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Schools, Household, Risk, and Gender: Determinants of Child Schooling in Ethiopia*

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Abstract

Drawing upon data from Ethiopia, we highlight the relationship between investments in child schooling and key factors related to household characteristics, supply and quality of schooling, and income shocks. The unique contribution of this study stems from our examination of the effect of adverse income shocks on gender-differentiated child schooling outcomes. While there are several empirical studies that test the degree to which households are able to smooth consumption in response to a covariate shock, only few studies probe the gender-differentiated impacts of those shocks within the household.

We find a strong bias against investments in female education in rural Ethiopia. Controlling for key supply and demand side factors such as household income, parental education, distance to and quality of schools, girls who reside in rural areas are almost 12 percent less likely to be enrolled in primary school compared to boys. Furthermore, while an adverse weather-induced crop shock has no discernable impact on the schooling of boys, the same adverse shock has a deleterious impact on both the probability of enrollment and completion of schooling for girls. Besides the impact of adverse income shocks on child schooling, we find that investment in child schooling is significantly influenced by positive education externalities with the household and community, availability and distance to schools, and quality of school infrastructure.

JEL classification: I21; J16; O12
Key words: Income shocks; Schooling; Ethiopia.

I. Introduction

Numerous studies from both developing and developed countries have highlighted the relationship between household income and child schooling (for an extensive review see Behrman and Knowles 1997). There is also a growing body of literature on the relationship between school quality (e.g., Glewwe 2002), governance (Kremer et al. 2004), and schooling outcomes in the developing world. Various studies have also highlighted the importance of factors outside of the education sector in influencing schooling outcomes[1]. For example, Glewwe and Jacoby (1995) highlight the effect of childhood malnutrition on primary school enrollment in Ghana, while Miguel and Kremer (2004) find that in one district in Kenya, the most cost effective intervention to increase primary school enrollment was a deworming program. While we acknowledge that poor schooling outcomes (e.g., low enrollment rates, low test scores) are influenced by a complex array of determinants (child, household and community factors, access, quality, school governance, cross-linkages across sectors) – this study limits its focus to examining some specific relationships between household demand and supply of schooling, drawing upon several rounds of a nationally representative household data and school census data from Ethiopia.

The unique aspect of this study stems from our examination of the effect of weather-induced income shocks, a frequently recurrent phenomenon in Ethiopia, on gender-differentiated child schooling outcomes. While there are several empirical studies that test the degree to which households are able to smooth consumption in response to a covariate shock, only few studies probe the gender-differentiated impacts of those shocks within the household. For example, while Foster (1995) examines the effect of flooding in Bangladesh on child health outcomes, and Jacoby and Skoufias (1997) examine the effects of rainfall shocks on child schooling attendance in India, neither study differentiates outcomes (nutritional status or educational attainment) by gender of the child[2]. A notable exception is Rose (1999) who examines the impact of rainfall shocks on gender-differentiated child mortality in rural India. Rose (1999) finds that negative rainfall shocks in the first two years of life lowers the relative survival probabilities of girls compared with boys, particularly among landless households. Conversely, a positive rainfall shock in the first two years of life increases the likelihood of a girl's survival relative to a boy's survival. This suggests that in a time of crisis, poor rural households in India allocate scare resources to boys at the expense of their daughters, while redressing the inequality during surplus seasons. Not only is this finding consistent with a coda of empirical studies on excess female mortality and pro-male bias in South Asia, it is also consistent with Behrman (1988) who finds pro-son bias in nutritional allocation to be greatest during the "lean" season (which is made up for during the surplus season).

The evidence from Africa, however, compared to South Asia is sparse and inconclusive. For example Hoddinott and Kinsey (2000) examine the gender-differentiated impact of a drought in rural Zimbabwe. Unlike Rose (1999), Hoddinott and Kinsey (2000) do not

[1] Particularly the relationship between health and education – for a review see Behrman (1996).
[2] In a recent study, Beegle et al. (2005) investigate the impact of crop loss on child labour in Tanzania without differentiing the impact by gender.

find significant differences in nutritional outcomes between boys and girls in response to the shock (they do find a significant reduction in the rate of growth of children aged 12-24 months, especially within poorer households). Very little research has taken place in Africa, or any other developing region for that matter, on the gender-differentiated impact on schooling due to an adverse covariate shock.

This paper departs from the existing studies in two ways. First, we merge household data with detailed school characteristics from official records in order to establish the relative importance of demand and supply side determinants of school participation in Ethiopia. To the best of our knowledge, apart from Handa (2002) there is no developing country studies that have jointly examined supply and demand side determinants of schooling using nationally representative data. Second, we additionally combine data on crop damage owing to rainfall shock and investigate its impact on household decision to send a child to school by gender. Once again, whilst a number of researchers has looked into the causes of low schooling in Ethiopia, none has considered the role of shocks (e.g. see Adamessie and Bedi, 2004; Rose and Al-Samarrai, 2001; Schaffner, 2003; Weir, Forthcoming).

Our results document a significant gender gap in favour of boys in primary school participation, particularly in the rural areas. The gap persists even after accounting for differences in family background, region of residence and school characteristics. On the demand side, there is a significant, negative impact of production shock on children's school participation in rural Ethiopia. However, disaggregated analysis reveals that this is significant only for girls. Among supply side factors affecting school participation, distance to school remains a key constraint.

The rest of the paper is organized as follows. Section 2 discusses the study background – schooling conditions in Ethiopia. Section 3 elaborates on the data and the empirical strategy. Section 4 discusses the result. Section 5 is conclusion.

2. Background: Education Policy and Basic Schooling Profile

Ethiopia has currently one of the lowest primary enrollment rates in the world and reaching universal primary education in Ethiopia poses an enormous challenge. Low enrollments, high gender and regional disparity, and low quality of education remain major challenges of the Ethiopian education system (Ministry of Education, Government of Ethiopia, 1999; 2002a). Ethiopia has, however, made tremendous improvements in access to primary education in the 1990s. Ethiopia more than doubled gross primary school enrollment rates from 24 percent in 1994 to 57 percent in 2000 for grades 1-8 and raised net enrollment rates from a mere 17.8 percent in 1994-5 to 48.8 percent in 2000. The boom in primary school enrollment has been largely attributed to growth in the number of grade 1 entrants. During the period 1994 and 1996, the number of new entrants exceeded those in the previous year by 20, 26, 15 percent respectively or by about 200,000 children in absolute terms (World Bank, 2004a). Since 1996-97, the number of new grade 1 entrants has grown at a slower pace of just four percent each year.

Ethiopia's success in expanding primary school enrolment since 1994 had its foundations in the government's New Education Policy, which was formulated and adopted in 1994. The major reforms included significant investments in government schools at the primary and secondary levels—which enabled the education sector to accommodate rapid growth in the number of children entering grade 1—as well as other policy reforms that sought to remove demand-side and institutional constraints to increasing educational attainment, especially among the poor. Key supply side reforms included: (1) the construction of new public schools; (2) an increase in the supply of private schools due to relaxation of government controls; and (3) an increase in the number of double-shift public schools which essentially enabled the government to boost enrollments using its existing capital stock in the education sector. In particular, large public investments in government schools under the government's 1994 Education and Training Policy and Strategy program has been cited as the engine behind the massive increase in primary school enrollment between 1994 and 2001 (Ministry of Education, Government of Ethiopia, 2002a). To foster the demand for schooling and remove barriers to school entry, the government's New Education Policy abolished school fees in government schools and also implemented food-aid programs in primary schools. Compulsory primary education was increased from grades 1-6 to grades 1-8.

