Economics of Education Review 28 (2009) 474–484

Contents lists available at ScienceDirect

Economics of Education Review

journal homepage: www.elsevier.com/locate/econedurev

Determinants of schooling for boys and girls in Nigeria under a policy of free primary education

Jane Arnold Lincove*

LBJ School of Public Affairs, University of Texas at Austin, 2315 Red River, Mailcode E2700, Austin, TX 78713, United States

ARTICLE INFO

Article history:
Received 19 October 2006
Accepted 12 October 2008

JEL classification:
I21
O15

Keywords:
Demand for schooling
Economic development
Human capital

ABSTRACT

This paper adds a measure of school costs to the model of determinants of schooling. Costs are estimated with controls for selection into school and the possibility of receiving free primary education (FPE). Controlling for costs, household wealth has a large, positive effect on primary school attendance with greater income elasticity for girls than boys. Girls' attendance also depends on opportunity costs generated by providing child care for younger siblings and living on a family farm. Policies that increase household resources and reduce opportunity costs are recommended to complement free primary education.

1. Introduction

To achieve the benefits of human capital, developing countries have committed to provide universal primary education (UPE) by 2015, as one of the United Nations Millennium Development Goals. At the same time, economic and political pressures have led governments to devolve the costs of education to local communities and parents (Colclough, 1996). Increases in tuition and fees have been blamed for reduced enrollments and increased gender gaps, as economic incentives drive parents to invest scarce resources in sons before daughters (Stromquist, 1999). This study examines the relative influence of gender, school costs, family wealth, and other factors on access to primary school in Nigeria.

In an economic model of determinants of schooling, parents compare the future benefits of a child's human capital to the direct and opportunity costs of schooling (Becker, 1975). A rich literature on determinants of schooling illustrates that child, family, and school characteristics related to costs and benefits influence enrollment and attainment (Al-Samarrai & Peasgood, 1998; Chernichovsky, 1985; Connelly & Zheng, 2003; Dostie & Jayaraman, 2006; Glick & Sahn, 2000; Handa, 2002; Holmes, 2003; Jamison & Lockheed, 1987; Tansel, 1997; Wolfe & Behrman, 1984; Zimmerman, 2001). Fewer studies have had access to the data required to directly measure the effect of school costs. Instead researchers use proxies for school cost such as distance to school (King & Lillard, 1987), the presence of free primary education (FPE) policies (Deininger, 2003), or community-level prices (Glick & Sahn, 2006). Birdsall and Orivel (1996) obtained official cost data from school headmasters and proxy for indirect costs with the distance to school. Glewwe and Patrinos (1999) develop a model of household willingness to spend on education, but do not test the effect on enrollment.

Excluding costs from models of determinants of schooling limits our understanding of family decision making. It is likely that high costs keep some children out of school. This is particularly important for countries where free primary education is limited by resource constraints. Models of determinants of schooling may also result in biased

* Tel.: +1 512 232 2561; fax: +1 512 471 1835.
E-mail address: lincove@mail.utexas.edu.

0272-7757/$ – see front matter © 2009 Elsevier Ltd. All rights reserved.
doi:10.1016/j.econedurev.2008.10.001

estimations for other variables if cost varies with other determinants, as predicted by Becker (1981, 1985) and demonstrated by Glewwe and Patrinos (1999). Understanding the direct effect of costs can also facilitate analysis of different policy tools such as free primary education or cash transfer programs. This study builds on the literature on determinants of schooling in developing countries by modeling costs as a predictor of school access in Nigeria. The results suggest that the effect of wealth dominates the effect of costs, and opportunity costs remain a significant obstacle to education for girls.

2. Estimating school access

The objective of this study is to control for school costs in a model of determinants of schooling. To overcome selection problems, the effects of costs are estimated in a three-stage structural model. The first stage identifies selection into paying for school. The second stage estimates costs with selection. The final stage includes estimated cost in a model of determinants of schooling.

We begin by adding cost to the basic model of determinants of schooling:

$$S = \alpha_0 + \alpha_1 \log C + \alpha_2 \mathbf{X} + \varepsilon \quad (1)$$

where S is the probability of attending school, C is the cost of school to parents, $\mathbf{X}$ is a vector of child, family, and school characteristics, and ε is unobservable variation in access to school. If ε is normally distributed, S can be estimated with a standard probit model. However, price data obtained from surveys are incomplete because costs are reported only if a child pays for school. This introduces bias in the error term if children are nonrandomly sorted into having positive school costs. If parents decide not to enroll a child because the price is too high, nonrandom sorting will occur, and a method to control for selection is required (Tunali, 1986).

A Heckman (1974, 1976) selection model would address this problem in a two-stage estimation in which costs are estimated using observable characteristics. The Heckman model treats all values of zero as similar and indicative of selection out of school attendance. The presence of free primary education in developing countries complicates the estimation. If all students receive primary education for free, costs would be irrelevant, but if FPE is limited, children may select into both attending school and attending school for free. If selection into FPE is not universal and not random, a double-selection problem is created. The correct estimation method must overcome the problem that zero costs can reflect either selection out of school or access to free education (Tunali, 1986).

This study applies a double-selection model developed by Connelly (1992) and replicated by Powell (1997) and Connelly and Kimmel (2003)[1]. These studies examined women's workforce participation as a function of wages and child care costs. Of the children in the samples with working mothers, some received child care for free from a relative, while others received paid care. Selection into free care was nonrandom and dependent on observable family characteristics. This created a double-selection case where mothers simultaneously selected into using child care and paying for child care. Like data on the costs of schooling, having zero child care costs could reflect either selection out of child care or access to free child care.

