pradesh	6675747	5741142	-62597	-41063	76593	26841	-49752	61359	37375	-23984	-2949	-1422
Uttar Pradesh	16285187	13679557	-65763	5385	129420	65644	-63776	86062	94218	8156	-4426	566
Bihar	15893345	10330674	-176201	-28593	189867	14055	-175812	72560	44813	-27747	-10421	-1645
Major 21 States	98,283,058	84,523,430	-246,346	98,371	722,511	607,891	-114,620	432,871	1,290,707	239,800	-8594.24 \$ 1.2 b	12877.95 \$ 1.8 b

Note: Sorted by column (c). 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 to all schools with a total enrolment of up to 60 pupils. The modified norm used here is to allocate one teacher to all schools with a total enrolment of up to 20 pupils, and to allocate two teachers to schools with 21 to 60 pupils. # the norm is being modified ONLY for the case of 'primary only' schools. We assume that Upper Primary schools will continue to have minimum three teachers irrespective of their number of pupils. Cost figures in the last two columns are in INR crore but in the last row we have also given the national figure in US dollars billions. ** removing fake enrolments. The last row in columns k and l also reports costs in terms of billions of US dollars.

Table 13(a): Proportion of public schools with total enrolment of <=60 AND 'total teachers' equal to given levels, 2019-20

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 469754 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	13,560	88.1	23.5	2.7	8.7	0.05	0.3	12.4	53.4	16.5	5.8	11.6
Uttarakhand	13,874	84.3	20.9	2	10.5	1.10	5.7	23.1	53.5	10.7	4.0	3.0
Jammu & Kashmir	19,557	83.0	23.2	3.1	7.5	4.25	4.2	11.5	43.6	11.6	7.2	21.9
Andhra Pradesh	28,820	64.6	27.7	1.8	15.4	0.44	5.8	34.4	49.8	4.5	1.7	3.7
Telangana	18,430	62.4	25.8	2.6	9.9	4.80	3.8	23.0	45.8	9.3	3.2	14.8
Chhattisgarh	26,558	60.4	33.2	2.3	14.4	0.19	0.6	14.5	53.6	20.6	8.4	2.3
Maharashtra	39,320	59.9	26.2	2.1	12.5	0.10	0.3	8.1	81.3	3.9	5.6	0.8
Madhya Pradesh	56,328	59.8	32.2	1.9	16.9	0.36	4.7	20.0	61.7	9.9	2.4	1.3
Karnataka	26,196	58.2	25.2	2.1	12.0	0.69	2.0	18.9	55.7	12.4	9.0	2.0
Odisha	29,117	56.0	31.9	2.5	12.8	0.12	0.2	1.8	66.7	20.1	6.5	4.7
Tamil Nadu	20,576	54.8	28.6	2.3	12.4	0.13	0.5	9.4	77.6	3.5	1.6	7.4
Assam	25,149	54.3	30.7	2.6	11.8	0.99	1.7	13.7	50.5	18.2	6.7	9.3
Punjab	10,079	52.0	33.3	2.5	13.3	0.01	4.3	0.4	58.1	22.1	8.6	6.5
Rajasthan	31,895	47.2	32.4	2.2	14.7	0.27	0.3	23.1	61.8	2.1	2.5	10.2
Jharkhand	15,965	45.3	37.1	1.8	20.6	0.51	0.9	28.8	63.4	5.1	1.3	0.4
West Bengal	37,446	44.9	35.5	2.7	13.1	0.60	1.2	9.0	39.7	30.7	14.0	5.4
Haryana	5,886	40.6	35.9	3.2	11.2	0.17	1.6	6.7	42.6	15.7	9.9	23.4
Kerala	1,769	36.9	32.2	4.2	7.7	0.02	0.1	12.3	4.3	7.5	38.8	37.0
Gujarat	10,171	30.3	33.8	2.3	14.7	0.04	1.2	7.9	65.7	9.7	11.7	3.7
Uttar Pradesh	33,090	24.3	41.1	2.7	15.2	0.05	0.9	11.2	35.1	32.4	15.7	4.6
Bihar	5,968	8.6	45.1	2.3	19.6	0.08	0.1	17.5	52.2	20.3	6.6	3.3
Total	469,754	48.0	31.0	2.3	13.5	0.53	2.1	15.3	56.2	13.9	6.6	5.9

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

Table 13(b): Pupil Teacher Ratio (PTR) in public elementary schools with <=60 enrolment and 'total teachers' equal to given levels, 2019-20

	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 2019-20 in such schools (Rupees)
	1 teacher	2 teachers	3 teachers	4 teachers	>=5 teachers				
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
Punjab	46.7	13.5	13.4	10.7	8.2	659	3634	29821	128560
Assam	25.3	15.0	11.5	8.7	5.1	2349	16692	84919	116505
Himachal Pradesh	17.8	10.3	9.2	7.1	5.3	1579	10224	53865	112501
Jammu & Kashmir	14.6	9.9	7.9	8.0	5.5	4274	27952	153469	107953
Uttarakhand	13.1	10.7	8.7	6.8	5.6	412	2479	13914	105601
Telangana	13.9	12.7	12.9	10.5	5.6	2722	19077	107526	105157
Kerala	10.8	12.9	10.3	8.3	6.6	654	3899	25911	89189
Haryana	27.4	15.0	15.5	10.1	6.7	1375	8352	55679	88908
Jharkhand	33.8	19.1	14.8	11.4	8.3	64	347	2881	88440
Uttar Pradesh	36.7	19.9	14.0	11.1	8.4	1528	8356	70563	82174
Maharashtra	14.0	12.8	13.0	10.4	7.5	332	1736	12990	79210
Andhra Pradesh	20.2	15.3	14.4	11.1	7.6	1077	6602	49858	78484
Rajasthan	25.4	16.2	14.7	10.4	7.6	3238	19232	145664	78255
Chhattisgarh	28.0	15.6	12.8	10.1	8.1	623	3263	26443	73139
Madhya Pradesh	32.7	15.1	13.2	10.6	8.1	724	3975	32331	72872
Tamil Nadu	21.4	13.5	14.4	10.4	7.0	1527	9946	69533	72500
Bihar	42.7	22.3	15.6	12.0	8.3	197	1114	9250	71381
West Bengal	26.0	15.9	13.2	10.6	7.0	2013	11852	83467	66472
Gujarat	29.2	15.9	13.4	10.0	9.1	375	1968	17929	65060
Odisha	26.9	14.8	11.4	10.1	8.1	1380	7636	61492	58546
Karnataka	17.5	11.2	12.0	10.4	8.6	517	2719	23453	57712
Total	24.5	14.6	12.7	10.1	6.6	27,619	171,055	1,130,958	89,947

