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The Effect of Older Siblings' Literacy on School-Entry and Primary School Progress in the Ethiopian Highlands

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The effects of older sisters' and brothers' literacy on the annual school entry and primary school grade progress probabilities of boys and girls are estimated using within-household variation. Older siblings' literacy has positive effects, especially for same-sex siblings. The literacy of older sisters appears to be more beneficial than that of older brothers, not least since it has positive effects on school entry among both boys and girls, and since it has positive effects also when the sister has left the household. There are positive effects both from literate older siblings who left school and from literate older siblings who are still in school. This suggests that within-household education spillovers, rather than time-varying credit constraints, explain the positive sibling-dependency, since with credit constraints children in school would compete over scarce resources. The positive effects on school progress are limited to same-sex siblings who are still present in the household, suggesting every-day interactions to be important.

Keywords: Primary education, Ethiopia, Within-Household, Spillovers, Credit-Constraints

JEL-codes: I21, D13

1. Introduction

There is a general consensus on the importance of parents' education for the education of their children. Increasing the schooling of today's children should thus have positive spillovers on the schooling of future generations. But is there a more immediate effect of educating a child on the education of her siblings? Little is known about this, and the answer has implications for all policies directed towards the education of individual children.

The effect of older sisters' and brothers' literacy on girls' and boys' primary schooling is here investigated, using data from the rural Amhara region in Ethiopia, a place where until recently most individuals have had very limited experience with formal education.

The annual conditional school entry and school progress probabilities for 6-16 year old girls and boys from 2000 to 2006 are estimated. To control for unobserved parental characteristics, a linear probability model with household fixed effects is used. This is important since older siblings' education is clearly endogenous to parents' attitudes to education and child human capital investments.

Theoretically there are reasons to expect both positive and negative effects of siblings' education, making the direction of a possible effect an empirical question. First, the total effects of older siblings' literacy on the school entry and school progress probabilities are estimated. Next, an attempt is made to answer which mechanisms created the effects, focusing on the role of time-varying credit constraints and within-household spillovers. The focus is on these two mechanisms since the total effects turn out to be positive and they could create positive sibling-dependency.

To differentiate between the mechanisms, literate older sisters and brothers are divided into those who were still in school and those who had left school. With time-varying credit constraints, we would expect positive effects of older siblings who had left school, but negative effects of older siblings who were still in school. Positive within-household spillovers would be expected both if older siblings were in school and if they had left school. To evaluate the importance of everyday interactions, literate older siblings are also divided into those who were still living in the household and those who were not.

Previous studies have investigated the effect of child-specific conditional cash transfers on education of siblings, where the cash transfer programme is an external intervention that should be unrelated to unobserved parental characteristics. In spite of an expected positive income effect, Barrera-Osorio et al. (2008), using data from Colombia, find a negative effect on schooling of having a sibling in the programme. Possible reasons could be a reallocation of household responsibilities across siblings or a diversification motive. Ferreira et al. (2009) find no effects of a Cambodian cash-transfer programme on schooling of siblings, even if the cash transfer was of a relatively smaller size than in Colombia. Both programmes were targeted towards increased secondary education.

While the literature on schooling effects of siblings' education is sparse, that on the effects of number and gender of siblings, and of birth order in the sibship, is large, despite the fact that number of siblings, just as education, is likely to be endogenous to unobserved parental preferences. According to the hypothesis on a child quantity-quality tradeoff, parents will beforehand make decisions about the number of children and how much to invest in their human capital (Becker and Lewis, 1973).

Sibling gender and relative birth order should be largely exogenous.[1] In developing countries, it is often found to be advantageous to be a later-born in the sibship. This is consistent with an impeding role of poverty and credit constraints for children's schooling, since parents' income tends to increase over time (Parish and Willis, 1993) and since older siblings can contribute to household income when they start working (Emerson and Souza, 2002; Chesnekova and Vaithianathan, 2008). Some authors have found a positive effect of having older sisters rather than brothers, and have therefore suggested that older sisters' work often makes younger siblings' education possible (Parish and Willis, 1993; Glick and Sahn, 2000; Morduch, 2000).

In developed countries, a negative effect of number of siblings, consistent with a child quantity-quality tradeoff, is often found. Also consistent with a quantity-quality tradeoff is the fact that the negative effect is usually reduced when instruments such as twin-births are used (Black et al., 2005; Booth and Joo Kee, 2009). In developing countries, and especially in Africa, it is, however, common to find positive sibship

[1] Sibling gender might not be completely exogenous in countries with strong son preferences and gender-selective abortions. However, this is not relevant in Africa.

effects (Chernichovsky, 1985). Some argue that this could be explained by the important role of the extended family in Africa; the additional costs of many children are absorbed in the larger extended family. Cornwell et al. (2005) find that more school-age children increases schooling for black South-African teenagers, and explain this with economies of scale in schooling and the creation of a 'culture of schooling'.

