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THE IMPACT OF SCHOOL QUALITY ON EARNINGS AND EDUCATIONAL RETURNS - EVIDENCE FROM A LOW-INCOME COUNTRY

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ABSTRACT

The expansion of education has been widely adopted as a key element in the development strategies of low-income countries. While there is substantial evidence on the benefits of greater educational attainment for subsequent labor market earnings, empirical evidence on the role played by school quality is scarce. This paper combines household survey data with unique data on school quality, from Honduras, to study the importance of school quality as a determinant of earnings. Our objective measures of school quality capture teacher training, school infrastructure and school crowding. The results display strong positive effects of school quality on earnings and on educational returns. These effects persist across a variety of model specifications.

Keywords: Earnings, Returns to Education, School Attainment, School Quality,

JEL Codes: J31, 015

CONTENTS

1. INTRODUCTION

Following the example of developed countries and the advice of international development institutions, developing countries have devoted and continue to devote substantial resources to their education sectors. In 1998, public spending on education accounted for 15.8% of total government expenditures in developing countries (UNDP, 1998). Yet, surprisingly, there is little consensus that this money is being spent wisely and even disagreement on whether it should come from the public sector at all.

Among other reasons, two empirically testable assertions play an important role in arguments for maintaining or expanding the role of the public sector. One is that education has a high rate of return. Another is that, by compensating for family-background handicaps, it tends to equalize the distribution of earnings. There is a substantial amount of empirical confirmation of these assertions when it comes to educational attainment, but surprisingly little factual evidence backs them up when it comes to the *quality* of education.[1]

This paper makes use of a unique data set from Honduras to examine these two assertions. We use traditional estimation techniques to examine the impact of school quality on earnings and educational returns. These estimates are scrutinized for several possible weaknesses that have been pointed out in the past. We find robust evidence that school quality has a positive and quantitatively important effect on labor market earnings of adults. Next, we attempt to shed light on the distributional question by estimating a set of quantile regressions. Although the main focus of our work is on the school quality-earnings link, we conclude our empirical analysis by examining the effects of school quality through another channel, that is, the effect of school quality on educational attainment.

Section II places our paper in the context of other work on the economics of education. Section III outlines an analytical framework and discusses estimation issues. Section IV describes the data and section V the estimation results. Concluding observations are presented in section VI.

[1] The lack of evidence on the benefits of investing in school quality is particularly true for developing countries. A brief review of the U.S. literature on this topic is provided in the following section.

2. BACKGROUND

2.1 The rationale for public provision

The theoretical refinement of education as economic behavior dates at least back to Schultz (1961), Mincer (1974) and Becker (1975). They argue that schooling increases human capital and human capital increases earnings. Optimal schooling choices are modeled as weighing the opportunity costs of school-attendance against an increased lifetime earnings stream. The fact that schooling attainment is modeled as such an inherently private microeconomic choice gives cause to question the dominant role of the public sector in providing it.

However, several arguments may be advanced in favor of public intervention in educational provision. For instance, recent work in the theory of economic growth (Romer, 1986; Lucas, 1988; Becker et al., 1990) provides a strong justification for public investments in human capital. These theories emphasize that there are externalities associated with private investments in human capital. That is, not only do investments in human capital enhance the productivity of the investing individual but through a process of interaction enhance the productivity of others. It is argued that in the presence of these externalities, factor returns may not diminish and consequently increasing investments in human capital may accelerate economic growth. The presence of these externalities and their potential effects on growth suggests that public intervention may be warranted. Empirical attempts to assess the externalities associated with human capital investments are reviewed by Jimenez (1995).

Other arguments in favor of a strong public presence are linked to the fact that parents make decisions for their children. For instance, if parents are unable to finance education by borrowing against their children's future earnings, their investment may well be sub-optimal. A purely private educational system can not function efficiently without perfect capital markets and capital market imperfections are likely to be especially severe in developing countries. Another rationale for public intervention views education as a merit-good. It is argued that universal education will tend to have an equalizing effect on the distribution of income, perhaps even compensating for differences in family background. If parents view their children's future welfare as a normal good, higher income parents will spend more on the education of their offspring. Distributional impacts are thus seen as an externality of sorts. Without public intervention income inequality will tend to be passed on from one generation to the next--or even increase.

2.2 Quantity and quality of education

It is well known and widely accepted that educational attainment (quantity) raises income (Psacharapoulos, 1993). There is also some evidence that educational expansion (quantity) which is associated with an increase in the level of schooling and a reduction in educational disparities, tends to be associated with a more equal income distribution (dos Reis and de Barros, 1991 and Lam and Levinson, 1992).

Most of the literature on the impact of quality looks at effects on intermediate outcomes, like test-scores and grade repetition and not directly on earnings.[2] But this is problematic. For one thing, it is reasonable to expect that shifts in educational standards will accompany variations in quality. More fundamentally though, if we consider education as investment, rather than as consumption behavior, it is clear that at best, test scores measure an intermediate input to earnings determination. Public investments in quality will be worthwhile only if it can be shown that they have a measurable impact on earnings.

Several papers have examined the impact of school quality on earnings for developed countries (mainly the United States). These papers provide very mixed evidence. One set of papers reports strong effects of school spending on students' subsequent earnings while another set finds little or no effect.[3] Based on a survey of this literature, Betts (1996a) notes that, in general, papers that report substantial effects measure school inputs at the state level, are based on data from older individuals (aged thirty or older) and those who attended school between 1900 and 1960 (which is the case for most of the state-level studies). In contrast,

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[2] In a detailed study, Harbison and Hanushek (1992) survey educational production function estimates for developing and developed countries and conclude that there is no "compelling case for specific input policies" (p.25). Also see Hanushek (1995) and the rejoinder by Kremer (1995). Fuller and Clarke (1994) are somewhat more sanguine about the approach, but find that the literature suffers from the absence of a systematic, uniform and universally comparable set of quality measures.

