Statistical analysis of Educational data of Tanzania

Consultancy for Mokoro - World Bank evaluation project

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# Introduction and empirical strategy

This report is part of an assessment commissioned by the World Bank (WB) Results in Education for All Children (REACH) for ‘Evaluating Results-Based Financing (RBF) in the Education Sector: Country Level Analysis’ and executed by Mokoro.

This report focuses on the results of RBF (B3) answering the following evaluation questions:

* Was there evidence of improved results to which RBF contributed?
* To what degree, and in what ways?
* Has behaviour change occurred, where and to what extent? Have changes been sustained?

We focus our analysis on DLI 4.2. and DLI 6.2:

* 4.2. LGAs meet annual target for schools achieving acceptable primary pupil-teache ratios range local governments
* 6.2. Meet annual target of improvement in average Kiswahili words per minute in 3R assessment among Standard 2 students, which relate to improvement in learning outcomes.

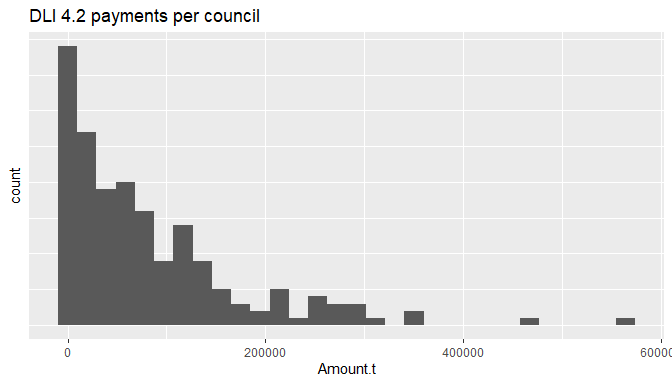
The analysis is structured in three main sessions, followed by an Appendix. The first section describes contextual and payment data. The second section focuses on descriptive and inferential analysis of data related to DLI 4.2., while the third section approaches DLI 6.2. There are 3 different sources of learning outcomes that will be analysed, namely, PSLE, SFNA and Uwezo.

# Contextual and payments dataset

* lgacontrols: 89 variables ranging from population, poverty, government expenditure, data on educational system. Data ranges from 2015-2019. Not all data has complete series.
* payments\_alldrs: 9 variables. Payments in dollars per DLI between 2015 and 2019, disaggregated at council level (LGA).
* Between 184 and 185 LGA are elegible, although not all of them receive funds.
* Not all DLI are paid across range of years.
* payments\_alldlrs.c: DLI payments are aggregated at council and DLI (losing time dimension) to use in the analysis of DLI 4 - PTR (only data on 2015 and 2019, a before/after).
* About DLI 4.2: Average amount received: 82016$, std. dev: 92569; 33 councils received 0. Quartiles: 1st: 14782, 3rd: 115000
* DLI 4.2 over time: many councils with 0; year 2018 is the highest average: 33880, std. dev 65192. years 2016 and 2017 average lower: 16141, 11207, respectively.
* There is no available data for DLI 6.2. Considering learning outcomes are a desired impact of an educational system with different factors influencing its results, we use the aggregated DLI resources to assess its association to learning outcomes.

DLI payments per year - potential councils

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | 2016 | 2017 | 2018 | 2019 |
| **2.2** | 184 | 0 | 0 | 0 |
| **2.3** | 0 | 0 | 185 | 185 |
| **3.2** | 184 | 184 | 184 | 184 |
| **4.2** | 184 | 184 | 184 | 185 |
| **7.1** | 0 | 184 | 185 | 185 |
| **7.2** | 0 | 0 | 185 | 185 |
| **8.2** | 0 | 0 | 0 | 185 |



Aggregated DLI 4.2 payments - Descriptive statistics

|  |  |  |  |
| --- | --- | --- | --- |
| count | Mean.Amount.t | SD.Amount.t | Councils not receiveing money for DLI 4.2 |
| 184 | 82016 | 92569 | 33 |

DLI 4.2 payments per year - Descriptive statistics

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Year | count | Mean.Amount | SD.Amount | Councils not receiveing |
| 2016 | 184 | 16141 | 48358 | 131 |
| 2017 | 184 | 11207 | 29187 | 133 |
| 2018 | 184 | 33880 | 65192 | 82 |
| 2019 | 185 | 20676 | 47083 | 127 |

# DLR 4 - Pupil teacher ratio

## Descriptive analysis

As DLR 4 payments are linked to reaching the the acceptable cutoff on PTR, there is a risk of endogeneity/reverse causality on the analysis.

16,631 schools surveyed in 2015 were matched to 2019 schools, of which 173 did not have teacher counts and 137 of those did not have pupil counts. As a result 96% of the national total enrolment in 2015 is placed in one of the 16,457 matched schools. Songwe LGA was dropped due to a lack of identifiable 2015 schools. 17,352 schools are present in 2017 and 17,792 are found in 2019. Aggregated PTR (without dealing with outliers) has increased over time from 46.2 in 2015 to 54.4 in 2019, while the distribution remains similar over time (see Table ??).

Summary PTR with outliers

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| year | n | PTR.median | PTR.mean | PTR.sd |
| 2015 | 16457 | 42 | 46 | 25 |
| 2017 | 17352 | 47 | 51 | 24 |
| 2019 | 17792 | 52 | 54 | 26 |

## Outliers treatment and selection of schools for analysis

### School level

Figure 1 shows school-level data for pupil-teacher ratios across years 2015, 2017 and 2019. Colours represent each regions. It is possible to observe a wide interquartile range in all years, a significant number of outliers on the upper bound and also values close to 0. This suggests the need to address data quality systematically.

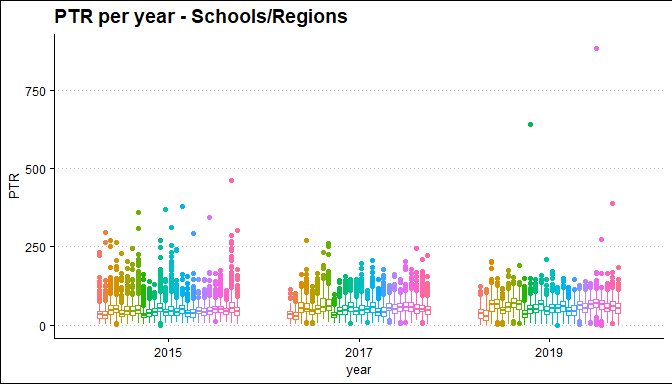


Figure 1: PTR

Among different alternatives of data quality analysis (see Appendix for analysis done through IQR and Mahalanobis distance), we chose to detect outliers based on z-scores distance from the mean. Figure 2 presents all schools identified as outliers with distances ranging from ± 3 to +32.5 standard deviations from the mean where schools in year 2019 shows the most extreme cases. Additionally, we present the absolute PTR for selected schools as a reference. For instance, the maximum value of PTR found was 884, equivalent to 32.5 standard deviations.

The criteria to exclude observations relies on the previous outliers analysis as well as a preference for longitudinal data. Any school falling under at least one of the criteria was excluded from the sample following this order:

* Negative numbers in pupils, teachers or PTR
* plus/minus PTR 3 SD assessed separately by each year
* difference within schools > 3SD or < 3SD
* in case of PTR very lows, exclusion of PTR < - 2 SD (as -3SD falls into the negative realm of values)
* schools without 3 observations (2015, 17 and 19)

By doing this, we lose 8.3% of the observations and won’t affect statistical power (51,786 to 47,778 observations), having a balanced panel of 15,926 schools.

Figure 2 presents identified outliers observations, where is possible to observe years 2017 and 2019 have outliers in the lower bound, and 2019 shows the largest range of outliers.

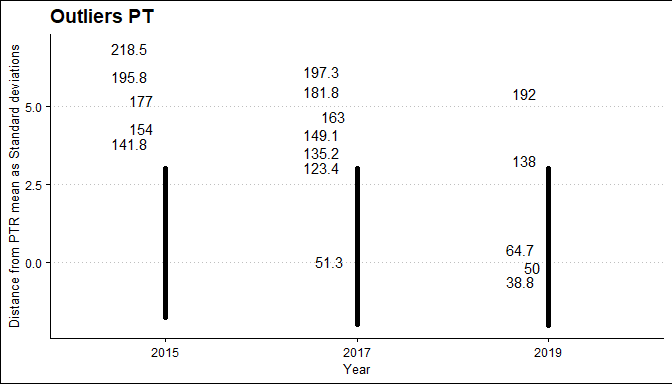


Figure 2: Outliers detection

Table ?? displays summary statistics such as mean, median and standard deviation for PTR after discarding outliers across years, where all statistics shows a consistent growth over time. While mean values are not affected after removing schools, the median and standard deviations changed significantly. Additionally, while number of students increased over time, the same did not happened to the number of teachers in the same proportion.

