

# Human Capital, Household Welfare, and Children's Schooling in Mozambique

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with  
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## Foreword

In 1996, following years of war, the government of Mozambique invited IFPRI to analyze the country's widespread poverty to help develop a strategy for alleviating it, based on a nationally representative household survey of living conditions. As part of the collaboration, IFPRI also provided training in policy analysis to researchers at the Ministry of Planning and Finance and to faculty at Eduardo Mondlane University.

The initial collaborative work on the poverty assessment report by IFPRI and its host institutions was the starting point for numerous papers, policy briefs, seminars, and reports. Results from the poverty assessment and an IFPRI research report titled *Rebuilding after War: Micro-level Determinants of Poverty Reduction in Mozambique* identified education as a pivotal force for improving income and household well-being in Mozambique, and thus for reducing poverty. This finding motivated an in-depth study on the effect of adults' past education on current living standards, the factors that influence children's enrollment in (and dropout from) school, and the possible policy levers available to the government to increase education levels in one of the world's poorest countries. This research report by Sudhanshu Handa and Kenneth R. Simler, with Sarah Harrower, is the product of that study.

That education is important may come as no surprise, but the strength of the findings in this report regarding the particular benefits of educating women is nevertheless dramatic. Children of educated mothers are healthier and better nourished, and they in turn are more likely to go to school and to stay in school longer. Building more and better schools and alleviating the monetary costs of schooling—by, for example, reducing fees for tuition, books, uniforms, and lunches—all help increase the number of children in school. For the well-being of today's families and for future generations, investment in education is clearly worthwhile, not only in Mozambique but in all countries where poverty is endemic.

Joachim von Braun  
Director General, IFPRI

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## Summary

**T**he role of education in determining the social and material well-being of Mozambican households is evaluated using the *Inquérito aos Agregados Familiares sobre as Condições de Vida* 1996–97, the country’s first national household survey of living conditions. The results demonstrate that education is a powerful determinant of both social and monetary well-being, and that the impact of female education in rural areas is especially strong.

In terms of monetary well-being, the presence of an additional adult female who has completed the first stage of primary school (*escola primária de primeiro grau*, or EP1) is associated with an increase in household per capita consumption of 18 percent in rural areas and 6 percent in urban areas. The corresponding increases in consumption associated with the presence of an additional male who completed the second stage of primary education (EP2) are 12 and 8 percent in rural and urban areas, respectively.

The mother’s education is strongly associated with the health and nutritional status of preschool children in rural areas of Mozambique. In rural areas, maternal literacy increases the Z-score of height-for-age (an indicator of chronic malnutrition) by 0.169 standard deviations, raises the probability of a child completing all vaccinations by 16 percentage points, and raises the probability of a child possessing a health card by 11 percentage points. In urban areas the effect of maternal literacy is significant for increasing children’s Z-scores of height-for-age but has a small and often statistically insignificant effect on other health outcomes for children.

The in-depth analysis of child schooling shows that the educational level of parents, or of other adults in the household, is one of the most important determinants of primary school enrollment in both urban and rural areas. In urban areas, household income and the child’s age are also important determinants of primary school enrollment, whereas in rural areas, the gender of the child is important—boys have higher enrollment than girls. For children who have ever gone to school, two other schooling outcomes are also analyzed: highest grade attained and schooling efficiency. For both of these outcomes, higher levels of parental education, such as completion of EP2, are key factors in influencing these choices but lower levels of education, such as basic literacy, are not.

The quality, availability, and efficiency of local primary schools have a positive impact on rural primary school enrollment. Both the proportion of trained female teachers and the proportion of female teachers who are trained in the administrative post have significant positive effects on primary school enrollment in rural areas. In terms of school availability, the presence of a school in the village, as well as the number of schools in the administrative post, significantly raise enrollment rates; the impact of a school in the village is especially strong. Furthermore, for girls, an additional positive impact on enrollment is improving the quality of the buildings, such as using concrete in school construction. The only dimension of school efficiency found to influence rural enrollment significantly is the school’s female pass rate in the preceding year. With all other variables equal, raising the female pass rate to the level of the male pass rate would raise rural enrollment by approximately 10 percentage points.

For girls’ primary school enrollment, the impact of school supply variables varies according to household income. The most notable interaction is for the presence of a school in the

village, which is estimated to be a substitute for household income. This implies that construction of a village school will have a *larger* impact on the enrollment of girls from *poorer* households.

Policy simulations comparing the impact of different policy interventions on rural primary school enrollment rates reveal that changes in demand-side (for example, household) characteristics dominate supply-side factors in their impact on children's schooling. For example, increasing the literacy rate among household heads in the bottom per capita expenditure quartile to 100 percent is associated with an 18 percent increase in rural enrollments. On the other hand, building 70 primary schools in each province would raise rural enrollment by only 6 percent, and providing households in the bottom expenditure quartile with at least 2,494 Mozambican meticaís (approximately equal to 25 U.S. cents at the time of the survey) per person per day would raise enrollment by a mere 2 percent. Furthermore, an analysis of alternative school supply investments that focuses on quality versus quantity interventions shows that expanding school quantity through the well-targeted construction of new schools is a more cost-effective method of raising enrollment rates than simply improving the quality of the existing infrastructure.

The main policy implications of this study are summarized as follows:

1. Investing in female education in rural areas will have very large monetary and nonmonetary benefits, both to the household and to society at large. Interventions that increase female adult literacy and that stimulate school enrollment of girls in rural areas are thus a priority. An effective supply-side instrument for raising girls' enrollment is improving the quality of the physical school infrastructure (for example, building schools made of concrete), while, on the demand side, raising the literacy of adult household members (household heads or adult females). This will also elicit a large response in terms of girls' enrollment. The latter implies a potentially important role for adult education or literacy campaigns in rural areas.
2. In urban areas, policies that alleviate the monetary constraint of households will have an important impact on school enrollment. Such policies include school lunches, as well as reduced fees for tuition, books, and uniforms.
3. In urban areas, primary school dropout rates increase significantly at around age 10. Policies at the school level that focus on keeping this group of children in school could be an important option for increasing grade attainment.
4. The quality, availability, and efficiency of schools all have a positive impact on rural primary school enrollment. Among the various school indicators evaluated in the study, the most important characteristics appear to be the number of trained female teachers, the pass rate for girls, the presence of a school in the village, and the presence of higher levels of primary and secondary schooling in the administrative post. Given scarce resources, supply-side interventions should focus on these dimensions of school infrastructure in rural Mozambique.



## CHAPTER 1

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### Introduction

**F**or much of its modern history, Mozambique has been in a state of war. The signing of the Peace Agreement in 1992 and the sustained absence of armed conflict since then have signified an important new era in Mozambique's political and economic evolution. The turbulent decades of the 1970s and 1980s led to severe destruction of productive resources, both physical and human, leaving a very weak base from which to begin economic recovery. (According to World Bank [1997] estimates of gross national product [GNP] per capita, Mozambique ranked as the poorest country in the world.) An essential first step in promoting sustained economic growth in the medium term will be for Mozambique to rebuild these productive assets.

This study focuses on the issue of human resources in postwar Mozambique, providing an empirical assessment of the existing stock of human capital, the association between household human capital and household well-being, and the determinants of investments in human capital. We focus on human capital for three reasons. First, human capital accumulation is recognized as an important means for poor countries to increase labor productivity, which in turn can attract capital to expand economic growth. Second, human capital can contribute to poverty reduction by substituting for physical capital in countries where physical capital, that is, land and wealth, is unequally distributed. Third, policy simulations by researchers of the International Food Policy Research Institute (IFPRI), using the same database as the one used here, show that the education level of adult household members is one of the most important determinants of poverty in Mozambique. Given the overall low attainment level of human capital in Mozambique, and the importance of education as a factor in determining poverty, it is thus important for policymakers to know the distribution of human capital as well as its full impact on household well-being. For policy interventions in the educational sector to be effective in terms of both efficiency and equity, it is necessary that these policymakers have a solid understanding of the process by which some children are sent to school and others are not.

This report is organized as follows. After briefly discussing the data and setting, we take stock of the level of education in Mozambique with descriptive information on adult literacy and school enrollment rates. Using community information from our data source, we also describe the supply side of the education market, looking at access to schools in rural areas by region. Chapter 4 outlines a general theoretical model of human capital formation, which we use to guide our empirical investigations in Chapters 5 and 6. In Chapter 5, we evaluate the impact of adult education on several dimensions of household well-being, from household consumption of goods and services (in meticaïs) to the health and nutritional status of children. Chapter 6 provides a rigorous econometric treatment of the determinants of schooling among 7- to 17-year-old children in the country, analyzing both demand- and supply-side factors that

influence household schooling choices, with policy simulations provided to assess the impact of different interventions on school enrollment rates. Chapter 7 summarizes the

main findings, evaluates the role of education in determining household well-being in Mozambique, and discusses the policy implications of the study.

## CHAPTER 2

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### **Background and Country Setting of Mozambique**

In 1975 Mozambique, located on the east coast of southern Africa, became one of the last sub-Saharan African countries to gain independence, following a prolonged war with Portuguese colonizers that began in the mid-1960s. After independence, Mozambique's first autonomous government, led by President Samora Machel, affirmed its commitment to developing a Marxist–Leninist state. In recognition of the dearth of skilled Mozambicans, an ambitious literacy campaign was among the government's important early initiatives. However, the ruling *Frente de Libertação de Moçambique* (FRELIMO) party's leftward leanings and its logistical support for the Zimbabwe African National Union (ZANU) rebels fighting for majority rule in Rhodesia provoked the Rhodesian government into sponsoring the rebel group *Resistência Nacional Moçambicana* (RENAMO) to engage in sabotage and terror in Mozambique. After Zimbabwean independence in 1980, the apartheid South Africa government took up sponsorship of RENAMO, as it was equally angered by the support FRELIMO provided to the African National Congress rebels. The war was most intense during the 1980s, especially in 1986 and 1987. Fighting was concentrated in the central and northern regions of the country and millions were forced to leave their land for urban centers and neighboring countries such as Malawi, Zimbabwe, and South Africa. The civil war ended in 1992 with the signing of a peace accord between FRELIMO and RENAMO in Rome; the country's first multiparty elections were held in 1994. Mozambique's 1997 census estimated the population at 16 million people, approximately 70 percent of whom lived in rural areas.

#### **The National Education System**

The national education system's general education program is divided into two levels: primary and secondary. Primary education consists of seven years of schooling divided into two levels, the first level comprising grades 1–5 (*escola primária do primeiro grãu*, or EP1) and the second level, grades 6 and 7 (*escola primária do segundo grãu*, or EP2). Secondary education consists of five years, also divided into two levels or cycles: the first cycle secondary, covering grades 8–10 (*escola secundária geral do primeiro grãu*, or ESG1) and the second cycle secondary, grades 11 and 12 (*escola secundária geral do segundo grãu*, or ESG2). Technical and professional education consists of elementary, basic, and middle levels, and is equivalent to EP2, ESG1, and ESG2, respectively.

Unlike in most African countries, entrance into successively higher levels of schooling is not based on national examinations, but on actual grades earned and the student's age. Among students with the same grades, those who are younger, and therefore either started on time or did not repeat as often, are given priority. Access to EP1 is not thought to be supply

constrained, but there are supply constraints for all the higher schooling levels. Fees do not exist in public lower primary schools, but an annual matriculation fee of approximately \$5 is charged. Private EP1 school fees can range from \$150 to \$600 per year, depending on the ownership structure and facilities provided.

### The Data

The database, collected in 1996–97 by the National Statistics Institute—the *Inquérito Nacional aos Agregados Familiares sobre as Condições de Vida* (National Household Survey of Living Conditions, or IAF), is the first postwar national household survey of the country. The IAF is a multipurpose household survey much like a typical Living Standards Measurement Study (LSMS) survey, and contains detailed information on consumption expenditures that has been used by IFPRI in collaboration with the Mozambican Ministry of Planning and Finance to construct a national poverty line and to develop a poverty profile of Mozambique (MPF/UEM/IFPRI 1998). This information on well-being can be linked to individual- and household-level data on education, health, employment, and migration to support analytical research on living standards and human resource development to inform policy in these areas.

The IAF is a three-stage stratified cluster sample. The strata were defined as the provinces in Mozambique, plus the capital city of Maputo as a separate stratum. In each

of these strata, *localidades*, in rural areas, and *bairros*, in urban areas, were randomly selected, with probability proportional to size. In the second stage, *aldeias* (villages) were selected in rural areas and *quarteirões* (blocks) were selected in urban areas, again with probability proportional to size. In the third and final stage of the sampling, households were randomly selected from the *aldeias* and *quarteirões*. The primary sampling unit (PSU) is therefore the *localidade* or *bairro*, and variance estimates provided in this report account for the complex sample design of the survey. The full survey covers approximately 42,000 individuals residing in 8,250 households, and sampling weights as provided by the *Instituto Nacional de Estatística* (INE) are applied to the summary statistics presented in this report.

The household survey data are supplemented by an extensive data set on school characteristics collected by the Mozambique Ministry of Education (MINED). Since 1992, MINED has administered a questionnaire to each school in the country at the beginning and end of each academic year, soliciting information on enrollment, teachers, teacher qualifications, pass rates, and characteristics of the school buildings. This information is used by MINED to create and monitor its internal performance indicators. Coverage is excellent, with more than 90 percent of schools returning questionnaires; summaries of these data are published in an annual report by the MINED titled “Educational Indicators.”

## CHAPTER 3

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### Basic Schooling Indicators

**T**his chapter presents descriptive information about educational attainment in Mozambique. It lays the foundation for the econometric analysis that follows by highlighting the ways in which educational levels differ between males and females, between poor and nonpoor, between rural and urban areas, and across generations.<sup>1</sup>

#### Adults

Table 3.1 provides literacy rates for adults by gender and region.<sup>2</sup> For prime-age adults (18–45 years), the national literacy rate is 53 percent, but it is much lower for women (39 percent) than for men. For those 46–65 years old, the rates at the national level and for women are again lower, at 29 percent and 13 percent, respectively. For this indicator and for the adult age groups shown in Table 3.1, women in rural areas have the lowest literacy rate; only 3 percent to 23 percent, depending on the age cohort, of this group is literate in Mozambique. As much of the agricultural work in Mozambique is done by women, the low level of female literacy has important implications for technological adoption and other interventions aimed at raising agricultural productivity, which is enhanced by literacy.<sup>3</sup> Female literacy has also been shown to be an important factor in nonfarm income generation and nonremunerative activities such as childcare and household food preparation.

Table 3.2 measures the quality of education by indicating the proportion of adults who have completed at least lower primary school (EP1). The national average for the prime age group (18–45 years) is 36 percent, with lower averages for women (25 percent) and those living in households that fall below the poverty line<sup>4</sup> (20 percent). Once again the group with the lowest stock of education as measured by this indicator is rural women—approximately 11 percent of all adult women ages 18–45 in rural areas have completed primary education, with

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<sup>1</sup>The education-related information contained in this document is taken from the education module of the IAF, which collected information on all household residents 7 years of age and older.

<sup>2</sup>Appendix Figures B.1–B.8 provide adult literacy and child enrollment rates by province and frequency distributions across all education attainments for adult men and women by urban and rural areas.

<sup>3</sup>Note that education not only enhances the efficient application of adopted technologies, but also increases the probability of adoption in the first place. See Fane (1975) and Jamison and Lau (1982) for examples of education improving farming efficiency. Lin (1991) and Feder, Just, and Zilberman (1985) present evidence that education improves the likelihood of adopting new agricultural techniques and technologies. Foster and Rosenzweig (1996) show that education is particularly important during periods of technological change.

<sup>4</sup>Poor individuals are defined as those who live in households where the value of per capita consumption expenditures is below the region-specific poverty line as reported in MPF/UEM/IFPRI (1998).

**Table 3.1 Adult literacy rates, by age group (percent)**

	18–45 years			46–65 years			66–99 years		
	All areas	Urban	Rural	All areas	Urban	Rural	All areas	Urban	Rural
Full sample	53.1	80.1	38.2	29.3	56.6	19.8	21.6	40.0	15.7
Men	69.7	89.3	57.7	47.0	75.5	36.3	32.3	59.0	25.3
Women	39.1	71.4	22.9	13.3	37.7	5.2	8.8	23.5	3.0
Poor <sup>a</sup>	34.9	61.2	29.7	18.2	34.7	16.4	12.6	17.6	11.9

Source: 1996–97 *Inquérito Nacional aos Agregados Familiares sobre as Condições de Vida*.

Notes: The literacy rate is the percentage of respondents who reported an ability to read and write in any language.

<sup>a</sup> Poor are defined here as persons who are members of households whose per capita consumption is below the poverty line.

**Table 3.2 Adult grade 5 (EP1) completion rate, by age group (percent)**

	18–45 years			46–65 years			66–99 years		
	All areas	Urban	Rural	All areas	Urban	Rural	All areas	Urban	Rural
Full sample	36.2	64.1	20.9	14.1	34.8	6.9	8.6	20.9	4.7
Men	49.3	75.3	33.5	23.9	52.3	13.2	13.5	35.2	7.8
Women	25.3	53.5	11.1	5.3	17.4	1.3	2.8	8.5	0.5
Poor <sup>a</sup>	20.1	44.3	15.3	8.3	22.2	6.8	1.8	0.0	2.1

Source: 1996–97 *Inquérito Nacional aos Agregados Familiares sobre as Condições de Vida*.

Notes: EP1 completion rate is the percentage in the sample and age group who completed *escola primária do primeiro grau* (EP1).

<sup>a</sup> Poor are defined here as persons who are members of households whose per capita consumption is below the poverty line.

much lower percentages for older cohorts of rural women.

## Children

Tables 3.3–3.6 provide data on the proportion of children who have ever attended school, mean current enrollment rates, highest class attained, and schooling efficiency for children ages 7–11 (primary school-age children) and 12–17 (secondary school age). For these two groups, 59 percent and 74 percent report ever attending school, respectively. At the time of the household survey (1996–97), national enrollment rates were 49 and 48 percent (Table 3.4), with

lower rates for females and slightly lower rates for poor children. Enrollment and “ever enrolled” rates are always higher in urban areas, and differences between poor and non-poor children also exist, although only in urban areas. Table 3.5 shows that for children age 12–17 (half of whom no longer attend school), the average grade level completed is 2.7 (or 3), and for rural girls, the average is below 2.

Table 3.6 presents means for an indicator of schooling efficiency, which measures how long it takes students to pass through the educational system. This indicator is created by dividing the child’s actual grade attained by the grade she should have attained, given

**Table 3.3 Children who have ever attended school (percent)**

	7–11 years			12–17 years		
	Mozambique	Urban	Rural	Mozambique	Urban	Rural
All	58.6	78.5	49.1	73.9	89.4	64.6
Boys	61.8	79.0	53.5	78.6	91.6	71.2
Girls	55.5	78.1	44.8	68.8	87.2	57.0
Poor	46.4	59.0	42.0	61.3	78.0	55.6

Source: 1996–97 *Inquérito Nacional aos Agregados Familiares sobre as Condições de Vida*.

**Table 3.4 Children's current enrollment, by age group (percent)**

	7–11 years			12–17 years		
	Mozambique	Urban	Rural	Mozambique	Urban	Rural
All	49.2	70.7	43.9	48.0	63.5	43.3
Boys	53.9	73.5	49.1	54.5	65.6	51.5
Girls	44.7	68.0	39.0	40.3	61.4	33.2
Poor	45.5	63.3	41.7	44.8	54.9	42.3

Source: 1996–97 *Inquérito Nacional aos Agregados Familiares sobre as Condições de Vida*.

**Table 3.5 Children's mean highest grade attained, by age group**

	7–11 years			12–17 years		
	Mozambique	Urban	Rural	Mozambique	Urban	Rural
All	1.17	1.90	0.98	2.68	4.29	2.17
Boys	1.30	1.97	1.12	2.93	4.38	2.50
Girls	1.04	1.85	0.84	2.39	4.19	1.76
Poor	1.05	1.60	0.92	2.36	3.78	2.04

Source: 1996–97 *Inquérito Nacional aos Agregados Familiares sobre as Condições de Vida*.

**Table 3.6 Children's schooling efficiency**

	7–11 years			12–17 years		
	Mozambique	Urban	Rural	Mozambique	Urban	Rural
All	0.70	0.79	0.67	0.53	0.64	0.47
Boys	0.70	0.78	0.67	0.52	0.63	0.48
Girls	0.70	0.79	0.66	0.54	0.65	0.47
Poor	0.69	0.76	0.66	0.50	0.61	0.46

Source: 1996–97 *Inquérito Nacional aos Agregados Familiares sobre as Condições de Vida*.

Notes: Efficiency is defined as the highest grade completed divided by highest grade possible, given the student's age. Sample is children who ever went to school.

her age, if she had started school on time and did not repeat.<sup>5</sup> Children who are in the “correct” grade for their age will have an indicator of 1 (or 100 percent). As children who never attended school will have an efficiency of 0, this group is omitted from the table. For both boys and girls in the 7- to 11-year-old age group, the mean efficiency at the national level is 70 percent, indicating that on average, young children who have entered the schooling system have achieved only 70 percent of what they should have achieved.<sup>6</sup> Of course this could be attributable to factors on either the demand side (the household/family) or supply side (schooling system) of the educational system. Efficiency is considerably lower among the 12- to 17-year-old age group, averaging just above 0.50 in each of the subgroups shown. Note also that although efficiency is higher in urban areas, among the younger age group the difference between poor children and the national average is virtually zero. This means that in the younger generation of children, household income may not be an important determinant of schooling achievement.

### Intergenerational Comparisons

Tables 3.1–3.6 indicate that important differences in schooling indicators exist between regions, between sexes, and also by level of family well-being. Is the distribution of schooling the same for adults as it is for children? To shed some light on this question, we divide adults ages 18–65 into 12 groups based on their region of residence (urban/rural), gender, and whether they live in households that are nonpoor, poor (below the poverty line), or very poor (less than

60 percent of the poverty line). The literacy rate for each of these 12 groups is calculated, ranked, and displayed in Figure 3.1. The same exercise is done for enrollment rates for children ages 7–11 and displayed in Figure 3.2. In these two figures, white bars represent females and gray bars represent males.

In Figure 3.1 (adults), the key factor determining whether a group has a high or low literacy rate is gender. Almost all the gray bars (male groups) are ranked ahead of almost all of the white bars (female groups). For children, however, this division does not persist (Figure 3.2). Here the decisive factor is region of residence rather than gender—almost all the urban groups are ranked ahead of rural groups. Current enrollment of primary school children measures schooling at a very early period in a child’s schooling career, and is therefore not a perfect indicator of final attainment. Nevertheless, if this trend were to continue, gender differences in educational attainment among the next generation of Mozambicans would be less than they currently are.

### Community-Level Information: School Access

The IAF collected community information in rural villages that were included in the main survey. This community-level information is common to all households from the same village, and contains a series of questions on topics such as infrastructure, market access, and crop production. This information is used here to quantify the level of access to schools in rural areas.

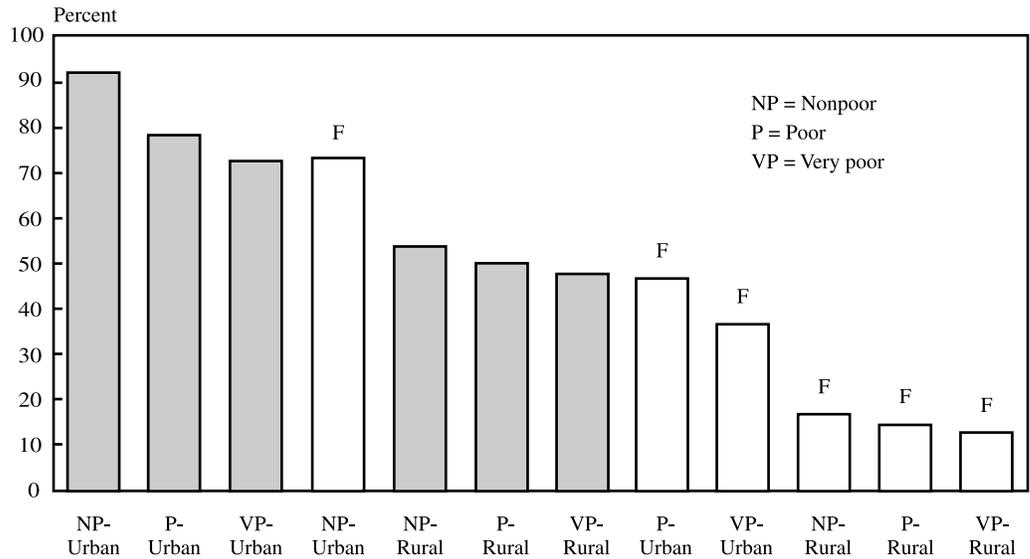
Figure 3.3 shows the proportion of households with a school in the village, by province.<sup>7</sup> For primary schools, the national rural

<sup>5</sup>Children no longer in school were asked what year they completed their highest grade. This information is used to calculate the age at which they completed that grade.

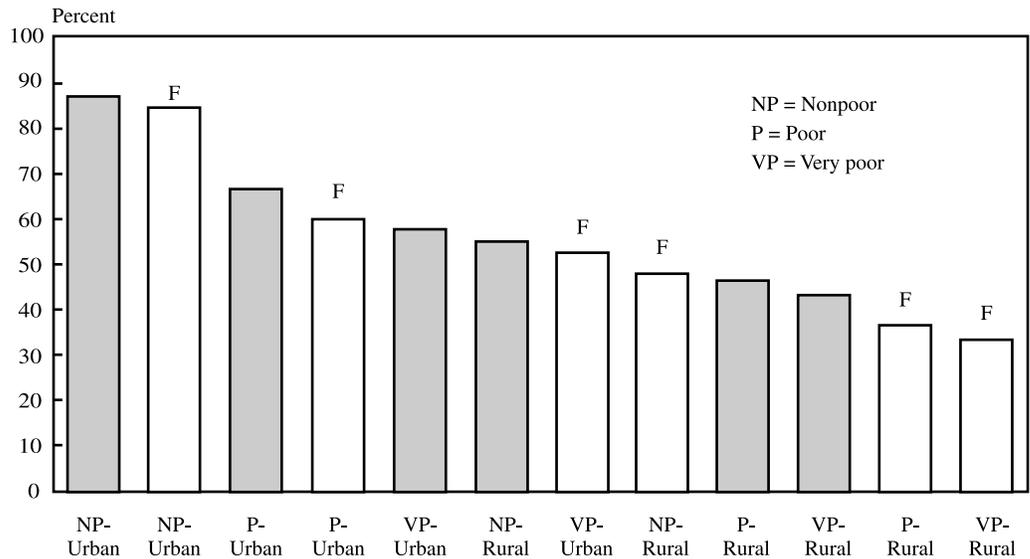
<sup>6</sup>Another way to analyze this number is to ask how much “extra” time it will take a child in Mozambique, once enrolled in school, to complete a given level. The answer is 43 percent “extra” time (1/.70).