[3] Examples of papers that find a positive and significant school quality effect on earnings include Rizutto and Wachtel (1980) and Card and Krueger (1992a, 1992b). Papers that find insignificant school quality effects inlcude Ribich and Murphy (1975), Betts (1995), and Grogger (1996a, 1996b). In general Heckman et al. (1995) also report insignificant effects, although the paper does report a positive effect of school quality on earnings for college graduates.

most of the papers that measure inputs at the school or district level, and find little effect of school inputs on wages, use earnings information from younger workers (i.e., those aged around 32 or younger) and those who attended school in the 1960s or later. Betts (1996a) considers a number of hypotheses to account for the patterns found in the literature. One possible hypothesis for the strong link between school resources and earnings between 1900 and 1960 and the absence of this relationship thereafter, may lie in diminishing returns to school quality. Betts (1996a) and Grogger (1996a) examine this explanation and conclude that while there is some support for this possibility, the evidence is not compelling. An alternative interpretation may lie in age-dependence. That is, the effects of school quality on earnings are only manifested as individuals become older and settle into their careers. Betts (1995; 1996b) does not find support for an age effect. Other possible explanations for the strong (weak) effect found in state (school)-level studies may lie in econometric explanations. For instance, if the data used in school-level studies is subject to measurement error, then the estimated coefficients may be attenuated. Betts (1995) and Grogger (1996a) examine and reject measurement error as a possible explanation. Finally, Heckman et al. (1995) point out that state-level studies may be afflicted by aggregation and omitted variable bias which may lead to an upward bias in the estimated coefficients. Based on their work, Heckman et al. (1995) conclude that returns to school spending accrue only to college-educated workers. Notwithstanding the ongoing debate, in his review, Betts (1996a) calculates wage elasticities and internal rates of return (IRR) with respect to school spending and teacher-pupil ratios. These estimates suggest that the IRR to additional spending per pupil and more specifically towards reducing class size is very low (based on the state level studies these returns are 2.55 percent and 2.35 percent respectively). In contrast, the returns to an additional year spent in school or college are much higher.[4]

[4] These estimates are based on the direct impact of school quality on earnings and ignore the indirect effect that school quality may exert through the level of educational attainment. However, based on a detailed survey of the U.S. literature, Betts (1996a) reports that there is a very weak link between spending per pupil (school quality) and educational attainment. The review shows that, similar to the school quality earnings literature, studies that rely on state-level data (e.g. Card and Krueger, 1992a) find a statistically significant relationship between school quality and educational attainment, while studies that use school level data (e.g. Ehrenberg and Brewer, 1994) do not report any links between spending per pupil and educational attainment.

While the varied findings, their underlying reasons and the lack of school quality effects on earnings and educational attainment continue to be debated in the United States, discussions in developing countries are hampered by the lack of empirical work devoted to the school quality-earnings link. This paucity can largely be explained by the lack of appropriate data. To date, only two studies have explored the link between school quality and earnings levels in a developing country context. Behrman and Birdsall (1983) examine the impact of state-level Brazilian teacher education on educational returns and earnings. They find that inclusion of this measure of educational quality sharply reduces the conventionally estimated rate of return to years of schooling. At the same time they find that an increase in school quality exerts a strong positive influence on the earnings level through its impact on the rate of return to education. Psacharopoulos and Velez (1993) use grade repetition, and test scores on university examinations, and university prestige ratings as indicators of school quality. They find that grade repetition fails to influence earnings, while university examination scores and university prestige ratings have a positive impact.

3. ANALYTICAL FRAMEWORK

3.1 Incorporating School Quality in a Model of Labor Earnings

Several models of earnings determination have been proposed in the literature. The most prominent are the Mincer-Becker (1975) human capital model and the hedonic model developed by Tinbergen (1951, 1956) and Rosen (1986). Suppressing the individual subscript i (to avoid clutter), a simple model that summarizes the earnings determination process can be written as,

$$Y = w_h H e^{u} , \quad (1)$$

where Y is the labor market earnings of the individual, w_h, is the market rental price per unit of human capital, H is unobservable human capital possessed by an individual, u is an error term representing random unobserved determinants of earnings.

The human capital possessed by an individual depends on the quantity and the quality of schooling, an individual's on-the-job training, as well as his/her family background. As shown by Behrman and Birdsall (1983), school quality may be incorporated into the traditional Mincer framework by allowing educational returns to depend on the quality of schooling. In order to allow for the various other influences on human capital formation we rely on a widely used log-linear human capital production function,

$$H = e^{\beta_s(Q)S + \beta_E E + \beta_F F + v}, \quad (2)$$

where Q is a vector of school quality variables, S represents years of schooling, E is experience and F is a vector of variables that captures the quality of the individual's home environment. β_S, β_E and β_F are conformable coefficient vectors, to be estimated. v is an error term representing random influences on human capital production. Substituting (2) into (1) and taking logs, we get the familiar semi-log form of the earnings equation,

$$\ln Y = \ln w_h + \beta_S(Q)S + \beta_E E + \beta_F F + v + u. \quad (3)$$

Assuming a linear approximation to the unknown function, that is, $\beta_S(Q) = \gamma + \gamma_1 Q$, we get

$$\ln Y = \ln w_h + \gamma S + \gamma_1 SQ + \beta_E E + \beta_F F + v + u. \quad (4)$$

This specification allows school quality to influence earnings through its effect on educational returns or the slope of the earnings-schooling relationship and does not allow for a direct school quality-earnings link. This implies that if the impact of quality on educational returns is positive then the return to educational quality will be higher at higher educational levels. In other words, school quality does not influence the intercept of the earnings function and for those with zero years of schooling there is no school quality effect. This approach is conceptually similar to Behrman and Birdsall (1983) and Card and Krueger (1992a). The first set of estimates presented in the paper are based on specification (4).

