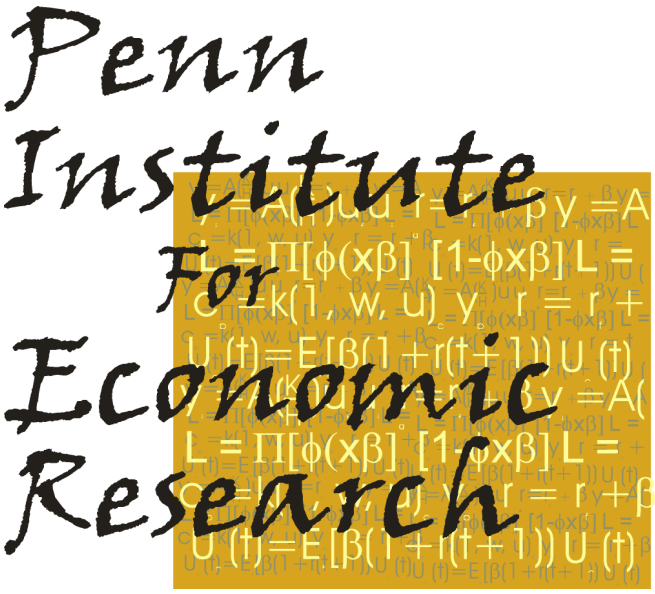

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"How Strongly is Child Schooling Associated with Household Income"

by

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HOW STRONGLY IS CHILD SCHOOLING ASSOCIATED WITH HOUSEHOLD INCOME?

by

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Abstract

Schooling is widely seen as critical for income generation in all types of economies. A growing concern among many has been the possibility of increasing inequality in part due to children from higher-income households obtaining more schooling and reaping greater gains from schooling than children from lower-income households. There are many empirical studies for various societies that tend to find significantly positive, but small associations between household income and schooling. But these studies generally have three major limitations for the purpose of characterizing the degree of association between household income and schooling-related investments: (1) use of income indicators that may be contaminated by relatively large measurement errors and endogeneity, (2) inclusion of other household, community and schooling variables that may represent part of the association with income in empirical estimates, and (3) use of limited indicators of schooling. This paper uses a rich new household survey-commune-school facility survey from Viet Nam to illustrate how important these limitations may be. The estimates suggest: (1) predicted income (expenditure) tends to yield estimates of much stronger associations than does current income or expenditures, (2) controlling for variables such as in most previous studies reduces the estimated associations with income substantially, and (3) including a wide range of schooling-related variables leads to more nuanced understanding of income-schooling associations, with some benefits for children from poorer households but a dominant tendency for school and private behaviors to favor significantly and in many cases substantially children from higher-income households.

Schooling is widely seen as critical in income generation and in altering inequality in all types of economies (e.g. Haveman and Wolfe 1995, Juhn, Murphy and Pierce 1993, World Bank 1990, 1991, 1995b). In recent years many economies have undergone considerable macro stabilization and market liberalization programs and have become increasingly integrated into international markets. The returns to schooling probably increase in such circumstances. Therefore who is schooled now is likely to be critical in determining not only future economic growth and the nature of international competitiveness, but also the future distributions of income in a wide range of economies.

A growing concern for many has been the possibility of increasing inequality and, perhaps, poverty under these economic changes. One dimension of this concern is the possibility that family "dynasties" will be reinforced if children from higher-income households are more likely to be more and better schooled and thus reap greater gains from schooling in the future than children from lower-income households. Because of the concern about the possibly unequalizing effects of schooling, the recent policy-related literature has increasingly considered "targeting" public school resources towards children from poorer families (van der Walle and Nead 1995 provide examples and references).

A basic empirical question related to these concerns is: How associated are schooling investments with household income? There have been numerous previous studies of the associations between indicators of household income and schooling for various countries. Table 1 summarizes the studies that we have been able to locate.[1] Estimates for about three-fifths of the schooling indicators used in these studies yield significant associations between household income

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[1]Almost all of these studies control for pressures on household resources by dividing the household income measure used by number of household members or by controlling for household demographics among the right-side variables. All of these studies use monetary income measures rather than full-income measures even though, for distributional concerns, if time uses are made voluntarily, full-income arguably would be preferable. The data that we use below to illustrate the impact of other practices on the estimated schooling investment-household income associations do not permit very satisfactory representation of full income, so we do not explore the importance of the use of monetary rather than full income on the estimated associations between schooling investments and household income.

Table 1. Estimated Income Elasticities for Schooling[a]

Country/year	Schooling Indicator	Income Elasticity	Source	Notes
Bangladesh 1980/1	School attendance	0.20	Hossain (1989)	Father's income; control for household and community characteristics.
Bolivia 1989	Grade repetition		Patrinos and Psacharopoulos (1993)	Income; control for household and community characteristics.
Bolivia 1990	Grade attained	0.04*	Behrman, Ii and Murillo (1995)	Expenditure per household member; control for household characteristics and community fixed effects.
	Days missed	-0.06**		
	Grades failed	-0.02		
Brazil 1970	Completed years	0.09 to 0.16*	Birdsall (1985)	Father's income; control for household and teacher characteristics.
Brazil 1972-4	Enrollment	-0.17*	Singh (1992)	Rural only; income (excluding children's income); control for household characteristics.
Brazil 1982	Completed years	0.06 to 0.14*	Barros and Lam (1996)	For Sao Paulo and the Northeast; household head's income; control for parental schooling.
Brazil 1982	Completed years	0.12 to 0.22*	Thomas, Schoeni & Strauss (1996)	Urban only; household income; control for household characteristics.
Côte d'Ivoire 1985/7	Completed years	0.19*	Montgomery and Kouame (1993)	Consumption per adult; control for mother's characteristics and region.
	Current enrollment*			
Côte d'Ivoire 1985/7	School attainment	0.14 to 0.42*	Tansel (1997)	Expenditure per capita (instrumented); control for age, sex (sig. for females, lower and insig or sig at 10% level for males), school distances, wages, rural.
Egypt 1980	Ever attended; currently attending; and years attended		Cochrane, Mehra and Osheba (1986)	Income per capita; control for household and school characteristics

Ghana 1988/9	Grade attainment*; reading*; attending other than nearest school*; delayed enrollment*; mathematics; dropping out age		Glewwe and Jacoby (1994, 1995)	Expenditure per capita (instrumented); control for household and (numerous) school characteristics and selectivity.
Ghana 1987	Ever-attended school; school attainment		Lavy (1996)	Income per capita; control for household and (numerous) school and community characteristics.
Ghana 1987/9	School attainment	0.18 to 0.56*	Tansel (1997)	Expenditure per capita (instrumented); control for age, sex (sig. for males, lower and insig or sig at 10% level for females), school distances, wages, rural.
Guatemala 1989	Repetition**		Patrinos and Psacharopoulos (1993)	Income; control for household and community characteristics.
India 1980-1	Enrollment		Duraisamy (1988)	Rural Tamil Nadu; non-labor market income; control for household and community characteristics
India 1991	Achievement test	0.12*	Kingdon (1996)	Lucknow, Uttar Pradesh; index of consumer durables; control for household and school characteristics.
Indonesia 1987	Probability of enrollment*		Deolalikar (1993)	Nonlabor income; control for household and community characteristics.
Indonesia 1989	Transition probabilities for initial enrollment and to next school level*		King (1995)	Expenditure per capita; control for household and community characteristics
Jamaica 1989	Enrollment*		Handa (1994)	Expenditure per capita; control for household and community characteristics.
Jamaica 1990	Mathematics	0.07*	Glewwe, Grosh, Jacoby and Lockheed (1995)	Expenditure per capita; control for household and (numerous) school characteristics and selectivity.
	Reading	0.04		
Kenya 1994	Enrollment*; household school expenditure*; student teacher ratio*		Deolalikar (1997)	Expenditure per capita; interacts with household and school characteristics.
Malaysia 1975-6	Current enrollment* (** for Malays)		De Tray (1984)	Income; control for household and school characteristics.

Malaysia 1975-6	Completed schooling (Malays*, Chinese)		King and Lillard (1987)	Income; control for household and school characteristics and right-censoring.
Malaysia 1988	Schooling progression probabilities		Lillard and Willis (1994)	Father's earnings; control for household characteristics, distance to primary schools & region.
Mali 1981-2	Enrollment		Birdsall and Orivel (1996)	Income; control for school characteristics.
Nepal 1980-1	grade attainment	0.38*	Moock and Leslie (1986)	Value of crop output; control for household characteristics, presence of local primary school and region.
	Enrollment*			
Nicaragua 1977-8	Grades completed	0.02 to 0.07	Behrman and Wolfe (1987)	Income or predicted mother's earnings plus other household income; control for household and community characteristics.
Pakistan 1991	Ever-enrolled*; expenditures on primary school*		Sather and Lloyd (1994)	Expenditure; control for household characteristics, distance to primary schools and region.
Pakistan 1989	Numeracy	0.05	Alderman, Behrman, Ross and Sabot (1996)	Household income (instrumented); control for household and community variables.
	Literacy	0.23*		
	Attendance (males*, females)			
Pakistan 1986-92	Enrollment*		Alderman, Behrman, Lavy and Menon (1997)	Rural only; expenditure (average over three years); control for household, school and community characteristics.
Paraguay 1990	Current enrollment*; years; grade repetition; dropping out		Patrinos and Psacharopoulos (1995)	Income; control for household characteristics
Peru 1985-6	Ever-enrolled*; early enrollment		Ilon and Moock (1991)	Rural only; household expenditure; control for household and community variables.
Peru 1985-6	Progression on time through school*		Jacoby (1994)	Income other than self-employed income; control for household and school variables.

South Africa 1993	Years	-0.01 to 0.10*	Case and Deaton (1996)	Expenditure per household member; age 10-18 for years of school, 8-24 for enrollment; control for household characteristics including race and pupil/teacher ratio; years of schooling lower and insig. for whites; reason not attending expense <0, illness, completed >0, insig. for pregnancy and can't cope; expenditure share insig. for secondary and, for whites, for primary.
	Enrollment (blacks)	0.01*		
	Reason not attending (blacks)	-0.02 to 0.02*		
	Expenditure share - school	-0.02 to 0.12*		
	Test scores* (blacks; for whites literacy not sig and numeracy sig at 10% level)			
Taiwan 1989	Years of schooling	0.12 to 0.33*	Parish and Willis (1993)	Father's income; birth cohorts 1940/9 through 1970/5, with declining elasticity for more recent cohorts; control for household characteristics.
United States 1957	Years of schooling	0.04*	Hauser and Daymont (1977)	Wisconsin high school graduates; parental income; control for household characteristics.
United States 1978	Years of schooling	-0.03 to 0.00	Datcher (1982)	Income; control for household and community characteristics.
United States 1981	Years of schooling	0.02*	Behrman and Taubman (1986)	Income; control for household characteristics.
United States 1982	Years of schooling	0.09*	Hill and Duncan (1987)	Income averaged over three; control for household and community characteristics.
United States 1981	Years of schooling	0.04*	Behrman and Taubman (1989)	Income; control for household characteristics.
United States 1979-1986	Neg. or insig. for college grades & grad. probabilities		Datcher Loury and Garman (1995)	Income; control for individual test scores, race, and college mean test scores.

