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University proximity at teenage years and educational attainment*

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Abstract

This paper investigates the impact of geographical proximity to universities on educational attainment in Nigeria. We relate individuals level of schooling obtained from three rounds of the Nigeria's Living Standard Measurement Survey (LSMS) to spatial distance to university measured by pairing residential and university campuses GPS coordinates. To identify the effect of the distance to university, we exploit the theory of residential sorting to instrument residential proximity to university. Specifically, we instrument distance to university drawing on variations in households' proximity to state boundary posts and neighbourhood population density. The instrumental variable estimates show a negative and significant effect of distance revealing that geographical constraints during teenage years represent a barrier to the subsequent human capital acquisition. Additional results from a difference-in-difference estimation strategy indicate that a large scale establishment of universities had beneficial trickle-down effects by decreasing the intention to drop out of secondary school, supporting evidence of the role of geographical constraints in the accumulation of human capital in Nigeria.

Keywords: Distance to university, educational attainment, university attendance, school dropout, Nigeria.

JEL Codes : I28, O15, I21, J24.

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1 Introduction

Increasing access to tertiary education, in particular university is among the top policy priorities in developing countries (World Bank, 2000). Universities support social and economic development through the production of specific and general human capital (Valero and Van Reenen, 2016; Cantoni and Yuchtman, 2014), which contribute to the process of economic growth (Becker et al., 2011; Baro, 2001). At the country level, the benefits of universities are expected to increase with the population' accessibility to educational infrastructure (Gibbons and Vignoles, 2012; Spiess and Wrohlich, 2010). Therefore, optimising the value of higher education might involve an appropriate spatial placement of the stock of universities and an increase of university capacity in outlying areas (Frenette, 2009). In a number of cases, distance to university has been used as identifying instrument for human capital attainment, anecdotally supporting the claim that it influences educational decisions, at least at the tertiary level (see Carneiro et al., 2011; Kling, 2001; Card, 1993; 2001). However, this pattern is mostly observed in the developed countries that have less limited access to university education and more developed credit market. In contrast, the less developed credit markets in the developing countries implies that individuals mainly rely on personal or family income to fund their tertiary education (Molina and Rivadeneyra, 2021). In addition, developing countries, particularly in Africa, are not well served by universities (Yusuf, 2009). Nigeria provides a typical case study, with approximately one university for every 1.2 million inhabitants, compared to one for every sixty thousand inhabitants in the US (Dahir, 2017; Ejiogu and Sule, 2012). Moreover, Nigeria is currently committed to increasing tertiary education capacity through the construction of more universities (Akpotu and Akpochafo, 2009).

The main objective of the paper is to investigate how distance to university during childhood affects individuals' educational attainment. We use the three first waves of the Living Standard Measurement Survey (LSMS) dataset for Nigeria, which provides information on households' location and individuals' completed years of schooling. We combine this dataset with one we build which provides the historical spatial distribution of universities. In particular, relying on GPS coordinates, we retrieve the shortest straight line distance between the residence of households and university for each individual when they were at the ages of 12 and 18 years. We chose these target ages because they mark the beginning of post basic and tertiary education in Nigeria, respectively (Lincove, 2009).

Our empirical strategy confronts several complexities surrounding the relationship between distance to university and educational attainment. The identification of the causal effect of geographical constraints is plagued by the fact that households and individuals are not randomly

located relative to universities. First, specific to the context, there are disparities between the southern and northern regions in terms of the location of educational infrastructures, mainly due to the consequences of colonial rule. Second, households may consider the provision of tertiary education in a given area when determining where to settle. Unobserved households' characteristics may explain both their location and their educational decisions. For instance, one may argue that parents with high expectations for educational completion are expected to locate in areas with great education supply and to have children with the longest and most successful schooling. Hence, schooling preference are not exogenous to the quantity of university supply. We address this endogeneity issue by adopting an instrumental variable approach drawn from the theory of general equilibrium residential sorting (Tiebout, 1956). Specifically, we use households' distance to border posts and local government area (LGA) population density where households' locate to instrument for households' distance to university. We argue that these two components gather preferences through the aggregation of public goods which renders any specific preference insignificant. The validity of our instruments relies on the assumption that distance to border posts and population density have no direct effect on educational attainment other than through households' proximity to university, conditional on the included control variables. The instrumental variable estimates show a negative effect of distance to university on completed years of schooling. This result is robust when accounting for the potential migration bias. The latter may occur if the individual's current place of residence differs from the area of residence during the teenage years. By considering a sub-samples of individuals that never leave their place of birth and households that headed by individuals aged below 35 years, we show that the migration concern does not represent a serious threat to the validity of our empirical strategy. Lastly, we find no gender-specific impact of geographical constraints on human capital accumulation. We also provide evidence of the existence of a neighborhood effect that may attenuate the impact of geographical constraints.

Next, we take advantage of the large-scale establishment of 12 public universities from 2011 which reduced the distance of certain households to the nearest university, as a result of living in areas close to the newly opened university campuses. In particular, we look at the effect of the creation of new universities on secondary school market. Using a standard difference-in-difference approach, we provide evidence of a positive spin-off effect on student retention in secondary school. We find that the policy leads to a reduction of 2.5 percentage points in the intention to drop-out of secondary school for those who live near to new universities (e.g. individuals' located in the 25 km radius). We show that our estimates are not explained by the presence of differential pre-trends in education levels. We also provide suggestive evidence that

the results are not driven by our definition of treatment and control groups.

