DOES SCHOOLING INCREASE AND SCHOOLING GENDER GAPS DECLINE WITH INCREASES IN PARENTAL SCHOOLING AND WEALTH? EVIDENCE FROM OVER A QUARTER CENTURY IN RURAL GUATEMALA

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INTRODUCTION

Schooling attainment in poor countries has been associated with a number of positive outcomes for individuals, including lower fertility, greater productivity and earnings, enhanced cognitive skills, and better health and nutrition. Schooling attainment also has been associated with positive intergenerational outcomes, including improved child-care practices, higher rates of child survival, and better health in children. Many of these associations are strong for men, but most of them are even stronger for women.[1]

In 1975, nevertheless, average schooling attainments in most poor countries were relatively low, and there were large gender gaps favoring males. In the three decades since then, there have been large increases in schooling attainment that have tended to be more rapid for females than for males. The 2005 United States National Research Council and Institute of Medicine (NRC-IOM) Panel on Transitions to Adulthood in Developing Countries, for example, included the following conclusion among their key findings on schooling (Lloyd et al. 2005, p. 142):

> *Young people in developing countries are spending more of their adolescence in school than previously.* The rate of growth in school attendance has been very rapid, in some cases far exceeding the pace of change that occurred in the historical transition to universal schooling in the West….
>
> *Growth rates in all indicators of school participation and grade attainment have been greater for girls than for boys. As a result, gender gaps are narrowing rapidly and have been eliminated or reversed in some countries.* Girls now have a small educational advantage in South America in terms of grade attainment and primary grade completion rates and may soon reach parity with boys in much of Africa.

Despite these overall gains in schooling and the large reductions in schooling gender gaps favoring males, roughly 130 million children in poor countries do not receive primary schooling, and nearly two thirds of these children are girls (UNICEF 1999, UNESCO 2004). As a result, the NRC-IOM Panel concludes that increasing schooling attainment and reducing persistent gender gaps in schooling should be given high priority. This recommendation is consistent with the United Nations Millennium Development Goals, which include the elimination of gender disparities at all levels of schooling, as well as universal completion of primary school.

In studies of children's schooling attainments in resource-poor settings, scholars often have stressed the role of *parental resources and investments in children*. First, if parental family income constrains investments in schooling because such investments must be largely self-financed, then part of the increase in schooling attainment in such contexts may reflect an increase in parental resources, which loosens those constraints. Second, if parental investments in the human resources of females are a luxury relative to such investments in males, then increased parental resources also may reduce the gender gap favoring males in schooling attainment. In studies of children's attainments in wealthier settings, scholars have stressed the role of *social or public investments in children*. To our knowledge, however, no studies have investigated potential *changes* in the role of parental family resources in poor settings that are exposed to direct social investments in children and to other local economic changes that may shape parental decisions about the allocation of resources to their children.

In this paper, we make use of rich community histories and repeated village censuses in four rural Guatemalan villages to describe trends in the schooling achievements of young males and females between 1975 and 2002. We then examine the extent to which these

patterns of change in schooling attainment by gender, and in gender gaps in such attainment, are associated with parental schooling and wealth, controlling for various indicators of social investments in children and the local economic environment.[2]

DETERMINANTS OF CHILD SCHOOLING ATTAINMENT

Economists often have viewed child schooling attainment to be an outcome determined by family behavior (Becker and Tomes 1986). Adults in the family—typically the parents—make decisions about the creation and use of family resources, including investments in children. Such models of household decision-making assume that parents care about the economic capabilities and success of their children, and influence the development of their children's human capital by making "expenditures on their skills, health, learning, motivation, 'credentials,' and many other characteristics" (Becker and Tomes 1986: S5). The amount and share of family resources that are allocated to children, the nature of these resources, and the timing of their allocation may affect the various achievements of children, including their entry into school, their progression in school, and the number of grades in school that they ultimately complete. Children also are affected by other choices of their parents concerning, for example, the number of other offspring, neighborhood of residence, and any moves and changes in family structure.

Sociologists and other social scientists have viewed the process of schooling attainment from other, complementary perspectives. For example, socialization theory stresses the potentially important effects of children's role models, who establish norms for behavior and achievement to which children aspire. Within this perspective, parents often are the primary role models, and their behavior, aspirations, values, and expectations about schooling directly affect the cognitive and social-psychological development of children. Although the mechanisms of effect in these economic and sociological frameworks differ, their implications with respect to

the potential effects of parental schooling are consistent (e.g., higher schooling attainments of parents will be associated with higher schooling attainments of their children).

Variables reflecting the parental resources that are available for investment are the most commonly used measures in analyses of children's schooling attainment. In this set, the most directly relevant resource has been parental human capital, which typically is measured by parental schooling attainment. Across a wide range of studies, associations of parental schooling with children's schooling outcomes are significant and positive, and measures of maternal schooling often are thought to be more closely associated with children's schooling attainment than are measures of paternal schooling (Behrman 1997).[3] Beyond parental schooling, the roles of family income (or wealth) and family structure also have been widely studied. These studies have shown that family income often is significantly associated with child schooling in a range of contexts, although the estimated strength of such associations varies considerably (Behrman and Knowles 1999).[4] Growing up in a one-parent family (or experiencing divorce or marital separation) also has been significantly negatively associated with children's schooling attainment, but the estimated magnitudes of this association vary widely (e.g., Ainsworth 2002, Case and Katz 1991, Graham, Beller, and Hernandez 1994, Seltzer 1994).

In a general critique of the literature on children's schooling attainments, Havemen and Wolfe (1995) have argued that economic and sociological models for the determinants of children's attainments have over-emphasized the role of parental and family resources and investments, often at the expense of other potentially relevant determinants. They propose a more comprehensive framework that views the attainments of children as functions of at least two factors: a) *parental* investments in children, or the choices made by parents regarding the quality and quantity of family resources that are devoted to children, but also b) *social*

investments in children, or the choices made by society or governments that affect the opportunities available to children and their parents.[5]

Empirically, social investments in children often has been operationalized with various measures for the characteristics of a child's neighborhood (e.g., region of residence, percentage of families with low incomes, and occupational structure). Other relevant factors of course include the expansion of school infrastructure and improvements in school quality (e.g., Duflo 2001). Controlling for a range of parental resources and other attributes, various favorable characteristics of the neighborhood – including (in the U.S.) measures of school quality, average neighborhood income, region of origin, the share of adult neighborhood residents with higher levels of schooling, and the share of neighborhood working persons with professional or managerial occupations – have been positively associated (albeit sometimes marginally) with children's schooling attainment (e.g., Ainsworth 2002, Crane 1991, Datcher 1982, Duncan 1994, Hill and Duncan 1987).