Venezuela 1987	Years	0.01**	Psacharopoulos and Yang (1991)	Family income; control for age, sex and father's schooling
	Neg. for currently in school*, repeating grade* & illiterate*			

[a]Income elasticities calculated at point of sample means for what appears to be preferred estimates. "*" indicates that the underlying point estimates are significantly nonzero at the 5% level and "**" indicates the 10% level. If information is not provided with which to calculate elasticities the dependent variables and significant levels are indicated.

and schooling.[2] Among the cases in which income elasticities can be estimated from the information provided in the studies, the median is 0.07 -- implying that a 100% increase in income around the sample means would be associated with only a 7% increase in the school indicator. Of course the associations may differ with income levels. The estimates tend to be higher for poorer samples and a number of the studies find small inverse associations of the estimates with income.[3] But taken at face value a fair summary of the micro literature on the association between schooling and household income that is summarized in Table 1 would seem to be that such associations often are significantly positive, probably somewhat larger for poorer than for richer populations, but generally are not all that large and in a significant minority of cases are not statistically significant. Such low values for these elasticities present a puzzle for those who perceive that there are high intergenerational correlations in income and that the income returns from income-associated schooling investments are a major mechanism through which intergenerational income correlations are generated.

However the studies that are summarized in Table 1 tend to have at least three possibly important limitations for representing the associations between schooling and income (though with variation among the studies regarding these limitations).

First, the income measures used in most of these studies probably are contaminated by measurement error (particularly if the relevant household resource constraint is a longer-run constraint) and endogeneity of schooling with other decisions. If there is random measurement

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[2]This proportion is from a crude count that does not reflect that in a number of these studies estimates are presented for subsamples defined by criteria such as age, sex, region, and urbanization. In such cases generally the income effects are similar across subsamples (though not in Cochrane, Mehra, and Osheba 1986, in which case income has a significantly positive coefficient estimate for one of the eight age/gender/urbanization subsamples for ever-attended school and for years of school attended).

[3]The largest estimates -- those over 0.20 -- are for low-income countries, areas or time periods: Côte d'Ivoire, Ghana, Nepal, Taiwan for the 1940/9 birth cohort, Northeastern Brazil, and rural Pakistan. But these are the only cases in which the estimates in the table exceed 0.20. In several cases beyond these six the specifications used allow nonlinear income associations and find diminishing marginal income relations (except for Singh 1992 who finds the opposite), though the changes in the elasticities implied by these inverse associations are small.

error in the income indicator used, its use biases the estimated association between income and schooling investments towards zero.[4, 5] If households adjust their income and expenditures simultaneously with the schooling decisions, there may be a bias towards or away from zero.[6] About two-thirds of these studies use annual household (or father's or head's) income. Most of the rest (and an increasing proportion of studies in recent years) use annual household

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[4]There are previous studies that emphasize the impact of measurement error in income on understanding other dimensions of behavior. For example, several recent studies suggest that intergenerational correlations in income (probably reflecting in part schooling investments) have been understated by about half in previous literature for the United States because only one year of income data were used rather than a more permanent measure (e.g., Behrman and Taubman 1990, Solon 1992, Zimmerman 1992) and earlier studies suggest that reporting errors biased understanding of income maintenance effects (e.g., Greenburg, Moffitt and Friedmann 1981, Greenburg and Halsey 1983). There also has been a literature that has attempted to assess the magnitude of underreporting for earnings in the United States by comparing estimates from different sources (e.g., Mellow and Sider 1983, Duncan and Hill 1985, Bound and Krueger 1991, Bound, Brown, Duncan and Rodgers 1994).

[5]If there are systematic biases, the effects are less clear. For example, it often is conjectured that income is under-reported at lower levels because of the relative prevalence of income-in-kind, more erratic income sources, and less-good recall and records. If there is such underreporting at low income levels the result *ceteris paribus* is to bias the estimated income association with schooling towards zero. On the other hand if income is under-reported at high levels as also often is conjectured because of taxes or other commitments, *ceteris paribus* the use of measured income causes an upward bias in the estimated income-schooling associations. Because it is not clear which of these effects prevails nor to what extent they differ for measured income versus other household resource indicators, it is not clear what is the nature of the bias for these reasons in using income versus the alternatives. We do not pursue such possibilities further in this study.

[6]This bias may be in either direction, depending in part on what income measure is used. It may be upward, for example, if total income is used and households reduce their total income (and possibly therefore their expenditure) when they have school-aged children through reduced child labor in order to increase schooling. But even if total income falls, expenditures may increase through dissavings to cover schooling costs, possibly with the opposite bias. Likewise the bias may be in the opposite direction if adult (head, father) income dominates in household income and parents increase their work efforts and income when children are of school age to finance their children's schooling.

expenditures (or expenditures for a shorter period)[7] under the assumption that households smooth consumption over time so this measure is less contaminated by random measurement error originating in transitory income fluctuations (which may be considerable, particularly in developing countries -- e.g., Deolalikar and Gaiha 1993). But expenditures still may have random measurement error and, like income, be determined simultaneously with schooling investments. Only a small subset of these studies instrument household expenditures (income) to attempt to deal with biases both due to random measurement error and due to endogenous income/expenditure choices.[8] None of these studies compare whether the alternative treatment of the income indicator affects the estimated income associations substantially.

Second, the true association between schooling and income may be masked in these studies because they generally include in multivariate relations a number of other household, community and school controls that are correlated with income and may be proxying in part for the income association.[9] If, for example, income affects schooling in part through determining the characteristics of the schools that are locally available and those school characteristics are

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[7]Alderman, *et al.* (1996) average household expenditure over three years around the time of school enrollment decisions and Hill and Duncan (1987) use average household income over three years when the children were 14-16 years of age. This averaging reduces random measurement error, but does not deal with possible endogeneity biases.

[8]Glewwe and Jacoby (1994, 1995), Montgomery and Kouame (1993), and Tansel (1997) instrument household expenditure (explicitly because of possible endogeneity) and Alderman, *et al.* (1996) instrument household income (explicitly to obtain a better indicator of the relevant constraint at the time of earlier schooling decisions). Also Kingdon (1996) uses a weighted average of consumer durables (apparently because that is what was available in the data that she uses).

[9]If the interest is in estimating multivariate causal relations (as is the case in most of these studies), then it is important to control for all of the factors that are correlated with income and that the underlying model suggests determine schooling in order not to have omitted variable bias in the income coefficient estimate. (There is a question regarding to what extent in fact these studies succeed in isolating the causal impact of income because they all may be subject to omitted variable biases. For example, innate child ability may affect schooling investments in children, be correlated across generations through genetic endowments, and be correlated with parental income -- so omitted variable bias results.) But to answer the question regarding the extent of association between schooling and household income, which is the focus of the present paper, there should not be control for other characteristics that are correlated with income.

included among the controls in the estimates, the income association with schooling is likely to be mis-estimated because the school characteristics represent part of this association.[10] If, likewise, parental schooling is correlated with household income and if parental schooling is controlled in the estimates, the estimated association of child schooling with income is likely to be underestimated. Over half of the studies include school characteristics among the controls and all but one control for parental (sometimes only one parent) schooling among household characteristics, so such biases in estimates of the true association between household income and schooling investments may be pervasive and perhaps substantial. The only one of the studies in Table 1 that presents estimates of the income association both with and without such controls, in fact, finds that the estimated income coefficient is about twice as large without as with control for household and community characteristics (Hill and Duncan 1987).

Third, most studies are limited to one or two schooling indicators that usually refer to students' time input in school or their grade attainment[11] and the minority of studies that have a somewhat broader range of indicators still consider a fairly limited range. This narrow focus misses many possible channels through which income may be associated with schooling that are suggested by standard models of human capital investments, by the literature on endogenous policy choices, and by the literature on the impact of schooling quality (not just quantity) on productivity and earnings.[12] For example, it misses the possible associations between household

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[10]In a related vein, generally the studies that are summarized in Table 1 do not present estimates of what determines school characteristics. The only exceptions are Alderman *et al.* (1996), which presents estimates of the determinants of the availability of local schools, and Deolalikar (1997), which includes the student-teacher ratio among the schooling indicators that are dependent variables. Note 12 gives references to other studies that consider the endogenous determination of school characteristics in other contexts.

[11]About four-fifths of the dependent variables in the table are accounted for by such variables (e.g., enrollment or attendance, years or grades of school attained, age of entry and exit, and failure-repetition-progression rates).

[12]The implications of standard models of human resource investment (e.g., Becker 1967) for multiple associations of household income with schooling investments are considered in Section 1. School characteristics may be determined in part in response to current or expected household income, as is emphasized in the literature on endogenous policies (e.g., Rosenzweig and Wolpin 1986 model the general point and give illustrations for the Philippines; also see

income and household resource uses such as time spent studying or being tutored if such time uses increase learning for a given grade of schooling and between household income and school characteristics that may be determined in part by school policies that are responsive to income levels of client households.

In this paper we explore the empirical importance of these three problems in the literature on associations between household income indicators. To illustrate we use a particular data set collected in a cross-sectional household survey (linked with community and schooling surveys) and schooling of current school-age children in those households. This is a simple paper. But despite its simplicity it contributes to the literature through addressing the three weaknesses in the previous literature just discussed: First, it compares estimates of the income associations using alternative measures of household resources -- household income versus household expenditures, with and without instrumenting to control for random measurement error and endogeneity -- and thereby yields estimates of how important such controls are. Second, it estimates such associations by abstracting from household, schooling and community characteristics that may be correlated with household income and thus mask the association with income, in some cases because household income may work through these characteristics (e.g., school characteristics that are responsive to incomes of local clients) and in other cases because these characteristics in part determine household income (e.g., parental schooling). Third, it takes a much broader view than in the previous empirical literature of the range of indicators of the quantity and quality of schooling -- from the perspective of households, schools and community leaders -- not just school

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Behrman and Birdsall 1988 on Brazil, Gershberg and Schuermann 1994 on Mexico, and Pitt, Rosenzweig and Gibbons 1993 on Indonesia). Evidence on the importance of school characteristics other than just the time in school or grade attained is emphasized for Brazil in Behrman and Birdsall (1983, 1985), Behrman, Birdsall and Kaplan (1996), Hanushek, Gomes-Neto and Harbison (1994), and Harbison and Hanushek (1992); for Ghana in Glewwe (1996); for Kenya and Tanzania in Boissiere, Knight and Sabot (1985); for Pakistan in Alderman, Behrman, Ross and Sabot (1996); for South Africa in Case and Deaton (1996) and Moll (1996); for various developing countries in Hanushek (1995); and for the United States in numerous studies references to many of which are given in the recent symposium on school quality edited by Moffitt (1996), the recent survey by Card and Krueger (1996), and the earlier surveys by Hanushek (1986, 1989).

enrollment and school attainment and perhaps a few other measures as in the previous literature.[13]

The particular data that we use for illustration are from Viet Nam. In 1996 we collected data in Viet Nam from households, schools and community leaders that permit the investigation of the three dimensions of the associations between household income and schooling indicators that are outlined in the previous paragraph. Viet Nam is a particularly interesting case because there have been substantial recent market liberalizations and there is growing concern and tension about the perceived unequalizing impact of those liberalizations, including the impact on schooling the next generation. Though the illustrative empirical estimates are for the particular case of Viet Nam, they raise questions about what income measure to use, what are the implications of controlling for other variables, and the range of impact of household income on schooling through multiple channels in other countries as well.

