

Final report

The allocation of teachers across public primary schools in Zambia

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The Allocation of Teachers across Public Primary Schools in Zambia

Torsten Figueiredo Walter¹

06/2018

Introduction

Pupil-teacher ratios (PTRs) vary widely across public primary schools in Zambia. While the national aggregate PTR² is 44.2, the bottom 10% of schools have PTRs below 29.9 and the top 10% have PTRs above 101. Approximately 475,000 pupils, about 16% of the public primary school population, attend schools with a PTR above 80.³

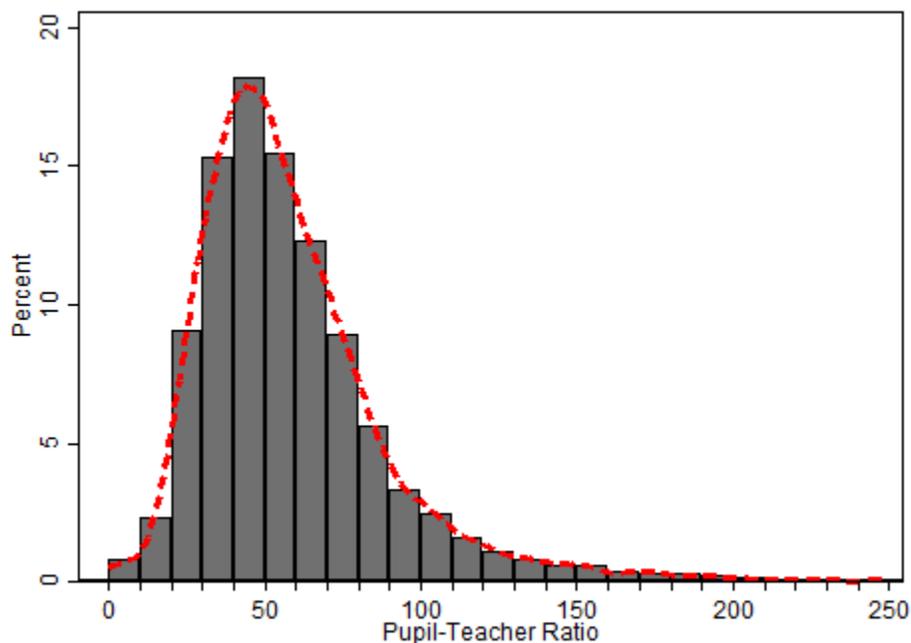


Figure 1: Distribution of PTRs across public primary schools in Zambia⁴

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² The national aggregate PTR is defined as the ratio of the total number of pupils in public primary schools over the total number of teachers in these schools.

³ Figures based on EMIS 2017. Primary schools are defined as those with an education level of “primary” and/or offering classes below grade 9 in EMIS. See appendix for details.

⁴ Figure based on the universe of public primary schools (6174) recorded to EMIS 2017.

The variation in PTRs across schools is local.⁵ A decomposition of the PTR variance reveals that the within-district variation (30.5) is far larger than the cross-district variation (12.1).⁶ At the same time, the cross-school PTR variation differs substantially across districts. As Figure 2 shows, the PTR standard deviation is relatively small in some districts and rather large in others.

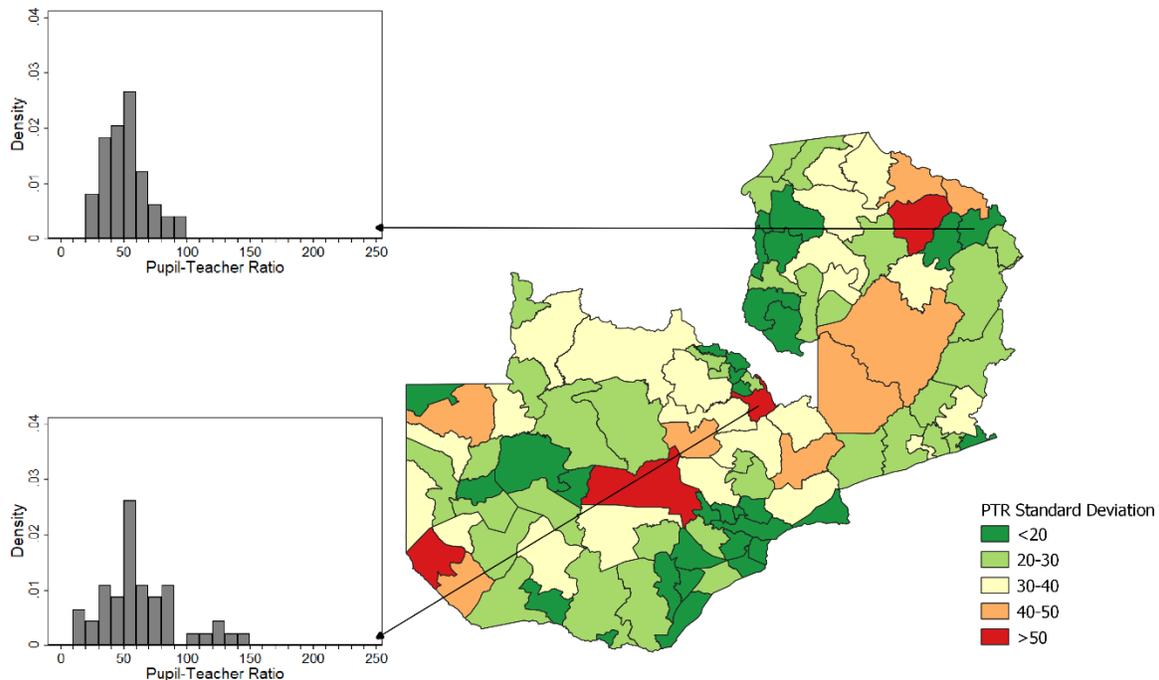


Figure 2: Standard deviation of PTRs within each district and distribution of PTRs in Isoka (top) and Masaiti (bottom) Districts

Moreover, in districts with larger cross-school PTR variation, pupil performance at national grade 7 exams in 2017 was lower - even after controlling for differences in population, economic development and aggregate PTRs (Figure 3). This suggests that PTR dispersion is not only worrisome from an equity point of view, but it also raises efficiency concerns. While these results do not prove that PTR variation causally affects educational outcomes, they definitely call for further investigation of the causes and consequences of the observed cross-school teacher distribution in Zambia. The main objective of this study is to understand the *causes* of PTR variation across Zambian public primary schools. This report traces the disparities in staffing levels back to a set of interlinked administrative and structural issues which are discussed below. These include:

1. Lack of enforcement of the Ministry's teacher allocation rule
2. Weak deployment and transfer policies
3. Payroll mismatch
4. Weaknesses in the budgeting process for teacher positions

⁵ See Figure 12 in the appendix for an illustration of local PTR variation.