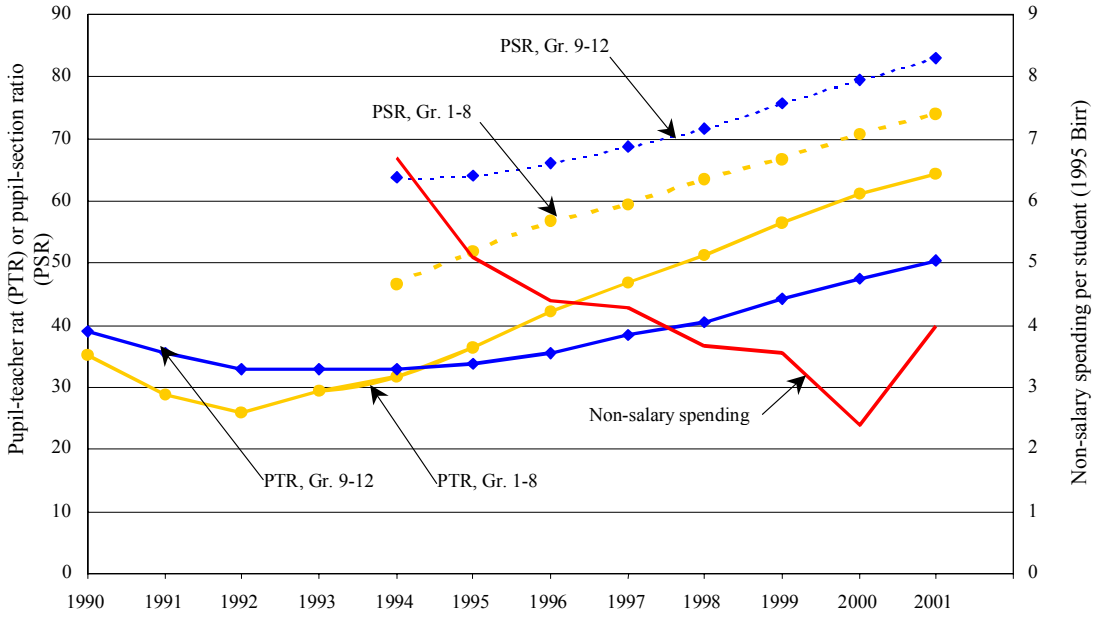
Other institutional reforms that help to explain the success of the government's efforts at boosting primary school enrollment in Ethiopia include a rigorous program of education sector decentralization that allowed for the introduction and use of local languages in the classroom and greater community involvement in the recruitment of teachers and management of fiscal resources in primary education.

In post-reform years (1994-2000), Ethiopia has seen a significant increase in the number of schools. This growth has occurred mostly in the public sector[3]. All the 14 provinces in Ethiopia experienced an increase in the total school availability. The province of Oromiya, Amhara, SNNPR and Tigray however gained most (Ministry of Education, Government of Ethiopia, 2002b).

Despite these gains, inefficiencies in spending levels remain and quality of schooling remains low. The primary school share of recurrent spending has decreased in favor of tertiary education, despite a dramatic increase in primary school enrollments implying an increasing demand for recurrent finance. In addition, a large share of the primary education budget is consumed by teachers' salaries, leaving minimal amounts available for non-wage recurrent spending on other schooling inputs such as textbooks. While non-salary spending per student continues to fall precipitously, pupil-teacher ratios have trended significantly upward since 1994 and by 2001 averaged 70 children per classroom for grades 1-8, and 80 at the secondary school level (Figure 1).

[3] New private schools have been very few and mostly have concentrated in Addis Ababa (Demeke, 1998). Historically, the supply of private schools has been almost non-existent. This is because, under the Military rule of the country during 1974-1991, all private schools were nationalized.

Figure 1: Trends in Pupil-Teacher and Pupil-Section Ratios and in Non-Salary Public Spending Per Primary and Secondary Student, Ethiopia, 1990-2001



Note: the PTR is computed by dividing total enrolments by the total number of teachers, and the PSR by dividing total enrolments by the total number of sections. These calculations yield weighted ratios which differ from the Unweighted ratios computed (as in table 5.X) by averaging the ratios across schools. Non-salary public spending per student is computed by dividing the reported budget amount for this item by the total number of primary and secondary students in government schools.
Source: based on data supplied by the Ministry of Education on enrolments, teachers and sections; and on MOFED budget data on expenditure.

On the demand side, there has been noticeable growth in school participation rate: gross enrolment ratio (GER) for grades 1-8 has seen 63 percentage point increase between 1994 and 2000. In 2000 gross primary school enrollment rate for the first cycle of primary school (grades 1-4) were 83 percent, and was 57 percent for grades 1-8. However, net primary school enrollment rate still lags at 49 percent, suggesting that grade repetition and educational quality are still concerns in Ethiopia. Nonetheless, these figures are remarkable given the modest target of increasing GER for grades 1-8 from 34% (in 1994) to 45% (by the year 2002) as set out in Education Sector Development Plan (ESDP) I (Ministry of Education, Government of Ethiopia, 1999).

Table 1: Gross Primary Enrolment in Ethiopia

	Grades 1-4			Grades 5-8			Grades 1-8		
	Boys	Girls	Total	Boys	Girls	Total	Boys	Girls	Total
1994-5	37.7	22.6	30.3	17	13.9	15.5	28.9	19	24.1
1995-6	58.3	33.2	46	19.3	13.8	16.6	39.8	24	32
2000-1	95.3	70.2	83	38.3	22.9	30.8	67.3	47	57.4

Source: Indicators of the Ethiopian Education System (various years), MoE.

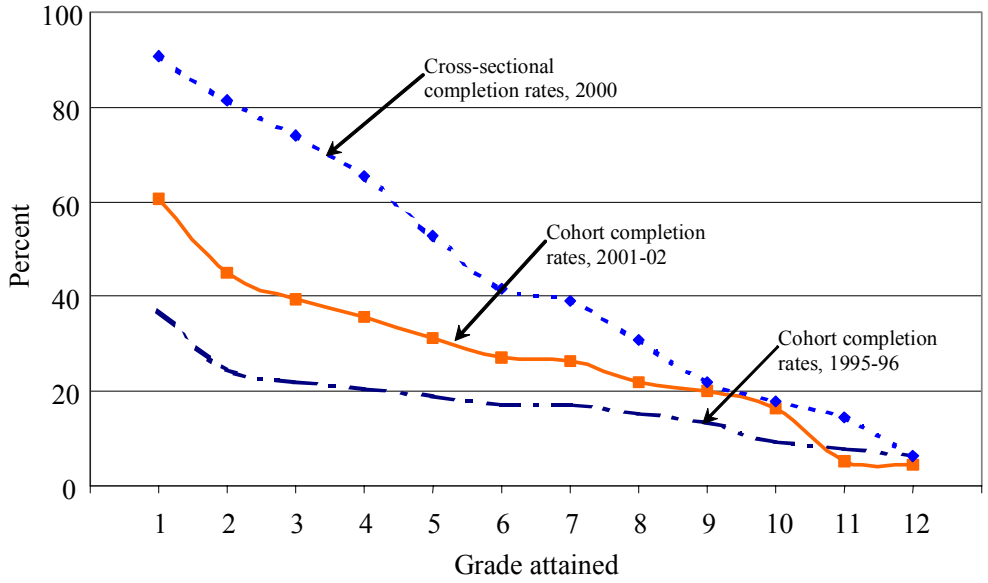
Table 2: Net Primary Enrolment in Ethiopia

	Grades 1-8		
	Boys	Girls	Total
1994-5	20.7	14.7	17.8
1995-6	28	18.6	23.4
2000-1	55.7	41.7	48.8

Source: Indicators of the Ethiopian Education System (various years), MoE.