Section 1 first discusses why there might be relations between dimensions of schooling and household income. Schooling investments can be viewed as outcomes determined by households' efforts to equate marginal private benefits and costs. Income can affect both the marginal benefits and costs because of private behaviors in the presence of imperfect capital markets, insurance markets, and markets for some complementary inputs for education such as conversations at home and help with homework. Income also can affect the quality of schooling available through political processes that may be positively responsive to income or may explicitly attempt to favor lower income households as part of anti-poverty efforts. Income further may be associated with other variables, such as parental schooling or child ability, that affect schooling investments.

Section 2 introduces the new data set that we use to illustrate our points in the rest of the study. Section 3 considers the implications of using alternative income indicators. It finds that these choices are important, with predicted income/expenditure yielding estimates on the order of

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[13]In addition it uses more recent data than the studies summarized in Table 1 (data from 1996, while less than a fifth of the studies in this table use data from the 1990s) and controls for mass points at zero, right-censoring (e.g., last age and grade in school for those still in school in Table 6), and limited dependent variables in contrast to most (but not all) of these studies (which affects some of the estimates substantially, but presenting these comparisons explicitly would add substantially to the complexity of this paper).

magnitude of 50 to 60% higher than current annual measures. Section 4 investigates the impact of controlling for household and schooling characteristics. Two alternative sets of controls for household, community and school characteristics -- that are similar to those used in the studies in Table 1 -- are considered. The inclusion of these controls makes a considerable difference, with a central tendency to reduce the estimated income association to only a quarter or a third of the full association and to reverse the sign of the association in some cases. Section 5 compares the estimates across different indicators of schooling investments. The result is a more nuanced understanding of these associations than would be obtained with as narrow a focus on schooling indicators as in most of the previous literature.

These results suggest that previous empirical characterizations of the relations between household income and schooling in various societies may have missed important dimensions of those associations by generally: (i) not controlling for measurement error and endogeneity in the income indicators used, (ii) controlling for other household, school and community characteristics that affect school investments and that are correlated with household income, and (iii) focusing on too narrow a set of indicators of schooling.

Section 1. Framework for Analysis of Associations between Schooling and Income

Becker's (1967) Woytinsky lecture on the determinants of human capital investments is a useful starting point. Within this framework schooling (and other human capital) investments are made until the private marginal benefit of the investment equals the private marginal cost of the investment. Figure 1-1 provides an illustration for one individual. The marginal private benefit curve depends on the expected private gains (e.g., in wages/salaries in labor markets) due to the human capital investment. The marginal private benefit curve is downward-sloping because of diminishing returns to human capital investments.[14] The marginal private cost may increase with human resource investments because of the increasing opportunity costs of more time devoted to

[14]Diminishing marginal returns might be expected (at least at sufficiently high investment levels) because of fixed genetic endowments (e.g., innate ability) for a given individual and because human capital investments such as schooling take time so that greater investments imply greater lags before beginning to obtain the post-investment returns and a shorter post-investment period in which to reap the returns.

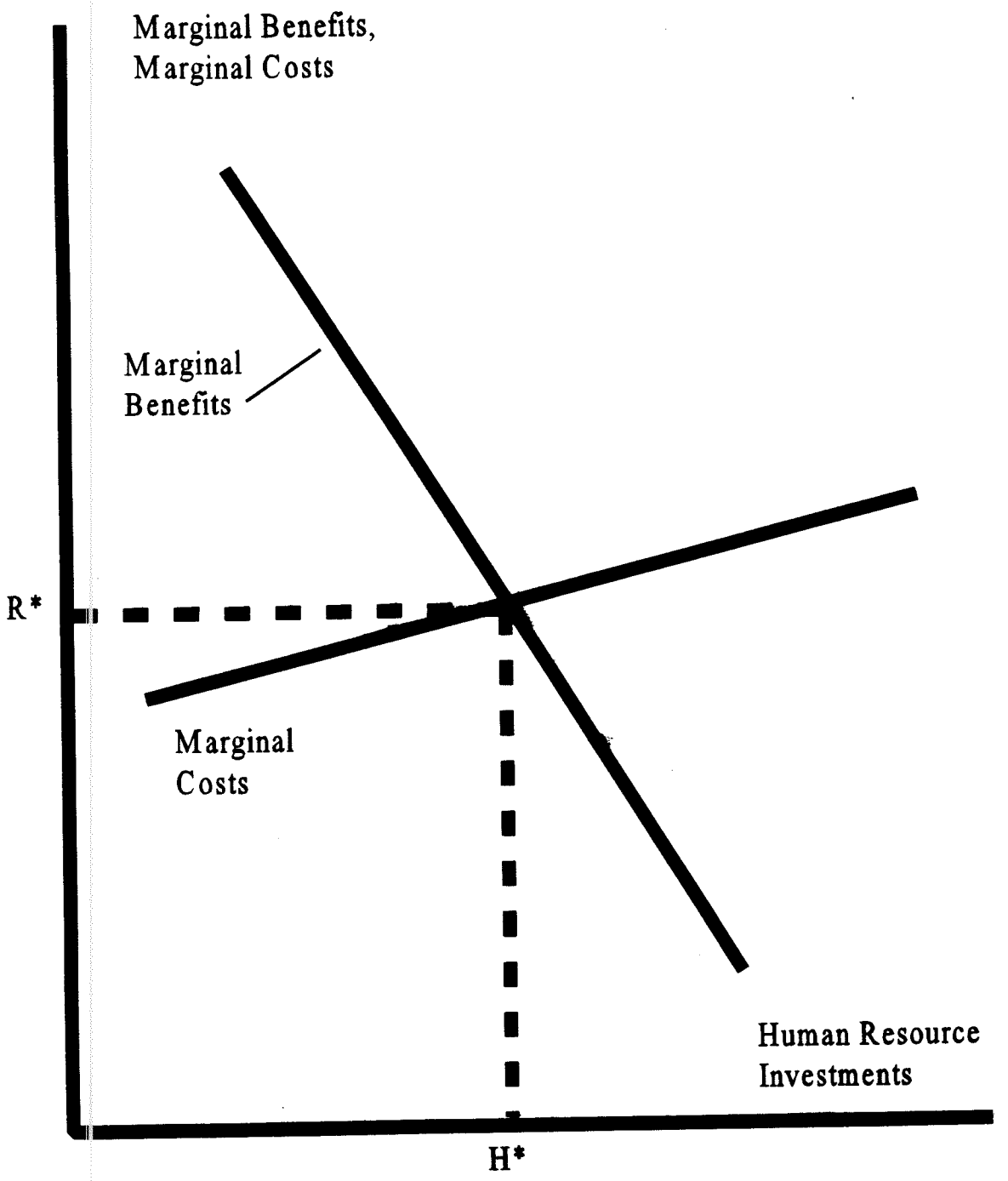

Figure 1-1. Private Marginal Benefits and Private Marginal Costs of Human Resource Investments

such investments and because of the increasing marginal private costs of borrowing on financial markets (if such markets do not easily permit borrowing for such purposes, at some point the marginal private cost curve may become very steep or even vertical). For a human resource investment at level H^*, the private returns net of costs are maximized.

If all markets function perfectly and schooling only is an investment (i.e., with neither consumption gains nor consumption loses) everyone invests in schooling until the expected rate of return equals the expected rate of return on alternative investments (at the level H* in figure 1-1) no matter what their income level. In this case the channels through which there may be an association between income and schooling are none or very few (there still may be some possibilities, e.g., the third and sixth ones below, depending in part on just how inclusive the definition of complete markets are). In the presence of the range of real-world market imperfections, however, there are many reasons why there may be associations between household income and schooling even if schooling is purely an investment. To illustrate, now consider what happens if first the marginal benefits and then the marginal costs are associated with household income in the presence of market imperfections.

Figure 1-2 illustrates the implications of the marginal private benefits for human capital being associated with household income, with two alternative curves indicated -- each depending on a different income level *ceteris paribus*. The dashed curve is drawn everywhere above the solid curve. If the (otherwise identical) individual is in the household with income that yields the dashed curve the private incentives are to invest at level H**, which is higher than the privately optimal level of human capital investment at level H* if the individual is in a household with income associated with the solid marginal private benefits curve.

Why might marginal private benefits of schooling be associated with household income in the presence of market imperfections? Among the answers to this question are:

1. Public policies may affect households differentially depending on their income level. On one hand policies may favor higher-income households by providing higher quality schooling to such households in response to their greater economic and political power. If school quality is complementary with household schooling investments, the dashed marginal private benefits line is for higher-income households. On the other hand, public

