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Can Targeted Allocation of Teachers Improve Student Learning Outcomes?

Evidence from Malawi

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Abstract

Teachers are one of the most important inputs for learning, but in many low-income countries they are poorly distributed between schools. This paper discusses the case of Malawi, which has introduced new evidence-based policies and procedures to improve the equity and efficiency of the allocation of teachers to schools. The analysis finds that adherence to these policies has been highly variable between the country's districts, with the most successful deploying 75 percent of teachers according to the rules and the least successful just 22 percent. Using administrative data, the paper identifies the impacts on student repetition rates of reductions in pupil–qualified teacher ratios as a result of the new teachers. The findings show that schools that moved from having more than 90 pupils per qualified teacher to a lower ratio experienced reductions in lower primary school repetition rates of 2–3 percentage points. However, similar impacts on dropout are not observed.

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Evidence from Malawi

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1. Introduction

Low-income countries, particularly in Sub-Saharan Africa, have typically struggled to deploy teachers to schools in remote areas, resulting in large variations in staffing levels between schools (Mulkeen, 2010; Majgaard and Mingat, 2012; Bashir et al., 2018). These variations stem primarily from teachers' preferences, typically for placements near to towns and larger villages, known as *trading centers* (Asim at al., 2019). Countries employ a range of rules and procedures to attempt to address these disparities, ranging from administrative policies to legal standards. The impact of these efforts, however, is highly variable. In India for example, maximum school PTRs are legally mandated by the Right to Education Act (2009); however, as of 2013 three provinces had an overall PTR above the legal maximum (Azim Premji, 2014). Teachers employ a range of formal and informal means to apply pressure to obtain desirable postings, and in many countries officials lack adequate incentives to enforce the rules (Cummings et al., 2016; Asim et al., 2019). In some countries, including some provinces of India, elected representatives have formal right of veto over teacher movements which can interfere with efforts to enforce PTR rules (Ramachandran et al., 2018). Additional incentives for teachers to remain in posting in remote areas, such as hardship allowances, are often required in order to achieve rationalization of teacher distributions, such as successfully tried in The Gambia (Pugatch and Schroeder, 2014).

In Malawi, one of the poorest countries in Sub-Saharan Africa, inequities in teacher distribution are particularly acute. While the national pupil-teacher ratio (PTR) is 62, 10 percent of schools have a PTR of 93 or more, while a more fortunate 10 percent have a PTR of 36 or lower. These inequities occur between districts and sub-district areas, but primarily occur within a single sub-district area (*zone*): school PTRs within a single zone can vary by a factor of ten or more (Ministry of Education, 2021a).

This inequitable distribution of teachers contributes to Malawi's poor levels of student retention and progression. More than 5 percent of students drop out in Grade 1,[1] with dropout rates rising to almost 7 percent in upper grades (Malawi Longitudinal School Survey, 2021). Fewer than two-thirds of students entering Grade 1 are still in school by Grade 5. Those students who remain in school frequently repeat grades:[2] more than one-third of Grade 1 students repeat, and repetition rates are above 18 percent in all grades (Ministry of Education, 2021b). Those students who do progress in school nevertheless achieve low learning outcomes: in Grade 2, fewer than 25 percent of students achieve minimum proficiency levels in the Early Grade Reading Assessment (EGRA) conducted by the United States Agency for International Development (USAID). At Grade 6, fewer than 25 percent of students achieve minimum proficiency levels in the Southern African Consortium for Monitoring Educational Quality (SACMEQ) assessment in Mathematics, placing Malawi near the bottom in the region.

The persistence of this poor distribution of teachers reflects weaknesses in Malawi's systems of national- and district-level resource allocation. Until recently, the rules governing allocations were excessively broad, requiring only that teachers be sent to schools with a PTR above 60. With more than half of schools above this level, this introduced a high degree of discretion in allocations.[3] Teachers exploit this discretion, using formal and informal channels of influence to resist placements

[1] Grades are known as Standards in Malawi, but will be referenced as Grades throughout this paper. Grades range from Grade 1-12. Primary Education is from Grade 1-8, and Secondary Education from Grade 9-12.
[2] Most Malawian schools require students to repeat grades if they fail to pass an end-of-year examination.
[3] In 2021, 61 percent of public primary schools had a PTR above 60.

in remote schools, resulting in continued disparities. Even where teachers are successfully placed in schools in remote areas, they may not remain for a significant period of time, exploiting these same formal and informal channels to obtain transfers to more desirable postings. A 'rural allowance' scheme is in place to motivate teachers to remain in remote postings, but it too is inadequately targeted with minimal incentive effect (see Asim et al., 2019, for a detailed exploration of these dynamics).

In recent years, a number of steps have been taken by the Ministry of Education (MoE) of Malawi, with support from the World Bank, to introduce more well-defined rules for allocation of teachers. Beginning in 2017, districts were advised to prioritize schools with the highest PTRs, not only those with PTR above 60. At the same time, districts were instructed to prioritize schools with fewer teachers than grades, in an attempt to address the common practice of multi-grade teaching in understaffed schools.[4]

In this paper, we assess the level of adherence to rules-based allocation of teachers in Malawi's schools over the period 2017-2019; and the impact of improvements in allocations on school PTRs and on outcomes. We draw data from multiple rounds of administrative data from the Government of Malawi's Educational Management Information System (EMIS) database. EMIS data is collected via an Annual School Census (ASC) and includes a wide range of data on school size, conditions, staffing, finances, infrastructure and equipment. We employ data on grades offered, staffing and enrollment to establish the schools which meet each of the criteria established by the government. In addition, we employ administrative data on the allocation of new teachers to schools provided by district-level officials via the MoE.

Our ultimate outcomes of interest are student dropout and promotion rates. These outcomes are informed by the international evidence on the impacts of improvements in school teacher staffing and reductions in PTRs. We anticipate reductions in class sizes at the most overcrowded schools as a result of improved staffing, and our selection is also informed by the literature on the impacts of reductions in class sizes.

There is substantial evidence for a relationship between reduced PTRs and improved test scores (Angrist and Lavy, 1999; Kreuger, 1999; Muralidharan & Sundararaman, 2013), although other studies find no significant effects (Hoxby, 2000; Duflo et al., 2015; Angrist et al., 2017). Reduced PTRs can lead to improvements in learning through two channels. First, an adequate supply of teachers can lead to reduced class sizes, with benefits for learning.[5] Second, having an adequate level of staff can reduce schools' reliance on multi-grade teaching where multiple classes are combined under a single teacher. Although the existing evidence-base is still limited, available research on the effects of multi-grade teaching suggests that it is harmful to student performance (Checci & De Paola 2017, Jacob et al. 2008).

Using administrative data, we are unable to present direct analysis of test scores. However, in Malawi, student promotion is closely linked to test performance, with mandatory repetition in most schools for students who do not pass a year-end assessment; we therefore measure repetition rates as a proxy for learning. Walter (2018), assessing evidence from a panel of 20 high-, middle- and low-income

[4] Although in most schools achieving this standard require eight teachers, Malawi includes a number of 'junior primary' schools which only teach Grades 1-4, as well as other schools without a complete set of eight grades.
[5] As is the case in Angrist and Lavy, 1999 and Muralidharan & Sundararaman, 2013.

countries, estimates the gains in student promotion from optimal allocation of existing teachers between schools at between 0.1 and 4.2 percentage points.

