PARENTAL EDUCATION AND CHILD LEARNING:

INVESTING IN GOODS AND TIME[1]

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4.1. Introduction

The landmark study of race and education in the United States known as the "Coleman Report" (United States National Center for Educational Statistics, 1966) reported 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" (see Judd, Bridge, and Moock, 1979 and Hanushek, 1997 for reviews), 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 control variables. 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. In these studies, parental education has repeatedly been shown to strongly influence children's educational outcomes. These relationships are generally found to be robust to the inclusion of various household, school, and community-level characteristics, suggesting that parental education has a real effect on child human capital acquisition (Strauss and Thomas, 1995 review the literature). Moreover, the effect of parental education on children's schooling has been shown to differ for men and women (Lillard and Willis, 1994; Sathar and Lloyd, 1994; Thomas, 1994).

The majority of the research on the relationship between parental education and child educational outcomes focuses on the duration of child schooling as the sole or primary outcome measure (e.g., Rumberger, 1983; Strauss, 1990; Parish and Willis, 1993; Lillard and Willis, 1994; Padilla, 1996; Paraita and Pastor, 2000; Heltberg and Johannesen, 2002). Fewer studies, however, have analyzed the relationship between parental education and children's learning within school. Behrman, Khan, Ross, and Sabot (1997) control for household income, teacher quality, and school resources to find that rural Pakistani children whose fathers completed middle school score 31 percent higher on reading tests and 29 percent higher on mathematics tests than children whose

fathers did not. Case and Deaton (1999) find that the head of household's education has a strong effect on both literacy and numeracy scores among black South African high school students after controlling for school characteristics. Glewwe and Jacoby (1994) find a strong relationship between mother's education and both mathematics and reading test scores (but no discernable relationship between father's education and test scores) using matched household-school data from Ghana.

Yet the reasons underlying these robust results are not well understood. One possibility often noted in the literature is that more educated parents may make greater investments in their children's human capital accumulation (Strauss and Thomas, 1995). That is, parents may influence learning outcomes via the purchase of goods that complement educational attainment and via time spent interacting with children (Figure 4-1). In resource-constrained households in areas with incomplete credit markets, however, parents face a trade-off between these investment choices. First, more educated parents may have higher wages and thus may be better able to afford goods, which facilitate learning. However, higher wages imply a higher opportunity cost of time spent outside the workplace, and these parents may substitute time spent interacting with children in order to provide more labor. Second, the returns to interacting with children may be higher for more educated parents. As a result, more educated parents may choose to spend more time helping their children with homework at the cost of forgoing some wages which could be used to purchase goods. Third, more educated parents may provide higher levels of both goods and time if they have different preferences for education than less educated parents or if their children have higher returns to schooling (Lam and Schoeni, 1993). How parents choose to invest in children's human capital is thus an empirical question.

Due to data limitations, however, few studies have analyzed how parental education affects investments in children's learning. Behrman, Foster, Rosenzweig, and Vashishta (1999) analyze how mother's education impacts parent time allocation using household data from India. Controlling for workforce participation, they find that literate mothers spend more time than illiterate mothers on "home care," which includes time devoted to childcare, cooking, and cleaning. Sathar and Lloyd (1994) investigate the impact of parental education on educational expenditures using survey data from

Pakistan, and show that spending on urban children whose mothers attended school is 60 to 75 percent higher than that of urban children whose mothers never attended school.

Using a remarkable survey of children, their families, and their schools in 100 rural villages in Gansu province, China, this study examines how parental education impacts the provision of two specific types of investment in children's learning – parent time and education-related goods – paying careful attention to differing effects of mother's and father's education on sons' and daughters' learning. I then analyze the extent to which these investments "explain" the relationship between parental education and child learning by comparing the estimated impact of parental education on children's test scores with and without controls for investments; the difference in the estimated effects is interpreted as being the share of the effect of parental education attributable to a given investment. If it is indeed found that investments in goods and time are important means by which more educated parents affect the education of their children, then policymakers may consider adopting policies that encourage these investments among less educated parents as well. If, on the other hand, investments explain little of the relationship between parental education and children's schooling, then other pathways of influence should receive further empirical attention.

The detailed data used in this work afford several innovations. First, these data capture better measures of investments than elsewhere in the literature: the number of hours that parents spend helping their children with homework each week, whether parents read to their children, and whether parents discuss their children's school performance with teachers measure parental investments in time used in children's human capital production, while non-required school-related expenditures, whether the household owns children's books, and whether the house has an area which children use for studying capture goods inputs. Second, detailed household, teacher, school, and village data – all linked to the sampled child – help to control for unobservables to better isolate the effects of parental education. Finally, these data go well beyond the scope of most empirical studies of Chinese education, which typically rely on large data sets with limited information. I find that more educated parents allocate higher levels of both goods and time to their children's human capital accumulation, and there is evidence that more educated parents expect higher returns to education for their children. Although

simultaneity and omitted variable bias remain concerns, I also find that controlling for the provision of children's books and whether parent read to children reduces the estimated effect of parental education on children's test scores; including these two measures together reduces the point estimates for parental education by between 7 percent and 35 percent. These results suggest that while investments in goods and time are important in understanding the relationship between parental education and child learning, parent characteristics such as their genetic endowment, preferences, and unobserved traits of the family may play a dominant role.

The remainder of this paper is organized as follows: section 4.2 develops a model for the demand for goods and time used in children's human capital production and derives predictions for household behavior; section 4.3 overviews China's rural education system; section 4.4 describes the empirical strategy and discusses some identification issues; section 4.5 introduces the data and variables; the demand for investments in goods and time used in children's human capital production is analyzed in section 4.6; section 4.7 explores the extent to which these investments may be used to explain the relationship between parental education and child learning; and section 4.8 concludes.

4.2. Theoretical Issues

This paper is primarily concerned with two questions. First, do more educated parents make greater monetary (goods) investments in their children's schooling, greater time investments in their children's schooling, or greater investments in both goods and time? Second, to what extent do these investments explain the robust relationship between parental education and children's learning reported in the literature? The latter question is purely empirical, but theoretical predictions may be made for the former.

Consider a two-period model in which each household consists of two parents with identical preferences[2] and *n* children. The household seeks to maximize a utility function, u, comprised of consumption in the first period (C^1) and consumption in the second period (C^2). That is, $u(C^1, C^2)$, where *u* is assumed to be strictly concave in each argument. Second period consumption by parents is derived from children sharing with them according to a sharing rule, δ_i, that may differ by individual child.[3] Parents

derive utility from their children's consumption according to an altruism function, σ_i, that may differ by individual child (S_i), by child sex, and by parental education (H), i.e., $\sigma_i = \sigma_i(S_i, H)$. u is assumed to be additively separable in each argument:

$$u = \phi u(C^1) + (1-\phi)\sum_{i=1}^{n}\left[\delta_i + (1-\delta_i)\sigma_i(S_i H)\right]u(C^2) \tag{1}$$

where ϕ is the household's preference for first period consumption, $\phi \in [0,1]$, and $\delta_i \in [0,1]$.

The resources available to children to support parents in period 2 are derived from human capital acquired in period 1 according to production function *g*. This production function may be written:

$$C^2 = \sum_{i=1}^{n} g_i(x_i, \theta_i, A_i, \mathbf{Q}_i, \mathbf{V}, Y; H) \tag{2}$$

where x_i is parental investments in education-related goods (e.g., supplementary textbooks, school supplies, a desk or table for studying, and private tutoring) for child *i*. Notably, while some of these inputs are exclusive to child *i* (e.g., private tutoring), others are not (e.g., a table used for studying), suggesting that the returns to certain investments may rise with the number of children in the household. θ_i is parental investments in education-related time inputs (e.g., time spent helping children with homework) for child *i*, A_i is the innate cognitive ability of child *i*, $\mathbf{Q}_i$ is a vector of characteristics describing child *i*'s teacher, and **V** is a vector of school and community characteristics. Household wealth (Y) may also affect learning via the provision of complementary goods that have consumption value beyond being used to produce children's human capital (e.g., nutritious food and electric lighting). Figure 4-1 shows the interplay between these different inputs. It is assumed that *g* is quasiconcave in each argument, although the cross-partials are of indeterminate sign. For example, if supplemental textbooks are more useful with parental assistance, then the two investments are compliments in the

production of children's human capital. Alternatively, if supplementary textbooks replicate what a parent does in helping children with homework, goods and time are substitutes in the production process.

Parental education is an exogenous parameter that may affect the choice and level of investments. First, higher parental education may result in higher wages which parents use to purchase goods for children's human capital investment, i.e., a substitution effect may dominate. Second, higher parental education may increase the efficiency or effectiveness of the time spent helping children with homework, i.e., an income effect may dominate. Third, higher parental education may increase the expected returns to children's education; this is plausible in the Chinese context because off-farm opportunities are often limited in rural areas, and more educated parents, who are more likely to occupy such positions, may be in better positions to use professional and social networks to secure such employment for their children. Fourth, higher parental education may result in increased demand for children's education via the utility function because more educated parents are more altruistic or because part of the returns to children's education accrue to parents, e.g., via caring for elderly parents.

The household's problem may be written:

$$
\begin{aligned}
&\max_{C^1, x_i, \theta_i, \ldots, x_n, \theta_n} \; u = \phi u(C^1) + (1-\phi)\sum_{i=1}^{n}\left[\delta_i + (1-\delta_i)\sigma_i(S_i H)\right]u(C^2) \\
&\text{s.t. } C^2 = \sum_{i=1}^{n} g_i(x_i, \theta_i, A_i, \mathbf{Q}_i, \mathbf{V}, Y; H) \\
&\qquad P^C C^1 + Px \le Y \\
&\qquad W + \theta = T \\
&\qquad \omega(H)W = Y
\end{aligned}
\tag{3}
$$

where P^C, the price of consumption goods, is normalized to 1. P is the price of goods used in human capital production, ω is a function describing the opportunity cost of parent's time, i.e., the wage received for labor or the shadow value of time spent in home or farm production, and W is the number of hours worked out of total time T. The budget constraint is assumed to bind to preserve efficiency. There is no leisure in this simple model; all hours not spent working are devoted to children's human capital production.

Further, the opportunity cost of time is assumed to be independent of the number of hours worked, precluding benefits to experience or on-the-job training.

Solving equation (3) yields the following first order conditions:

$$
\begin{aligned}
&\phi u_{C^1} - \lambda = 0 \\
&(1-\phi)\left[\delta_i + (1-\delta_i)\sigma_i\right] u_{C^2} g_{i_x} - P\lambda = 0 \\
&(1-\phi)\left[\delta_i + (1-\delta_i)\sigma_i\right] u_{C^2} g_{i_\theta} - \lambda\omega = 0
\end{aligned} \tag{4}
$$

where λ is the shadow value of money and arguments have been suppressed. Optimal investments in human capital for child *i* occur where $\frac{g_{i_x}}{P} = \frac{g_{i_\theta}}{\omega}$, i.e., where the marginal product of monetary investment in child *i*'s human capital per yuan spent equals the marginal product of time allocated to child *i*'s human capital development divided by its implicit cost, the wage foregone by not working. Furthermore, $\left[\delta_i + (1-\delta_i)\sigma_i\right] g_{i\,x} = \left[\delta_j + (1-\delta_j)\sigma_j\right] g_{j\,x}$ and $\left[\delta_i + (1-\delta_i)\sigma_i\right] g_{i_\theta} = \left[\delta_j + (1-\delta_j)\sigma_j\right] g_{j\,\theta}$, $i \neq j$. That is, the marginal return for a given type of investment is equal for each child in the household. Finally, the marginal utility of additional spending on current consumption equals the marginal utility per yuan spent investing in children's human capital, i.e., $u_{C^1} = \frac{(1-\phi)\left[\delta_i + (1-\delta_i)\sigma_i\right] u_{C^2} g_{i_{xx}}}{P}$. At the optimal allocation, then, the head of household is indifferent between consuming an additional yuan worth of consumption goods, buying an additional yuan worth of education-related goods for any child in the household, and forgoing the time it takes to earn one yuan to spend that time helping a child to acquire human capital.

