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Poverty, Education, and Intrahousehold Bargaining: Evidence from China

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Abstract
This dissertation is comprised of three separate essays that analyze decision making and education within resource-constrained households. Each essay makes use of data from households and schools in rural China to investigate problems of broad interest in development microeconomics.

Low income coupled with incomplete credit markets make financing educational investments difficult in poor areas even when the returns to education exceed the costs. These problems are compounded by the prevalence of less educated parents in poor areas because such parents may be less likely to educate their own children. In particular, less educated parents may have a lower ability to assist their children with schoolwork, may be less able to provide complementary inputs to learning, and may value education less. Moreover, their children may face lower returns to schooling. In addition, the low education levels of women may affect their relative intra-household bargaining positions and thus household decisions about children's education if parental preferences differ.

Poverty, Education, and Intrahousehold Bargaining: Evidence from China

by

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CHAPTER I

INTRODUCTION

This dissertation is comprised of three separate essays that analyze decision-making and education within resource-constrained households. Each essay makes use of data from households and schools in rural China to investigate problems of broad interest in development microeconomics.

Low income coupled with incomplete credit markets make financing educational investments difficult in poor areas even when the returns to education exceed the costs. These problems are compounded by the prevalence of less educated parents in poor areas because such parents may be less likely to educate their own children. In particular, less educated parents may have a lower ability to assist their children with schoolwork, may be less able to provide complementary inputs to learning, and may value education less. Moreover, their children may face lower returns to schooling. In addition, the low education levels of women may affect their relative intrahousehold bargaining positions and thus household decisions about children's education if parental preferences differ.

"Education and Poverty in Rural China," co-authored with Albert Park, examines the effects of poverty and credit constraints, decision-making authority, and school quality on educational attainment. Controlling for per capita expenditures, children from households that are poor and credit constrained are much more likely to drop out of school. Thus, for some of the poor, the lack of credit is a major obstacle to financing educational investments. However, being poor and credit constrained does not significantly affect academic performance. By contrast, there is weak evidence that wealth affects the duration of schooling independently of whether one is poor and credit constrained, and strong evidence that it affects test scores. In related findings, father's education has a weakly positive effect on the duration of schooling, and the children of more educated parents are considerably less likely to be held back in school. These results show that household wealth and parental education provide distinct advantages for

children's human capital accumulation even when households are not credit constrained. Next, women's intrahousehold bargaining position has strong implications for the probability that children have been held back. Moreover, the likelihood that children drop out of school falls dramatically when women have a greater say in enrollment decisions. This finding is particularly true for sons in junior secondary school, suggesting that women value education more than men and that, relative to men, they favor sons more than daughters. Finally, our measures of school quality do not noticeably impact learning in school as measured by test scores or being held back. School quality does have some effect on the duration of schooling, however, particularly at the primary level.

The other essays in this dissertation develop two of these themes. First, given that women's decision-making authority in the household has significant implications for children's education, discerning when women have this authority is important. "Dowry and Intrahousehold Bargaining: Evidence from China" seeks to determine whether her intrahousehold bargaining position affects a woman's decision-making authority and welfare within marriage, and is largely concerned with identification issues. In contrast to previous empirical studies which use contemporary control of resources and other endogenous measures to proxy for bargaining power, this study uses dowry (a pre-marital transfer that is assignable, exclusive, and returnable to the bride in the event of divorce – a realistic option in rural China) to measure bargaining position. While this approach eliminates concerns about simultaneity bias, omitted variable bias may remain a problem. To address this matter, I proxy for dowry using exogenous shocks to grain yield in the year preceding marriage and the sibling sex composition of the bride and groom as instruments. Shocks to grain yield are likely to have a substantial impact on household wealth accumulation in rural areas that depend on farm incomes, and thus on the ability of households to make transfers associated with marriage. Sibling sex composition likely affects the savings available for marital payments given the high costs associated with marrying sons versus the expected income from marrying daughters. These instruments influence payments made before marriage while remaining plausibly exogenous to household allocation decisions after marriage. I find that dowry has a positive and robust impact on a variety of household resource allocations of interest to the wife, including her

leisure time, the time that her husband allocates to household chores, spending on women's goods as a share of the total household expenditure, the probability that wives self-identify as being satisfied with their lives, and the degree to which wives have the authority to make decisions when the husband and wife disagree about household issues, e.g., children's schooling.

"Parental Education and Child Learning: Investing in Goods and Time" seeks to understand why higher parental education is associated with a lower incidence of children being held back in school, or more broadly, why parental education is such a strong determinant of children's learning in empirical studies from developing countries. One possible explanation is that more educated parents make greater investments in their children's human capital acquisition. However, resource-constrained parents may face a tradeoff between being able to provide more goods used in human capital production (resulting from increased time allocated to market work) and allocating more time to activities such as helping children with homework; hence, how more educated parents choose to invest is an empirical issue. I find that more educated parents allocate higher levels of both goods and time to their children's human capital accumulation. There is evidence that more educated parents expect higher returns to education for their children, offering one reason why parents in resource-constrained households make greater investments in both goods and time. I also find that parental education has a strong, positive effect on children's test scores and that controlling for investments in goods and time reduces the estimated effects of parental education on children's learning. Although the estimates may be susceptible to endogeneity bias, I show that more educated parents make larger investments in their children's human capital accumulation in rural China, and that these investments are an important mechanism – though certainly not the only mechanism – by which parental education affects children's learning.

CHAPTER II

EDUCATION AND POVERTY IN RURAL CHINA[1,2]

2.1. Introduction

In developing countries, poverty is often associated with low levels of educational attainment, as well as larger gender gaps in education (Filmer 2000). Low incomes and wealth combined with incomplete credit markets make it difficult to finance educational investments even when the returns exceed the costs. In addition, even after controlling for wealth differences, a robust finding is that parents with lower levels of education are less likely to educate their own children. Poorly educated parents may value education less, may have low scholastic aptitude which they pass on to their children, or may be less able to provide complementary inputs to learning (e.g., helping children with homework). The low education of mothers, in particular, may reduce their bargaining power within the household and affect family educational decisions if parental preferences over education differ. Further, a lack of community resources in poor areas often leads to lower quality schools, which may reduce the returns to education and discourage enrollment. Finally, in segmented labor markets, the returns to education in poor, remote areas may be sufficiently low to discourage educational investments.

In this paper, we analyze data collected from surveys of households and schools in poor counties in six Chinese provinces to examine the effects of individual, family, and school characteristics on educational attainment, focusing in particular on the importance of poverty and credit constraints, intra-household decision-making (especially as it relates to gender), and school quality. The detailed data make possible several innovations. First, unlike many studies that focus on single measures of attainment, especially enrollment, we examine multiple outcomes that reflect both investments in schooling and learning within school. Next, the data enable us to construct more direct measures of

variables of interest than in previous studies. Using data on existing debt and the ability to borrow money from both formal and informal sources, we construct a measure of household credit limits, which allows us to test separately the effects of wealth and credit limits. A direct question on the role of mothers relative to fathers in the decision to enroll children in school serves as a measure of women's empowerment. Last, local school quality measures, not included in most household surveys, are available from separate surveys of local primary and junior secondary schools. These innovations provide general insights, but also enable us to go well beyond the scope of existing empirical studies of educational attainment in rural China, which have typically used large data sets with limited information.

Previous research suggests that the different hypothesized connections between poverty and educational attainment are likely to be important in the Chinese context. Tsang (1996) and Hannum (1998) report that many schools have increased fees to offset rising costs resulting from education decentralization, and Park and Wang (2000) find that twelve percent of informal loans to households in our sample are used to pay school fees, which implies that credit constraints may be important for some poor households. Hossain (1996) reports that the poorest quintile of households in China spend 14.2 percent of annual income on education, while the wealthiest quintile spend only 5.5 percent.

With regard to intra-household decision-making, Knight and Song (2000) use 1995 survey data to show that a wife's bargaining position, measured by the relative education level of the mother, is positively correlated with children's education, and disproportionately so for boys. They also find that boys have a higher probability of enrollment at all levels. Hannum (1998) uses census data to demonstrate that boys are more likely to enroll than girls, and that this gap is exacerbated when households face resource constraints. Thus, it is not surprising that the gender gap in enrollment is much larger in poor counties than in non-poor counties (World Bank, 1999). Research also finds that after controlling for wealth and expenditure levels, educated parents in China are more likely to educate their children (Jamison and van der Gaag, 1987; Connelly and Zheng, 2000).

Finally, school quality is likely to be a concern in the Chinese context. China's fiscal system has struggled to generate adequate revenue, leading to a marked decentralization of fiscal responsibility and a revenue crisis for governments in poor counties (Park, Rozelle, Wong, and Ren, 1996). This has led to large differences in public spending on education and in teacher quality across regions (Tsang, 1994; West, 1996). World Bank (1999) reports that the recurrent per-pupil expenditure in the wealthiest 10 percent of counties was more than 4.5 times that in the poorest 10 percent in 1997. Unfortunately, no existing studies of educational attainment in China empirically examine the effects of school quality.

The remainder of the paper is organized as follows. Section 2.2 presents a simple model to illustrate the interplay of credit constraints, intra-household decision-making, and school quality variables in educational investment decisions. Section 2.3 describes the 1997 survey and describes the dependent and independent variables used in the analysis. Section 2.4 introduces China's rural educational system. Section 2.5 describes the empirical specifications and identification strategy. Section 6 presents descriptive and estimation results for each of the educational attainment outcomes. Section 2.7 concludes.

2.2. Modeling Educational Investments

We model the educational investment decision made by a family consisting of a mother, a father, and a single child. Educational investments (i.e., the number of years of schooling) are made by parents, who maximize a joint utility function U which is a weighted sum of parent and child payoffs.[3] Household income during the period of investment (and any initial wealth) is y, and the family invests E_c in the child's education and must pay a cost of P_E, which includes required school fees as well as the opportunity cost of the child's time (which we assume accrues to parents). Let R denote the returns to the child's education, and let α be the share of the returns that are transferred from the child to the parents through future financial support and care. Thus, $(1-\alpha)$ is the share of returns retained by the child. The parameter A represents the degree to which parents are altruistic toward their children. If $A=1$, parents care as

much about their children as themselves. Total spending on education cannot exceed the sum of income and the household's credit limit ($\bar{b}$). The parent's utility maximization problem is thus:

$$\begin{aligned} &\underset{E_c}{Max}\, U = y - P_E E_c + \alpha R(E_c) + A(1-\alpha)R(E_c) \\ &\text{s.t. } P_E E_c \le y + \bar{b} \end{aligned} \tag{1}$$

where $\alpha \in [0,1]$, $A \in [0,1]$, and $\bar{b} \ge 0$.[4] To simplify, we assume a zero interest rate and perfect enforcement of lending contracts.

We make several further assumptions about the model parameters. First, the share of returns to education retained by the parents is a function of the child's sex, i.e., $\alpha = \alpha(S)$. This is plausible in that in China daughters marry and leave the family, while sons often co-reside with parents and are generally responsible for the support of elderly parents (Parrish and Willis, 1993; Hannum and Xie, 1994; Hannum, 1998). Second, we model altruism as a linear combination of mother's preferences (A_m) and father's preferences (A_f), the relative weight placed on each depending upon the mother's intra-household bargaining power (β). Parental preferences are a weighted combination of sex (S), and parental education (E_m and E_f). Thus, the altruism parameter is defined as follows:

$$\begin{aligned} A &= \beta A_m + (1-\beta)A_f \\ A_m &= a_1 S + a_2 E_m \\ A_f &= b_1 S + b_2 E_f \end{aligned} \tag{2}$$

where $\beta \in [0,1]$. Thus, $A = A(\beta, S, E_m, E_f)$.

Assuming a Cobb-Douglas function with decreasing returns, the return function can be expressed as:

$$R(E_c) = rE_c^{\phi} \tag{3}$$

where $0 < \phi < 1$. Let $\mathbf{X}$ be a vector of variables that affect the returns to schooling, so that $r = \mathbf{w}'\mathbf{X}$, where $\mathbf{w}$ is a coefficient vector. The variables affecting returns to education, $\mathbf{X}$, include child characteristics ($\mathbf{X_C}$), household characteristics ($\mathbf{X_H}$), and school characteristics ($\mathbf{X_Q}$). Thus, $\mathbf{X} = [\mathbf{X_C}\ \mathbf{X_H}\ \mathbf{X_Q}]$.

If credit constraints do not bind, then the first order condition for equation (1) is:

$$\frac{\partial R}{\partial E_c} = \frac{P_E}{\alpha + (1-\alpha)A} \tag{4}$$

For the Cobb-Douglas return function, we can solve explicitly for the unconstrained optimum:

$$E_c^U = \left[\frac{[\alpha + (1-\alpha)A]\phi \mathbf{w}'\mathbf{X}}{P_E}\right]^{\frac{1}{1-\phi}} \tag{5}$$

Note that if parents capture the entire return to children's education (α=1) or if parents are fully altruistic (A=1), then the first order condition (equation 4) collapses to $R'(E_c) = P_E$, i.e., the marginal return equals the price. This special case serves as an efficiency benchmark (denoted E_c^E) since the investment decision maximizes social returns. Educational investments are only affected by factors that affect returns.

If the credit constraint does bind, however, then the constrained optimum is

$$E_c^C = \frac{y + \bar{b}}{P_E} \tag{6}$$

In this case, educational investments are solely determined by income and credit limits.

Thus, under different assumptions (unconstrained, efficient, and constrained) educational investments are functions of different arguments:

$$
\begin{aligned}
E_c^U &= E_c^U[\mathbf{X}, P_E, A(S, E_f, E_m, \beta), \alpha(S)] \\
E_c^E &= E_c^E[\mathbf{X}, P_E] \\
E_c^C &= E_c^C[y, \bar{b}, P_E]
\end{aligned} \tag{7}
$$

Note that **X** contains the full set of independent variables and that all variables affect whether the credit constraint binds, so that these different functions do not provide overriding restriction tests to distinguish among E_c^U, E_c^E, and E_c^C. But they do illustrate the multiple pathways through which variables of interest may affect educational outcomes, and so facilitate interpretation of the estimation results.

Consider, for example, the effect of a child's sex, which may be important if the returns to education differ for boys and girls, either because of labor market conditions, differential treatment in school, different levels of motivation, or different support for educational attainment at home. In addition, the share of the returns to education accruing to parents may differ by sex if girls marry and leave the family while boys remain within the family after marriage. Finally, the altruism that parents show to their children may differ for sons and daughters. If the preferences of fathers and mothers differ, bargaining power within the household also matters.

Household characteristics also affect schooling. Economic variables, including y and $\bar{b}$, impact educational investments by facilitating the purchase of goods that are complementary to learning (e.g., food, utilities, furniture) and, when credit constraints bind, directly determining the ability of households to finance desirable educational investments. Parental education affects optimal schooling levels by increasing returns (e.g., if educated parents provide more or better support for children's learning or have connections to better jobs in the labor market) and by affecting altruistic preferences (which depend on the interaction with women's empowerment if parental preferences differ). Education of parents also increases educational investments in children indirectly through household income and expenditures, and women's empowerment. Finally, school quality affects educational attainment by increasing the returns to education.

2.3. Data and Variables

The data come from a 1997 survey of households conducted by one of the authors in collaboration with the China Poverty Research Association. The households are located in six poor counties, each in a different province: Shaanxi and Gansu in the northwest, Sichuan and Guizhou in the southwest, and Henan and Jiangxi in central China. The provinces were chosen to broadly represent different poverty regions in the country. The county chosen in each province was selected from among counties that were: 1) nationally designated poor counties; 2) State Statistical Bureau (SSB) national rural household sample survey counties (about one third of all counties in China); and 3) located in the main poverty belt within each province. The household sample in each county was the same as that selected by the SSB, which draws a nationally representative stratified random sample each year. The survey encompassed 446 households and the 40 primary schools and 37 junior secondary schools that serve them. School data come from interviews with local primary and junior secondary school principals, which included questions about school infrastructure, teachers, enrollment, and finances. Student test scores in the most recent semester were also collected.

The household part of the survey included 472 school-aged children (between five years, six months and 16 years, 11 months). Of these, 296 were enrolled in primary school, 71 were in junior secondary school, and 3 were in senior secondary school (Figure 2-1). There were 55 drop outs, and 47 children had never enrolled. Of those who never enrolled, 83.0 percent were below age 10 at the time of the survey and thus plausibly would enroll in the future. Households provided data on time allocation, assets, income and credit, and family background. Table 2-1 presents summary statistics for the households with children and schools in the sample. Mean per capita expenditure is 1134 yuan (in 1997, US$1 $\cong$ 8 yuan), the mean household credit limit is 4643.4 yuan, the mean number of children is 2.2, and the mean number of years of parental education is 7.3 years for fathers and 3.4 years for mothers. Data on school-related variables are described below.

2.31. Dependent Variables

We study the determinants of one educational investment measure (years of schooling) and two learning outcomes (test scores and whether the child was ever held back). The former correspond to E_c^C in the model, the latter to the return function, R. Differences in labor market returns are controlled for via community fixed effects.

Years of schooling are calculated as the sum of grades completed and years held back. Examination scores are the average scores on the most recent language and math exams, which are administered each semester and which are the same for students in the same grade in the same county. We standardize test scores by grade within each county to make grades on different tests comparable; test score is thus defined as the number of standard deviations from the mean score of all children in the same grade in the same county. The survey also asks about the number of years held back, but does not report the grades in which children were held back. The large majority of those ever held back are held back for one year only (74 percent). We thus focus attention on whether children have ever been held back.

2.32. Independent Variables

As described above, factors affecting educational investments and learning outcomes (X) include child (X_C), household (X_H), and school quality variables (X_Q). X_C includes sex (S), age of enrollment, number of older siblings, and number of younger siblings.[5] X_H includes household expenditures per capita (y), the household's credit limit ($\bar{b}$), father's education (E_f), mother's education (E_m), and women's empowerment (β), which is also interacted with mothers education and child gender. X_Q includes the student-teacher ratio, the percentage of classrooms that are rainproof, the percentage of teachers with post-secondary education, and under certain assumptions, school fees and distance to school. School fees and distance to school are also measures of the price of educational investments (P_E).

Expenditures per capita, calculated from self-recorded diaries kept by households and tabulated by local State Statistical Bureau enumerators, is our main poverty measure.

With incomplete capital markets, expenditures per capita reflect wealth effects (Glewwe and Jacoby, 2000), which often have been found to influence educational investment decisions.[6] In theory, wealth could affect educational decisions even when credit constraints are not binding if wealthier households consume goods that are complementary to learning and also provide consumption value to the household for reasons unrelated to education (e.g., nutritious food, tables and chairs, books, TV). Thus, non-separable consumption and educational investment decisions can lead to wealth effects even in the absence of credit constraints. Tests using direct measures of credit constraints can help clarify the ambiguity inherent in measured wealth effects. In the survey, respondents were asked the value of outstanding formal and informal loans, and the additional amount that they felt they could borrow either from institutions or from friends and family members in the event of an emergency. Our credit limit variable is the sum of these values. Theory says that wealth should have a strong effect only when credit constraints bind; therefore we generate an interaction dummy variable indicating whether households are both poor and credit constrained, defined as being below the 33rd percentile of the sample in terms of both expenditure per capita and credit limits, accounting for 14.1 percent of sampled households.[7]

In evaluating the decision-making role of women versus men, the survey asks which parent is responsible for deciding whether children attend school. The variable for women's empowerment equals one if the wife decides, 0.5 if both decide, and zero if the husband decides. The definition of altruism in equation (2) suggests that women's empowerment should be interacted with the child's gender and mother's education.[8]

Conditional on ability, previous achievement, and earnings prospects, school quality has been found to have a positive impact on enrollment in other studies (e.g., Hanushek and Lavy, 1995). We focus on variables that measure different key aspects of school quality – class size, teacher quality, and infrastructure. Following much of the literature, our specific measures are the student-teacher ratio, the percentage of teachers with post-secondary education,[9] and the percentage of classrooms that are rainproof (Glewwe and Jacoby, 1994). In addition to these measures, our two cost of schooling measures, school fees and distance to school, might also reflect differences in school quality. Villages that set higher school fees may have larger per-pupil budgets, and field

interviews suggest that schools that serve multiple villages (i.e., schools that are likely to be farther away) achieve economies of scale and receive better funding.

2.4. China's Rural Educational System

While the minimum age of enrollment in China is six, households in many areas are accustomed to sending their children to school at older ages. The mean age of enrollment in our sample is 7.4, or about one year later than would be expected if all children enrolled as soon as possible after age six.[10] As seen in Figure 2-2A, a significant proportion of children do not start school until they are 8 or older, and girls are more likely to start later (the average starting ages are 7.3 for boys and 7.5 for girls). Interestingly, the age of enrollment for junior secondary school is lower for girls (mean of 13.1 versus 13.5 for boys, see Figure 2-2B).[11] This finding suggests a selection process in which only academically strong girls stay enrolled through primary school.

Nearly all children walk to the nearest primary school, usually located in the village. Primary school is completed in five or six years, depending on the region. Junior secondary schools are usually located in the nearby township. Despite the compulsory education law mandating nine years of education, children whose families do not pay school fees are not allowed to attend school. In our sample, school fees averaged 100.9 yuan in primary schools and 317.8 yuan in junior secondary schools (Table 2-1). Additional, non-required school-related fees, e.g., supplies and books, averaged 71.4 yuan per child. Thus, a family with one child in primary school and another in junior secondary school would spend about 550 yuan on school-related expenses, or fifty percent of mean expenditures per capita, likely a very high share of a family's cash income.

School quality has emerged as an important concern in China, where fiscal reforms have reduced redistributive budgetary transfers, exacerbating inequities. In our sample of schools, the mean student-teacher ratio is 28.5 for primary schools and 15.1 for junior secondary schools. The mean percentage of teachers with post-secondary education is 54 percent at the primary level, and 88 percent at the junior secondary school level. Seventy-eight percent of primary school classrooms and nearly all junior secondary school classrooms are rainproof. There is significant variation in school

quality among provinces (Table 2-1). For example, just 28 percent of primary school teachers have post-secondary education in Guizhou, compared to 86 percent in Shaanxi.

2.5. Empirical Specification

We analyze the determinants of years of schooling, test scores, and whether children have ever been held back. With exceptions noted below, we include a consistent set of child, household, and school quality variables, as described above.

We model the duration of schooling as a Cox proportional-hazard model (see, for example, Khandker, 1996 and Glewwe and Jacoby, 2000). Hazard models account for the dependence of current enrollment on past enrollment decisions, and handle censored observations (students currently enrolled at the time of the survey) in a natural way. The Cox model is attractive because it does not require a parametric specification of the baseline hazard function and thus allows the baseline hazard rate for each community to vary (Cox and Oakes, 1984).[12] We estimate separate hazard models for dropping out of primary school conditional on primary school enrollment, and for dropping out of junior secondary school conditional on junior secondary school enrollment. The hazard ratios can be interpreted as risk multipliers.[13]

Because nearly all children attend at least one year of primary school, there is no selection bias in the sample used to study the primary school duration of schooling. We include age of enrollment as an independent variable in the dropout hazards and other outcome equations because we expect age to affect school performance and the opportunity cost of children's time. We recognize that the coefficient will be upward biased if unobserved poor ability or lack of parental support delays the age of enrollment or makes dropping out more likely.

Test scores are regressed on the full set of independent variables using OLS, with different specifications employing county, village, and household fixed effects. We specify the equation estimating whether a child was ever held back as a conditional logit in order to be able to include county, village, and household fixed effects without introducing bias. We also include dummy variables for the number of grades completed to account for the fact that students who have reached higher grades have more chances to be held back.

2.51. Identification

Some independent variables may be endogenous because of simultaneity or omitted variables. Variables resulting from household decisions made by parents, such as expenditures per capita and number of siblings, are particularly susceptible to such bias because they are likely to be made simultaneously with investments in children's education. Expenditures in particular may include educational costs, which naturally increase if children are enrolled. To deal with this specific problem, our expenditure measure excludes educational expenditures, which creates downward rather than upward bias on the expenditure coefficient – a more severe test for finding significant effects. Expenditure levels also reflect household income, which is affected by labor supply decisions of parents, which in turn may depend on whether or not children are in school. Fertility may be negatively correlated with educational investments if there is a tradeoff between quantity and quality of children. However, given China's strict family planning policy, the number of children in many rural families is below desired levels, especially in poor areas.[14] When we regress the number of children on parental education and other parental characteristics, we find no significant effects.

Coefficients on household decision variables and on variables that are plausibly exogenous to household decisions on education (e.g., father's and mother's education, women's empowerment, and credit limits) also may misleadingly pick up the effects of unobserved child and/or parent characteristics. Parental education, for instance, may correlate positively with higher motivation or ability, which may also correlate with willingness to invest in children's education. If this is true, the inclusion of other variables that reflect ability and motivation, such as women's empowerment, expenditures per capita, and credit limits, could better isolate the effect of preferences related to parental education.

Without better data, dealing with all of these endogeneity concerns is challenging. As a practical matter, the vast majority of studies, especially those using cross-sectional data, do not attempt to do so, ignoring potential bias (e.g., Jamison and Lockheed, 1987; Parish and Willis, 1993; Glewwe, Grosh, Jacoby, and Lockheed, 1995; Khandker, 1996; Case and Deaton, 1999; King, Orazem, and Paterno, 1999). A few studies treat income and expenditure data as endogenous (Glewwe and Jacoby, 1994; Glewwe and Jacoby,

2000), and Lillard and Willis (1994) explicitly model the endogeneity of parental education. A conservative approach is to restrict the variable set to those that are strictly exogenous and do not reflect household decisions, leaving out variables such as expenditures per capita. Although this solves the simultaneity problem, it does not solve the omitted variables problem, and the strict reduced form estimates may be difficult to interpret because they are picking up multiple effects. Another approach is to use instrumental variables, but it may be difficult to find suitable instruments that are plausibly exogenous and explain sufficient variation in the endogenous variable. Finally, one can add additional controls to try to pick up background factors, but the possibility of omitted variable bias remains.