Contrary to most of the existing literature, Haveman's and Wolfe's (1995) depiction of the process of children's schooling attainment is sequential in the sense that the "society" or "government" acts first, by making some direct investments in children and also by shaping the economic environment within which parents and children make decisions about schooling. Given this context, parents then choose how to distribute their time between work and child care, and then given their income, they decide how much time and income to devote to their children. This sequential macro-micro model of children's schooling attainment suggests that as changes emerge in both the direct social investments in children as well as the (economic) environment in which families live, parental decisions about investments in children's schooling also will change. This prediction has potentially important implications for understanding the role of

parental investments in children's attainments in resource-poor settings *as they undergo* (sometimes rapid) expansions in the local infrastructures and economic markets within which such decisions are made. Despite the conceptual importance of this sequential macro-micro model, we have identified no studies that have investigated temporal changes in the role of parental resources in a setting that historically has been resource poor but that has undergone marked expansion in social investments in children and dramatic socioeconomic change.

To begin to fill this gap, in this paper we make use of an unusually rich set of repeated cross-sectional censuses and historical community-level data from four Guatemalan villages to address three specific research questions. First, what are the patterns of change in children's schooling outcomes, parental resources, and community resources in these villages between 1975 and 2002? Second, how, if at all, do the associations of maternal and paternal resources with children's schooling achievements change over time in a setting in which rapid socioeconomic changes and increased social investments in children are underway? Third, do changes in the associations of parental family resources and children's schooling achievements differ for girls and boys?

STUDY SETTING

Individuals in our study are from four Ladino (mixed Spanish-Mayan heritage), Spanish-speaking villages in the Department of El Progreso, about 100 km northeast of Guatemala City in Guatemala. Compared to the rest of Latin America,[6] trends in schooling and gender gaps in schooling differ in Guatemala in some notable ways. Despite overall gains in enrollment and attainment between 1990 and 2002,[7] enrollment ratios at ages 6–14 years and grades of schooling attained, especially among children reaching only the primary level, continue to be lower for girls than for boys (Filmer 2004). Whereas most LAC countries had female-to-male net

primary and secondary enrollment ratios ≥1.0, the same ratios for Guatemala were 0.93–0.94. As for the quality of schooling, the pupil-to-teacher ratio in primary schools was the highest in Guatemala among LAC countries with data (38 vs. 13–37).

The Institute of Nutrition of Central America and Panama (INCAP] selected the four villages mentioned above for a study that was undertaken between 1969 and 1977 to assess the effects of protein and energy supplementation on the growth and development of preschool children (Habicht and Martorell 1992). Originally, the villages were chosen because of their comparable size, social isolation, levels of schooling (30% adult literacy), and high prevalence of malnutrition and gastrointestinal and respiratory infections. Since then, multiple follow-up studies have been conducted, with the most recent one occurring during 2002–4.

Three of the four villages (Santo Domingo, Conacaste, and San Juan) lie in the cooler, more mountainous highlands of El Progreso, whereas Espíritu Santo borders the Motagua River in the hotter, more fertile lowlands (Bergeron 1992). The lifestyles of villagers have some similarities, yet socioeconomic and demographic changes have occurred at uneven rates since the 1960s (Engle 1992, Bergeron 1992, Maluccio et al. 2005). One striking but variable change across villages has been in the pattern of labor-market activity. Before the late 1960s, the economies of all four villages were based on small-scale subsistence agriculture (Maluccio et al. 2005). Subsistence farmers in the villages relied heavily on unpaid family labor until the 1980s, when young adults increasingly left the villages for non-agricultural wage work or continued schooling. As the supply of family labor diminished, subsistence farmers scaled back or exited subsistence agriculture. Today, subsistence agriculture is only a small part of the livelihood strategies of residents in the villages.

Residents in all villages have a history of seasonal migration for agricultural wage labor,

with the rate of migratory wage-labor varying with local demands for labor. In Espíritu Santo, local tobacco and vegetable farms provided a steady source of wage labor until Hurricane Mitch struck in 1998. In Conacaste during the 1980s, a horticultural cooperative provided hundreds of permanent jobs until the cooperative's collapse in 1991. Cementos Progreso, a cement company, has been a primary employer for residents of Santo Domingo since 1974 and for residents of Conacaste since 1980 (Maluccio et al. 2005). Many opportunities for non-agricultural wage work also exist along the Atlantic coast highway and in Guatemala City, and these opportunities have become steadily more accessible as roads and bus services have improved. Women have worked as domestic help in the capital since the 1960s, and in the 1980s and 1990s began working in higher paid jobs at free-trade assembly and re-export factories (Maluccio et al. 2005). Especially during the 1980s, men traveled to the capital for wage work in construction. Masonry (among men) and petty trade (among women) are common forms of self-employment in the villages, and palm-weaving has been a major source of income in Espíritu Santo since the 1960s. Outside industries have contracted (mostly female) villagers to do poorly paid piecework at home (Pivaral 1972, Murphy et al. 2005, Maluccio et al. 2005).

