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Aiding education? The effect of international aid on local educational enrolment in Nigeria

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Abstract

Education is associated with a range of positive micro and macro effects. It is hence no surprise that donors have recently increased the amount of official development aid specifically focused on restoring and maintaining education in less-developed states. While much attention has been paid to the effect of aid on educational enrolment at the country level, there is a clear knowledge gap at the subnational level. To fill this gap, we examine the impact on educational enrolment of geographical proximity to aid projects by combining individual-level information on education from six Nigerian Demographic and Health Surveys with spatio-temporal data from AidData on the precise location and timing of aid projects in Nigeria for the period 1990–2015. Using quasi-experimental approaches, with difference-in-differences estimates using information on active and inactive aid locations, we control for a vast number of unobserved factors that might otherwise be spuriously correlated with both education and aid. The results suggest that geographical proximity to active aid projects at school-starting age increases the probability that an individual will enrol in school, at both primary and secondary levels. The effect of aid on school enrolment is particularly pronounced for individuals from less-wealthy backgrounds. We also find evidence for a clear selection effect: aid disproportionately reaches areas with higher enrolment rates in the first place. Our findings have important implications for understanding the link between conflict, aid, and educational disruption and could have important consequences for the future spending of donors.

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1 Introduction

Promoting children's access to education is one of the main objectives of the Sustainable Development Goals (notably Goal 4), reaffirming the idea that education is a fundamental human right (INEE 2020). Access to education is critical to long-term improvements in productivity, economic growth, the reduction of intergenerational cycles of poverty, demographic transition, preventative health are, the empowerment of women, and reductions in inequality (e.g., Glewwe and Jacoby 2004; Julius and Bawane 2011; Lewin and Akyeampong 2009). Given these positive effects of schooling, it is not surprising that numerous countries and international organizations have increased the amount of international aid to the education sector:[1] from 2002 to 2018, aid to education increased from US$6 to $15.6 billion, an all-time high (UNESCO 2020).

This in turn has increased policy-makers' and academics' interest in the extent to which aid works. So far, studies examining aid effectiveness[2] have been focused primarily on how aid influences economic growth and other macroeconomic factors, and the results are mixed (e.g., Doucouliagos and Paldam 2009; Mekasha and Tarp 2013; Qian 2015). Recently, however, there have been studies conducted specifically to examine whether aid focused on education has a positive effect on educational outcomes (e.g., Birchler and Michaelowa 2016; Dreher et al. 2008; Michaelowa and Weber 2007). Most of these studies however, have been conducted at the country level. This aggregate level of analysis neglects potential subnational differences in both access to aid and education outcomes, thereby masking local-level effects of aid.

Our study overcomes this issue by examining the effect of aid on educational enrolment at the subnational level in Nigeria, a country with considerable geographical variation in terms of both aid and school enrolment rates (e.g., Fasanya and Onakoya 2012; Østby and Urdal 2014). We argue that international aid might affect educational enrolment in two different ways. First, aid might improve enrolment by strengthening the supply side of education, i.e., restoring and maintaining access to education by providing for the supplying learning materials and furniture and the building and rehabilitating of classrooms. Second, the influx of aid can also improve households' financial situation, thereby positively affecting the demand for education. Empirically, we examine the link between aid and educational enrolment at the subnational level by combining individual-level information on education from Nigeria's Demographic and Health Surveys (DHSs) with spatio-temporal data from AidData (Tierney et al. 2015) on the provision of aid projects in the country. Using quasi-experimental approaches, with both difference-in-differences estimates and fixed effects, we can control for a vast number of unobserved factors that might otherwise be spuriously correlated with both education and aid.

Our approach adds to the existing studies in several important ways. First, we extend the research on the effectiveness of aid by employing a disaggregated approach. In doing so, we take up the recommendations of other scholars, such as Kotsadam et al. (2018) and Turrent (2016), who have argued that we need to move beyond cross-sectional country-level studies and use more spatial and temporal information to examine the impact of aid. Second, this study also adds to those that investigate whether and how exogenous shocks

[1] Humanitarian aid, as well as development aid, falls under this term.

[2] By 'aid effectiveness', we understand the ability of aid to achieve stated development goals in recipient countries relative to resources spent.

to households' income affect educational outcomes. International aid is one such exogenous factor, which is currently ignored by those studying educational outcomes. Lastly, examining the relationship between aid and income is important if we want to say something about the effectiveness of aid from a policy perspective.

Our findings indicate that geographical proximity to active aid projects increases the probability that an individual will enrol in school, at both primary and secondary levels. Furthermore, aid has a stronger effect on enrolment for individuals from less-wealthy households. However, we also find that aid disproportionately reaches areas with higher enrolment rates in the first place, suggesting a clear selection effect.

This article is structured as follows: after briefly reviewing the existing literature on the effectiveness of aid and its linkage with education, we present our theoretical argument based on the framework of supply and demand. In the research design section, we lay the basis of our empirical approach by explaining our data and our methodological approach. After analysing the results, we end with a brief discussion of the results, future avenues of research, and some tentative conclusions.

2 Aid effectiveness and education: a brief overview of the literature

Since the Second World War, international aid has been one of the most prominent policy tools that high-income countries have used to assist low-income countries (Qian 2015: 278). For instance, in 2021 it was estimated that official development assistance (ODA) totalled US$185.9 billion, which amounts to a substantial proportion of revenue for many recipient countries. Given these enormous amounts of transferred resource, it is unsurprising that academics and policy-makers are interested in its effect.

Several meta-analyses have examined the overall effect of aid (e.g., Doucouliagos and Paldam 2009; Mekasha and Tarp 2013; Qian 2015). These studies have shown that there appears to be little consensus within the literature. As Dollar and Pritchet (1998: 2) famously described, foreign aid has been 'highly effective, totally ineffective, and everything in between'. For instance, scholars such as Arndt et al. (2015) and Juselius et al. (2013) show a positive impact of foreign aid on economic growth and various other macro- and microeconomic variables. Alvi and Senbeta (2011) show that aid plays a positive role in reducing poverty. Similarly, Bjørnskov (2010) and Shafiullah (2011) conclude that aid reduces economic inequality. These results stand in sharp contrast to studies showing that foreign aid is rather ineffective or can even have negative consequences (e.g., Easterly 2003, 2006). For example, Boone (1996) finds that aid does not significantly increase investment or benefit the poor as measured by improvements in several human development indicators. This mirrors the results of Herzer and Nunnenkamp (2012) and Chong et al. (2009), who find that aid has no effect in reducing economic inequality and poverty levels. Rajan and Subramanian (2011) even find a negative result: they conclude that aid inflows reduce the relative growth rate of export industries. Other scholars, however, have argued that aid may be effective only under certain conditions, such as a certain level of democracy in the recipient country (e.g., Burnside and Dollar 2000), if state institutions are strong (Kosack 2003), or when aid is outsourced to non-state actors in countries with poor governance (Dietrich 2016).