This paper contributes to the literature on education economics in the following aspects. The first is the literature that deals with how geographical distance to schools affects human capital acquisition (Afoakwah and Koomson, 2021; Lavy, 1996; Frenette, 2009; Spiess and Wrohlich, 2010; Gibbons and Vignoles, 2012; Falch et al., 2013; among others). Nevertheless, most studies relate proximity to specific categories of schools to participation in the corresponding level of education (e.g distance to university and participation in university education), whereas the presence of universities may generate trickle down effects. For instance, the establishment of universities may spur participation in primary and secondary education, instead of solely in the tertiary level (Jagnani and Khanna, 2020). Therefore, we focus on completed years of schooling, without any restriction on which level takes advantage of the proximity to the university. We contribute to this literature by using the GPS coordinates of the villages where the households reside to construct a measure of the distance to the nearest university. Second, this paper fits within the emerging literature on the so-called trickle down effects of universities that argues that proximity to higher education institutions affects lower levels of schooling (Jagnani and Khanna (2020)).

This paper is laid out as follows. Section 2 describes the Nigerian context. Section 3 presents the empirical framework for the first part of the paper that explores the effect of university proximity on completed schooling. The empirical results follow in Section 4. Section 5 presents the analyses relating to the effects of the new universities on current schooling. Finally, Section 6 concludes.

2 The Nigerian educational system and development

Due to colonial ties, Nigeria's formal education took off with administrative structures modelled after the British system of education, and consists of primary, secondary, and tertiary levels. However, starting from 2004, the system has been adjusted to now encompass the levels of basic, post-basic or senior secondary and tertiary education (Feda et al., 2015). According to the latest national policy on education, the basic level of education comprising six years of elementary and three years of junior secondary education is now compulsory (FRN, 2013). The senior secondary and tertiary levels are not compulsory. The tertiary level comprises the university and non-university sectors, where the later encompasses the polytechnics, monotechnics and colleges of education, which offer opportunities for undergraduate, graduate and vocational and technical education. Since after Nigeria implemented the Structural Adjustment Programme (SAP) in 1986, there have been deficiencies in the educational sector, ranging from low participation

at the basic level to severe capacity constraint at the tertiary level (Obasi, 1997). According to the 2010 World Development Indicators (WDI), Nigeria's elementary school enrolment rate at 64 percent still falls short of the global average of 89 percent. Furthermore, one quarter of this enrolled population is expected to dropout of school before reaching the final grade of their current (Uwaifo, 2010). The state of the basic level of education naturally reflects the health of the entire educational system, in the case of Nigeria, it shows up through overall poor educational attainment and widespread illiteracy, especially among the young people. As at 2015, Nigeria's youth and adult literacy rates of 72.8 and 59.6 percent were substantially below the global average of 90.6 and 85.3 percent, respectively (World Bank, WDI, 2016). The entrenched regional disparities masked by these national level statistics paint even more dire pictures. For instance, in 2010, whereas one in four youths could not read or write in the southern region, the ratio was three in four for the Northern region (Favara et al., 2015). At the tertiary level, deficient capacity remain a significant constraint. Despite the fact that the ongoing university expansion generally increased admission capacity by almost 20 percent between 2010 and 2015, data from the Joint Admissions and Matriculation Board (JAMB) shows that up to 70 percent of admission requests were rejected due to lack of capacity in 2015 alone. In fact, the average acceptance rate for admission requests made in the decade preceding 2015 is below 20%. The admission market is highly competitive and relies on the quality of precedent basic school qualifications and a general selection examination. The competition is politically determined to be unfair to applicants from the northern region because precedent qualifications are generally poorer than in other regions (Lebeau and Oanda, 2020; Oyebade and Keshinro, 2007). With this disparities in mind, the national higher education policy was redesigned to promote the policy of admitting undergraduate students on the basis of catchment areas, rather than purely on the basis of competition (Adeyemi, 2001).[1]

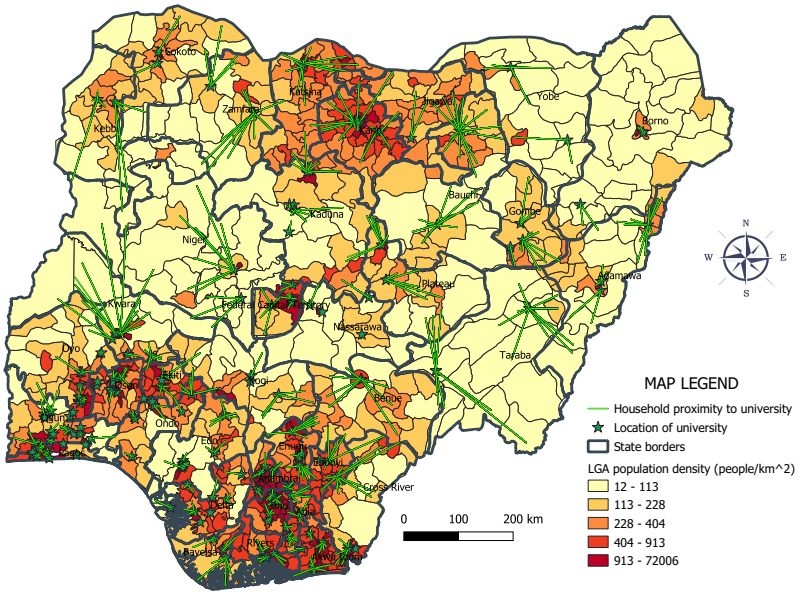
In part, the regional differences in access to education originated from the colonial period via the roles of the colonial administrators and the christian missionaries through whom formal education was introduced in Nigeria (Okoye and Pongou, 2014; Okoye, 2021). As part of its divide and rule policy, the colonial administration had made the missionaries to confine education activities and the associated infrastructures to the southern region because the administrators fear that education might disrupt the northern region's culture of conservatism and allegiance to the colonial government (Mustapha, 1986; Duan, 2000). This singular act brought about a long lasting trend of educational polarisation subsisting until today, whereby the northern region lags behind the rest of the country in educational achievement. However, since decolonisation,

