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THÈSE

UNIVERSITE DE PAU ET DES PAYS DE L'ADOUR

Ecole Doctorale Sciences Sociales et Humanités

TRANSITIONS ENERGÉTIQUES ET ENVIRONNEMENTALES (TREE)

Présentée et soutenue le 21 Avril, 2022

par **George Abuchi Agwu**

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Spécialité : Sciences Economiques

EMPIRICAL ESSAYS ON CONTEMPORARY ISSUES OF ECONOMIC DEVELOPMENT IN NIGERIA

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To Samuel and Ikenna

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Abstract

Civil conflicts are frequent in Nigeria, and have contributed in stalling economic progress in the country. The first empirical essay of this thesis investigates the effects of one of the most recent episodes; the Boko haram conflict. It examines the effects of exposure to the conflict on household food security and whether households cope with this major risk to household welfare by leveraging their resilience capacity including wage labor supply, access to livelihood networks and collective infrastructures. The primary finding of this study is that households cope better with the shocks if they are endowed with strong resilience capacity ex-ante, and as such exposes the usefulness of resilience as a concept of development for the Nigerian context. The second and third empirical essays focus on the the theme of relative deprivation which features among the top explanations for the frequent conflicts. Both essays approach deprivation from the perspective of access to education. The second essay considers issues relating to access to university education, and the general implication for accumulated human capital. It finds that the nature of the distribution of the universities affects not only the distribution of human capital at the tertiary level, but also at the basic primary and secondary education levels. The third empirical essay tackles the issue of persistence of inherited inequalities, particularly if colonial inequalities denoted by district level of human capital contributes to intergenerational transmission of human capital. The essay principally finds that district inequalities are quite persistent mainly because of the legacies of the christian missionaries in the areas of provision of social services such as schools and general social infrastructures.

Résumé

Les conflits civils sont fréquents au Nigeria et ont contribué à freiner le progrès économique du pays. Le premier essai empirique de cette thèse étudie les effets de l'un des épisodes les plus récents, le conflit de Boko Haram. Il examine les effets de l'exposition au conflit sur la sécurité alimentaire des ménages et détermine si les ménages font face à ce risque majeur pour leur bien-être en s'appuyant sur leur capacité de résilience, notamment l'offre de travail salarié, l'accès aux réseaux de subsistance et aux infrastructures collectives. La principale conclusion de cette étude est que les ménages font mieux face aux chocs s'ils sont dotés d'une forte capacité de résilience ex ante, ce qui montre l'utilité de la résilience comme concept de développement dans le contexte nigérian. Les deuxième et troisième essais empiriques se concentrent sur le thème de la privation relative qui figure parmi les principales explications des conflits fréquents. Les deux essais abordent la privation du point de vue de l'accès à l'éducation. Le deuxième essai examine les questions relatives à l'accès à l'enseignement universitaire et l'implication générale pour le capital humain accumulé. Il constate que la nature de la répartition des universités affecte non seulement la répartition du capital humain au niveau tertiaire, mais aussi aux niveaux de l'enseignement primaire et secondaire de base. Le troisième essai empirique aborde la question de la persistance des inégalités héritées, en particulier si les inégalités coloniales dénotées par le niveau de capital humain des districts contribuent à la transmission intergénérationnelle du capital humain. L'essai constate principalement que les inégalités de district sont assez persistantes, principalement en raison de l'héritage des missionnaires chrétiens dans les domaines de la fourniture de services sociaux tels que les écoles et les infrastructures sociales générales.

Chapter 1

General introduction

1.1 Setting the agenda

The following questions remain interesting to economists; who gets what, when, how, why and at whose cost? How to increase national economic productivity and ensure the equitable distribution occupies the central position in Nigeria's political and economic development. Many of the political and economic struggles the country has had to face since her six decades of independent existence typically originate from this central issue. The country survived through these multitude of struggles occurring mostly after her colonial independence from the Great Britain in 1960, but the consequences were not lost on her: in spite of abundant endowment of human and material resources, she let the struggles reduce her to a position where nearly 50% of her over 210 million population live in abject poverty and remain vulnerable to frequent economic shocks. Although contemporary political governance leaves much to be desired, it has been shown that legacies from colonialism including extractive institutions and regional economic imbalance make the political economic system difficult to sustain. However, notable examples such as China demonstrates that robust policies based on empirical evidence may reverse the trends, notwithstanding. This thesis empirically investigates three key areas of potential policy intervention and makes policies recommendations.

1.2 Nigeria's political economy context

Nigeria is home to about 371 nationalities and ranks as the 3rd most culturally diverse country in the world, and also has long history of ethno-religious tensions dating way back to the precolonial period. The existence of Nigeria in the current geographical and administrative form results mainly from the amalgamation of Southern and Northern colonial protectorates in 1914, which has also been blamed for many of the bitter rivalries that have been part of the political and social landscape of the country ([Papaioannou and Dalrymple-Smith, 2015]). Shortly after the independence in 1960, Nigeria got plunged into a deadly three-years civil war beginning from 1967 in which part of the territories of the former southern protectorate (the eastern region) attempted unsuccessfully to secede. The war was essentially provoked by perception of marginalisation

in the distribution of political and economic power. In the immediate aftermaths of the civil war, Nigeria reformed her political institutions evolving a more formal and proportional revenue sharing arrangement under its fiscal federalism structure, and provided more explicit sharing formula for her oil revenues. This however did not eliminate the ethno-regional-religious agitations and rising religious violence that have been a destabilising force in the political economy. Currently escalating unrests by the Niger-Delta militants in the south-south region, farmers and herders in the north central and the Boko haram in the northeast is a constant reminder of the Nigerian political economy realities ([Kraakrafaa-Bestman, 2018]). As such, policy makers need not only design policies to cushion the effects of these crises, but also to address the root causes which have been attributed to relative deprivation and inequitable distribution of economic resources ([Agbiboa, 2013]). This policy thrust goes to the core of this thesis: the research theme borders on the consequences of the Boko haram conflict and the role of resilience capacity, the distribution and human capital consequences of access to schools and the nature of persistence of economic inequalities over time. The outlines of the chapters are presented below:

1.3 Drawing lessons from the Boko haram conflict

Global early warning systems hardly suffice to prevent man-made disasters, neither are aids sufficient to overcome the consequences. Rather, if domestic policies cannot immediately address the root causes, they are expected to build livelihood systems that are resilient to the demands of shocks and stressors. This is the resilience approach to development which calls for the integration of sustainable livelihood systems comprising simultaneous growth in human capital accumulation, social protection and public goods in the process of development ([Tendall et al., 2015]; [Bene et al., 2016]). This is expected to ensure that unexpected adverse stressors do not have long lasting consequences. In the political economy of Nigeria, the penetration of social protection is abysmal despite the prevalence of economic shocks from natural and man-made sources. Such settings provide an ideal environment to explore the interactions among vulnerability, resilience and economic

shocks. Exploiting this setting, chapter one uses a unique identification strategy based on three rounds of panel data to test the role of resilience capacity in mitigating shocks arising from a deadly conflict. It has been difficult to identify the causal effects of violent conflicts due to dearth of longitudinal data in the appropriate settings. The chapter overcomes this shortcoming by drawing from a panel data collected before and after population exposure to the Boko haram conflict. Furthermore, while most of the previous studies in this area only investigate the short-term consequences, and assume direct relationship between conflict shocks and food security, the chapter investigates resilience capacity as an intervening variable and as a potential channel extending the consequences of the conflict from short to long terms. It casts resilience as an absorber of the food security shocks generated by the conflict, and by identifying that resilience cushions the effects of the conflict through its various pillars, the paper aligns with the growing literature on a resilience-based approach to managing development.

1.4 The human capital consequences of limited access to universities

Improved access to education, especially at the tertiary level should be a policy priority in developing countries. Schooling generally support social and economic development through the human capital of the population which is part of the resilience of the general economy ([Valero and Reenen, 2019]). As a result, the nature of the spatial distribution of the different categories of schools may generate economic inequalities within territories ([Gibbons and Vignoles, 2012];[Spiess and Wrohlich, 2010]). This chapter investigates how distance to university during childhood affects individuals' educational attainment. It uses the first three waves of the Living Standard Measurement Survey (LSMS) dataset for Nigeria, which provides information on households' location and individuals' completed years of schooling and combines it with self-constructed database of historical spatial distribution of universities. In particular, relying on GPS coordinates, the database retrieves 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.

Using instrumental variable strategies, the chapter finds a negative effect of distance to university on completed years of schooling. The result is robust to accounting for potential migration bias which may occur if the individual's current place of residence differs from the area of residence during the teenage years. It also confirms strong neighbourhood effects indicating longterm inequality of geographical access to universities. Furthermore, taking advantage of recent establishment of 12 public universities and difference-in-difference approach, the chapter provides evidence of a positive spin-off effect of access to universities on student retention in secondary schools. The new universities lead 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 - which is a significant contribution because the cross influence of universities on the lower levels of education are rarely of consideration in previous studies.

1.5 Making sense of persistence of inequalities of historical origin

That African countries rank highly in indices of relative inequality is generally well known. Although the earlier studies trace the origin of this to colonial heritage, they generally fail to account for the mechanisms of the transmission across generations. The theory of intergenerational transmission is such that dynasties (which may be families or social groups) maintain inherited inequalities. However, the estimation of the intergenerational elasticities is fraught with potential biases, including unobserved ability correlation and endogenous neighbourhood quality ([Zimmerman, 2001];[Glick and Sahn, 2000]). Using the 2019 Nigerian Living Standards Surveys (NLSS), this chapter investigates the persistence of economic opportunities captured through educational attainment, and relies on the original distribution of schools in Nigeria via the colonial Christian missionaries to identify the important estimates.

I employ the neighbourhood capital defined as the average years of education within neighbourhood as an intervening influence on the intergenerational transmission of human capital. This sets up a causal mediation framework where parental and neighbourhood

capitals are jointly determined. Then, drawing from historical accounts, I use measures of the historical activities of the missionaries as instrument to empirically parse out the direct and indirect effects of parental human capital. I argue that parents influence their children human capital directly by investing in their education, and indirectly by deciding the schooling neighbourhoods. The parental and neighbourhood capitals are necessarily linked through neighbourhood sorting based on educational preferences. The instrumental variable causal mediation analysis which harnesses these relationships is then employed to parse out the direct and indirect effects. The historical activities of the missionaries is assumed to jointly affect the parental and neighbourhood capitals, which is the identifying assumption of the causal mediation framework. Using conventional and heteroscedasticity based instruments, the study finds that parental and neighbourhood capitals significantly contribute to the human capital of offspring, where capitals are respectively denoted by average education of parents and neighbourhoods. Furthermore, when the total effect is decomposed based on the causal mediation framework, the parental capital accounts for about 25% while neighbourhood capital accounts for 75%. This implies that supply side policies such as raising the quantity and quality of schools across districts could be an important option for raising equality of economic opportunities.

Bibliography

- [Agbiboa, 2013] Agbiboa, D. E. (2013). Why boko haram exists: The relative deprivation perspective. *African Conflict and Peacebuilding Review*, 3(1):144–157.
- [Bene et al., 2016] Bene, C., Headey, D., Haddad, L., and von Grebmer, K. (2016). Is resilience a useful concept in the context of food security and nutrition programmes? some conceptual and practical considerations. *Food Security*, 8(1):123–138.
- [Gibbons and Vignoles, 2012] Gibbons, S. and Vignoles, A. (2012). Geography, choice and participation in higher education in england. *Regional Science and Urban Economics*, 42(1):98–113. ID: 271675.
- [Glick and Sahn, 2000] Glick, P. and Sahn, D. E. (2000). Schooling of girls and boys in a west african country: the effects of parental education, income, and household structure. *Economics of education review*, 19(1):63–87.
- [Krakrafaa-Bestman, 2018] Krakrafaa-Bestman, D. (2018). *The History of Terrorism in Nigeria: Examining the Relationship between Colonialism and Terrorism in Postcolonial Nigeria*.
- [Papaioannou and Dalrymple-Smith, 2015] Papaioannou, K. J. and Dalrymple-Smith, A. E. (2015). Political instability and discontinuity in nigeria: The pre-colonial past and public goods provision under colonial and post-colonial political orders. *The Economics of Peace and Security Journal*, 10(1).

- [Spiess and Wrohlich, 2010] Spiess, C. K. and Wrohlich, K. (2010). Does distance determine who attends a university in germany? *Economics of Education Review*, 29(3):470–479.
- [Tendall et al., 2015] Tendall, D., Joerin, J., Kopainsky, B., Edwards, P., Shreck, A., Le, Q., Krütli, P., Grant, M., and Six, J. (2015). Food system resilience: defining the concept. *Global Food Security*, 6:17–23.
- [Valero and Reenen, 2019] Valero, A. and Reenen, J. V. (2019). The economic impact of universities: Evidence from across the globe. *Economics of Education Review*, 68:53–67. ID: 271751.
- [Zimmerman, 2001] Zimmerman, F. J. (2001). Determinants of school enrollment and performance in bulgaria: The role of income among the poor and rich. *Contemporary Economic Policy*, 19(1):87–98.

Chapter 2

How the resilience approach to
development works for households:
the Boko-haram conflict, food
insecurity and resilience capacity

Abstract

Drawing from a robust identification strategy and household panel data collected before and after households were exposed to the Boko Haram conflict, this paper addresses the question of whether resilience capacity is an important factor in mitigating household welfare risks - particularly arising from rampant violent conflicts in developing countries where adequate welfare and financial insurance is lacking. Applying non-parametric difference-in-differences to closely matched exposed and non-exposed groups, the paper finds that the conflict shock affects food security negatively, but the effects are attenuated through resilience capacity. In the process, pillars of resilience gets decimated, thereby weakening households' long-run capacity to withstand future shocks. These results remain even after adjusting spatial distance of exposure and representing the conflict exposure by its intensity in terms of battle fatalities. The consistency of the findings with the hypotheses of the resilience approach to sustainable development yields the recommendation that development policies always target to establish development ecosystems that are households oriented and resilient to shocks.

2.1 Introduction

As the frequency of natural disasters and civil conflicts spikes globally, rapid response systems, the likes of early warning systems facilitating rapid intervention, assume prominence ([Smith and Davies, 1995]). While such interventions alleviate crises, they seldom address the underlying vulnerability. Occasionally, the short-term interventions generate serial dependence of individuals and households on aid and handouts ([Bene et al., 2016]; [Alinovi et al., 2008]). Some of these concerns motivate the recent calls for the resilience approach to development, whereby building resilience capacity becomes a primary concern of development planning and emergency interventions ([Tendall et al., 2015]). The resilience approach prioritizes the mobilization of resources through integrative livelihood strategies, human capital combination, social protection, nutritional health, and other private and public goods, which in times of shock protect households from extreme consequences ([Bene et al., 2016]). In the political economy of most developing countries, the penetration of social protection is abysmal despite the prevalence of economic shocks from natural and man-made sources. Such settings provide an ideal environment to explore the interactions among vulnerability, resilience and economic shocks. Exploiting this setting in the case of Nigeria, this paper uses a unique identification strategy based on three rounds of panel data to test the role of resilience capacity in mitigating shocks arising from a deadly conflict. The evidence from this paper might be useful for general development policies, particularly those related to emergency interventions.

From the economic theory perspectives, resilience protects households from loss of economic welfare and facilitates recovery from shocks ([Bene et al., 2016]; [Alinovi et al., 2008]). Acknowledging these roles, development agencies such as the World Bank (WB), the Food and Agricultural Organization (FAO), and the World Food Program (WFP) devote substantial resources to encouraging the build-up of household resilience, and to facilitate empirical assessment of the importance of the concept, the agencies commission works for streamlining its measurement. This incentive has motivated more vigorous assessment of the theoretical links between resilience and food security in particular, with most of the studies adopting the harmonized framework. In the meantime, the frame of analysis is

predominantly cross sectional, whereas it might be more appropriate to identify the role of resilience in dynamic settings where the dynamics of shocks, welfare and the intervention of resilience may be exploited ([Smith and Frankenberger, 2018]). In the particular case of shocks relating to violent conflicts, the difficulty of obtaining before and after longitudinal data with which to investigate the role of resilience confines most of the studies to cross-sectional analysis. The present study is distinguished from most of the previous studies in this respect because of the adoption of the setup of [d’Errico et al., 2018] and the replacement of its self-reported shocks with objective conflict shocks.

Therefore, this paper uses the shocks originating from the battles of Boko Haram, one of the leading violent terror groups in the world, to test the role of resilience capacity in shock mitigation. Most of the studies linking conflict and food security only investigate the short-term consequences, and assume direct cause and effect relationship between conflict shocks and food security. This study extends this literature by investigating resilience capacity as an intervention factor and as a potential channel of extending the immediate consequences of the conflict. The study casts resilience as an absorber of the food shocks generated by the Boko Haram conflict, which are expected to threaten household food security. By identifying that resilience cushions the effects of the conflict through its various pillars, the paper aligns with the growing literature on a resilience-based approach to managing development.

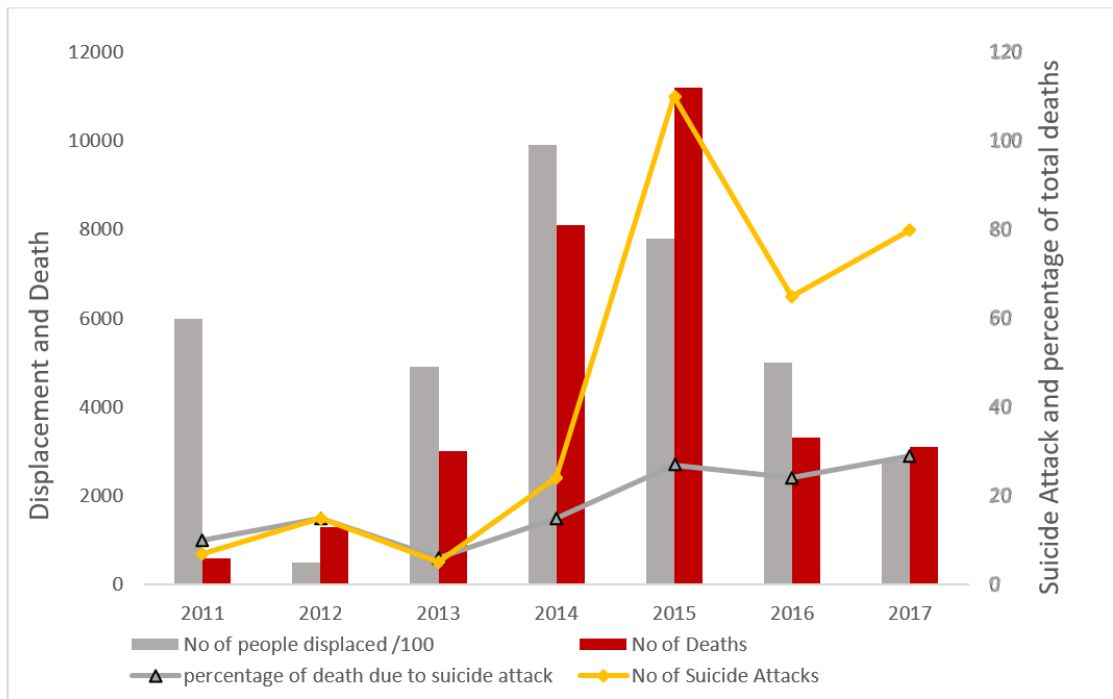
The remainder of the paper is organized as follows: Section 2 discusses the related literature and background of the study. Section 3 provides an overview of the data and descriptive statistics. Section 4 estimates the basic short-run relationships among the key variables. Section 5 extends the analysis to the long-run through the effects of the conflict exposure on dimensions of resilience capacity. Section 6 reports some robustness checks, and section 7 concludes with policy recommendations.

2.2 Literature and background of the study

2.2.1 The conflict

Violent conflicts such as the Boko Haram insurgency herald a lot of disruptions, including in food systems ([D'Souza and Jolliffe, 2013]). The Boko Haram conflict targets important economic activities such as farming and informal trading activities, and previous studies acknowledge that this pattern is behind most of its economic impact, particularly on the ability of households to access food and other livelihood resources ([Falode, 2016]; [Adelaja and George, 2019]). While the apparent objective of the Boko Haram is not directly related to the food systems, food is certainly used as a means to the end, and the food system is incidentally compromised through violent exchanges between state and the insurgents ([Bertoni et al., 2018]; [Messer and Cohen, 2007]). The Boko Haram adopts a menu of strategies to drive its objectives; first, it launched battles using massive foot soldiers, annexing and occupying territories in the north east of the country. This form of attacks usually involved clashes with the state forces, and from 2013, the conflict has intensified following a more spirited drive of the state to recapture annexed territories and eradicate the insurgency ([Onapajo, 2017]). Despite this, the Boko Haram attacks did not stop but grew more clandestine and concentrated in less-governed spaces such as farmlands and local markets. Hence, the estimates of this study are most relevant in the rural areas where the attacks remain consistent throughout the period.

Figure 2.1: Trends of Boko Haram attacks and casualties



Data source : [IDMC](#) and [ACLED](#)

Boko Haram became a much more formidable threat on account of this covert strategy; it became the world’s most deadly terrorist group in terms of casualty count, and direct confrontation with state forces was eschewed in favor of targeted and mostly suicide attacks ([Omeni, 2018]). Consequently, the sabotaging of economic activities through raids on agricultural farms and general disruption of essential economic activities was escalated within few soft target areas ([Campbell and Harwood, 2018]). Figure 2.1 clearly demonstrates this transition, where suicide fatalities rose sharply from 2014. One can therefore imagine the extent of disruption in the food system given that the transition focused attacks on agrarian hot spots ([Onapajo, 2017]). Cases of infrastructure and personal asset damages reportedly also depicted a similar trend ([Hoek, 2017]). This scenario illustrates potential mechanisms that might drive the expected negative consequences of the conflict on food security, namely, through limitation of food production and distribution ([Kimenyi et al., 2014]; [d’Errico et al., 2018]).

2.2.2 Food security and resilience capacity

According to [Spedding, 1988], the household is a central unit of the food system and subject to destabilization by economic shocks, idiosyncratic and general. Under normal circumstances, the household maintains its members' economic welfare by aligning its components with the immediate social and economic environments. Similarly, while facing economic shocks, the household remains central to austerity-coping decisions including deciding income-generating activities, allocating food and non-food expenditures, and choosing risk management strategies, which makes it a suitable nucleus of resilience analysis ([Cherchye et al., 2007]). The concept and measurement of resilience has tremendously transformed driven mainly by the evolution of the construct and the diversity of disciplines in which the construct is appropriated. The FAO of the United Nations defined resilience as "the capacity of a household to bounce back to a previous level of food security after a shock" and pioneered the Resilience Index Measurement and Analysis (RIMA) approach, which is widely applied in the field of food security analysis ([Alinovi et al., 2008]).

RIMA denotes resilience as a latent proxy index, which may be directly or indirectly measured ([Alinovi et al., 2009]). Under the framework, the latent proxy is usually estimated by reducing a large number of theoretical variables to a single resilience index derived from known pillars measured at the first of the two-stage estimation procedure. The direct measurement approach mostly uses structural models such as the MIMIC (Multiple Indicators Multiple Causes) and aims at describing households that may be more/less likely to resist shock at a particular point in time. On the other hand, the indirect approach focuses on the theoretical determinants of resilience to draw inference for policies or predict the dynamic path of resilience. However, [Ciani and Romano, 2014] pioneered a method of resilience capacity measurement that may be applied to predict the consequences of shocks on food security in dynamic settings, and which acts as a bridge between the direct and indirect RIMA measures. This method has been tested by [d'Errico and Giuseppe, 2016] and [Kozłowska et al., 2015] and is adopted for the present study. The Technical Working Group on Resilience Measurement (TWGRM), a group of expert stakeholders, provides the recommendations guiding the selection of

variables for the estimation ([d'Errico and Giuseppe, 2016]).