[Insert Figure 1 here]

Primary school in Guatemala includes grades one through six (*primarias*), and secondary school consists of five to seven grades. The first three years of secondary school are the basic grades (*básicos*), which provide academic and technical skills. The next two to four years are diversified grades (*diversificados*), in which students pursue more specialized training. Students can begin university after they have completed two diversified grades. In all four villages, public primary schools have been available in the villages since the 1960s. At that time, however, all primary-school infrastructures were extremely deficient. Only four grades were offered until the

1970s (Bergeron 1992), teachers had limited training and schooling, and none of the schools had electricity or running water. Since the late 1960s, schooling infrastructure has changed at varied paces in the villages. Espíritu Santo and Santo Domingo were the first to build cement-block primary schools around 1973 (Maluccio et al. 2005). An earthquake in 1976 destroyed the schools in Espíritu Santo and Conacaste, whereas the (adobe) school in San Juan and the (cement) school in Santo Domingo suffered minimal damage. Schools were rebuilt in the villages during the 1980s, and during the last 20 years, latrines, water, and electricity were installed. In 1979, the student-to-teacher ratio averaged 38:1 across villages, but varied from 31:1 in Santo Domingo to 51:1 in San Juan (Maluccio et al 2005). By 1998–2001, student-teacher ratios across the villages converged at around 30:1 (Maluccio et al. 2005). Before and even after the establishment of secondary schools in or near the villages in the 1990s,[8] students traveled to Sanarate, El Progreso, or Guatemala City to study at this level. In addition to fees for supplies, uniforms, books, and bus fare, there are fees associated with attending basic and diversified secondary school. Government-sponsored programs have contributed textbooks and scholarships to promote schooling in the villages.

DATA

The data for this analysis come from detailed village histories and village censuses that were conducted in 1975, 1987, 1996, and 2002. These censuses relied on an identical methodology within constant village boundaries and consisted of an interview form that was administered to the heads of all "nuclear" families in the villages.[9] The following family-level data were collected: civil status and religion of head(s), fertility of the female head, housing characteristics, and ownership of consumer durables. Gender, date of birth, whether alive or dead (and date of death), current location, self-reported literacy, schooling attainment, and

occupation also were collected for all nuclear-family members who were de facto residents during each census. Information for individuals who were counted in previous censuses was updated in successive censuses. Village-histories using a range of qualitative and quantitative methods have been conducted since 1965 and are described in detail in Pivaral (1972), Murphy et al. (2005), and Maluccio et al. (2005). These histories have been consolidated into a database that includes information, for example, about changes in school infrastructure, school quality, and economic markets in each village from 1960 to 2001.

Previous analyses of these data show that, across all villages, gross primary enrollment ratios increased from 78% in 1979 to 93% in 1998–2001 (Maluccio et al. 2005). These trends were positive in Conacaste (45% to 88%) and Santo Domingo (83% to 96%), constant in San Juan (96% to 97%), and negative in Espíritu Santo (106% to 84%). Rates of primary-school promotion, or the percentage of children graduating from one grade and eligible to enter the next, hovered around 49% to 56% in all villages except Conacaste, where these rates rose from 39% to 64% during the period. Rates of repetition and dropout also fell in Conacaste but averaged from 10% to 20% in the other villages (Maluccio et al. 2005). Between 1975 and 2002, the average number of grades of schooling increased from 1.4 to 5.0 for those aged 20–29 years and from 1.3 to 3.9 for those aged 15–64 years.

In 1975, men aged 20–29 years had 0.6 more grades of schooling than did their female peers, and by 2002, men's advantage among the 20–29 year-olds had increased to 0.8 grades. Trends in this gap varied by village, with men's advantage increasing in Santo Domingo and Conacaste (from -0.4 to 1.1 grades and from 0.0 to 1.2 grades, respectively), declining in Espíritu Santo (from 2.2 to 0.7 grades), and remaining insignificantly different in San Juan (Maluccio et al. 2005). In the mid-1990s, girl-to-boy ratios of promotion and/or enrollment

remained below one in every village except Conacaste (Maluccio et al. 2005).

This analysis focuses on females and males who were de facto residents in one of the four study villages and who were aged 7–12 years (1,692 female, 1,863 male) or 13–17 years (1,098 female, 1,328 male) during any of the census rounds.[10] Including children in this age range is appropriate for several reasons. First, virtually all of these children should have started primary school by age 7 years, and, some of them should have finished the last year of lower secondary school by age 17 years. Second, and for the substantive reasons mentioned above, questions about schooling in each census round were asked only for children who were at least 7 years of age. Third, older children are excluded from the analysis to minimize the problem of higher selective out-migration and in-migration after age 17 years.[11]

CHANGES IN CHILDREN'S SCHOOLING OUTCOMES DURING 1975–2002

We consider three measures of schooling achievements, namely (1) *ever schooling* -- whether the child ever attended school, (2) the schooling *progression ratio* -- or the number of grades that the child has attained relative to the number of expected grades attained, given the child's age and assuming that the child started school at age 6 years and completed one grade every year subsequently,[12] and (3) *schooling attainment* -- the highest grade that the child completed. Table 1 summarizes estimates for these three variables, separately for boys and girls, for 1975 and 2002 for those aged 7–17 years and for two subsets of this age range (7–12 years, 13–17 years). Some noteworthy patterns in this table are:

(1) *Schooling was low in 1975:* Among children aged 13–17 years, for example, only about two-thirds of them had ever attended school, the average progression ratio was about 0.30, and the average schooling attainment was about 2.5 grades.

(2) *There was almost no evidence of significant gender gaps in schooling in 1975:* For

children aged 7–17 years, none of the three indicators for schooling show a significant difference across boys and girls. For the two age subgroups, there are only two marginally significant differences. Specifically, compared to boys aged 7–12 years, girls the same age were marginally *more* likely ever to have attended school (0.47 versus 0.39) and completed a marginally higher number of grades (1.03 versus 0.82). These gaps favoring girls appear to contradict the average historical experience in developing countries, whereby gender gaps in schooling have tended to favor boys (see the introduction). Yet in 1975 in these villages, a gender gap in schooling favoring boys did exist among 20–29 year-olds (Maluccio et al. 2005), which is the age group at which young people are most likely to have completed their schooling. Given that boys aged 14–17 years in 1975 had 0.3 more grades of schooling than did girls the same age, it is possible that non-significant gender gaps among 14–17 year-olds in 1975 had expanded by the time this cohort had reached its twenties (and had completed its schooling). This explanation is even more plausible in light of trends toward a larger gender gap favoring boys aged 14–17 years in 2002 (see point 4, below).

