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Oxford Development Studies

ISSN: 1360-0818 (Print) 1469-9966 (Online) Journal homepage: http://www.tandfonline.com/loi/cods20

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To cite this article: John Knight , Li Shi & Deng Quheng (2009) Education and the Poverty Trap in Rural China: Setting the Trap, Oxford Development Studies, 37:4, 311-332, DOI: 10.1080/13600810903305232

To link to this article: https://doi.org/10.1080/13600810903305232

Oxford Development Studies,
Vol. 37, No. 4, December 2009

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Taylor & Francis Group

Education and the Poverty Trap in Rural China: Setting the Trap

JOHN KNIGHT, LI SHI & DENG QUHENG

ABSTRACT *Together with a companion paper to be published in the March 2010 issue, this is an ambitious attempt to view the relationships involving education and income as forming a system, and one that can generate a poverty trap. The setting is rural China, and the data are from a national household survey for 2002, designed with research hypotheses in mind. Enrolment is high in rural China in comparison with most poor rural societies, but the quality of education varies greatly. The paper analyses the determinants of drop-out from middle school and of continuation to high school. It also examines the determinants of pupil performance, time spent learning, and educational expenditure. Poverty is found to have an adverse effect on both the quantity and quality of education—so contributing to a poverty trap.*

1. Introduction

The objective of this paper, together with its closely linked companion paper (Knight *et al.*, in press), is to show that education and poverty are closely related in numerous ways, and that the interactions among a set of poverty-related and education-related variables are capable of generating a vicious circle of educational deprivation and poverty, and also a virtuous circle of positive interaction between education and income. We explore the numerous education-related processes and mechanisms that can create a poverty trap and that can enable households to emerge from poverty, illustrating them with a case study of rural China. Their complexity and simultaneous determination in an interrelated system, together with the cross-section nature of our data set, make it difficult to identify causal relationships, as opposed to associations, among our variables. Nevertheless, we believe the system of microeconomic results to be original not only for China but also more generally for poor countries, and to be sufficiently suggestive as to provide a road map for further research into the causal mechanisms.

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The research was conducted while Li Shi and Deng Quheng were visiting the Department of Economics, University of Oxford, from Beijing Normal University and the Institute of Economics, Chinese Academy of Social Sciences, respectively. We are grateful to Nina Fenton for her research assistance, to Chris Colclough for his comments, and to the UK Department for International Development (DfID) for financial support through John Knight's membership of the Research Consortium on Educational Outcomes and Poverty (RECOUP), which is based partly at the Centre for the Study of African Economies in the Department of Economics, University of Oxford. We wish to thank the editors and two referees for very helpful comments and suggestions.

ISSN 1360-0818 print/ISSN 1469-9966 online/09/040311-22

DOI: 10.1080/13600810903305232

The main hypothesis that we test in this paper is that poverty at both the household level and the community level can have an adverse effect on the quantity and also the quality of education. There are general reasons, falling under the rubric of "the poverty trap", and specific institutional reasons why this might be the case in rural China—the home of 800 million people. In the companion paper we test the hypothesis that the quantity and quality of education help to raise households out of poverty.

The data set that we use is the rural component of the national household survey for China, relating to 2002, that was designed by an international team including the authors and organized and administered by the Institute of Economics, Chinese Academy of Social Sciences (IE, CASS). In addition to the main "Rural Household Questionnaire", there was an "Administrative Village Questionnaire" and a "Social Network, Village Affairs and Living Quality Questionnaire". Both of these latter questionnaires contain questions that were introduced especially for our current purposes.

In Section 2 background information is provided, in Section 3 the notion of a poverty trap and its relevance to education in rural China is examined, and in Section 4 relevant pointers from the survey are described. Section 5 contains an empirical analysis of the factors governing school enrolment and their relationships to poverty: the determinants of drop-out from middle school and of continuation to high school. Section 6 examines the determinants of educational quality, again focusing on aspects of poverty. Section 7 concludes.

2. Background to the Study

By comparison with the rural areas of most developing countries, rural China provides better educational access, certainly at the primary level and probably at the secondary level. The Law of Nine-year Compulsory Education, passed in 1986, envisaged that all children would receive this minimum education, commonly 6 years of primary school and 3 years of "middle" (or "lower secondary") school. However, the implementation of the policy has varied in pace and extent according to local prosperity. With economic reform, the fiscal system moved towards decentralization and self-finance. The majority of government funding for rural education comes from the lowest levels (village, township and county). As fiscal pressures intensified with the decline in redistributive budgetary transfers, rural local authorities resorted to imposing a variety of user fees and charges. The educational access of poor rural households may thus have deteriorated, at least in relative terms and possibly in absolute terms.

By law, primary education is supposed to be free but in practice various fees have been levied: fees for tuition, for textbooks and for uniforms, and "financial contributions" and other school-based fees or charges. On the basis of ability to pay, we expect to find lower user charges in poorer areas. On the basis of community revenue, however, we expect poorer areas to rely more heavily on user charges. There is great spatial variation in the quality of the provision of basic education. At one end of the scale there is the "teaching point" to be found in poor, small, remote localities. This is a one-room school house (often dilapidated) with a single teacher (often with no more than middle school education) instructing all children within walking distance. At the other extreme, schools in the wealthy rural areas may have well-qualified teachers and be equipped with libraries, science laboratories, etc. School quality has emerged as an important policy concern in rural China.

A study (Liu *et al.*, 2006) based on interviews with 800 primary and middle school principals in poor rural areas of Hebei Province in 2002/03 provided evidence that the quality of education is a serious problem. The decentralized nature of the funding of compulsory education was also evident from their survey. Only 7% of funds came from central or provincial governments, 11% from county governments, 9% from township governments, and the remaining 73% from village revenues or tuition fees.

At the post-compulsory level—the 3 years of high (or "senior secondary") school—there tends to be educational rationing in rural areas. Pupils performing well in examinations can continue to high school, but only if they can afford to pay the school fees. The quality of high school education is in turn important for success in the competitive national examination that gives access to tertiary education and thence to the high-income and urban life that college graduation normally offers.

The existing literature on the determinants of education in rural China suggests that parental lack of income and also of education adversely affect the education of children, that credit constraints bite, and that higher school fees are associated with higher school quality (e.g. Knight & Li, 1996, Brown & Park, 2002, Connelly & Zheng, 2003, Hannum & Park, 2007a). Taken together, the institutional features described above and these research results suggest that poverty at both the household and the community levels can indeed have an adverse effect on the quantity and also the quality of schooling in rural China.

3. The Poverty Trap Hypothesis

A "poverty trap" or "low-level equilibrium trap" can be a general phenomenon associated with lack of savings and of access to credit, absence of productive social networks, scarcity of local economic opportunities, and the debilitating effects of a "culture of poverty". For instance, Bowles *et al.* (2006) argue that there are many conditions that can trap individuals or groups in intractable poverty. These include the existence of critical thresholds, dysfunctional institutions and neighbourhood effects, each of which can give rise to multiple equilibria.