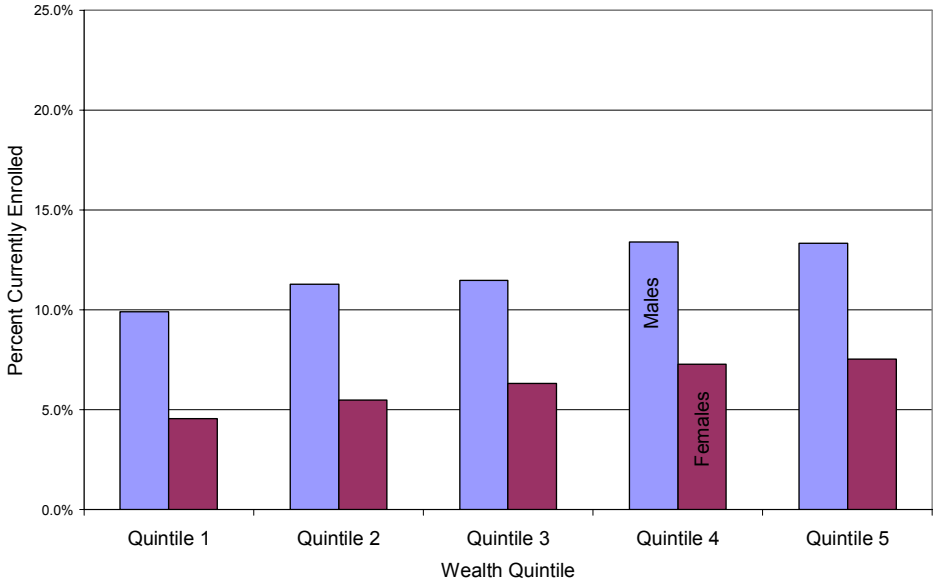
Figure 2 shows both cross-sectional and cohort completion rates in Ethiopia. While there has been an increase in the cohort completion rate at all grade levels since 1995-96, the overall completion rate in Ethiopia remains extremely low. Presently only 60 percent of each cohort enters grade 1, of which a quarter drop out by grade 2 and half drop out by grade 5. Low completion rates may reflect several factors such as dissatisfaction with school quality, demands on child labor for household labor, and low returns to education in the labor market.

Figure 2: Grade-specific completion rates, Ethiopia, 1995-96, 2000, and 2001/2



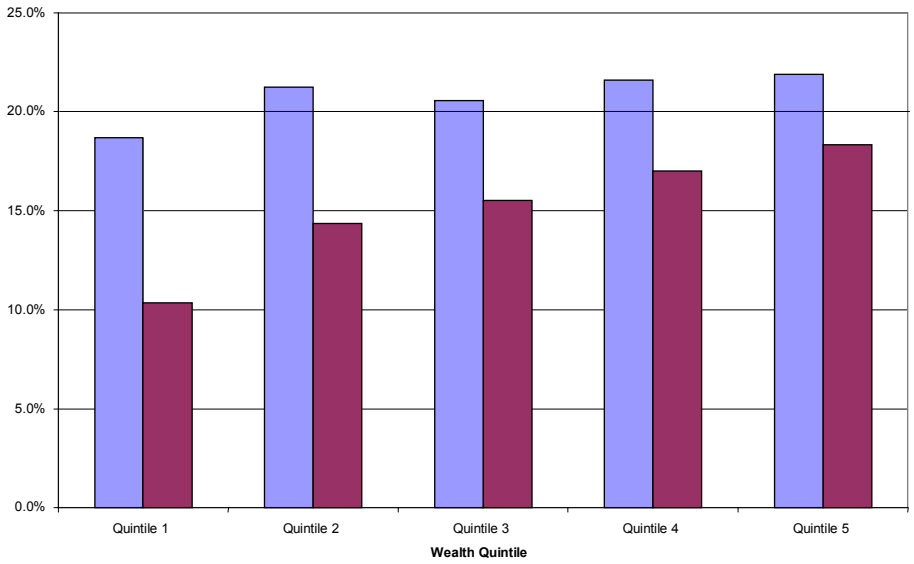
While we do not see stark disparities in educational attainment across wealth quintiles in Ethiopia, there is a wealth-gender nexus in educational outcome. In addition there are large disparities in educational outcomes between girls and boys within the same wealth quintile, which implies that households tend to under-invest in girls' education in Ethiopia. We find a negative female-biased pattern in gross primary school enrollment rates for both 1996 and 2000 (Figure 3.1 and Figure 3.2)[4]. The wealth gradient for boys in primary school enrollment appears to have flattened between 1996 and 2000, while the wealth-enrollment gradient for girls has persisted over time. The gender gap between male and female primary school enrollment rates within quintiles decreased between 1996 and 2000.

Figure 3.1: Gross primary enrollment rates by gender and wealth quintile, 1996



[4] We draw upon the Welfare Monitoring Survey (WMS) 1996 and WMS 2000 for our estimates. These household surveys are discussed further in the next section.

Figure 3.2: Gross primary enrollment rates by gender and wealth quintile, 2000



Wealth appears to be a stronger correlate of primary school completion than primary school enrollment in Ethiopia. This is particularly true for girls, as shown in Figures 4.1 and 4.2 below. Although there have been large increases in enrollments across all quintiles in Ethiopia between 1996 and 2000, overall primary school completion rates remain extremely low, less than 5 percent even for boys in wealthier families.