Source: DISE 2019-20 data. Note: Table is sorted by column (i). The total teacher salary cost of educating the 1.13 million children (column h) who are studying in the 27,619 public schools that have “<=60 pupils and 5 or more teachers” was just over Rs. 10,173 crore (Rs. 101.73 billion) per annum in 2019-20 (not shown in the table); that amount divided by 1.13 million pupils gives Rupees 89,947 per pupil expenditure on teacher salary in 2019-20 in such schools (column i). If these schools each had the mandated two teachers, they would have in total 55,238 teachers. Since these schools had 171,055 teachers, they have a total *surplus* of 115,817 teachers. The cost of these surplus teachers is Rs 6888 crore (Rs. 68.88 billion).

Table 14(a): Proportion of public schools with total enrolment of <=20 AND 'total teachers' equal to given levels, 2019-20

States	Total no. of schools with	% of all schools with <=20	Mean enrolment	Mean no. of	Mean PTR	Of all 129424 public schools with <=20 enrolment,					
						0	1	2	3	4	>=5
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)
Uttarakhand	8,064	49.0	11.1	1.8	6.2	3.5	32.0	52.6	8.0	2.8	1.1
Himachal Pradesh	6,656	43.2	12.3	2.2	5.6	0.0	16.7	62.5	11.9	4.2	4.6
Jammu & Kashmir	9,808	41.6	10.5	2.1	5.0	8.4	17.3	52.2	11.2	3.9	7.0
Karnataka	12,045	26.8	11.9	1.7	7.0	3.5	27.9	63.0	4.4	1.1	0.1
Telangana	7,569	25.6	10.4	1.6	6.5	8.5	43.4	41.2	2.4	0.6	3.8
Maharashtra	14,151	21.6	12.4	1.9	6.5	0.7	17.3	79.3	1.5	0.9	0.3
Andhra Pradesh	9,021	20.2	12.6	1.1	11.5	12.3	62.2	24.5	0.5	0.2	0.2
Tamil Nadu	6,629	17.7	13.8	1.9	7.3	0.7	16.0	80.8	1.2	0.3	1.0
Assam	7,273	15.7	12.6	2.2	5.7	4.5	20.4	51.2	13.2	5.0	5.7
Chhattisgarh	6,015	13.7	13.8	1.9	7.3	1.1	23.0	60.6	11.4	3.4	0.6
Madhya Pradesh	12,349	13.1	13.7	1.8	7.6	4.6	19.2	70.8	4.6	0.6	0.3
Odisha	6,667	12.8	15.6	2.2	7.1	0.5	2.8	78.3	15.3	2.4	0.6
Punjab	2,209	11.4	14.3	2.1	6.8	0.1	0.0	90.7	8.1	0.7	0.4
Kerala	489	10.2	12.2	2.8	4.4	0.4	40.7	6.7	8.0	30.7	13.5
Rajasthan	6,546	9.7	13.7	1.7	8.1	1.1	35.6	59.7	0.8	1.0	1.8
West Bengal	6,229	7.5	13.1	2.1	6.2	4.8	20.0	49.9	16.0	5.9	3.4
Haryana	1,037	7.2	13.2	2.4	5.5	2.9	12.6	63.7	4.1	4.7	12.0
Jharkhand	1,980	5.6	13.6	1.5	9.1	6.6	41.2	49.8	1.7	0.4	0.2
Gujarat	1,829	5.4	14.7	2	7.4	3.0	13.3	71.7	6.1	5.5	0.5
Uttar Pradesh	2,522	1.9	14.8	2.2	6.7	3.9	22.2	39.3	25.0	8.0	1.5
Bihar	336	0.5	12.4	2	6.2	0.9	31.0	47.0	13.7	3.9	3.6
Total	1,29,424	13.2	12.7	1.9	6.7	4.0	24.9	59.9	6.9	2.3	2.0

