Policy brief
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Where are the teachers?

The distribution of teachers across public primary schools in Mozambique

In brief

- Following the suspension of general budget support by the main bilateral donors in 2016, consequent fiscal tightening has seen the efficient use of resources in the education sector becoming a priority of the Mozambican government.
- Teachers are the largest cost component in the public education sector in Mozambique, with their compensation accounting for more than 70% of government education expenditure. Therefore, effective management of the teacher workforce is crucial.
- This project focuses on the allocation of teachers across public primary schools. Results show a large variation in school-level pupil-teacher ratios (PTRs) across schools. Surprisingly, PTRs are only tenuously correlated with school rurality and the variation is largely local: PTRs vary substantially between schools within districts.
- Public primary school pupils in districts with smaller differences in PTRs between schools tend to perform better – even if aggregate district PTRs are similar.
- While the large variation in PTRs is worrisome from an equity point of view, the negative correlation with educational outcomes raises additional efficiency concerns. The findings highlight the need for a deeper understanding of the underlying causes and the mechanisms through which the distribution of teachers is linked to educational outcomes.

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Overview of the research

The education sector has accounted for more than 20% of Mozambican government spending in recent years. Especially since the fiscal tightening following the suspension of general budget support by the main bilateral donors in April 2016, the efficient use of resources in the education sector has become a government priority.

Teachers are the largest cost component in the public education sector in Mozambique. Their compensation accounts for more than 70% of government education expenditure. Additionally, they constitute a key input into education. Lack of teachers, as measured by high school-level pupil-teacher ratios (PTRs), has been shown to negatively affect pupil achievement[1], whether through large class sizes, shortened instruction times, or an increased probability of multi-grade teaching. Therefore, an effective management of the teacher workforce is crucial.

This project takes a first step towards assessing the efficiency of teacher allocation across schools. The central questions this project addresses are:

1. How are teachers currently distributed across public primary schools relative to enrollment?
2. Are distributional patterns at the district level correlated with educational outcomes?

To answer these questions, first the distribution of PTRs across public primary schools is described using data from the Mozambican School Census 2016 on the universe of public schools. Second, within-district PTR dispersion across schools is correlated with district-level measures of educational performance.

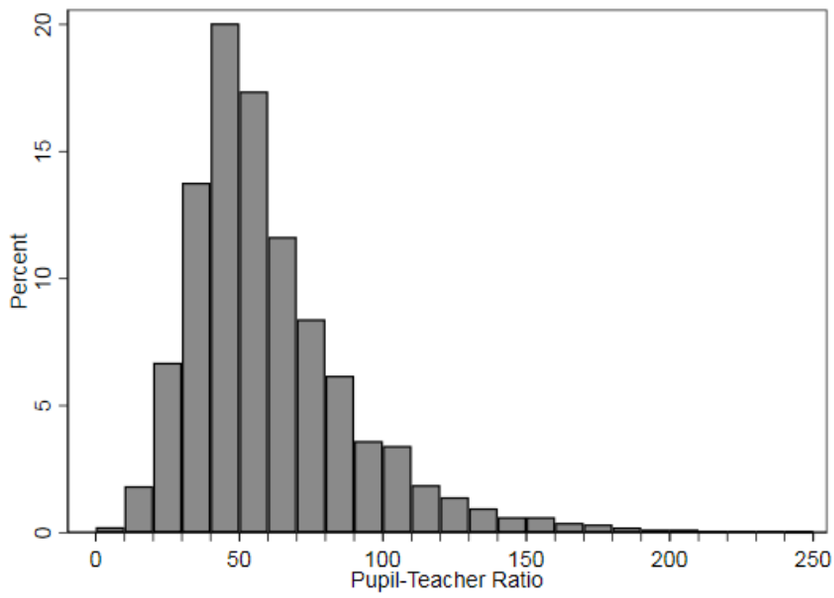
Key findings

'This dispersion in PTRs across schools is substantial and among the largest in the world'

Results show that there is substantial variation in PTRs across schools (see Figure 1). While the average PTR is 53.6, the bottom 10% of schools have PTRs below 31 and the top 10% have PTRs above 100. This dispersion in PTRs across schools is substantial and among the largest in the world[2].

1. See Muralidharan & Sundararaman (2013): "Contract Teachers: Experimental Evidence from India" (NBER Working Paper No. 19440).
2. Based on related comparative research by the principal investigator across more than 70 countries.