Despite the link between the Mincer framework and this specification (i.e., equation 4), most studies that have examined the effect of school quality on earnings have relied on an alternative specification. This alternative may be motivated by invoking the idea of "effective schooling", S^*, which depends on the quantity (S) and quality (Q) of schooling (see Behrman and Birdsall, 1983). In particular S may be replaced by S^*, giving rise to an alternative human capital production function,

$$H = e^{\beta_{s*} S^*(S,Q) + \beta_E E + \beta_F F + v_1}. \quad (5)$$

Substituting 5 into 1 and taking logs, we get

$$\ln Y = \ln w_h + \beta_{S^*} S^* (S,Q) + \beta_E E + \beta_F F + v_1 + u \ . \quad (6)$$

Since the functional form of effective schooling is not known we may rely on a linear approximation to the unknown function, i.e., $S^*(S,Q) = \eta + \eta_S S + \eta_Q Q$. Incorporating the linear approximation in (6) and rewriting, gives rise to

$$\ln Y = \ln w_h + \beta + \beta_S S + \beta_Q Q + \beta_E E + \beta_F F + v_1 + u \ . \quad (7)$$

This specification allows school quality to exert a direct impact on the level of earnings. That is, school quality exerts an impact on the intercept of the earnings function and does not alter the slope of the earnings-schooling relationship. This specification has been widely used to examine the school-quality earnings link. In fact, a majority of studies that have dealt with this issue have relied solely on a specification of this type (for recent examples see Grogger, 1996a, 1996b). Given the widespread use of (7), the second set of estimates presented in this paper relies on this specification.

In addition, some authors (Betts, 1995) have estimated specifications that are a hybrid of (4) and (7). These specifications allow school quality to influence educational returns and to exert a direct influence on earnings. That is, school quality may influence the slope of the earnings-schooling relationship and the intercept of the earnings function. Allowing for both effects leads to,

$$\ln Y = \ln w_h + \alpha + \alpha_s S + \alpha_Q Q + \alpha_{SQ} SQ + \beta_E E + \beta_F F + v_2 + u \ . \quad (8)$$

An advantage of (8) is that it nests (4) and (7), and statistical tests may be carried out to compare the merits of the three specifications. Two further points on the links between these three specifications may be made. First, if school quality does exert a direct influence on earnings, independent of its effect through educational returns, then restricting this effect (as in equation 4) may lead to an underestimate of the effect of school quality on earnings. Second, if the effect of school quality on educational returns is small (coefficient on - SQ), then the estimated impact of school quality on earnings based on (7) and (8) will be quite similar.

Finally, there is no reason to suppose that the linear approximations, to $\beta_S(Q)$ and S^*, that we rely on to specify (4), (7) and (8) are more appropriate as compared to quadratic approximations. While we did consider the effects of school quality on earnings and educational returns on the basis of quadratic approximations, in order to enable comparisons with the rest of the literature as well as for ease of interpretation, we focus largely on models with linear approximations.

3.2 Estimation Methodology

Following a well-established literature we first estimate (4), (7) and (8) by ordinary least squares. Results on the basis of these three specifications are compared and analyzed. These OLS results are then subjected to an extended empirical scrutiny in order to verify the robustness of the findings.

Next, we examine the impact of quality on the conditional earnings distribution using quantile regression techniques. Quantile regressions offer several advantages over OLS. First, the presence of heteroscedasticity can be conveniently analyzed and detected by estimating regression quantiles (see Deaton 1997). Second, since estimation of the quantiles is based on minimizing the absolute sum of errors, rather than minimizing the sum of squares, they are more resistant to outliers. Finally, as emphasized by Mosteller and Tukey (1977), by calculating regressions for different percentiles of the distribution, the shape of the conditional distribution can be thoroughly explored.

Quantile regressions are based on estimating regression curves/lines at various percentiles of the distribution. Formally, rewriting (4) in a compact manner, the quantile regression model can be written as,

$$Y = \beta'_\theta Z + u_\theta \text{ with } Quant_\theta (Y|Z) = \beta'_\theta Z \quad (9)$$

where Z is an n x k matrix of explanatory variables, β_θ, is a k x 1 vector of coefficients to be estimated. $Quant_\theta(Y|Z)$ denotes the θth conditional quantile of Y given Z, and u_θ is a random error term. The quantile regression estimator of β_θ can be obtained as a solution to,

$$\min_{\beta} \sum_{i=1}^{n} [\theta - 1(Y \leq \beta'Z)](Y - \beta'Z) \qquad (10)$$

where $0 < \theta < 1$ is the quantile to be estimated, and function $1(\cdot)$ is the usual indicator function. Computation of the regression quantiles is carried out by minimizing (10) using linear programming techniques. Standard errors of the estimated coefficients are obtained by utilizing bootstrap methods (for details see Buchinsky, 1994, 1995).

4. THE DATA

The data file used in this paper was created by combining information from a 1986 survey of urban Honduran households conducted by the *Office of Planning, Coordination and Budget* (SECPLAN) and data on primary school quality collected by the Ministry of Education for the same year. While we had access to more recent data, the 1986 data were purposely selected. It was in 1986 that USAID and the Honduran government launched the "Primary Education Efficiency Project" (PEEP), a major initiative to build schools and improve the quality of education. Thus, the more recent data would have made it very difficult to accurately estimate the quality of schools attended by the individuals in our sample (see Edwards, 1995).

The household survey is a random sample of 4,400 urban Honduran households. Survey information includes monthly income, demographic characteristics (such as education, age and family size), characteristics about housing quality, and detailed information on population movements. Date of birth, place of birth, place of residence five years before, and length of residence in current location are all recorded. This information is critical and allows us to identify in which of approximately 300 counties a person was educated.[5] The Ministry of Education files are a comprehensive source of school-level data on *all* primary schools in Honduras. The files contain information on students enrolled, teacher characteristics, school furnishings, availability of electricity and water, and the physical characteristics of schools (Edwards, 1994).