The remainder of this study starts with a theoretical discussion on mechanisms that could create sibling-dependency in education. This is followed by a section on the data, and one on the empirical approach. Section 5 presents the empirical results and Section 6 a discussion, and Section 7 concludes the paper.

2. What could create sibling-dependency in education?

Economic theory on education is dominated by human capital theory, which stipulates that investments in children's schooling are made as long as the marginal benefit exceeds the marginal cost (Becker, 1962; Ben-Porath, 1967). In the simple model, neither the presence of siblings nor their education matter for schooling.

Market imperfections, however, change this simple picture. Credit constraints have received most attention in the literature (Jacoby, 1994; Edmonds, 2006a; Gitter and Barham, 2007). Without perfect access to credit the schooling decision cannot be separated from decisions on the inter-temporal allocation of consumption; a poor household might not be able to afford costly schooling investments in spite of high expected future returns. With credit constraints, competition for scarce resources in the household creates negative sibling-dependency in education, especially among closely spaced siblings (Jacoby, 1994; Morduch, 2000)[2]. On the other hand, credit constraints can be eased by higher income contributions from better educated older siblings (Emerson and Souza, 2008; Chesnekova and Vaithianathan, 2008). With credit constraints, there are thus reasons to expect both positive and negative effects of older siblings' education, depending on whether or not they are still in school.

[2] There is also a large literature on competition over scarce resources, or resource dilution, in sociology where authors tend to have both limited financial resources and parental time in mind (Blake, 1989).

Labour market imperfections are also of relevance. Household labour is likely to be either the only source of household and farm labour available or at least considerably more cost-effective than hired-in labour. In a seminal paper, Bhalotra and Heady (2003) show how labour market imperfections could make child work more frequent in households owning more land, since the marginal product of (child) labour is higher in these households. Along the same lines, Edmonds (2006b) argues that education inequality across siblings could often be explained by differences in marginal productivity of child time at alternative activities. If household and farm work is shared by household members, the schooling decisions for different siblings cannot be separated from each other and neither can they be separated from decisions on household and farm production. It has for example been found that the presence of pre-school age children decreases schooling for girls, while the presence of other school-age girls has the opposite effect. These links are most likely due to the different effects on girls' household responsibilities (Glick and Sahn, 2000). If work is shared by household members and the time spent in school is increased for one child, the consequence could be that the burden of household duties and farm work is increased for other children in the household (Barrera-Osorio et al., 2008). While the presence of older siblings in the household should be beneficial, given their presence, their schooling coulde have a negative effect on the education of younger siblings.

Since the presence of siblings and their education should not matter in the simple human capital model, many have argued that any presence of sibling effects indicates credit constraints (Jacoby, 1994; Morduch, 2000; Sawada and Lokshin, 2009). Yet, as described, sibling effects could also be the outcome of differences in marginal productivity of time when labour markets are imperfect. However, another possibility is that siblings and their education directly affect costs and benefit, either actual or perceived or both. Such effects will hereinafter be referred to as within-household spillovers.

One source of such spillovers could be economies of scale in schooling; the additional cost of having one child more in school could be lower than the cost of having the first child in school (Cornwell et al., 2005). Children could accompany each other to school, and they may share books, clothes or school uniforms. Children could also enhance each other's learning and thus increase the benefits of schooling.

Using examples from Bangladeshi and Anglo children living in East London, Gregory (2001) finds evidence of sibling 'synergies', where older children teach younger siblings and by doing so also develop their own learning.

Spillovers could also be the result of siblings' influence on each other's and parents' attitudes and beliefs. The perceptions of costs and benefits of education could change in view of the siblings' experience of education. Beenstock et al. (2008) argue that interaction between siblings, which could supposedly both enhance learning and influence beliefs and attitudes, is an important factor behind sibling correlation in schooling and in earnings in Israel. Cornwell et al. (2005) argue that a 'culture of schooling' can be created in the household when one child is educated. They also suggest that a positive effect of migrant household members on girls' schooling could be explained by the increased knowledge about the benefits of schooling. In an experiment in a neighbourhood with few well-educated individuals in Santo Domingo, the Dominican Republic, Jensen (2010) shows the importance of perceived benefits of education for schooling decisions and how provision of information on returns to education can increase schooling. The effects of siblings' education on perceived benefits might be especially important in a setting such as rural Amhara, with very limited experience of formal education.