<sup>7</sup>These means are calculated using household sampling weights applied to the village-level information.

**Figure 3.1 Adult (18–65) literacy, by gender, region, and well-being**



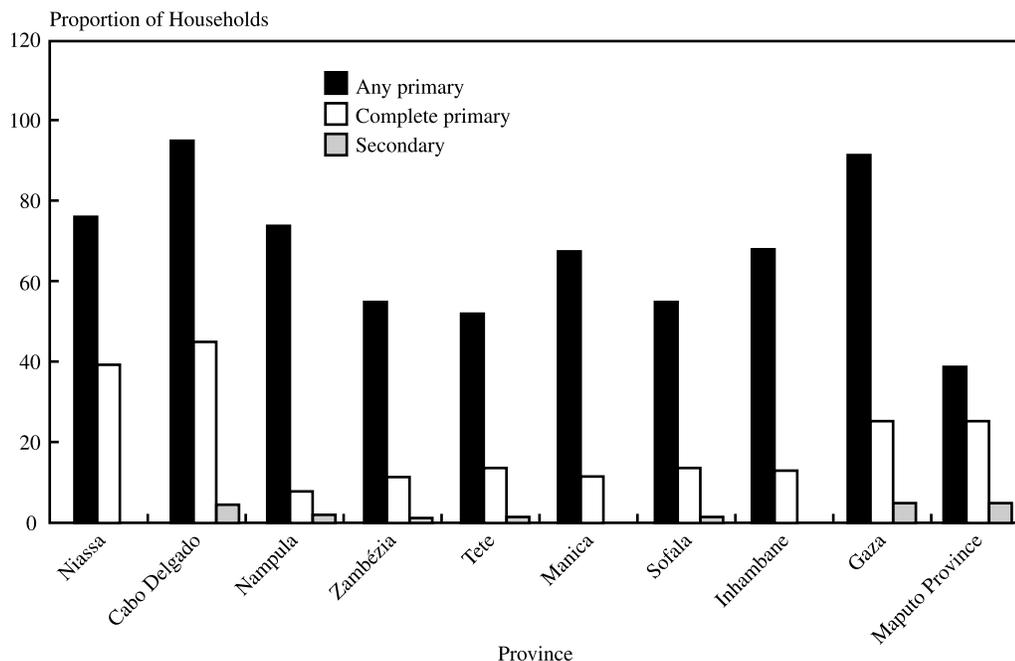
**Figure 3.2 School enrollment (7–11), by region, gender, and well-being**



average is 67 percent, and according to Figure 3.3, Cabo Delgado, Niassa, and Gaza have the highest proportion of households with a primary school in the village. Note from Appendix Figures B.3–B.6 that Gaza also displays the highest rural enrollment rates for children, but that Cabo Delgado and Niassa do not have enrollment rates significantly above mean enrollment, implying

that access to schools is not the only factor determining children’s school enrollment.

Figure 3.3 also shows the proportion of households with a complete primary school in the village (EP2) and here again, Cabo Delgado, Niassa, and Gaza have the highest rates (the national rural average is 17 percent). Finally, access to secondary education is almost nonexistent in rural Mozambique.

**Figure 3.3 Availability of schools in rural areas, by province**

The national rural average is less than 2 percent, with Maputo Province, Gaza, and Cabo Delgado showing rates above the mean.

Table 3.7 provides information on the main reason why some children do not attend school, taken from the village-level questionnaire.<sup>8</sup> For all rural areas, the most frequent reason was that school was too expensive (39 percent—last column); however, the response depends on whether there was a school in the village, as well as on the overall well-being of the village. In both villages with or without a school, the main reason given for nonattendance is costs, but in villages without a school, the second reason is time cost (32 percent), while in villages with a school, it is the need for children to work (26 percent). Finally, in poorer villages (column 3), the main reasons cited for nonattendance are time costs (distance) and monetary costs (too expensive). Together these results indicate that the monetary cost

of schooling is an important determinant of attendance in all types of villages, and that time costs of attendance are reduced in villages with a school.

An interesting sign of the revitalization occurring in Mozambique after the war is the construction of new primary schools in the rural areas. Figure 3.4, also based on information from the village-level survey of the IAF, displays a steady increase in the construction of new primary schools in rural areas after the peace agreement in 1992.

This overall picture of current education patterns and conditions in Mozambique indicates many opportunities through which aggregate levels of human capital can be improved. To examine the ways in which households can be influenced to achieve these goals, we next outline a general model of household decisionmaking that we apply in our analysis of child welfare in general and schooling outcomes in particular.

<sup>8</sup>The community questionnaire asks, “What is the reason why some children do not attend primary school?” This could refer both to why some children never attend, and why some drop out before completing primary school.

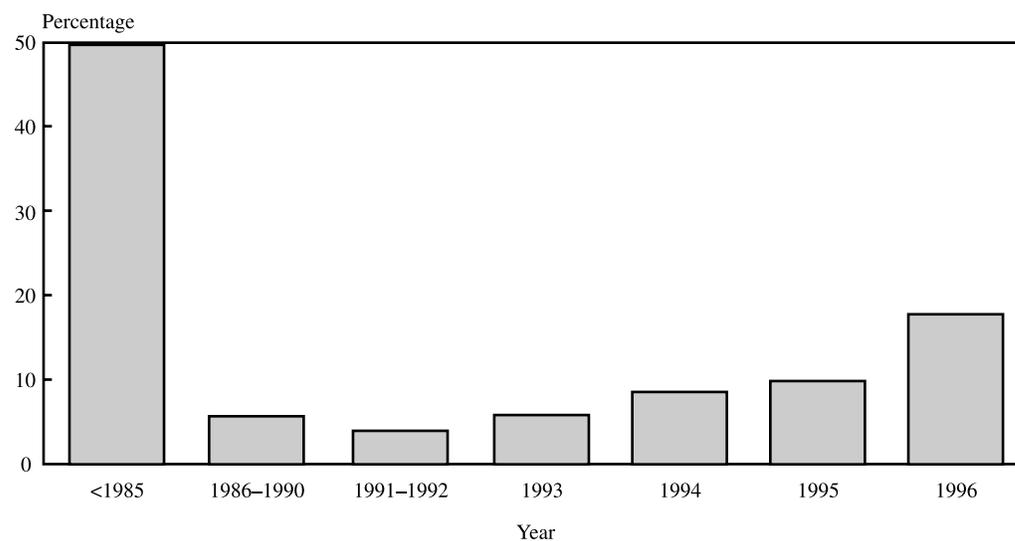
**Table 3.7 Main reasons for not attending primary schools in rural areas**

Main reasons why some children do not attend primary school <sup>a</sup>	Villages with a primary school	Villages without primary school	Poorest tercile <sup>b</sup>	Full sample
Too expensive	38.0	39.7	27.0	38.9
Too far away	4.4	32.3	33.2	13.4
Children work	26.2	4.4	3.3	19.2
School has no teacher	8.1	2.8	11.1	6.3
Other/no response	23.3	20.0	23.5	22.4
Total	100.0	100.0	100.0	100.0

Source: 1996–97 *Inquérito Nacional aos Agregados Familiares sobre as Condições de Vida*.

<sup>a</sup> Information collected at the community level in rural areas.

<sup>b</sup> Villages whose median consumption per person was in the bottom third of the distribution of per capita consumption.

**Figure 3.4 Year of construction of primary school in rural areas**

## CHAPTER 4

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### Theoretical Framework and Choice of Variables

The links between adult education and both monetary and nonmonetary well-being have been explored extensively in the education literature. Adult education plays an important direct role in determining the overall welfare of households through increased wage earnings, as well as an indirect role in the welfare of future households through its impact on the human capital attainment of children. In this chapter, we outline the theoretical framework used to examine household decisions regarding children's well-being, and apply it to health and education in Mozambique.

#### Theory

The estimations of the determinants of children's welfare are guided by the familiar New Households Economics model of household decisionmaking as pioneered by Becker (1965), and, in particular, the extensions to the model described by Strauss and Thomas (1995). In this framework, we assume that adult members make schooling and health-care decisions on behalf of children to maximize the well-being or utility ( $U$ ) of the household as they see it. Utility is defined over market purchased ( $X$ ) and home-produced ( $Z$ ) goods, including children ( $N$ ) and leisure ( $L$ ). Utility is maximized subject to time and budget constraints, and household production functions for home-produced goods ( $FZ$ ) and children ( $FN$ ). A simple version of this model can be written as follows:

$$\text{maximize } U = U(X, Z, N, L) \quad (\text{Utility}) \quad (1)$$

subject to

$$t + H + L = T \quad (\text{Time}) \quad (2)$$

$$P_x X = Y + A = wH + A \quad (\text{Money}) \quad (3)$$

$$Z = FZ(X, t; v) \quad (\text{Technology}) \quad (4)$$

$$N = FN(X, t; v) \quad (\text{Fertility}) \quad (5)$$

where

- $t$  = time spent in home production including childcare,  
 $T$  = total time endowment of the household,  
 $L$  = time devoted to leisure activities,  
 $H$  = time spent in off-farm or market work activity,  
 $P_x$  = the price of market purchased goods,  
 $Y$  = earned income,  
 $A$  = unearned or transfer income,  
 $w$  = the market wage rate,  
 $wH = Y$ , earned or cash income,  
 $F_i$  = the home production function for output  $i$ , where outputs are home-produced goods ( $Z$ ) and children ( $N$ ), with corresponding production functions  $FZ(\cdot)$  and  $FN(\cdot)$ , and  
 $v$  = a home production efficiency parameter.

Substituting for  $H$  in equation (3), using equation (2), we derive the full-income budget constraint that explicitly allows for time costs in the decisionmaking process of the household:

$$P_x X + wt + wL = wT + A \quad (6)$$

The left-hand side of equation (6) describes the total expenditures or costs of the household with leisure and time spent in home production valued at the market wage rate; the right-hand side of equation (6) is the full potential income available to the household. In practice, the aforementioned variables are vectors representing different goods and their respective prices, while time endowment ( $T$ ) and time allocations ( $t$ ,  $H$ ,  $L$ ) are vectors consisting of each household member's time allocation and endowment. Assuming the standard conditions for an interior solution, this model can be solved to obtain reduced form demand equations for choices of  $X$ ,  $Z$ ,  $N$ , and  $L$ :

$$D_i = D_i(P_x, w, T, A; v) \quad (7)$$

where  $i = X, Z, N, L$ .

These reduced-form household demand equations, applied to the health and schooling outcomes of children, provide the theoretical basis for the estimates presented in this report.

### Choice of Variables

Children's welfare, be it defined through schooling or health care, is typically modeled as a  $Z$ -good, and depends not only on the preferences of the adult decisionmakers, but also on the perceived costs and benefits of the good to the family. The benefits of health-care provision and education will primarily be the health, survival, and anticipated future incremental earnings of the child. Costs will have two components: time or opportunity costs and monetary or direct costs. Direct costs related to schooling are fees, books, and uniforms; the results from Table 3.7 indicate that these costs are important in keeping children away from school. Opportunity costs depend on the time spent traveling to the school or health care site as well as the time spent in school and studying, or waiting for and receiving health services. Distance to the services will therefore be an important factor influencing this cost component of schooling and health care. It is also likely that the opportunity cost of time, as well as expected benefits, will vary according to the age and gender of the child. For example, the opportunity cost of schooling for young girls may be higher than for young boys if girls are expected to help more in household activities or to do more farmwork. On the other hand, the opportunity cost of schooling for older boys may be higher than for older girls if boys are expected to enter the labor market and earn cash income for the household. Utility-maximizing decisions of adults, made subject to the cost and benefit considerations discussed in the preceding, will lead to observed choices about the welfare outcomes of children. To model these observed decisions of households with respect to investments

in the human capital of children, we employ our utility-maximizing framework and estimate regression equations in which we try to isolate the impact of household education by controlling for as many other potentially intervening factors as possible, in other words, factors that represent the costs and benefits mentioned earlier.

The details about the household's actual internal decisionmaking process are assumed away in the simple household utility model described earlier. But an important consideration is the weight that individual household members receive in the aggregate household utility function. There is a sizable literature based on data from developing countries showing that relative authority or bargaining power within the household influences the way resources are allocated within the household, thus shaping the household utility function (Alderman et al. 1995). This dimension of household decision-making is likely to be important in Mozambique, where the costs and perceived benefits of sending girls and boys to school are different for different adult members. In the example of the previous paragraph, if girls are indeed expected to help more in domestic duties, the cost of sending them to school may be greater for adult women than for adult men.

In Mozambique, intrahousehold differences in the net benefit of children's schooling are likely to vary by gender and geography, with different cropping patterns in different areas. Furthermore, relative authority within the household will also depend on geography, with matrilineal inheritance systems<sup>9</sup> prevailing in some regions, and outside opportunities, which are enhanced with education (see Chapter 2). Some of these intrahousehold effects will therefore vary by region of residence (to the province

or district level), gender of the child, and by the educational levels of the adult men and women.

An additional issue in the estimation of the reduced form in equation (7) is whether to include household size and composition. Typically these variables capture a significant portion of the variation in the demand for *Z*-goods, but as illustrated in the preceding theoretical model, they are endogenous, as they are determined simultaneously with the outcomes analyzed in this report. Although there are some exceptions, most empirical specifications in the literature do not include these variables on theoretical grounds, presuming that the estimated relationships are approximations of long-term ones; this tradition is followed and thus these variables are excluded in the estimates.

Based on the preceding discussion, the following control variables are included in all of the regression estimates for child outcomes (*D*) presented later: province and district dummy variables that control for regional characteristics representing the supply of infrastructure as well as differences in cropping patterns and ethnicity that may differentially influence the cost of schooling for boys and girls (*S*); indicators of household (sex of household head; education level of adults) (*H*) and child characteristics (age, age squared, and sex) (*C*); and a measure of household access to resources—total household per capita consumption expenditures (*I*) (described in more detail later):

$$D_i = \alpha + \beta_1 S + \beta_2 H + \beta_3 C + \beta_4 I + \mu_i \quad (8)$$

Equation (8) is the general empirical specification employed in this report, where  $D_i$  is one of a series of child health and ed-

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<sup>9</sup>Matrilineal inheritance systems are those in which land and other assets are passed from generation to generation through the mother's side of the family. In these societies, women have more control over assets, which raises their status and influence within the household.

education outcomes discussed later, the betas are parameters to be estimated, and  $\mu_i$  is a random error term.

### Controlling for Household Access to Resources

Education of adult household members is generally a significant correlate of household monetary well-being, even in a poor rural economy such as Mozambique; hence, it is important to control for household monetary well-being in order to measure the impact of adult education net of this “income” effect. Moreover, the theoretical model presented earlier indicates that access to monetary resources, ideally measured by exogenous forms of income such as unearned or transfer income, is an important determinant of demand. Empirical applications of the theory use different measures of access to resources depending on data availability, including unearned income, earned income, and total household expenditure, the latter two appropriately treated as endogenous. Studies of household demand for health and schooling in developing countries often use expenditure-based rather than income-based measures to capture access to resources because of the difficulty in collecting income data in economies where much of the labor force works outside the formal labor market, and most income is derived from agriculture and thus varies significantly within and across years because of seasonality and weather shocks. The IAF data contain an extensive expenditure module that is used to construct an aggregate expenditure measure that is used as the proxy for resource availability at the household level.<sup>10</sup> Because this measure of household resources is likely to be determined

jointly with schooling and labor force participation, and is thus endogenous, this variable is instrumented via the following auxiliary regression:

$$\ln(\text{EXP}) = \alpha + \beta_1 P + \beta_2 T + \beta_3 HH + \beta_4 W + \beta_5 M + \varepsilon, \quad (8a)$$

where

$\ln(\text{EXP})$  = the natural logarithm of per capita consumption expenditure,

$P$  = a set of provincial indicators,

$T$  = a set of month indicators to capture the seasonal patterns of expenditure in the area,

$HH$  = a set of household characteristics that includes the sex and age of household head and adult education levels,

$W$  = a set of household wealth characteristics, and

$M$  = the non-self cluster median value of per capita consumption expenditure.

The betas are the parameters to be estimated, and the regression is estimated separately for urban and rural households.<sup>11</sup> For households in urban areas, the set of wealth variables includes indicators of in-home access to electricity and potable water; in rural areas, the wealth variable is a measure of area of farmland. The identifying variables in this regression (variables included in this auxiliary regression [8a] but excluded in the outcome equations [8]) are these wealth variables and the non-self cluster median of per capita consumption.

The means and standard deviations of the variables included in these models are presented in Table 4.1, and a summary of the key ordinary least-squares (OLS) estimates

<sup>10</sup>Household expenditure per capita (or per adult equivalent) is routinely used in the poverty literature to track standards of living and to make welfare comparisons among households (Ravallion 1992). The measure is deflated by both a spatial and a temporal price index to permit comparability.

<sup>11</sup>Performing these and subsequent analyses using a household consumption estimate divided by the number of adults, rather than household size, did not significantly alter the results.

**Table 4.1 Means and standard errors of key variables for consumption estimates**

	Full sample	Rural	Urban
Log of consumption per capita (dependent variable)	8.468 (0.020)	8.452 (0.021)	8.539 (0.062)
Household head is literate	0.471 (0.013)	0.415 (0.012)	0.725 (0.038)
Proportion of adult males with EP2	0.103 (0.008)	0.061 (0.005)	0.297 (0.025)
Proportion of adult females with EP1	0.107 (0.008)	0.058 (0.005)	0.334 (0.027)
Highest education level in the household			
Primary	0.120 (0.006)	0.125 (0.007)	0.100 (0.009)
EP1	0.182 (0.008)	0.165 (0.009)	0.260 (0.018)
EP2	0.090 (0.008)	0.052 (0.005)	0.263 (0.023)
Secondary or higher	0.025 (0.003)	0.005 (0.001)	0.113 (0.015)
Age of household head	42.189 (0.376)	42.341 (0.452)	41.493 (0.504)
Male-headed household	0.785 (0.009)	0.787 (0.011)	0.777 (0.011)
Log of median consumption in cluster	8.429 (0.021)	8.414 (0.021)	8.501 (0.067)
Total area of farmland (hectares)	1.824 (0.053)	2.030 (0.056)	
Household has electricity	0.043 (0.006)		0.205 (0.027)
Household has piped water	0.051 (0.007)		0.249 (0.034)
Number of observations	8,250	5,811	2,439

Note: Standard errors, robust to sample design, are in parentheses.

of equation (8a) is presented in Table 4.2. The full set of estimates is presented in Appendix Table A.1. As with all other regressions in this report, standard errors (or  $t$ -statistics) are calculated taking into account the cluster-based sampling of the IAF.<sup>12</sup> The estimates in the coefficients column of Appendix Table A.1 are used to predict log per

capita consumption for use in the subsequent reduced-form analyses. Table 4.2 presents a summary of these results on associations between the schooling levels of adult household members and household monetary well-being; note that the coefficients indicate the percentage change in household per capita consumption for a unit change in any of the

<sup>12</sup>Variance estimates are based on computations at the primary sampling unit, or *localidade*, in this survey, which was also stratified by provinces. We use the routines for robust variance estimation available in the software package Stata (Stata Corp. 2003), which use a generalization of the Huber/White sandwich estimator described by Rogers (1993), Deaton (1997), and Williams (2000). Observations are held to be independent across *localidades* and provinces, but not necessarily independent within *localidades*.  $T$ -statistics are computed with  $(n - L)$  degrees of freedom where  $n$  is the total number of sampled PSUs and  $L$  is the number of strata or provinces. Statistics on these sampling units across the estimation samples are included in Appendix Table A.2.

**Table 4.2 Ordinary least-squares (OLS) regression to predict log consumption per capita**

	Model 1		Model 2		Model 3	
	Urban	Rural	Urban	Rural	Urban	Rural
Household head is literate	0.177 (4.2608)	0.060 (3.9666)	0.147 (3.4476)	0.046 (3.0383)		
Proportion of adult males with EP2			0.217 (6.6867)	0.117 (3.5087)		
Proportion of adult females with EP1			-0.013 (0.3750)	-0.003 (0.0839)		
Highest education level in household						
None (excluded)						
Some primary					-0.090 (1.4345)	-0.057 (2.5496)
EP1					-0.032 (0.6387)	-0.018 (0.8181)
EP2					0.058 (1.1987)	0.095 (3.2685)
Secondary or higher					0.281 (4.8327)	0.287 (3.0338)
Number of observations	2,439	5,811	2,439	5,811	2,439	5,811
$R^2$	0.4222	0.4234	0.4311	0.4247	0.4290	0.4251
Adjusted $R^2$	0.4157	0.4204	0.4243	0.4215	0.4219	0.4219

Note: Absolute values of  $t$ -statistics, robust to sample design, are in parentheses.

education characteristics listed in the table. For example, the estimates in column 1 of Table 4.2 indicate that in urban areas, households with heads who are literate have per capita consumption that is 19 percent greater than that of households whose heads are not literate. In rural areas, this difference is much smaller—only 6 percent—but still statistically significant.<sup>13</sup>

Columns 2 and 3 of Table 4.2 use different ways of measuring household education. For any definition, households with better educated adults (defined as members age 18 and older) have significantly higher consumption per capita, and in columns 1 and 2, this difference is greater in urban areas than in rural areas. The model in column 3

does not explicitly control for the household head's literacy but rather measures the highest schooling level of any adult in the household. These results also show higher schooling levels associated with higher household consumption, especially secondary schooling and above. Moreover, these estimates indicate a slightly higher association in rural areas relative to urban.

The estimates in Table 4.2 are not equivalent to the typical rate-of-return estimates based on individual wages or earnings that are reported in the literature. However, as Jolliffe (2002) and others have argued, in economies in which only a small proportion of individuals actually work for wages in a formal setting, and in which most income is

<sup>13</sup>When the dependent variable is in logarithms (as in Table 4.2), for independent variables that are dummy variables (for example, the variable for literacy of the head of household), the coefficient shown in the table is an approximation of the percentage in household per capita consumption. A more accurate estimate of the percentage change in the dependent variable is calculated as  $\exp(\beta) - 1$ . This more accurate estimate differs from the coefficient in the table. See Halvorsen and Palmquist (1980) and Kennedy (1981) for details.

**Table 4.3 Education level of household head and selected children's outcomes**

Household head's education	1 Current enrollment (percent)	2 Ever went to school	3 Highest grade attained	4 Schooling efficiency (percent)	5 Have health card (percent)	6 Low height-for-age (percent)
Never attended	36	48	2.8	56	63	46
No level completed	47	61	2.9	56	66	45
Some primary	63	77	3.4	65	80	38
EP1	62	73	3.4	67	73	38
EP2	75	87	4.0	75	88	27
First cycle secondary	85	95	4.5	77	97	32
Second cycle secondary	92	97	5.0	78	99	7
Age group		7–11 years			12–23 months	0–60 months

generated (and consumed) jointly by the household, the effect of adult education on total household income or consumption might be the more relevant approximation to the true return to schooling than private returns to individuals based on wage earnings.

To conclude this section, Table 4.3 provides an indication of the association between the education of the household head and the health and education of resident children of various age groups. For example, column 1 of Table 4.3 shows that children from households whose heads have completed EP1 or EP2 are much more likely to be enrolled in school than children from households with heads who have not completed primary schooling. The same is true for the three other indicators of schooling

performance: the higher the education of the household head, the better the performance of the child.

Table 4.3 also gives the percentage of children 12–23 months old who have a health card, an important indication of contact with the formal health service (column 5), and the percentage of preschool children who are stunted (low height-for-age) (column 6). In each case, the higher the educational level of the household head is, the better is the indicator of nutritional status or access to or use of health services. The associations in Table 4.3 cannot be attributed entirely to education, as there is no control for confounding variables such as income. This is addressed in the regression analysis of the next chapter.

## CHAPTER 5

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### **Adult Education and Children's Health**

**B**efore analyzing the relationship between adult schooling and children's schooling, we examine the effect of adult education on children's health outcomes to illustrate the overall importance of the former for a child's human capital development. Table 4.3 showed an important bivariate relationship between adult schooling and investment in children's health and education—these investments have important consequences for the future well-being of not only the household and individual child, but also for society. For example, the decision not to send a child for vaccinations has important implications for the eradication of infectious diseases, with obvious public health consequences for other members of society. To examine the impact that household education has on children's health outcomes, we estimated equation (8) using three health outcome indicators: height-for-age Z-score, possession of a health card, and vaccinations.<sup>14</sup> These data are taken from the children's health module of the IAF, which was administered to preschool aged children (0–60 months). Household education is measured by whether or not the child's mother is literate or has attained an EP1 level of education.<sup>15</sup> Household and individual characteristics in these estimates include sex of the household head, age (and age squared) of the mother, the child's gender and his age in months, age squared and age cubed to allow for established age-specific patterns in growth, and growth spurts and sexual differences in growth patterns (or differential treatment of children by gender). Finally, provincial and district fixed effects are included to capture supply-side effects, including differences in inheritance systems, religion, and cropping patterns.

#### **Household Demand for Child's Health**

##### **Stunted Growth or Chronic Malnutrition**

Height-for-age is an indicator of chronic malnutrition, and has been found to be correlated with long-term indicators of household socioeconomic status such as income, education, and

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<sup>14</sup>Means and standard deviations for these and other key variables of the following health outcomes analysis are presented in Table 5.1.

<sup>15</sup>This module also indicated the mother of the preschool child, allowing researchers to identify the mother and her characteristics for analytical purposes. For children who lived with their mothers, the mother's education is used in the subsequent analysis. For children who did not live with their mothers but where another caregiver was identified, this person's education is used in the analysis. Where neither a mother nor caregiver was indicated, the education of the eldest adult woman in the household was used in the analysis. Seven percent of preschoolers included in the study reported not living with their mothers at the time of the survey.

**Table 5.1 Means and standard errors of key variables in analysis of children's health outcomes**

	Children 0–60 months			Children 12–60 months			Children 0–24 months		
	Full sample	Urban	Rural	Full sample	Urban	Rural	Full sample	Urban	Rural
Child height-for-age Z-score	–1.931 (0.093)	–1.172 (0.072)	–2.151 (0.105)	–2.267 (0.112)	–1.449 (0.074)	–2.521 (0.126)	–1.702 (0.110)	–0.851 (0.113)	–1.923 (0.126)
Complete vaccinations (percent)	49.697 (2.365)	75.467 (4.270)	41.857 (2.474)	57.039 (2.592)	83.215 (3.807)	48.568 (2.844)	40.919 (2.386)	65.866 (5.883)	34.122 (2.418)
Has health card (percent)	70.522 (2.013)	92.519 (1.690)	63.814 (2.286)	69.475 (2.084)	91.096 (1.993)	62.496 (2.342)	74.300 (2.119)	96.407 (1.187)	68.246 (2.486)
Mother is literate (percent)	32.260 (1.997)	61.491 (4.093)	23.318 (1.904)	32.348 (2.223)	61.183 (3.991)	22.994 (2.154)	31.680 (1.973)	61.871 (5.730)	23.387 (1.889)
Child is female (percent)	50.398 (1.100)	48.081 (1.378)	51.107 (1.358)	49.791 (1.177)	46.382 (1.836)	50.898 (1.415)	52.819 (1.809)	52.759 (1.941)	52.836 (2.249)
Mother has at least EP1 education (percent)	19.761 (1.513)	45.412 (3.554)	11.919 (1.222)	19.614 (1.620)	44.346 (3.469)	11.586 (1.330)	19.647 (1.568)	46.765 (4.678)	12.225 (1.348)
Predicted log per capita consumption	8.451 (0.022)	8.530 (0.054)	8.427 (0.023)	8.451 (0.022)	8.538 (0.053)	8.423 (0.025)	8.454 (0.021)	8.520 (0.057)	8.437 (0.023)

Notes: Standard errors reported in parentheses. Reported means and standard errors were calculated correcting for stratified three-stage cluster survey sample design.