⁶ Within-district variation describes how different the relative staffing levels of schools in the same district are from each other. Cross-district variation describes how different the average relative staffing levels of each district are from each other.

5. Large spatial variation in living and working conditions

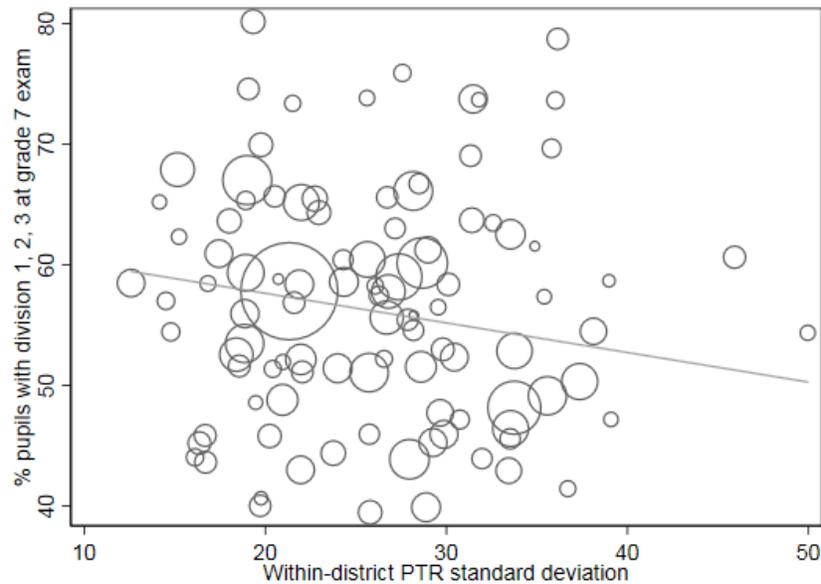


Figure 3: Pupil performance at national grade 7 examinations and within-district PTR variation across districts (after controlling for differences in aggregate district PTR, population, average nighttime luminosity⁷). Grey line is linear regression line. Districts are weighted by the number of pupils who signed up for the national grade 7 examination, illustrated by the size of the marker.

Acknowledgement

Many thanks go to government and NGO partners for their support in this analysis. In particular, I appreciate the support of the Ministry of Education's (MoE) Directorates of Human Resources, specifically Habakuku Mwale and Prince Ngulale; Planning, specifically Bupe Musonda, Billy Jere, Lancelot Mutale, and Steven Zimba; and Standards & Curriculum, specifically Vengi Sinda; the Examinations Council of Zambia, specifically Michael Chilala, Moona Hakalyamba, and Shakazo Myceze; and the Public Service Management Division, specifically Ackim Sakala, Vivien Ndhlovu, Stephen Chinama and Lufwendo Mangolwa. I would also like to thank the Zambian Education Sector Support and Technical Assistance facility for support in collecting MoE staff return data. Finally, thanks go to the International Growth Centre for financial support and Innovations for Poverty Action for support in project development.

Lack of Enforcement of Allocation Rule

In its 2015 Standards and Evaluations Guidelines, the Ministry of Education (MoE) established a rule that no school should have a PTR greater than 40.⁸ However, this rule is largely not followed, and 73% of public primary schools have PTRs greater than the required maximum. At the same time, 21% of schools have

⁷ VIIRS nighttime lights data are from the Earth Observation Group, NOAA National Geophysical Data Center. See <https://www.ngdc.noaa.gov/eog/> for details.

⁸ The 2011-2015 National Implementation Framework includes a similar goal of ensuring maximum class sizes of 40 students for all public primary schools.

more teachers than the minimum number required to meet this rule. Figure 4 shows schools' current staffing levels versus the minimum number of teachers that they would need to meet the Ministry's maximum PTR rule. As it indicates, while many schools have less than the minimum prescribed number of teachers (below the 45° line), there are also many that have well over this minimum (above the 45° line). Many of these schools could have teachers transferred to schools with fewer teachers than necessary and still have a PTR in line with the government directive. However, even if excess teachers from these schools were reallocated to schools in need of teachers, approximately 12,500 new primary school teachers would have to be hired in addition to the existing stock of teachers in order to be able to meet the target of a maximum PTR of 40 for all public primary schools.

