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Philip H. Brown
Colby College

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Abstract

The landmark study of race and education in the United States known as the "Coleman Report" (Coleman et al. 1966) concluded that family characteristics are more important determinants of educational achievement than school quality or teacher experience, particularly in the early stages of schooling. From this result sprang two prominent lines of academic inquiry. The first focuses on so-called education production functions (e.g., Hanushek 1997), with an eye toward cost-benefit analyses of various investments in teachers and schools. These studies often pay little attention to family background variables, treating them as exogenous controls. The second line of inquiry seeks to promote social policies that foster student achievement by studying why family background has such a pronounced effect on children's acquisition of human capital.

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I. Introduction

The landmark study of race and education in the United States known as the "Coleman Report" (Coleman et al. 1966) concluded that family characteristics are more important determinants of educational achievement than school quality or teacher experience, particularly in the early stages of schooling. From this result sprang two prominent lines of academic inquiry. The first focuses on so-called education production functions (e.g., Hanushek 1997), with an eye toward cost-benefit analyses of various investments in teachers and schools. These studies often pay little attention to family background variables, treating them as exogenous controls. The second line of inquiry seeks to promote social policies that foster student achievement by studying why family background has such a pronounced effect on children's acquisition of human capital.

Among the latter group, Behrman et al. (1997) find that rural Pakistani children whose fathers completed junior secondary school score 31% higher on reading tests and 29% higher on mathematics tests than children whose fathers did not. Similarly, Case and Deaton (1999) show that the head of household's education influences literacy and numeracy scores for black South African high school students. These relationships have generally been found to be robust to the inclusion of various household, school, and community-level characteristics, suggesting that parental education has a real effect on children's human capital acquisition (Strauss and Thomas 1995). In addition, Glewwe and Jacoby (1994) find a strong relationship between mother's education and mathematics and reading test scores using matched household-school data from Ghana. The fact that father's education does not also strongly

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influence child learning in this study suggests that human capital investments may depend on both parent and child gender, a finding consistent with the conclusions of Lillard and Willis (1994) for Malaysia and Thomas (1994) for Brazil, Ghana, and the United States.

Still, the reasons that parental education has such a pronounced effect on child learning are not very well understood. One explanation that is often posited is that more educated parents make greater investments in children's human capital (Strauss and Thomas 1995) by providing higher levels of goods and services that complement learning and by devoting more time to their children.[1] However, more educated parents in poor households without access to credit may face a trade-off between providing more goods and allocating more time to interacting with their children. Specifically, more educated parents may receive higher wages and thus may have a higher opportunity cost of time spent outside the workplace. Such parents may forgo some time spent interacting with children to spend more time working and may make greater investments in goods for their children's human capital production as a result. Alternatively, parental education may increase the efficiency or effectiveness of the time spent interacting with children, and more educated parents may thus forgo some time spent working in order to make greater time investments in their children's human capital. However, if the returns to education are higher for the children of more educated parents or if parental education positively influences parental preferences for children's education, then more educated parents may make greater investments in both goods and time, even in poor households. Unfortunately, in the absence of very restrictive assumptions about the functional form of the human capital production function and about the degree of substitutability of goods and time in human capital production, theory has little to say about the effect of parental education on investments in children's human capital.[2]

Whether and how more educated parents make greater investments in their children's human capital are thus important empirical questions. Due to data limitations, however, relatively few empirical studies have been undertaken. Sathar and Lloyd (1994) investigate the impact of parental education on educational expenditures using survey data from Pakistan. They find that household spending on children's education is up to 75% higher if mothers ever attended school relative to households wherein mothers did not. Similarly,

[1] Hereafter, the term "goods" will refer both to goods and to services used in human capital production.

[2] Comparative static results showing ambiguous effects of parental education on investments for simple models featuring Cobb-Douglas human capital production and quasilinear human capital production are available from the author on request.

Behrman et al. (1999) analyze how mother's education affects parental time allocation using household data from India. Controlling for workforce participation, they find that literate mothers spend more time than illiterate mothers on total time allocated to "home care," which is defined as caring for children and performing household chores. These results suggest that more educated parents may make greater investments in both goods and time, although neither article addresses this question specifically.

Using a survey of children and their families, teachers, and school and village leaders in 100 rural villages in Gansu province, China, this study examines how parental education affects educational investments in children, focusing on investments in goods and time. The detailed data used in this work afford several innovations. First, the data capture more complete measures of educational investments than those used elsewhere in the literature. For example, nonrequired education-related expenditures, whether the household owns children's reading materials, and whether the household has a designated study area for the sampled child measure investments in goods used in children's human capital production. The number of hours that parents spend helping their children with homework each week, whether parents read to the sampled child, and whether parents discuss their children's school performance with teachers measure parental investments in time used in children's human capital production. Second, a comprehensive teacher ranking captures numerous aspects of teacher quality that are generally unavailable elsewhere. Moreover, teachers in Gansu generally follow a single cohort through primary school, suggesting that the teacher ranking is likely to measure both past and present teacher quality. Third, the relatively large number of villages allows for village fixed effects to control for school quality, local socioeconomic conditions, labor market opportunities, and other forms of unobserved heterogeneity at the local level. Finally, a child cognitive development measure is employed to control both for innate ability and expected returns to child education, a key omitted variable in most studies.

It is found that more educated parents allocate higher levels of both goods and time to their children's human capital production, even controlling for wealth, teacher quality, village fixed effects, and child cognitive development. Evidence suggests that more educated parents expect higher returns to education for their children, offering one reason why parents in resource-constrained households make greater investments in both goods and time. It is also found that the effect of mother's and father's education differs, with a marginal year of mother's education having a larger impact on time investments than a marginal year of father's education.

The remainder of this article is organized as follows: Section II provides an

overview of China's rural education system; Section III describes the empirical strategy and discusses some identification issues; Section IV introduces the data and variables; the effect of parental education on investments in children's human capital is analyzed empirically in Section V; and Section VI concludes.

II. China's Rural Educational System

Education is widely seen as a key determinant of future income and occupational attainment in modern China (Davis 1992; Knight and Song 1993; Hannum 1998). At a minimum, education helps rural residents take advantage of new farming techniques and improves access to off-farm jobs that require literacy or numeracy (Unger 2002). Furthermore, for people who are able to attain high levels of education, legally sanctioned urban residency and nonmanual work become possible. That is, students are granted urban residency permits (*hukou*) upon admission to an urban specialized secondary school (*zhong zhuan*) or university (Wu and Treiman 2004). These specialized secondary schools and universities are open to all students on the basis of merit, at least in principle, providing a strong incentive for rural children to pursue education.

However, economic decentralization in the post-Mao period left responsibility for funding education to the county and village governments (Hannum 1998), and in recent years, tight budgets at the local level have shifted the burden to parents through a series of school fees (Unger 2002). Schooling is often relatively expensive as a result, with school fees representing a sizable portion of rural household's incomes. Paying for schooling thus exacerbates economic hardships in poor rural villages (Tsang 1994).

Although schooling is generally underfunded, the central government made 9 years of education compulsory in the late 1990s. Nearly all Chinese children thus enroll in primary school (Unger 2002; Connelly and Zheng 2003).[3] Because of the high cost, however, resource-constrained parents often withdraw their children before the 9 compulsory years of education have been completed, with academic performance and child gender strongly influencing this decision. For example, Brown and Park (2002) show that academically weak girls typically drop out of primary school (*xiao xue*) while academically weak boys generally finish primary school and enroll in junior secondary school (*chu zhong*). This finding is consistent with those of Hannum and Xie (1994), who describe sons receiving a disproportionate share of education in resource-constrained households because virilocal marriage (in which daughters marry out of the

[3] Unger (2002, 185) writes,"To a degree that is at once touching and inspiring, parents in these poor villages generally make major sacrifices to keep their children in school, even when it means cutting back on the quality or quantity of food consumed or on other very basic essentials."

family) is the dominant practice in China and because sons are generally responsible for caring for parents in their old age.

