Africa's Skill Tragedy: Does Teachers' Lack of Knowledge Lead to Low Student Performance?

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Children learn very little in Sub-Saharan African schools

- **Countries in Sub-Saharan Africa (SSA) have made considerable progress in increasing school enrolment in recent decades:**
  - Gross enrolment rate in primary education in SSA was 99.6% in 2013, up from 72.8% in 1990 (source: Word Development Indicators).

- **But enrolled children are learning remarkably little in school:**
  - PIRLS 2011: poor performance of Botswana and South Africa even compared to much poorer countries such as Honduras and Indonesia.
  - SACMEQ 2007: across 13 SSA countries, only 30% of 6th graders could calculate the number of pages remaining in a 130-page book when 78 pages have already been read (vs 66% of OECD 4th graders).

Can raising teachers' subject knowledge improve learning?

- **Problem:** economic growth not driven by the number of years spent in school, but by a population's skills (Hanushek and Woessmann 2012).
- **Main policy response so far:** give additional *physical* resources to schools (e.g., textbooks). But RCTs show little effect on achievement.
- **This paper: can student learning in SSA schools be boosted by improving teachers' skills (i.e. schools' *human* resources)?**
  - Motivation: increasing evidence on the importance of teachers for learning (e.g., Jackson et al. 2014, Azam and Kingdon 2015).
  - Focus on one particular dimension of skills: subject knowledge.

This paper in a nutshell

- **Use data from an assessment of the math and reading skills of students and their teachers in 13 SSA countries to estimate the effect of teacher subject knowledge on student achievement.**

- **Identification strategy** exploits within-student between-subject variation in student achievement and teacher subject knowledge (TSK).

- **Preview of results:**
  1. 1 SD rise in TSK $\Rightarrow$ 0.03–0.04 SD rise in student achievement.
  2. TSK effect is larger in more developed countries, in well-equipped schools, and for students with access to subject-specific textbooks.

Related literature and contribution

- **Previous studies from developing countries:** positive correlation between teacher test scores and student achievement. But: omitted-variable bias (exception: Metzler and Woessmann 2012).

- **Contribution of this paper:**
  - First credible evidence on impact of TSK in SSA.
  - Complementarities between TSK and physical resources.
  - Insight: what determines int'l differences in student performance?

The SACMEQ data

- **Southern and Eastern Africa Consortium for Monitoring Educational Quality (SACMEQ):** a collaborative network of 15 Ministries of Education and UNESCO's IIEP. ▸ SACMEQ countries

- **Regular assessments of the math and reading achievement of 6th-grade primary-school students and their teachers.**
  - Teachers only tested in the subject(s) they teach.
  - Detailed information on student and teacher characteristics and classroom and school resources from contextual questionnaires.