**Table 5.2 Two-stage least-squares estimates of mother's education on child height-for-age Z-score**

	Mozambique		Urban		Rural	
Mother is literate	0.139 (2.55)		0.099 (1.20)		0.136 (1.91)	
Mother with EP1		0.200 (3.36)		0.218 (2.86)		0.131 (1.38)
Predicted log consumption p.c. <sup>a</sup>	0.503 (7.08)	0.481 (6.94)	0.762 (8.53)	0.703 (8.84)	0.29 (2.68)	0.295 (2.72)
Child is female	0.140 (3.09)	0.142 (3.12)	0.240 (3.58)	0.244 (3.73)	0.086 (1.41)	0.086 (1.41)
Child's age (months)	-0.153 (12.80)	-0.154 (12.86)	-0.156 (7.54)	-0.157 (7.85)	-0.150 (10.36)	-0.150 (10.30)
Child's age squared	0.005 (9.37)	0.005 (9.44)	0.005 (5.66)	0.005 (5.79)	0.004 (7.50)	0.004 (7.45)
Child's age cubed/100	-0.004 (7.69)	-0.004 (7.76)	-0.005 (4.72)	-0.005 (4.79)	-0.004 (6.08)	-0.004 (6.04)
<i>R</i> <sup>2</sup>	0.219	0.220	0.167	0.170	0.212	0.211
Observations	4,260	4,260	1,572	1,572	2,688	2,688

Notes: The dependent variable is the Z-score of height-for-age, and the method of estimation is two-stage least-squares. The sample is children ages 0–60 months. The absolute value of *t*-statistics, robust to sample design, is shown in parentheses. Also included but not shown are district-level fixed effects, gender of household head, mother's age, mother's age squared, and a constant.

<sup>a</sup> Log per capita consumption is instrumented by the predicted value, with standard errors corrected for two-stage least-squares estimation. See text for details.

consumption. In the IAF, height was standardized according to World Health Organization recommendations, using the median and standard deviation height of a reference population of children of the same sex and age. Following these recommendations, 125 children with height-for-age Z-scores less than -5.79 (the sample mean minus 4 Z-scores) or greater than +3 were excluded from the analysis (WHO 1995). An additional 371 children were excluded because of inconsistencies in their anthropometric measures, using criteria developed by the U.S. Centers for Disease Control (Dean et al. 1996).

Table 5.2 provides two-stage least squares regression estimates of the impact of maternal education on the Z-score of height-for-age. At the national level (column 1), having a literate mother has an im-

portant positive and statistically significant impact on the height of a child, while the impact of having a mother with a complete EP1 level of education is even larger and also statistically significant. The positive association between maternal education and long-term nutritional status is strong across all areas of Mozambique, although nuanced. For example, in rural areas and holding other variables constant, the child of a mother who can read or write is 0.136 standard deviations taller (statistically significant at 7 percent) than a child whose mother is illiterate, whereas the height of a child whose mother has completed EP1 is not statistically different from one whose mother has not completed EP1. On the other hand, in urban areas, it is completion of EP1 rather than basic literacy that has the stronger and statistically

significant association with improved child height.<sup>16</sup>

These estimated associations between education and height are net of the influence of income or household well-being, as instrumented log per capita consumption has been included in the regressions. However, household well-being is itself an important determinant of child height, especially in urban areas, where an additional 10 percent increase in daily per capita consumption will increase height by 0.070–0.076 standard deviations. In rural areas, an increase of 10 percent raises height by 0.03 standard deviations.

In conclusion, maternal education has an extremely important association with stunted growth in rural areas of Mozambique, with the correlation between EPI schooling and height especially strong in urban areas. Income or household well-being, although important in both regions, is much more strongly correlated with stunted growth in urban areas than in rural areas.

### **Access to and Use of Health Services: Vaccinations and Health Cards**

As mentioned earlier, the IAF module on child health also contains information on vaccinations and possession of a health card. Vaccinations are extremely important to protect vulnerable children from infectious diseases, especially in a country such as Mozambique, where such diseases are the largest component of the disease burden.

Possession of a health card indicates that a child has had some contact with the public health system, either for vaccinations or for growth tracking. It is likely to be an important indicator of the parents' knowledge about formal public health facilities and services, and the household's access to those facilities and services.

A similar procedure is followed as before, and regression equations for the probability of a preschool child having a full set of vaccinations, and for having a health card, are estimated. In the case of vaccinations, complete vaccinations include the three doses for diphtheria, pertussis, and tetanus (DPT); three doses for polio; one for bacillus Calmette Guérin (BCG); and one for measles. For this analysis, the study uses the sub-sample of children 12 months and older, that is, those who have had time to acquire the full set of vaccinations. In the case of health cards, we choose children from 0 to 24 months because, ideally, a child will receive a health card at birth if born in a formal health facility, while the incidence of nonreporting (that is, missing values) of health cards in the data increases dramatically after age 2, when these cards become less important to households, because routine vaccinations should have been completed by then.

Table 5.3 provides the estimates of the probability of having a complete set of vaccinations for children between 12 and 60 months of age, by area of residence. In rural areas, having a mother who can read or

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<sup>16</sup>An additional complication with the anthropometric data in the IAF sample is that precise ages could not be determined for approximately 1,750 of the 7,000 children of preschool age in the survey. Thus height-for-age Z-scores could not be calculated for these children. To investigate the possibility that missing age data is a source of selection bias in the anthropometry analysis (for example, richer households might be more likely to have health cards, the main source of birth date information), a selection correction model was estimated to try to control for the probability of being included in the working sample. This selection model was identified by using variables that measure access to health services. In rural areas, this was the distance to the nearest health center, which was collected in the community questionnaire. The community questionnaire was not administered in urban areas, so the weighted non-self cluster mean of health card possession was used to identify the selection equation. The selection correction term (the inverse Mills ratio) in the regression was not statistically significant in any of the models, and all coefficient estimates were virtually identical to the standard OLS model reported in Table 5.2. These estimates are available from the authors on request.

**Table 5.3 Marginal probability estimates of mother's education on the probability of complete vaccinations for children 12–60 months of age**

	Mozambique		Urban		Rural	
Mother is literate	0.134 (6.45)		0.076 (4.29)		0.175 (5.54)	
Mother with EP1		0.136 (5.60)		0.072 (3.90)		0.196 (4.47)
Predicted log consumption p.c.	0.041 (1.05)	0.037 (0.94)	–0.026 (0.86)	–0.031 (1.11)	0.126 (2.45)	0.126 (2.46)
Residuals from predicted consumption	–0.025 (0.54)	–0.019 (0.40)	0.027 (0.69)	0.035 (0.96)	–0.091 (1.53)	–0.093 (1.54)
Child is female	–0.071 (0.68)	–0.068 (0.64)	–0.041 (0.55)	–0.035 (0.45)	–0.045 (0.26)	–0.043 (0.23)
Observations	3,751	3,751	1,338	1,338	2,371	2,371
Log likelihood	–1,662.0	–1,665.5	–442.6	–441.5	–1,196.9	–1,200.7

Notes: Dependent variable equals 1 if child has completed vaccinations, and 0 otherwise. Sample is children 12–60 months of age. Method of estimation is probit, and coefficients shown are marginal probabilities associated with a positive outcome. Absolute values of z-statistics, robust to sample design, are shown in parentheses. Included but not shown are district-level fixed effects, mother's age, mother's age squared, age and age squared of child in months, gender of household head, and a constant.

write increases the probability of a child having complete vaccinations by 18 percentage points, and having a mother with EP1 raises this probability by 20 percentage points. The impact of maternal education is much smaller in urban areas: 8 percentage points for maternal literacy and 7 percentage points in the case of EP1.

The same pattern of effects is found for the probability of a child 0–2 years old having a health card. In Table 5.4, having a literate mother raises the probability of having a health card by 10 percentage points in rural areas, and having a mother who completed EP1 raises the probability by 12 percentage points. However, the mother's education has no statistically significant effect in urban areas. The lower estimated effects of maternal literacy in urban areas are attributable in part to the higher overall mean rates of vaccinations and possession of health cards in urban areas. In the case of health cards, for example, 92 percent of children ages 0–2 years in urban areas are reported as having a health card, so there is little variation in the dependent variable. The pattern of income effects in Table 5.4 is also similar to that in

Table 5.3. Specifically, household resources, measured by per capita expenditures, have a much larger association with possession of a health card among rural households relative to urban ones.

Based on the analysis in this section and the previous one, the principal policy-relevant conclusion is that in rural Mozambique, women's education has a tremendous impact on household well-being, particularly nonmonetary. Women's literacy (and completion of EP1) is strongly related to long-term nutritional status of children, completion of a full regimen of vaccinations, and contact with formal health-care services, as indicated by possession of a health card. These observed relationships are all net of the independent effect of household resources on these same outcomes. Of course, as household adult education also has an important effect on household resources, the direct effects of schooling reported in Tables 5.2, 5.3, and 5.4 underestimate the total impact of adult schooling on child health outcomes. These total effects diverge significantly from the direct effects where household resources have a large and significant

**Table 5.4 Marginal probability estimates of mother's education on the probability of having a health card for children 0–24 months of age**

	Mozambique		Urban		Rural	
Mother is literate	0.089 (3.29)		0.035 (1.14)		0.101 (3.12)	
Mother with EP1		0.094 (2.72)		0.015 (0.70)		0.118 (2.60)
Predicted log consumption p.c.	0.067 (1.58)	0.067 (1.57)	–0.009 (0.33)	–0.005 (0.18)	0.104 (1.95)	0.104 (1.93)
Residuals from predicted consumption	–0.053 (1.10)	–0.052 (1.05)	0.044 (1.33)	0.042 (1.35)	–0.099 (1.64)	–0.097 (1.57)
Child is female	0.009 (0.08)	0.019 (0.15)	0.052 (0.27)	0.056 (0.26)		
Observations	1,993	1,993	350	350	1,608	1,608
Log likelihood	–882.3	–883.7	–67.1	–68.0	–791.4	–792.0

Notes: Dependent variable equals 1 if child has a health card and 0 otherwise. Sample is children ages 0–24 months. Method of estimation is probit, and coefficients shown are marginal probabilities associated with a positive outcome. Absolute values of *z*-statistics, robust to sample design, are shown in parentheses. Included but not shown are district-level fixed effects, mother's age, mother's age squared, age and age squared of child in months, gender of household head, and a constant.

impact on health, such as for child height in urban areas and for vaccinations and health cards in rural areas. For example, in urban areas, the direct effect of maternal literacy on child height is around 0.10 *Z*-scores as

reported in Table 5.2, but the total effect that accounts for the relationship between adult literacy and per capita consumption expenditures (estimated from Table 4.2) is 0.25.<sup>17</sup>

<sup>17</sup>To derive the total effect, we reestimated the regression in column 3 of Table 5.2 using literacy of the household head instead of the mother's literacy and found a coefficient of 0.110 for head's literacy and 0.77 for log of per capita consumption. The full effect of the household head's literacy was calculated by multiplying the coefficient of the household head's literacy from column 1 in Table 4.2 by the coefficient of per capita consumption (0.77) and adding the coefficient of the dummy variable for head's literacy (0.11).

## CHAPTER 6

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### **Household Education and Investment in Children's Schooling**

**T**he previous chapter illustrated the important role of adult education in ensuring the health of children in Mozambique. Given the strong social and private benefits to education, our next task in this report is to identify the determinants of children's schooling. We do this by estimating equation (8) on a set of four child schooling outcome indicators.

In this chapter, we explore the differences in household demand and regional supply on schooling indicators by separating the analysis into two parts. The first part of the analysis focuses on the influence of household education and resources on the demand for schooling. In these models, supply-side factors (*S*) are controlled for through district-level dummy variables. The district-level indicators capture the availability of infrastructure such as schools, roads, and markets, all of which determine the time or opportunity cost of schooling.<sup>18</sup> In the second part of the analysis, we focus explicitly on supply-side factors determining household schooling choices. We drop the district dummy variables and introduce detailed variables describing three dimensions of local or regional schooling infrastructure: access, quality, and efficiency. This information is obtained from the Ministry of Education database and is discussed in more detail later in this chapter. Note that these latter regressions continue to include all the household- and child-specific control variables as indicated in the discussion surrounding equation (8).

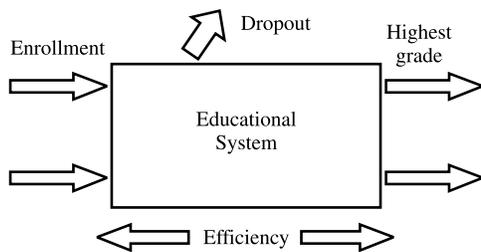
#### **Indicators of Child Schooling**

We analyze several dimensions of the schooling decision because each implies a different target group and different policy interventions. Figure 6.1 provides a graphic representation of the various dimensions of the schooling decision that households face. We begin with the school entry decision at the primary level and analyze the impact of adult education and household resources on the probability that a primary school age child (7–11 years old) has ever been enrolled in school, or is currently attending school. This is perhaps the most important stage in the schooling career of a young child. It is well known that children whose entry into school is delayed are unlikely to ever attend school, and delays and poor enrollment records early in schooling represent lost time that can never be recovered by the child. Given the low level of the current stock of human capital in Mozambique, one of the most pressing

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<sup>18</sup>The district fixed-effects specification, although based on district-level variation, will capture all aspects of supply variation, including those not directly related to school infrastructure but that affect school demand, such as labor market opportunities and cropping patterns. This allows us to control for a better set of intervening factors when assessing the impact of demand characteristics on child schooling.

**Figure 6.1 Different schooling decisions faced by households**



immediate concerns of the education sector must be to increase timely enrollment of children at the primary school level. (Recall from Table 3.4 that national primary school net enrollment is only 49 percent.)

Once students have entered the formal schooling system, the next challenge is for them to stay in the system for as long as possible. To understand the determinants of this choice, we look at the highest class attained for all children (7–17 years old) who have ever entered the system. While many of these children no longer attend school and have probably completed their schooling, a significant portion are still attending school, and so their highest grade attained is not yet known. We discuss and account for this censored variable problem in the econometric specification.

A final issue of policy concern in the education sector is the efficiency of the schooling system, measured by the length of time it takes a child to complete a given level of schooling. For all children 7–17 years old who ever entered the school, we estimate the determinants of their schooling efficiency, using the definition of efficiency given in Chapter 2.<sup>19</sup> However, we exclude

from our analysis children 7 and 8 years old because the efficiency of these few children was 100 percent.

Two important econometric issues are encountered when estimating the determinants of grade attainment and efficiency. First, there is the problem of truncation, which occurs because the estimation sample consists of only those children who once enrolled in school. Second, for those children currently in school, their completed grade attainment and schooling efficiency are still being determined, leading to right censoring of the dependent variable among these observations.<sup>20</sup> A variety of approaches are used to address these two estimation problems.

To address the sample selection or truncation problem, we estimate a two-stage selection model in which we first predict the probability of ever attending school, and use this information to correct for selectivity bias in the grade attainment and efficiency equations; this approach does not address the problem of right-censoring for children still currently enrolled in school. Moreover, for this selection problem we face the same constraint as Alderman et al. (1996), in that there is no theoretical basis for including information in the probit equation (for ever having attended school) and not in the two other outcome equations, as all three are reduced forms from the same underlying structural model. We are thus relegated to identifying the sample selection rule through functional form alone. The second approach taken is to estimate a generalized version of the tobit model where observations for children still attending school are treated as right-censored. In these estimates, the sample is restricted to only those chil-

<sup>19</sup>Efficiency is defined as the grade completed divided by the grade that should have been completed, given the child's age. In the regression analysis this indicator is measured in percent.

<sup>20</sup>For these two outcomes another potential source of bias stems from "home-leaving censorship" if there is a significant group of older children who have left school as well as their family home, and are thus not included in our sample. Unfortunately we do not have any information on the prevalence of this phenomenon, although one might expect that the implied bias is small, as rural-to-urban migration was generally low in Mozambique after 1992, following the signing of the peace accord.

dren who ever attended school—hence, these results account for censoring but not truncation associated with selectivity in entering school. A third approach is to repeat the generalized tobit model but estimated over the entire sample of children (in the age range), imposing right-censoring for those children still in school and left-censoring (at zero) for those children who never attended school. This approach attempts to address both the selection and censoring problems by treating the selection into school as a censoring problem and posits that desired schooling is a latent variable that must take on a minimum value before a child even enters the school system.

Several studies, based on household survey data from developing countries, have analyzed the schooling decision of households with respect to their children. Virtually all of these studies show that family

background or socioeconomic status, measured by household resources and parental education, is an important determinant of children's education. Examples of these studies include Handa (1996) for Jamaica, Singh (1992) for Brazil, Behrman and Wolfe (1984) for Nicaragua, Glewwe and Jacoby (1994) for Ghana, Alderman et al. (1996) for Pakistan, and Deolalikar (1993) for Indonesia. All these studies analyze at least one of the schooling outcomes addressed in this report.

## Household Demand for Schooling

### Probability of Ever Attending School

Table 6.1 presents the means and standard deviations for the key variables used in the

**Table 6.1 Means and standard errors of key variables in education determinants analysis**

	Ages 7–11		Ages 7–17		Ages 9–17	
	Urban	Rural	Urban	Rural	Urban	Rural
Proportion who ever attended school	0.767 (0.020)	0.484 (0.019)	0.818 (0.016)	0.547 (0.016)	0.864 (0.010)	0.598 (0.016)
Proportion presently in school	0.718 (0.019)	0.448 (0.019)	0.670 (0.016)	0.437 (0.016)	0.686 (0.013)	0.461 (0.015)
Highest grade attained	2.001 (0.083)	1.005 (0.046)	3.184 (0.094)	1.527 (0.060)	3.670 (0.084)	1.790 (0.068)
Schooling efficiency	0.595 (0.021)	0.309 (0.014)	0.578 (0.015)	0.304 (0.012)	0.579 (0.012)	0.300 (0.011)
Household head is literate	0.775 (0.022)	0.443 (0.016)	0.778 (0.021)	0.443 (0.016)	0.782 (0.021)	0.440 (0.017)
Household head completed EP2	0.396 (0.032)	0.066 (0.008)	0.447 (0.028)	0.077 (0.008)	0.468 (0.027)	0.080 (0.008)
Any adult in household completed EP2	0.204 (0.024)	0.025 (0.004)	0.201 (0.021)	0.027 (0.004)	0.203 (0.022)	0.027 (0.004)
Adult female completed EP1	0.423 (0.025)	0.081 (0.008)	0.473 (0.021)	0.093 (0.009)	0.492 (0.020)	0.097 (0.009)
Child is male	0.497 (0.011)	0.488 (0.009)	0.498 (0.006)	0.516 (0.006)	0.499 (0.009)	0.530 (0.008)
Predicted log of consumption per capita	8.509 (0.047)	8.397 (0.020)	8.553 (0.047)	8.378 (0.019)	8.572 (0.049)	8.373 (0.020)
Number of observations	2,054	4,367	4,467	8,511	3,658	6,697

Note: Standard errors, robust to sample design, are shown in parentheses.

**Table 6.2 Marginal impact of household characteristics on probability of ever attending school—All children 7–11 years of age**

	1		2		3	
	Urban	Rural	Urban	Rural	Urban	Rural
Household head is literate	0.128 (4.22)	0.149 (6.77)			0.097 (3.68)	0.124 (5.56)
Household head with EP2			0.074 (3.28)	0.299 (5.18)		
Any adult with EP2					0.041 (1.88)	0.181 (4.25)
Adult female with EP1					0.061 (3.37)	0.136 (3.18)
Child is male	0.006 (0.37)	0.106 (6.38)	0.007 (0.43)	0.103 (6.11)	0.007 (0.41)	0.107 (6.35)
Child's age in years	0.368 (5.64)	0.235 (3.09)	0.360 (5.78)	0.218 (2.83)	0.363 (5.70)	0.245 (3.16)
Age squared (×100)	-0.018 (5.15)	-0.009 (2.08)	-0.018 (5.29)	-0.008 (1.86)	-0.018 (5.16)	-0.009 (2.16)
Log p.c. consumption	0.219 (7.63)	0.057 (1.42)	0.220 (7.57)	0.058 (1.44)	0.180 (6.18)	0.026 (0.61)
Residual of log p.c. consumption	-0.145 (4.46)	0.069 (1.56)	-0.144 (4.38)	0.079 (1.77)	-0.110 (3.48)	0.104 (2.21)
Number of observations	2,054	4,367	2,054	4,367	2,054	4,367
Log likelihood	-763.2	-2,501.6	-770.6	-2,513.7	-752.0	-2,469.4

Notes: Dependent variable equals 1 if child ever attended school and 0 otherwise. Method of estimation is probit, and coefficients shown are marginal probabilities associated with a positive outcome. Absolute values of z-statistics, robust to sample design, are shown in parentheses. Included but not shown are district-level fixed effects, household head's age and gender, and a constant.

analysis in this section. Estimates for the probability of ever attending school by region are presented in Table 6.2. The coefficients shown in Table 6.2 represent the change in the probability of obtaining a positive outcome associated with a unit change in the corresponding variable. For example, the first column of the table indicates that in urban areas, having a household head who is literate increases the probability of a child ever having attended school by 12.8 percentage points.

Ten of the 11 household education variables in Table 6.2 are highly statistically significant determinants of the probability of a child ever attending school. In urban areas, the largest quantitative increase in probability occurs for literacy of household head (13 percentage points), while in rural areas the largest impact is associated with the

household head having completed EP2 (30 percentage points).

There are important differences in the impact of other characteristics between urban and rural areas. In urban areas, household well-being (measured by consumption per capita) is an important determinant of entering the school system—in column 1, a proportional increase in per capita consumption increases the probability of ever attending school by 12 percentage points. The age of the child is also very important in urban areas, with the probability of ever attending school increasing until age 10 and then decreasing. In rural areas, on the other hand, income is not a significant determinant of school entry. Here the important characteristic is gender, with boys 11 percentage points more likely to have ever attended school than girls.

### Probability of Current Enrollment

Estimates of the probability of current enrollment in school are summarized in Table 6.3 and tell almost the same story as those in Table 6.2. By any of the definitions used, higher levels of adult education significantly raise the probability of a child attending school. In urban areas, the largest increase in probability is associated with literacy of the household head (20 percentage points), while in rural areas, the biggest quantitative impact occurs when the household head has completed EP2 (29 percentage points). As before, household consumption is a significant determinant of current enrollment in urban areas but not in rural areas, while in rural areas, the sex of the child is an important factor in determining the probability of enrollment. Boys in rural areas

are, on average, 11 percentage points more likely to be currently enrolled than girls.

In summary, education of adults in the household, like child health, is an extremely important determinant of primary schooling of children, and in rural areas, adult education in the household is the single most important determinant of primary enrollment, followed by the gender of the child. In urban areas, on the other hand, both education and income are important determinants of the decision to send children to primary school, and the primary school dropout rate increases dramatically at age 10.

### Highest Grade Attained

The summary of estimates for highest grade attained for the three different econometric

**Table 6.3 Marginal impact of household characteristics on probability of currently attending school—All children 7–11 years of age**

	1		2		3	
	Urban	Rural	Urban	Rural	Urban	Rural
Household head is literate	0.195 (6.00)	0.135 (6.14)			0.156 (5.09)	0.108 (4.87)
Household head with EP2			0.095 (3.73)	0.286 (4.74)		
Any adult with EP2					0.064 (2.84)	0.177 (4.10)
Adult female with EP1					0.072 (3.10)	0.149 (3.57)
Child is male	0.020 (1.07)	0.109 (6.37)	0.021 (1.13)	0.106 (6.17)	0.022 (1.21)	0.110 (6.32)
Child's age in years	0.444 (5.28)	0.257 (3.78)	0.433 (5.53)	0.244 (3.51)	0.440 (5.52)	0.268 (3.84)
Age squared (×100)	-0.023 (4.99)	-0.011 (2.95)	-0.022 (5.26)	-0.010 (2.72)	-0.023 (5.20)	-0.011 (3.02)
Log p.c. consumption	0.228 (6.27)	0.031 (0.75)	0.233 (6.50)	0.031 (0.74)	0.176 (4.90)	-0.002 (0.05)
Residual of log p.c. consumption	-0.140 (3.49)	0.091 (1.97)	-0.141 (3.52)	0.102 (2.17)	-0.092 (2.36)	0.128 (2.63)
Number of observations	2,051	4,348	2,051	4,348	2,051	4,348
Log likelihood	-874.6	-2,519.6	-890.0	-2,528.8	-860.2	-2,484.7

Notes: Dependent variable equals 1 if child is currently attending school and 0 otherwise. Method of estimation is probit, and coefficients shown are marginal probabilities associated with a positive outcome. Absolute values of z-statistics, robust to sample design, are shown in parentheses. Included but not shown are district-level fixed effects, household head's age and gender, and a constant.

**Table 6.4 Heckman selection model estimates for highest grade attained—Children 7–17 years old who ever attended school**

	1		2		3	
	Urban	Rural	Urban	Rural	Urban	Rural
Household head is literate	0.833 (7.03)	0.785 (14.55)			0.585 (5.02)	0.584 (11.14)
Household head with EP2			0.638 (6.84)	1.037 (8.23)		
Adult with EP2					0.627 (8.96)	0.957 (11.99)
Female with EP1					0.516 (7.91)	0.852 (11.96)
Male	0.140 (2.36)	0.600 (12.76)	0.138 (2.33)	0.584 (12.37)	0.164 (2.80)	0.617 (13.65)
Age in years	0.861 (13.05)	0.910 (13.56)	0.840 (12.54)	0.919 (13.60)	0.895 (14.43)	0.922 (14.28)
Age squared	-0.017 (6.00)	-0.025 (8.83)	-0.016 (5.60)	-0.025 (8.92)	-0.019 (7.08)	-0.026 (9.53)
Log p.c. consumption <sup>a</sup>	1.455 (14.92)	0.607 (7.77)	1.365 (12.43)	0.630 (7.97)	1.009 (10.93)	0.314 (4.10)
Inverse Mills ratio	1.492 (16.60)	1.781 (60.40)	1.471 (14.72)	1.793 (59.28)	1.436 (17.35)	1.691 (57.26)
Number of observations	4,445	8,476	4,455	8,510	4,455	8,476

Notes: Dependent variable is highest grade attained and method of estimation is Heckman selection model. Absolute values of *z*-statistics, robust to sample design, are shown in parentheses. Included but not shown are district-level fixed effects, household head's age and gender, and a constant.