The studies on the effect of child-specific conditional cash transfers on the education of siblings in Colombia (Barrera-Osorio et al., 2008) and Cambodia (Ferreira et al., 2008) were mentioned earlier. One reason for the more beneficial outcome of the Cambodian programme could be that the money was received during ceremonies where the benefits of formal education were stressed. This might well have changed parents' view on the value of schooling.

Lastly, the returns to education are uncertain, and the riskiness associated with human capital investments could mean that parents want to diversify. This would result in negative sibling-dependency (Lilleør, 2008). In a companion paper (Lindskog, 2011), a possible desire to diversify household human capital investment is specifically investigated, by studying sibling-dependency in education in households with differently risk averse head, using the same Ethiopian data as in the present paper.

3. The data on children's primary schooling in rural Amhara

The data used in this study is from the Ethiopian Environmental Household Survey (EEHS). The sampled households come from 13 Kebeles[3] in the South Wollo and East Gojjam zones of the Regional State of Amhara. The two zones were chosen to represent different agro-climatic zones in the Ethiopian highlands, with less rainfall in South Wollo than in East Gojjam. Most households, in the sample and in the study areas, make their living on rain-fed subsistence agriculture. Access to roads and capital markets is limited in the areas.

To date, four rounds of data have been collected, in 2000, 2002, 2005 and 2007. Most of the information on children's education was collected in the fourth round, where respondents were asked about the schooling history of all household members age 6 to 24. Data was also collected for household members no longer residing in the household, yet less successfully.

The fourth round of data was used to create an annual panel, from 2000 to 2006, on entry into first grade and primary school progress. Interviews were conducted in April/May, i.e. at the end of the Ethiopian school year (September-June). Since children enter school in September and complete grades in June, there is information on school entry and grade progress only until 2006. The panel starts in 2000 since the first round of data collection took place in April/May that year, and explanatory variables use information from the last preceding round.

In the total sample from the fourth round, there are 5549 children from 1674 households. Disregarding children without older siblings reduces the sample to 2783 children from 936 households. Leaving out first-born girls and boys clearly means that the sample is not representative of all children in rural Ethiopia, but only of children with older sisters and brothers. Moreover, households with young and small families are more likely to be excluded from the sample. If small families are different in terms of human capital investments, as suggested by the quantity-quality tradeoff hypothesis, the sample becomes unrepresentative also at the household level. A comparison of households excluded from the sample due to lack of children with

[3] A Kebele is the smallest administrative unit in Ethiopia. In rural areas it is more or less equivalent to a village, while in larger cities it comprises a neighbourhood.

older brothers and sisters with other households (in Table 1) shows that the excluded households are both smaller and younger, but they do not differ with respect to literacy of the household head and spouse or school entry and progress of young household members.

Table 1: Comparison of households without children with older sisters and brothers with other households

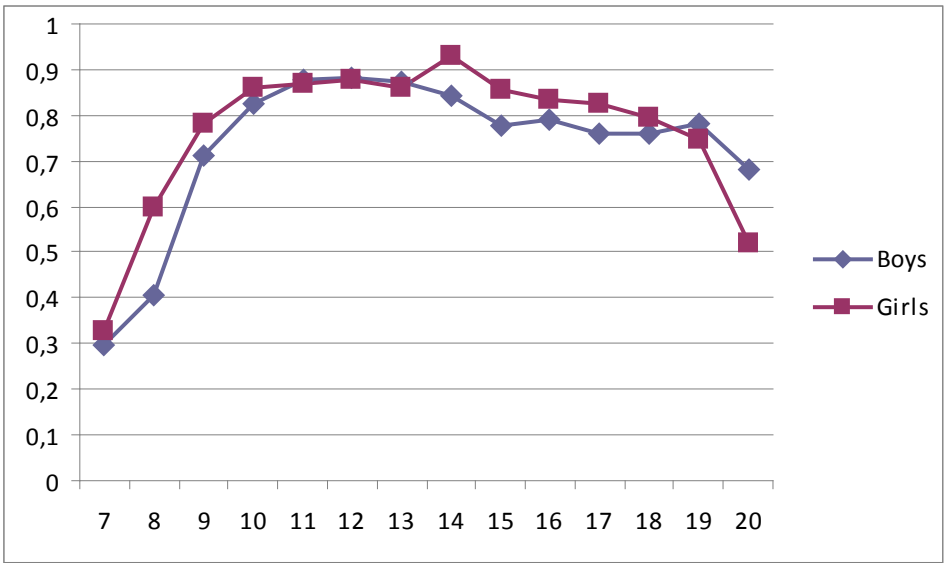
	Excluded households		Included Households			
	Mean	St. dev.	Mean	St. dev.	Difference	St. dev.
Entry rate	0.208	0.183	0.193	0.148	0.016	0.011
Progress rate	0.931	0.142	0.936	0.123	-0.005	0.010
Literate head	0.429	0.495	0.447	0.497	-0.019	0.032
Literate spouse	0.214	0.406	0.215	0.411	-0.000	0.028
Household size	3.057	2.489	6.079	1.907	-3.021***	0.142
Age of head	46.711	16.587	49.573	12.035	-2.862***	0.993
Asset index	12.705	28.003	15.190	27.559	-2.484	1.802