While children are still in school, rural parents often make significant nonrequired investments in their children's education (Hannum 2005) to increase their chances for gaining off-farm employment and admission to competitive secondary schools and universities. Such investments may include the purchase of educational goods and services (e.g., dictionaries, notebooks, reading material, desks, and tutors) and the provision of time for educational purposes (e.g., time spent helping children with homework, time spent reading to children, and time spent discussing a child's academic performance with his or her teachers) as well as other forms (Kong 2003).

Teacher and school quality vary widely across and within provinces. Despite high enrollment fees, school budgets in rural parts of China are often inadequate to pay teachers on time, to purchase supplies, or to make needed structural repairs. Classrooms may lack basic infrastructure such as a sufficient number of chairs and desks, functional blackboards, and electricity.[4] Top graduates from teachers' colleges are typically assigned to key schools in urban areas, leaving rural areas with teachers who may be less motivated or less well trained (Sargent and Hannum 2005) when they are available at all. Many rural communities cope with teacher shortages by hiring community members who have had no formal training to teach classes (Wang 2002). Furthermore, teachers in much of rural China follow student cohorts through school; students who attend school in poorly equipped classrooms or who are assigned to low quality teachers face high hurdles in their studies.

All but the largest rural villages have a single primary school comprising 6 years of education. Junior secondary schools consist of 3 years of schooling and are typically located in a larger village or in the township to which several villages belong. Due to the restrictive residency permit system, children almost always attend the nearest school; private schools and school choice are virtually nonexistent in most of rural China.[5] Moreover, the vast majority of the children of rural-urban labor migrants remain in their home villages for schooling—even when their parents migrate for extended periods—because rural residents face much higher pricing in schooling, health care, and other services in urban

[4] The worst schools I visited during survey fieldwork were barely functional: windows were missing or broken; a single piece of charcoal was used to heat a large classroom for an entire day; student-teacher ratios were very high due to inadequate funding for teacher salaries; and some teachers had acquired just a few years more education than their students. By contrast, schools in urban centers were generally modern, warm, and efficient.

[5] Similarly, Li and Zhang (2004) state that China's residency permit system rules out endogenous sorting in the context of fertility.

areas (Solinger 1999; Du, Park, and Wang 2005). Finally, children may enroll in school as early as age 6, although many rural families delay school enrollment until age 7 or 8.

III. Empirical Specification

Investments in children's human capital (INVEST) are manifest in the provision of goods for educational purposes and time spent interacting with children. Investment in goods is measured by the household's total expenditure on nonrequired educational goods, that is, spending on school supplies and private tutoring. This measure excludes school fees, required textbooks, required uniforms, and other required spending for enrolled children. Investment in goods used in human capital production is also measured by whether the household has children's reading materials and whether the household has a designated study area for the sampled child. Parental time used in the production of children's human capital is measured by the total number of hours parents spend helping their children with homework each week and by measures for whether parents read to the sampled child and whether either parent meets with the sampled child's teachers to discuss his or her schooling.

The determinants of educational investment i in household h may be estimated by ordinary least squares or a linear probability model as follows:

$$\begin{aligned}\text{INVEST}_{ih} = {} & \alpha + \beta_1 \text{FED}_{ih} + \beta_2 \text{MED}_{ih} + \mathbf{F}_{ih}\beta_3 + \mathbf{K}_{ih}\beta_4 \\ & + \beta_5(\text{FED}_{ih} \times \text{MALE}_{ih}) + \beta_6(\text{MED}_{ih} \times \text{MALE}_{ih}) + e_{ih}, \quad (1)\end{aligned}$$

where FED and MED are the number of grades completed by fathers and mothers, respectively; **F** is a vector of family characteristics including father's age (FAGE), mother's age (MAGE),[6] the number of other enrolled children (ENROLLED), and the number of nonenrolled children (NONENR) in the household; **K** is a vector of child-specific characteristics such as sex (MALE), age, and grade level; and e_{ih} is an error term. Because father's and mother's education may affect investments in sons and daughters differently (see, e.g., Glewwe and Jacoby 1994; Lillard and Willis 1994; Thomas 1994), the sex of the sampled child is interacted separately with mother's and father's education.

Parental education has many correlates that may influence investments in children's human capital, and controlling for these effects may better identify

[6] The timing of parental education may have implications for interpreting estimates because the quality and content of education have likely evolved over time, and controlling for measures such as parental age may help to mitigate this variation. A series of parental age dummies was also used to capture these effects, although the results are largely the same.

the true effect of parental education. For example, more educated parents may face less severe resource constraints; failing to control for household wealth may thus bias the estimated effect of parental education upward. Similarly, parental education may influence the decision to invest in children's human capital in response to either high or low teacher quality and school quality. A child's cognitive development may also affect the optimal household allocation because more educated parents may invest more in very gifted children or may help less gifted children by providing greater investments in their education. Additionally, local socioeconomic conditions, local labor market opportunities, and community preferences may also influence investment decisions. To test the robustness of the relationship between parental education and educational investments, wealth, teacher quality (TCHRRANK) and school and community characteristics (implemented via fixed effects), and a dummy for high cognitive development (HICOG) are added iteratively to the model described in equation (1). Finally, a model estimating the effect of parental education on educational investment i in household h in village v that incorporates all of these controls is estimated as follows:

$$\begin{aligned}\text{INVEST}_{ihv} = {} & \alpha + \beta_1 \text{FED}_{ihv} + \beta_2 \text{MED}_{ihv} + \mathbf{F}_{ihv}\beta_3 + \mathbf{K}_{ihv}\beta_4 \\ & + \beta_5(\text{FED}_{ihv} \times \text{MALE}_{ihv}) + \beta_6(\text{MED}_{ihv} \times \text{MALE}_{ihv}) \\ & + \beta_7 \text{WEALTH}_{ihv} + \beta_8 \text{TCHRRANK}_{ihv} + \beta_9 \text{HICOG}_{ihv} \\ & + \beta_{10}(\text{HICOG}_{ihv} \times \text{MALE}) + \beta_{11}(\text{FED} \times \text{HICOG}_{ihv}) \\ & + \beta_{12}(\text{MED} \times \text{HICOG}_{ihv}) \\ & + \beta_{13}(\text{FED} \times \text{HICOG}_{ihv} \times \text{MALE}) \\ & + \beta_{14}(\text{MED} \times \text{HICOG}_{ihv} \times \text{MALE}) + \gamma_{iv} + e_{ihv},\end{aligned} \tag{2}$$

where γ_v is a village fixed effect. Note that the cognitive development measure is interacted with parental education and child gender to allow for the possibility that parents invest differently in high-scoring boys and girls. If parental education is shown to have a positive effect on education investments even conditioning on this rich set of controls, then it will have been demonstrated that investments in education are an important means by which parental education influences child education.

Notably, the predicted values for dichotomous measures fall within the [0, 1] range, and the linear probability model facilitates simple implementation of fixed effects (below). To account for the fact that the error terms are likely correlated across the six different investments, the models are estimated jointly

via Zellner's (1962) seemingly unrelated regression method; because the regressors are identical across investments, this approach is asymptotically equivalent to ordinary least squares.

