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STEPHEN TAYLOR AND MARISA COETZEE

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STEPHEN TAYLOR
DEPARTMENT OF BASIC EDUCATION
PRETORIA,
SOUTH AFRICA
E-MAIL: TAYLOR.S@DBE.GOV.ZA

MARISA COETZEE
DEPARTMENT OF ECONOMICS
UNIVERSITY OF STELLENBOSCH
PRIVATE BAG X1, 7602
MATIELAND, SOUTH AFRICA
E-MAIL: MARISA.COETZEE@GMAIL.COM

UNIVERSITEIT STELLENBOSCH UNIVERSITY

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Stephen Taylor*and Marisa Coetzee†

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Abstract

For many children around the world, access to higher education and the labour market depends on becoming fluent in a second language. This presents a challenge to education policy: when and how in the school programme should a transition to the second language occur? While a large theoretical literature exists, empirical evidence is limited by the difficulties inherent to measuring the causal effect of language of instruction. In South Africa, the majority of children do not speak English as their first language but are required to undertake their final school-leaving examinations in English. Most schools offer mother-tongue instruction in the first three grades of school and then transition to English as the language of instruction in the fourth grade. Some schools use English as the language of instruction from the first grade. In recent years a number of schools have changed their policy, thus creating within-school, cross-grade variation in the language of instruction received in the early grades. We use longitudinal data on school characteristics including language of instruction by grade, and student test score data for the population of South African primary schools. Simple OLS estimates suggest a positive correlation between English instruction in the first three grades and English performance in grades 4, 5 and 6. After including school fixed effects, which removes the confounding effects of selection into schools with different language policies, we find that mother tongue instruction in the early grades significantly improves English acquisition, as measured in grades 4, 5 and 6. The significance of this study is twofold. Firstly, it illustrates the power of school-fixed effects to estimate causal impacts of educational interventions. Secondly, it is the first South African study (and one of a very few international studies) to bring robust empirical evidence to the policy debate around language of instruction.

JEL Classification: I24, I25, I28

Key words: Education, language of learning and teaching, South Africa, fixed effects

*taylor.s@dbe.gov.za, Department of Basic Education, Pretoria, South Africa

†marisa.coetzee@gmail.com, Department of Economics, University of Stellenbosch, South Africa

1 Introduction

Vast amounts of literature deal with the acquisition of a second language. In fact, second language acquisition is an entire sub-discipline of applied linguistics. In many parts of the world, however, the need to become fluent in a second language is essential for gaining meaningful access to education, the labour market and broader social functioning. In these contexts, such as most of Africa, parts of East Asia and for Spanish-speaking people in the United States, the question of how best to develop second language fluency amongst large parts of the population becomes critically important and a central matter for education planning.

South Africa is a prime example of a country facing the dilemma of how to most effectively equip the majority of its population with a second language, in this case English. Although there are 11 official languages in South Africa,[1] Afrikaans and English are the only languages with a developed academic literature and in which it is possible to write the secondary school leaving examinations. According to the 2011 census, only about 23% of South Africans speak Afrikaans or English as their first language (Statistics South Africa, 2012). In order to achieve educational and hence labour market success, the majority of South African children therefore need to become fluent in either English or Afrikaans. In reality, the vast majority choose to learn English rather than Afrikaans as the second language, given its status as a global language.

English language proficiency therefore influences life chances through its influence on educational success. However, Casale and Posel (2011) demonstrate that English proficiency also improves labour market returns directly. Using a traditional earnings function methodology controlling for an individual's amount of education, they find a significant wage premium for black South Africans associated with being able to read and write English fluently.

This situation presents a difficult policy question to countries like South Africa: when and how should the teaching of English be introduced in schools, and when and how should a transition to English as the primary language of instruction in non-language subjects occur? Several models exist in theory, each with numerous variations that have been applied in different parts of the world. At one end of the spectrum is the so-called "immersion model" in which children learn in the second language from the start of schooling. The "Straight-For-English" approach is a type of immersion model. In contrast, there are various types of bilingual models. Transitional models prescribe that a child's first language be used in the first years of schooling followed by a transition to the second language as the language of instruction. In "early exit transition" models the transition to second language occurs after about three years of schooling. In "late

[1] This list includes nine African languages (isiZulu, isiXhosa, isiNdebele, Sepedi, Setswana, Sesotho, SiSwati, Xitsonga, Thsivenda) as well as the two European languages (English and Afrikaans, which evolved from the Dutch spoken by the early Cape settlers).

exit transition" models the transition occurs after about six or eight years of schooling. There are also various models of "additive" or "subtractive" bilingualism in which the first and the second language are used alongside each other, perhaps with the relative balance of use changing through the school trajectory.

South African legislation and education policy does not prescribe which of the 11 official languages should be used, but leaves the choice of language of instruction to School Governing Bodies, which are comprised by a parent majority as well as the school principal, several staff members and, in the case of secondary schools, pupils (South Africa, 1996). Currently, most schools in which the majority of pupils are not English- or Afrikaans-speaking opt to use First Language in grades 1, 2 and 3 and then transition to English as the language of instruction in the fourth grade. This approach, though not compulsory in policy, has been encouraged by the national and provincial departments of education. Some schools, however, have chosen to go "Straight-For-English" as the language of instruction from the first grade. The Curriculum and Assessment Policy Statements (CAPS) also prescribe that the teaching of English as a subject should be introduced from Grade 1 in all schools (Department of Basic Education, 2011). Consequently, all schools should have some English being taught from the first grade, but for some schools English is also the language of instruction from Grade 1 whereas in most schools this is only the case from the fourth grade.

South African children perform poorly on international assessments of educational achievement. The Progress in International Reading Literacy Study (PIRLS) surveys of 2006 and 2011, as well as the Trends in International Mathematics and Science Study (TIMSS) surveys of 1995, 1999, 2003 and 2011 have consistently demonstrated that South Africa's performance is amongst the lowest of all participating countries. The extent to which language factors contribute to this low performance is not clear, given that language disadvantages are so strongly correlated with other confounding factors such as historical disadvantage, socio-economic status, geography, the quality of school management and the quality of teachers. However, there are many in the South African education community who feel that language, and in particular the language policy, is a key determinant of education outcomes. Proponents of Mother Tongue education argue that a later transition to English is necessary given that children cannot understand the language of instruction (for example, Brock-Utne, 2007). On the other hand, English is widely perceived to be the language of upward mobility and this leads to a preference for instruction in English from as early as possible.

Pedagogical theory appears to be stacked more heavily in favour of using First Language as language of instruction until a level of academic proficiency has been attained in that language (which may take three to six years) rather than using a Second Language from the start of school (Hakuta, Butler and Witt, 2000).

The proponents of the immersion approach argue that First Language instruction will distract from and delay the acquisition of English. This approach is fairly intuitive: Start learning English as early as possible and as comprehensively as possible. The theoretical underpinnings of this argument are that time-on-task is crucial and that language acquisition (including that of a second language) comes more naturally to young children than older children. Imhoff (1990), for example, argues that bilingual education denies the reality that "practice makes perfect."

In contrast, proponents of bilingual transitional models maintain that a child must first develop cognitively to a sufficient level in the medium of their First Language in order to gain the skills necessary for second language acquisition (World Bank, 2005). Cummins (1992) argues that there is a great interdependence between literacy skills across languages. He also holds that academic proficiency in a language takes considerable time to master – at least five years. Therefore, as the argument goes, once academic mastery in the First Language has been attained a child will possess the necessary literacy skills to transition to a second language.

