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# DOES FEMALE SCHOOLING REDUCE FERTILITY? EVIDENCE FROM NIGERIA

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## ABSTRACT

The literature generally points to a negative relationship between female education and fertility. Citing this pattern, policymakers have advocated educating girls and young women as a means to reduce population growth and foster sustained economic and social welfare in developing countries. This paper tests whether the relationship between fertility and education is indeed causal by investigating the introduction of universal primary education in Nigeria. Exploiting differences by region and age, the paper uses differences-in-differences and instrumental variables to estimate the role of education in fertility. The analysis suggests that increasing education by one year reduces fertility by 0.26 births.

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## I. INTRODUCTION

Over the past two decades, many developing countries have adopted policies designed to reduce rapid population growth. Among policy alternatives, educating girls and young women is considered a highly effective means of lowering fertility and accomplishing this goal (United Nations, 1995). Moreover, there is a growing consensus that investments in the education of young girls and women yield additional private and social returns, including improved child health and nutrition outcomes (Schultz, 2002; Thomas, 1991). Several empirical studies point to a robust, negative association between female education and fertility (Schultz, 1997). In fact, the negative relationship between female education and fertility has been described as "one of the most clear-cut correlations" in the social science literature (Cochrane, 1979).

Economic theory provides several explanations for why female education influences fertility. First, female schooling may increase the opportunity cost of childbearing and rearing among educated women (Becker, 1981; Schultz, 1981). Second, education may lower fertility through improvements in child health and reduced rates of child mortality as women need to have fewer births to yield the same desired family size (Lam and Duryea, 1999; Schultz, 1994). Finally, female schooling may affect fertility through knowledge and more effective use of contraceptive methods (Rosenzweig and Schultz, 1985; 1989) or by increasing female autonomy and bargaining power in fertility decisions (Mason, 1986). However, a survey of the existing literature suggests a need for caution in interpreting the observed relationship between female education and fertility as causal (Bledsoe *et. al.,* 1999). A negative association may arise due to omitted variables, such as individual ability or household and community resources, which affect both schooling and fertility decisions. In addition, schooling opportunities often are not randomly placed in communities (Duflo, 2001; Pitt *et. al.,* 1993). Furthermore, if fertility choices lead to interruptions in schooling, then fertility may be an endogenous variable within the context of schooling decisions (Angrist and Evans, 1999).

The ideal method to examine the issue of causality is to use an exogenous source of variation in schooling that is not related to fertility outcomes. This paper does so by focusing on the Universal Primary Education (UPE) program in Nigeria. Introduced in September 1976, the UPE was a large-scale, nationwide program designed to increase educational attainment. Funded by the federal government, it provided tuition-free primary education and increased the number of primary school classrooms and teacher-training institutions throughout the country, thereby marking a significant change in the educational opportunities available to young Nigerian children. During the UPE program, the number of primary school children in Nigeria increased from 4.4 million students in 1974 to 13.8 million by 1981 (Federal Office of Statistics, *Annual Abstract of Statistics,* various years).[1] In September 1981, the UPE program ended when the federal government handed over the financing of primary schools to states and regional governments. With reduced funding for primary schools, the reintroduction of school fees, and declining oil revenues in the 1980s, the gross primary enrollment rate stagnated or fell in many states after this date (Francis, 1998; World Bank, 2002).

In a seminal paper, Duflo (2001) examines the effect of a large-scale school construction program in Indonesia on educational attainment and wages by exploiting regional differences in program intensity and differences in exposure across cohorts induced by the timing of the program. Following this strategy, using the UPE program in Nigeria as an exogenous change in primary schooling investments, this paper examines whether increases in female schooling cause reductions in fertility. First, the paper examines how the UPE program affected female educational attainment by exploiting regional and age differences in the extent to which the policy affected investments in schooling. Second, the paper links these changes in education to

[1]The gross primary enrollment rate in Nigeria increased from 50.3 in 1975 to 120.7 in 1981. In comparison, in the five years before the UPE program commenced (1970-75), gross enrollment rates increased only by 17 percent from 43.7 in 1970 to 50.3 in 1975. By 1985, several years after the program ended, the gross enrollment rate had fallen to 91.8 (World Bank, *African Development Indicators*).

fertility outcomes thereby testing whether exogenous changes in education affect births in a causal manner. We employ differences-in-differences and instrumental variable methods, to estimate the relationship between schooling and fertility. This paper joins a growing number of studies that identify the impact of education policies and programs in developing countries.[2] In addition, the paper addresses the question of whether investments in education, specifically in primary education, impact fertility as there is little consensus about what level of education should be expanded to affect fertility outcomes.

Our results suggest that changes in schooling costs and the expansion of primary classrooms associated with the Nigerian UPE had a substantial impact on female education and fertility before the age of 25. We provide evidence that female education has a strong, negative association with early fertility even after accounting for the possible endogeneity of the schooling decision. The paper also considers the rapid advances in female schooling and demographic outcomes such as the state-level expansion in civil service employment during this period.[3] However, the results remain robust even with these additional controls.

This paper is organized as follows: Section II provides background on the Nigerian UPE program and a descriptive analysis of changes in educational outcomes after the introduction of the policy. Section III presents data sources and the empirical framework. Section IV examines the impact of UPE on educational outcomes and fertility, and Section V presents conclusions.

## II. EDUCATIONAL POLICY IN NIGERIA AND THE UPE

### *Background on Nigeria and Education before UPE*

[2] For example, Case and Deaton (1999) use data from South Africa to study the impact of increased resources on schooling outcomes. Breierova and Duflo (2004) rely on an individual's date of birth and region of schooling to identify the impact of male and female schooling on child mortality and fertility. Angrist, Bettinger, Bloom, King, and Kremer (2002) study the impact of school vouchers in Columbia.

[3] Unlike other related work, however, changes in contraceptive use and legal statues, such as the legalization of abortion and anti-discrimination laws, are less likely to be relevant in our environment.

Nigeria is an intriguing environment in which to study the impact of female education on fertility. Some of the earliest research on the economic determinants of fertility is based on survey evidence and field research from Nigeria and other parts of sub-Saharan Africa (Van De Walle, 1965; Caldwell, 1968; and Caldwell, 1977). In addition, total fertility rates in sub-Saharan are among the highest in the developing world at 5.9 lifetime births per women (World Bank, 2005). A noteworthy feature of the Nigerian environment is the absence of a sustained national family-planning program and government efforts to promote modern contraceptive methods (Caldwell et. al., 1992). However, Nigeria's average total fertility rate, at 5.6 lifetime births per woman, is comparable to the overall mean for sub-Saharan Africa (UNICEF, 2005).

Prior to independence in 1960 from the United Kingdom, Nigeria was divided into three administrative units governed as semi-autonomous regions. Nigeria's regions were composed of diverse ethno-linguistic groups often with distinct religious traditions. The Northern region was a predominantly Muslim area while the Eastern region was predominantly Christian (with both religions present in the Western region). After independence in 1960, four administrative regions were formed. Each region had developed its own education policies during this period. The Western Region, which was later carved into three states, was a forerunner in education. In January 1955, the Western Region was also the first area in Nigeria to experiment with universal education.[4] Tuition fees were abolished for all levels of primary schooling, and according to S.O. Awokoya, the education minister for the Western Region, advances in education were "imperative" and "urgent."[5] Education imbalances across regions were substantial in the decade that followed independence. The Northern, and to a lesser extent the Eastern regions did not

[4] In 1843, the Methodist mission established the first primary school in the Western region of Nigeria, partially due to its proximity to the Atlantic coast (Fafunwa, 1974). Lagos, also formerly in the Western Region and the capital of Nigeria after independence, also introduced its own universal primary education program in January 1957 and had achieved near-universal enrollments by the late 1960s.

[5] The priority afforded to education was reflected in the Western Region's budget, with primary education consuming nearly 40 percent of the government's recurrent budget in comparison to 10-20 percent in the Northern Region of the country (Nwachukwu, 1985).

implement sustained universal education programs in the pre-independence period. Specifically, in the Northern region, the legacy of the colonial policy to not interfere in Islamic religious practices had limited the expansion of formal primary schooling. It was against this background that the national UPE program was introduced.

***An Overview of UPE***

Nigeria's 1976 UPE nationwide initiative was characterized as "one of the most ambitious education projects in African history" due to the magnitude of the program in terms of government resources and the number of children who were expected to benefit (Bray, 1981, p.1). Fueled by revenues from the oil boom of the time, the nationwide UPE Program was announced formally on October 1, 1974 and commenced in September 1976. As part of the UPE program, the Nigerian central government provided tuition-free primary education nationwide. To enable the expansion of primary education, the government also recognized the need to construct a large number of new primary school classrooms. According to the *Nigerian Third National Development Plan 1975-80*, the country planned for the provision of 150,995 new classrooms at the primary-school level. This represented a 1.4-fold increase in the number of primary school classrooms in the country in 1965. To finance this expansion, about 700 million naira was disbursed to states by the Federal government for primary classroom construction between 1974 and 1979.[6]

The UPE appeared to have a substantial impact on both male and female enrollments. The gross primary enrollment rate for boys increased from 60.3 in 1974 to 136.8 in 1981. Similarly, although the gross female primary enrollment rate in Nigeria was only 40.3 percent in

[6] Federal Office of Statistics, *Social Statistics in Nigeria*, 1979, page 31. In 1976, the nominal exchange rate was N0.788 (naira) to $1 U.S. To meet the increased demand for teaching resources, the government announced plans to expand existing teacher-training institutions. According to Nwachukwu (1985), the UPE program required about 80,000 new teachers, and the government had also planned for 6,699 new classrooms in teacher-training institutions.