The resilience capacity measured under this approach incorporates the idea that households respond to economic shocks by drawing down on accumulated resources and utilizing available capacities to develop optimal coping strategies ([FAO, 2016]). Shocks such as violent conflicts may specifically target pillars of resilience including public infrastructure and income generation assets, which might then extend the duration of the consequences of the initial shocks. Therefore, in addition to the short-term analysis of the effects of the conflict on food security, the study considers the potential long-term impact through its effects on the resilience resources that should mitigate future shocks.

2.2.3 Relating the conflict, food security and resilience capacity

The prevailing state of conflict and humanitarian crisis in north-east Nigeria is attributed to the Boko Haram insurgency, which is rooted in a complex combination of institutional failures, extreme religiosity and welfare limitations ([Iyekekpolo, 2016]). Apparently, the general state of economic welfare including food security has dipped since the inception of the crisis. The FAO reports that about 3.7 million individuals would become food insecure in the region by 2018, and the WFP estimates that out of the 14.8 million people exposed to the crisis, about 8 million have become food insecure ([Baliki et al., 2018]). These reports indicate that agricultural productivity has declined in the region, but most importantly the functioning of local agricultural markets has been hampered. This implies that food scarcity and rising food prices might be prevalent. As a result, food provisioning strategies such as relying on less preferred foods, skipping meals and so forth have risen among the exposed households who are desperately attempting to survive the conflict ([Marc et al., 2015]).

Unlike other settings of shocks, "food wars" are usually part of civil conflicts, whereby food supply channels are targeted by actors in the conflict. The "Boko Haram" (BH) insurgency emerged primarily to discourage non-Islamic forms of education in the Muslim-dominated territories through advocacy. The first violence claimed by the insurgents in the country

was a series of attacks against military formations in Bauchi state on the 29th of July 2009 after their first leader, Mohammed Yusuf, was killed by the Nigerian security forces ([Adesoji, 2010]). Subsequently, Boko Haram metamorphosed into a terror group involved in violent confrontations with the state. Millions of people have been displaced from their homes and thousands killed in the course of the war ([Adelaja and George, 2019]). The group employs diverse tactics in the struggle against the state, one of which is the widely condemned kidnapping of about 300 high school girls in 2014 ([Iyekekpolo, 2016]). Of most concern for this study is the targeting of agricultural production through the kidnapping of farmers and the destruction of farm infrastructure such as irrigation and storage facilities. Additionally, the BH targets and destroys markets, roads, bridges, and other factors that constitute an enabling environment for the production and distribution of foods ([Campbell, 2019]). These have raised the concerns of stakeholders about possible long-term damages to economic welfare, and food security in particular ([Fao, 2015]).

Pioneering studies of this conflict detected negative effects on food supply due to substantial loss of agricultural production (see; [Adelaja and George, 2019]), leading to widespread food insecurity ([George et al., 2019]). However, beyond the immediate food systems, essential resources supporting household food security and general welfare resilience have also been affected. [Hoek, 2017] reports direct disruption of the functioning of local markets by the conflict due to actual attacks and threats of attacks, while [Bertoni et al., 2018] reports substantial decrease in human capital accumulation from the destruction of schooling infrastructures and threats to life. Similarly, [Chukwuma and Ekhaton-Mobayode, 2019] document substantial decrease in the production and consumption of health services. Theoretically, the erosion of resilience capacities as reported here would potentially leave affected households stuck in poor economic welfare and food insecurity long after the conflict might have been eliminated. For example, inadequate supply of health services could increase the frequencies of illnesses and draw down on household food consumption budget, and this would likely be the case in this particular conflict given that cases of epidemics are already being reported in the exposed communities ([Adamu et al., 2019]). Therefore, policy makers might be interested in understanding the immediate and the

long-term implications of the conflict on food security and related outcomes. Using similar shocks, previous studies have demonstrated the importance of resilience capacity for the household's long-term survival.

This paper stands out from the previous studies on this conflict through its investigation of the role of resilience in the context of violent conflict that compromises food security and resilience capacity simultaneously. In other contexts, while previous studies document negative effects of shocks on food security, they also demonstrate that resilience capacity intervenes by wholly or partially absorbing the food supply shocks thereby alleviating the adverse welfare consequences of the shocks for households. After the 2014 catastrophic floods in Bangladesh, [Smith and Frankenberger, 2018] demonstrate the role of resilience in ensuring household food security recovery, particularly the pillars of asset holdings, and access to basic services and social safety nets. [Bruck et al., 2019] demonstrate similar pattern of resilience mediation in the case of the Israel-Palestine conflict in the Gaza strip. The study identifies social safety nets and access to basic services as important dimensions of resilience, which attenuated the welfare-reducing effects of the conflict. The same mechanism operates also in the case of idiosyncratic shocks as self-reported by the households. For this case, [Bruck et al., 2019] identify the cushioning effects of resilience capacity, particularly the adaptive capacity.

2.3 Data

2.3.1 Conflict in the neighborhood of households

Overall, the empirical strategy relies on the difference-in-differences estimator (DiD) to identify the effects of exposure to the conflict on the relevant outcomes. Resultantly, this section adapts the estimation data to the DiD estimation set-up including the main assumption of parallel trend. To create the required treatment and control groups, the relevant households are classified as exposed and non-exposed based on their proximity to the Boko Haram conflict battles. Under this type of classification, the parallel trend assumption may be violated due to certain time-varying economic conditions that predis-

pose locations to conflicts, such as poverty ([Abadie, 2006]; [Blattman and Miguel, 2010]; [Pinstrup-Andersen and Shimokawa, 2008]). To mitigate this, the dynamic spatial extension of the conflict is closely monitored and used to pick out the locations to be included in each of the exposed and control groups. This mitigation requires that each of the designated treatment and control group experiences exposure to the conflict, but during different data collection rounds. This maneuver potentially mitigates endogenous selection into conflict exposure because economic conditions in exposed locations are likely to be comparable, irrespective of time of exposure. Hence, the identification relies on variation in the timing of exposure and on successive data collection rounds. The data selection process is as described below:

The post harvest visits of the first three waves of the Nigerian Living Standard Measurement Survey (LSMS) collected by the World Bank and Nigeria’s national bureau of statistics (NBS) are used in the study¹. The nationally representative LSMS panel contains comprehensive information on household socio-demographic characteristics and consumption, including a dedicated module for food security. The periods covered by the three waves are between February 2011 and April 2011 (hereafter: baseline), between February 2013 and April 2013 (hereafter: period 1), and between February 2016 and April 2016 (hereafter: period 2).² The survey data is accompanied by location longitudes and latitudes, which might be used to merge the data with other geo-referenced data sources such as the armed conflicts location and events database (ACLED) (Raleigh, 2010). Using string search within the ACLED database, conflict event data involving the Boko Haram in Nigeria are selected and spatially merged with the LSMS households. This allows spatial proximity analysis determining the spatial distance in kilometers (KM) of a household’s location from dated conflict events.

In partitioning the households into exposed and non-exposed households, the former must live within a distance close to any Boko Haram battle involving at least one fatality.

¹The visits are chosen because they contain the most comprehensive modules of agricultural production, being an important aspect of household consumption

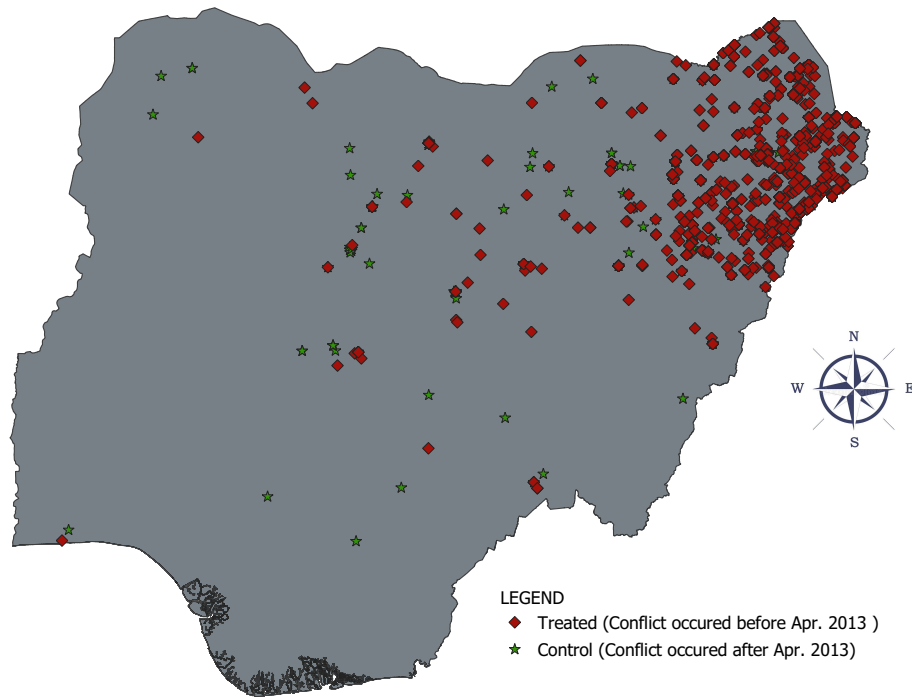
²Although the data collection spans more than one month, distinguishing which households were interviewed in which month is not possible. Hence, mention of period in the entire paper refers ”as a snapshot” to data collection within a specific data collection round of the LSMS

However, the distance should be such that not all the households are considered exposed at a given period. Two buffers of radii, 5KM and 7KM, are created around each conflict event based on distance bands already established for this conflict (see; [Bertoni et al., 2018]).³ Only the households residing within any of these buffers are included in the estimation sample. Restricting the main estimations to baseline and period one only, the dichotomy of exposed and control groups is determined by time of exposure as follows: the households that are exposed to events occurring during the time interval between baseline and period one are designated as exposed group, while those exposed to events occurring between periods one and two fall into the control group.⁴ Under this restriction, the control group is strictly exposed between periods one and two, whereas the exposed group is allowed to include certain households exposed consecutively in the two periods. Finally, households never exposed to any conflict were eliminated. The geographical distribution of the samples is shown in figure 2.2.

³Buffers above 7KM do not provide room to separate the exposed and control groups, because then nearly all the relevant data points fall within the buffer at any given event-date combination

⁴Note that households in this second group will be exposed in the future but remain unexposed as of the time of the estimations.

Figure 2.2: Conflict-defined treatment and control geographical locations



Data source : [LSMS and ACLED](#)

2.3.2 Description of main non-conflict variables

Food security and controls

Three main food security measures are considered in this paper: the coping strategy index (CSI), the food consumption score (FCS), and the share of food consumption expenditure in total household expenditure per capita. While the CSI captures the behavioral and food utilization aspect of food insecurity ([Maxwell, 1996]; [Maxwell et al., 1999]), the share of food expenditure captures access to food through household purchasing ability, and the FCS captures food availability through the diversity of household nutritional intake ([Lovon and Mathiassen, 2014]). Except for FCS, which is conversely distributed, higher values of the measures indicate higher food insecurity. Having utilized other household heterogeneities in the computation of household resilience capacity, the control variables

are selected to reflect mainly the structural characteristics of the households, including age, gender, schooling, occupation of household head, and size as well as proportion of children in the household. Table 2.1 summarizes the baseline control variables for all the estimations and compares them across exposure status. The household heads in the exposed group are slightly younger and are more likely to be in a polygamous marriage, otherwise the control variables are balanced across the exposure status divide. This being in line with the objective of the data selection strategy reveals that the households are quite comparable in the absence of the conflict exposure and lends credence to the identification strategy.

The relevant food security measures are computed as follows:

$$FS_{it} = \sum_{i=1}^n f_{it} * w$$

FS_{it} stands for both CSI and FCS. For the CSI, f_{it} represents frequency of coping strategy based on the number of days in the past seven days that such strategies were used and w represents weights based on the severity of the strategy ([WFP, 2008]; [Maxwell, 1996]). For the FCS, f_{it} represents the number of standard food classes that the household consumed during the past seven days and w weights based on the micro-nutrient contents of the food classes ([WFP, 2008]).⁵ The food ratio is calculated as the weekly per capita household food expenditure divided by the total weekly expenditure per capita.

Computing resilience capacity

As discussed in section 2.2.2, the method adopted to measure the RCI in this study is based on the approach developed by [Ciani and Romano, 2014]. Under this approach which embraces the framework of TWGRM, the resilience to food insecurity of a given household at a given time is assumed to depend primarily on the pillars of AC, access to assets (Assets), ABS and SSN, which are indices computed at the first of a two-stage

⁵The food classes include staples, pulses, vegetables, fruits, animal products, sugar, diaries, fats and oil, and the micro-nutrients weights obtained from the West African food composition table ([Barbara et al., 2012])

Table 2.1: Summary statistics for the control variables at baseline by household exposure status

Variable	pooled sample			Treatment 7KM			Control 7KM			t-test
	obs	Mean	Sd	obs	Mean	Sd	obs	Mean	Sd	
Urban	1,500	0.17	0.37	1,062	0.17	0.35	438	0.22	0.42	-0.06
Age of HH head	1,500	47.68	15.25	1,062	49.98	15.53	438	46.89	14.45	3.09*
HH head is wage worker	1,500	0.41	0.28	1,062	0.53	0.27	438	0.48	0.32	0.06
HH is agricultural worker	1,500	0.68	0.14	1,062	0.72	0.14	438	0.68	0.15	0.04
Household size	1,500	6.58	3.37	1,062	6.30	3.04	438	7.34	4.04	-1.05
Female HH head	1,500	0.07	0.25	1,062	0.08	0.27	438	0.04	0.19	0.04
HH head is literate	1,500	0.51	0.50	1,062	0.52	0.50	438	0.49	0.50	0.03
Ratio of children	1,500	0.36	0.23	1,062	0.35	0.23	438	0.38	0.22	-0.02
HH head marital status										
Never married	1,500	0.02	0.15	1,062	0.02	0.14	438	0.03	0.18	-0.01
Monogamous marriage	1,500	0.61	0.49	1,062	0.63	0.48	438	0.57	0.50	0.06
Polygamous marriage	1,500	0.28	0.45	1,062	0.27	0.43	438	0.35	0.48	-0.08*

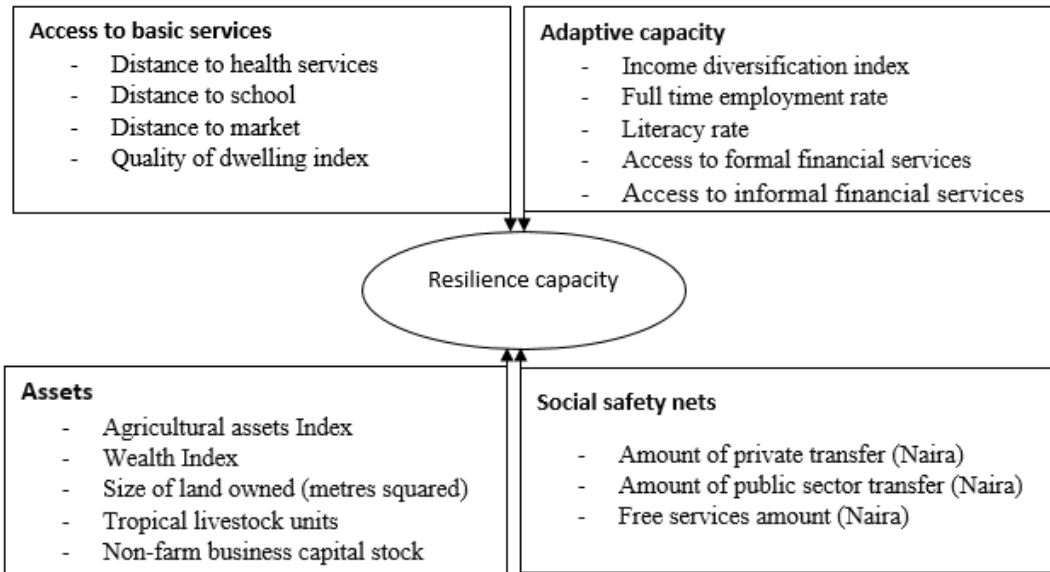
Notes: Treatment group comprises households exposed to conflicts occurring before September 2012. The control group comprises households exposed to conflicts occurring after September 2012. The date is chosen because treatment period survey commenced in September 2012. The t-test column refers to mean differences between the treatment and control groups. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

factor analysis strategy using variables reported at the household level (see table A.6). At the second stage, the index is calculated as specified below using the already defined index notations:

$$RCI_i = f(AC_i, Assets_i, ABS_i, SSN_i) \quad (2.1)$$

where i indexes household. [Bene et al., 2016] provide useful guidelines which the study followed in the selection of suitable variables from the LSMS. In practical terms, since the variables measure similar tendencies, the first stage variables are retained if they score up to 60 percent factor uniqueness. The retained variables used in the second stage are the ones displayed in Figure 2.3. Table A.7 presents the summary statistics resilience variables at the first stage, table A.8 displays the corresponding factor loadings, and table 2.2 compares the household indices across conflict exposure status and over time.

Figure 2.3: Indicators of resilience capacity and pillars



2.3.3 Attrition from the sample

Overall, the attrition in the Nigerian sample of the LSMS is known to be low at about 4% for the data collected during the period of estimations in this paper (see: [Osabohien, 2018]). However, the sample was further restricted for the analysis, eliminating four out of six political regions of Nigeria where the Boko Haram conflict does not exist. In particular, the North-East and North-West regions (the epicentre of Boko Haram) were retained, whereas the South-East, South-West, South-South and North-Central regions were eliminated. This technically reduced the sample from 5000 to 1589 households, of which 1511 were interviewed in two consecutive waves (2010 - 2016) and 11 further households were dropped due to missing values, thereby resulting in an attrition rate of 5.6%. In general, under normal residential relocation of households, the LSMS team traces and re-interviews such households in their new locations, but this was not the case for these 78 households, suggesting that it was due to the conflict. Although this attrition rate is considerably low, this section conducts a falsification test to confirm that attrition does not bias the estimates. Defined as missing households during the estimation period one, attrition is

Table 2.2: Summary statistics of the food security and resilience capacity outcomes by time and treatment status

Variable	Pooled sample			Treatment			Control			t-test of
	obs	mean	sd.	obs	Mean	Sd.	obs	Mean	Sd.	means
PRE										
CSI	1,500	1.80	5.55	1,062	2.15	6.32	438	1.90	2.64	0.26
Food ratio	1,500	0.77	0.17	1,062	0.78	0.17	438	0.75	0.17	0.03
FCS	1,500	53.06	21.88	1,062	52.71	22.99	438	54.50	18.16	-1.79*
RCI	1,500	0.23	0.15	1,062	0.22	0.15	438	0.24	0.15	-0.02
ABS	1,500	0.20	0.05	1,062	0.20	0.05	438	0.21	0.05	-0.01
AC	1,500	0.20	0.05	1,062	0.21	0.05	438	0.20	0.05	-0.01
SSN	1,500	0.34	0.18	1,062	0.33	0.17	438	0.37	0.18	-0.01*
ASSETS	1,500	0.83	0.12	1,062	0.83	0.12	438	0.82	0.13	0.01*
POST										
CSI	1,500	3.88	8.41	1,062	4.67	9.46	438	1.78	4.70	2.89***
Food ratio	1,500	0.80	0.22	1,062	0.83	0.23	438	0.73	0.13	0.10***
FCS	1,500	53.35	23.46	1,062	52.54	23.25	438	57.10	23.38	-4.56***
RCI	1,500	0.21	0.14	1,062	0.20	0.13	438	0.27	0.17	-0.07**
ABS	1,500	0.19	0.05	1,062	0.18	0.05	438	0.19	0.05	-0.01***
AC	1,500	0.19	0.05	1,062	0.16	0.05	438	0.21	0.05	-0.06***
SSN	1,500	0.36	0.14	1,062	0.43	0.11	438	0.26	0.17	0.17***
ASSETS	1,500	0.81	0.11	1,062	0.80	0.11	438	0.81	0.11	-0.01*

Treatment group comprises households exposed to conflicts occurring before September 2012 and after April 2011. The control group comprises households exposed to conflicts occurring after September 2012 and before July 2017.⁶ CSI stands for coping strategy index; Food ratio for share of per capita household food expenditure; FCS for food consumption score ; RCI for resilience capacity index; ABS for access to basic services; AC for adaptive capacity; SSN for social safety nets; and assets for assets index. The t-test refers to mean differences between the exposed and control groups. *** p<0.01, ** p<0.05, * p<0.1.

estimated as a function of the conflict exposure using the equation specified below:

$$Attrition_{i1} = \alpha + X'_{i0}\delta + \theta_c + \epsilon_i \quad (2.2)$$

where $Attrition_{i1}$ is the attrition dummy variable, and other variables and parameters remain as defined previously. As shown in table A.4, attrition is related to neither conflict exposure nor the control variables, which is reassuring. Nevertheless, the levels of resilience are weakly correlated with attrition: the coefficients of ABS and AC are negative and marginally significant at the 10 percent level. If households of low resilience capacity in their baseline conditions disintegrate or relocate upon exposure to the conflict, this might introduce a downward bias to the moderating effects of resilience capacity, and this should be remembered when interpreting the estimated role of resilience.

2.4 Estimation of the direct effects

2.4.1 The conflict and food (in)security: direct relationship

In the meantime, this section ignores the potential linkage between food security and resilience capacity and investigates the basic relationships between the Boko Haram shocks and food insecurity. In particular, the section estimates the average effects of the conflict without accounting for the mediation of resilience capacity. The extension of these analyses in section 4.4 explores the heterogeneous effects according to level of resilience capacity, and this sheds some lights on the theoretical roles of resilience capacity. In general, the identification is based on the difference-in-differences (DID) estimator where the main outcomes are continuous variables FS_{it} denoting the various measures of food (in)security. The treatment variable $Conflict_i$ assumes two forms: when denoted as a dummy variable, $Conflict_i$ equals 1 if as at 2012/2013 period the household resides within any of the buffer zones earlier described, but as a partially continuous variable $Conflict_i$ equals the conflict intensity conventionally represented by the fatalities arising from the conflict. The non-parametric DID estimator α estimates the impact of exposure to the conflict on food security as specified in equation 2.3 below:

$$\alpha_{DID} = E[FS_{i1} - FS_{i0}|Conflict = 1] - E[FS_{i1} - FS_{i0}|Conflict = 0] \quad (2.3)$$

If households were randomly exposed to the conflict, the exposure effect would simply be the difference in food security between the exposed and control households, which is not the case in the present study. However, given that exposure is eventually realized for all households in the sample in monitored time intervals, an empirical approximation of this difference may be obtained by monitoring the trends of food security across the defined groups, through for instance the DID framework. The non-parametric DID framework assumes that except for the conflict exposure, the treatment and control groups would have followed similar trends. Then, controlling for time-invariant household characteristics, the differences in food (in)security between the exposed and non-exposed households in the presence of group-based exposure are considered unbiased estimates of the average treatment effects of the conflict on the outcomes.⁷ The tests of mean differences by exposure status in table 2.2 provide the bivariate approximation of these differences. In nearly all the cases, the outcome levels are significantly different between the pre-exposure (*PRE*) and post-exposure (*POST*) periods, suggesting the occurrence of trend discontinuities that likely arose from exposure to the conflict. Nevertheless, these may only be considered associative since the trend may be conflated with other fixed time-varying household characteristics. Hence the multivariate extensions include all the available controls to narrow the sources of the remaining differences to the conflict exposure.