The notion of a "zone of proximal development" developed by Vygotsky (1962) is also relevant to second language acquisition. This notion suggests that all learning builds on existing skills and knowledge and that, consequently, there exists a zone in which new knowledge and skills can be developed using existing foundations. However, substantially more advanced skills or very different learning areas will be unattainable because the links to existing skills have not been established. Consequently, if a certain level of language proficiency and understanding of the principles of literacy (e.g. decoding text) has not been reached in the First Language (in which a child already possesses a substantial oral vocabulary), then academic mastery of a second language will be beyond the so-called "zone of proximal development." For these reasons, proponents of bilingual transitional models predict that not only will a later transition to English benefit a child's First Language proficiency, but it will also lead to better proficiency in English in the long run.

While pedagogical theory seems to point more strongly to late exit transitional models, there are often practical realities which may influence the relative effectiveness of alternative models. In many countries, such as South Africa, there are numerous First Languages and this introduces various logistical difficulties in providing quality First Language instruction. Sufficient high quality instructional materials may not exist in all the languages. In contexts where there are multiple home languages represented within the same classroom it may be preferable to teach in English rather than any particular home language. There may be a lack of teachers who are proficient in the various home languages. Conversely, though, teachers may not be fluent in English thus compromising the delivery of an English-Immersion programme. The general capability and motivation of the teacher force may also be a critical mediating factor – the advocates of "Structured Immersion Programmes" generally recommend sophisticated instructional

regimes (e.g. Rossell and Baker, 1996), which may, even if pedagogically sound, be flawed at the level of implementation in certain contexts. Similarly, the transition to English that must occur in bilingual models may be extremely disruptive and educationally damaging if a high quality of support materials and teacher expertise does not exist to manage this phase effectively – a concern that is often expressed in South Africa (e.g. Van der Berg, Burger, Burger, Vos, Randt, Gustafsson, Shepherd, Spaull, Taylor, Van Broekhuizen and Von Fintel, 2011).

There may be numerous other political or ideological motivations behind a particular language in education policy, such as using a single language to promote national unity or developing a diverse cultural heritage (World Bank, 2005). However, the question of which approach is most suitable in a particular context is ultimately an empirical one. As the next section will show, there is a dearth of empirical work using credible methods to identify the causal impact of alternative language-of-instruction models on second language acquisition or on other educational outcomes. There is an even more acute shortage of such research done in developing countries, especially those in Africa. Consequently, as Slavin, Madden, Calderon, Chamberlain and Hennessy (2011) observe, "ideology has often trumped evidence" in language policy debates.

Hulstijn (1997) explains the major limitation in the vast field of research studying second language acquisition, namely that confounding variables affect the comparability of groups who underwent different second language learning experiences. He argues that, "One of the most difficult methodological challenges is to keep all such variables constant. This is almost impossible in "normal" classrooms with real L2 learners. It comes as no surprise, therefore, that the outcomes of studies conducted in natural learning environments, including classrooms, often form the object of considerable disagreement." In South Africa, for example, it is invalid to simply compare schools that adopt a "Straight-for-English" approach with schools that transition from First Language to English in the fourth grade because these two groups of schools differ systematically on all sorts of observable and unobservable characteristics.

A further challenge that must be overcome in order to produce meaningful empirical evidence on the relative effectiveness of alternative language-of-instruction regimes is that studies must span several years. This is because the "treatment", which is either instruction in First Language or instruction in Second Language, lasts for several years. Furthermore, the outcome of interest is not English proficiency at the end of the "treatment period" but at a later stage once those in a bilingual programme have transitioned to English as language of instruction. The outcome of interest is really educational outcomes, in particular Second Language acquisition, in the long run. The vast majority of studies have not used data with a long enough time span to address this fundamental research question.

This paper uses a unique dataset that was constructed by combining several datasets covering all of the years from 2007 to 2012 for the entire population of South African schools. The

final subsample of data used after restricting the sample to the relevant section of the school system, contains 827 745 individuals in 9 180 primary schools. We estimate the impact of English instruction relative to First Language instruction in grades 1, 2 and 3 on English proficiency in grades 4, 5 and 6. We use a school-fixed effects model to exploit within-school variation in the language of instruction in grades 1, 2 and 3 caused by historical changes in the language of instruction at specific schools. This deals with the major source of endogeneity bias caused by systematic unobserved differences between schools that adopt different language policies. We also include several individual-level and grade-specific characteristics to control for any differences across grades within a school that may be systematically related to the language of instruction. We find that three years of English instruction in the Foundation Phase (Grades 1, 2 and 3) relative to three years of First Language instruction is associated with a negative effect on English performance in Grades 4, 5 and 6 of approximately 13% of a standard deviation in test scores. We argue that this estimate can be interpreted causally.

The next section reviews previous empirical studies and thus further establishes the relevance of this study, given its unique design. Section 3 describes the data that is used and the derivation of the treatment variable, namely years of English instruction in the Foundation Phase. It also presents descriptive statistics for SFE schools and MT schools as well as for schools that switched their language policy at some stage. Section 4 explains the identification strategy and statistical model used to measure the impact of the alternative language of instruction regimes. Section 5 presents the results, including numerous variations on the basic model to examine heterogeneous effects across different parts of the school system. Section 6 reports on a number of robustness checks that were conducted to address potential concerns regarding the causal interpretation that we offer. Section 7 concludes by discussing the significance of these findings for the literature on second language acquisition and for South African education policy.

2 Previous empirical studies

Several meta-analyses reviewing the literature on alternative language-of-instruction regimes have been conducted, mainly pertaining to the question of language policy for Spanish speaking children in the United States. Rossell and Baker (1996) argued that the weight of evidence from studies of sufficient methodological quality suggested no significant difference between bilingual education approaches and English-immersion approaches. However, subsequent re-analysis of the same studies (Greene, 1997; Cheung and Slavin, 2005, 2012) has demonstrated that many of these studies had serious methodological flaws and that the most credible studies in fact favoured bilingual approaches. Cheung and Slavin (2012) calculate a mean effect size of 0.21 standard deviations in favour of bilingual approaches amongst the studies they review.

Cheung and Slavin (2012) find 13 studies that met their methodological criteria for inclusion. We would contend that even these 13 studies do not all provide strong grounds for causal inference. For example, Cheung and Slavin (2012) regarded matching techniques as sufficient for inclusion even though matching cannot control for unobservable characteristics, which may well determine both selection into programme and educational outcomes. Secondly, many of the studies reviewed contain samples that are really too small for precise measurement. For example, the Randomised Control Trial conducted by Slavin, Madden, Calderon, Chamberlain and Hennessy (2011), which Cheung and Slavin (2012) laud as the "only multiyear randomized evaluation of transitional bilingual education" only included six schools. Slavin, Madden, Calderon, Chamberlain and Hennessy (2011) concede that the small sample was a weakness and that, therefore, in their calculation of standard errors they did not adjust for clustering at the school level.

Two studies that used observational data are worth mentioning given their strong influence in the literature. Ramírez, Pasta, Yuen, Ramey and Billings (1991) followed three types of schools in several districts in the United States – immersion schools, early exit to English schools and late exit to English schools – for four years. The report itself concedes a lack of comparability on teacher and school characteristics across school types. A second weakness is that the English proficiency of those in the late exit programme was not observed in years subsequent to the varying treatment. Furthermore, as Cheung and Slavin (2005) maintain, the study did not adequately control for pre-test scores. Nevertheless, the study found no significant differences across the three groups of schools at the end of the treatment period. Some, such as Cummins (1992), argue that this finding supports bilingual approaches since it demonstrates that these can lead to equal levels of English proficiency despite less time spent on English instruction.

A second influential study was carried out by Thomas and Collier (1997), also in the United States. They found that students who had undergone dual language instruction performed better at the end of high school than students who had experienced immersion in English.