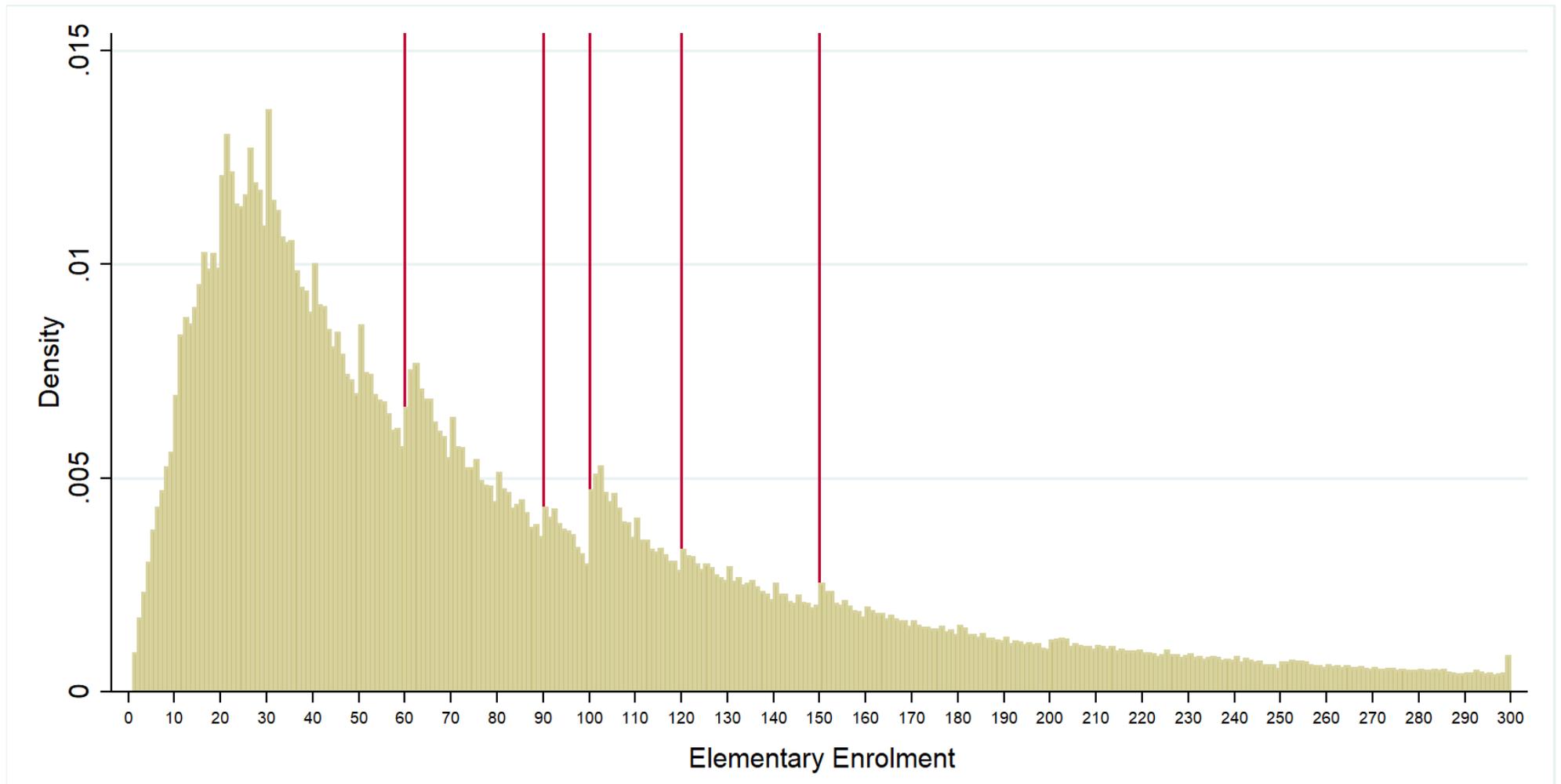
Note: This table is sorted by column (b).

Table 14(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 2019-20 (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)
Punjab	-	7.1	4.9	203	659	3243	214379	69.5
Telangana	9.0	6.4	2.8	514	2652	7388	212759	157.2
Bihar	12.4	6.7	2.9	71	265	764	205586	15.7
Jammu & Kashmir	9.3	5.8	3.0	2165	9127	27326	197968	541.0
Haryana	12.1	6.5	3.1	215	1050	3255	191197	62.2
Rajasthan	13.5	7.0	3.1	239	1115	3499	188874	66.1
Jharkhand	13.7	7.6	4.2	46	160	664	176936	11.7
Assam	11.7	6.7	3.4	1736	6982	23758	174186	413.8
Kerala	8.9	6.0	3.5	255	1085	3753	171354	64.3
Himachal Pradesh	10.4	6.2	3.5	1377	5375	18664	170693	318.6
Uttarakhand	8.3	6.4	3.7	960	3338	12358	160096	197.8
Andhra Pradesh	11.8	7.8	3.9	85	330	1282	152570	19.6
Uttar Pradesh	14.1	7.6	4.7	870	2905	13718	146949	201.6
Maharashtra	8.6	6.6	4.2	380	1356	5681	141474	80.4
Tamil Nadu	10.9	7.2	3.6	166	721	2601	140500	36.5
Gujarat	13.7	7.5	4.2	221	785	3327	139849	46.5
Chhattisgarh	12.7	7.1	4.4	925	3061	13451	134881	181.4
Madhya Pradesh	13.5	7.0	4.4	671	2183	9701	133376	129.4
West Bengal	11.7	7.1	3.7	1575	5836	21358	127914	273.2
Karnataka	9.3	6.5	4.4	674	2186	9665	112590	108.8
Odisha	13.0	7.9	4.9	1225	3966	19368	96542	187.0
Total	10.9	6.8	3.7	14,573	55,137	204,824	160,088	3,279.0
								\$ 449 m