(3) *Between 1975 and 2002, there were large and significant increases in all three indicators of achievements in schooling:* For both boys and girls in the 7–17 y age range, for example, the proportions who had ever attended school increased by about half (from 0.5 in 1975 to 0.8 in 2002), the progression ratios more than doubled (from 0.26 to 0.57), and the average schooling attainment more than doubled (from about 1.5–1.6 grades to 3.2–3.5 grades).

(4) *There is some evidence of significant gender gaps in schooling in 2002, favoring*

girls at earlier ages but favoring boys at older ages: Among children aged 7–12 years, a marginally significantly greater proportion of girls than boys have ever attended school (0.76 versus 0.72), and girls have a significantly higher school progression ratio than do boys (0.53 versus 0.48). Among 13–17 year-olds, boys are marginally more likely ever to have attended school (0.96 versus 0.93), have a significantly higher school progression ratio than do girls (0.69 versus 0.63), and have significantly higher grade attainment (by about half a grade).

[Insert Table 1 here]

CHANGES IN PARENTAL RESOURCES AND SOCIAL INVESTMENTS IN CHILDREN DURING 1975–2002

In the sections that follow, we investigate associations of the three indicators of children's schooling achievements that are described above with maternal grade attainment by child's age 7 years, paternal grade attainment by child's age 7 years, and an indicator for household standard of living by child's age 7 years (controlling for maternal age and other community attributes at child's age 7 years). The variable for household standard of living is a score derived from the first principal component of a principal components analysis of selected physical assets and other characteristics of each child's household, as described in Maluccio, Murphy, and Yount (2005).[13] Table 2 summarizes these parental characteristics for children aged 7–17 years in 1975 and 2002. Some noteworthy patterns in this table are that:

(1) *The numbers of parental grades of schooling were very low in 1975:* In 1975, children aged 7–17 years had mothers with less than one grade of schooling, on average, and had fathers with about 1.0 grade of schooling, on average.

(2) *There is little evidence of significant gender gaps in parental characteristics in*

1975: For the complete 7–17 y age range, there was no significant difference by child's gender in any of the indicators for parental resources (maternal age, maternal schooling, paternal schooling, percentage with missing information for maternal and paternal schooling, score for household standard of living). In fact, there is only one marginally significant gender difference in parental characteristics in 1975: compared to boys aged 13–17 years, girls the same age had mothers who were slightly older, on average (maternal age 35.8 years for girls versus 34.5 years for boys when these children were 7 years old).

(3) *Between 1975 and 2002, parental schooling increased substantially, and there was no significant change in the extent of missing information on parental schooling:* Compared to the low levels reported in 1975, both maternal and paternal grade attainments were significantly higher in 2002, and the pace of these changes were similar for boys and girls. For example, among children aged 7–12 years, maternal schooling increased from 0.9–1.0 grades in 1975 to 2.9–3.1 grades in 2002, and paternal schooling increased from 1.0–1.1 grades in 1975 to 3.7–3.8 grades in 2002. (Notably, the levels of parental schooling in 2002 are not very high compared with other countries in Latin America.) Estimates for maternal and paternal grade attainment in both census years are based on cases with the relevant information. Although the share of children with missing information on paternal schooling is higher than the share of children with missing information on maternal schooling for all ages, census years, and genders, the share of children with missing information on maternal and paternal schooling does not vary significantly either by child's gender (within census years) or over time (within child's gender).

(4) *Between 1975 and 2002, household standard of living increased dramatically:* The index for household standard of living increased significantly (four standard deviations) between 1975 and 2002 for girls and boys of all ages, which is consistent with improved housing characteristics and increased ownership of consumer durable goods seen over the period.

[Insert Table 2 here]

Below, we also investigate the associations of children's ever schooling, schooling progression ratio, and grade attainment with selected village-level measures. These village-level measures are assumed to reflect social investments in children before each child reached 7 years of age. In other words, these village-level attributes are constructed to reflect the local infrastructure and economic conditions that existed at or before the age at which each child should have entered school. By construction, these measures vary by village and within village by birth-year cohort. The specific indicators considered here include the average number of primary teachers per grade in the local primary school during the 5 years before each child turned 7 years old, the average number of grades offered in the local primary school during the 5 years before each child turned 7 years old, the number of years that an all-weather (e.g., with well defined drainage and/or pedestrian walks) access road to a paved highway was available in the village before each child turned 7 years old, and the percentage of adults aged 15 years and older who were working in wage labor when each child was aged 7 years. We also include village dummies (Santo Domingo, Conacaste, Espíritu Santo versus the reference village of San Juan) to control for all fixed village-level characteristics that may be associated with children's achievements in schooling. Table 2 also summarizes these community attributes for boys and girls who were aged 7–12 years and 13–17 years in the

1975 and 2002 censuses. Some noteworthy patterns in this table are that:

(1) *Average number of teachers per grade of primary school*: to be discussed.

(2) *For children aged 7–17 years in 1975, a full course of primary school (6 years) had not been consistently available in the villages before these children had turned 7 years; however, for children aged 7–17 years in 2002, a full course of primary school had been offered consistently in the villages before each child had turned 7 years*. In 1975, for example, an average of only *4.0* grades of primary school had been offered during the 5 years before children aged 13–17 years had turned 7 years, whereas an average of *5.0* grades of primary school had been offered during the 5 years before children aged 7–12 years had turned 7 years. By 2002, a full course of primary school (6 grades) had been offered during the 5 years before all children aged 7–17 years had turned age 7 years.

(3) *Children's years of exposure (before turning age 7 years) to an all-weather access road that led to a paved highway were very low in 1975, but increased steadily and significantly between 1975 and 2002.* In 1975, for example, children aged 13–17 years had only 1.6–2.0 years of exposure to an all-weather access road before turning 7 years, whereas children aged 7–12 years had 2.5–2.8 years of exposure. By 2002, 13–17 year-olds had had 10.3–11.3 years of exposure to an all-weather access road before turning 7 years, and 7–12 year-olds had had the longest exposure to an all-weather access road before turning 7 years (13.9–14.7 years).