Most of the above studies have examined the effect of aid on (macro-)economic variables, such as economic growth, investment, or the level of exports. More recently, however, scholars have started to examine its effect on non-economic outcomes, such as education (e.g., Michaelowa 2004). While the magnitude and significance of the effect vary substantially between different studies, a tentative consensus about the positive effect of aid

on education is emerging (Birchler and Michaelowa 2016). For instance, Michaelowa and Weber (2007) analyse the effect of global aid on education over 25 years in 129 countries. They find that a 1 per cent increase in aid to education leads to an increase in the primary completion rate of more than two percentage points. Notwithstanding this, they show that under conditions of poor governance, the impact of education aid on school enrolment turns out to be negative. In a similar study, Dreher et al. (2008) show that higher per capita aid for education increases country-level primary school enrolment rates to some extent. Likewise, D'Aiglepierre and Wagner (2013) find a positive effect. They use data on aid commitment over the period 1999–2007 and find that aid to primary education is positively related to school enrolment rate and gender parity. They also find that children in countries that receive aid are less likely to repeat school years. In a more recent study, Birchler and Michaelowa (2016) examine the effect of education aid on primary enrolment and education quality using macro data from 110 countries. They find that an increase in education aid substantially improves enrolment, and that the most robust effect is obtained through aid for education facilities and training. Wolf (2007), however, concludes that although aid might have increased school enrolment in Africa, it has not sufficiently translated into higher completion rates. Riddell and Niño-Zarazúa (2016) add to this conclusion that while aid has a tangible impact in terms of expanding school enrolment, especially in primary education, aid projects have insufficiently focused on education quality (Riddell and Niño-Zarazúa 2016).

Despite the increasing knowledge of how aid might affect educational outcomes, the above studies suffer from some crucial drawbacks. First, most studies have used information on educational outcomes and international aid at the country level. The use of such country-level data neglects potentially important geographical variation. This is especially an issue given that many aid projects are not randomly distributed across recipient countries or throughout a given recipient country, and consequently, not every individual in a recipient country is likely to benefit from aid. We also know that education is often very unevenly distributed within countries. Nigeria is a textbook example of such sharp spatial inequalities (e.g., Østby and Urdal 2014). A country-level analysis may therefore mask a potential relationship between aid and education at the local level. Second, as indicated already by Wolf (2007), most studies on the link between aid and education have focused on examining its effect on primary school enrolment, thereby largely neglecting other outcomes, such as secondary school enrolment and school completion (Birchler and Michaelowa 2016). This might be because data on these other educational outcomes are not always available at the country level. To overcome some of these drawbacks, we not only perform a subnational analysis but also consider the effect of local-level aid on both primary and secondary school enrolment.

3 The effect of aid on school enrolment

There is no unified framework for understanding the impact of aid on educational outcomes (Qian 2015). However, we find it useful to structure our argument in line with the framework of supply versus demand in educational services. That is, educational aid might especially influence the supply of educational services, and at the same time, aid in more general terms (whether focused on education or on other sectors) might also affect a household's demand for these services. Although these two sides of the educational equation are not mutually exclusive and are difficult to empirically test separately, they help to structure our proposed mechanisms.

3.1 Supply of education

From the late 1970s onwards, most educational aid has been intended to improve educational outcomes via supply-side policies or so-called 'first-order' educational requirements (e.g., Masino and Niño-Zarazúa 2016; Riddell and Niño-Zarazúa 2016; Yogo 2017). These supply-side interventions are focused on improving physical infrastructure, providing teaching materials, and training and hiring extra teachers. Investment in these different educational infrastructural elements is likely to positively affect the educational enrolment of children living in the area where the aid project is implemented. For example, Colclough et al. (2000) conclude in their study on Guinea and Ethiopia that children who live further away from school are less likely to be enrolled. Building new schools and reducing the travel distance to and from schools, then, might also incentivize parents to send their children to school. In addition, investment in the training of teachers and providing teaching materials might increase the quality of schooling, thereby encouraging parents to send their children to school. For instance, students in high-quality schools are found to stay in education for longer than in low-quality schools (Hanushek and Woessmann 2007); students in schools with more teachers also remain in education for longer (Glick and Sahn 2006). Improving these different infrastructural elements of educational services is thus likely to increase enrolment. Despite this assumed positive effect of educational aid on enrolment, some studies have also suggested that aid can trigger a crowding-out effect (e.g., Cohen 2023). That is, recipient governments might treat aid as a substitute for government funds and may adjust subnational resource allocations across regions and other sectors as a result. This phenomenon might suppress the assumed positive effect to some extent.

3.2 Demand for education

The supply of education services is only one side of the equation (Roberts 2003). Even if schools, teachers, and school supplies are available, households might decide, for a myriad of reasons, not to send their children to school or to withdraw their children. One of the key factors that influence the demand for schooling is household income (Roberts 2003). If aid (whether focused on education or on other sectors) has a positive effect on household income (e.g., Alvi and Senbeta 2011), especially for those living close to aid projects, it might also influence enrolment via the so-called standard income effect, which assumes that a positive income shock—in this case the influx of aid—is likely to lead to more investment in human capital, such as school enrolment (e.g., Basu and Van 1998). Many studies have established this poverty–schooling link (e.g., Bai and Wang 2021; Beegle et al. 2006; Maccini and Yang 2009; Nordman et al. 2022;). For instance, Glewwe and Jacoby (2004) show that increases in Vietnamese household wealth, measured by consumption expenditure, is significantly related to secondary school enrolment. Similarly, Björkman-Nyqvist (2013) shows that rainfall deviations, which negatively affect a household's income level by influencing the available crops that can be harvested, has a significant negative impact on school enrolment in Uganda. Taking this into account, we expect that the geographical proximity of any aid project(s), which increases the likelihood that aid influences a household's income, is associated with an increase in the likelihood of school enrolment for children.

Although we are unable to assess the supply and demand mechanisms separately, we will test the overall effect of aid on educational enrolment, examining the following general hypothesis:

- The geographical proximity of any aid project(s) is associated with an increase in the likelihood of school enrolment for children of school-starting age after the establishment of the project(s), in comparison with children of school-starting age before the establishment of the project(s).

It is important to note, however, that some scholars have emphasized another argument: positive income shocks will potentially crowd out human capital investment (e.g., Gylfason 2001). To be more precise, with the influx of aid as a source of income, a substitution effect might occur: the opportunity costs of children acquiring education significantly increase because employment opportunities become available (Ahlerup et al. 2020; Nordman et al. 2022; Shah and Steinberg 2017). Positive income shocks can then also negatively impact enrolment rates because children are put to work (outside the home, or in domestic chores to free adults to find outside work).

In addition to the existence of a possible contrasting mechanism, it might be that not every household is affected in the same way when aid enters a local area. We think that two economic heterogeneous effects might be of importance. First, the trade-off between enrolling children in school and keeping them out of school might be influenced by a household's initial income (e.g., Emerson and Knabb 2006; Nordman et al. 2022). Second, the decision to enrol children in school might also depend on the type of school and the costs associated with enrolment. Generally, the cost of enrolment in primary school is much lower than that of secondary school: not only are there many more primary schools than secondary schools (and thus there are fewer transportation costs), but tuition fees and other costs are significantly lower for primary school than for secondary school; also, the opportunity costs for older students increase per educational level, since they are more likely to find outside income-generating work the older that they become. Consequently, aid might especially positively affect primary school enrolment.

4 Methodology and data

To examine the relationship between aid and primary and secondary school enrolment at the subnational level, we link individual-level education data from six Nigerian Demographic and Health Surveys (DHSs) with information on the timing and the subnational location of aid projects from AidData (Tierney et al. 2011). Our unit of analysis is the individual: our sample includes all individuals who were of school-starting age (6 years for primary, 12 for secondary) in the period 1990–2015—that is, individuals born between 1984 and 2009 for primary enrolment and between 1978 and 2003 for secondary enrolment.

4.1 Dependent variables: educational enrolment

Our dependent variable, educational enrolment, stems from the DHS. DHSs are nationally representative household-level surveys carried out in many countries around the world at different periods. As such, the surveys offer the cross-sectional and temporal variation necessary to examine how wide-reaching events, such as aid, impact individual and household outcomes. In each household DHS, respondents are interviewed about the health, nutrition, family, and other demographic details, such as education, of each member of the household. Because we are interested in the location of each respondent and their spatial relationship with aid, we use only those DHSs containing GPS co-ordinates.