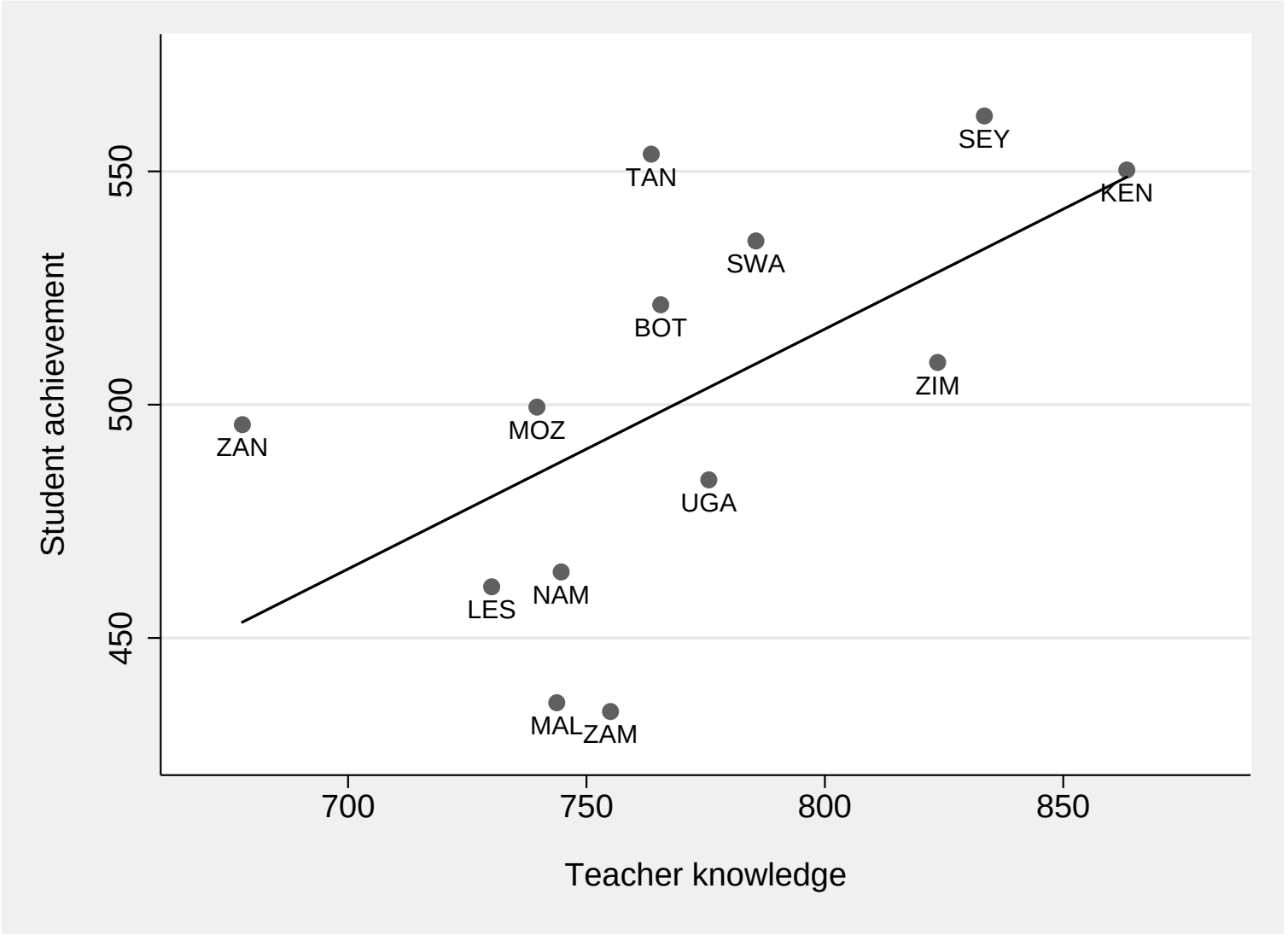
- **Pool data from 2000 and 2007 waves for 13 countries** (i.e. all waves/countries with teacher test scores; 75K students, 9K teachers).

Student and teacher assessments

- **Student assessments:**
  - Multiple-choice tests of students' knowledge of the common part of the 6th-grade math and reading curricula across SACMEQ countries.
  - IRT scale scores: mean 500, SD 100 in each subject in 2000 wave.

- **Teacher assessments:**
  - Items from student tests as well as additional, more difficult items $\Rightarrow$ test TSK that is directly relevant for the knowledge that students are tested on (should have been taught by same teacher in same year).
  - TSK directly comparable to student achievement (overlapping items).

Student achievement and TSK at the country level



Notes: Values are averages across math and reading.

Empirical specification

- **Main empirical specification:**

$$y_{ijs} = \alpha + \beta TSK_{js} + X_{js}\gamma + \lambda_i + \varepsilon_{ijs},$$

where i = students, j = teachers, and s = subjects (math or reading); y_{ijs} = student test score; X_{js} = class and teacher controls (class size, textbook availability, ...; teacher gender, education, ...).