To create the data file used here we restrict our analysis to Honduran males between the ages of 14 and 35, who are *not* currently full time students and who supply information on their labor income. We restrict our sample to males in order to avoid selectivity problems associated with female labor force participation. We limit the sample to the 14-35 year age

[5] Honduras is politically sub-divided into "Departamentos" and "Municipios", which roughly correspond to U.S. states and counties, respectively.

range, that is individuals who would have first enrolled in school between 1958 and 1979, to lessen the measurement error associated with the use of current school quality measures to explain current earnings. A total of 3,691 observations satisfy this criteria and are utilized in our analysis. Ministry of Education data are used to create municipal level school quality variables that capture teacher qualifications, school facilities, and school crowding. Information from the household survey is used to carefully map individuals to the municipality in which they received their schooling.

The descriptive statistics and definitions of the variables used in this paper are provided in table 1. The average individual in our sample has about 7 years of schooling and 11 years of work experience. Fifty one percent of the individuals in the sample are migrants. Almost 73% of the urban population lives in the central and northern parts of the country, areas which contain the capital of the country, Tegucigalpa, and the industrial center of the country, San Pedro Sula, respectively. Parental schooling averages approximately 3 years. The gap of almost 4 years between the parents and children displays the rapid gains in education being experienced by Honduras in recent years. As for the school quality variables, almost 70% of the teachers possess teaching degrees (PRO). There are approximately 41 students per teacher and 15 students per table. Around 41% of the schools are classified as "multigrade schools," implying that there are individuals in different grades in the same classroom. School facilities such as electricity and water are available in around 32% and 51% of all schools, respectively. Although aggregated at the municipal level, several school quality variables display substantial variation. For instance, provision of electricity ranges from 1.7% at the 10th percentile to 63.6% at the 90th percentile. Similarly, the student-teacher ratio ranges between 31 and 48 for the 10th and 90th percentiles respectively.

As compared to other countries, Honduran school quality is quite low. The student-teacher ratio is *nearly double* that reported in other studies that have examined the effects of school quality. For instance, it is 26 in Ghana (Glewwe and Jacoby, 1994), 25 in Northeast Brazil (Harbison and Hanushek, 1992), and 21 for the United States (UNESCO, 1992). In terms of water and electricity, Honduran schools seem to be on par with Brazil's poorest, Northeastern region (35 and 43 percent respectively), but compare unfavorably to Ghana (82 and 77 percent respectively).

While we have comprehensive data on several measures of school quality and our data might be some of the best developing country data with which to address the school quality-earnings issue it is subject to several drawbacks. First, our measures of school quality are municipal-level averages and therefore ignore any variation in school quality within schools in the same municipality. Second, for 11.5% (426 observations) of the sample we are unable to determine the county of school acquisition and are forced to assume that they were schooled in the county of their birth.

Third, and potentially the most troublesome, our data on school quality are for 1986, while our earnings information is for people who acquired their schooling much earlier.[6] If school quality has remained unchanged over the time period that individuals in our sample acquired education, or changes in school quality have been uniform across municipalities then the use of current school quality is not likely to create serious problems. However, if there have been substantial changes in the level and distribution of school quality across municipalities then it is likely that our data are subject to measurement error. For instance, if school quality has increased over time then current school quality will systematically overstate the actual school quality. Accordingly, the use of such data may be expected to lead to a downward bias in estimates of the effect of school quality on earnings. On the other hand, if school quality has declined over time then current school quality will understate actual school quality. This in turn may impart an upward bias to estimated school quality effects. Errors due to the use of current school quality probably increase with the age of the respondent. To minimize this source of measurement error we restrict our sample to individuals in the 14-35 age group. Similarly, as mentioned earlier, the use of data from 1986 is also an attempt to reduce this source of error.

In addition to these precautions, to get a better idea of the likely effects of these potential measurement errors we attempted to gather information on the pattern of school quality changes in Honduras. We were able to collect information (for some years we were unable

[6] This is a common problem in studies of this type. For example, in their study on Brazil, Behrman and Birdsall (1983) use a school quality indicator for the situation in 1970 while their earnings data are for individuals who acquired schooling in previous years. Similarly, in the developed country literature, Link and Ratledge (1975) use data on earnings and district level school quality variables for 1968. For additional examples of studies which employ a similar procedure see Behrman and Birdsall (1983).

to collect the required data) on the number of primary school teachers and the number of primary schools in Honduras over the period 1950-1986. This information was combined with population data to create measures of teacher and school density (i.e., the number of primary school teachers and number of primary schools per 1000 population). Although these measures capture only nation-wide changes and our information is spotty it does provide an idea of the evolution of school quality in Honduras. Figure 1 displays that both school and teacher density, register substantial increases from 1950 to around 1963. Subsequently, there appears to be almost no change in school density. Teacher density is also fairly stable. There is a decrease between the mid-60s to the 80s after which there appears to be a slight increase. Between 1963 and 1986, teacher density increases by around 9 percent. These patterns suggest that during the time period that most of the individuals in our sample acquired education (from the 1960s to the 1980s), changes in school quality were limited.[7] The limited changes in this measure of quality should not be particularly surprising as during these decades there was very little attention paid to the education sector (see Edwards, 1995). It was only after the establishment of a democratic regime in 1980 that there was an increase in educational expenditure.

It is clear from our discussion that the data are subject to errors. While acknowledging these shortcomings, we feel that the relatively mild changes in school quality combined with the precautions we have taken suggests that these data may indeed be fruitfully used to inform the school quality debate. Later on in the text we discuss attempts to identify the effects of measurement error on our results by instrumenting the school quality variables and carrying out specification tests.