To derive theoretical predictions about how investments in children's education change with parental education, the nature of the relationship between parental education and child learning must be known. That is, does parental education affect wages, the effectiveness of time spent helping children with homework, the perceived returns to education, the nature of the household utility function, or some combination of these? Also critical is understanding the cross-partial derivatives in *g*, i.e., are goods and time complements or substitutes in the production of children's human capital? Are

education-related investments and inputs such as teacher quality complements or substitutes? The comparative statics for the household's problem are crucially dependent on assumptions made about the direction and magnitudes of these relationships.[4]

To illustrate this point simply, suppose that the household has only one child, that utility is log separable, i.e., that $u(C^1, C^2) = \phi \log C^1 + (1-\phi)\left[\delta + (1-\delta)\sigma\right]\log C^2$, and that only investments in education-related goods and time enter the human capital production function. Further, suppose that parental education enters the wage function (ω), but neither the human capital production function nor the altruism function, and that the human capital production function is quasilinear in θ with $g(x,\theta) = x^a + \theta$.[5] Here:

$$d\theta/dH = \frac{a\left[a(\delta(\sigma-1)-\sigma)(\phi-1)+\phi\right]\left[\left(\frac{P}{a\omega(H)}\right)^{\frac{1}{a-1}}\right]^a \omega'(H)}{(a-1)\left[\sigma+\delta(\sigma-1)(\phi-1)+\phi-\sigma\phi\right]\omega(H)} < 0 \qquad \text{(5a)}$$

$$dx/dH = \frac{\left(\frac{P}{a\omega(H)}\right)^{\frac{1}{a-1}}\omega'(H)}{(1-a)\omega(H)} > 0$$

That is, more educated parents increase the provision of education-related goods while reducing time spent in education-related activities. If, instead, goods and time are complementary investments in a Cobb-Douglas production function, i.e., if $g(x,\theta) = x^a\theta^{(1-a)}$, then:

$$d\theta/dH = 0$$

$$dx/dH = \frac{aT\left[\delta(\sigma-1)-\sigma\right](\phi-1)\omega'(H)}{P\left[\sigma+\delta(\sigma-1)(\phi-1)+\phi-\sigma\phi\right]} > 0 \qquad \text{(5b)}$$

i.e., more educated parents provide more goods for children's human capital acquisition without reducing their provision of time to children by shifting some resources from current period consumption. Table 4-1 summarizes these comparative static results as well as those discussed below.

If, however, parental education affects the household problem by augmenting the returns to time spent with children but neither the wage function nor the altruism function, different comparative statics are derived. If parental education has no impact on the efficiency or efficacy of goods inputs and if the human capital production function is quasilinear in θ, i.e., $g(x,\theta;H) = x^a + H\theta$, then parents substitute time spent in income-generating activities in order to provide more time to their children. :

$$d\theta/dH = T\left[\delta(-1+\sigma)-\sigma\right](-1+\phi)$$

$$-\frac{a\left[a\left[-\delta+(-1+\delta)\sigma\right](-1+\phi+\phi\right]\left[\left(\frac{HP}{a\omega}\right)^{\frac{1}{-1+a}}\right]^a}{(-1+a)H} > 0 \qquad \text{(6a)}$$

$$dx/dH = \frac{\left(\frac{HP}{a\omega}\right)^{\frac{1}{-1+a}}}{-H+aH} < 0$$

If, however, human capital is generated according to a Cobb-Douglas production function, $g(x,\theta;H) = x^a(H\theta)^{(1-a)}$, then:

$$d\theta/dH = 0 \qquad \text{(6b)}$$
$$dx/dH = 0$$

i.e., the provision of neither goods nor time changes with parental education.

A third way by which parental education may affect the household problem is by increasing the returns to education. Assume again that parental education affects neither the wage function nor the altruism function. For simplicity, assume further that the percent of children's earning accruing to the parents in the second period is independent of the amount that children earn. With quasilinear production of the form $g(x,\theta;H) = (x^a + \theta)^H$, time spent helping children with homework rises as parental education increases while goods investments remain unchanged:

(7a)
$$d\theta / dH = \frac{[\delta(\sigma-1)-\sigma](\phi-11)\phi\left[T-(a-1)\left(\left(\frac{P}{a\omega}\right)^{\frac{1}{a-1}}\right)^{a}\right]}{\left[H(\delta(\sigma-1)-\sigma)(\phi-1)+\phi\right]^2} > 0$$
$$dx / dH = 0$$

With higher returns to education for the children of more educated parents and Cobb-Douglas production of the form $g(x,\theta;H) = (x^{a}\theta^{(1-a)})^{H}$, investments in both goods and time rise as parental education rises:

(7b)
$$d\theta / dH = -\frac{(a-1)T[\delta(\sigma-1)-\sigma](\phi-1)\phi}{\left[H(\delta(\sigma-1)-\sigma)(\phi-1)+\phi\right]^2} > 0$$
$$dx / dH = \frac{aT[\delta(\sigma-1)-\sigma](\phi-1)\phi\omega}{P\left[H(\delta(\sigma-1)-\sigma)(\phi-1)+\phi\right]^2} > 0$$

Finally, suppose instead that parental education affects the altruism function (σ), but neither the wage function nor the human capital production function. If the human capital production function is quasilinear in θ, then:

(8a)
$$d\theta / dH = \frac{(\delta-1)(\phi-1)\phi\left[T-(a-1)\left(\left(\frac{P}{a\varpi}\right)^{\frac{1}{a-1}}\right)^{a}\right]\sigma'(H)}{\left[\delta+\phi-\delta\phi+(\delta-1)(\phi-1)\sigma(H)\right]^2} > 0$$
$$dh / dH = 0$$

That is, more educated parents spend more time for the production of children's human capital, but neither more nor less money. By contrast, with Cobb-Douglas production:

(8b)
$$\frac{d\theta}{dH} = -\frac{(a-1)T(\delta-1)(\phi-1)\phi\sigma'(H)}{\left[\delta+\phi-\delta\phi+(\delta-1)(\phi-1)\sigma(H)\right]^2} > 0$$
$$\frac{dx}{dH} = \frac{aT(\delta-1)(\phi-1)\phi\omega\sigma'(H)}{P\left[\delta+\phi-\delta\phi+(\delta-1)(\phi-1)\sigma(H)\right]^2} > 0$$

In this case, parents forgo some of their own consumption in order to provide higher levels of both time and goods for children's human capital acquisition.[6]

In sum, without strong assumptions about the complementarity of goods and time in human capital production, strong predictions about how parental education affects investments in goods and time cannot be made. The demand for investments and the extent to which these investments explain the relationship between parental education and children's learning are thus empirical issues.

4.3. China's Rural Education System

Most villages in rural China have a government-sanctioned primary school that offers either five or six years of primary instruction, the latter being increasingly common. Almost every child attends primary school at some point during his or her childhood, and children generally walk to the nearest school. Junior secondary schools are predominantly located in townships – administrative hubs for several villages – and offer three years of instruction. Children whose parents are willing to pay school fees are generally able to attend through the junior secondary level. Senior secondary schools are located in some townships, but because admission is contingent on passing competitive examinations, many children in rural areas do not attend. In contrast to urban China, private schools are rare in rural areas.

Despite China's education law that makes nine years of schooling compulsory for all children, children whose families do not pay the required fees are not allowed to attend school. School fees are a burden to rural parents, and many schools have increased fees to offset rising costs resulting from education decentralization (Tsang, 1996; Hannum, 1998). Hossain (1996) reports that the poorest quintile of households in China spends 14.2 percent of their annual income on education, while the wealthiest quintile spend 5.5 percent.

Fiscal decentralization has led to increased disparity in the educational attainment of boys and girls (Hannum and Xie, 1994). Men are responsible for caring for elderly parents, and hence boys receive a disproportionate share of education in resource-constrained families. Indeed, Brown and Park (2002) show that high school fees are

much likelier to cause a girl to drop out of school than a boy paying identical fees in their sample of six poor Chinese counties. Fiscal decentralization has also led to increased disparity between schools. In an effort to reduce fees, many communities limited services or otherwise allowed quality to stagnate or deteriorate. Other communities sought philanthropy from business and community leaders who underwrite shares of the annual operating budgets. Still others have become creative in school financing by fostering income-generating activities on school property. Those communities that neither sacrificed quality nor found creative means of financing educational programs have experienced higher rates of attrition as schooling became less affordable.

China systematically evaluates teacher quality on an annual basis, incorporating such measures as student performance on standardized tests, evaluations by students and principals, teacher attendance, publications, and teacher education and experience. Because these official quality rankings incorporate many aspects of teacher performance, this measure of quality is likely more informative than the simple proxies (generally teacher education and/or experience) used to measure teacher quality in other countries (see Hanushek, 1995 for a survey of the literature from developing countries). Moreover, teachers in many rural areas (including 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 (see Park and Hannum, 2001 for a further description of teacher rankings in China). In the estimates that follow, then, teacher quality is measured as a variable rather than as a vector of descriptors.

Finally, China has a system of restrictive residency laws that prevent most rural residents from legally residing, working, or attending schools in areas outside their official residences. Regardless, many rural residents migrate to cities for at least part of the year to find casual work. These facts have several important implications. First, rural families have little choice over schools, and virtually all children attend the school nearest their homes. Second, education is generally seen as the best means of obtaining permits that enable the holder to legally obtain desirable, high paying work in urban areas. And third, migrant parents are less able to supervise their children's human capital acquisition and are unable to make time investments in their children's learning while they are away.

4.4. Empirical Strategy and Identification

To analyze how parental education affects investments in children's human capital, demand functions for education-related goods and time are estimated. The demand for goods used in human capital acquisition, x, is measured by the household's total spending on non-required education-related goods, e.g., spending on pens, pencils, notebooks, books other than required textbooks, and private tutoring; this measure excludes school fees, required textbooks, required uniforms, and other spending that is mandatory conditional on enrollment. I also measure investment in goods used in human capital production by bivariate measures of whether the household has any children's books and whether the household has an area suitable for children's study, i.e., a desk or bookshelf that is used by children. The demand for parent time used in the production of children's human capital, θ, is measured by the total number of hours parents spend helping their children with homework each week and by bivariate measures for whether either parent reads to the sampled child and whether either parent ever discusses the sampled child's school performance with his or her teachers.

The demand for non-required education-related goods (and similarly for time) in household h in village v is thus estimated by:

$$x_{hv} = \alpha + \beta_1 H_{hv}^f + \beta_2 H_{hv}^m + \mathbf{F}_{hv}\beta_3 + \mathbf{K}_{hv}\beta_4 + \beta_5 (H_{hv}^f \times S_{hv}) + \beta_6 (H_{hv}^m \times S_{hv}) + \beta_7 Y_{hv} + \beta_8 Q_{hv} + \beta_9 A_{hb} + \gamma_v + e_{hv} \tag{9a}$$

for the continuous outcomes and

$$\Pr(x_{hv} \neq 0) = \Phi(\alpha + \beta_1 H_{hv}^f + \beta_2 H_{hv}^m + \mathbf{F}_{hv}\beta_3 + \mathbf{K}_{hv}\beta_4 + \beta_5 (H_{hv}^f \times S_{hv}) + \beta_6 (H_{hv}^m \times S_{hv}) + \beta_7 Y_{hv} + \beta_8 Q_{hv} + \beta_9 A_{hb} + \gamma_v + e_{hv}) \tag{9b}$$

for the bivariate outcomes. H^j is parent j's education in grades completed, $j = \in \{m, f\}$; **F** is a vector of family characteristics including parent age,[7] the number of other children who are enrolled in school, and the number of non-enrolled children in the household; **K** is a vector of child-specific characteristics such as sex (S), age, and a grade level

dummy; Y is the household's wealth; Q is teacher quality; and e_{hv} is an error term. Because father's and mother's education may affect investments in sons and daughters differently, the sex of the child is also interacted with parental education.

Parental education has many correlates that may influence the household's decisions about investment in child schooling (Figure 4-1), and controlling for these effects may facilitate and better isolate the direct relationship between parental education and educational investments. For example, children's cognitive ability (A) may affect the optimal household allocation. On the one hand, parents may invest more in very gifted children; on the other, they might wish to help less gifted children by providing greater investments in their schooling. Similarly, community norms and school quality may influence investment patterns; notably, community is not generally a choice variable because of the strict residency system that limits the ability to sort by schooling preferences. Village fixed effects (γ_v) are thus included in the estimates as well.

The second objective of the paper is to investigate the extent to which these investments help to explain the relationship between parental education and child learning. This is accomplished by following the procedure suggested by Glewwe (1999) and Heltberg and Johannesen (2002). I first estimate the "baseline" determinants of children's learning:

$$\begin{aligned} Z_{hv} &= a + b_1 H_{hv}^{f} + b_2 H_{hv}^{m} + \mathbf{F}_{hv} b_3 + \mathbf{K}_{hv} b_4 \\ &\quad + b_5 (H_{hv}^{f} \times S_{hv}) + b_6 (H_{hv}^{m} \times S_{hv}) + u_{hv} \end{aligned} \tag{10a}$$

where Z is children's learning as measured by test scores and u is an error term. I then estimate the same equation with investments included as an additional regressor:

$$\begin{aligned} Z_{hv} &= a + b_1 H_{hv}^{f} + b_2 H_{hv}^{m} + \mathbf{F}_{hv} b_3 + \mathbf{K}_{hv} b_4 \\ &\quad + b_5 (H_{hv}^{f} \times S_{hv}) + b_6 (H_{hv}^{m} \times S_{hv}) + b_7 \eta + u_{hv} \end{aligned} \tag{10b}$$

where $\eta \in \{x_{hv}, \theta_{hv}\}$. Finally, I compare the estimated coefficients on parental education, interpreting reductions in the coefficient to mean the extent to which investments "explain" the relationship between parental education and children's learning.

