

South African teacher shortages as revealed through class sizes and learner-educator ratios

Gabrielle Wills | QER conference | 5 September 2023

“In many countries, teachers are not well allocated in relation to student numbers...Without a strong monitoring system and an enforcement of effective teacher allocation rules, a policy aimed at hiring more teachers to reduce class size may not even manage to do so.”

(Crawford & Le Nestour, 2022 p 90)

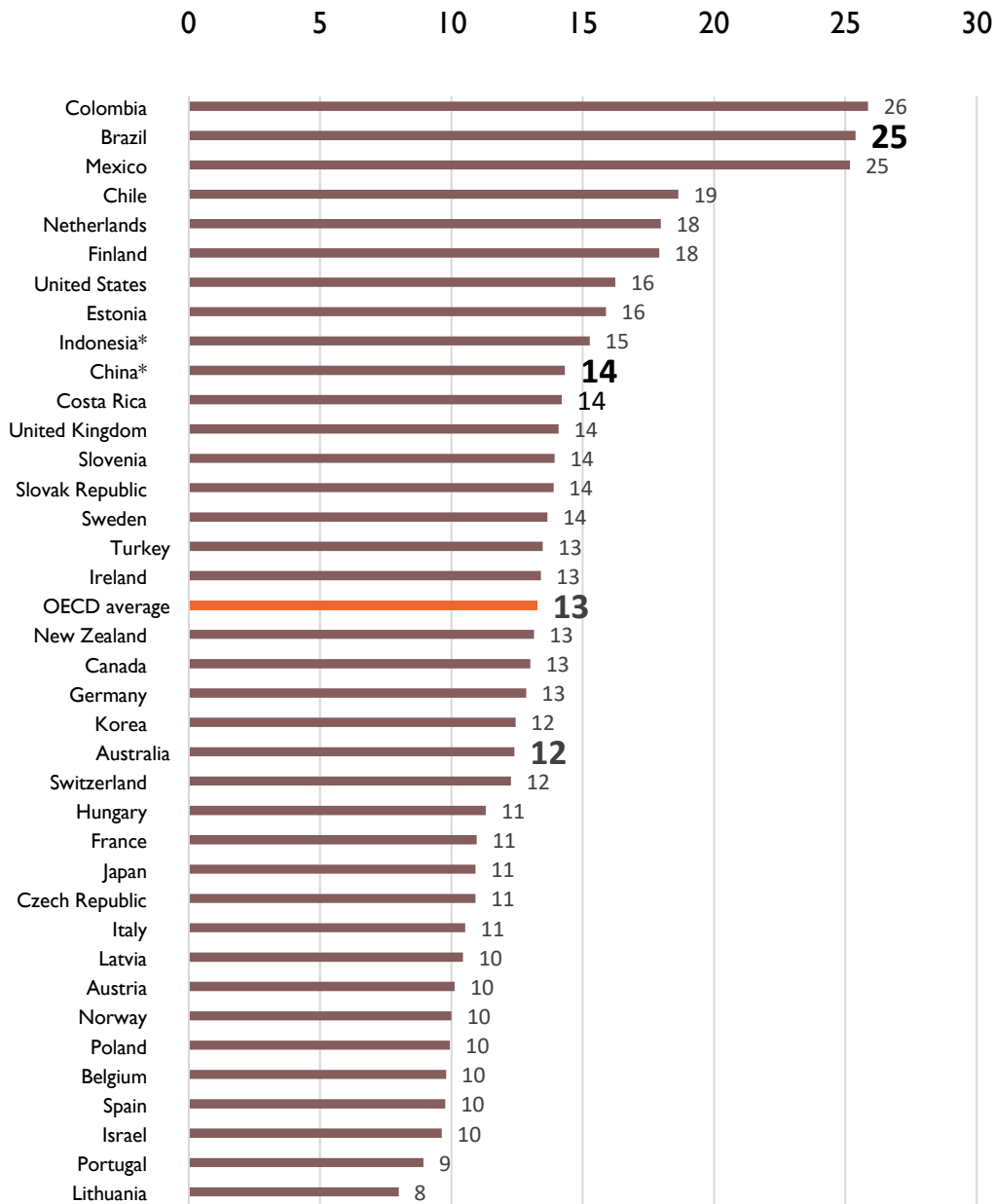
INTRODUCTION (1)

- South Africa has been experiencing a teacher shortage when expressed in terms of high learner-educator (LE) ratios and large class sizes.



- Even by developing country standards, class sizes in South Africa were already high over a decade ago (Van der Berg et al. 2020, p37, Department of Education 2006, p9).
- Why should we be concerned about LE ratios?
 - Significant implications for class sizes in a country.
 - LE ratios are compromised in budget constrained environments.

Ratio of students to teaching staff, upper secondary public (2017), OECD + partner countries



AVERAGE SA LE RATIOS ARE HIGH RELATIVE TO HIGH & MIDDLE-INCOME COUNTRIES

- OECD countries:
 - 15 students per teacher in primary education
 - 13 students per teacher in lower and upper secondary schools (OECD, 2021).
 - South Africa: 28 students per teacher in upper secondary public (2016)
 - BUT LE ratios are vastly higher in less resourced countries.
 - 70 in Malawi (2013)
 - 63 in Rwanda (2013)
 - 45 in Tanzania (2013)
 - 36 in Zimbabwe (2014)
- Pupil-teacher ratios in public primary education (IIEP/Pole de Dakar 2016, p5)

LE ratios \neq class sizes

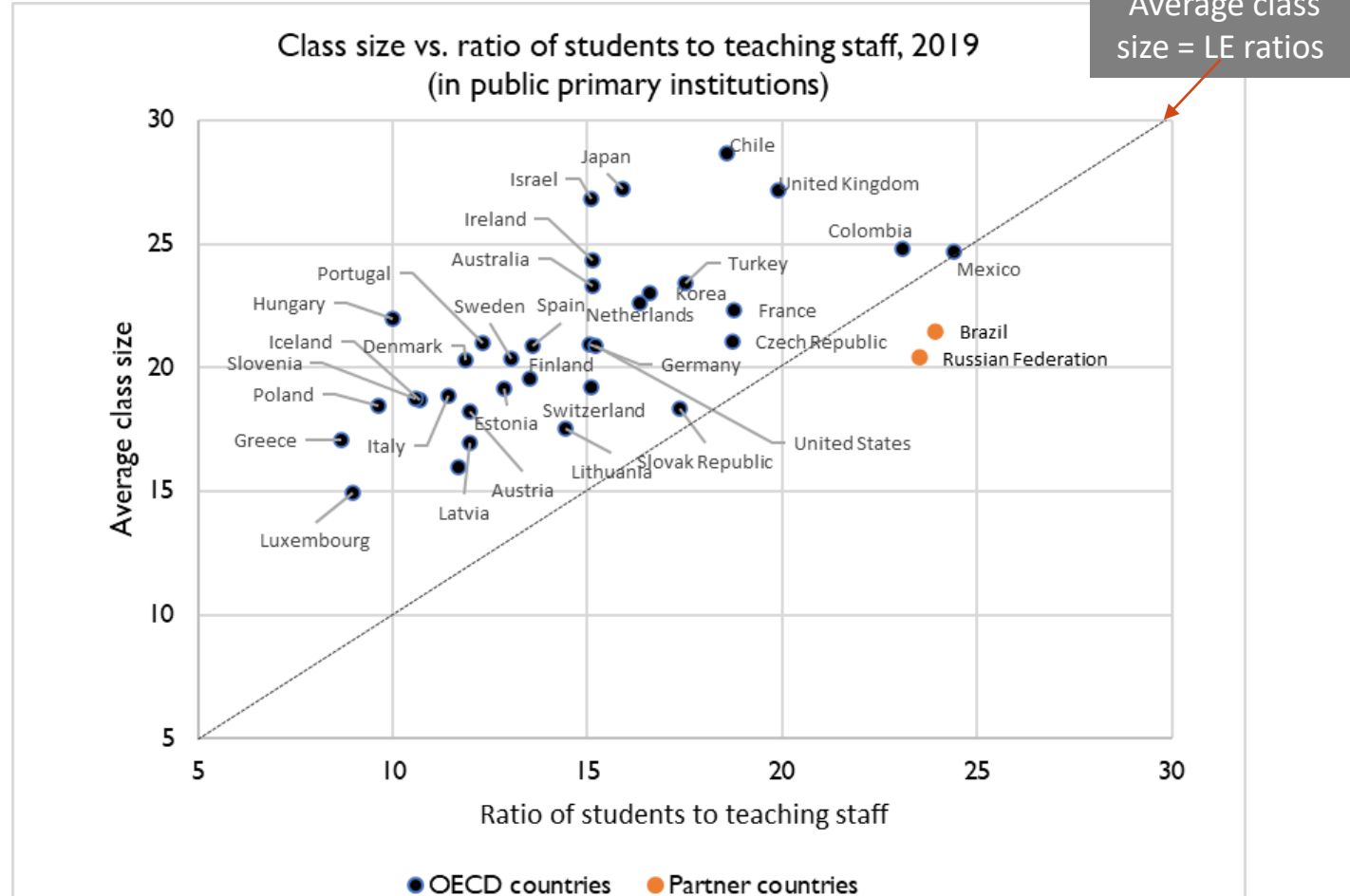
Even if educators are allocated to schools, they are not necessarily allocated to classes by school management.

Literature on teacher management systems provides some explanations for inequities in LE ratios within countries

(Miles & Darling-Hammond, 1998; Tournier 2015; Asim et al. 2017; Walter 2020; Zubairi 2020).

But not on why class sizes may differ widely from LE ratios

FIG: Class size vs. ratio of students to teaching staff in public primary institutions (OECD and partner countries), 2019



Data source: OECD 2021 using Table D2.2. 'Ratio of students to teaching staff in educational institutions, by level of education (2019)' and Table D2.1. 'Average class size, by type of institution and level of education (2013 and 2019)'. Own graph. Not all countries listed in the OECD Indicator tables have data for both average class size and student to teaching staff ratios. There is data for both indicators for 26 OECD countries and 2 partner countries. Staff are full time equivalents.



RESEARCH QUESTIONS

1

How **large** are class sizes and LE ratios in South Africa?

2

How much larger are class sizes **relative** to LE ratios in South Africa, and how does this compare to other countries?

3

Can we explain the large differences in class sizes across parts of the system in terms of differences in school structure / resources ?

4

How does the association between class sizes & LE ratios **vary** across different parts of the South African education system?

DATA

- **Global comparison:**
 - OECD indicators, SACMEQ
- **Local analysis:**
 - School Monitoring Survey 2017/18
 - Nationally representative of schools with grade 6 learners
 - Link to Masterlist 2018 → officially reported total learner enrolment & educator numbers (incl. privately paid SGB).

Table 1: SMS 2017/18 primary level sample (school offers grade 6)

	Maximum available sample size
Number of grade 3 educator responses	1 543
Number of schools with grade 3 educator response	929
Number of grade 6 educator responses	2 214
Number of schools with grade 6 educator response	978



How **large** are class sizes & LE ratios in South Africa?