Summary PTR without outliers

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| year | schools | Students | Teachers | Median.ptr | Mean.ptr | SD.ptr |
| 2015 | 15926 | 7628359 | 187569 | 42 | 44 | 19 |
| 2017 | 15926 | 8595837 | 182762 | 47 | 50 | 21 |
| 2019 | 15926 | 9647654 | 185042 | 53 | 55 | 22 |

### Council level

School PTR across councils have deteriorated between 2015 and 2019. The overall average of schools with a PTR over 50 (which was the standard in 2015) growths from 31% in 2015, 43% in 2017 and 56% in 2019. While the share dispersion measured by the standard deviation, also increases form 19% to 26% in the period (see Table ??).

Share of schools with PTR > 50 - Descriptive statistics

|  |  |  |  |
| --- | --- | --- | --- |
| year.ptr | Median | Mean | SD |
| 2015 | 0.3 | 0.31 | 0.19 |
| 2017 | 0.47 | 0.43 | 0.24 |
| 2019 | 0.59 | 0.56 | 0.26 |

An ideal surplus of teachers per council was computed as , which gives an idea of the ability of the council to achieve equity in the distribution of teachers. A major caveat of this calculation relies on the fact that students cannot follow the same ideal distribution due to household location, school resources and population age structure. However, this allows to understand the magnitude of gaps to be covered.

Figure ?? shows the average PTR per council and the ideal distribution of teacher surplus across years (each teacher allocated to 50 students). The best allocation of teachers will be across the horizontal 0 line, which represents no surplus of teachers in terms of actual PTR. The green area captures those councils that fall under the PTR threshold of 50, and diverse rates of efficiency on allocation. The read box represents councils both having an ideal surplus and a current PTR over 50. While it occurs, there is not excessive misallocation of teachers. Finally, the yellow are represents those councils that are above the PTR threshold and present a teacher’s deficit, which makes impossible reaching an average of PTR below or equal to 50 with current resources. In 2019 allocation on that area presents greater inequality than previous years.

There is a strong negative linear correlation between PTR and ideal teacher surplus (-.70, -.80 and -.87) across years (see Table ??). Both tails, in the negative and positive side, show different patterns. With a PTR less than 50, found in the left upper quadrant (green), there is a larger variance between councils in terms of teachers surplus, which suggests different levels of efficiency. However, the majority of councils on yellow and red areas could be considered efficient in terms of teachers allocation due to the lack of teachers’ surplus. This is also confirmed by the strong correlation (.95 across all years) between average PTR and share of schools with PTR above 50 per council (see Table ??).

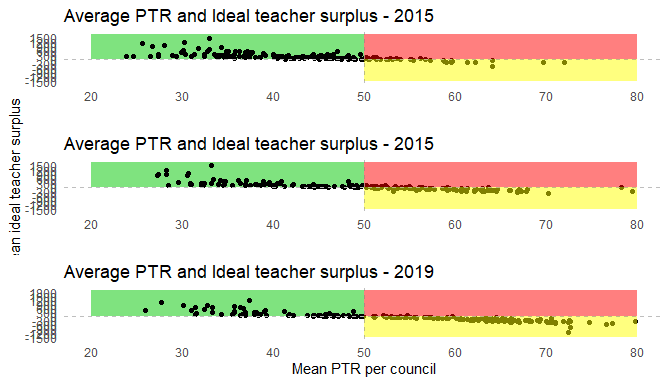


Figure 3: Average PTR and Ideal teacher surplus

Correlation PTR and ideal teacher distribution by council

|  |  |
| --- | --- |
| year.ptr | cor |
| 2015 | -0.7031859 |
| 2017 | -0.798178 |
| 2019 | -0.8742339 |

Correlation PTR and share of schools above PTR >50

|  |  |
| --- | --- |
| year.ptr | cor |
| 2015 | 0.9548447 |
| 2017 | 0.9518025 |
| 2019 | 0.9514969 |

## Inferential analysis

## Min. 1st Qu. Median Mean 3rd Qu. Max.   
## 2.379 34.900 47.329 49.814 62.600 130.400

### School level

Turning to the analysis of PBR, we model multilevel mixed-effect regressions allowing for random intercepts and slopes vary at provinces. These models are known as conditional growth curves and have the advantage of allowing variance occur within clusters and over time. All parameters are significant (p<.05). This models are similar to mixed-effects ANOVA to account for between- and within- clustered differences. The equation is written as:

where is the variable of interest of district at year, and are the fixed intercept and slopes respectively, and are the random intercept and slopes for Province, and is the residual. Finally, represents a set of predictors, being of our interest the ammount of money received for the DLI 4.2 and , a dummy variable identifying districts with a PTR > 50 in 2015.

While the interaction between and is of our main interest as predicting changes on PTR, we perform our analysis starting by studying each term separately and adjusting for each other in Models (1)-(3). Model (4) shows a statistically significant interaction between year (in relationship to baseline 2015) and the total amount received, associated with a decrease of PTR. As values are presented as z-scores, parameters are considered small effect sizes (-.14 and -.07). Descriptive statistics of the database is found in Appendix.

##   
## ================================================================================================  
## Dependent variable:   
## -------------------------------------------------------------------  
## scale(PTR)   
## (1) (2) (3) (4)   
## ------------------------------------------------------------------------------------------------  
## scale(Amount.t) 0.065\* 0.068\*\* 0.040   
## (-0.0005, 0.130) (0.002, 0.134) (-0.027, 0.108)   
##   
## year.ptr2017 0.286\*\*\* 0.286\*\*\* 0.280\*\*\*   
## (0.240, 0.332) (0.240, 0.332) (0.234, 0.325)   
##   
## year.ptr2019 0.534\*\*\* 0.534\*\*\* 0.523\*\*\*   
## (0.479, 0.589) (0.480, 0.589) (0.471, 0.575)   
##   
## scale(Amount.t):year.ptr2017 -0.070\*\*\*   
## (-0.119, -0.021)  
##   
## scale(Amount.t):year.ptr2019 -0.144\*\*\*   
## (-0.200, -0.088)  
##   
## Constant -0.367\*\*\* -0.297\*\*\* -0.290\*\*\* -0.294\*\*\*   
## (-0.426, -0.307) (-0.357, -0.236) (-0.351, -0.229) (-0.355, -0.233)  
##   
## ------------------------------------------------------------------------------------------------  
## Observations 47,583 47,583 47,583 47,583   
## Log Likelihood -60,185.520 -60,087.780 -60,088.490 -60,081.020   
## Akaike Inf. Crit. 120,389.000 120,195.600 120,199.000 120,188.000   
## Bayesian Inf. Crit. 120,468.000 120,283.300 120,295.500 120,302.100   
## ================================================================================================  
## Note: \*p<0.1; \*\*p<0.05; \*\*\*p<0.01

We also normalised councils’ received amounts by student, such as in and run the same models. Coefficients for are consistently statistically significant showing a negative sign, which suggests an association between an increase of amount/student and time and the reduction of PTR. Model (4) shows interactions with statistical significance although small effects (less than .01 z-scores).