For this study, we focus on six Nigerian household surveys conducted between 1990 and 2018. During this period, Nigeria received a vast amount of foreign aid (e.g., Fasanya and Onakoya 2012). Moreover, like many Sub-Saharan African countries, Nigeria faces large challenges when it comes to poverty alleviation and has struggled to keep pace with its rapidly growing school-age population and its integration into the educational system (USAID 2022). Nigeria has a 6–3-3–4 educational system: a child is expected to spend six years at primary school starting at the age of six, receives a total of six years of secondary school (three years at junior secondary school level and three years at senior secondary school level), and receives four years of tertiary education (Egugbo and Salami 202l).

Our enrolment measures are based on the DHS variable HV106 ('Highest level of education the household member attended'). This is a standardized variable, which divides the respondent's level of education into several categories: no education, primary, secondary, and higher (USAID 2018a). We code *Primary enrolment* as 1 if an individual was ever enrolled in primary school and 0 otherwise (i.e., no education).[3] Correspondingly, our measure of *Secondary enrolment* is coded as 1 if an individual was ever enrolled in secondary school and 0 otherwise (i.e., no education or only primary education). Among the 254,726 individuals included in our dataset, 72.35 per cent had at least some primary education while 27.65 per cent had never gone to school; 54.13 per cent had at least some secondary education, whereas 45.87 per cent had never enrolled in secondary school.

4.2 Independent variable: aid

To measure the localized effect of aid projects on enrolment, we use data from the USAID-sponsored AidData project (Tierney et al. 2011). This is an open-access database that records spatial and temporal information on bilateral and multilateral aid projects in many countries, Nigeria among them. The data comes from various sources, including the Creditor Reporting System of the Organization for Economic Co-operation and Development (OECD), annual reports and project documents published by donors, web-accessible databases, and data obtained directly from donor agencies. For this study, we use the aid data for Nigeria that was released in April 2016 (Nigeria Aid Information Management System/AIMS Geocoded Research Release, version 1.3.2; Tierney et al. 2011). This release contains information on a total of 376 aid projects covering a total of 1,419 locations. The aid projects focus on different sectors, ranging from agricultural support, health, and education to government/civil society, banking, and infrastructure. Several projects are multi-sector.

To test the localized aspect of aid effectiveness in relation to education, we need two types of information. First, we need information on the starting time of aid projects. For many projects, however, the actual starting year is not recorded. Therefore, we follow the strategy of Kotsadam et al. (2018) and use the planned starting year.[4] Second, we need the location of aid projects as recorded by AidData (Tierney et al. 2011). We include in our sample only projects that correspond to AidData precision coding 3 and below, which defines a project as specific to a local government area. These two restrictions reduce the number of projects that we include in our study to 74. It is important to note, however, that many of these projects are spread across several locations. A total of 633 project locations also fulfil our coding criteria, of which 496 have unique geographical locations. This includes aid projects across all sectors.[5] Table 1 disaggregates the types of projects that are included in our analysis. The earliest project included in the analysis was established in 1990 and the latest in 2014 (see Table A6 in the Appendix for a breakdown of projects and locations by planned start year).

[3] The two enrolment variables are based on DHS variable HV106 (highest educational level).

[4] The correlation between the actual start and planned start dates is as high as .96 for the projects for which we have information on both.

[5] It is important to note that because we focus on evaluating the effectiveness of projects with physical project sites as opposed to projects of a more intangible nature, the projects on which we focus are not necessarily representative of all types of aid given to Nigeria.

Table 1: Overview of included Nigerian aid project types, 1990–2015

Sector	Number of projects	Number of locations	Unique locations
Agriculture	17	95	89
Health	14	50	34
Energy generation and supply	5	20	19
Government and civil society	12	19	13
Women	2	13	13
General budget support	4	7	6
Banking and financing	1	7	7
Water and sanitation	2	3	3
Trade policy and regulations	2	3	3
Education	2	2	2
Admin	2	2	2
Communication	1	1	1
Unspecified	26	450	386
Totals	74	633	496

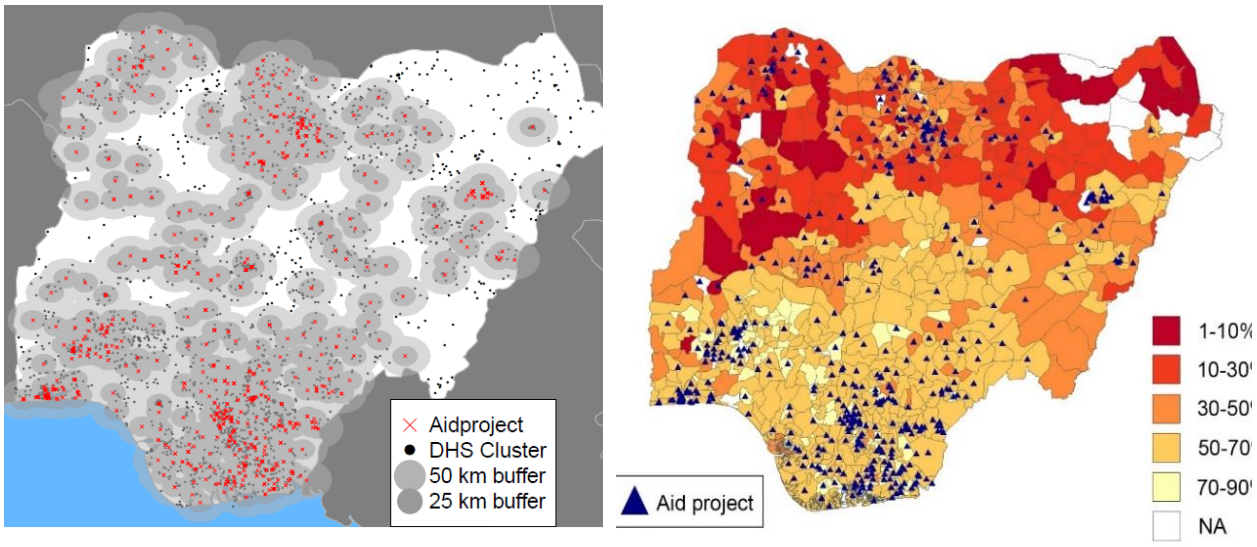
Source: authors' construction based on aid data for Nigeria (Tierney et al. 2011).

Three things are worth mentioning when looking at Table 1. First, the number of projects is higher than the total number of projects included in the analysis because one project can cover more than one sector. Second, the table shows that several projects are unspecified. This means that they did not fit into the pre-specified sector categories used by AidData. These projects cover, among others, sectors, infrastructure, emergency aid, and some unspecified agricultural projects. Lastly, only two projects are focused specifically on education, spanning only two geographical locations (both are in North Central Nigeria). This makes it difficult to examine the specific effect of educational aid (our supply argument). Hence, in our analysis we look at the aggregate effect on education of all types of localized aid (i.e., aid across all sectors). This said, as we have argued in the theoretical section, there are good reasons to believe that aid to other sectors might also positively impact educational outcomes (demand mechanism).

To test the link between aid and educational enrolment, we match the spatio-temporal information of the aid project with that of our DHS household respondents at the time of their assumed school-starting age, which in Nigeria is 6 for primary and 12 for secondary school. That is, we measure whether or not a given individual resided within 50 kilometres' distance of one or more aid projects at the time of their primary and secondary school-starting age. In choosing the 50 km buffer, we follow the conventional standard in literature that examines the impact of local spatial relationships (e.g., Østby et al. 2018).[6] Figure 1 shows the geographical distribution of aid projects, DHS respondents, and primary school enrolment in Nigeria from 1990 to 2015. The left-hand panel of the figure illustrates how the data are structured with 'buffer zones' around aid projects, indicating which DHS clusters are within the relevant distances of the aid projects. The light grey circles around the projects indicate a 50 km buffer zone while the darker circles depict a 25 km buffer zone. The right-hand panel of the figure shows the distribution of aid projects in combination with primary enrolment over the period 1990–2015 (the orange-red colour). It shows that in the Northern region of Nigeria, fewer aid projects are implemented in comparison with other areas and fewer students are enrolled in primary school. This is also one of the most marginalized regions in Nigeria, which is characterized by low enrolment numbers (dark red colours).