In regressing learning on parental education, omitted variables may bias the estimates. As a result, the preferred estimation method is instrumental variables (IV) estimation. Although grandparental education, the education of parents' siblings, and grandparent occupation have often been used as instruments for parental education in other studies, each of these may correlate with other unobservables that may impact child learning (e.g., parent aptitude), so the typical instruments are invalid in this study. A second-best strategy is to include additional regressors to control for known omitted variables. For example, village fixed effects reduce the impact of community characteristics and any endogenous sorting. I also control for correlation with latent ability by including the child's score on a test of cognitive development. Omitted variable bias may of course remain, but if the bias is identical across specifications (which requires that the investments are not correlated with the variables biasing parental education), then the comparisons are valid.

Following an identical procedure to that described above, I compare the estimated effect of parental education on children's learning in:

$$\begin{aligned} Z_{hv} = {} & a + b_1 H_{hv}^f + b_2 H_{hv}^m + \mathbf{F}_{hv} b_3 + \mathbf{K}_{hv} b_4 + b_5 (H_{hv}^f \times S_{hv}) \\ & + b_6 (H_{hv}^m \times S_{hv}) + b_7 Y_{hv} + b_8 Q_{hv} + b_9 A_{hv} + \gamma_v + u_{hv} \end{aligned} \tag{10a´}$$

with that estimated in

$$\begin{aligned} Z_{hv} = {} & a + b_1 H_{hv}^f + b_2 H_{hv}^m + \mathbf{F}_{hv} b_3 + \mathbf{K}_{hv} b_4 + b_5 (H_{hv}^f \times S_{hv}) \\ & + b_6 (H_{hv}^m \times S_{hv}) + b_7 Y_{hv} + b_8 Q_{hv} + b_9 A_{hv} + b_{10} \eta + \gamma_v + u_{hv} \end{aligned} \tag{10b´}$$

to see how investments impact the estimated effects of parental education.

4.5. Data and Variables

The data come from the Gansu Survey of Children and Families (GSCF), a collaborative effort of researchers from Northwest Normal University (Gansu, China), Harvard University, and the University of Michigan, including the author. The GSCF, conducted in the summer of 2000, is a survey of 1,970 children between the ages of 9 and 12 and their families in 100 villages in Gansu, a province in China's northwest. Gansu is a sparsely populated province whose 23 million people are primarily engaged in agriculture. The province is broadly reflective of other interior provinces and is marked by low income, low educational attainment, low expenditures on education, and relatively high rates of illiteracy.

The multi-stage probability sample drew 20 counties from all non-urban, non-Tibetan counties in Gansu.[8] From these counties, 100 villages were drawn from these townships using a probability sample. Within each village, the sampling scheme drew from lists of all village households with children in the target age range. Separate instruments were administered to children, mothers, heads of household, and village leaders, as well as to teachers and principals for children who were enrolled in school at the time of the survey. A cognitive development test designed by researchers at the Chinese Academy of Sciences Division of Psychology was also administered to each child; this test was designed to be independent of achievement.

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). I thus restrict the sample 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. Table 4-2 presents descriptive statistics for the former.

The average household spends 46.5 yuan[9] per year on school supplies, tutoring, and other non-required education-related goods for the sampled child. Only 6.2 percent of households allocate less than 10 yuan to this spending, while 1.8 percent of households

spend at least 200 yuan. Some 54.4 percent of households have children's books and 58.8 percent have study areas for use by children. Mothers and fathers spend 4.1 hours in total helping children with homework each week on average, although parents do not help their children with homework in 32.5 percent of the sampled households. At the other extreme, 5.7 percent of households spend at least 14 hours per week helping children with homework (this statistic reflects the average time allocation of parents across the entire year, so labor migrants are included in this figure). Time spent helping children with homework is inclusive of all children, not just the sampled child, and the average household has 1.9 children enrolled in school, including the sampled child (the average household has 2.3 children in total). Parents read to the sampled child in almost two-thirds of the sampled households and discuss the sampled child's school performance with teachers in 76.2 percent of the sampled households.

Fathers have completed one grade in junior secondary school on average, while mothers have completed 4.2 primary grades (as distinct from years of schooling). Fathers spend all or part of two months working outside the village on average, although the median father does not migrate at all. Fewer than 4 percent of women migrate for work, and both parents are absent for the entire year in only 6 households. Total household wealth (defined as the total present value of housing and other durables) averages 14,773.8 yuan, but there is considerable variation with 3 percent of households having over 50,000 yuan in wealth.

Boys comprise 53.9 percent of the sample. Primary school enrollees account for 96.0 percent of the sample, an artifact not only of the ages of the sampled children, but also of the delayed age of enrollment prevalent in many areas. The median child is in fourth grade, having enrolled at age 7. Chinese language and mathematics tests are given at the end of each semester and are used to determine whether children may proceed to the next grade. The same exam is administered to each student in the child's grade level across the county, and homeroom teachers reported test scores. Teachers did not report Chinese scores for 29 students and mathematics scores for 23 students.

A few comments about these variables should be noted. First, scores on the Chinese and mathematics tests are converted into Z-scores in the empirical analysis. That is, test scores are measured as the number of standard deviations from the mean test score

of all sampled children in the same grade and county. Where sampled children are either very advanced or very behind (i.e., where children attend the third year of junior secondary school and in many cases where they attend the first year of primary school or the second of junior secondary school), Z-scores cannot be calculated because there are too few tests scores for the county/grade, and these children are dropped from that part of the analysis. Next, scores on the cognitive development test vary significantly by age. Thus, the cognitive development test scores were also translated into Z-scores by age measured in half-year increments. Finally, nonlinearities in household wealth are accounted for by using the log of household wealth in all estimates.

4.6. Demand for Goods and Time Used in the Production of Human Capital

4.61. Education-Related Goods

More educated parents are likely to have higher incomes than other parents, perhaps because they are in positions which pay higher wages, because they operate their own businesses more efficiently, or because they better manage their farm production. Higher incomes facilitate more consumption, including consumption of education-related goods that are not required by schools. Moreover, the opportunity cost of not working rises as wages rise, making time spent with children relatively more expensive. Thus, one might expect that goods investments rise as parental education rises, i.e., the first order conditions of the household's utility maximization problem (equation 3) may be those described in equation (5a) or (5b).

The demand for (logged) non-required spending on education-related goods for the sampled child is estimated via a tobit model in which 33 observations are censored at 0. Estimates are presented in Table 4-3. Column 1 presents reduced form estimates for equation (9a), excluding household wealth, teacher quality, cognitive ability, and village fixed effects. An additional year of either father's or mother's education increases such expenditures by 1.0 yuan (2.2 percent of the mean) for both boys and girls, significant at the 0.01 level (the effect of mother's education is significant at the 0.05 level for boys and the effect of father's education is significant at the 0.05 level for girls). The number

of other children who are enrolled also has a strong positive effect, suggesting that parents are more willing to make such investments when there are more beneficiaries.

Column 2 includes household wealth as an additional regressor. As wealth increases, spending on non-required education-related goods also increases. Including the teacher quality ranking and village fixed effects (column 3). The percentage of the household's land allocation that is irrigated and the quality of the previous year's harvest are strong predictors of household wealth that are plausibly exogenous to the demand for current investments in education-related goods and time. Instrumenting for wealth does not change the sign of any of the regressors although it does significantly reduce their power. As a result, the results reported for household wealth here and below are for non-instrumented wealth.

Column 3 includes the teacher quality ranking as well as village fixed effects, thus controlling for unobservable community characteristics and endogenous sorting (to the extent it occurs). These variables greatly reduce the estimated effect of mother's education, suggesting that mother's education is highly stratified by village. Cognitive ability (column 4) has a negative effect on this category of spending, indicating that parents spend more on school supplies, supplemental textbooks, and private tutoring for children with lower ability, perhaps in an attempt to make them competitive with their classmates. Column 5 includes all of these regressors. While the relationship between mother's education and spending seems to operate largely through village characteristics, father's education remains a strong predictor of spending of education-related spending for both boys and girls; one grade completed increases such spending on the sampled child by 2.2 percent regardless of the child's sex, significant at the 0.05 level. Furthermore, the significance of the cognitive ability Z-score disappears, suggesting that cognitive ability is not randomly distributed across villages.

Determinants of whether the household has children's books are estimated via a probit model (equation 9b). The marginal effects are presented in Table 4-4 and errors are assumed to be clustered by village. Otherwise, the table is arranged identically to Table 4-3. An additional grade completed by fathers increases the probability that the household has children's books by about 1.5 percent for boys and 1.6 percent for girls,

each significant at the 0.01 level. An additional grade completed by mothers increases the probability by 1.3 percent for boys and 1.8 percent for girls, again both significant. Mother's age also has a positive effect. Surprisingly, perhaps, the presence of an additional child in the household reduces the probability of owning children's books by between 6.7 and 8.0 percent at the margin, suggesting that additional children crowd out such luxury goods. Child age also enters negatively; controlling for grade level, age may indicate lower ability because older children either start school later or are held back more often.

As above, column 2 includes household wealth, column 3 includes teacher quality rankings and village fixed effects, column 4 includes the cognitive ability Z-score, and column 5 includes all of these concurrently. Due to insufficient variation in the dependent variable in 5 villages, the sample size falls to 1818 when village fixed effects are implemented. The marginal effect of mother's education on the probability that household owns children's books falls to about 1 percent for boys, but becomes negative and is not significant when village fixed effects are included. The marginal effect of father's education persists at 1.4 percent for boys, however, regardless of additional controls. For girls, the marginal effect of an additional grade of either parent's schooling is roughly 1.6 percent, falling to 1.2 percent (but remaining significant at the 0.10 level) as village fixed effects are added. The effect of household wealth is positive as expected. Cognitive ability has a positive effect on the probability of owning children's books, but the coefficient is not significantly different from 0 when village fixed effects are included.

Table 4-5 is analogous to Table 4-4 except that the probit model estimates the determinants of whether the household has a study area for use by children. Again, errors are assumed to be clustered by village and marginal effects are presented. Seven villages are lost when village fixed effects are implemented due to insufficient variation in the dependent variable. Each additional completed grade of father's education increases the probability that girls' households have study areas by between 0.7 and 1.3 percent; the higher estimated coefficients correspond to the model with village fixed effects, but this could be an artifact of the smaller sample size. The marginal effect of mother's education is to increase the probability of having a study area by 1.2 to 1.5 percent per grade for

girls, lower with village fixed effects. The marginal effect of father's education is small and insignificant for boys, while that of mother's education ranges between 1.2 percent (significant at the 0.05 level) with village fixed effects to 2.0 percent (significant at the 0.01 level) without. Child age again enters negatively; again this may suggest lower ability since grade dummies are also included in the regression. Household wealth is a significant determinant of the probability that the household has a children's study area, again as expected. Cognitive ability has no impact.

4.62. Education-Related Time Use

From a theoretical perspective, higher parental education does not necessarily translate into higher spending. An alternative is that more educated parents may be better, more efficient home educators. Because such parents face higher returns to time spent helping their children with homework, they may devote fewer hours to market work and more hours to home production, including interacting with children, i.e., an income effect may dominate. In this case, the first order conditions of the household's utility maximization problem (equation 3) may be those described by equation (6a).

The demand for total parent time spent helping all children with homework is estimated as a tobit model (equation 9a) with censoring at 0 (623 households report 0 time allocated to helping children with homework). Estimates are presented in Table 4-6. As father's education increases by one grade level, time spent helping children with homework increases by 21 to 25 minutes per week (about 10 percent of the mean) if the sampled child is a girl and by about 19 minutes per week if the sampled child is a boy. The effect of an additional grade of mother's education is to increase time spent helping children with homework by 20 to 25 minutes for daughters and by 19 to 29 minutes for sons. These estimates are all significant at the 0.01 level, regardless of whether village fixed effects are included, suggesting that this relationship is quite robust. Surprisingly, the number of other enrolled children has a negative (but not significant) effect on parent time devoted to helping children with homework, perhaps because time increasingly becomes a luxury good as the household has more members to feed. Age also has a negative effect, due perhaps to older children being better able to help themselves; alternatively, older children are likely to have enrolled at later ages, suggesting that their

parents are less eager about their schooling. Cognitive ability has a positive effect, but the estimate becomes insignificant when village fixed effects are added. Further, it is possible that time spent with children affects scores on the cognitive ability test, calling the direction of causality into question.

Table 4-7 presents probit estimates for whether either parent reads to the sampled child (equation 9b). Marginal effects are reported, and errors are assumed to be clustered by village. There is no variation in the outcome variable for 2 villages, and they are thus dropped from the analysis when village fixed effects are implemented. Although the questionnaire did not specify which parent reads to the child, the effects are much stronger for mothers than for fathers. The effect of an additional grade of school completed by the mother is to raise the probability that either parent reads to the sampled child by 2.2 to 2.7 percent (3.7 percent of the mean probability) when the child is a girl and by 2.7 to 3.1 percent when the child is a boy, significant at the 0.01 level. The impact of father's education is smaller than that for mother's education when the sampled child is a boy (increasing the probability by 1.2 percent), but the coefficient remains significant as village fixed effects are implemented. Father's education has a still smaller impact when the sample child is a girl. As fathers age, the probability that either parent reads to the child falls; as mothers age, the probability rises. As with time spent helping with homework, the number of children reduces the probability that parents read to the sampled child; this is true whether or not those siblings are enrolled in school. Interestingly, the sign changes when village fixed effects are included, although the effect is still not significant. Household wealth has a positive but insignificant effect on this probability. Cognitive ability Z-scores have a positive effect, although the direction of causality may again be questionable.