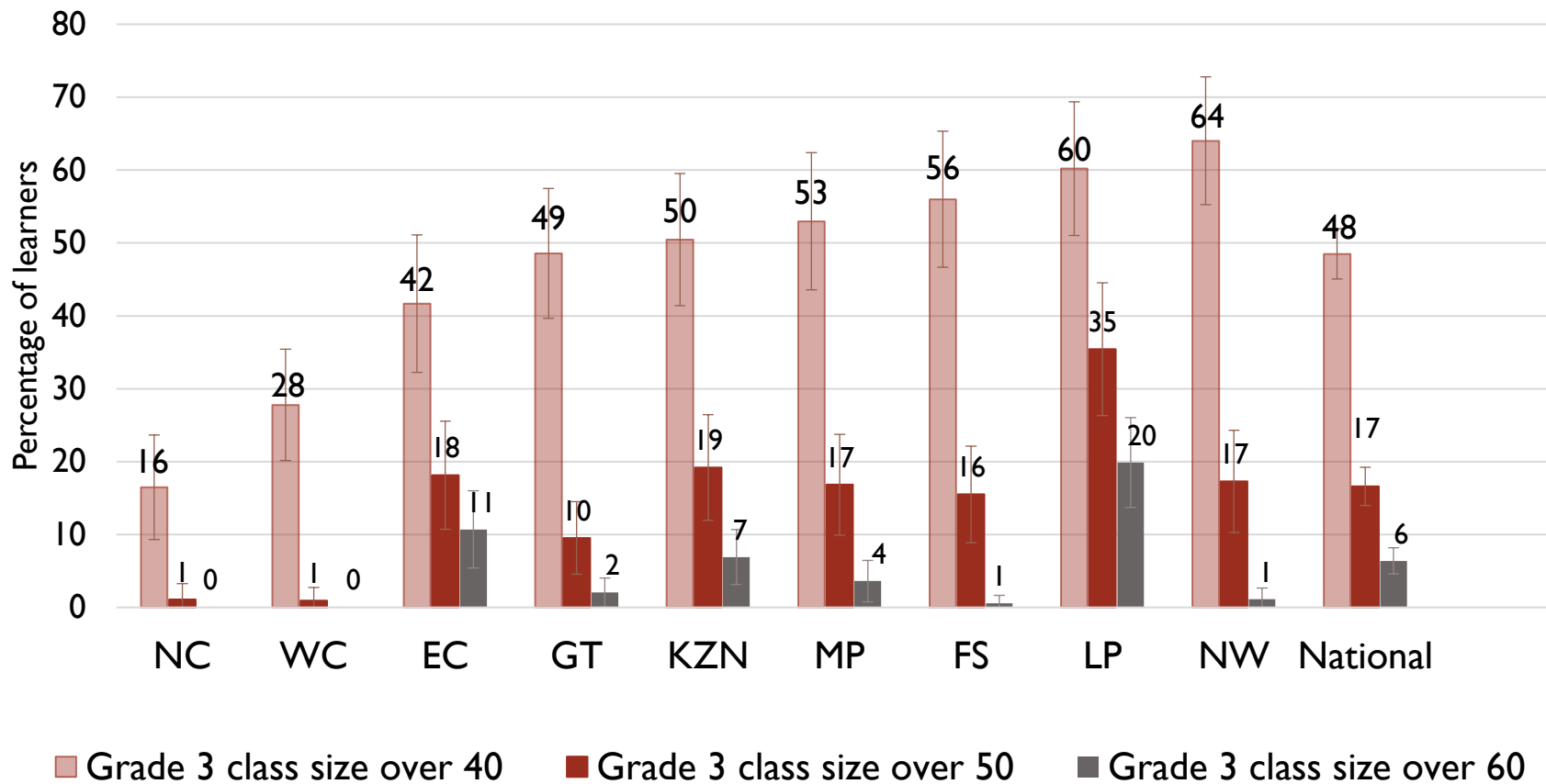
PRIMARY GRADE CLASS SIZES & LE RATIO IN SOUTH AFRICA (SMS 2017/8)

	Estimate
Average Grade 3 class size	
Self-reported	40.8
Headcount by fieldworker	39.6

Source data: SMS 2017/18. Notes: Learner weights applied. Educator level reports of class size are averaged within a school to get school level estimates of average grade 3 class size. N schools = 929 (grade 3), and 978 (grade 6).

PROVINCIAL INEQUALITIES IN PRIMARY GRADE CLASS SIZES

Figure: Percentage of learners in schools with grade 3 class sizes over 40, over 50 and over 60 by province (SMS 2017/18)



Source: SMS 2017/18. Learner weights applied. Educator responses averaged at school level.

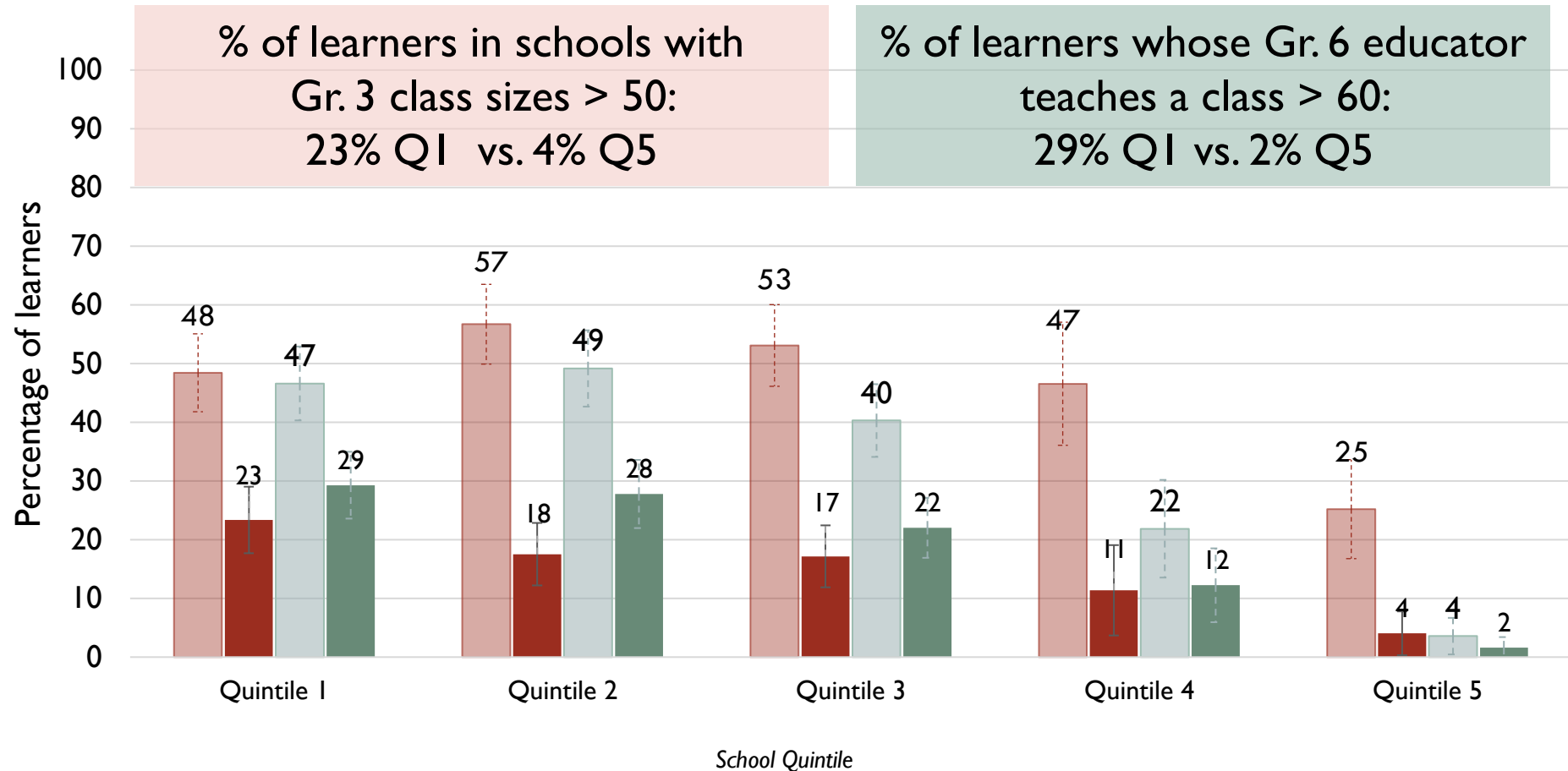
Technically, estimates should be interpreted in relation to grade 6 learners.

Percentage of learners in schools with grade 3 class sizes exceeding 40: Well below national average in NC (17%) & WC (28%)

Very high incidence of large grade 3 class sizes in Limpopo & EC, KZN, MP, FS & NW

WEALTH INEQUALITIES IN PRIMARY GRADE CLASS SIZES

National averages mask large differences in class sizes & incidence of very extreme class sizes in less resourced school contexts & in certain provinces



Data: SMS 2017/18, own calculations. Notes: Learner weighted. 95% confidence interval shown.

- Grade 3 class size over 40
- Grade 3 class size over 50
- Grade 6 educator's largest class taught is over 50
- Grade 6 educator's largest class taught is over 60



How much larger are **class sizes relative** to LE ratios in South Africa. How does this compare to other countries?

PRIMARY GRADE CLASS SIZES & LE RATIO IN SOUTH AFRICA (SMS 2017/8)

	Estimate
Average Grade 3 class size	
Self-reported	40.8
LE ratio	
incl. SGB educators	33.2
excl. SGB educators	35.0

A measure of teacher utilisation: "Alignment ratio"

(Class size / LE ratio)