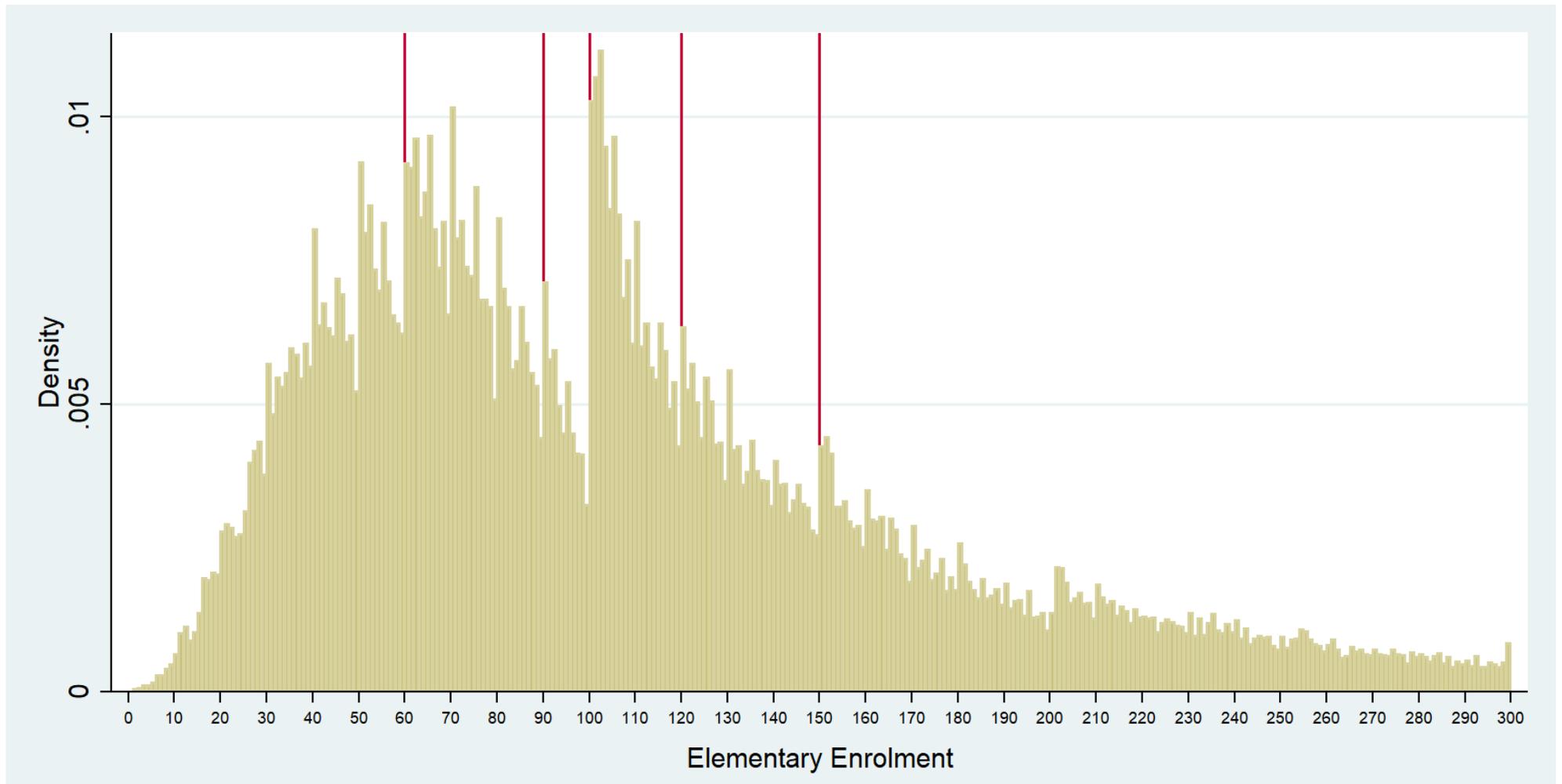
Note: Table is sorted by Column (g). Per capita income of India in 2019-20 was Rs. 134,432, and the PCI of Bihar that year was Rs. 50,735. Thus mean per pupil expense on teacher salaries (Rs. 160,088) in these tiny surplus-teacher schools is 1.2 times India’s PCI and 3.2 times Bihar’s PCI. Total salary expenditure on these 14,573 schools is Rs. 3279 crore (or US \$ 449 million). If these 14,573 tiny schools (with <=20 pupils and >=3 teachers) each had the mandated two teachers, they would have 29,146 teachers. This means that they have 25,991 surplus teachers, which costs the exchequer Rs. 1546 crore (Rs. 15.46 billion or US\$ 212 million) per annum in 2019-20 salary levels and prices.

Figure 1: Histogram of total enrolment in public elementary schools, 2019-20



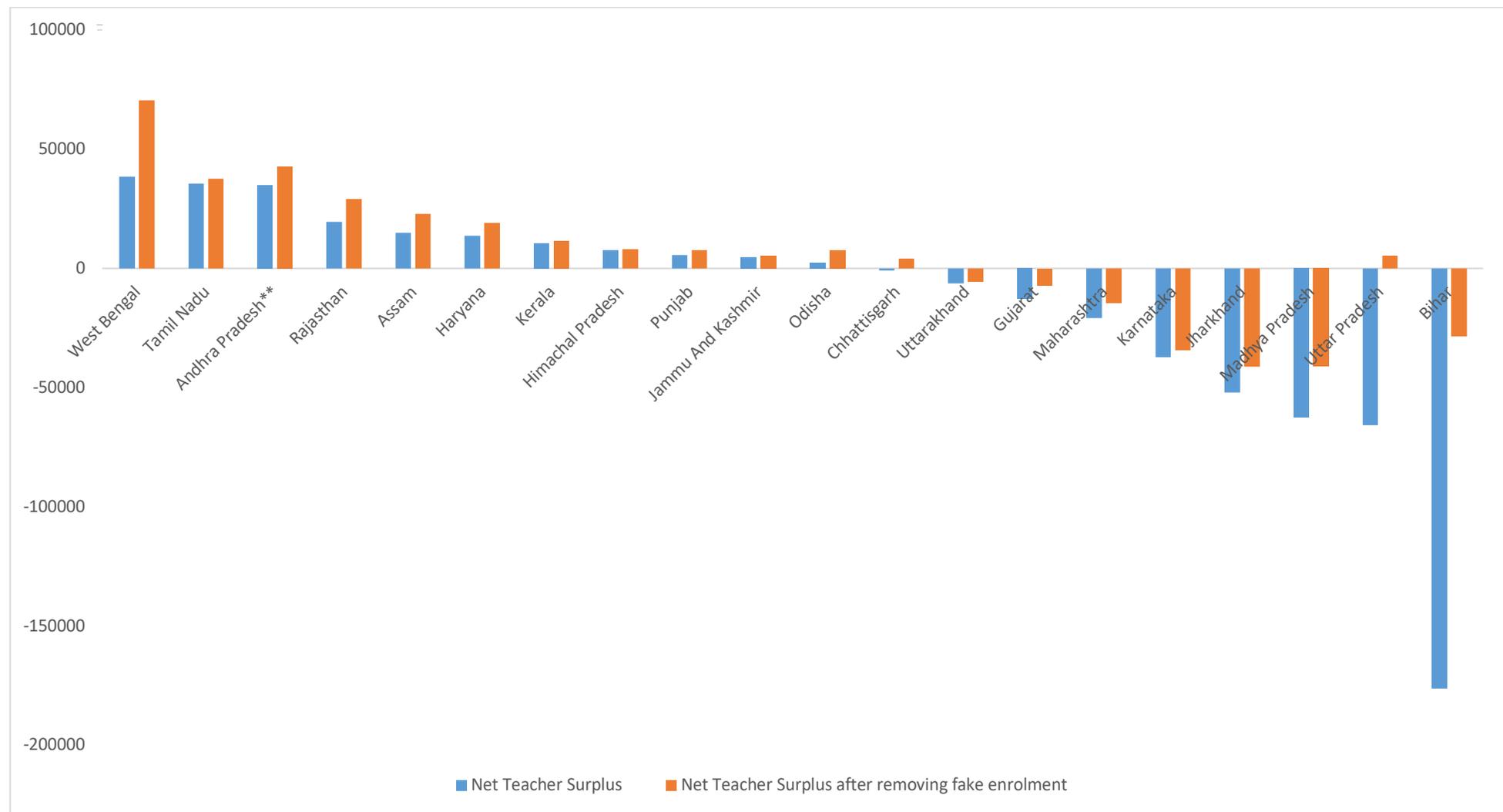
Note: The histogram shows the distribution of all public elementary schools by school size, i.e. by total enrolment. It shows that many schools report enrolment that is rounded to some desirable total, e.g. there are sudden peaks at a total enrolment of 20, 25, 30, 40, 50, etc. The trough at enrolment 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, 2019-20