* = p<0.10, **= p<0.05, ***= p<0.01

There are 2767 children with non-missing school entry data from 2000 to 2007, and 1173 children with non-missing school progress data. Of the children without progress data, 36.2% had never started school, data is inconsistent for 34.3% and data is missing for 29.5%.

Figure 1 shows the share of boys and girls of different ages who had ever attended school in 2007. Late entry is common among both girls and boys, but more so among boys. It is also clear that schooling increased relatively recently: after age 13 for boys and age 15 for girls, the share who had attended decrease with age.

Figure 1: Share of boys and girls who had ever attended school in 2007, by age.



The increasing share of children who attended school is a result of a massive primary school expansion in Ethiopia since the mid-1990s; from 1994/95 to 2005/06 the primary school gross enrolment rate in Ethiopia rose from 34.0% to 91.3%, and the gender parity index narrowed from 0.6 in 1997/98 to 0.84 in 2005/2006. In Amhara the net enrolment in 2004/2005 was 54.6% for boys and 53.1% for girls, making Amhara one of few regions with similar enrolment rates for girls and boys. As is common with such large expansions in enrolment though, the numbers of teachers and classrooms have not increased at pace with the number of pupils, raising concerns about reduced quality (Oumer, 2009; Ministry of Education, 2005; World Bank, 2005).

4. Empirical model

Completed schooling is the outcome of several sequential decisions: first on school entry then on school continuation. In this paper we separately estimate the annual conditional school entry and primary school grade progress probabilities.

The official school start age in Ethiopia is 7, but some start at age 6, and it is also common to start later, particularly in rural areas. In the empirical analysis, a child is classified as eligible to enter school if he or she is 6-16 years old and has not started previously. If someone who is eligible to enter school does not, it means that he or she

will never start school or will start later. A child is eligible for primary school grade progress if he or she is in primary school and is aged 6-16 years old. Failure to progress is due either to grade repetition or due to quitting school.

Essentially, the annual conditional school entry and grade progress probabilities are discrete-time "hazards". The advantage of estimating the annual school entry probability rather than duration until (or age at) school entry is that the data can be fully used while avoiding censoring problems. There is no need to restrict the sample to children old enough to know that most of those who haven't entered will not do so later. This is especially useful for the results to remain relevant in a situation, such as Ethiopia, where schooling has increased massively in recent years.

The main explanatory variable, literacy of older siblings, is clearly endogenous to parental characteristics that affect decisions on education of all children in a family. Some of these characteristics, such as parental attitudes towards formal education and investment in child human capital in general (education and health), are unobservable. To control for unobserved household characteristics, I use household fixed effects in a linear probability model. The fixed effects will capture the effect of many variables commonly considered to be important for children's schooling, e.g. permanent income and education of the household head and spouse.

There may still be problems of time-varying shocks to the households, affecting the education of all children in a household. Older siblings' education is lagged, something that would deal with shocks in a model without fixed effects. Yet with fixed effects, there must be strict exogeneity; that is, the explanatory variables should be uncorrelated with lags and leads of the error term (Arellano, 2003). In an attempt to deal with time-varying shocks, I include health and environmental shocks among the explanatory variables. Health shocks are deaths or illnesses of household members, and environmental shocks are mainly floods and droughts, but also other weather-related shocks and pests that hit plants or animals. The shock dummies measure whether a shock occurred at least once during the period between survey rounds.[4]

[4] If there was a shock during 2005-2006, the dummy was set to equal one for both these years. While there is information about the timing of the last shock in the data, there is no information about the timing of earlier shocks, so an annual shocks series could not be created. Estimations using an index of wealth in the preceding round instead of shocks where also run, which did not qualitative affect results.