5. ESTIMATION RESULTS

A. Earnings and School Quality

Table 2 presents estimates for a series of regression models designed to examine the

[7] Individuals in our sample started their schooling between 1958 and 1979. As Figure 1 shows, changes in school and teacher density between 1963 and 1986 are quite mild. However, changes between 1959 and 1963 are more pronounced and it is likely that current school quality is a less accurate measure for individuals educated between these years. To control for this we restricted our sample to those who started their education after 1963. Around 650 observations were dropped due to this exclusion. For the most part our results remained unchanged.

school quality earnings link. We begin by estimating a basic earnings equation, which is then augmented with several school quality variables. These school quality variables are added to the basic specification in accordance with the earnings models outlined earlier, i.e., equations (4), (7) and (8).

The model in column 1 is the most parsimonious specification and includes only years of schooling, experience and the square of experience. The rate of return to education is 13.8%. This estimate is at the lower end of the range that has been found for developing countries (Psacharopolous, 1993). Column 2 includes controls for marital and migration status, indicators for region of current residence and a selection correction term for migrant endogeneity. Controlling for these additional variables reduces educational return estimates by 1.6 percentage points. Returns to marriage and migration are positive and statistically significant (not reported in table 2). As has often been pointed out in the migration literature, earnings functions that include a migrant dummy without correcting for selectivity are likely to be plagued by endogeneity bias (e.g., Tunali, 1986). This is a potentially important source of bias given that about half of our sample is composed of migrants. Accordingly, we control for the potentially endogenous nature of this variable by constructing and including parametric and non-parametric selection correction terms. The coefficient on the parametric migration selection term is negative and significant indicating the endogeneity of the migrant dummy.[8]

We have several school quality variables at our disposal. These variables capture different facets of school quality. The teaching technology is captured by the percentage of multigrade schools in a county (MGRADE). In a multigrade school all grades are taught simultaneously in one classroom, by one teacher. The pedagogical technology is different in such classrooms and is often thought to be inferior to single-grade techniques. Teacher qual-

[8] The selection terms are created by estimating a first step probit model for migratory status. The non-parametric selection correction terms are constructed on the basis of results in Gallant and Nychka (1987) and Pagan and Vella (1989). This involves using the parametric selection correction term powered up by the predicted values from the selection equation. This approach is based on the argument that departures from normality can be approximated by multiplying the normal distribution by some suitable polynomial. A simple test for normality is to test whether these selection correction terms are jointly zero. An F-test (p-value - 0.2282) fails to reject the null hypothesis of normality. Details are available on request.

ity is picked up by variables measuring formal training (PRO), teacher education (T_SCHOOL) and experience on the job (T_EXPER). The physical infrastructure of the school and access to public services is captured by the availability of electricity (ELECTRICITY) and water (WATER).[9] Finally classroom crowding is picked up by student-teacher ratio (STTEACH) and classrooms per student (CLASST), and facility crowding by tables per student (TABLEST).[10]

In general, when these school quality variables are introduced into the regressions individually they have the expected sign and seem to be important determinants of earnings. However, due to the high correlation between some of the school quality variables, entering them jointly into the regression makes it difficult to identify school quality effects. In order to guide our selection of the appropriate school quality variables we rely on a principal components analysis. On the basis of this analysis, four variables that represent different facets of school quality and capture most of the variation in school quality are selected. These are a measure of teacher quality (PRO), student-teacher ratio, the table-student ratio, and provision of electricity. Together, these four variables capture 85% of the variation in school quality.

The remaining columns of table 2 present results that include these four school quality variables. These specifications include variables mentioned earlier. In addition, in order to isolate a distinct school quality effect we include controls for other municipal level variables that may influence earnings. In the absence of such measures it could have been argued that the school quality variables are picking up the effects of other municipal characteristics that may be correlated with earnings. Since there is no time variation in our data we cannot include municipal fixed effects to control for this possibility. However, to partially control for this effect we include five variables that control for inter-municipal variation in wealth.[11] These variables are included in all subsequent specifications.

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[9] While we do control for inter-municipality variation in access to public services, it is possible that some of the measures of school quality (e.g., electricity and water) do pick up the overall levels of infrastructure in the municipalities.

[10] The last two variables are defined in this way because some schools reported having no classrooms or no tables.

[11] These variables include percentage of houses in the municipality with brick walls, dirt floors, electricity, municipal level house ownership, and percentage of legal marriages in a municipality. The inclusion of the last variable as an indicator of wealth is based on the idea that in Honduras, legal marriages are more likely among socially dominant groups.

Results based on the first specification considered by us, i.e., equation (4) are presented in column 3. The estimates display that except for our measure of teacher quality (PRO), the school quality-education interaction terms are all statistically significant at at least the 10 percent level. This suggests that school quality influences the slope of the earnings-education relationship and that individuals educated in high quality municipalities have a higher rate of return to education as compared to those educated in municipalities with lower education. We find that an increase in the school quality measures by one standard deviation increases educational returns by 1.2 percent (bottom panel of table 2, column 3). In terms of earnings this implies that, an increase in the provision of electricity by one standard deviation is associated with an earnings increase of 3.1 percent. Similarly, a reduction in the student-teacher ratio and an increase in the table-student ratio by one standard deviation lead to an increase in earnings by 4.3 and 2.7 percent respectively. All computations are at the means of the school quality and education variables.

Before we proceed it should be pointed out that the results presented above are based on individual data that have been merged with municipal level data. As pointed out by Moulton (1986), in cases (as in the present context) where regressors include variables with repeated values within groups, ignoring intragroup error correlation may lead to incorrect statistical inference. To check for this possibility tests suggested by Breusch and Pagan (1980) and Moulton and Randolph (1989) were conducted. The tests were unable to reject the null hypothesis of no intra-group error correlation. For table 2, column 3 the test statistic displayed a p-value of 0.6272. Regardless of the rejection of the null, subsequent estimates are presented with standard errors corrected for intra-group correlation. A comparison of the estimates in columns 3 and 4 provides an idea of the impact of allowing for this correction. This comparison shows that, while the standard errors do increase, three of the four school quality variables remain statistically significant at at least the 10 percent level.