<sup>a</sup> Predicted log per capita household consumption.

specifications are presented in Tables 6.4–6.6. The model in Table 6.4 attempts to control for the selectivity into schooling by including the inverse Mills ratio from a probit regression for the probability of ever attending school; the Mills ratio tends to be statistically significant in urban but not rural areas. For these children, what determined the amount of time they stayed in school? Based on the results in Table 6.2 on the determinants of ever entering the school system (that is, attending school), these children live in households with better educated adults, and in rural areas, they are more likely to be boys, while in urban areas, they are more likely to come from richer households.

Column 1 of Table 6.2 indicates that literacy of the household head increases the probability of a child ever attending school (by 13 percentage points). Column 1

of Table 6.4 shows that in urban areas, literacy of the household head continues to have an important influence on the length of time a child stays in the system. Indeed, for urban areas, the selection-corrected model in Table 6.4 indicates that adult schooling, no matter how measured, is a highly significant determinant of grade attainment, with the relative magnitude of the impact ranging from 0.83 additional grades associated with literacy of the household head to 0.52 grades associated with an adult female in the household completing EP1 (column 3). The level of household resources also continues to be important in urban areas, although the relative magnitude of the income effect drops substantially in column 3 when the full set of adult education indicators is included in the specification. A proportional increase in consumption expenditure leads to between 1 and 1.5 additional grades attained.

**Table 6.5 Censored normal regression model for highest grade attained**

	1		2		3	
	Urban	Rural	Urban	Rural	Urban	Rural
Household head is literate	1.594 (6.57)	0.671 (5.25)			1.170 (5.01)	0.428 (3.55)
Household head with EP2			1.008 (4.15)	0.809 (2.67)		
Adult with EP2					1.159 (6.24)	1.458 (7.89)
Female with EP1					0.843 (4.61)	1.005 (6.30)
Male	0.745 (4.48)	0.940 (8.34)	0.716 (4.30)	0.934 (8.25)	0.802 (4.99)	1.029 (9.62)
Age in years	1.023 (3.88)	0.320 (1.74)	0.971 (3.67)	0.327 (1.77)	1.029 (4.06)	0.419 (2.42)
Age squared	-0.046 (4.47)	-0.018 (2.51)	-0.044 (4.24)	-0.019 (2.56)	-0.047 (4.72)	-0.022 (3.27)
Log p.c. consumption	2.919 (3.91)	0.553 (2.84)	2.814 (12.88)	0.563 (2.85)	2.085 (9.70)	0.126 (0.68)
Number of observations	3,783	4,791	3,783	4,791	3,783	4,791
Log likelihood	-2,329.2	-3,287.1	-2,341.9	-3,297.1	-2,290.2	-3,216.4

Note: Absolute values of *t*-statistics, robust to sample design, are shown in parentheses.

**Table 6.6 Two-limit tobit regression model for highest grade attained**

	Model 1		Model 2		Model 3	
	Urban	Rural	Urban	Rural	Urban	Rural
Household head is literate	3.770 (0.632)	3.593 (0.266)			2.800 (0.344)	2.832 (0.254)
Household head has EP2			2.418 (0.391)	5.052 (0.705)		
Adult with EP2					1.568 (0.290)	3.578 (0.433)
Female with EP1					2.436 (0.289)	3.394 (0.379)
Male	1.217 (0.254)	3.039 (0.232)	1.179 (0.256)	3.032 (0.236)	1.330 (0.243)	3.080 (0.224)
Age (years)	4.015 (0.359)	5.098 (0.338)	3.918 (0.362)	5.179 (0.344)	4.039 (0.344)	5.066 (0.326)
Age squared	-0.159 (0.015)	-0.197 (0.014)	-0.155 (0.015)	-0.201 (0.014)	-0.162 (0.014)	-0.198 (0.014)
Predicted log consumption	5.800 (0.361)	1.484 (0.372)	5.796 (0.376)	1.642 (0.380)	4.108 (0.353)	0.629 (0.360)
Number of observations	4,444	8,476	4,444	8,476	4,444	8,476
Log likelihood	-3,850.8	-8,245.4	-3,889.5	-8,320.0	-3,779.7	-8,134.5

Note: Standard errors, robust to sample design, are shown in parentheses.

The generalized tobit regressions for grade attainment in urban areas, shown in Table 6.5, explicitly account for the censored nature of the response variable for children who are still in school. The coefficient estimates for adult schooling and household consumption expenditure increase in magnitude and continue to be statistically significant. For example, a proportionate increase in household consumption now leads to 2.1–2.9 additional grades attained, an effect that implies a doubling of the mean attainment for urban children who ever attended school (Table 6.1). Note that the large increases in the estimated impacts are driven by proper accounting of the censored nature of the outcome for children still in school, as failing to account for the right-censored dependent variable would actually lead to lower estimates of the impact of these household characteristics among the sample of children who ever attended school.<sup>21</sup>

In rural areas, the results for the selection-corrected model in Table 6.4 are comparable to those for urban areas in that both adult schooling and household consumption are significant determinants of grade attainment. However, the income effect in rural areas is significantly smaller than in urban areas (ranging from one half to one third of the urban effect). Furthermore, the coefficients for higher schooling levels are slightly larger in rural areas; for example, having an adult female household member with EP1 leads to an additional 0.85 grades in rural areas compared to 0.52 in urban areas. Note that for this schooling outcome as well, the difference between girls and boys is much larger in rural areas compared to urban areas.

Table 6.5 presents the generalized tobit estimates for rural households. As in the case for urban areas, the coefficients for adult schooling and household income tend

to be larger in this model specification, although the differences are much smaller than those in the urban sample, and in one case (column 3), the estimated coefficient for household consumption is actually smaller in Table 6.5 and statistically insignificant. Hence, in rural areas, accounting for the censoring of grade attainment does not lead to large changes in the estimated coefficients of the family background variables, either because censoring is not as much of a problem in this sample, or because the sample selection bias (not controlled for in the tobit regressions) is much stronger among this group of children.

Finally, Table 6.6 also reports estimates of the generalized tobit using the entire sample of children and treating children who have never enrolled in school as left-censored observations. Note that the coefficients in this model are not directly comparable to the other results in that they capture both the effect of ever having enrolled in school as well as the actual highest grade attained; consequently, we focus our discussion on the patterns of significance and urban–rural differences. All adult schooling indicators in all model specifications are statistically significant, with the “returns” to higher levels of schooling and women’s education once again higher in rural areas. The pattern of income effects is also consistent with those previously estimated. Income is much more important in urban areas, and the size of the effect diminishes in the third specification, where the expanded set of adult schooling indicators is included, and becomes insignificant in rural areas.

In summary, adult schooling continues to have an important effect on grade attainment, even after controlling for possible selectivity into attending school and censoring of outcomes where children are still attending school. Income is also an important ex-

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<sup>21</sup>As the initial decision to attend school is highly positively correlated with adult schooling and household income, the distribution of these characteristics among the select sample of children who ever attended school has a lower variance and a higher mean than the full sample distribution.

**Table 6.7 Heckman selection model estimates of household characteristics on schooling efficiency—Children 9–17 years old who have ever entered school**

	1		2		3	
	Urban	Rural	Urban	Rural	Urban	Rural
Household head is literate	5.640 (4.05)	3.310 (3.37)			3.307 (2.22)	1.449 (1.69)
Household head with EP2			7.259 (6.63)	6.993 (3.89)		
Adult with EP2					7.892 (8.59)	6.755 (5.97)
Female with EP1					3.897 (4.60)	6.960 (6.65)
Male	-0.020 (0.03)	1.292 (1.54)	-0.069 (0.09)	0.817 (1.05)	0.228 (0.31)	1.538 (2.01)
Age in years	-10.506 (6.51)	-14.283 (8.18)	-10.805 (6.59)	-14.876 (8.76)	-10.280 (6.71)	-14.524 (8.83)
Age squared	0.331 (5.32)	0.486 (7.25)	0.343 (5.40)	0.508 (7.78)	0.315 (5.30)	0.488 (7.70)
Log p.c. consumption <sup>a</sup>	12.426 (10.62)	7.789 (6.77)	10.555 (8.28)	7.157 (6.15)	7.975 (6.82)	5.110 (4.47)
Inverse Mills ratio	-2.535 (1.42)	-2.941 (1.19)	-3.600 (2.02)	-4.827 (2.46)	-1.579 (1.13)	-4.988 (2.74)
Number of observations	3,561	6,493	3,569	6,519	3,561	6,493

Notes: Dependent variable is schooling efficiency, defined as grade completed divided by grade that should have been completed, given age ( $\times 100$ ). Estimation method is Heckman selection model. Absolute values of  $z$ -statistics, robust to sample design, are shown in parentheses. Included, but not shown, are district-level fixed effects, household head's age and gender, and a constant.

<sup>a</sup> Predicted log per capita household consumption.

planatory factor, but the income effect is significantly greater in urban areas, while the impact of women's schooling is larger in rural areas. Finally, all models show significant differences by gender of the child, with these differences being larger in rural areas.

### Schooling Efficiency

Schooling efficiency refers to the length of time it takes a student to achieve a given level of education. Delays in starting school, interruptions in schooling, and having to repeat grades reduce efficiency and demoralize the student, and tend to raise dropout rates.<sup>22</sup>

Selectivity-corrected estimates of the determinants of efficiency for those students

who ever enrolled in school are summarized in Table 6.7. The factors that increase student efficiency are remarkably similar to those that raise grade attainment. All the adult schooling variables in both urban and rural areas are highly positive and statistically significant, and as before, the income effects are significantly larger in urban areas, while the impact of having an adult female with EP1 is larger in rural areas (7 percentage points in rural versus 4 percentage points in urban areas—column 3).

The generalized tobit models for efficiency are presented in Table 6.8 and for these estimates as well, the pattern of differences is similar to those observed for grade

<sup>22</sup>In addition to demoralizing the student, as the student gets older, the opportunity cost of sending the child to school, rather than working for the family or outside the home, increases, so that parents become less inclined to send the child to school (especially if he or she is having to repeat grades).

**Table 6.8 Censored normal model estimates of household characteristics on schooling efficiency—Children 9–17 years old who have ever entered school**

	1		2		3	
	Urban	Rural	Urban	Rural	Urban	Rural
Household head is literate	15.619 (6.07)	7.024 (4.30)			11.160 (4.46)	4.392 (2.80)
Household head with EP2			10.432 (4.10)	10.654 (2.67)		
Adult with EP2					12.243 (6.31)	14.201 (6.17)
Female with EP1					7.496 (3.87)	12.295 (6.15)
Male	6.515 (3.74)	10.337 (7.20)	6.095 (3.50)	10.365 (7.19)	7.010 (4.11)	11.806 (8.48)
Age in years	-13.727 (3.13)	-16.070 (4.52)	-14.735 (3.34)	-15.795 (4.43)	-14.697 (3.45)	-15.594 (4.58)
Age squared	0.213 (1.32)	0.327 (2.46)	0.253 (1.55)	0.317 (2.38)	0.242 (1.54)	0.300 (2.36)
Log p.c. consumption	27.411 (12.33)	10.368 (4.16)	26.099 (11.33)	10.348 (4.11)	19.109 (8.36)	5.936 (2.45)
Number of observations	3,136	3,909	3,136	3,909	3,136	3,909
Log likelihood	-3,071.9	-4,383.0	-3,081.6	-4,388.5	-3,037.6	-4,328.7

Note: Absolute values of *t*-statistics, robust to sample design, are shown in parentheses.

attainment. For example, censoring matters more in urban areas relative to rural ones—the coefficient estimates for adult schooling and income increase significantly in the urban estimates, but much less so in the rural estimates. There continue to be interesting gender patterns to these results as well. As usual, the coefficient for males is much larger in rural areas compared to urban ones, while the impact of adult female education (measured by an indicator of whether an adult female household member has completed EP1) is much larger in rural areas than in urban areas (12.3 percentage points versus 7.5 percentage points in urban areas—column 3).

The two-limit generalized tobit, estimated over the entire sample of children and treating as left-censored those children who never entered school, is reported in Table 6.9. Focusing on the patterns of statistical significance and regional differences, we note that these results are entirely consistent with those of the other two models. Adult schooling is statistically significant in all specifi-

cations, and the returns to women's schooling are larger in rural areas relative to urban areas. Income is also significant, but the effects are much stronger in urban areas, and diminish significantly when the expanded set of adult schooling variables is entered into the regression. And for this specification again, the income effect becomes statistically insignificant in rural areas, indicating a larger (positive) correlation between these adult schooling indicators and household per capita consumption.

In summary, adult education and household income continue to be important determinants of schooling success for those children who have entered the school system, although there are some regional differences in the estimated effects. In urban areas, household income is much more important than in rural areas, while in rural areas, higher levels of adult schooling, particularly among women, are much more important. And even among children who have been sent to school, boys continue to have significantly higher schooling outcomes than

**Table 6.9 Two-limit tobit regression model for schooling efficiency**

	Model 1		Model 2		Model 3	
	Urban	Rural	Urban	Rural	Urban	Rural
Household head is literate	0.590 (0.059)	0.665 (0.054)			0.444 (0.057)	0.539 (0.052)
Household head with EP2			0.324 (0.065)	0.884 (0.148)		
Adult with EP2					0.227 (0.048)	0.552 (0.088)
Female with EP1					0.344 (0.048)	0.630 (0.078)
Male	0.196 (0.042)	0.603 (0.048)	0.187 (0.043)	0.599 (0.048)	0.214 (0.041)	0.623 (0.047)
Age (years)	0.217 (0.094)	0.903 (0.106)	0.179 (0.095)	0.944 (0.108)	0.229 (0.091)	0.902 (0.103)
Age squared	-0.012 (0.004)	-0.037 (0.004)	-0.010 (0.004)	-0.038 (0.004)	-0.012 (0.003)	-0.037 (0.004)
Predicted log consumption	0.841 (0.060)	0.273 (0.075)	0.855 (0.063)	0.302 (0.077)	0.598 (0.059)	0.143 (0.074)
Number of observations	3,561	6,493	3,561	6,493	3,561	6,493
Log likelihood	-2,006.5	-5,023.8	-2,046.8	-5,090.1	-1,955.3	-4,946.7

Note: Standard errors, robust to sample design, are shown in parentheses.

girls, with the difference especially large among rural households.

### School Supply

The previous analysis controlled for variations in the availability and characteristics of school infrastructure via district dummy variables (*S*). We now drop these district indicators and include explicit controls for differences in school supply in the vector of supply variables (*S*) to assess how these affect household schooling decisions.

Data on school characteristics have been generously provided by the *Direcção de Planificação* (Planning Directorate) of the Mozambique Ministry of Education (MINED), as described in Chapter 2. Raw data from these school surveys for 1995

and 1996 were acquired from MINED and merged at the administrative post level<sup>23</sup> with rural household data from the IAF survey. The analysis that follows focuses on the enrollment decision of rural children only (this represents 80 percent of the primary school-age children in Mozambique) to permit incorporation of the limited school information from the IAF community survey, which was administered only in rural areas. In all, there are 634 villages in the IAF, distributed across 175 administrative posts, 112 districts, and the 10 provinces of the country (excluding Maputo City).<sup>24</sup>

### School Characteristics

MINED divides its educational performance indicators into three groups—measuring coverage, quality, and efficiency of the school

<sup>23</sup>Administrative posts are administrative units in Mozambique that are smaller than districts and larger than *localidades*. There are approximately 420 administrative posts in Mozambique.

<sup>24</sup>In 17 cases, MINED did not have any school information for an administrative post found in the IAF. In these cases, school information from a bordering administrative post was used.

system—and we follow this classification to maximize the usefulness of the results presented here for policymakers in Mozambique. MINED has developed a set of indicators to measure each of the three dimensions of the educational system. Where possible, we use these same indicators in our regression analysis, although there is a high degree of collinearity among the indicators, both across and within the three dimensions of coverage, quality, and efficiency.

The basic quality indicators used by MINED are the number of trained teachers working in the system, the average class size, and the pupil/teacher ratio. We use the number of trained teachers in the administrative post as our basic indicator of teacher quality. We also found that gender of the teacher matters, and therefore show results that measure the number and proportion of trained female teachers in the administrative post. In addition to teacher training, we include the average pupil/teacher ratio for schools in the administrative post. Class size is not used because many schools in Mozambique are run on a shift system, and so smaller class sizes can be achieved by creating two shifts, but with only a small number of additional teachers. (Case and Deaton [1999] report the same phenomenon for South Africa.)

MINED measures the internal efficiency of the educational system by the pass rate (total pass rate, and pass rates by gender and subject), and the proportion of students who are repeating a class. The pass rate and repeat rate are highly collinear, so we focus on the former, and construct the average pass rate of schools in the administrative post *in the previous year* as our measure of school efficiency. The previous year pass rate (collected in the end-of-year survey) is the relevant variable, as school enrollment decisions are made at the beginning of the year, when the pass rate for that year is still unknown.

School coverage is measured by the number of EP1 schools in the administrative post. Given the large variations in the building structure of schools in Mozambique, and

evidence from other developing countries on the importance of building characteristics (for example, Glewwe and Jacoby 1994), we also include the number of schoolrooms made of concrete in the administrative post. Finally, Lavy (1996) argues that the availability of higher levels of schooling can be an important factor in raising primary school enrollment rates, and Appleton, Hoddinott, and Knight (1996) also point out that part of the return to primary school education is that it opens up the possibility of acquiring higher levels of schooling. With these arguments in mind, we construct indicator variables for whether the administrative post has a second level (EP2) primary school or a secondary school to see if these influence the lower primary enrollment decision.

Recall that all school supply variables are measured at the administrative post level, so each household in the administrative post will have the same school infrastructure characteristics. However, the IAF community questionnaire provides information on whether a primary school exists in the village, and this village-level indicator is included in all estimates presented in the following to control for the important travel time cost component of school attendance, as well as to allow for some village variation in school infrastructure. As in other sub-Saharan African countries, in Mozambique girls' schooling rates lag behind those of boys and are thus of particular policy importance. We allow the impact of all school infrastructure variables to vary by gender of the student, estimating separate models for boys and girls; significant differences in coefficient estimates by gender are noted where applicable. In Mozambique, raising primary school enrollment rates is a priority, and we thus restrict our analysis of school supply effects to the primary school enrollment decisions of rural households.

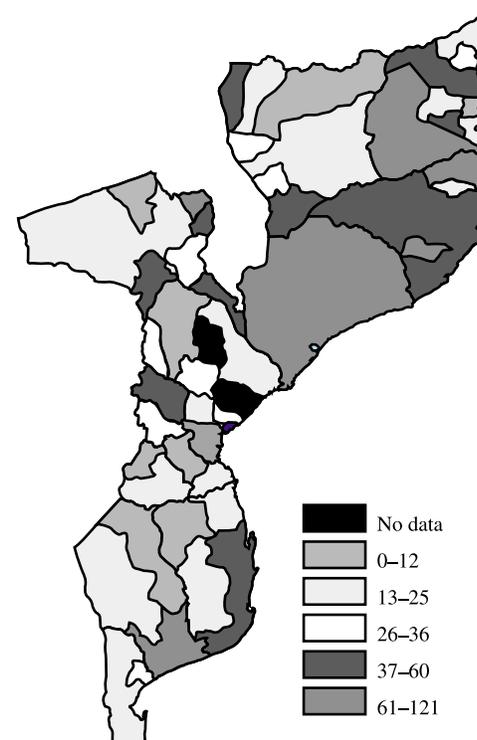
Table 6.10 provides administrative post-level means of the school supply variables used in the regression analysis. These means are calculated over the 175 administrative posts found in the rural sample of the IAF,

**Table 6.10 Administrative post level means for school characteristics, 1997**

Characteristic	Mean
Coverage or access indicators	
Number of EP1 schools	21
Number of concrete rooms	22
EP2 school exists	0.59
Secondary school exists	0.20
Quality indicators	
Number of trained teachers	66
Number of female trained teachers/total number of teachers	0.08
Number of female teachers/total number of teachers	0.37
Number of trained female teachers/total number of female teachers	0.15
Efficiency indicators	
Overall pass rate	0.64
Female pass rate	0.57
Male pass rate	0.68
Portuguese pass rate	0.66
Mathematics pass rate	0.68

Source: Ministry of Education school survey, 1997.

and show that the mean number of EP1 schools is 21 per administrative post with an average of one concrete room per school. Only 59 percent of administrative posts have an EP2 school, and only 20 percent have a secondary school. Figure 6.2 provides a graphical representation of the distribution of EP1 schools by district in rural Mozambique. The most densely populated provinces of Zambézia and Nampula (north center of the map) also have the greatest number of schools, while the southwest provinces of Gaza and Maputo have fewer schools per district. The efficiency indicators in Table 6.10 show that the male pass rate is more than 10 percentage points higher than that of females. Correlation coefficients for the school quality and access variables are presented in Table 6.11 and virtually all are statistically significant, with the teacher training indicators and infrastructure (cement rooms and number of schools) displaying the highest correlation coefficients. This indicates the high degree of correlation among supply-side indicators.

**Figure 6.2 Distribution of EP1 schools in Mozambique, by district**

### Placement of School Infrastructure

The analysis of the impact of school infrastructure on school enrollment runs the risk

**Table 6.11 Correlation coefficients between administrative post level school quality and school access indicators**

	Number of trained teachers	Trained female teachers/all teachers	Proportion of teachers female	Trained female teachers/all female teachers	Number of EP1 schools	Number of cement rooms	EP school exists	Secondary school exists
Number of trained teachers	1.00							
Trained female teachers/all teachers	0.44	1.00						
Proportion of teachers female	0.23	0.60	1.00					
Trained female teachers/all female teachers	0.41	0.84	0.51	1.00				
Number of EP1 schools	0.75	0.21	0.16	0.14*	1.00			
Number of cement rooms	0.72	0.60	0.31	0.55	0.51	1.00		
EPs exists	0.34	0.28	0.17	0.20	0.35	0.39	1.00	
Secondary school exists	0.39	0.38	0.25	0.31	0.23	0.47	0.39	1.00

Notes: All coefficients are significant at 5 percent or better, except the one marked with (\*). Sample size is 175 administrative posts covered by IAF in rural Mozambique.

of confounding cause and effect if households with a greater preference for schooling are able to move to areas with better schooling quality. In the United States, for example, households demonstrate preference for schooling quality through higher property prices in districts with better schools. In Mozambique and other poor countries, the allocation of infrastructure such as schools or health services may be influenced by local demand for services. In such cases, regression estimates that do not account for endogenous program placement will overstate the impact of school characteristics on household educational choices.

Mozambique's recent history of armed conflict led to destruction of physical infrastructure, including schools, roads, and health centers; indeed, RENAMO guerrillas overtly targeted these facilities for destruction. During the war, formal provision of educational centers by the state was limited to the southern part of the country and mostly to urban areas. During this period, few new schools were built, and some were constructed through community initiatives, which would reflect community preferences for schooling. Since the General Peace Accord in 1992 and the general elections of 1994, there has been a rapid increase in the number of schools constructed in the rural areas, through investments by the government and by nongovernmental organizations (NGOs). This is corroborated by the IAF community survey, which reports that nearly half of all rural primary schools were built after 1992.

The education budget is distributed among the provincial directorates of education, which allocate resources to their respective districts based on planning and need, as articulated by the district education directorates. In discussions with staff at the National Planning Directorate of MINED, considerable skepticism was expressed about the ability of parents and others at the village level to influence school placement and quality. This feeling was also expressed by primary schoolteachers interviewed by the

authors in urban Maputo, who felt that parents had very little influence on how schools were run or how resources were allocated. Presumably this would be even more evident in rural areas that are poorer and where families are more dispersed.

As mentioned earlier, there has been considerable rehabilitation of social infrastructure in rural Mozambique since the 1992 General Peace Accord. In the IAF sample of 634 villages, 68 percent of the villages report having a primary school. Of those schools that report a date of construction (82 percent of cases), 42 percent indicate that the school was built after the signing of the peace treaty. What determined the placement of these relatively new schools in rural areas of Mozambique? To evaluate the extent to which endogenous placement might bias the estimates of program effects, we compare the average characteristics of villages with a "recent" school (that is, one built after the war) to villages without a school, to see if village characteristics are sufficient to explain program placement.

Following Handa (2002), we define program exposure time as  $(1997 - t)$ , where  $t$  is the date the school was built in the village. The exposure time of villages that had a school built in the year of the survey (1996), for example, is thus 1, while villages without a school are given an exposure time of 0. The resulting variable is regressed on a set of village-level variables, including median village consumption expenditure, the proportion of household heads who are literate, the proportion of households with an adult member who completed EP2, and the proportion of households with a female adult who has completed EP1. Because geographic location is often an important determination of program placement, we also include the distance (in kilometers) to the district capital, and the distance to the nearest "good" road.

Ordered probit estimates of the village-level determinants of program exposure are presented in Table 6.12. Column 1 shows that none of the village-level socioeconomic

**Table 6.12 Ordered probit estimates of years since primary school was built in village**

	1		2	
	Coefficient	z-statistic	Coefficient	z-statistic
Median village consumption	0.000	(1.12)	0.000	(0.20)
Proportion of household heads literate	0.037	(0.14)	0.012	(0.04)
Proportion of households with female with EP1	0.017	(0.03)	0.279	(0.47)
Proportion of households with adult with EP2	0.129	(0.22)	-0.035	(0.06)
Distance to "good" road	-0.001	(0.84)	-0.001	(0.50)
Distance to district capital	-0.003	(0.60)	-0.008	(1.59)
Niassa			0.616	(1.44)
Cabo Delgado			1.397	(3.03)
Nampula			0.964	(2.44)
Zambézia			0.518	(1.32)
Tete			0.646	(1.55)
Manica			1.102	(2.67)
Sofala			0.771	(1.74)
Inhambane			0.312	(0.75)
Gaza			1.244	(2.85)
Log likelihood	-380		-374	
Observations		266		

Notes: Sample is villages that have no school or that had one built after 1991. Dependent variable equals 0 if village has no school, and equals  $(1997 - t)$  if it has a school, where  $t$  is the year the school was built.

status variables or the distance variables are able to predict school placement, as Mozambique's reconstruction began in 1992. Column 2 of Table 6.12 adds provincial dummy variables to the equation, and these results show some significant regional variation in program placement, but the village-level characteristics remain insignificant in determining placement.