Figure 4.1: Primary completion rates by gender and wealth quintile, 1996

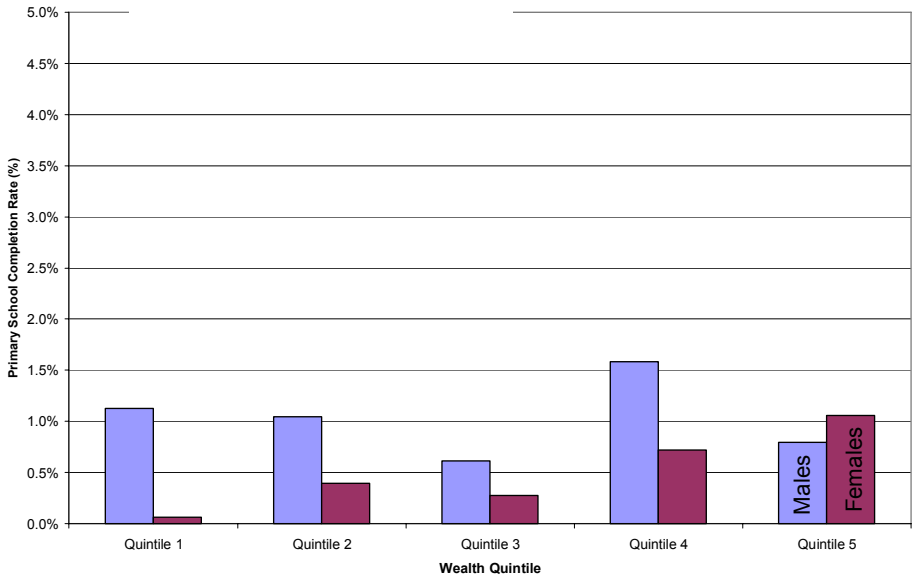
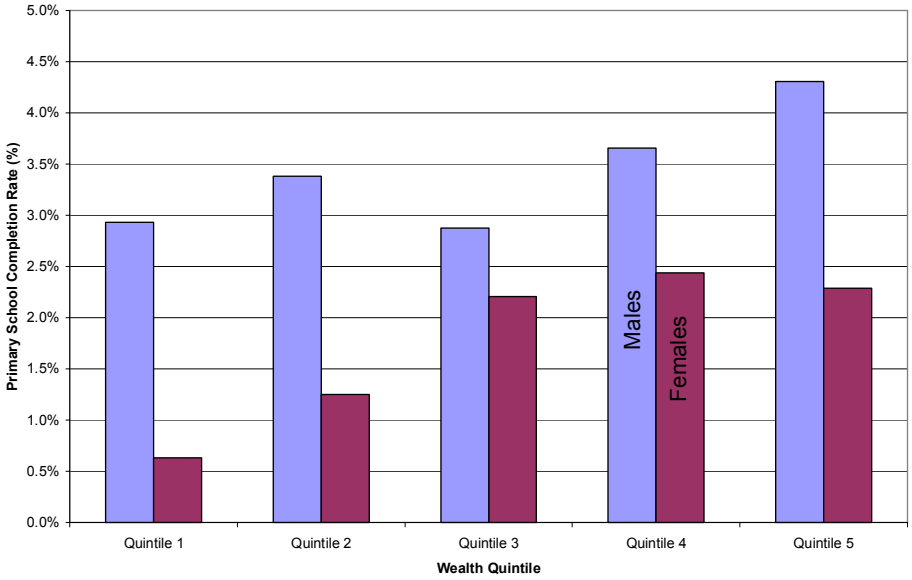


Figure 4.2: Primary completion rates by gender and wealth quintile, 2000



In sum, since 1994, substantial supply-side expansion has taken place in Ethiopia following the education sector reform program of the government. This is reflected in the steep rise in school participation rate. Whilst more boys and girls today attend schools, boys' schooling has increased more relative to girls'. Consequently, gender gap in school enrolment has widened between 1994 and 2000 (Tables 1 and 2). Therefore, in this study, we want to identify what factors specific to the household, school and community the causes of low schooling in general, and how their effects differ by gender.

3. Data Sources and Empirical Specification

3.1 Data

Our analysis in this paper is primarily based on nationally representative household survey data for the years 1996 and 2000. We use Welfare Monitoring Survey (WMS) data collected by the Central Statistical Authority (CSA) for the years 1996 and 2000. The WMS is a cluster-based nationally-representative multi-module household survey containing a wide range of information on demographics, schooling and assets[5]. In addition to detailed modules on household demographics, housing amenities, and distance to facilities, it provides information on household expenditures. However, the WMS does not provide any information on school quality and availability at the community level. In this endeavor, we merge WMS data to two types of data: (1) School Census data from the Education Management Information System (EMIS), Ministry of

[5] Even though the clusters might be the same, given that the surveys were not designed to be panels (i.e., same households visited on a continuous or rotational basis with unique household identifiers), we treat the datasets as two distinct cross-sections.

Education, from which obtain information on schools and (2) data on Woreda-level[6] rainfall shocks and household plot-level crop damage.

School census data collected by the Education Management Information System (EMIS), Ministry of Education for the years 1996 and 1999 were merged to WMS 1996 and 2000 respectively. The 2000 school census contained information on 11800 schools spread over 531 waredas and 11 regions. On the other hand, the 1996 census comprised of 10571 schools spread over 456 waredas. We draw upon various proxies for school quality from the census data such as teacher-pupil ratio (the most widely used and contested measure of school quality in the literature – e.g., Hanushek 1995; Angrist and Lavy, 1999; Case and Deaton 1999), and various other teacher and school level information (e.g., teacher experience and training, quality of physical infrastructure). The wereda-level average values of these variables are then merged with respective WMS dataset. Because it was necessary to express some of the wereda-level school census information on a per capita basis, we also merged in population totals by wereda from the Statistical Abstract 2001. Information on popualtion density was also obtained from the Abstract.

For the purpose of our analysis, we restrict attention to children ages 7 to 14[7]. Out of the 11 regions in Ethiopia, EMIS 1996 and 1999 dataset was complete for 7 regions[8]. Therefore, our analysis further limits observations to all children who belong to these regions, namely Amhara, Benshangul, Gambella, Harare, Tigray, Oromiya and SNPR. The working sample size (pooled across 1996 and 2000) falls to 17475 children when missing values for other WMS variables are dropped. Of these, 5368 belong to urban areas. Table A.2 reports means values and standard deviation of the variables employed in the subsequent analysis.

3.1 Empirical strategy

We model the probability of primary school enrollment (children aged 7-14) and completion in Ethiopia using a reduced form demand equation. While we cannot do justice to all the complex relationships highlighted in section 1, we intend to present the most comprehensive analysis to date on several important determinants of child schooling in Ethiopia. In particular, we highlight: (a) household factors which shape child schooling outcomes; (b) school quantity and quality factors; and (c) the impact of adverse shocks on schooling investments. To this end, we first estimate the following:

$$P^*(S_{ij}=1) = \vec{\beta}_1\vec{C}_i + \vec{\beta}_2\vec{H}_j + \vec{\beta}_3\vec{D}_w + \varepsilon 1_{ij} \qquad \textbf{(1)}$$

[6] The administrative structure in Ethiopia is broken down into Federal, Regional, Zonal, and Woreda level. Woredas are further broken down into Kebeles/communes (rural/urban).

[7] WMS 1995-6 had a total of 12260 households; total number of children aged 7-14 was 15845, spread across 8241 households. On the other hand, WMS contained 28822 children aged 7-14, spread across 15690 households.

[8] Regions that have been discarded are Afar, Somali, Dire Dawa and Addis Ababa.

Where P_{ij}^* is the probability that child i, belonging to household j, is currently in school. C_i is a vector of child-specific characteristics (e.g., age, gender); H_j is a vector of households characteristics (e.g., consumption-based measure of income, education of household head); D_w is a vector of region-level dummies which proxy for a wide range factors such as prices, agro-ecological conditions, infrastructure, and school quality (however, cannot separately identify any one of those factors); and εI_{ij} is a normally-distributed error term with mean zero and variance σ. We don't observe the latent variable P_{ij}^*. We only observe the results of the household's evaluation of (1), which is manifest in whether or not the child is in primary school:

$$P_i = 1 \text{ if } P_i^* > 0 \qquad \textbf{(2a)}$$
$$P_i = 0 \text{ if } P_i^* \leq 0 \qquad \textbf{(2b)}$$

We then augment (1) by introducing covariate shocks faced by household in the woreda. We further augment (1) by including the number of schools available in a woreda and some woreda-level school quality characteristics. We have plausible reason to believe that the spatial distribution of schools/school quality is orthogonal to a household's investment decisions regarding child schooling, i.e., we assume away problems associated with endogenous program placement and self-selection. This assumption, however, is not made callously. The allocation of schools, teachers, and funding, historically in Ethiopia has been made on the basis of population norms – not on the basis of enrollments rates or income. Also, there is little evidence within the Ethiopian context that households migrate to woredas with more schools and/or better school quality. Furthermore, given the legacy of the socialist commune system, it is quite rare for children to attend primary schools outside of their woreda of residence[9].