While omitted variable bias may be mitigated by including the regressors described above, measurement error in educational investments may bias the estimated effect of investments on children's test scores. For example, Robinson (1985) and Hofferth (1999) find that more educated mothers are more likely to overstate time engaged in socially desirable activities such as reading to children. Fortunately, measurement error in the investments included in this study is likely to be minimal. First, nonrequired educational expenditures are constructed from detailed consumption records rather than a single response, a method that has been demonstrated to reduce reporting error (Biemer et al. 2004). Second, whether the household has children's reading material and whether the sampled child has a designated study area were readily observable by survey enumerators; reporting error in these investments should thus be small. Third, parents and children were asked independently about parental reading to children. In most cases, children and parents gave the same answer. In cases where the responses did not match, children were as likely as parents to state that parents read to children, suggesting that any reporting error was not systematic. Similarly, parents and teachers were asked independently whether parents meet with teachers to discuss their children's schooling. As above, the responses matched in the vast majority of cases; where they did not, parents were no more likely than teachers to report that meetings took place, again suggesting that any reporting error is not systematic.[7] Finally, Juster (1985) finds that reporting error in time allocation is greatly reduced when a given activity is undertaken regularly and with limited variation. If assistance with homework is given frequently and regularly, then reporting error is likely to be small.

IV. Data and Variables

The data come from the Gansu Survey of Children and Families (GSCF),[8] a survey of 1,970 children ages 9–12 and their families in a province located

[7] One possible explanation for any difference in responses is that the teacher's questionnaire asked about parent/teacher discussions with parents within the previous month, whereas the mother's questionnaire asked about discussions within the previous year.

[8] The GSCF was administered in 2000. It was a collaborative effort between researchers in China, Canada, and the United States, including the author.

in northwestern China.[9] Gansu's 25.3 million people are primarily engaged in agriculture, and the province is broadly reflective of other western provinces in its low income, low educational attainment, and low expenditures on education. The multistage sample drew 20 counties from all nonurban, non-Tibetan counties and 100 villages from those counties.[10] Within each village, children in the correct age range were drawn with equal probability. Separate instruments were administered to children, mothers, heads of household, and village leaders as well as to teachers and principals of children who were enrolled in school at the time of the survey. A cognitive development test was also administered to each child.

Table 1 presents descriptive statistics. The average household spends 46.5 RMB per year on nonrequired educational goods and services for the sampled child.[11] Only 6.2% of households allocate less than 10 RMB to educational goods, while 1.8% of households spend at least 200 RMB. Some 54.4% of households have children's books, and 58.8% have designated study areas for children, for example, a child's desk, work table, or bookshelf. On average, mothers and fathers spend 4.1 hours in total helping children with homework each week, although parents do not help their children with homework at all in 32.5% of the sampled households. At the other extreme, 5.7% of households spend at least 14 hours per week helping children with homework.[12] Time spent helping children with homework is inclusive of all children, not just the sampled child. Parents read to the sampled child in almost two-thirds of the surveyed households and discuss the sampled child's school performance with teachers in 76.2% of the surveyed households.

Fathers have completed one grade in junior secondary school on average, while mothers have completed 4.2 primary grades.[13] Fathers spend all or part

[9] Of the 1,970 children in the sample, 16 did not reside full time in the sampled village, 17 others were missing important household demographic data such as parental education, and 19 were not enrolled in school at the time of the survey (6 of whom had dropped out of primary school and 1 of whom dropped out after completing primary school). The sample is thus restricted to the 1,918 children who were enrolled in school at the time of the survey, who were full-time residents of the village, and who have complete parent, schooling, and teacher data. For variables common to both the restricted and unrestricted samples, the data are largely indistinguishable.

[10] Of Gansu's 86 counties, seven are predominantly Tibetan. These counties were omitted from the sampling because Mandarin is not widely spoken in these areas.

[11] In 2000, US$1 = 8.27 Chinese RMB.

[12] This statistic is averaged across the entire year and thus properly accounts for parents who migrate for part of the year.

[13] Although I cannot distinguish between birth parents, adoptive parents, and stepparents, Hofferth and Anderson (2003) find that biology is less important than marital responsibility in fathers' investments in children.

TABLE 1
SUMMARY STATISTICS

Variable	Description	Unit	Mean	SD	Min	Max
EXPEND	Nonrequired expenditures	RMB	46.519	55.595	0	836
BOOKS	Has children's books	Dummy	.544	.498	0	1
DESK	Has designated study area	Dummy	.588	.492	0	1
HELP	Time helping with homework	Hours/week	4.121	4.953	0	35
READ	Parents read to child	Dummy	.657	.475	0	1
DISCUSS	Discuss schooling with teacher	Dummy	.762	.426	0	1
FED	Father's education	Grades	6.985	3.515	0	15
MED	Mother's education	Grades	4.190	3.514	0	12
FAGE	Father's age	Years	37.411	4.846	27	57
MAGE	Mother's age	Years	35.060	4.210	25	55
FRES	Father's village residency	Months/year	9.935	3.475	0	12
MRES	Mother's village residency	Months/year	11.732	1.547	0	12
MALE	Male child	Dummy	.539	.499	0	1
AGE	Child's age	Years	11.019	1.069	9	12.9
GRADE	Child's grade	Current level	4.301	1.343	1	9
ENROLLED	Other enrolled children	Number	.866	.714	0	4
NONENR	Nonenrolled children	Number	.452	.638	0	4
WEALTH	Household wealth	RMB	14,773.81	16,963.81	115	209,740
TCHRRANK	Teacher quality ranking	0 = probation, 1 = rank 1, 2 = rank 2, 3 = highest	1.468	.953	0	3
HICOG	Above average cognitive score	Dummy	.490	.500	0	1

of 2 months working outside the village on average, although the median father does not migrate at all. Fewer than 4% of women migrate for work, and both parents are absent for the entire year in only six households. The present value of housing and other durables (a measure indicative of household wealth) averages 14,773.8 RMB, but there is considerable variation. For example, 3% of households possess over 50,000 RMB in durables.

Boys constitute 53.9% of the sample. Primary school enrollees account for 96.0% of the sample, an artifact not only of the ages of the sampled children but also of the delayed age of enrollment prevalent in Gansu. The median child is in fourth grade, having enrolled at age 7. The household has 0.9 other enrolled children and 0.4 nonenrolled children, on average.

Teachers are regularly and systematically evaluated on such disparate mea-

TABLE 2
PARENTAL EDUCATION AND EDUCATION-RELATED INVESTMENTS

		Parental Education Quartiles			
Investment	Unit	1	2	3	4
EXPEND	RMB	33.97	47.37	52.10	54.01
BOOKS	Dummy	.38	.52	.64	.64
DESK	Dummy	.47	.54	.64	.73
HELP	Hours/week	2.24	3.91	4.90	5.72
READ	Dummy	.50	.63	.71	.82
DISCUSS	Dummy	.65	.75	.79	.88

sures as education, experience, attendance, professional publications, student test performance, and student and peer evaluations (Park and Hannum 2001). Because this official quality ranking incorporates many aspects of teacher quality, it is likely to be more informative than measures of teacher quality used in other countries. Moreover, teachers in the surveyed areas follow student cohorts through school, so controlling for current teacher quality goes a long way toward controlling for the quality of teachers in former grades.

The child cognitive development test was developed by researchers at the Institute for Psychology at the Chinese Academy of Social Sciences and was designed to be independent of academic achievement. This measure is employed to control both for innate ability and expected returns to child education. Scores on the cognitive development test do vary significantly by age, however, so test scores were converted into Z-scores by age measured in half-year increments.

Finally, it should be noted that China's system of restrictive residency laws prevents rural residents from legally attending school outside their registered residence areas. Since most villages have only one school, village fixed effects control for school quality as well as local socioeconomic conditions, labor market opportunities, and other forms of unobserved heterogeneity.

V. Investment in Goods and Services

Table 2 presents cross-tabulations of parental education and educational investments. Neglecting other factors, investments in both goods and time rise monotonically with parental education, suggesting that more educated parents make greater investments in both goods and time.