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

Appendix 1: Teacher vacancies and surpluses in the Districts : An Illustration from Uttar Pradesh, 2019-20

		Rural			Urban			All UP (rural + urban)			All UP (removing fake pupils)		
		Vacancy	Surplus	Net Vacancy	Vacancy	Surplus	Net Vacancy	Vacancy	Surplus	Net Vacancy	Vacancy	Surplus	Net Vacancy
		A	B	C=A-B	D	E	F=D-E	G	H	I=G-H	J	K	L=J-K
1	VARANASI	259	2002	-1743	159	51	108	418	2053	-1635	249	2773	-2524
2	AZAMGARH	1573	2003	-430	11	10	1	1584	2013	-429	880	2999	-2119
3	SULTANPUR	602	1389	-787	58	5	53	660	1394	-734	314	2194	-1880
4	KANPUR NAGAR	292	1652	-1360	347	92	255	639	1744	-1105	417	2179	-1762
5	UNNAO	1294	1602	-308	97	35	62	1391	1637	-246	833	2229	-1396
6	BIJNOR	968	1625	-657	218	40	178	1186	1665	-479	801	2042	-1241
7	DEORIA	1282	1532	-250	71	46	25	1353	1578	-225	912	2134	-1222
8	AMBEDKAR NAGAR	663	1026	-363	26	26	0	689	1052	-363	389	1541	-1152
9	FATEHPUR	1138	1364	-226	142	23	119	1280	1387	-107	809	1951	-1142
10	GORAKHPUR	1647	1521	126	211	26	185	1858	1547	311	1165	2234	-1069
11	MAU	623	872	-249	66	26	40	689	898	-209	415	1388	-973
12	ETAWAH	548	1142	-594	60	25	35	608	1167	-559	468	1397	-929
13	JAUNPUR	2073	1285	788	96	14	82	2169	1299	870	1258	2146	-888
14	MATHURA	742	1148	-406	135	24	111	877	1172	-295	641	1522	-881
15	SAHARANPUR	1000	1123	-123	104	85	19	1104	1208	-104	776	1624	-848
16	MORADABAD	874	1093	-219	162	51	111	1036	1144	-108	683	1517	-834
17	JHANSI	616	914	-298	156	12	144	772	926	-154	520	1282	-762
18	LUCKNOW	626	1014	-388	634	56	578	1260	1070	190	838	1598	-760
19	ALLAHABAD	2261	1169	1092	141	89	52	2402	1258	1144	1360	2114	-754
20	BASTI	1288	1140	148	32	4	28	1320	1144	176	882	1546	-664
21	RAE BARELI	1487	1138	349	105	6	99	1592	1144	448	968	1617	-649
22	FAIZABAD	1125	840	285	134	13	121	1259	853	406	759	1287	-528
23	AURAIYA	691	735	-44	23	2	21	714	737	-23	474	980	-506
24	MEERUT	452	601	-149	213	43	170	665	644	21	462	945	-483
25	GHAZIPUR	1955	1211	744	76	12	64	2031	1223	808	1338	1816	-478