[1]The catchment policy assigns fixed number of admissions (quota) to each state, where the catchment states of each university is defined by adhoc proximity to the university (Isumonah and Egwaikhide, 2013).

there have been national policies aimed at tackling this imbalance along with improving the general level of education nationally. Most of these policies have focused on the construction of more schools at various levels (Moja, 2000; Uwaifo, 2010; Osili and Long, 2008). In particular, since 1962, the Nigerian National Universities Commission (NUC) was established to manage the establishment of universities, and to ensure political equity through their geographical distribution (NUC, 1993).[2] The NUC sets conditionalities for the location of new universities, including recommending the range of proximity to urban centres, road networks, and other local amenities. Due to urban biased development, these standards are more likely to be fulfilled in the urban areas, thereby leading universities to concentrate within or near urbanised cities. This is demonstrated in Figure 1 which indicates that universities are generally closer to households living in densely populated LGAs, typically the urban areas. It might therefore be safe to say that the NUC conditionalities drive universities to be established near areas of high residential concentration - this is the pattern we would like to exploit in our empirical strategy to be discussed in the next section.

[2]From the time of Nigeria's independence in 1960, only the the central (federal) government is allowed by legislation to establish and run universities (designated as "unity schools", now the federal universities). Driven by the perceived inadequacy of the federal universities, the legislation was amended since 1972, and states that could afford it, began as well to establish and run universities (designated as the state universities). In 1999, the tertiary education system was fully deregulated, thereby allowing private universities to operate. However, up until the time of writing, most students seek admission into the federal universities because they are better funded by the federal government, and tend to have higher capacity for student admission compared to the state and private universities. In addition, government subsidies are available for students attending federal or state universities, especially the federal, whereas, students attending the private universities have to pay full costs of their tuition.

Figure 1: LGA population density and proximity to university



Data source : LSMS, NUC and Authors

3 Empirical approach

3.1 Data

In this paper, we use different data sources for the empirical analyses. The data acquisition heavily draws on the geographical information system (GIS), particularly the geographical point references provided by the various data sources. The main data source is the Nigerian Living Standard Measurement Surveys (LSMS). Collected by the Nigerian National Bureau of Statistics and the World Bank, the LSMS is a nationally representative panel dataset that provides detailed information on demographic and household characteristics, including GIS references of the location of the villages where the households settle.[3] We pooled data from the three waves of the panel, conducted in 2010/2011, 2012/2013, and 2015/2016. The three rounds include tracked questions on education and other individual characteristics of household members. However, the reported education attainment is categorised based on the standard Nigerian award of certificates. We converted the certificates reported for each individual to the number of years required to complete that level of education based on the Nigerian education system described in Section 2. Since we are interested in completed schooling, our sample comprises only individuals aged above 25 years during the last survey wave in which they appeared. The resulting pooled cross-section contains individual and household characteristics, including the completed years of

[3]The LSMS team applies a set of random offsets to the GIS points of the households residence to preserve their confidentiality, while indicating their approximate location within the primary sampling areas (NBS, 2012)

schooling and household location GIS points. The latter provides the basis for matching with the similarly geo-coded university location. We obtain the list of all the universities existing in Nigeria from the NUC, consisting of federal, state and private universities. There have been four major batches of universities creation as Table 10 shows. Using the establishment date of each university, we are able to match each individual in the survey sample to the university existing at every relevant point in time. This enables us to measure individual proximity to university since 1948, the date of creation of the first university.

3.2 Empirical specification

To quantify the effect of distance on completed years of schooling, we conceptualize individuals' educational attainment as determined by both supply and demand side factors. Specifically, we model educational attainment as a function of distance to university (measured at ages 12 and 18) and a number of demand-side variables at individual and household levels. Therefore, our main regression model is as follows:

$$Schooling_{ihlk} = \alpha + \beta.Dist^{a}_{hlk} + \sigma.X_{ih} + \theta_k + \varepsilon_{ihlk} \tag{1}$$

where $Schooling_{ihlk}$ is the number of years of education completed by individual i from household h living in LGA l and belonging to a cohort k, where cohort is defined at age a (12 and 18 years). We consider the ages of 12 and 18 as they constitute the end of primary and secondary schooling and therefore represent critical stages in the process of human capital accumulation. The variable of interest $Dist^{a}_{hlk}$ is the log distance of household h to the nearest university. X_{ih} is a vector of current individual and household characteristics. These include : individual's age and gender, household's distance to secondary school[4], household's sector of residence (urban vs rural) and average parental education[5]. We also include average village-level completed years of schooling to control for the potential neighborhood effect. The model also incorporates birth cohort fixed effects to account for unobserved factors specific to particular age cohort. Specifically, this may capture particular developments in the educational system that may have affected particular cohorts. Lastly, ε_{ihvs} is the error term clustered at the household-level to allow for abitrary correlation within households.

[4]This measure corresponds to the current distance of households from secondary schools. It would be better to compute this distance at ages of 12 and 18, but we do not have detailed information on secondary schools in Nigeria. Nevertheless, it is noteworthy that the establishment of secondary schools in Nigeria has not been substantial over the past few decades. From this perspective, taking the current distance to secondary schools may be a suitable measurement.