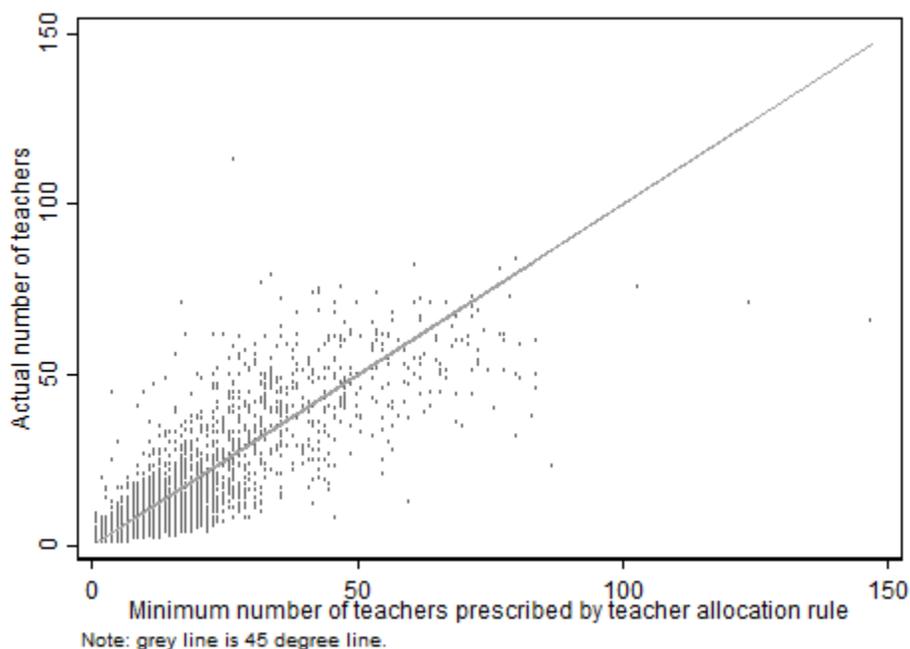


Figure 4: Actual vs. prescribed number of teachers across public primary schools

Deployment and Transfers

The deployment of teachers does not appear to be particularly responsive to current staffing needs. One would expect that more teachers are deployed to areas with higher PTRs. But figure 5 shows that there is very little correlation between the number of teachers a school would need to achieve a PTR in line with the government's mandate of 40 in 2013 and the number of new teachers deployed to that school in 2014 (both numbers per EMIS). As the figure indicates, most schools do not receive any new teachers. However, the schools that do receive teachers are often not those in the most need. In fact, many schools that already have more teachers than necessary to achieve the PTR rule receive new teachers in deployment, rather than those teachers being sent to understaffed schools. These schools, as well as those that previously had PTRs above 40 but receive more teachers than necessary to achieve the PTR rule, lie in the grey area of the plot.

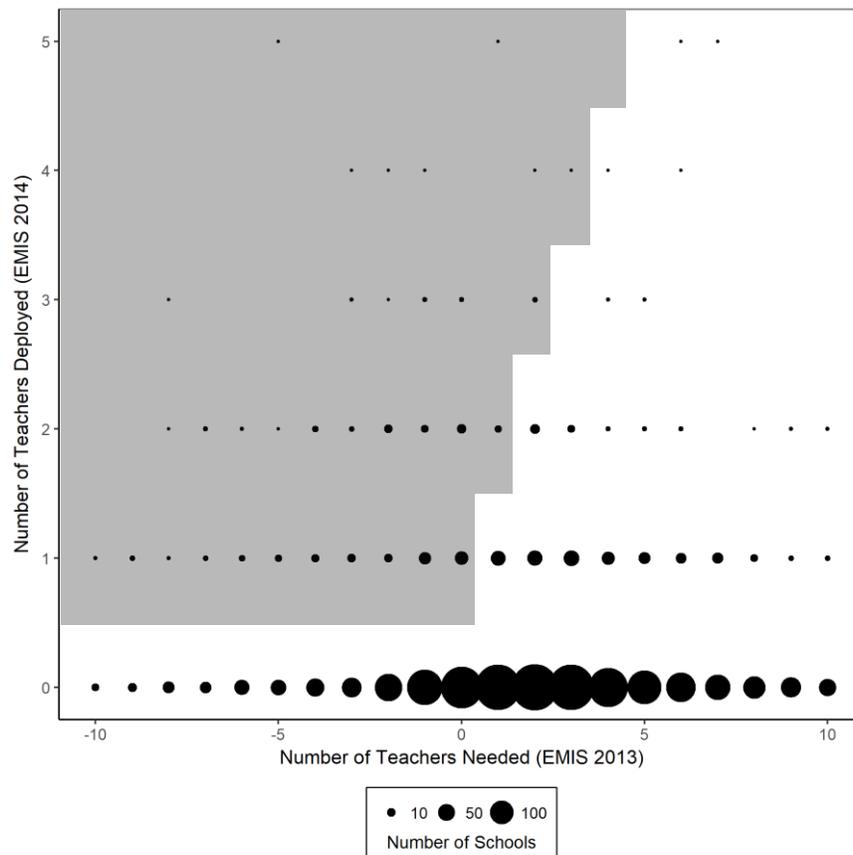


Figure 5: Need for teachers and deployment of teachers in the following year. Marker size indicates number of schools. Areas shaded in grey indicate more teachers deployed than necessary to achieve a PTR of 40.

Additionally, the teacher transfer process can contribute to unbalanced staffing patterns if transfers go from relatively understaffed to relatively overstaffed schools. Analysis of teacher movement in EMIS between 2010 and 2017 indicates that while the majority (approximately 60%) of transfers places a teacher into a school with a higher PTR than the one they come from, a large share of transfers (approximately 40%) move teachers into schools with lower PTRs than those they come from. Additionally, approximately the same number of transfers occurs from schools with PTRs above 40 to schools with PTRs below 40 (19%) as the inverse (20%). This suggests that overall transfers hardly contribute to equalizing PTRs. Moreover, it raises the question why so many transfers from understaffed schools to well-staffed schools occur.

In principle, there are regulations that limit the number of transfers and their impact on PTRs. Transfer requests must be approved by senior officers, and the government has imposed a minimum holding period at a new school before a teacher can transfer. This holding period was recently increased from two to four years. However, even with the shorter minimum it frequently has not been respected. As figure 6 indicates, over half of the teachers that transferred at some point between 2010 and 2016 did so before two years

had elapsed, and nearly 90% did so before four years.⁹ Anecdotal evidence suggests a number of causes for this including health issues that are sometimes exaggerated, teachers obtaining transfers to be with spouses, and teachers using social and political connections to obtain transfers to preferred locations.