[6] In the Appendix, we also examine more local buffers (25 km). The results remain largely robust.

Figure 1: Distribution of aid projects, DHS respondents, and primary enrolment in Nigeria, 1990–2015



Source: left-hand panel adapted from Kotsadam et al. (2018) under a CC BY 4.0 license; right-hand panel authors' illustration based on aid data (Tierney et al. 2011) and education enrolment data from Nigerian DHS surveys.

4.3 Empirical strategy

The data structure in our study allows us to compare educational outcomes across both time and geographical location. Since we know when and where an aid project was established, we can compare the educational enrolment of children at school-starting age before and after the aid project started with that of children living further away from the projects and those who had never seen such a project. To do so, we build upon the spatial-temporal strategies presented in Knutsen et al. (2017), Kotsadam and Tolonen (2016), and Kotsadam et al. (2018) and use a difference-in-differences method.

The model compares the likelihood of enrolling in primary (or secondary) school for individuals who reached the school-starting age of 6 (or 12 in the case of secondary school) before and after the introduction of any aid project(s) in local proximity (within 50 km). More precisely, we construct a dichotomous variable *ActiveAid* measuring whether an individual residing in an area within 50 km of at least one ongoing aid project enrolled at school-starting age (coded as 1, and otherwise 0). Conversely, our variable *InactiveAid* measures whether an individual resided in an area (within 50 km) where at least one aid project would be implemented in the future but had not yet started at the individual's school-starting age (coded as 1 if an aid project was planned but not yet implemented and 0 otherwise). For example, if an aid project started in 2001 in the area where a DHS household member reached the school-starting age of six in the year 2000 (i.e., born in 1994), this individual receives the value of 1 on the *InactiveAid* variable and 0 on the *ActiveAid* variable. However, another individual in the same area who reached school-starting age in 2001 (i.e., born in 1985) receives a value of 1 for the *ActiveAid* variable and 0 for the *InactiveAid* variable. The *ActiveAid* variable includes 69,167 individuals, the *InactiveAid* variable 158,729 individuals, and 26,830 individuals were not related to any aid project at primary school-starting age (i.e., whether implemented or upcoming). For the analysis that follows, we estimate the following baseline linear probability model:

$$Y_{ivt} = \beta_1 \cdot ActiveAid + \beta_2 \cdot InactiveAid + {}^{\lambda_t + \theta_{it}} + \varepsilon_{ivt} \qquad (1)$$

where the outcome Y_{ivt} (enrolment) of an individual i, cluster v, and for the year of school-starting age t is regressed on active and inactive aid projects. This model allows us to compare two differences. First, we can compare the enrolment rates of children residing in active and inactive aid areas with rates in the rest of the country. Comparing enrolment rates only between active areas and the rest of the country would be equivalent to assuming that areas receiving aid and areas not receiving aid are expected to be equal (i.e., that aid is randomly allocated). The comparison between inactive areas and the rest of the country (the first difference) will inform us as to whether aid projects are randomly distributed or whether there is a selection into becoming an aid area. Second, we can also compare the difference between the two differences (the second difference). That is, we compare the difference between active aid areas and the rest of the country with the same difference for inactive aid areas.[7] This strategy purges the selection effect captured by the *InactiveAid* measure, and as such it controls for the potential selection effects. For example, areas receiving aid could be generally poorer and less accessible than the rest of the country, and hence addressing the effect of aid on educational enrolment by comparing the proximate areas of the aid projects with the rest of the country might yield biased results.

The model further includes linear trends in the year of school-starting age λ_t. We include this term to control for the general improvement in education and aid over time.[8] In addition, we control for a time-varying vector, θ_{it}, measuring different individual covariates that might influence enrolment. This factor includes information about birth order, gender, and whether the individual is the child of the household head. According to the 'resource dilution' argument, parents with many children will have less money to spend on each child, and one might expect that the existence of many siblings will reduce a child's chance of entering school (e.g., Kravdal et al. 2013). Relatedly, it has also been suggested that girls have more difficulty than boys in accessing education (UNESCO 2022). Finally, there is evidence in favour of biological children gaining greater access to education (Amoateng et al. 2017). The standard errors are clustered at the level of the DHS sampling units (clusters) to account for the possibility that the observations are not independent within each DHS cluster.

[7] Units with school enrolment age after any aid project had been suspended were removed from the analysis because these units by definition cannot have active or inactive aid.

[8] Figures A1 and A2 in the Appendix show the proportion of secondary enrolment over time and across Nigerian regions.

5 Results

In Table 2, we present the difference-in-differences models of Equation 1, assessing the probability of enrolment for individuals of school-starting age (i.e., 6 for primary and 12 for secondary) in active aid areas—that is, areas with an ongoing aid project. In addition, we show the results for those individuals of school-starting age in inactive aid areas—areas that will get an aid project in the future. The results in Models 1 and 3 show that children living in areas with active aid are statistically more likely to enrol in school (both primary and secondary) compared with children in areas with no aid project (whether aid will arrive in the future or not). However, to account for a possible selection effect of aid, we also include the covariate for inactive aid. If aid project locations were selected at random, there should be no statistically significant difference in school enrolment between children residing in areas that will never receive aid projects (the reference category) and those who were of school-starting age in inactive aid areas (i.e. where the treatment has not yet been implemented). The positive significant coefficients for inactive aid in Models 2 and 4 suggest that aid projects are not primarily reaching those that need it the most, but are established in areas that on average have higher enrolment than the average non-aid location. This supports earlier findings (e.g., Briggs 2017; Kotsadam et al. 2018) that aid is not always reaching those that need it the most. There could be many possible explanations for this selection effect. For example, aid projects may be more likely to be established in urban areas with high population density or more generally in areas with better infrastructure.

Comparing areas with ongoing aid projects (active) with those with future projects (inactive), the positive effect of the former is greater, and the difference is statistically significant. More specifically, we find that for primary enrolment, children who experience active aid at the age of six are 7 per cent more likely to enrol in school than children who reside in areas that have not received any aid yet (Model 2). Compared with the average primary school enrolment rate in the sample (72.4 per cent), the effect of aid corresponds to an overall increase of 9.7 per cent in enrolment.[9] For secondary enrolment, Model 4 in Table 2 shows that the effect is 5.7 per cent percentage points or an overall increase of 10.5 per cent. This indicates that there is a positive effect of aid on children's enrolment, even when taking into account the non-random selection of aid projects. In sum, proximity to aid does indeed seem to improve educational enrolment for both primary and secondary school. All of the models in Table 2 also include a control for gender, a dummy for whether the individual is the child of the household head, household member order fixed effects, and a linear variable of the year of school-starting age for each child, controlling for the general improvement in education over time. As aid increase over time as well, the failure to include such a time variable could result in an overestimation of the effect of aid.

[9] The difference-in-differences score divided by the mean enrolment rate of the sample multiplied by 100.