In our estimation, we tried a combination of these approaches. Adopting linear specifications for each outcome, we instrumented expenditures per capita and credit limits using cultivated land and the share of cultivated land that is irrigated. To help control for unobserved parental attributes, we added background variables such as the education of grandparents and the number of siblings of each parent. In the end, however, we report estimates from specifications that do not control for endogeneity because none of our alternative specifications substantially alters the magnitude or sign of our coefficient estimates. Our instrumental variables, although significant in first stage regressions, suffer from being "weak" in that they do not explain sufficient variation in the endogenous variable to produce precise estimates (Bound, Jaeger, and Baker, 1995). Nonetheless, inclusion of IVs increased rather than decreased the magnitude of the coefficient of the instrumented variable in every specification, suggesting that our coefficients underestimate the true effects. Including family background variables did not appreciably alter the statistical significance or magnitudes of our estimates, and we dropped them to maximize sample size, since data on background variables were missing for some households. Even if endogeneity bias remains, our estimates are still informative in describing the statistical association between outcomes and various individual, household, and community factors, providing suggestive evidence, if not definitive proof, of causal relationships.

Estimates of the determinants of test scores may be subject to sample selection bias because data are available only for enrolled children. Despite the difficulty of

finding convincing identifying instruments, we estimate Heckman selection-correction models of test scores.[15] We find that the selection correction term does not enter significantly into the test score regression but that the effects of gender become smaller in magnitude and statistically insignificant. This lends weak support to the notion that a selection story underlies gender differences in test scores. However, because of the questionable identification assumptions we have imposed, we do not want to read too much into these results. Rather, we present the results for the uncorrected estimates and consider possible biases introduced by selection effects.

Another possible selection problem is endogenous school choice. If children who have higher ability or more supportive parents choose to attend higher quality schools, the measured effect of school quality variables will be biased upward. However, 94.1 percent of the children in our sample attended the nearest primary school, and of those that do not, 59 percent report that the main reason for not doing so is unrelated to school quality. This suggests that only 2 percent of children are changing schools for reasons related to quality.

Even without endogenous school choice, the student-teacher ratio may suffer from endogeneity because it is affected by the enrollment decisions of households, resulting in downward bias. This may be more important in middle school where dropout rates are higher. To deal with this potential problem, we instrument the student-teacher ratio in the test score regression with village population, and find that the results do not change.

In all specifications, we control for community unobservables by including a set of community dummy variables (or, in the hazard estimations, by stratifying by community). To identify the effects of school quality variables, which are village level attributes, we control for county fixed effects or stratify by county. Dropping these variables, we include village fixed effects or stratify by village. When possible, we also control for village attributes by stratifying by households or by implementing household fixed effects, although the effective sample is much reduced because it includes only households with more than one child. In some cases, especially for the years of schooling hazard, the effective sample for village and household stratification is too small for estimation. Also, when employing county fixed effects or stratification by county we

allow for error correlation (or clustering) within villages, adjusting reported standard errors appropriately. When employing village fixed effects or stratification by village, we allow for clustering by household.

2.6. Results

2.61. Enrollment

The enrollment rate for children in our sample is 78.4 percent — 81.8 percent for boys and 74.4 percent for girls (Table 2-2). Using a sample of 8000 households in 19 provinces, Knight and Song (2000) calculate a rural enrollment rate of 91 percent for children aged 7-12 and 87 percent for children aged 13-15. In our poor county sample, the enrollment rates for the same age groups are 92.1 percent and 71.2 percent, respectively. The lower enrollment of 13-15 year olds in poor areas is striking considering the fact that children in poor areas tend to enroll at older ages, so that many 13-15 year olds are not in junior secondary school but rather in primary school where enrollment rates tend to be higher. Nationally, the percentage of poor counties with junior secondary schooling enrollment above 85 percent is only 40 percent, compared to 70 percent in all counties (World Bank, 2000).

Figure 2-1 summarizes the enrollment status of children in the sample. School dropouts comprise 12.9 percent of the sample, and form a sample of students who have completed their educations, assuming that they do not subsequently return to school. Of these, 49.1 percent do not reach junior secondary school, 23.6 percent drop out during junior secondary school, and the remaining 27.3 percent withdraw just after completing junior secondary school, oftentimes involuntarily because they cannot pass senior secondary entrance exams. The mean number of grades completed among dropouts is 5.89. In our sample, male dropouts complete 6.5 years of schooling while female dropouts complete 5.3 years. The drop out rate for girls relative to boys is particularly high in the first three years of primary school (Figure 2-3). Students begin dropping out in earnest as early as age 12. Among 16-year-olds who had ever enrolled in school, 62.2 percent had dropped out (Figure 2-4).

Parents of dropouts were asked to select from a list of reasons for withdrawing their children from school, and they appear to be less willing to pay for the education of girls. For primary school dropouts, inability to pay high fees, the most frequent response, led to the drop out decision for 47 percent of girls, but only 33 percent of boys, while for junior secondary school dropouts, high fees were cited for half of the girls but only 8 percent of the boys.[16] This is consistent with a higher price elasticity of education for girls, which is found in many developing countries (World Bank, 2000).

Because the factors affecting the decision to continue schooling in primary and junior secondary schools may be different, we look separately at the number of years of schooling for children who ever enrolled at each level. Table 2-3 presents results from Cox proportional hazard models of the likelihood of stopping schooling at each level.[17] We stratify by county and by village to control for regional and community-level unobserved heterogeneity.[18]

Conditional on having remained in school until the current time, the probability that poor and credit constrained children will drop out of primary school is three times that of other children. Thus, it is not surprising that just 6.9 percent of those who had ever enrolled in junior secondary school are poor and credit constrained, while 13.9 percent of primary school enrollees are. Children from poor and credit constrained households who enroll in junior secondary school are much less likely to drop out, perhaps the result of a selection process in which only top students or children of particularly supportive parents remain by junior secondary school. Higher wealth (expenditures per capita) reduces the likelihood of dropping out from primary school, but the coefficient is not statistically significant. The number of siblings reduces the likelihood of dropping out, again suggesting that siblings either substitute for each other's household labor contributions or provide complementarities through cost saving or improved learning.

Variables reflecting intra-household decision-making also affect the duration of schooling. For each additional year of a father's education, the probability of his child dropping out of school falls by 12-14 percent. Also, children of empowered women are much less likely to drop out of primary school. The degree to which women's empowerment plays a role is smaller for girls (a finding consistent with Knight and Song,

2000), although the coefficient is not statistically significant. Finally, boys are more likely to drop out of junior secondary school. There is no statistically significant difference in the probability of boys and girls dropping out of primary school.

The probability of dropping out falls as school fees and distance to school increase. This finding is consistent with higher school fees being charged by higher quality schools. The coefficient is only significant at the primary level, suggesting that junior secondary school fees may be sufficiently high to be a deterrent to enrollment. The inverse relationship between distance to school and the probability of dropping out at the primary level is unexpected if distance increases the costs of schooling because of children's opportunity cost of time. However, the negative coefficient is consistent with a low opportunity cost for primary school students and a positive correlation between distance and school quality, as suggested above. When village strata are included, the coefficient on distance becomes much smaller in magnitude and is no longer statistically significant, which is consistent with our school quality story since identification is coming from within-village differences (where there are no quality effects) rather than differences between villages. The quality of infrastructure also enters the primary school decision in an intuitive way: as the percentage of rainproof classrooms rises, the likelihood of dropping out falls significantly.[19] Finally, the percentage of teachers with post-secondary education positively affects the probability of dropping out at the primary level. We hypothesize that this result stems from teacher education being negatively correlated with teacher experience. The opposite is true for middle schools, although the coefficient is not quite significant at the 90 percent confidence level. Unfortunately, we do not have data on the experience of individual teachers.[20]

2.62. Examination Scores

Table 2-4 presents estimation results for the determinants of the standardized average examination scores of students who were enrolled the previous semester. We incorporate county-grade fixed effects, village-grade fixed effects, and household fixed effects in separate specifications. Expenditures per capita has a robustly positive impact on test scores (a 10 percent increase in expenditures increases test scores by 0.05 standard deviations), suggesting that poverty may reduce human capital accumulation even when

enrollment rates are high. The poor and credit constrained dummy, however, is statistically insignificant. Also, children with older siblings have significantly higher test scores than their peers, possibly because they receive help from siblings or because older children substitute their own household labor for the enrolled child's.

Controlling for other covariates, junior secondary school girls outperform boys by 0.2-0.7 standard deviations, but the test score gender gap at the primary school level is not significantly different from zero. The performance gender gap is consistent with a gender selection story in which academically weak girls drop out in primary school but academically weak boys do not. The estimated junior secondary school gender difference (and statistical significance) falls as one moves from the county fixed effects specification to the village and household fixed effects specifications, perhaps suggesting that selection effects are greater in areas of poorer average performance, so that a greater share of girls with test scores are in the schools with better performance. Alternative explanations for higher female junior secondary school test scores are that girls study harder than boys or that girls have fewer distractions or other responsibilities that compete for their time. While the latter explanations cannot be ruled out, we find them unlikely.

There is some evidence that parental education and women's empowerment have a negative effect on test scores, although the coefficients are not significant in all specifications. The negative effect could reflect a higher opportunity cost of time for educated parents and empowered women or a selection story in which such parents keep children in school longer, even when their children are academically weak. The negative effect of women's empowerment is significant for girls only, providing weak support for greater gender bias by mothers than fathers. Finally, and somewhat surprisingly, the school quality variables do not enter these regressions significantly, suggesting that there is no effect of school quality on learning, that our measures of school quality do not capture important school quality attributes, or that our small sample of 40 primary and 37 junior secondary schools does not have enough variation for identification.

2.63. Grade Promotion

Of students who have ever been enrolled, 30.4 percent have been held back at least one year (Table 2-2). The mean number of years held back among those ever held back is 1.30, statistically identical for boys and girls. Of those who are ever held back, 74.4 percent are held back just one year. Ministry of Education (2000) observes that the percent of children held back is relatively high in first grade, but falls in every subsequent year. The propensity to be held back varies considerably by province; in Sichuan, for example, just 13 percent have ever been held back, while 47 percent have been held back in Shaanxi. Boys are more likely than girls to have been held back (35 and 25 percent, respectively), which may be because boys have poorer study habits or because boys go farther in their education and so have more chances to be held back.

Patterns in the percent of students ever held back and the average number of years held back among those ever held back provide support for a story in which poorly performing girls are more likely to drop out in primary school. If all children stay in school even if they are held back, or if children drop out for reasons uncorrelated with being held back, the percentage of children ever held back should increase with age since more time in school increases the number of chances of being held back. However, in our sample, the percentage of students ever held back falls with age for girls but not for boys, direct evidence that girls who are held back are relatively more likely to drop out. Also, as seen in Figure 2-5, the average number of years held back among those ever held back increases with age for boys but not for girls. Finally, comparing the performance of boys and girls among dropouts and non-dropouts, we find that the ratio of the share of boys ever held back to the share of girls ever held back is 0.8 for dropouts but 1.4 for non-dropouts. In other words, among those in school, boys are more likely to have been held back, but among dropouts, girls are more likely to have been held back. These patterns provide evidence for a differential selection story, and unlike the test score results, they have no plausible alternative explanation. King et al., (1999) show that in the Philippines, too, promotion is a much stronger predictor of continued enrollment for girls than for boys.

Table 2-5 presents results for a conditional logit model for ever having been held back. Odds ratios and coefficients are reported for specifications including county,

village, and household fixed effects. Dummies for the number of grades completed have been included to control for the number of opportunities to be held back.

Consistent with the gender selection story in which academically weak boys stay in school longer than academically weak girls, boys are more likely to have been held back than girls, particularly for those in junior secondary school. The economic and school quality variables do not significantly affect the likelihood of ever being held back. Expenditures per capita enters positively in the county fixed effects specification but not in the village fixed effects specification. One of the most significant factors affecting whether children are held back is the age of enrollment. Kids who enroll later are less likely to have ever been held back, consistent with our expectation that many of the children who are held back are those who enter school earlier and are held back in first grade. If promotion after first grade is relatively automatic, it may explain why many variables do not robustly explain whether kids are ever held back.

2.7. Conclusion

In concluding, we attempt to integrate the important results above to draw broader inferences about the importance of low wealth and credit constraints, intra-household decision-making, and school quality on educational attainment in poor areas.

Poverty significantly affects both educational investments and learning. Controlling for expenditures per capita, children from households that are both poor and credit constrained are three times as likely to drop out of school. Thus, for some of the poor, the lack of available funds is a major obstacle to financing educational investments. However, being poor and credit constrained does not significantly affect learning in school (as measured by test scores or being held back), suggesting that the inability to finance educational expenditures does not hurt children's performance in school . There is weak evidence that wealth, measured by expenditures per capita, affects years of schooling independently of whether one is poor and credit constrained, and strong evidence that it affects test scores; a ten percent increase in expenditures increases test scores by 0.05 standard deviations. In addition to pointing out the importance of credit constraints in poor areas, our results show that even when households are not credit constrained, children from wealthier households have an advantage in school

performance. Thus, even with high enrollments, poverty still may be an important issue in educational attainment because of its direct effects on learning. The different results for the wealth and credit constraint variables also highlight the value of using more direct measures of credit constraints when evaluating wealth effects on educational attainment.

We find strong evidence of a gender selection story in which poorly performing girls drop out in primary school while boys do not begin to drop out in earnest until junior secondary school. The relative likelihood of having ever been held back is greater for girls among dropouts but greater for boys among those in school. The average age of enrollment in primary school is younger for boys but the average age of enrollment in junior secondary school is younger for girls. These patterns suggest that girls that are held back are more likely to drop out than boys that are held back. In addition, girls score higher on tests in junior secondary school, suggesting a weeding out of poorly performing girls in primary school. The clear gender bias in educational investments may be due to lower returns to education for girls, the lower selfish returns to parents from investing in girls that will marry into other families, or from parental preferences that favor sons. Further research that more convincingly distinguishes among competing explanations for gender bias should receive high priority.

With regard to women's empowerment, the strongest effects occur for years of schooling. The coefficient estimates suggest that the likelihood of dropping out of primary school falls dramatically when women have a greater say in enrollment decisions (but not quite statistically significant with village strata), and the probability of dropping out of junior secondary school falls dramatically for sons. These results imply that women value education more than men, and that if anything they favor sons more than daughters, relative to men. Whether children were ever held back is also significantly influenced by women's empowerment; the empowerment of less educated women has a significantly stronger negative effect on the likelihood of children being held back than the empowerment of better-educated women.

Father's education has a much greater influence on educational investment decisions than mother's education. An additional year of father's education reduces the likelihood of dropping out by 12-14 percent and reduces the likelihood that the child was ever held back by 14 percent. These positive effects may reflect preferences associated

with higher education or higher returns to education if children have more educated fathers. This might be true if children of educated fathers have greater ability, if a father's education serves as a complementary input to children's learning, or if more educated parents have better social and professional networks that increase future labor market opportunities. The relative unimportance of mother's education may be partly due to the very low average educational level of women in the study areas.

We find evidence that the presence of siblings reduces the likelihood of dropping out, especially if siblings are older, and that children with older siblings score higher on exams. These findings suggest that children benefit from having siblings, and that younger siblings in particular benefit from the presence of older siblings. Siblings can increase the desirability of educational investments by substituting for each other's labor contributions to the household, economizing on costs, or helping each other with schoolwork.

Finally, our measures of school quality do not appear to affect learning in school (test scores, ever having been held back), but they do have some effect on the years of schooling. Higher school fees and distance to school, each of which may be a proxy for quality, result in lower probabilities of dropping out of primary school. The percentage of classrooms which are rainproof and the percentage of teachers with post-secondary education significantly impact the number of years of primary schooling (although the latter has an unexpected sign which we attribute to a negative correlation between education and experience). Thus, while school attributes do affect educational investment decisions, our estimates do not pick up direct effects on learning. This may be because there are no effects, because our particular measures of school quality do not adequately measure important school attributes in the Chinese context, or because our small sample of schools lacks the variation necessary to detect the effects of differences in school quality. Future research using better measures will be of great interest.

Notes to Chapter II

[1] This work is co-authored with Albert Park. It previously appeared as Brown, P.H. & Park, A. (2002). "Education and Poverty in Rural China." *Economics of Education Review*. 21(6): 523-541.

[2] We thank the Ford and Luce Foundations for supporting the field surveys in China, and Emily Hannum, David Lam, Lee Lillard, Gary Solon, Rohini Somanathan, Jan Svejnar, Sangui Wang, Robert Willis, seminar participants at the Harvard Graduate School of Education, the University of Michigan Department of Economics, the 2000 NEUDC Conference at Cornell University, the Institute of Population Studies (Chinese Academy of Social Sciences), and a Workshop on Poverty Policies in China held by the China Poverty Research Association in Beijing, as well as two anonymous referees for helpful comments.

[3] By modeling the parents' joint payoff, we abstract from possibly different payoffs to fathers and mothers. We do allow for different parental attitudes toward the welfare of children, however.

[4] We omit consumption in order to simplify; minimum consumption requirements would reduce further the maximum educational investment of credit constrained households.

[5] We include sibling effects to capture competition for resources even though our model includes only one child. It is straightforward to adjust the model to allow for multiple children. Presence of siblings might also affect the expected future contributions from children.

[6] In a systematic analysis using panel data, Glewwe and Jacoby (2000) find wealth effects for Vietnam; see also Filmer (2000) for cross-country evidence, Jacoby (1994) for evidence of the importance of credit constraints in Peru, and Behrman and Knowles (1999) for a review of the issues. Schultz (2000) and World Bank (2000) show that tuition subsidies increased enrollment in Mexico and other developing countries. Foster and Rosenzweig (1996), however, find no wealth effects for India.

[7] These cutoffs are, of course, arbitrary. However, a simple interaction term between expenditures per capita and credit constraints would miss an important nonlinearity. We tried different cutoff values and chose the highest values for which the effects were significant. Lower cutoffs produced similarly significant results.

[8] There is mixed evidence on whether men and women favor sons and daughters differently (World Bank, 2000). For example, Lillard and Willis (1994) find that mothers' education has a greater impact on daughters' education and that fathers' education has a greater impact on sons' education in Taiwan, but Quisumbing and Maluccio (1999) find the opposite in South Africa.

[9] Case and Deaton (1999) find significant effects of student-teacher ratios in South Africa. Birdsall (1985) finds strong effects of teacher's education in Brazil. Hanushek (1995) concludes from a review of previous studies that teacher training deserves greater support.

[10] 5.5 percent of our sample had enrolled before age six. Interviews suggest in most cases such children have siblings already attending school.

[11] We estimated age of enrollment hazards in which we stratified by county, village, and household. We found that the number of older siblings positively impacts the probability of enrollment, perhaps because an older siblings can accompany younger ones to school and can provide hand-me-downs that reduce the cost of schooling. Having a higher birth order reduces the probability of primary school enrollment, perhaps because families have accumulated less wealth when their first children are born or because older children contribute to the household in ways that make it easier to send younger children to school. Surprisingly, per capita expenditure has no discernable effect on the age of enrollment, and children who are both poor and credit constrained are likely to enroll earlier in primary school. We also find that boys enroll earlier in primary school than girls (50 percent more likely to enroll all things equal), and that an additional year of father's education raises the probability of earlier enrollment by 9 percent. Finally, our school quality variables do not enter the initial enrollment decision significantly.

[12] Using the stratified Cox proportional hazard model, the hazard at time t for child i in community j is assumed to equal $h_i(t) = h_{0j}(t)e^{\beta_1 x_1 + \ldots + \beta_k x_k}$.

[13] For example, a hazard ratio of 1.5 means that the child is 1.5 times more likely to drop out if the independent variable increases by one unit. Thus, hazard ratios greater than one correspond to positive coefficients and hazard ratios less than one correspond to negative coefficients.

[14] In most of the study regions, family planning policy dictates up to two children. Areas of the county in Guizhou may allow up to three children, since it is a minority county. The data show that two thirds of the families in the sample have two or fewer children, and 95 percent of families have three or fewer children. This would appear to be roughly consistent with the expected effects of the family planning policy.

[15] There are no obvious identifying variables for a selection equation. Many researchers have used distance to school and tuition as identifying variables. However, because our estimates find both to have positive effects on enrollment, we believe they are likely to reflect school quality differences, which may affect learning outcomes. Tuition, in particular, seems strongly associated with the wealth of the community and the quality of schools. In addition to our previous explanation about distance as an indicator of school quality, distance also could affect attendance (unobserved), ability to spend more time in school after class, etc., which could have effects on learning outcomes. Without good identifying variables, a Heckman-type selection model can only be identified from the

assumption of joint normality of the error terms in the selection and outcome equations. We estimate the selection model with and without distance as an identifying variable, and obtain similar results.

[16] For primary dropouts, the other main reasons cited were child unwillingness to attend school (44 percent), the interpretation of which is unclear, and poor grades (7 percent). For junior secondary dropouts, 35 percent reported poor grades, and 15 percent cited an unwillingness to attend.

[17] We could alternatively use an ordered logit model to estimate the determinants of grade attainment. We feel that years of schooling has a more natural behavioral interpretation since the decision of families is to keep the child in school, not to promote the child to the next grade. Grade attained also conflates the decision to stay in school and performance in school, and one of our goals is to consider these aspects of educational attainment separately. Nonetheless, we did estimate an ordered logit model of grade attainment, and found the important results to be quite similar.

[18] We do not stratify by village in the junior secondary school estimates, nor by household in either the primary or junior secondary school estimates. In each case, there was too little variation within the strata of concern.

[19] The rainproof classrooms variable was omitted from the junior secondary school hazard because it perfectly predicted dropping out in some counties due both to the small number of junior secondary school dropouts in the sample and to the large number of junior secondary schools without any leaking classrooms.

[20] To check the robustness of results to the included variable set, we also estimated the hazard models dropping the age of enrollment, and find no substantial changes. In general, the model is less precisely estimated, and in no cases do variables gain significance when the age of enrollment is excluded.

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Figure 2-1. Enrollment Status of Children in Sample

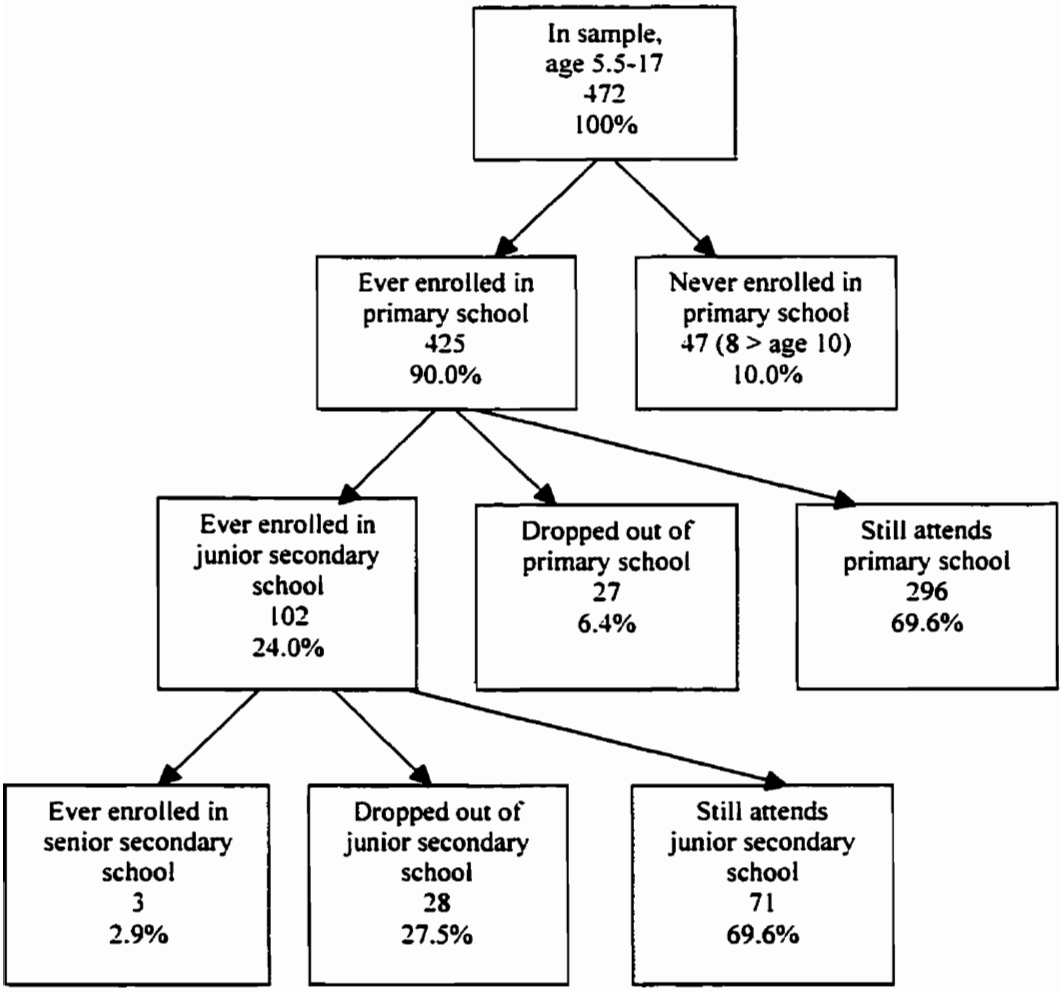


Figure 2-2A. Age of Primary School Enrollment by Sex

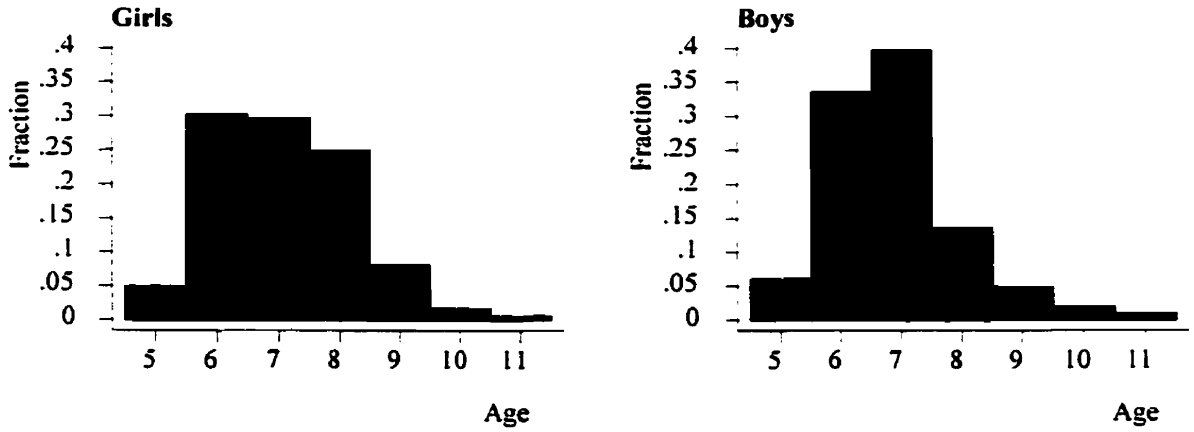
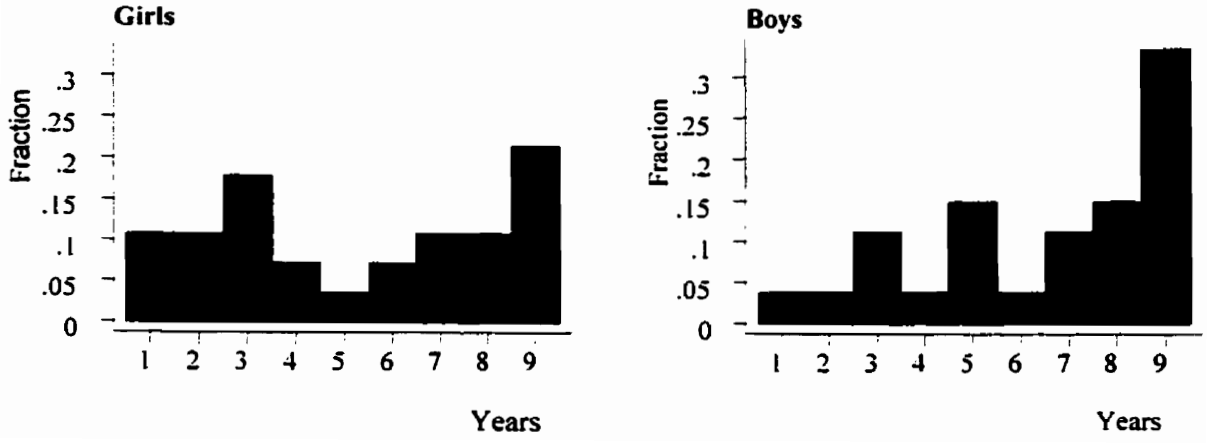