Table 4-8 presents the determinants of whether either parent discusses the sampled child's school performance with his or her teachers (equation 9b), once more estimated as a probit model with errors assumed to be clustered by village. Ten villages are omitted when implementing village fixed effects due to insufficient variation in the dependent variable. Again, marginal effects are shown and the format follows those described above. As with reading to the sampled child, father's education has a significant effect only for sons while mother's education affects sons and daughters alike.

The marginal effect of an additional grade completed by fathers is to increase the probability that a parent discusses a sampled son's schooling with teachers by 1.3 percent (1.7 percent of the mean probability), an estimate that is robust to the inclusion of village fixed effects (significant at the 0.01 level). Mother's education raises the probability by 1.3-1.9 percent above the mean per grade completed for both sons and daughters.

4.63. A Different Tradeoff

The results presented in Tables 4.3 through 4.8 show that investments in both non-required education-related goods and time increase with parental education, and that the relationships are quite robust. Thus, more educated parents are not substituting goods for time investment or vice versa, but are demanding more of both instead. Section 2 outlined two possible explanations: first, more educated parents may perceive that the returns to education are higher for their children; second, children's education may enter the household utility function differently for more educated parents, e.g., more educated parents may be more altruistic or may have different preferences for present and future consumption.

Distinguishing between these scenarios is difficult empirically, but the data lend some support for the first explanation. Specifically, mothers were asked about the expected pay 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 4-9). In the quintile with the lowest total parental education, 43.3 percent of mothers believe that junior secondary education has "a great deal" of influence for the future salary of boys and 40.2 percent of mothers agree that junior secondary education has a large influence on the future salary of girls. In the quintile with the highest total parental education, 48.6 percent of mothers believe that the influence of junior secondary schooling is large for boys and 48.5 percent believe that it is large for girls. Some 51.4 percent of mothers in households with low total education thought that senior secondary schooling makes a big difference for boys, while 56.8 percent of mothers in households with high total education did. The corresponding figures for girls at the senior secondary level are 49.0 and 52.2 percent. Thus, more educated parents perceive that the returns to education are higher for their children

regardless of sex. This is certainly plausible in the Chinese context, moreover, because more educated parents generally have better access to non-farm jobs – jobs that have higher educational requirements and offer higher returns than farming (see Lam and Schoeni, 1993). Unfortunately, the data do not offer insight into whether more educated parents are more altruistic or whether they simply have different preferences over the timing of consumption.

4.7. The Impact of Investments on the Estimated Effect of Parental Education

Investments in education are often cited as being an important pathway by which the relationship between parental education and child learning manifests itself. It has been shown that more educated parents invest more money (i.e., goods) and time in the their children's education, yet the extent to which these investments explain the relationship is not well understood. In this section, I estimate the "baseline" determinants of children's test scores (equation 10a) using OLS, repeat the estimates while including various investments in goods and time (equation 10b), and compare the estimated coefficients on parental education; reductions in the point estimates are interpreted as the extent to which the relationship between parental education and child learning is explained by various investments.

As noted in Figure 4-1, investments in education may reflect characteristics of the child, parent, household, schools, and community, some of which are not observed in the data, and the point estimates will suffer from omitted variable bias. Point estimates for the various instruments may also suffer from simultaneity bias because low test scores may prompt additional investment. IV estimation may be used to control for these biases if appropriate instruments are found. Irrigated land (as a percentage of the household's total land allocation) is a reasonably strong predictor of education-related investments, so each model was estimated using IV estimation in addition to OLS estimation. The coefficients on parental education have the same signs in both cases, but the power of the relationship between parental education and children's test scores disappears with instrumented investments. As a result, only the OLS estimates are reported.

A second-best strategy for handling omitted variable bias is to include controls for correlates of the omitted variables. I thus repeat the comparisons described above while

controlling for household wealth, the teacher quality ranking, cognitive ability, and unobservable characteristics of the school and village via village fixed effects (equations 10a´ and 10b´). Omitted variable bias may nevertheless persist if investments correlate with other unobservables, but if the bias is identical across specifications (which requires that the investments are not correlated with the variables biasing parental education), then the comparisons are valid. Regardless, this strategy does not rule out simultaneity bias, so endogeneity remains a concern.

4.71. Chinese Test Scores

Table 4-9 presents OLS estimates of the determinants of children's Chinese test scores (converted into Z-scores, defined as standard deviations from the county/grade mean score). Table 4-10 presents analogous estimates, but includes household wealth, the teacher quality ranking, cognitive ability, and village fixed effects. Grade dummies are included in all specifications and t statistics are calculated using robust standard errors. Column 1 presents the baseline estimates (equations 10a and 10a´). Column 2 includes the log of non-required spending on education-related goods as an additional regressor, column 3 includes a dummy for whether the household has children's books, column 4 includes a dummy for whether the household has a study area for children's use (e.g., a desk that children use to study), column 5 includes the total weekly hours that parents spend helping children with homework, column 6 includes a dummy for whether either parent reads to the sampled child, and table 7 includes a dummy for whether parents discuss the sampled child's academic performance with his or her teacher.

Father's education has a strong impact on Chinese test scores (Table 4-10, column 1). An additional grade of completed schooling increases a daughter's predicted test score by 0.026 standard deviations from the county/grade mean (significant at the 0.05 level) and increases a son's predicted test score by 0.032 standard deviations (significant at the 0.01 level). The effect of mother's education is weaker for both sons and daughters, with an additional completed grade raising test scores by 0.016 standard deviations for sons and 0.019 standard deviations for daughters, both significant at the 0.10 level. Including household wealth, teacher quality rankings, cognitive ability, and village fixed effects (Table 4-11, column 1) reduces the estimated effect of father's

education to 0.022 standard deviations per grade completed at the mean for daughters, but the effect is unchanged for sons. Including these variables increases the estimated effect of mother's education on girls' test scores to 0.024 standard deviations per grade completed at the mean. Teacher quality has a negative effect on Chinese test scores; if more educated mothers have children who are taught be worse teachers, this accounts for the increase in the estimated effect of mother's education with the inclusion of the additional regressors. Alternatively, mother's education may correlate negatively with some village characteristic to generate the downward bias in the estimates presented in Table 4-10.[10] This correlation is stronger for daughters than for sons, however, as the effect of mother's education on sons falls slightly when village fixed effects are included.

Boys perform significantly worse than girls on Chinese tests, although dropouts in this age group are much more likely to be girls, suggesting that the coefficient is biased upwards (for a similar interpretation, see Brown and Park, 2002). Age also has a negative effect on test scores. As noted above, because grade controls are included, age may indicate lower ability if these children either start school later. The sign changes as village fixed effects are added to the regression, suggesting that age of enrollment is subject to local norms and that – conditional on enrolling at the same as their cohort – older students perform somewhat better (although the estimate becomes insignificant).

Simultaneity between Chinese test scores and various investments may be a concern. That is, investments in education-related goods and time may result in higher test scores, else low test scores may prompt greater investments. The estimated effects of non-required education-related spending and of whether parents discuss academic issues with the sampled child's teacher are negative (but not significant), suggesting that the latter may be true. When village fixed effects and the other correlates of education are included, the provision of a children's study area and parent time allocated to helping children with homework also negatively impact Chinese test scores, the latter significantly so. The net effect is to increase the estimated effects of parental education above the baseline estimates presented in column 1, so little may conclusively be said about whether parental education impacts test scores through these investments.

By contrast, the provision of children's books and whether either parent reads to the sampled child have positive impacts on test scores (Table 4-10, columns 3 and 6).

Having children's books in the household increases Chinese test scores by 0.13 standard deviations, significant at the 0.05 level. Reading to the sampled child raises Chinese test scores by 0.08 standard deviations, significant at the 0.10 level. Although the significance diminishes as village fixed effects and the other regressors are added, the point estimates remain positive. Importantly, if most of the variance in whether the household has children's books and whether a parent reads to the sampled child is due to variance in parental education, then it is not surprising that the point estimates on these variables are not significant. If their inclusion nevertheless reduces the estimated coefficients on parental education, this suggests that these are important mechanisms by which parental education affects children's learning.

Controlling for whether the household has children's books reduces the estimated effect of father's education on girls' Chinese test scores to 0.024 standard deviations, a reduction of 7.3 percent from the baseline estimates. For sons, the effect of parental education falls by 5.1 percent. The reductions are larger for mothers; including children's reading materials reduces the estimated effect of mother's education by 10.4 percent for sons and by 10.4 percent for daughters. Household wealth, teacher quality rankings, cognitive ability, and village fixed effects reduce the magnitude of the reduction, particularly for mothers. Although the effect of cognitive ability is quite dominant, this investment still explains about 2 percent of the relationship between parental education and children's learning. Including the dummy for whether either parent reads to the sampled child reduces the effect of father's education on Chinese test scores by 3.3 percent for sons and by 3.5 percent for daughters. Again, the reduction in the estimated effect of mother's education is more dramatic; including this variables reduces the estimated effect of mother's education on sons' Chinese test scores by 15.3 percent and on daughters' test scores by 11.4 percent. Including village fixed effects and the other correlates reduces the magnitude of the reductions, albeit less than with the provision of children's reading material; while the point estimates on father's education fall by about 2 percent, those on mother's education fall by 4.6 percent for girls and by 13.5 percent for boys.

Because more educated parents provide higher levels of investment in both goods and time for their children's human capital production, column 8 presents estimates

including both the household's provision of children's reading material and the measure for whether a parent reads to the sample child. Not surprisingly, the estimated impact of parental education on Chinese test scores falls considerably when controlling for both types of investment. The estimated effect of father's education on sons' and daughter's test scores fall by 6.9 percent and 8.8 percent from the baseline estimates, respectively. The estimated effect of mother's education on sons' and daughter's test scores fall by 20.2 percent and 18.1 percent. Again, the reductions reported in Table 4-11 are smaller than those reported in Table 4-10; including the additional regressors, the effect of mother's education is 5.9 percent smaller than the baseline estimates for girls and 10.4 percent smaller for boys while the effect of father's education is 3.1 percent smaller than the baseline estimates for girls and 2.9 percent smaller for boys.

4.72. Mathematics Test Scores

Table 4-12 presents OLS estimates for the baseline determinants of the child's Z-score on a mathematics test (equation 10a) and Table 4-13 presents those including household wealth, the teacher quality ranking, cognitive ability, and village fixed effects (equation 10b). As above, investments are added iteratively in columns 2 through 7 (equations 10a´ and 10b´). Grade dummies are included in all specifications and t statistics are calculated using robust standard errors.

For the baseline estimates (column 1), an additional grade completed by fathers equates to an improved performance of 0.024 standard deviations from the county/grade mean mathematics score for girls and 0.029 standard deviations for boys. As with Chinese test scores, mother's education has a larger impact on girls than boys, but the magnitude is much smaller – an additional grade completed increases predicted mathematics scores by 0.011 standard deviations for girls and 0.008 standard deviations for boys. Including household wealth, the teacher quality ranking, cognitive ability, and village fixed effects prompts similar changes to those seen above in the estimated relationships between parents and their daughters and between mothers and sons. Specifically, the effect of an additional grade completed by mothers increases to 0.017 standard deviations for mothers with female children and falls to zero for mothers of male children. For fathers, the effect on an additional grade of completed schooling falls to

0.020 standard deviations from the mean for daughters, but remains the same for sons. These findings suggest again that mother's education correlates with some positive community characteristic when her child is male, as does father's education when his child is female. By contrast, mother's education correlates with some negative characteristic of the community when her child is female.

Father's age has a negative and significant effect on children's mathematics test scores. One possible explanation is that younger fathers may have better or more recent mathematics training, but this explanation does not offer insight as to why children's test scores increase significantly with mother's age. Controlling for grade level, age has a negative effect on test scores. Again, this is likely the result of academically weaker children either beginning school later, and the effect becomes positive (although not significant) when village fixed effects are included.

Investments have similar signs and similar magnitudes as they did in determining Chinese test scores. First, non-required spending on education-related goods has a negative effect on mathematics test scores in both regressions, and whether the home has a study area, parent time allocated to helping children with homework, and whether parents discuss academic performance with teachers all have negative effects when including village fixed effects and the additional regressors. Although none of these effects is significant, they may suggest that parents make these investments as a result of low school performance, i.e., the direction of causation is questionable. By contrast, whether the household has children's books and whether either parent reads to the sampled child positively affect children's test scores (columns 3 and 6): children whose household has appropriate reading material score 0.11 standard deviations higher on mathematics tests (significant at the 0.05 level) while children whose parents read to them score 0.76 standard deviations higher (not quite significant). With the additional controls, these effects fall in magnitude but remain positive.