In this and the companion paper we concentrate on the potential role of education—its absence or presence—in making or breaking a poverty trap. Postulating a vicious circle requires justification. There is some to be found in the literature. For instance, Galor & Zeira (1993) theorize that, given initial high inequality, liquidity constraints and set-up costs, it is possible that poor households will not invest in education, so locking their descendants into a poverty trap and perpetuating the inequality. Barham *et al.* (1995) developed a model in which households differ in their ability to accumulate human capital owing to their facing different rates of return to investment in education and having different capabilities to fund educational expenditures. They show that liquidity constraints can give rise to a poverty trap, in which able children remain uneducated and therefore poor. Durlauf (2006) argues that social interactions can explain persistent inequality across localities. McMahon (1999) provides a systematic account of the interrelationships and feedback between education and economic development, consistent with the existence of vicious and virtuous circles.

Our basic hypothesis is that it is easy for households to be trapped in a poverty trap linking income and education. We start with an elementary illustration of a basic poverty trap involving just education, income and a credit constraint. Consider a simple model in which education in years (E) is a function of income (Y) and income in turn is a function of

education. What are the conditions required for the existence both of a low-level equilibrium poverty trap and also of a high-level equilibrium? Figure 1 illustrates. Assume that the education function $E = E(Y, \dots)$ is inverse S-shaped to reflect the insensitivity of education to income when income is low (the effect of binding wealth and credit constraints), its sensitivity over a range of income, and its dependence only on the rate of return to education when wealth and credit constraints become irrelevant. The income function $Y = Y(E, \dots)$ can be linear, convex or concave without necessarily altering the analysis. In the figure we show it to be concave: income rises with education but at a diminishing rate.

The equilibrium of E and Y at point a is locally stable: small divergences result in a move back to a. However, there is a second equilibrium at point b, which is locally unstable. Thus, an exogenous increase in education from E_1 to a level less than E_2 leads in time, through interaction between the functions, to a restoration of equilibrium: the ensuing rise in income is insufficient to sustain that level of education, and in due course both income and education decline to point a. However, if education can be raised above the threshold, from E_1 to a level beyond E_2, interaction then raises both education and income. A third equilibrium is reached at point c, corresponding to education E_3, which is stable on account of the declining sensitivity and eventual insensitivity of education to income.

The other determinants of Y and of E may be such that some households face only one equilibrium. Thus, a sufficiently large vertical rise in $Y = Y(E, \dots)$, e.g. through investment in physical capital or an increase in product price, would confine a household to the high-level equilibrium, and a sufficiently large fall would confine it to the low-level equilibrium. Similarly, an improvement in access to credit or an increased subsidy of education would shift $E(Y, \dots)$ rightwards and, if sufficiently large, generate a single high-level equilibrium.

This very simple model is intended to illustrate two things. First, it is possible for a household to be stuck in a low-level poverty trap, involving both low education and low income. Second, there is a potential escape from poverty, at least for some households. A large enough intervention to raise education might go through the threshold and propel the household to another equilibrium involving higher levels of education and income.

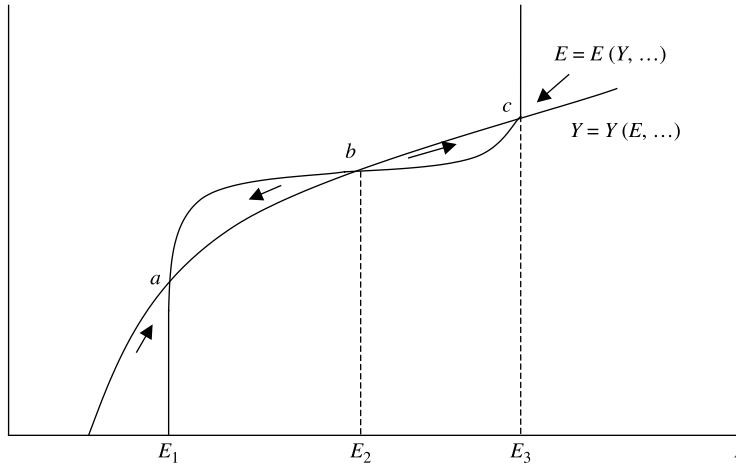

Figure 1. A poverty trap.

In reality, the forces creating vicious and virtuous circles are more complex than that and involve many more interdependent variables. We set up a system of interdependent equations. They are not simultaneous equations in the sense that they are not all contemporaneously determined, involving as they do some relationships running from one generation to another. They illustrate the nature of the vicious or virtuous circles that generate a poverty trap or engineer an escape from it. We have five equations, each dependent on some of the others.

$$EN = EN\,(EP^*, EC^*, YC^*, EQ, Y, HE) \tag{1}$$

$$EQ = EQ\,(YC^*, Y) \tag{2}$$

$$Y = Y\,(EN, EQ, HE) \tag{3}$$

$$HE = HE\,(Y, EN) \tag{4}$$

$$HA = HA\,(Y, EN, HE), \tag{5}$$

where *EP* is parental education, *EC* is community education, *YC* is community income, *y* is income, *EN* is educational enrolment in years, *EQ* is educational quality, *HE* is health, *HA* is happiness and an asterisk indicates that the variable is exogenous.

The first two equations—school enrolment and school quality—are analysed in this paper, and the other three in the companion paper. Our five-equation model bears similarities to the dynamic model of McMahon (2007), which contains an income growth equation, an equation determining non-income development goals, and an equation explaining investment in education.

Consider the reasoning underlying equations (1) and (2). We distinguish effects that operate through the community, on the one hand, and the individual or the household, on the other. The poverty of the community might mean that there is no local school, so raising the transport costs of school attendance or making it prohibitive. Inadequate community funding for education can reduce the quality of school provision, so decreasing its prospective rate of return. The community rationing of places at post-compulsory levels of education implies that poor school quality at the compulsory levels might prevent access to the high rates of return further up the educational ladder, so deterring even "compulsory" school enrolment. The lack of local tax revenue can also, or alternatively, necessitate higher school fees being charged, so reducing the prospective rate of return or causing credit constraints to bind. There might also be a low rate of return to education generally in a poor community on account of a lack of local productive economic opportunities. A more general phenomenon, which envelops these categories, is the "culture of poverty" that can take hold in a poor community and which dulls supply initiatives and demand incentives. For instance, a low level of education in the community—whether among adults or among children—can set a social norm for education and deter individual investment beyond the social norm. Through their effect on the quantity and quality of education that a child receives, community education and community income are externalities that affect the income of the next generation, so entering indirectly into equation (3).