Figure 2-2B. Age of Junior Secondary School Enrollment by Sex

Figure 2-3. Years of Schooling Among Dropouts



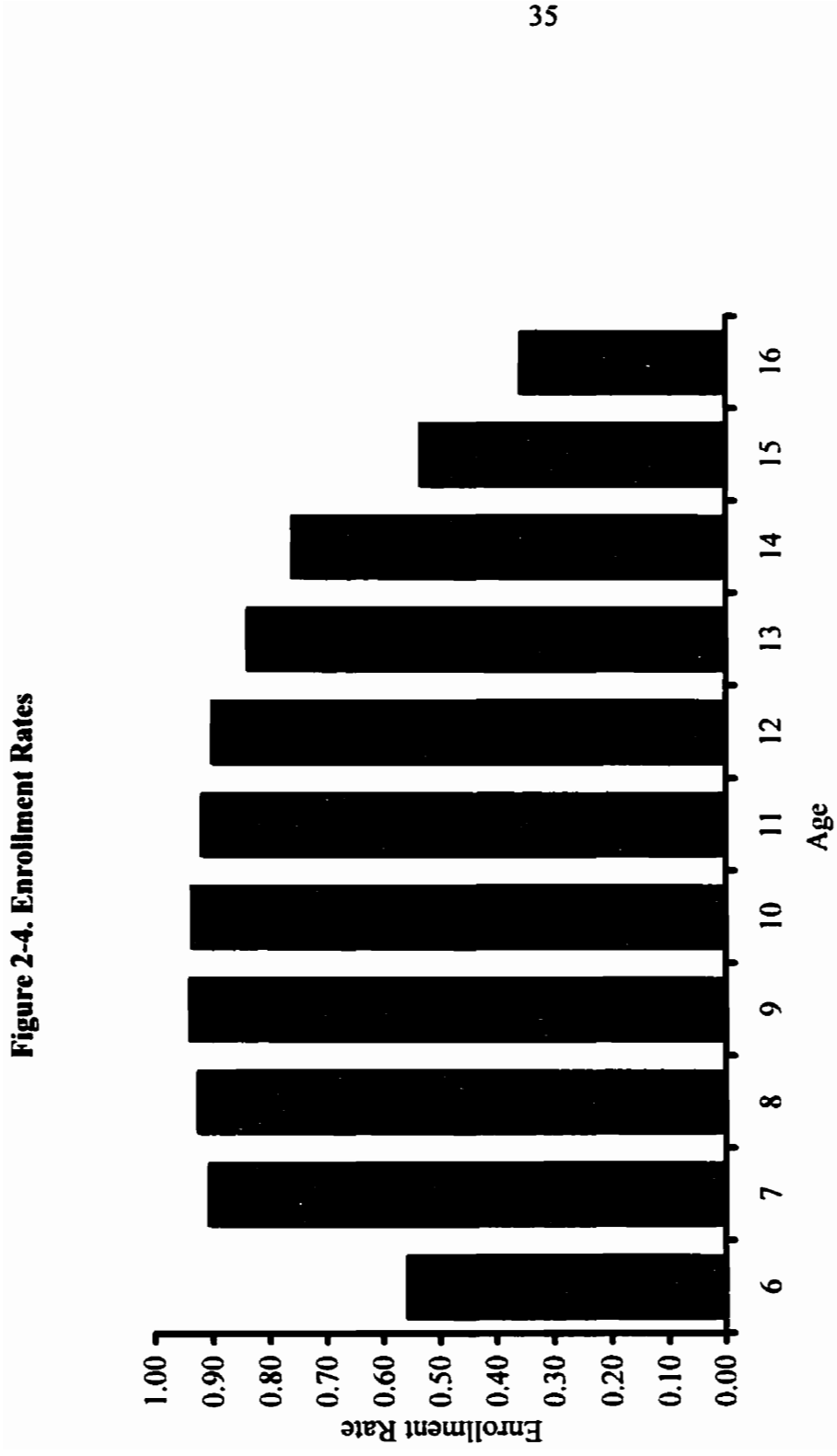


Figure 2-4. Enrollment Rates

Figure 2-5. Mean Number of Years Held Back (Among Those Ever Held Back)

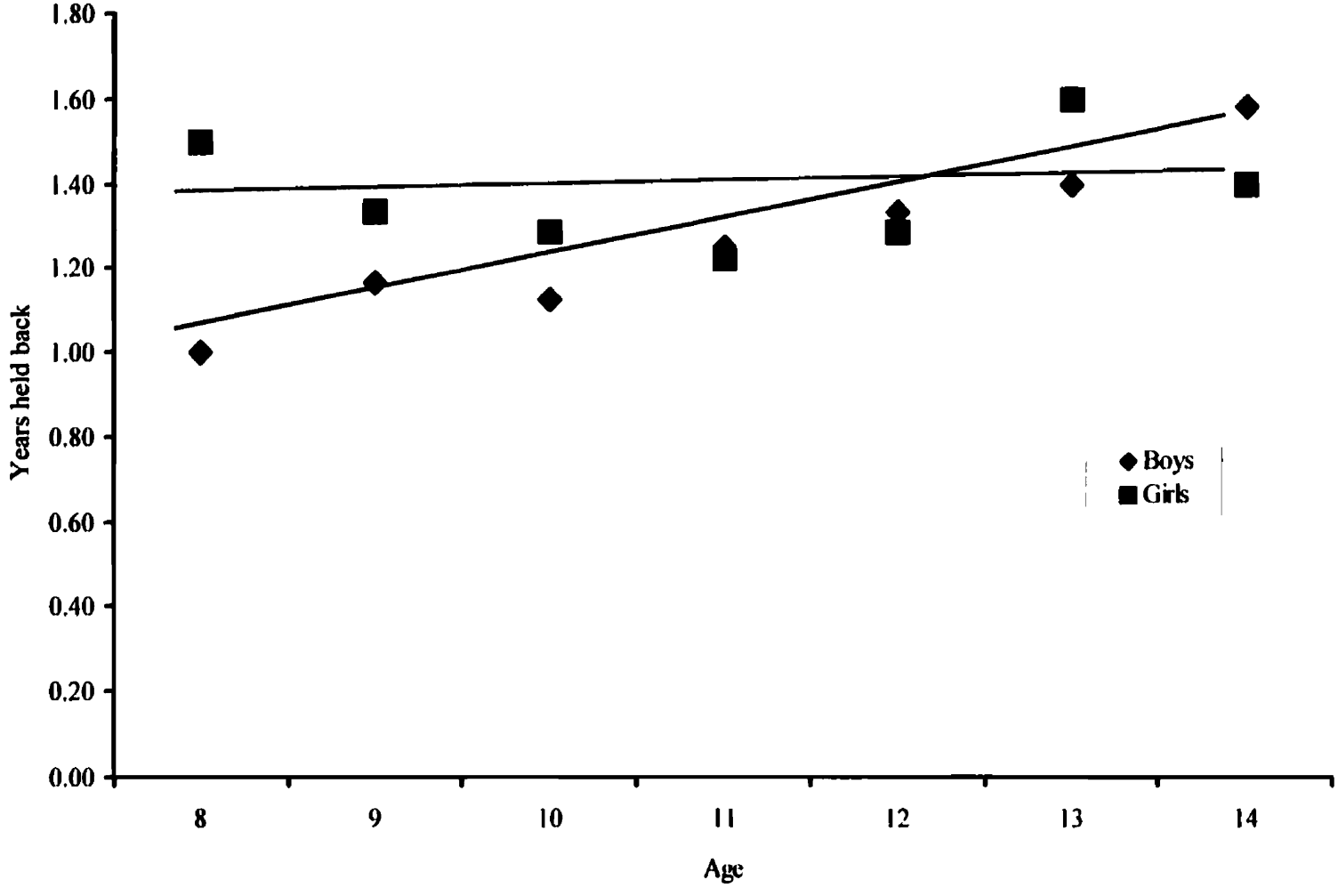


Table 2-1. Summary Statistics for Sample Households and Schools

			All			Means				
	Variable	Unit	Obs	Mean	Std dev	Henan	Jiangxi	Sichuan	Guizhou	Shaanxi	Gansu
Households	father's education	years	261	7.31	3.40	8.00	7.24	7.58	4.92	8.69	7.25
	mother's education	years	252	3.35	3.40	3.31	3.35	5.66	1.00	4.28	2.66
	women's empowerment	%	262	0.26	0.31	0.28	0.12	0.29	0.29	0.36	0.24
	number of children	#	262	2.15	0.84	2.28	1.93	1.98	2.12	2.16	2.44
	per capita expenditure	yuan	262	1133.54	651.97	857.10	1682.67	1718.75	971.18	687.60	811.81
	credit limit	yuan	262	4643.41	6596.45	6513.85	5000.29	3866.80	1685.78	6287.22	3468.44
	poor and credit constrained	1/0	262	0.14	0.35	0.18	0.02	0.00	0.25	0.19	0.22
	distance to primary school	km	195	1.22	(1.20)	0.54	1.20	1.56	2.34	0.62	1.24
	distance to junior secondary school	km	71	3.55	(4.87)	4.27	2.78	2.08	2.25	2.46	4.45
primary school	school fees	yuan	40	100.92	(47.01)	73.86	120.42	169.66	42.30	113.28	64.64
	student-teacher ratio	#	40	28.15	(9.49)	31.56	24.21	35.06	22.20	26.27	20.61
	teachers with post-secondary education	%	40	0.54	(0.34)	0.52	0.61	0.55	0.28	0.86	0.33
	rainproof classrooms	%	40	0.78	(0.51)	0.66	1.00	0.82	0.74	0.80	0.70
junior sec. School	school fees	yuan	37	317.80	(122.98)	295.68	304.95	383.90	216.86	400.25	294.83
	student-teacher ratio	#	37	15.10	(6.63)	14.10	18.78	18.64	11.66	11.39	11.37
	teachers with post-secondary education	%	37	0.88	(0.20)	0.91	0.95	0.85	0.79	0.93	0.83
	rainproof classrooms	%	36	0.90	(0.18)	0.95	1.00	0.94	1.00	0.80	0.68

Table 2-2. Educational Attainment Indicators

		All Children			Boys			Girls		
Variable	Unit	Obs	Mean	Std dev	Obs	Mean	Std dev	Obs	Mean	Std dev
current enrollment rate	%	472	0.78	(0.34)	253	0.82	(0.39)	219	0.74	(0.44)
age of primary enrollment	years	418	7.46	(1.13)	231	7.34	(1.07)	187	7.60	(1.17)
age of junior secondary enrollment	years	91	13.38	(1.04)	54	13.52	(1.08)	37	13.17	(0.94)
ever held back	%	425	0.30	(0.46)	234	0.35	(0.48)	191	0.25	(0.43)
years held back, if held back	years	129	1.30	(0.55)	81	1.30	(0.56)	48	1.31	(0.55)
highest grade completed among dropouts	#	55	5.89	(2.79)	26	6.51	(2.58)	28	5.28	(2.92)
average years per grade	years	336	1.17	(0.37)	234	1.21	(0.27)	152	1.14	(0.37)

Table 2-3. Years of Schooling (Cox Proportional Hazard)

Variable	Unit	(1) Haz. Ratio	(1) Coef.	(2) Haz. Ratio	(2) Coef.	(3) Haz. Ratio	(3) Coef.
male	dummy	1.148	0.138	0.599	-0.513	3.102**	1.132
		(0.23)		(1.15)		(2.26)	
age of enrollment	years	1.430*	0.358	1.090	0.086	0.477*	-0.740
		(1.73)		(0.62)		(1.68)	
younger siblings	#	0.654	-0.424	0.576	-0.551	0.577	-0.549
		(1.36)		(1.32)		(1.34)	
older siblings	#	0.147**	-1.917	0.138*	-1.980	0.617	-0.483
		(2.04)		(1.79)		(0.62)	
father's education	years	0.881	-0.127	0.875	-0.134	0.855	-0.157
		(1.61)		(1.51)		(1.45)	
mother's education	years	0.975	-0.025	0.960	-0.041	0.921	-0.082
		(0.16)		(0.34)		(0.99)	
women's empowerment	percent	0.087**	-2.441	0.209	-1.566	3.220	1.170
		(2.21)		(1.29)		(0.54)	
women's empower * male	interaction	0.558	-0.583	0.366	-1.005	0.055**	-2.898
		(0.41)		(0.73)		(2.08)	
women's emp * mother's ed	interaction	1.057	0.055	1.102	0.097	1.157	0.145
		(0.13)		(0.32)		(0.45)	
log expenditure per capita	log yuan	0.250	-1.386	0.833	-0.183	0.577	-0.550
		(0.78)		(0.20)		(0.66)	
poor and credit constrained	dummy	4.891**	1.587	3.047	1.114	0.244*	-1.412
		(2.47)		(1.43)		(1.65)	
distance to school	km	0.475**	-0.745	0.845	-0.169	0.901	-0.105
		(2.01)		(1.48)		(1.36)	
log school fees	log yuan	0.435*	-0.832			0.993	-0.007
		(1.68)				(0.01)	
student-teacher ratio	#	0.968	-0.032			0.998	-0.002
		(0.93)				(0.04)	
rainproof classrooms	%	0.047***	-3.067				
		(3.16)					
teachers with post-sec ed	%	4.164*	1.427			0.131	-2.034
		(1.88)				(1.62)	
County Strata		yes				yes	
Village Strata				yes			
Observations		373		406		79	

Robust z statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

Table 2-4. Standardized Examination Scores (OLS)

Variable	Unit	(1)	(2)	(3)
male	dummy	-0.668**	-0.443	-0.218
		(2.26)	(1.65)	(0.68)
male * primary	interaction	0.646**	0.342	0.099
		(2.30)	(1.51)	(0.29)
age of enrollment	years	-0.020	0.016	-0.032
		(0.25)	(0.20)	(0.31)
younger siblings	#	0.152	0.194	-0.117
		(1.18)	(1.41)	(1.11)
older siblings	#	0.268**	0.287**	
		(2.38)	(2.06)	
father's education	years	-0.021	-0.045*	
		(0.85)	(1.79)	
mother's education	years	-0.018	-0.007	
		(0.74)	(0.22)	
women's empowerment	%	-0.635**	-0.693	
		(2.06)	(1.54)	
women's empowerment * male	interaction	0.452	0.619	
		(1.08)	(1.52)	
women's empowerment * mother's education	interaction	0.080	0.068	
		(1.34)	(1.03)	
log expenditure per capita	log yuan	0.535***	0.544**	
		(3.03)	(2.30)	
poor and credit constrained	dummy	0.326	0.371	
		(1.49)	(1.50)	
distance to school	km	0.001	-0.007	
		(0.05)	(0.42)	
log school fees	log yuan	0.072		
		(0.45)		
student-teacher ratio	#	-0.015		
		(0.79)		
rainproof classrooms	%	-0.319		
		(0.39)		
teachers with post-secondary education	%	-0.316		
		(0.51)		
log school fees * primary	interaction	-0.336*		
		(1.79)		
student-teacher ratio * primary	interaction	0.012		
		(0.69)		
rainproof classrooms * primary	interaction	0.716		
		(0.82)		
teachers with post-secondary education * primary	interaction	0.726		
		(1.17)		
Constant		-2.813*	-3.663**	0.382
		(1.87)	(2.12)	(0.51)
County FE		yes		
Village FE			yes	
Household FE				yes
Observations		260	271	280
R-squared		0.11	0.25	0.71

Robust t statistics in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%
The dependent variable is standard deviations from mean test score for the same county-grade. The variable "primary" is a dummy variable for whether the child is currently enrolled in primary school

Table 2-5. Ever Held Back (Conditional Logit)

		(1)		(2)		(3)	
Variable	Unit	Odds Rat.	Coef.	Odds Rat.	Coef.	Odds Rat.	Coef.
male	dummy	3.971**	1.379	3.804*	1.336	2.192	0.785
		(2.11)		(1.89)		(0.84)	
male * primary	int.	0.468	-0.759	0.461	-0.774	0.953	-0.048
		(1.15)		(1.07)		(0.05)	
age of enrollment	years	0.701***	-0.355	0.693**	-0.367	0.320***	-1.141
		(2.67)		(2.32)		(2.96)	
younger siblings	#	1.381	0.323	1.095	0.091	2.540***	0.932
		(1.51)		(0.37)		(2.87)	
older siblings	#	1.081	0.078	0.764	-0.269		
		(0.36)		(1.02)			
father's education	years	0.864***	-0.146	0.855***	-0.157		
		(3.03)		(2.82)			
mother's education	years	0.921	-0.083	0.902	-0.103		
		(1.50)		(1.58)			
women's empowerment	%	0.788	-0.238	0.511	-0.672		
		(0.32)		(0.83)			
women's emp * male	int.	0.685	-0.378	0.961	-0.039		
		(0.44)		(0.04)			
women's emp * mother's ed	int.	1.183	0.168	1.283*	0.249*		
		(1.41)		(1.77)			
log expenditure per capita	log yuan	1.988	0.687	1.329	0.284		
		(1.63)		(0.61)			
poor and credit constrained	dummy	0.873	-0.136	1.459	0.378		
		(0.36)		(0.85)			
distance to school	km	0.948	-0.053	0.962	-0.039		
		(0.93)		(0.61)			
log primary school fees	log yuan	0.628	-0.466				
		(0.80)					
pri student-teacher ratio	#	0.990	-0.011				
		(0.49)					
primary rainproof classrms	%	0.528	-0.639				
		(0.92)					
pri teachers w/ post-sec ed	%	0.689	-0.372				
		(0.77)					
Grade Completed Dummies		yes		yes			
County FE		yes					
Village FE				yes			
Household FE						yes	
Observations			359		328		113

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

CHAPTER III

DOWRY AND INTRAHOUSEHOLD BARGAINING: EVIDENCE FROM CHINA[1]

3.1. Introduction

The predominant model of household behavior formalized by Becker (1991) assumes that families maximize a single utility function, i.e., that either all household members have identical preferences or that one household member functions as a dictator, determining all allocations within the household. While this "unitary" model has provided important insights into household behavior, it offers little perspective on how individual preferences inform these allocations. More general models of the household that explicitly account for differences in preferences have resulted. One prominent set of models treats household decisions as the result of household members engaging in cooperative Nash bargaining (Manser and Brown, 1980; McElroy and Horney, 1981).[2] In such "collective" approaches to household behavior, the bargaining position of household members plays an important role in determining resource allocations within the household.

While the concept of intrahousehold bargaining is theoretically straightforward, measuring bargaining position is difficult in practice; there is a paucity of socioeconomic data that include both plausible measures of household bargaining and individual welfare measures, and it has proven difficult to convincingly correct for endogeneity problems with existing data (Behrman, 1997). Nevertheless, numerous studies have been undertaken which find evidence supporting the collective models of households in many developing countries.

Due perhaps to intuitive appeal and empirical tractability, many studies focus on assignable income as relative measures of intrahousehold bargaining position, e.g., Folbre

(1984), Von Braun (1988), Garcia (1990), and Hoddinott and Haddad (1995). They find grounds to reject the income pooling hypothesis central to the unitary model and find considerable evidence that control of resources has strong implications for how those resources are used by the household. However, by using income as a regressor, they unrealistically assume that labor supply decisions are exogenous. To avoid this simultaneity problem, other studies rely on nonlabor income to measure relative bargaining power, e.g., Schultz (1990) and Thomas (1990). This strategy is also problematic, however, because nonlabor income may depend on individuals being in a particular state, e.g., receiving benefits due to temporary illness, and because persistent unobservable differences in productivity and taste may have influenced past asset accumulation (Behrman, 1997). Furthermore, nonlabor income may reflect previous labor supply decisions and may thus be endogenous across the lifespan (Strauss and Thomas, 1995; Hoddinott, Alderman, and Haddad,1997; Schultz, 2001).[3] An appealing alternative to income as an indicator of bargaining position are sex ratios at the relevant marriage ages, laws governing divorce, and other environmental factors that may shift threat points within marriage (Rao and Greene, 1993; Lundberg, Pollak, and Wales, 1997; Ward-Batts, 2001; Chiappori, Fortin, and Lacroix, 2002; Anderson, 2003). In principle, variation in such parameters can be used to identify how changing threat points affect household allocations. However, in the absence of randomized experiments, these factors may also be endogenous (Hoddinott et al., 1997).

In the search for exogenous determinants of intrahousehold bargaining position, one interesting recent approach has stressed the importance of assets controlled by individuals at the time of household formation. If such assets remain under control of the original holder, they may affect the relative bargaining positions in the household (and thus marital allocations) without the simultaneity concerns that arise in the previously described studies. Hence, Thomas, Contreras, and Frankenberg (1997) and Quisumbing and Maluccio (2003) find evidence that women's share of the assets brought to marriage by the spouses influences children's health and/or education outcomes in Indonesia, Bangladesh, Ethiopia, and South Africa. While concerns about simultaneity diminish when using pre-marital assets as a proxy for bargaining position, the possibility of omitted variable bias remains. Zhang and Chan (1999) thus implement a two-stage

estimation strategy in which parental education is used as an instrument for dowry when estimating the effect of pre-marital endowments on the probability that husbands do household chores in Taiwan. However, unobservable characteristics of the wife, e.g., intelligence, may be correlated with both parental education and household bargaining outcomes, and the instrument may thus not be exogenous in the second stage. Further, they do not control for cohort differences, resulting in biased estimates if younger husbands both have more educated parents and contribute more time to housework. Their identification strategy is thus subject to endogeneity problems similar to those in many previous studies of household behavior.

This paper makes use of detailed new data from China to investigate the effect of dowry on household allocation in a cooperative Nash bargaining framework. To control for the potential endogeneity of marital payments, I use two types of instruments. The first is regional grain yield shocks in the year preceding marriage. The surveyed households are located in rural areas where livelihoods have long depended on farming. Unanticipated shocks to grain yield in the period just before marriage are therefore likely to have a substantial impact on household wealth accumulation, and thus on the ability of households to make transfers associated with marriage. The second type of instrument is the sibling sex composition of the bride and groom. Sibling sex composition likely affects the savings available for marital payments given the high costs associated with marrying sons versus the expected income from marrying daughters and the fact that credit markets are not well developed. These instruments influence payments made before marriage while remaining plausibly exogenous to household allocation decisions after marriage. In contrast to many other studies, I also include family background measures to better control for unobservable characteristics of the couple that may correlate with marital payments. In addition, estimates include marriage cohort dummies to account for the possibilities that the amount of marital payments reflect generational norms and that factors affecting intrahousehold decisions may vary by cohort. Finally, I use village fixed effects to control for unobserved heterogeneity. This identification strategy represents a significant improvement over previous studies in controlling effectively for potential bias from omitted variables and simultaneity.

I analyze the effect of dowry on a variety of household allocation decisions of interest to the wife, including her total leisure time, the time that her husband allocates to household chores, and the probability that the wife self-identifies as being satisfied with her life. To help distinguish between wealth effects and bargaining effects, I also analyze the impact of dowry on household spending on women's goods as a share of total expenditures, on the wife's share of the couple's total leisure time, on her husband's share of the couple's total time devoted to chores, and on the degree to which the wife has the authority to make decisions when the husband and wife disagree about household matters. I find that dowry has a positive and robust effect on each of these outcomes, providing strong evidence that pre-marital endowments affect household bargaining, and thus household consumption choices.

