Long-Term Effects of Free Primary Education on Educational Achievement: Evidence from Lesotho

By

Ramaele Moshoeshoe

Research Paper 534

Bringing Rigour and Evidence to Economic Policy Making in Africa

AFRICAN ECONOMIC RESEARCH CONSORTIUM
CONSORTIUM POUR LA RECHERCHE ÉCONOMIQUE EN AFRIQUE

Long-Term Effects of Free Primary Education on Educational Achievement: Evidence from Lesotho[1]

By

Ramaele Moshoeshoe[2]
Department of Economics, National University of Lesotho

AERC Research Paper 534
African Economic Research Consortium
August 2023

THIS RESEARCH STUDY was supported by a grant from the African Economic Research Consortium. The findings, opinions and recommendations are, however, those of the author and do not necessarily reflect the views of the Consortium, its individual members or the AERC Secretariat.

Published by: The African Economic Research Consortium
P.O. Box 62882 – City Square
Nairobi 00200, Kenya

ISBN 978-9966-61-237-3

Contents

List of tables

List of figures

Abstract

Many Sub-Saharan African countries have instituted Free Primary Education (FPE) policies, which significantly increase primary school enrolment rates in developing countries. However, school attendance is different from learning. The main questions that still beg for answers are whether the many children in school are learning and whether the FPE learning effects are long-lasting. This paper attempts to estimate the long-term effects of the FPE programme on educational achievement in Lesotho. The programme was implemented grade by grade, beginning with grade one school fees abolition in 2000. The timing of the implementation created changes in programme coverage across age (and grade) groups over time. I employ a semi-parametric difference-in-differences strategy that exploits these variations to identify the long-term effects of the FPE policy on educational achievement, using university examinations record data for student cohorts that are FPE-treated and those that are FPE-untreated. The results indicate that the FPE effect on academic performance is between 2 percentage points (statistically insignificant) and 20 percentage points (statistically significant at 1%).

JEL Classification: H52, I22, I28, 015

Keywords: Free primary education; Educational achievement; Long-term effects; Lesotho

1. Introduction

The Dakar Framework for Action (DFA), adopted by the World Education Forum in 2000, called for complete, free, and compulsory quality education to redress global educational inequalities (UNESCO, 2000: 8). Since then, several Sub-Saharan African countries have instituted Free Primary Education (FPE) programmes[3] by abolishing all primary school user fees. Several studies have attempted to quantify the short-term effects of the FPE programmes in Sub-Saharan Africa on school enrolment, dropout, and grade progression (Deininger, 2003; Al-Samarrai and Zaman, 2007; Grogan 2009; Lucas and Mbiti, 2012; Hoogeveen and Rossi, 2013; Moshoeshoe et al., 2019). These studies find that FPE increased enrolment, reduced school dropout, and reduced grade progression. Therefore, largely owing to FPE programmes, the primary school enrolment rate in the developing world has reached 91% (UNDP, 2016), with 94% and 74% of children worldwide completing primary and lower secondary education, respectively (World Bank, 2016; 2018).

However, school attendance is different from learning. The main problem is that millions of children finish primary school without acquiring functional literacy and numeracy skills, which is more pronounced in Sub-Saharan Africa (World Bank, 2018). Given the enormous progress in school access and the ensuing learning crisis, achieving inclusive and equitable education quality by 2030 is the fourth most important Sustainable Development Goal (SDG) under the 2030 Agenda.

The main questions that still bug researchers and policy makers alike are whether the current learning crisis is due to school fees' elimination programmes and whether these effects are long-lasting. A few studies attempt to estimate the short-term effects of these FPE programmes and similar fee elimination policies in Africa on education quality (i.e., test scores), and they find mixed evidence. Lucas and Mbiti (2012), for example, apply a difference-in-differences strategy, exploiting the variation in pre-programme primary school dropout rates across districts in Kenya to estimate the effect of FPE on primary school completion rate and test scores. They find marginal negative effects of FPE on test scores but large and positive effects on primary school completion rate. Blimpo et al. (2016) find positive effects of the Gambian Girls' Scholarship programme (a secondary school fee elimination programme for girls) on student access and learning, using a difference-in-differences strategy. Unfortunately, as much as this question remains open, data availability remains a hindrance in answering it, and this paper does not attempt to address it for the same reasons.

All else held constant, the negative (or positive) effects of FPE on learning may still show up later in a child's academic life. According to Cunha et al. (2006), achievement test scores are determined by skills or abilities (both cognitive and non-cognitive)[4] that are malleable to environmental (family and school) influences. Moreover, these skills are self-productive and complementary. Skills acquired at primary school may augment skills attained at the secondary and university levels, and that skills acquired at primary school may raise the productivity of education investments at the secondary and university levels. Therefore, it is reasonable to assume that FPE, through its influence on school inputs and environments, will have lasting effects on education quality. This paper attempts to test this hypothesis.

Apart from the fact that this paper is among the first studies that attempt to estimate the long-term effects of FPE policies in Sub-Saharan Africa, it contributes to several strands of literature. First, it contributes to the literature that looks at the long-term impacts of schooling inputs on educational outcomes. For example, Fredriksson et al. (2013) look at the long-term effects of class size on human capital development. They find that smaller class sizes improve cognitive and non-cognitive abilities at age 13 and improve achievement test scores at age 16. Second, it adds to the literature that looks at the short-term impacts of fee elimination on educational outcomes in developing countries (Grogan, 2009; Lucas and Mbiti, 2012; Hoogeveen and Rossi, 2013; Chyi and Zhou, 2014; Moshoeshoe et al., 2019). Lastly, it also adds to the small but growing literature that studies the long-term effects of schooling subsidy programmes (including tuition fee eliminations) on human capital development. For example, Xiao et al. (2017) estimate the long-term effects of a free compulsory education reform in rural China on educational attainment, cognitive skills and health. They find that the reform had long-lasting positive effects on educational attainment and cognitive achievement (see also Baez and Camacho, 2011; Behrman et al., 2011 for evidence on the long-term effects of conditional cash transfers on human capital).

This paper attempts to answer the following questions: 1) Does FPE have lasting effects on children's academic performance? Furthermore, 2) Do these effects (if any) differ by student's gender? To my knowledge, no studies attempt to quantify the long-term education quality effects of FPE programmes in Sub-Saharan Africa. This paper, therefore, aims to bridge this knowledge gap. Specifically, the paper estimates the long-term causal effect of FPE on education performance using the first cohort of FPE-treated students observed later at the university level.

Answering these questions is not a matter of academic curiosity but great policy relevance. In order to build a productive, talented, and diverse labour force, it is essential to know well in time the effects of the implemented policies so that they can either be scaled up (if the effects are positive) and/or changed (if the effects are negative). Because of gender stereotypes in many cultures, girls' education is mostly considered of lesser value. Therefore, girls get less education, at least in terms of enrolment rates. However, whether conditional on attendance, boys and girls receive the same quality education remains unanswered.

To answer these research questions, we use Lesotho as the case study mainly for the following two reasons. First, unlike many Sub-Saharan African countries, the FPE programme in Lesotho was phased in grade by grade, starting with Grade 1 in 2000, until it covered the entire primary schooling system in 2006. This implementation strategy makes it possible to follow two cohorts of children (the FPE-treated and the FPE-untreated cohorts) from primary school through the university level and hence account for the underlying trends in achievement test scores of the cohorts through a difference-in-differences estimation strategy. Second, Lesotho has only one big (and premier) university, the National University of Lesotho (NUL), and two smaller (and new) universities, which only opened in 2007 and 2016, respectively. Therefore, it is possible to get data for a sizeable proportion of the FPE-treated and untreated cohorts that have written similar standardized achievement tests.

The results indicate that the FPE programme has lasting positive effects on educational quality: it increased university student's academic performance by about 20 percentage points. While these effects vary by student's programme of study (or faculty), there is no discernible FPE effect heterogeneity by student gender. This implies that conditional on university attendance, boys and girls receive the same quality education. The robustness checks analysis indicates that this increase in educational quality cannot be attributed to some positive time trend. These effects are stronger when the sample is narrowed to 18-22 years old, the age range appropriate for the undergraduate level.

The remainder of the paper proceeds as follows. Section 2 presents the institutional context and policy background. Section 3 briefly provides the theoretical framework, while Section 4 discusses the data and presents some descriptive statistics. In Section 5, we explain the identification strategy and present the main results in Section 6. Finally, section 7 concludes the paper.

2. The Institutional Context and Policy Background

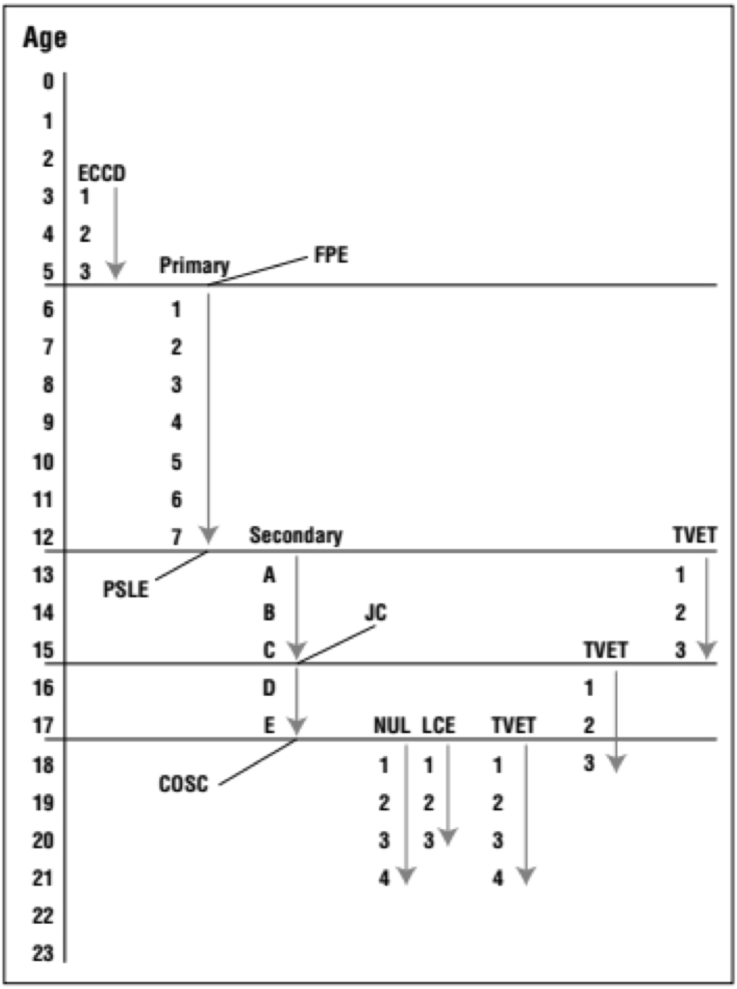
2.1 The Institutional Context

Lesotho education follows a 7-3-2-4 system, with seven years of primary education, three years of junior secondary education, two years of senior secondary education, and four years of university education (Figure 1). The official age of entry into primary schooling is 6 years, such that by age 12, children should be in Grade 7. This implies that the official primary school age is 6 to 12 years old and for secondary education is 13 to 17 years old.