Controlling for whether the household has children's books reduces the estimated effect of father's education on girls' mathematics test scores to 0.022 standard deviations, a reduction of 7.2 percent from the baseline estimates. For sons, the coefficient on father's education falls by 5.5 percent from the baseline. As with Chinese test scores, the reduction in the estimated effects of education is greater for mothers, falling by 17.0

percent and 18.1 percent from the baseline estimates for daughters and sons, respectively. Most of this reduction is explained by the inclusion of the other regressors, particularly cognitive ability. Nevertheless, including this investment reduces the estimated effect of father's education by about 1.5 percent for both boys and girls and reduces the estimated effect of mother's education by 2.3 percent for boys. Similarly, controlling for parents reading to children reduces the estimated effect of father's education on children's mathematics test scores by 3.4 to 3.5 percent in the baseline estimates and by 1.7 to 2.0 percent with the additional regressors. The effect of mother's education falls on girls' and boys' test scores falls by 17.9 and 25.3 percent from the baseline estimates, respectively, when controlling for parents reading to children. In the augmented regression, controlling for whether a parent reads to a sampled son reduces the estimated effect of mother's education by 5.2 percent. Controlling for these two investments concurrently (column 8) has the effect of reducing the estimated point estimates for father's education by 8.9 percent for girls and by 7.3 percent for boys, and of reducing the estimated effect of mother's education by 27.7 percent for girls and 35.0 percent for boys. The reductions in the estimated effects of parental education when controlling or household wealth, teacher quality rankings, cognitive ability, and village fixed effects are again much smaller, ranging from 2.8 percent to 6.7 percent.

4.8. Conclusion

The literature has documented a strong relationship between parental education and child human capital accumulation, 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 these investments is not well understood. Two such investments are money spent on education-related goods and time spent interacting with children, yet parents may face a trade-off between these investments in resource constrained households in areas with poorly developed credit markets. 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.

Alternatively, more educated parents are likely to be more adept at teaching children in the home, and thus they may forego some time in the workplace in order to provide more time for children's human capital development. Finally, more educated parents may provide more of both types of investments despite being resource constrained if the returns to children's human capital development differ for their children or if children's human capital development is valued differently in such households.

The first objective of this paper is to understand how parental education affects investments in children's human capital. Using a new survey of children, households, schools, and communities in Gansu, China, I estimate the demand for six education-related investments. I find that more educated parents provide higher levels of both education-related goods (e.g., the provision of children's books) and education-related time (e.g., time spent reading to children). For example, an additional grade completed by fathers increases the probability that the household owns children's books by approximately 1.6 percent at the mean. An additional grade completed by mothers increases this probability by up to 1.8 percent. At the same time, an additional grade completed by fathers increases the probability that either parent reads to the sampled child by between 0.7 percent and 1.3 percent, while an additional grade completed by mothers increases this probability by 2.1 percent to 3.1 percent. Evidence suggests that the perceived returns to education are higher for the children of more educated parents, a reasonable assumption in rural China because more educated parents may have better access to better paying off-farm jobs when their children seek employment.

The second objective of the paper is to analyze the extent to which these investments explain the robust relationship between parental education and children's learning described in the literature. To facilitate this, I estimate the effect of parental education on children's Chinese and mathematics test scores with and without controlling for individual investments; reductions in the estimated effect of parental education when controlling for investments are interpreted as the degree to which the particular investment explains the relationship between parental education and test scores.

Parental education has a strong positive effect on children's test scores, with an additional year of father's education increasing test scores by between 0.019 and 0.033 standard deviations from the mean test score. The effects of mother's education are

smaller, increasing scored by between 0.008 and 0.019 standard deviations at the mean. Controlling for whether the household has children's books reduces the estimated effect of parental education on Chinese test scores by between 5.1 percent and 10.9 percent and the estimated effect of parental education on mathematics test scores by between 5.5 and 18.1 percent. Similarly, controlling for whether either parent reads to the sampled child reduces the estimated effect of parental education on Chinese test scores by between 3.3 and 15.3 percent and the estimated effect of parental education on mathematics test scores by between 3.4 percent and 25.3 percent. Controlling for both of these investments reduces the estimated effect of parental education by between 6.9 percent and 20.2 percent for Chinese test scores and by between 7.2 percent and 35.0 percent for mathematics test scores. Other investments have a much less pronounced effect, however, and some (e.g., spending on education-related goods) have a negative impact on test scores. It may thus be the case that test scores drive investments, not the reverse, and simultaneity bias may be a concern. So, too, may omitted variable bias.

Lacking satisfactory instruments, I add several potential correlates of investments to control for omitted variable bias – household wealth, a teacher quality measure, a measure of the child's cognitive ability, and village fixed effects. The estimated effects of parental education are greatly reduced with the inclusion of these controls, and the extent to which investments explain the relationship between parent education and test scores diminishes accordingly. Nonetheless, the availability of children's books and whether a parent reads to the sample child still reduce the estimated effect of parental education on Chinese test scores by between 1.9 percent and 13.5 percent and reduce the estimated effect of parental education on mathematics test scores by between 1.3 percent and 2.4 percent.

Even though the direction of causality is uncertain in some estimates, the paper shows a correlation between parent education and various investments in children's human capital development is evident. Future work on this topic will thus emphasize searching for instruments for education-related investments to better control for endogeneity bias. In the meanwhile, it is evident that more educated parents make larger investments in their children's human capital accumulation in rural China, and these investments are an

important mechanism – though certainly not the only mechanism – by which parental education affects children's learning.

Notes to Chapter IV

[1] I am grateful to the Mellon Foundation and the University of Michigan Center for Chinese Studies for financially supporting this fieldwork and to the Spencer Foundation for supporting the write-up. I would like to thank David Lam, Albert Park, Jan Svejnar, and Bob Willis for providing many helpful suggestions. This paper also benefited from comments from Axel Anderson, Andrew Coleman, Emily Hannum, Peggy Kong, Yo Nagai, Steve Salant, and seminar participants at Northwest Normal University (Gansu, China) and the 2003 Midwest Economics Association Annual Meeting in St. Louis.

[2] Alternatively, it may be assumed that the household has a single decision-maker, else that there is only one parent present.

[3] A straightforward generalization makes the sharing rule a function of parental education as well, although it would function quite similarly to the altruism function.

[4] The comparative statics are indeterminate in the general case where no functional forms are assumed for the human capital production function, g. Although not included here, the derivations are available from the author upon request.

[5] The comparative static results are identical if the human capital production function is quasilinar in x rather than θ assuming that parental education affects either wages only or the productivity of time spent with children only. They differ if it is assumed that parental education affects the returns to education only or parental altruism only, and are sometimes ambiguously signed.

[6] Identical comparative statics are derived if parental education affects the weighting of first and second period consumption instead of parental altruism and if more educated parents have stronger preferences for second period consumption. See footnote 3.

[7] The quality of education eroded dramatically during the Cultural Revolution (1966-1976). Tertiary education was suspended and many senior high schools closed, streamlining ended, and the rigorous "bourgeois" exam system for access to higher education was replaced by system based on class background and recommendations (Han, 2000). Labor and study were undertaken together at every level, further diluting quality. Thus, the quantity of education has different implications depending upon when it was undertaken, and controlling for measures such as age may help to mitigate this variation.

[8] Of Gansu's 86 counties, 7 are predominantly Tibetan. These counties were omitted from the sampling because Mandarin is not widely spoken in these areas.

[9] In 2000, \$1US $\cong$ 8.27 Chinese yuan.

[10] Measurement error would also bias the estimates downward, but I doubt that this is the case. First, there is no systematic difference in the reported education levels of mothers of daughters in the sample and mothers with sons in the sample. Second, even if there is

a true difference in the education levels of mothers of daughters and mothers of sons, I find it implausible that mothers of daughters would misreport their education while mothers of sons would not.

References for Chapter IV

Behrman, J.R., Foster, A., Rosenzweig, M.R., & Vashishta, P. (1999). "Women's Schooling, Home Teaching, and Economic Growth." *Journal of Political Economy*. 107(4): 682-714.

Behrman, J.R., Ii, M., & Murillo, D. (1993). "Household Schooling Demands in Urban Bolivia." Mimeo, Department of Economics, University of Pennsylvania.

Behrman, J.R., Khan, S. Ross, D. & Sabot, R. (1997). "School Quality and Cognitive Achievement Production: A Case Study for Rural Pakistan." *Economics of Education Review*. 16(2): 127-142.

Bound, J., Jaeger, D.A., & Baker, R.M. (1995). "Problems with Instrumental Variables Estimation when the Correlation Between the Instruments and the Endogenous Explanatory Variables is Weak." *Journal of the American Statistical Association.* 90(430): 443-450.

Brown, P.H. & Park, A. (2002). "Education and Poverty in Rural China." *Economics of Education Review*. 21(6): 523-541.

Case, A. & Deaton, A. "School Inputs and Educational Outcomes in South Africa." *Quarterly Journal of Economics*. 114(3): 1047-1084.

Gaulthier, A.H., Smeedling, T., & Furstenberg, Jr., F. (2000). "Estimates of Parental Time: Theoretical and Methodological Issues." Mimeo, Center for Policy Research, The Maxwell School, Syracuse University.

Glewwe, P. (1999). "Why Does Mother's Schooling Raise Child Health in Developing Countries? Evidence from Morocco." *Journal of Human Resources*. 34(1): 124-159.

Glewwe, P., & Jacoby, H. (1994). "Student Achievement and Schooling Choice in Low Income Countries: Evidence from Ghana." *Journal of Human Resources.* 29(3): 841-864.

Han, D. (2000). "The Unknown Cultural Revolution: Educational Reforms and Their Impact on China's Rural Development." New York: Garland Publishing.

Hannum, E. (1998). "Educational Inequality: Hidden Consequences of the Reform Era in Rural China." Ph.D. Dissertation, Department of Sociology, University of Michigan.

Hannum, E. & Xie, Y. (1994). "Trends in Educational Gender Inequality in China: 1949-1985." *Research in Social Stratification and Mobility.* 13, 73-98.

Hanushek, E.A. (1995). "Interpreting Recent Research on Schooling in Developing Countries." *World Bank Research Observer*. 10(2): 227-246.

_____. (1997). "Assessing the Effects of School Resources on Student Performance: An Update." *Educational Evaluation and Policy Analysis*. 19(2): 141-164.

Hanushek, A., Batista, J., Neto, G. & Harbison, R.W. (1996). "Efficiency-Enhancing Investments in School Quality." In Birdsall, N. & Sabot, R.H., eds., *Opportunity Forgone: Education in Brazil*. Washington, D.C.: Inter-American Development Bank / Johns Hopkins University Press.

Heltberg, R. & Johannesen, N. (2002). "How Parental Education Affects Child Human Capital: Evidence from Mozambique." Working Paper No. 02-04. Institute of Economics, University of Copenhagen.

Hossain, S.A. (1996). "Making an Equitable and Efficient Education: The Chinese Experience." Mimeo, revised from *China: Social Sector Expenditure Review*. Washington, D.C.: The World Bank, 1996.

Judd, C.M., Bridge, C.R., & Moock, P.R. (1979). *The Determinants of Educational Outcomes: The Impact of Families, Peers, Teachers, and Schools*. Cambridge, MA: Ballinger Publishing.

Lam, D. & Schoeni, R. (1993). "Effects of Family Background on Earnings and Returns to Schooling: Evidence from Brazil." *Journal of Political Economy*. 101(4): 710-740.

Lillard, L., & Willis, R. (1994). "Intergenerational Educational Mobility: Effects of Family and State in Malaysia." *Journal of Human Resources*. 29(4): 1126-1166.

Padila, Y.C. (1996). "The Influence of Family Background on the Educational Attainment of Latinos." *New England Journal of Public Policy*. 11(2): 25-48.

Paraita, C. & Pastro, M. (2000). "The Primary School Dropout in Spain: The Influence of Family Background and Labor Market Conditions." *Education Economics*. 8(2): 157-168.

Parish, W.L., & Willis, R.J. (1993). "Daughters, Education and Family Budgets: Taiwan Experiences." *Journal of Human Resources.* 28(4): 863-898.

Park, A. & Hannum, E. (2001). "Do Teachers Affect Learning in Developing Countries?: Evidence from Matched Student-Teacher Data from China." Paper presented at the "Rethinking Social Science Research in the Developing World in the 21st Century" conference, Social Science Research Council, Park City, Utah.

Rumberger, W.W. (1983). "Dropping Out of High School: The Influence of Race, Sex, and Family Background." *American Educational Research Journal*. 20(2): 199-220.

Sathar, Z.A. & Lloyd, C.B. (1994). "Who Gets Primary Schooling in Pakistan: Inequalities Among and Within Families." *Pakistan Development Review*. 33(2): 103-134.

Strauss, J. (1990). "Households, Communities, and Preschool Child Nutrition Outcomes: evidence from Rural Côte d'Ivoire." *Economic Development and Cultural Change*. 38(2), 231-261.

Strauss, J. & Thomas, D. (1995). "Human Resources: Empirical Modeling of Household and Family Decisions." In Behrman, J. & Srinivasan, T., eds., *Handbook of Development Economics, vol. 3A*. Amsterdam: North-Holland, 1883-2023.

Thomas, D. (1994). "Like Father like Son, or, Like Mother like Daughter: Parental Education and Child Health." *Journal of Human Resources*. 29(4): 950-988.