Table 2: Effects of aid projects on school enrolment

	(1) Primary school	(2) Primary school	(3) Secondary school	(4) Secondary school
Active aid	0.135***	0.333***	0.114***	0.315***
	(14.65)	(15.46)	(12.62)	(17.23)
Inactive aid		0.263***		0.258***
		(12.40)		(14.79)
Constant	21.08***	14.76***	8.476***	3.426**
	(18.07)	(13.43)	(7.89)	(3.27)
Observations	254,695	254,695	212,689	212,689
R-squared	0.027	0.057	0.036	0.058
Mean in sample	0.724	0.724	0.542	0.542
Difference in differences		0.070		0.057
F-test: active-inactive = 0		73.51		43.85
p-value		0.000		0.000

Note: robust standard errors clustered at the DHS cluster level in parentheses; all regressions include fixed effects for birth order, gender, and whether the child is biologically related to the household head; in addition, we control for yearly linear time trend; *** p<0.01, ** p<0.05, * p<0.1.

Source: authors' construction based on aid data for Nigeria (Tierney et al. 2011) and education enrolment data from Nigerian DHS.

5.1 Heterogenous wealth effect

An important conditional factor that might determine a household's decision to enrol their children is their initial economic endowment. Less-wealthy households might have a different incentive structure from those that are better off—that is, household wealth might determine whether they enrol their children (income effect) or delay their enrolment (by increasing the opportunity cost). To examine this possibility, we make use of two different measurements of wealth. First, we separate our sample into different wealth levels. To do so, we rely on the wealth index quintiles given by the DHS, referring to the relative wealth of the household, divided into quintiles from the poorest (code 1) to the richest (code 5).[10] In doing so, we distinguish the 40 per cent poorest, the 20 per cent mid-category, and the 40 per cent richest. Table 3 shows the split-sample results. We find that the positive effect of aid on educational enrolment (for both primary and secondary school) is indeed only present for individuals from the relatively poorest households (cf. the positive and significant difference-in-differences results). In other words, despite the presence of a selection effect in the distribution of aid, our results suggest that aid has the strongest positive effect on education enrolment for those who are less wealthy. For the middle-income household we find no effect of aid on educational enrolment, whereas for the richest household, if anything, we find a negative effect of aid of educational enrolment. (However, note that the enrolment rate is already very high for the richest households, especially for primary enrolment.)

[10] The wealth index (variable HV270) from the DHS is a composite measure of a household's cumulative living standard. The wealth index is calculated using easy-to-use data on a household's ownership of selected assets, such as televisions and bicycles, materials used for housing construction, and types of water access and sanitation facilities. For more details see USAID (2018b).

Table 3: Effects of aid projects on enrolment, by household wealth

	Primary school			Secondary school		
	(1)	(2)	(3)	(4)	(5)	(6)
	Poor	Middle	Rich	Poor	Middle	Rich
Active aid	0.205***	0.110***	0.052**	0.127***	0.084***	0.074***
	(9.23)	(5.06)	(3.17)	(8.21)	(3.72)	(3.48)
Inactive aid	0.161***	0.100***	0.089***	0.100***	0.088***	0.117***
	(7.62)	(4.66)	(5.44)	(7.96)	(4.00)	(5.57)
Constant	11.49***	2.813*	−3.402***	0.00208	−12.34***	−11.23***
	(6.20)	(2.38)	(−3.66)	(0.00)	(−8.52)	(−10.27)
Observations	102,798	53,648	99,376	79,615	43,842	89,269
R-squared	0.044	0.032	0.025	0.060	0.063	0.032
Mean in sample	0.483	0.812	0.924	0.243	0.562	0.797
Difference in differences	0.044	0.01	−0.037	0.027	−0.003	−0.043
F-test: active-inactive = 0	10.16	1.14	57.17	5.97	0.08	36.22
p-value	0.002	0.287	0.000	0.017	0.773	0.000

Note: robust standard errors clustered at the DHS cluster level in parentheses; all regressions include fixed effects for birth order, gender, and whether the child is biologically related to the household head; in addition, we control for yearly linear time trend; *** p<0.01, ** p<0.05, * p<0.1.

Source: authors' construction based on aid data for Nigeria (Tierney et al. 2011) and education enrolment data from Nigerian DHS.

A non-trivial challenge with using the information on household wealth recorded by the DHS at the time of the interview is that this wealth might have changed since the year when an individual reached school-starting age. A good and perhaps more stable alternative proxy for household wealth is the education level of the household head. Education is often related to wealth and is less subject to change since the time of the survey interview. In Table 4, we split our sample between individuals from households where the head received some secondary education or more (i.e., they at least enrolled in secondary school) and individuals from households whose household heads had no secondary education (i.e., they completed primary education or less). Table 4 shows that the effect of local aid on educational enrolment is positive and statistically significant for individuals whose household heads are less educated (Models 1 and 3). In fact, the difference-in-differences coefficient shows that for households where the head enrolled in secondary education, the effect of aid is statistically insignificant for primary education (Model 2) and even has the opposite effect for secondary education (Model 4). This confirms our previous analysis and suggests that aid has a particularly positive effect on less-wealthy households.

In sum, the findings show that aid seems to contribute to reducing inequalities in educational enrolment. The positive effect of aid seems to be strongest for individuals from less-wealthy households. However, we also know that the allocation of aid primarily goes to areas with higher enrolment rates in the first place, so the total effect on inequality is uncertain.

Table 4: Effects of aid projects on school enrolment, by education of household head

	Primary school enrolment		Secondary school enrolment	
	(1)	(2)	(3)	(4)
	Head ≤ primary	Head ≥ secondary	Head ≤ primary	Head ≥ secondary
Active aid	0.347***	0.067***	0.317***	0.135***
	(16.63)	(6.20)	(20.61)	(8.57)
Inactive aid	0.266***	0.0685***	0.188***	0.114***
	(13.17)	(6.69)	(13.08)	(7.63)
Constant	16.94***	7.510***	29.82***	5.094***
	(13.07)	(12.65)	(18.27)	(5.83)
Observations	172,678	79,638	103,843	73,339
R-squared	0.0699	0.0311	0.0971	0.098
Mean in sample	0.629	0.929	0.427	0.836
Difference in differences	0.081	−0.0014	0.129	0.021
F-test: active-inactive = 0	64.10	0.12	161.27	9.68
p-value	0.0000	0.7335	0.0000	0.0019

Note: robust standard errors clustered at the DHS cluster level in parentheses; all regressions include fixed effects for birth order, gender, and whether the child is biologically related to the household head; in addition, we control for yearly linear time trend; *** p<0.01, ** p<0.05, * p<0.

Source: authors' construction based on aid data for Nigeria (Tierney et al. 2011) and education enrolment data from Nigerian DHS.

In sum, the above findings show that aid seems to contribute to reducing inequalities in educational enrolment. The positive effect of aid seems to be strongest for individuals from less-wealthy households. However, we also know that the allocation of aid primarily goes to areas with higher enrolment rates in the first place, so the total effect on inequality is uncertain.

5.2 Robustness checks

To ensure the robustness of our analysis, we conduct several additional analyses. The results can be found in the Appendix. We highlight the most important ones here.

First, when constructing the dataset and calculating the models presented above, we used a buffer of 50 km—that is, whether a respondent resided within 50 kilometres' distance of one or more aid projects at primary or secondary school-starting age. However, one could argue that we should opt for a more realistic walking distance. We hence also test the impact of aid within 25 km of the respondent's residence. The results can be found in Table A1 in the Appendix. The results remain robust: aid is positively associated with enrolment rates, but there is a clear selection effect to be found.