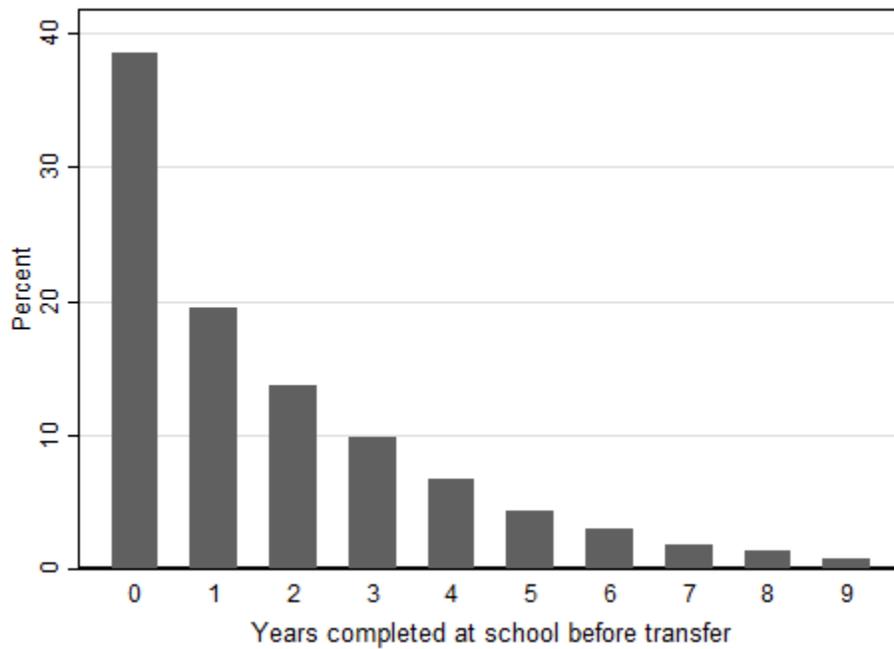


Figure 6: Distribution of holding periods (completed years) among teachers who transferred between 2010 and 2016

Payroll Mismatch

Transfers that are not in compliance with official guidelines are also likely to contribute to significant levels of payroll mismatch, another major administrative obstacle to teacher allocation. Payroll mismatch occurs when staff does not work at the organizational unit they are listed at in the government payroll system. Quantifying the exact magnitude of payroll mismatch in the education sector is difficult, however several studies have provided similar estimates. In a 2014 report on a sample of 88 schools in 4 provinces, the Office of the Auditor General (OAG) found that up to 60% of teachers do not work at the location where they are paid. A 2016 survey of 158 rural schools conducted by Innovations for Poverty Action placed this number at 40%. Analysis of 2017 staff returns collected by MoE from two provinces indicates a payroll mismatch range between 43% and 77% across districts.

Payroll mismatch is a major problem with regards to the allocation of teachers because a school may be understaffed while payroll does not show any vacancies for the school. In this case, some of the teachers on the school's payroll presumably work at other schools (or not at all). Figure 7 illustrates this problem. It

⁹ Computations based on teacher tables in EMIS 2010-2016.

plots the number of teachers reported in the payroll system versus the number of teachers reported through EMIS in 2014 for each public primary school.¹⁰ If there was no payroll mismatch, the points would all lie on the grey 45-degree line. But as the graph shows, many schools (30%) have more teachers in EMIS than on their payroll (indicating overstaffing relative to payroll), and an even larger number (61%) have more teachers on payroll than in EMIS (indicating understaffing relative to payroll).¹¹ Most teachers working at schools where EMIS teacher counts exceed the number of paypoints are likely occupying paypoints at understaffed schools, thus impeding adequate deployment of teachers to these schools.

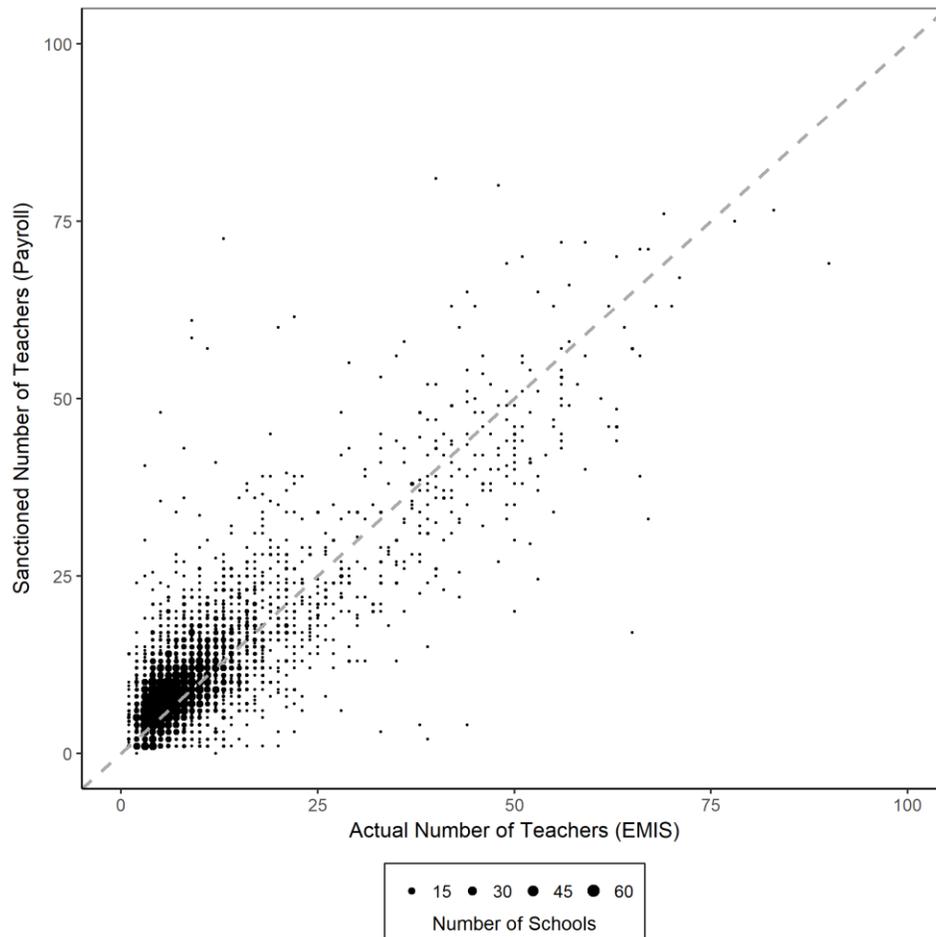


Figure 7: Number of teachers at each matched public primary school according to EMIS and payroll 2014

¹⁰ Based on 5,293 schools that can be matched between EMIS and the payroll by school name, 87% of schools in the payroll system.

¹¹ In the matched sample of schools, the total number of teachers on payroll (50,492) is larger than the total number of teachers in EMIS (44,056). Teachers that are listed on the payrolls of matched schools but not reported at any of these schools in EMIS may be working for government in unmatched primary schools, in other governmental education facilities (e.g. in secondary schools), or not at all.