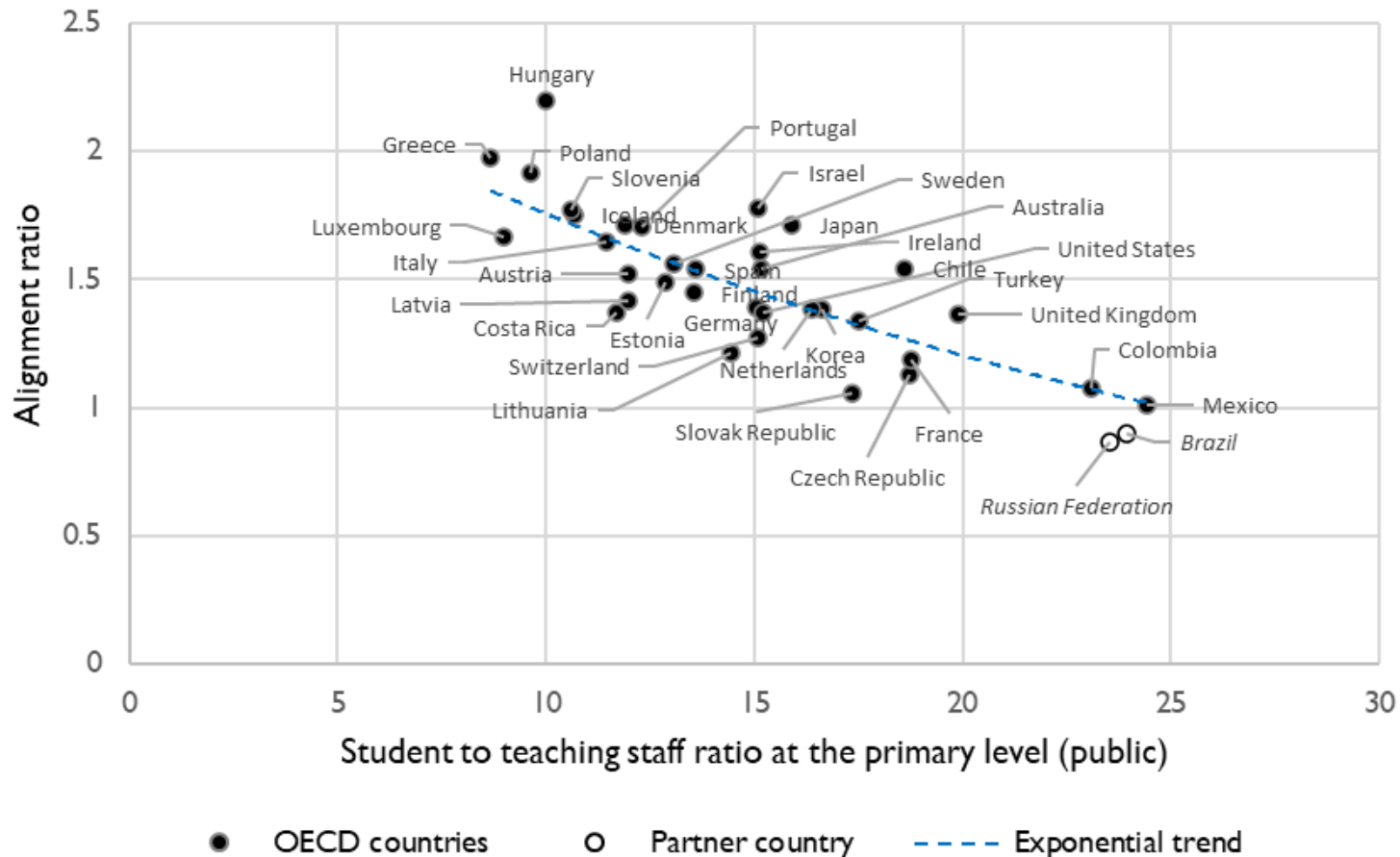
 $40.8 / 33.2 = 1.2$

Source data: SMS 2017/18. Notes: Learner weights applied. Educator level reports of class size are averaged within a school to get school level estimates of average grade 3 class size. N schools = 929 (grade 3), and 978 (grade 6).

Globally, alignment ratios decline as LE ratios rise

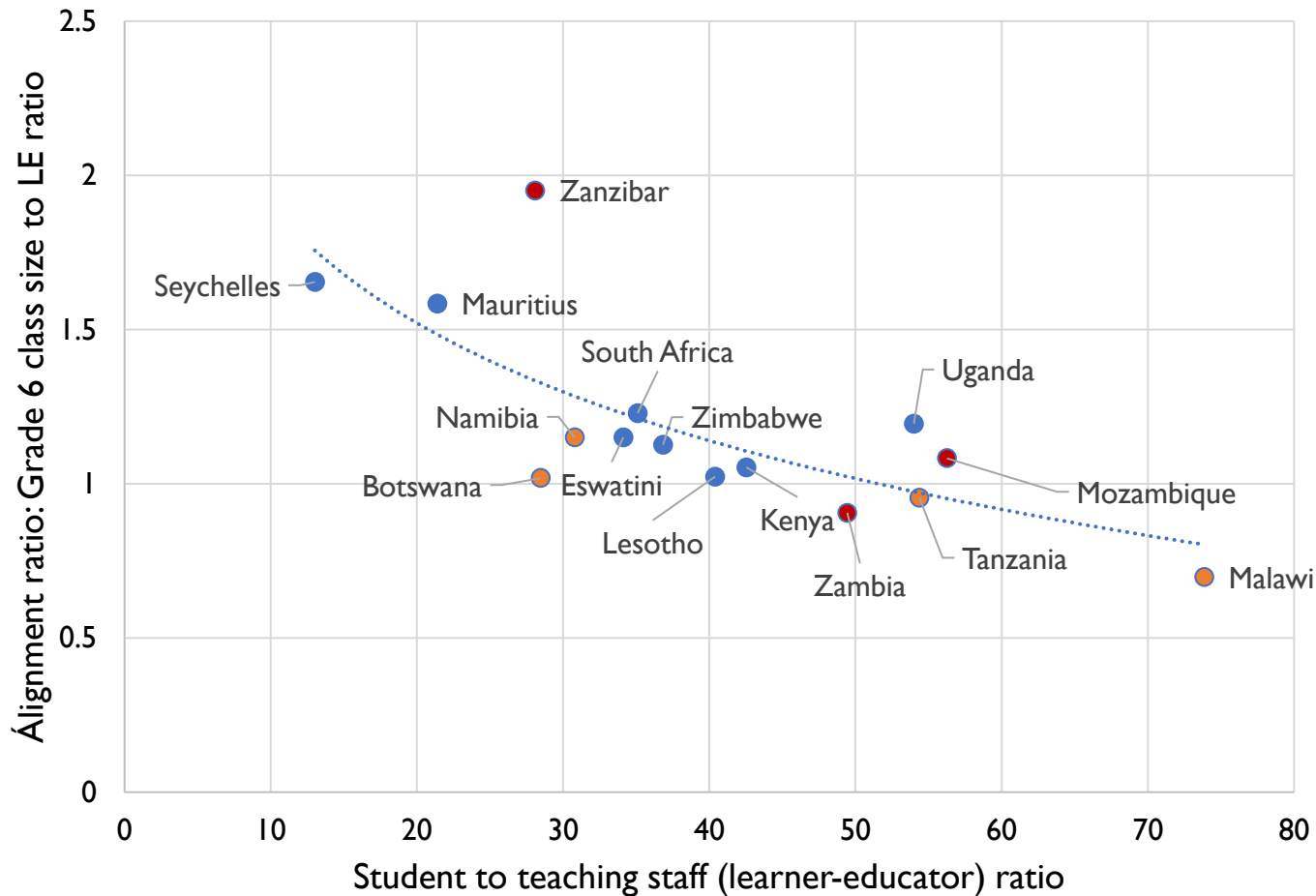
➔ As LE ratios rise, countries must more effectively **allocate & utilise** the teachers that they have to prevent class sizes from becoming excessively high

B. Alignment ratio at public primary level: Average class size divided by student to teaching staff ratio, 2019



OECD and partner countries

Fig: Alignment ratio vs. student to teaching staff ratio in Southern & East African countries, SACMEQ 2007 (Median values shown)



Data source: SACMEQ 2007, learner-weighted. Notes: Red marker signals that more than 50% of grade 6 students in the country are in schools that implement multi-shift systems. Orange marker: 5-50% of grade 6 students are in schools with multi-shift system. Dashed trendline (logarithmic function). Schools in each country sample are representative of a grade 6 population of students. LE ratios or class sizes are missing for 36% of the Zambian school sample, and 14% of the Zimbabwean school sample. The LE ratio reported does not necessarily capture full-time equivalent teaching staff in its derivation. Median LE ratio and median alignment ratio shown for each country sample.

This negative association also holds in African contexts with higher LE ratios...

Nationally, class sizes for a given LE ratio in South Africa are in line with expectations in Southern or Eastern African countries (2007)

But we could do better at containing class sizes for given LE ratios...



Do differences in school characteristics **explain** the large differences in class sizes across provinces?

WHY WOULD CLASS SIZES BE LOWER OR HIGHER THAN LE RATIOS?

CONCEPTUAL FRAMEWORK: 4 DIMENSIONS

Structure & pedagogical structure of schooling

- ✓ Grade combinations (incl. multi-grade) and highest grade offered
- Use of multi-shift systems
- Complexities of subject provisioning
- ✓ Teaching loads given to school managers
- Grade repetition practices

Student composition

- ✓ School size (Gr R-12 enrolment)
- ✓ Relative grade size
- ✓ Multiple languages offered as the medium of instruction

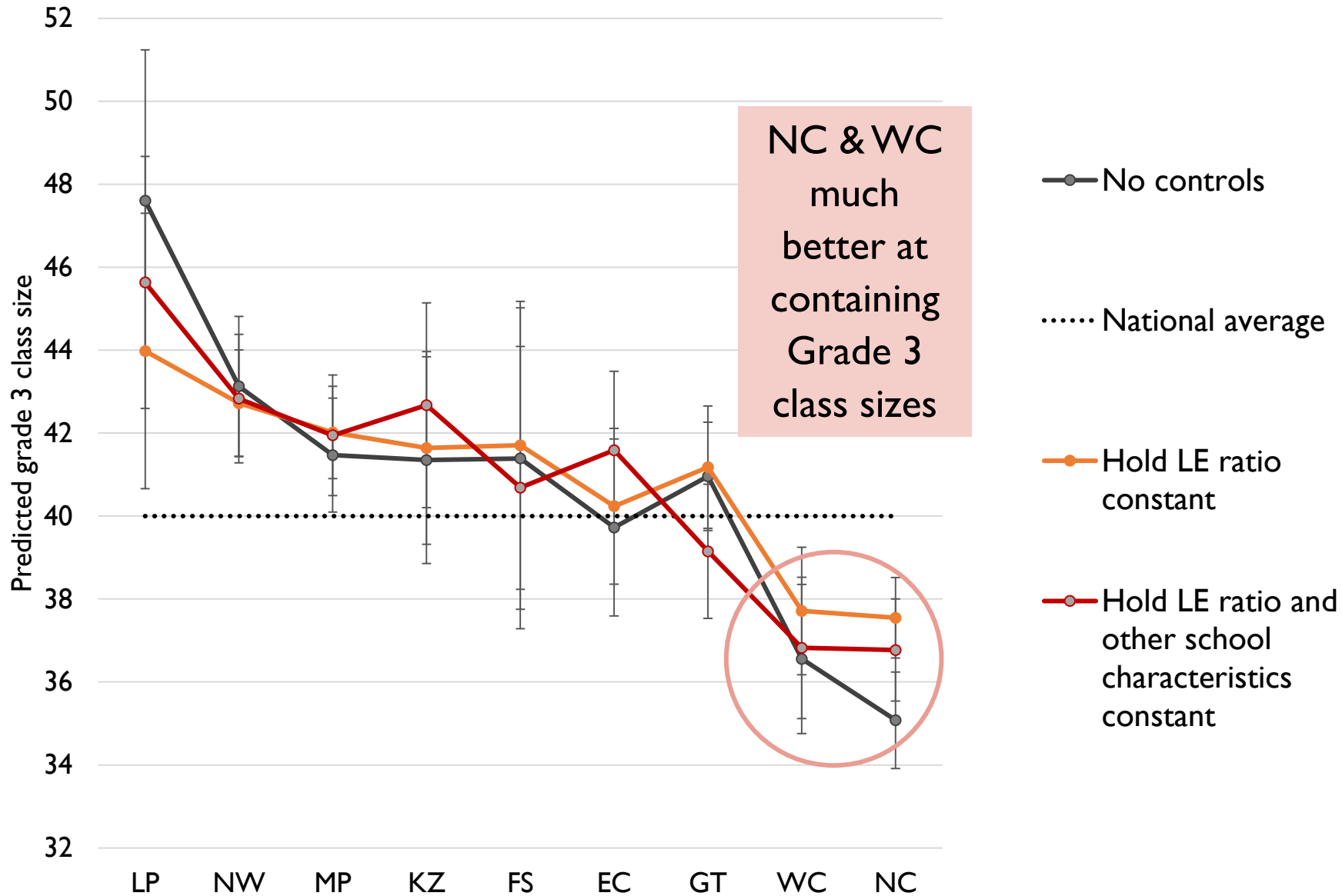
Resourcing constraints & resource utilization