The joint probability of attending school and paying is estimated by a system of equations:

$$\begin{aligned} S &= \beta_0 + \beta_1 \mathbf{X} + \beta_2 \mathbf{I} + \zeta \\ P &= \gamma_0 + \gamma_1 \mathbf{Y} + \gamma_2 \mathbf{I} + \eta \end{aligned} \quad (2)$$

where P is equal to one if a child pays for school, and P is equal to zero if a child either receives free education or does not attend school. $\mathbf{Y}$ is a vector of observable characteristics that overlaps, but is not identical to $\mathbf{X}$, and ζ and η are randomly distributed error terms in estimation of S and P, respectively. The system of Eq. (2) is estimated as a bivariate probit to identify joint selection into attending and paying (Mroz, 1987). The inverse Mills ratio (IMR) calculated from Eq. (2) controls for double-selection in the estimation of school costs (Tunali, 1986). A common problem with this approach is that the bivariate probit form estimates an IMR that is potentially non-linear, particularly at extreme values. To address identification problems introduced in multi-stage estimation, a vector of identification variables ($\mathbf{I}$) is included in this first stage of estimation and excluded in subsequent stages (Vella, 1998).

The predicted log cost of school is then estimated with the OLS model:

$$\log(C) = \delta_0 + \delta_1 \mathbf{Y} + \delta_2 \lambda + \theta \quad (3)$$

where λ is the IMR estimated from Eq. (2) and θ is normally distributed error in C. The t-test of the significance of the coefficient δ_2 serves as a test of the presence of selection bias. If we fail to accept the null hypothesis that δ_2 is equal to zero, the assumption of selection is validated (Vella, 1998).

From equation (3), $\hat{C}$ is the predicted cost of school conditioned on attending school. The expected value of school cost depends also on the probability of receiving free primary education. Following Connelly (1992), the expected value of costs is calculated conditioned on the probability of attending school and paying:

$$E[C] = Pr(\hat{C} > 0) \times E[\hat{C} | \hat{C} > 0] + Pr(\hat{C} = 0) \times E[\hat{C} | \hat{C} = 0] \quad (4)$$

Which is equivalent to

$$E[C] = \Phi(\hat{\delta}_0 + \hat{\delta}_1 \mathbf{Y} + \hat{\delta}_1 \hat{\lambda}) \times (\hat{\delta}_0 + \hat{\delta}_1 \mathbf{Y} + \hat{\delta}_1 \hat{\lambda} + \hat{\sigma} \times \hat{\lambda}) \quad (5)$$

where Φ is the standard normal conditional density function and σ is the standard deviation of predicted cost. $E[C]$ is the appropriate estimator of school enrollment, as it expresses the expected cost of school for parents given the total costs and the probability of receiving free primary education. For the final estimation of school access, Eq. (1) is modified as

$$S = \alpha_0 + \alpha_1 \log E[C] + \alpha_2 \mathbf{X} + \varepsilon \quad (6)$$

Estimation of Eq. (6) requires adjusted standard errors to overcome endogeneity introduced by estimating cost

[1] Similar methods were also used by Sorenson (1989), Krishnan (1990), and Mohanty (2001).

and access with an overlapping set of independent variables (Vella, 1998). In this case, robust standard errors were estimated through bootstrapping.

3. Data

The data for this study come from the 2004 Nigeria EdData Survey (NDES) and Demographic Health Survey (DHS) (NPC & ORC Macro, 2004). The DHS is conducted periodically in developing countries to collect household data on health indicators. The EdData component was added to the DHS in selected sub-Saharan African countries to examine information about household investments in primary education, including the costs of school. The two survey components are linked to provide full information about family health, primary education for children, and demographic variables. Approximately 8000 Nigerian women ages 15–49 were interviewed for the 2003 DHS from a geographically stratified sample. The 2004 NDES supplement revisited 4563 households. For this study, demographic data were merged from the DHS into the NDES through the child's mother.

The data set analyzed for this study includes the primary school-aged population of children ages 6–12. Children in the highest wealth quintile were excluded, because income inequality in Nigeria is very high, and the wealthiest families use elite private schools. Children were also excluded if they did not attend school due to a disability, or if they had already completed primary school. The resulting data set includes 3933 children with full data on child characteristics, household characteristics, school attendance, and school costs.

4. Primary education in Nigeria

Nigeria's first universal primary education policy was implemented in 1976, making grades one through six free but not compulsory. After initial success in expanding primary enrollment, Nigeria experienced an economic crisis and implemented a structural adjustment program in the 1990s, which included devolution of education financing from the federal level to local communities. This included an increasing dependence on parent contributions, which may have contributed to reductions in quality and access (Moja, 2000). Revised UPE policies were instated in 1999 and 2004, calling for the elimination of fees, but these policies remain underfunded. Currently, Nigeria maintains a formal policy of free primary education for all, but education is funded at less than 1% of GDP, and primary school is still not compulsory (World Bank, 2006).

Nigeria's education outcomes are influenced by a history of Christian missionary schools in a country with a majority Muslim population (Duan, 2000). Islamic communities, particularly in northern Nigeria, were not a target of the Christian school system and were often left with no education infrastructure. At the same time, traditional Islamic practices and a growing fundamentalist movement create additional obstacles for girls in these regions, including laws allowing child marriage, forced marriage, and the practice of female seclusion (Uduigwomen, 2004).

Table 1
Attendance status and school costs.

	Attends school	Attends school for free	Mean cost for students who pay
All children	66.8%	15.0%	$12.89
By gender			
Boys	72.9%	16.0%	$12.78
Girls	60.8%	14.1%	$13.03
By religion			
Protestant	94.3%	20.2%	$17.90
Catholic	93.0%	18.7%	$14.74
Islamic	53.6%	12.7%	$10.42
Traditional	69.7%	24.4%	$13.14
By urban/rural			
Urban	79.5%	17.8%	$14.28
Rural	62.1%	14.0%	$12.24
By region			
North central	87.1%	19.6%	$12.83
North east	54.1%	11.4%	$ 7.67
North west	53.7%	12.9%	$11.09
South east	94.6%	20.6%	$19.42
South south	94.8%	19.9%	$19.52
South west	90.5%	24.4%	$23.15

Although local laws do not explicitly conflict with UPE, they limit girls' access to schooling and returns to education by reducing age at marriage and limiting legal protections for the physical safety of girls (Iman, 2003).