At the end of primary school, students take the national exit exam, the Primary School Leaving Exam (PSLE), to enter the lower (junior) secondary school. After three years of junior secondary education, students take the Junior Certificate (JC) exam to progress to senior secondary. Finally, at the end of senior secondary school, they take the Cambridge Overseas School Certificate Exam (COSC).[5] Students can also enrol in different Technical and Vocational Education and Training (TVET) institutions after taking the PSLE, JC, and/or COSC exams. However, given that secondary education is not free in Lesotho, enrolment into TVET is primarily dictated by a child's academic performance (low performance) and/or household wealth.

Unlike many other countries, most primary schools in Lesotho (about 85%) are owned and controlled by different churches (Moshoeshoe et al., 2019), and these churches are represented in the national education advisory board by their appointed education secretaries (Ambrose, 2007). Non- religious private schools constitute about 1% of schools and are not covered by the FPE policy. The picture is very similar even at the secondary or high school level because most church-owned primary schools have their secondary schools nearby. However, the share of non-religious private secondary schools is slightly higher than at the primary level. As of 2014, about 1.4% of non-church private high schools (Bureau of Statistics, 2015) are concentrated in four country districts, namely Berea, Botha- Bothe, Leribe and Maseru.

Figure 1: Education System in Lesotho



Source: Liang et al. (2005: 25). Notes: ECCD refers to Early Childhood Care and Development; LCE refers to Lesotho College of Education, and TVET refers to Technical and Vocational Education and Training

Notwithstanding this co-ownership structure, except for non-church private schools, all schools follow the same national curriculum provided by the Ministry of Education and Training (MOET). Further, the government has overall authority in pronouncing education policies, management and regulation of education, training of teachers, teachers' placements, and deployments within government and church-owned schools. Nevertheless, some church-owned schools do, at times, privately hire contract teachers at their costs. Nonetheless, church and government-owned schools are public schools since they have no material differences.

Concerning students' progression within the system, the *de jure* government policy since 1967 is that of automatic grade promotion at the primary school level. However, the *de facto* policy is that schools still practice grade retention (Ambrose, 2007), and there has been an increased push for automatic grade promotion at the primary school level since 2010. But this latest policy call does not affect the cohorts this paper studies (i.e., those in primary school from 2000 to 2006). Therefore, coupled with delayed school enrolment, grade retention implies that in any given year (or grade), one finds students of different cohorts (Moshoeshoe et al., 2019). In addition, there is a grade retention policy at the secondary school level. Therefore, those who ultimately get into university are a select group of motivated, high-ability children coming from high-income households, as they were able to pass both the JC and COSC exams and also pay school fees for at least five years. Between 2005 and 2014, the PSLE exam failure rate ranged from 12% in 2013 to 17% in 2007. The JC exam failure rate increased from 24% in 2004 to 32% in 2009, when the FPE student wrote JC exams (Bureau of Statistics, 2015).

Beyond physical and monetary costs, there are no regulatory restrictions concerning school choice in Lesotho. Therefore, parents freely choose schools to which they prefer to take their children, based on their ability to meet costs. School choice is determined mainly by school availability, school's past pass rates, parental wealth, and parental tastes for education. High-performing high schools generally attract students from across the country and have stricter entry requirements. To cope with the high demand, high-performing high schools typically administer entry exams and do not admit their students whose JC exams are considered poor (usually second-class pass and below). Therefore, different schools largely cater to different types of students regarding performance.

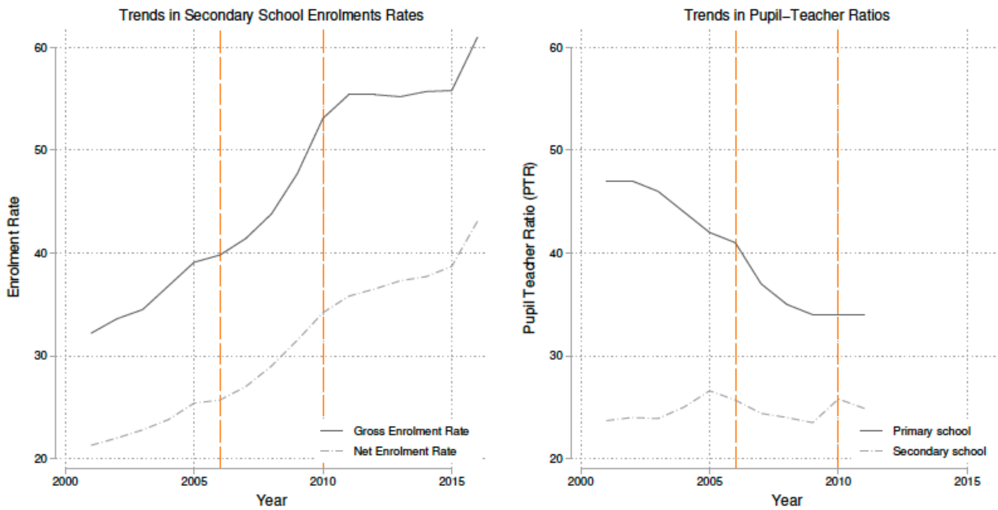
As of 2013, there were about 13 higher education institutions, 8 (i.e., 62%) of which are public institutions. The National University of Lesotho (NUL) is the leading tertiary institution in Lesotho and remained the only local bachelor's and master's degree-awarding institution until 2007. The university admits about 44% and 89% of Lesotho's undergraduate and postgraduate students, respectively (Council on Higher Education, 2013).

2.2 Policy Background

Lesotho instituted the FPE programme in 2000 to meet the Millennium Development Goal (MDG) of ensuring that primary education is free and available to all (UNESCO, 2000). As mentioned earlier, Lesotho's implementation strategy differed from that of other African countries. First, school fees were eliminated sequentially on a grade-by-grade basis, starting with grade one in 2000, such that by 2003, the first four grades were covered, and all seven primary school grades were under FPE by 2006. The main reason for this implementation strategy was to cushion FPE's financial impact on the public budget (Urwick, 2011).

The FPE policy is an amalgamation of several programme components that address the demand- and supply-side constraints to schooling. On the demand-side, the policy eliminates private schooling costs such as school fees, stationery and textbooks. On the supply-side, the government recruited more teachers and built additional classrooms in existing and new government schools where none existed. For example, between 2002 and 2011, the number of primary schools in Lesotho increased by about 10%, and the primary school pupil-teacher ratio dropped from 48 to 34 pupils per teacher (MOET (Ministry of Education and Training), 2011). This infrastructure increase also helped reduce the average distance to schools and transportation costs. In addition to school infrastructure, the government provides annual capitation grants, furniture and teaching materials to all schools, including church/private schools (Jopo et al., 2011; Lekhetho, 2013).

Figure 2: Changes in pupil-teacher ratio and enrolment



Source: Own representation using data from various Education Statistics Reports (MOET, 2010; 2011;2016)

Figure 2 shows changes in secondary school enrolment (demand for education), the left panel, and pupil-teacher ratio (supply of education), the right panel, since the FPE programme. We can see that while the secondary school gross enrolment rate was on the increase between 2001 and 2011, the increase was much faster between 2006 and 2010. The figure further shows that while the net enrolment rate increased throughout the period, gross enrolment rate plateaued between 2011 and 2015 and then began an upward trend. The first cohort of FPE children entered secondary school in 2007. Moshoeshoe et al. (2019) find that, within the first three years of the FPE policy implementation, enrolment of primary school-aged children increased by about 29%. Therefore, the increase in enrolment between 2007 and 2011 is partly due to the increased demand for education from the first three FPE cohorts. This first FPE cohort, which potentially had many over-aged children, completed secondary education in 2011. This partly explains the plateauing of the gross enrolment rate and the continued increase in net enrolment between 2011 and 2015.

According to MOET (2011), the government increased the number of secondary schools and recruited more teachers in anticipation of the increased demand. This is evident in the right panel of Figure 2. Secondary schools' student-teacher ratio was on the increase until 2005, after which it began to decline to about one teacher per 24 students in 2009. It is clear from this analysis that Lesotho's FPE programme had multiple components targeted at primary schools, which also had a knock-on effect on school resources at the secondary school level. This paper examines the long-term effects of this policy package, and not its elements.

3. Conceptual Framework

Understanding the process of a child's cognitive development has remained the preoccupation of economists since the early works of Leibowitz (1974) and Becker and Tomes (1986). According to Haveman and Wolfe (1995), a child's development is principally determined by three factors, namely, government choices regarding the number of resources invested in education; parental investment decisions in the form of quantity and quality of resources devoted; and the child's own choices (but only past age 13 or 15). In this setting, the government moves first by making direct investments in the child and setting the economic environment in which parents and children operate. Here the view is that investment in children cannot happen outside government involvement, and that this investment takes place only after the child is born.

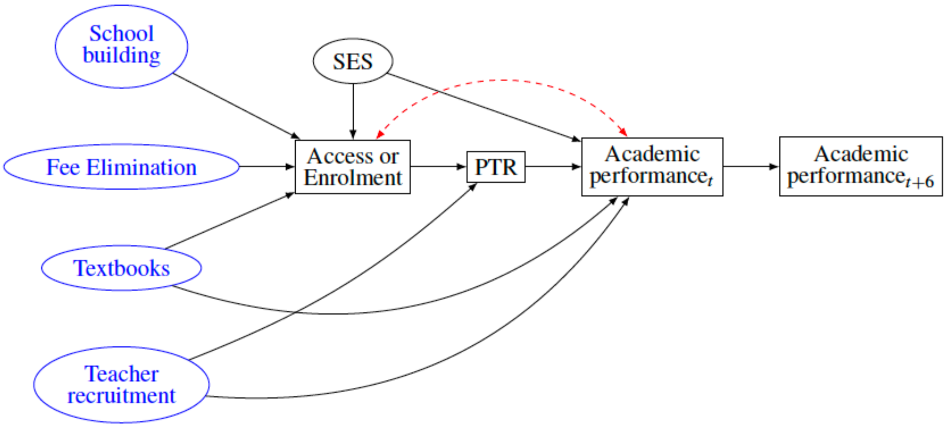
However, Cunha, Heckman, Lochner and Masterov (2006) argue that skill (or ability) formation is a life cycle process that starts much earlier in life, from the womb, and cognitive and non-cognitive abilities are malleable to environmental influences. They postulate that early and late investments in a child's development are complementary. Thus, early high-quality child investments increase the productivity of later child investments (i.e., skill begets skill), and this effectively places parents as critical first movers under the Haveman-Wolfe sequential framework. However, equally important is the role played by the society or government in the second stage of human capital development (after birth) because early investments are only productive if there is a follow-up investment.