- In **Chapter 2**, we present a stylized algorithm, based on the MoE's rules, to identify target schools in need of more teachers. Drawing on administrative data collected in 2017, 2018 and 2019, we apply this algorithm to identify all target schools in each year. We present estimated needs for teachers according to this algorithm, at national, district and school levels.
- In **Chapter 3**, we compare our targeting algorithm to the actual allocations of new teachers in Malawi in each of the four years, and assess the extent to which allocation met with need, both nationally and at the district level.
- In **Chapter 4**, we assess the impact of the allocation of new teachers on school PTRs.
- In **Chapter 5**, we assess the impact of reduced PTRs on student repetition rates and dropout rates.
- **Chapter 6** discusses the results.

2. Rules-based targeting of new teachers to schools

The allocation of newly deployed teachers – typically 3,000 to 5,000 per year – is a multi-stage process across multiple levels of government (see Asim et al., 2019, for a detailed discussion). Teachers enter the workforce having completed pre-service training under the auspices of the Department for Teacher Education and Development (DTED) of MoE, primarily through a program known as the Initial Primary Teacher Education (IPTE). Through the Directorate of Basic Education (DBE) and the Local Government Service Commission (LASCOM), MoE allocates teachers to each of Malawi's 34 education districts;[6] District Education Offices (DEOs) in each district then allocate teachers to specific schools.

Allocating new teachers equitably to schools may seem a simple matter of targeting the schools with the highest PTRs, but this has not historically been the case. Malawi has an official target for school PTRs of 60 and, prior to 2017, teacher allocations were guided only by this target. However, with more than half of schools above this ratio, this approach did not significantly guide allocations. The result was that allocations of teachers to districts and, in particular, to schools was conducted with a high degree of discretion that left district officials subject to pressure from teachers to avoid postings in remote schools (see Asim et al., 2019, for a detailed description of Malawi's teacher allocation system and the history of attempts to rationalize deployments).

Beginning in 2017, a new set of targeting rules was introduced to support more equitable allocations of teachers to schools. In 2017, national and district officials were instructed to allocate teachers to schools with PTR below 60 if they did not have at least one teacher per grade offered. This was intended to prevent multi-grade teaching. Beginning in 2018, officials were instructed that, having fulfilled this first condition, they should target the remaining teachers to the schools with the highest PTRs. A revised Primary Teacher Management Strategy codified the new guidance (Ministry of

[6] Malawi has 28 local government authorities, including districts and municipalities. Some of these are subdivided into two or three components for the purposes of education management, producing a total of 34 education districts. In this paper, we use 'district' to refer to these education districts. The country's four urban districts, Lilongwe City, Blantyre City, Mzuzu and Zomba Urban, are typically excluded from receiving newly deployed teachers owing to high existing levels of staffing.

Education, Science and Technology, 2018) and a spreadsheet-based tool was developed to guide districts in completing allocations according to the rules.

In this section, we employ administrative data to create lists of schools that would have been eligible to receive new teachers in each of the years 2017-2019 according to the new rules.

Maximizing the efficiency of allocation rules

T1: One teacher per grade

The first stipulation of the revised rules – to provide adequate teachers to schools to ensure that they have at least one teacher per grade offered – is intended to eliminate multi-grade teaching. This rule is most likely to be relevant in smaller schools, often in remote areas, which are the most likely to lack one teacher per grade owing to small enrollments.[7]

Such schools are large in number and concentrated in particular districts. In 2017, one district, Mzimba South, required 423 teachers to meet this rule, and the top five districts combined required 1,039 new teachers – more than 40 percent of all the new teachers needed to fully attain T1 in the whole country. These districts, unless experiencing severe overall shortages of staff, are poorly allocating their existing teacher resources and may not be expected to appropriately allocate additional teachers. In addition, meeting this need entirely would be likely to severely reduce the potential for PTR reduction at more understaffed schools, and would entail allocating a significant number of teachers to schools with PTR below 60 which are otherwise adequately staffed. This may not be an effective use of limited resources, given overall constraints on teacher availability.

We therefore apply the following modifications to T1:

- Schools with a PTR of 60 or below are excluded from receiving new teachers.
- Schools whose PTR would drop to 60 or below on receipt of a new teacher, are excluded from receiving new teachers.
- Districts where more than 50 percent of schools meet T1 are excluded from receiving teachers based on T1, unless their overall district PTR is above 75:1.

T2: Allocation to schools with high PTRs

The second stipulation, T2, is expected to be applied following fulfilment of the modified T1. In a context of perfect information, the preferred approach to allocating teachers in order to reduce PTRs would be the "smallest achievable maximum PTR rule" (Walter, 2018), in which teachers are allocated in order to reduce the largest school-level PTR, nationally or in a district, as much as possible. However, this approach, while the most efficient way to reduce PTRs in theory, is difficult to implement in practice as it requires a complete and accurate ranking of schools by PTR. As this may be complicated to implement, in practice, many countries adopt a simpler approach of identifying a target level of PTR above which schools are considered understaffed and providing teachers to bring

[7] Of schools in the most remote areas, known as 'Category A', 38 percent have fewer than eight teachers, versus only 18 percent of the least remote 'Category C' schools (Ministry of Education, 2022; see Asim et al., 2019, for categorization).

schools below that level. For example, India establishes a target of 30 for each class (Azim Premji, 2014).

In Malawi, as described above, the qualifying PTR level has historically been 60, but with more than half of schools having PTRs above this level, this targets teachers with inadequate specificity to bring down the maximum PTR effectively. Evidence from Malawi suggests that schools with PTRs above 90 typically achieve lower learning outcomes (Asim and Casley Gera, 2024). We therefore adopt a PTR of 90 as the threshold to consider schools highly understaffed and eligible to receive teachers under T2, for evaluation of the 2017 allocation of teachers.

However, as the allocation of teachers improves, we would expect the share of schools with PTR above 90 to reduce, making adherence to this rule more difficult. Indeed, the share of schools with PTR above 90 reduced from 32 percent in 2017 to just 16 percent in 2019. Applying T2 only to these schools would not identify enough beneficiary schools to utilize the full supply of teachers. Therefore, for 2018 and 2019, as the share of needy schools declines in response to optimal teacher allocations, we lower the threshold to 80, maintaining a similar share of schools identified as needy.

Over time, with continued need-based allocations, we would expect to be able to lower the threshold further and eventually to the government's official target of 60.

Box 2.1 summarizes the modified rules.

Box 2.1. New rules for teacher allocation

Target 1 (T1): deploys the least number of teachers needed such that schools would have at least one teacher per grade.

- Except schools with PTR of 60 or below or whose PTR would be reduced to 60 or below with addition of new teachers
- Except districts where more than 50 percent of schools meet T1 are excluded from receiving teachers based on T1, unless their overall district PTR is above 75:1.

Target 2 (T2): deploys the least number of teachers needed so that PTR reduces to below 90 (in 2017) or 80 (in 2018 and 2019).

Estimating need under the revised rules

Employing these revised rules, we then estimate the need for teachers to fulfill these targets in each year from 2017 to 2019. **Table 2.1** shows the number of teachers required in each district in each year following the application of both rules, along with the number of schools needing teachers. In each year, the data on school-level PTRs is drawn from EMIS data, reflecting the previous year's allocations of new teachers as well as other movements, deaths and retirements of teachers in the system.