##   
## =============================================================================================  
## Dependent variable:   
## -------------------------------------------------------------------  
## scale(PTR)   
## (1) (2) (3) (4)   
## ---------------------------------------------------------------------------------------------  
## scale(am.st) -0.314\*\*\* -0.313\*\*\* -0.258\*\*\*   
## (-0.324, -0.304) (-0.323, -0.303) (-0.273, -0.243)  
##   
## year.ptr2017 0.286\*\*\* 0.268\*\*\* 0.266\*\*\*   
## (0.240, 0.332) (0.222, 0.315) (0.221, 0.311)   
##   
## year.ptr2019 0.534\*\*\* 0.505\*\*\* 0.501\*\*\*   
## (0.480, 0.589) (0.449, 0.562) (0.448, 0.554)   
##   
## scale(Amount.t) 0.280\*\*\* 0.068\*\* 0.283\*\*\* 0.244\*\*\*   
## (0.218, 0.343) (0.002, 0.134) (0.220, 0.345) (0.180, 0.307)   
##   
## scale(am.st):year.ptr2017 -0.087\*\*\*   
## (-0.109, -0.064)  
##   
## scale(am.st):year.ptr2019 -0.097\*\*\*   
## (-0.120, -0.074)  
##   
## Constant -0.341\*\*\* -0.290\*\*\* -0.275\*\*\* -0.279\*\*\*   
## (-0.398, -0.285) (-0.351, -0.229) (-0.333, -0.218) (-0.337, -0.221)  
##   
## ---------------------------------------------------------------------------------------------  
## Observations 47,583 47,583 47,583 47,583   
## Log Likelihood -58,337.810 -60,088.490 -58,250.290 -58,214.660   
## Akaike Inf. Crit. 116,695.600 120,199.000 116,524.600 116,457.300   
## Bayesian Inf. Crit. 116,783.300 120,295.500 116,629.800 116,580.100   
## =============================================================================================  
## Note: \*p<0.1; \*\*p<0.05; \*\*\*p<0.01

### Additional analysis

We focus on the analysis of possible linkages between good/bad teacher management (our current measure is LGA-level variation in PTR) and other forms of success, including early learning (measured by Uwezo achievement), and primary completion (measured by survival rates). We adjust for sociodemographic and system efficiency characteristics. We can observe although the amount of money is linked to the outcomes in models (1)-(3) in the expected direction (reduction of survival rate and increase of learning scores), PTR does not show a significant association in any model. They are also not significant in models with interactions with Amount of money received by the council.

##   
## ===========================================================================================================================================  
## Dependent variable:   
## -------------------------------------------------------------------------------------------------------------------  
## scale(surv19) scale(uwezo17\_kiswahili\_competence) scale(uwezo17\_english\_competence) scale(uwezo17\_math\_competence)  
## (1) (2) (3) (4)   
## -------------------------------------------------------------------------------------------------------------------------------------------  
## scale(PTR) -0.000 0.000 -0.000 0.000   
## (0.000) (0.000) (0.000) (0.000)   
##   
## scale(Amount.t) -0.103\*\*\* -0.040\*\*\* 0.070\*\*\* -0.076\*\*\*   
## (0.004) (0.005) (0.005) (0.005)   
##   
## year.ptr2017 -0.003\*\* 0.00002 0.0004 -0.0003   
## (0.001) (0.001) (0.002) (0.001)   
##   
## year.ptr2019 0.012\*\*\* -0.0003 0.0004 -0.001   
## (0.002) (0.002) (0.002) (0.001)   
##   
## scale(`Total Primary`) 0.000 -0.000 -0.000 -0.000   
## (0.000) (0.000) (0.000) (0.000)   
##   
## scale(`Total Teachers`) -0.000 0.000 0.000 0.000   
## (0.000) (0.000) (0.000) (0.000)   
##   
## scale(surv18) 0.917\*\*\* 0.056\*\*\* 0.164\*\*\* 0.164\*\*\*   
## (0.004) (0.005) (0.006) (0.006)   
##   
## scale(surv17) 0.287\*\*\* 0.317\*\*\* 0.258\*\*\* 0.068\*\*\*   
## (0.004) (0.006) (0.007) (0.006)   
##   
## scale(povertyregion) 0.093\*\*\* 0.035\*\*\* -0.043\*\*\* -0.203\*\*\*   
## (0.004) (0.006) (0.006) (0.006)   
##   
## neverenrol\_uw2015\_pct 0.002\*\*\* -0.085\*\*\* -0.042\*\*\* -0.065\*\*\*   
## (0.0004) (0.001) (0.001) (0.001)   
##   
## Constant 0.073\*\*\* 1.983\*\*\* 0.901\*\*\* 1.478\*\*\*   
## (0.011) (0.016) (0.018) (0.017)   
##   
## -------------------------------------------------------------------------------------------------------------------------------------------  
## Observations 41,469 15,828 15,828 15,828   
## Log Likelihood 566,377.400 214,087.100 203,319.600 212,136.600   
## Akaike Inf. Crit. -1,132,719.000 -428,138.200 -406,603.200 -424,237.200   
## Bayesian Inf. Crit. -1,132,563.000 -428,000.200 -406,465.100 -424,099.200   
## ===========================================================================================================================================  
## Note: \*p<0.1; \*\*p<0.05; \*\*\*p<0.01

##   
## =============================================================================================================================================  
## Dependent variable:   
## ------------------------------------------------------------------------------------------------------------------  
## scale(surv19) scale(uwezo17\_kiswahili\_competence) scale(uwezo17\_english\_competence) scale(uwezo17\_math\_competence)  
## (1) (2) (3) (4)   
## ---------------------------------------------------------------------------------------------------------------------------------------------  
## scale(PTR) -0.000 -0.000 -0.000 0.000   
## (0.00000) (0.00000) (0.00000) (0.00000)   
##   
## scale(Amount.t) 0.042\*\*\* 0.009\*\* 0.040\*\*\* -0.019\*\*\*   
## (0.004) (0.004) (0.005) (0.005)   
##   
## year.ptr2017 0.00000 0.00000 0.000 0.000   
## (0.001) (0.0001) (0.0001) (0.00000)   
##   
## year.ptr2019 0.00000 0.00003 0.000 0.00000   
## (0.001) (0.002) (0.0003) (0.004)   
##   
## scale(`Total Primary`) -0.000 -0.000 -0.000 -0.000   
## (0.00000) (0.00000) (0.00000) (0.00000)   
##   
## scale(`Total Teachers`) 0.000 0.000 0.000 0.000   
## (0.00000) (0.00000) (0.00000) (0.00000)   
##   
## scale(surv18) 0.580\*\*\* 0.019\*\*\* 0.140\*\*\* 0.035\*\*\*   
## (0.004) (0.005) (0.006) (0.005)   
##   
## scale(surv17) 0.247\*\*\* 0.196\*\*\* 0.245\*\*\* 0.239\*\*\*   
## (0.004) (0.005) (0.007) (0.006)   
##   
## scale(povertyregion) -0.111\*\*\* -0.149\*\*\* -0.096\*\*\* -0.138\*\*\*   
## (0.004) (0.005) (0.006) (0.006)   
##   
## neverenrol\_uw2015\_pct 0.005\*\*\* -0.066\*\*\* -0.042\*\*\* -0.059\*\*\*   
## (0.0005) (0.001) (0.001) (0.001)   
##   
## scale(PTR):scale(Amount.t) 0.000 -0.000 -0.000 -0.000   
## (0.00000) (0.000) (0.00000) (0.00000)   
##   
## Constant -0.076\*\*\* 1.507\*\*\* 0.904\*\*\* 1.375\*\*\*   
## (0.011) (0.015) (0.017) (0.016)   
##   
## ---------------------------------------------------------------------------------------------------------------------------------------------  
## Observations 41,469 15,828 15,828 15,828   
## Log Likelihood 361,092.000 188,953.200 136,004.400 148,695.100   
## Akaike Inf. Crit. -722,146.000 -377,868.300 -271,970.800 -297,352.200   
## Bayesian Inf. Crit. -721,982.000 -377,722.600 -271,825.100 -297,206.500   
## =============================================================================================================================================  
## Note: \*p<0.1; \*\*p<0.05; \*\*\*p<0.01

# DLR 6

We now turn to exploring the association between PBR and learning outcomes, as stated in DLI 6.2. In one sense, DLI 6 could be considered as a remote impact, where RBF can be only understood contributing a small part of gain/loss. As a remote impact, we need to accumulate all the evidence available (money from all DLIs) to try to link it to the analysis.

## National exams

First we focus on national exams: PSLE and SFNA. Table ?? presents the number of observations for both exams across 2014-2019. SFNA doesn not present data available in 2014.

Observations per year/exam

|  |  |  |
| --- | --- | --- |
|  | PSLE | sfna |
| **2014** | 30940 | 0 |
| **2015** | 31403 | 33571 |
| **2016** | 29948 | 17361 |
| **2017** | 29718 | 17629 |
| **2018** | 32130 | 17829 |
| **2019** | 17047 | 17560 |

### PSLE

We follow the same approach to detect outliers than before, excluding observations with more or less than 3 zscores from mean and differences within schools on time larger than 3SD. Figure @(fig:psle2) shows the relatively small proportion of excluded observations.