The empirical literature on language in education in developing countries, especially those in Africa, is even less well developed. We were not able to find a single African study that had a large enough sample for precise estimations, a multi-year duration so as to shed light on ultimate educational outcomes, and randomised assignment or other suitable quasi-experimental method to provide a credible basis for causal inference.

The strong majority of studies on language of instruction in African countries are written by linguists in favour of Mother Tongue instruction. Some are quantitative, but tend to lack a methodology allowing for causal inference. Piper and Miksic (2011), for example, investigate the relationship between language of instruction and reading acquisition in Uganda and Kenya using observational data and regressing reading scores on a set of observed characteristics including

language of instruction which varies across schools. Piper and Miksic (2011), however, concede that the cross-sectional nature of their data precludes causal inferences.

The Six Year Primary Project (SYPP) or "Ife project" conducted in Nigeria is regarded by Alidou, Boly, Brock-Utne, Diallo, Heugh and Wolff (2006) as "the most authoritative case study on the use of mother tongue in formal education". This project began in 1970 with two experimental schools receiving six years of Mother Tongue instruction (Yoruba) and one control school receiving the traditional three years of Mother Tongue instruction and then switching to English as language of instruction. The project claimed to clearly demonstrate the positive effects of late exit transitional models relative to early exit from Mother Tongue. Although, several additional schools were added to the project in subsequent years, small sample size remains a weakness in comparison with recent standards in randomised control trials. Secondly, apart from receiving more years of Mother Tongue instruction, experimental schools received other instructional materials as well as a specialist English teacher. Therefore, as Akinnaso (1993) contends, it was not possible to separate the effects of language of instruction from other aspects of instructional quality.

Benson (2000) reports on an experiment in Mozambique comparing a bilingual programme to the traditional Portuguese-only programme. Although sample size was again small (four treatment and four control schools) and there were admittedly several design problems, Benson (2000) maintains that the project pointed to increased classroom participation, self-confidence and language proficiency amongst children in the experimental schools.

Walter and Chuo (2012) discuss a recent experiment in Cameroon in which 12 schools received instruction in Mother Tongue (Kom) in the first three grades and 12 matched schools received the traditional instruction in English. After five years of schooling (i.e. two years after the switch to English for experimental schools) those in experimental schools were performing better in English reading than those in control schools. However, there was no significant difference in mathematics skills between experimental and control schools. The major advantage of this study is its 5-year duration. However, a major weakness is that the experimental schools were recommended by local education officials. Therefore, despite the matching process, these schools may differ in certain unobserved ways to the control schools.

Empirical studies on the impact of language of instruction in South Africa are even scarcer. Most existing studies have been small-scale qualitative studies. Brock-Utne (2007), for example, shows, using observations from two classes, that IsiXhosa speaking children learn better when being instructed in their home language. Vorster, Mayet and Taylor (2013) use a nationally representative dataset (albeit excluding one of the nine provinces) to estimate the disadvantage of writing a test in English versus in Mother Tongue. This study makes use of a dataset containing two sets of test scores for the same children in the same year on the same test administered in

English on one occasion and in Mother Tongue on another occasion. These studies, however, do not really address the policy question on when the language of instruction should switch to English.

It is therefore clear that existing empirical evidence about the causal impact of bilingual transitional programmes relative to English immersion programmes on learning outcomes, specifically on second language acquisition, is insufficient. This is true internationally, but is especially true for African countries and South Africa.

3 The data

We constructed a unique dataset by merging information from the Department of Basic Education's Annual Surveys of Schools (ASS) from 2007 to 2011 with the Annual National Assessments (ANA) data for 2012.

The national Department of Basic Education administered standardised assessments in grades 1 to 6 and 9 in all public ordinary schools in 2012. All children wrote a mathematics test and a language test. For grades 1, 2 and 3 the language test was administered in the language that the school taught as the First Language. In grades 4, 5, 6 and 9 English- and Afrikaans-speaking pupils wrote English or Afrikaans on the First Language level, while pupils with a different First Language wrote a test for English as a "First Additional Language" or Afrikaans as a "First Additional Language". Consequently, the majority of children in poor, majority black schools wrote English as a First Additional Language in Grades 4, 5, 6 and 9. The ANA dataset also includes several individual characteristics, such as gender, age and population group.[2]

The ASS is conducted on the first Tuesday of March every year. It is completed by each school's principal and contains extensive administrative information about the numbers of children enrolled in each grade and about the teachers in each grade. The principal also indicates which language is used as the language of instruction in each grade. It is therefore possible to identify for pupils who were in grade 4 in 2012, what the language of instruction was when they were in grade 1 (in 2009) and in grade 2 (in 2010) and in grade 3 (in 2011). The same historical reconstruction applies to those tested in grade 5 in 2012 (using ASS data from 2008, 2009 and 2010) and those grade 6 in 2012 (using ASS data from 2007, 2008 and 2009). This assumes that children had not repeated any grades prior to being observed in grade 4, 5 or 6, an assumption

[2]South African education researchers and policy-makers remain interested in analysis by population group because this characteristic still serves as a proxy for language dynamics, historical disadvantage under the apartheid era and current poverty. Moreover, schools were formerly segregated on the basis of race and administrated by separate education departments. Consequently, institutional and managerial weaknesses persist in the historically black section of the school system (Van der Berg, 2008).

that it obviously not true for all children. However, this merely introduces random noise into the statistical models due to measurement error. In the school fixed-effects model this can be expected to cause a degree of attenuation bias (Angrist and Pischke, 2009).

We therefore derive a "treatment" variable for the number of years of English instruction in the Foundation Phase, which varies from zero to three. For each pupil in grades 4, 5 and 6 in 2012 we thus impute a value on this variable. For those years in which the language of instruction was not English it was one of the "African" languages. For most pupils this would have been their First Language, though for some pupils this also would not have been their First Language. For the identification of the students in our sample, we ignored all cohorts that received instruction in two languages during one or more years of their Foundation Phase. [3]

We restrict the sample to pupils in public schools, schools that wrote the English First Additional Language paper in 2012 (thus excluding schools with predominantly Afrikaans-speaking and English-speaking children as well as the few schools that opted to write the Afrikaans First Additional Language paper), schools in which at least 80% of children are black, and schools officially categorised as Quintile 1, 2 and 3.[4] The resulting sample of 827 745 individuals in 9 180 primary schools represents the population of schools in which the challenge of English acquisition as a second language is applicable. It is also the section of the South African school system that is seriously underperforming. Children in these schools typically find themselves in a poverty trap where low quality education outcomes lead to weak labour market prospects (Van der Berg et al, 2010).

Table 1 reports selected descriptive statistics for all pupils by treatment intensity. More than 80% of the sample received instruction in an African Language for all three years of the Foundation Phase. Schools in which three years of First Language instruction were provided were smaller schools on average.[5] The sample almost exclusively consists of black children. Interestingly, those schools with three years of First Language instruction were more likely to be Quintile 1 schools and less likely to charge fees in excess of R100.[6] This already indicates why it is not valid to simply compare educational performance across schools with differing language policies.

[3]The ASS questionnaire includes a question to school principals regarding the percentage of students in each grade who received instruction in English. If this percentage was not indicated as being either 0 or 100, we excluded the cohort from our estimation sample since it is not certain what the treatment is in a situation where children were instructed in a double medium (the terminology used in South Africa to describe schools where more than one language of instruction was used) school.

[4]Schools are categorised according to a measure of the poverty in the surrounding community. This is used to inform pro-poor public expenditure on non-personnel education spending. There are five poverty quintiles of schools, although these are not equal in size due to substantial reclassification of schools over time, mainly towards the lower quintiles. Quintile 4 and 5 schools include historically advantaged schools, which serve many children whose First Language is English or Afrikaans.