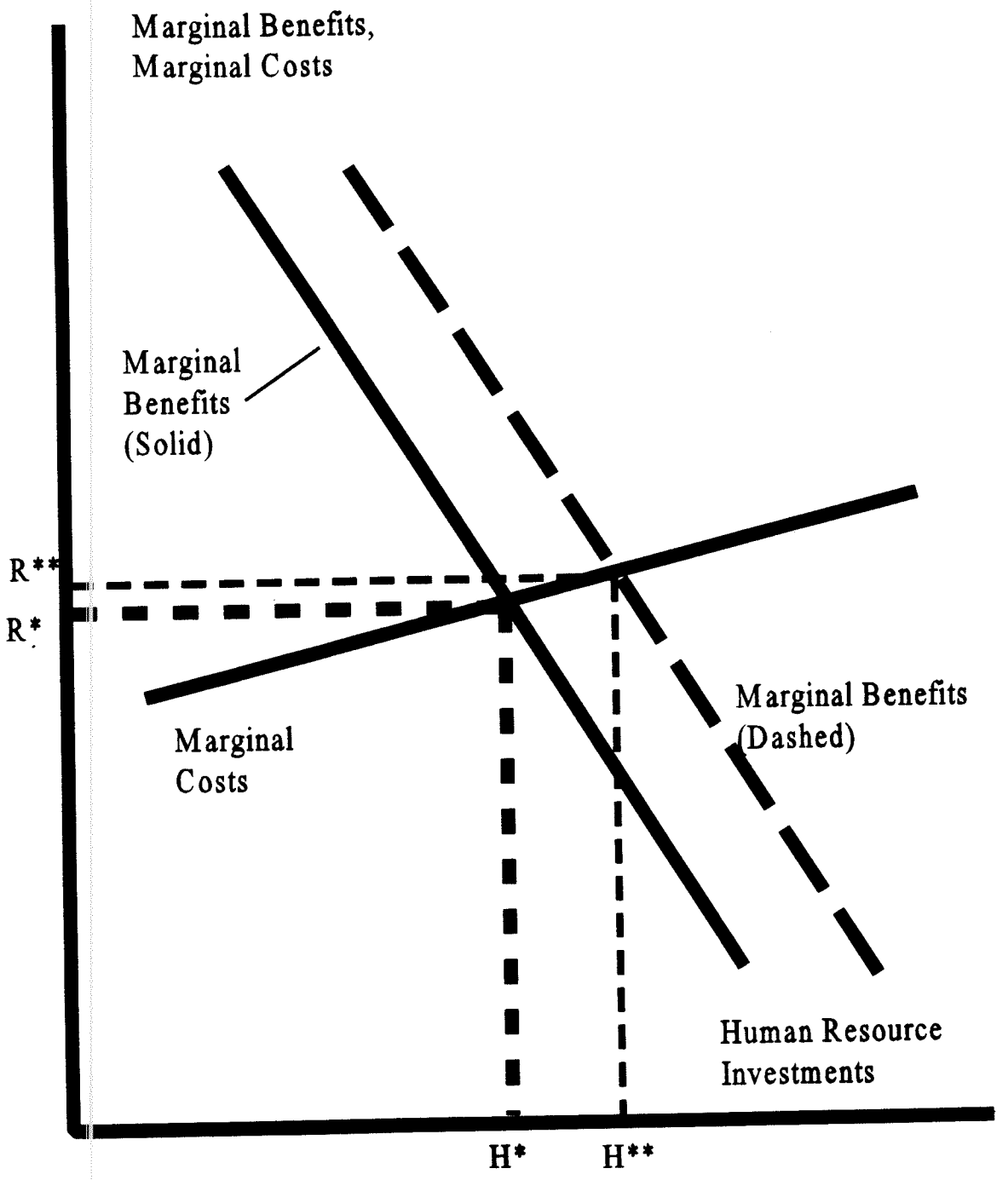

Figure 1-2. Private Marginal Benefits and Private Marginal Costs of Human Resource Investments, with Marginal Benefits Dependent on Income

policies may favor poorer households as part of programs to reduce inequality or to alleviate poverty by allocating better schooling to such households. In such a case, if school quality is complementary with household investments in education, the dashed marginal private benefits line is for lower-income households.

2. Households may make complementary investments directly in children's education at home and through tutoring or indirectly in their education by improving their health and nutrition. If markets for these investments (or for financing these investments) are imperfect and the costs are less for higher-income households, the marginal private benefits of schooling are higher for such households (e.g., the dashed rather than the solid line). For instance, the costs of such investments as helping with homework may be less for more-schooled parents than for less-schooled parents, and parental schooling is likely to be positively correlated with household income.

3. Children's genetic endowments, for which there are unlikely to be perfect markets, may interact with schooling investments in producing education and be correlated with parental endowments that, in turn, are correlated with household income because of direct effects of such endowments on income and indirect effects through parents' human capital stocks, including their education.[15]

4. Households may make complementary investments in job search and have contacts that affect children's search for jobs subsequent to completing schooling. If markets for financing such investments are imperfect and the costs are less for higher-income households in part because of more attractive possibilities for working in family enterprises and better connections for other employment opportunities, the marginal private benefits again are higher for such households.

5. Higher-income households may have better information (in part because of better family

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[15]Behrman, Rosenzweig and Taubman (1994, 1996) present evidence, using special twins data, that schooling investments respond positively to child genetic endowments. Behrman and Taubman (1989) present estimates that variations in such endowments are consistent with most of the variance in child schooling. The enormous literature on the associations between schooling of adults and their household earnings/income is surveyed in Psacharopoulos (1994) and Rosenzweig (1995).

enterprise options and better connections), in the presence of imperfect markets for information, so that they face less uncertainty regarding schooling investment decisions and -- holding constant risk aversion -- therefore have higher marginal private benefits than poorer households.

6. Higher-income households may have less risk aversion so that, in the presence of imperfect insurance markets or simply insurance that has positive private costs, their private incentives are to invest more in schooling than otherwise identical lower-income households.

7. Higher-income households may have better means of dealing with stochastic events -- e.g., through their connections they may be more able to offset a bad performance on admissions examinations by their children than can poorer households -- and therefore have private incentives to invest more in schooling than otherwise identical lower-income households.

8. Higher-income households may have lower discount rates, and thus invest more generally, including in schooling, than lower-income households.

The first case relates to endogenous policy choices, which -- depending on the mechanism -- may favor either higher or lower income households (e.g., Rosenzweig and Wolpin 1986). In the second through eighth of these cases there are private incentives to invest more in the schooling of otherwise equal children from higher-income households because such households cope better with other market imperfections or have unobserved characteristics that increase investments and are associated with household income.

Figure 1-3 represents two different marginal private cost schedules for schooling investments that depend on household income, with the dashed line drawn to be less than the solid line. With the solid line the private incentives are to invest at level H*, which is less than the privately-optimal level of human capital investment at level H*** if the dashed line is relevant.

Why might marginal private costs for human capital investments be associated with household income in the presence of market imperfections? Among the answers to this question are:

1. There are capital market imperfections, particularly for human capital investments (in

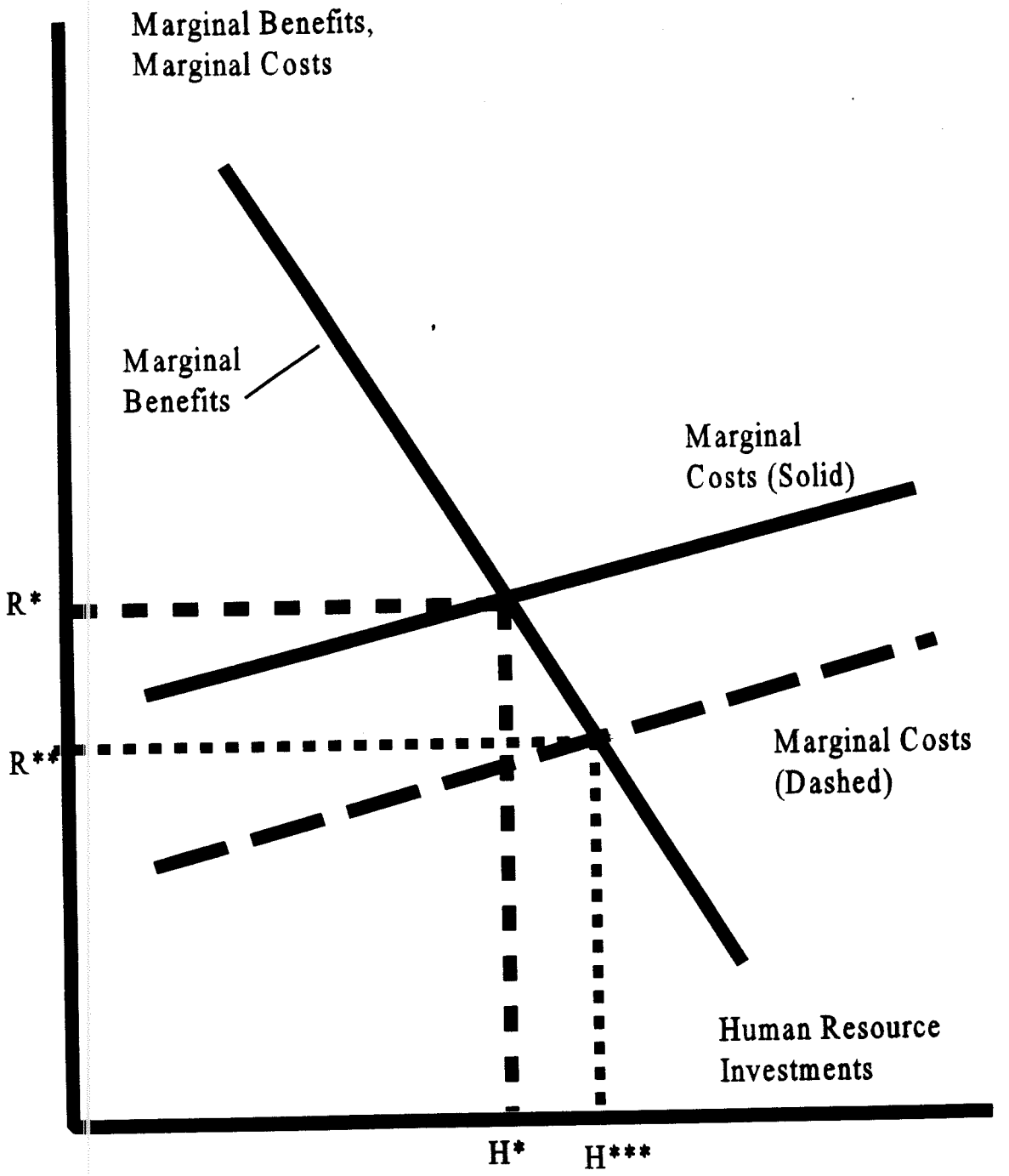

Figure 1-3. Private Marginal Benefits and Private Marginal Costs of Human Resource Investments, with Marginal Costs Dependent on Income

part because human capital is not recognized as collateral) so that the marginal private costs for such investments are particularly high for individuals from poorer families who can not relatively easily self-finance these investments. In this case the dashed line is for a household with higher income.

2. There are exemptions from paying school fees for children from poorer households, in which case *ceteris paribus* the dashed line is for a poorer household.

Thus, within this simple framework, there are reasons originating in both market failures and policy choices why household income may be related to the marginal private benefits and the marginal private costs of schooling investments, and thus to schooling investments themselves. If household income is correlated with determinants of schooling such as ability and preferences, moreover, this may lead to associations between schooling investments and household income. If schooling has consumption effects, further, they also may result in income-schooling associations (with the sign depending on the nature of the consumption effects) in addition to any that exist because of the investment dimension of schooling.

This one-period framework is silent about what time period is relevant for the income measure. But if households are able to transfer resources somewhat over time through mechanisms such as savings/dissavings, interhousehold transfers, and asset sales/purchases (as many studies suggest), a representation of income for a period of time longer than a year would seem relevant.

This simple framework also is not very directly informative about why different school-related inputs may be differentially related to household income. But underlying the private marginal benefits curves in these figures are production functions for education and for the impact of various dimensions of education on earnings and other benefits that include multiple inputs. In general the technologies in these production processes incorporate different degrees of substitution and complementarities among these inputs, which in itself may result in differential associations with income. There further may be differential associations with income because the prices of different inputs may be correlated differentially with income. Prices of parents' time, for example, are likely to depend on their schooling and therefore be associated positively with household income while the prices of some other inputs purchased on markets (e.g., textbooks)

may be independent of household income.