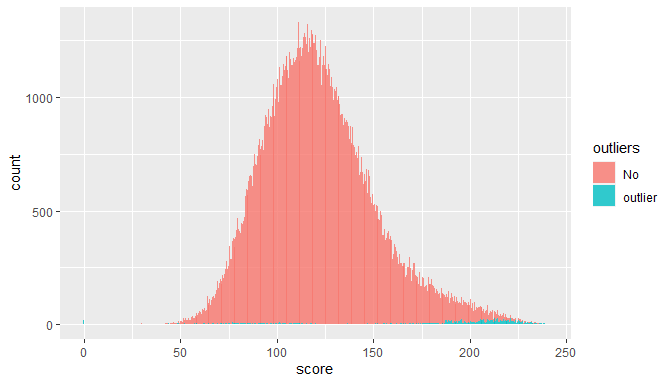


Figure 4 shows the association over time between DLR and PSLE scores per year. There is no clear slope suggesting an association between both variables, which is also assessed through a mixed-effects regression model allowing for random intercepts for councils and random slopes for years, where we fail to reject the hypothesis of no association between them. After subsampling to years 2017-2019 we also did not find association.

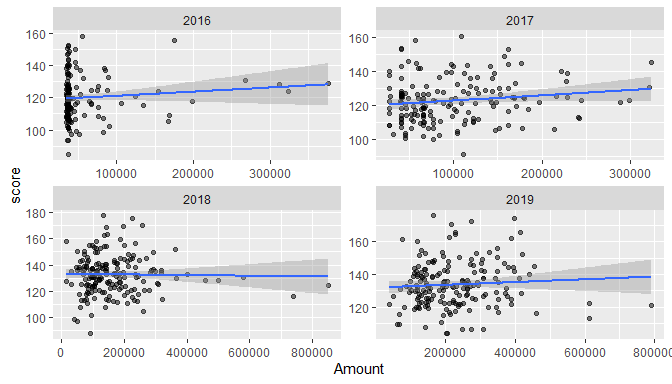


Figure 4: PSLE average of councils grouped by overall DLR received

##   
## ========================================================================  
## Dependent variable:   
## -------------------------------------------------  
## scale(score)   
## (1) (2) (3) (4)   
## ------------------------------------------------------------------------  
## scale(Amount) 0.003 -0.031 0.015 -0.007   
## (0.014) (0.047) (0.016) (0.042)   
##   
## year2017 0.084\*\*\* 0.096\*\*   
## (0.022) (0.039)   
##   
## year2018 0.447\*\*\* 0.466\*\*\* 0.364\*\*\* 0.375\*\*\*   
## (0.034) (0.045) (0.027) (0.034)   
##   
## year2019 0.482\*\*\* 0.490\*\*\* 0.393\*\*\* 0.400\*\*\*   
## (0.040) (0.051) (0.036) (0.041)   
##   
## scale(Amount):year2017 -0.008   
## (0.054)   
##   
## scale(Amount):year2018 0.053 0.025   
## (0.053) (0.050)   
##   
## scale(Amount):year2019 0.054 0.031   
## (0.054) (0.050)   
##   
## Constant -0.061 -0.085\* -0.217\*\*\* -0.228\*\*\*   
## (0.037) (0.048) (0.035) (0.041)   
##   
## ------------------------------------------------------------------------  
## Observations 107,981 107,981 78,165 78,165   
## Log Likelihood -134,142.800 -134,148.400 -98,324.130 -98,328.580  
## Akaike Inf. Crit. 268,317.600 268,334.800 196,670.300 196,683.200  
## Bayesian Inf. Crit. 268,471.000 268,517.000 196,772.200 196,803.600  
## ========================================================================  
## Note: \*p<0.1; \*\*p<0.05; \*\*\*p<0.01

Correlations at council level between average scores of Uwezo (kiswahili, english and math) and PSLE in 2015 and 2017 are week to moderate, with coefficients ranging from .31 to .46.

##   
## ===============================================================================================  
## uwezo15\_math uwezo17\_math uwezo15\_english uwezo17\_english uwezo15\_kiswahili uwezo17\_kiswahili  
## -----------------------------------------------------------------------------------------------  
## 1 0.320 0.414 0.369 0.457 0.314 0.378   
## -----------------------------------------------------------------------------------------------

### SFNA

We follow the same approach to detect outliers than before, excluding observations with more or less than 3 zscores from mean and differences within schools on time larger than 3SD. Figure @(fig:snfa2) shows the relatively small proportion of excluded observations.

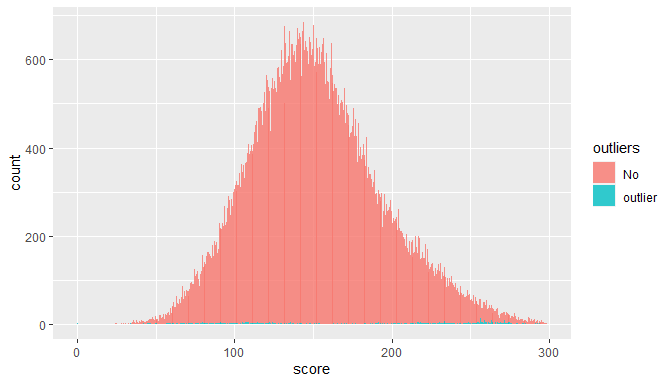


Figure 5 shows the association over time between DLR and SFNA scores per year. There is no clear slope suggesting an association between both variables, which is also assessed through a mixed-effects regression model allowing for random intercepts for councils and random slopes for years, where we fail to reject the hypothesis of no association between them.

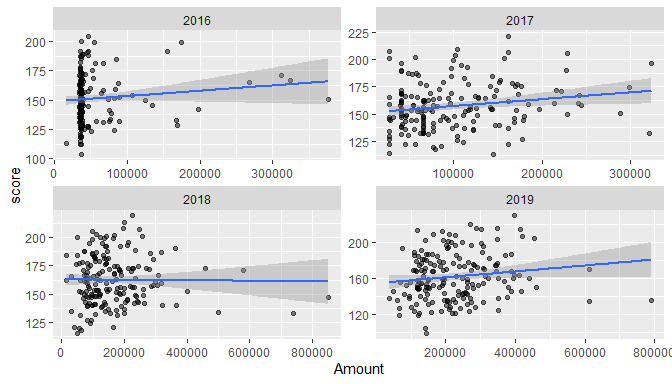


Figure 5: PSLE average of councils grouped by overall DLR received

##   
## ======================================================================  
## Dependent variable:   
## -----------------------------------------------  
## scale(score)   
## (1) (2) (3) (4)   
## ----------------------------------------------------------------------  
## scale(Amount) 0.002 -0.040 0.011 0.082\*   
## (0.013) (0.049) (0.014) (0.049)   
##   
## year2017 0.138\*\*\* 0.168\*\*\*   
## (0.022) (0.042)   
##   
## year2018 0.268\*\*\* 0.297\*\*\* 0.126\*\*\* 0.085\*\*   
## (0.032) (0.047) (0.027) (0.038)   
##   
## year2019 0.249\*\*\* 0.284\*\*\* 0.102\*\* 0.069   
## (0.044) (0.056) (0.040) (0.049)   
##   
## scale(Amount):year2017 0.044   
## (0.057)   
##   
## scale(Amount):year2018 0.048 -0.076   
## (0.052) (0.054)   
##   
## scale(Amount):year2019 0.035 -0.090   
## (0.056) (0.056)   
##   
## Constant -0.014 -0.044 -0.101\*\* -0.060   
## (0.037) (0.051) (0.039) (0.047)   
##   
## ----------------------------------------------------------------------  
## Observations 69,795 69,795 52,577 52,577   
## Log Likelihood -85,629.870 -85,636.410 -64,876.420 -64,879.800  
## Akaike Inf. Crit. 171,291.700 171,310.800 129,774.800 129,785.600  
## Bayesian Inf. Crit. 171,438.200 171,484.700 129,872.400 129,900.900  
## ======================================================================  
## Note: \*p<0.1; \*\*p<0.05; \*\*\*p<0.01

## [1] 0.00002677267

Correlations at council level between average scores of Uwezo (kiswahili, english and math) and SFNA in 2015 and 2017 are week to moderate, with coefficients ranging from .28 to .47.