The World Development Indicators report that Nigeria's primary net enrollment rate was 60% in 2004, with a seven-point gap between boys (64%) and girls (57%) (World Bank, 2005). Table 1 reports attendance and free primary education rates for the dataset analyzed in this study. The NDES survey data shows a slightly higher net attendance rate at 66.8%, with a 12-point gap between boys (72.9%) and girls (60.8%)[2]. Attendance rates are higher for children from wealthier families, Christians, children in urban areas, and children in the wealthier southern regions. Islamic children are the least likely to attend school with enrollment of only 53.6%. Despite a national policy of FPE, only 15% of children in the dataset receive free primary education. It does not appear that FPE is used to improve equality. Islamic children are least likely to receive FPE at only 12.7%, and FPE is more common in urban areas and southern regions than the poorest regions of North East and North West Nigeria.

Table 2 displays the disaggregated costs of schooling by wealth quintile for children who pay for school. Children in the wealthiest quintile are included in Table 2 to illustrate the level of inequality in school investments. Children in the study dataset, which excludes the highest wealth quintile, pay an average of $13.48 for school. Primary school tuition, which is technically illegal, is only a small portion of this cost at $1.63. The greatest costs are for books and supplies ($4.91) and uniforms ($4.22). By comparison, children in highest wealth quintile pay over $57 for school. The likelihood of receiving free primary education actually increases

[2] The NDES rates are based on parent reports that a child attends school. World Bank rates are based on official Ministry of Education enrollment reports.

Table 2
Mean school costs in US dollars.

	Regression data set[a]	Wealth quintile 1	Wealth quintile 2	Wealth quintile 3	Wealth quintile 4	Wealth quintile 5
	$n = 2087$	$n = 455$	$n = 479$	$n = 543$	$n = 610$	$n = 459$
% attending school	66.8	50.5	61.7	74.6	87.5	97.7
% with fpe	15.0	13.4	15.1	16.0	16.1	23.4
Costs of school[b]						
Tuition	$1.63	$0.90	$0.58	$1.58	$3.03	$17.41
School fees						
Development	$0.39	$0.41	$0.35	$0.36	$0.42	$1.73
PTA	$0.75	$0.65	$0.60	$0.81	$0.90	$1.58
Facilities	$0.24	$0.21	$0.15	$0.36	$0.22	$0.20
School supplies, etc.						
Book and supplies	$4.91	$3.53	$3.76	$4.94	$6.83	$15.06
Tutoring	$0.88	$0.34	$0.29	$0.79	$1.83	$11.65
Uniform	$4.22	$3.12	$3.77	$4.32	$5.32	$8.42
Travel	$0.12	$0.01	$0.35	$0.05	$0.09	$0.64
Food	$0.12	$0.05	$0.37	$0.05	$0.06	$0.18
Total costs	$13.48	$9.35	$10.34	$13.41	$19.09	$57.74
Total as % of GDP per capita[c]	3.1	2.2	2.4	3.1	4.4	13.4

[a] Includes wealth quintiles 1–4.
[b] Includes only children who pay for school.
[c] GDP per capita in Nigeria was $430 US in 2004 (World Bank, 2006).

with family wealth, with 13.4% of the poorest children benefiting compared to 16.1% of upper middle class children. The wealthiest children also are the most likely to benefit from FPE with 23.4% of children in highest wealth quintile attending school for free.

5. Variables

Human capital theory argues that parents choose a level of education based on costs, wealth, opportunity costs, returns to education, and preferences (Becker, 1975, 1985).

Table 3
Mean values of independent variables by attendance status (standard errors in parentheses).

	All children	Does not attend school	Attends school for free	Attends school and pays
	$n = 3933$	$n = 1307$	$n = 591$	$n = 2035$
Child characteristics				
Age	8.62 (0.03)	8.31 (0.06)	7.13 (0.05)	9.26 (0.04)
Female	0.504 (0.008)	0.595 (0.014)	0.472 (0.021)	0.455 (0.011)
Family structure				
Mother's years of school	2.54 (0.06)	0.70 (0.05)	3.00 (0.16)	3.59 (0.09)
Wealth index	0.004 (0.02)	−0.374 (0.021)	0.059 (0.042)	0.232 (0.024)
Urban	0.267 (0.007)	0.164 (0.010)	0.316 (0.019)	0.319 (0.010)
Family farm	0.454 (0.008)	0.566 (0.014)	0.469 (0.021)	0.378 (0.011)
Adults 14 and up	2.50 (0.03)	2.45 (0.05)	2.57 (0.08)	2.51 (0.04)
Children 0–5	2.42 (0.02)	2.57 (0.03)	2.48 (0.05)	2.31 (0.03)
Children 6–14	3.72 (0.03)	3.61 (0.05)	3.62 (0.08)	3.82 (0.04)
Religion				
Protestant	0.229 (0.007)	0.048 (0.006)	0.284 (0.019)	0.328 (0.010)
Catholic	0.093 (0.005)	0.016 (0.003)	0.125 (0.014)	0.133 (0.007)
Islamic	0.653 (0.008)	0.913 (0.008)	0.550 (0.020)	0.516 (0.011)
Traditional religions	0.025 (0.002)	0.023 (0.004)	0.041 (0.008)	0.022 (0.003)
School characteristics				
Minutes to primary school	18.7 (0.48)	25.5 (1.01)	15.4 (0.78)	15.1 (0.62)
Minutes to secondary school	82.8 (1.36)	120.4 (2.58)	74.4 (3.20)	61.1 (1.62)
Primary school public	0.946 (0.004)	0.974 (0.004)	0.946 (0.009)	0.929 (0.006)
Primary school private & religious	0.021 (0.002)	0.002 (0.001)	0.025 (0.006)	0.031 (0.004)
Primary school private & secular	0.025 (0.002)	0.013 (0.003)	0.027 (0.007)	0.031 (0.004)
Region				
North central	0.170 (0.006)	0.066 (0.007)	0.222 (0.017)	0.221 (0.009)
North east	0.306 (0.007)	0.423 (0.014)	0.232 (0.017)	0.253 (0.010)
North west	0.344 (0.008)	0.478 (0.014)	0.294 (0.019)	0.271 (0.010)
South east	0.080 (0.004)	0.013 (0.003)	0.110 (0.013)	0.115 (0.007)
South south	0.068 (0.004)	0.011 (0.003)	0.090 (0.012)	0.098 (0.007)
South west	0.032 (0.003)	0.009 (0.003)	0.052 (0.009)	0.041 (0.004)

Table 4
Probit estimations of the effect of community average cost on enrollment.