(4) *The percentage of adults (aged 15 years and older) who were working in wage labor (at children's age 7 years) was very low in 1975, but this percentage increased significantly between 1975 and 2002.* In 1975, children aged 7–17 years

had been living at age 7 years in an environment in which an average of 11.7–12.6 percent of adults was working in wage labor. By 2002, children aged 13–17 years had been living at age 7 years in an environment in which an average of over 25 percent of adults was working for a wage, and children aged 7–12 years had been living at age 7 years in a setting in which an average of over 29 percent of adults was working for a wage.

(5) *There were no gender differences in exposure to community characteristics in either 1975 or 2002.* This lack of a gender difference is not surprising, given that the distribution of girls and boys aged 7–17 years across study villages does not differ significantly in either 1975 or 2002.

Taken together, the discussion above suggests that children aged 7–17 years in these study villages experienced dramatic increases in both parental and community resources during the period 1975 to 2002.

METHODS

To estimate associations of parental and community resources with children's schooling outcomes during 1975 and 2002, we estimate the linear relation below, where S_{iht} denotes the schooling indicator of child i residing in household h observed at time t, I_{iht} a vector of personal characteristics of child i (e.g., age), H_{iht} a vector of parental household characteristics of child i (e.g., maternal and paternal grade attainment and household standard of living), V_{iht} a vector of specific village-level characteristics and village dummies, β_t coefficients to be estimated (with superscripts c referring to the constant, i referring to individual, h referring to the household and v referring to the village), and ε_{iht} a white noise disturbance term:

$$S_{iht} = \beta_t^c + \beta_t^i \cdot I_{iht} + \beta_t^h \cdot H_{iht} + \beta_t^v \cdot V_{iht} + \varepsilon_{iht} \quad (1)$$

This specification is estimated separately for males and females and for the age groups 7–12 years and 13–17 years.

To assess whether associations of parental characteristics with children's schooling outcomes change over time, we add interaction terms between variables in H and a dummy variable for all (1987, 1996, 2002) but one (1975) of the census years (Model 1). Because of the large number of interaction terms included in this "census-interacted," we estimate F-tests (for OLS models) and chi-squared tests (for probit models) for the joint significance of sets of interaction terms (e.g., maternal schooling * census year dummy interactions, paternal schooling * census year dummy interaction, etc). Model (2) presents the model that excludes all sets of interactions terms that are jointly not significant. We also attempted to fit the same sequence of models but including instead interactions between specific village-level characteristics and dummy variables for the census year; however, very high correlations among some interaction terms weakened our confidence in the stability and interpretability of the estimated coefficients and standard errors in these models. For this reason, we do not present the results from these models, but they are available upon request. [Add main effects models to tables and discuss]

RESULTS

Table 3 shows census-interacted and parsimonious models for the determinants of ever schooling, school progression ratios, and total grades attained for girls and boys who were aged 7–12 years and resident during any of the 1975, 1987, 1996, and 2002 census rounds. For girls, F-tests for the joint significance of interactions between the dummy variable for census year and 1) maternal schooling, 2) the natural logarithm of maternal age, and 3) paternal schooling in

models for the school progression ratio and grades attained suggest that none of these sets of interaction terms are jointly significant. Chi-square tests for the joint significance of the same sets of interaction terms in probit models for ever-schooling lead to similar conclusions. While chi-square tests for the joint significance of interactions between dummy variables for census year and measures of household standard of living indicate that these terms also are not jointly significant in probit models for ever schooling, these terms are jointly significant in models for girls' school progression ratio and grades attained. Thus, controlling for secular trends in schooling achievements, age-period cohort changes in schooling achievements, and a range of village-level characteristics that are significantly positively associated with schooling achievements (e.g., average number of primary grades offered in the 5 years before turning 7 years and percentage in wage labor at 7 years), maternal and paternal schooling are significantly positively associated with all schooling outcomes in girls, and the magnitudes of these associations remain constant over time. For grade attainment and the school progression ratio, the magnitude of the coefficient for maternal schooling is significantly larger than that for paternal schooling ($p < 0.05$). By contrast, the magnitude of the association of household standard of living with girls' grade attainment and school progression ratios declines over time. In 1975, a one-point (one standard deviation) increase in the score for household standard of living is associated with an increase of ~0.35 grades of schooling and ~0.09 in the ratio of achieved to expected grades of schooling. Relative to this association in 1975, the association of household standard of living and girls' schooling achievements is significantly lower in all subsequent years; for example, an increase of one point in the score for household standard of living is associated with an increase of only ~0.16 grades of schooling and ~0.04 in the ratio of achieved to expected grades of schooling.

[Insert Table 3 here]

For boys, F-tests for the joint significance of interactions between census year and 1) the natural logarithm of maternal age, 2) paternal schooling, and 3) household standard of living in models for the school progression ratio and grades attained suggest that none of these sets of interaction terms are jointly significant. Chi-square tests for the joint significance of the same sets of interaction terms in probit models for ever-schooling lead to similar conclusions. Both chi-squared- and F-tests for the joint significance of interactions between census year and maternal schooling indicate that these terms are jointly marginally significant in models for boys' ever schooling, school progression ratio, and grades attained. Thus, controlling for secular trends in schooling achievements, age-period cohort changes in schooling achievements, and a range of village-level characteristics that again are significantly positively associated with schooling achievements (e.g., average number of primary grades offered in the 5 years before turning 7 years and percentage in wage labor at 7 years), paternal schooling and household standard of living are significantly positively associated with all schooling outcomes in boys, and the magnitudes of these associations remain constant over time. By contrast, the magnitudes of the association of maternal schooling with boys' ever schooling, school progression ratios, and grade attainment declines over time. In 1975, a one-grade increase in maternal schooling was associated with an increase of ~0.14 grades of schooling and ~0.03 in the ratio of achieved to expected grades of schooling. Relative to this association in 1975, the association of maternal schooling and boys' schooling achievements is significantly lower in all subsequent years; for example, an increase of one grade of maternal schooling is associated with an increase of only ~0.16 grades of schooling and ~0.03 in the ratio of achieved to expected grades of schooling.