1974, by the end of the program in 1981, it had risen to 104.7 (World Bank, 2002).[7] These achievements are particularly impressive given that sub-Saharan and northern Africa have some of the lowest levels of female educational attainment, and many young girls and women have little or no exposure to formal schooling.[8]

To capture the intensity of the program by state, the analysis focuses on the amount of federal capital funds disbursed for classroom construction in 1976.[9] Figure 1 provides a map of Nigeria in 1976. Table 1 displays these amounts standardized by state population. Throughout the paper, we map the variables of interest to match the boundaries of the 19 states that existed when the UPE program commenced in 1976.[10]

As shown in Table 1, the states that received the highest levels of federal capital funds for classroom construction per capita were located outside the former Western region of Nigeria with the exception of Lagos.[11] These were the states that had relatively low primary school enrollment rates and levels of educational inputs prior to the UPE program. Throughout the rest of this paper, we use the term "high-intensity" to describe these states, which experienced a significant expansion in educational inputs.

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[7] The gross enrollment rate is calculated as the percentage of school-aged children who are enrolled in primary school in a given year. The rate can be over 100.0 percent due to the fact that older or younger students may be in the enrollment count and also due to grade repetitions.

[8] During the first year of UPE, the number of students enrolled in Grade 1 increased by 82 percent to 3 million students. This growth exceeded predictions that only 2.3 million would enroll (Federal Government of Nigeria, 1978-79).

[9] Alternative measures of the intensity of the program include the number of planned classrooms in primary schools and teacher training institutions. However, information on these amounts is only available for the 12 states that existed in Nigeria in 1974 and not the 19 states that existed by 1976 when the UPE was introduced.

[10] In 1965, Nigeria had 4 administrative areas (i.e. the Western, Eastern, Northern, and Midwestern regions). At the time of the UPE's announcement, these regions were split into 12 states. However, by 1976, when the UPE program commenced, additional states were created for a total of 19 states (the focus of this study). Currently, Nigeria has 36 states and 1 Federal Capital Territory. The number of states has changed over time to improve equity in the revenue-sharing system at the federal level. Federal government revenue allocations to states and local governments are governed by a formula based on population, need, and, to a lesser extent, derivation.

[11] The population estimates for Lagos are likely to be underestimated due to significant population growth resulting from rural-to-urban migration. During the first decade after independence in 1960, metropolitan Lagos was estimated to have experienced a growth rate of 14 per cent per annum (Lagos Executive Development Board, 1971). This would greatly reduce the actual funds per capita amount. However, when Lagos is eliminated from the sample, the results of the paper do not change.

Our calculations suggest that changes in gross enrollment ratios were also not distributed evenly across the country.[12] Using the projected state population for each Nigerian state, our calculations suggest that gross enrollment rates increased much faster in the high-intensity states that experienced large increases in federal capital expenditures and regional gaps appear to have been substantially reduced during the years of the UPE program.[13]

Figures 2 and 3 summarize the state trends in the number of students and primary schools before and during UPE with information from various years of the *Annual Abstract of Statistics* and *Social Statistics in Nigeria*.[14] As shown in the figures, the introduction of the nationwide UPE had a major impact on student participation in primary school education and the number of primary schools in Nigeria, especially in the high-intensity, non-Western states. The combined effects of the UPE program through the increase in capital funds for classroom construction and the elimination of primary school tuition fees appeared to been greatest in these states.

## III. DATA AND EMPIRICAL FRAMEWORK

### *The Data: The Nigerian Demographic Health Survey*

To study the impact of the UPE program, we rely mainly on the 1999 Nigerian Demographic Health Survey (NDHS). This dataset is a nationally representative survey containing rich information on socioeconomic and demographic variables for nearly ten

[12] The state population estimates used to standardize the expenditure numbers are based on the 1953 Population Census of Nigeria, the last census conducted by the British Colonial Administration. Due to significant controversies with the 1963 and 1973 censuses, we are less confident in the population figures from these sources. However, as shown in the final columns, the ranking and relative amounts by state are similar when using estimates based on the 1963 census.

[13] We calculate the gross enrollment rates in the Western region to be 0.65 in 1975-76 and 0.93 in 1980-81. For states outside the Western region, our estimates suggest that the gross primary enrollment rate increased from 0.45 in 1975-76 to 0.96 in 1980-81. In summary, by the time the program ended in 1981, many high-intensity states had experienced large changes in schooling inputs and enrollments.

[14] Although the ideal trend to display is enrollment rates, we do not have accurate population estimates for this time period because the 1973 population census in Nigeria was widely disputed and not publicly released.

thousand Nigerian women. The NDHS survey is ideal for this study because by design it provides reliable information on levels and trends in education, fertility, and family-planning practices for a large number of women. Table 2 provides summary statistics for the data. To study the impact of the UPE on education and early fertility, we use information from the NDHS on a respondent's region of birth to link individuals to educational policies and institutions. Table 2 also includes summary statistics on the 12 states that existed when the UPE program was announced in 1974 and the 19 states that existed when the program began in 1976.[15] An important advantage of the NDHS is that it contains detailed information on religion and ethnicity, and we can use these as control variables.

Although the NDHS survey has many important advantages, the data also have some shortcomings. First, we would ideally like to know precisely *when* and *where* an individual started and completed primary school. This is because our analysis exploits geographic variation to study the impact of the UPE. The NDHS survey has only limited information on migration.[16] Fortunately, two-thirds of the sample in the 1999 NDHS has never moved. When comparing the characteristics of individuals who did and did not move, we do not find significant differences.[17] In addition, recent studies on migration patterns in Nigeria in the 1990s suggest that most Nigerians do not move or only move within state. As noted by National Population Commission (1998), "If migration is defined as moves across state boundaries – most Nigerians can be classified as non-migrants. The only state with a sizeable share of migrants is Lagos State, with 87 percent of its population migrated from other states." (p. 285). Therefore, the subsequent

[15] As with Table 1, state population estimates are based on the 1953 Population Census in Nigeria, and we use only population of towns greater than 15,000 to maintain consistency in administrative boundaries.

[16] We can identify women who migrated, however, we are unable to determine if a woman moved across or within a state, and if the move occurred across states, we do not know in which state she lived during her school-age years. If an individual moved to their current state of residence before age six, then we can assume with some degree of certainty that education was completed in that state. However, if the individual moved after age six, then the educational opportunities she faced may have been in a different state.

[17] We do not find significant differences in the mean years of schooling completed or likelihood of completely primary-school between movers and non-movers. However, non-migrants tend to be younger and have fewer children than movers.

analysis will display the results with and without Lagos to account for possible measurement error, and the results are robust to excluding Lagos.

Another shortcoming of the 1999 NDHS is that it provides only limited information on wages or income at the household or individual level. Finally, because the cohort born after the initiation of the UPE program (1976-1981) was just reaching their mid-20s by 1999, we cannot fully use them to study the impact of education on fertility.

***Empirical Strategy #1: Differences-in-Differences***

To estimate the impact of UPE on educational and fertility decisions, the paper utilizes two empirical strategies that exploit the variation in which cohorts and in which geographical areas students were affected by UPE. The first strategy uses a differences-in-differences (DD) technique. By noting that the UPE occurred between 1976 and 1981 and had a larger impact on certain states (namely, the high-intensity states), we examine whether the introduction of universal primary education caused discontinuities in educational attainment and early fertility for the treatment group relative to a control group. This approach has been used in many recent studies, including Duflo (2001).

The first difference we use is exposure to the UPE as measured by age. In general, primary school lasts for six years in Nigeria, and we assume that most individuals start school at age 6. Given the timing of the program, UPE should have primarily affected individuals born between 1970 and 1975. However, there is a high prevalence of underage and overage enrollments in first grade in Nigeria.[18] For this reason, the program may have affected individuals outside of the main age range. Therefore, rather than using a cohort just a little older

[18] According to a Multiple Indicator Cluster Survey (MICS) conducted by UNICEF in 1999, underage enrollments, overage enrollments, and grade repetitions are common in Nigeria. Of the sample of 977 female students enrolled in first grade (primary one), about 4 percent of the sample was age four, 19 percent were age five, 31 percent were age six, 21 percent were age seven, and about 15 percent were above age seven.

than the target group for the control group, we use women who were age 15 to 20 when the UPE was initiated (born between 1956 and 1961); this group is less susceptible to overage enrollment. The main tables compare the outcomes of the group born 1970-75 (i.e. the main UPE group) to the group born 1956-1961 (i.e. out of the primary school age range before UPE). We also investigate the impact of UPE on additional cohorts (those born 1964-69 and 1976-81) as they may have benefited from UPE due to overage enrollments and the expansion in resources (the building of primary school classrooms and an increased number of trained teachers).

The second difference we use is state of residence. As shown above, the introduction of the UPE to Nigeria had varying effects on the states within the country. Because many non-Western, high-intensity states did not have tuition-free primary schooling prior to the nationwide UPE program, the program represented both an expansion in schooling inputs and a reduction in the cost of schooling. As a result, the national UPE program should have had a greater impact on primary-school enrollments in high-intensity states with educational attainment increasing *faster* in comparison to smaller effects in the low-intensity states. Therefore, our control group comprises of individuals in the low-intensity states that did not experience large growth in enrollments or schooling inputs. These states serve to account for any general trends that affected all states.

There are two ways to measure exposure to the UPE by state. The first is just to use a dummy variable that is equal to one if the woman grew up in a high intensity state. In this case, the differences-in-differences estimation of the impact of UPE on schooling can be described as:

$$(1)\quad S_{ijk} = \alpha_0 + \alpha_1 X_{ijk} + \alpha_2 (High\ Intensity_k * UPE\ Cohort_j) + \alpha_3 High\ Intensity_k + \alpha_4 UPE\ Cohort_j + \varepsilon_{ijk}$$

where *i* indexes individuals, *j* indexes cohorts, and *k* indexes states. $S_{ijk}$ is the years of schooling completed by individual *i* of cohort *j* in state *k*. $X_{ijk}$ includes controls for year of birth, religion, and ethnicity. The variable "High Intensity" is a dummy variable equal to one if the woman was educated in a high-intensity state (i.e. a non-Western state). "UPE Cohort" is a dummy variable that captures whether an individual was born between 1970 and 1975 and therefore would have been the age for primary school while UPE program was implemented. The parameter $\alpha_2$ is the reduced-form estimate of the effect of UPE. We expect that the change in schooling outcomes should be larger in the high-intensity states for the "UPE Cohort," and therefore, $\alpha_2$ is expected to be positive. In particular, it measures whether individuals in high-intensity states, who experienced large changes due to the UPE program, also experienced more rapid growth in schooling in comparison to individuals in the low-program intensity states, who did not experience much change due to UPE.