##   
## ===============================================================================================  
## uwezo15\_math uwezo17\_math uwezo15\_english uwezo17\_english uwezo15\_kiswahili uwezo17\_kiswahili  
## -----------------------------------------------------------------------------------------------  
## 1 0.469 0.277 0.536 0.315 0.474 0.246   
## -----------------------------------------------------------------------------------------------

## Uwezo

## [1] "id\_district" "id\_districtName" "id\_regionName" "Year"   
## [5] "council"

## # A tibble: 6 x 5  
## id\_district id\_districtName id\_regionName Year council  
## <dbl> <chr> <chr> <chr> <chr>   
## 1 101 Kondoa Dodoma 2012 <NA>   
## 2 102 Mpwapwa Dodoma 2012 <NA>   
## 3 103 Kongwa Dodoma 2012 <NA>   
## 4 105 Dodoma Urban Dodoma 2012 <NA>   
## 5 106 Bahi Dodoma 2012 <NA>   
## 6 107 Chamwino Dodoma 2012 <NA>

## # A tibble: 16 x 12  
## `as.factor(h130~ kiswahili h1702\_s1 h1702\_s2 english h1704\_s1 h1704\_s2 math  
## <fct> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl>  
## 1 0 1.60 1.90 1.90 1.26 1.95 1.95 1.99  
## 2 1 2.61 1.78 1.79 1.44 1.91 1.91 3.15  
## 3 2 3.64 1.55 1.57 1.62 1.87 1.87 4.22  
## 4 3 4.23 1.36 1.39 2.10 1.81 1.82 4.88  
## 5 4 4.52 1.22 1.26 2.48 1.74 1.75 5.25  
## 6 5 4.70 1.16 1.19 2.90 1.67 1.68 5.49  
## 7 6 4.72 1.13 1.15 3.20 1.60 1.63 5.55  
## 8 7 4.71 1.12 1.15 3.49 1.54 1.56 5.52  
## 9 8 4.90 1.05 1.07 4.46 1.27 1.30 5.82  
## 10 9 4.91 1.07 1.07 4.68 1.18 1.19 5.82  
## 11 10 4.93 1.04 1.06 4.81 1.11 1.13 5.87  
## 12 11 4.95 1.05 1.09 4.84 1.08 1.12 5.91  
## 13 12 5 1 1.33 5 1 1.33 6   
## 14 13 5 1 1 5 1 1 6   
## 15 14 5 2 2 5 2 2 6   
## 16 <NA> 2.39 1.69 1.70 1.70 1.85 1.86 2.83  
## # ... with 4 more variables: h1706\_h1 <dbl>, h1706\_h2 <dbl>, h1707\_p1 <dbl>,  
## # h1707\_p2 <dbl>

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## [5] "id\_regionName" "id\_village"   
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## [9] "districtcode" "districtName"   
## [11] "wardcode" "wardname"   
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## [17] "eacode" "ea\_type"   
## [19] "validationcode" "hhno"   
## [21] "date" "respondent"   
## [23] "yearofbirth" "permissiontouse"   
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## [33] "house\_lighting" "hh\_has\_toilet"   
## [35] "mealsPerDay" "meals\_accompaniedby"   
## [37] "h106" "asset\_tv"   
## [39] "asset\_radio" "asset\_phone"   
## [41] "asset\_computer" "asset\_car"   
## [43] "asset\_bicycle" "asset\_motorbike"   
## [45] "asset\_cart" "asset\_cattle"   
## [47] "asset\_sheep\_goat" "asset\_donkey"   
## [49] "asset\_camel" "h108\_favourites"   
## [51] "fav\_radio" "fav\_tv"   
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## [63] "h207" "h208"   
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## 3 3 2.15 0.454 0.456 3.92 0.828 0.802 6.02  
## 4 4 2.61 0.587 0.589 4.28 0.901 0.878 6.91  
## 5 5 3.01 0.669 0.656 4.56 0.939 0.919 7.60  
## 6 6 3.38 0.761 0.746 4.67 0.958 0.938 7.94  
## 7 7 3.69 0.805 0.790 4.72 0.962 0.947 8.13  
## 8 8 4.62 0.937 0.905 4.92 0.994 0.988 8.72  
## 9 9 4.73 0.956 0.930 4.93 0.990 0.983 8.74  
## 10 10 4.79 0.969 0.954 4.95 0.991 0.983 8.84  
## 11 11 4.75 0.971 0.957 4.92 0.992 0.974 8.76  
## 12 12 4.71 1 0.964 4.87 1 1 8.32  
## 13 <NA> 1.83 0.445 0.457 2.44 0.656 0.668 3.75  
## # ... with 2 more variables: mathEveryday1 <dbl>, mathEveryday2 <dbl>

##   
## 0 ARUSHA CC ARUSHA DC BABATI DC   
## 1313 1892 2690 4755   
## BABATI TC BAGAMOYO BAHI BARIADI DC   
## 2042 1774 3672 6459   
## BIHARAMULO BUHIGWE BUKOBA MC BUKOMBE   
## 3468 4824 2163 1908   
## BUNDA DC BUSEGA BUTIAMA CHAMWINO   
## 3188 3798 3850 3585   
## CHATO CHEMBA CHUNYA DODOMA CC   
## 3364 2796 2160 1968   
## GAIRO GEITA DC HAI HANANG   
## 4296 3560 1338 4584   
## HANDENI TC IGUNGA IKUNGI ILALA MC   
## 5286 4110 2940 3288   
## ILEJE ILEMELA MC IRAMBA IRINGA DC   
## 1970 1990 2956 2094   
## IRINGA MC ITILIMA KAHAMA TC KAKONKO   
## 2634 4400 4962 2826   
## KALAMBO KALIUA KARAGWE KARATU   
## 2860 3934 3825 2282   
## KASULU DC KASULU TC KIBAHA DC KIBAHA TC   
## 3504 2442 1880 1922   
## KIBONDO KIGOMA DC KILINDI KILOLO   
## 4338 4728 4572 2086   
## KILOMBERO KILOSA KILWA KINONDONI MC   
## 2074 1988 3189 2097   
## KISARAWE KISHAPU KITETO KONDOA DC   
## 1862 4728 4317 2626   
## KONGWA KOROGWE DC KOROGWE TC KWIMBA   
## 2508 2222 2168 3926   
## KYELA KYERWA LINDI DC LINDI MC   
## 1922 2972 1828 1506   
## LIWALE LONGIDO LUDEWA LUSHOTO   
## 2154 2964 2940 3480   
## MAFIA MAGU MAKAMBAKO TC MAKETE   
## 1612 3522 1912 1412   
## MANYONI MASASI DC MASASI TC MASWA   
## 2098 1510 1382 3670   
## MBARALI MBEYA CC MBEYA DC MBINGA DC   
## 2046 2403 2967 2026   
## MBOGWE MBOZI MBULU DC MEATU   
## 1963 3462 2992 5409   
## MERU MISSENYI MISUNGWI MKALAMA   
## 3036 2198 5079 3198   
## MKINGA MKURANGA MLELE MOMBA   
## 2334 3693 3526 2532   
## MONDULI MOROGORO DC MOROGORO MC MOSHI DC   
## 2398 2961 1476 2070   
## MOSHI MC MPANDA DC MPWAPWA MTWARA DC   
## 3774 3244 2576 2382   
## MTWARA MIKINDANI MC MUFINDI MUHEZA MULEBA   
## 1266 1686 2092 3522   
## MUSOMA DC MUSOMA MC MVOMERO MWANGA   
## 3466 3212 1770 2000   
## MWANZA CC NACHINGWEA NAMTUMBO NANYUMBU   
## 3657 1512 3426 2044   
## NEWALA DC NGARA NGORONGORO NJOMBE DC   
## 1334 2814 4176 1716   
## NJOMBE TC NKASI NYASA NZEGA DC   
## 1690 3068 2384 4125   
## PANGANI ROMBO RORYA RUANGWA   
## 2244 2775 4062 1326   
## RUFIJI RUNGWE SAME SENGEREMA   
## 2404 2484 2232 5622   
## SERENGETI SHINYANGA DC SHINYANGA MC SIHA   
## 4968 3486 2138 1774   
## SIKONGE SIMANJIRO SINGIDA DC SINGIDA MC   
## 3502 2580 3342 3543   
## SONGEA DC SONGEA MC SUMBAWANGA DC SUMBAWANGA MC   
## 2865 1854 4248 2600   
## TABORA MC TABORA/UYUI TANDAHIMBA TANGA CC   
## 3423 5766 2046 3225   
## TARIME TC TEMEKE MC TUNDUMA TC TUNDURU   
## 2926 2780 1734 1936   
## UKEREWE ULANGA URAMBO UVINZA   
## 4770 3099 2988 2914