Table 4 shows census-interacted and parsimonious models for the determinants of ever

schooling, school progression ratios, and total grades attained for girls and boys who were aged 13–17 years and resident during any of the 1975, 1987, 1996, and 2002 census rounds. For girls, F-tests for the joint significance of interactions between census year and 1) paternal schooling and 2) the household's standard of living in models for the school progression ratio and grades attained suggest that neither set of interaction terms is jointly significant. Chi-square tests for the joint significance of the same sets of interaction terms in probit models for ever-schooling lead to similar conclusions. While chi-square tests for the joint significance of interactions between census year and 1) maternal schooling and 2) the natural logarithm of maternal age indicate that these terms also are not jointly significant in probit models for ever schooling, these terms are jointly significant in models for girls' school progression ratio and grades attained. In this age-gender group, controlling for secular trends in schooling achievements, age-period cohort changes in schooling achievements, and a range of village-level characteristics (e.g., in this case, years of exposure to an all-weather access road is negatively associated with girls' schooling achievements at this age), paternal schooling and the household's standard of living are significantly positively associated with all schooling outcomes in girls, and the magnitudes of these associations remain constant over time. For example, an increase of one grade in paternal schooling is associated with an increase of ~0.15 grades and ~0.02 in the school progression ratio. By contrast, the magnitudes of the associations of maternal schooling and the natural logarithm of maternal age with girls' grade attainment and school progression ratios decline over time. In 1975, a one grade increase in maternal schooling is associated with an increase of ~0.48 grades and ~0.06 in the school progression ratio. Relative to this association in 1975, the association of maternal schooling and girls' schooling achievements is significantly lower in subsequent years; for example, an increase of one grade in maternal schooling is associated with

an increase of only ~0.16 grades of schooling and ~0.02 in the ratio of achieved to expected grades of schooling.

[Insert Table 4 here]

For boys, F-tests for the joint significance of interactions between census year and all parental household characteristics in models for the school progression ratio and grades attained suggest that no set of interaction terms is jointly significant. Chi-square tests for the joint significance of the same sets of interaction terms in probit models for ever-schooling lead to similar conclusions. In this age-gender group, controlling for secular trends in schooling achievements, age-period cohort changes in schooling achievements, and a range of village-level characteristics (e.g., in this case, years of exposure to an all-weather access road also is negatively associated with boys' schooling achievements at this age), maternal schooling, paternal schooling, and the household's standard of living are in most cases significantly positively associated with all schooling outcomes in boys, and the magnitudes of these associations remain constant over time. For example, an increase of one point (one standard deviation) in the score for household standard of living is associated with an increase of ~0.44 grades and ~0.05 in the school progression ratio. In this case, the magnitudes of the associations of boys' ever schooling, grade attainment, and school progression ratio with maternal schooling do not differ significantly from their respective associations with paternal schooling (results not shown; available upon request).

CONCLUSIONS

The purpose of this analysis has been threefold. First, to describe changes in the schooling achievements that successive cohorts of young girls and boys in four Guatemalan villages experienced during the last quarter of the twentieth century (1975–2002). Second, to

assess the extent to which associations of these schooling outcomes with parental resource variables also have changed, especially given dramatic local changes in both direct social investments in children (e.g., expansion of primary schools) and the economic environment in which parents were making decisions about investments in their children's schooling (e.g., increasing percentage of adults in wage labor). And third, to assess whether temporal changes in the associations of schooling outcomes and parental resource variables vary by gender.

As a conceptual backdrop to this analysis, we have drawn on elements of the framework proposed by Haveman and Wolfe (1995), who argue that *social* investments in children's schooling precede and provide the context for *parental* decisions about investments in their children's schooling. Such a model implies that the amount and nature of parental investments in their children's schooling may change if changes arise in the nature and scope of extra-familial investments to promote children's schooling.

This analysis is unique in that we draw on an unusually rich dataset that includes information on children's schooling, parental resource variables, and village histories for more than a 25 year period (1975–2002). We acknowledge, however, that this dataset lacks the information that, as noted by Haveman and Wolfe (1995), would allow us to treat both social and parental investments in children as behaviorally determined. Indeed, other research has shown that controlling for the endogeneity of parental schooling attainment can make a big difference in the estimated "impacts" of those parental resource variables (Behrman and Rosenzweig 2002, 2005, Black et al. 2005, Plug 2004). In light of these limitations, we explore changes in the associations of various measures of parental resources with children's schooling outcomes in multivariate models that control for secular trends in schooling, cohort-period trends in schooling, and a range of fixed community characteristics.

Our descriptive results for children in these study villages (Table 1) show that levels of schooling in 1975 were equally low for boys and girls aged 7–17 years, that there were large and highly significant increases in ever schooling, school progression ratios, and grade attainment between 1975 and 2002, and that there was some evidence by 2002 of significant gender gaps in schooling, favoring girls at earlier ages (7–12 years) but favoring boys at older ages (13–17 years). The latter patterns by gender suggest specifically that girls in these villages came to be more likely to enter school and to progress in school during their early years, but that boys began to catch and surpass girls on rates of ever schooling, progression, and attainment by young adulthood (ages 13–17 years). Although these gender gaps are not large, their emergence during 1975–2002 contradicts the experience of most other countries in Latin America (Behrman, Duryea and Székely 2004), which showed reversals in gender gaps in schooling (toward favoring girls) as overall schooling achievements improved. This apparent divergence of schooling trends in Guatemala may result from Guatemala's lower initial level of schooling, which offered less room for gender gaps. As levels of schooling have increased, however, gender gaps in schooling have been able to emerge. So, trends in schooling in Guatemala may simply be behind the regional curve toward a disappearance or reversal of these gaps.

Consistent with the model proposed by Havemen and Wolfe (1995), results of the multivariate analyses suggest that associations of parental resources with children's schooling outcomes tend to decline in magnitude over time, and implicitly with increases in various social investments in children's schooling. Some specific findings from these analyses warrant special note:

(1) *In 1975, associations of household standard of living with measures of schooling*

progression and attainment are significant for girls and boys aged 7–12 years, but the magnitude of this association is larger for girls (test), and declines over time only for girls. This finding is consistent with the idea that, in poor settings, schooling is largely financed by families, and so investments in girls' schooling are a luxury relative to investments in boys' schooling. In this climate, increases in a household's standard of living are associated with greater achievements in girls' schooling. However, as extra-familial groups begin to invest in the schooling of children (e.g., local primary schools are expanded to provide all 6 grades), the costs of schooling that families formerly assumed diminish, and the association between household standard of living and girls schooling declines to the level observed among boys.