- ✓ Availability of classrooms (including mobile)
- ✓ Classroom usage
 - Extent of repair of school buildings, how many classrooms are used for teaching
- ✓ School Wealth (Quintile)

Teacher utilisation challenges

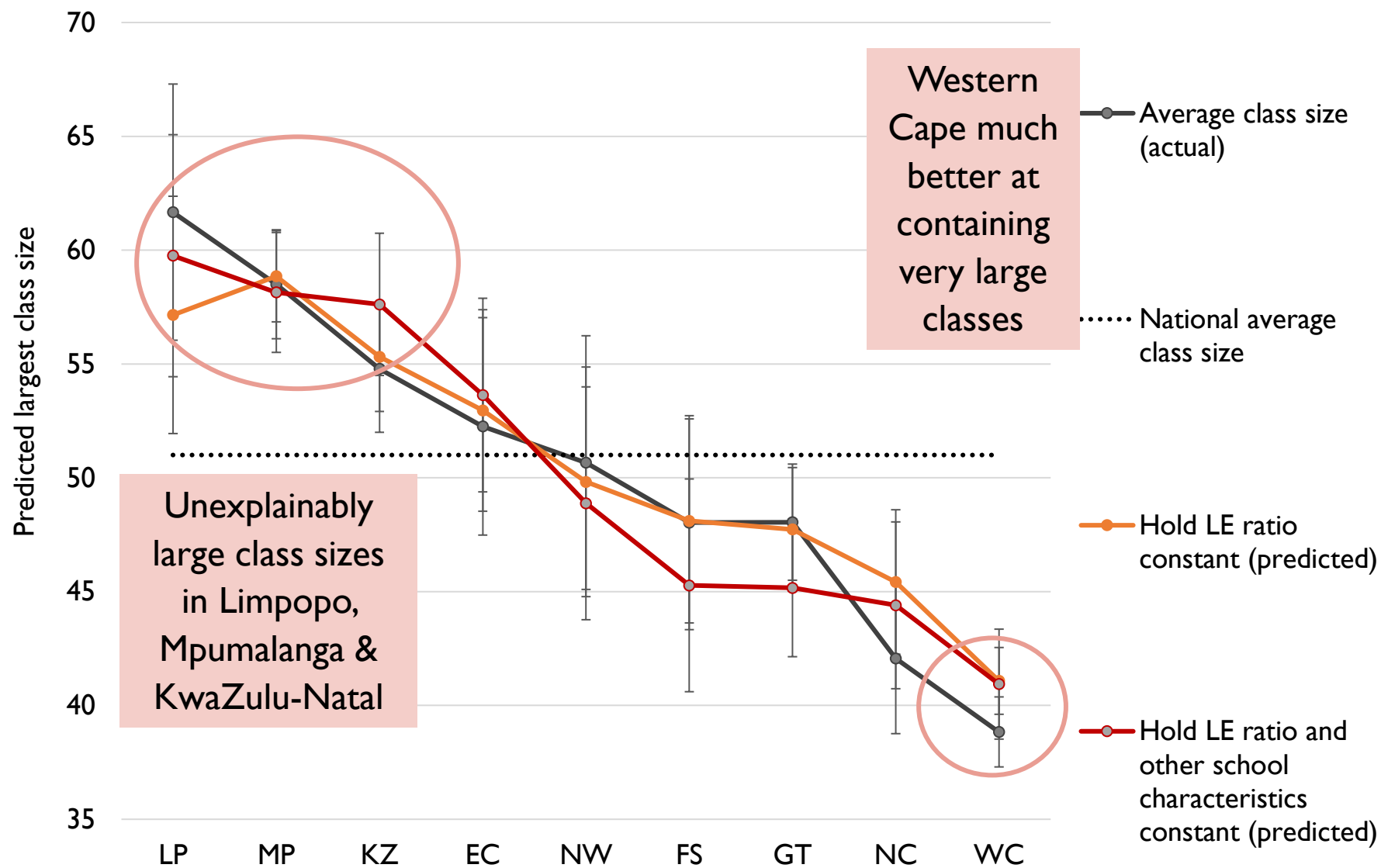
- ✓ Educator absenteeism levels
- ✓ Educator vacancy rates
- Timetabling practices
- Allocations of teaching loads across available educators
- Time spent teaching
- ✓ Teacher bargaining power in being allocated smaller classes

Fig: Estimating Grade 3 class sizes (all school Quintiles)



Differences in LE ratios & 4 school dimensions **do not explain** provincial differences in **Grade 3 class sizes**

FIG: Largest class sizes taught by Grade 6 educators (all Quintiles)



Differences in LE ratios & 4 school dimensions do not explain provincial differences in largest class sizes

TEACHER UTILISATION IN SOUTH AFRICA

- Teacher utilisation challenges in South Africa highlighted nearly two decades ago in work prepared by Gustafsson (DoE, 2006) ...

Sub-optimal teacher allocations (p35)

- If optimally allocated, two-thirds of learners would be in classes with 40 learners or fewer
- In reality, in 2004 only 40% of learners in South Africa were in classes with fewer than 40 learners

Classrooms shortages explain a little (p47)

- “Additional classrooms will not on its own solve the problem of excessively large classes.”

Key issue: Low teaching hours (p48)

- 2005 ELRC educator workload study...
- The average full-time teacher (excl. managers) taught 3.6 hours a day
- Learners receive far less contact time than the 5.2 hours prescribed in policy.



How does the **association** between class sizes & LE ratios **vary** across different parts of the South African education system?

ASSOCIATION BETWEEN CLASS SIZE AND LE RATIOS NATIONALLY

	<i>Estimating Grade 3 class size (all Quintiles, national)</i>		<i>Estimating largest class size (all Quintiles, national)</i>	
	(1)	(2)	(1)	(2)
LE ratio (incl. SGB)	0.952***	0.704***	1.458***	0.850***
R-squared	0.228	0.286	0.176	0.238
N (educators)	1503	1503	2155	2155
N (schools)	903	903	950	950
Controls:				
Province	X	X	X	X
School resources		X		X
School structure		X		X
Utilisation factors		X		X

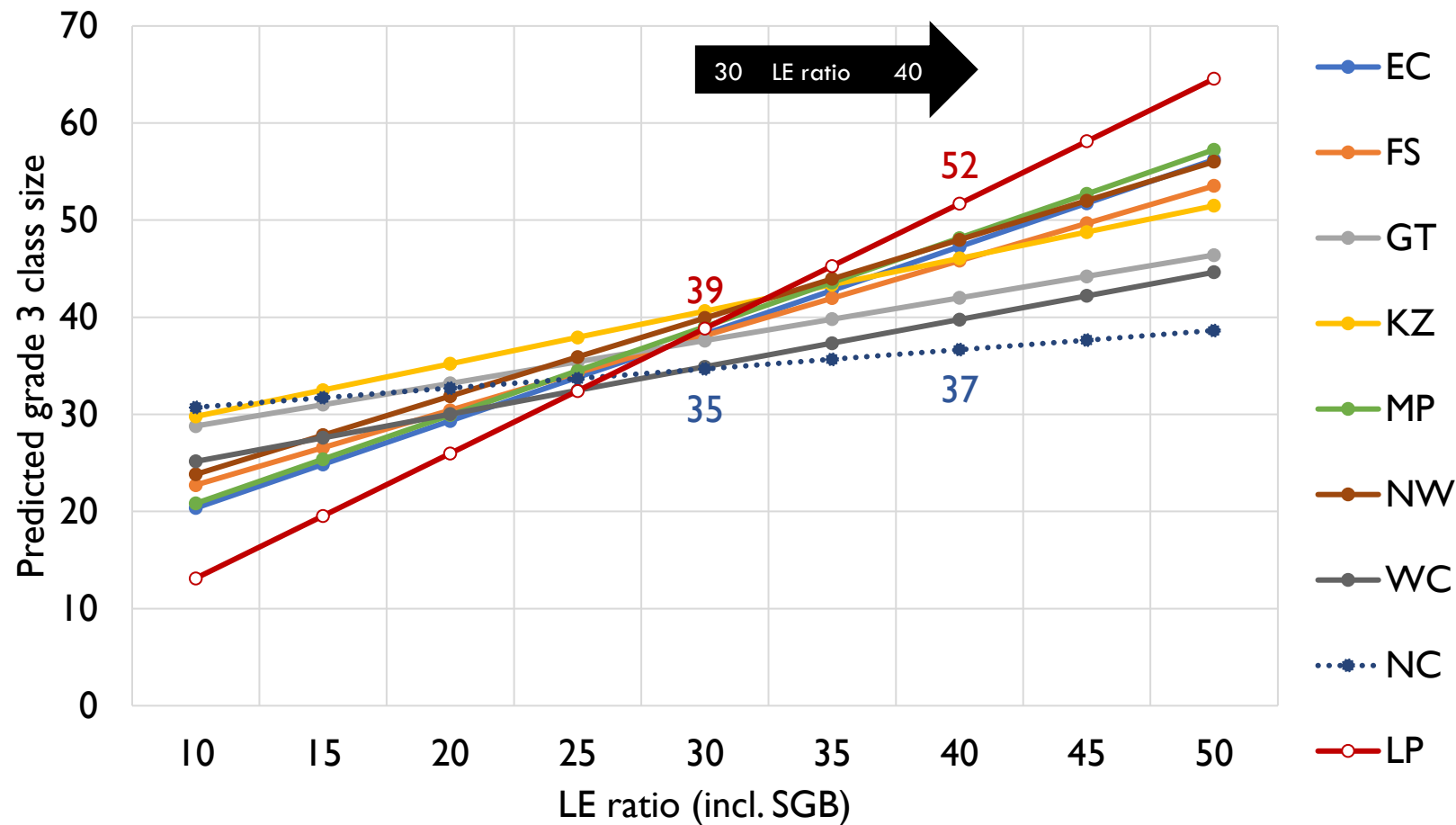
Class sizes rise as LE ratios rise in South Africa

But the association is
< than 1

Holding other things constant, reducing the LE ratio by 10 will only result in a grade 3 class size reduction of 7 or 8.5 fewer learners in the largest class taught by a grade 6 educator

THE ASSOCIATION VARIES ACROSS PROVINCES

Grade 3 class size (full controls)



Very steep slope in Limpopo: class sizes are not well contained as LE ratios rise

Using LE ratios as a tool to manage class sizes is likely to yield differing results across provincial administrations

Notes: All controls included (LE ratio, province, resourcing factors, structural factors, utilisation factors and teacher characteristics).