[5]We define it as the average number of years of father's and mother's schooling.

In the model, distance to university is expected to be endogenous due to selection issues. We address this problem by adopting an instrumental variable strategy. Hence, our identification strategy relies on variations in households' proximity to state boundary posts and neighbourhood (LGA) population density, while conditioning on relevant controls and fixed effects. The justification for these instruments is provided in the next subsection. The first stage equation is specified below:

$$Dist^{a}_{hlk} = \alpha + \lambda_1.Distborder_h + \lambda_2.Popdens_l + \sigma.X_{ih} + \theta_k + \varepsilon_{hlk} \tag{2}$$

where $Distborder_h$ and $Popdens_l$ represent logs of current household h distance to the nearest state boundary post and the population density of the LGA l, respectively. We use the population figures of the 1991 population census for the administrative units existing before 1991 and the figures of the 2006 census for the ones created or adjusted after 1991. The coefficient λ_1 and λ_2 measure the relevance of our instruments for distance to university. All other variables are defined as in Eq. 1. The vector X_{ih} includes individual and household characteristics and θ_k denotes the birth cohort fixed effects. Lastly, ε_{hlk} is the error term.

3.3 Identification Issues

If there are no systematic biases, Eq. 1 can estimate the causal relationship of our interest. However, given our reliance on pooled cross-sectional data, we are not able to rule out the existence of potential unobserved confounders. In particular, on the one hand, we acknowledge that households of superior preference for education may systematically sort into residency of localities in the neighbourhoods of the existing universities (see Gingrich and Ansell, 2014). On the other hand, it is plausible to argue that universities are not randomly distributed across locations, as the siting of educational facilities may be driven by political preferences. Addressing theses issues is the major motivation for our instrumental variables approach. We follow similar strategy as Falch et al., (2013), who exploited instrumental variables derived from household residential patterns. In our case, we rely on the theory of "Tiebout sorting" (Tiebout, 1956) - which contends that households would reveal their public goods preferences by sorting into neighbourhoods of varying public goods and taxation packages. The theory has been tested in different contexts and has inspired a large body of literature confirming its validity under strict assumptions (Rhode and Strumpf, 2003; Bayer et al., 2004; Martin and Webster, 2020). The standard Tiebout theory predicts uniformity in the public goods preferences of residents in the same neighbourhood, conditional on income (Gramlich and Rubinfeld, 1982). Contrary to this, preference mixing is often found in the urban sector where there are abundant varieties of public goods. Degrees of within-neighbourhood mixing denotes the extent of nonconformity to

the theory (Bayer and McMillan, 2012). Outlines of the major indicators of the nonconformity may be found in a number of studies (see; Bayer et al., 2007; Bayer and McMillan, 2012). These include the clustering of local amenities, a range of distinct neighbourhood attributes, including varieties of housing characteristics and the overall convenience of the geographical location in relation to access to jobs and other essential services.

Based on the general equilibrium theory of residential sorting, we chose a set of instruments that are likely to optimise the varieties of the attributes influencing the household residential choices. These include neighbourhood (LGA) population density and household's distance to the nearest state border post. The population density increases the capacity to provide public goods through taxation and exploits the non-rivalry property of public goods to deliver savings on costs (Boserup, 1981; Salmon and Tanguy, 2016; Grogan and Sadanand, 2013). As a result, abundant varieties of local amenities and development infrastructures are expected in more densely populated areas. However, population density alone may not be able to attract certain kinds of public goods. In particular, strategic infrastructures such as universities may additionally require a central location in terms of not being situated in the borders of the administrative regions(Asher et al., 2018; Lee, 2018). We exploit this complementarity by overidentifying the model with population density at the LGA level and the distance to the border posts of administrative states. The validity of these instruments derives from the assumption that they gather preferences through the aggregation of public goods while rendering any specific preference insignificant.

The residential sorting theory anchors on understanding the administrative level at which the public goods are provided. Thus, the administration of Nigeria is managed under three administrative levels; the central (federal), 37 states, and 774 LGAs. The functions of each level is provided under the principles of fiscal federalism in the Nigerian constitution (Ekpo, 1994). Although the LGA is the administrative level closest to the population, it has no meaningful power of public goods provision. Most of the infrastructures and amenities found in the LGAs are provided by the state, and in some cases by the federal government (Feda et al., 2015; Alm and Boex, 2020).[6] It is important to stress the overriding influence of the state in the location of infrastructures because only then can the state be expected to steer residential sorting in the manner discussed above. In particular, by taking population density and peripheral locations into consideration. For instance, Figure 1 shows that the universities tends to be located closer to densely populated LGAs, and within LGAs not located at the state borders.

One possible concern with our identification strategy is that households' proximity to state

[6]While the federal and state governments may each establish and manage universities, but in all cases, the state influences the location in terms of LGAs.

border posts and population density at the LGA level might be correlated with a range of unobserved factors affecting individuals' educational attainment. However, we attempt to reduce the influence of the unobservables by including the village-level average completed years of schooling, households' distance to secondary school and parental education in the model.

3.4 Descriptive evidence

Before moving to the empirical estimates, we first provide descriptive evidence of estimation sample. Table 1 summarises the main variables of the sample which consists of 16,581 individuals aged over 25 years[7]. The average number of years of schooling is slightly higher than 6 suggesting that most individuals in our sample did not go to university. Therefore, the effect we measure is at lower level of schooling. The sample is gender balanced (48% female) and average age is about 39 years. Moreover, most of the individuals live in rural areas (68%). For our variable of interest, individuals' average distance to university is about 128 km when measured at age 12, while slightly more than 97 when taken at age 18.