Inequalities in Sanctioned Positions

The prevalence of payroll mismatch means that there are substantial discrepancies between teachers' assigned placements and their actual working locations. However, this does not mean that eliminating payroll mismatch would eliminate the observed variation in staffing levels across schools. In fact, even if the payroll perfectly reflected schools' actual staffing levels, PTRs would still vary substantially across schools. Figure 8 illustrates this by comparing the distribution of actual PTRs across public primary schools to the distribution of pupil-teacher paypoint ratios (henceforth sanctioned PTRs) across the same schools. Actual PTRs are derived from EMIS 2014 and teacher paypoints are computed based on 2014 payroll data. The figure shows that there is not only significant variation in actual PTRs, but also in sanctioned PTRs, and 40% of schools have sanctioned PTRs above 40.

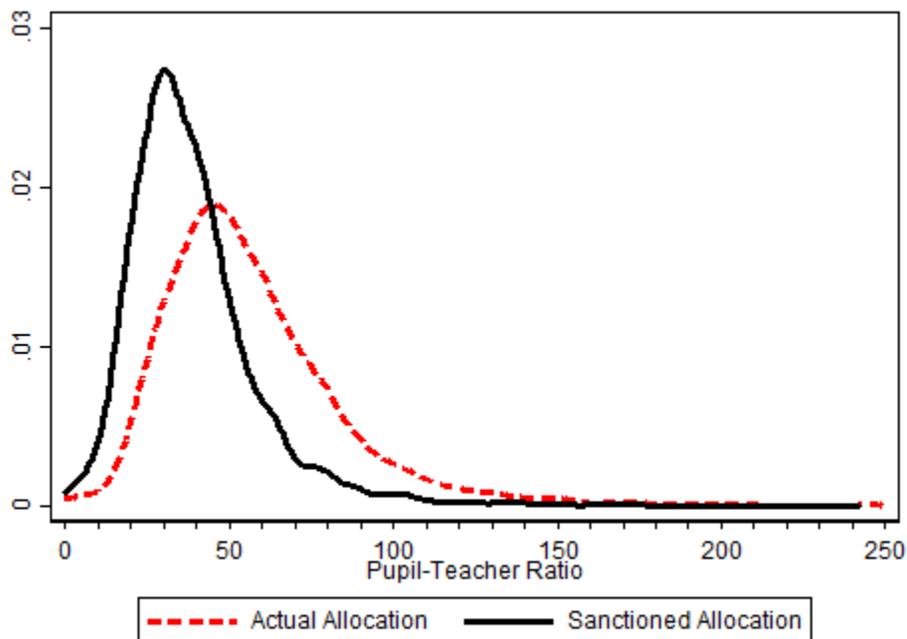


Figure 8: Actual and sanctioned distribution of PTRs across public primary schools in 2014

One of the main factors behind the dispersion in sanctioned PTRs appears to be that establishment registers are rarely updated. Once a school is opened, its establishment is rarely adjusted to reflect changes in enrollment. Between 2012 and 2016, only 10% of schools had any update, and only 8% had an update that added teachers.¹² It is also unclear how closely establishment updates reflect changes in enrolment. While schools that gained teachers did have larger increases in enrolment than schools without a change in their establishment, 90% of schools with an increase in enrolment did not see an increase in their establishment and 47% of schools that gained teaching positions saw decreases in enrolment.

Additionally, newly opened schools can take a long time to receive an establishment. Schools are frequently opened before funds are officially allocated toward fully staffing it. Even when funds are available, the process to approve an establishment is complex. Approval is needed at multiple levels of the Ministry of Education, the Public Service Management Division, and the Ministry of Finance, which opens many opportunities for the process to stall. It is difficult to estimate how many schools are functioning

¹² Only includes schools that were gazetted in both 2012 and 2016.

without an establishment, but in collaborative fieldwork with the HR department of the Ministry of Education and ZESSTA in one district found that 38% of schools did not have an establishment. Notice that Figure 8 does not take any facilities without establishment registers into account as they are not observed in payroll. Therefore, the true dispersion in sanctioned PTRs is even larger than shown in the figure.

Missing and outdated establishment registers are not only a problem for teacher allocation in and of themselves, but they also cause payroll mismatch and thus additionally affect teacher allocation indirectly through this channel. This is because district education offices need to send teachers from schools with establishment registers to schools that do not have sufficient, or any, payroll vacancies in order to guarantee the operation of these schools.

Simulation of Needs-based Teacher Allocation

If the existing stock of public primary school teachers was allocated across schools using a maximum pupil-teacher ratio rule informed by current pupil counts and this rule was strictly enforced, teachers would be distributed much more equally. Figure 9 shows how different the distribution of teachers would look in this case. Given the current stock of teachers, the smallest maximum PTR that could be achieved nationwide would be 48 (marked by the vertical line in the figure).¹³ While this is greater than the desired maximum PTR of 40, it would still represent a vast improvement for many schools over their current situation. At the same time, the implementation of such a policy would also imply PTR increases at schools that are currently well-staffed.

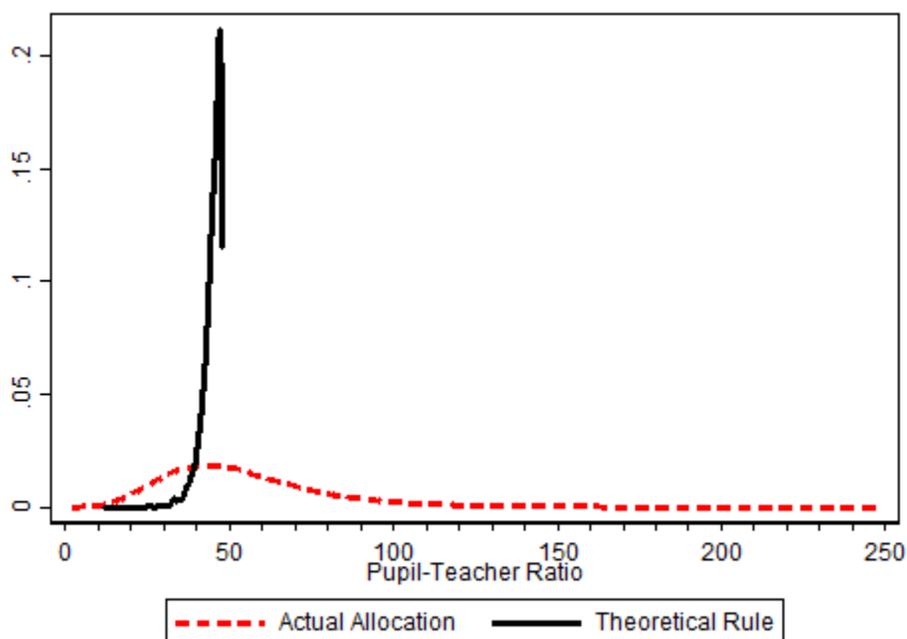


Figure 9: Actual and counterfactual distribution of PTRs across public primary schools

¹³ Based on EMIS 2017. It does not consider teachers on payroll that do not appear in EMIS.