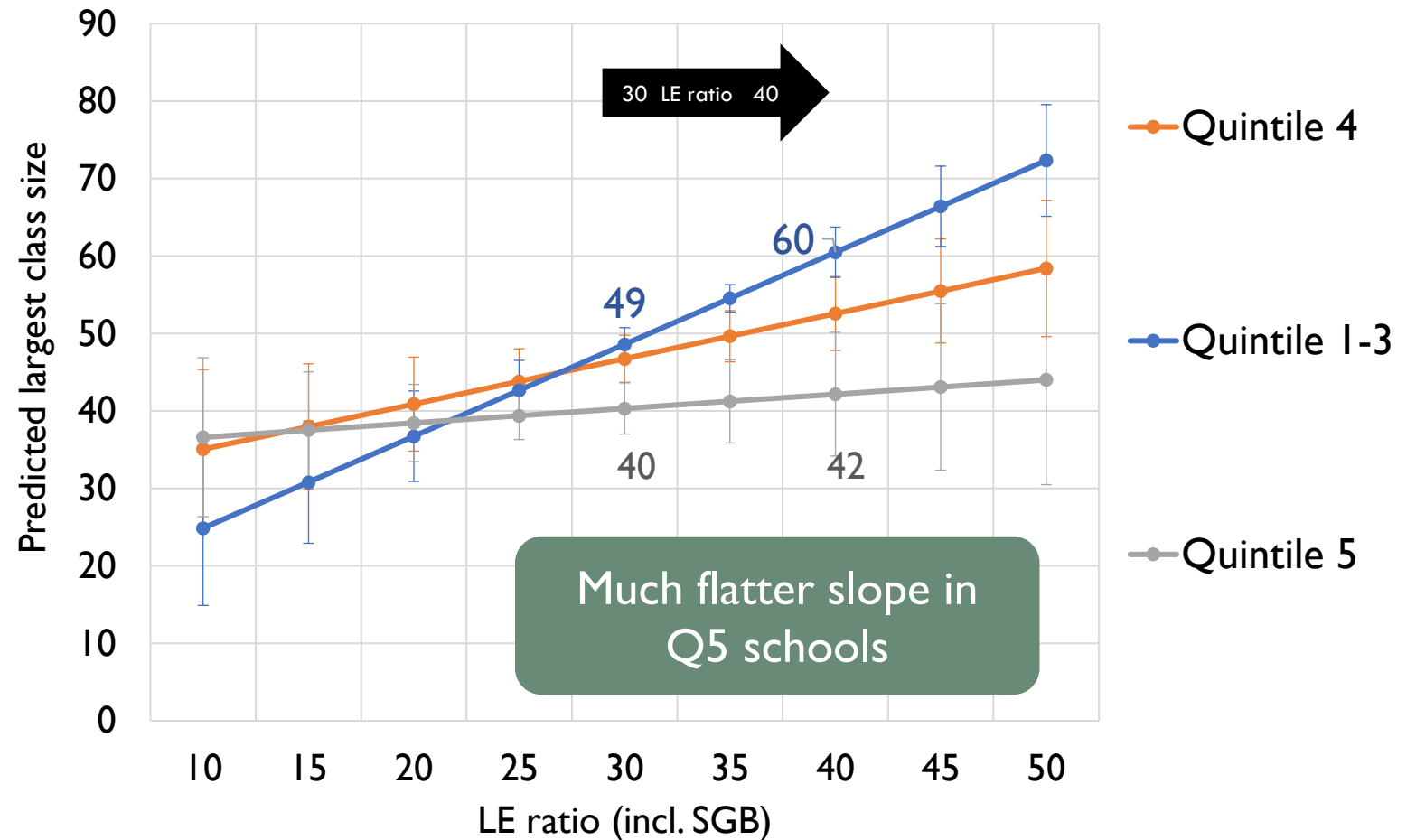
THE ASSOCIATION VARIES ACROSS SCHOOL QUINTILES

Accounting for differences in resources, Quintile 5 schools are still better able to contain large class sizes as LE ratios rise

Notes: All controls included (LE ratio, province, resourcing factors, structural factors, utilisation factors and teacher characteristics).

LE ratio considers SGB educators + public educators

Largest class size (full controls)



SUMMARY



Class sizes in SA primary schools exceed LE ratios, and considerably **exceed** suggested ideal class size guidelines.



There are large **differences** in class sizes across school quintiles & provinces – class sizes are unexplainably high in some provinces for a given level of resources

- Differences are not explained by different LE ratios or *observed* school characteristics (including resources!)



Although rising LE ratios should be contained, there exist opportunities for **class size reduction** in South Africa within existing resource limits



Leveraging LE ratios to manage class sizes will yield **differing** results across provinces → more longitudinal analysis to examine this

POLICY IMPLICATIONS

1. Tackling teacher utilisation problems should be prioritised with *targeted* programmes to improve LE ratios

- Echoes findings in earlier report on post-provisioning (DOE 2006)

2. Monitoring of class sizes is very important

- South Africa has not been systematically tracking class sizes.
- Use SA-SAMS to capture sizes of all classes in a school – monitor provincially & nationally
- Capture the range of class sizes in a school → Insufficient tracking class sizes at just 1 or 2 grades

3. More research

- Qualitative research needed to interrogate reasons for why class sizes are unexplainably large in some provinces.
- Research on class size impacts on learning

<https://tdd.sun.ac.za/research/#workingpapers>

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Extra slides

LEARNER-EDUCATOR (LE) RATIOS IN SOUTH AFRICA

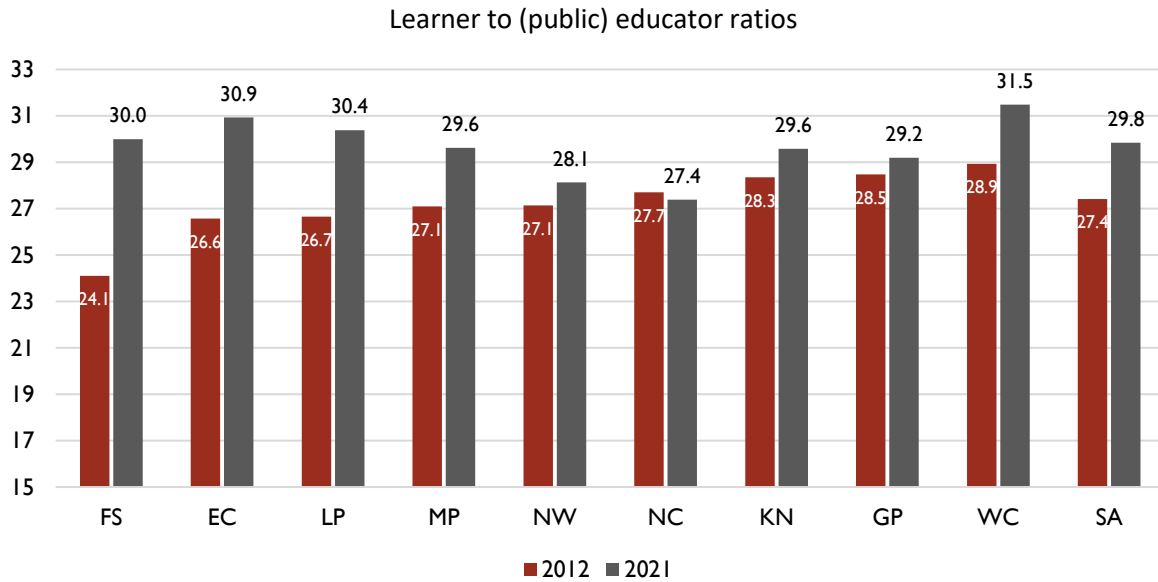


Figure 1: Learner-to-public-educator ratios in 2012 and 2021, grades 1 to 12 in public ordinary schools (DBE 2022b)

In four provinces (Free State, Mpumalanga, Limpopo and KwaZulu-Natal), positive enrolment growth has occurred with declines in educator numbers.

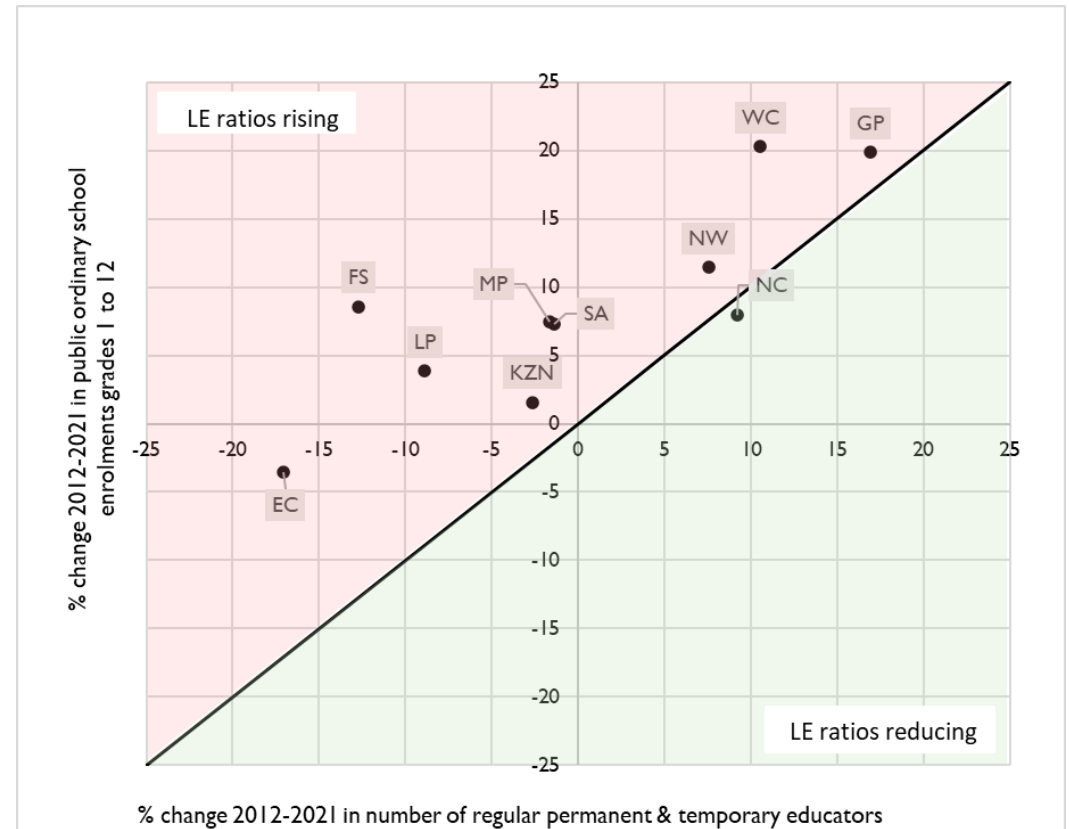


Figure 2: Percentage change from 2012 to 2021 in i) public ordinary school enrolments (Grades 1-12) and ii) number of regular temporary and permanent educators

Data source: Gustafsson (2022b, p3-4), Table 3 'Regular' permanent and temporary educators 2012 to 2021 by province (p3) and Table 4 'Public ordinary school enrolments grades 1 to 12', applying own calculations.