Section 2. Data to Illustrate Points About Income-Schooling Associations

As noted, we use data from Viet Nam to explore the three points raised in the introduction about schooling investment-household income associations. Our principal data source is the Vietnam Social Sector Financing Survey (VNSSFS), which the General Statistical Office (GSO) and we conducted in 1996 with funding provided by the Asian Development Bank. The VNSSFS was conducted in seven provinces, one from each administrative region of the country. It included a survey of 1,905 households and a series of commune and school surveys. The VNSSFS is one module within a larger multi-round survey being carried out by GSO, called the Multi-Objective Household Survey (MOHS). The MOHS is a large ongoing survey covering 45,000 households in 1,500 communes located in all 53 provinces of Vietnam that collects, *inter alia* income and expenditure data. The income and expenditure data that we use were collected retrospectively for the previous year (subsequent data are not yet available).

The VNSSFS was conducted in a subsample of the MOHS sample communes (three communes were sampled from each of three districts from each of seven sample provinces--a total of 63 communes--19 urban and 44 rural). The VNSSFS was administered to the same thirty households in each sample commune that participate in the ongoing MOHS. In addition, a community questionnaire was administered to the Commune People's Committee (CPC) Chairman in each commune and facility questionnaires were administered to schools (and to other social sector facilities). Households were interviewed by the commune-level MOHS interviewers who are residents of each commune, and the facility interviews were conducted by commune-level supervisors who are among the supervisory staff of the MOHS.

The VNSSFS household questionnaire collected information on the utilization and financing of schooling. Questions on schooling included, for each child in the household, age started school, whether currently enrolled, age last attended school if not currently enrolled, last grade attended (current grade if currently enrolled), type of school (public versus other) and last comprehensive examination score. For those currently enrolled in school, details were obtained for school-related expenditures (and exemptions) and the time use of children, as well as parental

evaluations of the quality of the school attended. For those not currently enrolled, the primary reason for not attending schooling was ascertained. The units of observation used in this study are the 2,789 children in the 6-17 age range in the 1844 sample households with basically complete data,[16] 2,203 of which (79%) were enrolled in school at the time of the survey. Because there is more than one child in the sample from a number of households, the regression and probit estimates of the associations with income that are summarized in Sections 3-5 use the Huber correction for clustering at the household level.

Information on the previous year's household income, expenditures and assets, as noted above, is available from the MOHS. These data were merged with the VNSSFS household data for use in the present study. To characterize income for this study, four alternative measures are considered: (1) annual household income per household member (hereafter "income" if a distinction among the measures is important), (2) household expenditures per household member ("expenditures"), (3) predicted household income per household member ("predicted income"), and (4) predicted household expenditures per household member ("predicted expenditures"). Appendix Table A1 gives the relations used to construct predicted income and predicted expenditures on the basis of longer run characteristics including religion, parental schooling, household demographics, broad sector of employment, and local utilities and communication systems.[17] As is discussed in the introduction, the predicted measures are preferable to the others

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[16]Useable income data were not available for 3.2% of the households. This is a small percentage in comparison with U.S. samples (e.g., in recent years item nonresponses on earnings in the U.S. CPS have exceeded 20%).

[17]In these estimates the dependent variable is income (expenditure) and the stochastic term is additive, which implies that the standard deviation of the measurement error is independent of the true income (expenditure) level. But some hypothesize that the standard deviation of measure error is likely to increase with income (expenditure). Therefore we also have explored an alternative in which the dependent variable is ln income (ln expenditure) with an additive stochastic term, in which case the standard deviation of the measurement error increases with the true income (expenditure) level (but is constant with respect to ln of that income or expenditure). The predicted income and expenditure from this alternative, however, are highly correlated with the respective predictions from the estimates in Table A1 (0.96 and 0.94, respectively). Thus the elasticities implied by using the alternative are virtually identical to those that we present below, so we do not discuss further these alternative elasticities.

if there is random measurement error or if current income/expenditure decisions are made simultaneously with current schooling decisions and the longer-run household resource constraint is relevant for the considerations discussed in Section 1.[18] As also is discussed in the introduction, if some consumption smoothing is possible, expenditures are likely to be a better measure than income.

Table 2 gives the means and standard deviations for each of these four income measures and the correlations among them for the 1844 sample households. The mean annual income per household member by the income measures is 2,076 thousand Viet Nam Dong (VND), which translates into $US 188 at current exchange rates. The mean annual expenditures are 1,728 thousand VND or $US 156. The standard deviations are about a third larger for the two income measures than for the parallel expenditure measures, which is consistent with transitory income fluctuations being smoothed somewhat over time so that income has greater measurement error as a representation of the longer-run household resource constraint than does expenditures.[19] The standard deviations are about half again larger for the actual than for the parallel predicted measures, which is consistent with the possibility that the actual values have considerable measurement error as representations of the longer-run resource constraint. All but one of the correlations are between 0.50 and 0.80, so most of these alternatives share substantial variance

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[18]If the relations being estimated were causal relations then it also would be necessary that the instruments used in the first-stage relations are not correlated with the disturbance term in the relation of interest, which is a condition that often is difficult to satisfy (e.g., demands for child schooling probably respond to unobserved child ability, which is likely to be correlated with first-stage variables that we use such as parents' schooling). For the present purpose of characterizing schooling-household associations, this condition need not be satisfied.

[19]These standard deviations imply that the distributions of income and expenditure are more equal in Viet Nam than in many societies. The World Bank (1995b, Table 30), for example, gives the percentage share of consumption by quintile for 22 low-income countries, including Viet Nam. The shares of the lowest quintile range from 2.1% to 9.7%. That for Viet Nam is reported to be 7.8%, which is ninth highest among these 22 countries. The shares of the highest quintile range from 38.6% to 63.5%. That for Viet Nam is reported to be 44.0%, which is ninth lowest among these 22 countries. World Bank (1995a) also discusses in some detail income distribution and poverty in Viet Nam.

Table 2. Summary of Alternative Income Measures

Alternative Income Indicators (1000s VND per capita)	Mean	Standard Deviation	Correlations			
			Income	Expenditure	Predicted Income	Predicted Expenditure
Income	2076	1740	1.00			
Expenditure	1728	1320	.80	1.00		
Predicted Income	2076	924	.53	.51	1.00	
Predicted Expenditure	1728	684	.52	.51	.99	1.00

but also each has some independent variation.[20] The one exception is the correlation of 0.99 between predicted income and predicted expenditure, which reflects the fact that the two predicted variables are not very dissimilar linear combinations of the same underlying vectors of variables. This almost perfect correlation means that there is not anything to be gained in presenting estimates for both of these predicted values below because they imply virtually identical elasticities. This correlation also is consistent with the possibility that both income and expenditure are representing the same underlying longer-run household resource constraint with random measurement errors drawn from differing distributions (with more variance in that for income than for expenditure). On *a priori* grounds the predicted values are preferable over actual income and actual expenditure because they are likely to be less contaminated by random measurement error and/or endogeneity bias.[21]

In addition to the VNSSFS household questionnaire, the community questionnaire collected information on the location of public and private schools within the commune and on the distance to schools used by the population resident in the commune (some of which, at the upper secondary school level, are located outside of the communes in which sample members reside) and on commune financing for schools during the 1991-95 period. School questionnaires were administered to heads of 209 schools used by commune residents. These questionnaires collected

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[20]If there are limits on the extent to which households can smooth transitory income fluctuations and such limits are greater for poorer than for better-off households, the correlation between fluctuations in expenditures and fluctuations in income are likely to be greater for poorer than for better-off households. We investigate this possibility by looking at the correlations between the residuals from the income and expenditure relations by income quintile and find support for it (for the lowest to the highest income quintiles the correlations respectively are 0.90, 0.87, 0.76, 0.65, and 0.58).

[21]The few previous studies that have used predicted expenditures, as noted above, have rationalized this use because of concern about endogeneity. They therefore have presented endogeneity tests by including the first stage residuals in the estimates (which generally have implied endogeneity, though Montgomery and Kouame 1993 decide in part on the basis of such tests to use actual expenditures). We do not present such tests in this paper because: (a) such tests are conditional on an underlying model of causal relations but our concern is with associations that are not conditional on a particular model and (b) our concern is not limited to endogeneity but also includes the possibility of random measurement error.

information on characteristics of the personnel, current inputs, physical structures and finances of the schools, as well as the school heads' overall quality evaluations of the schools. For the purpose of the present study these data were merged with the data on children in the 6-17 age range to give the nature of the school options available to each child, depending on the commune of residence.

Section 3. Impact of Alternative Income Measures on Estimated Associations

Does it make a difference which income indicator is used to characterize the income-schooling associations? Table 3 summarizes some information with which to answer this question. It permits comparisons among three pairs of indicators: (1) income versus expenditures, (2) income versus predicted expenditures, and (3) expenditures versus predicted expenditures. For each of these three pairs of income measures, Table 3 gives, for eight groups of schooling-investment variables:[22] (i) the percentage of elasticities that are smaller for the first than for the second in the pair and (ii) the median ratio of the elasticity for the first in the pair to the elasticity for the second in the pair. Medians are used here and in the next two sections so that outliers do not dominate in the comparisons. Elasticities are used here and in the next two sections so that there is an unitless basis for comparison among indicators that have different units of measurement. These elasticities, of course, refer to association, not to causality.

Income versus expenditures: In 58% of the cases the elasticity is higher if expenditure is used rather than income, with a median elasticity 9% higher. This pattern is consistent with income being contaminated by greater random measurement error than expenditure (as measures of longer-run household resource constraints) because some consumption smoothing occurs in the presence of transitory income shocks. But differential random measurement error relative to the true longer-run resource constraint is not the whole story that distinguishes between the two sets of elasticities. If it were the whole story, then the elasticities would always be smaller (in absolute value) with respect to income than with respect to expenditure -- but in about two fifths of the cases, the opposite is the case. There also must be other factors relating to systematic differences

[22]The components of these categories are discussed in some detail in Behrman and Knowles (1997). In Tables 3 and 4 each of the estimates for a category is treated equally.