Table 2.1. Summary of the number of teachers needed in 29 primarily rural districts[+]

	2017	2018	2019
Total number of schools	5,368	5,345	5,527
Total number of students	4,567,817	4,573,924	4,775,675
Total number of teachers	59,233	64,865	71,471
National PTR	77.1	70.5	66.8
Total number of teachers needed in 29 primarily rural districts	5904	5676	3789
% schools that needed at least one new teacher	36%	36%	29%
% schools that needed at least one new teacher to attain T1	17%	6%	5%
Teachers needed among schools with need			
Number of teachers needed – median	2	2	2
Number of teachers needed – 10th percentile	1	1	1
Number of teachers needed – 90th percentile	6	6	5

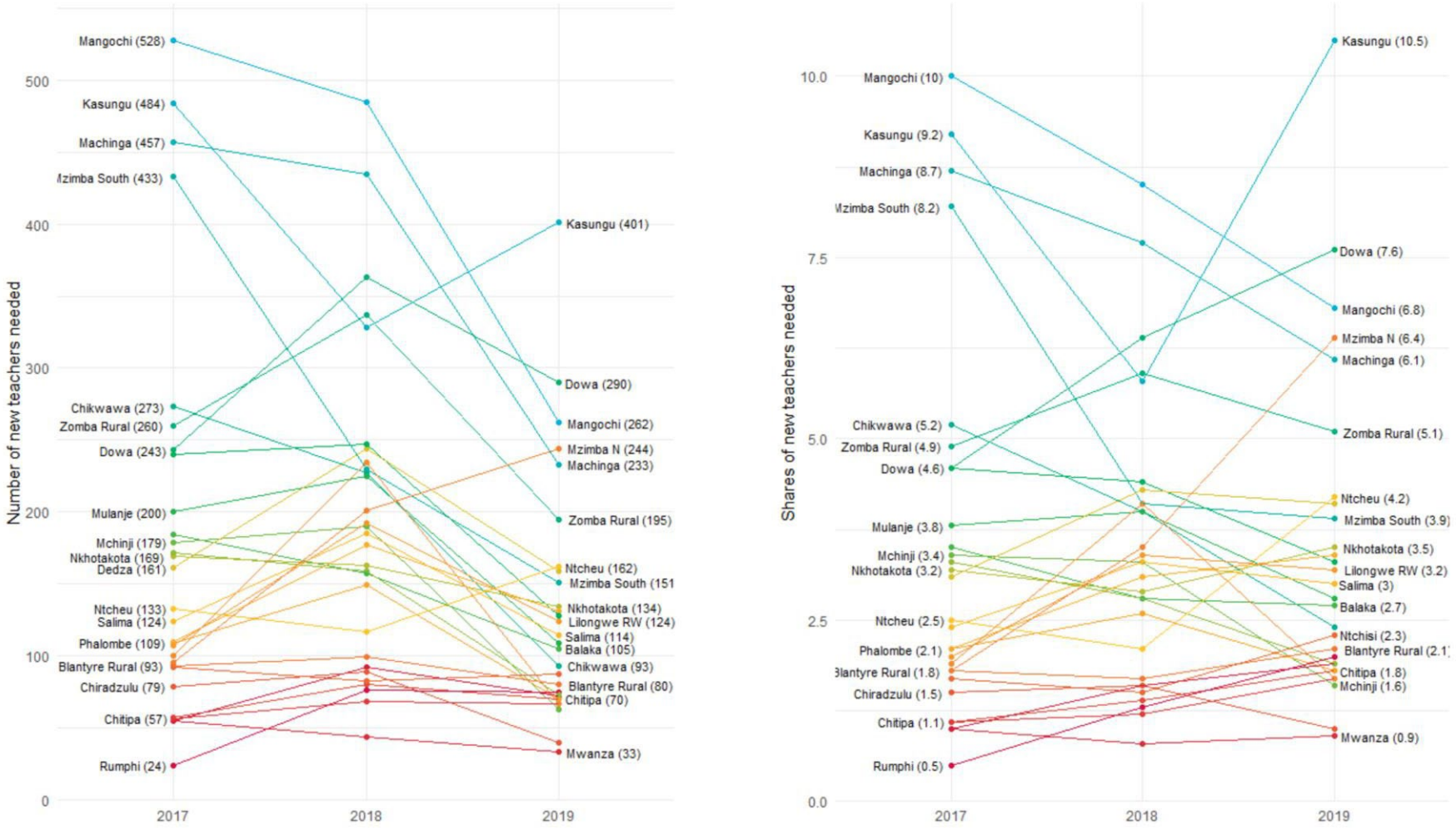
[+] Blantyre City, Lilongwe City, Mzuzu City, Zomba Urban, and Likoma are excluded.

The total need for teachers falls gradually, partly as a result of the improvement in allocations that took place during this period. This decline occurs despite the modification of T2 to require PTR above 80 in 2018 and 2019. The proportion of schools that needed at least one new teacher also drops over time.

Despite this overall trend of reducing need, however, district-level needs vary more widely over time. This reflects the fact that the extent to which allocations to districts is aligned to their needs also varies (see next section). **Figure 2.1** shows the district-level need in 2017-19 according to the modified rules. The mean number of teachers needed across districts in 2017 was 204, dropping to 196 in 2018 and 132 in 2019 (Table 3.2). The number of teachers needed across the districts varied between 25 (Rumphi) to over 550 (Mangochi) in 2017. This range narrowed in 2018 and in 2019. In terms of overall numbers (Panel A), the majority of districts reduced their need substantially, but some districts saw increasing need over time, notably Ntcheu and Mzimba North, suggesting allocations during this period were not adequate to meet these districts' needs. Section 3 provides further analysis of this.

Figure 2.1. Number and share of teachers needed to fulfil modified rules in 2017, 2018 and 2019: by district

A. Number of teachers required by district **B. Share of total teachers required by district**



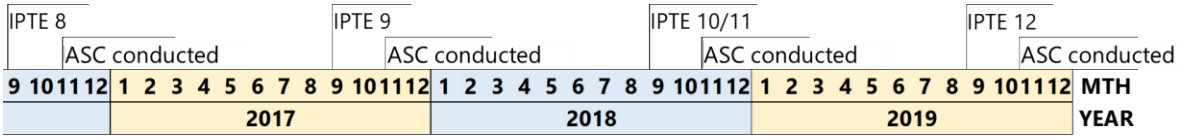
3. How well did teacher allocation match the modified rules?

In this section, we compare the actual allocation of teachers to schools with the predicted need according to the modified rules. We employ administrative data on annual IPTE allocations, linked to EMIS school records using a unique school ID number.

We focus our analysis on 29 districts which are rural and in mainland Malawi. We exclude four urban districts (Blantyre, Lilongwe and Zomba Urban districts, and Mzuzu) as these districts are excluded by custom from allocation of newly qualified IPTE teachers (as a result of generally lower PTRs). We also exclude Likoma, an island district in Lake Malawi, which has a small number of schools and experiences unusual constraints in receiving adequate allocations of teachers.

Figure 3.1 shows the timeline of allocations along with ASC data collection which informs the EMIS data. Teacher allocations typically take place in August, prior to the start of the school year, while ASC data collection takes place early in the school year in October-November.

Figure 3.1. Schematic timeline of EMIS and IPTE 9, 10-11 and 12 allocations, 2017-19



Total deployment at the national level

The total numbers of teachers deployed in 2017, 2018 and 2019 were 4,453, 5,511 and 3,387, respectively (**Table 3.1**). In 2018, the allocation was unusually large as it included two rounds of IPTE teachers.[8] Nevertheless, the allocation was not adequate to fill the national need according to the modified rules.

Table 3.1. Total number of teachers needed and allocated, and share of need met (national)

	2017	2018	2019	Average
Total number of teachers needed in 29 primarily rural districts	5,904	5,676	3,789	5,123
Total number of teachers allocated to the 29 primarily rural districts	4,453	5,511	3,387	4939
Share of need for teachers met at national level	75%	97%	89%	72%

Allocation of teachers to districts

The allocation of teachers to districts, conducted by the MoE, varied considerably over the three years as a proportion of districts' needs. **Table 3.2** (in Tables & Figures) shows the number of teachers

[8] In 2017, graduates of the seventh cohort of IPTE trainees, known as IPTE9, were deployed to schools two years after their graduation in 2015. In 2018, in order to reduce the waiting period for new graduates before deployment, both IPTE10 and IPTE11 graduates, who graduated in 2016 and 2017, were deployed to schools. In 2019, IPTE12 graduates, having graduated in 2018, were deployed to schools.

needed, the number allocated, and the share of district-level need met, for each rural district for each year 2017-19 and on average across the three years.