A. Estimates

The effect of father's and mother's education on the provision of six different education-related investments is estimated via seemingly unrelated regression methods. Note that because the regressors are the same across all six specifications, seemingly unrelated regression is asymptotically equivalent to

TABLE 3
DETERMINANTS OF EDUCATIONAL INVESTMENTS

	EXPEND	BOOKS	DESK	HELP	READ	DISCUSS
Estimates:						
FED	.0228***	.0152***	.0103**	.1986***	.0093**	.0056
	(2.59)	(3.09)	(2.10)	(4.08)	(2.00)	(1.31)
MED	.0332***	.0173***	.0143***	.2706***	.0261***	.0173***
	(3.62)	(3.39)	(2.81)	(5.33)	(5.37)	(3.88)
FAGE	.0088	−.0023	−.0003	−.0296	−.0090**	.0044
	(1.33)	(.63)	(.09)	(.81)	(2.58)	(1.35)
MAGE	−.0035	.0129***	.0021	−.0474	.0085**	−.0028
	(.45)	(3.03)	(.50)	(1.12)	(2.10)	(.75)
MALE	.0452	.0200	.0420	.0867	−.0033	−.0308
	(.50)	(.040)	(.48)	(.17)	(.07)	(.70)
AGE	.0148	−.0442[c]	−.0454***	−.2144	−.0184	−.0206*
	(.60)	(3.25)	(3.34)	(1.59)	(1.42)	(1.73)
ENROLLED	.4460***	−.0657***	−.0062	−.162	−.0358**	.0044
	(14.10)	(3.74)	(.35)	(.93)	(2.14)	(.28)
NONENR	.009	−.0764***	−.027	−.0460	−.0302	.0180
	(.25)	(3.78)	(1.34)	(.23)	(1.57)	(1.02)
FED × MALE	.0044	−.0013	−.0036	−.0554	.0029	.0076
	(.36)	(.20)	(.54)	(.83)	(.46)	(1.30)
MED × MALE	−.0147	−.0052	.0046	.0421	.0025	.0002
	(1.21)	(.77)	(.68)	(.63)	(.39)	(.03)
Constant	1.3456***	.3397	1.1130***	8.1775***	.6245***	.6983***
	(3.62)	(1.64)	(5.38)	(3.98)	(3.17)	(3.86)
Hypotheses:						
1. H0: FED = 0 for boys	10.28***	8.61**	2.00	9.34***	7.47***	10.34***
2. H0: MED = 0 for boys	4.94*	6.85**	16.66***	46.08***	42.00***	18.62***
3. H0: FED = MED for girls	.50	.07	.25	.79	4.69**	2.71
4. H0: FED = MED for boys	.39	.05	2.56	4.96**	5.02**	.40

Note. Grade dummies are included; for estimates, *t*-statistics are in parentheses; for hypotheses, *F*-statistics are shown.
* Significant at the 10% level.
** Significant at the 5% level.
*** Significant at the 1% level.

ordinary least squares regression. Estimates from the parsimonious model (eq. [1]), which controls for parental age, child gender and age, and other children in the household, is presented in table 3.

Parental education has a strongly significant effect on the provision of education-related goods for daughters. An additional year of father's education (FED) increases predicted spending on nonrequired educational goods (EXPEND) for daughters by 2.3% (significant at the 0.01 level). Similarly, an additional year of father's education raises the probability that the household has children's reading materials (BOOKS) by 1.5 percentage points (2.8% of

the mean, significant at the 0.01 level) and the probability that a daughter has a designated study area (DESK) by 1.0 percentage points (1.8% of the mean, significant at the 0.05 level). The effect of mother's education (MED) on the provision of education-related goods for daughters is somewhat larger: an additional year of completed education raises predicted education-related spending by 3.3%, increases the probability that the household has children's books by 1.7 percentage points, and increases the probability that the daughter has a designated study area by 1.4 percentage points (all significant at the 0.01 level). Although all of the point estimates are larger for mothers than for fathers, *F*-tests show that the hypothesis that there are effects of father's and mother's education on goods investments for daughters cannot be rejected.

Interactions of parental education and a male child dummy (MALE) are not statistically significant, suggesting the absence of systematic gender bias in goods investments on the part of both mothers and fathers. Specifically, an additional year of father's education increases predicted expenditures by 2.7% (significant at the 0.01 level) for sons and increases the probability that children's books are available in the household by 1.4 percentage points (significant at the 0.01 level). However, an additional year of father's education does not have a statistically significant effect on the likelihood that the son has a designated study area. The effect of mother's education on education-related expenditures and on the provision of books is smaller for sons than for daughters, although the difference is not statistically significant. An additional year of mother's education raises the probability of books being provided by 1.2 percentage points (significant at the 0.01 level). By contrast, the effect of an additional year of mother's education on the probability that a child has a designated study area is larger for sons (1.9 percentage points, significant at the 0.01 level) than for daughters, although the difference is again not statistically significant. As with daughters, I cannot reject the hypothesis that father's and mother's education have statistically identical effects on goods investments in sons' education.

Older students are less likely to have access to certain educational goods: an additional year of age reduces the probability that a household has children's books by 4.4% and reduces the probability that a child has a designated study area by 4.5% (both significant at the 0.01 level). This suggests that poorer parents may delay their children's enrollment or that parents with less favorable views of education may delay enrollment and may provide fewer investments. Alternatively, older students may perform better in school, and hence the return to such investments may be low. The presence of other children in the household (ENROLLED and NONENR)—whether or not they are enrolled in school—similarly reduces the likelihood that a household has children's

reading material by 6.6%–7.6% (significant at the 0.01 level), suggesting that additional children crowd out investment in educational goods. Interestingly, there is no statistically significant effect of additional children on the probability that a child has a designated study area. An additional child enrolled in school increases spending on nonrequired educational goods by 44.6% (significant at the 0.01 level), while nonenrolled children have no such effect, suggesting either that some of the nonrequired expenditures are strongly encouraged or that children's reading materials are not seen as being as valuable an investment as other education-related goods.

Similar results are found for parental investments in time, yet some important differences are evident. An additional year of father's education increases the time allocated to helping children with homework each week (HELP) by 0.20 hours when the sampled child is a daughter, 4.8% of the mean (significant at the 0.01 level). An additional year of mother's education raises the amount of time allocated to helping children with homework by 0.27 hours when the sampled child is a daughter (significant at the 0.01 level). However, we cannot reject the hypothesis that the marginal effect of education on time allocated to helping children with homework is statistically identical for mothers and fathers. More educated parents are more likely to read to their daughters (READ), with an additional year of father's education increasing the probability by 0.9 percentage points, 1.4% of the mean (significant at the 0.05 level) and an additional year of mother's education increasing the probability by 2.6 percentage points (significant at the 0.01 level). Moreover, results of an *F*-test show that the effect of parental education on the level of investment differs between mothers and fathers (significant at the 0.05 level), suggesting that mother's education leads to more time investments in children's education. An additional year of father's education does not significantly affect the probability that parents discuss a daughter's schooling with her teachers (DISCUSS), but an additional year of mother's education raises this probability by 1.7 percentage points, 2.3% of the mean (significant at the 0.01 level). The difference in the estimated effect of parental education is statistically significant at the 0.10 level, suggesting again that mother's education leads to disproportionate time investments in children's education.

As with goods investments, the interaction of parental education and the male dummy does not yield statistically significant estimates, suggesting that gender bias in time investments is very minor. An additional year of father's education raises the weekly time that parents allocate to helping children with homework by 0.14 hours when the sampled child is male, raises the probability that parents read to a son by 1.2 percentage points, and raises the probability that parents discuss a son's schooling with his teachers by 1.3% (all significant

at the 0.01 level). An additional year of mother's education raises the weekly time that parents allocate to helping children with homework by 0.31 hours when the sampled child is male, raises the probability that parents read to a son by 2.9 percentage points, and raises the probability that parents discuss a son's schooling with his teachers by 1.8 percentage points (all significant at the 0.01 level). The effect of mother's education on the time allocated to helping children with homework and the probability the parents read to sons is larger than that of father's education (both significant at the 0.05 level), again suggesting that mother's education has a larger effect on time investments in education than father's education.