At the individual or household level, educational enrolment can be constrained by lack of savings and by credit constraints. Household income, which would otherwise be irrelevant to a decision to invest in education, might therefore influence enrolment. The need for additional household current income might require that children work and thus raise the opportunity cost of enrolment. Poverty might reduce the prospective rate of return to education and thus discourage enrolment. There are several channels through which this can operate: ill-health, and physical and mental stunting, of the child; a weak and unproductive social network to provide economic opportunities; limited productive assets with which to combine human capital; credit constraints that raise the cost of, and thus lower the return to, education; and risk aversion, which requires a premium on the return to the investment. The higher school fees involved might restrict the quality of schooling that the household can afford. For various reasons, the education of parents might encourage the enrolment of their children: their own schooling experience might give the parents a "taste" for education, which then motivates their children; and they might impart out-of-school cognitive skills to their children, helping them to perform well at school. If uneducated parents are less successful in these matters, educational deprivation can be transmitted from one generation to another. The income poverty and educational poverty of the parents harm the child's schooling and thus feed through into their adult income. In this way the poverty trap has a dynamic component—although we are prevented from directly examining intergenerational effects on the future adult income of the children of the household by the cross-section nature of the data set.

4. Pointers from the Survey

Primary school normally takes 6 years to complete, middle school 3 years, and high school 3 years. No less than 84% of children in the sample were enrolled by the age of 7. We therefore take the age group 7–12 to be representative of primary school enrolment, 13–15 to correspond to middle school enrolment, and 16–18 to be relevant for high school. The primary school net enrolment rate in the sample is remarkably high (at 95%), as is the middle school net enrolment rate (90%). All but a small minority of children attend the compulsory years of school. Only in the non-compulsory high school years does the net enrolment rate fall sharply (55%).

Nevertheless, household income is important to schooling decisions. We use the detailed information collected on 7–16-year-olds to contrast three categories of 15- and 16-year-olds: those who did not complete their compulsory education, i.e. drop-outs before the end of middle school, those who had completed compulsory education but were no longer in school, and those who had completed middle school and were currently in school (we refer to the three groups as early drop-outs, middle school graduates and high school pupils). If teenagers are enrolled in school, the household is liable to forgo income and thus its income may be lower. As school enrolment can reduce household income, we simulate household income to correct for this effect, as will be explained in Section 5.

With the sample divided into five quintiles of households ranked by income per capita, we contrast the poorest households (the first quintile) with the richest (the fifth quintile). Among the children in poor households, 48% are early drop-outs, 23% middle school graduates and 29% high school pupils. The corresponding proportions for those in the richest households are 14, 13 and 74%. The ratios of early drop-outs to high school pupils are very different: 1.65 and 0.18, respectively. The enrolment rate of 15–18-year-olds

(whatever their level of education) rises monotonically, from 52% in the first quintile to 73% in the fifth quintile.

Household expenditure on each child in school varies with income. When households are classified into the bottom, middle and top income per capita terciles, both tuition fees and other educational spending (including that on uniforms and textbooks) vary greatly across the three household groups, and this is true of all three age groups. In the oldest age group (16–18 years), the ratio of the top to the bottom income group exceeds 2 : 1, and is the same for both tuition fees and other educational expenditures. We expect average county income per capita to serve as a proxy for public expenditure per pupil. If that is the case, private expenditure might be higher in poorer counties. When households are grouped into county per capita income terciles (aggregated over all sampled households in each county), the ratio of household expenditure per pupil in the richest third of counties to that in the poorest third generally exceeds 2 : 1. This is further evidence that poor households, and households in poor counties, suffer from poor quality education.

Despite the large differences in household expenditure per pupil, the burden of educational expenditure on household budgets is actually greater for poorer households. When total educational expenditure of the household is expressed as a percentage of (simulated) household income, it falls almost monotonically, from no less than 26% in the poorest quintile to 7% in the richest. For the poorest quintile to have to pay a quarter of their income on education is indeed a burden. These results are in line with the findings of Gustafsson & Li (2004), using the equivalent 1988 and 1995 IE, CASS surveys, that the private cost of education had risen sharply over those years and was particularly burdensome on the poor.

There are sharp differences in expenditure per pupil according to age group. The ratios of expenditures in the age groups corresponding to primary, middle and high school are roughly 1 : 2 : 4. The direct costs of schooling increase substantially as children enter middle school and again as they enter high school. Credit constraints might therefore deter progression up the educational ladder.

5. The Determinants of Enrolment

Given that the enrolment rates are so high in the age groups relevant to compulsory education, the estimation of enrolment functions predicting enrolment at that level is not very informative. The few children of primary school age who are not enrolled are mostly still waiting to attend school (33%) or not economically active (at least 40%). Among drop-outs of middle school age, most (at least 59%) are not economically active, but a minority (24%) are working. No fewer than 72% of the drop-outs of high school age are at work, but at least 15% are not economically active. Thus, by no means all drop-outs find work, at least immediately, but at high school age the choice is largely between employment and enrolment.

The general questionnaire of the rural survey gathered information on the education of all individuals, but the specially designed education module sought more detailed information on the education of children in the age group 7–16 years. Our analysis combines the two sources. Examining the children aged 15 or 16 years, there are three groups of interest: drop-outs before the end of middle school, drop-outs at the end of middle school, and those continuing after middle school. A total of 25% of those who had attended middle school had left school without completing, and of those children (here we

can extend the age group to 15–18 years) who had completed middle school, 41% continued to be enrolled in high school. We pose two key questions. First, why do some children drop out of middle school before they complete their compulsory education? Second, why do some children continue into high school after they complete their compulsory education? Our estimates can effectively explain enrolment in middle school and high school, respectively.

A key variable in our various estimations is income. However, income may well be endogenous, either because it is partly determined jointly with enrolment (omitted variables) or because it is itself partly determined by enrolment (reverse causation). In order to measure the causal effects of income, it is necessary to simulate this variable or to instrument it. We use a measure of income that standardizes for the loss of income that enrolment, with consequent withdrawal of labour, might cause: we calculate both farm and non-farm average hourly labour income at the county level, multiply these by the working hours of children of the relevant age group in the household, and subtract this sum from actual household income to obtain simulated income. This eliminates the difference in household income that is attributable to the greater hours worked by drop-outs. Without such a correction, there is a danger that the coefficient of income in an enrolment function will be biased downwards. That is the most likely source of bias. However, it is also possible that parents work harder to fund the education of their children, in which case there can be upward bias. There is a case for instrumenting income in a way that corrects for both sorts of bias. The difficulty, however, lies in finding valid instruments, as nearly all the variables at our disposal might influence the opportunity cost of enrolment. After experimentation, we chose to use the identifying variables reported in the notes to Table 3 (see later). Generally, however, we use simulated rather than instrumented income in our estimations.

We build on earlier research. Knight & Li (1996) estimated that household income raised the probability of teenage enrolment in 1988 and that, for the poorest quarter of households, two variables, both measured at the county level, were relevant: the opportunity cost of education deterred enrolment and the rate of return to education encouraged it. Connelly & Zheng (2003) found that teenage school attendance in 1990 was raised by parental educational attainment, the village school attendance rate and income per capita in the county. Brown & Park (2002) concluded that younger children in poor counties in 1997 were more likely to drop out of school if the household was "poor and credit-constrained" and if the father had less education. Both Knight & Li (1996) and Brown & Park (2002) found that school fees had a positive effect on enrolment, suggesting that higher fees improve the quality of education and hence the rate of return. Hannum (2003) examined community influences and found that enrolment of rural children of middle school age was raised by local middle school provision and village income.