In 2017, while the average district received 70 percent of their need (in line with the national picture as seen in Table 3.1), the share of need met at district level was as low as 6 percent (in Blantyre Rural district, which received only seven teachers against a need of 126); and as high as 162 percent (in Thyolo district, which received 170 teachers against a need of 105). In total, 10 districts received fewer than half the teachers needed to meet the modified rules.

In 2018, despite the overall size of the allocation being larger, three districts still received fewer than half the teachers they needed (receiving fewer than five teachers each). A total of 14 districts received more teachers than were needed to meet the modified rules, suggesting that the rules were not being consistently followed within MoE where the allocation of teachers to districts was carried out. In 2019, as the share of total need met fell to 94 percent, the allocation to districts remained only loosely aligned with need, with the result that ten districts received fewer than half the teachers needed while three received more than double the required number.

For a given district, the share of needs met was highly variable over time, with a single district, Chikwawa, receiving between one and 175 percent of the required teachers depending on the year. In total, 13 districts received fewer teachers than required across the three years while 16 received more than required. Only one district received fewer than half the required teachers across the three years, and one received more than double the required teachers.

Allocation of teachers to schools

How well did districts allocate the teachers they received? **Table 3.3** summarizes the total performance of the 29 districts in allocating teachers to needy schools according to the modified rules. Panel A shows the share of the total share of all schools in these districts which were allocated a teacher along with the average number of teachers received by these schools. Panel B shows the share of schools which did not need a teacher according to the modified rules, which nevertheless received them: between 24 and 32 percent of teachers across the three years were deployed to schools which did not qualify for one according to the modified rules. Panel C shows the share of schools which did need at least one new teacher which received teachers, rising to a high of 61 percent in 2018 before falling to 45 percent in 2019.

Strikingly, in the larger allocation of 2018, the share of both needy and non-needy schools receiving teachers increased, suggesting that an opportunity was missed to target this large one-off double allocation to achieve a large reduction in school PTRs.

Table 3.3 Allocation of teachers to schools (national)

	2017	2018	2019
A. All schools			
% schools allocated new teachers	38%	43%	33%
Number of teachers allocated – mean*	2.2	2.4	1.9
B. All schools that needed 0 new teacher			
% schools allocated new teachers	25%	32%	24%
Number of teachers allocated – mean*	1.7	1.9	1.6
C. All schools that needed at least one new teacher(s)			
% schools allocated new teachers	59%	61%	45%
Number of teachers allocated – mean*	2.6	3.0	2.2

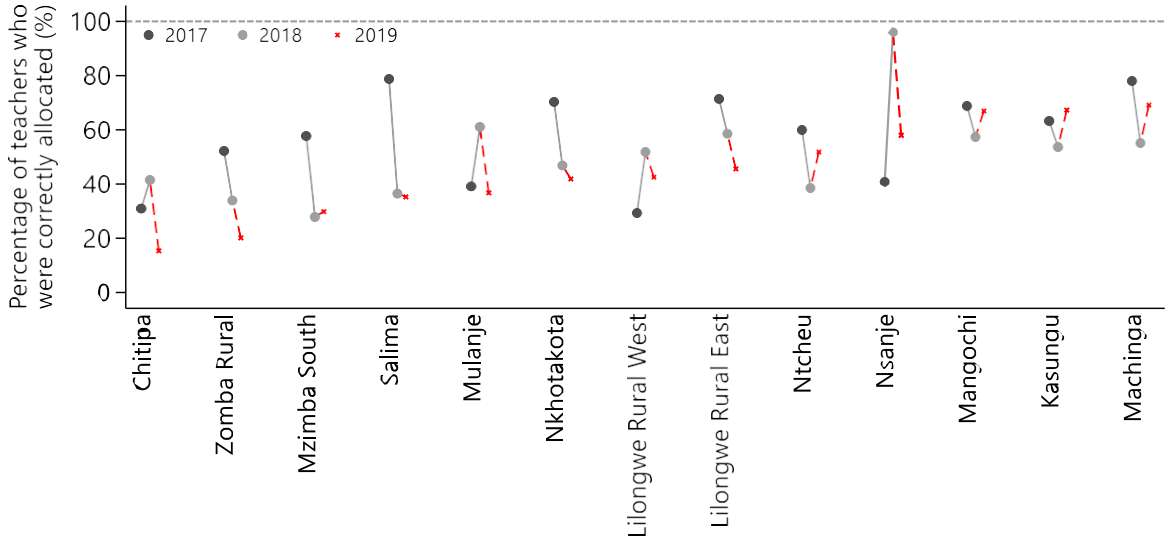
*Denotes number of teachers allocated to schools which were allocated a teacher.

Table 3.4 (in Section 8, Tables) shows the performance of individual districts in allocating teachers to the correct schools, as well as the national total performance. At national level, the share of deployed teachers who were allocated correctly fell from 56 percent in 2017 to 49 percent in 2018, reflecting the fact that the extra-large allocation was not well targeted as noted above. The share correctly allocated fell further to 43 percent in 2019, showing a further deterioration in adherence to the new rules following their introduction.

This aggregate picture, however, masks a high degree of variation between districts. On average across the three years, the share of teachers received which were allocated correctly varies from as low as 22-23 percent (Rumphi and Mzimba North districts) to 75 percent (Dowa district). Strikingly, each district varies considerably year-on-year in its adherence to the guidance, with only four districts (Mwanza, Kasungu, Mangochi and Machinga) allocating more than half their teachers correctly in all three years.

To provide a deeper exploration of the dynamics of district allocations over time, we focus on 13 districts which received at least 50 teachers in all three of the years 2017-19. **Figure 3.2** shows the performance of these districts in allocating teachers to schools across the three years. In a number of cases, the quality of allocations fell in 2018 in response to the larger-than-normal allocation before improving in 2019. However, in other cases the quality of allocations increased in 2019 before falling, or declined consistently. None of the 15 districts achieved a consistent improvement in the share of teachers which were allocated according to the modified rules.

Figure 3.2. % teachers correctly allocated to schools, 2017-19 (13 most allocated districts)