A more detailed way to measure program intensity is to use the 1976 per capita amount of federal funds disbursed to each state for classroom construction (shown in Table 1). This measure of UPE program intensity has several significant advantages in our context. First, the measure is available for all 19 states that existed when the UPE program commenced in 1976. In contrast, data on planned classroom construction, which previous studies have used, is only available for the 12 states that existed when the program was first announced in 1974. Second, the federal capital funds measure represents actual amounts disbursed to the states rather than the planned allocation of resources. This allows us to track more closely changes in schooling inputs that took place during the course of the program. Finally, our measure is strongly correlated with data on the projected primary school classroom construction detailed in Nigeria's *Third National*

*Development Plan*. It is also highly correlated with the projected expansion of classrooms at teacher training institutions.[19]

Using the continuous program intensity measure, the differences-in-differences estimation of the impact of UPE on schooling can be described as:

$$(2)\ S_{ijk} = \beta_0 + \beta_1 X_{ijk} + \beta_2 (UPE\ Inputs_k * UPE\ Cohort_{jk}) + \beta_3 UPE\ Inputs_k + \beta_4 UPE\ Cohort_{jk} + \varepsilon_{ijk}$$

The variable "UPE Inputs" is measured as the per capita federal funds disbursed for the primary school construction in the state where an individual was educated. The parameter $\beta_2$ is the reduced-form estimate of the effect of UPE. It measures whether individuals who grew up in states that received more resources during UPE experienced increases in educational attainment larger than women in states that did not receive as much.

The DD methodology can also be used to examine the impact of UPE on early fertility. The same regressions are run with the outcome being a measure of fertility rather than years of education. If women in the "UPE Cohort" who were educated in high intensity states had fewer births than women in the control groups, then we would expect that differences in fertility are due to the increased educational attainment associated with the UPE.

***Empirical Strategy #2: Instrumental Variable Approach***

A second strategy we use to determine the causal impact of education on fertility is an instrumental variable approach. As noted earlier, an important issue within the existing literature concerns the causal interpretation of the effect of education on fertility. If education has a causal

[19] We have also found that data on projected classroom construction detailed in Nigeria's *Third National Development Plan* (available for only 12 states) are highly correlated with actual changes reported in the number of classrooms in each state based on the Federal Office of Statistics, *Annual Abstract of Statistics*.

effect on fertility, then an expansion in schooling should induce lower fertility rates, holding other variables constant. However, unmeasured individual, household, and community-level resources may affect both education and fertility decisions. For example, an increase in the level of economic development may lead to higher educational attainment and lower fertility. Furthermore, education may serve as a proxy for unobservable factors, such as ability, cognitive skills, motivation, and parental background, and these factors may be important determinants of a woman's fertility choices (Thomas, 1991). Ignoring these factors would lead to biased estimates of the impact of education on fertility within the context of simple Ordinary Least Square (OLS) estimation. The DD methodology described above attempts to isolate the causal impact by including a control group, but an instrumental variables approach provides an additional option.

Valid instruments are variables that affect the level of educational attainment but have no direct impact on fertility. Again, our key measure of program intensity is federal disbursed funds per capita for primary school construction in the state where an individual was educated. If we assume that the UPE program had no direct effect on fertility, other than through its effect on educational attainment, then we can use exposure to the UPE program as an instrument for schooling. The age and state of schooling determines an individual's exposure to the UPE program. The key dependent variable is the number of children born before age 25.

The instrumental variable approach is described as follows:

$$(3) \qquad N_{ijk} = \alpha_i + BX_{ijk} + S_{ijk} + \varepsilon_{ijk} \qquad \text{where } S_{ijk} = f(UPE\ Inputs_k) + v_{ijk}$$

In equation (3), $N_{ijk}$ represents the number of children born before age 25 to an individual $i$ of cohort $j$ living in state $k$ and $S_{ijk}$ is instrumented for using $f(UPE\ Inputs_k)$. More formally, OLS estimates may lead to biased estimates if $\varepsilon_{ijk}$ is correlated with schooling due to unmeasured

ability and other factors, such as family background, social norms, or community wealth. We assume that exposure to the program (which is based on age and region of residence) is correlated with schooling outcomes after other explanatory variables are included. Equations (1) and (2) above form the basis for the first-stage regression represented by $f(UPE\ Inputs_k)$.

## IV. THE IMPACT OF THE UPE

### *Differences-in-Differences Analysis: The Impact on Schooling and Fertility*

In our empirical analysis, we first examine the impact of the UPE program on female educational levels. Before addressing the larger question of how schooling affects fertility, these results study the effect of the UPE on investments in female schooling. In the initial analysis, we limit our sample to the women of two cohorts: those born between 1956 and 1961 (ages 15-20 when the program started) and those born between 1970 and 1975 (ages 1-6 when the program started). Individuals born between 1970 and 1975 (i.e. the "UPE cohort") are likely to have been the primary beneficiaries of the program. Because primary school lasts for six years in Nigeria, an individual who was born in 1970 and enrolled in primary school in 1976 (and attended school continuously) was most likely exposed to a maximum of five years of the UPE program, which ended in 1981. In contrast, individuals who were born between 1956 and 1961 are likely to have been too old to benefit from the educational policy. Other cohorts also may have benefited from the UPE due to underage and overage enrollments and so are not used as control groups; they are examined in a later section.

The left side Table 3 reports the effect of UPE on the number of years of schooling completed using the differences-in-differences methodology. Panel A (the top panel) uses a dummy variable for growing up in a state that had a high level of UPE intensity. Panel B (the bottom panel) instead uses the 1976 per capita federal funds disbursed for primary school

construction as the measure of the UPE program intensity.[20] We present several specifications of the empirical model.. The baseline model (specification 1) includes controls for background such as religion and ethnicity. Because one might expect more growth in educational attainment in areas where fewer students were in school, we also control for the female share of total primary school enrollment in the state in 1970 to deal with the possibility of mean reversion. We also recognize that there may have been other programs in place to encourage women to become educated or enter the labor force. During this period in Nigeria, public-sector employment as well as the wages of civil servants significantly expanded. This expansion in the federal civil-service labor force may be correlated with the timing of the UPE program, and so to account for this factor, the baseline model also controls the time-varying share of female civil service employment in the state of residence.

Even with all the controls discussed above, there still may be unobserved state-level heterogeneity. This concern is important, because the high-intensity UPE states that experienced large changes in enrollments and schooling inputs during the program also had significantly lower educational and social indicators prior to the introduction of the UPE. For example, school availability and teacher quality tended to be lower in the high-intensity states, particularly in the northern states of Nigeria. Therefore, the second specification includes state fixed-effects to deal with time-invariant, unobserved heterogeneity at the state-level.[21] The fixed-effects regressions allow us to "sweep out" time-invariant, unobserved state characteristics, such as pre-UPE school availability and teacher quality, and initial differences in the level of economic development in the state, which may affect educational attainment. Finally, specification 3

[20] To obtain per capita amounts, we use state population estimates from the 1953 census. We use this earlier census because the 1963 and 1973 censuses suffered from considerable controversy, and so we have much less confidence in those numbers. In fact, the 1973 census was not publicly released. However, when we re-calculate the per capita amount using 1976 *projected* population numbers (based on the 1963 census) and re-estimate our regression models, the results do not differ from our main measure using the 1953 population numbers.

[21] The state fixed effects that we include refer to the state of residence as a child and are based on the 1970 boundaries of Nigerian states.

includes year-of-birth fixed effects to deal with government programs, policies, and other trends that took place during this period. We report robust t-statistics that are clustered at the state level and year of birth.

As shown in the first three columns of Panel A of Table 3, the UPE is estimated to have increased educational attainment. The results show a sizeable and statistically significant effect of the program whether we measure exposure to UPE by the high-intensity dummy variable or, as in Panel B, classroom construction funds per capita, a continuous measure of investments due to UPE. Our preferred estimates are shown in specification 3 of each panel. These results include all of the controls and both state and year of birth fixed-effects.[22] From Panel A, exposure to the UPE program is estimated to have increased the years of completed schooling by 1.54 for women age 1-6 in 1976 in comparison to the control group (age 15-20 in 1976). This represents a 0.32 standard deviation gain in schooling years completed and suggests that the UPE had a sizeable effect on schooling outcomes given that the average years of schooling in the NDHS sample is very low (5.0 years). Based on the results in Panel B using classroom construction funds to measure the treatment, we find a $100 naira increase in disbursed funds for primary school construction per capita increased the number of years of schooling completed by 2 years.[23] This represents a 0.42 standard deviation gain in schooling years completed.

Table 3 also examines the impact of the UPE program on fertility. Ideally, we would like to observe completed fertility. However, since the UPE cohort was a relatively young group at the time of the 1999 NDHS survey, we limit our analysis to early fertility indicators. Our key dependent variable here is the number of children born before age 25. Otherwise, the specifications follow the same pattern as the educational attainment estimates.

[22] The dummy variables "Born 1970-75" and "High-intensity state" are not shown in specifications 2, 3, 5, and 6 because their interpretation changes with the inclusion of state fixed effects and the year of birth fixed effects.
[23] In 1976, the nominal exchange rate was N 0.788 (naira) to $1 U.S. This suggests that a 100 naira increase corresponded to about $130 increase (World Bank, 2002).