BACKGROUND (2)

Some literature on teacher management systems provides some explanations for inequities in learner-educator ratios within countries (Miles & Darling-Hammond, 1998; Tournier 2015; Asim et al. 2017; Walter 2020; Zubairi 2020).

1

Administrative **bottlenecks** in allocating teachers to schools

2

Difficulties in **matching** teacher specialisations to enrolment or subject needs

3

Education **bureaucracies** slow to respond

Personnel hiring decisions lag population changes or lag policy changes (Crawford & Ali 2022).

4

Political interference & power dynamics in education systems (Zubairi 2020; Brunner et al. 2020)

?

Why would class sizes be lower or higher than learner-educator ratios

Little literature & understanding about this

ALIGNMENT RATIOS

Table 4: Class sizes, learner-educator ratios and ‘alignment ratios’ in schools with a representative sample of grade 6 learners (SMS 2017/18)

	Mean	Lower 95% CI	Upper 95% CI	N (schools)
Representative sample: Learners in grade 6				
Average grade 3 class size (self-reported by grade 3 teacher)	40.8	39.8	41.8	929
Average grade 3 class size (head-count in class by fieldworker)	39.6	38.5	40.6	929
Largest class taught by grade 6 teacher (self-reported by grade 6 teacher)	51.4	49.7	53.1	978
LE ratio (incl. SGB educators, Masterlist)	33.2	32.8	33.7	929
LE ratio (excl. SGB educators, self-report)	35.0	34.6	35.4	926
Alignment ratio: Grade 3 class size / LE ratio (incl. SGB educators, Masterlist)	1.23	1.2	1.3	929
Alignment ratio: Grade 3 class size / LE ratio (excl. SGB educators, self-report)	1.18	1.2	1.2	926
Alignment ratio: Grade 6 class size / LE ratio (incl. SGB educators, Masterlist)	1.54	1.49	1.59	977
Alignment ratio: Grade 6 class size / LE ratio (excl. SGB educators, self-report)	1.49	1.44	1.54	973

Source data: SMS 2017/18 linked to EMIS Masterlist 2018. Notes: Learner weights applied. Educator level reports of class size are averaged within a school to get school level estimates of average grade 3 class size.

ASSOCIATION BETWEEN CLASS SIZE AND LE RATIOS NATIONALLY

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R-squared	0.228	0.286	0.176	0.238
N (educators)	1503	1503	2155	2155
N (schools)	903	903	950	950
Controls:				
Province	X	X	X	X
School resources		X		X
School structure		X		X
Utilisation factors		X		X

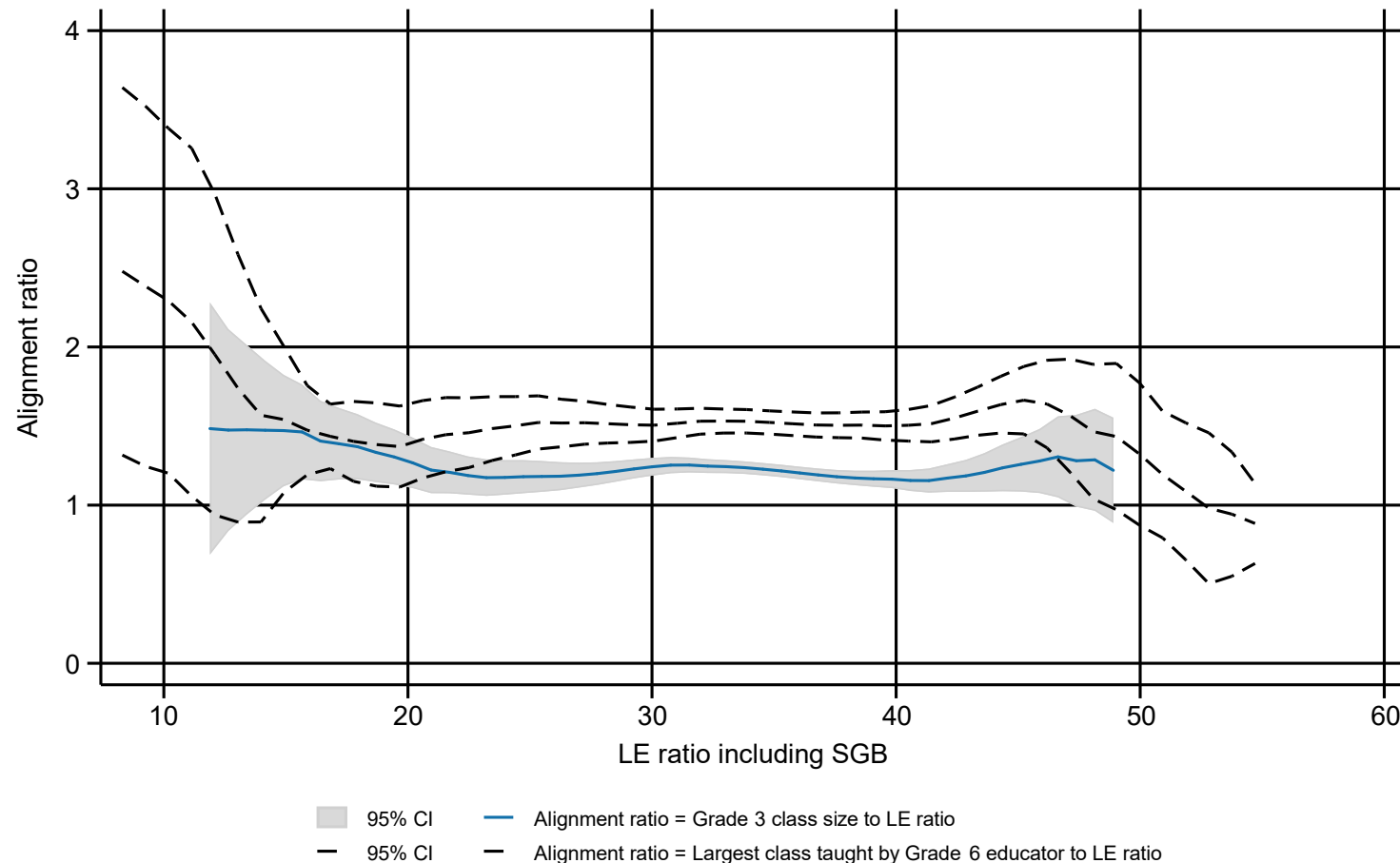
Class sizes rise as
LE ratios rise in
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...but

Holding other things
constant, reducing the
LE ratio by 10 will
only result in a grade
3 class size reduction
of 7 or 8.5 fewer
learners in the largest
class taught by a grade
6 educator

ALIGNMENT RATIOS IN SOUTH AFRICAN PRIMARY SCHOOLS

Figure 16: Alignment ratio to LE ratios (including SGB) nationally (SMS 2017/18)



Source: SMS 2017/18 linked to Masterlist 2018, own calculations Learner weighted

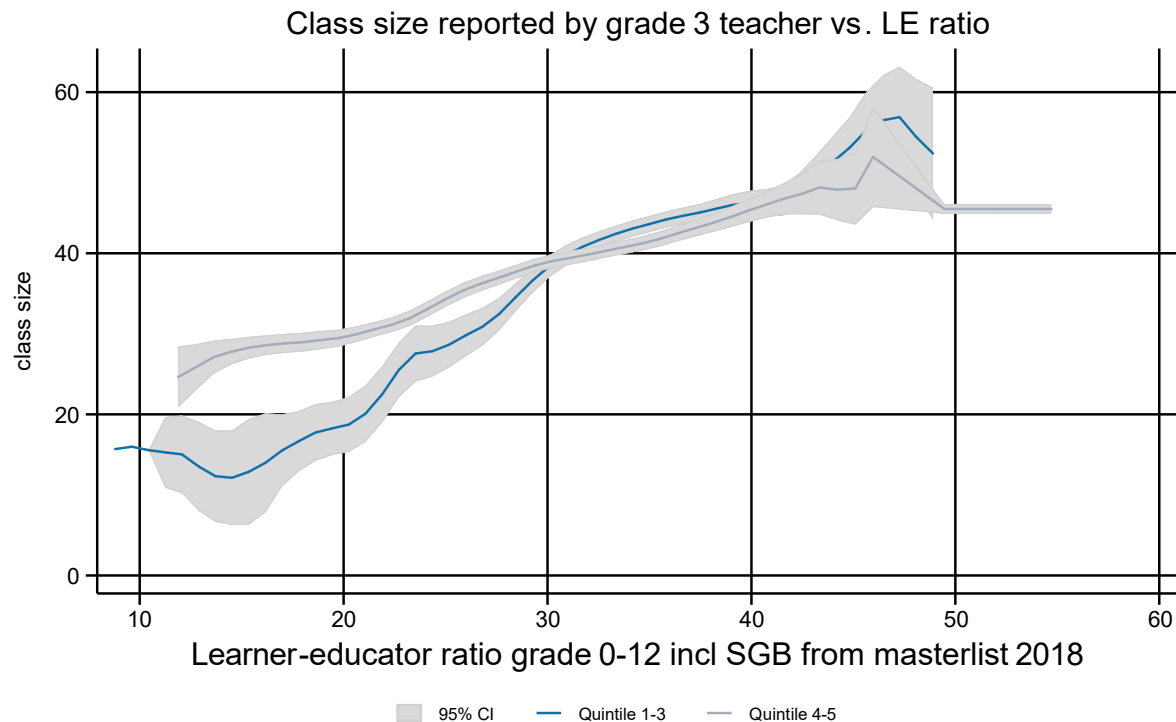
Overall, the negative association between the alignment ratio and LE ratios is **not seen** at the primary level in South Africa...

➔ Not seeing better class size containment where LE ratios are higher.

But this pattern varies across provinces and by school Quintile...