We now turn to our other estimates. Estimates reported in column 5 correspond to equation (7). This specification allows school quality to exert a direct and uniform (regardless of the level of schooling) impact on the level of earnings. As mentioned earlier, this specification has been widely used to examine the effects of school quality on earnings. Estimates of the rate of return to education are almost identical to those reported earlier. Similarly, three of the four school quality variables are statistically significant and their magnitudes suggest that school quality exerts a quantitatively significant impact on earnings. On the basis of this specification, an increase in electricity provision, a reduction in the student-teacher ratio and an increase in the table-student ratio by one standard deviation may be expected to increase earnings by 5.6 percent, 3.3 percent and 4.5 percent respectively. Overall, this specification appears to lead to slightly larger effects of school quality on earnings.

It is somewhat difficult to compare the relative merits of the two specifications. Equation (4), estimates in column 4, is theoretically closer to the Mincer model. However, it may be incorrect to assume that school quality does not exert a direct effect on earnings. To compare the two specifications on statistical grounds, J-tests for non-nested hypotheses were conducted. These tests were inconclusive. The specification in column 4 was rejected in favor of column 5 (p-value 0.020) and in turn, the column 5 specification was rejected in favor of column 4 (p-value 0.054). The inconclusive results suggest that the data are not rich enough to discriminate between the two specifications.

An alternative is to allow school quality to exert a direct effect on earnings and an effect through the rate of return to education. Estimates based on such a specification are presented in column 6. Jointly, the four school quality variables and their interactions are statistically significant (p-value 0.0001). As the bottom panel of table 2 displays, this hybrid specification suggests that returns to education are influenced by school quality. The effect on the level of earnings is also positive and quite similar to those reported on the basis of equation (7), column 5 estimates. As noted earlier, if the impact of school quality on educational returns is small then the estimates based on equation (7), column 5 and equation (8), column 6 should not differ appreciably. This appears to be the case in our estimates.

Since this hybrid specification nests the specifications reported in columns 4 and 5, F-tests may be used to discriminate between the three specifications. An F-test between column 4 and column 6 leads to a rejection of the null hypothesis that the coefficients on the four school quality variables are zero (p-value 0.0511). On the other hand a test between columns 5 and 6 does not lead to a rejection of the null hypothesis that the interacted school quality variables are zero (p-value 0.1273). While this does seem to provide some support for the direct school quality-earnings specification, it is clearly not very convincing. Given that we are unable to convincingly discriminate between the specifications, and that the school quality effects on the basis of column 5 and 6 estimates are very similar, we decided to continue our examination of the school quality-earnings relationship on the basis of *both*, column 4 and column 5 estimates. A related justification for persisting with both specifcations is that the former is more closely integrated with the Mincer model, while the latter is the most widely used specification and this may enhance the comparability of our results.

Overall, we note that regardless of the specification used, there appears to be a statistically and quantitatively significant impact of school quality on earnings. These estimates suggest that males educated in municipalities with better school quality do tend to be rewarded with higher earnings. Depending on the specification, the effect of an increase in electricity provision by one standard deviation increases earnings by 3-5.6 percent, a similar increase in the student-table ratio increases earnings by 3.3-4.3 percent, while a decrease in the student teacher-ratio may be expected to increase earnings by around 2.7 to 4.5 percent. The school quality effects obtained here appear to be much larger as compared to those reported for the United States. Betts (1996a) reports that, on average, studies that have used district level data to examine this issue find earnings elasticity with respect to the teacher-student ratio of 0.024. Based on the estimates reported here the elasticity of earnings with respect to the teacher-student ratio ranges from 0.171 to 0.232. This should not be particularly surprising as the teacher-student ratio in the United States is nearly double that in Honduras. For our other measures of school quality the comparable U.S. evidence is limited.

B. Specification Checks

In this section we conduct a series of specification checks. We use the estimates presented in table 2, columns 4 and 5 as our baseline estimates. These specifications are altered in several ways in order to probe the robustness of our results. Tables 3 and 4 summarize our analysis. In particular, table 3 examines the sensitivity of the school quality earnings link based on the specification which allows school quality to influence the rate of return to education, while table 4 deals with the specification that allows a direct school quality effect. To enable comparisons the first column in tables 3 and 4 reproduce the baseline estimates.

Endogeneity of regressors

The inclusion of school quality variables probably reduces the susceptibility of standard estimates of educational returns to omitted-variable bias. However, variables that do capture school quality can lead to other biases. As outlined in the previous section our school quality data suffers from several possible sources of measurement error. A second type of problem that might result from including school quality variables is endogeneity bias. If the allocation of education resources is systematically related to other factors which determine educational outcomes and these factors are known to school quality providers (the government) but unknown to the researcher, estimates of school quality impact may be misleading.[12]

To study the nature of these biases we need instruments for our school quality variables. These instruments should influence allocation of school quality across municipalities but should be legitimate exclusions from the earnings equation. Our data set contains some municipal level variables which may serve as legitimate instruments. We instrument each of our school quality variables with these municipal level variables. In particular, the school quality variables are regressed on municipal level averages of school attainment and infrastructure indicators such as availability of sewage services and water and municipal level information on occupational distribution in manufacturing and commerce. Typically, these instruments (first step regressions) are able to explain 20 to 50 percent of the variation in the various school quality indicators. Despite the fairly strong correlation between the school quality variables and these instruments, for both specifications (column 1 in tables 3 and 4), Hausman tests (p-values 0.3600 and 0.4187 respectively) retain the null hypothesis of consistent estimates. As an additional step we conducted simulation exercises assuming different levels of classical measurement error in our school quality variables. Allowing for a generous measurement error of 25% leads to a substantial understatement of our school quality effects (between 33-41 percent). However, the extent of the bias transmitted to the other coefficients does not appear to be a severe problem. These results are available on request.

[12] Studies on developed countries (e.g. Heckman et al. 1995) also acknowledge the possibility of endogeniety bias. However, the difficulties associated with controlling for such a bias usually leads to the assumption of exogenous school quality. An exception is Betts (1995) who tests for the endogeneity of the school quality variables and is unable to reject the null hypothesis of exogeneity.