The baseline estimates in specification 4 of each panel show a robust, negative impact of the UPE on the number of births. Again, our preferred estimates include year of birth and state fixed-effects and are shown in specification 6. In Panel A, we find that the UPE program reduced the number of births by 1.09. This represents a 0.6 standard deviation reduction in the number of births. From Panel B, we estimate that a 100 naira increase in classroom construction funds per capita associated with the UPE program reduced the number of births by 0.4 (Column 6). Given that average number of children born before age 25 is 2.35, this represents a 16 percent reduction in early births. We interpret these results as initial evidence that the UPE program had an impact on fertility through its effect on female schooling.[24]

***DD Analysis: The Impact on Additional Cohorts***

One interesting question to consider is whether other cohorts, beyond the main cohort that was primary school age during the UPE, also benefited from the program. Table 4 presents results that examine this issue and provide a robustness check. If the UPE really caused the effects on educational attainment and fertility, we should find *smaller* positive effects for the additional cohorts (the farther away from 1970, the smaller effects). Similar to the earlier results, the control group is women born between 1956 and 1961.

Table 4, Panel A shows results for women born between 1962 and 1965 who would have been between the ages of 11 and 14 when the program started in 1976. The impact of the UPE is likely to be limited for this group based on their age. However, to the extent that overage enrollments occurred, this group may have enjoyed some benefits from the program. In Panel A, although the coefficients are positive for educational attainment and negative for fertility, none

[24] While it is also possible that the number of children born before age 25 may also be lower among the UPE cohort due to other omitted variables that are correlated with the program such as birth control, changes in the diffusion of modern contraceptive methods are not likely to be important here as in other developing countries because the prevalence of such methods remains relatively low in Nigeria (Caldwell et al, 1992).

of them are statistically significant suggesting that the UPE did not have a strong effect on this cohort.

Table 4, Panel B focuses on the cohort of individuals who were born between 1966 and 1969 and were age seven to ten when the program was launched. This group is particularly interesting because it is very likely they also benefited from the UPE program but mainly in the latter years of primary schooling or as a result of overage enrollments. From Panel B, Column 3, we find some evidence that these women who were educated in high-intensity UPE states also enjoyed higher educational attainment compared to those of unaffected cohorts. This point justifies our decision not to use this cohort as the control group for the main results in Table 3 (instead opting to use women age 15 to 20 in 1976). We also examine fertility outcomes for this cohort, but the UPE is not found to have impacted the number of children before age 25.[25]

Because the program had a limited duration (1976-81), it is also possible to examine the impact of exposure to the UPE program for cohorts educated after the program ended. This analysis is shown in Panel C. Individuals who would have been age six after the program ended (born after 1976) may have also enjoyed some benefits if the program had a long-lasting impact on schooling due to classroom construction and teacher-training efforts. However, the end of the UPE program also marked significant reduction in funding resources available to primary schools. In most states, primary school tuition fees were reintroduced after 1981 as the federal government handed over control of the schools to states. Furthermore, the federal government no longer provided grants to states for teacher salaries and training. With these caveats in mind, we do not find evidence that there were long-term effects of the UPE program. Although the results in Panel C are positive in terms of years of schooling, the results are not statistically

[25] One caution in interpreting these results is that children who were born between 1965 and 1969 and were between ages 7 and 12 when the program commenced may have been influenced by the Nigerian Civil War (1969-1970). This factor may have led to some schooling interruptions in certain states for this cohort.

significant. We do not present fertility outcomes for this group because most were too young at the time of the 1999 NDHS survey to construct a complete measure of births before age 25.

***DD Analysis: Additional Robustness Checks***

One concern with the analysis is that schooling outcomes may be higher for the treated cohort because of reasons other than the UPE program. Instead, they may be due to a pre-existing differential trend in educational attainment across states. To address this concern, in Table 5, we compare the 1956-61 cohort to the 1950-55 cohort. Neither group should have been affected by UPE. However, if schooling levels were increasing faster in the high-intensity states prior to the UPE program, then we should find a spurious significant coefficient for the "younger" unaffected cohorts in high-intensity states. As shown in Panel A, however, when we compare successive cohorts who were unaffected by the UPE program, we find no evidence that schooling was increasing faster in the high-intensity areas prior to the program. Similar analysis is shown in Panel B using classroom construction funds per capita to measure UPE intensity, and likewise, no statistically significant results are found for the variable of interest.

Table 6 displays a second set of robustness checks. Our analysis is based on linking the resources and educational experiences of women while they were children to schooling and fertility outcomes as adults. While most of the households in our sample have never moved, among movers we do not know precisely where the woman was educated. While most movers appear to stay within their state birth, evidence from Nigeria suggests that Lagos is the only state with a significant share of migrants from other Nigerian states (National Population Commission, 1998). Therefore, Table 6 displays the results found in previous tables with and without Lagos to account for measurement error that could result from migration patterns. As shown in Panel A, the main results for the cohort age 1 to 6 in 1976 are robust to the exclusion of Lagos from the sample. In fact, as theory would predict, the results become stronger for both

schooling outcomes and fertility when excluding this group that may suffer with measurement error. The same is true in Panel B for the additional cohort shown to have increased their educational attainment due to UPE (those age 7 to 10 in 1976). Once we exclude women from Lagos in Column 2, the estimate increases in size and statistical significance.

***IV Analysis: The Impact on Fertility***

We now focus on the impact of the UPE on fertility using the instrumental variables strategy. The ideal candidate for an instrumental variable would affect schooling outcomes but have no direct impact on fertility. As shown earlier, year of birth interacted with the state classroom construction funds per capita had a positive and significant impact on years of completed schooling. Therefore, we use this measure as an instrument for schooling in our analysis. However, before displaying the IV result, we begin by estimating OLS regressions, which ignore the concern about the endogeneity of the schooling decision. Table 7, Panel A reports OLS estimates of the effect of education on fertility, measured as the number of children born before age 25. Similar to the order of the specifications in the above tables, all models include controls for religion and ethnicity, a control for the female share of total primary school enrollment in 1970 in the state, this variable interacted with a dummy variable for being in the Treatment cohort, and the proportion of civil servants in the state who were female the year the individual was age 6. In Column 2, we add state fixed effects. Finally, in Column 3, we also add year fixed effects.

As shown in Table 7A, Panel A, the OLS estimates suggest that increasing female schooling had a small, but precisely measured negative impact on early fertility. From these results, a one-year increase in female schooling is associated with a 0.11 reduction in the number of births. Starting at the mean, this represents about a 5 percent reduction in fertility.

In Panel B, we present the IV results, which account for the endogeneity of the schooling decision by instrumenting for years of schooling using UPE primary classroom construction funds per capita in the state of education interacted with year of birth indicators. The IV regressions suggest that a one-year increase in female schooling reduces fertility by 0.26 to 0.48 births – close to an 11 to 19 percent reduction in fertility depending on the specification of interest. These results suggest that the OLS estimates may underestimate the magnitude of the effect of schooling on fertility. We compare the differences between our OLS and IV estimates and find that the differences between the two estimates are statistically significant.[26]

We also compare our estimates to a number of recent studies that have examined the relationship between fertility and female schooling in developing countries. Ainsworth *et. al.* (1996) use data from the Demographic and Health Surveys for 14 sub-Saharan African countries and find that schooling has a negative and significant association with the number of children ever born in 13 out of the 14 countries included in their study. Although they do not attempt to instrument for schooling to deal with possible endogeneity, their point estimates on the impact of an additional year on the number of children ever born range from -0.06 to -0.13. Using cross-country panel data, Schultz (1994, 1997) estimates that a one-year increase in adult female years of schooling reduces fertility by 13 percent or about 0.5 children per woman. Schultz (1994) also finds that female education has a negative effect on fertility and population, while family planning and other variables do not appear to have a consistent, negative effect, although the estimates do not address concerns about endogeneity. Relative to these earlier studies, our OLS estimates are similar, but when we account for endogeneity, we estimate a larger effect.

***The Impact of UPE on Later Fertility***

[26] Based on standard Wu-Hausman test comparisons, we find that there are significant differences (at the 10 percent level) between the IV coefficients in Panel B and OLS estimates in Panel A.

In the tables above, we have presented evidence on early fertility outcomes. One final concern is that early fertility may be less indicative of final fertility outcomes for women. Several studies (Schultz, 1994, 1998) examine completed fertility, which is typically measured as the number of births for women age 45. The UPE cohort was relatively young at the time of the survey so it is not possible to investigate fertility to that age. However, among older cohorts, we observe that there is a significant decline in births after age 30, with a very steep decline in births after age 35. Furthermore, using the retrospective data available in the NDHS data, among women who are no longer in their reproductive years, we find that that early fertility is, in fact, strongly correlated with completed fertility. In particular, among women age 45 and above, the correlation coefficient between births before age 25 and completed fertility is 0.58. In addition, the correlation coefficient between births before age 30 and lifetime births is 0.74. We should note that for women age 45 and above, about 60 percent of births occurred before age 30.

To examine the impact of the program on later births, we use the 2003 NDHS, which allows us to examine fertility outcomes four years later for the UPE cohort. These results suggest that the UPE program had a robust, negative impact on births before 30. The OLS estimates show that an additional year of schooling reduces the number of births before age 30 by 0.11 while the IV estimates suggest a reduction of 0.36 in the number of births before age 30. These estimates are even larger than our results using fertility up to age 25 as the outcome. The complete results are shown in the Appendix. We do not include the 2003 NDHS in all our main analysis because it has some disadvantages due to higher levels of migration observed in the data.

## V. CONCLUSIONS

In this paper, we investigate the causal link between education and fertility using a large-scale policy experiment from Nigeria. Results from Nigeria suggest that the change in education policy had a significant impact on both female education and fertility decisions. At the mean, for each additional 100 naira per capita spent on primary school classroom construction in 1976, we estimate a 2-year increase in educational attainment. These results are robust to different specifications, and tests of alternate explanations lend additional support to the idea that the impact of schooling was due to the UPE program.

Under the assumption that exposure to the UPE program is a valid instrument for schooling, we construct IV estimates of the impact of female education on fertility. Our IV estimates are generally higher than OLS estimates and suggest that an additional year of schooling reduces the number of children born before age 25 by 0.26. Moreover, we find large and significant differences between the OLS and IV estimates when we examine the impact of the completion of seven or more years of schooling on early fertility. Therefore, while OLS estimates often provide an underestimate of the negative effect of schooling on fertility, the endogeneity bias appears smaller in the linear specification.