We estimate the probability of current enrollment in primary school and primary school completion within a Probit specification, correcting for unspecified heteroskedasticity. We estimate separate specifications by rural and urban samples. The assumption that the error term is iid, is a rather strong one, given that we are not controlling for the unobserved child and household factors (e.g., innate ability of the child). We can, however, control for certain (time-invariant) fixed effects, such as mother fixed-effects via inclusion of mother dummies.

4. Regression Results

We mostly focus our discussion of results on the determinants of primary school enrollment rates using pooled sample (Table 3)[10]. Many of the demand and supply side determinants of enrolment have similar effects on primary school completion rates, though overall the results are less significant, potentially related to the low completion rates observed in Ethiopia and thus the lack of variation in our sample.

[9] Rural pupils do travel considerable distances (and often live away from home) to attend secondary schools which are located mostly in peri-urban areas.

[10] Non-pooled regression results are quite similar; separate 1996 and 2000 results are not reported here but available upon request.

4.1 Household and community characteristics

There is a strong bias against investments in female education in rural Ethiopia. The magnitude of the gender bias is undoubtedly one of the striking findings of the analysis. Controlling for key supply and demand side factors such as distance to and quality of schools, household resources, and parental education, girls who reside in rural areas are 11.6 percentage points less likely to be enrolled in school compared to boys (see Table 3). To better appreciate the astounding magnitude of this effect, note that this implies that almost one million people of primary school age are denied schooling merely because of their gender, i.e. irrespective of the income of the household, the parental educational status, the distance to the school or the quality of the schooling.[11] Even in urban areas, girls are 4.3 percentage points less likely to be enrolled in school than boys. Given that various supply and demand side determinants have been controlled for, the reasons for this strong bias against female education must partially relate to cultural factors and perpetuate the disempowered position of female citizens. To further explore the reasons for this gender bias in school enrollment, we separately examine the effects of the various known determinants of enrollment and completion separately for girls and boys (see Table 4[12]). Again, there exists a strong gender bias in primary school completion. Girls are 8 to 10 percent less likely to complete 5th grade. Thus not only are girls likely to be enrolled, when enrolled they are also less likely to complete primary schooling.

[11] According to the DHS 2000, there are about 28.65 million females residing in rural areas, of which 28 percent are between 5 and 14 years old. Multiplying the total number of school age people by their reduced percentage likelihood of being enrolled yields 930,000.

[12] See Appendix Table A1 for gender-disaggregated primary school completion regressions; Table A2 for sample statistics.

Table 3: National level primary school enrollment and completion regression results[1]

	Probability child of primary school age (7-14) is currently enrolled in school				Probability of completing 5th grade for children aged 12 to 14			
Independent Variables	Rural: Significant?	Rural: Effect	Urban: Significant?	Urban: Effect?	Rural: Significant?	Rural: Effect	Urban: Significant?	Urban: Effect?
Dummy: Child age 8	Yes (1%)	0.11	Yes (1%)	0.077				
Dummy: Child age 9	Yes (1%)	0.229	Yes (1%)	0.12				
Dummy: Child age 10	Yes (1%)	0.309	Yes (1%)	0.144				
Dummy: Child age 11	Yes (1%)	0.304	Yes (1%)	0.133				
Dummy: Child age 12	Yes (1%)	0.333	Yes (1%)	0.148				
Dummy: Child age 13	Yes (1%)	0.342	Yes (1%)	0.119	No	0	Yes (1%)	0.095
Dummy: Child age 14	Yes (1%)	0.355	Yes (1%)	0.125	No	0	Yes (1%)	0.215
Female child	**Yes (1%)**	**-0.116**	**Yes (1%)**	**-0.043**	**Yes (1%)**	**-0.075**	**Yes (1%)**	**-0.098**
Female-headed household	No	0	No	0	No	0	Yes (5%)	-0.075
Age household head	No	0	Yes (1%)	0.001	No	0	Yes (1%)	0.005
Single household head	No	0	No	0	No	0	No	0
Schooling of household head	Yes (1%)	0.011	Yes (1%)	0.008	No	0	Yes (1%)	0.008
Schooling of non-head adult	Yes (1%)	0.011	Yes (5%)	0.004	No	0	Yes (1%)	0.012
Log of HH per capita expenditures	Yes (1%)	0.056	No	0	No	0	No	0
Rain-fall shock at plot level	**Yes (1%)**	**-0.042**	**-**	**-**	**No**	**0**	**--**	**--**
EA-level average literacy rate of males	Yes (1%)	0.098	No	0	Yes (10%)	0.062	No	0
EA-level average literacy rate of females	Yes (1%)	0.443	No	0	Yes (5%)	0.154	No	0
Primary school is within 2 km	Yes (1%)	-0.035	No	0	No	0	No	0
Primary school is within 3-4 km	Yes (1%)	-0.054	No	0	No	0	Yes (1%)	-0.141
Primary school is within 5-6 km	Yes (1%)	-0.098	No	0	No	0	Yes (5%)	-0.193
Primary school is within 7-12 km	Yes (1%)	-0.149	No	0	No	0	No	0
Primary school is more than 13 km away	Yes (1%)	-0.176	No	0	No	0	No	0
Distance to secondary school	Yes (5%)	-0.001	No	0	No	0	Yes (1%)	-0.005
Distance to food market	No	0	No	0	No	0	No	0
Distance to health clinic	No	0	No	0	No	0	No	0
Distance to post-office	No	0	No	0	No	0	No	0
Number of schools in the area	Yes (1%)	0.509	No	0	Yes (1%)	0.162	No	0
Population density	No	0	Yes (5%)	0	No	0	No	0
Student-teacher ratio	Yes (1%)	0.001	Yes (1%)	-0.002	No	0	No	0
Fraction of female teachers	No	0	Yes (1%)	0.005	Yes (1%)	-0.002	No	0
Fractions of teachers with certificates	No	0	No	0	No	0	No	0
Regional Dummy: Tigray	No	0	No	0	No	0	No	0
Regional Dummy: Amhara	Yes (5%)	0.089	Yes (5%)	0.115	No	0	No	0
Regional Dummy: Oromiya	No	0	No	0	No	0	No	0
Regional Dummy: Benshangul	No	0	No	0	No	0	No	0
Regional Dummy: SNPR	No	0	No	0	No	0	No	0
Year 2000 Dummy	Yes (1%)	0.144	Yes (1%)	0.089	Yes (1%)	0.11	No	0
Number of Observations	11763		4979		4171		2135	

1) All coefficients, when significant at a level above 10 percent, are reported as marginal probabilities

Table 4: Primary School Enrollment Regressions by gender– Rural and Urban in Ethiopia[1) 2)]