5.1 Explaining Middle School Drop-out

The implementation of the compulsory education programme is dependent on the financial capacity of local governments. It is inevitable that the programme is thwarted more in the poorer areas. Even in the less poor areas, the rapidly rising tuition fees of recent years might prevent some children from completing compulsory education. Table 1 presents the results of a binary logit analysis estimating the determinants of premature drop-out from middle school. The dependent variable is equal to one if the child had not completed middle school and equal to zero for completion. For each independent variable, the table reports the

Table 1. The determinants of drop-out from middle school, binary logit estimates

	(1)		(2)	
	Coefficient	Marginal	Coefficient	Marginal
Simulated ln income per capita	−0.479***	−0.055		
Simulated ln income per capita				
Quintile 1			0.744*	0.099
Quintile 2			−0.210	−0.022
Quintile 3			0.000	0.000
Quintile 4			0.096	0.011
Quintile 5			−0.426	−0.043
Credit-constrained	1.069	0.172	1.117	0.180
Disaster in 2002	0.534**	0.064	0.542**	0.064
Father's years of education	−0.008	−0.001	−0.013	−0.001
Mother's years of education	−0.113**	−0.013	−0.117**	−0.013
One or more brothers	0.001	0.000	0.038	0.004
One or more sisters	−0.034	−0.004	−0.017	−0.002
Male	0.459*	0.051	0.481**	0.053
Good performance in middle school	−1.703***	−0.190	−1.770***	−0.194
One or both parents a migrant	0.009	0.001	−0.022	−0.002
County simulated ln mean income	0.712	0.081	0.629	0.070
County migrant density	−2.215**	−0.253	−2.251**	−0.251
Distance to nearest middle school	0.032*	0.004	0.029	0.003
County proportion of adults aged 25–34 years who completed high school	−4.904**	−0.559	−5.187**	−0.579
County proportion dissatisfied with secondary schools	0.460*	0.052	0.398	0.045
County rate of return in farming	−23.671	2.701	−24.603	−2.748
Province rate of return in non-farming	−8.772	−1.001	−6.361	−0.710
County enrolment rate for 15–16-year-olds	−2.778***	−0.317	−2.895***	−0.323
Designated poor county	−0.274	−0.029	−0.339	−0.034
Intercept:	4.032**		0.719	
Mean of dependent variable:	0.131		0.128	
Number of observations:	631		631	

Notes: We use simulated rather than instrumented income; the latter has a similar but slightly smaller coefficient on ln income per capita and has less statistical significance. Standard errors are corrected for clustering at the county level.

***Significance at the 1% level, **significance at the 5% level, *significance at the 10% level.

coefficient and the marginal effect. Two specifications are shown, one with simulated log natural income and the other with five simulated income quintile dummy variables, intended to explore non-linearities in the effects of income. Given our interest in the role of poverty, we classify the determinants as poverty-related at the household level, poverty-related at the community level, other household variables, and other community variables.

Consider first the poverty-related household variables. Simulated log natural household income per capita has a highly significant negative coefficient: income reduces the probability of dropping out early (column 1). The marginal effect implies that a fall in income by one standard deviation increases the probability of dropping out early by 4.3 percentage points. As the actual drop-out rate is 21.2%, this represents an increase of

20.3%. However, in the alternative specification (column 2) we see that the relationship is non-linear: only the lowest income quintile has a coefficient significantly different from zero. The large positive coefficient implies that being in the poorest quintile of households (instead of in the middle quintile) increases the probability of dropping out early by 9.2 percentage points, or by 43.4%.

Whether the household perceives itself to be subject to a credit constraint is a second indicator of poverty. The coefficient on the variable indicating that the respondent's household would not be able to borrow 5000 yuan if it was urgently needed is positive but not quite significant. As lack of credit is often a concomitant of low income, we consider also their combined effect: an F-test (for column 1) shows that they are jointly significant at the 2% level. An indicator of temporary poverty is provided by the household reporting a natural disaster in 2002. Entered as a dummy variable, it has a significantly positive coefficient: a recent spell of poverty increases the probability of premature drop-out by 5.5 percentage points (25.9%). Poverty is indeed an obstacle to the completion of compulsory education.

Parental education is an indirect indicator of household poverty. The coefficients on years of schooling of both father and mother are negative, as expected, but the coefficient is significant only in the case of the mother. For instance, if the mother completed middle school instead of primary school, the probability of early drop-out would be diminished by 3.6 percentage points (17.0%) (column 1). Thus, the intergenerational transmission of educational outcomes may also perpetuate the poverty of a household. There can be sibling competition for educational resources within a resource-constrained household. We therefore include the possession of a brother and of a sister as explanatory variables, but in neither specification is the coefficient significantly different from zero.

We have four other individual or household variables. We found, unexpectedly, that being male actually increases the chances of early withdrawal, by 6.1 percentage points (28.8%) (column 2). Self-assessment of performance at middle school is highly significant: those who reported that their performance was good had a probability of early drop-out 18.7 percentage points (88.2%) lower (column 2). We examine hereafter the determinants of secondary school performance and find that it is weakened by poverty (see Table 4 later). Finally, we introduce a dummy variable indicating that one or both parents are currently migrants. On the one hand, migrant parents might be a source of school fees but, on the other hand, schooling might be neglected if parents are absent. However, the coefficient has a different sign in the two specifications and is not at all significant. We experimented with a dummy variable indicating that the child is in poor health. In no case was its coefficient statistically significant, probably because there are only 24 cases or because unhealthy children do not even get as far as middle school. However, Yu & Hannum (2006) found evidence from a survey for rural China, which was more appropriate for this purpose that, standardizing for household socio-economic characteristics, indicators of child ill-health do adversely affect grade attainment and test scores.

Consider how community-level variables affect early drop-out from compulsory education. The main unit for analysis is the county (average population about half a million) as only 10 households are sampled within each village—too few to provide reliable means. The county (simulated) mean per capita income of sampled households has a positive but insignificant sign. County prosperity has two contradictory effects. On the one hand, local government is better able to subsidize compulsory education; on the other hand, local prosperity raises the opportunity cost of education for teenagers. If it is not a

matter of chance, the positive coefficient implies that the latter effect prevails. The coefficient is insensitive to the exclusion of explanatory variables that are potentially correlated with county prosperity.

Another possible indicator of the opportunity cost of middle school attendance is the migration density in the county: the proportion of workers who are working outside the county is likely to reduce the search costs and psychological costs of migration. The existence of migration opportunities can have two contradictory effects: it can encourage teenagers to leave school early in order to earn wages as migrants that are higher than they can get in the village, or it can encourage them to stay on at school because the returns to education in migrant employment may be greater than the returns to education in the village. The coefficient is significantly negative: a rise by one standard deviation in the proportion of migrants lowers the probability of early drop-out by 3.2 percentage points (15.0%). This implies that the latter effect is the more important. As this variable might be endogenous, we use a valid instrument—farm land per capita—to predict migration intensity. However, the coefficient is barely altered, and the Wald test of exogeneity indicates that instrumenting is unnecessary. The distance between the household and the nearest middle school has a positive but slight and insignificant effect, possibly because this distance is typically small (mean 3.8 km).