Table 1: Descriptive Statistics

Variable	Mean	Std. dev.	Min	Max
Years of schooling	6.28	5.61	0	20
Distance to univeristy at 12 y.o	128.31	134.73	1.24	1007.29
Distance to univeristy at 18 y.o	97.07	105.04	0.44	960.57
Individual is a female	0.48	0.50	0	1
Individual's age	39.15	13.71	25	86
Urban	0.32	0.46	0	1
Parental education	0.04	0.52	0	12.50

4 Findings

4.1 Main estimates

We present the main estimates in this section. In general, the results indicate that geographical distance constrains educational attainment, irrespective of the age at which it was measured. Table 2, columns 1 and 3 report the first stage estimates specified in Eq. 2, whereas columns 2 and 4 report the second stage estimates specified in specified in Eq. 1. The instruments

[7]While we have 16,581 individuals, the number of observations is usually reduced in the regressions due to the availability of the covariates included.

appear to be strong predictors of proximity to university. The standard F-statistics for the test of joint significance of our IVs are 44.05 and 31.12, respectively. The F-statistics provide additional evidence of the strength of our instruments based on the "larger than 10" rule of thumb (Staiger and Stock, 1997). We also took the advantage of having over-identified the model, to additionally test the validity of the instruments using the Sargan over-identification test. With p-values higher than 5% (0.316 and 0.216), we fail to reject the validity of our instruments. From the main model with full controls and fixed effects, we can infer that one 1% increase in the distance to university is associated with 0.05 years reduction of schooling when distance is measured at the age of 12, and 0.06 years when measured at 18 years[8]. These estimates agree with the inference of previous studies (Falch et al., 2013 ; Kobus et al., 2015 ; Tigre et al., 2017 ; among others), to the extent that geographical constraints discourages schooling.

Table 2: Main estimates - The impact of distance to university on years of schooling

	(1)	(2)	(3)	(4)
	At 12 years		At 18 years	
VARIABLES	Dist. Univ	Yrs of Schooling	Dist. Univ	Yrs of Schooling
Dist. Univ		-5.423***		-6.520***
		(0.562)		(0.810)
Dist. Border	-0.176***		-0.119***	
	(0.0225)		(0.0247)	
LGA pop. Density	-0.0555***		-0.0642***	
	(0.0105)		(0.0104)	
Controls	Yes	Yes	Yes	Yes
Birth Cohort FE	Yes	Yes	Yes	Yes
Observations	14,797	14,749	14,889	14,841
F-test	44.05		31.12	
Sargan statistic p-value	0.316		0.216	

Robust standard errors in parentheses, clustered at the household level.

*** p<0.01, ** p<0.05, * p<0.1

[8]A comparison of the IV and OLS estimates suggests that the OLS underestimates the negative effects of distance to university. The OLS estimates are available upon request.

4.2 Heterogeneity analysis

In this section, we explore the distribution of the negative effects of distance to university estimated in the previous section with respect to household and individual characteristics . In Table 3, we explore the gender differences in the impact of distance to university on individuals' completed years of schooling. The estimates indicate that there is no gender-specific impact of geographical constraints on human capital accumulation in Nigeria. That said, decreasing geographic barriers will result in greater human capital for both girls and boys.

We also test the hypothesis of "neighborhood effect" or "information network effect", which highlights that education attainment of peers in the neighbourhood pushes individuals and parents to higher human capital demand (Patacchini and Zenou, 2011). The neighbourhood effect is most operative at adolescence (Agostinelli et al., 2020; Do, 2004 ; Spiess and Wrohlich, 2010). We empirically test the "the neighborhood effect" hypothesis by interacting proximity to university with the LGA educational attainment dummy[9]. The estimates provided in Table 4 reveal evidence of a neighbourhood effect. That is, the fact of living in a community or village that have higher level of schooling mitigates the adverse effects of distant university. .

Table 3: Heterogeneity : The impact of distance to university on years of schooling by gender

	(1)	(2)	(3)	(4)
	Years of schooling			
	At 12 years		At 18 years	
VARIABLES	Male	Female	Male	Female
Dist. Univ	-4.787***	-6.088***	-6.123***	-6.415***
	(0.610)	(0.767)	(0.921)	(0.994)
Controls	Yes	Yes	Yes	Yes
Birth Cohort FE	Yes	Yes	Yes	Yes
Observations	7,642	7,107	7,710	7,131

Robust standard errors in parentheses, clustered at the household-level.

*** p<0.01, ** p<0.05, * p<0.1

[9]The dummy is constructed on the median basis. It is equal to 1 for individuals belonging to LGAs with an education level above the median and 0 otherwise.

Table 4: Heterogeneity : The impact of distance to university on years of schooling by accounting for the neighborhood effect

	(1)	(2)
	At 12 years	At 18 years
VARIABLES	Years of Schooling	
Dist. Univ	-0.675***	-0.682***
	(0.0750)	(0.0754)
Dist. Univ x LGA schooling	0.393***	0.334***
	(0.108)	(0.105)
Controls	Yes	Yes
Birth Cohort FE	Yes	Yes
Chi2 test for joint significance	89.65***	96.53***
Observations	14,749	14,841

Robust standard errors in parentheses, clustered at the household level.
*** p<0.01, ** p<0.05, * p<0.1

4.3 Addressing potential migration bias

We measured household proximity to university by spatially matching permanent location of universities to the current location of households, thereby invariably assuming that the sample had maintained permanent residential location since commencement of schooling. In this context where urban - rural migration is rampant (Lall et al., 2006), this is a strong assumption. Ideally, we would measure the proximity to university from the location where each individual started and completed schooling, or at least from the place of birth which would approximate the residential location at the time of schooling. Unfortunately, the fact that the LSMS reports only the current location of households and their members lets labour migration threaten our estimates. Furthermore, given that the location of most of the universities is approximately urban - where job prospects are higher, the strength of this mechanism could drive us to find negative effects of distance to university, even if none truly exists. Therefore, we undertake the following steps to rule out the effects of this mechanism:

First, we drop households that are headed by individuals aged below 35 years, because such households are most likely formed by individuals who recently completed schooling, and thus have higher probability to have changed residential location. This maneuver reduced the number

of observations, but there is no significant change in the estimated effect of distance to university compared to the full sample estimates (see Table 5 columns 1-2).