[5]This probably reflects the pattern that remote rural schools usually opt for mother tongue instruction and are often small.

[6]Most of these schools are "no-fee schools" and receive a higher government subsidy as compensation for not charging fees.

Analysis of ASS data indicates that a considerable number of schools changed the language of instruction in at least one of the Foundation Phase grades between 2007 and 2011. Table 2 reports that 79.8% of children were in schools that experienced no change in policy during the period. However, 5.9% of children were in schools that switched towards English as language of instruction and 14.3% of children were in schools that switched from English to an African language during the period. There were some differences between the schools that switched in either direction and the non-switching schools, particularly with respect to school size. However, these are clearly not substantially different groups of schools along the dimensions that are known to be educationally important in South Africa. Interestingly, the variable describing the language homogeneity of the school (defined as the proportion of pupils that speak the most common home language in the school) was somewhat lower in schools that switched to English as language of instruction. This may indicate that language homogeneity of a classroom is one factor taken into consideration by schools when deciding on the language of instruction.

Table 3 shows selected descriptive statistics for schools before and after a switch in the language policy occurred. The table shows this information separately for schools that switched to English and schools that switched away from English, in case a switch in one direction was linked with other changes in school characteristics. Only in the case of class size was there a statistically significant decline in the class size within schools that switched to an African language.

Figure 1, however, confirms that a decline in class size was consistent with the trend amongst the large group of non-switching schools. Instead, the fact that schools switching to English retained similar average class size is the divergent trend. One possible explanation for this is that parents may have been attracted to schools that switched to English due to the perception that English is the language of upward mobility.

Figure 2 confirms that the trends in class size were largely driven by slight changes in enrolment patterns rather than by teacher recruitment. Schools switching to English experienced a stable average level of enrolments over the period, while the other two groups of schools saw slight declines in total enrolment.

Average school fees, though somewhat higher amongst non-switching schools, declined in all three groups over the period. It should be noted here that the high school fees in 2010 for schools that switched to First Language is driven primarily by 4 schools which indicated their school fees to be higher than R1 500.[7] Once these outliers are removed, the trend for schools that switched to First Language is similar to the other two groups. The main point from figures 1, 2 and 3 is that these time trends were fairly consistent across the three groups.

[7]These outliers report school fees of R1500 or less for 2011, which leads us to suspect that the 2010 data entry might have been a mistake.

4 Identification strategy

We first estimate the baseline effects of exposure to English as language of instruction by adopting a simple OLS estimation strategy using the following model:

$$Y_{igs} = \alpha + G_g + \beta T_{igs} + \delta' \mathbf{X_i} + \tau' \mathbf{Z_s} + \upsilon_s + \varepsilon_{igs} \tag{1}$$

Where $Y_{igs}$is the standardised test score of the English as First Additional Language or mathematics test of child i in grade g in school s. These standardised test scores are from the ANA tests written by grade 3, 4 and 5 children in 2012. Since our model includes children in grades 4, 5 and 6, we include grade fixed effects G_g to control for the differences in performance between grades. The impact of exposure to English instruction is estimated by including T_{igs}, an indicator variable equal to the number of years for which the child received instruction in English during their foundation phase (i.e. when they were attending grades 1, 2 and 3). This variable takes on the values 0, 1, 2 or 3. In the model, we also control for individual child characteristics by the inclusion of X_i, a vector of individual child covariates, while Z_s is a vector of school characteristics. The model also allows for unobserved school characteristics υ_s and ε_{igs} is the remaining random error component.

The estimation of these effects using simple OLS however has the distinct disadvantage that it does not control for school quality (and other school-level) unobservables υ_s that might be correlated with both the decision of schools to adopt a specific language policy T_{igs} as well as the outcomes of the children in the school Y_{igs}. Not controlling for these unobserved school-level characteristics will bias the estimates of the exposure to English, given the large variations in the quality of schools within South Africa as well as the fact that we observe certain quality differences being correlated with the language choices that schools make.[8] In principle, we would suspect this selection bias to result in an over-estimation of the impact of English language exposure. More specifically, if we believe the anecdotal evidence referred to earlier as well as the descriptive statistics set out in the previous section, we would suspect school quality and exposure to English as language of instruction to be positively correlated. Omitting to control for school quality would therefore lead to a positive bias in the OLS estimates.

[8] As set out in the previous section, schools that switched to English instruction are typically richer (in a higher quintile) and more likely to charge higher school fees. In addition, these are the schools where class sizes typically increased over the period. The descriptive empirical evidence therefore seems to bear out the perception present within the South African school system that schools that teach in English are better quality schools.

In order to control for (unobserved) school quality and eliminate this type of selection bias, we also adopt a school fixed effects approach. Including school fixed effects in the regression controls for the quality differences in South African schools and ensures that our estimates are not suffering from selection bias inherent in the South African school system. Our second estimation strategy therefore involves the following model:

$$Y_{igs} = \alpha + G_g + \beta T_{igs} + \delta' \mathbf{X_i} + \tau'_{\mathbf{s}} \mathbf{S_s} + \lambda' \mathbf{P_{gs}} + \upsilon_s + \varepsilon_{igs} \tag{2}$$

Where S_s now represents the school fixed effects. The variation in our variable of interest, T, now comes from the differences in the exposure to English as language of instruction present within each of the schools. Since this variation arises because some schools selected to change their language policy during the period 2007 to 2011, the estimation of β comes only from schools where there was indeed a switch in the language of instruction during the period 2007-2011[9].

Although the time invariant unobserved school-level characteristics are now controlled for by including the school fixed effects, there might still be time varying school characteristics which may bias our estimates. One would expect these to be attributes of the school that change over time and are correlated with both the performance of the children as well as the decision to adopt a certain language policy. These attributes would most likely be school quality characteristics such as changes in management. To limit the potentially confounding influence of these covariates, we include a vector of class-level characteristics (varying over time within the school) in the vector P_{gs}.

After interpreting the results from the pooled fixed effects model, we move on to investigate the heterogeneity in the results across different geographic areas as well as over time. The last part of our empirical strategy is to try and ascertain whether our results can be interpreted as being causal or not by conducting several robustness checks. First, we make use of time-variant class-level controls to make sure that our results are not influenced by other changes that occured at the school during the period we are interested in. Thereafter, we conduct further robustness checks to examine whether overall quality changes through a new principal or through improved provincial administration may be driving our observed impact of language of instruction. These will be discussed in further detail in section 6. In this section, our aim is to try and separate out the impact of the change in the language of instruction from other confounding changes that might be correlated with a change in the language of instruction, but are also signals of the changes in school quality.

[9]In other words the years in which all the children in our sample who are now in grade 4, 5 and 6 moved through grades 1, 2 and 3

5 Results

As set out in section 4, the first model we estimate is the OLS model set out in equation (1). The results from this regression are reported in table 4. These results seem to confirm our initial suspicion that, without adequately controlling for school quality, additional years of exposure to English as language of instruction seem to have a positive and significant effect on the performance of children.