Older siblings' education is measured by their literacy. Though a rough indicator of education, it has the advantage of few missing values. Literacy is measured by the number of literate older siblings. Since also the total number of older siblings is included this measures their literacy. The effect of older siblings could depend on gender, hence, older sisters are differentiated from older brothers and estimations are done separately for girls and boys. The number of older sisters and brothers and the number of older literate sisters and brothers are from the last preceding survey round and include both siblings who were living in the household and siblings who had left. In some estimations, a distinction is made between older literate siblings who were still in school and those who had left school and between older literate siblings who were living in the household and those who had left the household.

The model also controls for the year and for child age in years. Year dummies capture both the effect of the massive expansion of primary education during the study period and the possible effect of aging of households in the panel. Table A1 in the appendix report summary statistics of all variables.

5. Results

This section first presents results from the main regressions of the annual school entry and school progress probabilities on literacy of the child's older sisters and brothers (Table 2). Thereafter Table 3 reports regressions differentiating between literate siblings who were still in school and those who had another main activity, and Table 4 reports regressions differentiating between literate siblings who were still living in the household and those who had left.

Literacy of older siblings positively influences schooling of younger siblings. Both girls' and boys' school entry probabilities are more positively affected by older sisters' literacy than by older brothers' literacy; if an older sister is literate the school entry probability increases by 0.082 for girls and by 0.090 for boys, while if an older brother is literate the school entry probability increases by 0.041 for girls and by a smaller and not statistically significant amount for boys.

Since income and wealth could be endogenous to older siblings' education, the shocks variables were preferred despite their limitations.

Table 2: Effect of older siblings' literacy on primary schooling – Coefficients from linear probability models with household fixed effects.

	The annual school entry probability		The annual primary school progress probability	
	Girls	Boys	Girls	Boys
	(2)	(1)	(4)	(3)
Age in years	0.018***	0.033***	-0.016**	-0.012*
	(0.007)	(0.006)	(0.008)	(0.007)
Year 2001	0.074**	0.069**	0.020	0.001
	(0.029)	(0.027)	(0.029)	(0.028)
Year 2002	0.110***	0.116***	0.004	0.026
	(0.035)	(0.031)	(0.034)	(0.032)
Year 2003	0.206***	0.167***	-0.032	0.033
	(0.039)	(0.035)	(0.038)	(0.031)
Year 2004	0.174***	0.126***	-0.024	0.059
	(0.049)	(0.045)	(0.044)	(0.039)
Year 2005	0.250***	0.230***	-0.018	0.056
	(0.051)	(0.044)	(0.049)	(0.042)
Year 2006	0.281***	0.169***	-0.001	0.074
	(0.059)	(0.050)	(0.053)	(0.046)
Health shock	0.006	0.006	-0.008	0.011
	(0.041)	(0.039)	(0.026)	(0.017)
Environmental shock	-0.037	0.007	-0.018	0.007
	(0.035)	(0.036)	(0.020)	(0.016)
Number of older sisters	0.002	-0.004	0.010	-0.007
	(0.022)	(0.020)	(0.017)	(0.013)
Number of older brothers	-0.014	0.055***	-0.013	-0.027
	(0.028)	(0.020)	(0.028)	(0.018)
Literate older sisters	0.082***	0.090***	0.050**	0.019
	(0.031)	(0.028)	(0.022)	(0.024)
Literate older brothers	0.041*	0.022	-0.004	0.040**
	(0.025)	(0.021)	(0.020)	(0.016)
Constant	-0.151	-0.444***	1.090***	1.048***
	(0.102)	(0.090)	(0.101)	(0.090)
Observations	2114	2382	1865	1910
Children	693	785	515	564
Housholds	496	540	398	425

Standard errors, clustered at the household, in parentheses.
All estimations also include age, year dummies, a household wealth index, and a constant.
* = p<0.10, **= p<0.05, ***= p<0.01

Among girls, the primary school progress probability is more positively influenced by older sisters' than older brothers' literacy (0.050 compared to a close to zero and statistically insignificant effect), while among boys, it is more positively

influenced by older brothers' literacy (0.040 compared to a smaller and statistically insignificant effect).[5]

The number of older brothers has a positive effect on boys' school entry. But since first-born boys are not included in the sample, this says nothing about the difference between being first born and later born. Also, since only within-household variation is used for identification, it says nothing about the difference between families with more or fewer children. Among a given number of brothers, it thus appears beneficial to be as young as possible.

Turning to other explanatory variables, age increases the annual school entry probability, reflecting that late school entry is common. And, as should be expected, age decreases the annual school progress probability, since older children are more likely to quit school. The omitted reference year is 2000, and the coefficients of year dummies thus show that the probability that a child enters school increased during 2000-2006, and more so for girls than for boys. However, school progress does not seem to have changed much during 2000-2006. Last, there are no statistically significant effects of the shock variables.