In summary, our results provide robust evidence that female education reduces the number of early births. An important topic for future research would be to estimate the social savings associated with higher female schooling. Within the neoclassical framework, lower fertility impacts economic growth through several channels, including lower dependency burdens (share of workers to children in the population), which then increases savings and investment capital. We should note that calculating the social savings from a reduction in fertility would most likely provide an underestimate of the total benefits associated with increased female schooling because higher female educational attainment likely would also affect wages, child nutrition, child mortality, and other outcomes.

Based on macroeconomic evidence, female schooling could have a significant impact on economic growth. Using a Solow growth framework, Knowles *et. al.* (2002) estimate that a 1-percent increase in female education would increase average GDP levels by 0.37 percent. Between 1974 and 1979, the total cost of the UPE program in Nigeria (capital and recurrent expenditure) was about 2.8 billion naira (in 1995 naira) – on average, about 3 percent of annual real GDP during this period. In comparison, we estimate that the average increase in female schooling associated with the program was about 1.54 years, or female schooling attainment was about 30 percent higher than the sample mean of 5.0 years. Moreover, UPE may also have positively affected the outcomes of the children of the affected women. For example, health and schooling indicators for children are known to improve with the level of female education (Schultz, 1998). Therefore, the returns to universal primary education programs over the long term may be substantial.

## REFERENCES


Ainsworth, M., Beegle K., Nyamete, A., 1996. The impact of women's schooling on fertility and contraceptive use: A study of fourteen sub-Saharan African countries. *World Bank Economic Review* 10 (1), 85-122.

Awokoya, S.O. 1952 Proposals for an educational policy. *Western Regional Gazette* 13 (10).

Angrist, J. D., Bettinger, E., Bloom, E., King, E., Kremer, M., 2002. Vouchers for private schooling in Colombia: Evidence from a randomized natural experiment. *American Economic Review* 92 (5), 1535-1558.

Angrist, J. D., Evans, W.N., 1999. Schooling and labor market consequences of the 1970 state abortion reforms. *Research in Labor Economics* 18, 75-113

Basu, Alaka Malwade, 1999. Women's education, marriage, and fertility in South Asia: Do men really not matter? Critical Perspectives on Schooling and Fertility in the Developing World. Bledsoe, C.H, Casterline, J.B., Johnson-Kuhn, J.A., and Haaga, J.G., eds. National Academy Press, Washington D.C., 138-176.

Becker, G. S., 1981. *Treatise on the family*. Harvard University Press, Cambridge.

Bledsoe, Caroline H., Casterline, John B., Johnson-Kuhn, Jennifer A., Haaga, John G., 1999. *Critical perspectives on schooling and fertility in the developing world*. National Academy Press, Washington, D.C.

Bray, M., 1981. Universal primary education in Nigeria: A study of Kano State. Routledge and Kegan Paul Ltd., London.

Breierova, Lucia and Esther Duflo 2004. The Impact of Education on Fertility and Child Mortality: Do
Fathers Really Matter Less Than Mothers? *National Bureau of Economic Research Working Paper* No. 10513.

Caldwell, John C., 1968. The control of family size in tropical Africa**.** *Demography* 5 (2), 598-619.

Caldwell, John C., 1977. The economic rationality of high fertility: An investigation illustrated with Nigerian survey data. *Population Studies* 31 (1), 5-27.

Caldwell, John C., 1980. Mass education as a determinant of the timing of fertility decline. *Population and Development Review* 6 (2), 225-255.

Caldwell, John C., 1986. Routes to low mortality in poor countries. *Population and Development Review* 12 (2), 171-220.

Caldwell, John C., Orubuloye, I. O., Caldwell, Pat, 1992. Fertility decline in Africa: A new type of transition? Population and Development Review 18 (2), 211-242.Case, A., Deaton, A., 1999. Schooling inputs and educational outcomes in South Africa. *Quarterly Journal of Economics* 114 (3), 1047-84.

Cleland, J., Rodriguez G., 1988. The effect of parental education on marital fertility in developing countries. *Population Studies* 42 (3), 419-442.

Cochrane, S.H., 1979. *Fertility and education: What do we really know?* Johns Hopkins Press, Baltimore.

Duflo, E., 2001. Schooling and labor market consequences of school construction in Indonesia: Evidence from an unusual policy experiment. *American Economic Review* 91 (4), 795-813.

Fafunwa, Babs A., 1974. *History of education in Nigeria*. Allen and Unwin, London.

Federal Government of Nigeria, 1978-1979. *Implementation Committee for the National Policy on Education blueprint*.

Federal Ministry of Economic Development and Reconstruction, Central Planning Office, 1975. *Third national development plan, 1975-1980*. Lagos, Nigeria.

Federal Office of Statistics, various years. *Annual Abstract of Statistics*.

Federal Office of Statistics, various years. *Social Statistics in Nigeria*.

Francis, Paul A., 1998. Hard lessons: Primary schools, community and social capital in Nigeria. World Bank Technical Paper No. 420, Africa Region Series. World Bank, Washington D.C.

Glewwe, P., 2002. Schools and skills in developing countries: Education policies and socioeconomic outcomes. *Journal of Economic Literature* 11 (2), 436-482.

Hirschman, C., 1985. Premarital socioeconomic roles and the timing of family formation: A comparative study of five Asian societies. *Demography* 22, 35-59.

Jejeebhoy, S. J., 1995. *Women's education, autonomy and reproductive behavior: Experience from developing countries*. Oxford University Press, New York.

Klasen, Stephan, 2002. Low schooling for girls, slower growth for all? Cross-country evidence on the effect of gender inequality in education on economic development. *World Bank Economic Review* 16 (3), 345-73.

Knowles, Stephen, Lorgelly,P., Owen, P., 2002. Are educational gender gaps a brake on economic development? Some cross-country empirical evidence. *Oxford Economic Papers* 54 (1), 118-49.

Lam, D., Duryea, S., 1999. Effects of schooling on fertility, labor supply and investments in children, with evidence from Brazil. *Journal of Human Resources* 34 (1), 160-192.

Mason, K.O., 1986. The status of women: Conceptual and methodological debates in demographic studies. *Sociological Forum* 1, 284-300.

National Population Commission. 1998. *1991 Population Census of the Federal Republic of Nigeria Analytical Report at the National Level.* Abuja, Nigeria: National Population Commission.

Nwachukwu, A.E., 1985. An historical analysis of the roots of universal public primary education in Nigeria (1900-1980). University of Kansas, Ph. D. dissertation.

Odaga, A., Heneveld, W., 1995. *Girls and schools in sub-Saharan Africa: From analysis to action*. World Bank, Washington D.C.

Pitt, M., Rosenzwig, M.R., Gibbons, D. M., 1993. The determinants and consequences of the placement of government programs in Indonesia. *World Bank Economic Review* 7 (3), 319-348.

Rosenzweig, M. R., Schultz, T.P., 1985. The demand and supply of births and its life-cycle consequences. *American Economic Review* 75 (5), 992-1015.

Rosenzweig, M. R., Schultz, P. T., 1989. Schooling, information, and nonmarket productivity: Contraceptive use and its effectiveness. *International Economic Review* 30 (2), 457-77.

Schultz, Paul T., 1994. Human capital, family planning, and their effects on population growth. *American Economic Review* 84 (2), 255-260.

Schultz, P. T., E.D., 1995. *Investment in women's human Capital*. University of Chicago Press, Chicago.

Schultz, P. T., E.D., 1998. Demand for children in low income countries. *Handbook of Population and Family Economics 1A.* Mark Rosenzweig and Oded Stark, eds. The Netherlands Elsevier Press, Amsterdam.

Schultz, Paul T., E.D., 2002. Why governments should invest more to educate girls. *World Development* 30: 207-225.

Schultz, Paul T., 1994. Studying the impact of household economic and community variables on child mortality. *Population and Development Review* 10 (0), 215-235.

Thomas, D., 1999. Fertility, education and resources in South Africa. *Critical Perspectives on Schooling and Fertility in the Developing World.* Bledsoe, C.H, Casterline, J.B., Johnson-Kuhn, J.A., and Haaga, J.G., eds. National Academy Press, Washington D.C., 138-176.

Thomas, D., Maluccio, J., 1996. Fertility, contraceptive choice and public policy in Zimbabwe. *World Bank Economic Review* 10 (1), 189-222.

Thomas, D., Strauss, J., Henriques, M., 1991. How does mother's education affect child height? *Journal of Human Resources* 26 (2), 183-211.

UNESCO, 1971. Education In Nigeria, *Educational Projects for External Aid* Vol. 1 Report 560 Paris: UNESCO