Another way that parents can influence programs is by demanding better quality. Among recently constructed schools, are there systematic quality differences that vary by household characteristics? To answer this question, we must go up to the administrative post level, which is the lowest level at which we can merge school quality information with IAF villages. Now we select only those administrative posts that contain a recently (since 1991) constructed school and

examine whether school quality, measured by the average pupil/teacher ratio and the average proportion of teachers with training, vary according to the socioeconomic status of households in the administrative post.<sup>25</sup> The socioeconomic variables are the same as those used earlier for the village-level analysis, and as the level of aggregation is higher, we use average distance of villages in the administrative post to the provincial capital to capture geographic targeting.

Results of this analysis are presented in Table 6.13, and for either measure of school quality, the  $F$ -test at the bottom of the table fails to reject the null hypothesis that the set of socioeconomic status variables are jointly equal to 0. There is some indication (at the 10 percent significance level) that median consumption in the administrative post is *negatively* correlated with the pupil/teacher

<sup>25</sup>It is important to recognize that we cannot do this for all administrative posts. Administrative posts that have had schools for many years (high exposure) will probably also have higher rates of adult literacy and primary school completion, leading to a positive correlation between school placement or quality and household socioeconomic status.

**Table 6.13 Ordinary least-squares (OLS) estimates of determinants of school quality at the administrative post level**

	Proportion of teachers with training		Pupil/teacher ratio	
	Coefficient	z-statistic	Coefficient	z-statistic
Proportion of household heads literate	-0.043	(0.41)	-11.744	(1.34)
Proportion of households with adult with EP2	-0.139	(0.68)	-13.767	(0.81)
Proportion of households with woman with EP1	0.197	(1.21)	21.388	(1.57)
Median consumption of administrative post	0.000	(0.02)	0.002	(1.74)
Distance to provincial capital	0.000	(0.61)	0.034	(1.46)
Niassa	0.090	(1.19)	-28.619	(4.54)
Cabo Delgado	0.232	(2.77)	-36.078	(5.16)
Nampula	0.294	(4.09)	-25.574	(4.27)
Zambézia	0.188	(2.69)	-0.879	(0.15)
Tete	0.218	(2.79)	-19.038	(2.92)
Manica	0.259	(3.56)	-23.375	(3.85)
Sofala	0.340	(4.05)	-14.642	(2.10)
Inhambane	0.149	(2.07)	-9.368	(1.56)
Gaza	0.061	(0.77)	6.096	(0.91)
Constant	0.553	(6.77)	72.452	(10.64)
Adjusted $R^2$		0.30		0.60
$F$		2.63		9.17
$p$ -value for socioeconomic status variables		0.82		0.17
Observations (administrative posts)			102	

Notes: Sample is rural administrative posts with at least one school built after 1991. All variables are measured at the administrative post level, except for province dummies.

ratio (the higher the median consumption, the worse the ratio), while there continues to be significant variation across provinces in school quality.<sup>26</sup>

In cases where a massive expansion of infrastructure occurred at a particular point in time, as in rural Mozambique, older cohorts from the same village or area would have faced very different facilities, and can be used as a control group to check for pre-program heterogeneity (Duflo 2001). Given the rapid increase in schools since 1992, children ages 14–17 in the IAF would have been of primary school age in 1991, before

the Peace Accords, and would therefore have faced different school supply circumstances relative to children 7–11 years old in the IAF. Table 6.14 shows enrollment rates and grade attainment for these two cohorts across administrative posts that had large and small increases in school infrastructure between 1993 and 1996.<sup>27</sup> For each outcome, the pre-program difference (the difference across administrative posts for children 14–17 years old) is not statistically significant, which does not support the hypothesis of selective program placement. In the case of enrollment, the cross sectional difference

<sup>26</sup>The estimations of Table 6.13 were also performed on the proportion of all teachers who are female, the proportion of all teachers who are trained and female, and the proportion of female teachers who are trained. These results did not differ significantly from those in Table 6.13 and are consistent with the hypothesis that households are unable to influence the placement of these schooling resources.

<sup>27</sup>For children ages 14–17, current enrollment will be a function of previous enrollment, which would depend on access to a school.

**Table 6.14 Change in schooling outcomes across cohorts and by intensity of schooling construction**

Schooling outcome	Enrollment		Standardized grade attainment	
	No increase	Large increase	No increase	Large increase
Control (age 14–17) ( <i>N</i> = 2,290)	0.407 (0.49)	0.416 (0.49)	0.292 (0.27)	0.333 (0.29)
Treatment (age 7–11) ( <i>N</i> = 4,119)	0.433 (0.50)	0.532 (0.50)	0.298 (0.38)	0.372 (0.39)
First difference	0.026	0.116	0.006	0.039

Source: Reproduced from Handa (2002).

Notes: Standard deviation is shown in parentheses below mean. No (large) increase indicates administrative posts with less (more) than the median number of new schools built between 1993 and 1996. Standardized grade attainment is the current grade attainment as a proportion of ideal attainment, given age, and ranges from 0 to 1.

(among children 7–11 years old across high- and low-impact regions) is 0.099, while the difference-in-differences is virtually the same ( $0.116 - 0.026 = 0.09$ ); for grade attainment, the cross sectional difference (0.074) is higher than the difference-in-differences (0.033).

In conclusion, based on the discussions with administrators in the Mozambican MINED, and the results on the determinants of placement and quality of new schools in rural areas, it appears that very few, if any, of the program effects estimated in the following paragraphs represent unobserved household- or community-level demands for schooling.

### School Quality

Table 6.15 presents means and standard deviations for the school quality, efficiency, and access variables that are analyzed in this section. Table 6.16 shows selected probit marginal probability estimates of the impact of school quality on EP1 enrollment by gender in rural Mozambique. Column 1 of Table 6.16 presents the base estimates with quality measured by the number of trained teachers and the average administrative post

level pupil/teacher ratio; the latter is insignificant but the former is positive and significant, although the quantitative effect is small. Adding 10 more trained teachers will raise the probability of enrollment by 0.1 percentage points. On the other hand, the presence of a school in the village will raise the probability of enrollment by approximately 20 percentage points for both boys and girls.

When the total number of trained teachers is split into the number of male and female teachers and entered as two variables, only the number of male trained teachers is significant, possibly because there are so few trained female teachers (an average of 11 per administrative post, or roughly 11 percent of all teachers per region).<sup>28</sup> However, other indicators of the gender composition of the teaching staff seem to matter. Columns 2–4 of Table 6.16 replicate the base estimates with measures of the proportion of trained female teachers among all teachers, the proportion of all teachers who are female, and the proportion of all female teachers who are trained. Most of these alternative measures of gender composition and training are positive and significant determinants of

<sup>28</sup>The results based on number of male and female trained teachers entered separately are not shown, but are available from the authors on request.

**Table 6.15 Means and standard errors for school quality, efficiency, and access indicators**

	Mean	Standard error
Village has a school	0.699	0.031
Pupil/teacher ratio	64.882	1.311
Coverage or access indicators		
Number of EP1 schools	26.367	1.818
Number of concrete rooms	24.420	1.808
Village has an EP2 school	0.622	0.044
Village has a secondary school	0.221	0.033
Quality indicators		
Number of trained teachers	79.651	5.659
Number of female teachers as proportion of all teachers	0.073	0.005
Proportion of teachers who are women	0.074	0.005
Proportion of female teachers who are trained	0.141	0.010
Efficiency indicators		
Previous year's pass rate	0.636	0.003
Male pass rate	0.672	0.004
Female pass rate	0.562	0.004
Portuguese pass rate	0.654	0.004
Mathematics pass rate	0.673	0.004
Number of observations		4,465

**Table 6.16 Marginal impact of school quality indicators on EP1 enrollment**

	1		2		3		4	
	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls
Village has EP1 school	0.213 (6.02)	0.183 (5.13)	0.223 (6.37)	0.191 (5.39)	0.218 (6.25)	0.186 (5.26)	0.223 (6.33)	0.190 (5.37)
Pupil/teacher ratio	0.000 (0.31)	0.001 (1.14)	0.000 (0.12)	0.001 (1.09)	0.000 (0.12)	0.001 (1.08)	0.000 (0.12)	0.002 (1.37)
Number of trained teachers	0.001 (4.44)	0.001 (2.70)						
Trained female teachers/ all teachers			0.492 (2.46)	0.548 (2.71)				
Proportion of teachers who are female					0.335 (1.40)	0.445 (1.93)		
Proportion of female teachers who are trained							0.301 (2.82)	0.345 (3.20)
Number of observations	2,182	2,281	2,182	2,281	2,182	2,281	2,182	2,281

Notes: Sample is children 7–11 years old in rural Mozambique. Numbers shown are marginal probabilities derived from probit estimation, with absolute value of z-statistics, robust to sample design, in parentheses. School quality variables are measured at the administrative post level, except for presence of school in village. Control variables include household consumption; adult education; child's gender and age; household head's education, gender, and age; and provincial indicators.

enrollment, with the largest marginal effects coming from the variable measuring the proportion of trained female teachers among all teachers (column 2). The mean of this variable is 0.08; doubling this would increase enrollment by approximately 4 percentage points for both boys and girls. The mean proportion of female teachers across the administrative posts is 37 percent—taking this up to 50 percent would increase enrollment by four and six percentage points for boys and girls, respectively.

The recent participatory study sponsored by Oxfam (1999) reports that male teachers often force students to perform chores for them, such as fetching wood and water, and that parents are reluctant to send girls to school to be taught by male teachers. This is especially true in the heavily Muslim provinces of Cabo Delgado and Nampula, and may help explain the strong positive effect of female teachers reported in Table 6.16.

### School Efficiency

Table 6.17 presents probit marginal probability estimates of the impact of school effi-

ciency characteristics (measured by the pass rate of the previous year) on school enrollment. The total pass rate estimates in column 1 are not significant, but when male and female pass rates are disaggregated, female pass rates, but not male pass rates, appear to have a significant positive affect on enrollment probabilities. Moreover, the coefficient of the female pass rate variable is not statistically different across regressions. Raising the girls' pass rate to the level of boys (an increase of 11 percentage points) will raise the probability of enrollment by 12 percentage points for boys and 10 percentage points for girls. The reason why households would respond to the female pass rate and not the male pass rate is unclear. One explanation might be that the female pass rate is a better indicator of school quality because of girls' overall poorer performance in school.

The Oxfam (1999) participatory study of household attitudes toward children's schooling indicated that learning Portuguese and learning to "*fazer as contas*" (do accounting) are important motivations for sending children to school. Columns 3 and 4 in

**Table 6.17 Marginal impact of school efficiency indicators on EP1 enrollment**

	1		2		3		4	
	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls
Village has EP1 school	0.225 (6.47)	0.187 (5.17)	0.223 (6.40)	0.185 (5.14)	0.226 (6.51)	0.188 (5.20)	0.226 (6.51)	0.188 (5.20)
Previous year pass rate	0.409 (1.04)	-0.328 (0.78)						
Male pass rate			-0.326 (0.85)	-0.742 (1.68)				
Female pass rate			1.087 (3.15)	0.880 (2.57)				
Pass rate in Portuguese					0.497 (1.33)	0.085 (0.22)		
Pass rate in mathematics							0.556	0.010
Number of observations	2,182	2,281	2,182	2,281	2,182	2,281	2,182	2,281

Notes: Sample is children 7–11 years old in rural Mozambique. Numbers shown are marginal probabilities derived from probit estimation, with absolute value of  $z$ -statistics, robust to sample design, in parentheses. School efficiency variables are measured at the administrative post level, except for presence of school in village. Control variables include household consumption; adult education; child's gender and age; household head's education, gender, and age; and provincial indicators.

**Table 6.18 Marginal impact of school access indicators on EP1 enrollment**

	1		2		3	
	Boys	Girls	Boys	Girls	Boys	Girls
Village has EP1 school	0.198 (6.69)	0.160 (5.33)	0.204 (6.81)	0.165 (5.47)	0.199 (6.71)	0.161 (5.36)
Number of EP1 schools in administrative post	0.002 (1.91)	0.000 (0.11)			0.002 (1.84)	0.000 (0.04)
Number of concrete classrooms in administrative post	0.000 (0.46)	0.002 (2.01)			0.000 (0.49)	0.002 (1.93)
Administrative post has EP2			-0.026 (0.90)	-0.026 (0.85)	-0.041 (1.38)	-0.043 (1.35)
Administrative post has ESG or PRE			0.068 (1.95)	0.083 (2.19)	0.054 (1.47)	0.054 (1.37)
Number of observations	4,340	4,156	4,313	4,133	4,313	4,133

Notes: Numbers shown are marginal probabilities derived from probit estimation, with absolute value of *z*-statistics, robust to sample design, in parentheses. School access variables are measured at the administrative post level, except for presence of school in village. Control variables include household consumption; adult education; child's gender and age; household head's education, gender, and age; and provincial indicators.

Table 6.17 include the Portuguese language and mathematics subject pass rates as measures of schooling efficiency, but neither of these are significant determinants of EP1 enrollment in the sample.

### Coverage of the Educational System (Physical Access to School)

Estimation results using indicators of school access within the administrative post are reported in Table 6.18. The number of schools in the administrative post has a significant effect (at 10 percent) on boys' enrollment but not girls' enrollment (the *p*-value for the difference in effects is 0.04), while the number of concrete rooms has a significant effect on girls' but not boys' enrollment (the *p*-value for the difference is 0.08).<sup>29</sup> The possibility of further education within the administrative post also raises the probability of primary school enrollment. The coefficient in-

dicating whether the administrative post has a secondary school is significant for both girls and boys, with enrollment probabilities being approximately 9 percentage points higher for girls in administrative posts with at least one secondary school. Existence of an upper primary (EP2) school does not appear to increase enrollment probabilities, but the underlying data indicate that virtually every administrative post (all but one) with a secondary school also has at least one EP2 school, hence the secondary school indicator is picking up the effect of both EP2 and secondary schooling possibilities in the administrative post. When all school access variables are simultaneously included in the model (column 3), neither the EP2 nor secondary school variables are significant. (Although when secondary school is included without EP2, it is highly statistically significant.) Note that in column 3, the statistical significance of the number of EP1 schools

<sup>29</sup>Concrete school structures are probably picking up other dimensions of building or school quality, such as, for example, the availability of private toilets, which influences the enrollment of girls.

for boys (10 percent level of significance) and concrete rooms (for girls) is maintained.

### Interactions with Household Characteristics

The influence of community infrastructure, such as school quality, may be different in households with different characteristics. For example, the impact of a village school may be greater for richer households if these households are better able to take advantage of the school. On the other hand, richer households may be able to afford to send children away for schooling, in which case the impact of building a school in the village may actually be greater among poorer households, who otherwise would not have sent their children to study. The impact of community infrastructure on household behavior may also depend on the education of adults or parents, because of differences in preferences or access to information. In the child health literature, for example, the impact of the mother's education has been found to vary significantly with community characteristics such as sewerage and sanitation conditions (Thomas, Strauss, and Henriques 1991; Barrera 1990).

Both household income, measured by consumption per capita, and adult education significantly influence schooling choices in Mozambique, and school infrastructure also conditions these choices in rural areas. Does the impact of school infrastructure depend on household characteristics? Are certain households more likely than others to change their schooling decisions in response to variations in school infrastructure? These questions are addressed in this section using the approach pioneered by Birdsall (1985), in which the different school supply characteristics variables are allowed to interact with household adult education, measured by the literacy of the household head, and household income, to see if significant interactions do indeed exist between school supply and household characteristics. The interactions are tested

sequentially, first by interacting the school supply variables with the household head's literacy, and then by interacting the same variables with household log per capita consumption. Results are presented separately for each of the three dimensions of school supply—quality, efficiency, and access—in Tables 6.19–6.24.

Starting with school quality, Table 6.19 presents results of the interactions between each school quality indicator and the household head's literacy, while Table 6.20 presents the results of interactions with household consumption. For girls' enrollment, the impact of both the proportion of trained female teachers (at 10 percent significance level) and the proportion of female teachers depends on whether the household head is literate or not. The negative coefficient on the interaction term implies that these characteristics are substitutes, and therefore the impact of these dimensions of school quality are significantly greater among households where the head is *not* literate. For boys, there is a statistically significant (10 percent level) interaction between the head's literacy and presence of a school in the village, the negative coefficients implying that the presence of a school has a greater effect on inducing enrollment among boys from households where the head is not literate. The results for income in Table 6.20 also show some significant interactions. For both boys and girls, the presence of a school in the village and household income are substitutes; hence the positive impact of a school in the village will be *greater* among *poorer* households. The other significant interaction is between income and the proportion of trained female teachers in the administrative post for girls only, the positive coefficient in this case implying complementarity.

Table 6.21 presents results of the estimates of school efficiency indicators interacted with head's literacy, and in Table 6.22, with household consumption. There are no significant interactions among schooling ef-

**Table 6.19 Marginal impact of school quality indicators interacted with household head's literacy on EP1 enrollment**

	1		2		3		4	
	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls
Household head is literate	0.212 (1.81)	0.222 (2.33)	0.201 (1.72)	0.212 (2.26)	0.199 (1.69)	0.205 (2.14)	0.183 (1.57)	0.214 (2.26)
Village has EP1 school	0.268 (5.79)	0.210 (4.55)	0.274 (6.04)	0.224 (4.97)	0.268 (5.96)	0.215 (4.72)	0.274 (6.04)	0.221 (4.93)
<i>Village has school interacted with literate household head</i>	<i>-0.119 (1.94)</i>	<i>-0.062 (1.12)</i>	<i>-0.109 (1.84)</i>	<i>-0.073 (1.34)</i>	<i>-0.110 (1.82)</i>	<i>-0.065 (1.19)</i>	<i>-0.111 (1.88)</i>	<i>-0.070 (1.28)</i>
Pupil/teacher ratio (PTR)	0.000 (0.31)	0.001 (1.08)	0.000 (0.05)	0.001 (0.081)	0.000 (0.12)	0.001 (0.80)	0.000 (0.14)	0.001 (1.29)
<i>PTR interacted with household head literate</i>	<i>-0.000 (0.23)</i>	<i>-0.000 (0.06)</i>	<i>-0.000 (0.27)</i>	<i>0.000 (0.33)</i>	<i>-0.000 (0.11)</i>	<i>0.001 (0.38)</i>	<i>-0.000 (0.19)</i>	<i>-0.000 (0.04)</i>
Number of trained teachers	0.001 (3.17)	0.001 (3.01)						
<i>Number of trained teachers interacted with household head literate</i>	<i>0.000 (0.02)</i>	<i>-0.000 (0.94)</i>						
Trained women/(all teachers)			0.468 (2.01)	0.794 (3.27)				
<i>(Trained female teachers/all teachers) interacted with household head literate</i>			<i>0.096 (0.33)</i>	<i>-0.374 (1.82)</i>				
Proportion of teachers who are female					0.389 (1.50)	0.715 (2.52)		
<i>Proportion of teachers who are female interacted with household head literate</i>					<i>-0.018 (0.07)</i>	<i>-0.384 (2.05)</i>		
Proportion of female teachers who are trained							0.249 (1.97)	0.421 (3.35)
<i>Proportion of female teachers who are trained interacted with household head literate</i>							<i>0.127 (0.73)</i>	<i>-0.078 (0.62)</i>
Number of observations	2,182	2,281	2,182	2,281	2,182	2,281	2,182	2,281

Notes: Sample is children 7–11 years old in rural Mozambique. Numbers shown are marginal probabilities derived from probit estimation, with absolute value of *z*-statistics, robust to sample design, in parentheses. School quality variables are measured at the administrative post level, except for presence of school in village. Control variables include household consumption; adult education; child's gender and age; household head's education, gender, and age; and provincial indicators.

iciency, the household head's education, and household consumption. The negative and statistically significant coefficients for income interacted with the presence of an EP1 school in the village are consistent with those in Table 6.20. Building a school in the village will have a larger impact on the schooling efficiency of both girls and boys from poorer households than from richer ones.

The last set of estimates presents interactions among the presence of an EP1 school in the village, the household head's education, and household income, and these are reported in Tables 6.23 and 6.24. Significant interactions exist among several access indicators and household income. The positive impact of concrete classrooms on girls' enrollment is enhanced among richer

**Table 6.20 Marginal impact of school quality indicators interacted with household consumption on EP1 enrollment**

	1		2		3		4	
	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls
Log of p.c. consumption	0.093 (0.91)	-0.021 (0.23)	0.075 (0.73)	0.020 (0.22)	0.080 (0.78)	0.033 (0.34)	0.073 (0.73)	-0.021 (0.23)
Village has EP1 school	0.776 (2.45)	0.789 (3.55)	0.805 (2.71)	0.768 (3.37)	0.804 (2.67)	0.777 (3.43)	0.791 (2.61)	0.756 (3.27)
<i>Village has school interacted with consumption p.c.</i>	-0.107 (1.95)	-0.138 (3.09)	-0.117 (2.17)	-0.127 (2.87)	-0.117 (2.15)	-0.132 (2.95)	-0.111 (2.07)	-0.122 (2.77)
Pupil/teacher ratio (PTR)	-0.008 (0.74)	-0.013 (1.19)	-0.009 (0.81)	-0.007 (0.64)	-0.008 (0.69)	-0.009 (0.73)	-0.008 (0.75)	-0.012 (1.11)
<i>PTR interacted with consumption p.c.</i>	0.001 (0.75)	0.002 (1.36)	0.001 (0.77)	0.001 (0.79)	0.001 (0.66)	0.001 (0.87)	0.001 (0.74)	0.002 (1.31)
Number of trained teachers	0.003 (0.96)	-0.004 (1.57)						
<i>Number of trained teachers interacted with consumption p.c.</i>	-0.000 (0.65)	0.001 (1.83)						
Trained women/(all teachers)			0.989 (0.48)	-3.275 (1.74)				
<i>(Trained female teachers/all teachers) interacted with consumption p.c.</i>			-0.054 (0.22)	0.469 (2.07)				
Proportion of teachers who are female					0.224 (0.13)	-1.327 (0.78)		
<i>Proportion of teachers who are female interacted with consumption p.c.</i>					0.022 (0.10)	0.221 (1.09)		
Proportion of female teachers who are trained							0.193 (0.16)	-1.567 (1.53)
<i>Proportion of female teachers who are trained interacted with consumption p.c.</i>							0.014 (0.10)	0.240 (1.90)
Number of observations	2,182	2,281	2,182	2,281	2,182	2,281	2,182	2,281

Note: Sample is children 7–11 years old in rural Mozambique. Numbers shown are marginal probabilities derived from probit estimation, with absolute value of  $z$ -statistics, robust to sample design, in parentheses. School quality variables are measured at the administrative post level, except for presence of school in village. Control variables include household consumption; adult education; child's gender and age; household head's education, gender, and age; and provincial indicators.

households, given by the positive and significant coefficient on the interaction (column 3 of Table 6.24). For girls, there is also a significant interaction effect between the presence of an EP2 school in the administrative post and household income, with the

positive coefficient implying complementarity. This is probably attributable to the fact that richer households can better afford to send girls away to an EP2 school once the girls have completed EP1.

**Table 6.21 Marginal impact of school efficiency indicators interacted with household head's literacy on EP1 enrollment**

	1		2		3		4	
	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls
Household head is literate	-0.049 (0.14)	0.222 (0.74)	-0.060 (0.16)	0.160 (0.49)	-0.194 (0.59)	0.119 (0.38)	-0.087 (0.25)	0.108 (0.35)
Village has EP1 school	0.276 (6.27)	0.215 (4.68)	0.277 (6.28)	0.215 (4.75)	0.275 (6.27)	0.217 (4.75)	0.275 (6.22)	0.216 (4.74)
<i>Village has school interacted with literate household head</i>	<i>-0.110 (1.90)</i>	<i>-0.062 (1.12)</i>	<i>-0.116 (1.98)</i>	<i>-0.064 (1.18)</i>	<i>-0.105 (1.80)</i>	<i>-0.063 (1.15)</i>	<i>-0.104 (1.78)</i>	<i>-0.063 (1.14)</i>
Previous year pass rate	0.200 (0.41)	-0.329 (0.67)						
<i>Previous year pass rate interacted with literate household head</i>	<i>0.377 (0.70)</i>	<i>-0.031 (0.07)</i>						
Female pass rate			1.087 (2.72)	1.074 (2.72)				
<i>Female pass rate interacted with literate household head</i>			<i>-0.011 (0.03)</i>	<i>-0.385 (0.93)</i>				
Male pass rate			-0.539 (1.12)	-0.936 (1.73)				
<i>Male pass rate interacted with literate household head</i>			<i>0.386 (0.64)</i>	<i>0.388 (0.67)</i>				
Pass rate in Portuguese					0.237 (0.53)	0.047 (0.11)		
<i>Pass rate in Portuguese interacted with literate household head</i>					<i>0.583 (1.20)</i>	<i>0.130 (0.28)</i>		
Pass rate in mathematics							0.350 (0.82)	-0.029 (0.07)
<i>Pass rate in mathematics interacted with literate household head</i>							<i>0.402 (0.83)</i>	<i>0.141 (0.32)</i>
Number of observations	2,182	2,281	2,182	2,281	2,182	2,281	2,182	2,281

Notes: Sample is children 7–11 years old in rural Mozambique. Numbers shown are marginal probabilities derived from probit estimation, with absolute value of z-statistics, robust to sample design, in parentheses. School efficiency variables are measured at the administrative post level, except for presence of school in village. Control variables include household consumption; adult education; child's gender and age; household head's education, gender, and age; and provincial indicators.

**Table 6.22 Marginal impact of school efficiency indicators interacted with household consumption on EP1 enrollment**

	1		2		3		4	
	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls
Log consumption p.c.	0.125 (0.39)	0.488 (1.57)	0.115 (0.34)	0.588 (1.89)	0.122 (0.39)	0.205 (0.72)	0.231 (0.69)	-0.038 (0.13)
Village has EP1 school	0.812 (2.79)	0.762 (3.33)	0.826 (2.89)	0.769 (3.43)	0.807 (2.75)	0.763 (3.35)	0.812 (2.79)	0.759 (3.30)
<i>Village has school interacted with consumption p.c.</i>	-0.120 (2.25)	-0.126 (2.83)	-0.127 (2.36)	-0.129 (2.94)	-0.118 (2.21)	-0.126 (2.85)	-0.120 (2.25)	-0.124 (2.80)
Previous year pass rate	0.075 (0.02)	3.967 (1.02)						
<i>Previous year pass rate interacted with consumption p.c.</i>	0.038 (0.08)	-0.536 (1.13)						
Female pass rate			1.482 (0.42)	0.664 (0.19)				
<i>Female pass rate interacted with consumption p.c.</i>			-0.047 (0.11)	0.029 (0.07)				
Male pass rate			-1.053 (0.25)	4.805 (1.10)				
<i>Male pass rate interacted with consumption p.c.</i>			0.083 (0.16)	-0.693 (1.31)				
Pass rate in Portuguese					0.165 (0.04)	0.815 (0.24)		
<i>Pass rate in Portuguese interacted with consumption p.c.</i>					0.037 (0.08)	-0.090 (0.21)		
Pass rate in mathematics							1.510 (0.39)	-2.150 (0.61)
<i>Pass rate in mathematics interacted with consumption p.c.</i>							-0.121 (0.25)	0.267 (0.63)
Number of observations	2,182	2,281	2,182	2,281	2,182	2,281	2,182	2,281

Notes: Sample is children 7–11 years old in rural Mozambique. Numbers shown are marginal probabilities derived from probit estimation, with absolute value of z-statistics, robust to sample design, in parentheses. School efficiency variables are measured at the administrative post level, except for presence of school in village. Control variables include household consumption; adult education; child's gender and age; household head's education, sex, and age; and provincial indicators.