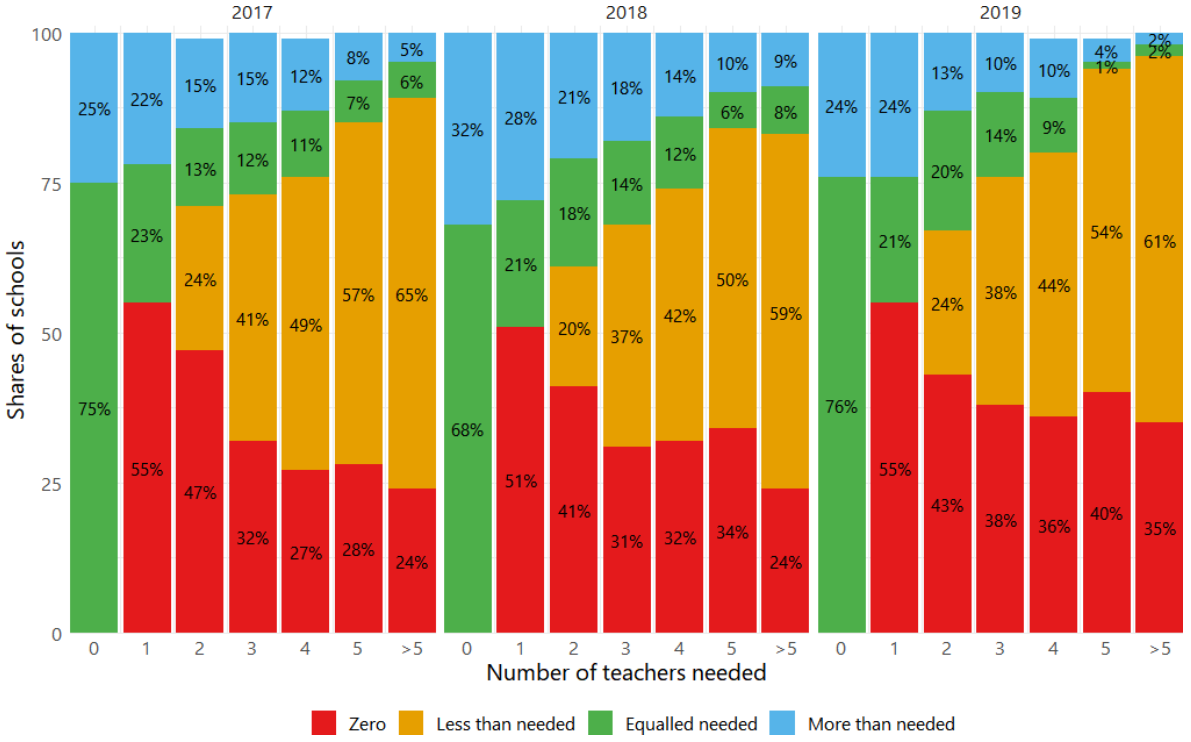
Share of need met at the school level

To what extent did the allocation of new teachers, flawed as it was, meet the needs of schools? The fourth column in each year in **Table 3.4** compares the number of new teachers correctly allocated to needy schools to the district-level need (as seen in Table 3.2) to identify the share of need which was met each year at district level by teachers being placed in needy schools. The share of needs met at the district level reflects both the adequacy of the number of teachers allocated to a district, and the quality of their allocation to schools. The share of need met varied at national level, from 31 percent in 2017 to 44 in 2018 and falling back to 37 percent in 2019. The fact that only 44 percent of need was met in 2018, despite the total number of teachers deployed being 97 percent of the need, demonstrates the inefficiency of allocations.

Figure 3.3 shows the relationship across districts between the number of teachers needed in schools to meet the modified rules, and the number of teachers allocated. In each year, at least 20 percent of even the neediest schools, in need of five or more teachers, received zero teachers, while a similar share of schools which needed zero teachers received them.

Overall, the analysis suggests that adherence to the revised targeting rules was generally weak and highly inconsistent, between districts and over time. But where teachers were allocated to schools correctly, what were the impacts on overall staffing levels? Section 4 explores this question.

Figure 3.3. Distribution of allocation outcome by level of need



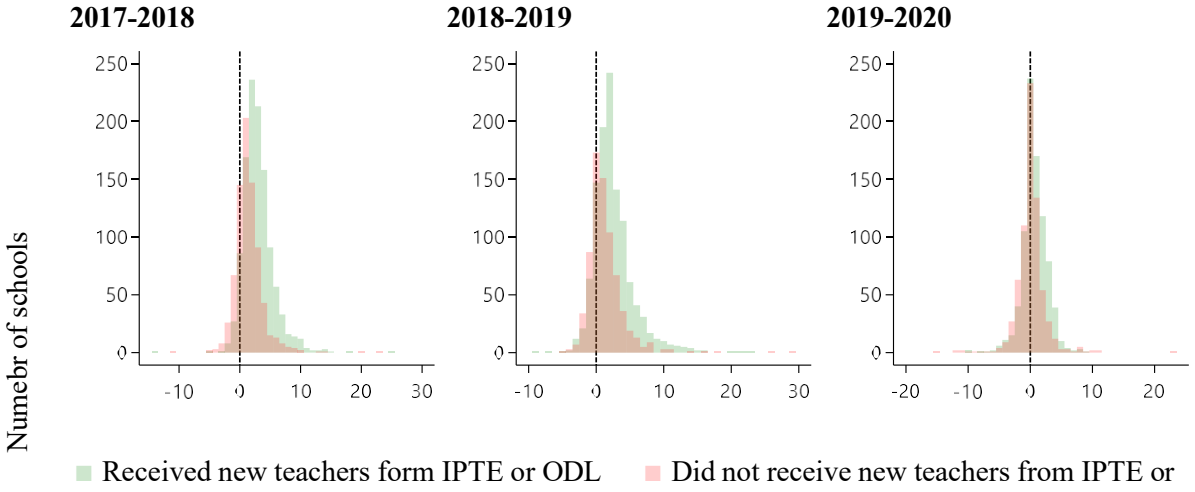
4. Impact of teacher allocation on school staffing

Although allocation of newly deployed teachers to schools is expected to lead to an increase in overall school staffing levels, there are a number of reasons why this relationship may not be consistent. First, teachers may leave a school at the same time that the school receives a new teacher, either through transferring to another school, movement out of teaching, death or retirement. New teachers allocated to schools may have been so allocated in response to an expected departure, leaving the school with no net gain in teachers.

Teacher headcounts

To analyze trends in the number of teachers employed at schools, we compare staffing levels year-on-year using EMIS data. Figure 4.1 shows the distribution of schools which needed at least one teacher each year, and the change in the number of teachers employed at schools, both those which received new teachers as part of the annual allocation and those which did not. Among schools that needed teachers and did not receive new teachers from IPTE, many still had more teachers in the next year (68 percent in 2017/18, 58 percent in 2018/19, 35 percent in 2019/20); and some schools that received teachers from IPTE had a lower recorded number of teachers in the following year (3 percent in 2017/18, 9 percent in 2018/19, 21 percent in 2019/20).

Figure 4.1. Changes in the number of teachers among schools that needed new teachers



PTR change

Even in a situation where the total number of teachers employed at a school increases, changes in enrollment can mean that PTR does not improve. We postulate that in remote areas in Malawi, where shortages of teachers are most common, additional teachers may be met by an increase in demand by parents and subsequently in school enrollment, effectively 'washing out' gains in PTR from the additional teacher.

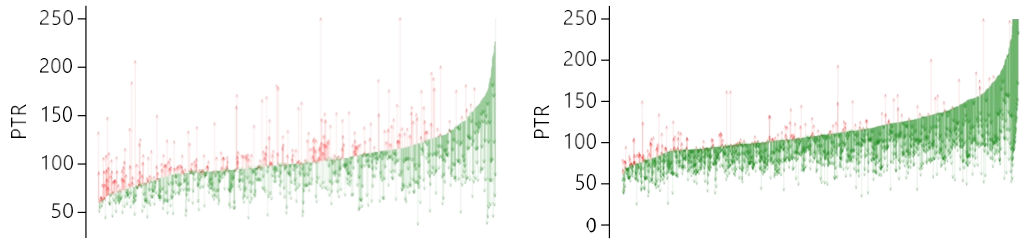
To what extent did the correct allocation of teachers, where achieved, reduce school PTRs? **Figure 4.2** shows the distribution of the change in school PTRs between 2017-2018 (Panel A), reflecting the impact of the 2017 allocation; 2018-19 (panel B), reflecting the impact of the 2018 allocation; and 2019-20 (Panel C), reflecting the impact of the 2019 allocation; for schools which needed teachers and (i) did not and (ii) did receive them. The green bars show schools which reduced PTR, while the red bars show schools where PTR increased. As expected, the share of schools with PTRs reducing is higher among those schools that received new teachers, as is the mean reduction in PTR. Nevertheless, PTRs did reduce on average in schools which did not receive new teachers, which may reflect teachers joining these schools through transfers, or declining enrollment. In addition, a number of schools receiving new teachers nevertheless experienced increases in PTR, reflecting a net decrease in teacher numbers (as a result of teachers moving away as described above) and/or increasing enrollments.