Indeed, Behrman (2010) propounds that for children aged 6 or 7 to 15, educational achievement is partly determined by formal schooling and its characteristics, including out-of-school experiences such as homework conditional on pre-school investments, individual, family, market and institutional characteristics. Therefore, early quality childhood investments at home and school manifest in high achievement and low grade-retention. Moreover, it is clear that achievement is a function of both abilities and school inputs, thereby placing family and government at the centre of the child's development.

Figure 3 is the directed acyclic graph (DAG) of the causal paths from FPE programme components (i.e., fee eliminations, textbooks, teacher recruitment, and school building) to academic achievement. We can see from this figure that because the elimination of school fees, the building of more schools, and the provision of textbooks reduce the costs of schooling, they are expected to affect access to schooling positively. In addition, the increase in enrolment will lead to an increase in pupil-teacher ratio (PTR), all else held constant, which will, in turn, affect (current or primary school) academic achievement. We can also see that recruiting more teachers will reduce PTR and academic achievement.

Further, textbook availability and teacher recruitment directly influence academic achievement. Students' socio-economic status directly affects academic achievement and indirectly through its influence on access and PTR, holding all else constant. Lastly, (current or primary) academic achievement can also influence current enrolment and academic achievement in the next period, say six years later.

Figure 3: The Directed Acyclic Graph (DAG) of causal effect of FPE on academic performance



Source: Own representation. Notes: PTR is the Pupil-Teacher Ratio; SES is socio-economic status. The direction of the arrow (A → B) indicates the direction of the cause from node A to node B.

Therefore, we model knowledge acquisition as a cumulative process that combines a full history of family, community and school inputs with the child's innate ability to produce a child's achievement as measured by test scores at a point in time (Todd and Wolpin, 2003). Let A_{it} be student i's academic achievement (or test scores), and S_{it} and X_{it} denote vectors of school-supplied inputs (e.g. student i's class size, school infrastructure, quality of teachers, etc) and family-supplied inputs at time t, respectively. Allowing for the idiosyncratic error, which includes all omitted inputs (observed and unobserved) and measurement error, ε_{it}, and inherited ability, a_{i0}, the general achievement production function is given as:

$$A_{it} = f(X_{it}, X_{it-1}, \dots, X_{i0}, S_{it}, S_{it-1} \dots, S_{i0}, a_{i0}, \varepsilon_{it}) \tag{1}$$

In this framework, a student's performance at the university level is influenced not only by her current individual and household characteristics but also by current and previous school/university-supplied inputs. Moreover, because skill begets skill, the influence of past school-supplied inputs is partly reflected by the child's performance on JC and COSC/LGCSE examinations.

4. Data and Descriptive Statistics

This paper uses the National University of Lesotho's students' administrative records data for the years 2010 up to 2014. It makes use of first-year and second-year students' data. As the largest and oldest undergraduate degree-awarding university in Lesotho, the NUL admits the largest share of all students who achieve the minimum score for university entry in the senior high school exit examinations. It, therefore, admits the largest proportion of students who have gone through the FPE system. Given that the first cohort that has gone through the FPE programme first entered the university level in 2012, the second-year students are a control group, while the first years are a treatment group. We discuss this group categorization in detail in Section 5.

The data contains information on each student's gender, date of birth, academic year, senior high school exit (or Cambridge Overseas School Certificate - COSC) examination pass grade, the NUL Admission Point System (APS) score[6] for each student, the high school attended, faculty, department or programme of study, the overall weighted mean or year mean performance, and whether a student is local or international. The overall weighted mean (OWM) is the main outcome variable. It is calculated as the weighted sum of the final scores of core, prerequisite, and/or elective subject courses that make a maximum of 36 credit hours, where the weights are each course's credit hours divided by 36.[7] In addition, we construct the student's district information based on the location of the high school attended.[8]

Table 1 gives the summary statistics for the sample, first- and second-year students not exposed to FPE, 2010 to 2011, and those exposed to FPE, 2012 to 2014. There are 6,613 students in the first and second years of their undergraduate studies (diploma and degree programmes) pre-FPE and 9,610 post- FPE. Excluding diploma students, there are 5,777 and 8,016 students from 230 high schools, pre- and post-FPE, respectively.

From Table 1, we can see that in the pre-FPE and post-FPE periods, the OWM largely remained unchanged at around 60%. However, the average age dropped slightly from 21.7 years old pre- FPE to 21.4 post-FPE, indicating that more young students were enrolled in the university post-FPE. This decline in students' average age could result from early or on-time school entry due to the FPE programme. On average, post-FPE students were of poor quality: the APS score increased from 15.4 to 16.0 points, indicating a decline in academic performance. However, the percentage of students passing the COSC exams with first- or second-class statistically remained constant at about 28% and 52%, respectively, between these periods. Therefore, the decline in academic performance is largely attributed to increase in the proportion of those attaining the third-class COSC pass from 19.5% to 21.0%. Furthermore, this drop in performance potentially implies that while some students attained the same pass categories pre- and post-FPE, their pass marks were towards the lower end of each pass category.

The decline in performance can also be deduced from the faculty's student shares. The three faculties of Agriculture, Health Sciences, and Science and Technology have the strictest entry requirements: candidates must score high in Mathematics, Sciences, and English and have a low APS score. The share of students in the Faculty of Science and Technology (FOST) declined by two percentage points between periods. Part of the decline in FOST student share could be due to differences in student careers or course tastes. However, it is also likely that most students could not meet the admission requirements due to their relatively poor performance at the COSC level. To further support this interpretation, we can also see from Table 1 that the proportion of students admitted into diploma courses at IEMS increased by 4 percentage points. We know that high-performing students would typically go for degree programmes. Therefore, the increase in the proportion of students going for a diploma programme indicates the students' poor COSC performance post-FPE relative to pre-FPE.

Table 1: Summary statistics

	Pre-FPE (2010-2011)			Post-FPE (2012-2014)			
Variable	N	Mean	Std.Dev	N	Mean	Std.Dev	p–value for diff.
OWM	6,433	59.76	9.921	9,289	59.68	8.963	0.6063
Standardized OWM	5,655	0.0281	1.039	7,795	-0.0204	0.970	0.1359
Female	6,613	0.579	0.494	9,610	0.614	0.487	0.0000
Age	6,599	21.67	4.598	9,596	21.43	4.236	0.0007
COSC pass							
First class	5,060	28.3	0.412	8,730	27.8	0.434	0.5451
Second class	5,060	52.3	0.490	8,730	51.1	0.499	0.1960
Third class	5,060	19.5	0.356	8,730	21.1	0.394	0.0230
APS	5,922	15.35	5.332	8,635	15.98	5.438	0.0000
Distribution of Students by (School) District (%)							
Berea	6,613	7.56	0.264	9,610	11.20	0.315	0.0000
Botha-Bothe	6,613	6.47	0.246	9,610	7.54	0.264	0.0090
Leribe	6,613	19.11	0.393	9,610	17.10	0.376	0.0008
Mafeteng	6,613	9.98	0.300	9,610	10.80	0.310	0.0933
Maseru	6,613	36.56	0.482	9,610	36.30	0.481	0.6863
Mohale's Hoek	6,613	8.01	0.272	9,610	6.04	0.238	0.0000
Mokhotlong	6,613	2.96	0.170	9,610	2.85	0.166	0.6742

Qacha's Nek	6,613	1.63	0.127	9,610	1.56	0.124	0.7177
Quthing	6,613	3.07	0.173	9,610	2.55	0.158	0.0469
Thaba-Tseka	6,613	0.77	0.0875	9,610	1.37	0.116	0.0004
Foreign	6,613	3.86	0.193	9610	2.81	0.165	0.0002
Distribution of Students by Faculty (%)							
Agriculture	6,613	4.99	0.218	9,610	4.89	0.216	0.7738
Education	6,613	2.22	0.416	9,610	20.50	0.404	0.0116
Health Sciences	6,613	6.14	0.240	9,610	6.25	0.242	0.7665
Humanities	6,613	10.00	0.300	9,610	10.90	0.311	0.0800
Law	6,613	3.95	0.195	9,610	4.05	0.197	0.7470
Science & Technology	6,613	12.50	0.331	9,610	10.30	0.304	0.0000
Social Sciences	6,613	27.50	0.447	9,610	26.50	0.441	0.1614
IEMS	6,613	12.60	0.332	9,610	16.60	0.372	0.0000

Source: Own calculations using NUL students' records data from 2010, 2011, 2012, 2013, and 2014. *Notes*: OWM is the overall weighted mean, calculated as the weighted sum of final scores of core, prerequisite, and/or elective subject courses that make a maximum of 36 credit hours, where the weights are each course's credit hours divided by 36. IEMS refers to the NUL's Institute of Extra-Mural Studies (IEMS), a diploma-awarding arm of NUL. The N for some variables is smaller due to missing values.