Older siblings' literacy seems to have beneficial effects on younger siblings' primary schooling for the children in rural Amhara. But why is this so? In the theoretical discussion, two mechanisms that could cause positive sibling dependency were brought up; time-varying credit constraints and within-household spillovers.

With credit constraints we would expect older siblings still in school to have a negative effect on primary schooling of younger siblings. But we would expect a positive effect of older siblings who have left school and who have started to contribute to household income. Positive within-household spillovers, on the other hand, could arise both from older siblings in school and from literate older siblings who have left school. In the regressions presented in Table 3, a distinction is therefore

[5] For boys, the null hypothesis of an equal effect of older sisters' and older brothers' literacy is rejected at the ten percent level for school entry (F-statistic=3.73), while it cannot be rejected for school progress. For girls, the null hypothesis is instead rejected at the ten percent level for school progress (F-statistic=2.94), while it cannot be rejected for school entry.

made between literate siblings who were still in school and those with another main activity.[6]

Table 3: Effect of literate siblings who were still in school and of those who had left school on primary schooling: Coefficients from linear estimations with household fixed effects.

	The annual school entry probability		The annual school progress probability	
	Girls	Boys	Girls	Boys
	(2)	(1)	(4)	(3)
Number of older sisters	0.005	-0.007	0.010	-0.006
	(0.022)	(0.020)	(0.017)	(0.013)
Number of older brothers	-0.008	0.052**	-0.013	-0.025
	(0.030)	(0.021)	(0.028)	(0.017)
Literate sisters in school	0.089**	0.075**	0.030	0.038
	(0.038)	(0.036)	(0.030)	(0.029)
Literate brothers in school	0.026	0.030	-0.006	0.035**
	(0.030)	(0.025)	(0.024)	(0.016)
Literate sisters who had left school	0.083***	0.090***	0.051**	0.021
	(0.031)	(0.028)	(0.021)	(0.024)
Literate brothers who had left school	0.038	0.023	-0.004	0.040**
	(0.025)	(0.021)	(0.020)	(0.016)
Observations	2114	2382	1865	1910
Children	762	853	524	587
Households	532	564	404	437

Standard errors, clustered at the household, in parentheses.
All estimations also include age, year dummies, a household wealth index and a constant.
* = p<0.10, **= p<0.05, ***= p<0.01

Whether or not an older sibling is still in school, the effects of their literacy appear to be positive – not negative. Moreover, the beneficial effects are fairly similar for older siblings who were in school and literate older siblings who had left school. Hence, positive sibling-dependency cannot be explained only with time-varying credit constraints – spillovers are also of importance. If an older sister was in school rather than illiterate, the annual school entry probability increases by 0.089 for girls and 0.075 for boys. If she was literate and had left school, the annual school entry probability increases by 0.083 for girls and 0.090 for boys. However, there is also a statistically significant increase in girls' annual school progress probability when the literate older sister had left school. If an older brother was in school rather than illiterate, boys' school progress probability increases by 0.035. If a literate older brother had left school, boys' school progress probability increases by 0.040.

[6] In the fourth round the most common activities of non-household heads, age 15-29, who did not study, were: farming (41%), domestic work (28%), non-farm work (17%), and looking for work (10%).

The regressions presented in Table 4 differentiate between literate older siblings who were still living in the household and those who had left. How do the effects depend on the presence of a sibling in the household? There should be a larger potential for positive interactions between siblings if they live together. If such everyday interactions are important for beneficial effects of older siblings' literacy on children's primary schooling, the beneficial impacts should of course mainly come from siblings in the household. However, we cannot with certainty differentiate between the importance of time-varying credit constraints and positive within-household spillovers with the results in Table 4. Larger effects of siblings in the household could be due to higher income contributions when they are still part of the household. Larger effects of siblings who have left the household could be due to changed perceptions of the benefits of schooling if the literate older sibling seems to be doing well, or it could be due to income contributions to the household of origin.

Table 4: Effects of literate siblings who lived in the households and of those who had left on primary schooling: Coefficents from linear estimations with household fixed effects.