Overall, the analysis suggests that the correct allocation of teachers to needy schools did reduce PTRs, but these effects were blunted by ongoing movement of teachers within the system. Section 5 explores whether, in those cases where PTRs were reduced, this led to improvements in student outcomes.

Figure 4.2. Annual change in PTR among schools that needed new teachers

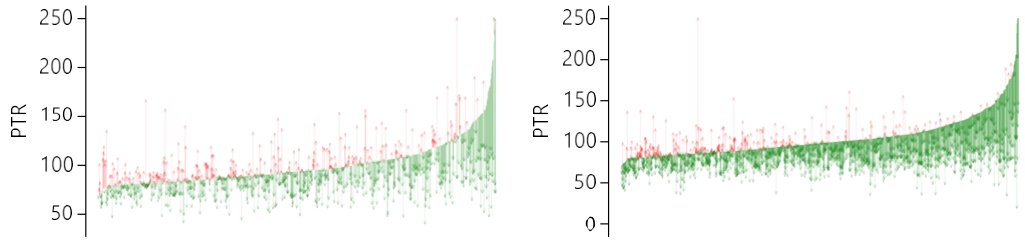
(i) Did not receive new teachers **(ii) Received new teachers**

1. 2017-2018



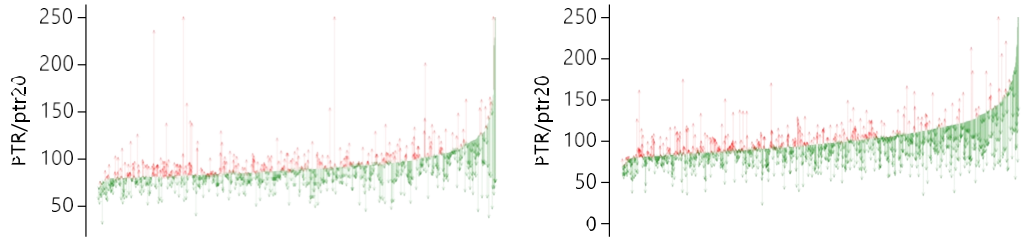
Mean PTR change: -11 (-14, -9) -29 (-31, -27)

2. 2018-2019



Mean PTR change: -11 (-14, -9) -21 (-22, -19)

3. 2019-2020



Mean PTR change: -5 (-7, -4) -12 (-14, -10)

5. Impact of improved staffing on student outcomes

In this section, we evaluate the extent to which improvements in staffing, primarily as a result of the correct allocation of newly deployed teachers to schools where implemented, led to improvements in student outcomes. Our outcome of interest is student repetition rates, as a proxy for learning levels (see Introduction). We derive these rates from EMIS data.

Although the assignation rules used in Malawi allocate teachers both to schools without one teacher per grade (T1) and schools with PTR above 90 or 80 (T2), in this analysis we focus primarily on T2 and the reduction of overall school PTRs. This is done in response to evidence from Malawi which suggests that schools with PTRs above 90 have lower overall learning outcomes (Asim and Casley Gera, 2024). In addition, in this analysis, we exclude non-qualified and student teachers and focus on school pupil-qualified teacher ratios (PqTRs).

In recognition of the fact that the dynamics of school staffing vary significantly regardless of the allocation of new teachers (see Section 4), we focus our analysis on schools which an increase in overall teacher numbers and experienced reduction in PqTR, regardless of whether they were allocated a new teacher. In other words, a school which gained an additional teacher through transfer is treated the same as one which received a newly deployed teacher.

We define a school has having been 'treated' with additional teachers in a given year if it meets the following conditions:

1. The number of teachers employed in the school is higher than in the previous year;

2. The school's overall PqTR was above 90 in the previous year and is now below 90.

We define a control group of schools which had PqTR above 90 in the previous year – meaning they needed a new teacher – but did not experience a net gain in the number of teachers.

As a result of the dynamic nature of teacher allocations, the treated and control schools therefore vary across the various year comparisons. **Table 5.1** summarizes the sample.

Table 5.1. Impact analysis sample

	2017-18	2018-19	2019-20
Treatment	902	710	468
Control	412	296	330

Both control and treatment schools experienced changes in PqTR, repetition rate, and dropout rate year-on-year. To capture the differential dynamics between treated and control schools, we employ difference-in-difference (DiD) analysis.

Table 5.2 (in Section 8, Tables) presents DiD estimates for the impact of treatment on PqTRs. As expected given the definitions of treatment and control, treated schools experienced decline in PqTR compared to control schools in each year – an substantial decline of 41 pupils per qualified teacher.

Lagged effects for dropout and repetition. Because dropout and repetition rates are determined by schools at the end of a school year, there is an expected 'lag' in impacts for an improvement in school staffing. Recall that new teachers are typically deployed to schools at the start of the new school year in September, with the EMIS data collection taking place around two months later in October-November. In order to allow time for the impacts of new teachers to be felt and measured, we report lagged effects for these indicators from the following year's EMIS data. For example, to evaluate the impact of teachers allocated in August/September 2017, we compare:

- EMIS 2018 (collected in October-November 2017, and reflecting the dropout and repetition status at the end of the 2016/17 school year, prior to the allocation of teachers) with

- EMIS 2019 (collected in October-November 2018, and reflecting the dropout and repetition status at the end of the 2017/18 school year, following the first full year of school with the increased level of staffing and reduced PqTR).

The COVID-19 pandemic led to the closure of all schools in Malawi for seven months during 2020 and appears to have led to significant dropout.[9] As the EMIS data collected in October-November 2019 is the most recent available prior to the onset of the pandemic, we restrict our analysis to the 2017 and 2018 allocations of teachers for which lagged information is available prior to the pandemic.

Tables 5.3-5.6 show DiD results. In each table:

- The first column defines treated schools as those which received at least one additional teacher in 2017 and as a result whose PqTR was brought below 90 in that year.[10] The regression compares the repetition or dropout rate in schools at the end of the 2016/17 year to those at the end of the 2017/18 school year, reflecting a full year of the increased staffing.

- The second column defines treated schools as those which received at least one additional teacher in 2018 and as a result whose PqTR was brought below 90 in that year.[11] The regression compares the repetition or dropout rate in schools at the end of the 2017/18 year to those at the end of the 2018/19 school year, reflecting a full year of the increased staffing.

Repetition

Tables 5.3 and 5.4 show DiD results for repetition rates. **Table 5.3** focuses on overall repetition across grades. We find that in schools treated in 2017, repetition rates were significantly reduced by 0.28 percentage points. We do not observe significant impacts on overall repetition rates from treatment in 2018.

[9] The total enrollment in Malawi's primary schools fell for the first time in over a decade following the closure of schools, with 4,815,286 students enrolled in public primary schools in 2020/21 versus 5,274,819 in 2019/20.
[10] To identify treated schools, we compare data from EMIS 2016 and EMIS 2017. As repetition and dropout rates are decided at the end of the school year and reported in the following year's EMIS, for repetition and dropout rates, we compare data from EMIS 2017 and 2018.
[11] To identify treated schools, we compare data from EMIS 2017 and EMIS 2018. As repetition and dropout rates are decided at the end of the school year and reported in the following year's EMIS, for repetition and dropout rates, we compare data from EMIS 2018 and 2019.

