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Do "better" teachers and classroom resources improve student achievement? A causal comparative approach in Kenya, South Africa, and Swaziland

Andrey Zakharov[a], Gaelebale Tsheko[b], Martin Carnoy[c,*]

[a] National Research University Higher School of Economics, Moscow, Russian Federation
[b] University of Botswana, Botswana
[c] Stanford University, United States and the National Research University Higher School of Economics, Moscow, Russian Federation

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ABSTRACT

We use the 2007 SACMEQ data to make traditional "upwardly biased" estimates of teacher and classroom resource correlates of 6th grade student achievement in Swaziland, Kenya, and South Africa using an OLS model, and a "less biased causal" approach using a student fixed effects model. Our fixed effects model exploits the fact that most students in all three countries have different teachers for reading and mathematics. Each student is therefore subject to the "treatment" of different teacher characteristics and classroom resources, yielding a relatively unbiased but rather "stringent" estimate of teacher and classroom effects. Our results suggest that: (a) several important identifiable teacher characteristics and classroom resources affect student achievement in each country; that (b) those characteristics and resources may differ from one national context to another, between male and female students, and across socioeconomic groups of students; and that (c) the "upwardly biased" results generally differ from the "less biased causal" results. We discuss and attempt to explain these differences.

1. Introduction

African students do poorly on international and national tests that benchmark learning against developed country standards in reading and mathematics. Their reading and math performance is certainly linked to their low level of family academic resources. The schools they attend are also often woefully inadequate to deliver quality education. Yet, some teachers and schools in Africa are effective in raising students' academic skills. There are also some countries in Africa whose students as a whole score much higher than students in other African countries, even accounting for differences in students' family and community academic resources (Spaull, 2011; Carnoy et al., 2015a,b). What are the sources of this greater effectiveness? Are some school resources more effective than others in improving student learning?

In this paper, we analyze empirically the relationship between school inputs and student outcomes in three African countries to find which teacher and school resources may be important for raising student achievement in various national education contexts. This is not an easy task. For one, the teaching-learning process is complex, and the relations between teachers, parents, and administrators are imbedded in each society's political history. The development of educational expectations and standards are themselves products of that history (Carnoy and Levin, 1985; Carnoy and Samoff, 1989; Carnoy et al., 2007).

Social scientists have gradually developed models of classroom inputs and student outputs (Levin, 1980) to include specific teaching practices and curriculum variation, as well as social context. While not completely satisfactory, better specifications have improved empirical estimates of how classroom and school resources can improve students' performance on tests. The vast majority of these studies focus on teachers and teaching, for good reason. Teachers are the key contact that students have with the schooling process. If teachers have higher levels of subject matter knowledge (Hill et al., 2005), are focused on instruction (Darling Hammond, 1997), and teach a high quality curriculum providing students greater opportunity to learn (Schmidt et al., 2001), student are likely to learn more.

* Corresponding author.
E-mail address: carnoy@stanford.edu (M. Carnoy).

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A second difficulty in estimating the relation between school resources and student learning – particularly in developing countries where longitudinal data on students in school are not available – is that most research attempting this has to rely on information at a single point in time in the student's academic trajectory. Such studies provide valuable information on how student background and educational stratification relate to student performance (for example, Hungi, 2011), but yield biased estimates of the relation between student learning outcomes and classroom/school resources, such as teacher characteristics or opportunity to learn. Student performance (the outcome variable) is generally the result of cumulated learning with various teachers. That relation is usually confounded by selection bias—"better" teachers tend to select into schools with higher performing students and more motivated families tend to send their children to "better" schools, those with higher performing/higher family resource students and more able teachers who are likely to provide more opportunity to learn for their students.

Thanks to the increasing availability of data on schools, teachers, and student achievement, some studies in African countries have been able to exploit longitudinal data to estimate learning gains for individual students associated with particular teachers and to measure opportunity to learn during a particular year of schooling (Fuller et al., 1994; Carnoy et al., 2012, 2015a; Spaull, 2011; Taylor and Taylor, 2013). These show that the role of teaching quality (experience, education), teacher content knowledge, and opportunity to learn (time on task, textbook availability) are important in improving student achievement. Experimental studies in Africa have also estimated the causal effect of particular educational interventions on student achievement (see McEwan, 2015; for a summary of such studies). They show that literacy interventions and some forms of incentives for teachers and students may work to improve student learning, even though most have no effect.[1] Despite their advantage of identifying a causal relation between intervention and outcome, the drawback of most of these intervention studies is that they are situational—they are limited to a particular intervention in a particular set of schools and often do not produce the same outcome in a different context (McEwan, 2015)

When students are exposed to different teachers teaching different (tested) subjects, more sophisticated statistical methods of cross section data can also allow for causal analysis.