	The annual school entry probability		The annual school progress probability	
	Boys	Girls	Boys	Girls
	(1)	(2)	(3)	(4)
Number of older sisters	-0.004	0.001	-0.007	0.010
	(0.020)	(0.022)	(0.013)	(0.017)
Number of older brothers	0.056***	-0.013	-0.024	-0.015
	(0.020)	(0.027)	(0.018)	(0.029)
Literate sisters in the household	0.084***	0.079**	0.031	0.051**
	(0.030)	(0.032)	(0.029)	(0.022)
Literate brothers in the household	0.026	0.056**	0.041**	-0.008
	(0.022)	(0.026)	(0.016)	(0.019)
Literate sisters that left the hh	0.193	0.487***	-0.104	0.049
	(0.132)	(0.154)	(0.099)	(0.033)
Literate brothers that left the hh	-0.021	-0.103	0.017	0.033
	(0.051)	(0.066)	(0.055)	(0.073)
Observations	2382	2114	1910	1865
Children	853	762	587	524
Households	564	532	437	404

Standard errors, clustered at the household, in parentheses.
All estimations also include age, year dummies, a household wealth index and a constant.
* = p<0.10, **= p<0.05, ***= p<0.01

Literate older sisters who lived in the household positively influenced school entry of both girls and boys, but only school progress of girls. If an older sister was literate and living in the household, the annual school entry probability increased by

0.079 for girls and by 0.084 for boys. Girls' annual school progress probability increased by 0.051. Literate older brothers who lived in the household had a positive effect on school entry for girls, increasing the annual school entry probability by 0.056, and on school progress for boys, increasing the annual school progress probability by 0.041.

Literate older sisters who had left the household has a huge positive effect on girls' school entry, increasing the annual probability of school entry by 0.487. There was also a large estimated effect on boys' school entry (0.193), yet it was not statistically significant. There were no statistically significant effects of literate older brothers who had left the household. Also, there were no positive effects of literate older siblings, regardless of gender, who had left the household; only of same-sex siblings still living in the household.

6. Discussion

First on annual school entry probabilities, literacy of older sisters seems to be more beneficial than literacy of older brothers for both boys and girls. Moreover, literate older sisters, as opposed to brothers, have beneficial effects even if they have left the household. Although there is a positive effect of older sisters in the household on girls' school entry, the effect of sisters who have left the household is much larger. Also for boys, the estimated effect of sisters who have left the household is larger than that of sisters still living in the household, yet the coefficient has a large standard error and is not statistically significant. The beneficial effect of older sisters who had left suggests that older sisters fare better when leaving the household if they are literate, something that could both increase their possibility to help the household of origin (easing credit constraints) and serve as a positive example of the benefits of schooling, in particular for girls.

There are different possible reasons as to why literate older sisters could fare well when leaving the household of origin. First, their own income earning capacity probably increases. The fact that over 50 percent of female household members who left the household age 10-25 did so to marry suggests that it is also important how literate girls manage in the marriage market. Fafchamps and Quisimbing (2005) find

substantive assortative matching in the marriage market in rural Ethiopia, where matching on human capital of spouses is becoming increasingly important. They also show that the lion's share of resources of the newly formed household comes from the groom and his family, and that gifts from the groom's to the bride's family are comparatively small. Hence, better educated older sisters probably end up in a wealthier new household. Moreover, their bargaining power in the new household is probably larger. Fafchamps et al. (2009) suggest cognitive ability to be important for intra-household bargaining power in rural Ethiopia.

Literate older brothers positively influence the annual school entry probability of girls, but only if the older brothers still live in the household. When differentiating between literate older brothers in school and literate older brothers who have left school, both coefficients become statistically insignificant. Since presence of an older brother in the household matters and the effect does not appear to differ depending on whether they are still in school, some sort of spillover seems to be a more likely explanation than income contributions easing credit constraints.

The number of older brothers has a positive effect on boys' school entry. To have more older brothers is good for boys, and it does not matter if they are literate or not. One possible explanation for this is that sons are expected to work on the family farm and later inherit it. With more sons, the work of the youngest son might not be needed, and parents might prefer to give him more formal education instead of preparing him to inherit the farm, i.e. behind this could be a low current opportunity cost of the boys' time, a low expected return to learning by doing in the field (if he is not expected to inherit the land), and a household-level diversification motive.

Turning to annual school progress probabilities, the positive effects of older siblings' literacy were limited to same-sex siblings, and while they did not differ depending on whether the older sibling was still in school or not, they do seem to depend on the presence of the older sibling in the household. This suggests that older siblings' income contributions are not important in this context, but that everyday interactions are. Interaction with same-sex older literate siblings can probably enhance a child's learning. Such effects on learning should be more important for school progress than for school entry. Everyday interactions could also have important effects on attitudes and beliefs.