2.4.2 Econometric specifications

Drawing from the preceding discussions, this section estimates two multivariate econometric approximations of the DID model: The first multivariate regression is estimated for the levels of the outcomes in *POST* conditioning on baseline control variables, including the baseline levels of the outcomes as a capture for the effects of differences in initial

⁷A replica of this strategy is also applied to test whether the conflict links with future vulnerability by decimating household endowments of resilience

levels of the outcomes, whereas the second version is dynamic with household fixed effects capturing any time-invariant household characteristics. These estimations are specified in equations 2.4 and 2.5 below:

$$FS_{i1} = \delta + \rho Conflict_i + \gamma FS_{i0} + \beta X_{i0} + \phi H_i + \epsilon_i \quad (2.4)$$

where FS_{i1} denotes the levels of food (in)security for household i measured at period $POST$, $Conflict_i$ is a dummy variable indicating exposure to the conflict or the conflict intensity represented as the battle fatalities - which is equal to zero when the dichotomous $Conflict_i$ equals zero, and strictly positive when $Conflict_i$ equals one. FS_{i0} is the baseline level of food (in)security, H_i is household fixed effects, X_{i0} is the baseline household characteristics, while ϵ_i is the idiosyncratic error term. Given the household controls, equation 2.4 yields an unbiased estimate of ρ , the impact of exposure to the conflict on the outcomes. Nevertheless, to capture potential sources of bias relating to unobserved household characteristics that may be correlated with conflict exposure and household food (in)security, household fixed effects are included in the estimations as follows:

$$FS_{it} = \tau_t + \theta_i + \alpha Conflict_i \times POST_t + \varepsilon_{it} \quad (2.5)$$

where FS_{it} is the food security indicator, τ_t is time fixed effect, θ_i is a set of household fixed effects, α is the *DiD* parameter obtained through the interaction of $Conflict_i$ and the post exposure period ($POST$), ε_{it} is the error term, while other parameters and variables maintain their previous definitions. Equation 2.5 exploits the panel structure of the data through within transformation to evaluate the relationships between the food security measures and the measures of the conflict. The panel structure allows time-invariant household-specific unobservable factors to be differenced out.

2.4.3 Estimates of direct effects

Using the various measures of the conflict exposure, the application of equations 2.4 and 2.5 yields the results reported in table 2.3. Panel A of table 2.3 reports estimates

of the direct effects of the conflict exposure $Conflict_i$ denoted as a dummy variable, whereas Panel B reports direct effects of the conflict intensity. In panel A, the estimates indicate significant negative effects of the conflicts on the various indicators of food security. Estimates in Panel A: columns 1, 2 and 3 derive from equation 2.4 estimated without household fixed effects, and indicate that exposure is associated with an increase of about 1.29 points in the coping strategy index, about 7.2 percent increase in the food expenditure share (food ratio) and no significant effect on food consumption score (FCS). The fixed effects DID estimates reported in Panel A: columns 4, 5 and 6 are prescriptively similar to the previously discussed estimates. Mostly, estimates regarding the FCS are insignificant, whereas those of the CSI and food ratio increased by 1.24 points and 8.6 percent, respectively. In magnitude, the increase in the CSI and food ratio constitutes 69 percent and 11 percentage points of their respective pre-exposure pooled means. Similarly, most of the outcomes respond strongly to the conflict intensity as shown in Panel B. Based on the DID fixed effect estimations in columns 4, 5 and 6, a unit increase in fatalities increases the CSI by about 0.023 points and the food ratio by about 0.075 percent, with no effect on the FCS. However, ignoring household fixed effects, a unit increase in fatalities is associated with about 0.12 points reduction in FCS. There are several discussions about the nature of households' consumption trade-offs during shocks, in terms of quality - represented by indicators of dietary diversity such as FCS, and quantity - represented by indicators such as CSI ([D'Souza and Jolliffe, 2013]; [Jensen and Miller, 2010]). In the current estimates, quality seems to have been traded off for quantity, but there might as well be other nuances, some of which might operate resilience capacity, which is addressed in section 4.4. In general, the models without the fixed effects seem to overestimate the relevant effects, as unaccounted fixed effects induce positive bias in the estimates, hence, the preference for the fixed effects model. Finally, in columns 1, 2 and 3, the initial values of the outcomes are included, and they significantly predict the current values as expected.

2.4.4 The role of resilience capacity

The main question of this section is how much resilience is required to cushion the households against adverse stressors. However, since conflict might as well affect resilience,

Table 2.3: Effect of conflict exposure on food (in)security

A: Conflict exposure within 7KM

VARIABLES	(1) CSI	(2) FCS	(3) Food ratio	(4) CSI	(5) FCS	(6) Food ratio
<i>Conflict</i> × <i>POST</i>	1.287*** (0.257)	-1.384 (0.858)	0.072*** (0.008)	1.240** (0.502)	-1.942 (1.566)	0.086*** (0.015)
Baseline CSI	0.884*** (0.027)					
Baseline FCS		0.343*** (0.014)				
Baseline food ratio			0.103*** (0.010)			
Baseline controls	yes	yes	yes	No	No	No
Household fixed effect	No	No	No	yes	yes	yes
Constant	1.277* (0.691)	41.070*** (2.318)	0.721*** (0.021)	12.962** (5.527)	53.421*** (16.401)	1.297*** (0.151)
Observations				3,000	3,000	3,000
Number of households	1,500	1,500	1,500	1,500	1,500	1,500

B: Conflict intensity (no. of fatalities)

Conflict intensity (100s of fatalities)	3.394*** (0.561)	-12.232*** (1.891)	0.204*** (0.062)	2.281*** (0.561)	-0.456 (1.930)	0.075*** (0.006)
Baseline CSI	0.951*** (0.026)					
Baseline FCS		0.471*** (0.017)				
Baseline Food ratio			0.281*** (0.013)			
Constant	0.226 (0.664)	31.665*** (2.263)	0.623*** (0.021)	8.778*** (2.502)	27.734*** (7.424)	0.872*** (0.069)
Baseline controls	yes	yes	yes	No	No	No
Household fixed effects	No	No	No	yes	yes	yes
Observations				3,000	3,000	3,000
Number of households	1,500	1,500	1,500	1,500	1,500	1,500

Notes: CSI = Coping strategy index, FCS = food consumption score; Food ratio = Share of household per capita food expenditure; Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

all estimations in this subsection use pre-conflict levels of resilience, which also accords with the literature on resilience insurance of risks ([Alinovi et al., 2010]). Specifically, the pooled estimation sample is partitioned and designated as low and high resilience capacity groups of households according to whether baseline resilience capacity was below or above the resilience of the median household. Thereafter, the following equation is estimated:

$$FS_{it} = \tau_t + \theta_i + \alpha Conflict_i \times POST_t + \eta Conflict_i \times R_{i0}^{high} \times POST_t + \varepsilon_{it} \quad (2.6)$$

where R_{i0}^{high} is a dummy variable indicator of whether the resilience capacity of the household at baseline exceeds the median resilience among the pool of households. The R_{i0}^{high} is computed from the overall resilience index and the indices of the respective four pillars, and included in equation 2.6. Other variables and parameters in the equation remain as described in the previous equations. The interest parameter in this equation is η , which captures the conflict effect differential on households of high resilience capacity compared to households of low resilience capacity. Similar to Equation 2.5, equation 2.6 exploits the panel structure of the data through within transformation, and the panel structure allows time-invariant household-specific unobservable factors to be differenced out.

The results reported in table 2.4 indicate that resilience indeed absorbs food security shocks. The estimated interactions in table 2.3 generally highlight that households of low level of resilience are more severely affected by the conflict than those of high resilience capacity are, which is observed across the dimensions of food security. Comparatively, the resilience pillar of SSN is the most influential in attenuating shocks in terms of magnitude of effects and spread across the food (in)security dimensions. The extant literature supports this, which has already established that SSN are important pools of resources for the mitigation of sudden shocks, most times supported by other pillars of resilience such as ABS and AC ([Smith and Frankenberger, 2018]; [Bruck et al., 2019]). Particularly, while the effect of the conflict on the outcome of FCS as reported in table 2.3 is insignificant, table 2.4 shows that households with higher overall resilience capacity seem to have gained in food security. Estimated as $\alpha + \eta$, high overall resilience capacity

is associated with a gain of about 4 FCS points, SSN alone with about 3 FCS points, and high assets with about half an FCS point. The strong response of FCS to RCI is somewhat puzzling, especially from the perspectives of households under destabilizing conflict and requires further accounting. It might be argued that SSN comprising public and private remittances to households reacts sharply to emergencies, and thus accounts for much of this effect. Thus, in table A.9, the entire variables used to compute the RCI are included in the estimation to explore the possibility that the entire interaction effect may be accounted by a few variables. Nevertheless, the estimate of interest did not change significantly, rather the overall effect of the conflict disappears, indicating that the conflict impacts on the FCS only through the variables constituting household resilience capacity. Among the variables constituting SSN, only the variables indicating whether the household was migrant are significant, but all the included variables collectively could not fully account for the estimate of interest, which is the triple interaction coefficient of resilience, conflict and post. Another potential mechanism might derive from the interference of the conflict with the inseparable production and consumption of agricultural households ([Bardhan and Udry, 1999]). [Hoek, 2017] describes the disruption of local markets by the Boko Haram conflict, which prevents the households from engaging in the usual market exchange of commodities. A plausible consequence of this might be that households discouraged from routine engagement in market exchanges would then resort to autoconsumption of home production, thereby contributing to multiplying dietary diversity. This is partially supported by the fact that proximity to markets accounts for a significant part of the FCS increase in table A.13, and this pattern is also reported in [George et al., 2019]. Unfortunately, the precise location of markets is not available in the data used in this study, which prevents further investigation of this intuition through strategies that would have accounted for conflict attacks within market locations.

Table 2.4: Impact of baseline resilience levels on the food security during exposure to the conflict

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
	CSI	CSI	CSI	CSI	CSI	FCS	FCS	FCS	FCS	FCS	FR	FR	FR	FR	FR
<i>Conflict</i> × <i>POST</i>	1.386*** (0.527)	1.625*** (0.540)	1.052* (0.547)	2.064*** (0.535)	1.211** (0.534)	-5.394*** (1.656)	-2.946* (1.693)	-1.500 (1.715)	-0.687 (1.684)	-3.991** (1.680)	0.079*** (0.015)	0.081*** (0.016)	0.078*** (0.016)	0.071*** (0.016)	0.078*** (0.016)
<i>RCI^{high}</i> × <i>Conflict</i> × <i>POST</i>	-0.380 (0.431)					9.119*** (1.353)					0.016 (0.012)				
<i>ABS^{high}</i> × <i>Conflict</i> × <i>POST</i>		-0.788* (0.417)					2.000 (1.315)					0.007 (0.012)			
<i>AC^{high}</i> × <i>Conflict</i> × <i>POST</i>			0.365 (0.418)					-0.914 (1.316)					0.013 (0.012)		
<i>SSN^{high}</i> × <i>Conflict</i> × <i>POST</i>				-1.783*** (0.417)					2.808** (1.319)					-0.030*** (0.012)	
<i>Asset^{high}</i> × <i>Conflict</i> × <i>POST</i>					0.0739 (0.420)					4.579*** (1.324)					0.017 (0.012)
Household controls ?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	1.030*** (0.357)	1.030*** (0.357)	1.030*** (0.357)	1.030*** (0.357)	1.030*** (0.357)	54.50*** (1.121)	54.50*** (1.132)	54.50*** (1.133)	54.50*** (1.131)	54.50*** (1.129)	0.747*** (0.010)	0.747*** (0.009)	0.747*** (0.009)	0.747*** (0.009)	0.747*** (0.009)
Observations	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000
Number of households	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500

Notes: RCI = Resilience capacity index, ABS = index of Access to basic services, AC = index of adaptive capacity, SSN = Index of social safety nets; Asset = Index of household assets; CSI = Coping strategy index, FCS = food consumption score; Food ratio = Share of household per capita food expenditure; Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

2.5 longer term effects

2.5.1 Conflict exposure and the household resilience capacity

The preceding section demonstrates the importance of resilience in protecting household food security despite the conflict shocks. However, conflict could also diminish resilience through the destruction of the various pillars upon which resilience is anchored such as assets and ABS ([Justino, 2012]; [Minoiu and Shemyakina, 2014]). In large parts, this portends the critical channel that extends current shocks to long-term consequences - described by [Bene et al., 2016] as a "vulnerability trap." This section estimates the empirical approximation of this relationships. To do this, the empirical specification developed in section 2.4.2 is replicated in equation 2.7 below:

$$RC_{it} = \tau_t + \theta_i + \alpha Conflict_i \times POST_t + \varepsilon_{it} \quad (2.7)$$

All variables and parameters remain as described in section 2.4.2, except that the outcome variable RC_{it} stands for the overall resilience index (RCI) or its pillars denoted by ABS, SSN, AC and access to assets (Asset). The inclusion of household fixed effects θ_i accounts for some time-invariant unobserved household characteristics that may be correlated with exposure to the conflict.

Table 2.5: Effects of conflict exposure on resilience capacity

VARIABLES	(1) RCI	(2) RCI	(3) ABS	(4) ABS	(5) SSN	(6) SSN	(7) AC	(8) AC	(9) ASSET	(10) ASSET
<i>Conf</i> × <i>POST</i>	-0.097** (0.044)		-0.065** (0.032)		0.190*** (0.063)		-0.076** (0.031)		-0.107 (0.077)	
<i>fatalities</i> × 100		-0.137*** (0.021)		-0.104*** (0.021)		1.653** (0.792)		-0.251*** (0.038)		-0.222*** (0.046)
Household FE ?	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Constant	1.559*** (0.189)	1.593*** (0.180)	1.675*** (0.059)	1.625*** (0.056)	4.211*** (0.203)	3.782*** (0.196)	1.559*** (0.067)	1.559*** (0.064)	7.914*** (0.149)	7.881*** (0.140)
Observations	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000
Households	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500

Notes: RCI = Resilience capacity index, ABS = index of Access to basic services, AC = index of adaptive capacity, SSN = Index of social safety nets; Asset = Index of household assets

Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

The results in table 2.5 show that the exposure to the conflict is negatively associated with overall resilience and most of its pillars - except the SSN, which actually increased. The RCI declined by 0.097 points - in the magnitude of about 42 percent of pre-exposure mean. The ABS declined by 32 percent (0.065 points reduction), AC declined by 40 percent (0.076 points reduction). As for ASSETS, the reduction was insignificant, and the study attributes this to the nature of the Boko Haram conflict being a guerrilla rather than a full-blown war. Such conflicts use mainly the strategies of kidnappings, petty thefts and scaremongering, which may not have enough intensity to significantly decimate assets by destruction or forced sales ([Falode, 2016]; [Baliki et al., 2018]; [Hoddinott, 2006]).

The increase in SSN aligns with the previous findings (e.g; [Bruck et al., 2019]). The average effect on the SSN is 0.19 points - about 56 percent of the pre-exposure mean. However, the incentive structures of SSN make the long-term extrapolation of this effect complex. Increased safety nets may safeguard household welfare during shocks or enable them to quickly recover lost economic welfare, inclusive of food security. Yet at the same time, disaster transfers can create moral hazard problems that may produce the so-called conflict merchants who create violence to attract aid ([Dercon, 2002]; [Heemskerk et al., 2004]). Nevertheless, this effect should be interpreted cautiously given that the exposed households were slightly more endowed with safety nets prior to conflict exposure, creating some doubts on the attribution of the observed increases to responses targeted at households exposed to the conflict. The effect on safety nets aside, other pillars are negatively affected; AC which incorporates informal networks within and outside households reduced, and so did access to critical infrastructures, which are part of the ABS. Hence, except when timely policies are well-targeted with respect to these aspects, the above results taken together may suffice to conclude in favor of negative long-run consequences within this partial equilibrium framework. In fact, [Sanders and Weitzel, 2013] argue that except when institutional resources are rapidly restored after violent conflicts, upsurge in aid during conflicts may have negative social and economic consequences through destructive entrepreneurship. Nevertheless, a general equilibrium framework may be most appropriate to reach such a conclusion, especially in view of the lack of conclusion on the domain of

safety nets.

2.6 Robustness checks

Results in the preceding sections established rather strong negative effects of the conflict, directly on food security but attenuated through the resilience capacity. The conflict also produced potential long-term effects through the reduction of the level of household resilience capacity. However, these effects are obtained conditional to the controls for observable characteristics and the study sample restriction strategy, which assumes a balanced distribution of unobservable characteristics (potential confounders) between the treated and control groups. This section tests the robustness of these results by relaxing some of the critical assumptions of the previous estimations, particularly relating to critical resilience capacity thresholds and sample selection that might bias the results. For the resilience thresholds, tables A.10, A.11 and A.12 replace the thresholds derived based on the median level of household resilience with the top quartiles of resilience in the estimations, and the results remain conclusively similar. Similarly, to further disaggregate the estimated effects of the conflict on resilience as reported in table 2.5, the original variables used to compute the resilience indices are employed as the outcome variables and estimated. While the results reported in table A.13 demonstrate that the conflict affected most of the original variables across the various resilience pillars, much of the effects fall on the components of the SSN.

2.6.1 Selection into conflict exposure

Although the determination of exposure and control groups by means of realized and future exposure to the conflict strongly suggests balance in treatment confounders, there remains some chance that time-varying confounders unrelated to the conflict might disrupt the parallel trend assumption and bias the estimations. In this subsection, I pursue a test of any indication of this that might have started during the pre-treatment period. Following the sample restriction adopted in the study, I estimate the probability of being included in the exposure group based on baseline control characteristics. The probability

is specified as follows:

$$Conflict_{i1} = \alpha + X'_{i0}\delta + \theta_c + \epsilon_i \quad (2.8)$$

where $Conflict_{i1}$ is a dummy variable which takes value 1 if $household_i$ living in community c is included in the exposure group (5km or 7km buffer), and zero otherwise. $X'_{i0}\delta$ is a vector of household and household head characteristics used as control in the previous estimations, and ϵ_{ijs} is the error term. On the premise that certain community characteristics are important determinants of conflict onset, θ_c is included in the selection model. θ_c denotes a vector of community dummy variables, where the survey enumeration areas are used as proxies for communities although they are a bit larger than communities geographically.

Table A.3 reports the results estimated by binary probit model. Clearly, exposure is not selective on the observed control variables. Additionally, indicators of resilience capacity are included to further assess the randomness of exposure even in this dimension. The results implicated the SSN dimension of resilience capacity, which is more favorable to the exposure group at the baseline. Therefore, this has to be remembered while interpreting this aspect of the estimations. The implication might be that the exposed group has a stronger external base of resilience that could be leveraged during emergencies, and this might be a source of potential bias to the estimated role of resilience capacity and its pillars. To further ensure robustness of this aspect of the analyses particularly in relation to the puzzling finding in the case of FCS, the entire array of the first stage variables used in the computation of the pillars of resilience is additionally employed in the estimation of the role of resilience capacity in table A.9. The finding did not significantly change, except that the direct effect of the conflict was taken over by the added variables.

2.6.2 Alternative measure of exposure

In order to partition the sample into exposed and control households, the paper creates a series of buffers around any conflict event, some of which prove too large to allow the separation of the two groups of households. The largest radius that allows reasonable separation is around the 7KM radius, which makes it the reference radius of exposure for the study. Nevertheless, in this section, the smaller alternative buffer (5KM radius) is

used. All the previous estimations were repeated under the new exposure measure and the new sets of estimations mirror the former. However, in some cases, coefficients appear stronger but are never statistically different from their previous levels. The estimated baseline estimation on food security is reported in table A.5, while the rest of the results are retained by the author to conserve space. The remaining results are available from the author on demand.

2.7 Conclusion and policy recommendations

Using three main indicators of food (in)security, the coping strategy index (CSI), share of food expenditure per capita (Food ratio) and the food consumption score (FCS), this paper demonstrates that exposure to the Boko Haram conflict caused the households to move down the ladder of food security. The overall effects of the conflict are substantial and negative on all the dimensions of food security. However, these overall effects hide substantial heterogeneities across levels of resilience capacity. These heterogeneities are further explored by comparing households of high and low levels of resilience through a model of triple interactions of resilience, conflict exposure and time. The estimations yield the unambiguous prediction that resilience protects household welfare during conflict shocks in line with the theoretical prediction of resilience as a place holder for household welfare. While social safety nets (SSN) dominate the other pillars of resilience in absorbing the shocks, other pillars also play significant roles.

It is anticipated that violent conflict might decimate resilience, and thus push the households into traps of poverty and vulnerability to food insecurity. Hence, it was further estimated that the conflict reduced the overall resilience capacity by 42 percent, ABS by 32 percent, and AC by 40 percent. Contrastingly, the index of SSN increased in line with theoretical expectation. The increase in SSN reflects all the humanitarian aid from donor agencies and private individuals provoked by the need to cushion the conflict-induced sufferings. In all, this study supports the ongoing arguments about the merits of the resilience approach to development, which aims to enhance the ability of systems (households, communities, and states) to withstand and recover from shocks. The

study demonstrates that resilience cushions shocks, while being susceptible to the same. Therefore, resilience deserves important consideration during post disaster interventions.

While short-term interventions such as food and cash aids may curtail immediate and direct welfare losses, serial vulnerability may only be eliminated through interventions rebuilding resilience. Advising on the specific projects for enhancing resilience lies beyond the scope of this study. However, it is clear from this study that the enabling environment for resilience comprises public use services such as markets, roads, health facilities and other basic infrastructure that policy would be able to target. To incorporate these in development, public policies in shock-prone regions need to be multi-sectoral and forward looking. The paper invites governments, inter-governmental, and non-governmental organizations to incorporate the enhancement of resilience in future intervention programs.

While the study has employed a number of rigorous estimation procedures to arrive at the reported estimates, no strong claim is being made as to causality given that certain aspects of the estimations do not yield to clear-cut identification. In particular, it may be acknowledged that whereas the computation of the resilience index follows a well-established procedure, the constructed index may not fully capture the essence of the concept. Resilience being multifaceted and data driven, its computation may easily be compromised (see; [Bruck et al., 2019]; [Smith and Frankenberger, 2018]). In this light, the structural relationships underlying the concept of resilience capacity risks being undermined due to data quality, and in turn compromising the estimated effects. This, therefore, invites cautious interpretation of this aspect of the results.

Bibliography

- [Abadie, 2006] Abadie, A. (2006). Poverty, political freedom, and the roots of terrorism. *American Economic Review*, 96(2):50–56.
- [Adamu et al., 2019] Adamu, P. I., Okagbue, H. I., Akinwumi, I., and Idowu, C. (2019). Trends of non-communicable diseases and public health concerns of the people of northeastern nigeria amidst the boko haram insurgency. *Journal of Public Health*, pages 1–9.
- [Adelaja and George, 2019] Adelaja, A. and George, J. (2019). Effects of conflict on agriculture: Evidence from the boko haram insurgency. *World Development*, 117:184–195.
- [Adesoji, 2010] Adesoji, A. (2010). The boko haram uprising and islamic revivalism in nigeria. *Africa spectrum*, 45(2):95–108.
- [Alinovi et al., 2008] Alinovi, L., Mane, E., and Romano, D. (2008). Towards the measurement of household resilience to food insecurity: applying a model to palestinian household data. *Deriving food security information from national household budget surveys. Food and Agriculture Organization of the United Nations, Rome, Italy*, pages 137–152.
- [Alinovi et al., 2009] Alinovi, L., Mane, E., and Romano, D. (2009). Measuring household resilience to food insecurity: application to palestinian households. *EC-FAO Food Security Programme Rom.*

- [Alinovi et al., 2010] Alinovi, L., Mane, E., and Romano, D. (2010). Measuring household resilience to food insecurity: Application to palestinian households. *Agricultural Survey Methods*, pages 341–368.
- [Baliki et al., 2018] Baliki, G., Bruck, T., and Stojetz, W. (2018). Drivers of resilience and food security in north-east nigeria: Learning from micro data in an emergency setting.
- [Barbara et al., 2012] Barbara, S., Ruth, C., Victor, N., Romaric, G., Etel, G., and Babacar, S. (2012). West african food composition table. *Food and Agriculture Organization*.
- [Bardhan and Udry, 1999] Bardhan, P. and Udry, C. (1999). *Development microeconomics*. OUP Oxford.
- [Bene et al., 2016] Bene, C., Headey, D., Haddad, L., and von Grebmer, K. (2016). Is resilience a useful concept in the context of food security and nutrition programmes? some conceptual and practical considerations. *Food Security*, 8(1):123–138.
- [Bertoni et al., 2018] Bertoni, E., Maio, M. D., Molini, V., and Nisticò, R. (2018). Education is forbidden: The effect of the boko haram conflict on education in north-east nigeria. ID: 271688.
- [Blattman and Miguel, 2010] Blattman, C. and Miguel, E. (2010). Civil war. *Journal of Economic literature*, 48(1):3–57.
- [Bruck et al., 2019] Bruck, T., d’Errico, M., and Pietrelli, R. (2019). The effects of violent conflict on household resilience and food security: Evidence from the 2014 gaza conflict. *World Development*, 119:203–223.
- [Campbell, 2019] Campbell, J. (2019). Nigeria security tracker: from africa program and nigeria on the brink. Technical Report p29483, The US Council on Foreign Relations.
- [Campbell and Harwood, 2018] Campbell, J. and Harwood, A. (2018). Boko haram’s deadly impact. Technical report, The US Council on Foreign Relations.