Second, following Cannonier and Mocan (2018), we repeat the estimations on a unique non-movers sub-sample of the LSMS - those providing answers to questions relating to cultures and institutions of the communities (LSMS enumeration areas). Prior to answering the community questions, the individuals were asked how many years they have lived in the community, so our sample of non-movers comprises those living in the community from birth, defined as those whose residence duration in the community is equal to their age. There is one caveat with respect to estimations on this sample. In fact, since we cannot match the non-movers sample to households, only individual and LGA controls are available for the estimation.[10] The estimates reported in Table 5 (columns 3-4) remain similar to the baseline ones.

Table 5: Alternative subsamples

	(1)	(2)	(3)	(4)
	HH head aged more than 35		Non-movers	
VARIABLES	At 12 years	At 18 years	At 12 years	At 18 years
Dist. Univ	-3.448***	-4.297***	-4.616***	-4.338***
	(0.846)	(1.212)	(0.770)	(0.682)
Controls	Yes	Yes	Yes	Yes
Birth Cohort FE	Yes	Yes	Yes	Yes
Observations	8,554	8,604	8,047	7,974

Robust standard errors in parentheses, clustered at the household level.

*** p<0.01, ** p<0.05, * p<0.1

5 New universities

So far, we found that the distance to university to which individuals are subjected at different critical ages acts as a deterrent to human capital accumulation. This section attempts to extend the analysis to current schooling and concentrates on the newly created federal universities in 12 states during 2011-2013 period.[11] More precisely, we would exploit episode of massive roll-out of public universities in Nigeria, specifically targeting states that previously had only

[10] Household controls such as parents' education are unavoidably omitted.

[11] In Table 10 in the Appendix, we provide a comprehensive list of federal universities in Nigeria.

indirect access to the federal university system. Typically, the federal government intervenes in the provision of education to balance access among the states (Isumonah and Egwaikhide, 2013).[12] We aim to examine how the latest intervention affects schooling the secondary school market. In particular, we investigate the effect of the establishment of universities affect pupils' secondary school drop-out intention. From an economic point of view, the initial rational behind the positive indirect effects of university establishment on pupils' secondary schooling relates to financial matters, the so-called "transaction cost effect". There is also what is described as the "neighbourhood effect" or "information network effect", which explains the benefits of the establishment of a university on the secondary local education market. Young people, surrounded by a university environment, can grow up to consider a post-secondary education as a natural goal, thus enhancing their school achievement (Do, 2004).

For the empirical framework, given that universities are not randomly assigned across hosting states, we step down the analysis to sub-state levels using proximity to university to identify the individuals that received the most - least - impact from the establishment of new universities. We define treatment as living within buffers of 25km radius around the universities. [13] The panel dimension of the data allows us to estimate a difference-in-differences (DiD) design whereby we compare changes over time of the school drop-out intention between the treatment and control groups. In particular, the estimation outcome is a dummy variable that represents whether an individual attending secondary school in time t intends to discontinue in $t+1$ ($Dropout$).[14] There are two estimation periods for the drop-out intention variable as it was collected only in the first and second waves of the LSMS survey. In existing literature on university enrollment, a number of direct and indirect factors have been highlighted (Molina and Rivadeneyra, 2021; Bahrs and Siedler, 2019; Spiess and Wrohlich, 2010). As part of this paper, we estimate the effect of the establishment of universities on secondary school market. Explicitly, at the secondary school level, students are forward-looking and include information about their next expected level of schooling into their subsisting human capital plans, choosing effort level (Oreopoulos and Dunn, 2013). For instance, introducing or increasing university fees affects enrollment behavior by lowering the intention of secondary school students to attend university (Bahrs and Siedler, 2019; Hübner, 2012). Thus, the benefits of completing secondary school may reduce if the intention to attend university decreases[15], and we claim that the latter depends on costs,

[12] Balance is usually determined by the number of similar institutions already existing, Adeyemi, 2001

[13] We follow the treatment definition provided by Molina and Rivadeneyra (2021).

[14] At 52 and 48 percent for boys and girls, incidence of secondary school drop-out is a major problem in Nigeria (NBS, 2020; Oyelere, 2008)

[15] This is mainly because students at this level wish to continue onto professional levels which depends on performance at current level (see Simon et al (2014))

notably distance to university, and the chance of being admitted to university.