Child age has a negative effect on the probability that parents discuss their children's schooling with teachers, with an additional year reducing the probability by 2.1 percentage points (significant at the 0.10 level). As discussed above, it may be the case that poor parents can afford neither to enroll their children on time nor to leave work to talk with children's teachers. Alternatively, this may reflect lower interest on the part of parents or older children doing sufficiently better in school that this investment is not warranted. The number of other children reduces the probability that parents read to the sampled child (significant at the 0.05 level for other children enrolled in school), again suggesting that other children may vie for parent's time. Curiously, the number of children does not have a statistically significant effect on the time that parents allocate to helping with homework; the number of older siblings is negatively correlated with the time that parents devote to helping with homework, suggesting that older siblings substitute for parents in helping younger children.

It is thus evident that more parental education is associated with larger educational investments in both goods and time. Moreover, while higher mother's and father's education lead to similar increases in goods investments, additional education on the part of the mother leads to disproportionately higher time investments. Finally, there is no statistical evidence suggesting that either parent favors children of one gender over the other when it comes to making education-related investments.

B. Robustness

While the parsimonious model highlights the relationship between parental education and investments in children's learning across a variety of investments, it does not account for other important determinants of educational investments. As discussed in Section III, more educated parents may have fewer resource constraints; thus controlling for household wealth may isolate the true relationship between parental education and investments in children's

schooling. Similarly, more educated parents invest differently in their children's education to compensate for teacher and school quality; if more educated parents are better able to assess teacher competence or school quality, then controlling for these attributes may better identify the relationship between parental education and educational investments. Finally, a child's cognitive development may affect the optimal investment because more educated parents may invest more in very gifted children. Alternatively, more educated parents may help less gifted children by providing greater investments in their schooling. These three possibilities are explored in tables 4–7.

The logged value of household durables (WEALTH) has a strong and positive effect on educational expenditures (table 4). The elasticity of wealth with respect to nonrequired educational expenditures is 0.11 (significant at the 0.01 level). Similarly, a 1% increase in the value of durables increases the probability that the household has children's reading materials by 0.11 percentage points and increases the probability that the household has a designated study area for the child by 0.09 percentage points (both significant at the 0.01 level). The value of household durables does not significantly affect investments in time.

Controlling for the value of household durables has little effect on the point estimates for parental education. For example, including the wealth measure reduces the estimated effect of an additional year of father's education on expenditures for daughters from 2.3% to 1.9%, remaining significant at the 0.05 level. Indeed, for every investment except time allocated to helping children with homework (owing to a weakly negative relationship between wealth and time spent helping with homework), the point estimates fall slightly when controlling for wealth. With the exception of the effect of father's education on the probability that the household has a designated study area for daughters, these effects also remain statistically significant. An additional year of mother's education raises the probability that a household has a designated study area for a sampled son by 1.6 percentage points, whereas an additional year of father's education raises this probability by only 0.3 percentage points, a difference that is significant at the 0.10 level. Otherwise, the differential effects of mother's and father's education remain as above. Note again that there is no statistical evidence in favor of gender bias in any investment.

With the inclusion of village fixed effects to account for differences in school quality (as well as unobserved heterogeneity at the local level), the teacher quality variable (TCHRRANK) does not have a statistically significant effect on the provision on educational investments (table 5). This suggests that poor teacher quality is not the primary concern of parents who make educational

TABLE 4
DETERMINANTS OF EDUCATIONAL INVESTMENTS WITH CONTROLS FOR WEALTH

	EXPEND	BOOKS	DESK	HELP	READ	DISCUSS
Estimates:						
FED	.0193**	.0115**	.0073	.2033***	.0090*	.0053
	(2.19)	(2.39)	(1.51)	(4.16)	(1.92)	(1.22)
MED	.0291***	.0131***	.0109**	.2760***	.0257***	.0169***
	(3.18)	(2.61)	(2.16)	(5.42)	(5.27)	(3.77)
FAGE	.0125*	.0015	.0028	−.0345	−.0087**	.0047
	(1.88)	(.41)	(.75)	(.93)	(2.47)	(1.46)
MAGE	−.0066	.0097**	−.0005	−.0433	.0083**	−.0031
	(.86)	(2.32)	(.11)	(1.02)	(2.03)	(.83)
MALE	.045	.0197	.0419	.0870	−.0033	−.0308
	(.50)	(.40)	(.85)	(.18)	(.07)	(.70)
AGE	.0220	−.0366***	−.0393***	−.2241*	−.0178	−.0198*
	(.91)	(2.74)	(2.92)	(1.66)	(1.37)	(1.67)
ENROLLED	.4515***	−.0601***	−.0016	−.1692	−.0353**	.0049
	(14.35)	(3.48)	(.09)	(.97)	(2.11)	(.32)
NONENR	.0152	−.0700***	−.0218	−.0543	−.0297	.0186
	(.42)	(3.53)	(1.09)	(.27)	(1.54)	(1.05)
FED × MALE	.0038	−.0019	−.0041	−.0547	.0029	.0076
	(.32)	(.29)	(.62)	(.82)	(.45)	(1.29)
MED × MALE	−.0136	−.004	.0055	.0407	.0026	.0003
	(1.13)	(.61)	(.83)	(.61)	(.40)	(.05)
WEALTH	.1055***	.1092***	.0889***	−.1408	.0094	.0111
	(4.71)	(8.90)	(7.19)	(1.13)	(.79)	(1.01)
Constant	.3778	−.6621***	.2977	9.4688***	.5384**	.5968***
	(.89)	(2.85)	(1.27)	(4.03)	(2.39)	(2.89)
Hypotheses:						
1. H0: FED = 0 for boys	7.43***	4.28**	.48	9.96***	6.96***	9.58***
2. H0: MED = 0 for boys	3.52*	3.98**	12.85**	46.98***	40.99***	17.87***
3. H0: FED = MED for girls	.46	.04	.20	.81	4.67**	2.69
4. H0: FED = MED for boys	.30	.00	3.05*	4.87**	5.08**	.42

Note. Grade dummies are included; for estimates, *t*-statistics are in parentheses; for hypotheses, *F*-statistics are shown.
* Significant at the 10% level.
** Significant at the 5% level.
*** Significant at the 1% level.

investments.[14] The addition of these controls reduces the point estimates for father's education on all six educational investments for both sons and daughters. For example, an additional year of father's education raises nonrequired expenditure for a son by 2.0% when controlling for teacher quality and village

[14] An alternative explanation that teacher quality varies little within individual schools in Gansu has been ruled out by Park and Hannum (2001). Teacher rank does have a modest effect on investments in the absence of village fixed effects, but the other estimates are not appreciably different from those in the parsimonious model described above.