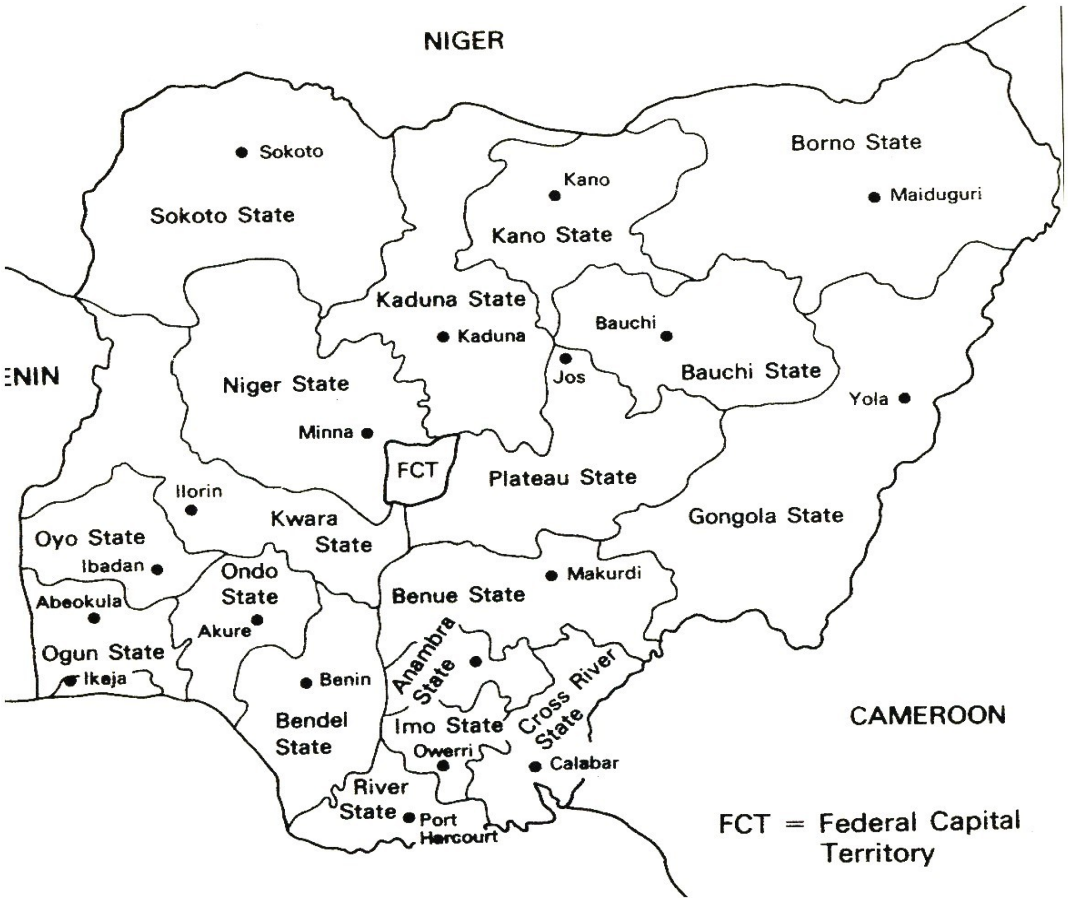
UNICEF Multiple Indicator Cluster Survey, 1999.

UNICEF, 2005. *Nigeria: Country Report.* http://www.unicef.org/infobycountry/nigeria_statistics.html retrieved February 19, 2007

Van de Walle, Etienne, 1965. An approach to the study of fertility in Nigeria. *Population Studies* 19 (1), 5-16.

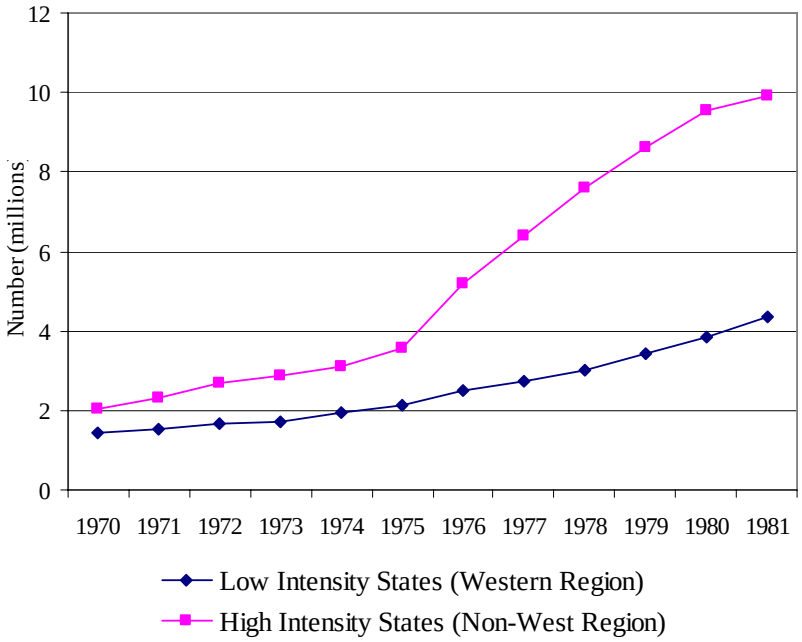
World Bank, 1996. Poverty lines: A joint publication of the Policy Research and Poverty and Social Policy departments of the World Bank. No.1.World Bank, 2002. African Development Indicators, database.

**Figure 1: The 19 States of Nigeria in 1976**



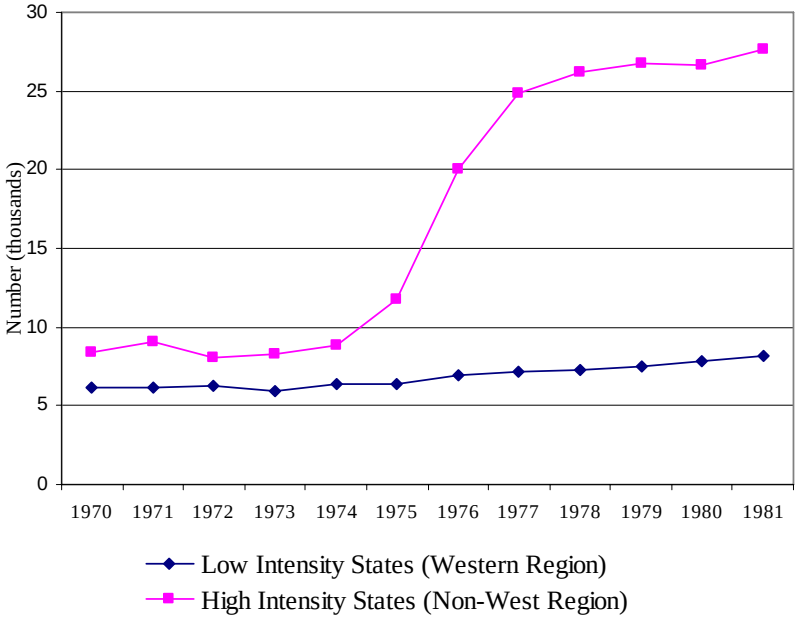

Source: Bray (1981).

**Figure 2: Number of Primary School Students, 1970-1981**




Source: Federal Office of Statistics (various years), *Annual Abstract of Statistics.*
Notes: High-intensity states refer to states that experienced the largest changes in schooling inputs during the program. These states are located largely outside of the Western region, while low-intensity refers to states of the Western Region (defined to include Lagos).

**Figure 3: Number of Primary Schools in Nigeria, 1970-1981**




Sources: Nigeria Federal Office of Statistics (various years), *Annual Abstract of Statistics.* Nigeria Federal Office of Statistics (various years), *Social Statistics in Nigeria*.
Notes: High-intensity states refer to states outside of the Western region, while low-intensity refers to states of the Western Region (defined to include Lagos, the former capital territory).

**Table 1: Federal Capital Funds allocated for Primary School Construction in 1976 (in naira)**

| State | Region | Funds Allocated | Using 1953 Census Population Estimates for Towns | | Using 1976 State Population Projections based on 1963 Census | |
|---|---|---|---|---|---|---|
| | | | Population | Funds / Capita | Population | Funds / Capita |
| ***Low-Intensity Areas*** | | | | | | |
| Oyo | Western | 1,744,305 | 1,243,090 | 1.40 | 7,330,400 | 0.24 |
| Ogun | Western | 321,524 | 166,274 | 1.93 | 2,182,600 | 0.15 |
| Ondo | Western | 717,838 | 219,741 | 3.27 | 3,841,400 | 0.19 |
| Lagos (Capital Region) | Western | 13,890,626 | 267,407 | 51.95 | 2,244,500 | 6.19 |
| ***High-Intensity Areas*** | | | | | | |
| Anambra | Eastern | 8,342,532 | 213,561 | 39.06 | 5,061,500 | 1.64 |
| Borno | Northern | 2,601,302 | 77,730 | 33.47 | 3,415,500 | 0.76 |
| Kaduna | Northern | 11,116,441 | 145,440 | 76.43 | 5,168,500 | 2.15 |
| Rivers | Eastern | 5,821,876 | 71,634 | 81.27 | 2,420,400 | 2.41 |
| Imo | Eastern | 8,271,194 | 93,633 | 88.34 | 3,666,300 | 2.26 |
| Kano | Northern | 12,131,038 | 130,173 | 93.19 | 8,126,800 | 1.49 |
| Sokoto | Northern | 8,369,744 | 87,845 | 95.28 | 6,387,300 | 1.31 |
| Kwara | Northern | 9,538,412 | 94,264 | 101.19 | 2,412,800 | 3.95 |
| Bauchi | Northern | 2,973,215 | 29,075 | 102.26 | 3,421,500 | 0.87 |
| Gongola | Northern | 5,005,510 | 47,643 | 105.06 | 4,894,700 | 1.02 |
| Bendel | Midwestern | 10,062,666 | 76,092 | 132.24 | 3,462,300 | 2.91 |
| Niger | Northern | 2,025,000 | 12,810 | 158.08 | 1,681,000 | 1.20 |
| Plateau | Northern | 6,287,450 | 38,527 | 163.20 | 2,852,100 | 2.20 |
| Benue | Northern | 3,175,804 | 16,713 | 190.02 | 3,463,300 | 0.92 |
| Cross-River | Eastern | 10,256,206 | 46,705 | 219.60 | 4,218,300 | 2.43 |

Source: *Social Statistics of Nigeria* (1979) p. 30. Information is not available on actual expenditures on classroom construction. Population figures are from national censuses.

Notes: The region refers to one of the 4 administrative areas defined in 1965 shortly after independence. At the time of the program's announcement, Nigeria's four administrative regions had been split into 12 states. However, by 1976, when the UPE program commenced, additional states were created for a total of the 19 states shown in this table. Throughout this paper, we map each variable of interest to match the 19 states that existed when the UPE program commenced in 1976. The population estimates derive from the 1953 Population Census, the last census conducted by the British Colonial Administration, which is considered the most accurate due to controversies surrounding the 1963 and 1973 Censuses. When mapping the 1953 town population numbers to the state boundaries of 1976, only towns with more than 15,000 people were included. This suggests that the population estimates are more accurate for the more urbanized Western Region and that the funds per capita estimates may be slightly inflated for the non-Western Regions. However, as shown in the final columns, the ranking and relative amounts by region are similar when using 1976 projected state estimates from the 1963 census. The population estimates for Lagos are likely to be underestimated due to significant population growth resulting from rural-to-urban migration. During the first decade after independence in 1960, metropolitan Lagos was estimated to have experienced a growth rate of 14 per cent per annum (Lagos Executive Development Board, 1971). However, when Lagos is eliminated from the sample, the results of the paper do not change.