Filling Positions in Rural Schools

If establishment registers were based on current student counts and a maximum PTR rule that is achievable under the national budget, and teachers were strictly allocated based on these establishment registers, one should not see schools with more teachers than the minimum prescribed by the rule. However, for certain schools it could be difficult to fill all vacancies because they are not attractive to teachers. Indeed, under the current system the probability that a vacancy is filled is lower in more remote and less well-equipped schools. Comparison of EMIS and Establishment Registers indicates that while the average rural school¹⁴ has 4 fewer teachers on staff than their establishment dictates, urban schools have 4 more. As Figure 10 shows, schools that are closest to their DEO tend to be overstaffed compared to the establishment register, while schools that are further away are often understaffed.¹⁵

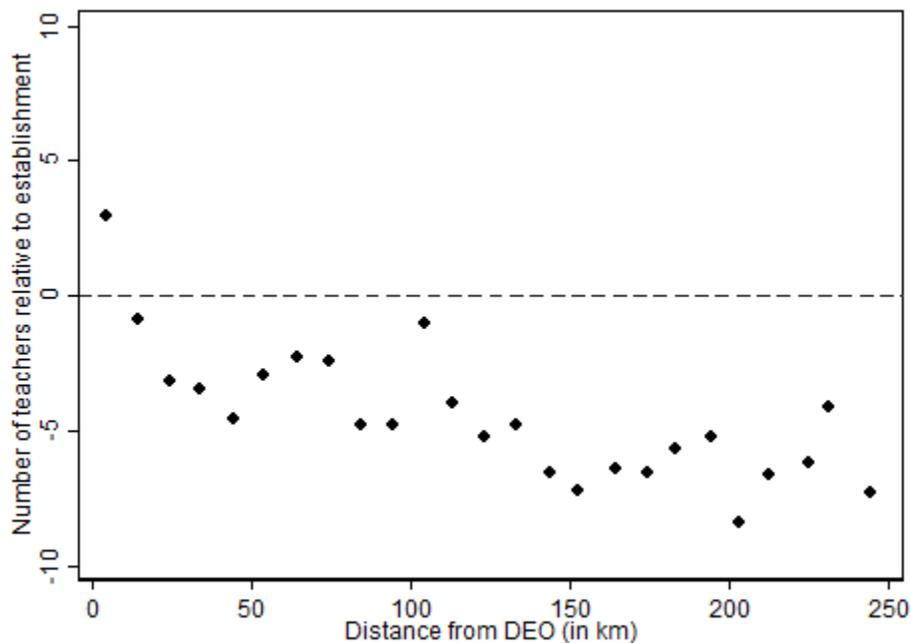


Figure 10: Average number of vacancies in a school by distance to DEO according to EMIS and Establishment Registers 2016

In order to adequately staff unattractive schools, it may be necessary to design incentive schemes for teachers. Such incentive schemes could take many different forms. One that is currently in place is the hardship allowance. However, research by Chelwa et al. (2018) suggests that the scheme is not effective¹⁶. Therefore, it could be helpful to rethink how to attract teachers to unpopular schools.

¹⁴ Rural as defined by EMIS classification.

¹⁵ Figure 10 depicts the average number of teachers in each school compared to the school's establishment within 10km bins of distance from the school's DEO. For example, the first point indicates that, on average, schools between 0 and 10 km from the DEO have about 4 more teachers than indicated by their establishment.

¹⁶ See original paper for details and a discussion of potential reasons.

Policy Recommendations

- *Eliminate payroll mismatch*

Payroll mismatch poses a major obstacle to the deployment of teachers to schools based on need. Paypoints occupied by teachers working at other schools or not working at all do not allow for the allocation of additional teachers to those schools.

- *Update establishment registers to reflect needs on the ground*

Because establishment registers are so rarely updated, they frequently do not reflect the actual staffing needs of a school. Establishing a system to regularly update establishments is essential. This includes the timely creation of establishment registers for newly opened schools.

- *Use an achievable maximum PTR rule to guide teacher allocation*

The rule that no school should have a PTR above 40 is infeasible given the current stock of teachers. Even with increased hiring, the government is unlikely to meet this goal in the near future. Using an achievable maximum PTR rule to guide teacher allocation would allow for achieving a more equitable teacher distribution.

- *Deploy new teachers exclusively to schools in need of teachers*

Because there is no reliable information on staffing levels and needs in the payroll system, deployments based on payroll are largely ineffective at providing understaffed schools with more teachers. Only when payroll mismatch has been eliminated and establishment registers have been updated based on an achievable maximum PTR rule, payroll vacancies will be truly reflective of teacher needs. At that stage, it will be crucial to prioritize schools for deployment by need.

- *Re-allocate teachers across schools to balance PTRs where possible*

While it is likely easier to place new teachers in areas with high need than it is to move existing teachers from their current working locations, there are schools with significantly more teachers than necessary. Staff should be moved from these schools to others with greater needs.

- *Enforce transfer policies*

Transfers that do not comply with the official transfer policies and are not reported in payroll increase payroll mismatch and frequently directly contribute to unbalanced staffing levels. Therefore, it is important to ensure that transfers follow the official policies and are always reported in payroll. This way any compliant transfers since the last recruitment can be taken into account at the next deployment and resulting imbalances can be addressed.