(2) *In 1975, associations of maternal schooling (and maternal age) with measures of schooling progression and attainment are significant for girls and boys aged 13–17 years, but the magnitudes of these associations are larger for girls (test), and decline over time only for girls.* Empirically, this tendency for the positive associations of maternal age and maternal schooling to decline only for girls and to levels in 2002 that are lower for boys explains the emergence of gender gaps in schooling favoring boys at this age. This tendency is consistent with situations in resource-constrained households where the role of a mother in promoting investments in her daughter(s) depends on the mother's own position. As the overall level of girls' schooling increases, the mother's role in promoting investments in her daughters may diminish, perhaps even in the context of increasing gender gaps in schooling.

(3) *Among boys aged 13–17 years, associations of parental resources with schooling outcomes are robust to changes in the social investments in children's schooling*.

As already mentioned, we do not have the data at hand to use the estimation methods (e.g., two-stage least squares) that would permit us to interpret coefficients as estimates of the causal relationship of parental and community resources on children's schooling achievements in any given year. However, *if* the endogeneity biases that lead to these estimated coefficients are *not* changing over time, then observed changes over time in the coefficients for parental resource may represent changes in the causal component of the parental resource variables.

In light of these findings and discussion, we will conduct further analyses with these data to assess the robustness of the findings that are presented. First, we will experiment with additional measures of parental resources that are cited in the literature as being potentially relevant determinants of children's schooling attainment (e.g., single-parent home or not at child's age 7 years). We also will test whether the findings above are robust to the inclusion of dummy-variable controls for migration into these villages since a prior census (e.g., children 7–17 years who were born elsewhere but are included in our analysis) and migration out of these villages in later censuses (e.g., children 7–17 years who appear in one census but who migrated before the next census). Finally, we will include an indicator for whether children in the analytic sample would have been age-eligible and in the villages at the time of the original nutrition intervention (which would have been the case for children aged 11–17 years in the 1987 census).

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Figure 1. Location of INCAP Longitudinal Study Communities in the Department of El Progreso, Guatemala (Source: Rose, Martorell, and Rivera 1992)

Table 1. Trends in Mean Grades of Schooling by Gender, and Grade Attainment for Girls vs. Boys, by Age and Census Year

	1975			2002				
Age Group	Girls	Boys	*p*	Girls	Boys	*p*	p^a	p^b
Ever schooling								
7-17	0.52	0.50		0.83	0.82		***	***
	(461)	(467)		(898)	(988)			
7-12	0.47	0.39	+	0.76	0.72	+	***	***
	(311)	(277)		(558)	(566)			
13-17	0.64	0.67		0.93	0.96	+	***	***
	(150)	(190)		(340)	(422)			
Progression								
7-17	0.26	0.26		0.57	0.57		***	***
	(461)	(467)		(898)	(988)			
7-12	0.25	0.21		0.53	0.48	*	***	***
	(311)	(277)		(558)	(566)			
13-17	0.30	0.32		0.63	0.69	**	***	***
	(150)	(190)		(340)	(422)			
Schooling Attainment								
7-17	1.50	1.57		3.21	3.52	*	***	***
	(461)	(467)		(898)	(988)			
7-12	1.03	0.82	+	1.93	1.85		***	***
	(311)	(277)		(558)	(566)			
13-17	2.47	2.65		5.31	5.77	*	***	***
	(150)	(190)		(340)	(422)			

Notes. Sample sizes are in parentheses.

+ p<.10, * p<.05, ** p<.01, *** p<.001

[a] T-test for difference in schooling outcomes for girls in 1975 versus girls in 2002.

[b] T-test for difference in schooling outcomes for boys in 1975 versus boys in 2002.

Table 2. Mean Parental or Household Characteristics for Census Years 1975 and 2002, Boys and Girls by Age

	7-12 years							13-17 years						
	1975			2002				1975			2002			
	Girls	Boys	*p*	Girls	Boys	*p*	p^a p^b	Girls	Boys	*p*	Girls	Boys	*p*	p^a p^b
(*n*)	(311)	(277)		(558)	(566)			(150)	(190)		(340)	(422)		
Parental Characteristics (at child's age 7 years)														
Maternal age in years	35.09	35.52		32.91	32.87		*** ***	35.81	34.47	+	34.11	33.93		***
Maternal grades of schooling	0.89	0.99		3.10	2.92		*** ***	0.81	0.92		2.57	2.60		*** ***
Maternal grades of schooling missing %	4.82	6.14		6.63	5.83			12.35	9.95		10.00	11.05		
Paternal grades of schooling	1.04	1.08		3.79	3.69		*** ***	0.92	0.98		3.18	3.41		*** ***
Paternal grade of schooling missing %	16.40	19.13		15.05	15.90			22.67	26.32		22.65	19.67		+
Score for household standard of living	-2.66	-2.61		2.05	1.99		*** ***	-2.48	-2.52		2.30	2.43		*** ***
Community Characteristics (at child's age 7 years)														
Avg. teachers per grade, 5 years prior	0.45	0.44		0.36	0.37		*** ***	0.74	0.73		1.10	1.07		*** ***
Avg. number of grades, 5 years prior	5.09	5.11		6.00	6.00		*** ***	3.96	4.00		6.00	6.00		*** ***
Exposure to an all-weather access road (years)	2.81	2.48		13.94	14.72		*** ***	1.61	1.95		10.28	11.26		*** ***
% in wage labor	12.09	11.67		29.14	29.15		*** ***	12.07	12.58		25.63	25.23		*** ***
Village														
Santo Domingo	28.30	28.52		32.62	33.75			32.00	33.68		34.12	31.52		
Conacaste	30.87	32.13		29.39	27.03			29.33	22.11		29.71	26.78		
Espiritu Santo	22.19	18.77		18.82	20.49			21.33	26.32		20.29	23.70		
San Juan	18.65	20.58		19.18	18.73			17.33	17.89		15.88	18.01		

+ p<.10, * p<.05, ** p<.01, *** p<.001

[a] T-test for difference in parental and community characteristics for girls in 1975 versus girls in 2002.