- **Identification is based on cross-subject variation in TSK.**
  - Student FEs account for sorting based on subject-invariant factors.
  - Two main threats to identification (address both in robustness checks):
    (1) sorting to teachers (TSK) based on subject-specific factors;
    (2) pick up the effect of another, unobserved teacher characteristic.

Results: the effect of TSK on student achievement

	Dependent variable: student math & reading scores			
	(1)	(2)	(3)	(4)
Teacher knowledge	0.070***	0.025***	0.025***	0.026***
	(0.007)	(0.005)	(0.005)	(0.005)
Student FE	No	Yes	Yes	Yes
Student controls	Yes	No	No	No
Class controls	Yes	No	Yes	Yes
Teacher controls	Yes	No	No	Yes
Observations	149,416	149,416	149,416	149,416

Notes: Standard errors clustered at the school level. * p<0.10, ** p<0.05, *** p<0.01.

Comments on main results

- **TSK coefficient drops by 65% once student FEs are included.**
  - One explanation: upward bias in basic estimates w/o student FEs.
  - Alternative explanation: downward bias due to measurement error is aggravated in the fixed-effects model. An attempt to correct for this potential bias leads to a 50% larger coefficient of 0.04 SD.

- **Putting the effect size into perspective:**
  - Previous studies: a 1 SD rise in teacher VA raises student scores by 0.15 SD on average $\Rightarrow$ TSK effect explains about 20% of this impact.
  - Estimate similar to impact of a 10% increase in instruction time (e.g., Lavy 2012) and to TSK effect in Peru (Metzler and Woessmann 2012).

Results: heterogeneity by availability of physical resources

	Dependent variable: student math & reading scores			
Heterogeneity at level of:	country	school	school	student
	(1)	(2)	(3)	(4)
Teacher knowledge	0.009	0.025***	0.017**	0.027***
	(0.008)	(0.005)	(0.007)	(0.005)
× high GDP p.c.	0.038***			
	(0.010)			
× school facilities (index)		0.011***		
		(0.005)		
× average class size			0.001	
			(0.006)	
× textbook availability				0.017**
				(0.007)
Textbook availability				0.006
				(0.010)
Observations	143,978	149,416	149,416	146,310

Notes: Specifications include student fixed effects and class and teacher controls. Standard errors clustered at the school level. * p<0.10, ** p<0.05, *** p<0.01.

Comments on heterogeneity results

- **Positive impact of TSK on student achievement is driven mostly by countries at a higher stage of economic development.**

- **Possible explanation:** there are complementarities between human and physical resources in educational production, and richer countries provide schools with better physical resources.

Further results and robustness checks

- **Effect is roughly linear in our sample.** ▸ Non-linearities
- **Robustness checks:** accounting for unobserved teacher traits and sorting based on subject-specific factors. ▸ Robustness checks
- **TSK and cross-country differences in student achievement:**
  - Open question: what explains student achievement gaps across countries? Suspicion by many authors: role for teacher quality.
  - Our estimates: differences in TSK explain only around 5% of gap between lowest- and highest-achieving countries. But figure rises once differences in physical resources are taken into account.

Conclusion

- First evidence on the impact of teacher skills on student achievement for a wide range of developing countries across SSA.
- Modest positive effect of TSK on student achievement, which is larger in richer countries and in better-equipped schools.
- Hiring better-skilled teachers (or training existing ones) *and* increasing physical resources as a potentially effective policy for raising student learning in SSA.