Family Background Characteristics

Due to data shortcomings the literature largely ignores the possibility that family background and school quality may jointly determine earnings. If family background and school quality are positively correlated then ignoring such characteristics may lead to misleading inferences about the effect of school quality on earnings. Although we do not have information on parental education for all individuals, we can partially control for parental education by using measures of average maternal and paternal education in the municipality in which the individuals in our sample acquired their education. Estimates including these parental schooling variables are presented in column 2 of tables 3 and 4. As these estimates indicate, the inclusion of these parental schooling variables does not substantially alter the baseline estimates. The parental schooling variables themselves have a positive although imprecise effect on earnings. [13]

Additional Teacher Characteristics

Despite having three variables that may be used to capture the quality of teaching, our baseline specifications only use information related to the possession of a teaching degree. In addition to this teaching degree, it may be argued that the level of education and the experience of teachers plays a role in determining educational quality. To allow for these effects, estimates including variables that capture teachers' years of schooling and experience are presented in column 3 of tables 3 and 4. Results in table 3 indicate that the coefficients on both these variables are statistically insignificant. The estimated return to education appears to be higher than that based on earlier specifications. The coefficients on the school quality variables register some changes with the schooling-electricity interaction term no longer statisitcally significant. For table 4, one of the measures of teacher quality is statistically significant (albeit with an unexpected sign). Despite this, it is quite clear that the school quality meas-

[13] Using Ghanian data to examine the determinants of test scores, Glewwe and Jacoby (1994) fail to find evidence for the sorting of children into better quality schools on the basis of family background. Further, as suggested by Heckman et al. (1995) our use of municipal-level school quality variables probably mitigates the selection effects associated with non-random sorting of children into schools. For an opposing view, see Hanushek et al. (1995).

ures retain their statistical significance and their magnitude is somewhat larger as compared to the baseline estimates.

Other school characteristics

We have three other measures of school quality that may have been included in our specifications. These are the availability of water (WATER), an additional measure of crowding-the number of students in a classroom (CLASST), and a measure of the teaching technology-the number of multigrade schools in a municipality (MGRADE). Estimates including these three measures of school quality are presented in column 4 of tables 3 and 4. For both sets of baseline estimates the inclusion of these variables leads to similar effects. Of the three measures only MGRADE is statistically significant and surprisingly, it has a positive effect on earnings (in table 3). This effect is unusual as one may expect a negative association between teaching several grades in the same classroom and earnings. In fact, regressions that include MGRADE but exclude other school quality indicators confirm this expectation. This sign-reversal, associated with the inclusion of other school quality variables suggests that multigrade teaching technology *per se* does not reduce earnings. Rather it is the other attributes of multigrade schools, such as their correlation with teacher training (-0.61) and electrification (-0.77) that appears to be the cause of negative effects associated with attending a multigrade school. The important feature to note from these results is that the estimated educational return appears to be similar to that obtained from earlier specifications. The baseline school quality measures retain their statistical significance and their quantitative impact is somewhat larger as compared to the baseline estimates.

So far we have proceeded by considering individual extensions to the baseline specification. In column 5 of tables 3 and 4 we include the family background variables, and the additional teacher and school quality characteristics jointly. These estimates reveal a familiar pattern. Consistent with our earlier estimates, the baseline school quality variables retain their signs and statistical significance. In terms of their magnitude the effects of the school quality variables lie in the same range as those obtained from previous specifications. In contrast, most of the variables added to our basic specification have insignificant effects.

On the basis of these various specifications it seems that, regardless of the manner in which school quality enters the earnings function there is a discernible and clear school quality impact on earnings. Despite the clarity of this finding, the range of estimated school quality effects suggests that the magnitude of these impacts is difficult to pin down. Consistent with a cautious approach, our baseline estimates lie at the lower end of the estimated school quality effects.

C. Quantile Regressions

Hitherto, we have limited our attention to the effect of school quality on the mean of the conditional earnings distribution. However, with the use of recently developed techniques it is possible to explore the shape of the conditional distribution. This may be achieved by estimating regressions for different quantiles (percentiles) of the conditional distribution. In addition, quantile regressions are useful in analyzing and detecting heteroskedasticity, and since these regressions are based on minimizing the absolute sum of errors, they are more resistant to outliers than OLS estimates (see Deaton, 1997).

Noting these advantages we tried to re-estimate our baseline specifications using quantile regressions. However, possibly due to limited variation in the data, we experienced some convergence problems with regressions based on the schooling-school quality interacted specifications (i.e., equation (4), in particular, the baseline specification presented in table 2, column 4).[14] Thus, this section is based on quantile regression estimates of equation (7), that is, our second baseline specification (table 2, column 5).
These estimates are reported in table 5.

There are several noteworthy points that emerge from the quantile regressions. Except for the magnitude and the imprecision of the electricity provision measure, a compari-

[14] To estimate the standard errors of the quantile regression estimates we rely on hundred bootstrap replications. At some percentiles and for some of these replications we experienced convergence problems with the schooling-school quality interacted specifications. This is probably due to the much higher correlation among variables that are used in the interacted specifications as compared to the specifications where school quality influences earnings directly. The absolute value of the correlation between school and the four school quality variables ranges between 0.06 and 0.15. After interacting these variables the correlation ranges between 0.61 and 0.92. The condition number of the matrix of explanatory variables used to estimate equation (4) is around 14, while for equation (7) it is around 10. While it is still possible to obtain estimates since convergence problems arose only for some of the replications, we decided to adopt a conservative approach and provide estimates only for equation (7).

son of the median and mean regressions indicates that the magnitude and the signs on the years of schooling and the other school quality variables are quite similar. This indicates that outlier observations do not drive our OLS results and once again suggests that individuals educated in municipalities with better school quality are rewarded with higher labor market earnings.