##   
## 0 BAHI BARIADI DC BUHIGWE BUKOBA MC   
## 1524 4104 7290 4824 3081   
## BUSEGA CHAMWINO CHATO GAIRO GEITA DC   
## 4388 4062 4032 4089 4102   
## HANANG ILALA MC IRINGA MC KAHAMA TC KARAGWE   
## 5277 4536 3618 5919 4158   
## KIBONDO KIGAMBONI MC KIGOMA DC KILINDI KILWA   
## 5229 1076 5145 4917 3768   
## KINONDONI MC KISHAPU KITETO KONDOA DC LUDEWA   
## 2025 5961 3999 3048 3783   
## LUSHOTO MBEYA CC MBEYA DC MBOZI MEATU   
## 4320 3084 3513 4107 6951   
## MERU MISUNGWI MKURANGA MOROGORO DC MOSHI DC   
## 3183 5394 4044 3642 3066   
## MTWARA DC MULEBA MWANZA CC NAMTUMBO NGORONGORO   
## 3198 4530 4089 4275 4323   
## NZEGA DC ROMBO RORYA RUNGWE SENGEREMA   
## 5472 3264 4800 3738 6438   
## SERENGETI SINGIDA MC SONGEA DC SUMBAWANGA DC TABORA MC   
## 5730 4245 3453 5172 3687   
## TABORA/UYUI TANDAHIMBA TANGA CC TEMEKE MC UBUNGO MC   
## 7002 2958 3609 4188 823   
## UKEREWE ULANGA   
## 5286 4341

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## [7] "council"