**Table 2A: Summary Statistics of the 1999 NDHS Data**

| | Mean | Std Dev |
|---|---|---|
| Number of Children Born (at the time of the survey) | 2.16 | (2.78) |
| Number of Births before Age 25 | 2.35 | (1.81) |
| Number of Births before Age 25 (Conditional on Births> 0) | 2.67 | (1.51) |
| First Birth before Age 16 | 0.14 | |
| First Birth before Age 18 | 0.25 | |
| Years of Education: Female | 5.00 | (4.71) |
| Completed seven or more years of education: Female | 0.34 | (0.47) |
| *Year of Birth* | | |
| Born 1982-1989 | 0.26 | |
| Born 1976-1981 | 0.22 | |
| Born 1970-1975 | 0.18 | |
| Born 1964-1969 | 0.15 | |
| Born 1958-1963 | 0.12 | |
| Born 1952-1957 | 0.07 | |
| Born 1946-1951 | 0.02 | |
| *Religion and Ethnicity* | | |
| Muslim | 0.44 | |
| Christian | 0.54 | |
| Other Religion | 0.02 | |
| Hausa | 0.24 | |
| Yoruba | 0.22 | |
| Ibo | 0.14 | |
| Other Ethnicity | 0.40 | |
| *Residency Characteristics* | | |
| Low-Intensity State (Western Region - 1965 definition) | 0.18 | |
| High-Intensity State (Non-Western Region) | 0.82 | |
| Number of Observations | 9,810 | |

Source: 1999 Nigerian Demographic and Health Survey.
Notes: The sample includes all respondents in the 1999 NDHS. The average number of births before age 25 is calculated for women age 25 and older.

**Table 2B: 1976 State Characteristics (N=19)**

| | Mean | Std Dev |
|---|---|---|
| Federal Capital Funds Disbursed in 1976 to State for Primary School Classroom Construction) in 1976 (in naira) | 6,455,404 | (4,145,556) |
| Average Population (1953 census estimates) | 160,465 | (272,468) |
| Population (1963 census estimates) | 2,843,827 | (1,269,354) |
| Projected Population in 1976 (Based on 1963 census) | 4,013,221 | (1,773,927) |
| Projected Enrollments in Grade 1-1976 (in '000) | 120.94 | (53.06) |
| Actual enrollments in Grade 1 -1976 (in '000) | 157.48 | (79.53) |
| Area in square miles | 18,035 | (14,477) |
| Share of Females in Civil Service Employment | 0.02 | (0.01) |

Sources: Nigeria Federal Office of Statistics (various years), *Annual Abstract of Statistics.* Nigeria Federal Office of Statistics (various years), *Social Statistics in Nigeria*.
Notes: The 19 states in the sample represent the 19 states that existed when UPE was introduced in 1976.

**Table 3: The Impact of the UPE Program – DD Analysis**
Treatment: Born 1970-1975 (Age 1-6 in 1976); Control: Born 1956-1961 (Age 15-20 in 1976)

***A. Program Intensity measured with a Dummy Variable for High-Intensity (non-Western) States***

| ***Dependent Var.*** | ***Years of Schooling*** | | | ***Number of Kids Before Age 25*** | | |
|---|---|---|---|---|---|---|
| | Baseline | Add State FE | Add Year FE | Baseline | Add State FE | Add Year FE |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Born 1970-75 * High-Intensity State | 1.632* | 1.573* | 1.537** | -1.110*** | -1.142*** | -1.086*** |
| | (1.77) | (1.76) | (2.22) | (4.35) | (4.49) | (5.03) |
| Born 1970-75 Dummy Variable | -0.297 | -1.188 | | 3.676*** | 3.774*** | |
| | (0.14) | (0.61) | | (4.35) | (4.38) | |
| High-Intensity State Dummy Variable | -0.605 | | | 0.766*** | | |
| | (0.64) | | | (3.28) | | |
| R-squared | 0.383 | 0.393 | 0.404 | 0.102 | 0.110 | 0.130 |
| Observations | 2646 | 2646 | 2646 | 2646 | 2646 | 2646 |

***B. Program Intensity measured by 1976 per capita federal funds disbursed for primary school construction***

| ***Dependent Var.*** | ***Years of Schooling*** | | | ***Number of Kids Before Age 25*** | | |
|---|---|---|---|---|---|---|
| | Baseline | Add State FE | Add Year FE | Baseline | Add State FE | Add Year FE |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Born 1970-75 * Classroom Construction Funds per capita | 0.007 | 0.007* | 0.008** | -0.003** | -0.003** | -0.003*** |
| | (1.61) | (1.72) | (2.43) | (2.00) | (2.24) | (2.91) |
| Born 1970-75 Dummy Variable | 1.903 | 1.144 | | 1.874*** | 1.922*** | |
| | (1.41) | (0.90) | | (2.80) | (2.78) | |
| Classroom Construction Funds per capita | -0.001 | 0.012** | 0.012** | 0.002 | -0.001 | -0.001 |
| | (0.24) | (2.30) | (2.40) | (1.18) | (0.56) | (0.64) |
| R-squared | 0.383 | 0.395 | 0.407 | 0.096 | 0.104 | 0.125 |
| Observations | 2646 | 2646 | 2646 | 2646 | 2646 | 2646 |

* Significant at 0.1 level. ** Significant at 0.05 level.
Notes: t-statistics are shown in parentheses. The t-statistics reported are based on standard errors that are clustered at the year*state level. The baseline models include dummy variables for religion (Muslim, Catholic, Protestant, Other Christian, Traditional Religion with "Other" being the left out group), ethnicity (Hausa, Yoruba, and Igbo with "Other" being the left out group), the female share of total primary school enrollment in 1970 in the state, this variable is also interacted with a dummy variable for being born 1970-75, and the proportion of civil servants in the state who were female the year the individual was age 6.

**Table 4: Providing evidence in favor of the identification assumption: The effect of the UPE program on unaffected cohorts**

**A. Born before UPE was announced -** Born 1962-1965 (Age 11-14 in 1976)
Control Group: Born 1956-1961 (Age 15-20 in 1976)

| ***Dependent Var.*** | ***Years of Schooling*** | | | ***Number of Kids Before Age 25*** | | |
|---|---|---|---|---|---|---|
| | Baseline | Add State FE | Add Year FE | Baseline | Add State FE | Add Year FE |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Born 1962-65 * Classroom Construction Funds per capita | 0.005 (0.94) | 0.005 (0.92) | 0.006 (1.48) | -0.002 (1.09) | -0.001 (0.70) | -0.001 (0.91) |
| R-squared | 0.350 | 0.357 | 0.374 | 0.031 | 0.050 | 0.060 |
| Observations | 1723 | 1723 | 1723 | 1723 | 1723 | 1723 |

**B. Born shortly before UPE was announced -** Born 1966-1969 (Age 7-10 in 1976)
Control Group: Born 1956-1961 (Age 15-20 in 1976)

| ***Dependent Var.*** | ***Years of Schooling*** | | | ***Number of Kids Before Age 25*** | | |
|---|---|---|---|---|---|---|
| | Baseline | Add State FE | Add Year FE | Baseline | Add State FE | Add Year FE |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Born 1966-69 * Classroom Construction Funds per capita | 0.007 (1.58) | 0.006 (1.34) | 0.006* (1.84) | -0.001 (0.84) | -0.001 (0.65) | -0.001 (0.89) |
| R-squared | 0.361 | 0.372 | 0.385 | 0.037 | 0.052 | 0.062 |
| Observations | 1956 | 1956 | 1956 | 1956 | 1956 | 1956 |

**C. Born after UPE program ended -** Born 1976-1981
Control Group: Born 1956-1961 (Age 15-20 in 1976)

| ***Dependent Var.*** | ***Years of Schooling*** | | |
|---|---|---|---|
| | Baseline | Add State FE | Add Year FE |
| | (1) | (2) | (3) |
| Born 1976-81* Classroom Construction Funds per capita | 0.003 (0.67) | 0.004 (0.86) | 0.004 (1.26) |
| R-squared | 0.425 | 0.447 | 0.456 |
| Observations | 2936 | 2936 | 2936 |

* Significant at 0.1 level. ** Significant at 0.05 level.
Notes: t-statistics are shown in parentheses. The t-statistics reported are based on standard errors that are clustered at the year*state level. The baseline models include dummy variables for religion (there are six religious categories, including Muslim, Catholic, Protestant, Other Christian, Traditional Religion with "Other" being the left out group), ethnicity (Hausa, Yoruba, and Igbo with "Other" being the left out group), the female share of total primary school enrollment in 1970 in the state, this variable is also interacted with a dummy variable for being born 1970-75, and the proportion of civil servants in the state who were female the year the individual was age 6.