Countries participating in SACMEQ 2007

Source: SACMEQ

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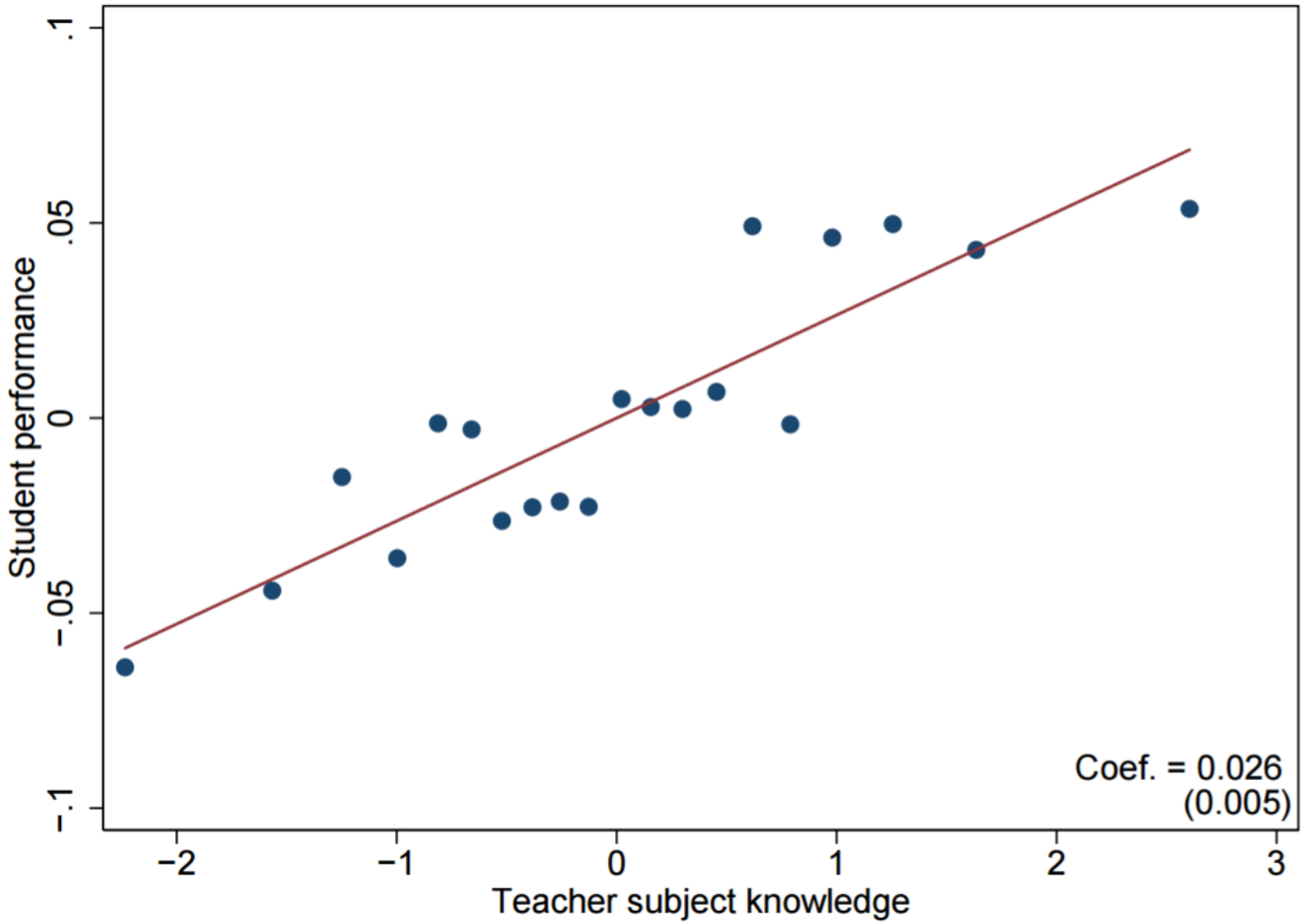
Results: linearity



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Results: robustness

Sample restriction:	Same teacher	Rural schools	One-class schools	School-lvl variables
	(1)	(2)	(3)	(4)
Teacher knowledge	0.025***	0.021***	0.022***	0.030***
	(0.010)	(0.006)	(0.008)	(0.005)
Observations	46,888	92,968	63,204	149,416

Notes: Specifications include student fixed effects and class and teacher controls. Standard errors clustered at the school level. * p<0.10, ** p<0.05, *** p<0.01.

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