Certain counties are designated as "poor counties" by central or province governments. Designated poor counties receive special funds from the national or provincial government to help them overcome their poverty. We introduced a dummy variable denoting that a county was designated in that way, to find out whether this support helps to reduce drop-out from middle school. In each case the coefficient is negative, as expected, but far from being significant; nor does its inclusion alter the coefficients on income. Designated poor counties are no different in the matter of early drop-out from compulsory education. Fiscal support from the higher tiers of government does not appear to help them to achieve universal compulsory education.

The equation contains two variables to proxy the quality of education in the county. One is the proportion of adults aged 25–34 years in the county who had attended high school. The coefficient is negative and highly significant: a reduction of the proportion by one standard deviation raises the probability of early drop-out by 5.7 percentage points (26.7%) (column 2). This rise may reflect the lower chances of progressing to high school when entry is more restricted or a lower quality of education is being received. On average 45% of people reported dissatisfaction with the quality of secondary education in their county. The coefficient on the proportion expressing dissatisfaction in the county is positive, as expected, but not quite significant. When two other potential proxies for the quality of county schools—average school fee in the county and educational expenditure per capita by the county government—were tried, they showed the expected signs but were not significant.

The theoretical concept for assessing the demand for education is the private rate of return to education. We estimated the return to a year of schooling at the community level. It was necessary to estimate the returns separately for farming (normally a household self-employment activity) and non-farming (often an individual wage employment activity), but this was helpful as the estimated returns were distinctly different, with the returns being generally higher in non-farm (province mean 3.4%) than in farm activities (county mean 1.2%). We estimated both returns at both the county and the province levels. In the probit equations the variable for the returns in farming performed better at the county level

and the variable for the returns in non-farming performed better at the province level. Thus, it appears that the relevant returns in farming are perceived to be those at the county level, whereas the relevant returns in non-farm activities relate to a larger area, the province, probably reflecting the greater mobility of non-farm labour. The rate of return to education may be important for those deciding whether to complete middle school. The coefficients on the return to a year of schooling in county farming and in province non-farming are both negative, as expected, but neither is statistically significant.

Finally, we note the large and significantly negative coefficient on the county enrolment rate among 15–16-year-olds. A reduction in this enrolment rate by one standard deviation increases the probability of withdrawal from middle school by 6.2 percentage points, or by 29.2% (column 2). The interpretation of this effect on individual enrolment is not straightforward (Manski, 1993; Soeteven, 2006). The problem is to identify the true relationship in the face of the "reflection" problem—whether the mirror image causes a person's behaviour or reflects it. The county enrolment rate may have an "endogenous" social effect, i.e. a high enrolment of the reference group itself encourages individual enrolment by way of social norms or peer influences or bandwagon effects. The reverse of the coin is that in counties with a "culture of poverty" the accepted social norm for education is low. The difficulty is to distinguish this effect from an "exogenous" effect and a "correlated" effect, both of which can also influence individual enrolment. An exogenous effect depends not directly on the enrolment but on the characteristics of the group, which may be such as to encourage individual enrolment. A correlated effect arises if individuals enrol similarly because they have similar characteristics and face similar incentives to enrol. It is possible that the positive coefficient on the county enrolment rate is due to county characteristics that encourage the enrolment of individuals in the county and which are not included in the enrolment equation, e.g. because the county has a history of strong demand for, and hence supply of, education.

5.2 Explaining High School Continuation

Our second exercise is to examine the determinants of the decision to enrol in high school after completion of middle school. For the binary logit analysis, among those 15–18-year-olds who have completed compulsory education, the group still enrolled is given a value of one and the group now out of school a value of zero. Table 2 reports the results, again with two specifications of the income variable. With minor exceptions the same set of explanatory variables is employed. Some of the results are very similar (allowing for the change in sign implicit in the dependent variable), but a few are different.

Consider the variables representing poverty at the household level. Simulated log natural income per capita has a significantly positive coefficient: an increase by one standard deviation increases the probability of enrolment by 18.1 percentage points (column 1). Recalling that the mean enrolment proportion is 45.8%, this represents an increase of 39.6%. The alternative use of (simulated) income quintiles again shows that children in the poorest quintile have significantly worse access to high school, although in this case the probability of enrolment increases monotonically across the quintiles (column 2). Thus, a child in the lowest quintile has a probability of being enrolled in high school 23.2 percentage points (50.8%) below a child in the middle quintile, and one in the richest quintile a probability 17.7 percentage points (38.6%) above. Moreover, if a household reports that it cannot raise a loan, there is a significant negative effect: the probability of high school

Table 2. The determinants of continuation from middle school to high school: binary logit estimates

	(1)		(2)	
	Coefficient	Marginal	Coefficient	Marginal
Simulated ln income per capita	0.774***	0.191		
Simulated ln income per capita				
Quintile 1			−1.002***	−0.232
Quintile 2			−0.067	−0.016
Quintile 3			0.000	0.000
Quintile 4			0.356**	0.088
Quintile 5			0.716***	0.177
Credit-constrained	−0.967**	−0.211	−0.911**	−0.202
Father's years of schooling	0.057*	0.014	0.064**	0.016
Mother's years of schooling	0.040*	0.010	0.042*	0.010
One or more brothers	−0.292**	−0.072	−0.280*	−0.069
One or more sisters	−0.168	−0.041	−0.158	−0.039
Good performance in middle school	1.365***	0.325	1.364***	0.326
Male	0.230**	0.057	0.241**	0.059
One or both parents a migrant	0.487***	0.121	0.489***	0.122
County ln simulated mean income	−1.125***	−0.277	−1.026***	−0.253
County migration density	1.413**	0.348	1.336***	0.330
County proportion of adults aged 25–34 years who completed high school	1.197	0.295	0.987	0.244
County proportion of children in key schools	0.589	0.145	0.453	0.112
County mean school fees	2.157***	0.531	2.250***	0.555
County proportion dissatisfied with secondary schools	0.459***	0.113	0.448***	0.111
County rate of return in farming	15.257**	3.759	15.569**	3.842
Province rate of return in non-farming	5.689	1.402	5.403	1.333
County enrolment rate for 15–18-year-olds	3.839***	0.946	3.798***	0.937
Designated poor county	−0.032	−0.008	0.023	0.006
Intercept:	−6.312***		−5.887***	
Mean of dependent variable:	0.440		0.443	
Number of observations:	1822		1882	

Notes: As for Table 1.
***Significance at the 1% level, **significance at the 5% level, *significance at the 10% level.

enrolment is reduced by 21.1 percentage points, or by 46.1% (column 1). Thus, the poor and credit-constrained are at a huge disadvantage in gaining access to high school.