The coefficients on the treatment variable seem to indicate that children who are exposed to one year of English instruction in their foundation phase (grades 1 to 3) on average score 0.07 of a standard deviation higher in the English test than children who were exposed to no years of English as instruction language. Similarly, children who were exposed to two years of English as language of instruction during their foundation phase scored on average 0.15 of a standard deviation higher in the English test than children who were exposed to no years of English as instruction language. Last, those children who were instructed in English for the entire duration of their first three grades, scores almost 0.35 of a standard deviation higher in the English test than their counterparts who were not exposed to any English during their first three years of school. These effect sizes are not small, and should be viewed in light of the literature on the impact of education interventions (Hill, Bloom, Black and Lipsey, 2008).[10]

We introduce school fixed effects in our next regression, in which we specify the model in equation (1), but replace the vector of school-level covariates Z_s with school fixed effects S_s. The results from this regression are reported in table 5. The introduction of school-level fixed effects has a large impact on the size and sign of the coefficients on the number of years a child was exposed to English instruction. In fact, we see a reversal of the positive impact of English instruction. Table 5 indicates that, after controlling for individual and school-level characteristics, children who were exposed to three years of English instruction scored on average 0.17 of a standard deviation lower in the English test and 0.02 of a standard deviation lower in the mathematics test11 than children who received Mother Tongue instruction in grades 1, 2 and 3.

To understand the reason for this large reversal in sign, it is useful to think of the introduction of the school fixed effects as variables erroneously omitted from the baseline OLS estimates. Given the evidence introduced in section 3, it is reasonable to assume that there is a positive correlation between school quality and English instruction. Without sufficient controls for school quality, we would therefore expect the coefficients on the indicator variable for English instruction to be over-estimated. Once controls for school quality (in the form of school fixed-effects) are included, the coefficients should therefore be lower than previously in order to correct the bias.

[10] One year of learning is often equated to 0.4 or 0.5 of a standard deviation.

It is interesting to break down the results further in order to try and get a sense of whether the results are heterogeneous across different school types. One way in which to do this is to look at the differences in the results for urban and rural schools. Since there is anecdotal evidence that rural schools are the schools where teachers are less likely to be proficient in English and have the ability to teach in English, we would expect that the coefficients for these schools would be larger, pointing to one of the channels through which the exposure to a language impacts the performance of these children. However, as set out in table 6, the results from running the main fixed effects specification on these two sub-samples seem to indicate no difference between the urban and rural schools. This provides us with some comfort that our results are not driven by the differences in the quality of teachers, but rather provide some indication of the impact of language per se.

6 Robustness checks

In the previous section, we dealt with the most obvious source of endogeneity biasing the results from the baseline OLS regression, namely the unobserved time-invariant school effects that are correlated both with school quality as well as the choice of language of instruction. However, we have not yet considered other factors that might be confounding the results.

One alternative explanation for our results is that we are not in fact estimating the impact of language of instruction but simply the impact of a policy switch. For example, changing the school's language policy could have a positive impact in itself if motivated individuals (teachers or parents, for example) tend to initiate a change in policy and also produce better learning outcomes. Conversely, a change in the language of instruction could have a negative disruptive impact. If this were the case, one would expect opposite signs on the treatment coefficient amongst schools that switched to English and schools that switched to Mother Tongue. Table 7 shows that a negative coefficient is obtained within both sub-samples of schools. Although the coefficient amongst schools switching to English is not statistically significant, there is clearly no evidence that switching in itself always leads to a positive or negative impact on learning.

Apart from the effect of switching, we have also not yet explored the possibility of time-varying school quality indicators which are correlated with the decision of the school to switch its language policy during the period 2007-2011. The difference between the OLS estimates and the fixed effects estimates indicates the need for including controls for unobserved school quality in regressions such as these, especially in situations where there are large differences which are often unobserved between schools. However, the fixed effect approach is limited in that it can only account for time-invariant unobserved differences between schools. If, however, there were changes over time which were correlated with the school's decision to change its language policy

biasing the estimates, the inclusion of fixed effects would not account for this type of bias[11]. The purpose of this section is to expand the baseline fixed effects strategy so as to specifically check the robustness of these estimates when allowing for changes in school quality over time being correlated with the change in the language policy of the school.

We conduct three types of robustness checks in this regard. In the first place, we look at quality measures that differ between classes within the same school. In this regard, we explore the influence of changes in class sizes and school fees from year to year as well as the language composition of children within a single class and how it changes over time. The second type of robustness check we conduct looks at the changes in the principals of the school within the time period we are looking at. Since principals are actively involved in the management of the school, it is possible that a change in principal could result in contemporaneous changes in both the language of instruction and other aspects of school quality. Last, we also look at changes at provincial level in order to ascertain whether these changes potentially caused the switch in the language of instruction at the level of the school while also being the impetus for a change in the quality of teaching at the school.

6.1 Changes in observed measures of school quality over time

The first set of robustness checks we perform are aimed at establishing whether some of the observed measures of school quality available in the data are correlated with the variable of interest. The rationale behind this approach is to ascertain whether there were changes in these observed quality measures (or other measures which would also influence the performance of children) over time in such a way that could bias the results. In other words, if the decision to change the language of instruction in grades 1, 2 and 3 was taken as a result of the change relating to a specific grade from one year to the next (in terms of, for example, class size or the language homogeneity of the children in the class), then what we would be observing in the regressions in the previous section would be caused by changes other than the change in the language of teaching. In addition, these observed changes in the school could also be used as proxies for unobserved changes in school quality. If there is a statistically significant correlation between these observed changes and the number of years of exposure to English as language of instruction, then we would suspect that there might also be unobserved changes in school quality which we are not controlling for and which may be driving the results.

The ASS includes some measures at the level of the class (in other words, time variant grade-level variables) that may be used as measures of school quality. These are class sizes, a measure of language homogeneity within the classroom and the fees charged by the school, as described in

[11] Another way to look at this is to think of this type of bias as resulting in changes between classes within a single school.

section3. We regress these measures on the full set of child-level controls as well as the measure of exposure to English instruction in a fixed effects regression after splitting the sample into schools that switched to and from English instruction. The results from these regressions are set out in table 8.

There seems to be no significant systematic relationship between any of these measures of quality and years of English language exposure.[12] This provides us with some assurance that there are not other changes in quality that are correlated with the decision to change the language policy of the school. However, in order to confirm the robustness of the results, we also include these controls in our main fixed effects specification and report on these results in table 9. It is reassuring to note that the inclusion of these controls does not significantly change any of the results.

6.2 Changes in principals

Next, we explore the possibility that there might have been a change in the management of schools during the period under investigation which is correlated with the change in the language of instruction. Since principals are part of the school governing bodies and usually take the lead in decisions taken by the school governing body,[13] we would expect that a change in principal to also affect the decisions taken by the school governing body. In addition, a change in principal might also act as a proxy for other unobserved quality changes taking place at the school which may influence the language policy of the school.[14]

We accordingly check the robustness of the results against a change in principal in the school during the period 2007-2011. Since the ASS data do not contain detail on whether the same principal remained at the school or not, we have to make use of the mobile number of the principal in order to track him or her over the period. Our assumption is that there was no change in the principal of the school if the mobile number provided by the principal of the school did not change for the 5 years of the ASS panel. However, if the mobile number provided in the dataset did change, we cannot be certain whether this is definitely because the principal changed or whether the principal merely changed his or her number. However, if there are no

[12] One exception is the relationship between language homogeneity in the class, as this there seems to be a significant relationship between the decision to switch to English as language of instruction and the language homogeneity of the class for schools that switched to English. This is intuitive since schools with more heterogeneous classes would probably be more likely to switch to English since there is no single dominant home language within the class.

[13] Especially in the schools in our sample, since parents at these schools are usually not highly educated themselves and often lack the confidence to participate in the decisions taken by the school.

[14] The newly appointed principal might implement other quality enhancing policies alongside the change in the language of instruction.

differences in the results between these two samples, it is more likely that the results are not confounded by other changes in the quality of the school.