	Boys only		Girls only	
	Marginal effect	$\|z\|$[a]	Marginal effect	$\|z\|$[a]
School costs				
Log (community avg. cost)	0.027	3.16***	0.029	3.32***
Family wealth				
Wealth index	0.060	3.03***	0.054	2.04**
Child characteristics				
Age	0.225	3.71***	0.326	4.12***
Age-squared	−0.010	3.05***	−0.019	4.26***
Family structure				
Mother's years of school	0.018	3.35***	0.023	4.10***
Urban	0.039	0.89	0.056	1.14
Farm	−0.005	0.17	0.009	0.23
Adults 14 and up	0.001	0.15	0.016	1.93*
Children 0–5	0.005	0.41	−0.010	0.80
Children 6–14	0.000	0.04	0.020	2.11**
Religion				
Catholic	−0.022	0.33	0.042	0.53
Islamic	−0.086	1.81*	−0.230	4.36***
Traditional religions	−0.189	1.29	−0.280	2.41**
School characteristics				
Minutes to primary school	0.000	0.05	−0.001	1.63*
Minutes to secondary school	0.000	0.86	−0.001	1.96**
Region				
North central	−0.048	0.44	−0.226	1.88*
North east	−0.256	2.09**	−0.340	3.14***
North west	−0.202	1.74*	−0.344	3.28***
South east	−0.024	0.19	−0.229	1.55
South south	−0.128	0.90	−0.268	1.63*
Pseudo *R*-squared		0.25		0.32
Number of observations		1844		1706

[a] *z*-Values calculated from robust standard errors for clustering within communities.
* $p < 0.10$.
** $p < 0.05$.
*** $p < 0.01$.

For the structural estimation of costs and attendance, variables were selected to reflect theoretical influences on both school access and school costs. Access to schooling is based on parent reports that a child was attending primary school at the time of the survey. School costs are based on parent reports of annual expenditures for tuition, facilities fees, books, supplies, uniforms, and food summed to a total annual cost.[3]

The NDES measures wealth with a standardized index of household resources such as plumbing, electricity, vehicles, and televisions (Filmer & Pritchett, 1998). Measures of wealth can be endogenous to school attendance if decisions about schooling depend on the opportunity costs of children's time (Glick & Sahn, 2006; Zimmerman, 2001). Additional variables were added to measure the need for child labor including whether the father's income comes from a family farm and the number of children under age five in the household. Returns to education are not measured directly in the NDES. Following Lavy (1996) this study includes the distance to secondary school as a proxy for potential returns to primary school. This data is missing for a nontrivial number of observations, and the community mean value replaced missing values for these observations.

Measures of family structure include the number of adults, number of other school-aged children, parents' education, religion, and urban residence. From a family resource perspective, additional adults should provide income and domestic support to enable children to attend school, while multiple school-aged children compete for scarce resources (Chernichovsky, 1985). However, from a sociological perspective, large extended families are associated with traditional family-based production where children are valued for their labor (Caldwell, 1978). Urban parents are expected to invest greater resources in education, because urban job markets are more likely to reward education and less likely to reward child labor (Caldwell, 1978). Parent education is measured as the mother's years of schooling.[4] Because Nigeria's education system has his-

[3] Travel costs were excluded from total costs due to potential endogeneity with school characteristics (King & Lillard, 1987).

[4] The education levels of mothers and fathers have been found to independently significant in previous studies of enrollment and to have different effects on male and female children (Holmes, 2003; Tansel, 1997). However, in the NDES dataset mother's and father's education are sufficiently correlated ($r = 0.50$) to risk introducing multicollinearity if both are included.

Table 5
Bivariate probit estimation of joint probability of attending school and paying for school, Boys only sample.

	Probability of attending school		Probability of paying for school	
	Coefficient	$\|z\|$[a]	Coefficient	$\|z\|$[a]
Child characteristics				
Age	−0.175	0.96	0.363	12.00***
Age-squared	0.023	2.24**		
Family structure				
Mother's years of school	0.088	4.17***	0.041	2.41**
Wealth index	0.187	2.32**	0.195	2.79***
Urban	0.177	1.07	0.078	0.55
Farm	−0.162	1.47	−0.145	1.39
Adults 14 and up	−0.031	1.09	−0.028	1.04
Children 0–5	−0.006	0.13	0.013	0.30
Children 6–14	0.014	0.40	0.033	1.13
Religion				
Catholic	0.120	0.54	−0.209	1.04
Islamic	−0.302	1.69*	−0.402	2.63***
Traditional religions	−0.378	0.97	−0.243	0.65
School characteristics				
Minutes to primary school	−0.003	1.28		
Minutes to secondary school	−0.0003	0.68		
Primary private & religious			0.023	0.18
Primary private & secular			−0.169	0.42
Region				
North central	0.148	0.40	0.342	1.41
North east	−0.549	1.44	−0.084	0.33
North west	−0.465	1.24	−0.085	0.35
South east	0.130	0.32	−0.060	0.22
South south	0.037	0.08	0.056	0.19
Identification variables				
Mother's current age	0.009	0.93	0.007	0.86
Mother's age at marriage	0.003	0.17	0.026	1.57
Mother works for wages	0.135	1.14	0.187	1.77*
Constant	0.537	0.52	−3.490	7.18***
Log likelihood	1423.01			
Wald chi-sq (H_0: rho = 0)	35.68***			
Number of observations	1950			

[a] z-Values calculated from robust standard errors for clustering within communities.
* $p < 0.10$.
** $p < 0.05$.
*** $p < 0.01$.

torically been based in religion, dummy variables are also included for Catholic, Protestant, Islamic, and traditional religions.