The education of both parents has a positive and significant effect. Three extra years of schooling (corresponding to a rise in educational level from primary school to middle school, or from middle school to high school) for the father raises the probability of high school enrolment by 4.2 percentage points (9.2%) and for the mother by 3.0 percentage points (6.6%) (column 1). There is evidence that siblings compete for household resources: the coefficient on the presence of a brother is negative and significant, implying that the probability of continuing to high school is reduced by 7.2 percentage points (15.7%) (column1).

In so far as poverty affects performance at middle school, there is a further mechanism by which the poor are disadvantaged. A report of good performance has a positive and significant coefficient: the probability of continuing beyond middle school is raised by no less than 32.5 percentage points (71.0%) (column 1), reflecting the rationing of high school places and thus the competitive nature of access to high school. As in the case of middle school drop-out, the coefficient on poor health was not significantly different from zero and was dropped. However, a stringent definition of ill-health, creating only 15 cases, did produce a significantly negative and substantial effect.

There are some interesting contrasts between Tables 1 and 2. In Table 1, against expectations, a boy was shown to be more likely than a girl to drop out of middle school. In Table 2 the significant positive coefficient indicates the opposite: a boy has a 5.6 percentage point (12.2%) higher probability of continuing to high school (column 1). Whereas having at least one migrant (away from the county) parent was not significant in the middle school equation, that coefficient is significant and positive in the high school equation, increasing the probability of enrolment by 12.2 percentage points (26.6%). Migrant remittances can be a source of funds for the payment of high school fees and charges; indeed, the need to make such payments might provide a motive for migration.

We turn to the community influences on high school enrolment decisions. County log natural income per capita has a significant negative coefficient: an increase by one standard deviation reduces the probability of high school enrolment by 13.3 percentage points (29.1%) (column 1). The migration density of the county has a significant positive sign: a rise by one standard deviation raises that probability by 4.3 percentage points (9.4%) (column 1). We again instrument migration density using farm land per capita in the county. In this case the Wald test of exogeneity is failed. For instance, there might be some unobserved variable, such as the ambition of local people, which explains both the dependent and the independent variable alike and masks a negative causal relationship. However, in both equations the effect of instrumenting is to raise the positive coefficient (e.g. from the reported 1.408 in column 1 to 2.522, both significant at the 1% level). Whereas county income appears to proxy the opportunity cost of high school enrolment, the income prospect from migration opportunities does not perform that role.

Consider the variables that might represent the quality of education. The proportion of adults aged 25–34 years who completed high school and the proportion of children at middle and high school who attend "key schools" (schools that are given more public resources, charge higher fees, and have highly competitive entry) have positive coefficients, as expected, but neither coefficient is significant. However, the coefficient on the mean level of high school fees in the county is positive, significant and important: a one standard deviation rise increases the probability of high school enrolment by 9.2 percentage points (20.1%) (column 2). We take this variable to represent the quality of high school education in the county, and its coefficient to represent the effect of quality on demand. Finally, the coefficient on the proportion of households in the county expressing discontent with the quality of secondary schools is significantly positive. This surprising effect—the opposite of the equivalent result in the equation for predicting middle school drop-out—might reflect the high expectations of those whose children continue to high school and the likelihood that many respondents answer by reference to the local middle school whereas their children attend a more distant high school.

The coefficient on the county rate of return to a year of education in farming is significantly positive. It implies that the probability of high school enrolment rises by

Table 3. The determinants of drop-out from middle school and of continuation to high school, restricted model with income instrumented

	Drop-out		Continuation	
	Coefficient	Marginal	Coefficient	Marginal
Income (instrumented)	−0.656**	−0.202	0.385**	0.148
Good performance in middle school	−0.838***	−0.244	0.811***	0.307
Male	0.020	0.006	0.119**	0.046
County rate of return in farming	−8.154	−2.506	13.611***	5.222
Intercept:	0.231		−1.168***	
Wald χ^2:	85.58		264.97	
Number of observations:	753		2262	

Notes: The Stata program ivprobit maximum likelihood is used. The identifying variables in the income equation are: whether the village leader has experience of running a business, whether the village had to sell grain at the officially specified price in 2002, and whether the terrain of the village is plain (the reference category), hilly or mountainous. All four variables have the expected sign and are statistically significant. The test of over-identifying instruments is passed in the continuation but not in the drop-out equation. In both equations, the Wald test of exogeneity indicates that we cannot reject the hypothesis that income is exogenous.

***Significance at the 1% level, **significance at the 5% level, *significance at the 10% level.

3.8 percentage points (8.3%) if the return rises by one standard deviation (column 2). The province rate of return in non-farm activities is also positive but not quite significant. These results suggest that the private demand for high school education is responsive to the prospective returns. Finally, the coefficient on the county enrolment rate for 15–18-year-olds is significantly positive: a one standard deviation increase in that rate boosts an individual's probability of high school enrolment by 16.5 percentage points (35.9%) (column 2). This is consistent with a bandwagon effect that can make or break an educational vicious circle, or with some unobserved factor influencing both dependent and independent variables, e.g. the tightness with which high school places are rationed or a county tradition of valuing education highly.

We made an attempt to estimate the drop-out and continuation equations using instrumented income instead of simulated income. Unfortunately, estimation with necessarily weak instruments reduced the precision of the estimates and, in the full equation, the coefficients on income were no longer significant. Our solution was to estimate a restricted model, retaining only the explanatory variables that were less likely to be correlated with poverty so that the income variable would be the sole proxy for poverty. The results are shown in Table 3. Poverty does indeed deter completion of middle school significantly: a fall in income by one standard deviation raises the probability of drop-out by 13.5 percentage points (57%) (column 1). Poverty also impedes continuation to high school: the same fall in income reduces the chances of continuing by 9.7 percentage points (21%) (column 2). In the estimations to come we generally use simulated rather than instrumented income.

6. The Determinants of Educational Quality

Educational quantity and quality are interrelated. The enrolment functions contain explanatory variables that are serving as proxies for quality of education: these suggest that higher quality raises enrolment. However, the proxies are in turn influenced by the

poverty of the household or the locality. The implication is that quality and quantity of education may interact positively, and that households can get stuck in a poverty trap because they experience both a poorer quality and lesser quantity of education: the value of their human capital suffers in two ways.

In this section, the determinants of educational quality are examined. As the survey lacks direct measures of educational "output", such as cognitive skill scores, quality has to be measured indirectly and implicitly—by the determinants of self-rated school performance, of time spent learning, and of expenditure on education. By contrast, Hannum & Park (2007b) did have direct measures of educational output. They analysed the determinants of pupil achievement and engagement in rural Gansu in 2000, and found that poorer children, and children of less-educated mothers, were at a significant disadvantage. This was attributed particularly to lower quality of teachers, less supportive home environments, and lower aspirations for education.

6.1 The Determinants of School Performance

Respondents were asked about their school performance relative to their peers when at middle school or, if they had not attended middle school, their performance when at primary school. We analyse the replies of children aged 13–18 years. Half of them (50%) reported that their performance was either good or very good. This group takes the value one, and the rest the value zero, in our binary logit analysis. Such a self-reported indicator may be inaccurate and also biased (few respondents owned up to a bad or very bad performance), but our estimates produce plausible and statistically significant results (Table 4).