TABLE 5
DETERMINANTS OF EDUCATIONAL INVESTMENTS WITH CONTROLS FOR TEACHER QUALITY AND VILLAGE FIXED EFFECTS

	EXPEND	BOOKS	DESK	HELP	READ	DISCUSS
Estimate:						
FED	.0197**	.0078*	.0094**	.1817***	.0067	−.0006
	(2.46)	(1.69)	(2.06)	(3.79)	(1.48)	(.15)
MED	.0097	.0091	.0075	.2258***	.0189***	.0108**
	(1.12)	(1.84)	(1.52)	(4.39)	(3.88)	(2.41)
FAGE	.0086	−.0018	−.0003	−.0699*	−.0098***	.0027
	(1.41)	(.52)	(.08)	(1.92)	(2.85)	(.85)
MAGE	.0036	.0062	.0009	−.0313	.0046	.0003
	(.51)	(1.54)	(.22)	(.74)	(1.14)	(.09)
MALE	.0672	.0349	.0435	.0654	−.0023	−.0577
	(.84)	(.76)	(.95)	(.14)	(.05)	(1.37)
AGE	−.0035	−.0214	−.0377***	.0056	−.0057	−.0143
	(.15)	(1.59)	(2.82)	(.04)	(.43)	(1.17)
ENROLLED	.4772***	.0124	.0215	−.0401	.0191	.0057
	(15.47)	(.70)	(1.22)	(.22)	(1.09)	(.35)
NONENR	.0250	−.0117	−.0192	−.0910	.0052	.0001
	(.74)	(.60)	(.99)	(.45)	(.27)	(.01)
FED × MALE	.0001	.0029	−.0029	−.0277	.0035	.0106*
	(.01)	(.47)	(.46)	(.43)	(.58)	(1.88)
MED × MALE	−.0063	−.0102	.0014	−.0106	.003	−.0006
	(.57)	(1.62)	(.22)	(.16)	(.48)	(.10)
TCHRRANK	−.0025	.0124	.0099	−.0124	.0110	.0036
	(.11)	(.93)	(.75)	(.09)	(.83)	(.30)
Constant	1.6364***	.7070***	1.2296***	5.6610**	.7545***	.8029***
	(4.13)	(3.11)	(5.45)	(2.39)	(3.36)	(3.88)
Hypotheses:						
1. H0: FED = 0 for boys	6.56**	5.76**	2.22	11.07***	5.48**	6.17**
2. H0: MED = 0 for boys	.18	.06	3.89**	20.83***	24.07**	6.23**
3. H0: FED = MED for girls	.57	.03	.07	.30	2.59	2.69
4. H0: FED = MED for boys	1.69	2.61	.10	.65	2.63	.00

Note. Grade dummies are included; for estimates, *t*-statistics are in parentheses; for hypotheses, *F*-statistics are shown;
* Significant at the 10% level.
** Significant at the 5% level.
*** Significant at the 1% level.

characteristics versus 2.7% in the parsimonious specification. Nevertheless, the effect remains positive and significant (generally at the 0.05 level or above) for the same investments for both sons and daughters, with the exception of reading to daughters.

The effects of mother's education on the probability that the household owns children's reading materials and on the probability that sons have designated study areas remain positive and statistically different from zero (albeit

with reduced point estimates). By contrast, the effect of mother's education on goods investments virtually disappears when controlling for teacher quality and school and village characteristics. For example, an additional year of mother's education increases expenditures for boys by 1.9% in the parsimonious specification but increases expenditures for boys by only 0.3% with the additional controls. When excluding father's education from this fixed effects regression, however, the effect of mother's education on goods investment is strong, positive, and significant, suggesting that the reductions in statistical significance are due to multicollinearity between mother's and father's education. However, the effect of mother's education on investments in time remains positive and highly significant (at the 0.05 level or above) even in the original specification in which father's education is included as a regressor.

The hypothesis that the effects of mother's and father's education on educational investments are equal cannot be rejected in this specification. Nevertheless, the hypotheses stating that mother's and father's education have equal effects on the probabilities that sons have access to reading material, that parents read to sons, that parents read to daughters, and that parents discuss schooling with daughters' teachers are nearly significant with p-values ranging between 0.101 and 0.108. Thus, the pattern described above in which mother's education results in disproportionate investments in time for children of both sexes persists. Moreover, it appears that father's education results in somewhat greater goods investments for sons, but not daughters.

Finally, there is some weak evidence for preferential treatment of sons by fathers in this specification. An additional year of father's education does not have any discernible effect on the probability that parents discuss a daughter's education with her teachers, but it does increase the probability that parents discuss a son's schooling with his teachers by 1.0%, a difference that is significant at the 0.10 level. This provides weak statistical evidence for systematic gender bias in educational investments.

High cognitive development among children (HICOG) has a weakly positive direct effect on educational investments undertaken by parents (table 6). Children with above-average cognitive development are 19.8 percentage points more likely to have access to children's reading material (significant at the 0.01 level) and are 17.5 percentage points more likely to have parents who read to them (significant at the 0.10 level), suggesting that parents reward children with higher cognitive development. Cognitive development does not have a statistically significant direct effect on other investments.[15]

More educated parents make greater educational investments even when

[15] None of the foregoing results is sensitive to different cut-offs for high cognitive development.

TABLE 6

DETERMINANTS OF EDUCATIONAL INVESTMENTS WITH CONTROLS FOR CHILD COGNITIVE DEVELOPMENT

	EXPEND	BOOKS	DESK	HELP	READ	DISCUSS
Estimates:						
FED	.0197	.0201***	.0127**	.1346***	.0176**	.0078
	(1.70)	(3.13)	(1.97)	(2.09)	(2.86)	(1.39)
MED	.0380***	.0160**	.0118*	.2873***	.0236***	.0083
	(2.99)	(2.26)	(1.66)	(4.08)	(3.51)	(1.35)
FAGE	.0088	−.0022	−.0003	−.0301	−.0090***	.0042
	(1.33)	(.59)	(.09)	(.82)	(2.57)	(1.30)
MAGE	−.0016	.0115***	.0019	−.0524	.0081*	−.0020
	(.21)	(2.69)	(.44)	(1.23)	(2.00)	(.54)
MALE	.1301	.0289	.0387	−.5410	.0673	−.0386
	(1.11)	(.44)	(.59)	(.83)	(1.08)	(.67)
AGE	.0058	−.0345**	−.0447***	−.1801	−.0141	−.0258**
	(.23)	(2.51)	(3.24)	(1.31)	(1.08)	(2.14)
ENROLLED	.4417***	−.0631***	−.0052	−.1476	−.0361**	.0023
	(13.94)	(3.59)	(.29)	(.84)	(2.16)	(.15)
NONENR	.0054	−.0748***	−.0266	−.0245	−.0314	.0162
	(.15)	(3.71)	(1.31)	(.12)	(1.63)	(.92)
FED × MALE	.0009	−.0049	−.0025	.0031	−.0105	.0038
	(.05)	(.54)	(.27)	(.03)	(1.22)	(.47)
MED × MALE	−.0317*	.0058	.0095	.0831	.0127	.0090
	(1.84)	(.61)	(.99)	(.87)	(1.39)	(1.08)
HICOG	−.1066	.1979***	.0545	−.6712	.1750**	−.858
	(.80)	(2.67)	(.73)	(.91)	(2.48)	(1.32)
HICOG × FED	.0070	−.0115	−.0060	.1504	−.0192**	−.0055
	(.40)	(1.18)	(.61)	(1.55)	(2.06)	(.64)
HICOG × MED	−.0101	.0018	.0047	−.0374	.0047	.0188**
	(.56)	(.18)	(.46)	(.37)	(.49)	(2.14)
HICOG × MALE	−.1978	−.0294	−.0017	1.5174	−.1714*	.0170
	(1.08)	(.29)	(.02)	(1.50)	(1.77)	(.19)

HICOG × FED × MALE	.0080	.0085	−.0014	−.1433	.0303**	.0089
	(.33)	(.63)	(.10)	(1.06)	(2.35)	(.75)
HICOG × MED × MALE	.0342	−.0204	−.0083	−.0791	−.0196	−.0182
	(1.40)	(1.51)	(.61)	(.59)	(1.52)	(1.53)
Constant	1.3790***	.2460	1.1022***	8.3091***	.5392***	.7440***
	(3.66)	(1.18)	(5.25)	(3.99)	(2.71)	(4.06)
Hypotheses:						
1. H0: FED = 0 for boys	3.14*	5.59**	2.52	4.60**	1.33	4.24**
2. H0: MED = 0 for boys	.28	10.60***	10.01***	30.76***	32.47***	8.78***
3. H0: FED = MED for girls	.87	.15	.01	1.96	.34	.00
4. H0: FED = MED for boys	2.31*	12.20***	9.08***	24.72***	21.75***	9.78***
5. H0: FED = 0 for HICOG girls	4.03**	1.37	.83	14.98***	.05	.14
6. H0: MED = 0 for HICOG girls	4.59**	6.02**	5.12**	11.97***	16.87***	18.24***
7. H0: FED = 0 for HICOG boys	.83	.03	.00	2.84*	2.64	.14
8. H0: MED = 0 for HICOG boys	.07	.69	1.82	1.01	.10	.09
9. H0: FED = MED for HICOG girls	.00	.57	.64	.09	6.77***	5.47**
10. H0: FED = MED for HICOG boys	.07	.69	1.82	1.01	.10	.09