Child characteristics include age and sex. Previous studies found the probability of attending school increases with age for young children, and then decreases as teenagers drop out for marriage or work (Chernichovsky, 1985; Holmes, 2003; Wolfe & Behrman, 1984). A quadratic age term is added to estimate this non-linear effect on attendance. The costs of schooling typically rise with age, as higher grade levels require more expensive textbooks and costly exams. A linear effect of age is estimated on school costs. Alderman and Gertler (1997) and Connelly and Zheng (2003) recommend that models of human capital investment should be run separately for boys and girls to estimate gender-specific elasticities in countries where economic incentives to invest in sons and daughters vary. This is likely in Nigeria, as evidenced by the large gender gap in enrollment and a history of gender inequality (Csapo, 1981).

School quality can influence both decisions about enrollment and the costs of schooling (Handa, 2002). To model for the quality of schools, regional dummies are included, as well as dummy variables for proximity to a private religious and private non-religious school. Distance to school creates direct costs of transportation and opportunity costs of travel time (Holmes, 2003; Jamison & Lockheed, 1987; Tansel, 1997). School location is measured by the number of minutes it takes to walk to school. The inclusion of school quality variables introduces endogeneity if school quality varies by community and parents choose schools primarily based on location (Dostie & Jayaraman, 2006). To correct for unobservable community effects, school costs and enrollment are estimated with robust standard errors based on clustering within NDES geographic sampling areas. In a majority Muslim country like Nigeria, girls' education may also be influenced by the availability of single-sex schools (Lee & Lockheed, 1990). The NDES does not identify single-sex schools, so a variable was constructed for

Table 6
Bivariate probit estimation of joint probability of attending school and paying for school, Girls only sample.

	Probability of attending school		Probability of paying for school	
	Coefficient	$\|z\|$[a]	Coefficient	$\|z\|$[a]
Child characteristics				
Age	−0.220	1.21	0.222	8.45***
Age-squared	0.015	1.53		
Family structure				
Mother's years of school	0.075	3.96***	0.044	2.56***
Wealth index	0.202	3.84***	0.383	5.71***
Urban	0.144	0.85	0.054	0.37
Farm	−0.163	1.23	−0.240	2.04**
Adults 14 and up	0.032	0.81	0.020	0.60
Children 0–5	−0.085	1.94*	−0.092	2.10**
Children 6–14	0.064	1.77*	0.038	1.21
Religion				
Catholic	0.283	0.97	0.236	1.18
Islamic	−1.121	5.40***	−0.951	5.55***
Islamic private school	−0.037	0.11		
Traditional religions	−0.802	2.72***	−0.852	3.70***
School characteristics				
Minutes to primary school	−0.003	1.57		
Minutes to secondary school	−0.0003	0.79		
Primary private & religious			0.201	1.21
Primary private & secular			−0.181	0.57
Region				
North central	−0.505	1.69*	−0.136	0.44
North east	−0.713	2.48**	−0.129	0.41
North west	−0.792	2.86***	−0.226	0.70
South east	−0.465	1.13	−0.314	0.92
South south	−0.631	1.52	−0.388	1.11
Identification variables				
Mother's current age	0.0002	0.03	0.006	0.76
Mother's age at marriage	0.036	2.27**	0.038	2.62***
Mother works for wages	0.143	1.31	0.125	1.15
Constant	1.763	1.94*	−2.040	3.92
Log likelihood	−1392.11			
Wald chi-sq (H_0: rho = 0)	32.70***			
Number of observations	1983			

[a] z-Values calculated from robust standard errors for clustering within communities.
* $p < 0.10$.
** $p < 0.05$.
*** $p < 0.01$.

the regressions on female enrollment of the proportion of Muslim girls in the community who attend private schools. While this is an imperfect measure of access to single-sex schools, it does reflect whether a private school for Muslim girls was available in the community.[5]

Table 3 displays mean values for all variables for all children and by school attendance status. The average child in the data set is from a rural, Islamic household in the North. Mean mother's education is low at 2.5 years, and family size is large at more than two adults and more than five children. The average walk to school is approximately 18 min to primary school and 83 min to secondary school. Comparing children across groups, children who are not in school are worst off in terms of mother's education and family wealth, and are more likely to be female and Muslim, and live in rural areas with a longer walk to school. Children who benefit from FPE are less well off than students who pay for school in terms of mother's education and family wealth. Children from the poorest regions of North East and North West Nigeria make up 65% of the data set, but these two regions include over 90% of out-of-school children and only 53% of children who benefit from FPE.

6. Results

We begin with a simple model that assumes selection into FPE is random. Following Glick and Sahn (2006), children were assumed to face the average cost of school in their community. Separate average costs were calculated

[5] Lee and Lockheed (1990) find that access to single-sex girls' schools in Nigeria is limited to upper class children, who are excluded from regression analysis in this study. Single-sex schools have not been implemented as a policy to enroll Muslim girls living in poverty.

Table 7
Linear regression estimation of the (log) cost of primary school with selection.