The empirical approach used in this paper is to exploit the introduction of federal universities in some Nigerian states. The analysis is at the individual level. Our difference-in-differences strategy assumes that the drop-out intention variable $Dropout_{iht} \in \{0, 1\}$ of an individual i can be written as :

$$Dropout_{iht} = \alpha + \beta_1 NewUniv25km_h + \beta_2 Post_t + \beta_3 NewUniv25km_h \times Post_t + \Gamma X_{it} + \Theta Z_{ht} + \sigma_s + \epsilon_{iht} \quad (3)$$

Subscripts i and h denote individuals and households, respectively. The dependent variable, $Dropout_{iht}$ denotes the secondary school drop-out intention of individual i from household h. It is important to note that assignment to treatment or control group is based on the place of residence of individuals at the time of the establishment of the new universities. The variables, $NewUniv25km_h$ and $Post_t$ capture individuals living within 25 km to any of the new universities and the dummy for the post new universities establishment period, respectively. The effect of interest is captured by the coefficient β_3 that represents the average treatment effect on the treated. It enable us to infer the counter-factual schooling outcome amongst individuals in the treated states. As the establishment of universities diminishes the marginal costs of education, we expect this coefficient to be negative. If this is the case, it indicates that the establishment of universities will improve the entire educational system, and in particular the secondary schooling stage. The estimation of Eq.(3) allows us to compare secondary school drop-out intentions across treated and untreated households' subsequent to the introduction of a federal university. X_{it} denotes the vector of individual including pupils' gender and age. Z_{ht} represent the vector of households characteristics that consits of household expenditures and the current distance of households from the main road, market, administrative center and population center. We include state fixed effects σ_s, to account for any state observed and unobserved time-invariant characteristics. Lastly, ϵ_{iht} represents the stochastic error term.

Data and raw differences

As in the main analysis, we rely on the first two waves - 2010/2011 and 2012/2013 - of the Nigerian Living Standard Measurement Survey (LSMS). The pre-treatment period ($t = 0$) corresponds to the first wave of 2010/2011 as universities have not yet been introduced in the twelve states concerned. Whereas, the second wave of 2012/2013 refers to the post-treatment ($t = 1$) period when universities have already been established.

Our sample consists of students in secondary school. The dependent variable equals to 0 if the individual yes to the question: *"Do you plan to attend school next year ?*, and 1 otherwise.

In Table 6, we provide descriptive evidence of the effect of the university creation on university attendance and secondary school drop-out intention. We split individuals according to their proximity to the new universities :"near university (treated)" includes individuals living within 25KM radius of the newly created universities, and "Far from university (controls)" covers those living beyond the 25KM radius. The "near university" group accounts for about 17.83% (2.247 obs.) of the total observations. The raw statistics in Table 6 indicate that the intervention led to a reduction in the intention to drop-out of secondary school in the two groups. The reduction is greater in the treatment group than in the control one, which provides a first insight into the positive effect of the introduction of universities on the lower level of schooling.

Table 6: Raw Differences

Drop-out Intention			
	Near university (treated)	Not near university (controls)	Diff
After ($t = 1$)	0.034	0.036	-0.002
Before ($t = 0$)	0.086	0.061	0.025***
Raw DiD			-0.027***

* p<0,10, **p<0,05 , ***p<0,01

Findings

As the results discussed in the first part of this paper emphasize the importance of geographical constraints in human capital accumulation by increasing the marginal costs of education, it is relevant to grasp a potential mechanism that may be at work in lower levels of schooling. In Table 7, we report estimates relating to the intention to dropout of secondary school. The DiD estimation finds 2.5 percentage points reduction in the intention to drop out of secondary school, attributed to the establishment of a new university. The results show that beyond the obvious monetary impact (transaction cost explanation) of a new university on local population, there is also a neighborhood effect (or information network effect). When a new university is formed, it provides strong incentives for individuals to continue education. One may argue that secondary students who live very close to a university have lower information costs when seeking information on the decision to participate in higher education.

Table 7: DiD estimates : The effect of new university on secondary school drop-out intention

	(1)	(2)	(3)	(4)
VARIABLES	Drop-out intention			
NewUniv [0, 25 kms] × Post	-0.0265***	-0.0257**	-0.0258**	-0.0245**
	(0.0103)	(0.0102)	(0.0102)	(0.0101)
Constant	0.0617***	0.235***	0.281***	0.284***
	(0.00302)	(0.0163)	(0.0189)	(0.0199)
Observations	12,605	12,603	12,603	12,603
R-squared	0.005	0.022	0.023	0.025
Individual Controls	No	Yes	Yes	Yes
HH controls	No	Yes	Yes	Yes
Distance variables	No	No	Yes	Yes
State FE	No	No	No	Yes

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Additional diagnoses of the DiD estimates

This subsection aims to provide various robustness checks to the estimates previously discussed on the effect of the introduction of new universities on secondary school drop-out intention. First, the validity of the difference-in-differences strategy relies on the common trend assumption. The key identifying assumption here is that the trend of the secondary school drop-out intention would have been the same for treatment and control groups in the absence of treatment (i.e. university establishment). Ideally, the parallel trend assumption can be investigated exploiting data on multiple periods (at least two data periods prior to university introduction), but we do not have this in the present case. Indeed, we provide a partial test of the common trend hypothesis by specifying a model that examine the effect of a placebo treatment on the outcome. More particularly, we regress the outcome prior to the introduction of the new universities on the "future" treatment dummy. Following Senne (2014) and Havnes and Mogstad (2011), we specify the model as follows:

$$Dropout_{ih,2010} = \alpha + \sigma NewUniv25_{2011} + \gamma X_{ih,2010} + \epsilon_{ih,2010} \quad (4)$$

Eq. 4 relates the secondary school drop-out intention in 2010 to a dummy $NewUniv25_{2011}$ that indicates living within 25 km of the location where any of the new universities would be

established in 2011 or 2013 as the case may be. The regressions equally condition on the previous controls. The estimates are presented in Table 8, and indicate that there is no statistically significant difference between the two groups prior to treatment, for secondary school drop-out intention.