26	KANPUR DEHAT	1044	949	95	20	22	-2	1064	971	93	766	1244	-478
27	CHANDAULI	989	594	395	51	9	42	1040	603	437	559	1035	-476
28	AGRA	1498	1320	178	470	69	401	1968	1389	579	1412	1868	-456
29	ALIGARH	1443	1158	285	211	41	170	1654	1199	455	1141	1553	-412
30	MAINPURI	919	842	77	72	22	50	991	864	127	685	1088	-403
31	HATHRAS	779	736	43	81	11	70	860	747	113	617	997	-380
32	BHADOI	666	383	283	54	17	37	720	400	320	377	736	-359
33	FIROZABAD	1010	858	152	193	21	172	1203	879	324	848	1184	-336
34	KANNAUJ	845	642	203	76	23	53	921	665	256	592	915	-323
35	PRATAPGARH	1993	1241	752	71	8	63	2064	1249	815	1447	1673	-226
36	KAUSHAMBI	927	469	458	1	3	-2	928	472	456	543	761	-218
37	BALLIA	2206	1130	1076	123	37	86	2329	1167	1162	1474	1675	-201
38	BAGHPAT	309	258	51	58	3	55	367	261	106	219	412	-193
39	BULANDSHAHR	1643	1160	483	266	17	249	1909	1177	732	1372	1509	-137
40	ETAH	1104	699	405	114	0	114	1218	699	519	817	934	-117
41	MUZAFFARNAGAR	843	537	306	178	20	158	1021	557	464	685	791	-106
42	Jyotiba Phule (AMROHA)	825	605	220	113	12	101	938	617	321	672	768	-96
43	MAHOBA	562	318	244	134	26	108	696	344	352	459	534	-75
44	CHITRAKOOT	1062	515	547	43	2	41	1105	517	588	708	781	-73
45	HAPUR (PANCHSHEEL)	451	283	168	91	15	76	542	298	244	387	444	-57
46	SITAPUR	3131	999	2132	178	26	152	3309	1025	2284	1918	1944	-26
47	SHAMLI (PRABUDH)	550	376	174	144	8	136	694	384	310	478	493	-15
48	HAMIRPUR (U.P.)	868	381	487	121	37	84	989	418	571	667	586	81
49	GAUTAM BUDDHA NG	707	285	422	32	2	30	739	287	452	471	389	82
50	GHAZIABAD	405	427	-22	693	41	652	1098	468	630	809	612	197
51	SANT KABIR NAGAR	1204	393	811	30	16	14	1234	409	825	875	613	262
52	LALITPUR	1464	475	989	144	44	100	1608	519	1089	1072	789	283
53	FARRUKHABAD	1455	579	876	186	7	179	1641	586	1055	1145	812	333
54	RAMPUR	1536	628	908	163	23	140	1699	651	1048	1239	890	349
55	JALAUN	1146	392	754	177	28	149	1323	420	903	965	601	364

56	AMETHI - CSM NAGAR	1527	392	1135	22	7	15	1549	399	1150	1031	599	432
57	BAREILLY	2789	1236	1553	458	31	427	3247	1267	1980	2264	1776	488
58	BARABANKI	3163	1027	2136	84	27	57	3247	1054	2193	2067	1559	508
59	KUSHINAGAR	2602	809	1793	62	16	46	2664	825	1839	1777	1199	578
60	MAHARAJGANJ	2135	576	1559	39	14	25	2174	590	1584	1493	908	585
61	KANSHIRAM NAGAR	1502	305	1197	117	6	111	1619	311	1308	1137	462	675
62	GONDA	2892	820	2072	165	9	156	3057	829	2228	2053	1351	702
63	BANDA	2155	533	1622	126	21	105	2281	554	1727	1549	835	714
64	SHRAWASTI	1634	189	1445	1	7	-6	1635	196	1439	1118	337	781
65	PILIBHIT	1994	362	1632	82	13	69	2076	375	1701	1437	619	818
66	SONBHADRA	2975	758	2217	--	--	--	2975	758	2217	2081	1052	1029
67	MIRZAPUR	2657	557	2100	149	0	149	2806	557	2249	1903	845	1058
68	SIDDHARTHANAGAR	3004	583	2421	38	37	1	3042	620	2422	2105	954	1151
69	BALRAMPUR	2563	382	2181	54	5	49	2617	387	2230	1818	616	1202
70	HARDOI	4448	1138	3310	231	13	218	4679	1151	3528	3126	1719	1407
71	SAMBHAL (BHIM NAG)	2542	175	2367	163	13	150	2705	188	2517	1947	314	1633
72	SHAHJAHANPUR	3821	617	3204	232	21	211	4053	638	3415	2747	1029	1718
73	BUDAUN	3612	433	3179	142	13	129	3754	446	3308	2557	774	1783
74	BAHRAICH	5492	460	5032	138	7	131	5630	467	5163	3806	789	3017
75	KHERI	6548	403	6145	202	11	191	6750	414	6336	4693	701	3992
	Total	119,718	62,528	57,190	10,270	1,697	8,573	129,988	64,225	65,763	86,739	92,124	-5,385

Source: Authors' analysis from DISE 2019-20 raw data.

Note: This table is sorted by the last column (L), i.e. by the Net Surplus Teachers column. The net teacher-surplus districts are highlighted in colour. When we do *not* remove the estimated fake enrolment, in 16 of the 75 districts of UP, within the district there are more surplus teachers than the teacher vacancies. Totalling them, in these 16 districts, against a total deficit of 6775 teachers, there were 9581 surplus teachers and a net surplus of 2806 teachers, in these 16 districts. If the state were ready to transfer/redeploy all 64,225 surplus teachers to deficit-teacher schools within the district or to nearby districts within the same division or in adjoining divisions, to fill part of the state's vacancies, it would save Rs. 4457 crore rupees (US\$ 610 million) per annum, compared to fresh recruitment of 64,225 teachers. The Table is based on taking schools' self-reported enrolments into account, but if fake enrolments were removed, the number of vacancies would fall from 129,988 (column g) to 86,739 (column j), and the number of surplus teachers would rise from 64,225 (column h) to 92,124 (column k), and there would be a net surplus of 5,385 teachers in UP in 2019-20, instead of a net deficit of 65,763 teachers (column i). The government of UP is planning a recruitment of about 51,000 teachers in late autumn 2021. After removing fake enrolments, in 47 districts (highlighted in the last column, L), against a total deficit of 36,787 teachers, there were 68,394 surplus teachers, giving a net surplus of 31,607 teachers. By within-district redeployment (as opposed to new recruitment), the UP state government can save the salary of 31,607 teachers, i.e. save Rs. 2193 crore or 21.93 billion Rupees (USD 300 million) per annum in 2019-20 rupee terms, given that in UP, take-home salary of public primary school teacher (averaging the salaries of new and very experienced teachers) is Rs. 57,827 per month in 2019-20.

Appendix 2: STATA programme for the calculation of teacher vacancies and surpluses in DISE data 2019-20

Note for the calculation of surplus teachers.