	Boys only		Girls only	
	Coefficient	$\|t\|$[a]	Coefficient	$\|t\|$[a]
Child characteristics				
Age	0.666	7.85***	0.360	4.99***
Family structure				
Mother's years of school	0.063	1.68*	0.061	1.58
Wealth index	0.465	2.86***	0.699	4.75***
Urban	0.016	0.05	−0.010	0.03
Farm	−0.346	1.55	−0.518	2.00**
Adults 14 and up	−0.068	1.27	0.027	0.40
Children 0–5	0.033	0.34	−0.101	1.15
Children 6–14	0.063	0.98	0.033	0.53
Religion				
Catholic	−0.227	0.56	0.378	1.05
Islamic	−0.871	2.30**	−1.273	2.56**
Traditional religions	−0.544	0.58	−1.041	1.67*
School characteristics				
Primary private & religious	0.877	1.32	1.949	3.75***
Primary private & secular	−0.347	0.43	−0.517	0.75
Region				
North central	−0.041	0.07	−0.946	1.33
North east	−0.835	1.44	−0.898	1.22
North west	−0.779	1.42	−1.028	1.39
South east	−0.508	0.84	−0.654	0.85
South south	−0.141	0.22	−0.877	1.08
Selection variable				
IMR	−2.224	1.96**	−3.491	2.86***
Constant	−0.092	0.08	3.226	3.33***
R-Squared	0.33		0.37	
Number of observations	1950		1983	

[a] *t*-Values calculated from robust standard errors for clustering within communities.
* $p < 0.10$.
** $p < 0.05$.
*** $p < 0.01$.

for boys and girls, and these average costs were used to predict school attendance. For communities with low or no enrollment, costs were imputed based on community characteristics including region, urban location, and community rates of wealth, family size, mother's education, and family farms. Table 4 displays the results. The effect of community average costs is positive and significant for boys and girls, suggesting that children are more likely to attend school if it is more expensive. These results conflict with economic theory and support the presence of selection bias in the estimation.

Tables 5 and 6 display the results of the first stage of the structural model to control for selection. Stage one includes bivariate probit estimations of school attendance and paying for school. Significant variables for boys include age, mother's education, wealth, and Islamic religion for both attendance and paying for school. Significant variables for girls include mother's education, wealth, Islamic and traditional religions, regional dummies, and the number of infant and school-age siblings. Living on a family farm is also significant for girls for paying but not attendance. The presence of young children and living on a family farm decrease the likelihood that a girl will attend school, while the presence of school-age siblings increases the likelihood of attendance. The variation in results for boys and girls suggests that added opportunity costs for girls and regional cultural differences contribute to the gender gap in school access.

Table 7 displays the results of the second stage linear estimations of the log cost of school for boys and girls. The IMR is significant in both estimations, indicating that the assumption of selection into school costs is valid. For boys and girls, costs increase significantly with age, mother's years of schooling, and wealth. Islamic religion has a significant negative effect on costs for girls and boys. Traditional religion is negative and significant for girls but not boys. For girls only, living on a family farm also decreases the amount paid for school, reinforcing the finding that opportunity costs may limit investments in girls. Girls also pay significantly more to attend a private religious school. Controlling for other characteristics and selection into school, there are not significant regional differences in school costs.

The final stage of the structural model estimates attendance as a function of expected costs. These results are displayed in Table 8. Controlling for wealth and other characteristics, costs are no longer significant. Instead, we see large significant effects of wealth on boys and girls, which translate to income elasticities of 6.4 for boys and 9.0 for

Table 8
Probit estimations of probability of school attendance.

	Boys only		Girls only	
	Coefficient	$\|z\|$[a]	Coefficient	$\|z\|$[a]
School costs				
Log (predicted cost)	0.156	1.33	0.091	0.82
Family wealth				
Wealth index	0.242	4.04***	0.260	4.97***
Child characteristics				
Age	1.013	4.52***	1.160	6.42***
Age-squared	−0.047	3.71***	−0.066	6.48***
Family structure				
Mother's years of school	0.088	6.67***	0.086	6.16***
Urban	0.096	0.94	0.126	1.15
Farm	−0.091	1.17	−0.096	1.13
Adults 14 and up	−0.028	1.39	0.012	0.53
Children 0–5	0.020	0.64	−0.067	2.18**
Children 6–14	0.016	0.70	0.074	3.36***
Religion				
Catholic	0.030	0.16	0.149	0.50
Islamic	−0.486	3.42***	−1.252	6.92***
Traditional religions	−0.452	1.27	−0.973	3.80***
School characteristics				
Islamic private school			0.111	0.23
Minutes to primary school	−0.003	2.34**	−0.007	2.57***
Minutes to secondary school	−0.002	3.42***	−0.003	5.89***
Region				
North central	0.171	0.62	−0.792	1.12
North east	−0.645	2.42**	−1.302	1.92*
North west	−0.553	2.02**	−1.385	2.06**
South east	0.042	0.12	−0.835	1.05
South south	−0.124	0.41	−1.041	1.44
Constant	−4.476	3.29***	−2.820	2.20**
Pseudo R-squared	0.26		0.36	
Number of observations	1950		1983	

[a] z-Values calculated from bootstrapped standard errors with 100 replications.
* $p < 0.10$.
** $p < 0.05$.
*** $p < 0.01$.

girls. The difference between boys and girls is statistically significant.[6] The results also show that child and family characteristics have an effect on attendance that is independent of the effect on school costs. For boys, wealth and mother's education increase the likelihood of attending school. Age has the predicted quadratic effect. Islamic religion, distance to primary and secondary school, and living in the North East or North West have significant negative effects on attendance. For girls, wealth and mother's education are also significant and positive, and the quadratic effect of age is also significant. Both Islamic and traditional religions significantly reduce the likelihood a girl will attend school, as well as distance to primary and secondary school and living in the North East or North West. Again, family structure variables are significant for girls only. Controlling for school costs, girls more likely to attend school if they have school-age siblings and less likely to attend if there are infants at home.