Next, we revisit the composition of our sample. In fact, as already discussed, the selection of states where the universities are sited is known to depend on level of educational development, which we did not fully observe. The definition of the treatment based on physical distance and not state political borders is therefore based on the assumption that the localisation within a state may be quasi-random, conditional on the NUC localisation criteria. However, the free use of the physical distance runs into the risk of extending the groups (particularly the control group) beyond states administrative boundaries, which might then include samples from states that might be at dis-similar level of educational development and other characteristics. To ensure that this is not the case, we restrict the sample to the intervention states only. The idea is to neutralise the catchment policy given that catchment is equally distributed within state and all hosting states are expected to offer the same catchment advantage (see Adeyemi (2001)). Thus, the restricted sample removes those residing in states other than the hosting states, thereby isolating the pure effect of proximity by guaranteeing catchment advantage to all individuals in the sample. In other words, apart from helping to disentangle the effects of the catchment policy and proximity to university, the strategy also helped to reduce potential bias that may arise from comparing dissimilar groups. The estimates from the restricted sample are displayed in Table 9. Similar to the main estimates, the results highlight significant negative effect on the intention to drop-out of secondary school. In this case, one may argue that the entire increase in admission might be attributed to proximity and none to the fact that the treatment group was unduly favoured in admissions through the catchment policy.

Table 8: Test of parallel trend assumption

	(1)
VARIABLES	Drop-out intention
NewUniv [0,25 Kms] × Post (t+1)	0.116
	(0.171)
Constant	0.410**
	(0.173)
Observations	6,426
R-squared	0.059
Individual Controls	Yes
HH controls	Yes
Distance variables	Yes

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 9: DiD estimates : Restricted sample

	(1)
VARIABLES	Drop-out intention
NewUniv [0,25 Kms] x Post	-0.0316**
	(0.0153)
Constant	0.168***
	(0.0372)
Observations	4,440
Individual Controls	Yes
HH controls	Yes
Distance variables	Yes
State FE	Yes

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

6 Conclusion and policy implications

The question of enhancing human capital in developing countries has been attracting concerns from policy-makers and development stakeholders. while inadequate quantity of institutions of higher learning remains a significant constraint, most of the countries have constructed large number of higher education institutions in recent times. Nevertheless, not much is known about the nature of the spatial distribution and whether such constitute a dimension of the constraints. This study trails this question, focusing on one of the most populous countries of the world, and one of the most under-served higher education markets. In two related parts, the paper interrogates the relationship between geographical distance and the chain of schooling. The first part estimates completed schooling as a function of distance experienced at the time of schooling, and finds unambiguous negative effect of distance on completed schooling. The second part exploits recent mass creation of universities and the associated dramatic increase in proximity to university. Using difference-in-differences strategy, it finds that the intervention led to a reduction in the intention to drop out of secondary school.

The article has a number of policy implications. In a geographically large country like Nigeria, while university agglomeration may attract substantial external economies, it necessarily affects equality of access and impedes overall human capital accumulation. This calls attention to spatial distribution in higher education access policies. In lower levels of education, this is already a standard, but it does not apply to higher education because it was considered an elite good. If the developing countries would be able to compete in the present knowledge economy, they must universally expand access to higher learning and create abundance of the skills in demand for the twenty-first century global economy. Some of these countries still prioritize basic education, neglecting expansion of higher learning. However, this paper also demonstrate possible synergy between both. It shows in line with few other studies that access to higher education institutions may enhance the quality of basic schooling, in this case, by discouraging dropout from secondary schools.

7 Appendix

Table 10: Locations and establishment dates of the universities

State	LGA	City	Established
	1st generation		
Oyo	Ibadan North	Ibadan	1948
Enugu	Nsukka	Nsukka	1960
Kaduna	Zaria	Zaria	1962
Osun	Ife Central	Ile Ife	1962
Lagos	Lagos Island	Lagos	1962
Edo	Oredo	Benin City	1970
	2nd generation		
Kano	Kano	Kano	1975
Cross River	Calabar Municipal	Calabar	1975
Kwara	Ilorin	Ilorin	1975
Plateau	Jos North	Jos	1975
Borno	Maiduguri	Maiduguri	1975
Rivers	Port Harcourt	Port Harcourt	1975
Sokoto	Sokoto North	Sokoto	1975
	3rd generation		
Imo	Owerri Municipal	Owerri	1980
Ondo	Akure South	Akura	1981
Adamawa	Yola	Yola	1981
Niger	Chanchaga	Minna	1982
Bauchi	Bauchi	Bauchi	1988
Federal Capital Territory	Abaji	Abuja	1988
Ogun	Abeokuta	Abeokuta	1988
Benue	Makurdi	Makurdi	1988
Akwa-Ibom	Uruan	Uyo	1991
Abia	Umuahia North	Umudike	1992
Anambra	Awka South	Awka	1992
	4thgeneration		
Jigawa	Dutse	Dutse	2011
Katsina	Dutsin-Ma	Dutsin-Ma	2011
Gombe	Gombe	Gombe	2011
Nasarawa	Lafia	Lafia	2011
Kogi	Lokoja	Lokoja	2011
Ebonyi	Ikwo	Ikwo	2011
Bayelsa	Ogbia	Ogbia	2011
Ekiti	Oye	Oye-Ekiti	2011
Taraba	Wukari	Wukari	2011
Yobe	Bade	Gashua	2013
Kebbi	Birnin Kebbi	Birnin Kebbi	2013
Zamfara	Gusau	Gusau	2013

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