Table 3. Summary of Relative Magnitudes of Elasticities with Respect to Income Depending on Income Indicator Used*

Categories of School Investment Indicators (Number of Elasticities in Category in Parentheses)	Income/Expenditure		Income/Pred Expenditure		Expenditure/Pred Expend	
	% < 1	Median	% < 1	Median	% < 1	Median
Standard Indicators of Individual Schooling (7)	64	0.86	93	0.72	93	0.75
School-Related Household Expenses (15)	67	0.94	87	0.74	87	0.74
Hours Students Spend in Normal Week (8)	44	0.95	88	0.55	88	0.53
Why Not Enrolled (6)	100	0.72	50	1.03	20	1.12
School Characteristics (16)	59	0.99	94	0.61	82	0.64
School Head Quality Evaluations (4)	75	0.84	100	0.34	75	0.62
Household Head Quality Evaluations (4)	50	1.02	88	0.71	75	0.71
Commune Per Capita Real School Expenditures, 1991-95 (2)	0	1.19	100	0.05	100	-0.12
All Categories (62)	58	0.92	87	0.67	77	0.62

*There are three pairs of elasticities indicated in the column heads. For each pair the first column indicates in what percentage of cases the ratio of elasticities is less than one (with 50% used for ties)and the second column indicate the median ratio for all of the elasticities in the group (with a negative sign indicating opposite signs). The number of underlying elasticities in each category is indicated in parentheses after the category. The included items in each category are: Standard Indicators of Individual Schooling including Currently Enrolled in School, Private Schooling, Age Started School, Last Age in School, Grades Passed/Year in School, Last Grade in School, and Comprehensive exam scores; School-Related Household Expenses - total, subdivided into Paid to Schools (further subdivided into School fees, School improvement fees, Parent associations fees, Insurance) and Not Paid to Schools (further subdivided into Textbooks, Supplies/materials, Uniforms, Tutoring, Travel, Meals, Other) and Exemption from School Fees; Hours Students Spend in Normal Week subdivided into Classwork, Travel to/from School, Homework on Own, Homework with Assistance of Household Member, Tutoring, Extra-curricular Activities, Family Work, Sibling Care; Why Not Enrolled subdivided into Work, Don't Like School, Didn't Pass, School Poor or Distant or Expensive, Poor Health, Other; School Characteristics subdivided into four indices for School Staff, Current Inputs, Permanent Construction, and Congestion (each of which indices is considered as a Total, Primary, Lower Secondary, and Upper Secondary) School Head Quality Evaluation (again Total, Primary, Lower Secondary, and Upper Secondary); Household Head Quality Evaluation (again Total, Primary, Lower Secondary, and Upper Secondary); and Commune Per Capita Real School Expenditures subdivided into Recurrent and Capital for 1991-5. The underlying elasticities for the individual components of these categories are given in Appendix Tables B1-B4. Further details of these variable definitions and the distributions of the variables in the sample are discussed in Behrman and Knowles (1997).

between income and expenditure, functional form, or endogeneity -- though we cannot identify what they are.

Income or expenditure versus predicted expenditure (income): Both of these comparisons reveal similar patterns: Though there is some variation across the categories (with the why-not-enrolled category notably different), the estimates generally tend to be less for the actual than for the predicted income measures -- in 87% of the cases for the comparison of actual income with the predicted values and 77% of the cases for the comparison of actual expenditure with the predicted values. These patterns are consistent with there being considerably greater random measurement error in the actual measures (more so in income than in expenditures) than in the predicted values -- though, again, that can not be the whole story. Whatever the cause, these patterns suggest that the use of actual annual income or actual annual expenditure as in the vast majority of previous studies rather than the predicted values tends to lead to smaller estimates of the associations between household income and schooling investments. And the differences are large, at least in relative terms; at the medians, the use of predicted rather than actual values leads to elasticities that are 50 to 60% larger. Thus it makes a fair amount of difference (at least in a relative sense) regarding the magnitude of the associations between household income and schooling investments whether actual annual income indicators or longer-run predicted measures are used. And if, as we argue, the predicted income indicators are preferred over the actual values because of random measurement errors and/or endogeneity, the use of the annual indicators results in substantial underestimates of the income associations.

Section 4. Impact of Including Controls for Household, Community and School Characteristics

If the associations between income and schooling investments are estimated from multivariate relations that include other controls that are correlated with income, as noted in the introduction, the estimated associations may be biased. The direction of the bias can be up or down, depending on the signs of the correlations with the included controls and of their true coefficients.

Table 4 summarizes two illustrations of such possibilities. This table is organized similarly

Table 4. Comparison of Income Elasticities Using Predicted Income (or Expenditures) with and without Control for Other Household and Community Characteristics[a]

Categories of School Investment Indicators (Number of Elasticities in Category in Parentheses)	Elasticities with Control for Selected Household and Community Characteristics Relative to Those without Such Controls[b]		Elasticities with Control for Selected Household, Community and School Characteristics Relative to Those without Such Controls[c]	
	% < 1	Median	% < 1	Median
Standard Indicators of Individual Schooling (7)	86	-0.19	93	0.14
School-Related Household Expenses (15)	80	0.42	73	0.26
Hours Students Spend in Normal Week (8)	75	0.56	88	0.59
Why Not Enrolled (6)	67	0.56	100	-0.67
School Characteristics (16)	81	0.34	--	--
School Head Quality Evaluations (4)	50	0.81	75	0.01
Household Head Quality Evaluations (4)	100	-0.52	50	0.93
Commune Per Capita Real School Expenditures, 1991-95 (2)	100	-4.68	--	--
All Categories (62)	81	0.35	82	0.24

[a]There are two pairs of elasticities indicated in the column heads. For each pair the first column indicates in what percentage of cases the ratio of elasticities is less than one (with 50% used for ties)and the second column indicates the median ratio for all of the elasticities in the group (with a negative sign indicating opposite signs). The number of underlying elasticities in each category. Note a in Table 4 provides further information about the components of the categories.

[b] The variables include sex, age, mother's and father's schooling, whether member of ethnic group, religion (with Catholic and Buddhist singled out), whether primary sector primary income source, and indicators for transportation, electricity, water, and news.

[c] Variables include those in note b plus indices of quality of school staff, instructional inputs, school congestion, and whether schools are of permanent construction. These estimates are not made for two categories -- school characteristics and commune per capita real school expenditures (so "--" appears in the table).

to Table 3. The first illustration includes, in addition to our preferred income measure, a number of household and community characteristics similar to those often included in multivariate relations such as those that are summarized in Table 1: sex, age, mother's and father's schooling, ethnicity, religion, whether primary sector is major source of income, and indicators for local transportation, electricity, water and news availabilities. The second illustration includes, in addition, local school characteristics.

In both illustrations, adding the additional controls reduces the estimated elasticities of associations between income and school investments in about four-fifths of the cases. The reductions in most cases, moreover, are considerable. At the median across all categories the estimated associations are only 35 and 24%, respectively, of those that are obtained without controls. Therefore in these cases the inclusion of other controls in a multivariate relation, which yields an estimate of the partial or conditional association (i.e. conditional on those controls), generally tends to yield substantial underestimates of the total associations between schooling investments and household income.[23]

Section 5. Variations in Income-Schooling Associations Across Schooling Indicators

If there are a number of inputs to education and a number of dimensions of education, limiting attention to one or a very few schooling indicators as in most of the studies summarized in Table 1 may lead to misunderstanding of the nature of the association of schooling with household income. To consider this question Table 5 summarizes the elasticities for individual schooling indicators that are similar to the one or two used in most of the studies summarized in Table 1, and Table 6 summarizes the distributions of elasticities for the same categories of schooling indicators as in Tables 3 and 4.

The elasticities for the individual indicators predominantly used in previous studies (Table 5) indicate a considerable range. Most commonly used in previous studies is school attainment or

[23]The inclusion of these controls may or not lead to better estimates of the causal effects, depending on how well they represent the other factors (or at least those parts of those factors that are correlated with income) implied by the underlying model on which the estimates are conditional.

Table 5. Elasticities of Standard Schooling Indicators with Respect to Predicted Expenditure (Income) per Household Member[a]

Schooling Indicators	Elasticity with Respect to Predicted Expenditure (Income) per Household Member
Probability Currently Enrolled	0.16
Probability Attended Private School	-0.01
Age Started School	-0.07
Last Age in School	0.35
Grades Passed/Year in School	0.13
Last Grade in School	0.71
Comprehensive exam scores	0.11

[a]Based on all children age 6-17 in sample except for attended private school which is based only on children in this age range who were enrolled in school.
[b]Elasticities are based on probits or regressions (with control for right-censoring for last age in school and last grade in school) with quadratics in income indicators at sample means (see Tables B1 and C1).

completed years of schooling. The most comparable elasticity in Table 5 is for last grade completed, which is 0.71. This elasticity is twice as large as the next largest and over five times as large as the other five elasticities in this table. If one were to characterize the schooling-income association alone from this one elasticity -- which would be similar to what has been done in many of the previous studies, there would be a considerable overstatement of the strength of this association as compared with the understanding that would be obtained by considering the other elasticities in Table 5.

If attention were limited to any or all of the usual indicators that are included in Table 5, further, much is likely to be missed or misunderstood if in fact the broader set of indicators summarized in Table 6 is relevant. The median elasticity for all the categories in Table 6, for example, is over twice that for the variables in Table 5. The range in elasticities also is much greater in Table 6. Some of elasticities summarized in that table are negative, reflecting advantages in a few respects, such as less school congestion, for children from poorer households. Others -- almost a fifth -- are more than unitary, implying advantages for children from better-off households that in percentage terms are greater than the percentage differences in household incomes. For a variety of reasons related to the nature of the underlying production processes and possibly selectivity, the associations of household income with different school investment indicators varies considerably across the indicators. Attention to one or a very few of these indicators such as in the previous literature is not likely to lead to a very satisfactory understanding of these associations.

Section 6. Conclusions

The associations between household income and schooling investments are of considerable interest in many societies because of concerns about to what extent schooling helps to lessen or perpetuate across generations income inequalities and to what extent there is effective targeting of schooling towards children in poorer families. Schooling investments can be viewed as the outcomes determined by efforts by households to equate the marginal private benefits and costs. Household income can be associated with the marginal benefits and costs because of private behaviors in the presence of imperfect capital markets, insurance markets, and markets for some

Table 6. Ranges and Medians for Elasticities of Schooling Characteristics with Respect to Predicted Expenditure (Income) per Household Member[a]

Categories of School Investment Indicators (Number of Elasticities in Category in Parentheses)	Elasticities with Respect to Predicted Expenditure (Income) per Household Member	
	Range	Median
Standard Indicators of Individual Schooling (7)[b]	-0.01 to 0.71	0.13
School-Related Household Expenses (15)	0.23 to 14.57	1.01
Hours Students Spend in Normal Week (8)[c]	0.11 to 28.79	0.64
Why Not Enrolled (6)[d]	0.15 to 0.50	0.30
School Characteristics (16)	0.01 to 1.06	0.25
School Head Quality Evaluations (4)	-0.02 to 0.35	0.13
Household Head Quality Evaluations (4)	-0.14 to 0.25	0.18
Commune Per Capita Real School Expenditures, 1991-95 (2)	0.11 to 0.75	0.43
All Categories (62)[e]	-0.14 to 28.79	0.35

[a]Note a in Table 4 provides further information about the components of the categories.
[b]The absolute value of the negative elasticity for age starting school is used because starting when younger *ceteris paribus* is advantageous.
[c]Five of the time categories considered presumably are positively related to education (e.g., time in classwork, time in homework), but three presumably represent diversions from education (i.e., travel, family work, sibling care). For this summary of the distribution of elasticities the absolute values of the negative elasticities for the last three time uses are used.
[d]The absolute values of these elasticities are used here even though four of the six are negative because the sign depends on how the question is asked and what is of interest is the degree of association of the answer with income, not the sign.
[e]See notes b-d. The interquartile range is 0.14 to 0.73.

complementary inputs such as meal time conversations and help with homework. Income also can be associated with the quality of schooling available to different communities through political processes that may be positively responsive to income or may explicitly attempt to favor lower income households as part of anti-poverty efforts. There are a number of previous studies that have estimated income-schooling associations in various societies and found them to be significantly positive more often than not, but small in magnitude. But these studies generally have: (1) used current income or expenditures to represent the household resource constraint, (2) controlled for other variables such as parental schooling and school characteristics that are likely to be correlated with income and (3) focused on school enrollments and school attainment, a restricted subset of possible indicators of schooling-related inputs and outcomes.