5. Identification Strategy

5.1 The standard Difference-in-Differences method

The paper employs the difference-in-differences (DID) identification strategy to tease out the long-term treatment effect of the FPE programme on academic performance (Angrist and Lavy, 1999; Blundell and Dias, 2009; Imbens and Wooldridge, 2009). The DID approach is appropriate in settings where we observe outcomes for individuals in two groups (i.e., control and treatment groups) for two or more periods (pre- and post-programme) as in panel data, and in settings where we have repeated cross-sections from the same population, pre- and post-programme, for individuals in the control and treatment groups. This paper uses repeated cross-section-type administrative data. In this case, the standard DID strategy is as follows. Suppose student i belongs to a group $G_i = g \in \{0,1\}$ (where $G_i = 1$ is the treat- ment cohort), and is observed in period $T_i = t \in \{0,1\}$ (where $T_i = 1$ is post-programme period). Let $Y_i(0)$ and $Y_i(1)$ be her potential outcomes (e.g. achievement test score) before and after the programme, respectively. Therefore, student ii's outcome is given as:

$$Y_i = \begin{cases} Y_i(0) \equiv \alpha + \gamma T_i + \lambda G_i + \varepsilon_i, & if\ T_i = 0 \\ Y_i(1) \equiv \alpha + \gamma T_i + \lambda G_i + \delta_{DID} + \varepsilon_i, & if\ T_i = 1 \end{cases} \quad (2)$$

where γ is the year-specific effect common to both control and treatment cohorts; λ is a cohort-specific, time-invariant coefficient; δ_{DID} is the DID effect parameter; and εi is an unobserved individual error term.[9] The DID estimand (or the average treatment effect on the treated (ATT), δ_{DID}, is then given by:

$$ATT = \delta_{DID} = E[Y_i(1) - Y_i(0)] = (E[Y_i|G_i = 1, T_i = 1] - E[Y_i|G_i = 1, T_i = 0]) - (E[Yi|Gi = 0, T_i = 1] - E[Y_i|G_i = 0, T_i = 0]) \quad (3)$$

This double differencing procedure removes biases due to pre-existing differences between the two groups and biases resulting from common time trends unrelated to the programme. Let D_i be the treatment dummy equal to the interaction of the group and time dummies, $D_i = T_i \times G_i$, which equals 1 if $T_i = 1$ and $G_i = 1$. That is, $D_i = d$, where $d \in \{0,1\}$. Then equation 3 can be estimated by least squares methods using the following regression DID:[10]

$$Y_i = \alpha + \gamma T_i + \lambda \cdot G_i + \delta_{DID} \cdot D_i + \boldsymbol{X}_i \beta + \varepsilon_i \quad (4)$$

where X_i is a vector of controls (current and past school- and family-supplied inputs). Interacting $\boldsymbol{D_i}$ with an indicator for gender will identify the gender effects of the programme.

The DID method requires that the control group should not be influenced by the programme and should be comparable to the treatment group. As mentioned earlier, the FPE programme was progressively implemented from Grade 1 in 2000. The first FPE cohort that successfully passed senior high school exit examinations entered the university in 2012. Given the school entry age of 6 years, the age-appropriate cohort for first- and second-year(s) of university education are 18 and 19, respectively. Thus, the treatment group is defined in two ways. First, the treatment group is defined by age group (i.e., the age-appropriate cohort for university year 1). Second, it is defined by grade group (i.e., whether a university student wrote primary school exit exams in 2006 or after, irrespective of whether the student should have written it earlier and be in the second year of university education). Table A.1 in the Appendix summarizes the composition of the control and treatment groups over time.

Given that the FPE did not have age restrictions, it is inevitable that the definition of the control group under the age-appropriate cohort treatment group also includes the FPE-treated students either because of delayed school enrolment and/or grade repetition. The control group includes all second-year students, including those repeating the year and excluding all those repeating the first year and who ought to have been in the second year if they had passed. The latter group, first-year repeaters, contaminate the treatment group and will likely bias upwards the performance of first years. Since the composition of the control group is similar pre- and post-FPE, there is likely to be an upward bias in the FPE effect.

Further, the control group could be contaminated by the potential presence of intra-household spillover effects. For example, a younger sibling who directly benefited from FPE may have freed up some household resources to pay fees for an older sibling in secondary education. While Moshoeshoe et al. (2019) find no evidence of these intra-household spillover effects at the primary school level, these spillovers might be present at this level. The main advantage of the age-group definition is that it cannot be manipulated for one to fall into any particular group. For these reasons, the DID estimand is likely biased downwards and identifies the lower bound effect of FPE.

For the grade-group (year of study) treatment group definition, the treatment group is much broader as it likely includes those who delayed school enrolment and those who repeated grades in primary school, secondary, or even university levels. Due to class peer effects, all students who did not benefit from the no-fee policy at the primary school level but ended up being in the same grades as the FPE-treated cohort at the secondary and university levels are indirectly FPE-treated. The control group, in this case, is largely clean of contamination because students are less likely to skip grades. Therefore, under this treatment group definition, the DID method likely identifies the upper-bound effect of FPE.

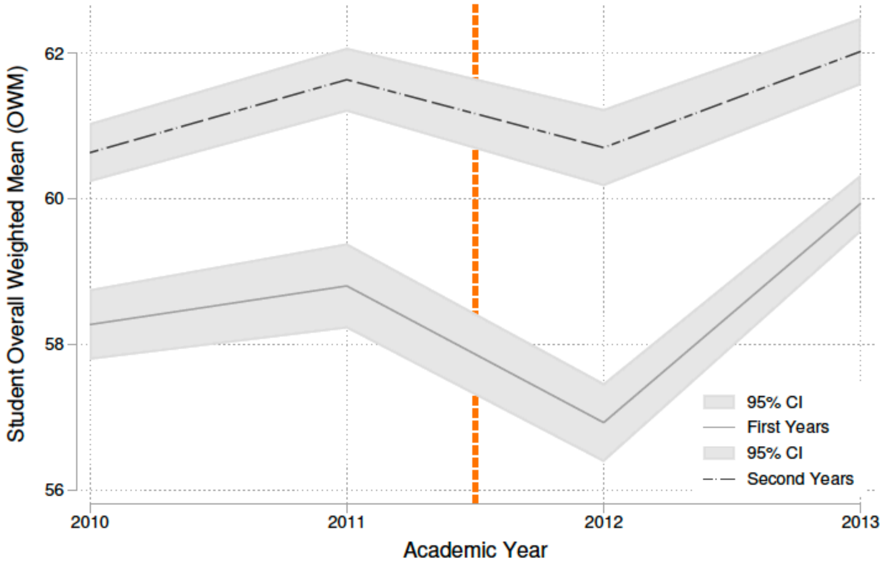
5.2 Assessing the Plausibility of the Parallel Trends Assumption

As highlighted in the above sub-section, the critical identifying assumption for the DID method is the parallel trends assumption that, in the absence of the FPE policy, the change in academic performance of the treatment group would have been equal to the change in academic performance of the control group. We discuss the plausibility of this assumption in this sub-section. First, we assess the assumption's plausibility when the treatment group is defined by the year of study. Then we discuss when the treatment group is age-appropriate for years 1 and 2 at the university level.

5.2.1 Parallel trends in academic performances of first- and second-year undergraduate students

Figure 4 shows the trends in students' academic performance for 2010–2014. As we can see from the figure, both first- and second-year academic performance increased between 2010 and 2011 but plummeted in 2012, the year when the first FPE cohort entered university. Since then, the academic performance of first-years has recovered, surpassing the pre-FPE levels in the following years. While the gap in average performance between the first- and second-year students remained almost constant between 2010 and 2011, the first-year's average performance dropped significantly in 2012 relative to the second-years' (see also Table A.2 in the Appendix). This analysis points out that the trends in first- and second-years' academic performances were parallel before treatment (i.e., before the FPE cohort entered the university level). Therefore, it implies that the academic performance of second-year students is a credible counter-factual for the academic performance of first-year students.

Figure 4: Trends in students' average academic performance by year of study: 2010–2014



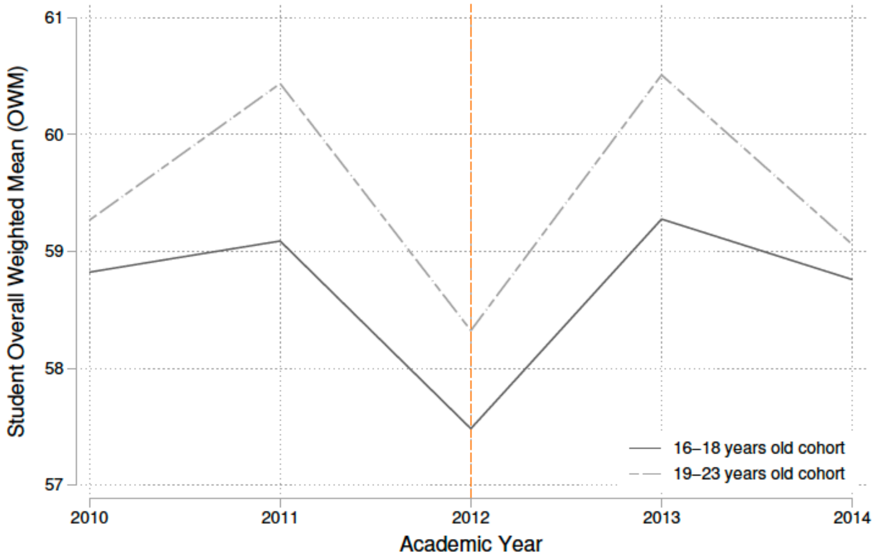
Source: Own calculations using the NUL students' records data for the academic years 2010, 2011, 2012, 2013, and 2014. Notes: OWM is the overall weighted mean

5.2.2 Parallel trends in academic performances of 16-18-year-old and 19-23-year-old student groups at undergraduate

We now turn to the assessment of the parallel trends assumption when the treatment group is defined as the age-appropriate cohort for the first year of university. Because of early school entry, some children reach university before the age of 18 years. The data shows a small fraction of students aged below 18 years in their first year of university. While it is possible that age (i.e., date of birth) was captured incorrectly for some students in this category, a small fraction of students enter the schooling system before the age of 6. According to MOET (2016), about 7% and 17% of children aged 16 years and 21 years and older, respectively, were in their last grade of secondary school. Therefore, we define the treatment cohort as those aged 16-18 years because they are of the appropriate age for the first year of university, and those aged 19-23 years as the control cohort.

Figure 5 presents trends in students' academic performance between 2010 and 2014 by treatment cohort. We can see from the figure that the trends in academic performance of the 16-18-year-olds and the 19-23-year-olds are parallel throughout the period. As mentioned earlier, the control group (i.e., the 19–23-year cohort) possibly includes children directly affected by FPE. Therefore, it is more than likely that this cohort's observed drop in average performance in 2012 is largely driven by the decline in the performance of a fraction of old but FPE-treated children. This further supports the idea that our DID method under this treatment group definition will only identify the lower-bound effect of FPE on academic performance.

Figure 5: Trends in students' average academic performance by cohort: 2010–2014



Source: Own calculations using the NUL students records data for the academic years 2010, 2011, 2012, 2013, and 2014. Notes: OWM is the overall weighted mean.