The remainder of the paper is organized as follows: section 3.2 reviews the collective Nash bargaining model; section 3.3 describes the role of marital payments in the marriage ritual in China; section 3.4 details the identification strategy used in the empirical investigation; section 3.5 introduces the data used in the analysis; section 3.6 presents empirical evidence that dowry affects a wife's bargaining position; and section 3.7 concludes.

3.2. Cooperative Nash Bargaining Model

Following McElroy and Horney (1981), consider two unmarried individuals, w and h, who each care about their own consumption of goods and leisure. Individual i's utility in the single state is given by $U_s^i = U_s^i(X^i)$, where $i \in \{w,h\}$, which is assumed to be nondecreasing and quasiconcave. Here, $X^i \in \{x^i, l^i\}$, x^i is i's consumption of goods, and l^i represents i's leisure. Suppose that w has a private endowment given by D. In the single state, w maximizes utility by choosing X^w subject to the constraint given by $px^w + r^w l^w = r^w T^w + D$ and h maximizes utility by choosing X^h subject to $px^h + r^h l^h = r^h T^h$. Here, p is the price of x^i, r^i is i's wage rate, and T^i is the total time available to i. This yields the strictly quasiconvex indirect utility functions $V^w(D,p,r^w,T^w)$ and $V^h(p,r^h,T^h)$, with the indirect utility of individual w increasing

in the endowment, D. That is, $dV^w / dD > 0$. The indirect utilities *outside* of marriage correspond to the threat points of individuals *within* marriage (i.e., the minimum utility available to each individual in the event of marital dissolution),[4] and thus to their relative intrahousehold bargaining positions.

In the cooperative Nash bargaining framework, w and h jointly choose consumption to maximize the gains from marriage over their own and their spouse's consumption:

$$(1) \qquad \left[U_m^w(X^w, X^h) - V^w(D, p, r^w, T^w)\right]\left[U_m^h(X^w, X^h) - V^h(p, r^h, T^h)\right]$$

subject to the joint budget constraint equating total household expenditure to total household income:

$$(2) \qquad px^w + px^h + r^w l^w + r^h l^h \leq r^w T^w + r^h T^h + D$$

which is assumed to be binding.[5] In the context of marriage, D may be interpreted as dowry, and it is assumed that D reverts to w in case of divorce.

By the implicit function theorem, the solution to the household's problem is a system of demand equations for goods and leisure:

$$(3) \qquad \begin{aligned} X^w &= f^1(D, p, r^w, T^w, r^h, T^h) \\ X^h &= f^2(D, p, r^w, T^w, r^h, T^h) \end{aligned}$$

The total effect of a change in dowry on the optimal allocation of x and l may be decomposed into a wealth effect, $\frac{\partial X^i}{\partial D}$, stemming from a shift in the budget constraint, and a bargaining effect, $\frac{\partial X^i}{\partial V^w}\frac{dV^w}{dD}$, resulting from a change in the relative marital threat points. That is,

$$(4) \qquad \frac{dX^i}{dD} = \frac{\partial X^i}{\partial D} + \frac{\partial X^i}{\partial V^w}\frac{dV^w}{dD}$$

Holding the total budget constant, an increase in the relative bargaining position of one spouse must lower that of the other spouse. Thus, the net effect of a change in dowry has an ambiguous impact on h's consumption because the wealth and bargaining effects associated with dowry offset each other, i.e., $dX^h / dD >< 0$, assuming that each individual's consumption is a normal household good. However, the wealth and bargaining effects are both positive for w, i.e., $dX^w / dD > 0$. As such, it is important to distinguish between bargaining and wealth effects before concluding that dowry shifts bargaining positions within marriage.

3.3. Marital Transactions in Rural China

Multiple transfers between the natal families characterize the marriage ritual in China. Brideprice (*pinli* or *pinjin*) is a transfer or series of transfers from the groom's parents to the bride's parents, while dowry (*jiazhuang*) represents a subsequent transfer from the bride's family to the bride. Thatcher (1991) documents this system dating to the Spring and Autumn period of the Eastern Chou dynasty (770 - 256 B.C.), and it persisted through the first half of the 20th century. However, the Chinese government sought to combat "feudal" practices in marriage with the founding of the People's Republic of China. Central to this objective was enacting the 1950 Marriage Law that specifically prohibited "the exaction of money or gifts in connection with marriage" (Meijer, 1971). Yet as Parish and Whyte (1978) put it, "Poor peasants were less enthusiastic about marriage struggle than they were about class struggle," and the new rules were largely ignored (Ocko, 1991; Min and Eades, 1995), particularly in rural areas.

In rural China, brideprice is negotiated between the two natal families, typically using a matchmaker as intermediary.[6] Because the bride formally leaves her own family at marriage to join her husband's, the brideprice negotiation focuses on how the bride's family should be compensated for investments made in rearing the bride (Croll, 1981) and the loss of rights over her (Goody, 1973). A further consideration, particularly after agricultural decollectivization when families could again profit from the sale of excess production, is the loss of a bride's future productivity (Parish and Whyte, 1978; Min and Eades, 1995; Zhang, 2000). That is, brideprice is a mechanism for clearing the market,[7]

but not generally for making bequests to the husband or to the conjugal unit directly. A marriage date is also fixed at the time of betrothal, with engagement typically lasting one year (Liu, 2000). Brideprice is usually given to the bride's family in several installments over the course of the engagement.[8]

After brideprice is received, the bride's family decides the size and composition of the dowry; unlike brideprice, it is not subject to negotiation by the groom's parents. Offering elaborate dowries provides a vehicle for prestige building (Potter and Potter, 1990; Siu, 1993; Liu, 2000) and serves as an efficient pre-mortem inheritance (Parish and Whyte, 1978; Croll, 1981). The difference in timing of inheritance for sons and daughters may be attributed to higher transaction costs for daughters who have married and left the household, and in many cases the local area. In much of rural China, current practice is that brides' parents retain part of the brideprice and pay out part as dowry. Dowry today typically includes bedding, clothing, furniture, and possibly other durables such as a bicycle, sewing machine, radio, and television (Siu, 1993; Liu, 2000). It also includes a significant cash component for the bride's exclusive use. Dowry thus forms the basis of the new conjugal unit's household. While the groom has equal access to the non-pecuniary aspects of dowry, the bride retains ultimate authority in its use (Zhang, 2000). For example, Yan (1996) describes brides using their dowries to make high-interest loans to in-laws who must pay brideprice in the marriage of a younger son. Prior to 1981, divorce was legally difficult to obtain and the divorce rate was accordingly low. The 1981 Marriage Law considerably eased the requirements for divorce, however, and the rates have risen steadily since. In 1998, there were 0.954 divorces per 1000 population (Wang, 2001),[9] with the highest rates occurring in rural interior provinces (Zeng and Wu, 2000). Furthermore, the 1981 Marriage Law stipulates that dowry reverts to the bride in the event of marital dissolution (Ocko, 1991). Divorce is therefore a realistic outside option for wives in the surveyed areas.

Given that brideprice is an intergenerational transfer from the groom's parents to the bride's parents and that dowry is an intergenerational pre-mortem bequest made by the bride's parents to the bride, it is expected that dowry affects bargaining position within marriage, while brideprice has no effect, as Zhang and Chan (1999) find in

Taiwan. In what follows, I nevertheless test whether brideprice also affects marital allocations by including it as an additional regressor.

3.4. Empirical Specification and Identification

The wife's share of marital resources, X^w, resulting from the cooperative Nash bargaining process may be written as follows:

$$X^w = \alpha_1 + \beta_1 D + \beta_2 B + \mathbf{Z}_1 \beta_3 + e_1 \tag{5}$$

where D is the dowry a wife brings to marriage, B is the brideprice payment made to the bride's parents, and $\mathbf{Z}_1$ is a vector of demographic and explanatory variables including differences in the husband and wife's age and education levels, the number of children and adults (other than the husband and wife) in the household, household wealth, characteristics of the natal families, and marriage cohort and village dummies. Age differences (defined as the husband's age less the wife's) and education differences (defined analogously) may affect marital threat points. Household demographics may affect the distribution of household chores and the opportunity to engage in work outside the home. Household wealth (defined as the current value of household durables) may influence consumption choices. Characteristics of the natal household are included to control for unobserved characteristics of the conjugal couple that might correlate with marital payments. Marriage cohort dummies are included to control for generational differences in marital norms and the factors affecting intrahousehold decisions. These dummies were chosen to capture observed variation over time in both marital payments and household allocations, and vary by county. In addition, a set of cohort or village dummies are included to control for sex ratios, unemployment rates, and unobserved heterogeneity at the local level.[10] If dowry affects the wife's consumption of goods or leisure, then β_1 will be positive.

Dowry and brideprice are unlikely to be exogenous in equation (5) because any unobserved characteristic of the wife that affects these payments may also affect her share of marital output. For example, Boulier and Rosenzweig (1984) show that physical attractiveness affects marital allocations, and it is plausible that it might also affect the

size of the dowry transfer. Alternatively, women with very likable personalities may receive higher dowries from their parents and have better marital allocations than women with disagreeable personalities. In either case, estimating equation (5) using ordinary least squares (OLS) would produce biased and inconsistent estimates. Identification of equation (5) therefore requires instruments that are excludable from $\mathbf{Z}_1$. Dowry and brideprice may thus be estimated by:

$$
\begin{aligned}
D &= \alpha_2 + \mathbf{Z}_1\delta_1 + \mathbf{Z}_2\delta_2 + \delta_3 B + e_2 \\
B &= \alpha_3 + \mathbf{Z}_1\omega_1 + \mathbf{Z}_2\omega_2 + e_3
\end{aligned} \tag{6}
$$

where $\mathbf{Z}_2$ is a vector of instrumental variables that explain D and B but which is independent of X^w.

With incomplete credit markets in China's rural areas (Jalan and Ravallion, 1999), household savings are the primary source for marital payments. As a result, the instruments employed in this analysis each reflect savings available at the time of marriage. The first instrument is a measure of regional grain yield shocks – specifically, the deviation from trend in provincial per capita grain yield in the year immediately preceding marriage. Grain yield is a particularly important determinant of income (and thus savings) in rural western China where virtually all families are engaged in grain production, and this was even truer for the parents of the surveyed couples. The deviations from trend are the residuals from regressing historical per capita grain yield data in each province on a linear spline of harvest year; this identification strategy isolates the effect of transitory output shocks that are independent of time trends in the level of economic development in each locality. Because marriage typically occurs in the year following betrothal negotiations (Liu, 2000), grain shocks are lagged one year. The timing of marriage may be endogenously determined because families may seek to postpone entering marital negotiations until after a good harvest, especially in the absence of complete credit markets. The willingness to wait for a good harvest may nevertheless be tempered by cultural preferences for children marrying at certain ages. In any event, the groom's family is unlikely to permit delays to the wedding once a couple is betrothed and the wedding date has been fixed.[11] I find that negative regional grain

shocks have a small negative influence on the number of marriages in the following year, but that the relationship is not significant (output omitted), suggesting that current wealth is not an overriding concern in deciding when to begin marriage negotiations.

The second instrument is the sibling sex composition of the bride and groom. Because brideprice exceeds dowry in most areas, the marriage of a daughter represents net household income while that of a son represents net household expenditures. Moreover, because these transfers tend to be substantial, the sex composition of children in the household is an important determinant of the lifetime wealth profile of Chinese families. Note that for this identification strategy to be successful, sibling sex composition cannot correlate with important unobservable characteristics of the individual. To that end, other family background factors such as parental education and the total number of siblings are included as additional controls.[12]

Given that the sex composition of children in the household is known, parents may anticipate future cash flows and adjust savings in order to smooth consumption over the lifetime. However, if preferences are time-inconsistent, i.e., if the household discount rate is hyperbolic (Angeletos, 2001; Harris and Laibson, 2001), then the sex composition of older children may play a larger role in determining dowry and brideprice than the sex composition of younger children given that Chinese children tend to marry in birth order. If, on the other hand, parents value future consumption more than current consumption, the sex composition of younger siblings may be more important. Finally, a prominent thought in the sociology and anthropology literatures is that while the sex composition of the groom's older siblings is a primary determinant of the size of the brideprice (Parish and Whyte, 1978; Siu, 1993), the sex composition of the bride's younger siblings is an overriding determinant of the size of the dowry (Min and Eades, 1985); this scenario is plausible because the brideprice payment is made before the dowry payment and because the former is typically larger than the latter, and suggests that rural Chinese parents may have difficulty smoothing consumption via savings.

Tables 3-1A and 3-1B present first-stage estimates for the determinants of dowry and brideprice, respectively, adjusted to 1985 prices. Column 1 presents the determinants of dowry and brideprice including exogenous shocks to grain yield as well as the sex composition of all siblings (suggesting time-consistent preferences with savings), column

2 substitutes the sex composition of older siblings (suggesting hyperbolic discounting), column 3 substitutes the sex composition of younger siblings (suggesting patience), and column 4 presents the determinants of marital payments when the groom's older siblings affect brideprice and the bride's younger siblings affect dowry (the scenario described in the sociology and anthropology literatures). Concurring with the observations of many social scientists conducting fieldwork in rural China, F-tests for the joint significance of the instruments show that the sex composition of the groom's older siblings and the bride's younger siblings are indeed strong determinants of marital payments, and these are the instrumental variables used in the analysis that follows.[13] Using Bassman's (1960) test, overidentification is rejected. These instruments are therefore used in the two-stage estimations that follow.

There are several concerns about the identification strategy that are worth noting. First, wealth may be simultaneously determined with household allocation. However, the only appropriate instrument available is the family's holding of high-quality flat (i.e., non-sloping and non-terraced) land – the preferred land for agricultural production. This instrument is plausibly exogenous from household decisions about the wife's consumption of goods, x^w, but not leisure, l^w, because a household's land holding is correlated with the time used to farm it. Wealth is therefore excluded from the empirical specifications wherein time is the outcome of interest. For completeness, I nevertheless included wealth as an additional regressor in these empirical specifications. I found that the point estimate for wealth is not significant and the other coefficients are not significantly different when it is included (output omitted).

Another concern is whether the effect of dowry persists after years of marriage. On the one hand, the cash component is likely to have been spent and the value of durables will have depreciated after a number of years, suggesting that dowry becomes less important. On the other hand, norms established early in the marriage may persist, so the effect of dowry on household allocations may endure. Indeed, I find that the estimated effect of dowry on certain aspects of a wife's welfare (such as her free time and the time that her husband allocates to household chores) is not significantly different for couples married for more than 10 years versus those married fewer than 10 years (output omitted). This finding suggests that the effects of dowry persist well into marriage.[14]

It should also be noted that it is possible that dowry correlates with some other characteristic of the bride such as her social network, and that this trait is the true determinant of her marital bargaining position. To address this particular concern, I included measures of the bride's social network (e.g., whether family benefactors are related to the husband or wife and which families were visited during important holidays) as additional regressors in the empirical work that follows. I found that including these regressors had no discernable impact on the dowry coefficients (output omitted).[15]

A more general concern is whether the relationship between dowry and a wife's consumption works through her bargaining position rather than through a wealth effect. I thus analyze the effect of dowry on the wife's *share* of the couple's time allocation, on the household spending on assignable goods, and on the wife's decision-making authority when the husband and wife disagree. Differences in these outcomes stemming from differences in dowry suggest changes in the relative bargaining positions of the spouses, a story that is inconsistent with pure wealth effects (assuming, in the case of an individual's share of the couple's total leisure time, that any wealth effect is gender neutral).[16] While the evidence I present suggests that dowry operates through a bargaining effect, I nevertheless cannot rule out other models that generate similar comparative statics.

3.5. Data and Variables

The second wave of the China Rural Poverty Survey, a collaborative effort of researchers from the Chinese Academy of Agricultural Science's Institute of Agricultural Economics and the University of Michigan (including the author), was conducted in February 2001. The survey covered four officially designated poor counties, with one county in each of four interior provinces: Gansu, Guizhou, Shaanxi, and Sichuan.[17] The survey encompassed 587 households evenly distributed across 40 villages.

Approximately two-thirds of the households also participated in the first wave of the survey, conducted in December 1997.[18] Excluding households whose head is widowed, divorced, single, or absent reduces the sample to 460. I restrict the sample further by dropping 5 households that have key variables missing and 4 households in which marriage preceded the 1950 Marriage Law. The final sample thus consists of 451 couples married between 1950 and 2000, inclusive.

Respondents were asked detailed information about their marriages, including the values of dowry and brideprice.[19] Detailed demographic and time allocation data were collected for all members of the household. Additionally, household expenditures on a range of goods were collected. Last, a separate instrument designed to assess attitudes, preferences, marital roles, and decision-making authority was asked of husbands and wives separately.

In this study, a wife's welfare within marriage is measured in the following ways:

1. the wife's total leisure (non-work) time;
2. the total time that husbands allocate to household chores;
3. the share of annual household accruing to women's goods;
4. the wife's self-reported satisfaction; and
5. the wife's decision-making authority

As noted above, dowry may have a wealth effect, a bargaining effect, or both. Spending on women's goods and the wife's decision-making authority help to distinguish between these effects. To further distinguish between wealth and bargaining effects, I also analyze the impact of dowry on the wife's share of the couple's total leisure time and on the husband's share of the couple's time devoted to chores; if wealth effects are gender neutral (admittedly, a strong assumption), then they cannot explain changes in the share of leisure time accruing to one of the partners.

These measures may require some explanation. Leisure time is defined as the time spent outside of market work, farm work, and household chores; although it excludes the wife's time allocated to gathering wood, cooking meals, cleaning, and several other chores, it may include unmeasured household activities such as time spent rearing children, sleeping, or not working because of illness. This measure therefore represents a wife's total potential leisure time (see Schultz, 2001 for discussion). Husbands' time allocated to chores is defined as the hours spent cooking, cleaning, and gathering firewood in an average week. To proxy for spending on women's goods, I use a category of spending called "*ge ren yongpin zhichu*" (expenditures on items of personal use), of which makeup, jewelry, and razors were given as examples. Because razors are inexpensive and durable, and thus likely contribute little to the total annual expenditure (unlike jewelry which is expensive or makeup which is consumed quickly), I attribute

this consumption to the wife.[20] This variable is measured as a share of total household spending. A wife's satisfaction is measured by the extent to which she agrees with the following statement, "Overall, I am satisfied with my life." This may be of interest because it may reflect welfare beyond the other outcomes evaluated here. It is reported as a categorical variable with values 1 ("completely unsatisfied"), 2 ("somewhat unsatisfied"), 3 ("somewhat satisfied"), and 4 ("completely satisfied").[21] Because few wives reported being either "completely unsatisfied" or "completely satisfied," the analysis will investigate only whether women report being satisfied or unsatisfied; this bivariate measure has the advantage of allowing IV probit estimation with corrected standard errors. Finally, the wife's decision-making authority is an index variable for which a value of 0 is assigned if the husband is responsible, 1 is assigned if the wife is responsible, and 0.5 is assigned if they are jointly responsible. Unlike decision-making authority which may simply reflect household specialization strategies (Thomas et al., 1997), this outcome measures the wife's empowerment to make decisions when there is a household dispute, a measure that is likely influenced by bargaining position directly. This question was asked separately of husbands and wives. In the few cases wherein the spouses disagreed, the wife's assessment is used in the analysis.

Basic indicators for the 451 sample households are presented in Table 3-2. On average, women spend 5 hours per day engaged in income-generating activities and household upkeep, leaving 19 hours per day for other activities, including leisure, sleeping, rearing children, and other activities. The distribution of leisure between husband and wife is roughly equal in the mean household, with women spending 4.0 percent less time in leisure than their husbands.[22] Husbands spend 44 minutes per week cooking meals, cleaning, and gathering wood on average, although roughly half of the surveyed husbands do none of this work. The time that husbands spend helping with household chores amounts to 17.7 percent of the total time that couples devote to these activities, but 8.6 percent of husbands perform at least half of these chores. Spending on women's goods accounts for 0.2 percent of annual household spending, although this figure varies widely. Surveyed households commonly spend nothing on this form of consumption, while one percent of households spent 2 percent or more of their total expenditures on women's goods. Women were split nearly evenly between feeling

satisfied and feeling unsatisfied with their lives. The majority of women reported feeling either "somewhat satisfied" or "somewhat unsatisfied," with only 13 women at either extreme. Finally, wives have sole decision-making authority when disputes arise in 27.0 percent of households, and shared responsibility in a further 16.0 percent of the surveyed households.

Turning to the independent variables, the average couple has been married for 19.4 years. The typical husband is 43 years old, 3 years older than his wife, and has completed primary schooling, 3 grades more than his wife. Households include 1.4 children and 0.6 other adults (typically an elderly parent) on average. Using 1985 as the base year, the real average household wealth as measured by the value of major durables was 655.9 yuan. Total parental education averages 2.4 years and husbands and wives have 3.8 and 2.7 siblings in their natal families, respectively.[23]

The mean real brideprice was 538 yuan (in 1985 yuan) and the mean real dowry was 247 yuan, suggesting that the bride's family retains 54 percent of the brideprice received on average. Practice varies widely by province, however. In Gansu, dowry averages just 22 percent of brideprice, while average dowry exceeds brideprice by 18 percent in Sichuan (Figures 3.1A and 3.1B). Further, dowry and brideprice have been appreciating at 3.8 percent and 4.6 in real terms, respectively, since 1950.[24] The simple correlation between real dowry and brideprice is 0.43.

3.6. Empirical Results

This section analyzes the effect of dowry on the wife's total leisure (non-work) time, the husband's time allocated to performing household chores, and the degree to which wives self-identify as being satisfied with their lives. To help distinguish between wealth and bargaining effects, I also analyze the effect of dowry on the amount of money spent on women's goods as a share of annual household spending, on the wife's share of the couple's total leisure time and on the husband's share of the couple's total time allocated to household chores, and on the wife's decision-making authority when the spouses disagree about household issues. Per the discussion in section 3.4, I estimate the

following fixed effects model for the effect of dowry on the wife's allocation, X^w_{hv}, in household h in village v:

$$X^w_{hv} = \alpha + \beta_1 D_{hv} + \beta_2 B_{hv} + \beta_3 A_{hv} + \beta_4 E_{hv} + \beta_5 N^k_{hv} + \beta_6 N^a_{hv} + \beta_7 W + \mathbf{F}_{hv}\beta_8 + \sum_c \sum_m \lambda^{cm} + \gamma_v + e_{hv} \quad (7)$$

where D is the dowry she received at marriage, B is the brideprice her parents received when she was betrothed, A is the age difference between the husband and wife, E is the difference in their education, N^k is the number of children in the household, N^a is the number of other adults in the household, W is the household's wealth, $\mathbf{F}$ is a vector of natal family characteristics, and λ^{cm} is a county - marriage cohort interaction term.

Table 3-3 shows the OLS, probit, and ordered probit estimates for several measures of the wife's allocation. Household wealth is omitted to save space, but including wealth does not appreciably change the signs or magnitudes of the other coefficients (output omitted). Column 1 presents OLS estimates for the wife's total leisure time, column 2 presents those for the husband's total time allocated to household chores, column 3 shows OLS estimates for women's goods as a share of household expenditures, column 4 presents the marginal effects for the probability that wives reports being satisfied (as opposed to unsatisfied) with their lives, and column 5 presents the marginal effects for the probability that women have some or full autonomy in making decisions when the husband and wife disagree about household issues using ordered probit estimation. The "shares" measures of husband and wife's time allocations are omitted to save space. County-marriage year interactions are included to control for time and location trends in marriage payments and household responsibilities. Also, village fixed effects are included in the first three estimates to control for unobserved heterogeneity at the local level. Because some survey forms were asked during a subsequent visit to the household during which some respondents were unavailable, there are fewer observations for the attitudinal outcomes. Due to the smaller sample size and the fact that there exists no variation in these outcomes within some villages, county

fixed effects supplant village fixed effects in estimating the determinants of these measures.[25]

With the exception of a husband's time allocated to household chores, dowry has a positive effect on a woman's welfare within marriage. Except for influencing a woman's decision-making authority, these effects are also significant. Dowry has a modest effect on a woman's leisure (non-work) time, with a 100 yuan increase (40 percent of the mean real dowry) increasing non-work time by 0.5 percent of the mean. The effect of dowry on the share of the household budget accruing to women's goods is more pronounced, with a 100 yuan increase in dowry corresponding to the mean budget share increasing by 12.6 percent. Similarly, higher dowry is associated with higher self-reported levels of satisfaction, with a 100 yuan increase in dowry at the mean resulting in an 8.9 percent higher probability of feeling satisfied. Again, the marginal effect of dowry on decision-making authority is not significant.

The estimated effects of brideprice are considerably smaller than those of dowry (except in determining the husband's time allocated to chores, although neither of these point estimates is significant) and are largely insignificant, consistent with the theory that brideprice should not affect marital welfare except via its effect on dowry. Brideprice has a significant, negative impact on household spending accruing to women's goods, suggesting perhaps that families that pay higher brideprice negotiate lower consumption for the bride, but the magnitude is less than one-third that of dowry.

Other regressors enter largely as expected. When the difference in ages between husband and wife are greater, the wife's leisure time declines. Simple cross-tabulations suggest that relatively young wives do more manual labor, such as cleaning and gathering firewood (output omitted). Similarly, as the gap between husband's and wife's education increases, the likelihood that the wife is less satisfied increases. The presence of other adults raises both a wife's satisfaction and the share of the household spending accruing to women's goods, which is sensible if these other adults are women. The wife's total number of siblings positively affects the time that husbands allocate to chores, perhaps because such women are used to sharing responsibility for household activities, while the husband's parents' education and his total number of siblings increase a wife's decision-making authority, perhaps because such men have more progressive attitudes or are used

to sharing authority. Finally, the wife's parents' education has a positive effect on the time that husbands allocate to chores for reasons are not immediately clear.