Figure 1: PTR distribution across public primary schools

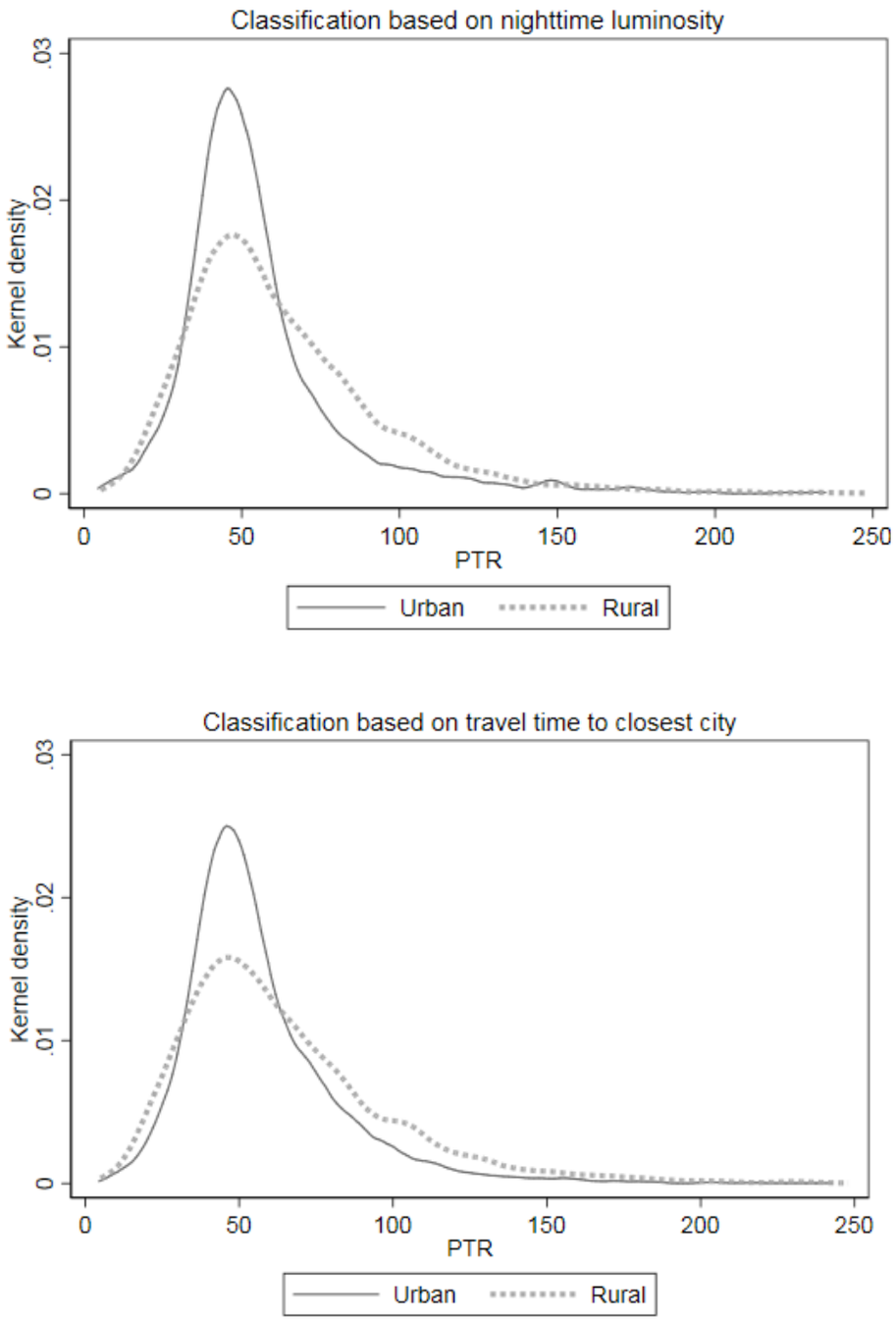


Surprisingly, school-level PTRs are only weakly correlated with the school rurality. Figure 2 shows the distribution of PTRs across rural and urban schools, using two different measures to classify schools as rural or urban. The graph on the left-hand side divides schools into rural and urban based on nighttime luminosity[3], the graph on the right-hand side based on travel time to the closest city[4]. While PTRs are on average slightly higher in rural areas, there is large variation in PTRs across schools within both the rural and the urban sphere.

The spatial variation in PTRs across schools is also illustrated in Figure 3. The map includes all public primary schools for which coordinates are available (90%) and uses different shades of red and green to indicate high and low PTRs, respectively. It is evident that PTRs do not only vary substantially across provinces and districts, but also within these[5].