1. To calculate teacher deficit and surplus for any individual school, we have strictly followed the RTE Act's teacher allocation norms for elementary schools. Using these norms, we calculated the number of posts that are to be sanctioned to any school, given its category (primary, upper primary, primary plus upper primary, upper primary with secondary, etc. etc.) and given its pupil enrolment number. We also call these sanctioned posts "required teachers". This is then compared with the actual number of teachers teaching in the school. The difference gives the number of teacher vacancies or teacher surpluses in that school.
2. Since, there are no clear guidelines of recruitment of head-teachers particularly in such schools where primary, upper primary, secondary and higher secondary sections are attached, we have made some reasonable assumptions about the allocation of head-teachers. The assumptions are as follows:

Assumptions

- a). School Category 2 (Primary with Upper Primary (classes 1-8)) : If the enrolment in primary section is greater than 150 and enrolment in upper primary section is greater than 100, then we have allotted only one head teacher in such schools, and not two head teachers.
- b). School Category 3 (Primary with Upper Primary, Secondary and Higher Secondary (classes 1-12)): We have not allotted any head teacher (wherever required, by enrolment) to primary and upper primary section as per RTE Act, since we assume that there will already be a head teacher from the secondary / higher secondary sections.
- c). School Category 5 (Upper Primary, Secondary and Higher Secondary (classes 6-12)): We have not allotted any head teacher (wherever required, by enrolment) to the upper primary section as per RTE Act, since there is already a head teacher in the school from the secondary / higher secondary sections.
- d). School Category 6 (Primary, Upper Primary and Secondary Only (classes 1-10)): We have not allotted any head teacher (wherever required, by enrolment) to the primary and upper primary section as per RTE Act, since we assume there is already a head teacher in the school from the secondary section.
- e). School Category 7 (Upper Primary and Secondary (classes 6-10)): We have not allotted any head teacher (wherever required, by enrolment) to the upper primary section as per RTE act, since we assume that there is already a head teacher in the school from the secondary section.

** Generating sanctioned post and excess teacher estimates by applying RTE Act's norms **

```
gen teacher_req_pri_1 = 2 if prim_enrol<=60
replace teacher_req_pri_1 = 3 if prim_enrol>=61 & prim_enrol<=90
replace teacher_req_pri_1 = 4 if prim_enrol>=91 & prim_enrol<=120
replace teacher_req_pri_1 = 5 if prim_enrol>=121 & prim_enrol<=150
replace teacher_req_pri_1 = 6 if prim_enrol>=151 & prim_enrol<=200
replace teacher_req_pri_1 = 1+ceil(prim_enrol/40) if prim_enrol>200

gen teacher_req_up_pri_1= max(3, ceil(upp_prim_enrol/35)) if upp_prim_enrol<=100
replace teacher_req_up_pri_1= 1 + max(3, ceil(upp_prim_enrol/35)) if upp_prim_enrol>100
```

** SCHOOL CATEGORY IS NAMED SCHCAT. IT IS DEFINED AS FOLLOWS :

- * 1 -Primary, 2 - Primary with Upper Primary, 3 - Pr. with Up.Pr. Sec. and H.Sec., 4 - Upper Primary only,
- * 5 - Up. Pr. Secondary and Higher Sec, 6 - Pr. Up Pr. and Secondary Only, 7 - Upper Pr. and Secondary,
- * 8 - Secondary Only, 10 - Secondary with Higher Secondary, 11 - Higher Secondary only/Jr. College

- * SCHCAT 1 IS "PRIMARY-ONLY" SCHOOLS
- * SCHCAT 2 IS "PRIMARY WITH UPPER PRIMARY" SCHOOLS
- * SCHCAT 3 IS "PRIMARY WITH UPPER PRIMARY, SECONDARY & HIGHER SECONDARY"
- * SCHCAT 4 IS "UPPER PRIMARY ONLY" SCHOOLS
- * SCHCAT 5 IS "UPPER PRIMARY WITH SECONDARY & HIGHER SECONDARY" SCHOOLS
- * SCHCAT 6 IS "PRIMARY, UPPER PRIMARY & SECONDARY ONLY" SCHOOLS
- * SCHCAT 7 IS "UPPER PRIMARY AND SECONDARY" SCHOOLS
- * (SCHCAT 8 TO 11 HAVE SECONDARY AND ABOVE ONLY, (I.E. NEITHER PRIMARY NOR UPPER PRIMARY), SO THEY ARE NOT RELEVANT FOR US.

***** Calculating Total Teacher variable *****

gen tot_teach=class_taught_pr + class_taught_upr + class_taught_pr_upr + class_taught_upr_sec +
class_taugt_pre_primary_only + class_taught_pr_and_pre_pri

***** Calculating teacher requirements *****

gen tot_teacher_req_1 = teacher_req_pri_1 if schcat==1
replace tot_teacher_req_1 = teacher_req_up_pri_1 if schcat==4

replace tot_teacher_req_1 = teacher_req_pri_1+ teacher_req_up_pri_1-1 if schcat==2 & prim_enrol>=151 &
upp_prim_enrol>100

*** In a composite schools primary Head Teacher will be considered as Upper Primary School Asst. Teacher ***

replace tot_teacher_req_1 = teacher_req_pri_1+ teacher_req_up_pri_1 if schcat==2 & prim_enrol<151 &
upp_prim_enrol>100
replace tot_teacher_req_1 = teacher_req_pri_1+ teacher_req_up_pri_1 if schcat==2 & prim_enrol>=151 &
upp_prim_enrol<100
replace tot_teacher_req_1 = teacher_req_pri_1+ teacher_req_up_pri_1 if schcat==2 & prim_enrol<151 &
upp_prim_enrol<100
*replace tot_teacher_req_1 = teacher_req_pri_1+ teacher_req_up_pri_1+1 if schcat==2 & prim_enrol<151 &
upp_prim_enrol<100 & elem_enrol>100