As discussed above, dowry and brideprice may reflect unobserved characteristics of the bride and groom, and hence these estimates may be biased. For example, Boulier and Rosenzweig (1984) have shown that physical attractiveness affects allocations within marriage, and it is plausible that it might similarly impact the size of marital transfers. Similarly, a bride with a nice personality may receive a higher transfer from her parents and may also be treated well within her marriage. These unobserved positive characteristics of the bride will bias the estimated coefficients on dowry upward. By contrast, higher dowries may also result from unobservable *negative* characteristics of the groom and/or his family. That is, the bride's family may attempt to insure against poor treatment of their daughter in her conjugal home by influencing her bargaining intrahousehold bargaining position via a larger dowry. In such cases, the estimated coefficients on dowry are biased downward.[26] Because the direction of the bias caused by omitted variables is ambiguous, whether dowry and brideprice have true effects on household allocations remains questionable.

Following the procedure described by Davidson and MacKinnon (1993), I test for the exogeneity of dowry and brideprice. Using the residuals from regressing dowry and brideprice on all of the exogenous variables in equations (5) and (6) as additional regressors when estimating equation (5), I test the hypothesis that the coefficients of the residuals are jointly zero. I find that the joint exogeneity of dowry and brideprice is rejected at the 99 percent confidence level (output omitted). Therefore, OLS is an inconsistent estimator and estimation using a two-stage approach is warranted.

Dowry and brideprice are instrumented using regional grain shocks in the year preceding marriage and the sibling sex composition of the bride and groom, as detailed in section 3-4. Because wealth may be simultaneous with household allocation decisions, I estimate the determinants of spending on women's goods, the wife's satisfaction, and the wife's decision-making authority when household disputes arise with and without controlling for wealth. When including wealth as an additional regressor, the household's allocation of high-quality, flat land is used as an instrument. However, I lack a satisfactory instrument when the outcome of interest is related to time allocation,

so wealth is excluded in these regressions. As noted above, including un-instrumented wealth in these regressions nevertheless has no impact on the other estimated coefficients (output omitted).

Table 3-4 presents two-stage least squares estimates for the determinants of the wife's potential leisure time, defined as time spent outside of wage work, farm work, work in private business, and household chores. Column 1 presents estimates for leisure time in hours per day and column 2 presents estimates for the wife's share of the couple's total leisure time. Increasing dowry by 100 yuan increases the wife's potential leisure time by 44.4 minutes per day, or 3.9 percent of the mean. This effect is considerably larger than the OLS estimate presented in Table 3-3, suggesting that dowry correlates with unobserved negative characteristics of the groom more strongly than unobserved positive characteristics of the bride, per the above discussion. An alternative explanation is that dowry may be measured with considerable error. Given the cultural significance of this transfer, the fact that survey respondents rarely had difficulty recalling exact values, and the extent to which marital transactions are recorded in the public record, however, I find this explanation unlikely.

As noted in section 3-2, dowry may have a wealth effect, a bargaining effect, or both on the wife's potential leisure time. If there is only a wealth effect and if the wealth effect is gender neutral, the distribution of the couple's total leisure time should be unaffected by changes in dowry. However, dowry is associated with an increase in the percent of the couple's total leisure time accruing to the wife, with her share of leisure time increasing by 0.8 percentage points for a 100 yuan increase in dowry. Moreover, dowry has no discernable effect on a husband's total leisure time in separate regressions (output omitted), suggesting that a bargaining effect may offset a wealth effect associated with dowry. Controlling for dowry, brideprice has a weakly negative impact on a wife's leisure time, although the coefficients are not significant at the 0.10 level.

The determinants of the time that husbands allocate to cooking meals, cleaning, and gathering wood in an average week are presented in Table 3-5, both as a level (column 1) and as a share of the total time that the couple devotes to these activities (column 2). For every additional 100 yuan of dowry, husbands increase their time allocated to chores by 28.6 minutes on average, an increase of 64.4 percent. This finding

is robust to the time spent on other household chores as well (output omitted). If dowry operates through a wealth effect alone, the time that husbands devote to household chores should fall; this finding to the contrary suggests that a bargaining effect overrides the wealth effect. Again, the magnitude of the effect is larger than that estimated using OLS, suggesting that the bride's family uses dowry as a means of insuring against unobserved negative characteristics of the groom and/or his family. Dowry also impacts the time share of household chores performed by husbands,[27] with a 100 yuan increase in dowry resulting in an 11.2 percentage point increase in the share of household chores performed by men. This finding is also consistent with the notion that dowry has a bargaining effect, assuming again that wealth effects are gender neutral. Larger age gaps are associated with the husband doing a greater share of the household chores, as is the size of the wife's natal family.

The determinants of women's goods as a share of household expenditures are presented in Table 3-6. Two specifications are estimated, the first excluding wealth (column 1), the second including it (column 2). The coefficient for instrumented wealth is not significant, and including this measure does not dramatically alter the point estimates for dowry or brideprice. Increasing dowry by 100 yuan corresponds to increasing the expenditure share of women's goods by 0.08 percentage points, or 45.6 percent of the average expenditure. Moreover, regressing the share of household spending allocated to alcohol and tobacco (goods consumed exclusively by men in the survey areas) on dowry and brideprice does not yield significant estimates (output omitted). These findings provide further evidence that dowry works through a bargaining effect. Additionally, having more adults in the household is associated with higher spending on women's goods, presumably because some of the additional adults are women. As before, the magnitudes of the point estimates are smaller than those estimated using OLS.

Table 3-7 shows the marginal effects of the determinants of women's satisfaction using IV probit estimation. Standard errors are corrected following the procedure described in Maddala (1983) and Newey (1987). As noted above, there are fewer observations for the attitudinal outcomes, and limited variation in some villages renders including village fixed effects impossible. Thus, county fixed effects replace village

fixed effects in the remaining estimations. Column 1 presents estimates when wealth is excluded from the specification and column 2 presents those when wealth is included. The point estimates for dowry are 22.9 percent lower when wealth is included, providing evidence that the wealth effect is important. Still, the coefficient is positive and significant even when controlling for wealth, again suggesting that there is a bargaining effect at play. As dowry increases by 100 yuan, women are 12 to 16 percent more likely to report being satisfied with their lives. Women report higher satisfaction when there are other adults in the home, but neither brideprice nor the other regressors has a discernable effect on wife's satisfaction. Once again, the point estimates are larger than those obtained from OLS estimation, supporting the notion that dowry compensates for negative characteristics of the groom and/or his family.

Wife's decision-making authority is an index variable that describes whether women have no authority, complete authority, or joint authority with their husbands to make decisions when spouses disagree about household matters. Joint decision-making authority occurs in 16.0 percent of households and may be an important reflection of bargaining power. Estimates from the two-stage ordered probit model are thus shown in Table 3-8, columns 1 and 2. Because the asymptotic variance-covariance matrix has not been derived for this model, however, the standard errors have not been corrected and the z statistics that are shown are unreliable. Point estimates nevertheless suggest that a wife's dowry has a strong influence on her decision-making authority, and that this finding is robust to the inclusion of household wealth, again suggesting that dowry operates through a bargaining effect. The estimated effect of brideprice is negative, as above, and much smaller than that of dowry.

Aggregating wives who have no decision-making authority with those who have joint decision-making authority permits estimation of an IV probit model with corrected standard errors (Maddala, 1983; Newey, 1987), shown in columns 3 and 4. Again, dowry has a positive and significant impact on a wife's decision-making authority. Controlling for household wealth reduces the point estimate of dowry by 20.5 percent, but the effect remains significant. That dowry influences a wife's decision-making authority and that it does so independently of household wealth lend further credence to the notion that dowry affects a wife's intrahousehold bargaining position. Neither brideprice nor wealth has a

significant effect on a wife's decision-making authority. Finally, the point estimate for instrumented dowry is larger than that of un-instrumented dowry, again suggesting that dowry correlates with negative characteristics of the groom and/or his family, i.e., that the OLS estimates are biased downward.

All of these results show a consistently negative (if insignificant) effect of brideprice on a wife's welfare. If brideprice only acts as a price mechanism, then it is unclear why it should have any impact on marital outcomes once dowry is controlled for. However, it appears that families who pay higher brideprices may compensate by extracting more labor or negotiating lower consumption for brides. In the cooperative Nash bargaining context, it is possible that this outcome is achieved by making unmeasured, private transfers to sons in order to raise their marital threat points, but this hypothesis cannot be confirmed with these data.

3.7. Conclusion

Theory predicts that individual control of resources affects one's bargaining position within marriage and thus one's allocation of marital output. While the concept of bargaining position is straightforward, measuring it for empirical investigation has proven difficult. Labor income, nonlabor income, and extrahousehold environmental parameters each may suffer from simultaneity bias in the absence of strong identifying assumptions. An interesting alternative indicator of bargaining position is individual endowments brought to the marriage, such as dowry. However, previous studies focusing on the impact of these transfers on welfare within marriage have not sufficiently controlled for omitted variable bias.

In the Chinese context, brideprice serves as a market clearing price by compensating a woman's family for human capital investments made during the woman's childhood (Croll, 1981), for the loss of rights over her (Goody, 1973), and for the loss of her future contribution to household income (Parish and Whyte, 1978; Min and Eades, 1995; Zhang, 2000). Dowry, on the other hand, is an intergenerational transfer that serves primarily as a pre-mortem bequest to a daughter (Parish and Whyte, 1978; Croll, 1981). Because the wife controls dowry and because she retains this

authority even in the event of divorce (a realistic option in rural China), dowry may serve as a proxy for a woman's bargaining position.

This paper makes use of new data from rural China to investigate the impact of dowry on several measures of intrahousehold allocation in a cooperative Nash bargaining framework. To control for the potential endogeneity of marital payments, I use two types of instruments that reflect household savings available for marital payments. The first is regional grain shocks in the year preceding marriage. Agriculture shocks are likely to have large effects on savings in rural communities in which credit markets are incomplete and in which the population consists almost entirely of farmers, and thus on the ability of households to pay dowry or brideprice. The second instrument is the sibling sex composition of the bride and groom. Because dowry payments are generally smaller than brideprice payments in the surveyed areas, the marriage of daughters represents net household income while that of sons represents net household expenditures. Hence, the sex composition of children impacts the resources available to the family for making marital payments. I control for unobservable correlates of sibling sex composition by including family characteristics as additional regressors. All estimates also include marriage cohort dummies to control for generational norms in household allocation. Furthermore, the empirical specifications are estimated with village fixed effects to control for unobserved heterogeneity. This identification strategy represents a significant improvement over previous studies in controlling effectively for potential bias from omitted variables and simultaneity.

I find that dowry has a positive and robust impact on the wife's leisure time, on the amount of time that husbands allocate to performing household chores each week, and on the probability that the wife self-identifies as being satisfied with her life. To better discern between wealth effects and bargaining effects associated with dowry, I also analyze the effect of dowry on spending on women's goods as a share of the total household expenditures, on the wife's share of the couple's total leisure time, and on the husband's share of the couple's time allocated to performing household chores. Dowry has a positive and significant effect on each of these outcomes, and changes in the distribution of goods and time within the household are difficult to explain if dowry only has a wealth effect. Finally, I investigate the effect of dowry on a wife's decision-making

authority when the husband and wife disagree about matters of importance to the household. Dowry has a positive and significant effect, again suggesting that dowry affects the wife's bargaining position.

These results provide strong empirical support for the theoretical literature linking control of resources to intrahousehold allocation decisions, and thus to the collective models of the household. Based on the robustness of these findings, it is plausible that dowry serves as a vehicle for altruistic parents to improve their daughter's marital welfare in addition to being a pre-mortem inheritance. Better understanding the motivation for giving dowry and the determinants of dowry size remain priorities for further research.

Notes to Chapter III

[1] This research was generously supported by the Ford Foundation. This paper has benefited from the insights and suggestions of David Lam, Albert Park, Jan Svejnar, and Bob Willis. I am also grateful for helpful comments from Claudio Agostini, Axel Anderson, Rachel Connelly, Cheryl Doss, Martin Farnham, Emma Hutchinson, Charlene Kalenkoski, Peter Katuschek, Laura Malaguzzi, Bill Parish, Vijayendra Rao, and seminar participants at University of Michigan Department of Economics, the University of Michigan Population Studies Center, the 2002 NEUDC conference in Williamstown, and the 2002 RAND Economic Demography Workshop.

[2] A more general model assumes only that household members allocate resources in a Pareto efficient manner (Chiappori, 1988; Chiappori, 1992).

[3] Nevertheless, Schultz (2001) points out that there is a dearth of studies that systematically establish simultaneity bias between nonlabor income and household outcomes.

[4] Lundberg and Pollack (1993) have shown that that the central predictions of the collective models of household behavior hold even when divorce is precluded in that couples may revert a noncooperative Nash equilibrium within marriage, i.e., the "separate spheres" solution.

[5] The solution to this game is characterized by Pareto optimality in the allocation of resources, invariance with respect to linear transformations of each player's utility function, and independence of irrelevant alternatives. Manser and Brown (1980) discuss these implications.

[6] Marriages that are arranged by the bride and groom themselves are increasingly common throughout China (Cheng, 1992). Interestingly, brideprice and dowry are paid even in the majority of these marriages (Parish and Whyte, 1978).

[7] It may be surprising that brideprice serves as the market clearing mechanism (as opposed to an analogous transfer from the bride's family to the groom's) because population growth and sex differences in age of marriage imply that the number of women exceeds the number of men in each marriage cohort (Rao, 1993 investigates a similar phenomenon in India). Possible explanations are that the benefits of marriage accrue disproportionately to husbands, that divorced men remarry while divorced women do not, or that there is greater male vis-à-vis female heterogeneity (Edlund, 1996). This puzzle remains an issue for further investigation in China.

[8] An alternative practice sometimes observed is the "exchange marriage" in which a sister of the groom marries a brother of the bride in lieu of formal brideprice. These marriages also tend to have lower dowries (Selden, 1993).

[9] For comparative purposes, the equivalent rate in the U.S. was 4.2 divorces per 1000 population in 1998 (Centers for Disease Control and Prevention, 1999).

[10] Ideally, dummies for the bride's and groom's home villages would both be used, but the former are not available in this survey. Still, marriages typically occur between households in neighboring villages or towns, and only rarely across long distances. Therefore, conditions in the two natal villages are likely to be similar.

[11] The groom's family is expected to give elaborate and expensive gifts to the bride's family during the length of the engagement, and a postponement increases the family's expenses (Yan, 1996). In addition, the bride will contribute to the groom's family's income, so there is an opportunity cost associated with delaying marriage.

[12] If unobservables remain important after controlling for family characteristics, they might affect outcomes such as education in the same way that they affect marital allocation. I thus regressed the wife's education on family characteristics, birth year, province dummies, and sibling sex composition. I find that sibling sex composition does not have a significant effect on a wife's education.

[13] I tried a variety of other instruments as well, including parent occupational status, historical data on land affected by natural disaster, and historical local grain yield data. However, none of these measures explains as much variation in dowry or brideprice as regional grain yield shocks and the sibling sex composition of the bride and groom. There is low variation in parent occupation, with only 1.7 percent of households not having at least one farmer. Historical natural disaster data has strong predictive power, but is unavailable for 1967-1977. Like disaster data, local grain yield is unavailable for several years; moreover, this variable has surprisingly little predictive power even when it is available. Indeed, even including these variables as additional instruments lowers the adjusted R^2 in the first stage. A related issue is that wealthier households may be able to smooth consumption and thus be better insulated against income shocks (Foster, 1995 provides evidence for Bangladesh). In my sample, however, interacting the instruments with parent characteristics such as education and occupation provides no additional explanatory power.

[14] Future work will extend the analysis to account for dynamic bargaining models of the household such as that described by Lich-Tyler, 2001.

[15] The relative strength of the wife's social network was associated with each measure of wife's welfare, but never significantly so. Exploring this issue may be of interest for further study.

[16] If however, the wealth effect is not gender neutral, then wealth effects and bargaining effects are indistinguishable when looking at the shares of leisure accruing to each spouse. It is also possible that wife's leisure is a luxury good desired by both spouses. If so, then the wealth effect and bargaining effect may again be indistinguishable.

[17] The sampled county in Guizhou is a designated minority county with sizable Miao and Yi populations, but 80 percent of the sampled households in Guizhou are ethnic Han Chinese, making it difficult to distinguish differences between minority and non-minority households.

[18] Park and Ren (2001) and Brown and Park (2002) describe the first wave of the China Rural Poverty Survey.

[19] Detailed records of marital transactions are generally kept as part of the public record. When questioned, few respondents had difficulty recalling the exact amounts of their brideprice and dowry – or that of their siblings, children, or neighbors. Marital prices were converted to real values using 1985 as the base year. For marriages occurring prior to 1985, prices were converted using the general retail price index, which was first calculated in 1950. For marriages occurring after the mid-1980s, prices were converted using the rural consumer price index, a more accurate reflection of rural prices that was introduced in 1985.

[20] This interpretation is clearly problematic if many male goods are included in this expenditure category, but the results detailed below are difficult to explain if this is the case. In addition, similar (but slightly weaker) results are obtained when using the share of expenditures spent on children's clothing as the outcome variable of interest. This result is consistent with higher female bargaining power resulting in improved conditions for children, a common finding in the household bargaining literature, e.g., Thomas (1990).

[21] Importantly, data on the wife's satisfaction were collected when husbands and members of his natal family were not present.

[22] Again, this measure excludes child rearing. The wife's share of leisure time may be misleading if wives spend more time caring for children than their husbands.

[23] Average family size in these areas fell considerably after the One Child Policy was adopted formally in 1979.

[24] Regressing dowry on marriage year yields highly significant, positive coefficients in each province. Regressing brideprice on marriage year produces highly significant, positive coefficients for Sichuan, Shaanxi, and Gansu. The effect in Guizhou is positive but not significant.

[25] The difference in the sample size reported in columns 4 and 5 is attributable to the fact that there is no variation in wife's decision-making authority among the households in one marriage cohort in one county.

[26] It has been pointed out that negative aspects of the bride may also prompt a larger dowry in some cultures, but this may be less likely in the Chinese context because dowry is assignable and exclusive to the bride.

[27] Men are reported as doing all of these chores in 5 percent of the sampled households. One explanation is that husbands do all of the household chores when wives are chronically sick. Health information including the frequency and duration of sickness is available for two-thirds of these households. In this subsample, the wife self-reported no sickness in the previous year in 47 percent of households. Only one woman reported being sick for more than a month, and none reported being sick for more than 5 weeks. An alternative hypothesis is that men specialize in performing these chores in some households. Dropping these households from the sample reduces the point estimate by 23 percent and the effect remains significant.

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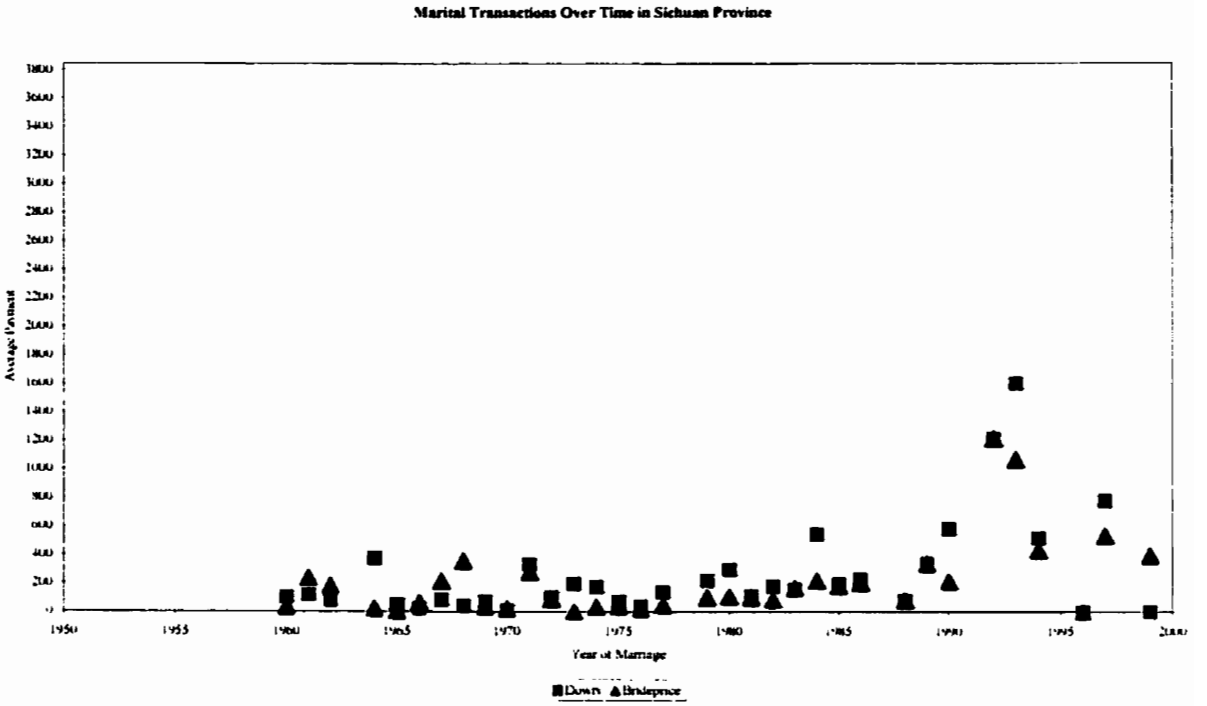
Figure 3-1A. Mean Value of Marital Transactions (Sichuan and Guizhou)



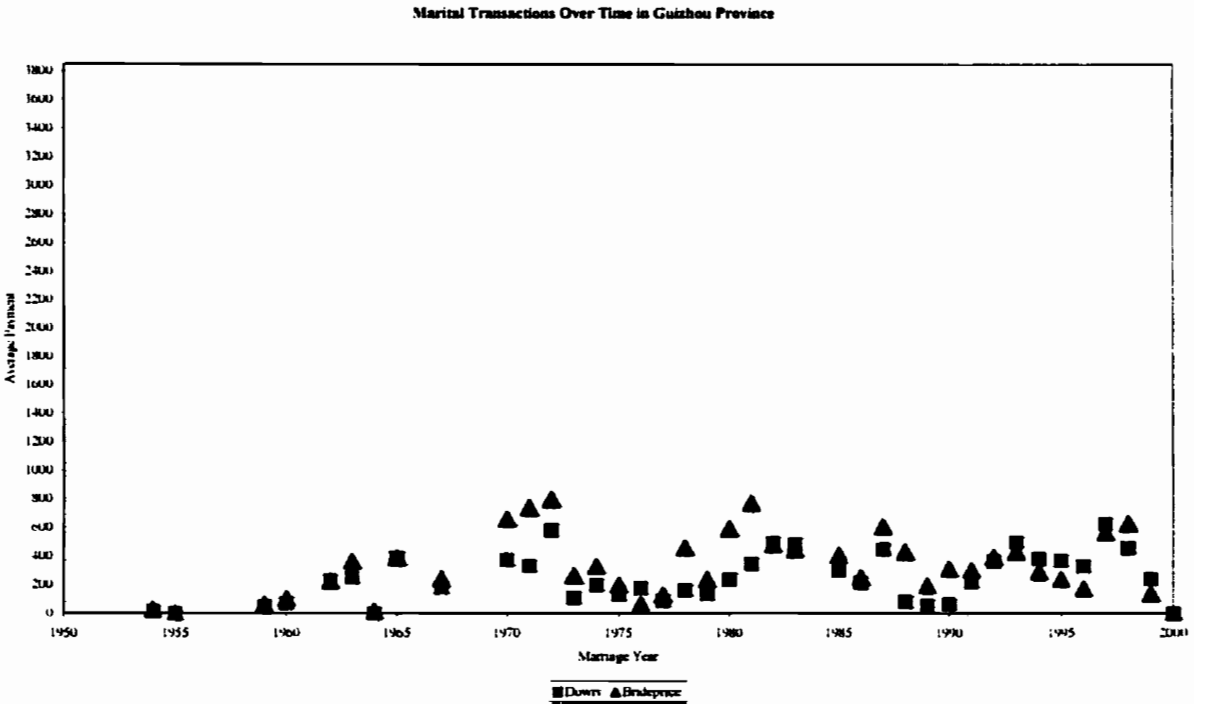
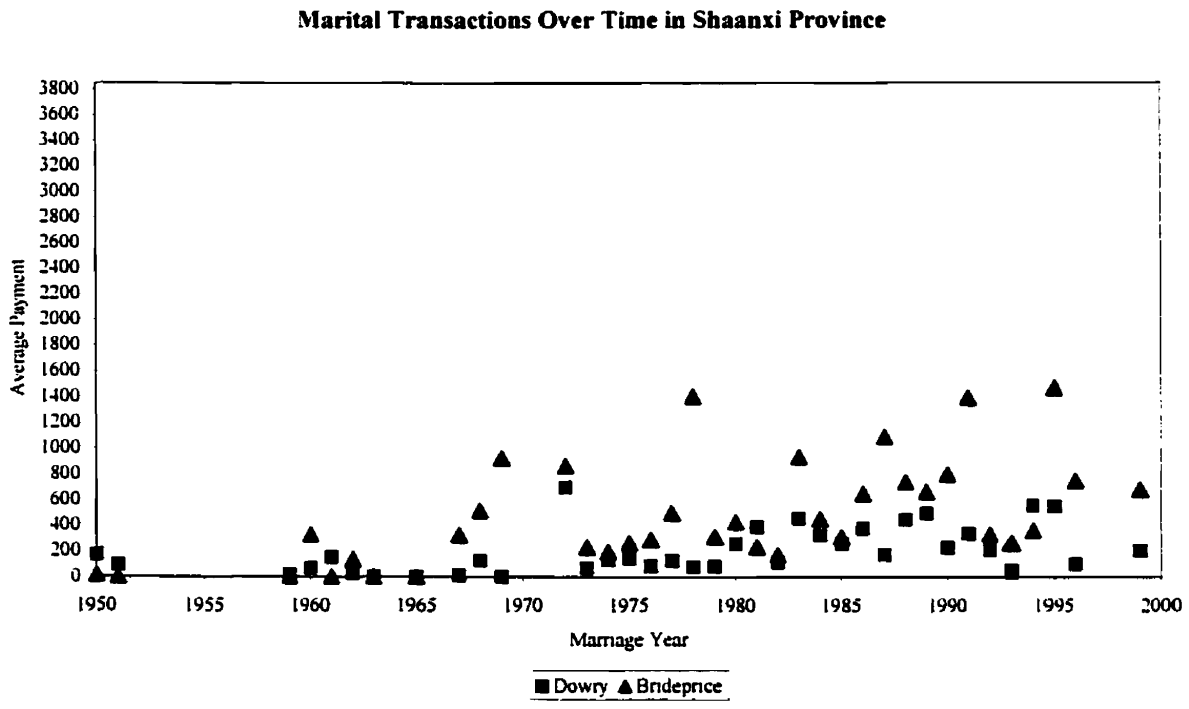