The positive effects of older siblings' literacy on younger siblings' schooling found in this study contradict the results from studies on the impact of child-specific conditional cash transfers on siblings' education in Colombia (Barrera-Osorio et al., 2008) and Cambodia (Ferreira et al., 2008). These studies of course differ from the present one in many important ways, but a potentially central one that may explain the difference in results is that they estimate immediate effects while this study is likely to capture more long-run effects. Reallocation of household work duties is for example likely to matter mostly in the short run. Another potentially important difference is the very limited experience with any level of formal education in rural Amhara, and that the above studies investigate the effect of increased secondary education while the present study investigates the effect of a very modest level of education (literacy). The effect of a modest level of education in a place with little formal education may be very different from that of more secondary education in places where it is common to have at least some primary education.

7. Summary and conclusions

This paper investigates the effects of older sisters' and brothers' literacy on younger siblings' annual school entry and primary school progress probabilities, using only within-household variation and distinguishing girls from boys. Theoretically, there are reasons to expect both positive and negative effects.

Older siblings' literacy turns out to have positive effects on primary schooling of younger siblings. Overall, the beneficial impact of an older sister's education appears to be larger than that of an older brother's education. If an older sister is literate, the annual school entry probability increases by 0.082 for girls and by 0.090 for boys. If an older brother is literate, girls' annual school entry probability increases by 0.041. Boys' annual school entry probability instead increases when they have more older brothers, independent of their literacy. This could be since the boys' work is not needed on the farm and since they are not, as boys with fewer older brothers, expected to inherit the land.

Beneficial effects on school progress are limited to same-sex siblings, i.e. older sisters' literacy favours girls' school progress, increasing the annual probability by

0.050, and older brothers literacy favours boys' school progress, increasing the annual probability by 0.040.

So what can explain the positive effects of older siblings' literacy? From the theoretical discussion, two candidate explanations are time-varying credit constraints, eased by higher income contributions from better educated older siblings, and within-household spillovers, affecting actual or perceived benefits and costs of schooling (siblings could for example share books, walk or ride to school together, enhance each other's learning, and affect each other's beliefs about the benefits of schooling). With the credit-constraint explanation, we expect a negative effect of older literate siblings who are still in school (due to competition over scarce resources), but a positive effect if they have left school. A distinction is therefore made between literate siblings who are still in school and those who are mainly involved in something else. Moreover, to evaluate the importance of everyday interactions, regressions differentiating between literate older siblings who live in the household and those who have left it are made.

The effects of literate older siblings in school and of those who have left school turn out to be similar, suggesting an important role of spillovers. Moreover, effects of same-sex older literate siblings on school progress appear to depend on their presence in the household, suggesting an important role of everyday interaction. Girls' interaction with older literate sisters and boys' interaction with older literate brothers could probably enhance their learning, which should be more important for school progress than for school entry.

While literacy of older brothers seems to have beneficial effects on schooling only if they still live in the household, literacy of older sisters appears to matter also if they have left the household. Literate older sisters who have left have a huge positive effect on girls' annual school entry probability, increasing it by 0.487; the estimated effect on boys' school entry is also large (0.193), but statistically insignificant. This suggests that literate older sisters fare better than illiterate ones after leaving the household, making it possible for them to help their household of origin, but possibly also serving as a good example of the benefits of schooling, especially for girls.

Though there is little evidence on within-household spillovers other than from parents in the literature, it is not surprising to find them considering the large effects

of parents' education usually found. However, it is quite possible that interaction with educated older siblings has a larger effect when parents have little education, i.e. that parents' and older siblings' education are substitutes. Under circumstances similar to those in rural Ethiopia in the last 15 years, where education has been heavily expanded from a very low initial level, older siblings' education may be especially important. Thus, there are reasons to do research on within-household spillovers under different circumstances.

8. References

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Appendix

Table A1: Variables and summary statistics

Variable	Obs	Mean	Std. Dev.
Age in years	8081	11.116	2.977
Year=2000	8081	0.117	0.322
Year=2001	8081	0138	0.345
Year=2002	8081	0.143	0.350
Year=2003	8081	0.141	0.348
Year=2004	8081	0.163	0.369
Year=2005	8081	0.156	0.363
Year=2006	8081	0.141	0.348
Health shock	8059	0.178	0.383
Environmental shock	8059	0.347	0.476
Number of older sisters	8081	2.138	1.180
Number of older brothers	8081	2.277	1.281
Number of literate older sisters	8081	0.778	0.891
Number of literate older brothers	8081	1.416	1.165
Number of literate older sisters who were in school			
Number of literate older brothers who were in school			
Number of literate older sisters who lived in the household			
Number of literate older brothers who lived in the household			