- [Cherchye et al., 2007] Cherchye, L., Rock, B. D., and Vermeulen, F. (2007). The collective model of household consumption: a nonparametric characterization. *Econometrica*, 75(2):553–574.
- [Chukwuma and Ekhatator-Mobayode, 2019] Chukwuma, A. and Ekhatator-Mobayode, U. E. (2019). Armed conflict and maternal health care utilization: evidence from the boko haram insurgency in nigeria. *Social science medicine*, 226:104–112.
- [Ciani and Romano, 2014] Ciani, F. and Romano, D. (2014). Testing for household resilience to food insecurity: Evidence from nicaragua. In *2014 Third Congress, June 25-27, 2014, Alghero, Italy*. Italian Association of Agricultural and Applied Economics (AIEAA).
- [Dercon, 2002] Dercon, S. (2002). Income risk, coping strategies, and safety nets. *The World Bank Research Observer*, 17(2):141–166.
- [d’Errico and Giuseppe, 2016] d’Errico, M. and Giuseppe, S. D. (2016). *A dynamic analysis of resilience in Uganda*.
- [d’Errico et al., 2018] d’Errico, M., Romano, D., and Pietrelli, R. (2018). Household resilience to food insecurity: evidence from tanzania and uganda. *Food Security*, 10(4):1033–1054.
- [D’Souza and Jolliffe, 2013] D’Souza, A. and Jolliffe, D. (2013). Conflict, food price shocks, and food insecurity: The experience of afghan households. *Food Policy*, 42:32–47.
- [Falode, 2016] Falode, J. A. (2016). The nature of nigeria’s boko haram war, 2010-2015: A strategic analysis. *Perspectives on Terrorism*, 10(1):41–52.
- [FAO, 2016] FAO (2016). Rima - ii resilience index measurement and analysis - ii. Technical Report ISBN 978-92-5-109235-4, Food and Agricultural Organisation of United Nations.
- [Fao, 2015] Fao, I. (2015). Wfp (2014) the state of food insecurity in the world 2014: strengthening the enabling environment for food security and nutrition. *FAO, Rome*.

- [George et al., 2019] George, J., Adelaja, A., and Weatherspoon, D. (2019). Armed conflicts and food insecurity: Evidence from boko haram’s attacks. *American Journal of Agricultural Economics*.
- [Heemskerk et al., 2004] Heemskerk, M., Norton, A., and de Dehn, L. (2004). Does public welfare crowd out informal safety nets? ethnographic evidence from rural latin america. *World Development*, 32(6):941–955. ID: 271773.
- [Hoddinott, 2006] Hoddinott, J. (2006). Shocks and their consequences across and within households in rural zimbabwe. *The Journal of Development Studies*, 42(2):301–321.
- [Hoek, 2017] Hoek, J. V. D. (2017). *Agricultural market activity and Boko Haram attacks in northeastern Nigeria*.
- [Iyekekpolo, 2016] Iyekekpolo, W. O. (2016). Boko haram: understanding the context. *Third World Quarterly*, 37(12):2211–2228.
- [Jensen and Miller, 2010] Jensen, R. T. and Miller, N. H. (2010). *A revealed preference approach to measuring hunger and undernutrition*.
- [Justino, 2012] Justino, P. (2012). Shared societies and armed conflict: Costs, inequality and the benefits of peace. *IDS Working Papers*, 2012(410):1–23.
- [Kimenyi et al., 2014] Kimenyi, M., Adibe, J., Djire, M., and Jirgi, A. J. (2014). The impact of conflict and political instability on agricultural investments in mali and nigeria.
- [Kozłowska et al., 2015] Kozłowska, K., d’Errico, M., Pietrelli, R., and Giuseppe, S. D. (2015). *Resilience analysis in Burkina Faso*.
- [Lovon and Mathiassen, 2014] Lovon, M. and Mathiassen, A. (2014). Are the world food programme’s food consumption groups a good proxy for energy deficiency? *Food security*, 6(4):461–470.
- [Marc et al., 2015] Marc, A., Verjee, N., and Mogaka, S. (2015). *The challenge of stability and security in West Africa*. The World Bank.

- [Maxwell et al., 1999] Maxwell, D., Ahiadeke, C., Levin, C., Armar-Klemesu, M., Zakariah, S., and Lamptey, G. M. (1999). Alternative food-security indicators: revisiting the frequency and severity of ‘coping strategies’. ID: 271787.
- [Maxwell, 1996] Maxwell, D. G. (1996). Measuring food insecurity: the frequency and severity of “coping strategies”. *Food Policy*, 21(3):291–303.
- [Messer and Cohen, 2007] Messer, E. and Cohen, M. J. (2007). Conflict, food insecurity and globalization. *Food, Culture Society*, 10(2):297–315.
- [Minoiu and Shemyakina, 2014] Minoiu, C. and Shemyakina, O. N. (2014). Armed conflict, household victimization, and child health in côte d’ivoire. *Journal of Development Economics*, 108:237–255.
- [Omeni, 2018] Omeni, A. (2018). Boko haram’s covert front. *Journal of African Conflicts and Peace Studies*, 4(1):2.
- [Onapajo, 2017] Onapajo, H. (2017). Has nigeria defeated boko haram? an appraisal of the counter-terrorism approach under the buhari administration. *Strategic Analysis*, 41(1):61–73.
- [Osabohien, 2018] Osabohien, R. (2018). Contributing to agricultural mix: Analysis of the living standard measurement study–integrated survey on agriculture data set. *Data in Brief*, 20:96–100.
- [Pinstrup-Andersen and Shimokawa, 2008] Pinstrup-Andersen, P. and Shimokawa, S. (2008). Do poverty and poor health and nutrition increase the risk of armed conflict onset? *Food Policy*, 33(6):513–520.
- [Sanders and Weitzel, 2013] Sanders, M. and Weitzel, U. (2013). Misallocation of entrepreneurial talent in postconflict environments. *Journal of Conflict Resolution*, 57(1):41–64.
- [Smith and Frankenberger, 2018] Smith, L. C. and Frankenberger, T. R. (2018). Does resilience capacity reduce the negative impact of shocks on household food security? evidence from the 2014 floods in northern bangladesh. *World Development*, 102:358–376.

- [Smith and Davies, 1995] Smith, M. B. and Davies, S. (1995). *Famine early warning and response: the missing link*. Intermediate Technology Publications.
- [Spedding, 1988] Spedding, C. (1988). *A systems approach to agriculture*, pages 15–40. *An Introduction to Agricultural Systems*. Springer.
- [Tendall et al., 2015] Tendall, D., Joerin, J., Kopainsky, B., Edwards, P., Shreck, A., Le, Q., Krütli, P., Grant, M., and Six, J. (2015). Food system resilience: defining the concept. *Global Food Security*, 6:17–23.
- [WFP, 2008] WFP (2008). Food consumption analysis: Calculation and use of the food consumption score in food security analysis. *United Nations Vulnerability Analysis and Mapping Branch*.

Chapter 3

Accessing schools when it matters:
the effect of university proximity
during teenagehood on educational
attainment

Abstract

From the point of view of access to education being a serious constraint to human capital accumulation in developing countries, we investigate the impact of geographical proximity to universities at critical ages on educational attainment in Nigeria. We rely on three available rounds of the Nigeria's Living Standard Measurement Survey to match educational attainments of individuals to spatial distance to universities during schooling years measured by pairing residential locations and university campuses using geographical information systems. To address potential endogenous residential choices and identify the effect of university proximity, we derive identifying instruments based on the "Tiebout 1956"'s theory of residential sorting. Specifically, we instrument distance to university drawing on variations in households' proximity to state boundary posts and neighbourhood population density, which captures the Tiebout hypothesis of "voting with the feet" in response to economic opportunities including education. Under the instrumental variables strategy, we find that distance to university limits schooling irrespective of sector of settlement and gender. The main result indicates that 10km increase in the distance leads to 0.5 years reduction in completed schooling. We further support the finding with impact evaluation of recently established large-scale universities in selected states of Nigeria. Exploiting the quasi-random nature of the establishment under difference-in-difference strategy, we find that the universities have positive spillovers on the secondary schools market by decreasing the intention to drop out, supporting the earlier finding that access to education may be a critical constraint to accumulation of human capital in Nigeria.

3.1 Introduction

Improved access to education, especially high skills producing units such as universities features in the policy priorities of developing countries ([Moja, 2000]). Universities support social and economic development through the production of specific and general human capital ([Valero and Reenen, 2019]; [Cantoni and Yuchtman, 2014]), as part of the process of economic growth ([Barro, 2001]; [Becker et al., 2011]). In spatial terms, the costs of access may increase with distance ([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, 2001]; [Card, 1993]). 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 et al., 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 ([Kazeem, 2017]; [Ejoigu and Sule, 2012]). Moreover, Nigeria is currently committed to increasing tertiary education capacity through the construction of more universities ([Osili and Long, 2008])

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 ([Afoakwa and Koomson, 2021]; [Gibbons and Vignoles, 2012]; [Falch et al., 2013]). 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

3.2 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 ([Oyelere, 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. 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

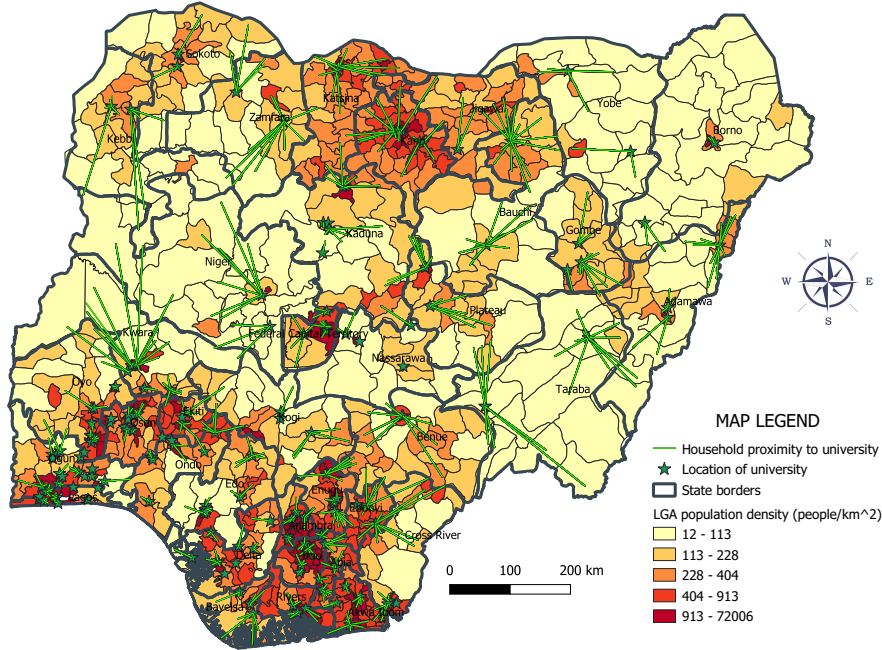
In part, the regional differences in access to education originated from the colonial period via the roles of the colonial Christian missionaries through whom formal education was introduced in Nigeria ([Okoye and Pongou, 2014]; [Okoye, 2021]). As part of its divide and rule policy, the colonial administration 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]; [Daun, 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, there have been national policies aimed at

¹The 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])

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]; [Oyelere, 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 ([commission (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 3.1 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.

²From 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 3.1: LGA population density and proximity to university



Data source : [LSMS](#), [NUC](#) and [Authors](#)

3.3 Empirical approach

3.3.1 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

³The 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])

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 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 B.1 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.

3.3.2 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:

$$Schooling_{ihlk} = \alpha + \beta.Dist_{hlk}^a + \sigma.X_{ih} + \theta_k + \varepsilon_{ihlk} \quad (3.1)$$

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 $Dist_{hlk}^a$ 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 school⁴, household’s sector of residence (urban vs rural) and average parental education⁵. 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 arbitrary correlation within households.

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:

$$Dist_{hlk}^a = \alpha + \lambda_1.Distborder_h + \lambda_2.Popdens_l + \sigma.X_{ih} + \theta_k + \varepsilon_{hlk} \quad (3.2)$$

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. 3.1. 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.

⁴This 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.

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

3.3.3 Identification Issues

If there are no systematic biases, Eq. 3.1 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 these 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., 2007]; [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 et al., 2007]). 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 ([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 over-identifying 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, 2002]).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 3.1 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 border posts and population density at the LGA level might be correlated with a range of

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

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.

3.3.4 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 years⁷. 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 3.1: 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

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

3.4 Findings

3.4.1 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. 3.2, whereas columns 2 and 4 report the second stage estimates specified in Eq. 3.1. The instruments 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 years⁸. These estimates agree with the inference of previous studies (e.g. [Falch et al., 2013]), to the extent that geographical constraints discourages schooling.

⁸A 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.

Table 3.2: Main estimates - The impact of distance to university on years of schooling

VARIABLES	(1)	(2)	(3)	(4)
	At 12 years		At 18 years	
	Dist. Univ	Yrs of Schooling	Dist. Univ	Yrs of Schooling
Dist. Univ		-5.423*** (0.562)		-6.520*** (0.810)
Dist. Border	-0.176*** (0.0225)		-0.119*** (0.0247)	
LGA pop. Density	-0.0555*** (0.0105)		-0.0642*** (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

3.4.2 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 dummy⁹. The estimates provided in Table 3.4 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 3.3: Heterogeneity : The impact of distance to university on years of schooling by gender

VARIABLES	(1)	(2)	(3)	(4)
	Years of schooling			
	At 12 years		At 18 years	
	Male	Female	Male	Female
Dist. Univ	-4.787*** (0.610)	-6.088*** (0.767)	-6.123*** (0.921)	-6.415*** (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

⁹The 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 3.4: Heterogeneity : The impact of distance to university on years of schooling by accounting for the neighborhood effect

VARIABLES	(1)	(2)
	At 12 years	At 18 years
	Years of Schooling	
Dist. Univ	-0.675*** (0.0750)	-0.682*** (0.0754)
Dist. Univ x LGA schooling	0.393*** (0.108)	0.334*** (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

3.4.3 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.

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

Table 3.5: Alternative subsamples

VARIABLES	(1)	(2)	(3)	(4)
	HH head aged more than 35		Non-movers	
	At 12 years	At 18 years	At 12 years	At 18 years
Dist. Univ	-3.448*** (0.846)	-4.297*** (1.212)	-4.616*** (0.770)	-4.338*** (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.

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

3.5 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 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

¹¹In Table B.1 in the Appendix, we provide a comprehensive list of federal universities in Nigeria.

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

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 decreases¹⁵, and we claim that the latter depends on costs, notably distance to university, and the

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

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

¹⁵This 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])

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 :

$$Drop_{iht} = \alpha + \beta_1 New25km_h + \beta_2 Post_t + \beta_3 New25km_h \times Post_t + \Gamma X_{it} + \Theta Z_{ht} + \sigma_s + \epsilon_{iht} \quad (3.3)$$

Subscripts i and h denote individuals and households, respectively. The dependent variable, $Drop_{iht}$ 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, $New25km_h$ 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 3.6 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 3.6: Raw Differences

<i>Drop-out Intention</i>			
	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			-.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 3.7, 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 3.7: DiD estimates : The effect of new university on secondary school drop-out intention

VARIABLES	(1)	(2)	(3)	(4)
	Drop-out intention			
NewUniv [0, 25 kms] \times Post	-0.0265*** (0.0103)	-0.0257** (0.0102)	-0.0258** (0.0102)	-0.0245** (0.0101)
Constant	0.0617*** (0.00302)	0.235*** (0.0163)	0.281*** (0.0189)	0.284*** (0.0199)
Observations	12,605	12,603	12,603	12,603
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:

$$Dropout_{ih,2010} = \alpha + \sigma NewUniv25_{2011} + \gamma X_{ih,2010} + \epsilon_{ih,2010} \quad (3.4)$$

Eq. 3.4 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 3.8, 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 3.9. 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 3.8: Test of parallel trend assumption

VARIABLES	(1) Drop-out intention
NewUniv [0,25 Kms] \times 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 3.9: 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

Standard errors in parentheses

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

3.6 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 educational constraints. This study follows 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 analyses, the paper interrogates the relationship between geographical distance and the accumulation of schooling. The first 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 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.

Bibliography

- [Adeyemi, 2001] Adeyemi, K. (2001). Equality of access and catchment area factor in university admissions in nigeria. *Higher Education*, 42(3):307–332.
- [Afoakwah and Koomson, 2021] Afoakwah, C. and Koomson, I. (2021). How does school travel time impact children’s learning outcomes in a developing country? *Review of Economics of the Household*, 19(4):1077–1097.
- [Agostinelli et al., 2020] Agostinelli, F., Doepke, M., Sorrenti, G., and Zilibotti, F. (2020). *It takes a village: the economics of parenting with neighborhood and peer effects*.
- [Alm and Boex, 2002] Alm, J. and Boex, J. (2002). An overview of intergovernmental fiscal relations and subnational public finance in nigeria. *International Center for Public Policy Working Paper Series, at AYSPS, GSU*, (paper0201).
- [Asher et al., 2018] Asher, S., Nagpal, K., and Novosad, P. (2018). The cost of distance: Geography and governance in rural india. *World Bank Working Paper*.
- [Bahrs and Siedler, 2019] Bahrs, M. and Siedler, T. (2019). University tuition fees and high school students’ educational intentions. *Fiscal Studies*, 40(2):117–147.
- [Barro, 2001] Barro, R. J. (2001). Human capital and growth. *American economic review*, 91(2):12–17.
- [Bayer et al., 2007] Bayer, P., Ferreira, F., and McMillan, R. (2007). A unified framework for measuring preferences for schools and neighborhoods. *Journal of political economy*, 115(4):588–638.

- [Bayer and McMillan, 2012] Bayer, P. and McMillan, R. (2012). Tiebout sorting and neighborhood stratification. *Journal of Public Economics*, 96(11-12):1129–1143.
- [Becker et al., 2011] Becker, S. O., Hornung, E., and Woessmann, L. (2011). Education and catch-up in the industrial revolution. *American Economic Journal: Macroeconomics*, 3(3):92–126.
- [Cannonier and Mocan, 2018] Cannonier, C. and Mocan, N. (2018). The impact of education on women’s preferences for gender equality: Evidence from sierra leone. *Journal of Demographic Economics*, 84(1):3–40.
- [Cantoni and Yuchtman, 2014] Cantoni, D. and Yuchtman, N. (2014). Medieval universities, legal institutions, and the commercial revolution. *The Quarterly Journal of Economics*, 129(2):823–887.
- [Card, 1993] Card, D. (1993). *Using geographic variation in college proximity to estimate the return to schooling.*
- [Card, 2001] Card, D. (2001). Estimating the return to schooling: Progress on some persistent econometric problems. *Econometrica*, 69(5):1127–1160.
- [Carneiro et al., 2011] Carneiro, P., Heckman, J. J., and Vytlacil, E. J. (2011). Estimating marginal returns to education. *American Economic Review*, 101(6):2754–2781.
- [commission (NUC), 1993] commission (NUC), N. U. (1993). Guidelines for establishing institutions of higher education in nigeria.
- [Daun, 2000] Daun, H. (2000). Primary education in sub-saharan africa—a moral issue, an economic matter, or both? *Comparative Education*, 36(1):37–53.
- [Do, 2004] Do, C. (2004). The effects of local colleges on the quality of college attended. *Economics of Education Review*, 23(3):249–257.
- [Ejoigu and Sule, 2012] Ejoigu, A. and Sule, S. (2012). Sixty-five years of university education in nigeria: Some key cross cutting issues. *Bulgarian Comparative Education Society.*

- [Ekpo, 1994] Ekpo, A. H. (1994). Fiscal federalism: Nigeria’s post-independence experience, 1960–90. *World Development*, 22(8):1129–1146. ID: 271773.
- [Falch et al., 2013] Falch, T., Lujala, P., and Strøm, B. (2013). Geographical constraints and educational attainment. *Regional Science and Urban Economics*, 43(1):164–176.
- [Favara et al., 2015] Favara, M., Appasamy, I., and Garcia, M. H. (2015). *Nigeria: skills for competitiveness and employability*. World Bank.
- [Feda et al., 2015] Feda, K., Savrimootoo, T. J., Lomme, R., Tomita, R., Siwatu, G. O., Dedu, G., and Miningou, E. W. (2015). *Governance and finance analysis of the basic education sector in Nigeria*.
- [Frenette, 2009] Frenette, M. (2009). Do universities benefit local youth? evidence from the creation of new universities. *Economics of education review*, 28(3):318–328.
- [FRN, 2013] FRN (2013). National policy on education, sixth edition. Technical report, Ministry of Education, Federal Republic of Nigeria.
- [Gibbons and Vignoles, 2012] Gibbons, S. and Vignoles, A. (2012). Geography, choice and participation in higher education in england. *Regional Science and Urban Economics*, 42(1):98–113. ID: 271675.
- [Gingrich and Ansell, 2014] Gingrich, J. and Ansell, B. (2014). Sorting for schools: housing, education and inequality. *Socio-Economic Review*, 12(2):329–351.
- [Gramlich and Rubinfeld, 1982] Gramlich, E. M. and Rubinfeld, D. L. (1982). Micro estimates of public spending demand functions and tests of the tiebout and median-voter hypotheses. *Journal of political Economy*, 90(3):536–560.
- [Grogan and Sadanand, 2013] Grogan, L. and Sadanand, A. (2013). Rural electrification and employment in poor countries: Evidence from nicaragua. *World Development*, 43:252–265.

- [Havnes and Mogstad, 2011] Havnes, T. and Mogstad, M. (2011). No child left behind: Subsidized child care and children’s long-run outcomes. *American Economic Journal: Economic Policy*, 3(2):97–129.
- [Hübner, 2012] Hübner, M. (2012). Do tuition fees affect enrollment behavior? evidence from a ‘natural experiment’ in germany. *Economics of Education Review*, 31(6):949–960.
- [Isumonah and Egwaikhide, 2013] Isumonah, V. A. and Egwaikhide, F. O. (2013). Federal presence in higher institutions in nigeria and the north/south dichotomy. *Regional Federal Studies*, 23(2):169–188.
- [Jagnani and Khanna, 2020] Jagnani, M. and Khanna, G. (2020). The effects of elite public colleges on primary and secondary schooling markets in india. *Journal of Development Economics*, page 102512.
- [Kazeem, 2017] Kazeem, Y. (2017). Only one in four nigerians applying to university will get a spot.
- [Kling, 2001] Kling, J. R. (2001). Interpreting instrumental variables estimates of the returns to schooling. *Journal of Business Economic Statistics*, 19(3):358–364.
- [Lall et al., 2006] Lall, S. V., Selod, H., and Shalizi, Z. (2006). *Rural-urban migration in developing countries: A survey of theoretical predictions and empirical findings*. The World Bank.
- [Lebeau and Oanda, 2020] Lebeau, Y. and Oanda, I. O. (2020). Higher education expansion and social inequalities in sub-saharan africa: Conceptual and empirical perspectives. Technical Report WP 2020-10, United Nations Research Institute for Social Development (UNRISD).
- [Lee, 2018] Lee, M. M. (2018). The international politics of incomplete sovereignty: How hostile neighbors weaken the state. *International Organization*, 72(2):283.
- [Lincove, 2009] Lincove, J. A. (2009). Determinants of schooling for boys and girls in nigeria under a policy of free primary education. *Economics of Education Review*, 28(4):474–484.