Figure 3-1B. Mean Value of Marital Transactions (Gansu and Shaanxi)



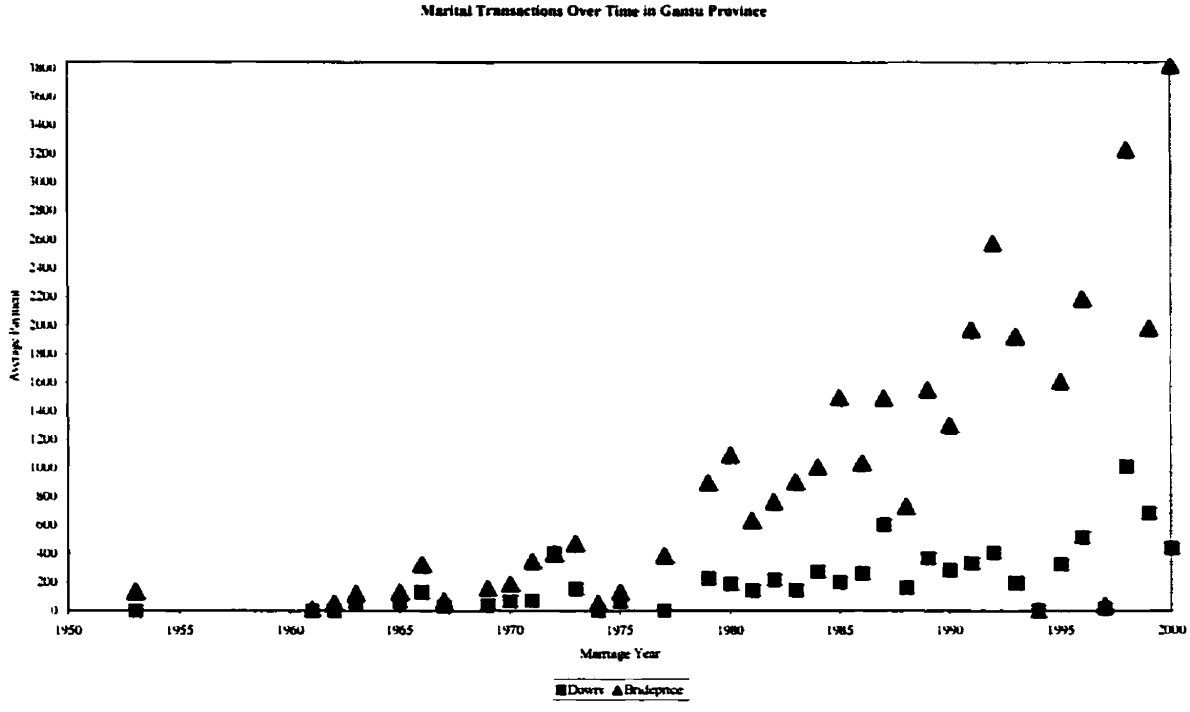


Table 3-1A: Determinants of Dowry (OLS)

Variable	Unit	(1)	(2)	(3)	(4)
grain shock 1 year before marriage	kg/person	1.628***	1.715***	1.703***	1.709***
		(2.66)	(2.78)	(2.79)	(2.81)
sex composition of wife's sibs	difference	24.442***			
		(2.70)			
sex composition of husband's sibs	difference	8.328			
		(1.10)			
sex comp of wife's older sibs	difference		2.964		
			(0.27)		
sex comp of husband's older sibs	difference		18.421*		15.494
			(1.77)		(1.51)
sex comp of wife's younger sibs	difference			37.437***	35.872***
				(3.09)	(2.96)
sex comp of husband's younger sibs	difference			-0.373	
				(0.04)	
age difference	years	-7.032	-7.983*	-7.649*	-7.378
		(1.54)	(1.75)	(1.67)	(1.63)
education difference	grades	-3.905	-3.919	-2.833	-3.408
		(1.00)	(1.00)	(0.73)	(0.88)
children in home	#	32.150**	33.221**	31.656**	30.797**
		(2.23)	(2.29)	(2.20)	(2.15)
other adults in home	#	-2.167	-0.564	-1.260	-2.534
		(0.13)	(0.03)	(0.07)	(0.15)
wife's parents' ed	years	5.748	17.450*	15.512	15.384
		(0.57)	(1.79)	(1.41)	(1.41)
husband's parents' ed	years	17.238	19.647*	4.327	4.566
		(1.58)	(1.90)	(0.43)	(0.45)
wife's total siblings	#	0.752	-0.944	2.045	0.886
		(0.09)	(0.11)	(0.24)	(0.10)
husband's total siblings	#	2.945	2.933	3.109	3.145
		(0.34)	(0.33)	(0.36)	(0.36)
Constant		240.315***	235.443***	241.273***	247.216***
		(3.66)	(3.55)	(3.68)	(3.78)
Village FE		yes	yes	yes	yes
County FE					
Observations		451	451	451	451
R-squared		0.296	0.286	0.297	0.301
F(3, 392) instruments jointly equal 0		5.59	3.58	5.76	6.56
Prob > F		0.0009	0.014	0.0007	0.0002

Village fixed effects implemented
County * Marriage Cohort interactions included
Absolute value of t statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

Table 3-1B: Determinants of Brideprice (OLS)

Variable	Unit	(1)	(2)	(3)	(4)
grain shock 1 year before marriage	kg/person	1.883	2.118	2.115	2.042
		(1.43)	(1.63)	(1.60)	(1.57)
sex composition of wife's sibs	difference	33.233*			
		(1.70)			
sex composition of husband's sibs	difference	22.322			
		(1.37)			
sex comp of wife's older sibs	difference		25.663		
			(1.12)		
sex comp of husband's older sibs	difference		85.894***		81.598***
			(3.92)		(3.74)
sex comp of wife's younger sibs	difference			25.548	16.223
				(0.98)	(0.63)
sex comp of husband's younger sibs	difference			-36.074*	
				(1.67)	
age difference	years	-8.568	-9.220	-13.218	-9.542
		(0.87)	(0.96)	(1.34)	(0.99)
education difference	grades	12.569	10.377	14.454*	11.215
		(1.50)	(1.25)	(1.73)	(1.35)
children in home	#	58.892*	58.406*	62.584**	56.734*
		(1.90)	(1.91)	(2.01)	(1.85)
other adults in home	#	-8.927	-10.471	0.326	-10.293
		(0.24)	(0.29)	(0.01)	(0.29)
wife's parents' ed	years	-16.087	-14.528	-6.331	-16.382
		(0.74)	(0.63)	(0.71)	(0.70)
husband's parents' ed	years	-16.407	0.043	-16.868	-6.433
		(0.70)	(0.00)	(0.29)	(0.30)
wife's total siblings	#	5.852	-1.690	10.366	2.097
		(0.32)	(0.09)	(0.57)	(0.12)
husband's total siblings	#	4.717	4.377	6.263	5.396
		(0.25)	(0.24)	(0.33)	(0.29)
Constant		550.746***	574.593***	527.010***	565.251***
		(3.90)	(4.11)	(3.72)	(4.04)
Village FE		yes	yes	yes	yes
County FE					
Observations		451	451	451	451
R-squared		0.426	0.441	0.424	0.440
F(3, 392) instruments jointly equal 0		2.51	6.05	2.00	5.74
Prob > F		0.0583	0.0005	0.1141	0.0007

Village fixed effects implemented
County * Marriage Cohort interactions included
Absolute value of t statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

Table 3-2. Variables and Summary Statistics

Variable	Unit	Mean	Std. Dev.	Min	Max
wife's leisure (non-work) time	hours per day	19.02	2.57	11.51	24
wife's share of couple's total leisure (non-work) time	% of couple's total leisure time	48.00%	3.82%	33.02%	58.34%
husband's time allocated to chores	hours per week	0.74	1.41	0	15
husband's share of couple's time allocated to chores	% of couple's total time devoted to chores	17.73%	27.13%	0%	100%
share of household spending accruing to women's goods	% of annual household spending	0.19%	0.38%	0%	2.01%
wife's satisfaction	1 = completely unsatisfied, 2 = somewhat unsatisfied, 3 = somewhat satisfied, 4 = completely satisfied	2.60	0.57	1	4
wife's decision-making authority	0 = husband makes decisions, 0.5 = both make decisions, 1=wife makes decisions	0.35	0.43	0	1
dowry	yuan, 1985 real value	247.12	313.79	0	2044
brideprice	yuan, 1985 real value	537.89	748.19	0	7493
wealth	value of durables, 1985 real yuan	653.90	806.29	0	7297
length of marriage	years	19.38	10.80	1	51
husband's age	years	43.18	10.79	23	74
wife's age	years	40.45	10.38	21	70
age difference	husband's age - wife's age	2.73	3.24	-7	16
husband's education	grades completed	6.14	3.80	0	16
wife's education	grades completed	2.90	3.47	0	14
education difference	husband's ed - wife's ed	3.24	3.75	-12	12
children in home	#	1.43	1.14	0	5
other adults in home	#	0.64	0.91	0	4
wife's parents' education	total years	2.38	4.01	0	24
husband's parents' ed	total years	2.36	3.70	0	24
wife's total siblings	#	3.84	1.74	0	11
husband's total siblings	#	3.70	1.74	0	8
Sichuan	province dummy	0.24	0.43		
Guizhou	province dummy	0.30	0.46		
Shaanxi	province dummy	0.23	0.42		
Gansu	province dummy	0.23	0.42		
grain shock 1 year before marriage	deviation from time trend, in kg/person	-1.65	27.86	-90.82	64.01
wife's sibling sex composition	difference in #s of younger sisters and brothers	-0.21	1.38	-4	4
husband's sibling sex composition	difference in #s of older sisters and brothers	0.11	1.41	-6	6

Table 3-3. Non-Instrumented Estimates (OLS and Probit)

1: wife's leisure (non-work) time (OLS)
2: husband's time allocated to chores (OLS)
3: share of household spending accruing to women's goods (OLS)
4: wife's satisfaction (probit)
5: wife's decision-making authority (ordered probit)

Variable	Unit	(1)	(2)	(3)	(4)	(5)
dowry	100 yuan	0.10376**	-0.01172	0.00024***	0.08851***	0.02234
		(2.24)	(0.43)	(3.46)	(5.59)	(1.30)
brideprice	100 yuan	-0.02539	-0.01144	-0.00007**	0.00263	0.01352
		(1.16)	(0.90)	(2.32)	(0.43)	(1.50)
age difference	years	-0.08083**	0.02182	-0.00000	-0.00227	0.00056
		(2.11)	(0.98)	(0.05)	(0.23)	(0.03)
education difference	grades	-0.03858	0.01324	-0.00006	-0.01546*	0.00368
		(1.18)	(0.69)	(1.32)	(1.70)	(0.24)
children in home	#	0.07411	0.02665	-0.00025	0.01530	-0.03103
		(0.61)	(0.38)	(1.44)	(0.45)	(0.38)
other adults in home	#	0.14579	-0.11921	0.00048**	0.09041***	0.11499
		(1.03)	(1.44)	(2.29)	(2.63)	(1.53)
wife's parents' ed	years	0.06429	0.11730***	0.00003	-0.01893	0.02796
		(0.83)	(2.61)	(0.26)	(1.10)	(1.00)
husband's parents' ed	years	0.02941	0.02935	0.00011	0.01853	0.05837**
		(0.32)	(0.55)	(0.85)	(0.89)	(2.14)
wife's total siblings	#	0.00742	0.09580**	-0.00002	-0.00952	0.01449
		(0.10)	(2.31)	(0.17)	(0.46)	(0.49)
husband's total sibs	#	-0.06223	0.01293	-0.00007	0.01569	0.07524**
		(0.85)	(0.30)	(0.62)	(0.82)	(2.08)
Constant		20.31254***	0.28503	0.00126		
		(15.49)	(0.37)	(0.65)		
Village FE		yes	yes	yes		
County FE					yes	yes
Observations		451	451	451	290	284
R-squared		0.255	0.155	0.283		

County * Marriage Cohort interactions included
Absolute value of robust t or z statistics in parentheses
Errors are assumed to be clustered by village when county fixed effects are implemented
* significant at 10%; ** significant at 5%; *** significant at 1%

Table 3-4. Wife's Time Allocation (IV OLS)

1: wife's daily leisure (non-work) time
2: wife's share of couple's total daily leisure (non-work) time

Variable	Unit	(1)	(2)
dowry	100 yuan	0.74092**	0.00772*
		(2.22)	(1.75)
brideprice	100 yuan	-0.27232	-0.00208
		(1.63)	(0.94)
age difference	years	-0.05477	-0.00025
		(1.06)	(0.36)
education difference	grades	0.01607	0.00032
		(0.31)	(0.47)
children in home	#	-0.00887	-0.00051
		(0.05)	(0.21)
other adults in home	#	0.13337	-0.00063
		(0.75)	(0.27)
wife's parents' ed	years	-0.04456	-0.00049
		(0.40)	(0.33)
husband's parents' ed	years	-0.14026	-0.00205
		(0.97)	(1.07)
wife's total siblings	#	0.01996	-0.00026
		(0.22)	(0.22)
husband's total siblings	#	-0.07392	-0.00070
		(0.80)	(0.58)
Constant		17.60930***	0.44572***
		(9.13)	(17.44)
Village FE		yes	yes
County FE			
Observations		451	451

County * Marriage Cohort interactions included
Absolute value of t statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

Table 3-5. Husband's Time Allocation (IV OLS)

1: husband's weekly time allocated to chores
2: husband's share of couple's total weekly time allocated to chores

Variable	Unit	(1)	(2)
dowry	100 yuan	0.47691**	0.11173**
		(2.27)	(2.41)
brideprice	100 yuan	-0.11662	-0.02934
		(1.11)	(1.27)
age difference	years	0.05154	0.01309*
		(1.58)	(1.82)
education difference	grades	0.04329	0.01053
		(1.33)	(1.47)
children in home	#	-0.09568	-0.02296
		(0.85)	(0.92)
other adults in home	#	-0.12680	-0.01503
		(1.13)	(0.61)
wife's parents' ed	years	0.03348	-0.01909
		(0.48)	(1.23)
husband's parents' ed	years	-0.09314	-0.02024
		(1.03)	(1.01)
wife's total siblings	#	0.09908*	0.01403
		(1.75)	(1.13)
husband's total siblings	#	-0.00180	-0.01509
		(0.03)	(1.18)
Constant		-1.46965	-0.27327
		(1.21)	(1.02)
Village FE		yes	yes
County FE			
Observations		451	451

County * Marriage Cohort interactions included
Absolute value of t statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

Table 3-6. Share of Household Spending Accruing to Women's Goods (IV OLS)

Variable	Unit	(1)	(2)
dowry	100 yuan	0.00081*	0.00074*
		(1.85)	(1.67)
brideprice	100 yuan	-0.00035	-0.00034
		(1.60)	(1.56)
age difference	years	0.00001	0.00003
		(0.21)	(0.38)
education difference	grades	-0.00001	-0.00000
		(0.10)	(0.05)
children in home	#	-0.00029	-0.00028
		(1.24)	(1.21)
other adults in home	#	0.00046**	0.00035
		(1.98)	(0.89)
wife's parents' ed	years	-0.00007	-0.00009
		(0.47)	(0.55)
husband's parents' ed	years	-0.00004	-0.00007
		(0.23)	(0.33)
wife's total siblings	#	-0.00000	-0.00001
		(0.02)	(0.07)
husband's total siblings	#	-0.00007	-0.00009
		(0.61)	(0.71)
household wealth	100 yuan		0.00002
			(0.38)
Constant		-0.00154	-0.00175
		(0.61)	(0.66)
Village FE		yes	yes
County FE			
Observations		451	451

County * Marriage Cohort interactions included
Absolute value of t statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

Table 3-7. Wife's Satisfaction (IV Probit)

Variable	Unit	(1)	(2)
dowry	100 yuan	0.16087**	0.12371*
		(2.23)	(1.73)
brideprice	100 yuan	0.00823	0.01649
		(0.26)	(0.48)
age difference	years	0.00947	0.00896
		(0.69)	(0.66)
education difference	grades	-0.01546	-0.01420
		(1.44)	(1.25)
children in home	#	-0.02719	-0.01917
		(0.53)	(0.39)
other adults in home	#	0.09032**	0.07068
		(2.23)	(1.29)
wife's parents' ed	years	-0.03548	-0.03355
		(1.35)	(1.29)
husband's parents' ed	years	-0.00195	0.00006
		(0.06)	(0.00)
wife's total siblings	#	-0.00946	-0.01621
		(0.43)	(0.66)
husband's total siblings	#	0.01521	0.01568
		(0.70)	(0.71)
household wealth, yuan	100 yuan		0.00531
			(0.58)
Village FE			
County FE		yes	yes
Observations		290	290

Marginal effects shown
County * Marriage Cohort interactions included
Absolute value of z statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

Table 3-8. Wife's Decision-Making Authority (IV Ordered Probit and IV Probit)

1 & 2: IV Ordered Probit Estimation
3 & 4: IV Probit Estimation

Variable	Unit	(1)	(2)	(3)	(4)
dowry	100 yuan	0.40227***	0.41359***	0.15732**	0.12514*
		(2.55)	(2.54)	(2.03)	(1.66)
brideprice	100 yuan	-0.09291	-0.09850	-0.03656	-0.02666
		(0.96)	(0.99)	(0.94)	(0.69)
age difference	years	0.02879	0.02466	0.01023	0.01078
		(1.22)	(0.95)	(0.63)	(0.70)
education difference	grades	0.02467	0.02416	0.00930	0.01233
		(1.56)	(1.51)	(0.73)	(0.92)
children in home	#	-0.11180	-0.10539	-0.05196	-0.04510
		(1.23)	(1.12)	(0.92)	(0.85)
other adults in home	#	0.07585	0.10048	0.05779	0.02890
		(1.02)	(0.77)	(1.22)	(0.44)
wife's parents' ed	years	-0.03288	-0.02988	-0.01948	-0.02157
		(0.82)	(0.73)	(0.73)	(0.83)
husband's parents' ed	years	-0.04052	-0.03417	-0.04121	-0.04517
		(1.14)	(0.75)	(1.25)	(1.37)
wife's total siblings	#	0.02638	0.02647	0.01525	0.00639
		(0.81)	(0.81)	(0.59)	(0.23)
husband's total siblings	#	0.05520	0.05940	0.02624	0.02396
		(1.39)	(1.27)	(1.04)	(0.99)
wealth	100 yuan		0.00465		0.00645
			(0.26)		(0.61)
Village FE					
County FE		yes	yes	yes	yes
Observations		293	293	284	284

Marginal effects shown
County * Marriage Cohort interactions included
Absolute value of robust z statistics in parentheses
Standard errors are *not* corrected for IV ordered probit
* significant at 10%; ** significant at 5%; *** significant at 1%

CHAPTER IV

PARENTAL EDUCATION AND CHILD LEARNING: INVESTING IN GOODS AND TIME[1]

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). 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 have analyzed the relationship between parental education and children's actual learning as measured by test scores. Behrman, Khan, Ross, and Sabot (1997) control for household income, teacher quality, and school resources to find that rural Pakistani children whose fathers completed junior secondary 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 parental 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 unique 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 – parental time and education-related goods – paying careful attention to the different effects of mother's and father's education on sons' and daughters' learning. This study also analyzes 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. Under certain assumptions, the difference in the estimated effects may be interpreted as 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. Non-required education-related expenditures, whether the household owns children's books, and whether the household has a designated area for

children's 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. For example, an additional grade completed by fathers increases the probability that parents read 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. There is evidence that more educated parents expect higher returns to education for their children, offering one reason why parents in resource-constrained households make greater investments in both goods and time. I also find that parental education has a strong, positive effect on children's test scores, and that controlling for investments in goods and time reduces the estimated effects of parental education on children's learning. For example, an additional year of mother's education raises daughters' Chinese test scores by 0.019 standard deviations. Controlling for whether parents read to the sampled child reduces the point estimate to 0.14 standard deviations, a reduction of 28.5 percent. Although the estimates may be susceptible to endogeneity bias, I show that more educated parents make larger investments in their children's human capital accumulation in rural China, and that these investments are an important mechanism – though certainly not the only mechanism – by which parental education affects children's learning.

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 provides an overview of 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, ξ_i, that may differ by individual child (S_i), by child sex, and by parental education (H). i.e., $\xi_i = \xi_i(S_i, H)$. The utility function is assumed to be additively separable in each argument:

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

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 $\mathbf{V}$ 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 the production of children's human capital (e.g., nutritious food and electric lighting). Figure 4-1 shows the relationships among these 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 complements in the production of children's human capital. Alternatively, if textbooks replicate the effect of parents 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 developing country context because off-farm opportunities are often limited in rural areas, and more educated parents 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:

$$\max_{C^1, x_1, \theta_1, \ldots x_n, \theta_n} u = \phi u(C^1) + (1-\phi)\sum_{i=1}^{n}\left[\delta_i + (1-\delta_i)\xi_i(S_i H)\right]u(C^2)$$

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

$$P^C C^1 + Px \le Y \tag{3}$$

$$W + \theta = T$$

$$\omega(H)W = Y$$

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:

$$\phi u_{C^1} - \lambda = 0$$

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

$$(1-\phi)\left[\delta_i + (1-\delta_i)\sigma_i\right]u_{C^2} g_{i_\theta} - \lambda\omega = 0$$

where λ is the shadow value of money and arguments have been suppressed. Optimal investments in human capital for child i occur when $\frac{g_{i_x}}{P} = \frac{g_{i_\theta}}{\omega}$, i.e., when 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, $\left[\delta_i + (1-\delta_i)\xi_i\right]g_{i_x} = \left[\delta_j + (1-\delta_j)\xi_j\right]g_{j_x}$ and $\left[\delta_i + (1-\delta_i)\xi_i\right]g_{i_\theta} = \left[\delta_j + (1-\delta_j)\xi_j\right]g_{j_\theta}$, $i \neq j$. 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., $u_{C^1} = \frac{(1-\phi)[\delta_1 + (1-\delta_1)\xi_1]u_{C^2} g_{t_{11}}}{P}$. 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 (case 1), the effectiveness of time spent helping children with homework (case 2), the perceived returns to education (case 3), the nature of the household utility function (case 4), or some combination of these? Also critical for deriving theoretical predictions are assumptions made about the complementarity of goods and time in the human capital production process. Specifically, if goods and time are complements in the human capital production process, then more educated parents may choose a different strategy for investing in their children. To illustrate this point simply, I derive the comparative statics for each of the above four scenarios first by assuming that production is quasilinear in θ (which does not allow for complementarity in goods and time),[4] then by assuming that the production function is Cobb-Douglas (allowing for complementarity). I suppose that the household has only one child, that utility is log separable, i.e., that $u(C^1, C^2) = \phi \log C^1 + (1-\phi)[\delta + (1-\delta)\xi]\log C^2$, and that only investments in education-related goods and time enter the human capital production function. Appendix 4-1 derives the comparative statics formally and Table 4-1 summarizes the findings.

Suppose that parental education enters the wage function (ω), but neither the human capital production function nor the altruism function (case 1), and that the human capital production function is quasilinear in θ with $g(x,\theta) = x^a + \theta$.[5] Here:

(5a)
$$d\theta / dH < 0$$
$$dx / dH > 0$$

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:

$$\text{(5b)} \qquad \begin{aligned} d\theta / dH &= 0 \\ dx / dH &> 0 \end{aligned}$$

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. Complementarity is thus an important consideration; because goods investments are more productive in the presence of time investments. more educated parents do not reduce their provision with Cobb-Douglas production. unlike with quasilinear production.

If, instead, 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 (case 2) 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:

$$\text{(6a)} \qquad \begin{aligned} d\theta / dH &> 0 \\ dx / dH &< 0 \end{aligned}$$

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

$$\text{(6b)} \qquad \begin{aligned} d\theta / dH &> 0 \\ dx / dH &< 0 \end{aligned}$$

i.e., parents reduce their investments in goods in order to increase their investments in time. In this case, complementarities in production do not affect the signs of the comparative static results.

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 (case 3). 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 $g(x,\theta;H)=(x^{\mu}+\theta)^{H}$, time spent helping children with homework rises as parental education increases while goods investments remain unchanged:

(7a)
$$d\theta/dH>0$$
$$dx/dH=0$$

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

(7b)
$$d\theta/dH>0$$
$$dx/dH>0$$

Complementarities in production are again important. Assuming quasilinear production, goods investments do not change with parental education. With Cobb-Douglas production, by contrast, both types of investments increase with parental education.

Finally, suppose instead that parental education affects the altruism function (ξ), but neither the wage function nor the human capital production function (case 4). If the human capital production function is quasilinear in θ, then:

(8a)
$$d\theta/dH>0$$
$$dh/dH=0$$

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:

$$(8b) \qquad \begin{aligned} d\theta / dH &> 0 \\ dx / dH &> 0 \end{aligned}$$

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] Once again, the form of the human capital production function is quite important in deriving comparative statics, with more educated parents providing higher levels of both goods and time investments in the presence of complementarities.

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. Indeed, the comparative static results are ambiguously signed except in the case of $d\theta / dH$ with complementary production (Table 4-1). However, if it is found that $dx / dH < 0$, then it must be the case that the efficiency of parental time (case 2) is the dominant means by which parental education affects the household problem. If, by contrast, it is found that $d\theta / dH < 0$, then it must be true that the wage effect (case 1) dominates. Regardless, 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 relatively 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; 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 China's poor areas.