Second, a potential problem that might trouble our inference is migration. In our study, it might be especially likely that less-educated people will move to areas that will receive aid in the future, thereby potentially downplaying the effect of aid on enrolment (e.g., Ahlerup et al. 2020). Although we cannot entirely rule out this possibility, we conduct an additional analysis in which we restrict our sample to individuals who are assumed not to have moved from their present residence since they started school. It is important to note that migration information is not asked for in every survey round, nor is it available for all members of the household because it is included only in the DHS individual interviews and not in the household surveys. However, to approximate whether household members have migrated or not, we connect the household files to individual recode files. In doing so, we assume that if an individual cohabits with a household member who has resided in the same place since the

individual's school-starting age, they have not migrated. The results can be found in Table A2 in the Appendix. The analysis shows that our main results are robust, and if anything a little stronger if we only consider the non-movers.

Third, we measure the effect of initial economic endowments on a household's decision to send their children to school or not by looking at the wealth—as recorded by the DHS—and the level of education of the household. An alternative proxy for initial economic endowments might be urbanization. That is, it might be that the effect of aid is different in urban versus rural areas. To examine this, we split the sample into those households in rural areas and those in urban areas. The results can be found in Table A3 in the Appendix. The analysis shows that aid is more effective in boosting enrolment for children residing in rural areas than for those in urban areas. More specifically, in rural areas, aid leads to an increase of 7.7 percentage points for primary enrolment and 7.0 percentage points for secondary enrolment. This is in line with our expectations and is another indicator that aid might especially affect those in need.

Fourth, a criticism sometimes raised against the use of enrolment is the fact that it does not say anything about whether an individual completed school or not (Wolf 2007). To examine this in more detail, we change the outcome variable to educational attainment, i.e., the total number of years of education an individual has received. Since many of the households in our sample have several younger children at the time of the DHS interview, who by default have not had the chance to accumulate many education years during our observation period, we also restrict the samples to those aged 12 years and above and those aged 18 years and above at DHS interview time. The results can be found in Table A4 in the Appendix. The effect of aid on educational attainment is positive across all the models. When we consider only household members who were 18 years and above at the time of the interview, living in an active aid area actually adds some 1.9 extra years of education, which is quite substantial.

Finally, we put our results to a very strict test by introducing household fixed effects, which allows us to estimate the effect of aid on educational enrolment using only within-household variation. Consequently, all potential confounding factors associated with households are controlled for. It is important to note, however, that by introducing household fixed effects, we reduce our sample significantly, by around 75 per cent. Table A5 in the Appendix shows the results, which only partly confirm our expectations. In the full sample, the results indicate that active aid is associated with lower chances of enrolment than inactive aid. However, additional analysis shows that these unexpected results are due largely to the low number of aid projects initiated in the first decade of observation. If we consider the last 15 years of data (2001–15)—the period during which not only are aid data regularly collected and recorded but also the most aid is delivered—we find a positive effect on enrolment, even when including household fixed effects.

8 Conclusion

Education is a crucial factor for many positive macro and micro developments. Hence, it is not surprising that foreign aid has increasingly been focused on improving the educational sector. Studies examining the effectiveness of aid in improving educational outcomes, such as enrolment, have emphasized a positive correlation, albeit small (e.g., Birchler and Michaelowa 2016; Michaelowa and Weber 2007). One drawback of these studies is that they have examined this relationship on the country level, thereby ignoring the fact that aid is not randomly distributed within and across countries.

To overcome this drawback, we empirically combine six demographic and health household surveys from Nigeria with spatio-temporal information on aid projects from AidData (Tierney et al. 2011). This empirical set-up allows us to compare the effect of aid projects on the enrolment of school-aged children living near these projects with the effect on school-aged children living in areas of aid projects that are not yet established. We theorize two mechanisms. First, aid can improve the educational infrastructure (supply side), thereby positively influencing enrolment rates. Second, aid can improve household income, thereby improving investment in children's education. In addition to examining the existence of this positive aggregate effect, we look at the influence of the initial economic endowment of the household and the difference between primary and secondary school enrolment.

Our analysis shows that aid increases the educational enrolment and attainment of children, despite a selection effect. That is, aid does not necessarily go to the areas with the lowest levels of education. Instead, our results suggest that aid is generally distributed to relatively highly educated areas. However, even when taking the non-random selection of aid projects into account, we find a positive effect of aid on the likelihood that a child will enrol in school. Examining the effect of the initial income of the household, our analysis suggests a clear positive income effect: aid has an especially large effect on poorer households. Children from low-income households are more likely to enrol in school when aid projects are established in their areas.

This study is one of the few that have examined the localized impact of aid. Consequently, there are plentiful avenues for future research, a few of which we mention here. First, our study is focused on one particular educational outcome: enrolment. However, enrolment does not say anything about the quality of education, or educational performance. To examine these questions, more precise subnational information is needed, such as information on individual reading or maths skills. Second, our study is focused on Nigeria, a country that has received a lot of aid and has struggled with growing poverty and a rapidly growing school-age population (e.g., USAID 2022). However, our data for Nigeria show that only 2 out of the 74 locally based aid projects were focused specifically on improving education. As a consequence, we were unable to test the supply-side argument (i.e., that educational aid should improve the education infrastructure and thereby positively influence enrolment rates). Finally, our argument is very much focused on testing the economic incentive structures underlying a household's decision to enrol their children in school. However, this focus ignores to some extent the more social and demographic factors, such as traditions and cultural norms.

Regarding the policy relevance of our results, we would like to emphasize that although our study shows an overall positive effect of aid on educational enrolment, especially for less-wealthy households, our results also reveal a clear and important selection bias. That is, overall aid in Nigeria did not go to the most vulnerable people. Rather, it went to already highly educated areas. One reason for this could be the lack, in many parts of Nigeria, of the reliable infrastructure which is necessary to set up and implement successful aid projects. However, unless aid is given to those that are the most in need, development is hampered, and progress will be slow.

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Appendix

A1 Change of buffers

When constructing the dataset and calculating the models presented in the main analyses, we use a 50 km buffer—that is, whether a respondent resides within 50 kilometres of one or more aid projects at primary or secondary school-starting age. However, one could argue that we should opt for a more realistic walking distance. We hence also assess the impact of aid within 25 km of the respondent's residence. The results can be found in Table A1. Models 1 and 2 depict the results as presented in the main manuscript (with the 50 km buffer), while we use the buffer of 25 km in Models 3 and 4. The results remain robust: aid is positively associated with enrolment rates, but there is a clear selection effect to be found.

Table A1: Effects of aid projects on school enrolment; different distances from aid

	(1)	(2)	(3)	(4)
	Primary school	Secondary school	Primary school	Secondary school
Active aid 50 km	0.333***	0.315***		
	(15.46)	(17.23)		
Inactive aid 50 km	0.263***	0.258***		
	(12.40)	(14.79)		
Active aid 25 km			0.241***	0.252***
			(17.71)	(19.39)
Inactive aid 25 km			0.207***	0.225***
			(15.89)	(19.18)
Constant	14.76***	3.426**	11.00***	0.142
	(13.43)	(3.27)	(10.61)	(0.14)
Observations	254,695	212,689	254,264	212,657
R-squared	0.0566	0.0581	0.0675	0.0754
Mean in sample	0.724	0.542	0.722	0.541
Difference in differences	0.070	0.057	0.034	0.027
F-test: active-inactive = 0	73.51	43.85	17.48	9.22
p-value	0.000	0.000	0.000	0.0024

Note: robust standard errors clustered at the DHS cluster level in parentheses; all regressions include fixed effects for birth order, gender, and whether the child is biologically related to the household head; in addition, we control for yearly linear time trend; *** p<0.01, ** p<0.05, * p<0.1.

Source: authors' construction based on aid data for Nigeria (Tierney et al. 2011) and education enrolment data from Nigerian DHS.