Looking at the sub-sample of schools where there was a change in principal, as set out in table 10, it would appear that these schools were somewhat less likely to change their language of instruction than if there was no change in the principal during the time period. However, when we repeat the main fixed effects regression using the two sub-samples, we find that the results hold in both sub-samples. In fact, the treatment effect is slightly larger amongst schools where there was no change in the principal, thus suggesting that our estimated impact of language of instruction is not being driven by simultaneous changes in the quality of school management.[15]

6.3 Changes in provincial language policy directives

Last, we investigate whether the change in language policy was caused by some provincial level directive which might have been part of a provincial level improvement in administrative support. For this we decompose the proportion of grade 1 children in the sample who attend a school where English is the language of instruction by province. Figure 4 illustrates how this proportion has changed per province of the period of interest between 2004 and 2011. Some provinces had clear shifts toward English (such as the Free State province), while others (such as the Eastern Cape and Gauteng) had clear shifts toward home language instruction.

If we believe these shifts to be correlated with a change in the provincial policy regarding language of instruction which was communicated to schools and we further believe that such a change was accompanied by additional learning materials and other improvements in the general quality of schools, it is possible that the results from the baseline estimates are merely reflecting a broader change in quality rather than the language policy of the school.

In order to test this hypothesis, we repeat the fixed effects regression on three sub-samples. First, we estimate the impact on the sub-sample of schools who complied with the dominant trend in their specific province over the period, first for schools switching to English and then for schools switching to Mother Tongue.[16] We then repeat the estimations on the sub-sample of schools that defied the general trend of the province in that they switched in the opposite direction to the general trend in the province.

Here we find a significant advantage for the schools that complied with the general trend of switching to home language, but no such advantage for the schools that switched to English.

[15] Again, this is the case for English but the results for mathematics are not as clear.

[16] In other words, if the dominant trend of the province was to switch to English, this would include only schools that actually switched from home language to English during the period under consideration and *vice versa* for home language.

This might be because the switch to home language was as a result of a provincial move in that direction which was accompanied by various other initiatives aimed at improving school quality (for example, additional teacher assistance and learning material). However, there are two reasons why this is unlikely to have been the case. In the first place, the largest province in this sample of compliers is the Eastern Cape, in which the quality of provincial education administration is widely thought to have been consistently weak and even deteriorating over the period.[17] Second, for mathematics, there is no significant difference between the results for the compliers and non-compliers, which seems to indicate that general quality improvements at the provincial level were not driving the results..

After conducting these robustness checks, we hold that a causal interpretation of our main results is defensible and that the results are not confounded by other changes in school quality.

7 Conclusion

The language in which children are instructed in primary school is one of the most important inputs into the education production function. In many African countries, the predominant indigenous home language spoken by the majority of children is not well-developed for academic purposes, leading to the adoption of English as the language of instruction from an early age. This is also the case in South Africa, where most primary schools use home language education for the first three years and switch to English at the beginning of grade 4, while some primary schools use English as the language of teaching and learning, even though the majority of the children in the school do not speak English as home language. Since children with an African home language perform significantly worse than English home language speakers, one of the questions that is frequently raised is to what extent this language policy contributes to the under-performance of these children.

In this paper, we make use of longitudinal administrative data from the Annual Survey of Schools as well as test scores in English and mathematics from standardised tests from the Annual National Assessment. The OLS estimates show that instruction in English is associated with better performance in the English and the maths tests. However, we find that, after controlling for school fixed effects, receiving Mother Tongue instruction (rather than English instruction) in grades 1, 2 and 3 leads to better English proficiency in grades 4, 5 and 6. This result does not seem to be driven by changes in school quality correlated with the change in language of instruction over this period. This finding is in line with pedagogical theory which promotes the acquisition of a first language before moving on to a second language.

[17] In response to deteriorating provincial governance, the Eastern provincial education department was placed under the administration of the national Department of Basic Education between March 2011 and April 2013.

The results presented here indicate the advantage of additional years of home language education to children in the poorest schools in South Africa. However, although the results are robust to a host of robustness checks, they are also very heterogeneous and so not hold for all schools in South Africa. We therefore believe that they could be used as suggestive evidence that the current language policy, where schools have the autonomy to make their own decisions regarding the language of instruction adopted, is the correct policy.

Several things should be borne in mind when interpreting these findings. This research tells us the *average* impact of language of instruction in South African schools *as things are currently being implemented*. Advocates of both immersion approaches and mother-tongue instruction envisage a carefully thought-through set of instructional practices implemented by high-quality teachers and supported by sufficient materials. However, we estimate the impact of the alternative models as they are being implemented currently, within specific contexts of schools, teachers and homes. Consequently, there may be important impact heterogeneity that we do not pick up. For example, when accompanied by certain materials or when taught by certain teachers, English instruction from grade 1 may be preferable. Therefore, we maintain that the current language in education policy – to encourage the use of Mother Tongue instruction in grades 1, 2 and 3 but to allow schools the final decision – is a suitable approach. Our findings cannot, however, tell us what the impact would be of extending Mother Tongue instruction in grades 4, 5 or 6.

In addition, although our study confirms that the language of instruction is an important contributor to the academic performance of South African children, it is not in our view the main contributor. Factors such as community- and home-level poverty, weak school functionality, weak instructional practices, inadequate teacher subject knowledge, and a need for greater accountability throughout the school system all represent much more severe constraints to achieving better education in South Africa.

The significance of this paper is twofold: Firstly, it demonstrates the value of the school fixed effects model to overcome the bias caused by unobserved differences between schools, something which is particularly relevant in the case of South Africa. Secondly, it is the first South African study (and one of a very few international studies) to bring robust empirical evidence to the policy debate around language of instruction.

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Table 1: Descriptive statistics by treatment intensity

Years of English	0	1	2	3
Proportion of sample	85.77	7.39	3.33	3.51
Total school enrolment	357.32	415.19	393.11	453.38
Percentage Black	99.80	99.79	99.75	98.95
Class Size	38.94	43.80	43.85	43.76
Percentage Quintile 1	39.34	38.63	36.15	24.71
Fees (%>R100)	2.10	2.70	5.85	18.94
Number of children	709 985	61 113	27 574	29 053

Table 2: Descriptive statistics by switching and non-switching schools

	Switch to English	Switch from English	No switch
Language homogeneity	0.83	0.91	0.91
Total school enrolment	470.62	377.62	355.19
Class size	43.71	42.93	38.75
School fees (%>R100)	3.54	3.51	2.69
Number of schools	545 (5.94%)	1 311 (14.28%)	7 324 (79.78%)

Table 3: Selected descriptive characteristics for switching schools before and after the switch

Description	Sub-sample	Pre-switch		Post-switch	
		Mean	Standard Error	Mean	Standard Error
Proportion black enrolment	All switchers	0.997	0.000	0.998	0.000
	To English	0.996	0.001	0.997	0.001
	From English	0.997	0.001	0.998	0.001
Total Enrolment	All switchers	293.079	0.404	280.834	0.405
	To English	345.185	0.733	344.624	0.747
	From English	269.182	0.471	251.578	0.462
Class Size	All switchers	46.560	0.035	40.398	0.031
	To English	44.569	0.047	41.971	0.046
	From English	47.473	0.046	39.676	0.040

Table 4: Baseline OLS Regression

	English	Maths
1 year of English	0.065***	0.042
	(0.019)	(0.026)
2 years of English	0.148***	0.078**
	(0.031)	(0.039)
3 years of English	0.346***	0.122***
	(0.045)	(0.041)
N	827 745	827 745
Number of clusters	9 180	9 180
R-squared	0.054	0.020

Notes: OLS regression including individual controls. Coefficients with standard errors (clustered at school level). * Significant at the 10% level **Significant at the 5% level ***Significant at the 1% level