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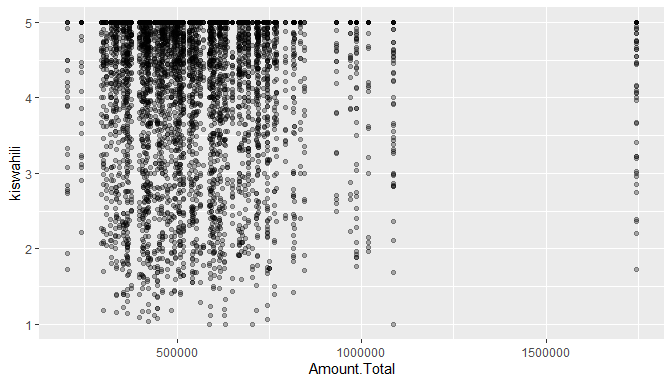
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## BUKOBA MC 24 25  
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## BUTIAMA 22 0  
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## HANANG 20 24  
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## KIBONDO 21 25  
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## KIGOMA DC 23 23  
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## KISARAWE 24 0  
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## MOSHI DC 25 25  
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## RORYA 23 23  
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## SAME 24 0  
## SENGEREMA 21 24  
## SERENGETI 22 22  
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## SHINYANGA MC 24 0  
## SIHA 24 0  
## SIKONGE 21 0  
## SIMANJIRO 20 0  
## SINGIDA DC 21 0  
## SINGIDA MC 23 24  
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## TABORA MC 24 25  
## TABORA/UYUI 20 23  
## TANDAHIMBA 24 24  
## TANGA CC 23 27  
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## TEMEKE MC 23 24  
## TUNDUMA TC 23 0  
## TUNDURU 24 0  
## UBUNGO MC 0 26  
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## ULANGA 24 25  
## URAMBO 23 0  
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##   
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## ARUSHA CC 0 2 2 2 2 2 2 2 2 2 2 2 1 0 0  
## ARUSHA DC 0 2 2 2 2 2 2 2 2 2 2 2 1 0 0  
## BABATI DC 0 2 2 2 2 2 2 2 2 2 1 2 0 0 0  
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## BAGAMOYO 0 2 2 2 2 2 2 2 2 2 2 0 0 0 0  
## BAHI 2 4 4 4 4 4 4 4 4 4 1 1 0 0 0  
## BARIADI DC 2 4 4 4 4 4 4 3 4 4 4 2 0 0 0  
## BIHARAMULO 0 2 2 2 2 2 2 2 1 0 0 0 0 0 0  
## BUHIGWE 2 4 4 4 4 4 4 4 4 4 2 1 0 0 0  
## BUKOBA MC 2 4 4 4 4 4 4 4 4 4 4 3 0 0 0  
## BUKOMBE 0 2 2 2 2 2 2 2 2 2 2 0 0 0 0  
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## CHAMWINO 2 4 4 4 4 4 4 4 4 4 3 1 0 0 0  
## CHATO 2 4 4 4 4 4 4 4 4 4 3 1 0 0 0  
## CHEMBA 0 2 2 2 2 2 2 2 2 2 1 1 0 0 0  
## CHUNYA 0 2 2 2 2 2 2 0 2 2 2 0 0 0 0  
## DODOMA CC 0 2 2 2 2 2 2 2 2 2 2 1 2 0 0  
## GAIRO 2 4 4 4 4 4 4 4 4 4 3 2 0 0 0  
## GEITA DC 2 4 4 4 4 4 4 4 4 4 3 0 0 0 0  
## HAI 0 2 2 2 2 2 2 2 2 2 2 0 0 0 0  
## HANANG 2 4 4 4 4 4 4 4 3 4 3 0 0 0 0  
## HANDENI TC 0 2 2 2 2 2 2 2 2 2 2 2 0 0 0  
## IGUNGA 0 2 2 2 2 2 2 2 2 2 1 0 0 0 0  
## IKUNGI 0 2 2 2 2 2 2 2 2 2 2 1 0 0 0  
## ILALA MC 2 4 4 4 4 4 4 4 4 4 4 4 0 0 0  
## ILEJE 0 2 2 2 2 2 2 1 2 2 2 2 0 0 0  
## ILEMELA MC 0 2 2 2 2 2 2 2 2 2 2 2 0 0 0  
## IRAMBA 0 2 2 2 2 2 2 2 2 2 2 2 0 0 0  
## IRINGA DC 0 2 2 2 2 2 2 2 2 2 2 0 0 0 0  
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## ITILIMA 0 2 2 2 2 2 2 2 2 2 1 0 0 0 0  
## KAHAMA TC 2 4 4 4 4 4 4 4 4 3 2 0 0 0 0  
## KAKONKO 0 2 2 2 2 2 2 2 2 2 2 0 0 0 0  
## KALAMBO 0 2 2 2 2 2 2 2 2 0 1 0 0 0 0  
## KALIUA 0 2 2 2 2 2 2 2 2 1 1 0 0 0 0  
## KARAGWE 2 4 4 4 4 4 4 4 4 4 2 2 0 0 1  
## KARATU 0 2 2 2 2 2 2 2 2 2 2 2 0 0 0  
## KASULU DC 0 2 2 2 2 2 2 2 2 2 0 1 0 0 0  
## KASULU TC 0 2 2 2 2 2 2 2 2 2 2 0 0 0 0  
## KIBAHA DC 0 2 2 2 2 2 2 2 2 2 2 2 0 0 0  
## KIBAHA TC 0 2 2 2 2 2 2 2 2 2 2 0 0 0 0  
## KIBONDO 2 4 4 4 4 4 4 4 4 4 2 2 0 0 0  
## KIGAMBONI MC 2 2 2 2 2 2 2 2 2 2 2 0 0 0 0  
## KIGOMA DC 2 4 4 4 4 4 4 4 4 4 3 1 0 0 0  
## KILINDI 2 4 4 4 4 4 4 4 4 4 4 0 0 0 0  
## KILOLO 0 2 2 2 2 2 2 2 2 2 2 2 0 0 0  
## KILOMBERO 0 2 2 2 2 2 2 2 2 2 2 2 0 0 0  
## KILOSA 0 2 2 2 2 2 2 2 2 2 2 1 0 0 0  
## KILWA 2 4 4 4 4 4 4 4 4 3 3 1 0 0 0  
## KINONDONI MC 2 4 4 4 4 4 4 4 4 4 4 3 0 0 0  
## KISARAWE 0 2 2 2 2 2 2 2 2 2 2 2 0 0 0  
## KISHAPU 2 4 4 4 4 4 4 4 4 4 3 3 0 0 0  
## KITETO 2 4 4 4 4 4 4 4 4 3 2 2 0 0 0  
## KONDOA DC 2 4 4 4 4 4 4 4 4 3 4 1 0 0 0  
## KONGWA 0 2 2 2 2 2 2 2 2 2 2 0 0 0 0  
## KOROGWE DC 0 2 2 2 2 2 2 2 2 2 2 0 0 0 0  
## KOROGWE TC 0 2 2 2 2 2 2 2 2 2 2 2 0 0 0  
## KWIMBA 0 2 2 2 2 2 2 2 2 2 2 0 0 0 0  
## KYELA 0 2 2 2 2 2 2 2 2 2 2 2 1 0 0  
## KYERWA 0 2 2 2 2 2 2 2 1 1 0 0 0 0 0  
## LINDI DC 0 2 2 2 2 2 2 1 2 2 2 2 0 0 0  
## LINDI MC 0 2 2 2 2 2 2 2 2 2 2 0 0 0 0  
## LIWALE 0 2 2 2 2 2 2 2 2 2 2 0 2 0 0  
## LONGIDO 0 2 2 2 2 2 2 2 2 0 0 2 0 0 0  
## LUDEWA 2 4 4 4 4 4 4 4 4 4 3 1 0 0 0  
## LUSHOTO 2 4 4 4 4 4 4 4 4 4 4 1 0 0 0  
## MAFIA 0 2 2 2 2 2 2 2 2 2 1 0 0 0 0  
## MAGU 0 2 2 2 2 2 2 2 2 2 2 1 0 0 0  
## MAKAMBAKO TC 0 2 2 2 2 2 2 2 2 2 2 2 0 0 0  
## MAKETE 0 2 2 2 2 2 2 2 1 2 0 0 0 0 0  
## MANYONI 0 2 2 2 2 2 2 2 2 1 2 0 0 0 0  
## MASASI DC 0 2 2 2 2 2 2 2 2 1 1 1 0 0 0  
## MASASI TC 0 2 2 2 2 2 2 2 2 2 0 0 0 0 0  
## MASWA 0 2 2 2 2 2 2 2 2 2 1 0 0 0 0  
## MBARALI 0 2 2 2 2 2 2 2 1 2 1 0 0 0 0  
## MBEYA CC 2 4 4 4 4 4 4 4 4 4 4 4 0 0 0  
## MBEYA DC 2 4 4 4 4 4 4 4 4 4 3 2 0 0 0  
## MBINGA DC 0 2 2 2 2 2 2 2 2 2 1 2 1 0 0  
## MBOGWE 0 2 2 2 2 2 2 2 2 2 1 1 0 0 0  
## MBOZI 2 4 4 4 4 4 4 4 4 4 4 3 0 0 0  
## MBULU DC 0 2 2 2 2 2 2 2 2 1 2 0 0 0 0  
## MEATU 2 4 4 4 4 4 4 4 4 3 2 3 0 0 0  
## MERU 2 4 4 4 4 4 4 4 4 4 4 3 0 0 0  
## MISSENYI 0 2 2 2 2 2 2 1 2 2 2 2 0 0 0  
## MISUNGWI 2 4 4 4 4 4 4 4 4 4 2 0 0 0 0  
## MKALAMA 0 2 2 2 2 2 2 2 2 2 2 1 0 0 0  
## MKINGA 0 2 2 2 2 2 2 2 2 2 2 0 0 0 0  
## MKURANGA 2 4 4 4 4 4 4 4 4 4 4 2 0 0 0  
## MLELE 0 2 2 2 2 2 2 2 2 2 0 0 0 0 0  
## MOMBA 0 2 2 2 2 2 2 2 2 2 1 1 0 0 0  
## MONDULI 0 2 2 2 2 2 2 2 2 2 0 0 1 0 0  
## MOROGORO DC 2 4 4 4 4 4 4 4 4 4 3 0 0 0 0  
## MOROGORO MC 0 2 2 2 2 2 2 2 2 2 2 0 0 0 0  
## MOSHI DC 2 4 4 4 4 4 4 4 4 4 4 3 1 0 0  
## MOSHI MC 0 2 2 2 2 2 2 2 2 2 2 2 0 0 0  
## MPANDA DC 0 2 2 2 2 2 2 2 1 1 0 0 0 0 0  
## MPWAPWA 0 2 2 2 2 2 2 2 2 2 2 1 0 0 0  
## MTWARA DC 2 4 4 4 4 4 4 4 4 4 4 1 0 0 0  
## MTWARA MIKINDANI MC 0 2 2 2 2 2 2 2 2 2 1 1 0 0 0  
## MUFINDI 0 2 2 2 2 2 2 2 2 2 2 1 0 0 0  
## MUHEZA 0 2 2 2 2 2 2 2 2 2 1 1 0 0 0  
## MULEBA 2 4 4 4 4 4 4 4 4 4 4 2 0 0 0  
## MUSOMA DC 0 2 2 2 2 2 2 2 2 2 2 1 0 0 0  
## MUSOMA MC 0 2 2 2 2 2 2 2 2 2 2 2 0 0 0  
## MVOMERO 0 2 2 2 2 2 2 2 2 2 2 1 0 0 0  
## MWANGA 0 2 2 2 2 2 2 2 2 2 2 2 0 0 0  
## MWANZA CC 2 4 4 4 4 4 4 4 4 4 4 2 2 0 0  
## NACHINGWEA 0 2 2 2 2 2 2 2 2 2 2 0 0 0 0  
## NAMTUMBO 2 4 4 4 4 4 4 4 4 4 4 4 1 0 0  
## NANYUMBU 0 2 2 2 2 2 2 1 2 2 1 1 0 0 0  
## NEWALA DC 0 2 2 2 2 2 2 2 2 2 2 0 0 0 0  
## NGARA 0 2 2 2 2 2 2 2 2 2 1 0 0 0 0  
## NGORONGORO 2 4 4 4 4 4 4 4 4 4 4 2 0 0 0  
## NJOMBE DC 0 2 2 2 2 2 2 2 2 1 1 0 1 0 0  
## NJOMBE TC 0 2 2 2 2 2 2 2 2 1 0 0 0 0 0  
## NKASI 0 2 2 2 2 2 2 2 2 1 0 0 0 0 0  
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## PANGANI 0 2 2 2 2 2 2 2 2 2 2 2 0 0 0  
## ROMBO 2 4 4 4 4 4 4 4 4 4 4 4 3 0 0  
## RORYA 2 4 4 4 4 4 4 4 4 4 2 2 0 0 0  
## RUANGWA 0 2 2 2 2 2 2 2 2 2 1 0 0 0 0  
## RUFIJI 0 2 2 2 2 2 2 2 2 2 2 1 0 0 0  
## RUNGWE 2 4 4 4 4 4 4 4 4 4 4 3 0 0 0  
## SAME 0 2 2 2 2 2 2 2 2 2 2 2 0 0 0  
## SENGEREMA 2 4 4 4 4 4 4 4 4 4 3 0 0 0 0  
## SERENGETI 2 4 4 4 4 4 4 4 4 4 2 0 0 0 0  
## SHINYANGA DC 0 2 2 2 2 2 2 2 2 2 0 1 0 0 0  
## SHINYANGA MC 0 2 2 2 2 2 2 2 2 2 2 2 0 0 0  
## SIHA 0 2 2 2 2 2 2 2 2 2 1 2 1 0 0  
## SIKONGE 0 2 2 2 2 2 2 2 2 2 1 0 0 0 0  
## SIMANJIRO 0 2 2 2 2 2 2 2 2 1 1 0 0 0 0  
## SINGIDA DC 0 2 2 2 2 2 2 2 2 2 1 0 0 0 0  
## SINGIDA MC 2 4 4 4 4 4 4 4 4 4 4 1 0 0 0  
## SONGEA DC 2 4 4 4 4 4 4 4 4 4 4 1 0 0 0  
## SONGEA MC 0 2 2 2 2 2 2 2 2 2 2 2 1 0 0  
## SUMBAWANGA DC 2 4 4 4 4 4 4 4 4 4 3 2 0 0 0  
## SUMBAWANGA MC 0 2 2 2 2 2 2 2 2 2 2 1 0 0 0  
## TABORA MC 2 4 4 4 4 4 4 4 4 4 4 3 0 0 0  
## TABORA/UYUI 2 4 4 4 4 4 4 4 4 3 1 1 0 0 0  
## TANDAHIMBA 2 4 4 4 4 4 4 4 4 4 4 2 0 0 0  
## TANGA CC 2 4 4 4 4 4 4 4 4 4 4 3 0 1 0  
## TARIME TC 0 2 2 2 2 2 2 2 2 1 1 1 0 0 0  
## TEMEKE MC 2 4 4 4 4 4 4 4 4 4 4 1 0 0 0  
## TUNDUMA TC 0 2 2 2 2 2 2 2 2 2 2 1 0 0 0  
## TUNDURU 0 2 2 2 2 2 2 2 2 2 2 2 0 0 0  
## UBUNGO MC 2 2 2 2 2 2 2 2 2 2 2 2 0 0 0  
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## ULANGA 2 4 4 4 4 4 4 4 4 4 4 3 0 0 0  
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##   
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## BAGAMOYO 11 11  
## BAHI 22 22  
## BARIADI DC 22 25  
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## BUHIGWE 22 23  
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## CHUNYA 10 10  
## DODOMA CC 12 13  
## GAIRO 23 24  
## GEITA DC 23 22  
## HAI 11 11  
## HANANG 22 22  
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## IGUNGA 10 11  
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## ILALA MC 25 25  
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## IRINGA DC 11 11  
## IRINGA MC 23 26  
## ITILIMA 10 11  
## KAHAMA TC 21 22  
## KAKONKO 11 11  
## KALAMBO 10 9  
## KALIUA 9 11  
## KARAGWE 23 24  
## KARATU 12 12  
## KASULU DC 11 10  
## KASULU TC 11 11  
## KIBAHA DC 12 12  
## KIBAHA TC 11 11  
## KIBONDO 23 23  
## KIGAMBONI MC 12 12  
## KIGOMA DC 23 23  
## KILINDI 23 23  
## KILOLO 12 12  
## KILOMBERO 12 12  
## KILOSA 11 12  
## KILWA 22 23  
## KINONDONI MC 24 25  
## KISARAWE 12 12  
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## KITETO 23 22  
## KONDOA DC 22 24  
## KONGWA 11 11  
## KOROGWE DC 11 11  
## KOROGWE TC 12 12  
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## KYELA 13 12  
## KYERWA 9 9  
## LINDI DC 12 11  
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## LIWALE 12 12  
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## LUDEWA 22 24  
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## MERU 24 25  
## MISSENYI 11 12  
## MISUNGWI 21 23  
## MKALAMA 11 12  
## MKINGA 11 11  
## MKURANGA 24 24  
## MLELE 10 10  
## MOMBA 10 12  
## MONDULI 10 11  
## MOROGORO DC 22 23  
## MOROGORO MC 11 11  
## MOSHI DC 26 24  
## MOSHI MC 12 12  
## MPANDA DC 9 9  
## MPWAPWA 12 11  
## MTWARA DC 23 24  
## MTWARA MIKINDANI MC 10 12  
## MUFINDI 12 11  
## MUHEZA 10 12  
## MULEBA 24 24  
## MUSOMA DC 11 12  
## MUSOMA MC 12 12  
## MVOMERO 12 11  
## MWANGA 12 12  
## MWANZA CC 25 25  
## NACHINGWEA 11 11  
## NAMTUMBO 25 26  
## NANYUMBU 10 11  
## NEWALA DC 11 11  
## NGARA 10 11  
## NGORONGORO 24 24  
## NJOMBE DC 11 10  
## NJOMBE TC 9 10  
## NKASI 9 10  
## NYASA 11 10  
## NZEGA DC 22 22  
## PANGANI 12 12  
## ROMBO 27 26  
## RORYA 22 24  
## RUANGWA 10 11  
## RUFIJI 11 12  
## RUNGWE 24 25  
## SAME 12 12  
## SENGEREMA 22 23  
## SERENGETI 22 22  
## SHINYANGA DC 11 10  
## SHINYANGA MC 12 12  
## SIHA 11 13  
## SIKONGE 10 11  
## SIMANJIRO 11 9  
## SINGIDA DC 10 11  
## SINGIDA MC 23 24  
## SONGEA DC 23 24  
## SONGEA MC 13 12  
## SUMBAWANGA DC 22 25  
## SUMBAWANGA MC 12 11  
## TABORA MC 24 25  
## TABORA/UYUI 21 22  
## TANDAHIMBA 24 24  
## TANGA CC 26 24  
## TARIME TC 9 12  
## TEMEKE MC 24 23  
## TUNDUMA TC 12 11  
## TUNDURU 12 12  
## UBUNGO MC 13 13  
## UKEREWE 25 24  
## ULANGA 24 25  
## URAMBO 11 12  
## UVINZA 10 11