- [Martin and Webster, 2020] Martin, G. J. and Webster, S. W. (2020). Does residential sorting explain geographic polarization? *Political Science Research and Methods*, 8(2):215–231.
- [Moja, 2000] Moja, T. (2000). Nigeria education sector analysis: An analytical synthesis of performance and main issues. *World Bank Report*, 3:46–56.
- [Molina and Rivadeneyra, 2021] Molina, T. and Rivadeneyra, I. (2021). The schooling and labor market effects of eliminating university tuition in ecuador. *Journal of Public Economics*, 196:104383. ID: 271705.
- [Mustapha, 1986] Mustapha, A. R. (1986). The national question and radical politics in nigeria. *Review of African Political Economy*, 13(37):81–96.
- [NBS, 2012] NBS (2012). Basic information document: Nigeria general household survey–panel.
- [NBS, 2020] NBS (2020). Nigerian bureau of statistics.
- [Obasi, 1997] Obasi, E. (1997). Structural adjustment and gender access to education in nigeria. *Gender and education*, 9(2):161–178.
- [Okoye, 2021] Okoye, D. (2021). Things fall apart? missions, institutions, and interpersonal trust. *Journal of Development Economics*, 148:102568.
- [Okoye and Pongou, 2014] Okoye, D. and Pongou, R. (2014). Historical missionary activity, schooling, and the reversal of fortunes: Evidence from nigeria. *Schooling, and the Reversal of Fortunes: Evidence from Nigeria (August 20, 2014)*.
- [Oreopoulos and Dunn, 2013] Oreopoulos, P. and Dunn, R. (2013). Information and college access: Evidence from a randomized field experiment. *The Scandinavian Journal of Economics*, 115(1):3–26.
- [Osili and Long, 2008] Osili, U. O. and Long, B. T. (2008). Does female schooling reduce fertility? evidence from nigeria. *Journal of Development Economics*, 87(1):57–75.

- [Oyebade and Keshinro, 2007] Oyebade, S. and Keshinro, O. (2007). The gap between the demand for and supply of university education in nigeria (1979–2002). *Kampala International University Research Digest*, 1(1):60–67.
- [Oyelere, 2008] Oyelere, R. U. (2008). Disparities in labor market outcomes across geopolitical regions in nigeria. fact or fantasy? *Journal of African Development*, 10(1):11–31.
- [Oyelere, 2010] Oyelere, R. U. (2010). Africa’s education enigma? the nigerian story. *Journal of Development Economics*, 91(1):128–139.
- [Patacchini and Zenou, 2011] Patacchini, E. and Zenou, Y. (2011). Neighborhood effects and parental involvement in the intergenerational transmission of education. *Journal of Regional Science*, 51(5):987–1013.
- [Rhode and Strumpf, 2003] Rhode, P. W. and Strumpf, K. S. (2003). Assessing the importance of tiebout sorting: Local heterogeneity from 1850 to 1990. *American Economic Review*, 93(5):1648–1677.
- [Salmon and Tanguy, 2016] Salmon, C. and Tanguy, J. (2016). Rural electrification and household labor supply: Evidence from nigeria. *World Development*, 82:48–68.
- [Senne, 2014] Senne, J.-N. (2014). Death and schooling decisions over the short and long run in rural madagascar. *Journal of Population Economics*, 27(2):497–528.
- [Simon et al., 2014] Simon, F., Pauline, M., and Álvarez Galván José-Luis (2014). *OECD Reviews of Vocational Education and Training A Skills beyond School Review of South Africa*. OECD Publishing.
- [Spiess and Wrohlich, 2010] Spiess, C. K. and Wrohlich, K. (2010). Does distance determine who attends a university in germany? *Economics of Education Review*, 29(3):470–479.
- [Staiger and Stock, 1997] Staiger, D. and Stock, J. H. (1997). Instrumental variables regression with weak instruments. *Econometrica: journal of the Econometric Society*, pages 557–586.

- [Tiebout, 1956] Tiebout, C. M. (1956). A pure theory of local expenditures. *Journal of political economy*, 64(5):416–424.
- [Valero and Reenen, 2019] Valero, A. and Reenen, J. V. (2019). The economic impact of universities: Evidence from across the globe. *Economics of Education Review*, 68:53–67. ID: 271751.
- [Yusuf et al., 2009] Yusuf, S., Saint, W., and Nabeshima, K. (2009). Accelerating catch-up: Tertiary education for growth in sub-saharan africa. *World bank*.

Chapter 4

Colonial missions and persistent inequality: evidence from human capital transmission

Abstract

High level of association between parents and children education capturing extent of economic inequalities is a consistent finding in the literature especially in developing countries, but it has been difficult to distinguish the causal mechanisms from pure selection. This has implications for the relative effectiveness of demand and supply sides interventions. This paper exploits the original geographical distribution of schools in Nigeria to identify the parental and neighbourhood contributions to educational mobility. Using conventional and heteroscedasticity based instruments, the study finds that parental and neighbourhood capitals significantly contribute to the human capital of offspring, where capitals are respectively denoted by average education of parents and neighbourhoods. Furthermore, when the total effect is decomposed based on the causal mediation framework, the parental capital accounts for about 25% while neighbourhood capital accounts for 75%. This implies that supply side policies such as raising the quantity and quality of schools across districts could be an important option for raising equality of economic opportunities.

4.1 Introduction

In the literature of human capital accumulation, studies frequently find inequalities across individuals and groups which is known to spillover into economic opportunities. Earlier studies of inequalities of opportunities in Africa trace the origin to colonial heritage (e.g; [Cogneau and Mesple-Soms, 2008]), but fail to account for the mechanisms of transmission across generations. While most of this may be due to the distribution of innate abilities, it has been shown that family backgrounds and neighbourhood quality make substantial contributions (see: [Zimmerman, 2001]; [Glick and Sahn, 2000]). Studies under the framework of intergenerational transmission focus specifically on the role of parental endowments including education, and this has produced overwhelming evidence that parents have large effects on the education of their children. However, the question is no longer if they do, but to what degree? The degree to which parents manipulate the economic outcomes of their children captures the degree of persistence of social and economic inequalities. Policies might need to alter this and improve economic equality, but through what policies? From the point of view of human capital accumulation, the optimal set of policies might depend on whether the inertia is due to demand or supply constraints. Nigeria has in the past deployed a mix of demand and supply sides policies but with little achievements ([Lincove, 2015]). Using the 2019 Nigerian Living Standards Surveys (NLSS), this paper investigates the persistence of economic opportunities designated in terms of educational attainment, and relies on the original distribution of schools in Nigeria via the colonial Christian missionaries to identify the important estimates.

The missionaries pioneered the provision of social services comprising education and health services in Nigeria at a time when the colonial governments had limited capacity to provide such services. The missionaries also transmitted various forms of cultural change towards modern economic systems, but in general were not allowed to distribute the activities all over the country. I employ the neighbourhood capital defined as the average years of education within neighbourhood as an intervening influence on the intergenerational transmission of human capital. This sets up a causal mediation framework where parental and neighbourhood capitals are jointly determined. Then, drawing from historical

accounts, I use measures of the historical activities of the missionaries as instrument to empirically parse out the direct and indirect effects of parental human capital. I argue that parents influence their children human capital directly by investing in their education, and indirectly by deciding the schooling neighbourhoods. The parental and neighbourhood capitals are necessarily linked through neighbourhood sorting based on educational preferences. The instrumental variable causal mediation analysis which harnesses these relationships is then employed to parse out the direct and indirect effects. The historical activities of the missionaries is assumed to jointly affect the parental and neighbourhood capitals, which fulfils the identifying assumption of the causal mediation framework.

On the whole, the study finds large effects of parental and neighbourhood capitals on the child human capital. However, the causal mediation analysis finds that the total effects may be distributed 25% and 75% respectively between the parental and neighbourhood capitals. The decomposition of the effects are robust to the inclusion of a battery of controls. The policy implication is that supply side educational policies remains relevant for the objective of achieving more egalitarian distribution of economic opportunities at this stage of Nigeria's economic development. The rest of the paper is organised as follows: section 4.2 discusses the background of the study, section 4.3 presents the empirical framework, section 4.4 presents the data and descriptive statistics, section 4.5 presents the results and section 4.6 estimates and discusses the mechanisms, while section 4.7 concludes.

4.2 Background

4.2.1 Historical missionaries activities in colonial Nigeria

In the existing literature, colonial experience has been shown to broadly vary across centralised and decentralised ethnic groups within the various colonies, and the economic development legacies of colonialism linked to this variation. This is because the leadership of the centralised ethnic groups had more intimate interactions with the colonial regimes

that enabled them imbibe positive institutional behaviours that sustain economic and social developments ([Gennaioli and Rainer, 2007]; [Porta et al., 1999]; [Archibong, 2019]). In the Nigerian case, the special attraction of the regime to the areas of high ethnic centralisation was predicated on the propriety of the later for direct taxation - a factor considered essential for internal stability by the British colonial regime. Therefore, the regime adopted two different approaches to administration in the centralised and decentralised ethnic groups, whereby important policies were bargained with rulers in the centralized ethnic groups, but imposed in the decentralised ethnic groups ([Archibong, 2016]; [Okoye, 2021]; [Fields, 2021]). The bargaining institutionalised the Native Authority Proclamation of 1907, which guaranteed colonial non-intervention in matters of cultures and religion, and further hegemonised traditional rulership over the people. With Muslim emirs ruling virtually all the centralised ethnic groups, this hegemony later became the singular most important tool used to limit the advancement of the missionaries and their activities ([Archibong, 2018]; [Berger, 2009]; [Burdon, 1904]). In the end, the major achievement in these locations was that the local Islamic population was spared widespread conversion to Christianity unlike the experience of the other locations where there was decentralised leadership. However, this was at the expense of the social services inclusive of education and health plus the associated infrastructures which the missionaries would have provided. The persistence of the resultant inequality in educational opportunities long after the missionaries had left the country is well documented ([Bauer et al., 2022]).

In the literature of economic history, more rapid post-colonial economic and social development is often seen as a product of better involvement of ethnic rulers in colonial administration such as indicated above, due to the acquired leadership training such entails ([Gennaioli and Rainer, 2007]). However, the case in point stands out: such areas in Nigeria are the centralised Muslim dominated ethnic groups which today more strongly associated with poor indices of development in the areas of education and other economic outcomes despite being more advanced prior to colonisation ([Gennaioli and Rainer, 2007]; [Okoye and Pongou, 2014]). This unexpected turnout

of outcomes has been described as "reversal of fortunes", and attributed to limited exposure to the externalities of the missionaries' activities, education in particular ([Okoye and Pongou, 2021]; [Lincove, 2009]; [Agwu and Atta, 2021])

4.2.2 Nigeria's educational system

Nigeria's education system consists of primary, secondary, and tertiary education. Schooling grades 1-6 or the primary school level leading to the award of first school leaving certificate (FSLC) typically lasts between the ages of 6 and 11. Grades 7-12 or the secondary school follows and typically lasts between the ages 12 and 17 years, and the Basic Education Certificate Examination (BECE) and Senior Secondary Certificate Examination (SSCE) may be awarded at the first and second successful three years respectively. The tertiary education level which typically consists of 3-5 years programmes in colleges and universities is accessed upon completion of the secondary school level. Nigerian children face significant demand and supply sides constraints to accessing the educational systems, as participation at any level of the schools system remains low compared to the global average: At 52% dropout rate, Nigeria accounts for about 10% of global out-of-school children during 2010 ([Bertoni et al., 2019]). According to the World Bank, Nigeria's gross primary and secondary schools enrolment rate hovers around 87.5% and 44% respectively. In terms of distribution, there is a wide educational disparities between the Nigerian geographical regions: For example, most likely due to the mechanisms discussed in section 4.2.1, school participation is generally higher in south compared with the north, and more than 66% of school participants in the north remain illiterate even after completing primary school, whereas the equivalent is only about 18-28% in the south ([Favara et al., 2015]; [Lincove, 2009]).

Nigeria's first major national education expansion policy, the Universal Primary Education Policy (UPE) was implemented in 1976, and among other provisions, it abolished tuition for grades 1-6. Although the programme faced huge financial and implementation capacity

challenges, a number of studies acknowledge that it helped alleviate the human capital deficit of the country ([Csapo, 1983]; [Osili and Long, 2008]). However, one of its objectives which is to eliminate the educational imbalance between the northern and southern regions failed to materialize. In fact, some studies suppose that the imbalance reinforced due to the programme, because of inadequate capacity to implement the programme in the north ([Lincove, 2009]).

4.3 Empirical framework

4.3.1 The model of intergenerational mobility

The standard empirical framework of intergenerational mobility inspired by the seminal works of [Becker and Tomes, 1986] and [Solon, 1992] focuses solely on the role of parental education and specified as follows:

$$y_{ij,t} = \gamma_0 + \gamma_1 y_{ij,(t-1)} + \epsilon_{ij,t} \quad (4.1)$$

where $y_{ij,t}$ represents completed years of schooling of individual child i within group j belonging to generation t , and $y_{ij}(t-1)$ that of parents belonging to generation $t-1$. The error term; $\epsilon_{ij,t}$ is assumed to be independently and identically distributed (i.i.d), while standard controls such as child gender and age are suppressed. The interest parameter γ_1 is the inverse measure of the extent of regression towards the mean across generations.

The model incorporating group capital

Recent studies of intergenerational mobility tend to embrace augmentation of equation 4.1 with measures of group capital measured as average years of education at the levels of family ([Adermon et al., 2021]), ethnic group ([Borjas, 1992]; [Güell et al., 2018]) or geographical location ([Patacchini and Zenou, 2011]). The studies argue that equation 4.1 underestimates γ_1 due to the omission of the group capital. I therefore decide to define

the group capital at the district level and augment the model ¹. This captures the level at which basic education services are provided in Nigeria. Furthermore, many previous studies contend that ethnic capital operates mainly through geographical clustering of ethnic groups, which suggests that the group capitals may be picking up certain fixed factors within the ethnic homelands (see; [Leon, 2005]; [Borjas, 1995]; [Alesina et al., 2021]). Equation 4.1 is then modified as follows:

$$y_{ij,t} = \gamma_0 + \gamma_1 y_{ij,(t-1)} + \gamma_2 y_{v(j),(t-1)} + \theta_3 X_{ij} + \epsilon_{ij,t} \quad (4.2)$$

where $y_{v(j),(t-1)}$ represents educational level of the group which get partially transmitted across generations. In addition to individual controls such as gender and age, X_{ij} captures group level controls. The previous studies generally find that the parental and the group capitals jointly influence human capital accumulation. This is consistent with the theoretical proposition that parents value the human capital of their next generation, and have to invest in it within neighbourhoods whose capitals may act as complements or substitutes ([Becker et al., 2018]).

The model with interacted parental and group capitals

Given that the group effect is captured at spatial location level (district, in this case), $y_{v(j),(t-1)}$ denotes fixed effects capturing not only parental social interactions, but also the quality of the neighbourhoods including the quality of the school system. Then, in line with neighbourhood interactions models ([Benabou, 1993]; [Ioannides, 2003]; [Patacchini and Zenou, 2011]), I adapt the model to include interaction effects, and the interaction is between the parental and neighbourhood capitals. The interacted model is specified as below

:

$$y_{ij,t} = \gamma_0 + \gamma_1 y_{ij,(t-1)} + \gamma_2 y_{v(j),(t-1)} + \delta y_{ij,(t-1)} \times y_{v(j),(t-1)} + \theta_3 X_{ij} + \epsilon_{ij,t} \quad (4.3)$$

¹This is acceptable in Nigeria because even though rural-urban migration is high, there is but little migration across districts ([Funjika and Getachew, 2022])

The interaction coefficient (δ) captures the nature of the relationships between the two capitals: If δ is less than zero, this implies that intergenerational persistence is lower for those living in neighbourhoods with higher capital, and vice versa. Another advantage of the interaction is that it enables the decomposition of the direct effects of the parental and the neighbourhood capitals respectively under the causal mediation framework ([Imai et al., 2011]).²

4.3.2 Identification

In order to identify the parameters of interest, I apply instrumental variables strategy to the models above.³ The identifying instrument is the intensity of the historical activities of the missionaries, which is relevant because of the documented roles of the missionaries in the provision of social services (education and health) at the time when the colonial governments were not financially and/or administratively in the position to provide them ([Bauer et al., 2022]). Economists generally find that modern economies are affected by past institutions, even after the institutions have ceased to exist ([Acemoglu and Robinson, 2008]; [Nunn, 2010]). In the history of colonial formal education development, public goods investments of the missionaries have been found to endure through current provision of schools, collective and individual educational attainments and literacy levels ([Gallego and Woodberry, 2010]; [Lankina and Getachew, 2013]; [Okoye and Pongou, 2021]). I assume that after controlling for the historical factors that influenced the penetration of missionaries including ethnic precolonial centralisation, precolonial ethnic share of Muslims, location on the coasts, population density and the presence of cities in the 1940s, the influence of the missionaries only passes through the accumulation of human capital at the neighbourhood level

²Further discussion of this is provided in the identification section

³I estimate $y_{ij}(t-1)$ and $y_{v(j),(t-1)}$ separately using equation 4.2 before including them together in subsequent equations. This is to demonstrate the effect of omitting any of them in the model

As robustness and to overcome potential bias due to innate ability correlation within family dynasties, I additionally follow the approach proposed by [Lewbel, 2012] to alternatively identify the models using internally generated instruments. The instruments are generated internally relying on the presence of heteroscedasticity in the error term of the first-stage equation.⁴ The instruments are derived as the deviations from the mean of a vector of independent exogenous variables interacted with the residual from the first-stage regression, and may be used exclusively or to support external instruments. Theoretically, the heteroscedasticity is generated by the interaction of an unobserved common factor with included exogenous variables. Within the current framework, the interaction of unobserved innate ability with socioeconomic factors is commonly exploited through the procedure ([Postepska, 2019]; [Farre et al., 2013]; [Klein and Vella, 2010]). To illustrate the basic framework: An attempt to estimate γ_1 through OLS regression of $Y_1 = \alpha + \beta X + \gamma_1 Y_2 + \epsilon_1$ is likely to encounter endogeneity bias because $Y_2 = \alpha + \beta X + \gamma_2 Y_1 + \epsilon_2$. However, two standard OLS assumptions are exploited by the procedure to overcome the endogeneity: $E(X\epsilon_1) = E(X\epsilon_2) = cov(X, \epsilon_1\epsilon_2) = 0$ and $cov(X, \epsilon_2^2) \neq 0$.

Table 4.1: Breusch-Pagan heteroskedasticity test in parental and ethnic capital equations

Cohort	Parental capital			Neighbourhood capital		
	Chi2 statistic	Pvalue	Obs	Chi2 statistic	Pvalue	Obs
1950 - 1959	418.05	0.000	2,590	298.87	0.000	2,590
1960 - 1969	651.35	0.000	4,426	491.12	0.000	4,426
1970 - 1979	508.94	0.000	7,117	757.22	0.000	7,117
1980 - 1989	241.67	0.000	9,480	850.93	0.000	9,480
1990 - 1999	31.81	0.000	5,808	479.91	0.000	5,808

In the current setup, the later assumption ensures that the contribution of unobserved ability to intergenerational transmission depends on individual's socioeconomic factors ([Postepska, 2019]; [Klein and Vella, 2010]). Therefore, [Lewbel, 2012] proposes $|X - E(X)|\epsilon_2$ as instruments for Y_2 given that $cov(X, \epsilon_1\epsilon_2) = 0$ guarantees that $|X - E(X)|\epsilon_2$ is uncorrelated with ϵ_1 and the heteroscedasticity ($cov(X, \epsilon_2^2) \neq 0$) guarantees that $|X -$

⁴Given that the presence of heteroskedasticity in the parental and neighbourhood capital equations is required, table 4.1 presents the results of the Breush-Pagan tests. The null hypothesis of homoscedastic errors is strongly rejected, confirming the presence of heteroskedasticity in both equations

$E(X)|\epsilon_2$ correlates with ϵ_2 and Y_2 .⁵

Furthermore, as the theory proposes, equation 4.3 interacts parental and the neighbourhoods capitals and then rely on the causal mediation framework to decompose the total effects into direct effect due to parental capital and indirect effect due to neighbourhood capital. The causal mediation framework requires just an instrument to identify direct effect of treatment T and indirect effects of mediator M on the relevant outcome Y . The decomposition is identified as long as the endogeneity originates from confounders that jointly influence T and M but not T and Y ([Dippel et al., 2020]). The intensity of the missionaries activities could provide this joint influence because it is expected to correlate with the neighbourhood capital M through school quality as discussed in section 4.2.1, and also with parental capital T via institutional persistence and possible parental neighbourhood sorting ([Ioannides, 2003]; [Patacchini and Zenou, 2011]). Assuming that parents sort into neighbourhoods of better school quality, this increases the value of the causal mediation framework because then the interaction between the parental and neighbourhood capitals would be endogenous.

4.4 Data and descriptive statistics

4.4.1 Data

The sample for analysis derives from the nationally representative Nigerian Living Standards Surveys (NLSS) collected by the Nigerian Bureau of Statistics (NBS) across the 774 Local Governments Areas (districts) of Nigeria in 2019 ([NBS, 2019]). The NLSS follows the format of the World Bank’s Living Standards Measurement Surveys (LSMS), but is preferred in this study because of its universal coverage of the Nigerian districts and larger sample size. The information collected include; years of education of individuals and parents, and demographic characteristics at the individual and household levels. I limit

⁵I made use of the STATA algorithm contributed by [Baum and Schaffer, 2021] which facilitates the construction of the instruments and the implementation of the procedure, and offers option to over-identify the parameters by combining the internally generated instruments with available external instruments. The combination offers additional advantages, including improved efficiency of the instruments and chance of performing the ‘Sargan-Hansen’ tests of the orthogonality conditions of both the external and internal instruments ([Baum and Lewbel, 2019])

the sample to those who were at least 25 years old in the year of the survey (i.e those born between 1950 and 1994) because such are expected to have completed schooling based on Nigeria’s educational system ([Lincove, 2009]). The restriction reduced the sample to 29,522 individuals in 16,621 households belonging to 103 ethnic homelands. The vector X of equation 4.2 includes measures of historical population density and land suitability for agriculture which are potential drivers of the spread of Islam and Christianity ([Michalopoulos et al., 2018]), and obtained from the History Database of the Global Environment ([Goldewijk et al., 2010]). Considering that waterways may facilitate trade and economic activity and affect incentives for human capital accumulation, I measure the total length of rivers within the ethnic group’s homeland with data from from the Natural Earth Project. Disease vectors may also have persistent effects on development ([Alsan, 2015]): hence, I include climatic susceptibility to malaria from the Malaria Atlas Project in the vector of controls, and to account for the economic and social consequences of the slave trade, I include controls for the total number of slaves exported through the Atlantic and Indian trade routes for each ethnic group as derived from [Nunn and Wantchekon, 2011]. As a measure of colonial government’s investment, I include the length of colonial railroads in the ethnic group’s territory also drawn from [Nunn and Wantchekon, 2011]. Finally, given that there may be other important geographic features of an ethnic homelands that are not directly observed, I include measures of average elevation and terrain roughness from the U.S. geological Survey’s global digital elevation model, size of the ethnic group’s land territory, latitude and longitude.