**Table 6.23 Marginal impact of school access indicators interacted with household head's literacy on EP1 enrollment**

	1		2		3	
	Boys	Girls	Boys	Girls	Boys	Girls
Household head is literate	0.170 (2.85)	0.211 (3.91)	0.164 (2.59)	0.202 (3.43)	0.160 (2.47)	0.215 (3.51)
Village has EP1 school	0.267 (6.02)	0.212 (4.61)	0.278 (6.24)	0.219 (4.71)	0.269 (6.03)	0.211 (4.55)
<i>Village has EP1 school interacted with literate household head</i>	<i>-0.110 (1.88)</i>	<i>-0.062 (1.12)</i>	<i>-0.115 (1.99)</i>	<i>-0.066 (1.19)</i>	<i>-0.111 (1.90)</i>	<i>-0.061 (1.09)</i>
Number of EP1 schools in administrative post	0.003 (2.83)	0.001 (0.79)			0.003 (2.57)	0.001 (0.64)
<i>Number of EP1 schools in administrative post interacted with literate household head</i>	<i>-0.001 (0.76)</i>	<i>-0.001 (0.86)</i>			<i>-0.001 (0.61)</i>	<i>-0.001 (0.74)</i>
Number of concrete classrooms in administrative post	-0.000 (0.17)	0.002 (2.23)			0.000 (0.09)	0.002 (2.47)
<i>Number of concrete classrooms in administrative post interacted with literate household head</i>	<i>0.002 (1.54)</i>	<i>0.000 (0.44)</i>			<i>0.001 (0.76)</i>	<i>0.000 (0.07)</i>
Administrative post has EP2			-0.011 (0.25)	-0.021 (0.44)	-0.036 (0.79)	-0.042 (0.90)
<i>Administrative post has EP2 interacted with literate household head</i>			<i>0.010 (0.18)</i>	<i>-0.024 (0.42)</i>	<i>0.011 (0.19)</i>	<i>-0.022 (0.38)</i>
Administrative post has secondary school			0.053 (0.98)	0.068 (1.41)	0.039 (0.69)	0.019 (0.39)
<i>Administrative post has secondary school interacted with literate household head</i>			<i>0.075 (1.20)</i>	<i>0.054 (1.03)</i>	<i>0.060 (0.89)</i>	<i>0.053 (0.88)</i>
Number of observations	4,340	4,156	4,313	4,133	4,313	4,133

Notes: Numbers shown are marginal probabilities derived from probit estimation, with absolute value of z-statistics, robust to sample design, in parentheses. School access variables are measured at the administrative post level, except for presence of school in village. Control variables include household consumption; adult education; child's gender and age; household head's education, sex, and age; and provincial indicators.

**Table 6.24 Marginal impact of school access indicators interacted with household consumption on EP1 enrollment**

	1		2		3	
	Boys	Girls	Boys	Girls	Boys	Girls
Log consumption p.c.	0.137 (2.22)	0.064 (1.24)	0.119 (1.93)	0.071 (1.25)	0.118 (1.82)	0.031 (0.56)
Village has EP1 school	0.813 (2.70)	0.802 (3.78)	0.796 (2.71)	0.769 (3.36)	0.807 (2.69)	0.807 (3.86)
<i>Village has EP1 school interacted with log of p.c. consumption</i>	-0.122 (2.20)	-0.145 (3.30)	-0.113 (2.16)	-0.128 (2.86)	-0.119 (2.18)	-0.148 (3.38)
Number of EP1 schools in administrative post	-0.007 (0.63)	-0.003 (0.32)			-0.005 (0.43)	0.000 (0.00)
<i>Number of EP1 schools in administrative post interacted with log of p.c. consumption</i>	0.001 (0.85)	0.000 (0.37)			0.001 (0.64)	0.000 (0.05)
Number of concrete classrooms in administrative post	0.006 (0.74)	-0.019 (2.00)			0.004 (0.46)	-0.024 (2.39)
<i>Number of concrete classrooms in administrative post interacted with log of p.c. consumption</i>	-0.001 (0.67)	0.003 (2.27)			-0.000 (0.39)	0.003 (2.64)
Administrative post has EP2			-0.243 (0.56)	-0.751 (2.22)	-0.231 (0.51)	-0.589 (1.55)
<i>Administrative post has EP2 interacted with log of p.c. consumption</i>			0.030 (0.55)	0.106 (2.15)	0.025 (0.44)	0.071 (1.43)
Administrative post has secondary school			0.283 (0.64)	0.140 (0.33)	0.330 (0.75)	0.672 (1.80)
<i>Administrative post has secondary school interacted with log of p.c. consumption</i>			-0.026 (0.46)	-0.006 (0.13)	-0.036 (0.62)	-0.092 (1.74)
Number of observations	4,340	4,156	4,313	4,133	4,313	4,133

Note: Numbers shown are marginal probabilities derived from probit estimation, with absolute value of  $z$ -statistics, robust to sample design, in parentheses. School access variables are measured at the administrative post level, except for presence of school in village. Control variables include household consumption; adult education; child's gender and age; household head's education, gender, and age; and provincial indicators.

## CHAPTER 7

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### Policy Simulations

**B**ased on the analytical framework and results from the previous chapter, we provide a set of policy simulations and cost-effectiveness results to illustrate the potential impact that different policy interventions can have on schooling outcomes in Mozambique. According to the Ministry of Education’s strategic plan, raising basic primary education levels is a priority for Mozambique, and so our main focus is on ways to increase primary school enrollment rates. We recognize that some policy interventions, such as improving school quality, may also affect grade attainment or efficiency, and so we provide some cost-effectiveness estimates for these indicators as well. The analysis is divided into two parts, and is motivated by two questions frequently discussed in the literature on schooling determinants in low-income countries. First, what is the relative importance of supply- vs. demand-side factors in determining children’s schooling outcomes? Second, on the supply side, is it more effective for governments to invest in quantity or quality?<sup>30</sup>

#### Demand vs. Supply

In this section, we compare the relative impact of demand-side vs. supply-side interventions on primary school enrollment rates in rural Mozambique. The simulations are based on the probit regressions for the determinants of current enrollment of children 7–11 years old in rural areas that were presented in Chapter 6. The school characteristics included in the model are the number of trained teachers and the pupil/teacher ratio, and the number of schools and concrete rooms in the administrative post. All of the household-level characteristics mentioned in the text are included in the model, as well as the variable indicating the presence of a school in the village. Because of Mozambique’s vast size and geographical and economic heterogeneity, we allow the impact of the hypothetical policy interventions to vary by province by interacting the policy variables with provincial dummy variables. We do not find systematic differences in the effect of policy interventions on boys’ and girls’ enrollment rates and so provide estimates for the full sample only.

The mechanics of the simulations are as follows. We estimate the base model for the school outcome of interest and use it to predict the mean outcome (by region)—this is the baseline. We then change the policy variables to reflect the simulation and use the estimated coefficients to predict the new mean outcome (by region). We report the percentage change in the mean outcome over the baseline (by region).

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<sup>30</sup>It is important to note that the simulations are static, not dynamic, and so do not capture any second-round general equilibrium effects. However, we do include indirect effects that occur concurrently, such as the indirect effect of travel time on all villages in an administrative post when a school is built in only one particular village.

### Supply-Side Simulations

The supply-side policy simulations consider the impact on enrollment rates of increasing the number of schools in rural areas in Mozambique. The IAF community questionnaire indicates that approximately 68 percent of rural villages have a basic (EP1 only) primary school, and the regression analysis shows that the presence of a school in the village is an extremely important determinant of children's enrollment. We calculate the increase in EP1 enrollment that would occur as a result of three separate interventions: (1) increasing the proportion of villages with EP1 schools to 79 percent, which implies building a school in 70 villages per province; (2) increasing the proportion of villages with EP1 to 89 percent, which implies building schools in 140 villages per province; and (3) increasing the EP1 coverage rate to 100 percent by ensuring that all villages have a primary school.

To capture the impact of school characteristics—and not just access—on enrollment, we assume that each school consists of three concrete rooms and employs two trained teachers. The addition of a school in a village will have a direct impact on the village and an indirect impact on all villages in the administrative post through the administrative post level variables: the number of schools, the number of concrete school rooms, and the number of trained teachers in the administrative post. These indirect effects at the administrative post level are accounted for in the policy simulations.

Results of these simulations are presented in Table 7.1, which also provides baseline figures for predicted enrollment (calculated from the probit estimates using the original survey data), and the EP1 coverage for each province, as well as nationally. The numbers in column 3, associated with the policy of increasing EP1 coverage to 79 percent, will

**Table 7.1 Policy simulations of impact of school supply investment on rural lower primary school (EP1) enrollment (percent)**

Region	Baseline characteristics		Percentage change in enrollment for each policy intervention		
	(1)	(2)	(3)	(4)	(5)
	Predicted enrollment	Proportion of villages with EP1 school	Policy 1: Build school in 70 villages per province	Policy 2: Build school in 140 villages per province	Policy 3: Build school in all villages
Niassa	37.3	75	5.5	10.9	18.2
Cabo Delgado	31.4	95	3.8	3.8	3.8
Nampula	49.4	73	6.3	12.0	14.0
Zambézia	41.2	54	5.7	16.5	29.0
Tete	38.1	52	8.8	21.9	34.7
Manica	40.9	67	5.0	14.5	17.9
Sofala	31.7	57	8.5	19.2	25.9
Inhambane	45.4	67	7.7	15.6	21.7
Gaza	71.3	91	1.7	1.7	1.7
Maputo Province	63.4	38	6.4	13.7	24.4
All Mozambique	44.0	67	5.8	13.0	19.3

Notes: The simulations are based on the assumption that each school consists of three concrete rooms, employs two trained teachers, and average class size in the administrative post is held constant. Column 1 gives the predicted enrollment for the base model without any simulation. Provincial differences are generated through interactions with province and number of schools in each administrative post, and province and whether village has a school.

increase overall enrollment by 6 percent, but with substantial regional variations. Sofala (9 percent), Tete (9 percent), and Inhambane (8 percent) Provinces would be the biggest beneficiaries of this intervention. Doubling the size of the intervention would roughly double the size of the impact. Constructing 140 more schools per province would increase overall enrollment by 13 percent, with the largest increases in enrollment occurring in Tete (22 percent), Sofala (19 percent), and Zambézia (17 percent) Provinces.

### Demand-Side Simulations

The impact of policy interventions designed to influence the demand-side (or household) characteristics are based on the same model used in the simulations presented earlier. Two types of interventions are simulated, one influencing household income (or consumption) and the other influencing adult education. The income-related interventions involve raising the per capita consumption of all households to at least the level of consumption of the 25th percentile of the per capita consumption distribution (2,494 meticaïcs per person per day in the IAF); the second policy is to raise all households to at least 3,584 meticaïcs, which is equal to the median per capita consumption level in the IAF. Because these interventions affect only poor households they will not be evenly distributed throughout the country. In particular, the poorer the province, the larger the share of households in the bottom quartile or bottom half of the per capita consumption distribution, and thus the larger the number of households that will be affected by the policy.

Columns 4 and 5 of Table 7.2 provide estimates of the percentage change in enrollment associated with the two income-related policy interventions described earlier. The overall (national) impact is to raise enrollment rates by 2 and 4 percent, respectively, for policies 1 and 2; these effects are smaller than the estimated enrollment effects of building more schools that were presented in Table 7.1. Note that the income policy im-

act is largest in Sofala and Inhambane, the two poorest provinces. This is attributable not only to the size of the coefficient on the province  $\times$  consumption interaction term, but also to the fact that more households in these provinces benefit from the policy.

Analysis presented earlier in this report has indicated that adult household education significantly conditions almost all aspects of household outcomes, including children's schooling. We simulate the impact on enrollment rates if all household heads in the bottom quartile of the per capita expenditure distribution were literate. As in the income case, the benefits of this intervention will not be distributed equally across provinces. Although poorer provinces have more eligible households, the policy affects only heads of household who are not literate and so the proportion of heads who are literate also matters.

Columns 6 and 7 of Table 7.2 present simulation results based on interventions that raise the literacy level of heads of household in the bottom portions of the per capita consumption distribution. The most important result is that the overall impact of this intervention is substantially larger than the income or school access interventions. Increasing literacy of heads in the bottom quartile would increase overall enrollment by 17 percent; increasing literacy of heads in the bottom half of the distribution would increase enrollment rates by 26 percent.

Once again there are substantial regional variations in the impact of adult education interventions on primary school enrollment. The biggest effects are estimated in Niassa (46 percent), Sofala (35 percent), Tete (29 percent), and Inhambane (28 percent). This is partly attributable to having more beneficiary households in these provinces: Inhambane and Sofala are the two poorest provinces, and Tete and Niassa have the lowest literacy rates for household heads.

### Cost-Effectiveness

The simulations presented above provide an idea of the overall benefit of different policy

**Table 7.2 Policy simulations of impact of household characteristics on rural lower primary school (EP1) enrollment (percent)**

	Percentage change in enrollment due to:						
	Baseline characteristics			Income policy		Adult education policy	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Region	Predicted enrollment	Median p.c. expenditure	Percent age of household heads literate	Policy 1: Bring p.c. consumption to 25th percentile	Policy 2: Bring p.c. consumption to median	Policy 3: Raise literacy rate to 100 percent among household heads in bottom quartile	Policy 4: Raise literacy rate to 100 percent among household heads in bottom two quartiles
Niassa	37.3	3,588	42	3.9	9.6	46.4	67.4
Cabo Delgado	31.4	4,441	40	-0.3	-1.5	18.0	25.9
Nampula	49.4	4,137	48	-0.6	-1.6	9.6	11.5
Zambézia	41.2	3,659	43	1.7	6.8	8.8	24.1
Tete	38.1	2,878	39	2.7	5.8	29.2	44.3
Manica	40.9	3,721	42	1.5	4.6	12.5	23.2
Sofala	31.7	2,064	49	7.8	13.0	34.7	39.7
Inhambane	45.4	2,643	46	4.6	11.0	28.4	37.8
Gaza	71.3	4,307	54	0.2	0.4	4.9	4.5
Maputo Province	63.4	3,396	52	-0.5	-124.0	13.1	20.3
All Mozambique	44.0	3,584	45	1.7	4.3	16.6	26.0

Notes: In column 4, the policy simulation is to bring all households in the bottom quartile up to the consumption of the 25th percentile (2,494 meticais). In column 5, the policy simulation is to raise consumption of all households below the median-to-median consumption (3,584 meticais). In column 6, the simulation is to make literate all heads of households in the bottom quartile of the p.c. consumption distribution. Column 7 is similar to column 6, except applied to all household heads below median consumption.

interventions without considering the cost of these same interventions. We have gathered approximate costs for adult literacy campaigns and school construction from NGOs working in the education sector in rural Mozambique. The cost of building a basic three-room concrete school in rural Mozambique is estimated to be US\$50,000. To this construction cost we include the cost (including administrative costs) of employing two teachers for 20 years, which according to the pay structure for teachers adds an additional US\$40,000 to the cost of a rural primary school. The policy simulation in column 3 of Table 7.1 calls for building 70 schools in each of the 10 rural provinces, at a cost of US\$90,000 per school, or a total cost of US\$63 million. Dividing this figure by the percentage increase in enrollment (6 percent) gives approximately US\$10.5 million per percentage point increase in enrollment.

Kulima, a local NGO that has provided adult literacy campaigns in rural Mozambique, estimates a total cost per adult of US\$30 for the delivery of a 1-year literacy program in a rural village. According to the IAF, and using population weights, there are approximately 490,000 illiterate heads of household in the bottom quartile (59 percent of household heads in the bottom quartile cannot read or write), and approximately 930,000 illiterate heads of household in the bottom two quartiles (54 percent of heads are illiterate among this group). Providing literacy training for the heads in the bottom quartile at a cost of US\$30 per person leads to a total cost of US\$14.7 million, which, when divided by the expected percentage increase in enrollment (18), yields US\$820,000 per percentage point increase in enrollment.<sup>31</sup>

Finally, using the (population weighted) figures for per capita household consumption in the IAF, we calculate the total amount of transfer required to bring all households

below the 25th percentile to a per capita household consumption exactly equal to consumption in the 25th percentile. This figure is US\$24 million per year, and when divided by the expected percentage increase in enrollment (2 percent—see column 4 of Table 7.2), yields US\$12 million per unit of expected benefit.

The approximate costs associated with each intervention, the estimated percentage increase in enrollment, and the ratio of the two are presented in Table 7.3. These estimates clearly show that adult literacy is the most cost-effective method of raising primary school enrollment in rural Mozambique. Even if we assume that half the impact of household heads' literacy represents preferences or ability, and therefore divide the estimated benefit of literacy campaigns by half, the resulting cost-effectiveness figures are still at least five times less expensive than the other policy interventions considered in this chapter.

### Quality vs. Quantity

Our next policy exercise addresses the question of quality vs. quantity in schooling investment. While the issue of school quality has been extensively studied and debated in the United States (see Hanushek 1995 for a review), the policy question in developing countries such as Mozambique is different, because these countries often have a substantial portion of the school-aged population that is not being served by the school system. In Mozambique, for example, primary school enrollment is less than 50 percent. The debate in the United States on “what school inputs matter” is therefore relevant only up to a certain point, as many poorer countries are still faced with the challenge of getting children into school in the first place. On the other hand, for those children who are in school, quality characteristics

<sup>31</sup>The cost-effectiveness analysis does not take into account the income foregone (opportunity cost) of adults as a full social cost-benefit analysis would.

**Table 7.3 Cost-effectiveness of supply- and demand-side interventions**

Intervention	1	2	3	4
	Unit cost (\$)	Total cost (\$ million)	Benefit <sup>a</sup>	Effectiveness (2)/(3) (\$ million)
Build 70 schools per province	90,000	63.0	6	10.5
Build 140 schools per province	90,000	126.0	13	9.7
Bring households to 25th percentile <sup>b</sup>	292	24.0	2	12.0
Bring households to 50th percentile <sup>b</sup>	552	91.0	4	22.8
Literacy to household heads in bottom quartile	30	14.7	17	0.9
Literacy to household heads in bottom two quartiles	30	27.9	26	1.1

<sup>a</sup> Percent increase in enrollment taken from Tables 7.1 and 7.2.

<sup>b</sup> Average per household for 1 year.

such as trained teachers and textbooks may be motivational, and serve to keep children in school longer and improve their overall level of knowledge. Budget-constrained governments obviously must pay attention to both quality and school access or coverage, but the balance between these two types of investments is likely to be different in developing countries than in richer countries where enrollment is universal, especially in the lower levels.

In this chapter, we simulate a set of quality and quantity type investments in school supply in Mozambique, and assess their impact on schooling indicators. Because school quality is likely to benefit those children already in school by keeping them in school longer and by improving their learning environment, we simulate the impact of the interventions not just on school enrollment rates, but also on overall grade attainment and schooling efficiency. These last two variables are achievement variables, in that they measure the level of schooling achieved by the child, and the time it took the student to attain that level.<sup>32</sup>

The econometric approach is essentially the same as that described in Chapter 6, and the same estimation issues arise here, namely selection bias, because only a subset of school-age children ever attend school, and censored dependent variables for those children still in school at the time of the survey. We use the same approach for these simulations, estimating sample selection models, single-limit generalized tobit models that take right censoring into consideration, and generalized two-limit tobit models that incorporate both left and right censoring of the achievement variables.

Two modifications to the approach are required for these simulations. First, because we are interested in both enrollment and attainment, we expand our sample of children to 7–14 years of age to allow for more variation in grade attainment and schooling efficiency. Second, the efficiency variable has modes at 0.5 and 1.0 because children age 7 or 8 who have attended school can mathematically have efficiency scores of only 0.5 or 1.0. This problem arises by construction and not from any flaw in the data. We can

<sup>32</sup>In the economics of education literature “achievement” typically refers to test scores and not to grade attainment or efficiency as done here.

obtain a distribution for this variable that more closely approximates normal by simply dropping the 7- and 8-year-old children from our sample when estimating the model for school efficiency, and this is what is presented.

Using the estimated models described in the preceding, we simulate the impact on schooling outcome of a set of independent interventions aimed at increasing school access and school quality. For the sample selection model, we adopt a variation on the approach of Alderman et al. (1996). This model is estimated in two stages, first by simulating the impact on the probability that a child will be sent to school, and then multiplying the simulated probability of ever attending school by the simulated highest grade attained and school efficiency. For example, the simulated impact of policy  $p$  on the highest grade attained is estimated as:

$$E(\hat{G}_p) = E(\hat{E}_p) \cdot E(\hat{G}_p | \hat{E}_p) \quad (9)$$

where  $E(\hat{G}_p)$  is the mean predicted years of schooling completed (across the entire 7- to 14-year-old population) following implementation of the policy,  $E(\hat{E}_p)$  is the mean predicted probability of a child in that age group ever enrolling in school following implementation of the policy, and the final term is the mean predicted years of school completed conditional on the child ever enrolling in school. A similar exercise is carried out for schooling efficiency, for policy interventions aimed at increasing quantity, quality, and both. We also compare these simulated benefits to estimates of the associated costs to give the reader and Mozambican policymakers an idea of the cost-effectiveness of the different types of interventions considered in the simulations.

### Policy Variables

We use three key variables as our proxies for school quality and school quantity. School quality is measured as the the pupil/teacher ratio (PTR) in the administrative

post, while quantity is measured on the basis of the number of lower primary schools in the administrative post, and a dummy variable indicating whether the household has a school within a 1-hour walking distance. This latter variable comes directly from the community module of the IAF, while the former two indicators are taken from the MINED database. We use the PTR in the same spirit as Case and Deaton (1999), that is, as a general measure of school quality, recognizing that it is likely to be correlated with other aspects of school quality such as building conditions, access to books, and so forth. Therefore, the results on the PTR that we present in this chapter should not be interpreted as the impact on educational outcomes of the PTR per se, but as the impact of school quality more generally. The control variables in the regression models are the same as those described previously.

### School Quality and the Pupil/Teacher Ratio

To what extent does the PTR represent school quality in general? We assess this by presenting regression estimates of the correlates of the PTR. For each lower primary school in the MINED data, we construct several other indicators of school quality and regress them against the PTR and a set of provincial dummy variables. These estimates, presented in Table 7.4, show that a lower PTR is associated with better school resources more generally in rural Mozambique. In column 1 of Table 7.4, schools with higher PTRs also tend to have more than one shift, fewer concrete classrooms as a proportion of all classrooms, larger class sizes, and more students per number of classrooms in the school. Schools with high PTRs also tend not to have a secondary school in the same administrative post. The one exception to this pattern of better resources at schools with lower PTRs is the proportion of teachers in the school who are trained, which is positively correlated with

**Table 7.4 School-level determinants of pupil/teacher ratio (PTR)**

Dependent variable	(1)	(2)	(3)
	PTR	Log(PTR)	Log(PTR)
School has more than one shift	12.352 (10.22)	0.211 (13.90)	0.185 (11.87)
Proportion of rooms concrete	-6.971 (6.37)	-0.106 (7.70)	-0.108 (7.90)
Proportion of trained teachers	7.151 (5.16)	0.071 (4.10)	0.079 (4.58)
Administrative post has secondary school	-5.496 (5.27)	-0.075 (5.75)	-0.084 (6.45)
Class size	1.309 (27.92)	0.020 (33.35)	
Pupils per room	0.048 (4.52)	0.001 (4.06)	
Log(class size)			0.081 (5.92)
Log(pupils per room)			0.817 (30.39)
Province indicators			
Cabo Delgado	(7.64) -14.872 (5.47)	(10.97) -0.272 (7.99)	(10.49) -0.261 (7.69)
Nampula	-21.471 (7.96)	-0.333 (9.86)	-0.343 (10.18)
Zambézia	-0.514 (0.21)	-0.051 (1.65)	-0.062 (2.01)
Tete	-9.744 (3.58)	-0.220 (6.46)	-0.220 (6.48)
Manica	-11.913 (4.10)	-0.182 (5.01)	-0.185 (5.13)
Sofala	-8.308 (2.79)	-0.145 (3.88)	-0.145 (3.90)
Inhambane	-10.241 (4.04)	-0.148 (4.65)	-0.152 (4.83)
Gaza	4.903 (1.84)	0.034 (1.02)	0.040 (1.21)
Constant	0.526 (0.16)	3.180 (75.20)	0.688 (7.06)
Number of observations	2,928	2,928	2,928
Adjusted $R^2$	0.44	0.53	0.54

Notes: Sample is all (lower) primary schools in rural areas. Absolute values of  $t$ -statistics are shown in parentheses. Method of estimation is ordinary least-squares.

the PTR.<sup>33</sup> Columns 2 and 3 of Table 7.4 provide results with the PTR in log form (column 2), and then the PTR, class size, and pupils per classroom entered in log form.

These two models improve the overall fit of the regressions by 10 percentage points, and the individual coefficients and  $t$ -statistics tell the same general story—the PTR is

<sup>33</sup>This is consistent with a policy that gives trained teachers larger classes.

**Table 7.5 Probit estimates for ever having attended school**

	Coefficient	z-statistic	$dP/dX$
Female household head	0.180	2.94	0.070
Household head's age in years	0.006	2.96	0.002
Log consumption per capita	0.139	1.72	0.055
Residual of log consumption per capita	0.147	1.65	0.058
Household head is literate	0.384	8.04	0.150
Adult in household completed EP2	0.479	5.43	0.178
Female adult in household completed EP1	0.443	4.92	0.166
Child is female	-0.337	9.20	-0.132
Child's age (7 excluded)			
8	0.302	4.55	0.116
9	0.469	6.86	0.175
10	0.627	9.88	0.230
11	0.834	12.34	0.291
12	0.891	11.57	0.308
13	0.869	11.62	0.298
14	0.960	12.72	0.323
School less than 60 minutes away (dummy)	0.754	8.59	0.292
Number of schools in administrative post	0.005	3.26	0.002
Pupil/teacher ratio (PTR)	-0.001	0.35	0.000
Provincial dummies (Niassa excluded)			
Cabo Delgado	-0.018	0.11	-0.007
Nampula	0.368	2.18	0.140
Zambézia	0.283	1.51	0.109
Tete	0.366	2.12	0.139
Manica	0.429	2.39	0.161
Sofala	0.052	0.29	0.020
Inhambane	0.198	1.08	0.077
Gaza	0.809	3.84	0.283
Maputo Province	0.786	4.21	0.273
Constant	-2.988	4.21	
Number of observations	6,385		

Notes: Sample is children 7–14 years old in rural Mozambique. The z-statistic is robust to sample design.  $dP/dX$  is marginal probability derived from probit estimation.

correlated with other dimensions of school quality in lower primary schools in rural Mozambique.