replace tot_teacher_req_1 = teacher_req_pri_1+ teacher_req_up_pri_1-2 if schcat==3 & prim_enrol>=151 &
upp_prim_enrol>100
replace tot_teacher_req_1 = teacher_req_pri_1+ teacher_req_up_pri_1-1 if schcat==3 & prim_enrol<151 &
upp_prim_enrol>100
replace tot_teacher_req_1 = teacher_req_pri_1+ teacher_req_up_pri_1-1 if schcat==3 & prim_enrol>=151 &
upp_prim_enrol<100
replace tot_teacher_req_1 = teacher_req_pri_1+ teacher_req_up_pri_1 if schcat==3 & prim_enrol<151 &
upp_prim_enrol<100

replace tot_teacher_req_1 = teacher_req_up_pri_1-1 if schcat==5 & upp_prim_enrol>100
replace tot_teacher_req_1 = teacher_req_up_pri_1 if schcat==5 & upp_prim_enrol<=100

replace tot_teacher_req_1 = teacher_req_pri_1+ teacher_req_up_pri_1-2 if schcat==6 & prim_enrol>=151 &
upp_prim_enrol>100
replace tot_teacher_req_1 = teacher_req_pri_1+ teacher_req_up_pri_1-1 if schcat==6 & prim_enrol<151 &
upp_prim_enrol>100
replace tot_teacher_req_1 = teacher_req_pri_1+ teacher_req_up_pri_1-1 if schcat==6 & prim_enrol>=151 &
upp_prim_enrol<100
replace tot_teacher_req_1 = teacher_req_pri_1+ teacher_req_up_pri_1 if schcat==6 & prim_enrol<151 &
upp_prim_enrol<100

replace tot_teacher_req_1 = teacher_req_up_pri_1-1 if schcat==7 & upp_prim_enrol>100
replace tot_teacher_req_1 = teacher_req_up_pri_1 if schcat==7 & upp_prim_enrol<=100

**** PROGRAM LINES FOR CALCULATION OF TEACHER VACANCIES & SURPLUSES

gen vacancy_1 = tot_teacher_req_1 - tot_teach
*** take any teacher teaching at primary and upper primary level as an elementary teacher***
gen excess_1 = vacancy_1*(-1) if vacancy_1<0
gen not_required_1 = 0 if vacancy_1==0
replace vacancy_1=. if vacancy_1<0
replace vacancy_1=. if vacancy_1==0

ⁱ The draft National Education Policy (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 The two most recent citations are as follows: In reply to unstarred question number 1953 in parliament on 30.07.2018, the education minister gave the total number of teacher vacancies in public elementary schools as 900,316 in all states/UTs, but for our subset of 21 major states it shows 882,200. A similar parliamentary question (unstarred question No. 1243), answered by the education minister on 19.09.2020 cites 1,035,001 teacher vacancies in our 21 major states. The Ministry’s reply to parliament included a justification for increased teacher vacancies: “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”. However, student strength has consistently and strongly fallen year on year, as per the government’s own official DISE data. It is not clear why, despite losing over 4 million students between 2017 and 2019, the number of teacher vacancies in public elementary schools has risen rather than fallen.

ⁱⁱⁱ 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.

^{iv} 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).

^v 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, Datta and Kingdon (2021) using a student fixed-effects estimation approach, find a non-decreasing relationship between class size and student learning in secondary schools.

^{vi} The studies that do show the expected negative relationship find that the size of the relationship is very small. 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.

^{vii} Elementary schools are schools that have grades 1 to 5; or 1 to 8; or 6 to 8. Telangana and Andhra Pradesh are considered one state, and are included here as Andhra Pradesh, since in 2010 they were one undivided state. Thus, although we show 20 states, the data is actually for 21 major states which together constitute 97% of the population of the country.

^{viii} In the Indian number systems, equal to 10.35 lakh. One lakh is one hundred thousand; Ten ‘lakh’ is equal to one million; one ‘crore’ is equal to ten million or hundred lakh.

^{ix} Out of the total 1,006,374 public elementary schools in the country (i.e. any school with elementary classes 1 to 8) (not just for 21 major states), 643,044 schools were ‘primary-only’ i.e. they had only classes 1 to 5, and 363,330 schools had upper primary classes in them, i.e. grades 6 to 8. Thus 36% of all public elementary schools were upper primary. The number of classes in primary is 5 grades. The number of grades in upper primary is 3 grades (classes 6, 7 and 8). Thus, the mean number of grades in elementary schools is : 5 grades of primary in 100% of primary schools, plus 3 grades of upper primary in 36% of schools, which contributes another 1.08 grades, i.e. it comes to an average of 5 + 1.08 grades, i.e. say 6 grades.

^x 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.

^{xi} Hindustan Times (2017) reported 2.0 lakh (0.2 million) 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). In CAG Report 2 (2014, p. 22) it states: regarding Bihar that “Government had carried out in 2011-12 cleaning of attendance register by removing names of fake/double enrolled students. However, scrutiny of admission and attendance registers of class-I of 125 schools in four test checked districts ... disclosed that against admission of 3691 children, 5104 children were shown as enrolled in attendance register. Besides, test-check records of four DPOs revealed that enrolment figure was more than the population of children of 6-14 years age group during 2012-13”.

^{xii} Rural parts of districts Agra, Shrawasti, Mahoba, Bijnor and Lucknow.

^{xiii} In an IZA Discussion Paper No. 14251 by Datta and Kingdon in April 2021, we explore the concepts of effective PTR and ‘cost-conscious’ PTR, based on adjusting for student and teacher absence rates.

^{xiv} 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.

^{xv} Firstly, there is no in-depth attention or scrutiny exercised with respect to the vacancy calculations in each district; secondly, politicians (who often want more teacher appointments in their constituencies to distribute largesse/patronage) may be able to influence vacancy calculations; thirdly, influencers may wish to create posts for relatives; fourthly, the greater the number of vacancies shown, the greater the number of appointments and the total bribe money (‘facilitation payments’) received by those sitting on recruitment boards, or by the concerned politician.

^{xvi} Due to space constrains, we did not report the values of vacancies and excess teachers under either rule.

^{xvii} We have used an exchange rate of Rs. 73 per US dollar. On 30th Sept. 2018, the rate was Rs. 72.5 per dollar.

^{xviii} 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.