7. Discussion

Research on determinants of schooling has consistently found that school access in developing countries depends on child characteristics, family resources, and school quality. This research has contributed to policy innovations to increase enrollments, and developing countries can now choose from a varied policy toolbox that includes improvements to school quality, outreach to parents, and economic policies that alter incentives. Free primary education and conditional cash transfers are two popular approaches to achieve UPE, focusing on the price of school and family resources, respectively. Of course it is not possible to demonstrate a causal relationship between these policies and enrollment with cross-sectional data. However, some

[6] To determine which effects vary by gender, the final regression model was also run on a combined data set of boys and girls with interaction terms for gender and bootstrapped standard errors. Significant interaction terms suggest that the positive effect of wealth is significantly greater for girls ($p < 0.001$). The negative effect of Islamic religion is also significantly greater for girls ($p < 0.001$). All other effect sizes are not significantly different by gender.

insight is provided by knowing the price and wealth elasticities of schooling in an individual country. The model developed for this study advances this analysis by adding a cost component to the model of determinants of schooling.

The first finding is that free primary education is not a reality in Nigeria, despite national policies outlawing tuition and fees. Nigeria is an excellent example of why school costs must be examined, even in countries that has formally declared primary school to be universal and free. Only 15% of children in the sample benefited from FPE, and 33% of children were not attending school. The chances of receiving FPE actually increase with wealth, indicating that these subsidies are not always targeted to assist poor households. The costs of schooling, as well as the likelihood of enrollment, continue to be influenced by child and family characteristics including wealth and religion.

Despite remaining costs to parents, the results suggest that cost is not a significant obstacle to schooling. This result should not be interpreted to mean that costs are irrelevant in family decision-making. One interpretation is that current costs are sufficiently low that small changes would have little influence on enrollment. A second possibility is that poverty and family economics dominate the effect of costs. The complications associated with estimation of cost are also a concern. This study depends on cross-sectional data of parent reports of costs, which may be inaccurate. Also, the three-stage estimation process may suffer from omitted variable bias, particularly because specific data on school quality are not available. The complex relationship between school quality and enrollment is modeled by other researchers and appears to be important (Handa, 2002).

The results also support the theory that gender differences play an important role in investments in human capital (Becker, 1975). Alderman and Gertler (1997) illustrate that investments in health care for girls can be more price and income elastic than investments in boys. This study finds that investments in primary school are also more income elastic for girls (9.0) than boys (6.4). Enrollment of boys and girls also varies based on the opportunity costs of schooling. Girls' likelihood of attendance decreases if there are younger siblings to care for and family farming responsibilities at home. Contrary to the predictions of family resource theory, multiple school-age children do not appear to compete for education resources in Nigeria. Instead, school-age siblings increase the likelihood that a girl can attend primary school, possibly by sharing the burden of domestic work. We do not see a similar effect of opportunity costs for boys.

Given these differences, expecting boys and girls to have similar responses to policy changes in unrealistic. This study does not establish a causal relationship between price changes and enrollment, which would require longitudinal data on enrollment as prices change. However, the results suggest that gender blind policies like FPE may have unintended effects on the gender gap. The measure of wealth in this study is an index of household resources, so these elasticities should be interpreted carefully. We cannot say that a 1% increase in income will increase girls' enrollment by 9% and boys' by 6.4%, but we can predict that policies that improve family wealth or household resources – including access to clean water, modern cooking fuels, and modern home construction – may have a greater impact on girls than boys.

Girls' education may also require additional policies that respond to other demands on girls' time. Policies such as school health programs, flexible school schedules, and reducing the distance to school by increasing supply, respond to opportunity costs and have all been successful in increasing girls' education in other SSA countries (Herz & Sperling, 2004). Following Lavy (1996), this study also confirms that opportunities for secondary school influence parent investments in primary education, suggesting that increasing the supply of secondary schools can increase enrollment for girls and boys. A second set of policy recommendations responds to parents' concerns about daughters' well-being at school, which may be an obstacles for families from Islamic and traditional religions in Nigeria. Offering single-sex schools (Lee & Lockheed, 1990), training female teachers (Heward, 1999), and allowing communities to play an active role in the design of female education (Global Campaign for Education, 2003) are strategies that increase parents' confidence about school safety.

These findings have important implications of the future of UPE policy. First, researchers and policy-makers cannot assume that free primary education policies are effective at reducing prices without further investigation. Second, seemingly neutral policies may influence equity. In Nigeria, gender and religious differences are particularly important. In some cases, policies that redistribute income may do more to increase school access and reduce disparities than policies that reduce school costs. Finally, simply eliminating costs is probably not enough to promote universal access. Other obstacles, both cultural and economic, may keep some groups out of school even is access is truly free. UPE policy must consider all these elements of access to school, while researchers continue to improve methods to identify obstacles to access.

References

Alderman, H., & Gertler, P. (1997). Family resources and gender differences in human capital investments: The demand for children's medical care in Pakistan. In L. Haddad, J. Hoddinott, & H. Alderman (Eds.), *Intra-household resource allocation in developing countries*. Baltimore: The Johns Hopkins University Press.

Al-Samarrai, S., & Peasgood, T. (1998). Educational attainments and household characteristics in Tanzania. *Economics of Education Review*, *17*(4), 395–417.

Becker, G. (1975). *Human capital*. New York: National Bureau of Economic Research.

Becker, G. (1981). *A treatise on the family*. Cambridge, MA: Harvard University Press.

Becker, G. (1985). Human capital, effort, and the sexual division of labor. *Journal of Labor Economics*, *3*(1), S33–S58.

Birdsall, N., & Orivel, F. (1996). Demand for primary schooling in rural Mali: Should user fees be increased? *Education Economics*, *4*(3), 279–296.

Caldwell, J. C. (1978). A theory of fertility: From high plateau to destabilization. *Population and Development Review*, *4*(4), 553–577.

Chernichovsky, D. (1985). Socioeconomic and demographic aspects of school enrollment and attendance in rural Botswana. *Economic Development and Cultural Change*, *33*(2), 319–332.

Colclough, C. (1996). Education and the market: Which parts of the neoliberal solution are correct? *World Development*, *24*(4), 589–610.

Connelly, R. (1992). The effect of child care costs on married women's labor force participation. *The Review of Economics and Statistics*, *74*(1), 83–90.