Tsang, M.C. (1996). "Financial Reform of Basic Education in China." *Economics of Education Review*. 15(4): 423-444.

United States National Center for Educational Statistics. (1966). *Equality of Educational Opportunity, by James S. Coleman.* Washington, D.C.: U.S. Department of Health, Education, and Welfare, Office of Education.

Figure 4-1. Pathways of Influence

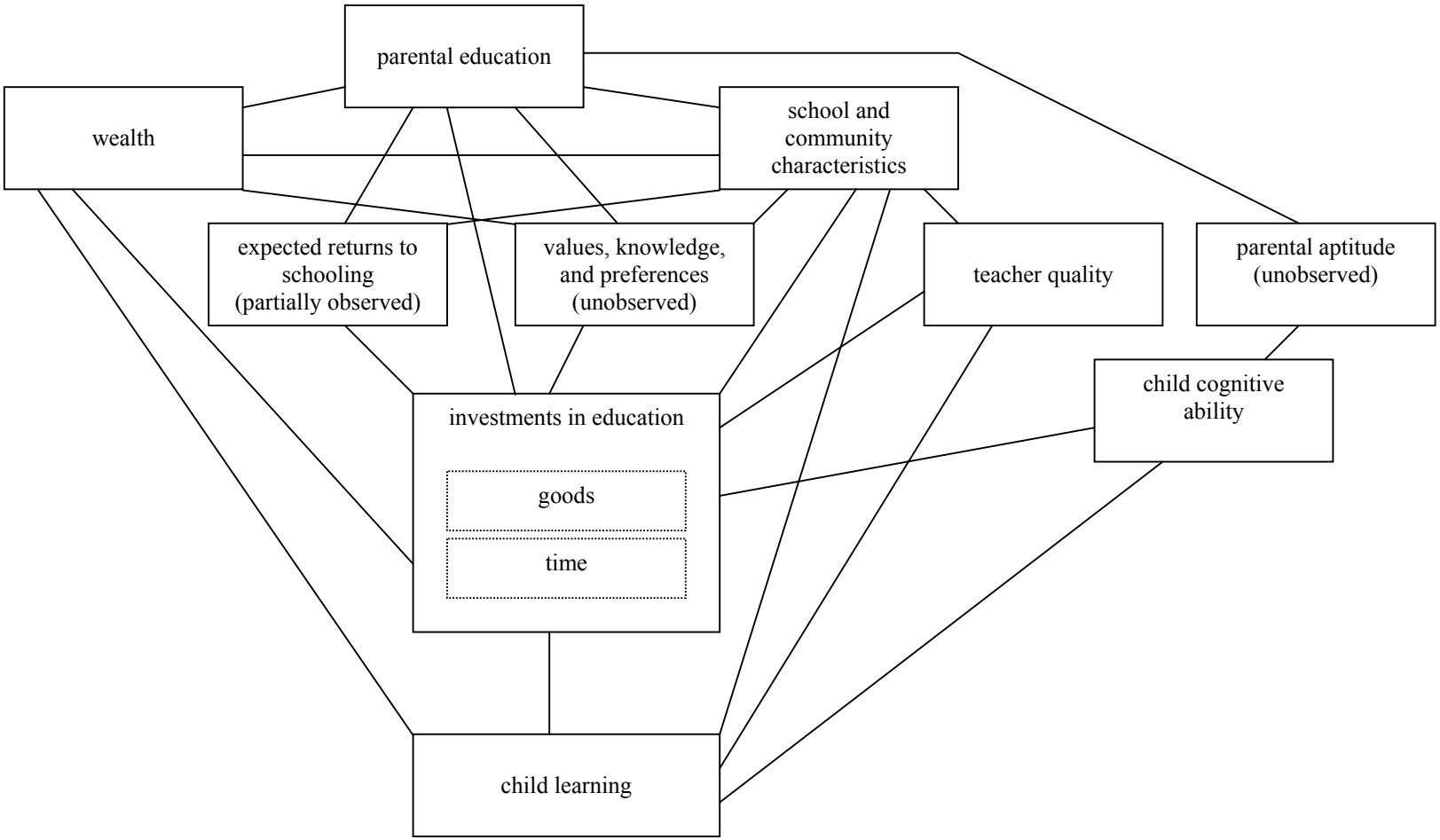

Table 4-1. Comparative Static Results

production function	how parent human capital affects the household's problem			
	wage function	efficiency of time	returns to education	altruism function
quasilinear in θ	$g = x^a + \theta$	$g = x^a + H\theta$	$g = (x^a + \theta)^H$	$g = x^a + \theta$
$d\theta / dH$	-	+	+	+
dx / dH	+	-	0	0
Cobb-Douglass	$g = x^a \theta^{(1-a)}$	$g = x^a (H\theta)^{(1-a)}$	$g = (x^a \theta^{(1-a)})^H$	$g = x^a \theta^{(1-a)}$
$d\theta / dH$	0	0	+	+
dx / dH	+	0	+	+

Table 4-2. Variables and Summary Statistics

Variable	Obs.	Unit	Mean	Std. Dev.	Min	Max
non-required education-related expenditures	1918	yuan	46.519	55.595	0	836
household has children's books	1918	dummy	0.544	0.498	0	1
child has study area	1918	dummy	0.588	0.492	0	1
help with homework	1918	total hours per week, both parents	4.121	4.953	0	35
reads to child	1918	dummy	0.657	0.475	0	1
discuss child's school performance with teacher	1918	dummy	0.762	0.426	0	1
Chinese test score	1889	percentage	72.502	13.155	0	100
mathematics test score	1895	percentage	73.992	14.581	0	100
father's education	1918	grades completed	6.985	3.515	0	15
mother's education	1918	grades completed	4.190	3.514	0	12
father's age	1918	years	37.411	4.846	27	57
mother's age	1918	years	35.060	4.210	25	55
wealth	1918	yuan	14773.810	16963.810	115	209740
father's village residency	1918	months per year	9.935	3.475	0	12
mother's village residency	1918	months per year	11.732	1.547	0	12
male child	1918	dummy	0.539	0.499	0	1
child's age	1918	years	11.019	1.069	9	12.917
grade	1918	current grade level	4.301	1.343	1	9
cognitive score	1918	points	17.693	10.036	0	43
other enrolled children	1918	number	0.866	0.714	0	4
other non-enrolled children	1918	number	0.452	0.638	0	4
teacher rank	1918	0=on probation, 1 = rank 1, 2 = rank 2, 3 = highest rank	1.468	0.953	0	3

Table 4-3. Log Spending on Non-Required Education-Related Goods (Tobit)

Variable	Unit	(1)	(2)	(3)	(4)	(5)
father's education	grades	0.0228**	0.0193**	0.0199**	0.0222**	0.0181**
		(2.56)	(2.17)	(2.51)	(2.49)	(2.29)
mother's education	grades	0.0335***	0.0295***	0.0097	0.0341***	0.0077
		(3.60)	(3.17)	(1.14)	(3.68)	(0.91)
father's age	years	0.0088	0.0125*	0.0085	0.0087	0.0102*
		(1.31)	(1.85)	(1.42)	(1.30)	(1.69)
mother's age	years	-0.0036	-0.0066	0.0036	-0.0018	0.0025
		(0.46)	(0.86)	(0.51)	(0.23)	(0.35)
male	dummy	0.0471	0.0468	0.0700	0.0404	0.0680
		(0.52)	(0.52)	(0.88)	(0.44)	(0.86)
age	years	0.0165	0.0236	-0.0034	-0.0028	-0.0001
		(0.67)	(0.96)	(0.15)	(0.11)	(0.00)
other enrolled children	number	0.4482***	0.4536***	0.4781***	0.4438***	0.4726***
		(13.99)	(14.23)	(15.72)	(13.87)	(15.52)
non-enrolled children	number	0.0089	0.0150	0.0242	0.0055	0.0207
		(0.24)	(0.41)	(0.72)	(0.15)	(0.62)
father's ed * male	interaction	0.0041	0.0036	-0.0004	0.0050	-0.0010
		(0.34)	(0.29)	(0.04)	(0.41)	(0.10)
mother's ed * male	interaction	-0.0144	-0.0133	-0.0060	-0.0139	-0.0054
		(1.17)	(1.09)	(0.55)	(1.14)	(0.50)
log wealth	yuan		0.1046***			0.0577**
			(4.61)			(2.57)
teacher quality	ranking			-0.0012		-0.0028
				(0.05)		(0.12)
cognitive ability	Z-score				-0.0662***	0.0105
					(3.01)	(0.41)
Constant		1.2266***	0.2680	1.5409***	1.3180***	0.9501**
		(3.22)	(0.62)	(3.92)	(3.46)	(2.08)
Village FE				yes		yes
Observations		1918	1918	1918	1918	1918

Grade dummies included
Absolute value of t statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

Table 4-4. Household Provision of Children's Books (Probit)

Variable	Unit	(1)	(2)	(3)	(4)	(5)
father's education	grades	0.0164***	0.0126**	0.0109*	0.0171***	0.0083
		(3.19)	(2.41)	(1.79)	(3.41)	(1.35)
mother's education	grades	0.0183***	0.0139**	0.0121*	0.0179***	0.0091
		(3.12)	(2.37)	(1.90)	(3.05)	(1.41)
father's age	years	-0.0026	0.0014	-0.0027	-0.0026	-0.0001
		(0.58)	(0.30)	(0.59)	(0.57)	(0.02)
mother's age	years	0.0138**	0.0107**	0.0087	0.0123**	0.0069
		(2.57)	(1.98)	(1.63)	(2.30)	(1.28)
male	dummy	0.0243	0.0236	0.0535	0.0307	0.0515
		(0.46)	(0.44)	(0.85)	(0.60)	(0.81)
age	years	-0.0464***	-0.0398**	-0.0283	-0.0301**	-0.0228
		(3.06)	(2.56)	(1.59)	(2.00)	(1.21)
other enrolled children	number	-0.0699***	-0.0644***	0.0178	-0.0661***	0.0108
		(3.07)	(2.80)	(0.78)	(3.01)	(0.47)
non-enrolled children	number	-0.0805***	-0.0756***	-0.0146	-0.0782***	-0.0205
		(3.06)	(2.77)	(0.58)	(3.03)	(0.80)
father's ed * male	interaction	-0.0019	-0.0026	0.0036	-0.0028	0.0023
		(0.30)	(0.41)	(0.43)	(0.44)	(0.28)
mother's ed * male	interaction	-0.0055	-0.0040	-0.0137*	-0.0062	-0.0124
		(0.66)	(0.48)	(1.68)	(0.73)	(1.50)
log wealth	yuan		0.1209***			0.0890***
			(6.40)			(5.16)
teacher quality	ranking			0.0172		0.0147
				(0.99)		(0.84)
cognitive ability	Z-score				0.0589***	0.0200
					(3.44)	(1.04)
Robust std errors		yes	yes		yes	
Village FE				yes		yes
Observations		1918	1918	1818	1918	1818

Grade dummies included
Absolute value of z statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

Table 4-5. Household Provision of a Children's Study Area (Probit)

Variable	Unit	(1)	(2)	(3)	(4)	(5)
father's education	grades	0.0105**	0.0074	0.0127**	0.0106**	0.0102*
		(2.03)	(1.39)	(2.11)	(2.05)	(1.68)
mother's education	grades	0.0147**	0.0115*	0.0093	0.0147**	0.0067
		(2.32)	(1.76)	(1.46)	(2.31)	(1.04)
father's age	years	-0.0003	0.0030	0.0000	-0.0003	0.0027
		(0.07)	(0.66)	(0.00)	(0.06)	(0.58)
mother's age	years	0.0022	-0.0006	0.0010	0.0020	-0.0009
		(0.41)	(0.12)	(0.18)	(0.37)	(0.17)
male	dummy	0.0391	0.0394	0.0570	0.0400	0.0533
		(0.79)	(0.77)	(0.95)	(0.80)	(0.88)
age	years	-0.0462***	-0.0407**	-0.0460***	-0.0440***	-0.0508***
		(2.81)	(2.48)	(2.60)	(2.69)	(2.72)
other enrolled children	number	-0.0067	-0.0011	0.0306	-0.0060	0.0257
		(0.31)	(0.05)	(1.30)	(0.27)	(1.08)
non-enrolled children	number	-0.0277	-0.0232	-0.0279	-0.0273	-0.0327
		(1.14)	(0.92)	(1.09)	(1.12)	(1.26)
father's ed * male	interaction	-0.0035	-0.0039	-0.0041	-0.0036	-0.0048
		(0.52)	(0.57)	(0.50)	(0.53)	(0.59)
mother's ed * male	interaction	0.0054	0.0063	0.0034	0.0053	0.0046
		(0.69)	(0.77)	(0.41)	(0.67)	(0.56)
log wealth	yuan		0.0940***			0.0821***
			(5.88)			(4.81)
teacher quality	ranking			0.0151		0.0143
				(0.85)		(0.80)
cognitive ability	Z-score				0.0079	-0.0164
					(0.47)	(0.83)
Robust std errors		yes	yes		yes	
Village FE				yes		yes
Observations		1918	1918	1784	1918	1784