5.3 The Semi-parametric Difference-in-Differences Method

5.3.1 Compositional differences

Despite the evidence of the parallel trends presented above, the identifying assumption may be implausible if pre-treatment individual characteristics correlated with the outcome variable's dynamics are not balanced between the FPE-treated and FPE-untreated groups (Abadie, 2005). Therefore, the FPE effect identified by the standard DID would be biased in such a case. It is, therefore, important to check whether the pre-PFE characteristics are balanced between the control and treatment groups.

Table 2: Pre-FPE compositional differences between control and treatment groups

Variable	Treatment	Control	p-value	Diff (X1 – X0)	Norm-diff
	(1)	(2)	(3)	(4)	(5)
OWM	58.506 (10.9261)	61.093 (8.5287)	0.0000	-2.5869	-0.1866
APS	19.2063 (3.9627)	11.271 (3.0859)	0.0000	7.9353	1.5799

Child Age	21.3088 (4.7751)	22.1 (4.2376)	0.0000	-0.7912	-0.1239
Gender (female)	0.592 (0.4915)	0.5651 (0.4958)	0.0270	0.0269	0.0384
School or Home District					
Berea	0.0699 (0.255)	0.0817 (0.274)	0.0694	-0.0118	-0.0315
Botha-Bothe	0.0717 (0.258)	0.0573 (0.2324)	0.0177	0.0144	0.0413
Leribe	0.1863 (0.3894)	0.1963 (0.3973)	0.3017	-0.0100	-0.018
Mafeteng	0.0991 (0.2989)	0.1005 (0.3007)	0.8549	-0.0013	-0.0031
Maseru	0.3729 (0.4837)	0.3579 (0.4794)	0.2040	0.0151	0.0221
Mohale's Hoek	0.0801 (0.2716)	0.0801 (0.2715)	0.9988	0.0000	0.0000
Mokhotlong	0.0304 (0.1718)	0.0288 (0.1673)	0.6990	0.0016	0.0067
Qacha's Nek	0.0158 (0.1247)	0.0169 (0.1289)	0.7214	-0.0011	-0.0062
Quthing	0.0298 (0.1701)	0.0316 (0.175)	0.6736	-0.0018	-0.0073
Thaba-Tseka	0.0088 (0.0933)	0.0066 (0.0808)	0.3069	0.0022	0.0178
Faculty					
Agriculture	0.0374 (0.1899)	0.0632 (0.2434)	0.0000	-0.0258	-0.0836
Education	0.1778 (0.3824)	0.2696 (0.4438)	0.0000	-0.0917	-0.1566
Health Sciences	0.0541 (0.2262)	0.0692 (0.2538)	0.0107	-0.0151	-0.0444
Humanities	0.0758 (0.2646)	0.1265 (0.3324)	0.0000	-0.0507	-0.1194
Law	0.043 (0.2029)	0.0356 (0.1856)	0.1275	0.0073	0.0266

Science & Technology	0.1272 (0.3333)	0.1234 (0.3289)	0.6346	0.0039	0.0083
Social Sciences	0.2401 (0.4272)	0.3125 (0.4636)	0.0000	-0.0723	-0.1147
Observations	3419	3194			

Source: Own calculations using NUL students' records data for the academic years 2010, 2011, 2012, 2013, and 2014. Notes: OWM is the overall weighted mean. The treatment group is all students in their first year of university studies. Standard deviations are in parentheses. The reported p-values are for tests of equality of means between the treatment and control groups (independent samples). Diff stands for difference in means by treatment status. Norm-diff means normalized differences between treatment and control means computed as $\text{Norm} - \text{diff} \equiv \Delta_X = \frac{\bar{X}_1 - \bar{X}_0}{\sqrt{S_0^2 + S_1^2}}$, where S_G^2 is the sample variance of X_i in sub-sample with treatment $G_i = \{0,1\}$. $G = 1$ if a student is in second year.

Table 2 presents the pre-FPE compositional differences between the control and treatment groups. Specifically, the table shows pre-FPE mean differences, by treatment group, in the main outcome variable (OWM) and the individual characteristics (APS, age, gender, and location). Column (3) shows the p–value of the t–test for differences in mean characteristics of the control and treatment groups pre-FPE. Looking at these p–values, we can see that there are statistically significant differences between the control and treatment groups with respect to their age, pre-university (i.e. COSC) academic performance, gender and location (e.g., Berea and Botha-Bothe district)[11]. Undoubtedly, these characteristics are associated with the changes in students' academic performance over time. For example, because early and current investments in human capital development are complementary, a child's high school academic performance influences his/her university-level performance. Given these compositional differences, Abadie (2005) proposes that the treatment effect be estimated by the semi-parametric DID strategy, which allows for the distribution of both observed and unobserved characteristics to differ by treatment group[12]. Below, we present this strategy as implemented in the paper.

5.3.2 The semi-parametric DID strategy

Under the semi-parametric DID strategy, the main identifying assumption is that conditional on individual pre-FPE characteristics, the average performance of the FPE-treated and FPE-untreated students would have followed parallel trends in the absence of the FPE policy (Assumption 3.1, Abadie, 2005)). Therefore, taking the average of the differences in change in academic performance over time between FPE-treated and FPE-untreated with similar pre-FPE characteristics allows us to identify an unbiased estimate of the ATT (δ_{SDID}) (Abadie, 2005; Houngbedji, 2018). This estimator requires that individuals first be matched based on their propensity score (i.e. the probability of being under FPE conditional on their pre-FPE characteristics, $\pi_0(\boldsymbol{X}_i) \equiv P(D = 1|\boldsymbol{X}_i)$, before averaging the differences in outcome changes over time. In a repeated cross-sections setting, as in this study, Abadie (2005) shows that the ATT is given by:

$$\delta_{SDID} = E_M\left[\frac{P(D=1|X_i)}{P(D=1)} \cdot \varphi_0 \cdot Y\right] \tag{5}$$

if $P(D = 1) > 0$ and $\pi_0(X_i) < 1$, where

$$\varphi_0 = \frac{T_i - \lambda}{\lambda \cdot (1-\lambda)} \cdot \frac{D - \pi_0(X_i)}{\pi_0(X_i) \cdot (1-\pi_0(X_i))} \tag{6}$$

Substituting φ into equation (5) gives

$$\delta_{SDID} = \frac{1}{N}\sum_{i=1}^{N}\left[\frac{D - \widehat{\pi_0}(X_i)}{(1-\widehat{\pi_0}(X_i))} \cdot \frac{\tilde{Y}}{P(D=1)}\right] \tag{7}$$

where $\tilde{Y} = \frac{T_i - \lambda}{\lambda \cdot (1-\lambda)} \cdot Y$, and λ is the proportion of post-treatment individuals in the sample.[13] Therefore, SDID is a weighted average of temporal changes in $\tilde{Y}$. It weighs the FPE-untreated individuals by their probability of being under FPE, given their characteristics. According to Abadie (2005), if the parallel trends assumption holds unconditionally and conditional on the predetermined variables of interest such as gender, the conditional identification can still be used to tease out the treatment effect for different population groups. Given that the object of this paper is also to evaluate the heterogeneous effects of FPE by gender, we use the semi-parametric estimator in this paper to examine the FPE policy effects on academic performance.

6. Results

This section presents the estimation results of the long-run effect of FPE on student achievement. First, in Section 6.1, we present results from the non-parametric estimation of ATT (δˆDID) directly from equation 3. These non-parametric results are important because they are based on a framework that: (1) does not impose, a priori, any functional form assumptions on the data and; (2) allows us to visualize the effect (without any controls). Second, in Section 6.2, we present the semi-parametric DID results, having controlled for observed differences in individual characteristics between the control and treatment groups, and for cohort effects using age fixed-effects models.

6.1 Non-parametric Estimation Results

Table 3 presents the non-parametric results of the long-term effects of FPE on educational achievement. Panel A shows the (lower-bound effect) results when the treatment group is defined by the age appropriate for year one of university, and panel B shows the (upper-bound effect) results when the treatment group is defined by year of study.

Looking at Panel A of Table 3, we can see that before the FPE policy, the average academic performance in the control group ($E[Y_i|G_i = 0, T_i = 0]$) and the treatment group ($E[Y_i|G_i = 1, T_i = 0]$) was, respectively, 59.97% and 58.94%. After the FPE policy implementation, the average academic performance dropped slightly to 59.95% in the control group ($E[Y_i|G_i = 0, T_i = 1]$), and 58.57% in the treatment group ($E[Y_i|G_i = 1, T_i = 1]$). However, the decline in performance over time for the two groups, respectively, is both economically and statistically insignificant. The non-parametric estimate of the average treatment effect on the treated ($ATT: \hat{\delta}_{DID} = \Delta_{G=1} - \Delta_{G=0}$) equals 0.34 percentage points drop in academic performance, which is not statistically significant. This, therefore, implies that the non-parametric lower bound effect of FPE on student achievement is statistically equal to zero.

Table 3: Effect of FPE on student achievement: Non-parametric results by treatment group definition

	Pre-FPE	Post-FPE	ΔG=g
A: Group defined by Age-appropriate cohort			
Control group	59.9683	59.9494	-0.0189
	(0.1358)	(0.1019)	(0.1667)
Treatment group	58.9376	58.5742	-0.3634
	(0.2943)	(0.2233)	(0.3628)
ATT: $= \Delta_{G=1} - \Delta_{G}$			-0.3445
			(0.3992)
B: Group defined by year of study			
Control group	61.0930	60.7804	-0.3126
	(0.1527)	(0.1332)	(0.2019)
Treatment group	58.5060	58.9179	0.4118
	(0.1898)	(0.1266)	(0.2197)

Source: Own calculations. Notes: $\Delta_{G=g} = E[Y_i|G_i = g, T_i = 1] - E[Y_i|G_i = g, T_i = 0]$ is time change in OWM for group $G_i = g \in \{0,1\}$. Standard errors in parentheses and significance levels are indicated as follows: *** p<0.01, ** p<0.05, * p<0.1

Now turning to Panel B of Table 3, we can see that before the FPE policy, the average academic performance in the control group was 61.09%. In comparison, the treatment group had 58.51%. Post-FPE policy introduction, the average academic performance dropped slightly by 0.31 percentage points in the control group to stay at 60.78%. In the treatment group, however, student performance increased by 0.41 percentage points to 58.92%. While these time changes in performance within each group are both economically and statistically insignificant, the non-parametric estimate of the average treatment effect on the treated ($ATT: \hat{\delta}_{DID} = \Delta_{G=1} - \Delta_{G}$) is statistically significant. The ATT is equal to 0.72 percentage points, which implies that FPE increased academic performance by 0.72 percentage points. Taken together, these results indicate that the FPE effect is bounded between zero and 0.72 percentage points, at least in this non-parametric setting.