A2 Migration

A potential problem that might trouble our inference is migration. It might be especially likely that less-educated people will move to areas that will receive aid in the future, thereby potentially downplaying the effect of aid on enrolment (e.g., Ahlerup et al. 2020). Although we cannot entirely rule out this possibility, we conduct an additional analysis in which we restrict our sample to individuals who are assumed not to have moved from their present residence since they started school. It is important to note that migration information is not asked for in every survey round, nor is it available for all members of the household because it is included only in the DHS individual interviews and not in the household surveys. However, to approximate whether household members have migrated or not, we connect the household files to individual recode files. In doing so, we assume that if an individual cohabits with a household member who has resided in the same place since the individual's school-starting age, they have not migrated. The results are presented in Table A2. The table shows that our main results are robust, and if anything a little stronger if we consider only the non-movers. Migration, then, also does not affect the results presented in the main paper.

Table A2: Effects of aid projects on school enrolment; restricting sample to non-movers

	(1)	(2)	(3)	(4)
	Primary school	Secondary school	Primary school	Secondary school
	Full sample	Full sample	Non-movers	Non-movers
Active aid	0.333***	0.315***	0.307***	0.300***
	(15.46)	(17.23)	(10.62)	(11.87)
Inactive aid	0.263***	0.258***	0.205***	0.186***
	(12.40)	(14.79)	(7.50)	(8.08)
Constant	14.76***	3.426**	13.03***	−0.130
	(13.43)	(3.27)	(7.76)	(−0.08)
Observations	254,695	212,689	83,388	69,168
R-squared	0.0566	0.0581	0.0534	0.0769
Mean in sample	0.724	0.542	0.719	0.524
Difference in differences	0.070	0.057	0.102	0.114
F-test: active-inactive = 0	73.51	43.85	78.46	84.98
p-value	0.000	0.000	0.000	0.000

Note: robust standard errors clustered at the DHS cluster level in parentheses; all regressions include fixed effects for birth order, gender, and whether the child is biologically related to the household head; in addition, we contro for yearly linear time trend; *** p<0.01, ** p<0.05, * p<0.1.

Source: authors' construction based on AidData for Nigeria (Tierney et al. 2011) and education enrolment data from Nigerian DHS.

A3 Urban/rural effect

In the main paper, we measure the effect of initial economic endowments on a household's decision to send their children to school or not by looking at the wealth—as recorded by the DHS—and the level of education of the household. An alternative proxy for initial economic endowments might be urbanization. That is, it might be that the effect of aid is different in urban versus rural areas. To examine this, we split the sample into those households in rural areas and those in urban areas. The results are presented in Table A3. The analysis shows that aid is more effective in boosting enrolment for children residing in rural areas than for those in urban areas. More specifically, in rural areas, aid leads to an increase of 7.7 percentage points for primary enrolment and 7.0 percentage points for secondary enrolment. As the enrolment rate is lower for secondary school, the positive effect of aid is stronger for secondary than for primary enrolment. When it comes to urban areas, the effect of aid on primary enrolment has the opposite sign but is not statistically significant. For secondary education, the effect of aid in urban areas is negative and statistically significant.

Table A3: Effects of aid projects on school enrolment, rural vs urban location

	(1)	(2)	(3)	(4)
	Primary school	Primary school	Secondary school	Secondary school
	Rural	Urban	Rural	Urban
Active aid	0.314***	0.205***	0.267***	0.222***
	(12.57)	(6.02)	(13.17)	(6.99)
Inactive aid	0.237***	0.211***	0.197***	0.256***
	(9.78)	(6.29)	(10.42)	(8.28)
Constant	16.82***	3.971***	4.611***	-7.058***
	(11.10)	(3.70)	(3.55)	(-5.24)
Observations	163,251	91,444	132,840	79,849
R-squared	0.0545	0.0400	0.0598	0.0400
Mean in sample	0.637	0.879	0.427	0.732
Difference in differences	0.077	−0.006	0.070	−0.034
F-test: active-inactive = 0	47.24	0.82	40.35	10.40
p-value	0.0000	0.3663	0.0000	0.0013

Note: robust standard errors clustered at the DHS cluster level in parentheses; all regressions include fixed effects for birth order, gender, and whether the child is biologically related to the household head; in addition, we contro for yearly linear time trend; *** p<0.01, ** p<0.05, * p<0.1.

Source: authors' construction based on aid data for Nigeria (Tierney et al. 2011) and education enrolment data from Nigerian DHS.

A4 Educational attainment

A criticism sometimes raised against the use of enrolment is the fact that it does not say anything about whether an individual completed school or not (Wolf 2007). To examine this in more detail, we change the outcome variable to educational attainment, i.e., the total number of years of education an individual has received. Since many of the households in our sample have several younger children at the time of the DHS interview, who by default have not had the chance to accumulate many education years during our observation period, we also restrict the samples to those aged 12 years and above and those aged 18 years and above at DHS interview time. The results are presented in Table A4. The effect of aid on educational attainment is positive across all the models. When we consider only household members who were 18 years and above at the time of the interview, living in an active aid area actually adds some 1.9 extra years of education, which is quite substantial.

Table A4: Robustness tests; educational attainment

	(1)	(2)	(3)
	Full sample	12 years and above	18 years and above
Active aid (at age six)	2.286***	3.703***	5.357***
	(15.92)	(17.69)	(20.69)
Inactive aid (at age six)	2.264***	2.937***	3.478***
	(14.78)	(14.54)	(15.05)
Constant	−75.27***	−13.02	−58.36
	(−4.39)	(−0.53)	(−1.94)
Observations	254,693	171,204	98,336
R-squared	0.3386	0.1491	0.1287
Mean in sample	5.135	6.858	7.950
Difference in differences	0.022	0.766	1.879
F-test: active-inactive = 0	0.11	71.19	168.57
p-value	0.7431	0.0000	0.0000

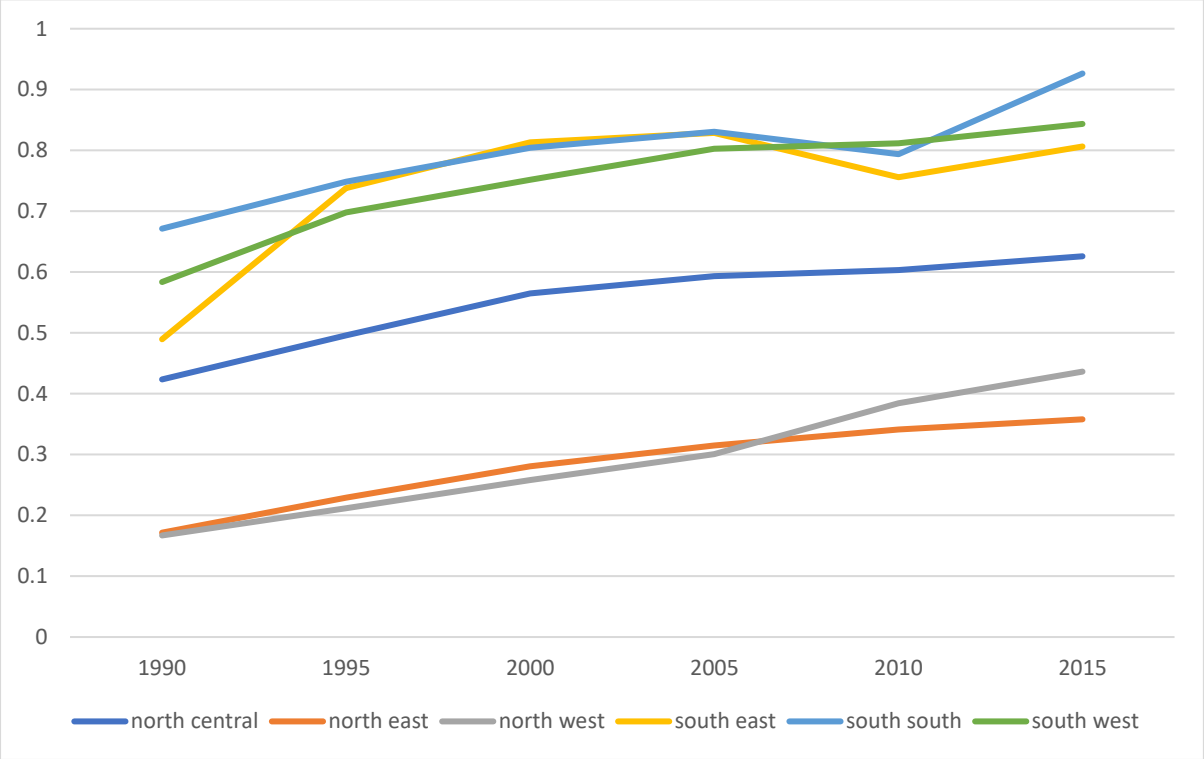
Note: robust standard errors clustered at the DHS cluster level in parentheses; all regressions include fixed effects for birth order, gender, and whether the child is biologically related to the household head; in addition, we control for yearly linear time trend; *** p<0.01, ** p<0.05, * p<0.1.