Variable	Rural		Urban	
	Girls	Boys	Girls	Boys
Child age 8	0.114	0.103	0.07	0.08
	(4.59)***	(3.68)***	(2.88)***	(4.09)***
Child age 9	0.214	0.24	0.115	0.116
	(7.94)***	(8.35)***	(5.05)***	(6.43)***
Child age 10	0.282	0.323	0.155	0.122
	(10.25)***	(11.22)***	(7.16)***	(6.78)***
Child age 11	0.249	0.352	0.15	0.11
	(8.41)***	(11.47)***	(6.58)***	(5.75)***
Child age 12	0.258	0.38	0.148	0.13
	(9.49)***	(13.57)***	(6.87)***	(7.27)***
Child age 13	0.252	0.408	0.103	0.121
	(8.59)***	(13.68)***	(4.34)***	(6.39)***
Child age 14	0.294	0.391	0.113	0.118
	(9.86)***	(12.90)***	(4.88)***	(6.21)***
Female head of household	0.015	0.015	-0.017	0.041
	-0.59	-0.52	-0.72	(1.83)*
Age of head of household	0	-0.001	0.002	0.001
	-0.57	(1.76)*	(2.19)**	-1.51
Single head of household	-0.006	-0.087	0.022	-0.053
	-0.2	(2.37)**	-0.75	-1.54
Schooling of household head	0.016	0.004	0.008	0.008
	(5.88)***	-1.14	(4.17)***	(4.55)***
Other adult schooling	0.012	0.006	0.002	0.007
	(3.08)***	-1.18	-0.76	(3.33)***
Log of per capita household expenditures	0.051	0.065	-0.007	0.041
	(4.40)***	(4.71)***	-0.46	(2.97)***
Rain damage	**-0.053**	-0.02		
	(2.87)***	-0.94		
EA- Average male adult literacy rate	0.055	0.17	0.045	0.206
	(1.65)*	(4.21)***	-0.7	(3.61)***
EA- Average female adult literacy rate	0.454	0.374	0.24	0.149
	(8.26)***	(5.41)***	(3.71)***	(2.67)***
Distance Primary School 1-2 km	-0.037	-0.033	-0.022	-0.018
	(2.68)***	(1.82)*	-1.39	-1.24
Distance Primary School 3-4 km	-0.067	-0.046	-0.057	-0.007
	(4.80)***	(2.54)**	-1.51	-0.22
Distance Primary School 5-6 km	-0.104	-0.093	-0.071	0.034
	(6.86)***	(4.55)***	-0.88	-0.48
Distance Primary School 7-12 km	-0.122	-0.177		
	(7.07)***	(7.75)***		
Distance Primary School > 13 km	-0.16	-0.179	-0.131	0.064
	(4.56)***	(4.43)***	-0.6	-0.43
Distance to secondary school	0	-0.001	-0.002	-0.001
	-1.17	-1.32	-1.41	-0.4
Distance to food market	0.003	-0.001	0.002	0
	(2.45)**	-0.43	-0.72	-0.05

Distance to health clinic	-0.002	0	0	-0.007
	(2.58)***	-0.18	-0.04	(1.90)*
Distance to post office	-0.001	0	-0.001	0
	(1.70)*	-0.32	-0.41	-0.28
Number of schools per capita	0.363	0.706	0.179	0.044
	(7.07)***	(10.42)***	(1.69)*	-0.5
Population density	0	0	0	0
	(2.02)**	-1.27	-0.43	(2.76)***
Student-teacher ratio	0.001	0.001	-0.001	-0.002
	(4.23)***	(3.59)***	(2.75)***	(3.79)***
Percent female teachers	0	0	0.005	0.004
	-0.1	-0.61	(3.79)***	(3.78)***
Percent teachers with certification	0.022	0.106	0.098	0.125
	-0.43	(1.66)*	-0.83	-1.18
Tigray	0.09	0.081	0.132	0.003
	(1.69)*	-1.29	(1.69)*	-0.03
Amhara	0.105	0.118	0.166	0.064
	(2.08)**	(1.91)*	(2.36)**	-0.8
Oromiya	-0.022	0.176	0.184	0.029
	-0.5	(2.93)***	-1.62	-0.3
Benshangul	-0.065	0.212	0.104	0.071
	(1.79)*	(3.41)***	-1.52	-1.23
SNPR	-0.001	0.189	0.149	0.085
	-0.02	(3.07)***	(1.87)*	-1.15
Harari	0.038	0.272	0.126	-0.028
	-0.71	(3.85)***	-1.64	-0.3
Year 2000 dummy	0.14	0.157	0.103	0.069
	(11.76)***	(11.08)***	(4.70)***	(3.41)***
Number of Observations	5808	6299	2739	2629

1) All coefficients are reported as marginal probabilities
2) * significant at 10%; ** significant at 5%; *** significant at 1%; robust z statistics are in parentheses.

Households with better educated adults and those living in better educated communities are more likely to have children enrolled in primary school. For every additional year of educational attainment of the household head, the probability that a child is enrolled in school increases by 1.1 percentage points in rural areas. The positive effect of the household's education is especially strong in determining girls' initial enrollment, where each additional year of education increases the probability of a girl's enrollment by 1.6 percent. In urban areas, the effect is estimated at 0.8 percentage points for both girls and boys. There are also strong positive externality effects of educational attainment at the community level, particularly associated with female literacy. These are most pronounced in the rural areas: a 10 percentage point increase in the female literacy rate in a rural community results in a 4.5 percentage point increase in the probability of enrollment for girls and a 3.7 percentage point increase in the probability of enrollment for boys[13]. The effects are about half as large in urban areas. Interestingly, adult male literacy rate of the

[13] Similar evidence of externalities in children's schooling arising from community-level education is also documented by Weir (Forthcoming).

community seems to especially benefit the enrollment probabilities of boys. These results may indicate that the individual demand for education is partially shaped by community preferences and social norms. Alternatively, or in addition, community educational attainments could be proxying for average community wealth. Household income, however, has a modest positive impact on the likelihood of primary school enrollment. The effect is slightly stronger in rural areas and for the enrollment of boys. A ten percent increase in household income results in approximately a 0.5 percentage point increase in the probability that a rural child is enrolled in school.

Schooling of the household head only appears to affect completion rates in urban areas. However, there is strong positive education externality of adult female literacy on the probability of primary school completion for girls. Similarly, in the urban sample, adult male literacy has strong positive externalities in increasing the probability of primary school completion among boys, but not for girls. There appears to be a perverse wealth effect in the primary school completion specification for which we do not have any explanation (Table A.1).

4.2 Shocks

Adverse covariate shocks effect rural primary school enrollment, particularly among girls. Households with half of their plot area damaged are 4 percent less likely to send their child of school-going age to school (Table 3). It further appears that harvest failure has asymmetric effects for male and female children of affected households. In the event that a household is faced with an adverse production shock, while there is no significant impact on male enrollment, females on the other hand are less likely to attend primary school (Table 4), and also less likely to complete primary schooling (Table A.1). This suggests that when vulnerable households are forced to make tradeoffs in educational investments of their children, they choose to protect their schooling investments in their sons rather than in their daughters. Strengthening farmers' risk management instruments will not only reduce their poverty and improve their children's nutritional status, it will also enhance the educational achievements of their children, especially their daughters.

4.3 School Characteristics

The distance of the nearest school from the homestead negatively impacts enrollment and completion probabilities, especially in rural areas. The regression results suggest that households are reluctant to send their children to schools far from home. This effect may capture the opportunity cost of primary school attendance, which will increase as the child's distance to school increases. Given that schoolchildren must generally walk to school, distance may also serve as a direct barrier to attending primary school among children living on remote farms, particularly young girls. To illustrate this point, households seven to twelve kilometers away from a school are 12 percent less likely to send their daughters and 18 percent less likely to send their sons to primary school (Table 4). If a school is more than 13 kilometers away, children are 17.6 percent less likely to be enrolled in school (Table 3). These findings suggest that supply side reforms in the

education sector (e.g. construction of new schools and classrooms in underserved areas) will continue to be a critical factor in increasing primary school enrollment in Ethiopia.