Table 5: School fixed-effects

	English	Maths
1 year of English	-0.063***	0.005
	(0.018)	(0.021)
2 years of English	-0.081***	-0.006
	(0.030)	(0.033)
3 years of English	-0.170***	-0.024
	(0.045)	(0.046)
N	827 745	827 745
Number of clusters	9 180	9 180
R-squared (overall)	0.039	0.018

Notes: OLS regression including individual controls. Coefficients with standard errors (clustered at school level). * Significant at the 10% level **Significant at the 5% level ***Significant at the 1% level

Table 6: Heterogeneous effects - urban and rural estimates

	Urban sub-sample		**Rural sub-sample**	
	English	Maths	English	Maths
1 year of English	-0.107***	-0.058	-0.054**	0.033
	(0.036)	(0.039)	(0.021)	(0.030)
2 years of English	-0.036	-0.063	-0.139***	0.012
	(0.056)	(0.056)	(0.035)	(0.045)
3 years of English	-0.160**	-0.076	-0.175***	0.046
	(0.074)	(0.081)	(0.059)	(0.060)
N	210 332	210 332	462 774	462 774
Number of clusters	1 794	1 794	6 029	6 029
R-squared (overall)	0.0527	0.0267	0.0296	0.0133

Notes: School fixed effects regression including individual covariates. Coefficients with standard errors (clustered at school level). * Significant at the 10% level **Significant at the 5% level ***Significant at the 1% level

Table 7: Heterogeneous effects - two sub-samples of switching schools

	English		Maths	
	To English	To MT	To English	To MT
1 year of English	-0.079	-0.076**	0.055	0.007
	(0.054)	(0.032)	(0.076)	(0.037)
2 years of English	-0.016	-0.116**	0.057	0.005
	(0.109)	(0.048)	(0.133)	(0.053)
3 years of English	-0.159	-0.193***	0.029	0.016
	(0.152)	(0.070)	(0.197)	(0.077)
N	56 663	113 397	56 663	113 397
Number of clusters	545	1 311	545	1 311
R-squared (overall)	0.059	0.041	0.029	0.015

Notes: School fixed effects regression including individual controls. Coefficients with standard errors (clustered at school level). * Significant at the 10% level **Significant at the 5% level ***Significant at the 1% level

Table 8: School fixed effects models predicting potential indicators of endogeneity (including grade, race, age, gender controls) - (3 years of English versus 0)

Outcome Variable	To HL schools	To English schools
Class size	-1.15	2.90
Language homogeneity	0.006	-0.06*
Log fees	-0.14	-0.35

Notes: School fixed effects regression incuding individual controls. Coefficients with standard errors (clustered at school level). * Significant at the 10% level **Significant at the 5% level ***Significant at the 1% level

Table 9: Fixed effects results with class-level covariates

	English	Maths
1 year of English	-0.068***	-0.019
	(0.023)	(0.025)
2 years of English	-0.092**	-0.032
	(0.037)	(0.040)
3 years of English	-0.190***	-0.036
	(0.053)	(0.056)
N	529 057	529 057
Number of clusters	6 849	6 849
R-squared (overall)	0.045	0.021

Notes: School fixed effects regression including individual and class-level covariates. Coefficients with standard errors (clustered at school level). * Significant at the 10% level **Significant at the 5% level ***Significant at the 1% level

Table 10: Likelihood of switching language of instruction by principal changes

	Change in principal	No change in principal	Total
Switched to English	7.64%	6.06%	6.85%
Switched away from English	13.94%	13.64%	13.70%
No Switch	78.42%	80.48%	79.46%
Total	100%	100%	100%

Table 11: Main treatment effects for schools with a possible principal change and schools with no principal change

	English	Maths
No change in principal	-0.197***	0.023
	(0.066)	(0.067)
Change in principal	-0.149**	-0.076
	(0.024)	(0.063)

Notes: Effect is for 3 years of English compared to 0 years of English. School fixed effects regression coefficients with standard errors (clustered at school level). * Significant at the 10% level **Significant at the 5% level ***Significant at the 1% level

Table 12: Compliance (English test score only)

	Non-Compliers	Compliers to HL	Compliers to English
1 year of English	-0.014	-0.092**	0.071
	(0.025)	(0.039)	(0.093)
2 years of English	0.079	-0.139**	0.007
	(0.051)	(0.059)	(0.161)
3 years of English	0.074	-0.230***	-0.062
	(0.076)	(0.083)	(0.241)
N	735 423	66 764	25 558
Number of clusters	8 046	903	231
R-squared (overall)	0.0477	0.0489	0.0759

Notes: School fixed effects regression ncluding individual covariates. Coefficients with standard errors (clustered at school level). * Significant at the 10% level **Significant at the 5% level ***Significant at the 1% level

Figure 1: Trends in class size for switching schools and non-switching schools

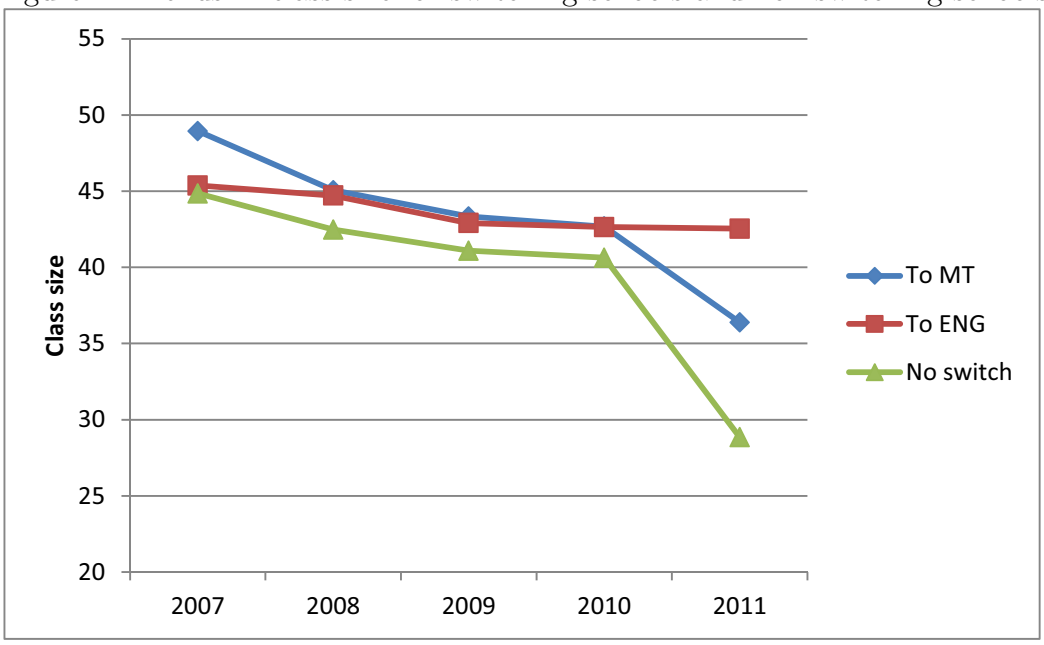


Figure 2: Trends in total enrolments for switching schools and non-switching schools