4.4.2 Measurement of key variables and descriptive statistics

Human capital variables

The human capital variables are measured to accord with the fundamental theory where it is conceived as the embodiment of sustained investments of time and financial resources in education, and this must be distinguished from snapshot school enrolment. Thus, I measure child and parental human capital as stocks, capturing the highest number of years of schooling completed. With respect to parental human capital, I follow [Behrman et al., 2001] by

using the highest number of years of schooling of either parent.⁶ I transform the categorical education levels collected as highest grade completed or highest qualification attained into a continuous variable, years of schooling, using the layout on the number of years of schooling required to attain the different education levels in the Nigeria educational system and the format may be found in [Bertoni et al., 2019]. The neighbourhood capital is derived from the years of schooling of the parents and is measured as the average of the parents living in specific neighbourhoods defined as the district of current residence. This fundamentally assumes that the respondents currently reside in the districts where they were principally schooled. To confirm this, I use migration history contained in the NLSS to determine how long individuals have lived in their current locations, and it shows that only less than 0.5% had ever migrated out of their districts since birth. Though the rate of migration is negligible, each migrant is returned to their original districts if they migrated after reaching 18 years age or discarded if otherwise.

Missionaries activities

To construct measures of the historic influence of the missionaries (Catholic and Protestants) within Nigerian districts, I use the missions base stations digitized by [Nunn, 2010]. I sum the number of missions within each polygon of the 774 administrative districts of Nigeria. The sum is then normalized by the land area of each district. Given the absence of the missionaries in many districts, the measure is left skewed. I then follow [Nunn, 2010] and take the natural log of one plus the normalized number of missions. I also measure the distance from the centroid of each district (LGA) to the nearest mission station as an alternative measure of the presence of the missionaries. The locations of the missionary schools and hospitals are not necessarily within the mission stations, but not far from them since mission stations operate as the walking supervision stations for the schools and hospitals. Hence, both the measured distance and the normalized number of missions are only indicative of areas that benefited from the missionaries establishments.

⁶This overcomes the potential bias due to the generally low levels of mothers' education in the sample and the fact that fathers' education are most times not reported in female headed households. However, this approach is also generally associated with lower correlation between child's and parents' education, as a result of which the arising estimate of intergenerational persistence should be interpreted as lower bound (see; [Funjika and Getachew, 2022])

Descriptive statistics

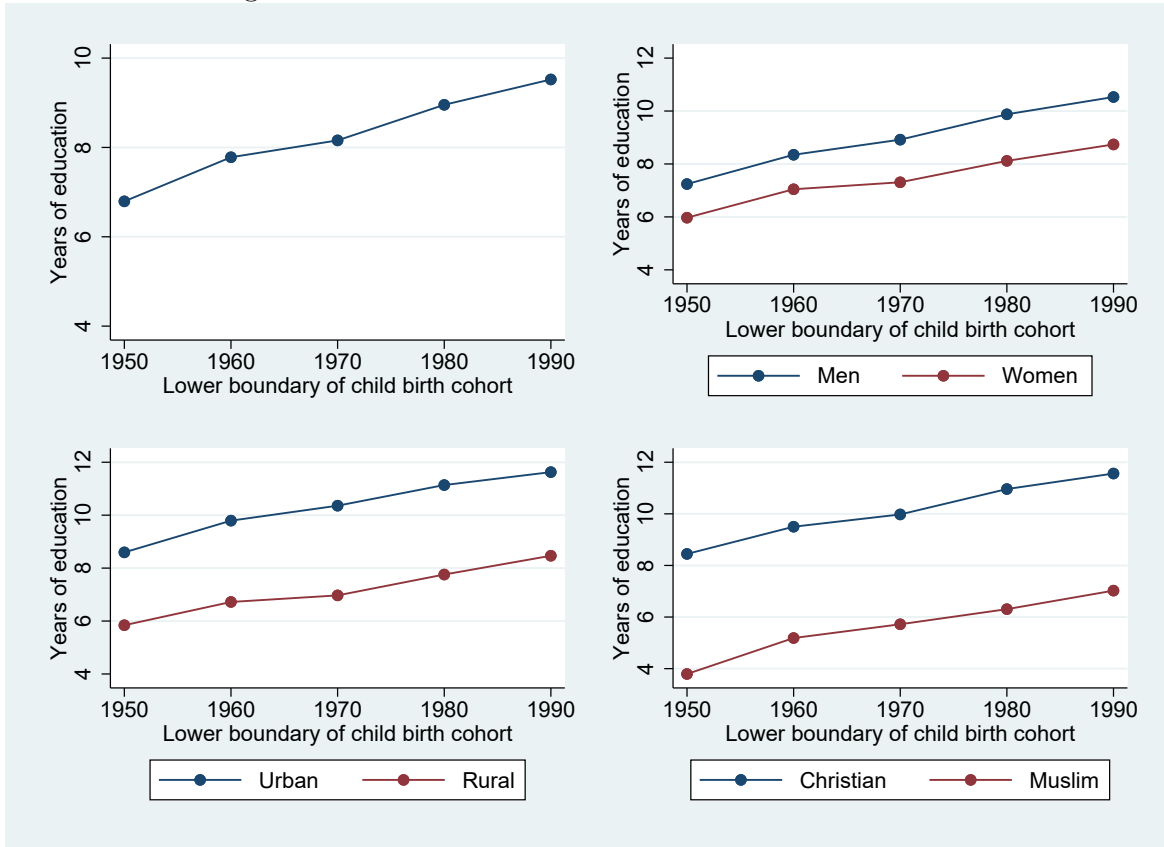
The descriptive statistics presented in table 4.2 provide insight to the human capital accumulation of the respondents in comparison to their parents and according to cohorts of birth. The summary of the statistics according to cohorts shows that there had been improvements over time in human capital accumulation across child, father and mother. Figure 4.1 is a graphical demonstration of this upward trends with respect to the child.

Table 4.2: Descriptive statistics by cohorts

Cohort	Child education			Father education			Mother education		
	mean	sd	n	mean	sd	n	mean	sd	n
1950 - 1959	6.793	5.259	2590	1.638	3.667	2590	0.797	2.559	2590
1960 - 1969	7.781	5.200	4426	2.136	4.122	4426	1.195	3.108	4426
1970 - 1979	8.158	5.057	7117	3.149	4.803	7117	1.943	3.802	7117
1980 - 1989	8.954	5.103	9480	4.607	5.499	9480	3.204	4.648	9480
1990 - 1999	9.522	4.871	5808	5.717	5.789	5808	4.305	5.063	5808

In figure C.1, I also show that the human capital accumulation varies also according to distance to the mission stations: precisely that accumulated stock falls as individuals live further from the stations. Figures 4.1 also shows that the accumulation of human capital differs according to social economic factors such as gender, sector of settlement and religion, which lends credence to the adoption of the heteroscedasticity based instruments for the identification. This is because it indicates that the unobserved ability reacts differently to the various socioeconomic factors, resulting to the heteroscedastic errors which would be exploited to generate the internal instruments.

Figure 4.1: Distribution of child education over cohort



Data source: NLSS, 2019

4.5 Main results and discussion

The main results pertain to the effects of parental and neighbourhood capitals independently and jointly. The results identified through the instrument measured as log number of missions per district land area are discussed in this section. The rest, relying on alternative measurement of the instrument as the nearest distance to missions are reported in tables C.2 and C.3 as robustness. Table 4.3 reports the results of the parental capital estimated in isolation of the neighbourhood capital. In column 1 which is based on OLS, the table 4.3 shows that an increase of parental education by a year leads to 4 months increase in child's years of education. This estimate of persistence falls within the range of OLS estimates for Nigeria from recent studies (see; [Funjika and Getachew, 2022]; [Azomahou and Yitbarek, 2021]) - it indicates substantial impact of parental endowments on children outcomes, and therefore persistent inequalities of economic opportunities in the country and other African

countries. Note however that the OLS estimates in the current and most of the previous studies are subject to a number of estimation biases: The most common of which are non-random distribution of educational opportunities and influence of unobserved innate abilities ([Holmlund et al., 2011]). Columns 2 – 4 attempt to address these concerns using *2SLS* identification framework. Using the intensity of the missionaries’ activities as identifying instrument, column 1 shows that the intergenerational elasticity is around one year of education, suggesting that the OLS underestimates the effect of parental capital. The *2SLS* based solely on the above instrument may fail to eliminate the innate ability bias. Therefore, columns 3 and 4 employs the internal instruments based on [Lewbel, 2012]. I use the internally generated variables not only as alternative instruments, but also as complements to the external instrument under overidentification restrictions. Assumed to have addressed the two main sources of bias, the estimates in columns 1 and 2 are highly similar and suggest that the effects of parental capital range within 0.144 – 0.150. As already indicated in the literature, this might imply that the correlation of innate abilities constitute a large part of the intergenerational transmission process ([Holmlund et al., 2011]). On the other hand, table 4.4 reports the effects of the schooling neighbourhood capital which constitute a larger portion of the total effects than the parental capital, also in line with the related previous studies ([Funjika and Getachew, 2022]). It suggests that an increase of the average years of education in the neighbourhood by one year increases child’s years of education in the range of 1.284 – 1.362.

Table 4.5 attempts to measure the relative contribution of the parental and neighbourhood capitals through their interaction in the model. Assuming in line with the literature that the parental capital exert direct effect while the neighbourhood capital exert indirect effect, the table 4.5 shows that their interactions support intergenerational mobility. In particular, that one year increase in the mean years of education in the neighbourhood reduces the effect of parental capital in the range of 0.077 – 0.080 depending on whether or not the geographical controls are included. Since there are no separate instruments for the parental and neighbourhood capitals, straightforward identification of the interaction effect is problematic. However, the causal mediation framework allows the interaction

Table 4.3: Effect of parental capital on child education

VARIABLES	(1) OLS	(2) IV Stage-2	(3) IV Stage-2	(4) IV Stage-2	(5) Stage-1
Instrument		external only	internal only	external & internal	
log(number of missions)					103.510*** (13.159)
parental capital	0.318*** (0.005)	1.002*** (0.148)	0.144*** (0.012)	0.150*** (0.012)	
Child age	0.079*** (0.016)	0.148*** (0.024)	0.061*** (0.016)	0.062*** (0.016)	-0.102*** (0.016)
Child is male	1.761*** (0.045)	1.504*** (0.077)	1.827*** (0.046)	1.824*** (0.046)	0.374*** (0.046)
child is muslim	-1.822*** (0.073)	-0.482 (0.302)	-2.163*** (0.078)	-2.151*** (0.078)	-1.928*** (0.078)
Rural	-2.383*** (0.051)	-1.046*** (0.295)	-2.723*** (0.055)	-2.711*** (0.055)	-1.951*** (0.052)
Time trends	yes	yes	yes	yes	yes
Geographical Controls	yes	yes	yes	yes	yes
Cragg-Donald Wald F statistic		72.042			
Kleibergen-Paap Wald F statistic		61.874			
Hansen J statistic (pvalue)			118.45 (0.000)	173.524 (0.000)	
Constant	1.156 (1.104)	-5.531*** (1.966)	8.060*** (0.045)	8.041*** (0.045)	9.908*** (1.096)
Observations	29,522	29,522	29,522	29,522	29,522
R-squared	0.410	0.140	0.393	0.394	0.235

Robust standard errors in parentheses

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

Table 4.4: Effect of neighbourhood capital on child education

VARIABLES	(1) OLS	(2) IV Stage-2	(3) IV Stage-2	(4) IV Stage-2	(5) Stage-1
Instrument		external only	internal only	external & internal	
log(number of missions)					125.506*** (4.049)
Neighbourhood capital	1.003*** (0.014)	0.826*** (0.093)	1.362*** (0.047)	1.284*** (0.043)	
Child age	0.013 (0.015)	0.019 (0.016)	0.001 (0.016)	0.004 (0.016)	0.033*** (0.006)
Child is male	1.840*** (0.044)	1.847*** (0.044)	1.825*** (0.044)	1.828*** (0.044)	0.038** (0.018)
child is muslim	-1.348*** (0.071)	-1.541*** (0.123)	-0.955*** (0.088)	-1.040*** (0.085)	-1.054*** (0.032)
Rural	-1.187*** (0.056)	-1.508*** (0.174)	-0.537*** (0.102)	-0.678*** (0.094)	-1.806*** (0.019)
Time trend	Yes	Yes	Yes	Yes	Yes
Geographical Controls	Yes	Yes	Yes	Yes	Yes
Cragg-Donald Wald F statistic		91.998	223.075	257.346	
Kleibergen-Paap Wald F statistic		160.905	143.143	197.528	
Hansen J statistic (pvalue)			79.366 (0.000)	105.079 (0.000)	
Constant	-1.008 (1.064)	-0.078 (1.179)	0.862*** (0.265)	1.298*** (0.239)	5.413*** (0.433)
Observations	29,522	29,522	29,522	29,522	29,522
R-squared	0.447	0.444	0.434	0.439	0.600

Robust standard errors in parentheses

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

to be identified via decomposition under a recently developed algorithm by relying on a single identifying instrument ([Dippel et al., 2020]). I apply this approach using the previously used external instrument (the intensity of the missionaries' activities), and the results are reported in table 4.6.

Table 4.5: Relative contributions of parental and neighbourhood capitals

VARIABLES	(1)	(2)	(3)	(4)
Parental capital (<i>pc</i>)	0.239*** (0.005)	0.227*** (0.005)	0.789*** (0.019)	0.762*** (0.020)
Neighbourhood capital (<i>nc</i>)	0.828*** (0.013)	0.854*** (0.015)	0.956*** (0.013)	0.993*** (0.016)
Interaction (<i>pc</i> × <i>nc</i>)			-0.080*** (0.003)	-0.077*** (0.003)
Child age	0.060*** (0.015)	0.041*** (0.015)	0.056*** (0.014)	0.039*** (0.015)
Child is male	1.736*** (0.041)	1.760*** (0.043)	1.704*** (0.041)	1.727*** (0.042)
Child is muslim	-1.486*** (0.055)	-1.066*** (0.069)	-1.360*** (0.055)	-1.089*** (0.068)
Rural	-1.163*** (0.051)	-1.013*** (0.055)	-1.202*** (0.050)	-1.041*** (0.054)
Time trends	Yes	Yes	Yes	Yes
Geographical controls	No	Yes	No	Yes
Constant	-2.510*** (0.972)	-2.445** (1.040)	-2.955*** (0.958)	-2.768*** (1.025)
Observations	32,006	29,522	32,006	29,522
R-squared	0.461	0.474	0.475	0.488

Robust standard errors in parentheses

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

The table 4.6 represents summary of findings of the causal mediation analysis: the human capital of generation $t - 1$ (parents and neighbourhood) jointly promote the human capital of generation t via the positive total effects. The direct and indirect effects due respectively to parental and neighbourhood capitals are also positive. In relative terms, the table 4.6 shows that the indirect effects outweighs the direct effects within the range 73.7 – 74.8%, suggesting that increasing access to education for the public at the meso

or macro levels might be highly rewarding in the context. Given the instrument, the decomposition of the effects remains the local average treatment effects of those affected by the historical education provision of the missionaries. In the next section, I discuss the possible mechanisms including the persisting inequalities in the quantity and quality of schools through the settlements of the missionaries.

Table 4.6: Causal mediation decomposition of parental and neighbourhood effects

	(1)	(2)
Total effect (Parental and neighbourhood capitals)	1.037*** (0.137)	1.002*** (0.144)
Direct effect (Parental capital)	0.257*** (0.013)	0.252*** (0.0123)
Indirect effect (Neighbourhood capital)	0.764*** (0.142)	0.750*** (0.150)
% of total effects mediated by neighbourhood capital	73.7%	74.8%
Geographical controls	No	Yes
Number of observation	29522	29522
F-statistics of excluded instruments		
- first stage one (T on Z)	79.668	72.042
- first stage two (M on Z—T)	524.254	591.907

Standard errors in parentheses

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

4.6 Mechanisms

4.6.1 The mediation mechanisms

This section addresses how the historical settlements of the missionaries remain relevant for human capital until this day. Events during the Nigeria's colonial period in which the missionaries rather than the colonial government champion the provision of social services including education must have generated inequality of schooling opportunities because the missionaries only had access to selected localities. However, one might be puzzled that the inequality remains in the present despite governmental policies since independence in 1960. Mainly since 1976, Nigeria launched aggressive campaign for mass education, and allocated huge budgets for the construction and redistribution of educational infrastructures across

the country (see; [Osili and Long, 2008]). What is not clear therefore is whether these attempts fail to redistribute the educational opportunities, or the education provided fail to substitute the one originally provided by the missionaries. In this section, I obtain the contemporary distribution of quality and quantity of primary and secondary schools in Nigeria, and employ them as the mediators of the intergenerational transmission in place of the average neighbourhood schooling, and then use measures of exposure to the missionaries as the identifying instrument. In this case, the local average treatment effects (LATE) should capture the effects of quality differences in local schools due to the historical settlements of the missionaries, implying that persistence of the missionaries activities might pass through schools quality. I estimate various measures of school quality; teacher-pupils ratio, qualified teacher-pupils ratio and pupils per class. The source data is from [OSSAP, 2012], a comprehensive survey of Nigerian schools by the Nigerian government in collaboration with the Sustainable Engineering Lab at Columbia University.⁷

Table 4.7: The correlation of access to missions and school quality

VARIABLES	Teacher-pupils ratio		Qualified teacher-pupils ratio		Pupils -class ratio	
	(1)	(2)	(3)	(4)	(5)	(6)
log (dist. to mission)	-0.100*** (0.032)		-0.032* (0.017)		6.337*** (0.794)	
Mission (dummy)		0.282*** (0.107)		0.122** (0.056)		-8.068*** (2.714)
Constant	1.046*** (0.123)	0.642*** (0.042)	0.439*** (0.065)	0.305*** (0.022)	27.763*** (3.018)	51.886*** (1.071)
Observations	700	700	700	700	700	700
R-squared	0.013	0.010	0.005	0.007	0.084	0.013

Standard errors in parentheses

*** p_i0.01, ** p_i0.05, * p_i0.1

I start with analysing the correlation of exposure to the missionaries and the contemporary quality of local schools. I regress the measure of exposure to the missionaries on the measures of contemporary school quality and the locational controls. The results reported in table 4.7 shows that access to the missions whether measured as continuous or dummy

⁷The survey is further described in section C.1

variable is positively correlated with local schools' quality: Teacher-pupils ratio and Pupils per class are negatively and positively related to distance to missions, suggesting that both quality and quantity of schools are still more constrained in the places that experienced less presence of the missionaries, all things being equal. I then proceed to apply the causal mediation framework as described above. The results which corresponds to the earlier results in table 4.6 is reported in table 4.8. However, the percentage of effects mediated is slightly lower than previously, suggesting the existence of other channels.

Table 4.8: Mediation effects of school quality

Average causal mediation effects based on school quality as the mediator				
Mediator	Teacher-pupuls ratio (1)	QTteacher-pupuls ratio (2)	Pupils-class ratio (3)	PCA (4)
Total effect	1.34***	1.34***	1.34***	1.34***
Direct effect	0.61***	0.48***	0.31***	0.47***
Indirect effect	0.73***	0.86***	1.03***	0.87***
% of effects mediated	54.6%	64.3%	76.9%	64.79%
Number of observation	48749	48749	48749	48696
Controls	Yes	Yes	Yes	Yes
F-statistics for excluded instruments				
- first stage one (T on Z)	4240	4240	315	4239.878
- first stage two (M on Z—T)	261.977	603.524	11000	818.954

Outcome: Child education

Instrument: log(number of missions)

Standard errors in parentheses

*** p_i0.01, ** p_i0.05, * p_i0.1

4.6.2 The persistence mechanisms

This section pertains the mechanisms of the effect of the parental capital. The potential mechanisms also necessarily intersects with indicators of economic inequalities, which the theory of intergenerational transmission aims to capture. Hence, for example, while household credit constraint might capture the extent of income poverty, it also portends limitation on parental ability to invest in their offspring education. Theoretically, parents choose education levels for their children subject to costs and benefits under credit constraints and inefficient credit markets ([Becker, 1985]; [Becker et al., 2018]). To test

this, I focus on proxies of credit constraints, particularly household income represented by consumption expenditures per capita, and family family size. Fortunately, a recent paper, [Okoye and Pongou, 2021] provides a suitable background to the analysis in this section: Using regression discontinuities design (RDD) and exploiting discontinuities in mission stations around the borders of the Emirates of the Northern Nigeria⁸, the paper finds that areas with greater historical missionary activities have higher levels of schooling, lower levels of fertility, and higher household wealth in the present. I merely add to this evidence by estimating within the current data the relationships between parental capital and household consumption expenditures and family size. There may be reverse causality between education and most of the outcomes, hence, I apply the two-stage least square method using the missionaries activities as instrument. The results are reported in table 4.9.

Table 4.9: Mechanism of persistence

VARIABLES	(1)		(2)		(5) Stage-1
	log consumption		family size		
	OLS	IV Stage-2	OLS	IV Stage-2	
log (number of missions)					1.154*** (0.072)
Parental education	0.008*** (0.001)	0.069*** (0.008)	0.050*** (0.005)	-0.114** (0.055)	
Full controls	Yes	Yes	Yes	Yes	Yes
State FE	Yes	Yes	Yes	Yes	Yes
Constant	14.252*** (0.252)	13.316*** (0.308)	2.952*** (0.617)	6.640*** (0.680)	7.893*** (2.194)
Observations	16,019	16,019	16,019	16,095	16,019
R-squared	0.416	0.261	0.113	0.055	0.198

Robust standard errors in parentheses

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

The results suggest that parental education is negatively correlated with credit constraints in terms of per capital household consumption as well as family size. Although its not possible to determine parental investments in other dimensions such as non-monetary

⁸That is, the areas where missionary activities were restricted during the colonial period

efforts known to complement financial investments (see; [Patacchini and Zenou, 2011]), the results show that more educated parents have more financial resources at their disposal for educational investments. The table 4.9 shows that on average, each additional year of parental education is associated with 6.9% increase in per capita household expenditure (which also includes educational expenditures). The theory also emphasises the trade-off between the size of the family or number of children and the parental investment in education (see; [Becker and Lewis, 1973]).

In line with this, table 4.9 shows that parental capital is negatively associated with family size. Given the established trade-off between the quality and quantity of children, this is a potential channel of the intergenerational persistence. Collectively, the results indicate that credit constraints may be less binding for the more educated parents allowing them the leverage to invest in more their children. Nevertheless, there is no way to determine if these resources are actually employed in the educational investment for the children but it might suffice to infer that more educated parents have higher capacity to invest in their children as a potential channel for the intrahousehold persistence of human capital.

4.7 Conclusion

In this paper, I investigate intergenerational mobility in Nigeria using education as a symbol of economic status. Drawing from the intergenerational mobility theory, I argue that quality of neighbourhoods acts as an externality in the production function for human capital. In particular, the quality of the neighbourhoods in which children are raised, influences their human capital and economic opportunities. Previous studies denote this as ethnic capital, but in the context of Nigeria, ethnicities, geographies and administrative boundaries inexorably intersect and jointly interfere in the human capital production. Therefore, I chose to conduct the analysis on the basis of the administrative level where basic schools are provided. This approach not only exploits the contribution of access to education, but also aligns the analysis to potential policies intervention. I rely on the human capital intervention of the colonial Christian missionaries to identify and disentangle for the first time the effects of parental and neighbourhood capitals.

The empirical results yield two main sets of finding: First, the neighbourhood capital supports intergenerational mobility by acting as mediator to the productivity of parental capital, which is consistent with previous findings. However, I further decomposed the total effect into direct and indirect effects, due respectively to parental and neighbourhood capitals. As it turns out, the parental and neighbourhood capital are substitutes, implying that intergenerational persistence is higher in neighbourhoods of lower quality. What is more, the ratio of the effect of the parental capital to neighbourhood capital is 25:75. I confirm that the effects of the neighbourhood capital is driven by the quality of schools in the neighbourhood, which means that policies aimed at improving schools supply could be relevant in alleviating the persistence of inequalities.