In general, student teacher ratios and the proportion of female teachers positively and substantially affect enrollment and completion rates, especially in urban areas. To explore the effects of the quality of schooling we look at the effects of the student-teacher ratios, the percentage of female teachers and the percentage of teachers with a certificate. Overcrowding in the classroom decreases the chances of enrollment in urban areas and the effects can be substantial. A reduction in the student-teacher ratio in urban areas from the current average of 60 to 50 is estimated to increase enrollment by two percentage points. Surprisingly however, we find a positive relationship between the student teacher ratio and enrollment in rural areas. This may reflect the community-level preferences or social norms favoring education hypothesized above. In both urban and rural areas primary school completion rates (fifth grade) are negatively associated with student teacher ratios, though the effects are estimated with great imprecision.

The larger the percentage of female teachers, the larger the probability that urban children will be enrolled in school. We do not find a relationship between the gender of the teacher and enrollment in rural areas. Interestingly, the presence of female teachers has only a slightly larger positive effect on the enrollment of girls relative to boys. Overall the effects are substantial: raising the percentage of female teachers from its current average level of almost 30 percent to 50 percent would increase enrollment rates in urban areas by 10 percentage points for girls and 8 percentage points for boys (Table 4). Moreover, while the presence of female teachers positively affects the completion rates of boys in urban areas, it negatively affects their completion rates in rural areas. No effects on the completion rates of girls were discerned (Table A.1). These gender dynamics deserve further exploration. No clear pattern was detected regarding the effect of teacher certification.

Finally, the quality of school infrastructure greatly increases the probability of male enrollment[14]. Availability of water and toilets only affect boys' enrollment. Boys are 15 percent more likely to be enrolled if the closest school has drinking water and they are 7 percent more likely to be enrolled if the closest school has a toilet. This not only highlights the importance of the school environment, but also further points to the fact that households are less likely to send their daughters to school, whatever the school environment.

Distance to school and the number of schools also have gender-specific impacts in the urban sample. Girls are less likely to complete primary schooling if they live far from a school, while boys are more likely to complete primary schooling in communities with a greater availability of schools.

[14] Results based on 2000 only for which we had more school infrastructure information. Regression results not reported here but available from the authors upon request.

5. Conclusion

This paper has empirically investigated the determinants of school participation and attainment in Ethiopia. In doing so, it makes two contributions to the existing literature on children's school outcomes in developing countries. First, we combine several rounds of nationally representative household survey datasets with school census datasets at a regional level and jointly explore the role of supply and demand side determinants of schooling. Second, we make a novel contribution by documenting the adverse impact of weather-induced shocks on household decision to invest in schooling. While there are a few developing countries studies highlighting the role of exogenous shocks in constraining children's development, none of these studies do so jointly accounting for supply-side differences in access to and quality of schools.

Our findings suggest that supply side interventions remain critical to increasing primary school enrollment and completion rates in Ethiopia. It further appears that in rural areas supply side interventions should be mainly focused on increasing accessibility to schooling, especially through the construction of new schools in underserved areas. Remoteness from a school increases the opportunity cost of primary school attendance, and given that schoolchildren must walk to school, distance may also serve as a direct barrier to attending primary school, especially for young girls. Supply side interventions in urban areas, where most children are already within 2 kilometers from a primary school, should focus on increasing the quality of schooling, as captured by the student-teacher ratio.

On the demand side, there is a need for social protection programs which could help mitigate the negative impact of idiosyncratic shocks on school enrollment and completion, especially for girls. There may also be opportunities to expand and improve risk mitigation practices on smallholder farms and to introduce insurance programs (e.g., crop insurance schemes) which would help buffer household food consumption and income from idiosyncratic production shocks. Given the strong association between parental (and especially female adult) education and the educational achievements of the community, the role of awareness and adult literacy campaigns should be further explored.

The evidence on persistent gender gap presented here has serious policy implications. A more detailed ethnographic examination of why households are less likely to invest in girls' education, particularly during times of adverse shocks, would help to inform the design of social risk management practices to protect female enrollment during shocks, and to close the gender disparity in educational outcomes across wealth quintiles in Ethiopia. Differential returns to education among men and women may influence household investment decisions. Empirical analyses aimed at understanding labor market segmentation and wage determination by gender could thus also improve our understanding of the underlying causes of household underinvestment in female education. Alternatively, or in addition, there may be a deep-rooted cultural bias as suggested by the disempowered position of women in Ethiopian society generally (Colclough et al, 2000; Rose, 2003). Measures to strengthen women's legal rights and

expand their economic opportunities, may help to improve the standing of women and to gradually erode this bias.

6. References

Admassie, Assefa and Bedi, Arjun (2004), "Attending school, Two "Rs" and child labour in rural Ethiopia", paper presented at the CSAE Annual Conference, University of Oxford, 2004.

Alderman, H., J. R. Behrman, D. R. Ross, and R. Sabott, 1996a. "Decomposing the Gender Gap in Cognitive Skills in a Poor Rural Economy". Journal of Human Resources, 31(1):229-254.

Alderman, H. , R. F. Orazem, and E. M. Paterno, 1996b. "School Quality, School Cost, and the Public/Private School Choice in Low Income Households in Pakistan". Working Paper No. 2, Impact Evaluation of Education Reforms Project. Washington, D.C. Processed.

Angrist, J. D., and V. Lavy, 1999. "Using Maimonides' Rule to Estimate the Effect of Class Size on Scholastic Achievement". *Quarterly Journal of Economics*, 114, pp. 533-75.

Behrman, J. R., (1996), "The impact of health and nutrition on education", *World Bank Research Observer*, 11, pp. 23-37.

Behrman, J. R. , and J. C. Knowles, (1997), "How Strongly is Child Schooling Associated with Household Income ?". Department of Economics, University of Pennsylvania, Philadelphia. Processed.

_____, 1999. "Household Income and Child Schooling in Vietnam". The World Bank Economic Review, 13(2), pp. 211-56.

Beegle, Kathleen & Dehejia, Rajeev H and Gatti, Roberta (2005) "Child Labour, Crop Shocks and Credit Constraints," CEPR Discussion Papers 4881.

Case, A., and A. Deaton, (1999), "School Quality and Educational Outcomes in South Africa", *Quarterly Journal of Economics*, Vol 118, pp. 1047-1084.

Colclough C., Rose, P. and Tembon, M. (2000), "Gender inequalities in primary schooling - The roles of poverty and adverse cultural practice", *International Journal of Educational Development*, Vol. 20(1), pp. 5-27.

Deolalikar, A. B., 1998. "Increasing School Quantity versus Quality in Kenya: Impact on Children from Low-and High-Income Households". Policy Reform, 2, pp. 223-246.

Demeke, Mulat (1998), "Constraints to school enrolment and demand for fee-charging schools in Ethiopia", *Ethiopian Journal of Development Research*, Vol. 20(1), pp. 41-72.

Foster, Andrew. (1995), "Prices, Credit Market, and Child Growth in Low-Income Rural Areas", *Economic Journal*, 105 (430), pp. 551-70.

Glewwe, Paul, 2002. "Schools and Skills in Developing Countries: Education Policies and Socioeconomic Outcomes". Journal of Economic Literature 40(2): 436-82.

Glewwe, Paul, Michael Kremer and Sylvie Moulin, 1999. "Textbooks and Test Scores: Evidence from a Prospective Evaluation in Kenya". Processed.

Glewwe, P., and H. Jacoby, (1995), "An Economic Analysis of Delayed Primary School Enrollment and Childhood Malnutrition in a Low Income Country", *Review of Economics and Statistics*, 77(1), pp. 156-69.