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 while absent.

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 parental 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 parents read 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, rural parents have little ability to choose where they live due to the strict residency permit system, and school selectivity is not an important issue because virtually all children attend the nearest school. 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:

$$\text{(10a)} \qquad \begin{aligned} Z_{hv} = {} & a + b_1 H^f_{hv} + b_2 H^m_{hv} + \mathbf{F}_{hv} b_3 + \mathbf{K}_{hv} b_4 \\ & + b_5 (H^f_{hv} \times S_{hv}) + b_6 (H^m_{hv} \times S_{hv}) + u_{hv} \end{aligned}$$

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 additional regressors:

$$Z_{hv} = a + b_1 H_{hv}^f + b_2 H_{hv}^m + \mathbf{F}_{hv} b_3 + \mathbf{K}_{hv} b_4 + b_5 (H_{hv}^f \times S_{hv}) + b_6 (H_{hv}^m \times S_{hv}) + b_7 \eta_{hv} + b_8 (H_{hv}^f \times \eta_{hv}) + b_9 (H_{hv}^m \times \eta_{hv}) + u_{hv} \quad \text{(10b)}$$

where $\eta \in \{x_{hv}, \theta_{hv}\}$. There may exist complementarities between parental education and investments in children's human capital. For example, the returns to time spent helping children with homework may rise as parental education rises. Parental education × investment interactions are included to capture these effects. 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 these typical instruments are likely to be invalid. 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 control for correlation with latent ability by including the child's score on a test of cognitive development. I also control for household wealth via the present value of household durables[8] and teacher quality via the ranking described above. 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 remain valid.

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

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

with that estimated by:

$$
\begin{aligned}
Z_{hv} = {} & a + b_1 H_{hv}^{f} + b_2 H_{hv}^{m} + \mathbf{F}_{hv} b_3 + \mathbf{K}_{hv} b_4 + b_5 (H_{hv}^{f} \times S_{hv}) + b_6 (H_{hv}^{m} \times S_{hv}) \\
& + b_7 Y_{hv} + b_8 Q_{hv} + b_9 A_{hv} + b_{10} \eta + b_{11} (H_{hv}^{f} \times \eta_{hv}) + b_{12} (H_{hv}^{m} \times \eta_{hv}) \\
& + \gamma_v + u_{hv}
\end{aligned}
\tag{10b'}
$$

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.[9] 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[10] 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 was 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

The comparative static results derived in section 4-2 depended critically on the functional form of the human capital production function. In particular, optimizing parents were shown to make different consumption choices depending on assumptions made about the complementarity of goods and time in producing human capital. To investigate this issue empirically, I regress mathematics test scores (Z) on investments in goods (x), investments in time (θ), and their interaction, controlling for parental education (H), family characteristics ($\mathbf{F}$), child attributes ($\mathbf{K}$), household wealth (Y), teacher ranking (Q), child cognitive ability (A), and village characteristics (γ):

$$
\begin{aligned}
Z_{hv} = {} & a + b_1 H_{hv}^f + b_2 H_{hv}^m + \mathbf{F}_{hv} b_3 + \mathbf{K}_{hv} b_4 + b_5 (H_{hv}^f \times S_{hv}) + b_6 (H_{hv}^m \times S_{hv}) \\
& + b_7 Y_{hv} + b_8 Q_{hv} + b_9 A_{hv} + b_{10} x + b_{11} (H_{hv}^f \times x_{hv}) + b_{12} (H_{hv}^m \times x_{hv}) \\
& + b_{13} \theta + b_{14} (H_{hv}^f \times \theta_{hv}) + b_{15} (H_{hv}^m \times \theta_{hv}) + b_{16} (x_{hv} \times \theta_{hv}) + \gamma_v + u_{hv}
\end{aligned} \tag{11}
$$

If goods and time are complements in production (as with the Cobb-Douglas production functions discussed in section 4-2), then the interaction term will be positive. Although I have 3 measures of goods investments (non-required education-related spending, whether the household has children's reading materials, and whether the household has a children's study area) and 3 measures of time investments (parental time allocated to helping children with homework, whether parents read to the sampled child, and whether parents discuss academic issues with the child's teachers), allowing for nine goods/time combinations, none of the interaction terms is significant (output omitted). This finding suggests that my measures of investment are not complements in the production of children's human capital.

4.61. Education-Related Investment in Goods and Services

The demand for (logged) non-required spending on education-related goods and services for the sampled child is estimated via OLS. 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. Errors are assumed to be clustered by village, hence robust t statistics are shown. 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 positive effect, suggesting that parents are more willing to make such investments when there are more beneficiaries or when there exists the possibility of handing goods down to other children in the household.

Column 2 includes the teacher quality ranking as well as village fixed effects, thus controlling for unobservable community characteristics and endogenous sorting (to the limited extent that it occurs). These variables greatly reduce the estimated effect of mother's education, suggesting that mother's education is highly stratified by village. Column 3 includes household wealth as an additional regressor. As wealth increases, spending on non-required education-related goods also increases. 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 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 one more 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 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 teacher quality rankings and village fixed effects, column 3 includes household wealth, 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 significant 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; as above, 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 Investment in Time

The demand for total parental 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 parental time devoted to helping children with homework, perhaps because parents must devote additional hours to income-generating activities in order to provide for more household members. 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 parents read 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 parents read 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 parents read to the child falls; as mothers age, the probability rises. As above, 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. Discussion

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 (equation 7b); 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 (equation 8b).

Distinguishing between these scenarios is difficult empirically, in part because parental education may enter the household's problem through multiple channels. Nevertheless, the data do provide evidence for the notion that the returns to education are higher for children of more educated parents. 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 (Lam and Schoeni, 1993 discuss this phenomenon for Brazil). Unfortunately, the data do not offer insight into whether more educated parents are more altruistic or whether they 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 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. I then repeat the estimates while including investments in goods and time and their interactions with parental education (equation 10b). Reductions in the point estimates are interpreted as the extent to which the relationship between parental education and child learning is explained by these investments.

4.71. Chinese Test Scores

Table 4-10 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 4-11 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 controls for the log of non-required spending on education-related goods and services, column 3 includes a dummy for whether the household has children's books, column 4 includes a dummy for whether the household has a designated study area for children (e.g., a desk that children use), column 5 includes the total hours that parents spend helping children with homework each week, column 6 includes a dummy for whether parents read to the sampled child, and column 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 0.033 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 virtually 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 by 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. This correlation is stronger for daughters than for sons, however, as the effect of mother's education on sons' test scores falls slightly when village fixed effects are included.[11]

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 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 time spent helping children with homework are negative (but not significant), suggesting that the latter may be true. The negative impact of these investments is mitigated, however, by parental education. That is, the estimated effect becomes less negative as parental education increases. This finding suggests that more educated parents may use time with children proactively to encourage high performance while less educated parents help their children with homework reactively, i.e., in response to poor academic performance.

Other investments have a positive effect on Chinese test scores, however. For example, children whose parents discuss their academic performance with their teachers score 0.17 standard deviations higher than their peers (not quite significant at the 0.10 level). As parental education rises, however, these effects are often mitigated. Children whose parents have completed an average number of grades of schooling score slightly worse (although not significantly differently) on Chinese tests than other children. Further, children whose parents read to them score 0.13 standard deviations higher on Chinese exams if their parents have had no formal schooling, but only 0.08 standard deviations higher if their parents have average education. Likewise, children that come from households with children's study areas score 0.09 standard deviations above average on Chinese test scores when their parents have had not been formally educated, but the provision of a study area only raises test scores by 0.01 standard deviations among children of parents with average education. These findings, coupled with those above, suggest that parents adopt different strategies for investing in their children's human capital accumulation as their education levels rise. Also of interest, parental help

with homework positively contributes to Chinese test scores as father's education rises (this effect becomes negative when village fixed effects are added), but mothers appear to tutor children who are performing poorly, particularly more educated mothers.

Although the effects of these investments are not significant at any conventional level, this is not surprising if most of the variance in these investments is due to variance in parental education. 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.

Including these investments and the investment × parental education interaction terms has the effect of reducing the estimated coefficients on mother's and father's education for both sons and daughters. Again, these changes are interpreted as the extent to which the relationship between parental education and child learning is explained by various investments in education-related goods and time.

Controlling for non-required education-related spending reduces the estimated effects of mother's education on sons' test scores by 55.8 percent and on daughters' test scores by 47.2 percent. The associated reductions in the coefficients for father's education are negligible. Controlling for whether the household has a study area for children has a more modest impact on the relationship between mother's education and children's test scores, but a larger impact on the relationship between father's education and children's test scores. Including this regressor and its interactions with parental education reduces the estimated effect of father's education on daughters' Chinese test scores by 14.2 percent and that on sons' Chinese test scores by 9.0 percent. The estimated effects of mother's education on sons' and daughters' test scores fall by 14.1 and 12.4 percent, respectively. Time investments are also important in the relationship between parental education and children's test scores. Controlling for whether parents discuss academic performance with their children's teachers reduces the estimated effect of father's education on daughters' test scores by 18.5 percent and on sons' test scores by 15.1 percent. The estimated effect of mother's education falls by 19.0 percent for sons' test scores and by 15.5 percent for daughters' test scores.

Including household wealth, teacher quality rankings, cognitive ability, and village fixed effects, the estimated coefficients on parental education *rise* after controlling

for time spent helping children with homework. This suggests that parental education and these investments correlate negatively with some unobserved characteristic of the village. For example, if more educated parents compensate for poor school quality by spending more time helping their children with homework, then including village fixed effects (which capture school quality) will increase the point estimates for parental education, making the changes in the coefficients hard to interpret. Nevertheless, including dummies for whether the household has a designated children's study area, for whether parents read to their children, and for whether parents discuss academics with their children's teachers has the expected effect on the point estimates for parental education despite including village fixed effects. Controlling for whether parents read to their children reduces the point estimates for father's education by 16.1 percent for a son's test score and by 11.1 percent for a daughter's. The point estimates for how mother's education affects sons' and daughters' test scores fall by 44.8 percent and 17.2 percent, respectively, when controlling for reading to children, suggesting that this is an important mechanism by which mother's influence their children's learning, particularly where sons are concerned. The magnitudes in the reductions of the estimated effects of parental education are similar when controlling for discussing children's academic performance with teachers. Controlling for whether the household has a children's study area reduces the estimated effects of father's education on sons' and daughters' test scores by 13.3 percent and 21.4 percent, respectively. The effect of mother's education on sons' and daughters' test scores falls by 12.5 percent and 7.1 percent, respectively.

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 10a′). As above, investments are added iteratively in columns 2 through 7 (equations 10b 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, significant at the 0.01 level. 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 with 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 0.029 standard deviations 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 those that affect Chinese test scores. Although none of the point estimates is significant, non-required spending on education-related goods and services and parental time allocated to helping children with homework negatively impact mathematics test scores. Again, this may suggest that poor academic performance prompts parental investments rather than parental investments resulting in higher academic performance. Regardless, neither of these effects is significantly different from zero at the mean parental education level. Children from households that have children's reading material score 0.08 standard deviations above other children when their parents have no formal education and 0.11

standard deviations higher when their parents have completed the average number of grades, indicating that providing books may be an important vehicle for more educated parents to influence their children's learning. By contrast, parents reading to their children has a larger effect on test scores for parents with less than average education. That is, while children whose parents have no formal schooling score 0.13 standard deviations above average if their parents read to them, those whose parents have completed the mean level of schooling score 0.07 standard deviations higher than average. Having a children's study area and discussing academic performance with teachers has a large impact on test scores for children of parents with little education, but no discernable impact for parents with average or greater levels of education. These findings nevertheless suggest that more educated parents choose different investment vehicles than less educated parents. With village fixed effects and the other controls, these effects fall in magnitude; indeed the estimated effect of providing children's reading material changes signs for children of less educated parents.

Controlling for non-required spending on education-related goods and services reduces the estimated impact of father's education on sons' mathematics test scores by 22.5 percent and on daughters' test scores by 28.1 percent. The effect of mother's education falls by 44.1 percent for sons' test scores and falls by 32.1 percent for daughters' test scores. Controlling for reading to the child reduces the estimated effect of parental education on sons' test scores by 8.3 percent for fathers and by 60.7 percent for mothers. The estimated effect of parental education on daughters' test scores falls by 8.9 percent for fathers and by 47.3 percent for mothers. Including household wealth, teacher quality rankings, cognitive ability, and village fixed effects has little influence on these relationships, although the effect of mother's education on daughters' test scores rises, suggesting again that mother's education correlates negatively with some community characteristic (because mother's education has no measurable effect on sons' test scores in the baseline estimates including village fixed effects, percentage changes in this variable are not defined). Controlling for household wealth, teacher quality rankings, cognitive ability, village fixed effects, and whether the household has a designated study area yields a small reduction in the estimated effect of father's education on children's test scores, but the estimated effect of mother's education on daughters' test scores falls

by 56.1 percent. Controlling for household wealth, teacher quality rankings, cognitive ability, village fixed effects, and whether the parents discuss academics with the child's teacher has the opposite effect: while the reduction in the point estimates for mother's education are negligible, the coefficient on father's education falls by 26.3 percent for daughters and by 17.0 percent for sons.

4.73. Discussion

Father's education has a strong positive effect on children's test scores, with an additional grade completed increasing test scores by between 0.020 and 0.033 standard deviations from the mean test score. The effect of mother's education is smaller, increasing scores by between zero and 0.024 standard deviations at the mean. Several of the investments in goods and time examined here have also been shown to affect test scores, often with investments increasing the test scores for children of highly educated parents and reducing test scores for children of less educated parents. This suggests, perhaps, that more educated parents invest in their children's learning proactively while less educated parents invest in their children's education in reaction to poor performance in school. Moreover, controlling for these investments reduces the estimated effects of parental education on child learning. For example, controlling for reading to children reduces the point estimates for father's education by between 4.6 percent and 16.1 percent and the point estimates for mother's education by 17.2 to 60.7 percent.

Of course, all of these estimates may be subject to endogeneity bias. Simultaneity bias is a particular concern because low test scores may prompt additional investment in education by concerned parents, as described above. Omitted variable bias may also be problematic; 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. IV estimation may be used to control for these biases if appropriate instruments are found, but good IVs remain elusive. I tried using various exogenous determinants of household wealth (e.g., the household's allocation of high quality, irrigated land as a share of the total land allocation and the quality of the previous year's harvest), but they did not explain sufficient variation in the endogenous variable to produce precise estimates. The second-best strategy adopted in this paper was to control

for correlates of the omitted variables, e.g., household wealth, the teacher quality ranking, cognitive ability, and unobservable characteristics of the school and village via village fixed effects, but simultaneity and omitted variable bias may remain.

Even if these biases affect the point estimates, correlation between parental education and various investments has been established, and subsequent research should emphasize the search for instruments to better isolate the effects of investments on children's test scores. Moreover, although these measures explain a share of the relationship between parental education and child learning, much is left unexplained. One possible explanation is that the there are other, unobserved investments that may more fully explain the relationship of interest, and field researchers should consider including these measures in future surveys.

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 services 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. Theoretical predictions about the demand for education-related goods and time depend critically on

assumptions about how parental education affects ages, parental preferences, and the production of children's human capital as well as assumptions about the complementarity of goods and time in producing human capital.

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 a designated study area for children) and education-related time (e.g., time spent reading to children). For example, an additional grade completed by either parent increases non-required spending on education-related goods and services by 2.2 percent at the mean. At the same time, an additional grade completed by fathers increases the probability that parents read 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 0.020 and 0.033 standard deviations from the mean test score. An additional grade completed by mothers increases test scores by between zero and 0.024 standard deviations at the mean. Controlling for whether parents read to the sampled child reduces the estimated effect of parental education on Chinese test scores by between 4.6 percent and 33.1 percent and the estimated effect of parental education on mathematics test scores by between 8.3

percent and 60.7 percent. Similarly, controlling for log spending on non-required education-related goods and services reduces the estimated effect of parental education on Chinese test scores by between 1.0 percent and 55.8 percent and the estimated effect of parental education on mathematics test scores by between 22.5 percent and 44.1 percent. Unfortunately, these estimates may be biased by omitted variables. As a result, 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. With the additional regressors, the effect of controlling for whether parents read to the sampled child is to reduce the point estimates on parental education by between 5.9 percent and 33.1 percent.

Even though endogeneity bias may remain, this paper demonstrates a strong correlation between parental education and various investments in children's human capital development. Future work on this topic will thus emphasize searching for instruments for education-related investments to better control for 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 tremendously from programming help from Axel Anderson. I also thank Andrew Coleman, Emily Hannum, Peggy Kong. Steve Salant, and seminar participants at Northwest Normal University 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 operate quite similarly to the altruism function.

[4] The comparative static results are identical if the human capital production function is quasilinear in x rather than θ assuming that parental education affects either wages only (case 1) or the productivity of time spent with children only (case 2). If parental education affects the returns to education only or parental altruism only, the comparative statics are ambiguous. As a result, only the comparative statics for quasilinear production in θ are reported.

[5] The elasticity of substitution between x and θ in $g(x,\theta)$ is $\sigma_{x\theta} = \dfrac{(1-a)x_1^a - c}{(a-1)(c-x_1^a)}$, where $c = x_1^a + \theta$ is a point along the production isoquant. The elasticity of substitution for Cobb-Douglas production is $\sigma_{x\theta} = 1$. The elasticities of substitution for the other production functions given in the text are similar.

[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 a 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; controlling for measures such as age may help to mitigate this variation.

[8] Ideally, one would instrument for wealth because it may correlate with both parental education and educational outcomes. I tried using the share of the household's land allocation that is irrigated and the quality of the previous year's harvest as IVs; although these measures performed well in the first stage, they do not explain sufficient variation in the endogenous variable to produce precise estimates. Nevertheless, instrumenting for wealth did not produce sign changes or large changes in the magnitudes of any coefficients, so wealth is not instrumented in the analysis.

[9] 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.

[10] In 2000, $1US ≅ 8.27 Chinese yuan.

[11] 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 of 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.

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Figure 4-1. Pathways of Influence

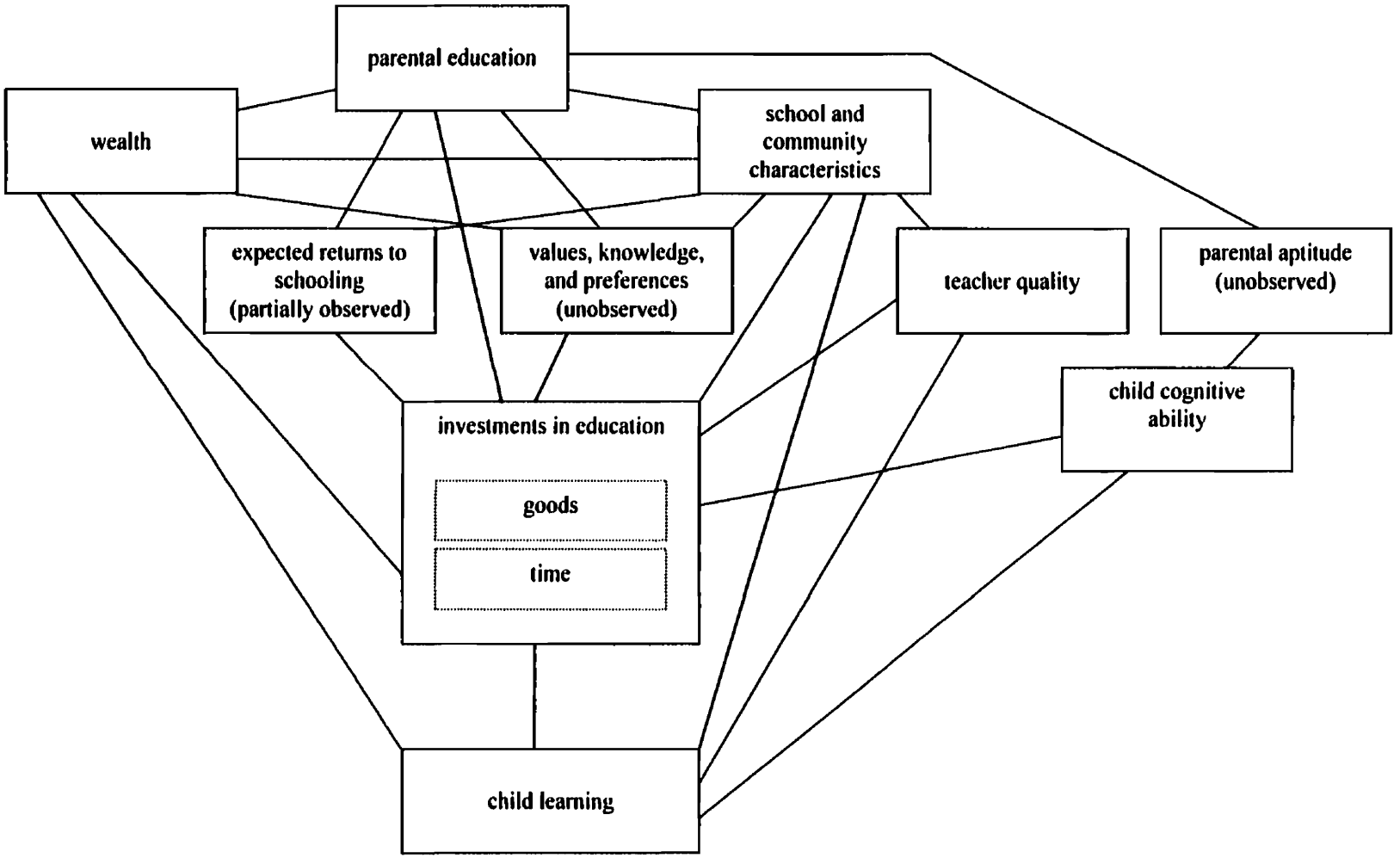

Table 4-1. Comparative Static Results

production function	Relationship between parental education and the household problem (case 1) wage function	(case 2) efficiency of time	(case 3) returns to education	(case 4) altruism function
quasilinear in θ	$g = x^a + \theta$	$g = x^a + H\theta$	$g = (x^a + \theta)^H$	$g = x^a + \theta$
dx/dH	+	-	0	0
$d\theta/dH$	-	+	+	+
Cobb-Douglass	$g = x^a\theta^{(1-a)}$	$g = x^a(H\theta)^{(1-a)}$	$g = (x^a\theta^{(1-a)})^H$	$g = x^a\theta^{(1-a)}$
dx/dH	+	-	+	+
$d\theta/dH$	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 (OLS)

Variable	Unit	(1)	(2)	(3)	(4)	(5)
father's education	grades	0.0228**	0.0197**	0.0193*	0.0221**	0.0180**
		(2.12)	(2.46)	(1.76)	(2.08)	(2.24)
mother's education	grades	0.0332***	0.0097	0.0291**	0.0338***	0.0077
		(2.83)	(1.12)	(2.43)	(2.92)	(0.89)
father's age	years	0.0088	0.0086	0.0125	0.0087	0.0102*
		(0.94)	(1.41)	(1.33)	(0.94)	(1.67)
mother's age	years	-0.0035	0.0036	-0.0066	-0.0017	0.0025
		(0.37)	(0.51)	(0.69)	(0.18)	(0.35)
male	dummy	0.0452	0.0672	0.0450	0.0386	0.0653
		(0.50)	(0.84)	(0.52)	(0.43)	(0.81)
age	years	0.0148	-0.0035	0.0220	-0.0042	-0.0000
		(0.46)	(0.15)	(0.71)	(0.13)	(0.00)
other enrolled children	number	0.4460***	0.4772***	0.4515***	0.4416***	0.4715***
		(12.11)	(15.47)	(12.50)	(12.27)	(15.26)
non-enrolled children	number	0.0090	0.0250	0.0152	0.0057	0.0216
		(0.22)	(0.74)	(0.38)	(0.14)	(0.64)
father's ed * male	interaction	0.0044	0.0001	0.0038	0.0053	-0.0005
		(0.32)	(0.01)	(0.28)	(0.38)	(0.05)
mother's ed * male	interaction	-0.0147	-0.0063	-0.0136	-0.0142	-0.0057
		(1.14)	(0.57)	(1.06)	(1.11)	(0.52)
teacher quality	ranking		-0.0025			-0.0040
			(0.11)			(0.17)
log wealth	yuan			0.1055***		0.0579**
				(3.33)		(2.55)
cognitive ability	Z-score				-0.0652**	0.0109
					(2.16)	(0.43)
Constant		1.3456**	1.6364***	0.3778	1.4339***	1.0413**
		(2.60)	(4.13)	(0.73)	(2.72)	(2.26)
Robust std errors		yes		yes	yes	
Village FE			yes			yes
Observations		1918	1918	1918	1918	1918
R-squared		0.194	0.417	0.203	0.197	0.419