[b] T-test for difference in parental and community characteristics for boys in 1975 versus boys in 2002.

ENDNOTES

[1] The literature reporting on these associations is voluminous. Some selected examples, many of which suggest larger impacts for female than for male schooling, include Baxter and Kane (1995), Behrman and Deolalikar (1995), Behrman et al. (2005), Caldwell (1980), Casterline, Cooksey and Ismail (1989), Desai and Alva (1998), Kamens (1988), King and Mason (2000), LeVine et al. (1991), Lloyd (2005), Lloyd et al. (2005), Lloyd, Kaufman and Hewett (2000), Miller (1984), Robinson and Bell (1978), Schultz (1988), Wils and Goujon (1998). For the most part, these studies present associations and do not attempt to control for schooling being behaviorally determined in the presence of unobserved factors such as innate ability and motivation and family connections. Some studies that do control for what determines schooling report that such controls alter substantially the estimated impact of schooling. For example, recent studies that investigate the impact of maternal schooling on child schooling in developed countries using special data to control for unobserved endowments and the behavioral determination of schooling (e.g., twins data, adoption data, "natural" experiments through the timing of policy changes) report that significant positive associations using the usual methods become insignificant or even negative with such controls (e.g., Behrman and Rosenzweig 2002, 2005, Plug 2004, Black, Devereux and Salvanes 2005). The data for the present study, however, do not permit us to investigate such possibilities, and it is for this reason we emphasize that we explore the associations among the various study variables rather than assessing causality.

[2] Changes also occurred on the schooling supply side. However, our data come from only four communities, and so we are not able to identify school supply effects. Instead, we control for them by controlling for overall community effects.

[3] Although conventional wisdom is that the associations are much stronger between maternal and child schooling than between paternal and child schooling, the evidence in favor of this position is not overwhelming. For instance, in a now-dated review (but we do not know of a more recent one) of all the estimates that could be located for 21 countries, Behrman (1997) reports that only in 52% of the cases are the reported estimates for mother's schooling greater than those for father's schooling.

[4] Behrman and Knowles (1999) survey a number of these estimates. They also present estimates for Vietnam that suggest that many of the previous estimates in the literature may under-represent the association of family income with schooling because they use fairly short-run indicators of family income rather than longer-run "permanent income" measures.

[5] Haveman and Wolfe (1995) also argue that a third factor is relevant for children's schooling attainments, namely the choices that children make themselves, given prior investments in them and prior opportunities made available to them. Here, we argue that parents are more likely than an individual child to have control over the decision to invest in schooling in poorer settings in which norms of collectivism and parental authority are more pronounced and in which schooling attainment levels are relatively low (so the children are relatively young at the time of schooling attainment decisions).

[6] Behrman, Duryea and Szekely (2004), based on household survey data from 18 Latin American and Carribean countries, estimate an average increase of 4.6 years of schooling attainment between cohorts born in 1930 and 1970. Although women had an average of 1.1 fewer grades of schooling than men in the 1930 birth cohort, the gender gap subsequently reversed with average grades of schooling in 12 countries being *higher* for women than men for the 1970 birth cohort.

[7] Levels of schooling still are relatively low in Guatemala (UNESCO 2001). Compared to other LAC countries in 1998, Guatemalan gross and net enrollment ratios in primary (102%, 83%) and secondary (33%, 28%) school were among the lowest, and rates of repetition in primary school were among the highest (15%).

[8] Schools offering the basic secondary education (three years) were built in all villages except Espíritu Santo, in which case a secondary school where diversified education is located in its Municipal City (El Jicaro) only 1km away. Diversified secondary schools also are available in the Municipal Cities of the other three villages.

[9] A nuclear family included the following: (1) a couple (including their children, if any), regardless of whether they lived on their own or with others such as parents, (2) a single adult, with children and/or pregnant, regardless of whether s/he lived on their own or with others, and (3) a single adult living alone. A single woman without children, not pregnant, and living with her parents was considered a member of her parents' nuclear family. If the woman was pregnant and/or had had any children, she and her children (if present) would constitute a nuclear family apart from her parents.

[10] The age determining eligibility to be a subject is the integer of the difference between the date of birth and the date of interview.

[11] Including individuals over the age of 7 years is somewhat more problematic in 1975 because of relatively high rates of selective out-migration. Estimates of retention for individual years of age for the age range 0–17 years are available upon request. Also, rates of migration vary to some extent by period, gender, and village. Variation by gender results in part from earlier ages at marriage for girls and the strong propensity for girls to migrate out of their village of origin after marriage. Variations in migration by period and village often are a result of changes in labor markets and related economic factors. To evaluate these issues, we make use of the repeated cross-sectional design of these censuses to estimate 1) the proportion of those who were in the villages in 1975, 1987, and 1996 who would have been in the analytic age range in 1987, 1996, and 2002, respectively, but who were not observed in the subsequent census (here called *out-migrants*), and 2) the proportion of those observed in the 1987, 1996, and 2002 census who are in the analytic age range but were not observed in the prior census (here called *in-migrants*). In future sensitivity analyses, we will include a variable for in-migrant for these individuals in the 1987, 1996, and 2002 censuses.

[12] The expected years of schooling is capped at 9 grades because the average grades of schooling among those aged 20–29 years varies from 2.2 grades in 1975 to only 5.8 grades in 2002 (Maluccio et al. 2005), and only X% and X% of those aged 20–29 years completed more than 9 grades in 1975 and 2002, respectively.

[13] In constructing this index for the purposes of this analysis, the only notable difference from the description in this reference is that the scale was constructed by pooling cases across *all* census years and villages. In this way, the score for household standard of living for child *c* in village *v* and census year *y* can be compared with another child's score in any village and census year.