Grade dummies included
Absolute value of z statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

Table 4-6. Parent Time Allocated to Helping Children with Homework – Hours per Week (Tobit)

Variable	Unit	(1)	(2)	(3)	(4)	(5)
father's education	grades	0.4029***	0.4094***	0.3560***	0.4065***	0.3554***
		(5.71)	(5.78)	(5.24)	(5.75)	(5.22)
mother's education	grades	0.4214***	0.4285***	0.3392***	0.4187***	0.3385***
		(5.94)	(6.01)	(4.87)	(5.90)	(4.83)
father's age	years	-0.0634	-0.0703	-0.1295**	-0.0624	-0.1290**
		(1.20)	(1.32)	(2.52)	(1.18)	(2.50)
mother's age	years	-0.0605	-0.0549	-0.0550	-0.0689	-0.0553
		(0.98)	(0.88)	(0.91)	(1.11)	(0.92)
male	dummy	0.2552	0.2569	0.1488	0.2766	0.1500
		(0.34)	(0.34)	(0.21)	(0.37)	(0.21)
age	years	-0.3932**	-0.4062**	-0.0993	-0.3106	-0.0816
		(2.04)	(2.10)	(0.51)	(1.56)	(0.40)
other enrolled children	number	-0.3407	-0.3508	-0.0335	-0.3233	-0.0393
		(1.37)	(1.41)	(0.13)	(1.30)	(0.15)
non-enrolled children	number	-0.2452	-0.2550	-0.2090	-0.2317	-0.2138
		(0.85)	(0.88)	(0.74)	(0.80)	(0.75)
father's ed * male	interaction	-0.1020	-0.1014	-0.0420	-0.1054	-0.0428
		(1.06)	(1.05)	(0.46)	(1.09)	(0.47)
mother's ed * male	interaction	0.0634	0.0618	-0.0232	0.0618	-0.0236
		(0.68)	(0.66)	(0.26)	(0.66)	(0.26)
log wealth	yuan		-0.1857			0.0203
			(1.05)			(0.11)
teacher quality	ranking			0.0637		0.0643
				(0.34)		(0.34)
cognitive ability	Z-score				0.2811*	0.0609
					(1.65)	(0.29)
Constant		7.9211***	9.6390***	5.8840*	7.5389**	5.4417
		(2.64)	(2.82)	(1.77)	(2.51)	(1.41)
Village FE				yes		yes
Observations		1918	1918	1918	1918	1918

Grade dummies included
Absolute value of t statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

Table 4-7. Either Parent Reads to the Sampled Child (Probit)

Variable	Unit	(1)	(2)	(3)	(4)	(5)
father's education	grades	0.0094*	0.0091*	0.0074	0.0098*	0.0077
		(1.85)	(1.79)	(1.39)	(1.95)	(1.43)
mother's education	grades	0.0271***	0.0267***	0.0220***	0.0269***	0.0222***
		(4.95)	(4.86)	(3.80)	(4.94)	(3.80)
father's age	years	-0.0091**	-0.0088**	-0.0115***	-0.0091**	-0.0117***
		(2.51)	(2.40)	(2.82)	(2.53)	(2.84)
mother's age	years	0.0085*	0.0082*	0.0055	0.0076*	0.0057
		(1.81)	(1.74)	(1.18)	(1.67)	(1.22)
male	dummy	-0.0087	-0.0086	-0.0145	-0.0041	-0.0098
		(0.17)	(0.17)	(0.27)	(0.08)	(0.18)
age	years	-0.0183	-0.0175	-0.0080	-0.0080	0.0034
		(1.08)	(1.05)	(0.51)	(0.46)	(0.20)
other enrolled children	number	-0.0368*	-0.0363*	0.0211	-0.0339*	0.0194
		(1.83)	(1.79)	(1.03)	(1.75)	(0.94)
non-enrolled children	number	-0.0282	-0.0276	0.0069	-0.0263	0.0048
		(1.28)	(1.25)	(0.30)	(1.23)	(0.21)
father's ed * male	interaction	0.0031	0.0031	0.0049	0.0026	0.0042
		(0.45)	(0.44)	(0.68)	(0.38)	(0.58)
mother's ed * male	interaction	0.0045	0.0046	0.0056	0.0040	0.0048
		(0.57)	(0.59)	(0.74)	(0.50)	(0.64)
log wealth	yuan		0.0100			0.0001
			(0.77)			(0.00)
teacher quality	ranking			0.0136		0.0134
				(0.87)		(0.86)
cognitive ability	Z-score				0.0358**	0.0392**
					(2.05)	(2.22)
Robust std errors		yes	yes		yes	
Village FE				yes		yes
Observations		1918	1918	1885	1918	1885

Grade dummies included
Absolute value of z statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

Table 4-8. Parents Discuss Sampled Child's Academic Performance with Teachers (Probit)

Variable	Unit	(1)	(2)	(3)	(4)	(5)
father's education	grades	0.0051	0.0048	-0.0011	0.0049	-0.0013
		(1.12)	(1.05)	(0.24)	(1.08)	(0.28)
mother's education	grades	0.0177***	0.0173***	0.0132**	0.0178***	0.0130**
		(3.89)	(3.73)	(2.53)	(3.85)	(2.49)
father's age	years	0.0044	0.0047	0.0032	0.0044	0.0033
		(1.25)	(1.34)	(0.87)	(1.26)	(0.91)
mother's age	years	-0.0029	-0.0032	0.0002	-0.0022	0.0001
		(0.70)	(0.78)	(0.05)	(0.58)	(0.02)
male	dummy	-0.0333	-0.0332	-0.0690	-0.0368	-0.0695
		(0.84)	(0.83)	(1.50)	(0.93)	(1.51)
age	years	-0.0182	-0.0176	-0.0142	-0.0250	-0.0140
		(1.39)	(1.36)	(1.02)	(1.63)	(0.96)
other enrolled children	number	0.0040	0.0045	0.0056	0.0015	0.0052
		(0.20)	(0.23)	(0.31)	(0.08)	(0.28)
non-enrolled children	number	0.0189	0.0196	-0.0004	0.0172	-0.0006
		(0.84)	(0.87)	(0.02)	(0.80)	(0.03)
father's ed * male	interaction	0.0080	0.0079	0.0132**	0.0084	0.0131**
		(1.55)	(1.53)	(2.05)	(1.61)	(2.05)
mother's ed * male	interaction	0.0013	0.0013	-0.0004	0.0017	-0.0004
		(0.24)	(0.25)	(0.06)	(0.32)	(0.05)
log wealth	yuan		0.0106			0.0055
			(0.80)			(0.41)
teacher quality	ranking			0.0051		0.0050
				(0.37)		(0.36)
cognitive ability	Z-score				-0.0245	0.0010
					(1.26)	(0.07)
Robust std errors		yes	yes		yes	
Village FE				yes		yes
Observations		1918	1918	1749	1918	1749

Grade dummies included
Absolute value of z statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

Table 4-9. Expected Returns to Education

percent of mothers who agree that education has "a great deal of influence" on children's future income, by educational attainment of the parents and educational attainment and sex of the child

	difference in child's educational attainment			
	junior secondary school vs. primary school		senior secondary school vs. junior secondary school	
	boys	girls	boys	girls
quintile of households with the lowest adult educational attainment	43.3%	40.2%	49.0%	51.4%
quintile of households with the highest adult educational attainment	48.6%	48.5%	52.2%	56.8%

Table 4-10. Effect of Investments on Chinese Test Scores (OLS)

Variable	Unit	(1)	(2)	(3)	(4)
father's education	grades	0.0260**	0.0266**	0.0241**	0.0258**
		(2.43)	(2.49)	(2.23)	(2.38)
mother's education	grades	0.0193*	0.0203*	0.0172	0.0191*
		(1.67)	(1.73)	(1.50)	(1.67)
father's age	years	-0.0053	-0.0050	-0.0050	-0.0053
		(0.70)	(0.66)	(0.64)	(0.70)
mother's age	years	0.0043	0.0041	0.0026	0.0042
		(0.51)	(0.50)	(0.31)	(0.51)
male child	dummy	-0.2395**	-0.2389**	-0.2403**	-0.2402**
		(2.23)	(2.22)	(2.24)	(2.23)
age	years	-0.0697**	-0.0697**	-0.0638**	-0.0689**
		(2.40)	(2.40)	(2.20)	(2.36)
other enrolled children	number	0.0208	0.0334	0.0288	0.0209
		(0.60)	(0.90)	(0.83)	(0.60)
non-enrolled children	number	0.0549	0.0552	0.0647	0.0554
		(1.39)	(1.40)	(1.61)	(1.40)
father's education * male	interaction	0.0072	0.0074	0.0074	0.0073
		(0.51)	(0.52)	(0.51)	(0.51)
mother's education * male	interaction	-0.0030	-0.0034	-0.0026	-0.0031
		(0.21)	(0.24)	(0.18)	(0.22)
non-required spending	log yuan		-0.0280		
			(1.03)		
has children's books	dummy			0.1283**	
				(2.33)	
has child's study area	dummy				0.0172
					(0.32)
help with homework	hours/wk				
parents read to child	dummy				
discusses with teacher	dummy				
Constant		0.6857*	0.7216*	0.6537	0.6661
		(1.71)	(1.78)	(1.61)	(1.64)
Robust std errors		yes	yes	yes	yes
Observations		1876	1876	1876	1876
R-squared		0.037	0.037	0.041	0.037

Grade dummies included
Robust t statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

Table 4-10. Effect of Investments on Chinese Test Scores (OLS) (cont.)

Variable	Unit	(5)	(6)	(7)	(8)
father's education	grades	0.0260**	0.0251**	0.0260**	0.0237**
		(2.45)	(2.35)	(2.41)	(2.19)
mother's education	grades	0.0193*	0.0171	0.0194*	0.0158
		(1.66)	(1.48)	(1.69)	(1.38)
father's age	years	-0.0053	-0.0045	-0.0053	-0.0044
		(0.70)	(0.59)	(0.70)	(0.57)
mother's age	years	0.0043	0.0035	0.0043	0.0022
		(0.51)	(0.42)	(0.51)	(0.26)
male child	dummy	-0.2395**	-0.2396**	-0.2396**	-0.2403**
		(2.22)	(2.22)	(2.23)	(2.23)
age	years	-0.0697**	-0.0683**	-0.0698**	-0.0634**
		(2.39)	(2.37)	(2.39)	(2.20)
other enrolled children	number	0.0208	0.0241	0.0208	0.0304
		(0.60)	(0.69)	(0.60)	(0.87)
non-enrolled children	number	0.0549	0.0577	0.0550	0.0658
		(1.39)	(1.44)	(1.39)	(1.63)
father's education * male	interaction	0.0072	0.0070	0.0072	0.0072
		(0.50)	(0.49)	(0.51)	(0.50)
mother's education * male	interaction	-0.0030	-0.0033	-0.0030	-0.0028
		(0.21)	(0.23)	(0.21)	(0.20)
non-required spending	log yuan				
has children's books	dummy				0.1164**
					(2.13)
has child's study area	dummy				
help with homework	hours/wk	0.0000			
		(0.00)			
parents read to child	dummy		0.0862*		0.0612
			(1.65)		(1.20)
discusses with teacher	dummy			-0.0039	
				(0.06)	
Constant		0.6855*	0.6224	0.6888*	0.6117
		(1.74)	(1.53)	(1.69)	(1.49)
Robust std errors		yes	yes	yes	yes
Observations		1876	1876	1876	1876
R-squared		0.037	0.038	0.037	0.041

Grade dummies included
Robust t statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

Table 4-11. Effect of Investments on Chinese Test Scores (OLS) - 2

Variable	Unit	(1)	(2)	(3)	(4)
father's education	grades	0.0224**	0.0229**	0.0220**	0.0227**
		(2.32)	(2.37)	(2.29)	(2.36)
mother's education	grades	0.0238**	0.0241**	0.0234**	0.0241**
		(2.29)	(2.32)	(2.25)	(2.31)
father's age	years	-0.0039	-0.0036	-0.0039	-0.0039
		(0.54)	(0.49)	(0.53)	(0.53)
mother's age	years	0.0044	0.0044	0.0041	0.0044
		(0.51)	(0.52)	(0.48)	(0.51)
male child	dummy	-0.2077**	-0.2063**	-0.2092**	-0.2060**
		(2.16)	(2.14)	(2.17)	(2.14)
age	years	0.0146	0.0140	0.0159	0.0131
		(0.49)	(0.47)	(0.53)	(0.44)
other enrolled children	number	-0.0037	0.0101	-0.0044	-0.0030
		(0.10)	(0.25)	(0.12)	(0.08)
non-enrolled children	number	0.0208	0.0214	0.0221	0.0199
		(0.51)	(0.53)	(0.54)	(0.49)
father's education * male	interaction	0.0091	0.0091	0.0089	0.0090
		(0.71)	(0.71)	(0.69)	(0.69)
mother's education * male	interaction	-0.0142	-0.0143	-0.0136	-0.0141
		(1.08)	(1.09)	(1.03)	(1.07)
household wealth	log yuan	0.0829***	0.0847***	0.0778***	0.0853***
		(3.03)	(3.09)	(2.82)	(3.10)
teacher quality	ranking	-0.0140	-0.0141	-0.0148	-0.0137
		(0.50)	(0.51)	(0.53)	(0.49)
cognitive ability	Z-score	0.3359***	0.3359***	0.3348***	0.3358***
		(10.76)	(10.76)	(10.73)	(10.76)
non-required spending	log yuan		-0.0289		
			(1.01)		
has children's books	dummy			0.0739	
				(1.49)	
has child's study area	dummy				-0.0399
					(0.80)
help with homework	hours/wk				
parents read to child	dummy				
discusses w/ teacher	dummy				
Constant		-1.4211**	-1.3912**	-1.4158**	-1.3956**
		(2.48)	(2.42)	(2.47)	(2.43)
Village FE		yes	yes	yes	yes
Observations		1876	1876	1876	1876
R-squared		0.213	0.213	0.214	0.213

Grade dummies included
Absolute value of t statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

Table 4-11. Effect of Investments on Chinese Test Scores (OLS) - 2 (cont.)