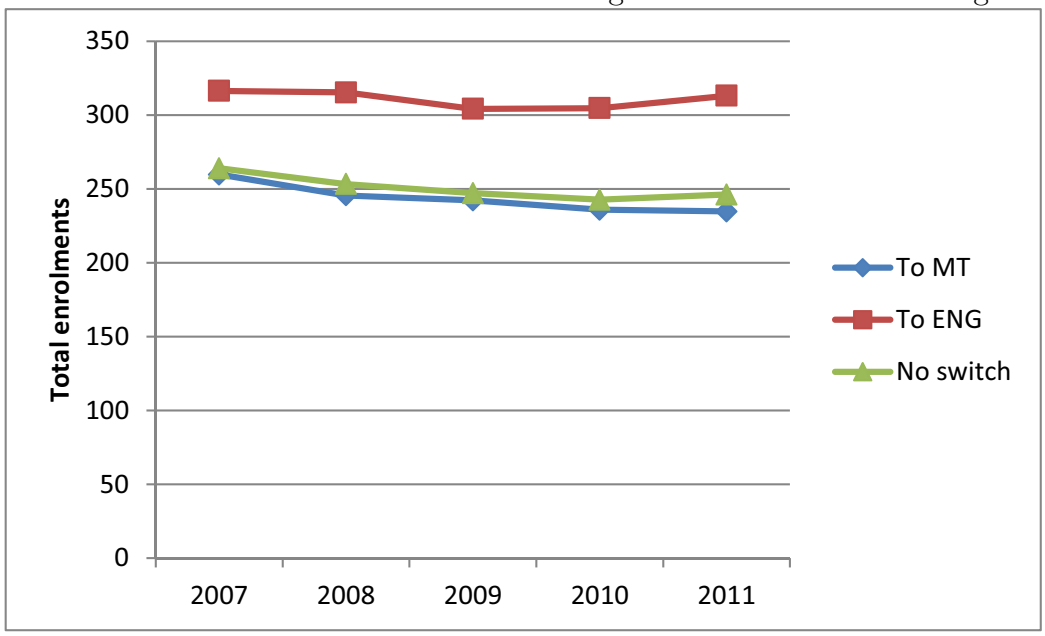
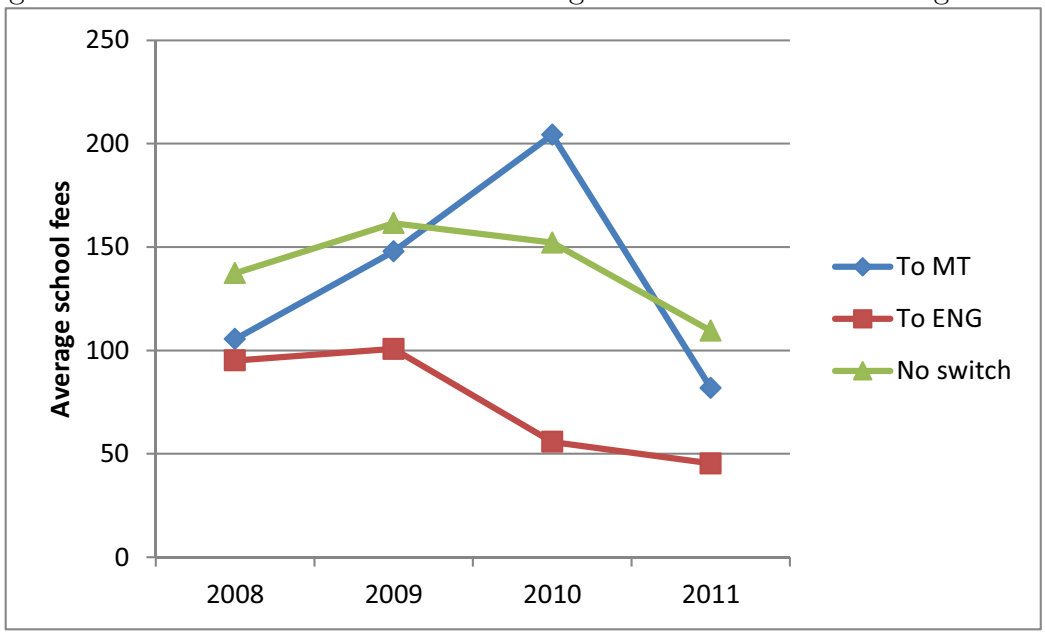


Figure 3: Trends in school fees for switching schools and non-switching schools



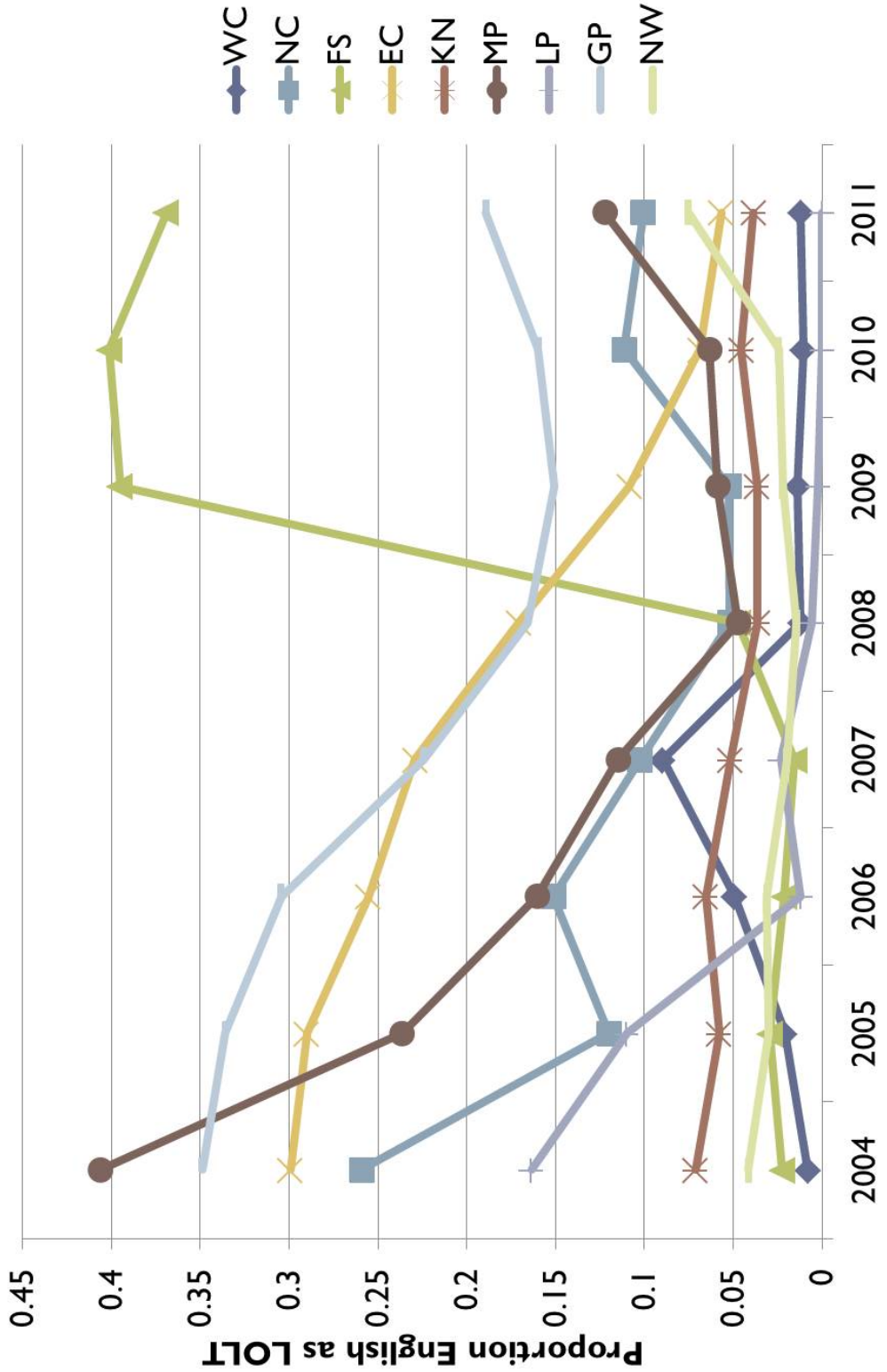


Figure 4: Proportion of grade 1 children (in population) with English as language of learning