### School Quality and Quantity

Probit coefficient estimates, and respective mean probability derivatives, of the probability of ever having attended school are shown in Table 7.5, using the sample of children 7–14 years old and the policy variables described earlier in this chapter. The school supply results show that quantity is more important than school quality in determining a child's chances of ever attending school. Enrollment probability does not vary

according to the mean PTR in the administrative post, but does vary significantly according to the number of schools in the post, as well as the distance to the nearest school. Living within a 1-hour walk of a school raises the chance of going to school by 29 percentage points, while adding 10 more schools to the administrative post raises the probability of ever having attended by 2 percentage points.

Table 7.6 presents econometric estimates of the determinants of the highest grade attained, using the sample of children 7–14 years old who ever attended school. We control for selection bias by including the inverse

**Table 7.6 Heckman selection model estimates of determinants of highest grade**

	Model 1		Model 2	
	Coefficient	z-statistic	Coefficient	z-statistic
Female household head	0.048	0.67	0.089	1.29
Household head's age in years	0.003	1.25	0.004	1.94
Predicted log per capita consumption (urban and rural)	0.269	3.29	0.298	3.67
Household head is literate	-0.079	0.95	0.013	0.17
Adult in household completed EP2	0.114	0.91	0.242	2.09
Female adult in household completed EP1	0.054	0.48	0.168	1.66
Child's age (7 excluded)				
8	0.215	2.85		
9	0.330	3.55		
10	0.557	4.96		
11	0.655	4.49		
12	0.974	6.18		
13	1.316	8.53		
14	1.620	9.40		
Age (years)	0.256	12.92		
Child is female	0.093	1.30	0.010	0.16
School less than 60 minutes away (dummy)	-0.405	2.75	-0.244	1.89
Number of schools in administrative post	-0.002	1.36	-0.001	0.59
Pupil/teacher ratio (PTR)	-0.009	3.29	-0.009	3.30
Provincial dummies (Niassa excluded)				
Cabo Delgado	-0.292	1.45	-0.301	1.48
Nampula	-0.188	0.85	-0.111	0.51
Zambézia	0.213	0.89	0.254	1.05
Tete	0.149	0.63	0.219	0.93
Manica	-0.324	1.34	-0.239	1.00
Sofala	0.511	2.16	0.533	2.25
Inhambane	0.564	2.39	0.595	2.51
Gaza	-0.481	1.65	-0.297	1.05
Maputo Province	-0.238	0.84	-0.066	0.23
Inverse Mills ratio	0.992	4.40	0.665	3.61
Constant	-0.740	1.02	-2.980	3.91
Observations		3,503		
$R^2$	0.3334		0.3301	

Notes: Sample is children aged 7–14 years in rural Mozambique who ever attended school. Inverse Mills ratio is calculated from the probit estimation reported in Table 7.5.

Mills ratio calculated from the first-stage probit. In each of the two models tested, the inverse Mills ratio is significant, indicating that the characteristics of the children who ever attended school are systematically different from those who never attended.

Estimates in column 1 show that school quality matters in the determination of the highest grade attained. The PTR is highly significant and negative; reducing the PTR by one standard deviation (approximately

17) would raise average grade attainment by 0.14 years (or roughly 6 percent at the mean). Notice that having a school within a 1-hour walking distance and having more schools in the administrative post are negatively associated with grade attainment. It turns out that in the select sample of children who once attended school, only 10 percent do not live within a 1-hour walking distance of a school (recall from Table 7.5 that this indicator is a significant determinant of

ever attending school and thus being in this select sample). When the model in column 1 is estimated over all children, the coefficients of the two quantity variables become positive and statistically significant.<sup>34</sup> Note also that if all children who entered school did so at the appropriate starting age, and moved to the next grade each year, the difference in the coefficients of adjacent age dummy variables would be 1. In column 1, this difference is 0.1 between ages 8 and 9, and is largest between ages 12 and 13 (0.34). In column 2, age is entered linearly and this has an effect on the school supply variables. The (negative) impact of living within 60 minutes of a school is reduced by half, while the other school supply coefficients remain the same.

Table 7.7 presents the generalized tobit results for the estimated effects of school quality on highest grade completed. Columns 1 and 2 show the single-limit tobit model, using the sample of children 7–14 years old who ever attended school. The censoring point is specified as the current grade of the student for those still in school at the time of the survey; thus, it varies from student to student. The magnitude and significance of several coefficients are markedly different than in the selection model. For example, the presence of a school within a 1-hour walking distance is positive and significant, most likely because it is picking up the role of school proximity in the school enrollment decision (recall from Table 7.5 that this variable is a significant determinant of ever enrolling in school). Conversely, the PTR is not significant in the single-limit generalized tobit, because the PTR has no effect on the enrollment decision, thus dampening the positive effect of the PTR on grade attainment that is observed in the selection model. In the two-limit generalized tobit estimation (columns 3 and 4), which uses observations on all children 7 to

14 years old, the pattern of the school supply variables is similar to that seen in the single-limit generalized tobit. The main exception is that the number of schools in the administrative post is a positive and significant determinant of grade attainment in this model.

Table 7.8 presents the second-stage estimates of the determinants of schooling efficiency (multiplied by 100), controlling for ever enrolling in school. For this outcome as well, school quality matters. The coefficient on the PTR is negative and highly significant, and the value of its coefficient implies that a one-standard-deviation decline in the PTR will raise schooling efficiency by about 5 percentage points (9 percent, at the mean). Note that efficiency declines rapidly (about 8 percentage points per year) between ages 9 and 11, then slows to a decline of 2 percentage points, on average, per year, which is driven mostly by the larger proportion of children who started school late, or who repeated a year, in the older age groups. In column 2, we show the specification in which age is treated linearly. Once again, the coefficient for residing within a 1-hour walking distance of a school diminishes by half in this specification, while the other two coefficients (for the number of schools in the administrative post and the PTR) remain the same.

Table 7.9 shows the generalized tobit estimates of the effect of school quality on efficiency. As with the grade attainment estimates, controlling for right censoring but not sample selection (columns 1 and 2) yields positive and significant coefficients for school proximity, and coefficients for PTR that are not significantly different from zero. Again, this is likely because of sample selection bias. The pattern of the two-limit generalized tobit (columns 3 and 4) is also similar to that observed in the grade attainment regressions.

<sup>34</sup>Alderman et al. (1996) also report school quality indicators to be negatively correlated with student achievement in their “select” sample of children who attend school in Pakistan.

**Table 7.7 Generalized tobit estimates of determinants of highest grade**

	Right-censored tobit				Two-limit tobit			
	Model 1		Model 2		Model 1		Model 2	
	Coefficient	<i>t</i> -statistic	Coefficient	<i>t</i> -statistic	Coefficient	<i>t</i> -statistic	Coefficient	<i>t</i> -statistic
Female household head	0.392	1.65	0.404	1.70	2.955	4.07	2.940	4.06
Household head's age in years	0.007	0.96	0.007	0.99	0.086	3.89	0.087	3.95
Predicted log per capita consumption (urban and rural)	0.240	0.97	0.232	0.93	1.731	2.35	1.785	2.43
Head is literate	0.453	2.36	0.464	2.42	6.230	9.34	6.136	9.25
Adult in household completed EP2	1.627	4.87	1.635	4.89	7.805	6.78	7.653	6.67
Female adult in household completed EP1	0.992	3.49	0.996	3.50	6.900	6.79	6.823	6.74
Child's age (7 excluded)								
8	-0.850	0.93			4.691	4.52		
9	-1.815	2.07			7.223	6.50		
10	-1.621	1.89			9.574	8.68		
11	-1.741	2.03			12.575	10.22		
12	-1.814	2.12			13.157	10.76		
13	-2.106	2.45			12.096	9.66		
14	-2.074	2.43			12.799	10.40		
Age (years)			-0.159	3.33			1.784	12.53
Child is female	-0.778	4.57	-0.785	4.61	-5.310	9.14	-5.223	9.05
School less than 60 minutes away (dummy)	1.378	5.53	1.373	5.51	12.120	12.43	12.094	12.44
Number of schools in administrative post	0.005	0.96	0.005	0.94	0.080	4.92	0.077	4.74
Pupil/teacher ratio (PTR)	-0.002	0.25	-0.002	0.26	-0.009	0.40	-0.009	0.42
Provincial dummies (Niassa excluded)								
Cabo Delgado	-2.974	4.88	-2.935	4.82	-1.792	1.39	-1.674	1.30
Nampula	-1.592	2.71	-1.561	2.66	4.942	4.21	5.098	4.34
Zambézia	-1.497	2.43	-1.472	2.40	3.701	2.81	4.081	3.10
Tete	-0.971	1.58	-0.972	1.59	5.241	4.11	5.340	4.19
Manica	-1.711	2.82	-1.702	2.81	5.622	4.26	5.675	4.30
Sofala	-2.071	3.42	-2.066	3.37	-0.050	0.04	-0.043	0.03
Inhambane	-1.569	2.59	-1.541	2.55	2.331	1.84	2.557	2.02
Gaza	-1.630	2.57	-1.598	2.53	10.934	7.05	11.02	7.11
Maputo Province	-1.487	2.40	-1.467	2.38	10.919	7.12	10.932	7.15
Constant	6.177	2.63	6.276	2.76	-43.022	6.45	-53.063	7.71
Number of observations	3,503		3,503		6,385		6,385	

Notes: For right-censored tobit, the sample is children 7–14 years old who ever attended school. For two-limit tobit, the sample is all children 7–14 years old.

### Quality and Quantity Simulations

Using these econometric results as a basis, we now explore the expected outcomes from a set of plausible actions that the government can take to increase school enrollment and improve school achievement. Five policy interventions are considered. Simula-

tion 1 is a 25 percent reduction in the PTR. Simulation 2 models the opening of an EP1 school in every village that does not have a school at present. Simulation 3 is a less ambitious, but targeted version of simulation 2, in which new schools are built only in villages that do not have a school within

**Table 7.8 Heckman selection model estimates of determinants of schooling efficiency**

	Model 1		Model 2	
	Coefficient	z-statistic	Coefficient	z-statistic
Female household head	1.099	0.74	2.099	1.44
Household head's age in years	0.069	1.42	0.103	2.15
Predicted log per capita consumption (urban and rural)	5.330	3.11	6.057	3.53
Household head is literate	-0.085	0.05	2.196	1.39
Adult in household completed EP2	1.208	0.49	4.326	1.88
Female adult in household completed EP1	4.003	1.84	6.825	3.33
Child's age (9 excluded)				
10	-7.793	5.40		
11	-15.471	8.21		
12	-17.182	8.82		
13	-19.045	9.21		
14	-20.113	9.36		
Age (years)			-3.285	9.31
Child is female	1.051	0.70	-1.029	0.70
School less than 60 minutes away (dummy)	-7.235	2.43	-3.205	1.15
Number of schools in administrative post	-0.032	0.91	0.001	0.01
Pupil/teacher ratio (PTR)	-0.195	3.50	-0.192	3.41
Provincial dummies (Niassa excluded)				
Cabo Delgado	-7.062	1.71	-7.445	1.77
Nampula	-2.631	0.59	-0.812	0.18
Zambézia	4.901	1.04	5.517	1.15
Tete	4.106	0.87	5.757	1.21
Manica	-4.885	1.02	-2.998	0.63
Sofala	9.463	1.97	9.791	2.05
Inhambane	11.295	2.44	11.939	2.57
Gaza	-5.704	0.96	-1.642	0.28
Maputo Province	-1.742	0.31	2.449	0.43
Inverse Mills ratio	13.508	3.11	5.531	1.41
Constant	19.958	1.35	38.370	2.45
Observations			2,814	
$R^2$		0.1547		0.1441

Notes: Sample is children 9–14 years old in rural Mozambique who ever attended school. Inverse Mills ratio is calculated from the probit estimation reported in Table 7.5.

a 1-hour walking distance. In simulation 4, new schools are opened in 56.4 percent of the villages that do not have schools, with the villages selected at random; 56.4 percent was chosen because it yields the same number of new schools as simulation 3, the difference being that the intervention in simulation 4 is not targeted. Finally, simulation 5 models a combination of quality and quantity interventions, combining simulations 1

and 3. Changes in the number of schools are simulated by varying the values of the variable for the number of schools in the administrative post and the dummy variable for the presence of an EP1 school within a 1-hour walking distance.

The choice of model to use as the basis for the simulations is guided by our wish to report separately on the effects of school supply on matriculation rates and achievement,

**Table 7.9 Generalized tobit estimates of determinants of schooling efficiency**

	Right-censored tobit				Two-limit tobit			
	Model 1		Model 2		Model 1		Model 2	
	Coefficient	<i>t</i> -statistic	Coefficient	<i>t</i> -statistic	Coefficient	<i>t</i> -statistic	Coefficient	<i>t</i> -statistic
Female household head	4.466	1.33	4.647	1.38	40.801	2.97	41.839	3.05
Household head's age in years	0.177	1.71	0.176	1.70	1.448	3.42	1.450	3.42
Predicted log per capita consumption (urban and rural)	4.443	1.26	4.763	1.35	38.980	2.76	38.496	2.73
Household head is literate	6.786	2.49	6.877	2.52	110.534	8.77	111.175	8.83
Adult in household completed EP2	18.134	3.92	18.077	3.89	117.407	5.34	116.318	5.30
Female adult in household completed EP1	16.497	4.12	16.189	4.04	122.511	6.20	122.203	6.19
Child's age (9 excluded)								
10	-8.052	1.55			32.784	2.02		
11	-20.839	4.10			78.623	4.42		
12	-27.221	5.52			84.314	4.80		
13	-39.156	7.89			62.087	3.34		
14	-43.152	8.99			70.117	3.88		
Age (years)	-8.840	11.75			13.439	4.40		
Child is female	-10.366	4.29	-10.512	4.34	-99.580	8.92	-98.430	8.86
School less than 60 minutes away (dummy)	17.128	4.88	16.945	4.82	197.370	11.38	196.644	11.37
Number of schools in administrative post	0.072	0.97	0.070	0.96	1.429	4.52	1.402	4.44
Pupil/teacher ratio (PTR)	-0.128	1.22	-0.125	1.19	0.041	0.10	0.042	0.10
Provincial dummies (Niassa excluded)								
Cabo Delgado	-44.683	5.14	-45.154	5.20	-29.977	1.19	-27.691	1.10
Nampula	-21.627	2.57	-21.916	2.61	71.971	3.16	72.592	3.19
Zambézia	-17.703	2.01	-18.331	2.09	67.300	2.62	70.190	2.74
Tete	-11.470	1.31	-11.929	1.36	106.494	4.31	106.797	4.32
Manica	-24.301	2.81	-25.120	2.91	96.682	3.76	97.939	3.82
Sofala	-26.469	3.01	-26.339	3.00	-8.051	0.32	-9.199	0.36
Inhambane	19.157	2.22	-19.448	2.26	25.422	1.04	26.912	1.10
Gaza	-22.166	2.45	-22.736	2.51	174.360	5.82	175.723	5.87
Maputo Province	-19.662	2.23	-20.118	2.29	166.977	5.83	166.248	5.82
Constant	93.924	3.00	170.475	5.24	-669.363	5.33	-765.256	5.85
Number of observations	2,814		2,814		4,634		4,634	

Notes: For right-censored tobit, the sample is children 9–14 years of age who ever attended school. For two-limit tobit, the sample is all children 9–14 years of age.

as specified in equation (9). Although enrollment and achievement are no doubt related, they have different policy implications, especially as MINED policy is to increase equity of educational opportunities, and move toward universal primary education. For the simulations, we discard the two-

limit tobit, because it does not permit separation of the enrollment and achievement components. Although the right-censored generalized tobit permits some separation of the enrollment and achievement components, the fact that the selection effect is embedded in the achievement coefficients also

**Table 7.10 Simulations of investments in educational quality and quantity**

Simulation	Mean change (percent)				
	Probability of ever attending school	Highest class completed		Schooling efficiency	
		All children	School attendees	All children	School attendees
1. Reduce pupil/teacher ratio by 25 percent	0.85	9.22	8.30	7.92	7.01
2. Build a school (EP1) in every village that does not have a school	12.86	10.47	-2.12	11.95	-0.81
3. Build a school (EP1) in every village that does not have a school within 1 hour's walking distance	11.18	9.16	-1.82	10.28	-0.81
4. Build a school (EP1) in 56.4 percent of villages that do not have schools <sup>a</sup>	9.09	7.54	-1.42	8.45	-0.59
5. Build a school (EP1) in every village that does not have a school within 1 hour's walking distance, and reduce pupil/teacher ratio by 25 percent	12.06	19.31	6.47	19.00	6.19

<sup>a</sup> This is an untargeted version of simulation 3.

makes it a less than ideal choice. We opt to base the simulations on the results obtained using the selection model, but also note the results obtained with the right-censored generalized tobit.<sup>35</sup>

Table 7.10 shows the results of these simulations, presented as the percentage change from the base scenario in the mean value of the three outcome variables: the probability of ever attending school, the number of years of school successfully completed, and schooling efficiency. Recall from equation (9) that for the latter two measures, there are two mechanisms for improvement. One is through improved schooling efficiency and more years completed by those already in the school system,

while the other is through increases in school enrollment. Table 7.10 presents two sets of results for the mean change in school achievement. One is the global (unconditional) estimated mean change for the entire population between ages 7 and 14, and the other is the (conditional) estimated mean change, which considers only that portion of the age group who has ever attended school (as per the simulation).

The first striking finding is that improving school quality alone (simulation 1) has almost no impact on the probability of attending school, but a significant positive impact on school achievement for those who do enroll, raising the average number of years successfully completed by 9 percent

<sup>35</sup>Both of the generalized tobit estimators assume that the error terms are distributed normally, and are very sensitive to deviations from normality, which is another motivation for choosing the selection model results, which are more robust.

and average schooling efficiency by 8 percent. In contrast, the three quantity-oriented interventions<sup>36</sup> (simulations 2–4) have a much larger impact on the probability of a child ever enrolling in school. The increases in enrollment shown in Table 7.10 correspond to increasing the enrollment rate from the 53 percent that prevailed during the IAF survey period to between 58 percent and 60 percent. This large increase in enrollment leads to significant increases in average school achievement for the 7- to 14-year-old age group, even though the impact on mean achievement among school attendees is slightly negative. The negative impact on mean school achievement could be a result of attracting new students who are less capable, less motivated, or have less supportive home environments than the students already in the school system. In simulations 2–4, the unconditional percentage increases in schooling efficiency are greater than the increase seen in the quality-only intervention (simulation 1), whereas the increases in the average number of years completed in simulations 2–4 are in the same neighborhood as the increase seen in simulation 1. Not surprisingly, the combined quality-plus-quantity simulation (simulation 5) yields results that are approximately equal to the sum of the results of its two components (simulations 1 and 3).

Simulations 2 through 4 reveal the critical role of targeting in the placement of new schools. Building schools in the villages that are currently the most poorly served (simulation 3) yields improvements in school achievement that are almost as strong as building a school in every village that does not have a school (simulation 2), even though the latter implies building, equipping, and staffing nearly twice as many

schools. Likewise, targeting school placement to areas that are poorly served at present has a much larger impact on school enrollment and achievement than random allocation of an equal number of schools among all villages without schools (simulation 4).

The simulations were also conducted using the right-censored generalized tobit model, combined with the probability of enrollment results from the selection model. In terms of equation (9), we use the same  $E(\hat{E}_p)$  term as in the selection model, and use the generalized tobit results for the  $E(\hat{G}_p | \hat{E}_p)$  term. In effect, this gives extra weight to the interventions that boost enrollment rates (the school quantity variables), so it is not surprising that—compared to the selection model—this approach yielded a larger impact on school achievement for simulations 2–4, and a smaller impact for simulations 1 and 5.<sup>37</sup>

### Cost-Effectiveness

One of the three key elements that determine the size of the changes shown in Table 7.10 is the magnitude of the change in the independent variables in the simulation (the other two are the size and sign of the estimated regression coefficient and the proportion of the population affected by the simulation). Simulation 5 clearly yields the best outcomes, but at the cost of what additional resources, relative to the other simulations presented? In this section, we estimate, and compare, the cost of achieving the results in the five policy simulations presented here. The estimated costs of building rural primary schools are the same as those presented earlier in this chapter. We follow the same format by assuming that each school carries with it the cost of two teachers for a 20-year

<sup>36</sup>These simulations also imply hiring new teachers, as the pupil/teacher ratio is assumed to be held constant in simulations 2–4.

<sup>37</sup>These results are not presented here, but are available from the authors on request.

**Table 7.11 Estimates of the total costs of interventions**

Simulation	Increase <sup>a</sup>		Unit cost (US\$) <sup>b</sup>	Component cost (\$ million)	Total cost (\$ million)
1. Reduce pupil/teacher ratio by 25 percent	5,167	Teachers	19,200	99	99
2. Build a school (EP1) in every village that does not have a school	2,364	Schools	50,000	118	169
	2,669	Teachers	19,200	51	
	167,993	Students			
3. Build a school (EP1) in every village that does not have a school within 1 hour's walking distance	1,334	Schools	50,000	67	111
	2,309	Teachers	19,200	44	
	145,337	Students			
4. Build a school (EP1) in 56.4 percent of villages that do not have schools	1,333	Schools	50,000	67	103
	1,882	Teachers	19,200	36	
	118,454	Students			
5. Build a school (EP1) in every village that does not have a school within 1 hour's walking distance, and reduce pupil/teacher ratio by 25 percent	1,334	Schools	50,000	67	227
	8,347	Teachers	19,200	160	
	160,114	Students			

<sup>a</sup> Assumes that there are no villages with more than one EP1 school. The number of additional teachers is based on the predicted increase in the number of students, maintaining the sample pupil/teacher ratio.

<sup>b</sup> Teacher costs reflect the cost of employing one teacher over a period of 20 years.

period. With this information we estimate the cost of implementing each of the simulations, specifying that the new schools built, and the additional students attracted by these new schools, will be matched by enough additional teachers to preserve the current PTR.<sup>38</sup> The cost calculations are shown in Table 7.11.

As the simulations typically involve varying more than one variable at a time (for example, building new schools will change both the number of schools in the administrative post and the proportion of households who have a school within a 60-minute walk), we cannot simply divide the intervention cost by the relevant regression coefficient, as in Tan, Lane, and Coustere (1997). Instead, the total cost estimates in the final column of Table 7.11 are divided

by the percentage increases in school enrollment and achievement shown in Table 7.10 to arrive at the estimated cost per unit of benefit, which is shown in Table 7.12. These results show that in the context of present-day Mozambique, investing in school quantity (access) is a much more cost-effective mechanism for increasing school enrollment than is investing in school quality. For school achievement, investments in school quantity are also slightly more cost-effective in raising average schooling efficiency, whereas investments that focus on school quality appear to be marginally more cost-effective in improving the average number of years successfully completed. If the cost of training the new teachers required for these interventions were included, the advantages of the quantity-oriented

<sup>38</sup>Simulations 2–4 all indicate that the growth in enrollment will be slower than the growth in numbers of schools. Therefore, assuming a constant current pupil/teacher ratio implies an increase in the ratio of teachers per school.

**Table 7.12 Estimated costs per unit of benefit**

Simulation	Cost of a 1 percent increase in outcome (over 20 years) (US\$ million)		
	Probability of ever attending school	Highest class completed	Schooling efficiency
1. Reduce pupil/teacher ratio by 25 percent	116	11	13
2. Build a school (EP1) in every village that does not have a school	13	16	14
3. Build a school (EP1) in every village that does not have a school within 1 hour's walking distance	10	12	11
4. Build a school (EP1) in 56.4 percent of villages that do not have schools <sup>a</sup>	11	14	12
5. Build a school (EP1) in every village that does not have a school within 1 hour's walking distance, and reduce pupil/teacher ratio by 25 percent	19	12	12

approach would be even greater than is shown in Table 7.12. Similarly, lengthening the time horizon for teacher costs, or increasing teacher salaries (which might be required to attract additional teachers) also

reinforces the finding that, at this juncture in Mozambique, focusing on school quantity is more cost-effective than focusing on school quality.<sup>39</sup>

<sup>39</sup>When the simulations are conducted using the right-censored generalized tobit models, the greater cost-effectiveness of the school quantity-oriented interventions is even more pronounced.

## CHAPTER 8

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### Conclusions and Policy Implications

#### Summary of Results

**P**resent educational levels in Mozambique are extremely low, which may be attributed to four major factors: low levels of investment in human capital during the colonial period, the large-scale withdrawal of Portuguese settlers at the time of independence, severe disruptions to the educational system during the 16-year civil war that followed independence, and only modest school enrollment rates since the war ended in 1992. Against this backdrop of conflict, migration, and destruction of infrastructure, it is reasonable to ask whether education, which is often seen as a key investment area for poverty reduction in other countries, can be expected to have the same impact in Mozambique. The results from this study show that the role of education is just as strong in Mozambique, if not stronger, than in other developing countries in determining the health, education, and material well-being of households.

In all the outcomes analyzed in this report, both monetary and nonmonetary, the role of adult educational levels is found to be highly significant and quantitatively important. Moreover, the role of adult literacy, especially female adult literacy, is most influential in rural areas of Mozambique. For example, the probability of completing all vaccinations and the probability of having a health card are all highly correlated with female educational levels in rural areas. For nutritional status in urban areas, household income appears to matter the most, with estimated income effects that are double those in rural areas.

The importance of adult schooling is also established for monetary well-being. Literacy of the household head is associated with an increase in per capita household consumption of 19 percent in urban areas, compared to only 6 percent in rural areas. However, in rural areas, more comprehensive measures of adult schooling—such as the completion of grade 7 or secondary school by any adult in the household—have larger impacts on per capita expenditure compared to urban areas. This might be attributable to the notion of the household as a production unit that is common among agricultural households in developing countries. The more rigorous analysis of child schooling outcomes also shows adult education to be one of the most important factors influencing school decisions in both rural and urban areas, with quantitative differences depending on the region of residence. For both the initial decision to send a child to school and the child's performance in school (as measured by grade attainment and efficiency), adult literacy has a larger impact in urban than in rural areas, but higher levels of adult schooling (EP2) and women's schooling have larger effects in rural areas.

Gender and income are also interesting and important determinants of the schooling choice of households. In rural areas, income does not appear to play a large role in the enrollment decision, but gender does—boys are more likely to be sent to school, and once in school, they are

more likely to be kept in school longer and proceed more quickly through the system. On the other hand, in urban areas, gender differences among current school attendees are not significant. Here the crucial factor after adult education is household well-being or income: better-off households are much more likely to send their children to school, and more likely to keep them there. The estimated income effects are often four times larger in urban areas than in rural ones.