Compared to recent related studies, the current study connects with the political realities of Nigeria by exploiting variation in the provision of basic education across the 774 districts. It also exploits a combination of identification approaches that not only accounts for endogenous human capital accumulation process, but also the bias of innate abilities correlation. Based on the findings, policymakers have clear path towards ensuring upward mobility opportunities to individuals across the country, through enhancing the provision of schools at the district level.

Bibliography

- [Acemoglu and Robinson, 2008] Acemoglu, D. and Robinson, J. A. (2008). Persistence of power, elites, and institutions. *American Economic Review*, 98(1):267–293.
- [Adermon et al., 2021] Adermon, A., Lindahl, M., and Palme, M. (2021). Dynastic human capital, inequality, and intergenerational mobility. *American Economic Review*, 111(5):1523–1548.
- [Agwu and Atta, 2021] Agwu, G. and Atta, O. B. (2021). *University proximity at teenage years and educational attainment*.
- [Alesina et al., 2021] Alesina, A., Hohmann, S., Michalopoulos, S., and Papaioannou, E. (2021). Intergenerational mobility in africa. *Econometrica*, 89(1):1–35.
- [Alsan, 2015] Alsan, M. (2015). The effect of the tsetse fly on african development. *American Economic Review*, 105(1):382–410.
- [Archibong, 2016] Archibong, B. (2016). Where local kings rule: Long-term impacts of precolonial institutions and geography on access to public infrastructure services in nigeria.
- [Archibong, 2018] Archibong, B. (2018). Historical origins of persistent inequality in nigeria. *Oxford Development Studies*, 46(3):325–347.
- [Archibong, 2019] Archibong, B. (2019). Explaining divergence in the long-term effects of precolonial centralization on access to public infrastructure services in nigeria. *World Development*, 121:123–140. ID: 271773.

- [Azomahou and Yitbarek, 2021] Azomahou, T. T. and Yitbarek, E. (2021). Intergenerational mobility in education: Is africa different? *Contemporary Economic Policy*, 39(3):503–523.
- [Bauer et al., 2022] Bauer, V., Platas, M. R., and Weinstein, J. M. (2022). Legacies of islamic rule in africa: Colonial responses and contemporary development. *World Development*, 152:105750. ID: 271773.
- [Baum and Schaffer, 2021] Baum, C. and Schaffer, M. (2021). Ivreg2h: Stata module to perform instrumental variables estimation using heteroskedasticity-based instruments.
- [Baum and Lewbel, 2019] Baum, C. F. and Lewbel, A. (2019). Advice on using heteroskedasticity-based identification. *The Stata Journal*, 19(4):757–767.
- [Becker, 1985] Becker, G. S. (1985). Human capital, effort, and the sexual division of labor. *Journal of Labor Economics*, 3(1, Part 2):S33–S58.
- [Becker et al., 2018] Becker, G. S., Kominers, S. D., Murphy, K. M., and Spenkuch, J. L. (2018). A theory of intergenerational mobility. *Journal of Political Economy*, 126(S1):S7–S25.
- [Becker and Lewis, 1973] Becker, G. S. and Lewis, H. G. (1973). On the interaction between the quantity and quality of children. *Journal of political Economy*, 81(2, Part 2):S279–S288.
- [Becker and Tomes, 1986] Becker, G. S. and Tomes, N. (1986). Human capital and the rise and fall of families. *Journal of Labor Economics*, 4(3, Part 2):S1–S39.
- [Behrman et al., 2001] Behrman, J. R., Gaviria, A., Székely, M., Birdsall, N., and Galiani, S. (2001). Intergenerational mobility in latin america [with comments]. *Economia*, 2(1):1–44.
- [Benabou, 1993] Benabou, R. (1993). Workings of a city: location, education, and production. *The Quarterly Journal of Economics*, 108(3):619–652.

- [Berger, 2009] Berger, D. (2009). Taxes, institutions and local governance: evidence from a natural experiment in colonial nigeria. *Unpublished manuscript*.
- [Bertoni et al., 2019] Bertoni, E., Maio, M. D., Molini, V., and Nistico, R. (2019). Education is forbidden: The effect of the boko haram conflict on education in north-east nigeria. *Journal of Development Economics*, 141:102249.
- [Borjas, 1992] Borjas, G. J. (1992). Ethnic capital and intergenerational mobility. *The Quarterly journal of economics*, 107(1):123–150.
- [Borjas, 1995] Borjas, G. J. (1995). Ethnicity, neighborhoods, and human-capital externalities. *The American Economic Review*, pages 365–390.
- [Burdon, 1904] Burdon, J. A. (1904). The fulani emirates of northern nigeria. *The Geographical Journal*, 24(6):636–651.
- [Cogneau and Mesple-Somps, 2008] Cogneau, D. and Mesple-Somps, S. (2008). Inequality of opportunity for income in five countries of africa. In *Inequality and opportunity: Papers from the second ecineq society meeting*. Emerald Group Publishing Limited.
- [Csapo, 1983] Csapo, M. (1983). Universal primary education in nigeria: Its problems and implications. *African Studies Review*, 26(1):91–106.
- [Dippel et al., 2020] Dippel, C., Ferrara, A., and Heblich, S. (2020). Causal mediation analysis in instrumental-variables regressions. *The Stata Journal*, 20(3):613–626.
- [Farre et al., 2013] Farre, L., Klein, R., and Vella, F. (2013). A parametric control function approach to estimating the returns to schooling in the absence of exclusion restrictions: an application to the nlsy. *Empirical Economics*, 44(1):111–133.
- [Favara et al., 2015] Favara, M., Appasamy, I., and Garcia, M. H. (2015). *Nigeria: Skills for Competitiveness and Employability*. World Bank.
- [Fields, 2021] Fields, K. E. (2021). *Christian missionaries as anticolonial militants*, pages 951–965. *Critical Readings in the History of Christian Mission*. Brill.

- [Funjika and Getachew, 2022] Funjika, P. and Getachew, Y. Y. (2022). Colonial origin, ethnicity and intergenerational mobility in africa. *World Development*, 153:105841. ID: 271773.
- [Gallego and Woodberry, 2010] Gallego, F. A. and Woodberry, R. (2010). Christian missionaries and education in former african colonies: How competition mattered. *Journal of African Economies*, 19(3):294–329.
- [Gennaioli and Rainer, 2007] Gennaioli, N. and Rainer, I. (2007). The modern impact of precolonial centralization in africa. *Journal of Economic Growth*, 12(3):185–234.
- [Glick and Sahn, 2000] Glick, P. and Sahn, D. E. (2000). Schooling of girls and boys in a west african country: the effects of parental education, income, and household structure. *Economics of education review*, 19(1):63–87.
- [Goldewijk et al., 2010] Goldewijk, K. K., Beusen, A., and Janssen, P. (2010). Long-term dynamic modeling of global population and built-up area in a spatially explicit way: Hyde 3.1. *The Holocene*, 20(4):565–573.
- [Güell et al., 2018] Güell, M., Mora, J. V. R., and Solon, G. (2018). New directions in measuring intergenerational mobility: Introduction. *The Economic Journal*, 128(612):F335–F339.
- [Holmlund et al., 2011] Holmlund, H., Lindahl, M., and Plug, E. (2011). The causal effect of parents’ schooling on children’s schooling: A comparison of estimation methods. *Journal of economic literature*, 49(3):615–651.
- [Imai et al., 2011] Imai, K., Keele, L., Tingley, D., and Yamamoto, T. (2011). Unpacking the black box of causality: Learning about causal mechanisms from experimental and observational studies. *American Political Science Review*, 105(4):765–789.
- [Ioannides, 2003] Ioannides, Y. M. (2003). Empirical nonlinearities and neighbourhood effects in the intergenerational transmission of human capital. *Applied Economics Letters*, 10(9):535–539.

- [Klein and Vella, 2010] Klein, R. and Vella, F. (2010). Estimating a class of triangular simultaneous equations models without exclusion restrictions. *Journal of Econometrics*, 154(2):154–164.
- [Lankina and Getachew, 2013] Lankina, T. and Getachew, L. (2013). Competitive religious entrepreneurs: Christian missionaries and female education in colonial and post-colonial india. *British Journal of Political Science*, 43(1):103–131.
- [Leon, 2005] Leon, A. (2005). Does' ethnic capital'matter? identifying peer effects in the intergenerational transmission of ethnic differentials. *Identifying Peer Effects in the Intergenerational Transmission of Ethnic Differentials (August 2005)*.
- [Lewbel, 2012] Lewbel, A. (2012). Using heteroscedasticity to identify and estimate mismeasured and endogenous regressor models. *Journal of Business Economic Statistics*, 30(1):67–80.
- [Lincove, 2009] Lincove, J. A. (2009). Determinants of schooling for boys and girls in nigeria under a policy of free primary education. *Economics of Education Review*, 28(4):474–484. ID: 271751.
- [Lincove, 2015] Lincove, J. A. (2015). Improving identification of demand-side obstacles to schooling: Findings from revealed and stated preference models in two ssa countries. *World Development*, 66:69–83. ID: 271773.
- [Michalopoulos et al., 2018] Michalopoulos, S., Naghavi, A., and Prarolo, G. (2018). Trade and geography in the spread of islam. *The Economic Journal*, 128(616):3210–3241.
- [NBS, 2019] NBS (2019). Nigeria living standards survey a survey report by the nigerian national bureau of statistics (in collaboration with the world bank). Technical report, National Bureau of Statistics.
- [Nunn, 2010] Nunn, N. (2010). Religious conversion in colonial africa. *American Economic Review*, 100(2):147–152.
- [Nunn and Wantchekon, 2011] Nunn, N. and Wantchekon, L. (2011). The slave trade and the origins of mistrust in africa. *American Economic Review*, 101(7):3221–3252.

- [Okoye, 2021] Okoye, D. (2021). Things fall apart? missions, institutions, and interpersonal trust. *Journal of Development Economics*, 148:102568.
- [Okoye and Pongou, 2014] Okoye, D. and Pongou, R. (2014). Historical missionary activity, schooling, and the reversal of fortunes: Evidence from nigeria. *Schooling, and the Reversal of Fortunes: Evidence from Nigeria (August 20, 2014)*.
- [Okoye and Pongou, 2021] Okoye, D. and Pongou, R. (2021). Missions and heterogeneous social change: Evidence from border discontinuities in the emirates of nigeria. *Available at SSRN 3946708*.
- [Osili and Long, 2008] Osili, U. O. and Long, B. T. (2008). Does female schooling reduce fertility? evidence from nigeria. *Journal of Development Economics*, 87(1):57–75.
- [OSSAP, 2012] OSSAP, N. (2012). Nigeria ossap-mdgs’ facility-based surveys.
- [Patacchini and Zenou, 2011] Patacchini, E. and Zenou, Y. (2011). Neighborhood effects and parental involvement in the intergenerational transmission of education. *Journal of Regional Science*, 51(5):987–1013.
- [Porta et al., 1999] Porta, R. L., de Silanes, F. L., Shleifer, A., and Vishny, R. (1999). The quality of government. *The Journal of Law, Economics, and Organization*, 15(1):222–279.
- [Postepska, 2019] Postepska, A. (2019). Ethnic capital and intergenerational transmission of educational attainment. *Journal of Applied Econometrics*, 34(4):606–611.
- [Solon, 1992] Solon, G. (1992). Intergenerational income mobility in the united states. *The American Economic Review*, pages 393–408.
- [Zimmerman, 2001] Zimmerman, F. J. (2001). Determinants of school enrollment and performance in bulgaria: The role of income among the poor and rich. *Contemporary Economic Policy*, 19(1):87–98.

Chapter 5

Conclusion

This thesis examined a number of important themes relating to Nigeria's economic development. These themes are quite recurrent in the political economy discussions and include households' vulnerability to economic shocks mostly as a result of civil conflicts, the nature and consequences of access to schools, and the nature of socioeconomic mobility. Given the wide ethnic and religious diversity of Nigeria's population, economic shocks due to inter-groups rivalries and other types of civil conflicts are rampant and often produce grave consequences for the standard of living of households. Therefore, policy makers are expected to adopt strategies to protect households' welfare, which may include adhering to the theory of systems' resilience that may provide cushions against economic shocks. In the literature, social services investments and collective capitals such as roads, health and educational institutions support resilient systems. On the other hand, existing studies show that the civil conflicts in Nigeria fits into the relative deprivation theory, which implies that the nature of the distribution of economic opportunities is part of the causes and potentially an integral part of the alleviation. The thesis first assesses the effects of one of the latest civil conflicts under the lenses of the resilience theory, finding that the resilience approach is an important tradition to incorporate in development policies. Afterwards, it examines deprivation from the standpoint of access to education and the intergenerational transmission. I summarise the key findings of the empirical chapters of the thesis below:

Chapter 2 examines the consequences of recent Boko haram conflict and the mechanisms of coping with the shocks emanating from the conflicts. It was difficult to causally identify the effects of the conflict given highly selective choices of the conflict actors. The chapter exploits both longitudinal data and robust identification strategy that checks the selection bias and finds that resilience capacity is an important factor in mitigating household welfare risks due to conflict shocks. The identification is based on a non-parametric difference-in-differences strategy applied to closely matched exposed and non-exposed groups. As expected, the chapter finds that the conflict shock affects food security negatively, attenuated by resilience capacity but the strength of resilience is weakened in the process. The consistency of the findings with the hypotheses of the resilience approach

to sustainable development yields the recommendation that development policies always target to establish development ecosystems that are households oriented and resilient to shocks.

The major limitation of the study is data: Obtaining high-quality survey data in the extreme conditions of the Boko haram is difficult. While, I find the existing LSMS panel and the ACLED datasets quite sufficient for the analysis, a more tailored dataset for wider range of welfare indicators and more direct measures of conflict exposure could provide more robust analysis. Furthermore, I was unable to observe the possible inducement of migration by the conflict which could bias the estimates, and also how the conflict might have affected the data collection. In the future as better data become available, other researchers could assess the robustness of the current estimates. In addition, the span of the panel data which is approximately six years is too short for the long-term concept that resilience represents. The long-term effects of the conflict on economic welfare and resilience is also another aspect that future studies could explore.

Chapter 3 tackles the question of strategic distribution of universities in order to evenly enhance human capital accumulation across the country as this remains a topical issue in Nigeria's policy circles. Social services and institutions of higher learning inherited from the colonial period were not equitably distributed, but how much has the contemporary government been able to affect the distribution? In two related analyses, the chapter interrogates the relationship between geographical distance and the accumulation of schooling. The first set of analyses 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 set 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 overall policy implication is that much still needs to be done to spread schooling opportunities more evenly in order to reduce the incidence of relative deprivation.

However, one of the main concerns in the analysis is the effect of internal migration and residential sorting given that I only observe the location of individuals when they have completed schooling and not when they were schooling. I measured individual's 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, this is a strong assumption. Ideally, I 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 the estimates. Furthermore, given that the location of most of the universities is approximately urban - where job prospects are higher, this mechanism may reinforce the migration bias. Future studies may well exploit datasets that includes historical residential re-locations which might mitigate these concerns.

Finally, chapter 4 focuses on how inherited inequality denoted by educational attainment is transmitted across generations and whether this is mitigated by the educational quality of the growing up environment. The empirical results yield two main sets of findings: First, the neighbourhood capital supports intergenerational mobility by acting as mediator to the productivity of parental capital, which is consistent with previous findings. However, I further decomposed the total effect into direct and indirect effects, due respectively to parental and neighbourhood capitals. As it turns out, the parental and neighbourhood capital are substitutes, implying that intergenerational persistence is higher in neighbourhoods of lower quality. What is more, the ratio of the effect of the parental capital to neighbourhood capital is 25:75. I confirm that the effects of the neighbourhood capital is driven by the quality of schools in the neighbourhood, which means that policies aimed at improving schools supply could be relevant in alleviating the persistence of inequalities.

Compared to related recent studies, the current study connects more with the political realities of Nigeria by exploiting variation in the provision of basic education across the 774

districts. It also exploits a combination of identification approaches that not only helps to address endogenous human capital accumulation process, but also the bias of innate abilities correlation. Based on the findings, policymakers have clear path towards ensuring upward mobility opportunities to individuals across the country, through enhancing the provision of schools at the district level. The main limitation of the study however is that it was not possible to distinguish between ethnic capital per se and neighbourhood characteristics due to the clustering of ethnicities in the Nigerian case. This could lead to the conflation of the theoretical ethnic and neighbourhood capital. Therefore, the objective of unique contributions of environments and ethnic networks is not possible in this case.

A Appendix to chapter two

Table A.1: Summary statistics for the control variables at baseline by household exposure status

Variable	pooled sample			Treatment at 5KM			Control at 5KM			t-test
	obs	Mean	Sd	obs	Mean	Sd	obs	Mean	Sd	
Urban	1,374	0.17	0.37	986	0.15	0.36	388	0.24	0.43	-0.09
Age of HH head	1,374	47.68	15.25	986	48.10	15.59	388	47.05	14.33	1.05*
HH head is wage_worker	1,374	0.41	0.28	986	0.52	0.27	388	0.48	0.32	0.04
HH is agricultural worker	1,374	0.68	0.14	986	0.66	0.14	388	0.74	0.17	-0.08
Household size	1,374	6.58	3.37	986	6.29	3.06	388	7.16	4.07	-0.87
Female HH head	1,374	0.07	0.25	986	0.08	0.27	388	0.04	0.20	0.04
HH head is literate	1,374	0.51	0.50	986	0.51	0.50	388	0.50	0.50	0.02
Ratio of children	1,374	0.36	0.23	986	0.35	0.23	388	0.37	0.23	-0.02
HH head marital status										
Never married	1,374	0.02	0.15	986	0.02	0.15	388	0.04	0.19	-0.02
Monogamous marriage	1,374	0.61	0.49	986	0.62	0.48	388	0.57	0.50	0.05
Polygamous marriage	1,374	0.28	0.45	986	0.25	0.43	388	0.35	0.48	-0.10*

Notes: Treatment group comprises households that were exposed to conflicts occurring before September 2012. The Control group comprises households that were exposed to conflicts occurring after September 2012. The date is chosen because treatment period survey commenced in September, 2012. t-test column refers to mean differences between the treatment and control groups. *** p<0.01, ** p<0.05, * p<0.1.

Table A.2: Effects of conflict exposure on resilience capacity

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	RCI	RCI	ABS	ABS	SSN	SSN	AC	AC	ASSET	ASSET
<i>Conflict</i> × <i>POST</i>	-0.077** (0.037)		-0.065** (0.029)		0.104** (0.056)		-0.079** (0.037)		-0.081 (0.069)	
<i>fatalities</i> × 100		-0.152*** (0.029)		-0.090** (0.038)		1.216** (0.622)		-0.206*** (0.044)		-0.189*** (0.041)
Pre-treatment controls ?	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Household FE ?	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Constant	1.214*** (0.167)	1.211*** (0.163)	1.333*** (0.066)	1.159*** (0.065)	1.012*** (0.307)	3.244*** (0.216)	1.373*** (0.081)	1.378*** (0.083)	6.017*** (0.209)	6.006*** (0.195)
Observations	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000
Households	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500

Notes: RCI = Resilience capacity index, ABS = index of Access to basic services, AC = index of adaptive capacity, SSN = Index of social safety nets; Asset = Index of household assets

Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table A.3: Probit estimation of selection into conflict exposure

VARIABLES	(1) Conflict	(2) Conflict	(3) Conflict	(4) Conflict	(5) Conflict
Urban	-0.0014 (0.0088)	-0.0003 (0.0087)	0.0101 (0.0091)	-0.0004 (0.0087)	-0.0006 (0.0087)
Age of HH head	-0.0000 (0.0001)	-0.0000 (0.0001)	-0.0000 (0.0001)	-0.0000 (0.0001)	-0.0000 (0.0001)
HH head is wage worker	-0.0032 (0.0061)	-0.0029 (0.0061)	-0.0033 (0.0061)	-0.0026 (0.0061)	-0.0033 (0.0061)
Household size	0.0001 (0.0006)	0.0002 (0.0006)	0.0001 (0.0006)	0.0004 (0.0006)	0.0002 (0.0006)
Female head	0.0022 (0.0073)	0.0024 (0.0073)	0.0028 (0.0073)	0.0022 (0.0073)	0.0025 (0.0073)
HH head is literate	0.0026 (0.0039)	0.0032 (0.0038)	0.0035 (0.0038)	0.0035 (0.0038)	0.0029 (0.0038)
Ratio of children	0.0037 (0.0094)	0.0035 (0.0095)	0.0036 (0.0094)	0.0023 (0.0095)	0.0034 (0.0094)
Head is never married	-0.0001 (0.0113)	-0.0004 (0.0113)	0.0004 (0.0112)	-0.0004 (0.0113)	0.0001 (0.0113)
RCI	0.0011 (0.0014)				
ABS		0.0005 (0.0042)			
SSN			0.0196*** (0.0052)		
AC				-0.0032 (0.0045)	
ASSET					0.0016 (0.0015)
Village Dummies	yes	yes	yes	yes	yes
Constant	0.7012*** (0.0322)	0.7205*** (0.0327)	0.9746*** (0.0328)	0.7080*** (0.0332)	0.9904*** (0.0340)
Observations	1,703	1,703	1,703	1,703	1,703
Pseudo R2	0.4842	0.4842	0.4843	0.4842	0.4842

Notes: RCI = Resilience capacity index, ABS = Access to basic services
SSN = Social safety nets, AC = Adaptive capacity, ASSET = Assets index
Standard errors in parentheses

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

Table A.4: Probit estimation of sample attrition

VARIABLES	(1) Attrition	(2) Attrition	(3) Attrition	(4) Attrition	(5) Attrition
Conflict	-0.0005 (0.0544)	0.0005 (0.0543)	0.0047 (0.0546)	-0.0016 (0.0543)	0.0020 (0.0544)
Urban	0.0125 (0.0182)	0.0148 (0.0180)	0.0096 (0.0189)	0.0141 (0.0180)	0.0150 (0.0180)
Age of head	0.0003 (0.0003)	0.0003 (0.0003)	0.0003 (0.0003)	0.0003 (0.0003)	0.0003 (0.0003)
HH head is a wage worker	0.0045 (0.0128)	0.0064 (0.0127)	0.0054 (0.0127)	0.0064 (0.0127)	0.0063 (0.0127)
Household size	-0.0032*** (0.0012)	-0.0022* (0.0013)	-0.0031** (0.0012)	-0.0022* (0.0013)	-0.0030** (0.0012)
Female head	-0.0188 (0.0152)	-0.0192 (0.0152)	-0.0187 (0.0152)	-0.0193 (0.0152)	-0.0190 (0.0152)
HH head is literate	0.0092 (0.0080)	0.0118 (0.0079)	0.0103 (0.0079)	0.0118 (0.0079)	0.0112 (0.0079)
Ratio of children	0.0239 (0.0195)	0.0179 (0.0197)	0.0231 (0.0195)	0.0179 (0.0197)	0.0229 (0.0195)
HH head is never married	-0.0111 (0.0234)	-0.0119 (0.0234)	-0.0119 (0.0234)	-0.0119 (0.0234)	-0.0125 (0.0234)
RCI	0.0020 (0.0030)				
ABS		-0.0161* (0.0087)			
SSN			-0.0090 (0.0109)		
AC				-0.0172* (0.0093)	
ASSET					-0.0036 (0.0031)
Constant	-0.0041 (0.0862)	0.0189 (0.0869)	0.0049 (0.0867)	0.0302 (0.0879)	0.0215 (0.0888)
Observations	1,703	1,703	1,703	1,703	1,703
Pseudo R2	0.3171	0.3173	0.3172	0.3173	0.3172

Notes: RCI = Resilience capacity index, ABS = Access to basic services
SSN = Social safety nets, AC = Adaptive capacity, ASSET = Assets index
Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table A.5: Food (in)security and conflict exposure within the 5km radius of exposure