Note. Grade dummies are included; for estimates, *t*-statistics are in parentheses; for hypotheses, *F*-statistics are shown.
* Significant at the 10% level.
** Significant at the 5% level.
*** Significant at the 1% level.

controlling for child cognitive development. For example, an additional year of father's education raises the probability that parents provide reading materials to children who do not score above average on the cognitive development test by between 1.5 percentage points (significant at the 0.05 level) and 2.0 percentage points (significant at the 0.01 level). The effect of father's education is not significant for either sons or daughters with high cognitive development. An additional year of mother's education increases the probability that parents provide reading materials to daughters who do not score highly by 1.6 percentage points and to sons who do not score highly by 2.2 percentage points (both significant at the 0.01 level). Furthermore, mother's education increases the probability that high-scoring daughters have access to reading materials in the home by 1.8 percentage points (significant at the 0.05 level). The effect of mother's education on providing reading material to high-scoring sons is negligible.

Results for time investments are similar. An additional year of father's education raises the probability that parents read to the sampled child by 1.8 percentage points for daughters who do not score highly on the cognitive development test (significant at the 0.05 level); the effect of father's education for low-scoring sons and for high-scoring sons and daughters is not significantly different from 0. An additional year of mother's education raises the probability that parents read to the sampled child by 2.4 percentage points for daughters who do not score highly, by 3.6 percentage points for sons who do not score highly, and by 2.8 percentage points for high-scoring daughters (all significant at the 0.01 level). Mother's education has no effect for high-scoring sons. Indeed, mother's education is associated with significantly higher investments for all gender-ability combinations with the exception of high-scoring boys; father's education has a significant effect on four of the six investments for low-scoring boys and girls and on two of the six investments for high-scoring girls.

With the inclusion of the cognitive development measure, the statistical differences in the effects of father's and mother's education are more pronounced. For example, an additional year of father's education raises predicted expenditures on educational goods by 2.1% for sons who have not scored above average on the cognitive development test, while an additional year of mother's education raises predicted spending by 0.6%, a difference that is statistically significant at the 0.10 level. However, the effect of mother's education on investments for sons who have not scored highly on the cognitive test is significantly larger than that of father's education for each of the other five investments. For example, an additional year of father's education raises the time allocated to helping a son with homework by 0.14 hours while an

additional year of mother's education raises the time allocated by 0.37 hours, a difference that is significant at the 0.01 level. Interestingly, there is no discernible difference in the effect of father's and mother's education for daughters who have not scored highly on the cognitive test or for sons who have. For high-scoring daughters, however, mother's education has a larger effect than father's education for both the probability that a parent reads to the sampled daughter and the probability that parents discuss schooling with her teachers. Overall, these results suggest that the effect of mother's education on investment in both goods and time is larger than that of father's education and that this difference is especially pronounced for time investments.

It is also interesting to note that the interaction term of mother's education and the male child dummy is negative in education-related expenditures (significant at the 0.10 level), suggesting that more educated mothers favor low-scoring daughters over low-scoring sons. By contrast, there is evidence to suggest that more educated fathers favor high-scoring sons over high-scoring daughters in terms of reading to children (significant at the 0.05 level). These findings again suggest that some mild gender bias may exist in educational investments.

Table 7 presents results from regressions in which wealth, teacher quality, child cognitive development, and village fixed effects are all added to the parsimonious specification. Interestingly, any statistical significance of the high cognitive development measure disappears when fixed effects are included, suggesting that the cognitive development score correlates with some unobserved characteristic of the village.[16] Nevertheless, the inclusion of village fixed effects reduces the estimated effect of mother's education on investment in goods, likely as a result of multicollinearity with father's education.[17] Still, mother's education has a small negative effect (significant at the 0.05 level) on the probability that a son who has not scored highly on the cognitive development test has a study area. The negative coefficient suggests that mother's education correlates with some unobserved characteristic of the village that affects certain expenditures.[18] Parental education remains a positive and significant determinant of most of the time investments for children who scored below average on the cognitive development test. However, father's

[16] For example, some communities may have norms about children's diets, which have been shown to affect cognitive development in numerous developing countries (e.g., Freeman et al. 1980).

[17] The point estimates for mother's education are largely positive and significant when father's education is omitted from the regression.

[18] If more educated mothers are more likely to live in villages in which schools are open late to promote studying, then more educated mothers may substitute studying at school for studying at home.

TABLE 7

DETERMINANTS OF EDUCATIONAL INVESTMENTS WITH A FULL SET OF CONTROLS

	EXPEND	BOOKS	DESK	HELP	READ	DISCUSS
Estimates:						
FED	.0196*	.0058	.0104*	.1331**	.0151**	.0051
	(1.86)	(.96)	(1.74)	(2.11)	(2.53)	(.92)
MED	.0141	.0078	.0008	.2256***	.0166**	.0085
	(1.18)	(1.15)	(.11)	(3.16)	(2.46)	(1.36)
FAGE	.0104*	−.0000	.0014	−.0685*	−.0099***	.0027
	(1.70)	(.01)	(.40)	(1.87)	(2.85)	(.84)
MAGE	.0025	.0048	−.0003	−.0336	.0047	.0003
	(.35)	(1.19)	(.08)	(.79)	(1.17)	(.07)
MALE	.1280	.0312	.0316	−.2468	.0669	−.0431
	(1.21)	(.22)	(.53)	(.39)	(1.12)	(.78)
AGE	−.0034	−.0178	−.0375***	.0450	−.0038	−.0146
	(.14)	(1.31)	(2.78)	(.32)	(.28)	(1.17)
ENROLLED	.4714***	.0062	.0160	−.0513	.0171	.0050
	(15.22)	(.35)	(.91)	(.28)	(.97)	(.31)
NONENR	.0212	−.0157	−.0224	−.0996	.0024	−.0008
	(.62)	(.81)	(1.16)	(.49)	(.13)	(.04)
FED × MALE	−.0044	−.0011	−.0063	−.0153	−.0118	.0045
	(.30)	(.13)	(.76)	(.17)	(1.43)	(.59)
MED × MALE	−.0199	.0016	−.0121	.0539	.0130	.0065
	(1.28)	(.18)	(1.37)	(.58)	(1.47)	(.80)
WEALTH	.0594***	.0675***	.0612***	.0602	.0022	.0046
	(2.61)	(5.20)	(4.74)	(.44)	(.17)	(.38)
TCHRRANK	−.0047	.0124	.0088	−.0035	.0133	.0043
	(.20)	(.94)	(.67)	(.03)	(1.01)	(.36)
HICOG	−.0536	.0365	.0147	−.2906	.1328	.0685
	(.42)	(.51)	(.20)	(.38)	(1.85)	(1.04)
HICOG × FED	−.0034	−.0002	−.0069	.1607	−.0197**	−.0136
	(.21)	(.02)	(.76)	(1.12)	(2.18)	(1.63)