- *Revise incentive schemes to attract teachers to remote schools*

While there are salary allowances for teachers who work in rural and remote areas, these do not appear to attract enough teachers to the areas of most need. Revising these schemes as well as introducing alternative or additional ones could attract more teachers to “hard-to-staff” schools.

Ways Forward: Towards a More Equal Distribution of Teachers

This section suggests a roadmap for implementing the above recommendations, thereby addressing the staffing imbalances across schools and resolving payroll mismatch.

Collect Data on Paypoints and Actual Locations of Teachers

Good data quality on teacher allocation is the first step towards achieving a more equitable allocation. It is essential to know where every teacher actually works and where their paypoint is. One way to obtain this information is the collection and aggregation of staff returns in a way that indicates the school where each teacher is working and paid from. In collaboration with MoE HR and ZESSTA, I have developed a staff return data collection template that provides both pieces of information. MoE HR and ZESSTA worked with local officers in Chavuma district to collect this data, and MoE HR is currently using this template to collect staff returns from all district offices.

However, collecting high-quality staff return data is very time-consuming. An alternative or additional approach to gathering data on paypoints and the actual location of teachers would be the integration of the payroll system with EMIS at the teacher level. While payroll lists the paypoint of each teacher, EMIS contains lists of all teachers working at each school. In both datasets, teachers can be identified based on their names and their NRC numbers. Therefore, it is possible to compare the paypoint and working location according to EMIS for each teacher. This approach has the added benefit of allowing MoE to identify and address payroll mismatch on an annual basis. Moreover, this comparison could help to uncover teachers who are not in schools but who are on the payroll.

While nationwide high-quality data indicating teacher working and paypoint locations is currently not available, the aforementioned staff returns data from Chavuma can be used to illustrate how such data could be used. All of the following proposals are simulated using this data – combined with school-level data on the number of sanctioned positions from establishment registers and student counts from EMIS.¹⁷

Establish an Achievable Maximum PTR Rule to Guide Teacher Allocation

Given data on the number of pupils and teachers at each school and the total stock of teachers, the smallest achievable maximum PTR can be computed. In order to achieve balanced staffing, paypoints (and subsequently teachers) should be allocated to schools based on the smallest achievable maximum PTR. In the sample of 35 schools from Chavuma with complete data, this would lead to a maximum PTR of 42 for primary schools.

Update School Establishments with Regards to the Achievable Maximum PTR Rule

Once the allocation rule has been established, school establishments need to be updated accordingly. While this may be an administratively complex process, it does not require an increase in the total number of paypoints in the district and is budget-neutral in this sense. Instead, paypoints will be taken from schools with more budgeted positions than necessary to achieve the rule and added to schools with insufficient paypoints – including those that are not currently gazetted.

¹⁷ In addition to focusing on only one district, this analysis is a simplification in that it does not take frozen paypoints and paypoints for different teaching positions into account.

In Chavuma, ensuring that each school has a PTR of at most 42 leads to significant changes in school establishments. All of the 35 public primary schools with teacher and student data would have a different establishment, with 10 (29%) schools gaining teaching paypoints (including 6 (17%) that are currently ungazetted) and 25 (71%) losing paypoints.

Align Staffing with Establishments

Once paypoints reflect staffing needs to achieve the maximum PTR rule, the next step is to ensure that actual staffing levels match the payroll system. In all schools where the number of teachers is equal to or smaller than the updated number of paypoints, all teachers can be added to the school’s payroll (after removing teachers paid from a school but not working there). In Chavuma, this would be the case for 127 (52%) teachers across 22 (63%) schools. Of those, 7 (20%) schools would have the same number of teachers as paypoints, while the other 15 (43%) schools would be understaffed relative to their updated establishment. Correspondingly, there will also be a number of schools with more teachers than paypoints. Whenever this occurs, teachers need to be reallocated to understaffed schools and added to their payroll. In Chavuma, there will be 13 (37%) schools with more teachers than paypoints, and a total of 35 (14%) teachers will need to be transferred from these schools.

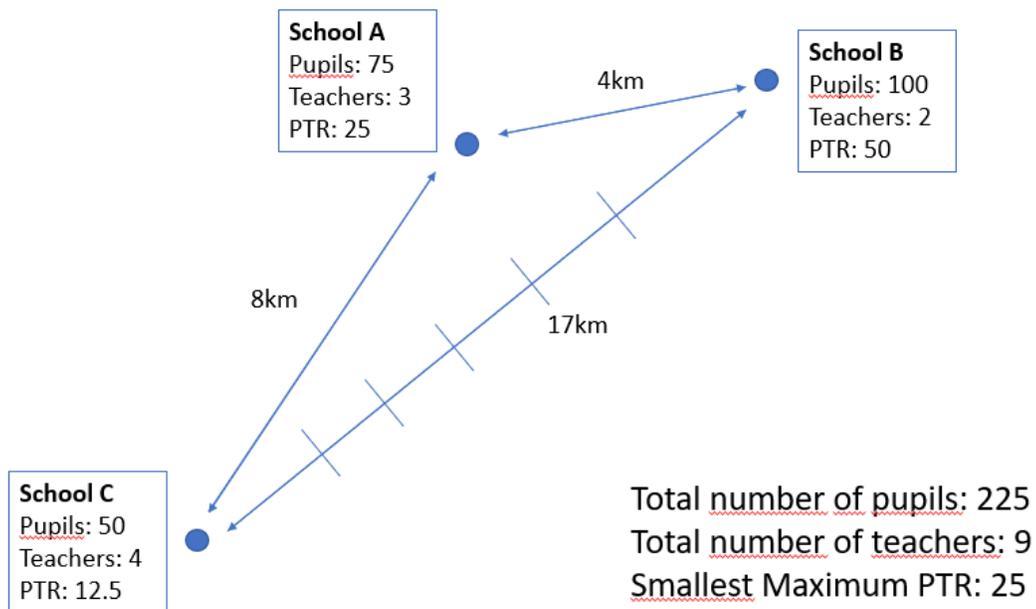


Figure 11: Illustrative example of local teacher transfer scheme

These transfers may be hard to implement in practice, especially when considering the entire country and not only Chavuma district. However, while a large-scale teacher re-allocation program will never be a simple process, it could trigger less opposition if teachers were only transferred locally. Even if re-allocation were restricted to local transfers, e.g. a maximum distance of 10km between origin and destination school, it could have a major impact on the overall equity of staffing, as PTR disparities are relatively localized. In the whole of Zambia, at least 45% of schools with a deficit of teachers to ensure a PTR of 48 (the smallest achievable PTR nationwide) are within 10km of a school with more teachers than