3. Schools classified as urban if nighttime luminosity is above the median, and as rural otherwise. Data source: VIIRS nighttime lights 2015 data from the Earth Observation Group, NOAA National Geophysical Data Center. Matched to schools using school GPS coordinates from Carta Escolar.
4. Schools classified as urban if travel time to the closest city is below the median, and as rural otherwise. Data source: Accessibility to Cities dataset from the Malaria Atlas Project at Oxford University. See Weiss et al. (2018): "A global map of travel time to cities to assess inequalities in accessibility in 2015" (Nature) for details. Matched to schools using school GPS coordinates from Carta Escolar.
5. A variance decomposition confirms this impression: the within-province PTR standard deviation (28.4) is much larger than the between-province standard deviation (12.6). Similarly, the within-district PTR standard deviation (25.4) exceeds the cross-district standard deviation (16.7).

Figura 2: Distribuição do RAP nas escolas rurais e urbanas

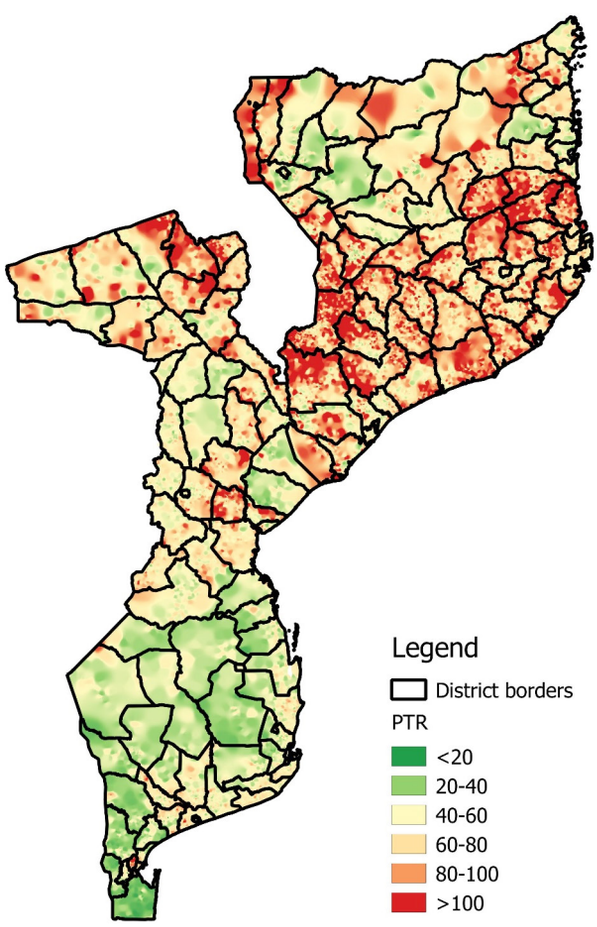


In some districts, differences in PTRs between schools are large while in others, PTRs are relatively similar. Figure 4 shows the distribution of PTRs across public primary schools in Chifunde district and Macanga district. Aggregate PTRs are very similar in these two districts, amounting to 67 in Chifunde and 69 in Macanga. However, PTRs vary much more between schools in Chifunde than in Macanga. Notably, student performance

is significantly better in Macanga. Average annual grade completion in Macanga is 85%, but only 78% in Chifunde even though Chifunde has the lower aggregate PTR. This negative relationship between student performance and PTR differences between schools holds more generally. On average, students in districts with less variation in PTRs perform better – even if aggregate PTRs are similar[6]. This suggests that there may be substantial efficiency gains from distributing teachers more equally . As long as performance losses at low-PTR schools are outweighed by gains at high-PTR schools, re-allocating teachers from low-PTR to high-PTR schools would increase overall educational performance.