While these non-parametric results are intuitive, they may be biased by the differences in the composition of the treatment and control groups over time. One of the obvious differences between the control and treatment groups is age (see Table 2). Those in the treatment group are significantly younger than those in the control group, implying that they are from different age cohorts. If the younger cohort was in primary school during times of good economic performance, they possibly enjoyed better familial resources during their formative years compared to the older cohort. To the extent that human capital investments are more productive when made at an early stage (see Cunha and Heckman, 2009; Heck- man and Mosso, 2014), the observed better performance of the treatment group is potentially due to the differences in investments (family wealth) enjoyed while young.

Further, it is possible that young and motivated teachers taught the younger cohort in both primary and secondary school, hence their better performance in high school exit or COSC examinations (see Table 2). Therefore, the observed increase in academic performance post-FPE could be attributed to these factors, not FPE. In the next Section, we estimate the FPE effect after controlling for these potential confounders. For example, we control for age-fixed effects to approximate the cohort effects on performance (Cabus and De Witte, 2011).[14]

6.2 Semi-parametric DID Estimation Results

In this Section, we present the semi-parametric estimates of the FPE effect after controlling for compositional differences between groups. The results are shown in Table 4, which shows both the overall and heterogeneous effects of FPE by gender and faculty (or programme of study). Columns (1) and (2) show results when the treatment group is those in their first year of university (identifying the upper-bound effect), and columns (3) and (4) show results when the treatment is those aged 16-18 years old (identifying the lower-bound effect). Columns (1) and (3) report the estimates of the average effect of FPE when the treatment group is defined by year of study and by age appropriate for year one of university studies, respectively. Columns (2) and (4) present results that are showing how the average effect of FPE varies across different groups of students (i.e., gender and faculty of study groups).

Looking at column (1) of Table 4, we can see that, having controlled for groups' compositional imbalances, the upper-bound effect of the FPE policy on academic achievement is 16.13 percentage points, which is statistically significant at 1% level. This implies that the FPE policy increased university academic performance of the beneficiaries by about 16 percentage points. The pre-FPE average performance of 59.76% represents a 27.00% increase in academic performance at the university level, which is economically significant. If we look at column (3), however, we can see that the lower bound effect of FPE on academic performance is 4.67 percentage points (or 1%), which is economically and statistically insignificant. Therefore, these results indicate that the FPE effect is effectively bounded between zero and 16 percentage points. It is important to note that, apart from the differences in the effect size, these semi-parametric results are consistent with the non-parametric results presented above. This assures us that the FPE policy did not cause a decline but an increase in education quality. Furthermore, these results are consistent with those of Xiao et al. (2017), who found long-lasting positive effects of a free and compulsory education programme in China.

Table 4: Long-term effect of FPE on educational achievement

Variables	Treatment group: First year students		Treatment group: 16-18 year olds	
	(1)	(2)	(3)	(4)
Total ATT of FPE				
ATT $\hat{\delta}_{SDID}$)	16.1306*** (2.3118)	19.5775*** (5.5131)	4.6605 (2.9943)	1.9819 (8.3979)
Heterogeneities of FPE effect				
Female	1.0273 (4.9178)		6.9604 (6.6636)	
Agriculture	-6.3365 (9.3246)		-56.4087*** (17.2619)	
Health Sciences	11.8019 (8.5942)		-18.982 (13.0157)	
Humanities	5.9689 (9.8102)		44.7461*** (11.387)	
Law	-11.0816 (9.9652)		9.8017 (12.9863)	
Science & Technology	-14.5587* (7.8774)		-8.2308 (10.2872)	
Social Sciences	-9.5781 (5.8717)		-4.1507 (8.3324)	
Observations	9,274	9,274	6,161	6,161

Notes: The estimates of the FPE effect on achievement (OWM) using asdid Stata command by Houngbedji (2016). Models (1) and (3) report estimates of the average ATT. Models (2) and (4) show how the ATT varies across different groupsof students. All models are estimated using a linear polynomial function of degree 4 to approximate the propensity score. The covariates used in the estimation of the propensity score are APS, gender, district, and age dummies to approximate the cohort effects). Standard errors in parentheses and significance levels are indicated as follows: *** p<0.01, ** p<0.05, * p<0.1.

Turning to columns (2) and (4) on the heterogeneous effects of FPE by gender and faculty (or programme of study), we can see from Table 4 that the effect of FPE on students' achievement is bounded between zero effect to 19.6 percentage points increase on students' achievement. The upper bound slightly increases in this case, but not by a significant margin. More importantly, there are no noticeable heterogeneities by gender. This implies that the FPE policy has equally affected the academic performance of females and males. However, the effect of FPE varies by the programme of study. For instance, looking at column (2) results, we notice that post-FPE, the academic performance of students doing science and technology programmes increased by 5 percentage points (i.e., $19.6 - 14.6$) compared to 19.6

percentage points increase for a typical student. However, this effect is marginally significant at 10%. Further, we can see from column (4) results that while FPE has increased the academic performance of students in the faculty of humanities, it has decreased the academic performance of those in the faculty of griculture.

The faculties of agriculture, health sciences, and science and technology have the exact entry requirements, the most important being a good COSC pass in mathematics and sciences. Therefore, while these results seem to suggest that FPE-treated students are less prepared in mathematics and science subjects, they likely reflect the effect of discontinuing the bridging programme for students into these faculties, known as the pre-entry science programme (PESP), in 2012.[15] In the next section, we test the sensitivity of the results against this potential confounder.

6.3 Robustness Checks

In this sub-section, we present three robustness checks' results. First, we present the placebo test results using the pre-FPE data, assuming that FPE was introduced in 1999, such that the first FPE-treated cohort entered the university in 2011. Second, we narrow the age window to include only students between 18 and 22 years old. Lastly, we present the semi-parametric DID results controlling for some confounding factors, particularly the discontinuity of PESP at NUL, which affected all students doing physical science-based programmes.

6.3.1 Pre-FPE effect of FPE on student academic performance

Here, we estimate the placebo FPE effect using the pre-FPE data (i.e. 2010-2011), assuming that the FPE- treated first enrolled in university in 2011. Because the FPE-treated students were not at the university in those years, we do not expect to see any positive placebo FPE effect on performance. If there is a positive effect, it will imply that the observed increase in academic performance post-FPE presented in Table 4 cannot be attributed to FPE. It would imply that academic performance is simply continuing its upward trend post-FPE. The results are reported in Table 5. Looking at column (1) results, we can see that pre-FPE, there was no statistically significant increase in academic performance. The results in column (2) indicate that, in fact, academic performance was on the decline pre-FPE. Taken together, these results indicate that the observed significant increase in academic performance post-FPE is indeed attributable to FPE, not some positive time trend.

6.3.2 The narrow age range (18-22 years old sample)

Given the school entry age of 6 years, the 18 to 22-year-olds are the age-appropriate cohort for undergraduate university level. Further, narrowing the sample's age range increases the chances that the treatment and control groups were in primary and high school at the same time, though in different grades. This makes it likely that they experienced more or less the same teacher and school resource inputs, other than no-fee school attendance. We, therefore, can expect the FPE effects to be stronger within this age range. The results are presented in Table 6. Indeed, we can see from the table that the FPE effect estimates on academic performance is slightly larger than those reported in Table 4 (the main results). Further, column (2) results indicate that the lower bound FPE effect is now statistically significant at 10% level. That is, at the minimum, the FPE policy increased academic performance at the university level by 3.7 percentage points. Therefore, these results indicate that the main results are not sensitive to sample restrictions.

Table 5: Long-term effect of FPE on educational achievement: Pre-FPE (placebo) effect

	(1)	(2)
Variables	Treatment group: First year students	Treatment group: 16-18 year olds
ATT ($\hat{\delta}_{SDID}$)	3.3336	-11.5052**
	(3.6820)	(4.6691)
Observations	3,827	2,409

Notes: The reports estimates of the FPE effect on achievement (OWM) using asdid Stata command by Houngbedji (2016). All models are estimated using a linear polynomial function of degree 4 to approximate the propensity score. The covariates used in the estimation of the propensity score are APS, gender, district, and age dummies to approximate the cohort effects). Standard errors in parentheses and significance levels are indicated as follows: *** p<0.01, ** p<0.05, * p<0.1.

Table 6: Long-term effect of FPE on educationalachievement: Narrow age range (18-22)

	(1)	(2)
Variables	Treatment group: First year students	Treatment group: 16-18 year olds
ATT ($\hat{\delta}_{SDID}$)	19.8659***	3.7067*
	(3.8932)	(2.1174)
Observations	10,032	3,943

Notes: The reports estimate of the FPE effect on achievement (OWM) using asdid Stata command by Houngbedji (2016). All models are estimated using a linear polynomial function of degree 4 to approximate the propensity score. The covariates used in the estimation of the propensity score are APS, gender, district, and age dummies to approximate the cohort effects). Standard errors in parentheses and significance levels are indicated as follows: *** p<0.01, ** p<0.05, * p<0.1

6.3.3 The discontinuity of the pre-entry science programme (PESP)

The university began running the Pre-Entry Science Programme (PESP) in 1996 to bridge the knowledge gap between high school and university science and mathematics education and ultimately enhance students' performance in science programmes. During the PESP period, all students admitted into science programmes would have to go through PESP, where they would be taught science subjects - biology, chemistry, mathematics and physics and English. Moreover, all those who would have completed the PESP would now proceed to enrol into what was known as the common first year of science programmes.

However, due to financial constraints, PESP was discontinued in 2012. To counter the potential negative effects of discontinuing PESP on students' performance, the Faculty of Science and Technology, which used to run the PESP and the common first-year programme, employed extra staff and extended the first year programme's academic year by two (2) weeks. These two policy shocks coincided with the entry of the first FPE cohort into the university (i.e. the FPE policy). Thus, they will likely bias the overall FPE effect on academic achievement.