HICOG × MED	−.0129	−.0012	.0099	−.0095	.0056	.0058
	(.78)	(.12)	(1.05)	(.10)	(.59)	(.67)
HICOG × MALE	−.1383	.0413	.0166	.7086	−.1650*	.0369
	(.84)	(.44)	(.18)	(.72)	(1.77)	(.43)
HICOG × FED × MALE	−.0082	.0069	.0072	−.0395	.0343**	.0140
	(.37)	(.55)	(.58)	(.30)	(2.77)	(1.23)
HICOG × MED × MALE	.0271	−.0213*	−.0198	−.1163	−.0206	−.0147
	(1.22)	(1.69)	(1.58)	(.88)	(1.64)	(1.28)
Constant	1.0585**	.0153	.6303**	4.7949*	.6388**	.7248***
	(2.30)	(.06)	(2.41)	(1.74)	(2.45)	(3.01)
Hypotheses:						
1. H0: FED = 0 for boys	2.03	.60	.46	3.38*	.29	2.93*
2. H0: MED = 0 for boys	.26	2.10	3.97**	16.85***	21.12***	6.32**
3. H0: FED = MED for girls	.10	.04	.90	.74	.02	.13
4. H0: FED = MED for boys	1.02	1.85	2.87*	13.59***	12.57***	6.49***
5. H0: FED = 0 for HICOG girls	1.80	.65	.26	10.89***	.44	1.80
6. H0: MED = 0 for HICOG girls	.01	.93	2.39	8.83***	10.42***	5.05**
7. H0: FED = 0 for HICOG boys	.54	.33	.05	.86	2.62	.10
8. H0: MED = 0 for HICOG boys	.63	.09	.04	.77	2.63	.13
9. H0: FED = MED for HICOG girls	.58	.01	.40	.04	5.64**	4.79**
10. H0: FED = MED for HICOG boys	.43	5.83**	.02	.09	.11	.19

Note. Grade dummies are included; for estimates, *t*-statistics are in parentheses; for hypotheses, *F*-statistics are shown.
* Significant at the 10% level.
** Significant at the 5% level.
*** Significant at the 1% level.

TABLE 8
PERCENTAGE OF MOTHERS WHO AGREE THAT EDUCATION HAS "A GREAT DEAL OF INFLUENCE" ON A CHILD'S FUTURE INCOME

	Junior Secondary School versus Primary School		Senior Secondary School versus Junior Secondary School	
	Boys	Girls	Boys	Girls
Lowest quintile of MED	41.4	40.6	51.1	46.1
Highest quintile of MED	48.7	47.1	58.2	51.8

education does not have a statistically significant impact on the probability that parents read to high-scoring daughters or that parents discuss a high-scoring daughter's schooling with her teachers, and parental education does not have a statistically significant effect on time investments in high-scoring sons.

With all of the regressors included, father's education is found to disproportionately affect the probability that high-scoring sons have access to reading materials in the home. By contrast, the estimated effect of mother's education is larger than that of father's education for time investments in sons who did not score highly on the cognitive development test and for daughters who did. Mother's education also disproportionately affects the probability that sons who did not score highly have designated study areas. Again, these findings suggest that the effect of mother's education is at least as important as father's education in determining educational investment, especially with regards to investments in time. Finally, there is again some limited evidence of gender bias; more educated fathers favor high-scoring sons over high-scoring daughters when reading to children, more educated mothers favor high-scoring daughters when reading to children, and more educated mothers favor high-scoring daughters over high-scoring sons when providing reading materials to children.

C. Discussion

As described in the introduction, the finding that both types of educational investment rise with parental education suggests that more educated parents perceive that the returns to education are higher for their children, that more educated parents have different preferences for children's education, or both. Distinguishing between these scenarios is difficult empirically, although there is some evidence in favor of both being true.

First, mothers were asked about the expected income difference if their children obtained a junior secondary education versus a primary education, and if they obtained a senior secondary education versus a junior secondary education (table 8). Among mothers in the lowest quintile of education, 41.4%

believe that junior secondary education has "a great deal" of influence for the future salary of boys, and 40.6% of mothers believe that junior secondary education has "a great deal" of influence for the future salary of girls. Among mothers in the highest quintile of education, 48.7% believe that junior secondary education has "a great deal" of influence for the future salary of boys, and 47.1% of mothers believe that junior secondary education has "a great deal" of influence on the future salary of girls. Some 51.1% of low education mothers thought that senior secondary schooling makes a large difference for boys, while 58.2% of high education mothers did. The corresponding figures for girls at the senior secondary level are 46.1% and 51.8%. Thus, more educated mothers perceive that the returns to education are higher for their children. This is certainly plausible in the Chinese context, moreover, because more educated parents generally have better access to nonfarm jobs, that is, jobs that have higher educational requirements and offer higher incomes than farming (e.g., Dong and Bowles 2002; Zhang, Huang, and Rozelle 2002; Zhang and Li 2003).

Second, mothers were asked how many years of schooling they wished their children could achieve in the absence of any constraints on finances, ability, or time. Some 61.5% of women in the lowest two quintiles of mother's education responded that they wished their children could attend university. By contrast, 75.9% of women in the highest two quintiles of mother's education responded that they wished their children could attend university. This finding suggests that more educated households may have preferences for higher levels of schooling among children. Both higher returns to education and different preferences thus likely help to explain why more educated parents invest more in their children's human capital.

VI. Conclusion

The literature has documented a strong association between parental education and child human capital development, a relationship that persists despite the inclusion of controls for household and community background factors. This relationship is often attributed to higher levels of investment in children's human capital made by more educated parents, but the nature of such investments has not been well understood. Investments in human capital may include spending on educational goods and services and time spent interacting with children for educational purposes, yet parents in resource-constrained households in areas with incomplete credit markets are likely to face a trade-off between these investments. Because more educated parents are likely to earn higher wages, the opportunity cost of time spent outside the workplace is high, and these parents may spend less time interacting with children in

order to provide more goods for children's human capital development. However, more educated parents are likely to be more adept at teaching children in the home; thus they may forgo some time in the workplace in order to provide more time interacting with children. Finally, more educated parents may provide higher levels of both investments despite being resource-constrained if the returns to children's human capital development differ for their children or if such parents have different preferences for children's education.

In this study, the determinants of six different educational investments are estimated using a survey of children, households, schools, and communities in northwestern China. It is shown that more educated parents are not substituting goods investments for time investments or vice versa but are, instead, providing higher levels of both types of investments. This result is generally robust to conditioning on a rich set of controls, including household wealth, teacher quality, child cognitive development, and community fixed effects, suggesting that the relationship between parental education and educational investments is quite strong. Evidence suggests that the perceived returns to education are higher for the children of more educated mothers. In addition, more educated mothers are shown to prefer more education for their children. Greater investment in both goods and time among more educated parents is thus likely explained by both higher expected returns and different preferences for education.

A second key finding is that the marginal effect of education differs for mothers and fathers: an additional year of mother's education leads to greater time investments than an additional year of father's education. This finding is particularly true for sons who scored below average on a cognitive development test and for daughters who scored above average. Mother's education also has a stronger impact on investments in some goods investments for low-scoring sons. An additional year of father's education raises nonrequired expenditures on sons' education and the probability that the sampled child has access to reading materials by more than mother's education, although this result is very sensitive to the empirical specification. The pronounced difference of parental education does not have a strong, systematic gender bias in investments; promoting education in time investments suggests that mothers either have a greater interest in their children's schooling or that they have a lower opportunity cost of time.

Finally, evidence of parental bias in allocating educational investments is limited. Specifically, fathers weakly favor sons and mothers weakly favor daughters in some educational investments. Nevertheless, these results are sensitive to the specification.

Therefore, if the relationship between parental education and investments

in children's human capital persists for future generations, then promoting educational attainment among the current generation of students will increase educational investments for their children, leading to higher levels of schooling and greater investments in their children—a virtuous cycle. Furthermore, because an additional year of mother's education generally increases investment in children's human capital by more than an additional year of father's education, and because mother's education does not have a strong, systematic gender bias in investments, promoting education in the current generation of girls is likely to have enduring effects for future generations of both girls and boys in rural China.

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