Both father's and mother's years of schooling have a significant positive effect. For instance, if the father completed middle school instead of primary school, the probability of performing well rises by 5.1 percentage points, or by 10.2%. When log natural simulated household income per capita is included as a proxy for parental support for the

Table 4. The determinants of school performance of children aged 13–18 years, binary logit analysis

	Coefficients		Marginal effects	
	(1)	(2)	(1)	(2)
Male	−0.055	−0.048	−0.014	−0.012
Father's years of schooling	0.068***	0.061***	0.017	0.015
Mother's years of schooling	0.059***	0.048***	0.015	0.012
ln simulated household income per capita	0.121**	0.046	0.030	0.012
ln expenditure on child's schooling		0.231***		0.058
Child works after school	−0.165**	−0.088	−0.041	−0.022
Child not in good health	−0.826***	−0.844***	−0.197	−0.200
Constant term	−1.685***	−2.589***		
Mean of dependent variable:	0.504	0.500		
Number of observations:	3564	3323		

Notes: The dependent variable is (self-reported) excellent or good performance at secondary school (or, if secondary school was not attended, at primary school) = 1. The dummy variable for work is child does farm work or housework after school during school terms = 1, and the dummy variable for health is child's health is so-so, bad, or very bad = 1.

***Significance at the 1% level, **significance at the 5% level, *significance at the 10% level.

child's education (column 1), it has a positive and significant coefficient: a one standard deviation rise in this variable increases the chances of performing well by 2.3 percentage points, or by 4.6%. However, when the highly correlated variable, log educational expenditure, is included as well, the income coefficient is not significant and it is the educational expenditure variable that does the work (column 2). In other words, income has its main effect through enabling parents to spend more on their child. The marginal effect for log expenditure indicates that an increase by one standard deviation increases the probability of performing well by 5.6 percentage points, or by 11.2%. The two variables with links to household poverty have significantly negative coefficients (column 1). A dummy variable indicating that the child works after school and another indicating that the child is not healthy reduce the probability of good performance by 4.1 and 19.7 percentage points, respectively.

6.2 The Determinants of Time Spent Learning

The quality of education that children receive can depend on the intensity with which they study. Moreover, children may need to study hard at primary and middle school if they are to succeed in the competition for entry to high school. If children from poor households are more likely to engage in work out of school, they may have less time for study and therefore may learn less and also have a smaller chance of securing a rationed high school place. We know whether certain activities are "always performed after school": farm work, childcare and housework. Binomial logit estimates for participation in these activities were estimated (Table 5).

Table 5. Logit model indicating that a child always performs certain activities after school: children aged 6–16 years

Dependent variable:	Farm work	Childcare	Housework
Simulated income per capita	−0.005***	0.000	−0.005***
At least one parent a migrant	−0.026*	−0.019**	−0.016
Attendance at key school	−0.060***	−0.017	−0.100***
School fee ('000 yuan)	−0.029***	−0.003	−0.031***
Age (years)	0.024***	−0.004***	0.024***
Male	0.010	−0.024***	−0.068***
Minority group	0.100***	0.008	0.154***
Younger sibling at school	0.039***	0.020***	0.085***
Younger sibling not at school	0.032*	0.266***	0.017
County educational expenditure per capita	−0.986**	0.300	−3.656***
County proportion of pupils aged 15–18 years in key schools	−0.018	−0.030	−0.144***
Intercept:	0.026	0.151***	−0.008
Mean value of dependent variable:	0.226	0.074	0.352
Number of observations:	6333	6294	6328

Notes: The dependent variable is "always performs farm work after school" = 1; and equivalently for childcare and for housework. The county educational expenditure per capita variable is created by aggregating village educational expenditure per capita to the county level. Other variables in the equations but not reported are older sibling working, older sibling not working, older sibling not in school, father's schooling, mother's schooling, county enrolment rate, and county income per capita.

***Significance at the 1% level, **significance at the 5% level, *significance at the 10% level.

Simulated income significantly reduces the probability of both farm work and housework. There is also a negative effect when at least one parent is a migrant, suggesting that parental migration has its effect more through remittances than by leaving children to cope with household tasks. The variables indicating the quality of the child's school—school fees and attendance at a key school—significantly reduce both farm work and housework. The same is true of the variables that proxy the general quality of education in the county—village educational expenditure aggregated to the county level, and the proportion of county students aged 15–18 years attending key schools. In summary, the value of human capital received by poor children is adversely affected by out-of-school work in two ways. There is the direct effect of household poverty in reducing the amount of study time available, and the indirect effect, which operates, at both household level and county level, through the quality of schooling being received. Children lack the incentive to study hard if they cannot learn much at school, and if the prospect of continuing to high school is low.

6.3 The Determinants of Expenditure on Education

Even in rural areas, children can face a choice of schools of varying quality. Schools may charge different fees and involve variation in other costs, including transport costs, uniform costs, and costs of materials and books. Independently of the school, parents can choose to boost their child's education by buying more books and paying for extra tuition and other extracurricular activities. The quality of education as opposed to mere school attendance may be important both for the value of human capital acquired in school and for the prospects of entering the generally competitive and rationed system beyond compulsory education. The amount that parents spend on education may thus have a powerful effect on future outcomes.

One of the issues underlying the quality of education is whether private and public expenditures on education are substitutes or complements. For given enrolments, if educational quality is constant, more public funding implies less private funding: there is less need to charge school fees. By contrast, if quality is a variable to be optimized, greater public funding might encourage households to spend privately on education: the required condition is that government spending raises the marginal benefit of private spending. A third possibility is that both government and household spending are similarly influenced by a third factor such as local prosperity. For instance, if poor households are credit-constrained and local governments in poor counties are budget-constrained, poverty can depress educational quality. Higher incomes in a county might then enable both local governments and households to increase their educational spending so as to bring educational quality towards the optimum level, which is governed by the rate of return to quality-enhancing expenditure.

We analyse the determinants of household educational expenditure per child, conditional on the child being enrolled. Table 6 reports the results of equations in which educational expenditure (expressed in thousand yuan) on children at primary, middle and high school are the dependent variables, concentrating on the explanatory variables that illuminate the relationships between poverty at the household and community levels and educational quality. Note that total educational expenditure rises from 426 yuan per child at primary school to 882 yuan at middle school and to 2566 yuan at high school.