Table 7: Long-term effect of FPE on educational achievement: Without PESP-affected students

	(1)	(2)
Variables	Treatment group: First year students	Treatment group: 16-18 year olds
ATT ($\hat{\delta}_{SDID}$)	16.7242*** (3.7189)	-24.6571 (25.6638)
Observations	9,946	3,893

Notes: The reports estimate of the FPE effect on achievement (OWM) using asdid Stata command by Houngbedji (2016). All models are estimated using a linear polynomial function of degree 4 to approximate the propensity score. The covariates used in the estimation of the propensity score are APS, gender, district, and age dummies to approximate the cohort effects). Standard errors in parentheses and significance levels are indicated as follows: *** p<0.01, ** p<0.05, * p<0.1

Therefore, as a robustness check, we control for this potential confounding factor by removing all PESP-affected students from the Faculties of Agriculture, Health Sciences, and Science and Technology and estimate the FPE effect on academic achievement. The results are reported in Table 7. We can see from this table that, similar to the main results, the upper bound effect of FPE is positive and statistically significant. The lower bound effect of FPE is negative but statistically insignificant with large standard errors. Therefore, the FPE programme's effect is not driven by the PESP discontinuity and the resulting increase in employment and teaching time.[16]

6.4 Potential Mechanisms

So far, we have not specified any possible channels through which the FPE programme generates these positive effects. Therefore, this section attempts to narrow down the possible causal channels through which the programme's observed positive effects could have emerged based on Figure 3 and previous research.

The literature has well documented that eliminating user fees leads to increased access to schooling and, conditional on teacher recruitment, increases pupil-teacher ratio (PTR) (see Grogan, 2009; Chyi and Zhou, 2014; Moshoeshoe et al., 2019). High PTR leads to a decline, or at the most no change, in academic performance, holding all else constant (see Case and Deaton, 1999; Lucas and Mbiti, 2012). Similarly, building more schools, holding teacher recruitment constant, leads to increased access and PTR, and hence a decrease in academic achievement.

Furthermore, conditional on enrolment and teacher quality, increasing access to textbooks leads to an increase, at least not a decline, in academic achievement (see Glewwe et al., 2009; Frölich and Michaelowa, 2011; Kuecken and Valfort, 2013). The increase in teacher quality (i.e. teacher level of qualification and years of experience) can increase, but not decrease, academic achievement (Glewwe et al., 2011; Harris and Sass, 2011; Chetty et al., 2014). Following the introduction of the FPE programme, there was a decline in PTR, an increase in students' textbook ownership, and an increase in teacher qualification and years of professional training (Moshoeshoe, 2015). Further, Moshoeshoe (2019) shows that academic achievement between 2000 and 2007 after FPE, and the increase is partly attributable to the fall in PTR. Therefore, the increase in teacher employment likely contributed to increased academic achievement at the primary school level.

Taken together, it is less likely that the positive FPE programme effects documented in this paper could have been due to fee eliminations. The progressive implementation of the fee eliminations allowed the government to plan for the influx by recruiting more teachers, building more schools, and possibly enabling teachers to adjust their teaching strategies as they learn to reach low-ability and/or poor students effectively. These additional programme components, individually and in complementarity, are the likely drivers of the positive FPE programme effect on academic achievement. For instance, while the school-building component of the FPE programme is less likely to have contributed to the increase in academic achievement individually, it was potentially complemented by teacher recruitment to affect achievement positively. Moreover, because skill begets skill, this led to increased academic achievement at the university level.

7. Conclusion

This paper examines the long-term effects of Free Primary Education policy on educational achievement and how this varies by gender. The results indicate that the effect of FPE on educational achievement at the university level is bounded between 2 percentage points (which is statistically insignificant) and 20 percentage points (which is statistically significant at 1%). Furthermore, we do not find any FPE effect heterogeneities by student gender, but the effect varies by faculty or programme of study.

In countries where the FPE policy was introduced simultaneously for all grades, education quality declined, at least in the short-run (see Lucas and Mbiti, 2012). However, in countries where no user-fee programmes have been implemented progressively, like rural China's free and compulsory education reform programme, there are positive long-run effects on education quality (Xiao et al., 2017). The results of this paper are consistent with the latter evidence from China. They suggest that, if implemented gradually or on a grade-by-grade fashion as in Lesotho, educational outcomes can be increased. They further suggest that other Sub-Saharan African countries that are yet to implement free education programmes can increase their chances of meeting the SDG goal of inclusive and equitable education quality for all if they replicate Lesotho's FPE implementation approach.

This paper is not without limitations. As highlighted earlier, the FPE programme in Lesotho is a true package of supply and demand side programmes all geared towards achieving quality education for all. Therefore, while these results are interesting, they must be interpreted with caution: they do not show the effects of just fee eliminations. As we have seen in Figure 2, maybe in anticipation of the influx into the secondary schooling system, secondary school resources increased from 2005. Thus, these results are partly attributable to resource increase at the secondary school level.

Furthermore, we cannot completely rule out the possibility that the FPE-treated group worked harder than they would compensate for the perceived lower education quality they received under FPE. That is, there could have been a Hawthorne effect. In addition to this, it is also possible that secondary school teachers may have doubled their effort when teaching the FPE cohort for the same reasons as perceived primary school education. While these are real threats to the validity of the results, nothing indicates that there has been any of these coordinated responses by students and/or teachers that could have biased the results this way. Further research is still needed to tease out the pathways through which the FPE policy increased students' academic performance.

Notes

1 I thank Justine Burns, Abbi Kedir, Germano Mwabu, Patrick Plane, the audiences of the AERC December 2018 and June 2019 biannual conferences, and seminar participants at the National University of Lesotho for valuable comments and suggestions. Financial support from African Economic Research Consortium (AERC), through grant No. RT18537, is gratefully acknowledged. All remaining errors are my own.

2 Department of Economics, National University of Lesotho; rmoshoeshoe@gmail.com

3 Including but not limited to Burundi, Cameroon, Ghana, Kenya, Lesotho, Mozambique, Namibia, Rwanda, Swaziland, Tanzania, and Zambia.

4 Cognitive skills are malleable to environmental factors up to age 10 or so, while non-cognitive skills are malleable for a much longer time (Cunha et al., 2006).

5 The COSC is now called the Lesotho General Certificate of Secondary Education (LGCSE). Therefore, throughout this paper, COSC and LGCSE are used interchangeably.

6 APS (commonly known as the aggregate score) is the sum of grade points/ranks for 6 COSC subjects, including the English language. For example, grade A* (or A+) is given a point/rank of 1; grade A is equivalent to 2 points; grade B is equivalent to 3 points, etc. Therefore, the lower the APS score, the higher the performance in COSC exams. The APS score for top students is 6.

7 Suppose a student has registered for 12 courses, each with 3 credit hours. These courses make up a total of 36 credit hours and will all be used in the calculation of the OWM. If the student scores 60% in each course, her OWM is the weighted sum of all the 60s, where the weights are $\frac{3}{36} = \frac{1}{12}$, which equals 60%. If the student has taken courses with more than 36 credit hours, then only courses making at least 36 credit hours, starting with core and prerequisite courses, are included in the OWM calculation.

8 Even though some students attend schools outside their home districts, many attend schools within their home districts.

9 A much stronger version of the assumption about the individual error term for the DID strategy is that it is assumed to be independent of the G_i, and to have the same distribution over time, $\varepsilon_i \perp (G_i, T_i)$.

10 Equation 4 is an estimable version of the production function in Equation 1, where $Y_i \equiv A_i$.

11 Column (5) of the table presents the normalized difference in characteristics between groups. The normalized difference between means is a scale-free measure of the difference in the distribution of characteristics by treatment status. It is given as $\text{Norm} - \text{diff} \equiv \Delta_X = \frac{\bar{X}_1 - \bar{X}_0}{\sqrt{S_0^2 + S_1^2}}$, where S_i^2 is the sample variance of X_i in sub-sample with treatment $G_i = \{0,1\}$. If the normalized difference is less than one quarter in absolute value, the unconfoundedness assumption is likely satisfied (Imbens and Wooldridge, 2009). Using this indicator, we can see that pre-FPE performance at the COSC exams (pre-university entry exams) differs between groups.

12 Another solution could be to use matching methods, e.g., propensity score matching. However, Chabé-Ferret (2015) shows that when selection bias is either symmetric or asymmetric around the treatment date, the matching methods are dominated by symmetric DID - i.e. DID that is implemented symmetrically by comparing outcomes observed the same number of periods before and after the treatment date. Further, matching methods would result in greater information loss in this case, since some pre- and post-FPE observations would not be used.

13 Subscript M in the expectation sign indicates that the expectation is taken on data coming from the following mixture distribution $P_M(Y = y, D = d, X = x, T = t) = \lambda \cdot t \cdot P(Y(1) = y, D = d, X = x) + (1 - \lambda) \cdot (1 - t) \cdot P(Y(0) = y, D = d, X = x)$, where $\lambda \in (0, 1)$.

14 The standard DID results are presented in Appendix Table A.3, and are largely consistent with the non-parametric results except that they are not statistically significant (see columns (1) and (2)).

15 We explain the PESP programme in detail below.

16 The standard DID results presented in Table A.3 - see columns (3) and (4) - are consistent with the results presented here.

References

Abadie, A. 2005. “Semi-parametric difference-in-differences estimators”. *The Review of Economic Studies*, 72: 1-19.

Al-Samarrai, S. and Zaman, H. 2007. “Abolishing school fees in Malawi: The impact on education access and equity”. *Education Economics*, 15: 359-375.

Ambrose, D. 2007. “The history of education in Lesotho: Six brief sub-sectoral studies”. *Lesotho Miscellaneous Documents*, No. 23.

Angrist, J.D. and Lavy, V. 1999. “Using Maimonides’ rule to estimate the effect of class size on scholasticachievement”. *The Quarterly Journal of Economics*, 114: 533-575.

Baez, J.E. and Camacho, A. 2011. Assessing the long-term effects of conditional cash transfers on human capital: Evidence from Colombia, IDB Working Paper Series No. IDB-WP-432.

Becker, G.S. and Tomes, N. 1986. “Human capital and the rise and fall of families”. *Journal of Labour Economics*, S1–S39.

Behrman, J.R. 2010. “Investment in education – inputs and incentives”. In *Handbook of Development Economics* . D. Rodrik and M. Rosenzweig ((Eds), Elsevier, Vol. 5: 4883-4975.

Behrman, J.R., Parker, S.W. and Todd, P.E. 2011. “Do conditional cash transfers for schooling generatelasting benefits? A five-year followup of progresa/oportunidades”. *Journal of Human Resources*, 46: 93-122.

Blimpo, M.P., Gajigo, O. and Pugatch, T. 2016. “Financial constraints and girls’ secondary education: Evidence from school fee elimination in The Gambia”. *The World Bank Economic Review*, lhw051.