In this paper we have examined the importance of each of these three practices common to most previous related research for understanding what the associations are between income and schooling investments using a particular data set from Viet Nam for illustration. We find that each of them makes a considerable difference in understanding the nature of associations between household income and schooling.

First, the use of predicted household income or expenditure -- which would seem preferred because of random measurement errors and endogenous income/expenditure decisions -- tends to lead to substantially higher associations than the use of actual annual measures, 50 to 60% higher at the medians of our estimates.

Second, dropping controls for other household, community and school characteristics also leads to substantially higher estimates of the associations between income and schooling related investments. For the two illustrations that we present in Section 4, for example, at the medians the estimated associations are 185 and 316% higher without than with such controls and there are some cases in which even the signs of the association are reversed. This does not mean that such controls should not be included in investigations of the causal effect of income -- if they are implied by the underlying model of behavior, they (and probably others that usually are not included) should be included. But for the purpose of characterizing the associations between income and schooling-related investments that is of interest for the income distribution/targeting questions, including such controls may lead to a very misleading understanding -- generally with

downward biases regarding the strength of such associations.

Third, our examination of a much broader set of household and school system behaviors that may be related to household income leads to some much different understandings than would result from a much more narrowly focused study such as in most of the literature. We find some instances of pro-poor policies. But the dominant tendency is that school policies and private behaviors favor children from higher-income households. Focus on one or two indicators of schooling as in the previous literature, such as grade attainment and current enrollments, misses the range of differential income associations that in some cases favor children from poorer households and in others favor those from better-off households much more than would be indicated by limiting attention to the schooling investment indicators on which the previous literature has focused.

Thus, at least in the particular empirical case considered in this paper, the practices generally followed in the previous literature would give a very partial and misleading indication of the associations between household income and schooling-related investments and outcomes. They would miss that some of the underlying associations are negative and others positive and that some of the positive associations are considerable and are likely to lead to substantial advantages to children from higher-income households. These results therefore suggest that in Viet Nam the associations between household income and schooling are much more extensive and operate through a wider range of channels than emphasized in the previous literature, and raise the question of whether similar results would not obtain with use of longer-run income measures, dropping controls for other characteristics, and broader investigations of household income-schooling associations in other societies.

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Table A1. Estimates of Current Income per Household Member and of Total Household Expenditure per Household Member as Functions of Longer-Run Household Characteristics[a]

Right-side Variables	Dependent Variable	
	Current Income per Household Member	Current Expenditures per Household Member
Parent's Schooling		
Mother's schooling	2.49 (2.3)	5.38 (2.2)
Father's schooling	2.20 (1.9)	1.90 (2.1)
Mother's schooling missing	8.16 (0.7)	9.23 (1.0)
Father's schooling missing	10.60 (0.9)	15.50 (1.8)
Number of household members		
Male	-8.43 (3.5)	-6.31 (3.4)
Female	-15.69 (7.0)	-11.23 (6.5)
Ethnic group	4.72 (0.5)	4.88 (0.7)
Formal religion	66.89 (4.9)	35.31 (3.4)
Catholic	-56.95 (3.8)	-28.81 (2.5)
Buddhist	-27.90 (2.1)	-12.41 (1.2)
Assets/ 0000	0.359 (6.1)	0.186 (4.2)
Income primarily from primary sector	16.81 (2.0)	7.59 (1.2)
Employment		
State	-30.67 (1.1)	10.17 (0.5)
Cooperative	-104.84 (4.0)	-58.45 (2.9)
Private sector	-31.20 (1.2)	-4.70 (0.2)
Infrastructure availability/use		
Electricity	45.27 (6.3)	28.49 (5.2)
Good water	5.51 (0.8)	6.89 (1.2)
Latrine	62.49 (8.1)	41.90 (7.1)
Good transportation	-2.98 (0.5)	-3.49 (0.7)
Regular news	37.88 (5.5)	31.28 (6.0)
Constant	166.90 (5.7)	119.06 (5.3)
Adjusted R^2, Root MSE	0.27, 124.00	0.26, 94.78

[a]Sample includes all 1844 households with relevant data. Absolute t values are in parentheses to right of point estimates.

Table B1. Elasticities of Standard Individual Schooling Indicators with Respect to Alternative Indicators of Income per Household Member[a]

Schooling Indicators	Elasticities of Household School-Related Expenditures with Respect to:		
	Annual Income per Household Member	Total Annual Expenditure per Household Member	Predicted Expenditure (Income) per Household Member
Probability Currently Enrolled	0.12	0.12	0.16
Probability Attended Private Schools	-0.01	0.04	-0.01
Age Started School	-0.05	-0.06	-0.07
Last Age in School	0.30	0.35	0.35
Grades Passed/Year in School	0.06	0.05	0.13
Last Grade in School	0.59	0.65	0.71
Comprehensive Exam Scores	0.08	0.07	0.11

[a]Based on all children age 6-17 in sample (except probability of private school attendance based only on those currently in school). Elasticities are based on probits or regressions (censored for last age in school and last grade in school) with quadratics in income indicators (those with predicted expenditure per household members are given in Table C1) at sample means.

Table B2. Elasticities of Household School-Related Expenditures and Fee Exemption with Respect to Alternative Indicators of Income per Household Member[a]

Variables	Elasticities of Household School-Related Expenditures with Respect to:		
	Annual Income per Household Member	Total Annual Expenditure per Household Member	Predicted Expenditure (Income) per Household Member
School-Related Household Expenses			
Paid to Schools	0.50	0.55	0.76
School fees	1.34	1.65	1.30
School improvement fees	0.40	0.44	0.54
Parent associations fees	1.07	1.29	2.26
Insurance	0.29	0.29	0.62
Not Paid to Schools	0.82	0.70	1.09
Textbooks	0.34	0.32	0.42
Supplies/materials	0.35	0.24	0.48
Uniforms	0.85	0.90	1.21
Tutoring	2.22	2.65	3.83
Travel	17.43	12.21	14.57
Meals	2.23	1.99	3.24
Other	1.40	1.78	1.50
Total	0.75	0.74	1.01
Probability of Exemption from Fees	-0.19	-0.22	-0.23

[a]Observations for this table are children age 6-17 for whom the dependent variables are available (for which a necessary condition is that they were in school at the time of the survey). Elasticities are based on tobit and probit estimates with quadratic in income indicator (with examples for total predicted expenditures in Table C2), at sample means.

Table B3. Elasticities of Hours Students Spend in Normal Week and If Not Enrolled, Why Not with Respect to Alternative Income Indicators[a]

Schooling Indicators	Elasticities of Household School-Related Expenditures with Respect to:		
	Annual Income per Household Member	Total Annual Expenditure per Household Member	Predicted Expenditure (Income) per Household Member
Hours Students Spend in Normal Week			
Classwork	0.07	0.06	0.11
Travel to/from School	-0.07	-0.09	-0.43
Homework on Own	0.13	0.12	0.15
Homework with Assistance of Household Member	0.27	0.48	0.84
Tutoring	1.31	1.15	2.51
Extra-curricular Activities	11.62	14.12	28.79
Family Work	-1.71	-1.47	-2.93
Sibling Care	-0.42	-0.42	-0.35
Why Not Enrolled			
Work	0.15	0.29	0.33
Don't Like School	-0.32	-0.38	-0.34
Didn't Pass	0.56	0.84	0.50
School Poor, Distant, Expensive	0.07	-0.22	-0.20
Poor Health	0.88	1.23	-0.15
Other	-0.57	-0.77	-0.25

[a]Elasticities are based on tobit and probit regressions (the estimates for predicted household expenditures per household member are given in Table C3), evaluated at sample means. The time use estimates are for all current students age 6-17 in sample and the why not enrolled estimates are for all children age 6-17 in sample who are not current students.

Table B4. Elasticities of School Characteristics, Commune Financing and Schools Evaluated Excellent or Good by School Heads and by Household with Respect to Alternative Income Indicators[a]

Schooling Indicators	Elasticities of Household School-Related Expenditures with Respect to:		
	Annual Income per Household Member	Total Annual Expenditure per Household Member	Predicted Expenditure (Income) per Household Member
School Characteristics[b]			
School Staff	0.06	0.06	0.10
Primary	0.07	0.07	0.09
Lower Secondary	0.09	0.09	0.15
Upper Secondary	0.03	0.03	0.09
Current Inputs	0.28	0.29	0.47
Primary	0.40	0.42	0.65
Lower Secondary	0.25	0.26	0.49
Upper Secondary	0.20	0.20	0.30
Permanent Construction	0.53	0.44	0.84
Primary	0.29	0.25	0.64
Lower Secondary	0.17	0.07	0.32
Upper Secondary	0.62	0.51	1.06
Congestion	0.06	0.09	0.08
Primary	0.12	0.14	0.20
Lower Secondary	0.05	0.10	0.07
Upper Secondary	0.01	0.07	0.01
School Head Quality Evaluation	0.07	0.05	0.15
Primary	0.00	-0.06	-0.02
Lower Secondary	0.09	0.10	0.11
Upper Secondary	0.07	0.09	0.35
Household Head Quality Evaluation	0.16	0.14	0.21
Primary	0.16	0.18	0.25
Lower Secondary	0.14	0.09	0.14
Upper Secondary	-0.09	-0.17	-0.14
Commune Per Capita Real School Expenditures (1991-95 thousand VND per year)			
Recurrent	0.04	-0.09	0.75
Capital	-0.25	-0.21	0.11

[a]Based on local schools/communes for all children age 6-17 in sample and on regression and probit estimates with quadratics in income indicator (those with predicted expenditure per household member given in Table C4), at sample means.