##   
## Call:  
## censReg(formula = scale(kiswahili) ~ as.factor(year) + scale(Amount.Total) +   
## scale(grade) + as.factor(sex), left = 0, right = 5, data = subset(uwezo.payments,   
## grade < 11))  
##   
## Observations:  
## Total Left-censored Uncensored Right-censored   
## 4126 1466 2660 0   
##   
## Coefficients:  
## Estimate Std. error t value Pr(> t)   
## (Intercept) 0.258900 0.007746 33.422 < 2e-16 \*\*\*  
## as.factor(year)1 0.067306 0.010401 6.471 9.75e-11 \*\*\*  
## scale(Amount.Total) -0.006769 0.004772 -1.418 0.156051   
## scale(grade) 0.408715 0.005535 73.846 < 2e-16 \*\*\*  
## as.factor(sex)2 0.033634 0.009442 3.562 0.000368 \*\*\*  
## logSigma -1.288107 0.014416 -89.355 < 2e-16 \*\*\*  
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## Newton-Raphson maximisation, 6 iterations  
## Return code 1: gradient close to zero  
## Log-likelihood: -1164.196 on 6 Df

##   
## Call:  
## vglm(formula = scale(kiswahili) ~ as.factor(year) + scale(Amount.Total) +   
## scale(grade) + as.factor(sex), family = tobit(Upper = 5,   
## Lower = 0), data = subset(uwezo.payments, grade < 11))  
##   
## Pearson residuals:  
## Min 1Q Median 3Q Max  
## mu -3.863 -0.5818 -0.2657 0.65318 3.281  
## loglink(sd) -1.006 -0.5726 -0.2978 0.05846 9.882  
##   
## Coefficients:   
## Estimate Std. Error z value Pr(>|z|)   
## (Intercept):1 0.258898 0.007356 35.194 < 2e-16 \*\*\*  
## (Intercept):2 -1.288101 0.012783 -100.767 < 2e-16 \*\*\*  
## as.factor(year)1 0.067306 0.010270 6.554 5.61e-11 \*\*\*  
## scale(Amount.Total) -0.006769 0.004673 -1.448 0.147494   
## scale(grade) 0.408716 0.005044 81.036 < 2e-16 \*\*\*  
## as.factor(sex)2 0.033634 0.009294 3.619 0.000296 \*\*\*  
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## Names of linear predictors: mu, loglink(sd)  
##   
## Log-likelihood: -1164.196 on 8246 degrees of freedom  
##   
## Number of Fisher scoring iterations: 12   
##   
## No Hauck-Donner effect found in any of the estimates



# Conclusions

* Data quality:
  + data usually robust, with small number of unexpected outliers
* Inference:
  + Multilevel modelling accounting for clusters (council) and time
  + Subsampling to avoid extreme measurement errors.
  + Association of reduction of PTR and DLI ammount received over time. No evidence of association on survival rates or Uwezo scores (as early assessments)
  + No evidence of association of whole DLI ammounts and learning scores
  + Limitations: not a counterfactual analysis, data quality problems (ghosts teachers and students impossible to assess at province level)

# Apendix

##   
## =====================================================================================  
## Statistic N Mean St. Dev. Min Pctl(25) Pctl(75) Max   
## -------------------------------------------------------------------------------------  
## PTR 47,583 49.815 21.337 2.379 34.900 62.600 130.400   
## Amount.t 47,584 91,800.770 102,899.700 0 13,677 128,032 564,774   
## Total Primary 47,583 542.163 387.525 6.000 298.000 672.000 7,365.000  
## Total Teachers 47,583 11.638 8.056 1.000 7.000 14.000 152.000   
## surv19 47,583 0.824 0.116 0.440 0.741 0.922 1.072   
## surv18 47,583 0.885 0.104 0.580 0.809 0.955 1.326   
## surv17 47,583 0.670 0.155 0.299 0.576 0.785 0.990   
## povertyregion 47,583 0.270 0.086 0.080 0.210 0.345 0.450   
## neverenrol\_uw2015\_pct 41,469 23.674 8.611 8.810 16.480 30.060 48.630   
## -------------------------------------------------------------------------------------  
##   
## ===================================================  
## Statistic N Mean St. Dev. Min Pctl(25) Pctl(75) Max  
## ===================================================

##   
## ===================================================================  
## Statistic N Mean St. Dev. Min Pctl(25) Pctl(75) Max   
## -------------------------------------------------------------------  
## score 169,594 121.598 28.478 29.867 101.644 138.111 236.730  
## -------------------------------------------------------------------  
##   
## ===================================================  
## Statistic N Mean St. Dev. Min Pctl(25) Pctl(75) Max  
## ===================================================

##   
## ===================================================================  
## Statistic N Mean St. Dev. Min Pctl(25) Pctl(75) Max   
## -------------------------------------------------------------------  
## score 103,192 151.836 41.595 24.250 122.963 177.175 298.500  
## -------------------------------------------------------------------  
##   
## ===================================================  
## Statistic N Mean St. Dev. Min Pctl(25) Pctl(75) Max  
## ===================================================

1. Univesidad Católica San Pablo [↑](#footnote-ref-20)
2. University of East Anglia [↑](#footnote-ref-21)