Variable	Unit	(5)	(6)	(7)	(8)
father's education	grades	0.0238**	0.0219**	0.0223**	0.0217**
		(2.46)	(2.28)	(2.32)	(2.25)
mother's education	grades	0.0256**	0.0227**	0.0245**	0.0224**
		(2.46)	(2.17)	(2.35)	(2.15)
father's age	years	-0.0045	-0.0033	-0.0038	-0.0034
		(0.61)	(0.44)	(0.52)	(0.46)
mother's age	years	0.0042	0.0040	0.0044	0.0038
		(0.49)	(0.47)	(0.52)	(0.45)
male child	dummy	-0.2079**	-0.2083**	-0.2109**	-0.2095**
		(2.16)	(2.16)	(2.19)	(2.18)
age	years	0.0147	0.0141	0.0141	0.0153
		(0.50)	(0.47)	(0.47)	(0.51)
other enrolled children	number	-0.0044	-0.0046	-0.0034	-0.0051
		(0.12)	(0.12)	(0.09)	(0.14)
non-enrolled children	number	0.0198	0.0206	0.0207	0.0218
		(0.49)	(0.51)	(0.51)	(0.53)
father's education * male	interaction	0.0090	0.0090	0.0097	0.0089
		(0.70)	(0.70)	(0.75)	(0.69)
mother's education * male	interaction	-0.0145	-0.0144	-0.0143	-0.0138
		(1.10)	(1.09)	(1.08)	(1.05)
household wealth	log yuan	0.0837***	0.0826***	0.0831***	0.0781***
		(3.06)	(3.02)	(3.04)	(2.83)
teacher quality	ranking	-0.0143	-0.0148	-0.0139	-0.0153
		(0.51)	(0.53)	(0.50)	(0.55)
cognitive ability	Z-score	0.3361***	0.3339***	0.3359***	0.3332***
		(10.77)	(10.68)	(10.76)	(10.66)
non-required spending	log yuan				
has children's books	dummy				0.0657
					(1.31)
has child's study area	dummy				
help with homework	hours/wk	-0.0078*			
		(1.65)			
parents read to child	dummy		0.0635		0.0532
			(1.27)		(1.05)
discusses w/ teacher	dummy			-0.0532	
				(0.98)	
Constant		-1.3821**	-1.4617**	-1.3793**	-1.4504**
		(2.41)	(2.55)	(2.40)	(2.53)
Village FE		yes	yes	yes	yes
Observations		1876	1876	1876	1876
R-squared		0.214	0.214	0.213	0.214

Grade dummies included
Absolute value of t statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

Table 4-12. Effect of Investments on Mathematics Test Scores (OLS)

Variable	Unit	(1)	(2)	(3)	(4)
father's education	grades	0.0235*	0.0239**	0.0218*	0.0234*
		(1.96)	(2.01)	(1.81)	(1.96)
mother's education	grades	0.0112	0.0119	0.0093	0.0112
		(0.99)	(1.05)	(0.82)	(0.98)
father's age	years	-0.0150**	-0.0147**	-0.0146*	-0.0150**
		(2.04)	(2.01)	(1.97)	(2.04)
mother's age	years	0.0197**	0.0196**	0.0182**	0.0197**
		(2.56)	(2.53)	(2.36)	(2.55)
male child	dummy	-0.0833	-0.0830	-0.0841	-0.0835
		(0.65)	(0.65)	(0.65)	(0.65)
age	years	-0.0684**	-0.0684**	-0.0630**	-0.0682**
		(2.16)	(2.16)	(1.99)	(2.15)
other enrolled children	number	-0.0191	-0.0092	-0.0119	-0.0191
		(0.48)	(0.22)	(0.30)	(0.48)
non-enrolled children	number	0.0034	0.0037	0.0123	0.0035
		(0.09)	(0.10)	(0.32)	(0.09)
father's education * male	interaction	0.0054	0.0055	0.0055	0.0054
		(0.34)	(0.35)	(0.35)	(0.34)
mother's education * male	interaction	-0.0029	-0.0031	-0.0025	-0.0029
		(0.21)	(0.24)	(0.19)	(0.22)
non-required spending	log yuan		-0.0217		
			(0.80)		
has children's books	dummy			0.1126**	
				(2.14)	
has child's study area	dummy				0.0034
					(0.07)
help with homework	hours/wk				
parents read to child	dummy				
discusses with teacher	dummy				
Constant		0.5267	0.5501	0.4918	0.5230
		(1.51)	(1.56)	(1.41)	(1.49)
Robust std errors		yes	yes	yes	yes
Observations		1876	1876	1876	1876
R-squared		0.022	0.022	0.025	0.022

Grade dummies included
Robust t statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

Table 4-12. Effect of Investments on Mathematics Test Scores (OLS) (cont.)

Variable	Unit	(5)	(6)	(7)	(8)
father's education	grades	0.0234*	0.0227*	0.0234*	0.0214*
		(1.97)	(1.91)	(1.95)	(1.78)
mother's education	grades	0.0111	0.0092	0.0111	0.0081
		(0.98)	(0.80)	(0.99)	(0.71)
father's age	years	-0.0149**	-0.0142*	-0.0150**	-0.0141*
		(2.05)	(1.95)	(2.05)	(1.91)
mother's age	years	0.0197**	0.0190**	0.0197**	0.0178**
		(2.56)	(2.48)	(2.56)	(2.32)
male child	dummy	-0.0833	-0.0837	-0.0830	-0.0842
		(0.65)	(0.65)	(0.65)	(0.66)
age	years	-0.0683**	-0.0672**	-0.0682**	-0.0627**
		(2.15)	(2.14)	(2.15)	(1.99)
other enrolled children	number	-0.0190	-0.0162	-0.0191	-0.0105
		(0.48)	(0.41)	(0.48)	(0.26)
non-enrolled children	number	0.0034	0.0058	0.0032	0.0132
		(0.09)	(0.15)	(0.08)	(0.34)
father's education * male	interaction	0.0054	0.0052	0.0053	0.0054
		(0.34)	(0.33)	(0.34)	(0.34)
mother's education * male	interaction	-0.0029	-0.0030	-0.0029	-0.0027
		(0.21)	(0.23)	(0.21)	(0.20)
non-required spending	log yuan				
has children's books	dummy				0.1022*
					(1.89)
has child's study area	dummy				
help with homework	hours/wk	0.0003			
		(0.06)			
parents read to child	dummy		0.0756		0.0538
			(1.47)		(1.03)
discusses with teacher	dummy			0.0086	
				(0.15)	
Constant		0.5233	0.4746	0.5204	0.4579
		(1.46)	(1.36)	(1.48)	(1.31)
Robust std errors		yes	yes	yes	yes
Observations		1876	1876	1876	1876
R-squared		0.022	0.023	0.022	0.025

Grade dummies included
Robust t statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

Table 4-13. Effect of Investments on Mathematics Test Scores (OLS) - 2

Variable	Unit	(1)	(2)	(3)	(4)
father's education	grades	0.0202**	0.0205**	0.0199**	0.0205**
		(2.06)	(2.10)	(2.03)	(2.09)
mother's education	grades	0.0173	0.0174*	0.0169	0.0175*
		(1.64)	(1.65)	(1.60)	(1.65)
father's age	years	-0.0147*	-0.0144*	-0.0147*	-0.0146*
		(1.96)	(1.92)	(1.96)	(1.95)
mother's age	years	0.0225***	0.0225***	0.0222**	0.0224***
		(2.59)	(2.60)	(2.56)	(2.59)
male child	dummy	-0.0552	-0.0543	-0.0564	-0.0536
		(0.56)	(0.55)	(0.57)	(0.55)
age	years	0.0195	0.0190	0.0205	0.0180
		(0.64)	(0.63)	(0.67)	(0.59)
other enrolled children	number	-0.0344	-0.0242	-0.0347	-0.0337
		(0.90)	(0.60)	(0.91)	(0.89)
non-enrolled children	number	-0.0116	-0.0111	-0.0106	-0.0124
		(0.28)	(0.27)	(0.26)	(0.30)
father's education * male	interaction	0.0087	0.0087	0.0086	0.0085
		(0.66)	(0.66)	(0.65)	(0.65)
mother's education * male	interaction	-0.0175	-0.0176	-0.0171	-0.0174
		(1.31)	(1.31)	(1.27)	(1.29)
household wealth	log yuan	0.0510*	0.0523*	0.0474*	0.0533*
		(1.83)	(1.87)	(1.69)	(1.90)
teacher quality	ranking	-0.0162	-0.0162	-0.0167	-0.0159
		(0.57)	(0.57)	(0.59)	(0.56)
cognitive ability	Z-score	0.3349***	0.3349***	0.3341***	0.3347***
		(10.56)	(10.56)	(10.53)	(10.56)
non-required spending	log yuan		-0.0213		
			(0.73)		
has children's books	dummy			0.0517	
				(1.02)	
has child's study area	dummy				-0.0395
					(0.78)
help with homework	hours/wk				
parents read to child	dummy				
discusses w/ teacher	dummy				
Constant		-1.3871**	-1.3672**	-1.3861**	-1.3594**
		(2.31)	(2.27)	(2.31)	(2.26)
Village FE		yes	yes	yes	yes
Observations		1876	1876	1876	1876
R-squared		0.181	0.181	0.181	0.181

Grade dummies included
Absolute value of t statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

Table 4-13. Effect of Investments on Mathematics Test Scores (OLS) - 2 (cont.)

Variable	Unit	(5)	(6)	(7)	(8)
father's education	grades	0.0213**	0.0198**	0.0201**	0.0196**
		(2.16)	(2.03)	(2.06)	(2.00)
mother's education	grades	0.0187*	0.0164	0.0176*	0.0162
		(1.76)	(1.54)	(1.66)	(1.53)
father's age	years	-0.0151**	-0.0142*	-0.0146*	-0.0142*
		(2.01)	(1.89)	(1.95)	(1.90)
mother's age	years	0.0223**	0.0222**	0.0225***	0.0221**
		(2.57)	(2.56)	(2.59)	(2.54)
male child	dummy	-0.0553	-0.0557	-0.0569	-0.0567
		(0.56)	(0.57)	(0.58)	(0.58)
age	years	0.0196	0.0191	0.0192	0.0200
		(0.65)	(0.63)	(0.63)	(0.66)
other enrolled children	number	-0.0347	-0.0351	-0.0342	-0.0353
		(0.91)	(0.92)	(0.90)	(0.93)
non-enrolled children	number	-0.0123	-0.0118	-0.0117	-0.0109
		(0.30)	(0.28)	(0.28)	(0.26)
father's education * male	interaction	0.0086	0.0086	0.0090	0.0085
		(0.65)	(0.65)	(0.68)	(0.65)
mother's education * male	interaction	-0.0177	-0.0176	-0.0175	-0.0172
		(1.32)	(1.31)	(1.31)	(1.28)
household wealth	log yuan	0.0516*	0.0508*	0.0511*	0.0477*
		(1.85)	(1.82)	(1.83)	(1.70)
teacher quality	ranking	-0.0163	-0.0167	-0.0161	-0.0171
		(0.58)	(0.59)	(0.57)	(0.60)
cognitive ability	Z-score	0.3351***	0.3334***	0.3349***	0.3329***
		(10.57)	(10.50)	(10.56)	(10.48)
non-required spending	log yuan				
has children's books	dummy				0.0455
					(0.89)
has child's study area	dummy				
help with homework	hours/wk	-0.0061			
		(1.26)			
parents read to child	dummy		0.0475		0.0404
			(0.93)		(0.78)
discusses w/ teacher	dummy			-0.0277	
				(0.50)	
Constant		-1.3594**	-1.4149**	-1.3663**	-1.4100**
		(2.26)	(2.35)	(2.27)	(2.35)
Village FE		yes	yes	yes	yes
Observations		1876	1876	1876	1876
R-squared		0.181	0.181	0.181	0.181

Grade dummies included
Absolute value of t statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%