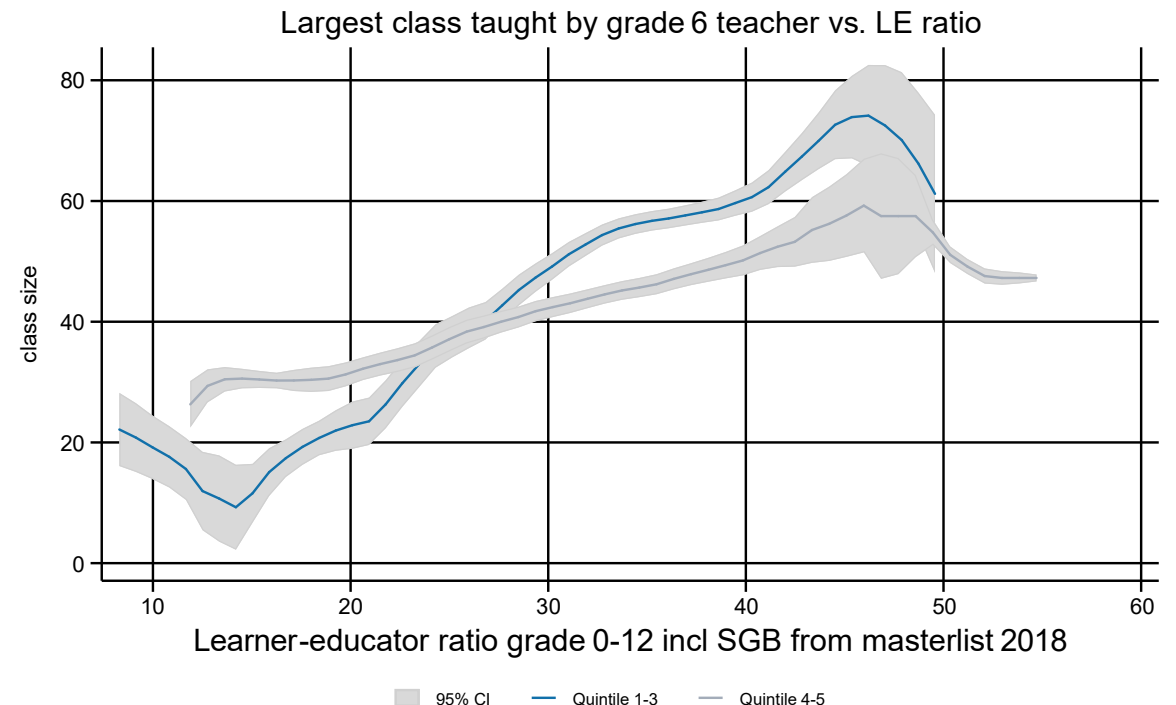
A NON-PARAMETRIC LOOK: CLASS SIZE VS. LE RATIO

Figure 21: Association between grade 3 class size and LE ratio (including SGB educators), local polynomial regression



Source: SMS 2017/18. Learner weights LE ratio truncated at 55 where 99th percentile is 52

Figure 22: Association between the largest class taught by grade 6 educator and LE ratio (including SGB educators), local polynomial regression



Source: SMS 2017/18. Learner weights LE ratio truncated at 55 where 99th percentile is 52

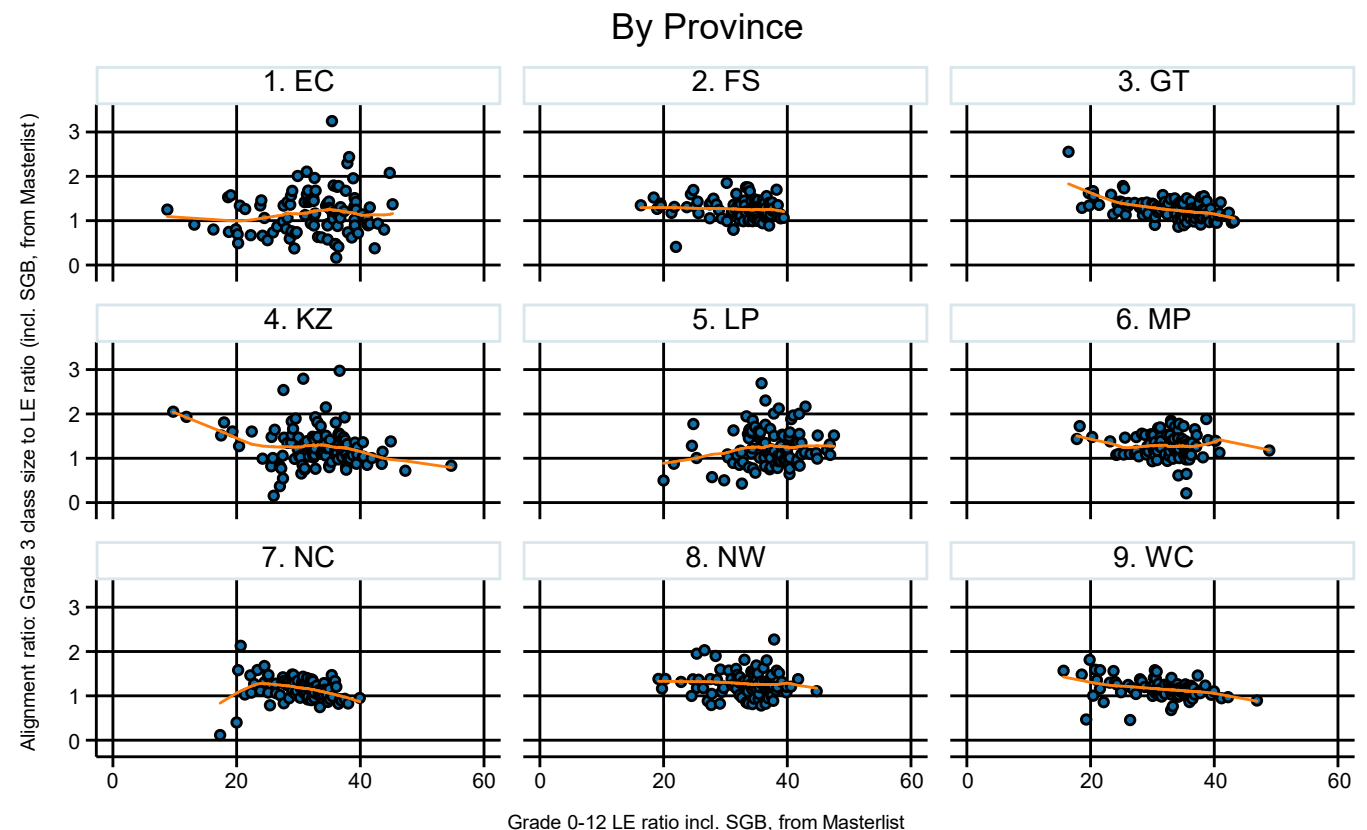
Account for possible non-linearities (far less than before due to better enrolment estimate!)

$$Y_{is} = \beta_0 + \beta_1 LE_S + \beta_2 LE_S^2 + \beta_3 PROV + \beta_4 R_S + \beta_5 S_{is} + 6T_{is} + \beta_6 U_S + \varepsilon_{is} \quad (2)$$

ALIGNMENT RATIO BY PROVINCE

- In Gauteng, the Western Cape and the Northern Cape there appears to be a slightly negative association between grade 3 alignment ratios and LE ratios.
- In schools in these three provinces, as well as in the Free State and Mpumalanga, grade 3 class sizes seldom (if ever) reach or exceed twice the LE ratio.
- By exception, grade 3 alignment ratios exceed twice the LE ratio in quite a few schools in the Eastern Cape, KwaZulu-Natal, North West and Limpopo.

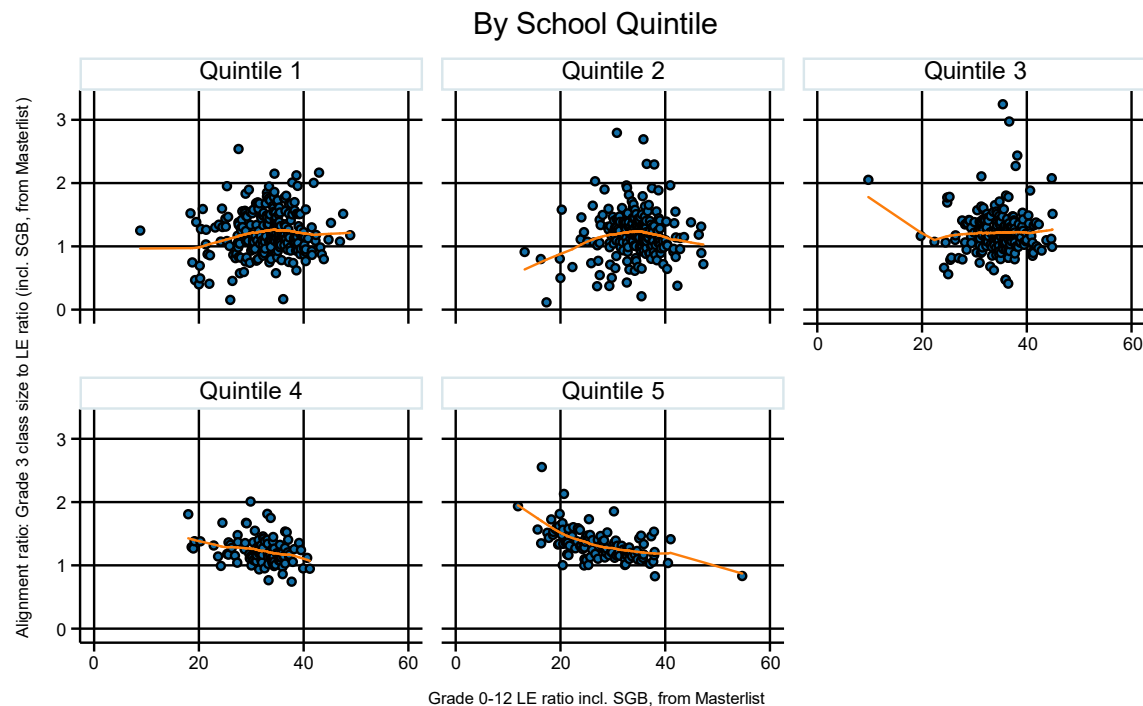
Fig 17: Association between grade 3 alignment ratio and LE ratio (including SGB) within provinces



Data source : SMS 2017/18 & Masterlist 2018. Locally weighted regression
Each dot represents a unique school .