Source: authors' construction based on aid data for Nigeria (Tierney et al. 2011) and education enrolment data from Nigerian DHS.

A5 Gross enrolment in Nigeria over time per region

In order to gain more insights into the enrolment trends across time and region, in Figure A1 we plot information on secondary enrolment. Unlike primary school enrolment, secondary enrolment varies considerably across time and subnational region. Figure A1 shows that the regional inequalities are systematic and considerable, with enrolment rates being much higher in the southern than the northern regions.

Figure A1: Gross secondary enrolment in Nigeria over time and by region, 1990–2015

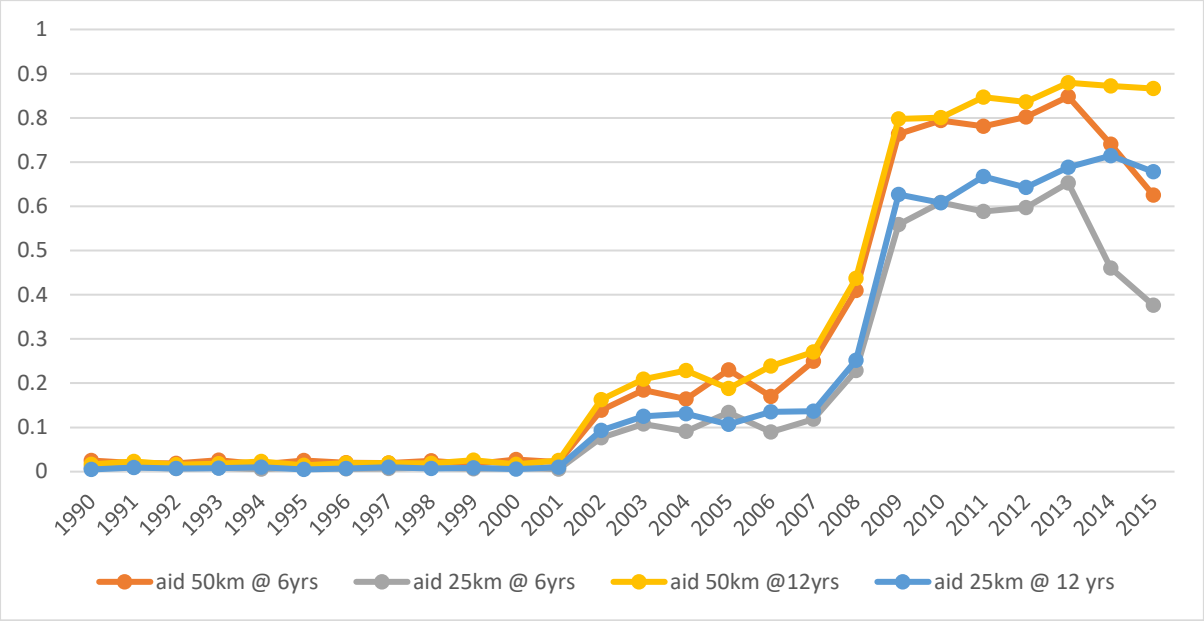


Source: authors' illustration based on six Nigerian DHS surveys.

A6 Share of children living close to aid projects

In Figure A2, one can see the temporal trend with regard to the aid provision. The figure shows the share of children of school-starting age living in geographical proximity (50 km or 25 km) to one or more aid projects by year. The graph suggests that the share of children exposed to local-level aid was very low in the 1990s and then started to increase in 2001 with a steeper increase after 2007.

Figure A2: Share of children living close to aid projects at school-starting age in Nigeria, over time



Source: authors' illustration based on aid data for Nigeria (Tierney et al. 2011).

A7 Household fixed effects

Another alternative robustness test is undertaken by introducing household fixed effects. This allows us to estimate the effect of aid on educational enrolment using only within-household variation. In other words, by including household fixed effects, we ensure that we are comparing the effects of aid on educational enrolment for individuals with as similar conditions as possible, except for aid exposure. Since we are now comparing individuals within the same household before and after aid, we need only to include the active aid coefficient in this specification. It is important to note, however, that in introducing household fixed effects, we use only variation from households with individuals who reach school-starting age both before and after an aid project has started nearby, and thus we have far fewer observations than in the baseline results. While in the baseline regression (in the main paper) there were 254,695 individuals residing in 102,555 households, the result with the household fixed effects are based on only 61,138 individuals residing in 15,582 households, a reduction of more than 75 per cent of our sample.

Table A5 shows the results, which only partly confirm our expectations. In the full sample, the results indicate that active aid is associated with lower chances of enrolment than inactive aid. However, additional analysis shows that these unexpected results are largely due to the low number of aid projects initiated in the first decade of observation (see also Figure A2). If we consider the last 15 years of data (2001–15)—the period during which not only are aid data regularly collected and recorded but also the most aid is delivered, we find a positive effect on enrolment.

Table A5: Household fixed effects

	(1)	(2)	(3)	(4)
	Primary school	Secondary school	Primary school	Secondary school
	Full sample	Full sample	2001–15	2001–15
Active aid	−0.031***	−0.024***	0.003	0.012*
	(−12.16)	(−6.50)	(0.80)	(2.22)
Constant	−1.616**	−7.178***	17.52***	23.53***
	(−2.93)	(−10.00)	(12.57)	(11.40)
Observations	254,695	212,689	155,388	116,400
R-squared	0.7711	0.7693	0.8076	0.8204
Household FE	Yes	Yes	Yes	Yes
Mean in sample	0.724	0.541	0.710	0.558

Note: robust standard errors clustered at the DHS cluster level in parentheses; all regressions include fixed effects for birth order, gender, and whether the child is biologically related to the household head; in addition, we control for yearly linear time trend; *** p<0.01, ** p<0.05, * p<0.1.

Source: authors' construction based on aid data for Nigeria (Tierney et al. 2011) and education enrolment data from Nigerian DHS.

A8 Projects and locations by planned start year

In Table A6, we show the planned start year, the number of aid projects, and the number of project locations of all included projects of our analysis. One can see that the number of projects rises over time, and this is especially noticeable from 2002 onwards.

Table A6: Yearly breakdown of projects and locations

Planned start year	Number of projects	Number of project locations
1990	1	1
2002	1	6
2003	3	15
2004	1	2
2005	1	4
2007	3	18
2008	9	23
2009	14	370
2010	7	49
2011	8	17
2012	15	27
2013	10	92
2014	1	9
Total	74	633

Source: authors' construction based on aid data for Nigeria (Tierney et al. 2011).