Blundell, R. and Dias, M. C. 2009. “Alternative approaches to evaluation in empirical microeconomics”. *Journal of Human Resources*, 44: 565-640.

Bureau of Statistics. 2015. 2014. Education Statistics Report Force Survey, *Statistics Report, No. 28*.

Cabus, S.J. and De Witte, K. 2011. “Does school time matter? - on the impact of compulsory education age on school dropout”. *Economics of Education Review*, 30: 1384-1398.

Case, A. and Deaton, A. 1999. “School inputs and educational outcomes in South Africa”. *The Quarterly Journal of Economics*, 114, 1047-1084.

Chabé-Ferret, S. 2015. “Analysis of the bias of matching and difference-in-difference under alternative earnings and selection processes”. *Journal of Econometrics*, 185: 110-123.

Chetty, R., Friedman, J.N. and Rockoff, J.E. 2014. “Measuring the impacts of teachers ii: Teacher value-added and student outcomes in adulthood”. *American Economic Review*, 104: 2633-79.

Chyi, H. and Zhou, B. 2014. “The effects of tuition reforms on school enrolment in rural China”. *Economics of Education Review*, 38: 104-123.

Council on Higher Education. 2013. Report on the state of higher education in Lesotho. Technical Report. Council on Higher Education.

Cunha, F. and Heckman, J.J. 2009. "The economics and psychology of inequality and human development". *Journal of the European Economic Association*, 7: 320-364.

Cunha, F., Heckman, J.J., Lochner, L. and Masterov, D.V. 2006. "Interpreting the evidence on life cycle skill formation". In *Handbook of the Economics of Education* (Eds.) E. Hanushek and F. Welch, Elsevier, Vol. 1: 697-812.

Deininger, K. 2003. "Does cost of schooling affect enrolment by the poor? Universal primary educationin Uganda". *Economics of Education Review*, 22: 291-305.

Fredriksson, P., Öckert, B. and Oosterbeek, H. 2013. "Long-term effects of class size". *The QuarterlyJournal of Economics*, 128: 249-285.

Frölich, M. and Michaelowa, K. 2011. "Peer effects and textbooks in African primary education". *Labour Economics*, 18: 474-486.

Glewwe, P., Kremer, M. and Moulin, S. 2009. "Many children left behind? Textbooks and test scores in Kenya". *American Economic Journal: Applied Economics*, 1: 112-135.

Glewwe, P.W., Hanushek, E.A., Humpage, S.D. and Ravina, R. 2011. School resources and educational outcomes in developing countries: A review of the literature from 1990 to 2010. NBER Working Paper, No. 17554.

Grogan, L. 2009. "Universal primary education and school entry in Uganda". *Journal of African Economies*, 18: 183-211.

Harris, D.N. and Sass, T.R. 2011. "Teacher training, teacher quality and student achievement". *Journal of Public Economics*, 95: 798-812.

Haveman, R. and Wolfe, B. 1995. "The determinants of children's attainments: A review of methods and findings". *Journal of Economic Literature*, 33: 1829-1878.

Heckman, J.J. and Mosso, S. 2014. The economics of human development and social mobility. NBER Working Paper 19925.

Hoogeveen, J. and Rossi, M. 2013. "Enrolment and grade attainment following the introduction of free primary education in Tanzania". *Journal of African Economies*, 22: 375-393.

Houngbedji, K. 2016. "Abadie's semi-parametric difference-in-differences estimator". *The Stata journal*, 16: 482-490.

Houngbedji, K. 2018. "Property rights and labour supply in Ethiopia". *Annals of Economics and Statistics/Annales d'Économie et de Statistique*, 137-179.

Imbens, G.W. and Wooldridge, J.M. 2009. "Recent developments in the econometrics of programme evaluation". *Journal of Economic Literature*, 47: 5-86.

Jopo, H., Maema, M. and Ramokoena, M. 2011. "Quality of primary school inputs in Lesotho". *SACMEQ Policy Brief*, No. 2.

Kuecken, M. and Valfort, M.A. 2013. "When do textbooks matter for achievement? Evidence from African primary schools". *Economics Letters*, 119, 311-315.

Leibowitz, A. 1974. "Home investments in children". *The Journal of Political Economy*, 82: S111-S131.

Lekhetho, M. 2013. "The impact of free primary education on access and quality of primary education in Lesotho". *International Journal of Educational Science*, 5: 397-405.

Liang, X., Tan, J.P. and Mutumbuka, B. Dzingai. 2005. Primary and secondary education in Lesotho: A country status report for education. Africa education country status report. Washington, DC: World Bank.

Lucas, A.M. and Mbiti, I.M. 2012. "Access, sorting, and achievement: The short- run effects of free primary education in Kenya". *American Economic Journal: Applied Economics*, 4, 226-253.

MOET. 2010. Education Statistics Report), Technical Report.

MOET (Ministry of Education and Training). 2011. Presentation on Education Management Information System (EMIS): 1999-2011, Technical Report.

MOET. 2016. 2016 Education Statistics Report. Technicl Report.

Moshoeshoe, R. 2015. Essays in economics of education: Free primary education, birth order and human capital development in Lesotho. [PhD thesis]. University of Cape Town.

Moshoeshoe, R. 2019. Changes in educational achievement after the Free Primary Education programme in Lesotho: A relative distribution analysis. Working Paper.

Moshoeshoe, R., Ardington, C. and Piraino, P. 2019. "The effect of free primary education policy on school enrolment and relative grade attainment in Lesotho". *Journal of African Economies*, 28511-532.

Nishimura, M., Yamano, T. and Sasaoka, Y. 2008. "Impacts of the universal primary education policy on educational attainment and private costs in rural Uganda". *International Journal of Educational Development*, 28: 161-175.

Todd, P.E. and Wolpin, K.I. 2003. "On the specification and estimation of the production function for cognitive achievement". *The Economic Journal*, 113: F3–F33.

UNDP. 2016. Sustainable Development Goals Booklet. Technicl Report. UNDP.

UNESCO. 2000. The Dakar Framework for Action: Education for All, Meeting our Collective Commitments, Technical Report. UNESCO.

Urwick, J. 2011. "Free primary education in Lesotho and the disadvantages of the highlands". *International Journal of Educational Development*, 31: 234-243.

World Bank. 2016. World Development Indicators: Featuring the Sustainable Development Goals, Technical Report. World Bank.

World Bank. 2018. World Development Report: Learning to Realize Education's Promise, Technicl Report. World Bank.

Xiao, Y., Li, L. and Zhao, L. 2017. Education on the cheap: The long-run effects of a free compulsory education reform in rural China". *Journal of Comparative Economics*, 45: 544-562.

Appendix

Table A.1: Treatment and control group by treatment group definition

	Pre-FPE	Post-FPE
A: Group defined by Age-appropriate cohort		
Control group	($G_i = 0, T_i = 0$)	($G_i = 0, T_i = 1$)
	(cohort: $\geq$ 19 year olds)	(cohort: $\geq$ 19 year olds)
Treatment group	($G_i = 1, T_i = 0$)	($G_i = 1, T_i = 1$)
	(cohort: 16–18 year olds)	(cohort: 16–18 year olds)
B: Group defined by year of study		
Control group	($G_i = 0, T_i = 0$)	($G_i = 0, T_i = 1$)
	(cohort: 2nd year students)	(cohort: 2nd year students)
Treatment group	($G_i = 1, T_i = 0$)	($G_i = 1, T_i = 1$)
	(cohort: 1st year students)	(cohort: 1st year students)

Source: Own representation.

Table A.2: Students' average academic performance by year of study: 2010–2014

Year	OWM (Mean)		difference (year1 – year2)	p–value
	Year 1	Year 2		
2010	58.27	60.670	-2.40	0.0000
2011	58.81	60.640	-2.83	0.0000
2012	56.93	60.700	-3.78	0.0000
2013	59.94	62.700	-2.07	0.0000
2014	59.23	59.92	-0.69	0.0153

Source: Own calculations using NUL students' records data for the academic years 2010, 2011, 2012, 2013, and 2014.
Notes: OWM is the overall weighted mean.

Table A.3: Long-term Effect of FPE on educational achievement: Standard DID results

Variables	(1)	(2)	(3)	(4)
	All students		Without FOA, FOHS, and FOST students	
	Treatment group: First Year students	Treatment group: 16-18 year olds	Treatment group: First Year students	Treatment group: 16-18 year olds
ATT ($\hat{\delta}_{DID}$)	-0.1986 (0.4127)	0.3077 (0.5161)	0.0505 (0.3935)	0.8722* (0.5225)
First Year of study or Age-Appropriate (16-18 years)	1.9499*** (0.5661)	0.7100 (0.4347)	1.2837** (0.4985)	0.5104 (0.4252)
Period (Post-FPE)	-0.8578*** (0.2593)	-0.9312*** (0.2140)	-0.6356** (0.2774)	-0.7282*** (0.2371)
Female	1.5807*** (0.2179)	1.4871*** (0.2155)	2.0025*** (0.2349)	1.9139*** (0.2345)
APS score	-0.5217*** (0.0535)	-0.3983*** (0.0271)	-0.2898*** (0.0374)	-0.2072*** (0.0216)
Constant	68.3291*** (0.9359)	66.7340*** (0.8588)	61.0506*** (0.9132)	59.5750*** (0.8310)
Observations	12239	12239	9021	9021
R-squared	0.0750	0.0730	0.0370	0.0370

Notes: FOA means Faculty of Agriculture, FOHS means Faculty of Health Sciences, and FOST means Faculty of Science and Technology. All regressions control for district, faculty, nationality of the student, age and age squared. Clustered standard errors are in parentheses, and significance levels are indicated as follows: *** p<0.01, ** p<0.05, * p<0.1.

Mission

To strengthen local capacity for conducting independent, rigorous inquiry into the problems facing the management of economies in sub-Saharan Africa.

The mission rests on two basic premises: that development is more likely to occur where there is sustained sound management of the economy, and that such management is more likely to happen where there is an active, well-informed group of locally based professional economists to conduct policy-relevant research.

www.aercafrica.org

Learn More

www.facebook.com/aercafrica

www.instagram.com/aercafrica_official/

twitter.com/aercafrica

www.linkedin.com/school/aercafrica/

Contact Us
African Economic Research Consortium
Consortium pour la Recherche Economique en Afrique
Middle East Bank Towers,
3rd Floor, Jakaya Kikwete Road
Nairobi 00200, Kenya
Tel: +254 (0) 20 273 4150
communications@aercafrica.org