Table 5.3. Impact of PqTR reduction on repetition rates

	2017-18	2018-19
Control	0.266***	0.253***
	(0.010)	(0.006)
Time	-0.014	-0.001
	(0.014)	(0.009)
Treatment	0.007	-0.016
	(0.011)	(0.012)
DiD (Treatment and Time)	-0.028*	-0.021
	(0.016)	(0.015)
Control (N)	118	292
Treatment (N)	379	134

Data Source: EMIS 2016-2019

*Note: Robust standard errors in parentheses. * p<0.10, ** p<0.05, *** p<0.01*

2017/18 compares Repetition rates at end 2016/17 and end 2017/18. Treated schools are those where PqTR brought below 90 in 2017.

2018/19 compares Repetition rates at end 2017/18 and end 2018/19. Treated schools are those where PqTR brought below 90 in 2018.

Table 5.4 focuses on repetition rates in lower primary (Grades 1-4). Again, we find significant impacts from the 2017 allocation of teachers, with lower primary repetition rates reduced by 3.5 percentage points, but we do not observe similar impacts from the 2018 deployment.

Table 5.4. Impact of PqTR reduction on repetition rates in lower primary

	2017-18	2018-19
Control	0.276***	0.269***
	(0.011)	(0.007)
Time	-0.014	-0.005
	(0.015)	(0.010)
Treatment	0.016	-0.026**
	(0.013)	(0.013)
DiD (Treatment and Time)	-0.035**	-0.017
	(0.017)	(0.016)
Control (N)	118	292
Treatment (N)	379	134

Data Source: EMIS 2016-2019

*Note: Robust standard errors in parentheses. *p<0.10, ** p<0.05, *** p<0.01*

2017/18 compares lower primary Repetition rates at end 2016/17 and end 2017/18. Treated schools are those where PqTR brought below 90 in 2017.

2018/19 compares lower primary Repetition rates at end 2017/18 and end 2018/19. Treated schools are those where PqTR brought below 90 in 2018.

Dropout

Table 5.5 and 5.6 show DiD results for dropout rates. **Table 5.5** focuses on overall dropout across grades; **Table 5.6** focuses on lower primary dropout rates. In both cases, we do not observe significant impacts in schools treated in either 2017 or 2018.

Table 5.5. Impact of PqTR reduction on dropout rates

	2017-18	2018-19
Control	0.031***	0.040***
	(0.004)	(0.003)
Time	0.001	-0.003
	(0.006)	(0.004)
Treatment	0.020***	0.003
	(0.006)	(0.006)
DiD (Treatment and Time)	-0.006	0.005
	(0.008)	(0.008)
Control (N)	118	292
Treatment (N)	379	134

Data Source: EMIS 2016-2019
*Note: Robust standard errors in parentheses. *p<0.10, ** p<0.05, *** p<0.01*
2017/18 compares dropout rates at end 2016/17 and end 2017/18. Treated schools are those where PqTR brought below 90 in 2017.
2018/19 compares dropout rates at end 2017/18 and end 2018/19. Treated schools are those where PqTR brought below 90 in 2018.

Table 5.6. Impact of PqTR reduction on dropout rates in lower primary

	2017-18	2018-19
Control	0.029***	0.037***
	(0.005)	(0.004)
Time	-0.001	-0.003
	(0.007)	(0.005)
Treatment	0.020***	0.002
	(0.006)	(0.006)
DiD (Treatment and Time)	-0.004	0.009
	(0.009)	(0.009)
Control (N)	118	292
Treatment (N)	379	134

Data Source: EMIS 2016-2019
*Note: Robust standard errors in parentheses. * p<0.10, ** p<0.05, *** p<0.01*
2017/18 compares lower primary dropout rates at end 2016/17 and end 2017/18. Treated schools are those where PqTR brought below 90 in 2017.
2018/19 compares lower primary dropout rates at end 2017/18 and end 2018/19. Treated schools are those where PqTR brought below 90 in 2018.

Robustness checks

In order to ensure that our particular treatment definition, of schools gaining additional teachers to bring PqTR below 90, is not creating a false appearance of systemic results with regard to repetition, we conduct additional analysis employing two alternative definitions of treated schools:

1. The number of teachers employed in the school is higher than in the previous year, and the school's overall PqTR was above 80 in the previous year and is now below 80.

2. The number of teachers employed in the school is higher than in the previous year, and the school's overall PqTR was above 100 in the previous year and is now below 100.

For this analysis, we focus on the 2017 allocation of teachers. Using lagged effects, we compare the repetition rates in schools at the end of the 2016/17 year to those at the end of the 2017/18 school year, reflecting a full year of the increased staffing according to the adjusted thresholds.[12]

Tables 5.7 and 5.8 (in Section 8, Tables), show the findings. Adopting PqTR reduction below 80 as the threshold, we observe impacts on repetition rates in lower primary and overall of a slightly larger scope than with the original treatment definition of PqTR reduction below 90. However, adopting PqTR reduction below 100 as the threshold, although we still observe a substantial reduction in lower primary repetition rates, it does not obtain statistical significance. The findings suggest that reducing PqTRs below 90 is the 'minimum' treatment to achieve impacts on student learning.

6. Conclusion

Our findings suggest that improvements in allocation of newly deployed teachers to schools, enabled by improved rules for allocation, can lead to improvements in student learning. Adopting repetition as a proxy for learning, we find that schools which gained additional teachers and brought PqTRs below 90 achieved significant improvements in lower primary repetition rates in comparison to schools with PqTR above 90 which did not gain additional teachers. The findings mirror others from Israel, the United States and India (Angrist and Lavy, 1999; Kreuger, 1999; Muralidharan & Sundararaman, 2013) which suggest that improvements in PTR are associated with improved learning outcomes, and demonstrate that similar dynamics persist in low-income countries. However, we do not observe impacts on dropout rates.

The descriptive analysis also reveals the extent to which rules-based approaches to teacher allocations may face challenges in implementation on the ground. Despite the clarification of allocation rules and provision of software tools to support allocations, the adherence to guidance for allocation of new teachers appears to have been weak and highly variable. At the national level, the allocation of new teachers to districts was not fully aligned with the guidance, with the share of districts' need for new teachers met through allocations varying from a low of 32 percent to a high of 224 percent across three years. At the district level, too, the quality of allocations was highly variable, with the most successful deploying 75 percent of teachers in accordance to the rules and the least successful just 22 percent. Had the teachers deployed during this period all been allocated according to the guidance, it is likely that the number of schools achieving reduction in PqTR to below 90 would have been larger,

[12] The comparison of staffing to identify treatment and control schools remains non-lagged, e.g. comparing EMIS data from 2016 and 2017.

with the result that more students would benefit from increased learning and reduced repetition rates. In addition, even where schools were correctly allocated new teachers, the effects on PTR were blunted by other movement of teachers away from these schools. A new Hardship Support Scheme, expected to be rolled out during 2024, is intended to provide additional incentives to teachers in remote schools to remain in post (see Asim et al., 2019, for background). Future research will explore the impact of this scheme on teacher behavior, school PTRs, and student outcomes.

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8. Tables

Note: Tables 2.1, 3.1, 3.3, and 5.1-5.4 can be found in the main text.