Handa, Sudhanshu (2002), "Raising primary-school enrolment in developing countries. The relative importance of supply and demand, *Journal of Development Economics*, Vol. 69, pp. 103-128.

Hanushek, E., (1995), "Interpreting Recent Research on Schooling in Developing Countries". *World Bank Research Observer*, 10, pp. 227-46.

Hoddinot, J., and B. Kinsey. (2000), "Adult Health in the Time of Drought". Mimeo. Food Consumption and Nutrition Discussion Papers No.79. International Food Policy Research Institute. Washington, DC.

Jacoby, H., and E. Skoufias (1997), "Risk, financial markets, and human capital in a developing country". *Review of Economic Studies*, 64(3), pp. 311-35.

Kremer, M., S. Moulin, D. Myatt, and R. Namunyu (1996), "Textbooks, Class Size, and Test Scores: Evidence from a Prospective Evaluation in Kenya. Discussion Paper, MIT. Processed.

Miguel, E., and M. Kremer (2004), "Worms: Identifying Impacts on Education and Health in the Presence of Treatment Externalities", *Econometrica*, Vol. 72 (1), pp. 159-217.

Ministry of Education (1999), *Improving retention with a special focus on girls*, Ministry of Education, Women's affairs Department, in collaboration with Project BESO.

_____ (2002a), *Education sector development program II: Program action plan.* Addis Ababa, Ministry of Education.

_____ (2002b), *Education statistics annual abstract 2001-02*, Addis Ababa, Ministry of Education.

Rose, E. (1999), "Consumption Smoothing and Excess Female Mortality in Rural India", The *Review of Economics and Statistics* 81(1): 41-9.

Rose, Pauline (2003), "Can Gender Equality in Education be attained?: Evidence from Ethiopia", *Background paper for 2003 UNESCO Global Monitoring Report*.

_____ and Al-Samarrai, S. (2001), "Household Constraints on Schooling by Gender: empirical evidence from Ethiopia", *Comparative Education Review*, Vol.45(1).

Schaffner, Julie (2003), "The determinants of schooling investments among primary school aged children in Ethiopia", report prepared for the World Bank.

Weir, Sharada (Forthcoming), "An examination of some mechanisms underlying externality benefits of girls' schooling", *Journal of Population Economics*.

Wolpin, K. I., 1982. " A new test of the permanent income hypothesis: the impact of weather on the income and consumption of farm households in India". International Economic Review, 23: 583-94

Table A.1 Primary School Completion Regression – Rural and Urban Ethiopia[1)]

Variable	Rural				Urban			
	Girls		Boys		Girls		Boys	
	Statistical Significance	Effect	Statistical Significance	Effect	Statistical Significance	Effect	Statistical Significance	Effect
Child age 13	No	0	No	0	Yes (1%)	0.147	Yes (1%)	0.252
Child age 14	No	0	No	0	Yes (1%)	0.287	Yes (1%)	0.355
Female head of household	No	0	No	0	No	0	No	0
Age of head of household	No	0	No	0	Yes (1%)	0.003	Yes (5%)	0.002
Single head of household	No	0	No	0	No	0	No	0
Schooling of household head	No	0	No	0	No	0	Yes (1%)	0.009
Other adult schooling	No	0	No	0	No	0	No	0
Log of per capita household expenditures	No	0	No	0	Yes (5%)	-0.037	No	0
Rain damage	No	0	No	0	No	0	No	0
EA- Average male adult literacy rate	No	0	No	0	No	0	Yes (5%)	0.203
EA- Average female adult literacy rate	Yes (10%)	0.126	No	0	No	0	No	0
Distance Primary School 1-2 km	No	0	No	0	Yes (5%)	-0.048	No	0
Distance Primary School 3-4 km	No	0	No	0	Yes (10%)	-0.078	No	0
Distance Primary School 5-6 km	No	0	No	0	No	0	No	0
Distance Primary School 7-12 km	No	0	No	0				
Distance Primary School > 13 km	No	0	No	0	No	0		
Distance to secondary school	Yes (5%)	-0.001	No	0	No	0	No	0
Distance to food market	Yes (5%)	0.003	No	0	No	0	No	0
Distance to health clinic	No	0	No	0	No	0	No	0
Distance to post office	No	0	No	0	No	0	No	0
Number of schools per capita	No	0	Yes (1%)	0.199	No	0	Yes (5%)	0.28
Population density	No	0	No	0	No	0	No	0
Student-teacher ratio	No	0	No	0	No	0	No	0
Percent female teachers	No		Yes (1%)	-0.003	No	0	Yes (10%)	0.003
Percent teachers with certification	No	0		0	No	0	No	0
Tigray	No	0		0	No	0	No	0
Amhara	No	0		0	No	0	Yes (5%)	0.312
Oromiya	No	0		0	No	0	Yes (10%)	0.26
Benshangul	No	0		0	Yes (10%)	0.246	No	0
SNPR	No	0		0	No		No	0
Harare	No	0	Yes (10%)	0.174	Yes (10%)	0.287	No	0
Year 2000 dummy	Yes (1%)	0.104	Yes (1%)	0.115	Yes (1%)	0.084	No	0
Number of Observations	2014		2290		2927		2731	

1) Coefficients are reported as marginal probabilities.

Table A2. Sample Statistics for Education Regressions – Rural and Urban Regressions

Variable	Urban		Rural	
	Female	Male	Female	Male
Currently enrolled	0.82	0.85	0.24	0.34
Child age 8	0.12	0.12	0.15	0.15
Child age 9	0.12	0.12	0.13	0.13
Child age 10	0.14	0.14	0.14	0.13
Child age 11	0.10	0.10	0.09	0.10
Child age 12	0.15	0.16	0.14	0.15
Child age 13	0.13	0.12	0.10	0.10
Child age 14	0.14	0.13	0.10	0.11
Female headed household	0.38	0.35	0.19	0.18
Age of household head	44.4	44.8	45.8	46.1
Single head of household	0.21	0.20	0.10	0.09
Years of schooling: household head	4.45	4.19	0.73	0.69
Years of schooling: other adult	4.06	3.80	0.39	0.35
log of per capita household expenditures	7.16	7.09	6.82	6.79
			0.23	0.24
EA - Average male literacy	0.77	0.77	0.33	0.33
EA - Average female literacy	0.52	0.53	0.09	0.09
Distance primary school 1-2 km	0.42	0.40	0.27	0.26
Distance primary school 3-4 km	0.05	0.05	0.25	0.26
Distance primary school 5-6 km	0.01	0.01	0.16	0.16
Distance primary school 7-12 km	0.00	0.00	0.11	0.11
Distance primary school > 13 km	0.00	0.00	0.02	0.03
Distance secondary school	2.49	2.57	23.54	23.58
Distance food market	1.31	1.22	6.83	6.80
Distance health clinic	1.42	1.45	8.89	9.07
Distance post office	2.81	2.88	24.30	24.27
Number of schools per capita	0.26	0.27	0.25	0.25
Population density	126.65	129.57	123.58	125.24
Student-teacher ratio	59.01	59.32	60.31	60.65
Percent female teachers	29.00	28.72	26.46	26.22
Percent teachers with certification	0.91	0.91	0.89	0.89
Tigray	0.13	0.12	0.07	0.07
Amhara	0.29	0.29	0.22	0.22
Oromiya	0.39	0.38	0.32	0.32
Benchangul	0.04	0.04	0.05	0.05
SNPR	0.11	0.12	0.31	0.31
Year 2000	0.59	0.60	0.67	0.67
N	2739	2629	5808	6299