[b]The "permanent construction" variable is the proportion of buildings occupied by the school that are "permanent construction" (as opposed to "semi-permanent" or "temporary"). The "school staff," "current inputs," and "congestion" indicators each are based on the sum of a number of components, for each component of which the range of responses for all schools has been normalized to be 0 to 1. The components for "school staff" are: whether school head is qualified to teach at the level of the school, years of experience as head of school head, the proportion of the school's teachers who are qualified by

the Ministry of Education and Training to teach at this level, the proportion of teachers ranked "excellent" or "good" by school head, the proportion of teachers who are full-time, and the average teaching experience of teachers. The components for "current inputs" are: the proportion of classrooms wired for electricity, the proportion of classrooms with legible blackboards, the proportion of classrooms with ceiling fans, whether the school has safe water, whether the school has hygienic latrines, whether the school has a library, whether the school has a science laboratory, the number of computers per student, and the number of textbooks per student for rental or loan to poor students. The components for "congestion" are: the proportion of classes taught in the third shift, the number of students per class, and the number of students per teacher.

Table C1. Probits and Regressions for Standard Individual Schooling Indicators, Using Predicted Expenditure per Household Member as Income Measure[a]

Variables	Income	Income^2	Constant	$\bar{R}^2$/ χ^2 (2)
Probability Currently Enrolled	.11e-3(3.2)	-9.6e-9(1.1)	.31(3.2)	49.8
Probability Attended Private School	-.21e-4(1.0)	5.7e-9(1.1)	-1.3(7.1)	1.1
Age Started School	-.37e-3(3.1)	3.0e-8(1.3)	6.9(49.8)	0.04
Last Age in School[a]	.24e-2(2.8)	-3.8e-8(0.2)	14.3(19.3)	75.8
Grades Passed/Year in School	.11e-3(5.6)	-1.3e-8(2.7)	.74(39.0)	.06
Last Grade in School[a]	.20e-2(3.3)	2.3e-8(0.1)	6.7(12.9)	131.9
Comprehensive exam scores	.58e-3(3.3)	-5.1e-8(1.1)	5.4(36.0)	.05

[a]The sample is all children age 6-17 in the sample except that the estimates for the probability of attending private schools is based only on those currently enrolled. Probit estimates are given for currently enrolled and private schools, with the point estimates of the parameters of the income terms transformed to give dF/dX evaluated at sample means. Absolute z statistics (with Huber correction for clustering at household level) are given in parentheses to right of point estimates for these probits. The χ^2 statistics indicate significance at the 0.001 level except for current enrollment, but not for private schools. Regressions are given for the other schooling indicators, with absolute t values are in parentheses to right of point estimates. The regressions for last age in school and last grade in school control for right-censoring (because some sample members are still in school). The χ^2 for these two regressions indicate significance at the 0.0000 level. The other regressions have Huber corrections for clustering at the household level.

Table C2. Tobit Estimates for Annual Household Monetary Payments Related to Schooling in VND and Probits for School Fee Exemption using Predicted Expenditure per Household Member as Income Indicator[a]

Dependent Variables	Income	Income^2	Constant	χ^2 (2)
Paid to Schools	24.8(3.0)	.15e-2(0.7)	1.3e+4(1.7)	189.1
School fees	14.0(0.9)	.11e-2(0.3)	-7.5e+4(4.9)	18.0
School improvement fees	6.1(1.7)	.82e-3(1.0)	6.3e+3(2.0)	93.5
Parent associations fees	7.6(2.9)	.43e-4(0.1)	-1.6e+4(6.2)	125.0
Insurance	4.5(4.5)	-.41e-3(1.6)	8.8e+2(0.9)	117.9
Not Paid to Schools	76.4(2.1)	.32e-1(3.5)	1.3e+4(0.4)	383.0
Textbooks	3.0(0.8)	.19e-2(2.0)	2.2e+4(6.3)	107.7
Supplies/materials	8.9(2.8)	.12e-3(0.1)	1.5e+4(5.1)	121.3
Uniforms	37.5(3.9)	-.14e-2(0.6)	-3.6e+4(3.9)	162.8
Tutoring	136.1(3.7)	-.82e-3(0.1)	-3.2e+5(8.7)	212.2
Travel	-2.8(0.1)	.14e-1(1.5)	-3.8e+5(7.0)	22.0
Meals	157.8(4.2)	.18e-2(0.2)	-3.4e+5(9.0)	286.8
Other	-15.9(0.7)	.90e-2(1.7)	-9.4e+4(4.6)	13.6
Total	97.5(2.4)	.34e-1(3.4)	3.3e+4(0.9)	422.7
Exemption from fees	-.12e-3(2.0)	8.5e-9(0.6)	0.89 (5.9)	31.7

[a]Tobit estimates are used for monetary payments because of mass points at zero. Absolute t statistics are given in parentheses to right of point estimates. Probit estimates are given for fee exemptions, with the point estimates of the parameters of the income terms transformed to give dF/dX evaluated at sample means. Absolute z statistics (with Huber correction for clustering at household level) are given in parentheses to right of point estimates; the χ^2 statistic indicates significance at the 0.001 level.

Table C3. Tobit Estimates for Hours Students Spend in Normal Week and Probit Estimates for If Not Enrolled, Why Not, Using Predicted Expenditure per Household Member as Income Measure[a]

Dependent Variables	Income	Income^2	Constant	χ^2 (2)
Hours Students Spend in Normal Week				
Classwork	.19e-2(3.4)	-1.5e-7(1.1)	18.4(36.0)	79.6
Travel to/from School	-.13e-2(4.0)	1.5e-7(1.8)	4.8(16.2)	75.7
Homework on Own	.19e-2(2.4)	-2.9e-7(1.5)	8.0(11.0)	17.2
Homework with Assistance of Household Member	.21e-3(0.2)	2.4e-7(1.0)	-3.6(3.7)	18.2
Tutoring	.75e-2(4.6)	-5.2e-7(1.3)	-13.1(8.1)	181.7
Extra-curricular Activities	.16e-1(3.8)	-1.8e-6(2.0)	-43.7(7.7)	102.6
Family Work	-.94e-2(4.0)	4.4e-7(0.7)	9.3(4.5)	143.7
Sibling Care	-.15e-3(0.1)	-3.1e-7(0.7)	1.9(1.3)	9.6
Why Not Enrolled				
Work	.13e-3(1.9)	-2.5e-8(1.4)	-1.1(4.5)	4.4
Don't Like School	-.12e-3(1.7)	2.0e-8(1.0)	-.24(1.2)	5.2
Didn't Pass	.55e-4(0.9)	-1.1e-9(0.1)	-1.3(4.5)	5.9
School Poor, Distant, Expensive	.89e-4(1.4)	-3.0e-8(1.5)	-2.1(4.1)	3.0
Poor Health	-.17e-4(0.6)	4.1e-9(0.5)	-1.6(5.3)	0.3
Other	-.72e-4(1.1)	1.1e-8(0.6)	-.51(2.3)	2.2

[a]Tobit estimates are used for hours in different tasks because of mass points at zero (except for classwork and travel time). Absolute t values are given in parentheses to right of point estimates. Probit estimates are given for if not enrolled, why not–with the point estimates transformed to give dF/dX evaluated at the sample means. Absolute z statistics (with Huber correction for clustering at household level) are given in parentheses to right of point estimates. All the χ^2 statistics indicate significance at the 0.001 level except at the 0.01 level for sibling care; at the 0.05 level for homework with assistance, didn't pass and poor health; at the 0.10 level for don't like school; at the 0.15 level for work; at the 0.25 level for school poor/distant/expensive; but not at the 0.25 level for poor health and other.

Table C4. Regression and Probit Estimates of School Characteristics--Staff, Current Inputs, Construction, Commune Financing--and Schools Evaluated Excellent or Good by School Heads and Household Needs, using Predicted Expenditure per Household Member as Income Measure[a]

Variables	Income	Income^2	Constant	R^2/ χ^2 (2)
School Staff	.77e-4(4.5)	-9.7e-9(2.6)	.62(34.2)	.12
Primary	.59e-4(2.7)	-6.1e-9(1.0)	.61(30.0)	.06
Lower Secondary	.11e-3(3.1)	-1.3e-8(1.7)	.55(15.5)	.10
Upper Secondary	.41e-4(4.3)	-3.8e-9(1.7)	.70(71.6)	.08
Current Inputs	.17e-3(3.4)	-1.5e-8(1.1)	.18(4.7)	.28
Primary	.14e-3(3.2)	-6.5e-9(0.5)	.09(2.5)	.25
Lower Secondary	.18e-3(6.3)	-2.6e-8(4.1)	.06(1.9)	.10
Upper Secondary	.13e-3(2.1)	-1.1e-8(0.6)	.33(6.8)	.12
Permanent Construction	.19e-3(6.0)	-2.0e-8(3.0)	-.01(0.3)	.15
Primary	.12e-3(1.7)	-1.4e-8(0.8)	.03(0.6)	.03
Lower Secondary	.14e-3(2.2)	-2.6e-8(1.6)	.13(2.5)	.01
Upper Secondary	.33e-3(3.7)	-3.4e-8(1.4)	-.10(1.5)	.18
Congestion	-3.3e-6(0.4)	3.9e-9(2.1)	.19(24.9)	.03
Primary	.20e-4(0.9)	1.3e-9(0.2)	.16(9.3)	.05
Lower Secondary	3.0e-7(0.0)	2.3e-9(1.0)	.18(13.5)	.01
Upper Secondary	-.20e-4(1.5)	6.9e-9(1.9)	.22(20.6)	.01
School Head Quality Evaluation	.87e-4(2.4)	-3.9e-9(0.5)	.66(17.0)	.05
Primary	-.26e-4(0.8)	4.8e-9(0.6)	.98(3.5)	1.0
Lower Secondary	-.21e-3(4.3)	8.0e-8(5.8)	.77(2.6)	69.5
Upper Secondary	.12e-3(2.7)	1.4e-8(1.0)	-.05(0.2)	214.6
Household Head Quality Estimation	-.37e-4(0.5)	3.6e-8(1.9)	.10(0.6)	38.1
Primary	-.19e-4(0.2)	3.4e-8(1.3)	-.70e-2(0.0)	21.4
Lower Secondary	-.74e-4(0.6)	3.9e-8(1.2)	.29(1.1)	9.0
Upper Secondary	-.23e-3(0.9)	5.1e-8(0.8)	1.6(1.8)	1.1
Commune Per Capita Real School Expenditures, 1991-95, 1,000 VND				
Recurrent	.57(2.9)	-.70e-4(1.4)	19.4(0.1)	.02
Capital	1.8(2.1)	-.50e-3(2.1)	1651(2.3)	.01

[a]Tobit estimates are used for school head (by level) and household quality evaluations. Absolute z statistics are given in parentheses to the right of these point estimates, which have been transformed into dZ/dX. χ^2 are significantly nonzero at the 0.001 level except: permanent construction for lower secondary at 0.01 level; commune real per capita recurrent expenditures and current inputs for upper secondary at 0.15 level; and school head and household head quality evaluations for upper secondary not significant at 0.50 level. All the other estimates are regressions, with the absolute value of t statistics in parentheses to the right of the point estimates. Huber corrections for clustering at the household level are used throughout.