Table 3.2. Total number of teachers needed and allocated, and share of need met (by district)

District	No. of teachers needed/allocated, district level, 2017-19											
	2017			2018			2019			Total		
	Need	Allo'ted	% need met	Need	Allo.	% need met	Need	Allo.	% need met	Need	Allo.	% need met
Dowa	313	90	29	363	7	2	247	148	60	923	245	27
Blantyre Rural	126	8	6	99	35	35	80	48	60	305	91	30
Balaka	193	100	52	157	1	1	105	48	46	455	149	33
Neno	83	39	47	68	1	1	67	45	67	218	85	39
Ntcheu	167	67	40	117	88	75	162	58	36	446	213	48
Mwanza	58	25	43	44	31	70	33	13	39	135	69	51
Salima	130	51	39	185	159	86	114	51	45	429	261	61
Dedza	228	158	69	244	181	74	159	49	31	631	388	61
Ntchisi	99	25	25	83	61	73	87	80	92	269	166	62
Chiradzulu	80	20	25	89	104	117	40	7	18	209	131	63
Mzimba North	110	26	24	201	1	0	244	362	148	555	389	70
Lilongwe Rural East	253	118	47	247	279	113	128	79	62	628	476	76
Chikwawa	317	320	101	227	3	1	93	163	175	637	486	76
Lilongwe Rural West	133	91	68	192	139	72	124	143	115	449	373	83
Zomba Rural	291	211	73	337	329	98	195	191	98	823	731	89
Machinga	463	384	83	435	533	123	233	162	70	1131	1079	95
Nkhotakota	180	104	58	163	174	107	134	178	133	477	456	96
Nsanje	132	103	78	177	124	70	131	200	153	440	427	97
Mchinji	196	142	72	190	283	149	63	15	24	449	440	98
Mangochi	574	552	96	485	599	124	262	163	62	1321	1314	99
Kasungu	537	618	115	328	520	159	401	208	52	1266	1346	106
Phalombe	119	129	108	149	204	137	70	27	39	338	360	107
Thyolo	105	165	157	234	293	125	67	16	24	406	474	117
Karonga	178	150	84	159	294	185	73	35	48	410	479	117
Mzimba South	488	409	84	230	456	198	151	173	115	869	1038	119
Mulanje	206	200	97	225	318	141	109	142	130	540	660	122
Nkhata Bay	58	46	79	92	95	103	72	177	246	222	318	143
Chitipa	62	84	135	80	53	66	70	215	307	212	352	166
Rumphi	25	18	72	76	146	192	75	191	255	176	355	202
Mean	204	154	69	196	190	93	131	117	95	530	460	88
Median	167	103	72	185	146	98	109	142	62	449	388	89

Table 3.4 Allocation of teachers to schools (by district)

	2017				2018				2019				Average			
	Teachers allocated	Correctly allocated	% cor'ly allocated	% need met	Teachers allocated	Correctly allocated	% cor'ly allocated	% need met	Teachers allocated	Correctly allocated	% cor'ly allocated	% need met	Teachers allocated	Correctly allocated	% cor'ly allocated	% need met
Balaka	100	68	68	35	1	0	0	0	48	21	44	20	50	30	37	18
Blantyre Rural	8	4	50	3	35	16	46	16	48	26	54	33	30	15	50	17
Chikwawa	320	186	58	59	3	0	0	0	163	53	33	57	162	80	30	39
Chiradzulu	20	16	80	20	104	69	66	78	7	1	14	3	44	29	54	33
Chitipa	84	26	31	42	53	22	42	28	215	33	15	47	117	27	29	39
Dedza	158	81	51	36	181	122	67	50	49	26	53	16	129	76	57	34
Dowa	90	48	53	15	7	7	100	2	148	114	77	46	82	56	77	21
Karonga	150	60	40	34	294	97	33	61	35	10	29	14	160	56	34	36
Kasungu	618	391	63	73	520	279	54	85	208	140	67	35	449	270	61	64
Lilongwe Rural East	118	84	71	33	279	163	58	66	79	36	46	28	159	94	58	42
Lilongwe Rural West	91	27	30	20	139	72	52	38	143	61	43	49	124	53	41	36
Machinga	384	299	78	65	533	295	55	68	162	112	69	48	360	235	67	60
Mangochi	552	379	69	66	599	344	57	71	163	109	67	42	438	277	64	60
Mchinji	142	54	38	28	283	127	45	67	15	5	33	8	147	62	39	34
Mulanje	200	78	39	38	318	194	61	86	142	52	37	48	220	108	46	57
Mwanza	25	15	60	26	31	16	52	36	13	7	54	21	23	13	55	28
Mzimba N	26	5	19	5	1	0	0	0	362	183	51	75	130	63	23	27
Mzimba S	409	235	57	48	456	128	28	56	173	52	30	34	346	138	39	46
Neno	39	22	56	27	1	1	100	1	45	14	31	21	28	12	63	16
Nkhata Bay	46	13	28	22	95	33	35	36	177	39	22	54	106	28	28	37
Nkhotakota	104	73	70	41	174	81	47	50	178	74	42	55	152	76	53	48
Nsanje	103	42	41	32	124	119	96	67	200	116	58	89	142	92	65	63
Ntcheu	67	40	60	24	88	34	39	29	58	30	52	19	71	35	50	24
Ntchisi	25	11	44	11	61	36	59	43	80	23	29	26	55	23	44	27
Phalombe	129	60	47	50	204	100	49	67	27	13	48	19	120	58	48	45
Rumphi	18	3	17	12	146	34	23	45	191	49	26	65	118	29	22	41
Salima	51	40	78	31	159	58	36	31	51	18	35	16	87	39	50	26
Thyolo	165	27	16	26	293	155	53	66	16	9	56	13	158	64	42	35
Zomba Rural	211	110	52	38	329	112	34	33	191	39	20	20	244	87	36	30
Malawi	4453	2497	56	42	5511	2714	49	46	3387	1465	43	3	1	3810	1751	30

Table 5.2. Impact of treatment on PqTRs in treated schools

	2016-17/ 2017-18	2017-18/ 2018-19	2018-19/ 2019-20
Control	111.067 ***	108.804 ***	106.133 ***
	(1.066)	(1.284)	(0.860)
Time	5.231 ***	3.585*	1.845
	(1.789)	(2.058)	(1.508)
Treatment	3.193**	1.433	2.392
	(1.393)	(1.535)	(1.549)
DiD (Treatment and Time)	-46.187 ***	-40.099 ***	-37.431 ***
	(2.036)	(2.263)	(2.085)
Control (N)	415	299	470
Treatment (N)	912	714	330

Data Source: EMIS 2016-2019

*Note: Robust standard errors in parentheses. * p<0.10, ** p<0.05, *** p<0.01*

Table 5.7. Robustness check: Impact of PqTR reduction on repetition rate (PqTR 80)

	Overall	Lower Primary
Control in 2018	0.260***	0.272***
	(0.007)	(0.008)
Time (year=2019)	-0.009	-0.010
	(0.010)	(0.011)
Lagged Treatment	0.012	0.016
	(0.009)	(0.010)
Lagged Treatment (DiD)	-0.034***	-0.040***
	(0.012)	(0.014)
Control (N)	216	216
Treatment (N)	424	424
r2	0.03	0.03

Data Source: EMIS 2018 and 2019

*Note: Robust standard errors in parentheses. * p<0.10, ** p<0.05, *** p<0.01*

Compares rates at end 2017/18 and end 2018/19. Treated schools are those where PqTR brought below 90 in 2018.

Table 5.8. Robustness check: Impact of PqTR reduction on repetition rate (PqTR 100)

	Overall	Lower Primary
Control in 2018	0.268***	0.277***
	(0.013)	(0.015)
Time (year=2019)	-0.017	-0.016
	(0.018)	(0.020)
Lagged Treatment	-0.002	0.005
	(0.015)	(0.017)
Lagged Treatment (DiD)	-0.026	-0.033
	(0.020)	(0.023)
Control (N)	73	73
Treatment (N)	253	253
r2	0.03	0.04

Data Source: EMIS 2018 and 2019

*Note: Robust standard errors in parentheses. * p<0.10, ** p<0.05, *** p<0.01*

Compares rates at end 2017/18 and end 2018/19.

Treated schools are those where PqTR brought below 100 in 2018.