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

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

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

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

Variable	Unit	(1)	(2)	(3)	(4)	(5)
father's education	grades	0.4029***	0.3560***	0.4094***	0.4065***	0.3554***
		(5.71)	(5.24)	(5.78)	(5.75)	(5.22)
mother's education	grades	0.4214***	0.3392***	0.4285***	0.4187***	0.3385***
		(5.94)	(4.87)	(6.01)	(5.90)	(4.83)
father's age	years	-0.0634	-0.1295**	-0.0703	-0.0624	-0.1290**
		(1.20)	(2.52)	(1.32)	(1.18)	(2.50)
mother's age	years	-0.0605	-0.0550	-0.0549	-0.0689	-0.0553
		(0.98)	(0.91)	(0.88)	(1.11)	(0.92)
male	dummy	0.2552	0.1488	0.2569	0.2766	0.1500
		(0.34)	(0.21)	(0.34)	(0.37)	(0.21)
age	years	-0.3932**	-0.0993	-0.4062**	-0.3106	-0.0816
		(2.04)	(0.51)	(2.10)	(1.56)	(0.40)
other enrolled children	number	-0.3407	-0.0335	-0.3508	-0.3233	-0.0393
		(1.37)	(0.13)	(1.41)	(1.30)	(0.15)
non-enrolled children	number	-0.2452	-0.2090	-0.2550	-0.2317	-0.2138
		(0.85)	(0.74)	(0.88)	(0.80)	(0.75)
father's ed * male	interaction	-0.1020	-0.0420	-0.1014	-0.1054	-0.0428
		(1.06)	(0.46)	(1.05)	(1.09)	(0.47)
mother's ed * male	interaction	0.0634	-0.0232	0.0618	0.0618	-0.0236
		(0.68)	(0.26)	(0.66)	(0.66)	(0.26)
teacher quality	ranking		0.0637			0.0643
			(0.34)			(0.34)
log wealth	yuan			-0.1857		0.0203
				(1.05)		(0.11)
cognitive ability	Z-score				0.2811*	0.0609
					(1.65)	(0.29)
Constant		7.9211***	5.8840*	9.6390***	7.5389**	5.4417
		(2.64)	(1.77)	(2.82)	(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*	0.0074	0.0091*	0.0098*	0.0077
		(1.85)	(1.39)	(1.79)	(1.95)	(1.43)
mother's education	grades	0.0271***	0.0220***	0.0267***	0.0269***	0.0222***
		(4.95)	(3.80)	(4.86)	(4.94)	(3.80)
father's age	years	-0.0091**	-0.0115***	-0.0088**	-0.0091**	-0.0117***
		(2.51)	(2.82)	(2.40)	(2.53)	(2.84)
mother's age	years	0.0085*	0.0055	0.0082*	0.0076*	0.0057
		(1.81)	(1.18)	(1.74)	(1.67)	(1.22)
male	dummy	-0.0087	-0.0145	-0.0086	-0.0041	-0.0098
		(0.17)	(0.27)	(0.17)	(0.08)	(0.18)
age	years	-0.0183	-0.0080	-0.0175	-0.0080	0.0034
		(1.08)	(0.51)	(1.05)	(0.46)	(0.20)
other enrolled children	number	-0.0368*	0.0211	-0.0363*	-0.0339*	0.0194
		(1.83)	(1.03)	(1.79)	(1.75)	(0.94)
non-enrolled children	number	-0.0282	0.0069	-0.0276	-0.0263	0.0048
		(1.28)	(0.30)	(1.25)	(1.23)	(0.21)
father's ed * male	interaction	0.0031	0.0049	0.0031	0.0026	0.0042
		(0.45)	(0.68)	(0.44)	(0.38)	(0.58)
mother's ed * male	interaction	0.0045	0.0056	0.0046	0.0040	0.0048
		(0.57)	(0.74)	(0.59)	(0.50)	(0.64)
teacher quality	ranking		0.0136			0.0134
			(0.87)			(0.86)
log wealth	yuan			0.0100		0.0001
				(0.77)		(0.00)
cognitive ability	Z-score				0.0358**	0.0392**
					(2.05)	(2.22)
Robust std errors		yes		yes	yes	
Village FE			yes			yes
Observations		1918	1885	1918	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	-0.0011	0.0048	0.0049	-0.0013
		(1.12)	(0.24)	(1.05)	(1.08)	(0.28)
mother's education	grades	0.0177***	0.0132**	0.0173***	0.0178***	0.0130**
		(3.89)	(2.53)	(3.73)	(3.85)	(2.49)
father's age	years	0.0044	0.0032	0.0047	0.0044	0.0033
		(1.25)	(0.87)	(1.34)	(1.26)	(0.91)
mother's age	years	-0.0029	0.0002	-0.0032	-0.0022	0.0001
		(0.70)	(0.05)	(0.78)	(0.58)	(0.02)
male	dummy	-0.0333	-0.0690	-0.0332	-0.0368	-0.0695
		(0.84)	(1.50)	(0.83)	(0.93)	(1.51)
age	years	-0.0182	-0.0142	-0.0176	-0.0250	-0.0140
		(1.39)	(1.02)	(1.36)	(1.63)	(0.96)
other enrolled children	number	0.0040	0.0056	0.0045	0.0015	0.0052
		(0.20)	(0.31)	(0.23)	(0.08)	(0.28)
non-enrolled children	number	0.0189	-0.0004	0.0196	0.0172	-0.0006
		(0.84)	(0.02)	(0.87)	(0.80)	(0.03)
father's ed * male	interaction	0.0080	0.0132**	0.0079	0.0084	0.0131**
		(1.55)	(2.05)	(1.53)	(1.61)	(2.05)
mother's ed * male	interaction	0.0013	-0.0004	0.0013	0.0017	-0.0004
		(0.24)	(0.06)	(0.25)	(0.32)	(0.05)
teacher quality	ranking		0.0051			0.0050
			(0.37)			(0.36)
log wealth	yuan			0.0106		0.0055
				(0.80)		(0.41)
cognitive ability	Z-score				-0.0245	0.0010
					(1.26)	(0.07)
Robust std errors		yes		yes	yes	
Village FE			yes			yes
Observations		1918	1749	1918	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**	0.0251	0.0265*	0.0299**
		(2.43)	(1.11)	(1.83)	(2.42)
mother's education	grades	0.0193*	0.0063	0.0162	0.0227
		(1.67)	(0.25)	(1.12)	(1.63)
father's age	years	-0.0053	-0.0050	-0.0051	-0.0056
		(0.70)	(0.65)	(0.66)	(0.73)
mother's age	years	0.0043	0.0039	0.0026	0.0044
		(0.51)	(0.46)	(0.31)	(0.53)
male child	dummy	-0.2395**	-0.2391**	-0.2403**	-0.2451**
		(2.23)	(2.22)	(2.24)	(2.26)
age	years	-0.0697**	-0.0695**	-0.0638**	-0.0683**
		(2.40)	(2.39)	(2.22)	(2.35)
other enrolled children	number	0.0208	0.0333	0.0284	0.0202
		(0.60)	(0.89)	(0.81)	(0.58)
non-enrolled children	number	0.0549	0.0540	0.0653	0.0558
		(1.39)	(1.38)	(1.62)	(1.41)
father's education * male	interaction	0.0072	0.0073	0.0073	0.0079
		(0.51)	(0.51)	(0.51)	(0.55)
mother's education * male	interaction	-0.0030	-0.0030	-0.0025	-0.0029
		(0.21)	(0.21)	(0.17)	(0.20)
non-required spending	log yuan		-0.0469		
			(0.81)		
has children's books	dummy			0.1530	
				(1.26)	
has child's study area	dummy				0.0916
					(0.84)
help with homework	hours/wk				
parents read to child	dummy				
discusses with teacher	dummy				
father's ed * investment	interaction		0.0005	-0.0047	-0.0076
			(0.09)	(0.31)	(0.54)
mother's ed * investment	interaction		0.0039	0.0019	-0.0058
			(0.56)	(0.14)	(0.39)
Constant		0.6857*	0.7689*	0.6503	0.6137
		(1.71)	(1.85)	(1.60)	(1.45)
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)
father's education	grades	0.0211*	0.0253	0.0396**
		(1.76)	(1.60)	(2.38)
mother's education	grades	0.0206	0.0244	0.0330*
		(1.62)	(1.40)	(1.77)
father's age	years	-0.0055	-0.0045	-0.0054
		(0.73)	(0.60)	(0.70)
mother's age	years	0.0043	0.0035	0.0040
		(0.52)	(0.42)	(0.48)
male child	dummy	-0.2393**	-0.2386**	-0.2346**
		(2.23)	(2.22)	(2.22)
age	years	-0.0709**	-0.0681**	-0.0670**
		(2.40)	(2.36)	(2.28)
other enrolled children	number	0.0227	0.0250	0.0200
		(0.65)	(0.72)	(0.57)
non-enrolled children	number	0.0542	0.0594	0.0567
		(1.37)	(1.50)	(1.44)
father's education * male	interaction	0.0074	0.0068	0.0071
		(0.52)	(0.48)	(0.50)
mother's education * male	interaction	-0.0033	-0.0029	-0.0032
		(0.23)	(0.20)	(0.22)
non-required spending	log yuan			
has children's books	dummy			
has child's study area	dummy			
help with homework	hours/wk	-0.0090		
		(0.67)		
parents read to child	dummy		0.1271	
			(1.28)	
discusses with teacher	dummy			0.1700
				(1.62)
father's ed * investment	interaction	0.0014	-0.0005	-0.0184
		(1.04)	(0.04)	(1.14)
mother's ed * investment	interaction	-0.0003	-0.0106	-0.0167
		(0.18)	(0.61)	(0.90)
Constant		0.7483*	0.5949	0.5649
		(1.90)	(1.46)	(1.42)
Robust std errors		yes	yes	yes
Observations		1876	1876	1876
R-squared		0.037	0.039	0.039

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**	0.0247	0.0231*	0.0289**
		(2.21)	(1.09)	(1.73)	(2.25)
mother's education	grades	0.0238**	0.0115	0.0221	0.0275**
		(2.23)	(0.46)	(1.59)	(2.01)
father's age	years	-0.0039	-0.0036	-0.0040	-0.0041
		(0.51)	(0.46)	(0.52)	(0.54)
mother's age	years	0.0044	0.0043	0.0041	0.0047
		(0.51)	(0.49)	(0.48)	(0.55)
male child	dummy	-0.2077**	-0.2061**	-0.2089**	-0.2132**
		(2.03)	(2.01)	(2.04)	(2.05)
age	years	0.0146	0.0138	0.0158	0.0127
		(0.49)	(0.46)	(0.53)	(0.42)
other enrolled children	number	-0.0037	0.0107	-0.0046	-0.0043
		(0.10)	(0.27)	(0.12)	(0.11)
non-enrolled children	number	0.0208	0.0209	0.0221	0.0203
		(0.55)	(0.55)	(0.57)	(0.53)
household wealth	log yuan	0.0829***	0.0846***	0.0779**	0.0856***
		(2.74)	(2.79)	(2.56)	(2.83)
teacher quality	ranking	-0.0140	-0.0143	-0.0149	-0.0138
		(0.43)	(0.44)	(0.46)	(0.43)
cognitive ability	Z-score	0.3359***	0.3353***	0.3349***	0.3365***
		(7.84)	(7.73)	(7.77)	(7.82)
father's education * male	interaction	0.0091	0.0090	0.0089	0.0097
		(0.62)	(0.61)	(0.60)	(0.65)
mother's education * male	interaction	-0.0142	-0.0141	-0.0135	-0.0137
		(1.01)	(1.00)	(0.95)	(0.98)
non-required spending	log yuan		-0.0403		
			(0.80)		
has children's books	dummy			0.0794	
				(0.69)	
has child's study area	dummy				0.0592
					(0.56)
help with homework	hours/wk				
parents read to child	dummy				
discusses w/ teacher	dummy				
father's ed * investment	interaction		-0.0004	-0.0021	-0.0113
			(0.07)	(0.14)	(0.78)
mother's ed * investment	interaction		0.0035	0.0022	-0.0054
			(0.51)	(0.17)	(0.36)
Constant		-1.4211***	-1.3526***	-1.4198***	-1.4644***
		(3.06)	(2.92)	(3.07)	(3.08)
Village FE		yes	yes	yes	yes
Observations		1876	1876	1876	1876
R-squared		0.213	0.214	0.214	0.214

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)
father's education	grades	0.0254**	0.0260*	0.0320**
		(2.28)	(1.80)	(2.07)
mother's education	grades	0.0265**	0.0303*	0.0434**
		(2.12)	(1.91)	(2.59)
father's age	years	-0.0044	-0.0032	-0.0036
		(0.58)	(0.41)	(0.47)
mother's age	years	0.0041	0.0040	0.0037
		(0.48)	(0.47)	(0.42)
male child	dummy	-0.2076**	-0.2080**	-0.2054**
		(2.03)	(2.05)	(2.03)
age	years	0.0153	0.0132	0.0158
		(0.52)	(0.45)	(0.53)
other enrolled children	number	-0.0051	-0.0044	-0.0024
		(0.13)	(0.12)	(0.06)
non-enrolled children	number	0.0202	0.0233	0.0256
		(0.53)	(0.62)	(0.67)
household wealth	log yuan	0.0838***	0.0821***	0.0825***
		(2.74)	(2.71)	(2.73)
teacher quality	ranking	-0.0144	-0.0144	-0.0134
		(0.45)	(0.44)	(0.41)
cognitive ability	Z-score	0.3369***	0.3337***	0.3357***
		(8.03)	(7.77)	(7.78)
father's education * male	interaction	0.0090	0.0092	0.0096
		(0.61)	(0.63)	(0.65)
mother's education * male	interaction	-0.0145	-0.0144	-0.0145
		(1.03)	(1.04)	(1.03)
non-required spending	log yuan			
has children's books	dummy			
has child's study area	dummy			
help with homework	hours/wk	-0.0031		
		(0.24)		
parents read to child	dummy		0.1517	
			(1.46)	
discusses w/ teacher	dummy			0.1102
				(1.01)
father's ed * investment	interaction	-0.0005	-0.0072	-0.0129
		(0.39)	(0.51)	(0.82)
mother's ed * investment	interaction	-0.0002	-0.0106	-0.0234
		(0.13)	(0.64)	(1.36)
Constant		-1.4168***	-1.5089***	-1.4775***
		(3.02)	(3.27)	(3.28)
Village FE		yes	yes	yes
Observations		1876	1876	1876
R-squared		0.214	0.214	0.215

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*	0.0139	0.0187	0.0234*
		(1.96)	(0.58)	(1.34)	(1.83)
mother's education	grades	0.0112	0.0059	0.0109	0.0255*
		(0.99)	(0.24)	(0.86)	(1.94)
father's age	years	-0.0150**	-0.0146*	-0.0145*	-0.0149**
		(2.04)	(1.97)	(1.96)	(2.05)
mother's age	years	0.0197**	0.0191**	0.0182**	0.0195**
		(2.56)	(2.43)	(2.37)	(2.56)
male child	dummy	-0.0833	-0.0834	-0.0841	-0.0876
		(0.65)	(0.65)	(0.65)	(0.68)
age	years	-0.0684**	-0.0683**	-0.0630**	-0.0661**
		(2.16)	(2.15)	(1.99)	(2.10)
other enrolled children	number	-0.0191	-0.0090	-0.0115	-0.0209
		(0.48)	(0.22)	(0.29)	(0.53)
non-enrolled children	number	0.0034	0.0029	0.0115	0.0029
		(0.09)	(0.07)	(0.30)	(0.08)
father's education * male	interaction	0.0054	0.0055	0.0056	0.0055
		(0.34)	(0.35)	(0.35)	(0.35)
mother's education * male	interaction	-0.0029	-0.0029	-0.0026	-0.0018
		(0.21)	(0.22)	(0.19)	(0.13)
non-required spending	log yuan		-0.0487		
			(0.85)		
has children's books	dummy			0.0819	
				(0.72)	
has child's study area	dummy				0.0942
					(0.99)
help with homework	hours/wk				
parents read to child	dummy				
discusses with teacher	dummy				
father's ed * investment	interaction		0.0030	0.0061	0.0011
			(0.48)	(0.45)	(0.08)
mother's ed * investment	interaction		0.0017	-0.0028	-0.0250*
			(0.24)	(0.20)	(1.76)
Constant		0.5267	0.6093*	0.4947	0.4356
		(1.51)	(1.69)	(1.41)	(1.21)
Robust std errors		yes	yes	yes	yes
Observations		1882	1882	1882	1882
R-squared		0.022	0.022	0.025	0.023

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)
father's education	grades	0.0166	0.0243	0.0404**
		(1.21)	(1.54)	(2.22)
mother's education	grades	0.0172	0.0166	0.0057
		(1.35)	(1.03)	(0.29)
father's age	years	-0.0152**	-0.0142*	-0.0151**
		(2.11)	(1.95)	(2.06)
mother's age	years	0.0198**	0.0190**	0.0196**
		(2.58)	(2.49)	(2.54)
male child	dummy	-0.0830	-0.0830	-0.0785
		(0.65)	(0.65)	(0.62)
age	years	-0.0680**	-0.0670**	-0.0669**
		(2.09)	(2.12)	(2.11)
other enrolled children	number	-0.0165	-0.0153	-0.0200
		(0.42)	(0.39)	(0.50)
non-enrolled children	number	0.0030	0.0081	0.0030
		(0.08)	(0.21)	(0.08)
father's education * male	interaction	0.0060	0.0051	0.0050
		(0.38)	(0.33)	(0.32)
mother's education * male	interaction	-0.0037	-0.0027	-0.0029
		(0.27)	(0.20)	(0.21)
non-required spending	log yuan			
has children's books	dummy			
has child's study area	dummy			
help with homework	hours/wk	-0.0062		
		(0.43)		
parents read to child	dummy		0.1327	
			(1.34)	
discusses with teacher	dummy			0.1297
				(1.21)
father's ed * investment	interaction	0.0018	-0.0029	-0.0225
		(1.05)	(0.22)	(1.44)
mother's ed * investment	interaction	-0.0014	-0.0106	0.0069
		(0.86)	(0.71)	(0.35)
Constant		0.5628	0.4390	0.4427
		(1.48)	(1.24)	(1.27)
Robust std errors		yes	yes	yes
Observations		1882	1882	1882
R-squared		0.022	0.023	0.023

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*	0.0115	0.0155	0.0226*
		(1.71)	(0.45)	(1.12)	(1.68)
mother's education	grades	0.0173	0.0201	0.0163	0.0310**
		(1.60)	(0.80)	(1.33)	(2.38)
father's age	years	-0.0147**	-0.0142*	-0.0144**	-0.0145**
		(2.07)	(1.98)	(2.03)	(2.07)
mother's age	years	0.0225***	0.0222***	0.0221***	0.0223***
		(2.81)	(2.73)	(2.80)	(2.84)
male child	dummy	-0.0552	-0.0543	-0.0558	-0.0595
		(0.43)	(0.42)	(0.43)	(0.46)
age	years	0.0195	0.0191	0.0203	0.0193
		(0.65)	(0.64)	(0.68)	(0.65)
other enrolled children	number	-0.0344	-0.0241	-0.0336	-0.0365
		(0.82)	(0.55)	(0.80)	(0.87)
non-enrolled children	number	-0.0116	-0.0113	-0.0121	-0.0128
		(0.30)	(0.30)	(0.32)	(0.34)
household wealth	log yuan	0.0510	0.0522	0.0474	0.0526*
		(1.61)	(1.65)	(1.46)	(1.66)
teacher quality	ranking	-0.0162	-0.0161	-0.0162	-0.0162
		(0.43)	(0.43)	(0.43)	(0.43)
cognitive ability	Z-score	0.3349***	0.3350***	0.3340***	0.3360***
		(7.81)	(7.79)	(7.78)	(7.81)
father's education * male	interaction	0.0087	0.0087	0.0085	0.0086
		(0.53)	(0.53)	(0.52)	(0.52)
mother's education * male	interaction	-0.0175	-0.0176	-0.0170	-0.0161
		(1.35)	(1.34)	(1.30)	(1.25)
non-required spending	log yuan		-0.0363		
			(0.63)		
has children's books	dummy			-0.0133	
				(0.12)	
has child's study area	dummy				0.0738
					(0.76)
help with homework	hours/wk				
parents read to child	dummy				
discusses w/ teacher	dummy				
father's ed * investment	interaction		0.0027	0.0086	-0.0025
			(0.39)	(0.62)	(0.17)
mother's ed * investment	interaction		-0.0007	0.0009	-0.0234*
			(0.10)	(0.06)	(1.67)
Constant		-1.3871***	-1.3346***	-1.3670***	-1.4495***
		(2.82)	(2.66)	(2.79)	(2.91)
Village FE		yes	yes	yes	yes
Observations		0.181	0.181	0.181	0.182
R-squared		0.18	0.18	0.18	0.18

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)
father's education	grades	0.0192	0.0208	0.0362**
		(1.42)	(1.37)	(2.02)
mother's education	grades	0.0251**	0.0258*	0.0207
		(2.05)	(1.70)	(1.19)
father's age	years	-0.0151**	-0.0142**	-0.0145**
		(2.15)	(2.00)	(2.06)
mother's age	years	0.0224***	0.0224***	0.0220***
		(2.79)	(2.82)	(2.74)
male child	dummy	-0.0551	-0.0550	-0.0510
		(0.43)	(0.43)	(0.40)
age	years	0.0206	0.0184	0.0203
		(0.69)	(0.62)	(0.68)
other enrolled children	number	-0.0359	-0.0347	-0.0339
		(0.86)	(0.84)	(0.80)
non-enrolled children	number	-0.0133	-0.0097	-0.0087
		(0.35)	(0.26)	(0.23)
household wealth	log yuan	0.0532	0.0504	0.0510
		(1.66)	(1.59)	(1.61)
teacher quality	ranking	-0.0164	-0.0161	-0.0154
		(0.43)	(0.43)	(0.41)
cognitive ability	Z-score	0.3358***	0.3329***	0.3341***
		(7.92)	(7.77)	(7.71)
father's education * male	interaction	0.0091	0.0085	0.0086
		(0.55)	(0.52)	(0.53)
mother's education * male	interaction	-0.0184	-0.0173	-0.0177
		(1.42)	(1.34)	(1.35)
non-required spending	log yuan			
has children's books	dummy			
has child's study area	dummy			
help with homework	hours/wk	-0.0016		
		(0.11)		
parents read to child	dummy		0.1119	
			(1.07)	
discusses w/ teacher	dummy			0.1208
				(1.09)
father's ed * investment	interaction	0.0004	-0.0021	-0.0209
		(0.24)	(0.16)	(1.33)
mother's ed * investment	interaction	-0.0015	-0.0135	-0.0036
		(0.92)	(0.90)	(0.20)
Constant		-1.4149***	-1.4551***	-1.4434***
		(2.82)	(2.94)	(2.98)
Village FE		Yes	Yes	yes
Observations		0.182	0.181	0.182
R-squared		0.18	0.18	0.18

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

Appendix to Chapter IV

This appendix presents the comparative static results for section 4-2 more formally. If parental education enters the wage function (ω), but neither the human capital production function nor the altruism function (case 1), and if the human capital production function is quasilinear in θ with $g(x,\theta) = x^a + \theta$, then:

$$d\theta/dH = \frac{a[a(\delta(\xi-1)-\sigma)(\phi-1)+\phi]\left[\left(\frac{P}{a\omega(H)}\right)^{\frac{1}{a-1}}\right]^a \omega'(H)}{(a-1)[\xi+\delta(\xi-1)(\phi-1)+\phi-\xi\phi]\omega(H)} < 0 \qquad \text{(A1a)}$$

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

If, instead, goods and time are complementary inputs and the production technology is Cobb-Douglas with $g(x,\theta) = x^a\theta^{(1-a)}$, then:

$$d\theta/dH = 0$$

$$dx/dH = \frac{aT[\delta(\xi-1)-\sigma](\phi-1)\omega'(H)}{P[\xi+\delta(\xi-1)(\phi-1)+\phi-\xi\phi]} > 0 \qquad \text{(A1b)}$$

Now suppose that parental education affects the household problem by augmenting the returns to time spent with children but neither the wage function, the altruism function, nor the efficiency or efficacy of goods inputs (case 2). If the human capital production function is quasilinear in θ with $g(x,\theta;H) = x^a + H\theta$:

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

(A2a)
$$-\frac{a[a[-\delta+(-1+\delta)\xi](-1+\phi+\phi]\left[\left(\frac{HP}{a\omega}\right)^{\frac{1}{-1+a}}\right]^{a}}{(-1+a)H} > 0$$

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

By contrast, with a Cobb-Douglas production function in which $g(x,\theta;H) = x^{a}\theta^{H(1-a)}$:

(A2b)
$$d\theta/dH = -\frac{(a-1)T[\delta(\xi-1)-\xi](\phi-1)[a[\delta(\xi-1)-\xi](\phi-1)+\phi]}{[-[a(H-1)-H][\delta(\xi-1)-\xi](\phi-1)+\phi]^{2}} > 0$$

$$dx/dH = \frac{(a-1)aT(\delta+\xi-\delta\xi)^{2}(\phi-1)^{2}\omega}{P[-[a(H-1)-H][\delta(\xi-1)-\xi](\phi-1)+\phi]^{2}} < 0$$

Assume again that parental education affects neither the wage function nor the altruism function, but that it affects the returns to education (case 3). With quasilinear production of the form $g(x,\theta;H) = (x^{a}+\theta)^{H}$:

(A3a)
$$d\theta/dH = \frac{[\delta(\xi-1)-\xi](\phi-1\,1)\phi\left[T-(a-1)\left(\left(\frac{P}{a\omega}\right)^{\frac{1}{a-1}}\right)^{a}\right]}{[H(\delta(\xi-1)-\xi)(\phi-1)+\phi]^{2}} > 0$$

$$dx/dH = 0$$

If, instead, $g(x,\theta;H) = (x^{a}\theta^{(1-a)})^{H}$, then:

(A3b)
$$d\theta/dH = -\frac{(a-1)T[\delta(\xi-1)-\xi](\phi-1)\phi}{[H(\delta(\xi-1)-\xi)(\phi-1)+\phi]^{2}} > 0$$

$$dx/dH = \frac{aT[\delta(\xi-1)-\xi](\phi-1)\phi\omega}{P[H(\delta(\xi-1)-\xi)(\phi-1)+\phi]^{2}} > 0$$

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:

(A4a)
$$d\theta/dH = \frac{(\delta-1)(\phi-1)\phi\left[T-(a-1)\left(\left(\frac{P}{a\varpi}\right)^{\frac{1}{a-1}}\right)^{a}\right]\xi'(H)}{\left[\delta+\phi-\delta\phi+(\delta-1)(\phi-1)\xi(H)\right]^2} > 0$$
$$dh/dH = 0$$

With Cobb-Douglas production:

(A4b)
$$d\theta/dH = -\frac{(a-1)T(\delta-1)(\phi-1)\phi\xi'(H)}{\left[\delta+\phi-\delta\phi+(\delta-1)(\phi-1)\xi(H)\right]^2} > 0$$
$$dx/dH = \frac{aT(\delta-1)(\phi-1)\phi\omega\xi'(H)}{P\left[\delta+\phi-\delta\phi+(\delta-1)(\phi-1)\xi(H)\right]^2} > 0$$