Connelly, R., & Kimmel, J. (2003). The effect of child care costs on the employment and welfare recipiency of single mothers. *Southern Economic Journal*, *69*(3), 498–519.

Connelly, R., & Zheng, Z. (2003). Determinants of school enrollment and completion of 10 to 18 year olds in China. *Economics of Education Review*, *22*(4), 379–388.

Csapo, M. (1981). Religious, social and economic factors hindering the education girls in Northern Nigeria. *Comparative Education*, *17*(3), 311–319.

Deininger, K. (2003). Does cost of schooling affect enrollment by the poor? Universal primary education in Uganda. *Economics of Education Review*, *22*(3), 291–305.

Dostie, B., & Jayaraman, R. (2006). Determinants of school enrollment in Indian Villages. *Economic Development and Cultural Change*, *54*(2), 405–421.

Duan, H. (2000). Primary education in sub-Saharan Africa—A moral issue, an economic matter, or both? *Comparative Education*, *36*(1), 37–53.

Filmer, D. & Pritchett, L. (1998). Estimating wealth effects without income of expenditure data—or tears: Educational enrollment in India. World Bank Policy Working Paper No. 1994. Washington, DC: The World Bank.

Glewwe, P., & Patrinos, H. A. (1999). The role of the private sector in education in Vietnam: Evidence from the Vietnam living standards survey. *World Development*, *27*(5), 887–902.

Glick, P., & 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.

Glick, P., & Sahn, D. E. (2006). The demand for primary schooling in Madagascar: Price, quality, and the choice between public and private providers. *Journal of Development Economics*, *79*(1), 118–145.

Global Campaign for Education. (2003). *A fair chance: Attaining gender equality in basic education by 2005*. South Africa: Global Campaign for Education.

Handa, S. (2002). Raising primary school enrolment in developing countries: The relative importance of supply and demand. *Journal of Development Economics*, *69*, 103–128.

Heckman, J. (1974). Effects of child-care programs on women's work effort. *Journal of Political Economy*, *82*(supplement), 153–161.

Heckman, J. (1976). The common structure of statistical models of truncation, sample selection and limited dependent variables and a simple estimator for such models. *Annals of Economic and Social Measurement*, *5*, 475–492.

Herz, B., & Sperling, G. B. (2004). *What works in girls' education: Evidence and policies from the developing world*. New York: Council on Foreign Relations.

Heward, C. (1999). Closing the gender gap? The informal sector in Pakistan. In C. Heward & S. Bunwaree (Eds.), *Gender, education & development* (pp. 203–217). London: Zed Books Ltd.

Holmes, J. (2003). Measuring the determinants of school completion in Pakistan: Analysis of censoring and selection bias. *Economics of Education Review*, *22*(3), 249–264.

Iman, A. (September 2003). Women, Muslim laws and human rights in Nigeria. Keynote address presented at the Woodrow Wilson International Center's Africa Program and Middle East Project on Women, Islam and Human Rights in Africa.

Jamison, T., & Lockheed, M. E. (1987). Participation in schooling: Determinants and learning outcomes in Nepal. *Economic Development and Cultural Change*, *35*(2), 279–306.

King, E. M., & Lillard, L. A. (1987). Education policy and schooling attainment in Malaysia and the Philippines. *Economics of Education Review*, *6*(2), 167–181.

Krishnan, P. (1990). The economics of moonlighting: A double self-selection model. *The Review of Economics and Statistics*, *72*(2), 361–367.

Lavy, V. (1996). School supply constraints and children's education outcomes in rural Ghana. *Journal of Development Economics*, *51*(2), 291–314.

Lee, V. E., & Lockheed, M. E. (1990). The effects of single-sex schooling on achievement and attitudes in Nigeria. *Comparative Education Review*, *34*(2), 209–331.

Mohanty, M. S. (2001). Testing for the specification of the wage equation: Double selection approach or single selection approach. *Applied Economics Letters*, *8*, 525–529.

Moja, T. (2000). *Nigeria education sector analysis: An analytical synthesis of performance and main issues*. Washington, DC: The World Bank.

Mroz, T. (1987). The sensitivity of an empirical model of married women's ours of work to economic and statistical assumptions. *Econometrica*, *55*, 765–799.

National Population Commission & ORC Macro. (2004). *Nigeria EdData Survey 2004: Education data for decision-making*. Calverton, MD: ORC Macro.

Powell, L. M. (1997). The impact of child care costs on the labour supply of married mothers: Evidence from Canada. *The Canadian Journal of Economics*, *30*(3), 577–594.

Sorenson, E. (1989). Measuring the pay disparity between typically female occupations and other jobs: A bivariate selectivity approach. *Industrial and Labor Relations Review*, *42*(4), 624–639.

Stromquist, N. P. (1999). The impact of structural adjustment programmes in Africa and Latin America. In C. Heward & S. Bunwaree (Eds.), *Gender, education and development: Beyond access to empowerment*. London: Zed Books Ltd.

Tansel, A. (1997). Schooling attainment, parental education, and gender in Cote D'Ivoire and Ghana. *Economic Development and Cultural Change*, *45*(4), 825–856.

Tunali, I. (1986). A general structure for models of double-selection and an application to a joint migration/earnings process with remigration. *Research in Labor Economics*, *8*(b), 235–282.

Uduigwomen, A. R. (2004). A philosophy of education for Nigerian women: Problems and prospects. *African Symposium*, *40*(1), 1–6.

Vella, F. (1998). Estimating models with sample selection bias: A survey. *The Journal of Human Resources*, *33*(1), 127–169.

Wolfe, B. L., & Behrman, J. R. (1984). Who is schooled in developing countries? The roles of income, parental schooling, sex, residence and family size. *Economics of Education Review*, *3*(3), 231–245.

World Bank. (2005). *World development indicators*. Washington, DC: The World Bank.

World Bank. (2006). Nigeria: Country overview. Washington, DC: The World Bank. www.worldbank.org/Nigeria.

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.