Table 6. The determinants of total household expenditure per enrolled child at primary, middle and high school: ordinary least square estimates

	Primary school	Middle school	High school
ln simulated income per capita	0.011***	0.039***	0.035***
At least one parent a migrant	0.017	0.099**	0.277
Older sibling working	−0.011	0.002	−0.525***
Older sibling at school	−0.046***	−0.017	−0.396*
Younger sibling at school	−0.030***	−0.092***	−0.402***
Younger sibling not at school	−0.055***	−0.044	−0.668*
Attendance at key school		0.699***	0.622***
Minority group	−0.103***	−0.296***	0.010
Distance to closest middle school (km)		0.019***	0.047***
County income per capita	0.111***	0.167***	0.668***
County educational expenditure per capita	1.336***	5.197***	15.884**
County proportion of pupils aged 15–18 years in key schools	−0.022	0.223*	1.049
Intercept:	0.379***	0.483**	1.355***
Mean value of dependent variable ('000 yuan):	0.426	0.882	2.566
Adjusted *R*-squared:	0.252	0.152	0.261
Number of observations:	3643	2555	683

Notes: Other variables in the equations but not reported are male, credit constraint applies, and the county enrolment rate. The dependent variable is expressed in thousand yuan per annum.
***Significance at the 1% level, **significance at the 5% level, *significance at the 10% level.

The (simulated) income variable has significant positive coefficients at all three levels. Parental migration, plausibly reflecting disposable income in the form of cash remittances, also increases the amount spent, but significantly so only at middle school. The older sibling variables reduce expenditure significantly at high school level, and the younger sibling variables do so at all three levels. This evidence of competition for household resources means that households are unable to spend as much as they would like on education. If households were not constrained, expenditure should reflect the rate of return to the investment and should not be influenced by the presence of siblings. A child's attendance at a key (secondary) school involves substantial and significant additional expenditure. There is a positive coefficient on county income per capita and on county educational expenditure per head of population, each coefficient rising monotonically with educational level. The former is a proxy for the capacity of local governments to pay for education and the latter a direct but crude measure of actual payment. Both jointly and singly, these two variables have a significant effect on the household's expenditure at each level. The results suggest that household expenditure is complementary to local government expenditure on education, not a substitute for it. The implication is that, if schools are of higher quality, parents are in turn willing to invest more in educational quality for their children.

It is possible to distinguish between household expenditure on school fees and on other educational inputs such as books, uniforms and private tuition. Table 7 distinguishes between fee and non-fee expenditures (each roughly half the total) and converts the dependent variables into logarithmic form so as to assist comparison of relative sensitivity. An increase in simulated income by one standard deviation raises total educational

Table 7. The sensitivity of household educational expenditure components to household income and public educational expenditure: ordinary least square estimates

	Primary school	Middle school	High school
ln total expenditure per child			
Simulated household income	0.015***	0.018***	0.017**
County income per capita	0.060***	0.068***	0.125***
Educational expenditure by local government	0.178	1.163**	2.665*
ln tuition fee per child			
Simulated household income	0.053***	0.019	0.015
County income per capita	0.120***	0.083**	0.168***
Educational expenditure by local government	−0.981	5.485*	5.229
ln other expenditure per child			
Simulated household income	0.060***	0.031**	0.013
County income per capita	0.130***	0.120***	0.111**
Educational expenditure by local government	2.219	2.465	5.664

Notes: Simulated income is income minus income earned by children in the relevant age group (primary 7–12, middle 13–15, high school 16–18 years). County income per capita is the average household income per capita of all sampled households in the county. Educational expenditure by local government is the average village per capita expenditure on education aggregated to the county level. The ordinary least square estimates contain all the explanatory variables of Table 6, but only the coefficients of the three variables of most interest are reported. As the dependent variables are in logarithmic form, the coefficients represent the percentage increase in expenditure attributable to a unit increase in each explanatory variable.

***Significance at the 1% level, **significance at the 5% level, *significance at the 10% level.

expenditure per enrolled pupil by 2.7, 3.7 and 4.3% at primary, middle and high school level, respectively, and the household income variable is no less important for other expenditure than for tuition fees.

In summary, household educational expenditure per child rises with the income per capita of the household, the income per capita of the county, and also the county average of local government educational expenditure per capita. This is generally true of both tuition fees and of other, more discretionary, educational expenses. It appears that household and community prosperity improve both the quality of education provided in the schools and the quality of additional educational support provided by the parents, and that greater subsidization by local government is associated with more, rather than less, household expenditure on a child's education.

7. Summary and Conclusions

We have investigated the role that various aspects of household and community poverty play in determining the quantity and quality of education obtained by children in rural China. Although the cross-section nature of the data set and the complex web of interrelationships require the exercise of caution in attributing causation, our evidence suggests that several relationships have the potential to contribute to a poverty trap. We list them in turn.

There is evidence (Tables 1–3) that household poverty, as measured by income per capita, has adverse effects both on completion of middle school and on continuation to

high school. Our other indicator of poverty, the presence of a credit constraint, reduces the chances of continuing to high school and, although less certainly, the chances of completing middle school.

The education of children suffers if parents are poorly educated (Tables 1 and 2). Mother's additional education encourages completion of middle school, and additional education of each parent encourages continuation to high school.

We know that there is a strong positive relationship of community income with community enrolment. The same is true of community enrolment with individual enrolment (Tables 1 and 2). The latter is difficult to interpret but might be due to social interaction or social norms. Should that be the case, it would help to explain how poor communities and the households within them, and even poor countries, can get stuck in a vicious circle of low education.

The quality of education that a child receives, or expects to receive, has an effect on enrolment. School performance is raised by expenditure on a child's schooling, which in turn is influenced by household income per capita (Table 4), and school performance is a powerful determinant of enrolment, decreasing the probability of dropping out of middle school and increasing the probability of continuing to high school (Tables 1 and 2). Dissatisfaction with secondary school quality encourages drop-out from middle school. Higher county high school fees—which we take to imply higher quality—raise the chances of continuing to high school.

There is evidence (Tables 4–7) that lower parental income means inferior educational quality for their children. Household income per capita raises the total household expenditure per enrolled child, and there is sibling competition for educational spending, especially at high school (Table 6). Household poverty and sibling competition increase the amount of time that children spend on non-school activities (Table 5).

The community also influences the quality of education that children receive. The county average of village educational expenditure per capita raises the household's expenditure per enrolled child (Table 6), suggesting that households demand a higher quality of education, and are prepared to pay for it, as the quality of publicly provided education improves.

Each of the relationships summarized above is a part of the interrelated web that can constitute a vicious or virtuous circle. Each appears in equations (1) and (2) of our five-equation model. We examine more relationships, corresponding to equations (3)–(5) of the model, in the companion paper (Knight *et al.*, in press). On account of their many interactions, the whole is greater than the sum of the parts. It will then be possible to draw the results together and provide an overview of the education–income poverty trap, as illustrated by this case study of rural China.

The companion paper, to be published in the next issue of this journal, will provide evidence of the importance of education in raising rural household incomes and, by implication, of educational investment in raising rural economic growth. How best can policies improve the quantity and quality of education for the rural poor? Credit constraints were found to deter the enrolment of children, particularly those from the poorest households. Household incomes and local community incomes were found to influence the quality of education that children receive. This evidence suggests the need for greater centralization of the highly decentralized fiscal arrangements in rural China. There is a case for fiscal redistribution towards poor communities, earmarked for educational expansion and improvement.

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