**Table 5: Additional evidence in favor of the identification assumption – Robustness Check**
*False Treatment*: Born 1956-1961 (Age 15-20 in 1976) *Control*: Born 1950-1955 (Age 21-26 in 1976)

***A. Program Intensity measured with a Dummy Variable for High-Intensity (non-Western) States***

| ***Dependent Var.*** | ***Years of Schooling*** | | | ***Number of Kids Before Age 25*** | | |
|---|---|---|---|---|---|---|
| | Baseline | Add State FE | Add Year FE | Baseline | Add State FE | Add Year FE |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Born 1956-61 * High-Intensity State | -0.447<br>(0.42) | -0.400<br>(0.38) | -0.765<br>(0.93) | 0.230<br>(0.72) | 0.210<br>(0.64) | 0.221<br>(0.76) |
| Born 1956-61 Dummy Variable | -0.789<br>(0.36) | -0.555<br>(0.27) | | 0.772<br>(0.84) | 0.807<br>(0.89) | |
| High-Intensity State Dummy Variable | -0.104<br>(0.16) | | | 0.681**<br>(2.55) | | |
| R-squared | 0.253 | 0.273 | 0.291 | 0.026 | 0.034 | 0.046 |
| Observations | 1552 | 1552 | 1552 | 1552 | 1552 | 1552 |

***B. Program Intensity measured by 1976 per capita federal funds disbursed for primary school construction***

| ***Dependent Var.*** | ***Years of Schooling*** | | | ***Number of Kids Before Age 25*** | | |
|---|---|---|---|---|---|---|
| | Baseline | Add State FE | Add Year FE | Baseline | Add State FE | Add Year FE |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Born 1956-61 * Classroom Construction Funds per capita | 0.0003<br>(0.06) | -0.0003<br>(0.06) | -0.002<br>(0.59) | 0.0001<br>(0.05) | 0.0007<br>(0.37) | 0.0007<br>(0.44) |
| Born 1956-61 Dummy Variable | -1.599<br>(1.01) | -1.224<br>(0.93) | | 0.976<br>(1.23) | 1.043<br>(1.35) | |
| Classroom Construction Funds per capita | 0.0001<br>(0.03) | 0.003<br>(0.44) | 0.005<br>(0.77) | 0.0001<br>(0.07) | -0.005<br>(1.53) | -0.005*<br>(1.69) |
| R-squared | 0.253 | 0.273 | 0.291 | 0.016 | 0.036 | 0.047 |
| Observations | 1552 | 1552 | 1552 | 1552 | 1552 | 1552 |

* Significant at 0.1 level. ** Significant at 0.05 level.
Notes: t-statistics are shown in parentheses. The t-statistics reported are based on standard errors that are clustered at the year*state level. The baseline models include dummy variables for religion (Muslim, Catholic, Protestant, Other Christian, Traditional Religion with "Other" being the left out group), the female share of total primary school enrollment in 1970 in the state, this variable is also interacted with a dummy variable for being born 1970-75, and the proportion of civil servants in the state who were female the year the individual was age 6.

**Table 6: The Impact of UPE by Migration (Including and Excluding Lagos) – Robustness Check**

**A. Main Treatment and Control Groups:** Treatment Group: Born 1970-1975 (Age 1-6 in 1976)
Control Group: Born 1956-1961 (Age 15-20 in 1976)

| ***Dependent Var.*** | ***Years of Schooling*** | | ***Number of kids before age 25*** | |
|---|---|---|---|---|
| | Full Sample | Excl. Lagos | Full Sample | Excl. Lagos |
| | (1) | (2) | (3) | (4) |
| Born 1970-75 * Classroom construction funds per capita | 0.008** | 0.011*** | -0.003*** | -0.004*** |
| | (2.43) | (3.22) | (2.91) | (3.39) |
| R-Squared | 0.407 | 0.409 | 0.125 | 0.123 |
| Observations | 2646 | 2503 | 2646 | 2503 |

**B. Born shortly before UPE was announced:** Treatment Group: Born 1966-1969 (Age 7-10 in 1976)
Control Group: Born 1956-1961 (Age 15-20 in 1976)

| ***Dependent Var.*** | ***Years of Schooling*** | | ***Number of kids before age 25*** | |
|---|---|---|---|---|
| | Full Sample | Excl. Lagos | Full Sample | Excl. Lagos |
| | (1) | (2) | (3) | (4) |
| Born 1966-69 * Classroom construction funds per capita | 0.006* | 0.007** | -0.001 | -0.002 |
| | (1.84) | (2.23) | (0.89) | (0.97) |
| R-Squared | 0.385 | 0.380 | 0.062 | 0.057 |
| Observations | 1956 | 1840 | 1956 | 1840 |

* Significant at 0.1 level. ** Significant at 0.05 level.
Notes: The t-statistics reported are based on standard errors that are clustered at the year*state level. The t-statistics are clustered at the year*state level. All models include dummy variables for religion and ethnicity, a control for the female share of total primary school enrollment in 1970 in the state, this variable interacted with a dummy variable for being in the Treatment cohort, the proportion of civil servants in the state who were female the year the individual was age 6, state fixed effects, and year of birth fixed effects. The results that exclude Lagos to focus on women who did not migrate from the state in which they were educated.

**Table 7: The Impact of Education on Fertility - Instrumental Variable Estimates**
Treatment: Born 1970-1975 (Age 1-6 in 1976); Control: Born 1956-1961 (Age 15-20 in 1976)
*Dependent Variable:* Number of Kids Before Age 25

**A. OLS Estimates**

| | Baseline | Add State Fixed Effects | Add Year of Birth Fixed Effects |
|---|---|---|---|
| | (1) | (2) | (3) |
| Years of Education | -0.111*** | -0.113*** | -0.109*** |
| | (14.08) | (14.35) | (13.89) |
| R-Squared | 0.163 | 0.172 | 0.187 |
| Observations | 2646 | 2646 | 2646 |

**B. Instrumental Variables Estimates**
*Instruments Used: Year of Birth Dummies * State Capital Allocation for Classroom Construction*

| | Baseline | Add State Fixed Effects | Add Year of Birth Fixed Effects |
|---|---|---|---|
| | (1) | (2) | (3) |
| Years of Education | -0.444*** | -0.475*** | -0.263** |
| | (3.70) | (3.99) | (2.28) |
| Overidentification Test (P-values) | 0.086 | 0.032 | 0.281 |
| R-Squared | -0.442 | -0.530 | 0.063 |
| Observations | 2646 | 2646 | 2646 |

* Significant at 0.1 level. ** Significant at 0.05 level. *** Significant at 0.01 level.

Notes: t-statistics are shown in parentheses. The t-statistics reported are based on standard errors that are clustered at the year*state level. All models include dummy variables for religion (Muslim, Catholic, Protestant, Other Christian, Traditional Religion with "Other" being the left out group), ethnicity (Hausa, Yoruba, and Igbo with "Other" being the left out group), the female share of total primary school enrollment in 1970 in the state, this variable is also interacted with a dummy variable for being born 1970-75, the proportion of civil servants in the state who were female the year the individual was age 6, and state and year fixed effects.

## APPENDIX: The Impact of UPE on Later Fertility

**Appendix Table 1: The Impact of the UPE program- DD Analysis**
Treatment: Born 1970-1975 (Age 1-6 in 1976);
Control: Born 1956-1961 (Age 15-20 in 1976)
*Dependent Variable:* Number of Kids Before Age 30

*A. Program Intensity measured with a Dummy Variable for High-Intensity (non-Western) States*

| | Baseline | Add State FE | Add Year FE |
|---|---|---|---|
| | (1) | (2) | (3) |
| Born 1970-75 * High-Intensity State | -1.505*** (4.19) | -1.460*** (4.32) | -1.407*** (5.29) |
| Born 1970-75 Dummy Variable | 3.405*** (3.32) | 3.431*** (3.37) | |
| High-Intensity State Dummy Variable | 1.029*** (3.69) | | |
| R-squared | 0.205 | 0.219 | 0.246 |
| Observations | 2688 | 2688 | 2688 |

***B. Program Intensity measured by 1976 per capita federal funds disbursed for primary school construction***

| | Baseline | Add State FE | Add Year FE |
|---|---|---|---|
| | (4) | (5) | (6) |
| Born 1970-75 * Classroom Construction Funds per capita | -0.004** (2.22) | -0.004*** (2.64) | -0.004*** (3.63) |
| Born 1970-75 Dummy Variable | 0.953 (1.23) | 1.102 (1.43) | |
| Classroom Construction Funds per capita | 0.003** (1.98) | -0.001 (0.29) | -0.001 (0.38) |
| R-squared | 0.197 | 0.213 | 0.240 |
| Observations | 2688 | 2688 | 2688 |

* Significant at 0.10 level. ** Significant at 0.05 level.
Notes: This table is similar to Table 3 in the main text except that we look at fertility outcomes up to age 30 rather than age 25. T-statistics are shown in parentheses. The standard errors are clustered at the year*state level. The baseline models include dummy variables for religion (the six religion categories are Muslim, Catholic, Protestant, Other Christian, Traditional Religion with "Other" being the left out group), ethnicity (Hausa, Yoruba, and Igbo with "Other" being the left out group), the female share of total primary school enrollment in 1970 in the state, this variable interacted with a dummy variable for being born 1970-75, and the proportion of civil servants in the state who were female the year the individual was age 6.

**Appendix Table 2: The Impact of Education on Fertility - Instrumental Variable Estimates**
Treatment: Born 1970-1975 (Age 1-6 in 1976)
Control: Born 1956-1961 (Age 15-20 in 1976)
*Dependent Variable:* Number of Kids Before Age 30

**A. OLS Estimates**

| | Baseline | Add State Fixed Effects | Add Year of Birth Fixed Effects |
|---|---|---|---|
| | (1) | (2) | (3) |
| Years of Education | -0.109*** | -0.112*** | -0.108*** |
| | (7.92) | (10.59) | (10.28) |
| R-Squared | 0.243 | 0.260 | 0.283 |
| Observations | 2688 | 2688 | 2688 |

**B. Instrumental Variables Estimates**
*Instruments Used: Year of Birth Dummies * State Capital Allocation for Classroom Construction*

| | Baseline | Add State Fixed Effects | Add Year of Birth Fixed Effects |
|---|---|---|---|
| | (1) | (2) | (3) |
| Years of Education | -0.297* | -0.400*** | -0.359*** |
| | (1.67) | (2.75) | (2.69) |
| Overidentification Test (P-values) | 0.0014 | 0.0022 | 0.408 |
| R-Squared | 0.106 | -0.049 | 0.053 |
| Observations | 2688 | 2688 | 2688 |

* Significant at 0.10 level. ** Significant at 0.05 level. *** Significant at 0.01 level.

Notes: T-statistics are shown in parentheses. The t-statistics reported are based on standard errors that are clustered at the year*state level. The baseline models include dummy variables for religion (the six religion categories are Muslim, Catholic, Protestant, Other Christian, Traditional Religion with "Other" being the left out group), ethnicity (Hausa, Yoruba, and Igbo with "Other" being the left out group), the female share of total primary school enrollment in 1970 in the state, this variable interacted with a dummy variable for being born 1970-75, and the proportion of civil servants in the state who were female the year the individual was age 6.