In a significant contribution to the literature, Shepard (2015) used a correlated random errors variant of fixed effects models developed by Metzler and Woessmann (2012) to analyze the Southern and Eastern Africa Consortium for Monitoring Educational Quality (SACMEQ) 2007 survey of 6th graders for South Africa. Specifically, Shepard estimates the effect that one important teacher quality indicator, higher teacher subject knowledge (as measured by subject test score), had on student achievement.

In this paper, we use a similar methodology—a student fixed effects model and a student fixed effect/teacher fixed effect model—to extend the SACMEQ causal analysis in two directions: (a) We estimate the causal effect that a number of teacher characteristics in addition to teacher subject knowledge, including experience, training, and gender, as well as the causal effect of several other school inputs, notably the availability of textbooks and principal supervision of teachers, have on student achievement. (b) We compare how these variables effect achievement in three historically different African countries. A comparative analysis helps us address the broader question of possible differences in how teacher and other inputs affect student achievement across developing countries.[2]

To make this comparison, we focus on two neighboring southern African countries, Swaziland and South Africa, and one relatively high scoring eastern African country, Kenya. We chose these three countries because they represent a variety of African economic and educational situations: a relatively large, high-income (PPP$ 13,500), multi-ethnic, low average student achievement country (although very high variation among regions) marked by years of segregationist policies (South Africa); a small, lower income (PPP$ 9,700 per capita) ethnically homogenous neighbor (Swaziland), economically closely tied to the South African economy, whose students score considerably higher on average in both math and reading than South Africa's; and another relatively large, very low-income (PPP $3,200) multi-ethnic country with high student achievement (Kenya).[3]

This variety in country size, wealth, and education policies permits us to discuss whether different classroom factors are likely to be more important for student achievement in some contexts than others. The main advantage of the SACMEQ data is that they are national, are fairly large samples, and contain many data on teacher characteristics and some data on classroom conditions, although very little on classroom processes. Also, in most 6th grades in the three countries, different teachers teach reading and mathematics, the two main subjects tested by SACMEQ.[4] The principal disadvantage of the SACMEQ data is that they are cross-sectional. They only measure student achievement at one point in time, at the end of 6th grade.

We first estimate traditional ordinary least squares (OLS) cross-section production functions of 6th grade performance. To reduce selection bias somewhat, we estimate student achievement within three different levels of family academic resources (FAR). Even so, there is considerable variation of student ability within FAR group, and we have no measure of individual student performance in earlier grades, nor of (unobserved) family motivation—both are sources of bias in our estimates of teacher and other school effects on student 6th grade performance. We consider these cross-section estimates of teacher and other classroom/school resource effects as "traditional upwardly biased estimates" of how much resources could impact student outcomes in Kenya, Swaziland, and South Africa. We also use the cross-section data to estimate the relation between teacher/other classroom/school resources and

[1] In general, studies show that many measureable classroom resources have small or no causal impact on student performance (see Clotfelter et al., 2007, 2010).

[2] It is important to note at the outset that "national" models such as we estimate may hide considerable possible variation in the effects that classroom factors may have on student achievement in different types of schools or among administrative regions/states within a country (see Carnoy et al., 2015b). There is large variation in average SACMEQ scores among provinces within South Africa, for example, driven in part by average socio-economic differences, but also in part by the quality of resources going into schools in the different provinces, and the quality of the administration of education among them. Further research could assess these differences within provinces were student and school samples randomized in each province.

[3] Income distribution in South African is one of the most unequal of any countries in the world (Gini coefficient is equal to 0.63). Swaziland's economy is also marked by rather high ncome inequality, with a Gini coefficient equal to 0.49, but Kenya's income distribution is more equal, with a Gini equal to 0.42. Some studies argue that more unequal income distribution is related to more unequal quality of education and that this contributes negatively to student performance (Adamson, 2010).

[4] We would have liked to include Botswana, also South Africa's neighbor, in the study, but only 15% of students in the Botswana sample have different teachers for mathematics and reading. We were able to estimate a student fixed effects/teacher fixed effects model for Botswana that we can make available to readers upon request.