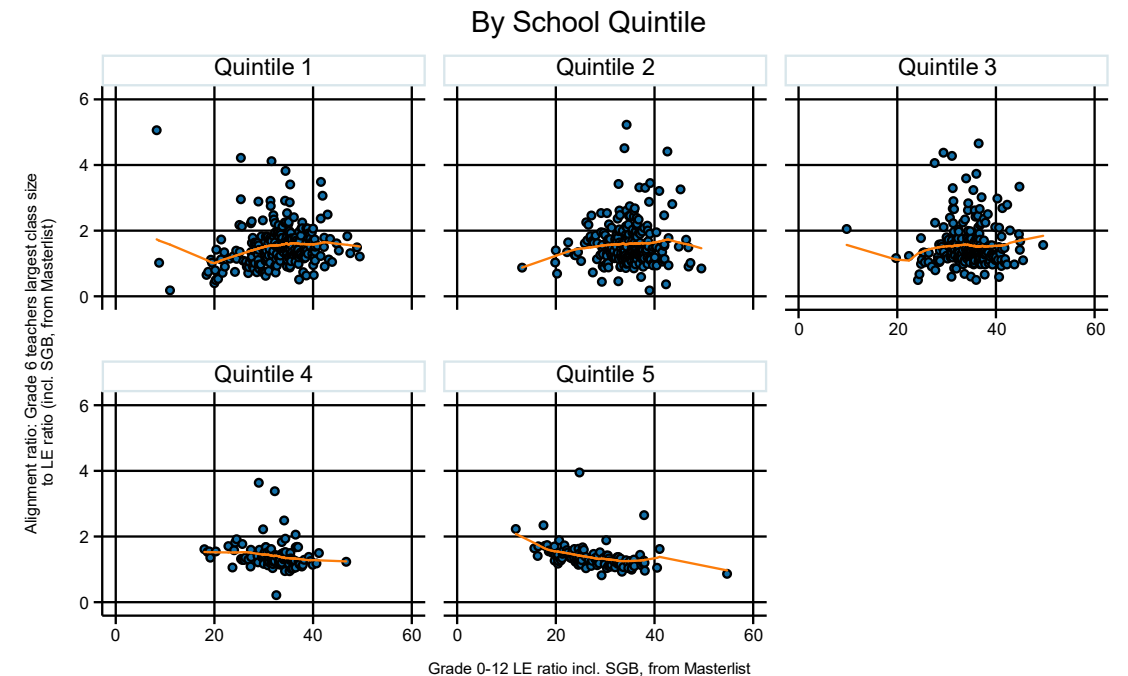
ALIGNMENT RATIO BY QUINTILE

Figure 18: Association between grade 3 alignment ratio and LE ratio (including SGB) within school Quintiles



Data source : SMS 2017/18 & Masterlist 2018. Locally weighted regression
Each dot represents a unique school .

Figure 20: Association between the alignment ratio calculated using largest class size and the LE ratio (including SGB) within school Quintiles



Data source : SMS 2017/18 & Masterlist 2018. Locally weighted regression
Each dot represents a unique school .

- A negative association between grade 3 alignment ratios and LE ratios is only observed in Quintile 4 and 5 schools implying they are better at containing class sizes as LE ratios rise compared to Quintile 1-3 schools

ESTIMATING CLASS SIZES

- A regression framework is used to control for observed differences in these sets of factors as follows

$$Y_{is} = \beta_0 + \beta_1 LE_s + \beta_3 PROV + \beta_4 R_s + \beta_5 S_{is} + \beta_6 T_{is} + \beta_6 U_s + \varepsilon_{is} \quad (1)$$

Class
size

LE ratio

Province

School
resources

School
composition &
pedagogical
structure

Teacher
characteristics

Teacher
utilisation

- Availability of classrooms (incl. mobile classrooms) relative to learners
- School Quintile (proxy for school SES)
- the extent of disrepair of school buildings that may affect how classrooms are used.

- Total grade R-12 enrolment
- Ratio of grade enrolment to total enrolment
- highest grade offered at the school
- Teaches a multi-grade class
- Total languages offered at the school
- The intensity of SMT activity in the school (proxied by frequency of reported HOD visits to a teacher, and ratio of all educators to SMT members)

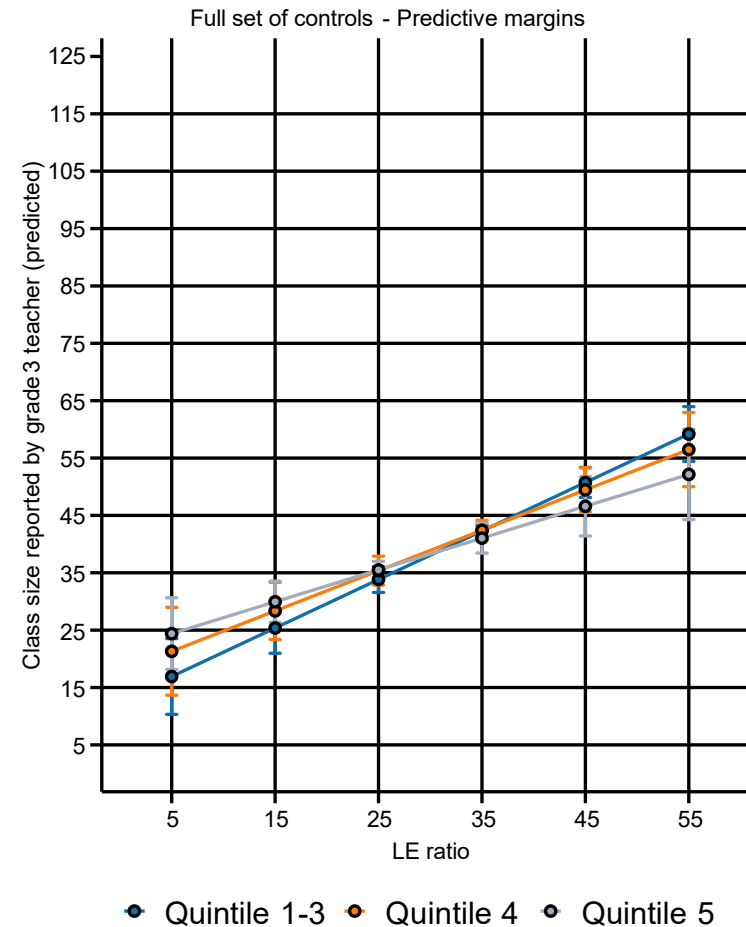
- years of experience;
- teaching mathematics;
- holding a management position

- Teacher absenteeism (proportion of educators who did not sign the register on the Friday before the visit);
- Educator vacancy (% allocated public educator posts that are vacant);
- Number of ordinary classrooms that are not used for teaching purposes;
- School autonomy in teacher hiring and management (proxied by the extent to which financial management functions are transferred to schools)

QUINTILE INTERACTIONS WITH LE RATIOS (GRADE 3)

Figure 26a: Class size simulations after interacting school Quintile with LE ratios

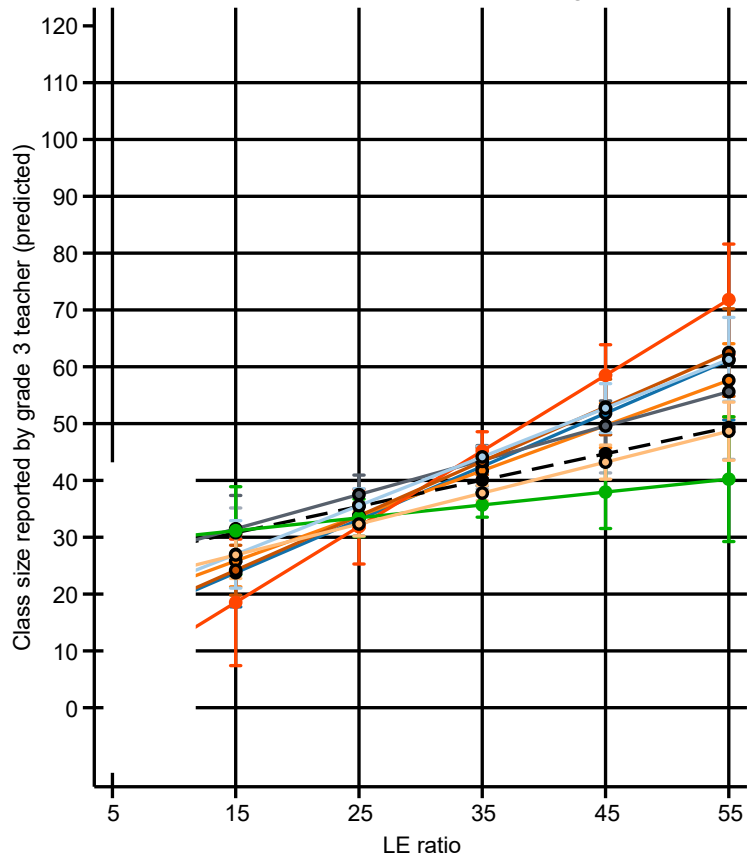
The coefficient on Quintile 5 interacted with LE ratio is, only weakly significant (10% level) in the fully controlled model.



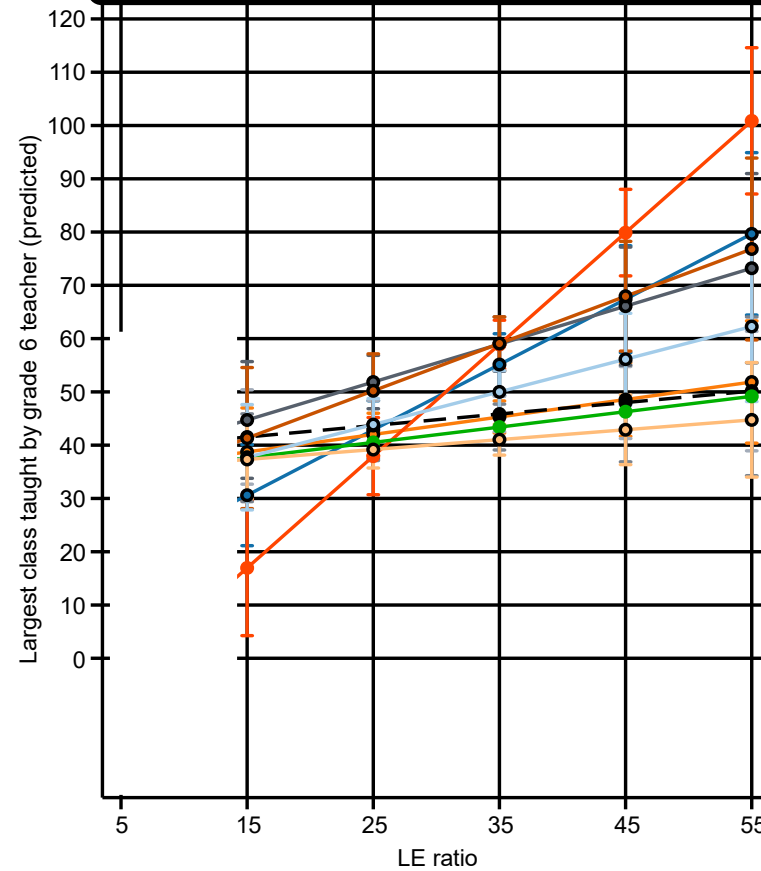
Notes: In the left figures, only the LE ratio (linear inclusion) and Quintile are controlled for. In the right figure, all controls as in Model 6b are included (LE ratio, province, resourcing factors, structural factors, efficiency factors and teacher characteristics).

THE ASSOCIATION VARIES ACROSS PROVINCES

Grade 3 class size (full controls)



Largest class size (full controls)



Very steep slope in Limpopo: class sizes are not well contained as LE ratios rise above 30-35.

Using LE ratios as a tool to manage class sizes is likely to yield differing results across provincial administrations

● EC ● FS ● GT
● NC ● NW ● WC

● KZ ● LP ● MP

Notes: All controls included (LE ratio, province, resourcing factors, structural factors, utilisation factors and teacher characteristics).