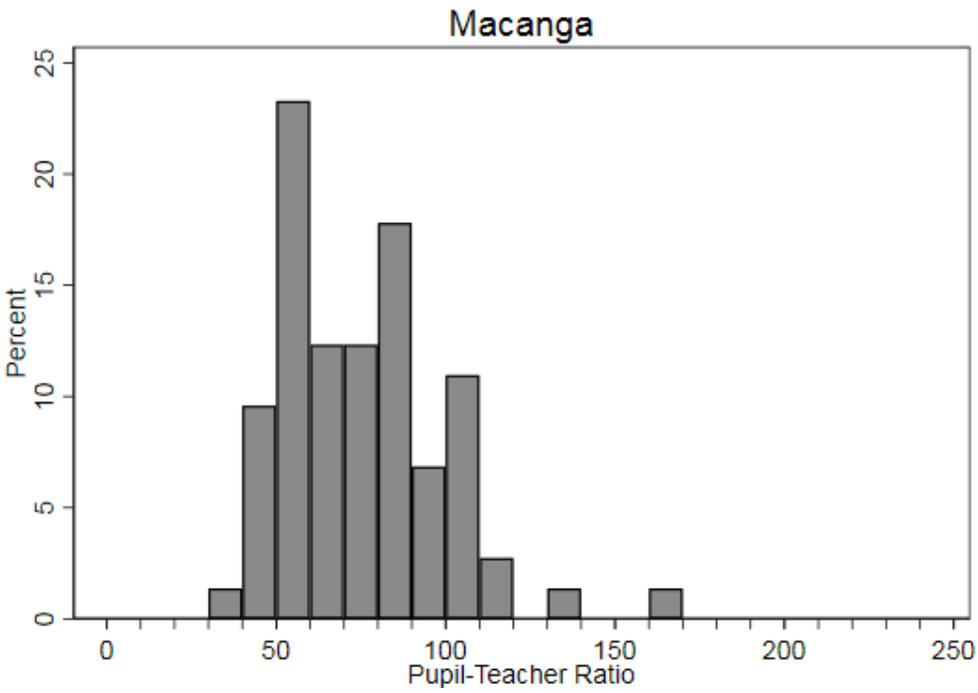
'This suggests that there may be substantial efficiency gains from distributing teachers more equally'

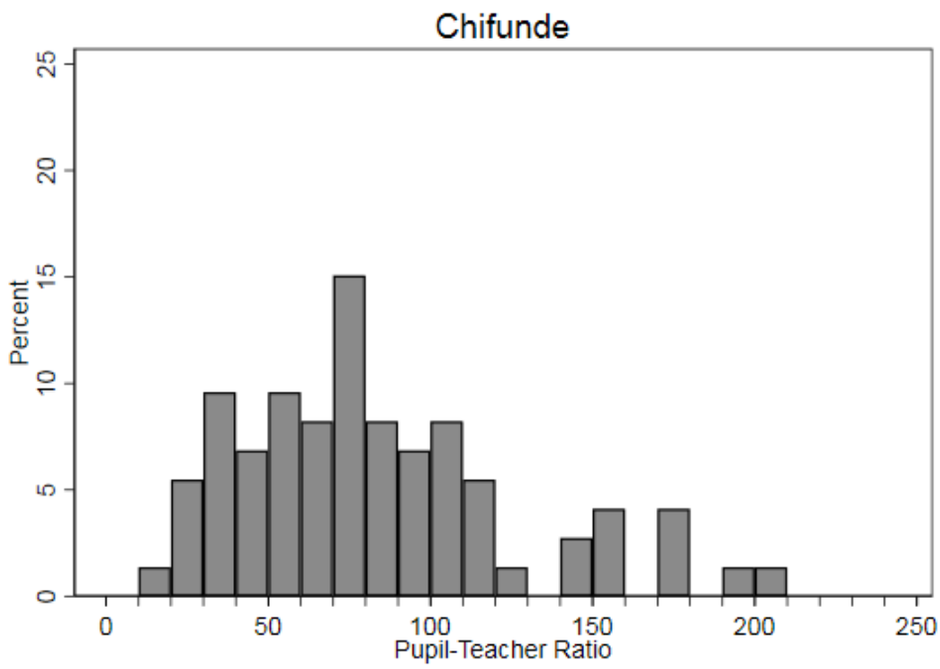
Figure 3: Heatmap of PTRs at public primary schools in Mozambique



6. An increase in within-district standard deviation from 25th to the 75th percentile in the cross-district distribution is associated with a 3.3 percentage point decrease in the pass rate – even after controlling for differences in aggregate district PTRs, population, and economic development as measured by nighttime luminosity. Controls for population and local economic development are derived from the 2017 population census and 2015 VIIRS nighttime lights data from the Earth Observation Group, NOAA National Geophysical Data Center.

Figure 4: PTR distribution in Macanga and Chifunde





Policy recommendations

- **Understand and address the causes of PTR variation.**

  The reported variation in PTRs across schools is large and raises equity concerns. It is essential to investigate the underlying causes in order to understand how these concerns could be addressed. Anecdotally, lack of school infrastructure, such as teacher housing and classrooms, and administrative weaknesses are important factors.

- **Understand the drivers of the negative association of PTR dispersion with educational outcomes.**

  It has been shown that PTR dispersion is negatively associated with educational performance, but it remains unclear through which channels dispersion and performance are linked. A clear understanding of this link, however, will be crucial to be able to address associated performance deficits. There could be a direct effect of dispersion on performance as outlined above. In this case, efficiency gains from teacher redistribution loom large. But it is also possible that both large PTR differences and weak pupil performance are merely the reflection of a third factor, such as weak management at the district education office.