necessary to ensure the same level.¹⁸ If one were not only to execute transfers between pairs of nearby schools where one schools has deficit of teachers relative to the PTR rule and the other a surplus, but were to allow for a more complex arrangement of local transfers, PTRs could be equalized even more. Figure 11 illustrates how this would work. Assume the maximum transfer distance is 10km. This implies that it is not possible to transfer teachers between schools B and C. However, this is exactly what would be required here to equalize PTRs across schools: moving two teachers from School C to School B would yield a PTR of 25 at all schools. To equalize PTRs without violating the maximum transfer distance of 10km, two teachers could instead be transferred from school A to B and two teachers from C to A. While this is a simplified example, it is possible to use computer algorithms to simulate such transfer schemes at large scale and to determine how much more equal staffing levels would become given a certain maximum transfer distance (as well as potential other restrictions on transfers).

References

Chelwa, Grieve; Pellicer, Miquel; Maboshe, Mashekwa. 2018. Teachers Pay and Educational Outcomes: Evidence from the Rural Hardship Allowance in Zambia. Working paper

¹⁸ This is a lower bound due to missing school coordinates and PTR data.

Appendix

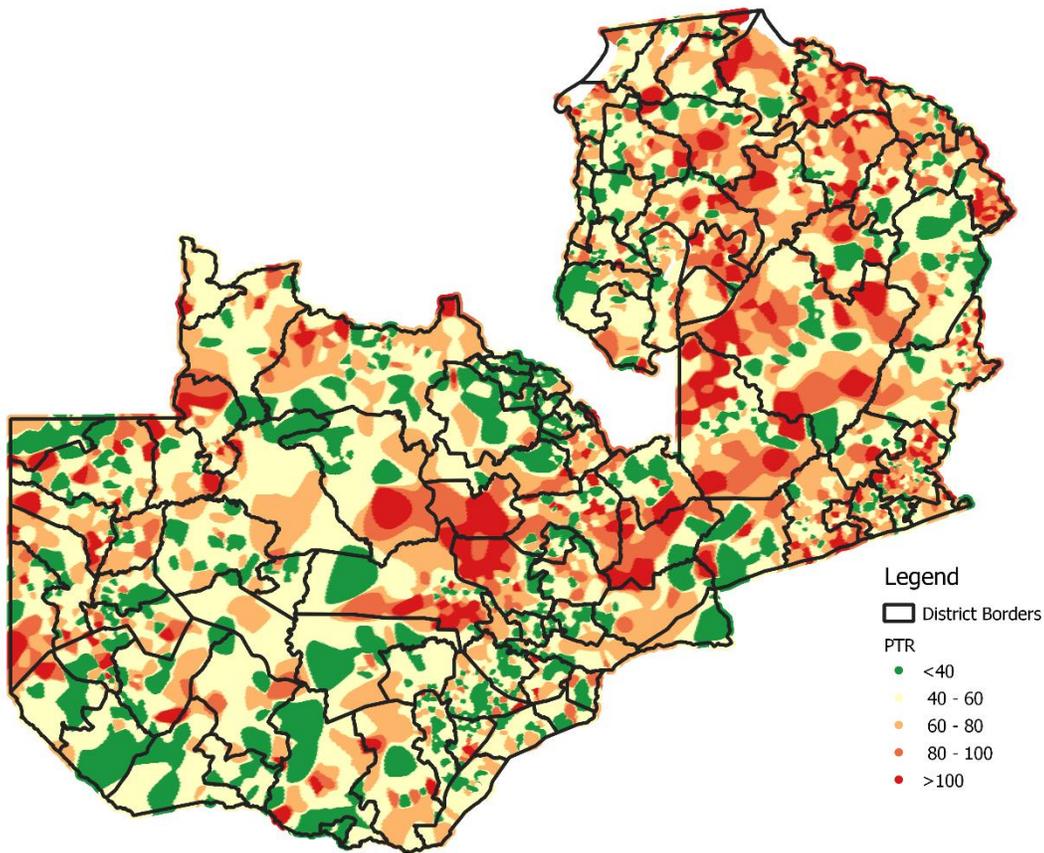


Figure 12: Heatmap of pupil-teacher ratios across schools. Based on subsample of public primary schools for which coordinates are available (~70% of all public primary schools)

Data

This report relies on the following data sources:

- EMIS – The Education Management Information System contains all the information collected through the Annual School Census. This data has been collected every year since 2000, but most analyses in this report rely on data from 2010-2017. Reported statistics may not always align with official MoE estimates due to differences in the cleaning of school identifiers.
- Payroll – The Public Service Management Division provided anonymized monthly data from the Ministry of Education payroll from September 2012-December 2014. This data indicates the location (district and organizational unit) of occupied staff paypoints.
- Establishment Registers – The Public Service Management Division annually publishes establishment registers indicating the number of staff paypoints allocated for each position in each facility throughout the country. Data from 2012 and 2016 establishment registers were used in this analysis. Establishment register data on paypoints is very similar to payroll data on

paypoints. However, the two do not align perfectly due to vacant paypoints and the policy of freezing positions that have been left unfilled.

Sample

All results from this report are based on public primary schools, as indicated by EMIS variables indicating a school's managing agency and level. Public schools are defined as any school whose running agency is GRZ. Primary schools are harder to define because multiple variables indicate a school's level. Variables are not all available in all years and can contradict each other even within the same year. The following variables are relevant towards defining school levels:

- School_lvl: range of grades taught (2001-2005)
- Grade_range_st: highest and lowest grade of students (2002-2008, 2010-2017)
- Grade_range_cl: highest and lowest grade of classes taught (2006-2008, 2010-2017)
- Edlevel_num: level of education taught in school (2004-2017)

A school is classified as primary if at least 50% of variables in a year indicate that it offers primary education. When no classification can be made for a given school in a given year, the school is classified as primary if it is classified as primary in all non-missing years.

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