A: Conflict exposure within 5KM

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
	CSI	FCS	Food ratio	CSI	FCS	Food ratio
<i>Conflict</i> × <i>POST</i>	1.312*** (0.204)	-1.143 (0.858)	0.075*** (0.010)	1.262** (0.610)	-1.889 (1.616)	0.088*** (0.017)
Baseline CSI	0.893*** (0.031)					
Baseline FCS		0.347*** (0.012)				
Baseline food ratio			0.115*** (0.009)			
Baseline controls	yes	yes	yes	No	No	No
Household fixed effect	No	No	No	yes	yes	yes
Constant	1.285* (0.691)	45.142*** (2.318)	0.813*** (0.021)	10.652** (5.527)	53.011*** (16.401)	0.771*** (0.151)
Observations				2,766	2,766	2,766
Number of households	1,383	1,383	1,383	1,383	1,383	1,383

B: Conflict intensity (no. of fatalities)

Conflict intensity (100s of fatalities)	4.102*** (0.342)	14.311*** (0.210)	0.323*** (0.010)	2.317*** (0.224)	-0.307 (1.462)	0.172*** (0.033)
Baseline CSI	1.022*** (0.026)					
Baseline FCS		0.239*** (0.015)				
Baseline Food ratio			0.296*** (0.020)			
Constant	0.365 (0.543)	27.119*** (1.800)	0.488*** (0.031)	7.654*** (1.913)	19.225*** (5.326)	0.735*** (0.053)
Baseline controls	yes	yes	yes	No	No	No
Household fixed effects	No	No	No	yes	yes	yes
Observations				2,766	2,766	2,766
Number of households	1,383	1,383	1,383	1,383	1,383	1,383

Notes: CSI = Coping strategy index, FCS = food consumption score; Food ratio = Share of household per capita food expenditure; Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table A.6: Definition of Pillars and Observed Predictors

Variable	Definition/Description
Access to Basic Services (ABS)	measuring tendency to access basic welfare support services
Infrastructure index	Index of dwelling quality computed using principal component analysis based on the ownership of household items such as personal house, modern roof, non-dirty floor, running water, and electricity.
KM to secondary school	distance
KM to primary school	distance
KM to health services	distance
KM to market	distance
Assets (Asset)	measuring, inter alia, the tendency for consumption smoothening using owned assets
agricultural asset index	index of agricultural assets computed using principal component analysis based on the ownership of specific agricultural tools e.g hoe, plough, harrow, tractor harvesting and thrashing machines, reapers, water pumps, etc.
wealth index	index of non-productive assets computed using principal component analysis based on the ownership of specific household assets e.g telephone, fridge, furniture, lantern, computer, utensil, television, radio, lamp, mosquito nets, iron, stove, water-heater, stereo, books, antenna, motor vehicle, motorcycle and bicycle.
land owned	hectares of land owned per capita
Tropical livestock units	TLU is a weighted sum of the number of different livestock owned by the households. They are converted as follows: Camel 1, Cattle 0.7, donkey/mules/horses 0.55, sheep/goats 0.1, chicken 0.01.
Adaptive capacity (AC)	measuring, inter alia, the tendency to maintain welfare using human capital endowment
Income diversification	Principal component index with dummies for income from (1) agriculture and fishing wages; (2) non-agriculture wages; (3) farming production; (4) livestock and fishing production; (5) non-agriculture business; (6) transfers and (7) other income
Average education	Average years of education among household members
participation rate	Number of active household members divided by household size
Social Safety Nets (SSN)	measuring tendency to receive succour from family and other social networks
private transfer in naira	monthly amount received per capita
other transfer in naira	monthly amount received per capita
scholarship (yes or no)	Dummy variable
Has at least one migrant	Dummy variable

Notes: Bold fonts = pillars; for all indices, higher values represent higher attribute

Table A.7: Summary statistics for variables used to compute the resilience indices

	PRE			POST		
	Treatment	Control	t-test	Treatment	Control	t-test
RCI	0.310	0.280	0.030	0.180	0.260	-0.080*
ABS	0.190	0.222	-0.032	0.140	0.220	-0.080
Infrastructure index	-0.170	-0.130	-0.040	-0.220	-0.150	-0.070*
Distance to primary school (km)	19.740	20.220	-0.480	28.310	21.440	6.870*
Distance to secondary school (km)	32.020	42.050	-10.030*	37.020	40.110	-3.090*
Distance from health services (km)	34.160	43.760	-9.600	51.190	44.170	7.020**
Distance to market (km)	30.700	29.980	0.720	31.200	29.500	1.700
Distance to major road (km)	18.100	30.140	-12.040**	26.100	25.210	0.890
Asset	0.210	0.189	0.021	0.150	0.260	-0.110*
index of agricultural asset	0.240	0.170	0.070	0.080	0.190	-0.110
index of non-farm business assets	-0.010	-0.030	0.020	-0.060	-0.020	-0.040*
index of household wealth	0.170	0.190	-0.020	0.120	0.350	-0.230
Tropical Livestock Unit	0.380	0.270	0.110	0.210	0.290	-0.080*
AC	0.380	0.400	-0.020	0.250	0.370	-0.120**
Participation index	0.560	0.450	0.110	0.360	0.490	-0.130*
HH average years of education	5.010	5.170	-0.160	5.120	5.330	-0.210
Dependency ratio	0.880	1.430	-0.550	0.890	1.540	-0.650
diversity of income sources	0.810	0.840	-0.030	0.680	0.850	-0.170*
SSN	0.220	0.190	0.030	0.390	0.200	0.190***
transfers (naira)	297	203	94	564	223	341**
other transfers (naira)	205	186	19	880	156	724**
scholarship (yes or no)	0.560	0.490	0.070	0.670	0.440	0.230*
Has a migrant (yes or no)	0.290	0.300	-0.010	0.570	0.260	0.310*

Notes:t-test reports mean differences (treatment minus control). *** p_i0.01, ** p_i0.05, * p_i0.1.

Table A.8: Factor loadings for resilience capacity index and pillars

	factor 1	factor 2	factor 3	factor 4	factor 5	uniqueness
Resilience capacity index						
Asset	0.67	0.22	0.26	NA	NA	0.95
AC	0.78	-0.22	0.39	NA	NA	0.75
SSN	0.58	0.43	0.28	NA	NA	0.81
ABS	0.41	0.18	-0.61	NA	NA	0.88
Asset						
index of agricultural asset	0.77	0.12	0.04	NA	NA	0.95
index of non -farm business asset	0.29	-0.22	0.11	NA	NA	0.65
index of household wealth	0.38	0.23	0.08	NA	NA	0.81
Tropical Livestock Unit	0.42	0.18	-0.08	NA	NA	0.93
AC						
Participation index	0.63	0.21	0.08	NA	NA	0.92
HH average years of education	0.21	0.34	0.22	NA	NA	0.71
Dependency ratio	0.45	0.18	-0.23	NA	NA	0.94
diversity of income sources	0.55	0.44	0.67	NA	NA	0.88
SSN						
transfers (naira)	0.65	0.34	0.19	NA	NA	0.92
other transfers (naira)	0.54	-0.45	0.33	NA	NA	0.87
scholarship (yes or no)	-0.46	0.37	0.26	NA	NA	0.66
Has a migrant (yes or no)	0.66	0.4	0.24	NA	NA	0.95
ABS						
Infrastructure index	0.49	0.18	-0.15	0.34	0.46	0.93
Distance to primary school (km)	0.22	0.38	-0.32	0.33	0.37	0.68
Distance to secondary school (km)	0.39	0.45	0.11	0.45	-0.11	0.74
Distance from health services (km)	0.64	0.35	-0.22	0.39	-0.44	0.95
Distance to market (km)	0.77	0.41	0.44	0.29	0.11	0.96
Distance to major road (km)	0.34	0.53	0.27	0.31	0.25	0.82

notes: NA obtains when indicated factor number does not apply to component

Table A.9: Effects of resilience on FCS, disaggregated

VARIABLES	FCS
$\text{Conflict} \times \text{Post}$	-0.966 (1.055)
$\text{Conflict} \times \text{RCI}^{\text{high}} \times \text{Post}$	3.406*** (0.616)
SSN	
cash transfer	-4.847 (8.361)
In-kind gift	9.473 (9.763)
Has migrants	7.789*** (1.324)
scholarship	2.795 (1.791)
ABS	
Infrastructure index	4.141 (15.757)
Distance to primary school	15.906*** (4.808)
Distance to secondary school	16.859*** (4.999)
Distance to market	16.301*** (4.843)
Distance to health services	83.809 (62.133)
Distance to major road	6.795 (5.068)
ASSET	
farming asset index	-120.323* (65.697)
non-farming asset index	1.184 (9.579)
Household asset index	0.011 (0.035)
Tropical livestock unit	4.303*** (1.568)
AC	
Labour force participation rate	0.301* (0.168)
Average years of education	-2.705*** (0.920)
Dependency ratio	1.223 (2.527)
Diversity of income sources	1.344 (3.174)
Usual controls	yes
Observations	3,000
Number of hhid	1,500

Standard errors in parentheses

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

Table A.10: Top resilience capacity quartiles, interactions and FCS

VARIABLES	(1) RCI	(2) SSN	(3) AC	(4) ABS	(5) ASSET
$\text{Conflict} \times \text{Post}$	-3.125* (1.798)	-4.277** (1.959)	-4.263** (1.867)	-4.253** (2.021)	-4.253** (1.925)
$\text{conflict} \times \text{Post} \times Q2$	-2.778 (2.398)				
$\text{conflict} \times \text{Post} \times Q3$	-0.322 (2.646)				
$\text{conflict} \times \text{Post} \times Q4$	7.198*** (2.586)				
$\text{conflict} \times \text{Post} \times Q2$		0.651 (2.093)			
$\text{conflict} \times \text{Post} \times Q3$		0.365 (2.222)			
$\text{conflict} \times \text{Post} \times Q4$		-0.637 (2.154)			
$\text{conflict} \times \text{Post} \times Q2$			0.751 (2.491)		
$\text{conflict} \times \text{Post} \times Q3$			-0.461 (2.527)		
$\text{conflict} \times \text{Post} \times Q4$			-0.438 (2.656)		
$\text{conflict} \times \text{Post} \times Q2$				2.616 (2.615)	
$\text{conflict} \times \text{Post} \times Q3$				-2.123 (2.671)	
$\text{conflict} \times \text{Post} \times Q4$				1.622 (2.628)	
$\text{conflict} \times \text{Post} \times Q2$					4.046 (2.599)
$\text{conflict} \times \text{Post} \times Q3$					0.968 (2.542)
$\text{conflict} \times \text{Post} \times Q4$					4.019 (2.576)
Observations	3,000	3,000	3,000	3,000	3,000
Number of hhid	1,500	1,500	1,500	1,500	1,500

Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

RCI = Resilience capacity index, SSN = Social safety nets, AC = Adaptive capacity,

ABS = Access to basic services, ASSET = Access to Assets

Q1 - Q4 = Resilience quartiles. Q1 = reference category

Table A.11: Top resilience capacity quartiles, interactions and CSI

VARIABLES	(1) RCI	(2) SSN	(3) AC	(4) ABS	(5) ASSET
Conflict \times Post	1.867*** (0.586)	2.982*** (0.631)	1.569*** (0.600)	2.345*** (0.647)	3.406*** (0.616)
conflict \times Post \times Q2	-0.461 (0.780)				
conflict \times Post \times Q3	-0.318 (0.861)				
conflict \times Post \times Q4	0.385 (0.842)				
conflict \times Post \times Q2		-1.993** (0.855)			
conflict \times Post \times Q3		-0.741 (0.854)			
conflict \times Post \times Q4		-2.679*** (0.887)			
conflict \times Post \times Q2			0.390 (0.803)		
conflict \times Post \times Q3			0.249 (0.814)		
conflict \times Post \times Q4			0.156 (0.855)		
conflict \times Post \times Q2				-0.862 (0.841)	
conflict \times Post \times Q3				-0.422 (0.858)	
conflict \times Post \times Q4				-1.208 (0.843)	
conflict \times Post \times Q2					-2.603*** (0.833)
conflict \times Post \times Q3					-2.264*** (0.815)
conflict \times Post \times Q4					-1.602* (0.825)
Observations	3,000	3,000	3,000	3,000	3,000
Number of hhid	1,500	1,500	1,500	1,500	1,500

Standard errors in parentheses. *** p \leq 0.01, ** p \leq 0.05, * p \leq 0.1.

RCI = Resilience capacity index, SSN = Social safety nets, AC = Adaptive capacity,

ABS = Access to basic services, ASSET = Access to Assets

Q1 - Q4 = Resilience quartiles. Q1 = reference category

Table A.12: Top resilience capacity quartiles, interactions and food ratio

VARIABLES	(1) RCI	(2) SSN	(3) AC	(4) ABS	(5) ASSET
<i>Conflict</i> × <i>Post</i>	0.078*** (0.015)	0.076*** (0.016)	0.056*** (0.016)	0.060*** (0.017)	0.082*** (0.016)
<i>conflict</i> × <i>Post</i> × <i>Q2</i>	-0.026 (0.021)				
<i>conflict</i> × <i>Post</i> × <i>Q3</i>	0.013 (0.023)				
<i>conflict</i> × <i>Post</i> × <i>Q4</i>	-0.008 (0.022)				
<i>conflict</i> × <i>Post</i> × <i>Q2</i>		0.015 (0.023)			
<i>conflict</i> × <i>Post</i> × <i>Q3</i>		-0.010 (0.022)			
<i>conflict</i> × <i>Post</i> × <i>Q4</i>		-0.026 (0.023)			
<i>conflict</i> × <i>Post</i> × <i>Q2</i>			0.017 (0.022)		
<i>conflict</i> × <i>Post</i> × <i>Q3</i>			0.035 (0.022)		
<i>conflict</i> × <i>Post</i> × <i>Q4</i>			0.016 (0.023)		
<i>conflict</i> × <i>Post</i> × <i>Q2</i>				0.000 (0.023)	
<i>conflict</i> × <i>Post</i> × <i>Q3</i>				0.019 (0.023)	
<i>conflict</i> × <i>Post</i> × <i>Q4</i>				0.025 (0.023)	
<i>conflict</i> × <i>Post</i> × <i>Q2</i>					0.015 (0.023)
<i>conflict</i> × <i>Post</i> × <i>Q3</i>					-0.031 (0.022)
<i>conflict</i> × <i>Post</i> × <i>Q4</i>					-0.028 (0.022)
Observations	3,000	3,000	3,000	3,000	3,000
Number of hhid	1,500	1,500	1,500	1,500	1,500

Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

RCI = Resilience capacity index, SSN = Social safety nets, AC = Adaptive capacity,

ABS = Access to basic services, ASSET = Access to Assets

Q1 - Q4 = Resilience quartiles. Q1 = reference category

Table A.13: Effects of the conflict on resilience, disaggregated levels

Social safety nets (SSN)								
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Conflict × <i>Post</i> fatalities	1.921***		0.007***		0.051***		0.010	0.004***
		ns		ns		ns		
Columns: (1 - 2) log of cash tranfer + 1; (3 - 4) log of in-kind transfer + 1; (5 - 6) HH has migrant; (7 - 8) member of HH has scholarship								
Assets								
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Conflict × <i>Post</i> fatalities	-0.013***		ns		ns		-0.015**	
Columns: (1 - 2) farming asset index; (3 - 4) nonfarm asset index; (5 - 6) wealth index; (7 - 8) Tropical Livestock unit								
Adaptive Capacity (AC)								
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Conflict × <i>Post</i> fatalities	-0.017**		ns		ns		-0.001**	
		ns		ns		ns		ns
Columns: (1 - 2) Participation index; (3 - 4) Average years of education; (5 - 6) Dependency ratio; (7 - 8) Income diversity								
Access to Basic Services (ABS)								
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Conflict × <i>Post</i> fatalities	-0.017**		ns		ns		-0.001**	
		ns		ns		ns		ns
Columns: (1 - 2) Infrastructure index; (3 - 4) Distance to health services; (5 - 6) Distance to town; (7 - 8) Distance to market								

Standard errors in parentheses

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

ns indicates that there is no significant effect.

ABS omits distance to primary and secondary schools both of which did not have significant variation.

B Appendix to chapter three

Table B.1: Locations and establishment dates of the universities

State	LGA	City	Established
<i>1st generation</i>			
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
<i>2nd generation</i>			
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
<i>3rd generation</i>			
Imo	Owerri Municipal	Owerri	1980
Ondo	Akure South	Akure	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
<i>4th generation</i>			
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

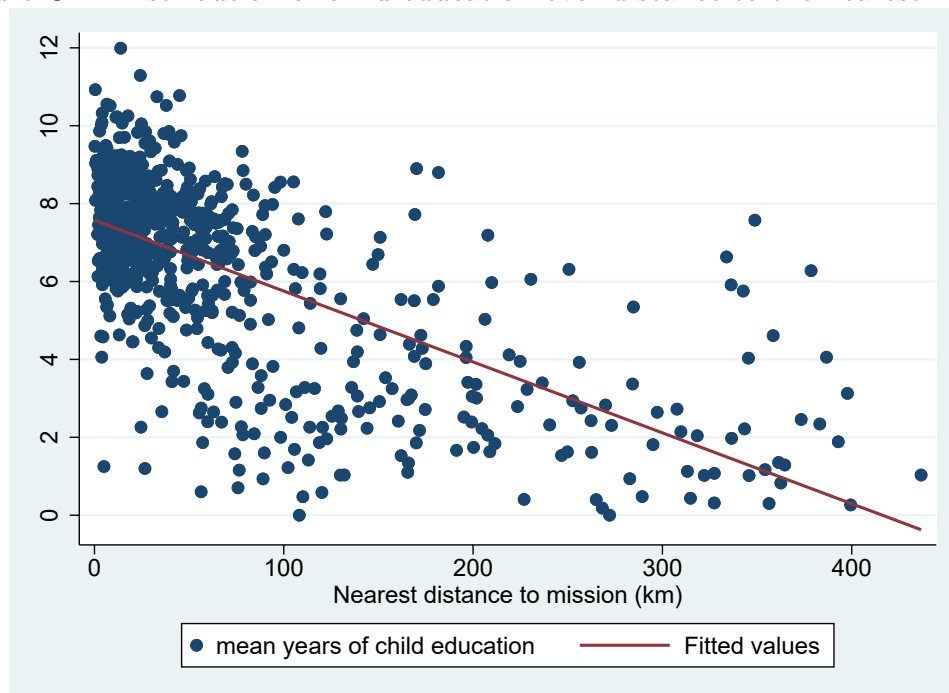
C Appendix to chapter four

C.1 Direct measurement of schools supply

In an effort spearheaded by the Nigerian government, researchers from the Office of the Senior Special Assistant to the President on MDGs (OSSAP), in collaboration with the Sustainable Engineering Lab at Columbia University, conducted extensive, comprehensive surveys of schools at LGAs. During 2012, the office administered questionnaires to each school in the country, soliciting information on enrolment, teachers, teacher qualifications, and building characteristics. This information is used by the government to create and keep track of its internal performance indicators. Coverage is excellent, with over 70% of total schools in the country covered, and this includes the ones constructed or improved before and after Nigeria's independence in 1960. Approximately 80% of schools surveyed were primary schools, and 86% of the sample was from public schools ([?]).

I focus on the measures of school quality that capture the three main dimensions of the educational system; teacher-pupils ratio, trained teacher-pupil ratio and pupils per class([?]). There is a high degree of collinearity among the indicators, so I used them individually in the model and as well as composite index.

Figure C.1: Distribution of child education over distance to the nearest mission



Data source: NLSS, 2019

Table C.1: Summary statistics of group controls

Variable	Obs	Mean	Std. dev.	Min	Max
Child Age	29,555	40.14	11.55	23	69
Male	29,555	0.51	0.50	0	1
Muslim	29,555	0.42	0.49	0	1
Rural	29,555	0.65	0.48	0	1
share of muslims in 1952	29,555	39.89	36.65	0.1	98.40
Population density in 1940	29,555	778.86	2351.82	6.90	41012.70
Political centralisation	29,555	2.58	0.82	1	4
Land suitability for agriculture	29,555	3.13	0.49	2.53	4.18
Land ruggedness	29,555	0.26	0.10	0.04	0.47
Mean temperature	29,555	0.95	0.30	0.22	1.23
Lenght of river	29,555	269.95	155.76	1	508.00
Malaria ecology	29,555	0.51	0.40	0.00	1.00
Land area	29,555	148.19	90.75	2.95	278.66
Distance to railway	29,555	71.89	56.70	0.98	315.09
Distance to coast	29,555	400.45	294.90	2.94	1047.47
Number of missions	29,555	0.73	2.04	0	16
Distance to mission	29,555	74.43	89.75	0.24	436.64
latitude	29,555	8.67	2.69	4.33	13.77
longitude	29,555	7.38	2.26	2.78	13.75

Table C.2: Effect of parental capital based on distance to the mission

VARIABLES	(1)	(2)	(3)	(4)	(5)
Instrument	OLS	IV stage-2 external only	IV stage-2 internal only	IV stage-2 external & internal	Stage-1
Distance to mission (km)					-0.004*** (0.000)
Parental capital	0.341*** (0.006)	0.923*** (0.116)	0.172*** (0.012)	0.183*** (0.012)	-0.094*** (0.017)
Child age	0.088*** (0.017)	0.143*** (0.022)	0.071*** (0.017)	0.072*** (0.017)	0.406*** (0.047)
Child is male	1.765*** (0.047)	1.528*** (0.073)	1.834*** (0.048)	1.830*** (0.048)	-1.981*** (0.081)
child is muslim	-1.815*** (0.077)	-0.619** (0.255)	-2.163*** (0.082)	-2.141*** (0.082)	-1.970*** (0.053)
Rural	-2.377*** (0.053)	-1.221*** (0.237)	-2.713*** (0.058)	-2.691*** (0.057)	
Time trend			0.116*** (0.024)	0.114*** (0.024)	
Geographical Controls					
Cragg-Donald Wald F statistic		105.16	519.85	500.36	
Kleibergen-Paap Wald F statistic		108.85	187.09	204.57	
Hansen J statistic (pvalue)			116.51 (0.000)	165.51 (0.000)	
Constant	1.007 (1.133)	-5.177*** (1.803)	7.883*** (0.047)	7.849*** (0.046)	9.792*** (1.105)
Observations	27,090	27,090	27,090	27,090	27,090
R-squared	0.422	0.239	0.407	0.409	0.253

Robust standard errors in parentheses

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

Table C.3: Effect of neighbourhood capital based on distance to the missions

VARIABLES	(1)	(2)	(3)	(4)	(5)
Instrument	OLS	IV stage-2 external only	IV stage-2 internal only	IV stage-2 external & internal	Stage-1
Distance to mission (km)					-0.004*** (0.000)
Neighbourhood capital	0.984*** (0.015)	0.794*** (0.085)	1.267*** (0.051)	1.185*** (0.047)	0.038*** (0.007)
Child age	0.021 (0.016)	0.027 (0.017)	0.011 (0.016)	0.013 (0.016)	-0.003 (0.019)
Child is male	1.904*** (0.046)	1.904*** (0.046)	1.904*** (0.046)	1.904*** (0.046)	-1.193*** (0.035)
child is muslim	-1.258*** (0.077)	-1.500*** (0.131)	-0.895*** (0.100)	-1.001*** (0.096)	-1.891*** (0.021)
Rural	-1.175*** (0.060)	-1.537*** (0.170)	-0.634*** (0.113)	-0.792*** (0.106)	
Time trend			-0.024 (0.024)	-0.013 (0.024)	
Geographical Controls					
Cragg-Donald Wald F statistic		125.12	519.847	500.369	
Kleibergen-Paap Wald F statistic		112.85	187.095	500.369	
Hansen J statistic (pvalue)			(0.000)	(0.000)	
Constant	-1.680 (1.096)	-0.463 (1.231)	1.331*** (0.285)	1.793*** (0.264)	5.445*** (0.455)
Observations	27,090	27,090	27,090	27,090	27,090
R-squared	0.453	0.449	0.445	0.449	0.625

Robust standard errors in parentheses

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

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