The analysis of the impact of school characteristics on primary school enrollment in rural Mozambique indicates that dimensions of school quality, access or availability, and efficiency all work to stimulate enrollment, although the effects are small and differ somewhat by gender of the child. School quality, measured by the number of trained teachers in the administrative post, has a positive and significant impact on enrollment, but the gender composition of the teaching staff appears to be more important in the household decision to send children to school. Both the simple proportion of teachers who are female and the share of trained female teachers among all teachers are important positive determinants of enrollment rates. Raising the proportion of female teachers in the administrative post from 0.37 to 0.50 is associated with an increase in enrollment rates of roughly 5 percentage points. Both school efficiency and availability also have gender-differentiated effects on enrollment rates. For efficiency, raising the female pass rate to the level of boys raises enrollment for boys and girls by 12 and 10 percentage points, respectively, although the overall pass rate and the boys' pass rate do not significantly affect enrollment rates. Finally, the presence of an EP1 school in the village increases enrollment for both sexes by approximately 20 percentage points, and the impact of school availability is enhanced for girls if the school is built with concrete.

There is some evidence of interactions between school supply indicators and household characteristics. In terms of policy, the

most interesting of these is the negative effect of the interaction between presence of a school in the village and household income on both boys' and girls' enrollment. This implies that the two factors are substitutes—construction of a village school will increase enrollment by more among poorer households. The other notable interactions are between concrete classrooms, female teachers, and household income. Here the estimated interactions are positive, implying that richer households will benefit from these interventions more than poorer ones (complementarity).

### **Policy Implications**

The principal policy implications of the results presented in this research report pertain to the potential social and economic benefits of improving education, particularly women's education, in rural areas. Adult schooling brings an important private benefit to households in terms of higher levels of income and consumption, but it also brings important benefits to society in terms of children's health, nutritional status, and schooling. For these nonmonetary outcomes, women's schooling in rural areas is especially important, with estimated impacts that are usually larger than those associated with literacy of the household head. Adult literacy campaigns in rural areas may help to generate these improvements in well-being in the near future, but equally important is raising schooling levels among the current population of school-age girls.

The analysis of the household schooling choices shows that in rural areas, girls continue to receive less education than boys. Given the observation in the previous paragraph, an immediate and important policy intervention that will reap major social and private benefits in the future is to devise strategies to increase female enrollment and retention in primary school.

The importance of household income in determining primary school enrollment in urban areas is also of policy concern and

deserves attention. This result is no doubt driven by the opportunity cost of time of young children, especially after age 10, which is related to overall household poverty. In urban areas, policies should be directed at reducing the dropout rates of children age 10 years and older by finding ways to relax the monetary constraint faced by households. Incentives such as school lunch programs, free tuition, and free uniforms or supplies may have roles to play here.

The comparison of the impact of demand- vs. supply-side interventions on primary school enrollment rates indicates that in rural Mozambique, demand-side interventions will have a greater impact on enrollment rates than supply-side factors. On the demand side, it is the education levels of adult household members that seem most important in stimulating child enrollment. An example is the simulation that associates increased literacy (to 100 percent) among the heads of the poorest 25 percent of households with an increase of 17 percent in rural primary school enrollment, with the largest increases occurring in the provinces of Niassa and Sofala. In contrast, building 70 more schools in each province is associated with raising rural school enrollment rates by only 6 percentage points, and bringing per capita consumption of the poorest consumption quartile up to 2,494 meticaís per day would raise rural enrollment by a mere 2 percentage points. When relative costs are considered, the intervention of improving adult literacy appears to be 10 times less expensive than the alternatives.

Of course, adult literacy as measured in our analysis probably represents literacy attained in school, which might have a more profound effect on attitudes and value than adult literacy programs. Nevertheless, even if the estimated benefit of adult literacy campaigns is overstated twofold, this intervention still appears as five times more cost-effective than cash transfers or schooling infrastructure. In general, given that the results are based only on a single study using cross-sectional data, a prudent approach might be to experiment with alternative interventions—such as literacy campaigns, cash transfers conditional on schooling, school supply investments—on a small-scale basis in different regions before developing a national program. Such an approach is feasible in Mozambique, given the strength of NGO and donor presence in different districts throughout the country.

On the supply side, the analysis of alternative investments in schooling infrastructure shows that given present conditions, increasing primary school access through the well-targeted placement of schools in rural communities is the most cost-effective way of increasing overall primary school enrollment, especially among the poorest households, as income and school access are estimated to be substitutes. However, these results are based on maintaining current pupil/teacher ratios. The deterioration of school quality may not influence the initial enrollment decision of households, but will affect grade attainment and schooling efficiency, which are also important educational goals for Mozambique.

## APPENDIX A

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### **Supplementary Tables**

**Table A.1 Full results for instrumenting equation for log consumption per capita**

Variable	Urban		Rural		
	Coefficient	Standard error	Coefficient	Standard error	
Highest educational level in household					
Some primary	-0.090	0.063	-0.057	0.022	
EP1	-0.032	0.049	-0.016	0.021	
EP2	0.058	0.049	0.110	0.029	
Secondary or higher	0.281	0.058	0.350	0.096	
Household has electricity	0.302	0.046			
Household has piped water	0.057	0.041			
Area of farmland	-0.014	0.004			
Age of head of household	-0.005	0.001	-0.003	0.001	
Male-headed household	0.088	0.037	-0.051	0.018	
Log of cluster median consumption per capita	0.705	0.034	0.911	0.013	
Monthly dummy variables:					
January	-0.011	0.054	March 1996	0.081	0.052
February	0.013	0.055	April 1996	-0.010	0.035
March	-0.113	0.035	May 1996	0.060	0.036
April	-0.128	0.045	June 1996	0.037	0.038
May	0.029	0.045	July 1996	0.060	0.035
June	0.017	0.046	August 1996	0.038	0.039
July	-0.046	0.069	September 1996	0.064	0.038
August	0.053	0.063	October 1996	0.018	0.033
October	-0.017	0.049	November 1996	0.055	0.036
November	0.040	0.060	December 1996	0.042	0.037
December	0.002	0.035	January 1997	0.060	0.034
			February 1997	0.039	0.037
			March 1997	0.017	0.038
			April 1997	0.078	0.035
Provincial dummy variables:					
Niassa	-0.119	0.047		-0.037	0.026
Cabo Delgado	-0.165	0.077		0.012	0.023
Nampula	-0.162	0.052		-0.037	0.021
Zambézia	-0.177	0.029		-0.038	0.021
Tete	-0.155	0.064		-0.048	0.024
Manica	-0.021	0.035			
Sofala	-0.133	0.058		-0.106	0.027
Inhambane	-0.137	0.051		0.016	0.026
Gaza				0.038	0.024
Maputo Province	-0.104	0.045		0.004	0.027
Maputo City	-0.119	0.039			
Constant	2.711	0.298		0.946	0.126
Number of observations		2,439			5,811
Number of strata		11			10
Number of PSUs		271			234
<i>F</i>		113.43			289.39
Prob > <i>F</i>		0.000			0.000
<i>R</i> <sup>2</sup>		0.4290			0.4231
Adjusted <i>R</i> <sup>2</sup>		0.4219			0.4219
Root MSE		0.66325			0.53569

**Table A.2 Survey statistics, by estimation samples**

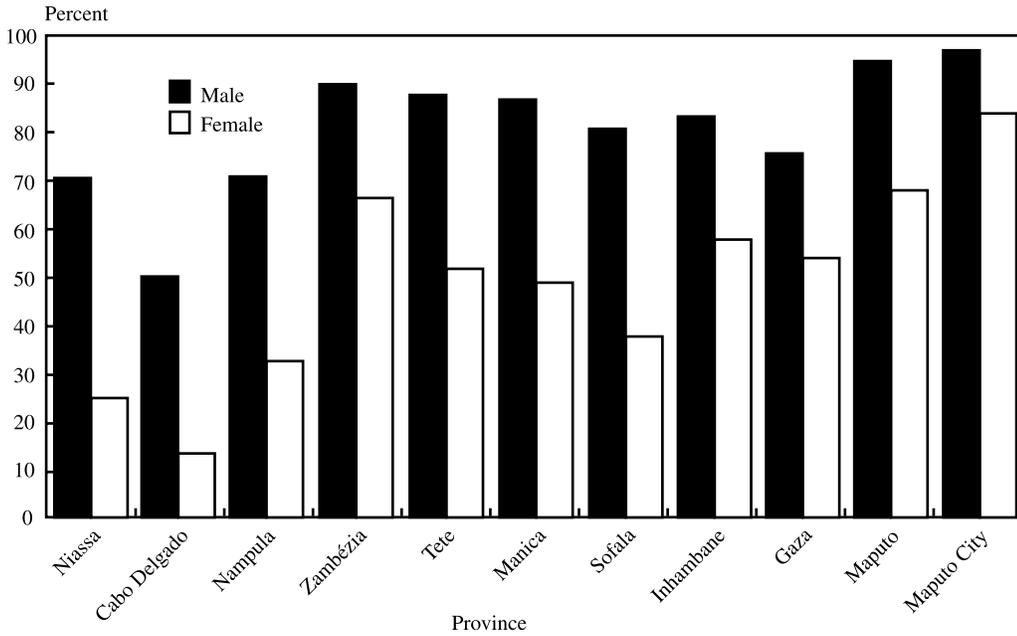
Strata	Number of PSUs	Number of observations	Number of observations per PSU		
			Minimum	Mean	Maximum
Full sample					
Niassa	23	2,991	93	130.0	201
Cabo Delgado	27	3,006	91	111.3	173
Nampula	25	4,384	122	175.4	296
Zambézia	24	3,965	135	165.2	278
Tete	21	3,101	88	147.7	252
Manica	23	3,494	109	151.9	219
Sofala	24	4,311	135	179.6	416
Inhambane	26	4,101	101	157.7	256
Gaza	19	3,729	115	196.3	396
Maputo Province	22	4,184	95	190.2	446
Maputo City	37	5,503	101	148.7	245
	271	42,769	88	157.8	446
Children 0–60 months					
Niassa	23	606	19	26.3	52
Cabo Delgado	27	598	11	22.1	44
Nampula	25	824	15	33.0	62
Zambézia	24	659	10	27.5	50
Tete	21	661	16	31.5	63
Manica	23	731	21	31.8	48
Sofala	24	823	18	34.3	90
Inhambane	26	701	13	27.0	41
Gaza	19	630	17	33.2	63
Maputo Province	22	719	10	32.7	82
Maputo City	37	817	7	22.1	43
	271	7,769	7	28.7	90
Children 7–17 years old					
Niassa	23	908	24	39.5	62
Cabo Delgado	27	755	17	28.0	47
Nampula	25	1,336	30	53.4	99
Zambézia	24	1,264	36	52.7	103
Tete	21	1,073	27	51.1	72
Manica	23	1,073	27	46.7	76
Sofala	24	1,324	31	55.2	125
Inhambane	26	1,255	15	48.3	97
Gaza	19	1,135	30	59.7	119
Maputo Province	22	1,297	32	59.0	147
Maputo City	37	1,772	24	47.9	78
	271	13,192	15	48.7	147

## APPENDIX B

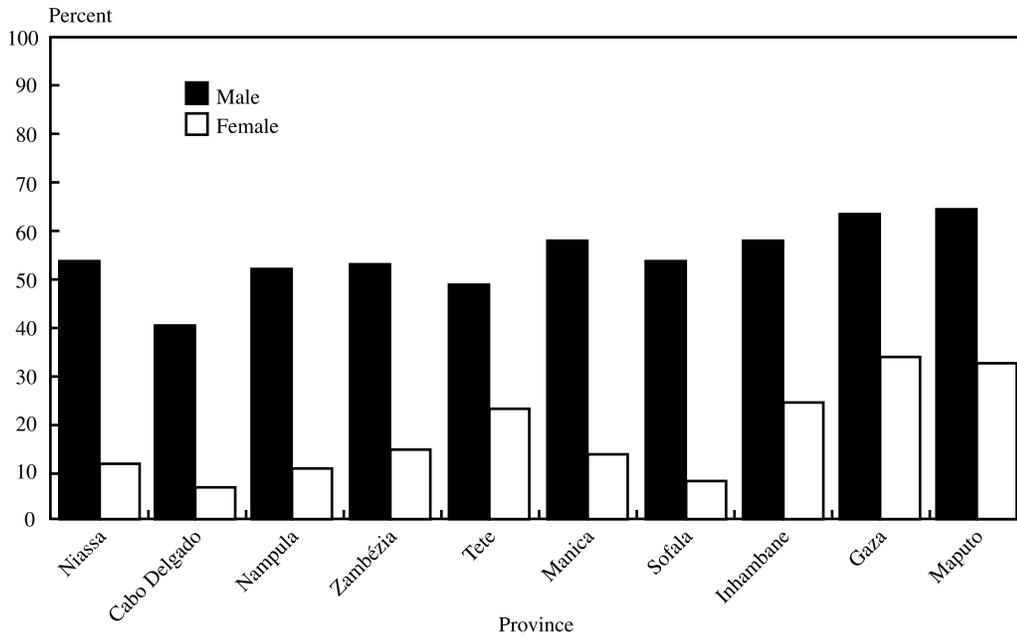
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### **Supplementary Figures**

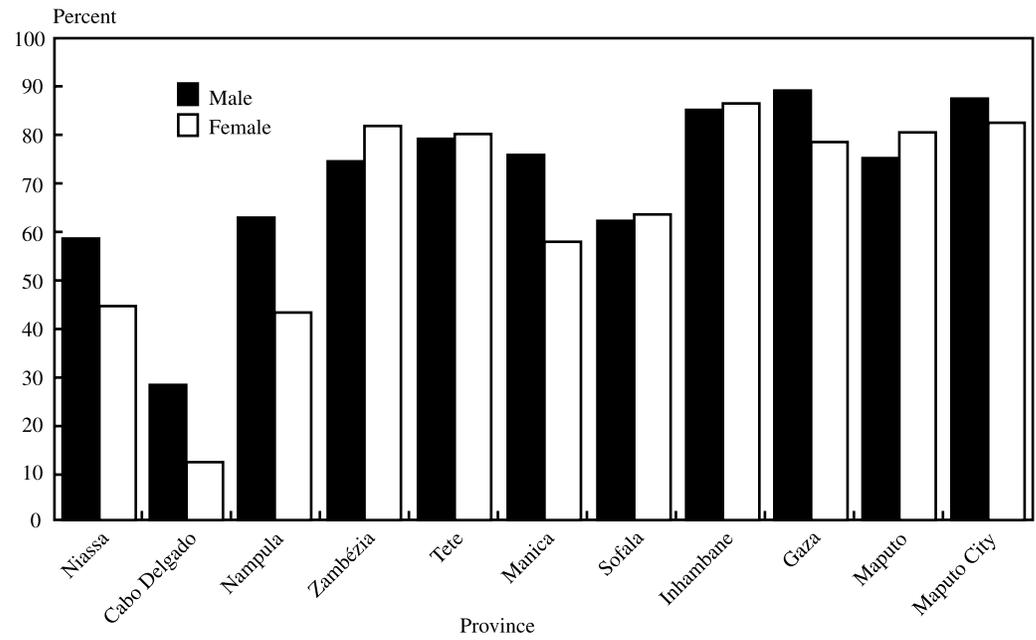
**Figure B.1 Urban literacy rates for adults 18–65 years old**



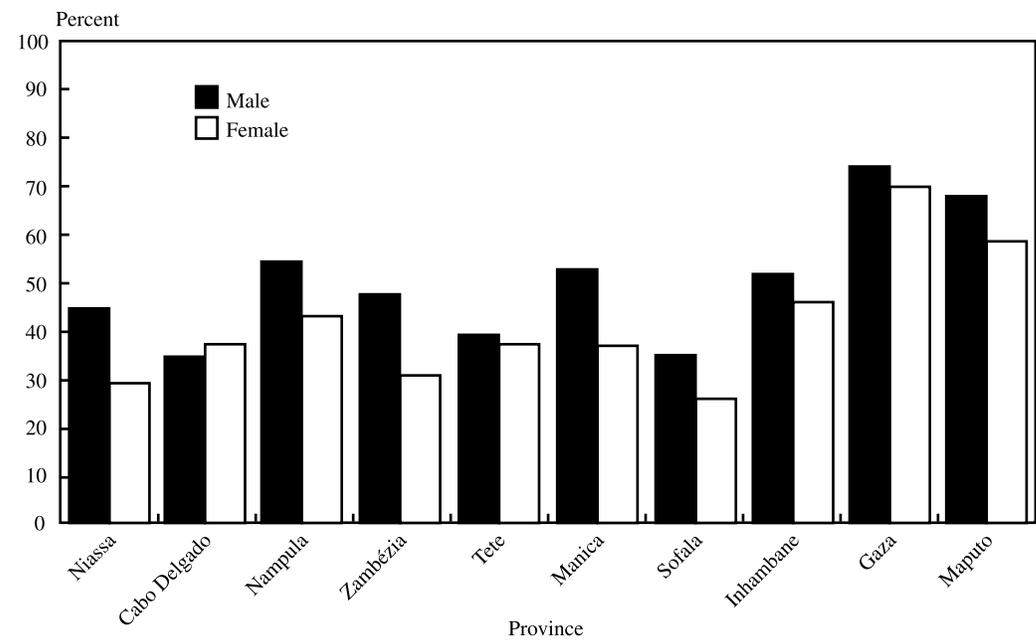
**Figure B.2 Rural literacy rates for adults 18–65 years old**



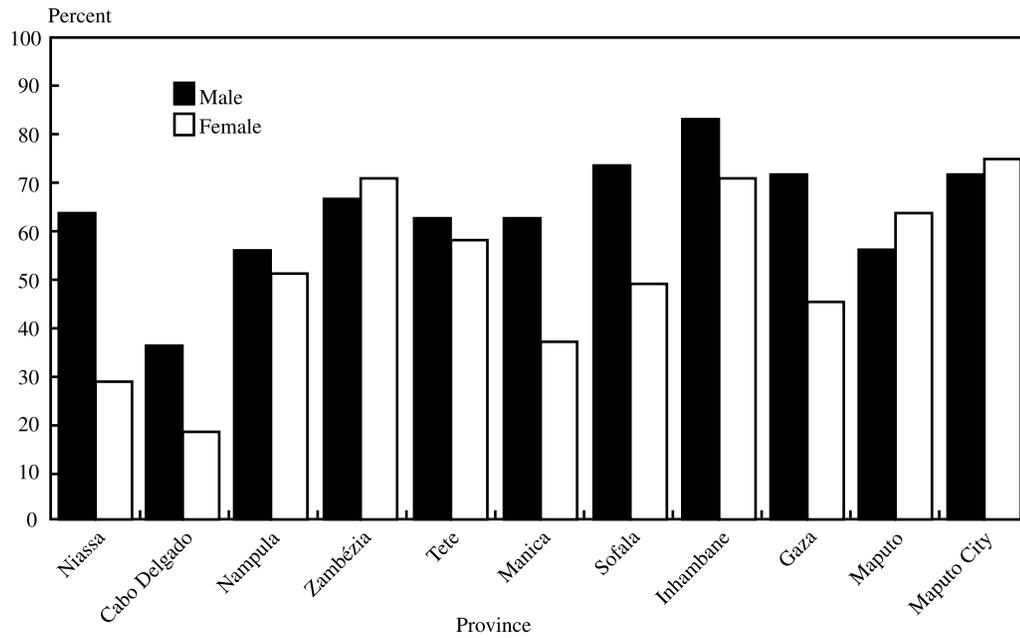
**Figure B.3 Urban enrollment for children 7–11 years old**



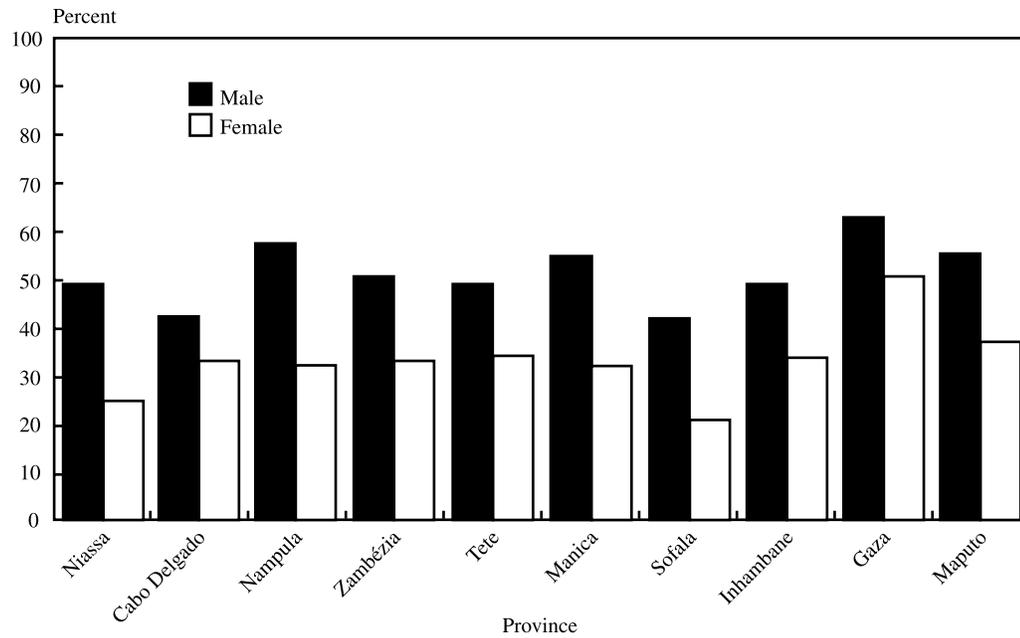
**Figure B.4 Rural enrollment for children 7–11 years old**



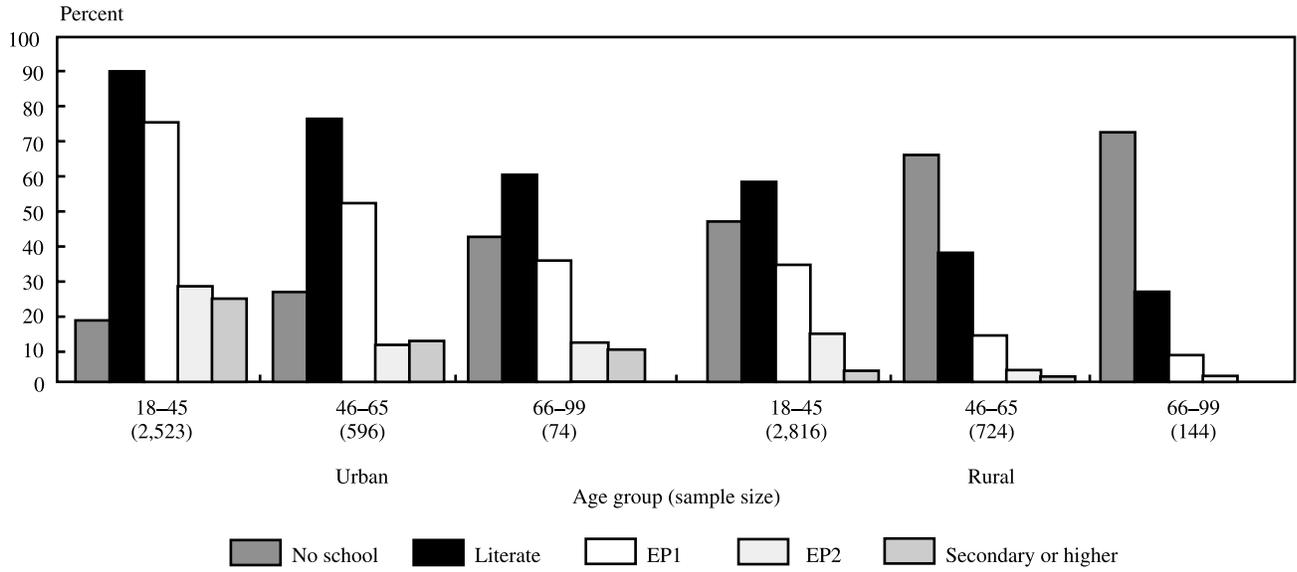
**Figure B.5 Urban enrollment for children 12–17 years old**



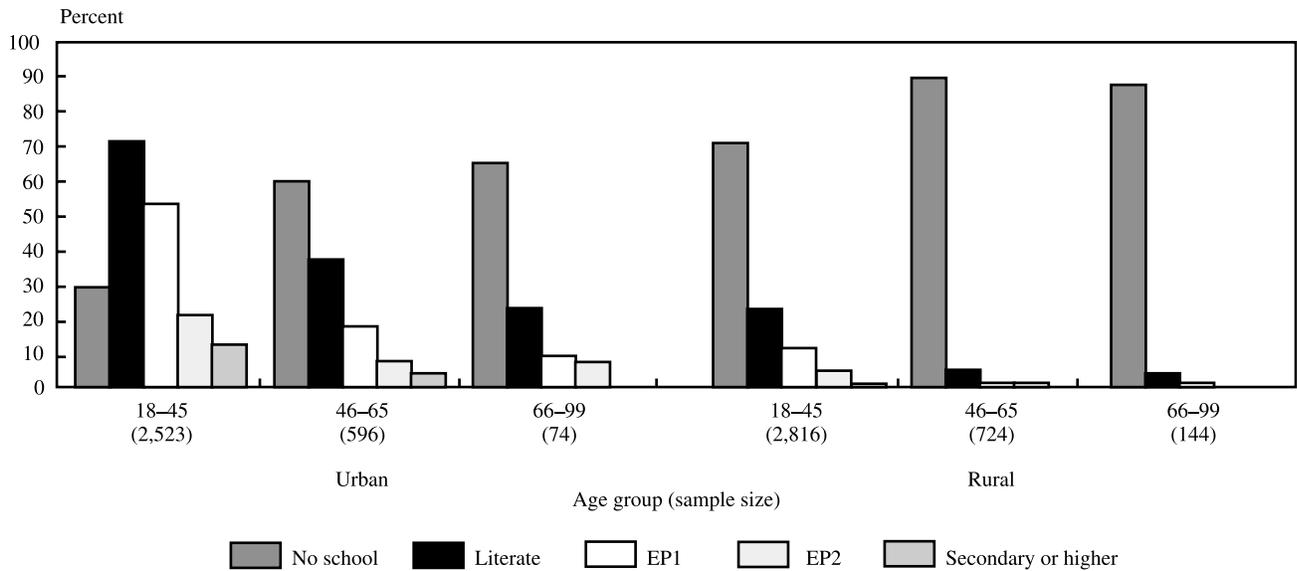
**Figure B.6 Rural enrollment for children 12–17 years old**



**Figure B.7 Distribution of adult male education attainments**



**Figure B.8 Distribution of adult female education attainments**





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