Turning to the effects at different percentiles, we see that there is a steady increase in educational returns from 10.3 percent at the 10^{th} to 13.4 percent at the 90^{th} percentile. The increasing slope on the schooling coefficient and the consequent widening of the conditional earnings distribution as schooling increases, reflects the increasing conditional variance (evidence of heteroscedasticity) of the regression among more highly educated individuals. The 10^{th} and 90^{th} percentiles of the conditional earnings distribution are much further apart among highly educated people than those with less education. Thus, those with higher education earn more but there is also greater dispersion of earnings among them. In other words within group income inequality is much higher among those with higher education as compared to those with lower education.

As far as the school quality variables are concerned, the effects are not as clear cut as those for educational returns. Provision of electricity has a large effect at the 10^{th} percentile, while at all other percentiles there is no statistically significant impact. The coefficients on the student-teacher ratio are insignificant at the 10^{th} and the 25^{th} percentiles, while at the 50^{th} and 75^{th} they indicate that an increase in the student-teacher ratio is associated with higher earnings. At the 90^{th} percentile there is no discernible impact of this measure. For our other measure of crowding, except for the 75^{th} percentile the effect on all the other percentiles seems fairly uniform. Although not very clear, the muted school quality effects at the 90^{th} percentile suggests that as provision of electricity or the student-teacher ratio increases there is a decline in the conditional variance of the regression. That is, the various percentiles of the conditional earnings distribution are closer among those with higher availability of school quality than among those with lower school quality. These results suggest that increases in school quality have a stronger effect on lower percentiles of the conditional earnings distribution. To the extent that higher percentiles of the conditional earnings distribution reflect higher ability levels, the results suggest that more able individuals are not affected by school quality, while for the less able, the effects of school quality appear to be stronger. However, given the lack of clear patterns on the various school quality coefficients it is rather difficult to draw any clear-cut implications from these estimates.

Overall, these regressions support the pattern of results already established. In addition, they provide a fuller picture of the somewhat contrasting effects of educational attainment and school quality on earnings. While increasing educational attainment is clearly associated with a widening of the conditional earnings distribution, there is some evidence that higher school quality may be associated with lower conditional variance. It should be noted that, while these regressions provide some more insights they do not tell us anything about the causal relationship between school quality and distributional outcomes, nor about the factors that may be responsible for the differing effects of educational attainment and school quality. While it is tempting to speculate on the underlying reasons for these patterns, we restrict ourselves in order to retain focus on the issue at hand (see Mwabu and Schultz, 1996 for a potential explanation).

D. The Impact of School Quality on Earnings and School Attainment

To this point our analysis has concentrated on the effect of school quality on earnings. We have examined this role by considering the direct impact of school quality on earnings as well as its impact on earnings through its influence on educational returns. An additional channel through which school quality may influence earnings is through its impact on educational attainment. To explore this channel of influence we present some reduced form estimates on the link between school quality, educational attainment and earnings.

These estimates are presented in table 6. The first column in the table presents reduced form estimates of the schooling equation while the second column presents reduced form estimates of the earnings equation. The reduced form earnings estimates do not control for schooling. Therefore, the estimated school quality coefficients capture the effect of school quality on education as well as on earnings.

On the basis of the estimates in column 1, the impact of some of the school quality measures on educational attainment appears to be quite different from their impact on earnings. Although statistically significant at around the twelve percent, in contrast to its persistently negative effect on earnings, teacher qualification (PRO) has a positive impact on schooling (an increase of 0.172 years of schooling for a one standard deviation increase in this quality measure). The provision of electricity has a considerable impact on school attainment. An increase of one standard deviation increases educational attainment by 0.28 years. Unlike their strong influence on earnings the crowding measures play a relatively minor role in influencing educational attainment. They are statistically insignificant in the schooling regressions, and an increase in these quality measures by one standard deviation increases schooling by around 0.048 to 0.090 years. What explains the different effects of our school quality variables on earnings and educational attainment? A plausible explanation might lie in the nature of these variables. Teacher training (PRO) and provision of electricity may be capturing the availability of schooling rather than the quality of instruction received by a student. The presence of a school in an area can be expected to increase educational attainment and hence the stronger effect of these two variables on educational attainment. However, the quality of the instruction received in this school might be reflected through measures of school crowding and consequently the greater influence of these variables on earnings.

Turning to the reduced form earnings equation we see that, although the magnitude of the variables is considerably larger, their qualitative impact is similar to those reported earlier. These reduced form estimates may be used to evaluate the total impact (the effect on educational attainment and earnings) of school quality on earnings versus their impact on earnings through educational attainment. On the basis of the estimates in columns 1 and 2, an increase in instructor qualifications (one standard deviation) decreases earnings by -1.9 percent (albeit insignificant) and increases educational attainment by 0.172 years. The return to schooling (when it is added to the earnings specification) is 11.7 percent. Thus, a 0.172 year increase in educational attainment may be expected to raise earnings by 2.01 (0.172 x 11.7) percent. Although the teacher quality measure seems to be associated with higher educational attainment, it does not appear to be translated into higher earnings.

Except for the teacher quality measure, comparisons of the school quality-earnings effects based on the reduced form earnings equations versus their impact through an increase in educational attainment, reveals a similar story. For instance a decrease in the student-teacher ratio by one standard deviation increases earnings by 7.4 percent and increases schooling by

0.090 years. This increase in educational attainment may be expected to raise earnings by about a percent (11.7 x 0.090). Thus the overall increase in earnings due to a reduction in the student-teacher ratio is considerably larger than that expected on the basis of an increase in years of schooling. A similar underestimate is found for our other measure of crowding and for school electrification. For the table-student ratio the effects are 6.3 percent on the basis of the reduced from earnings results and less than a percent on the basis of an increase in years of schooling, while for school electrification the effects are 21.5 percent and 3.3 percent respectively.

We draw a couple of conclusions from these results. One, although the relative importance of the different school quality measures for earnings and educational outcomes appear to be different, it seems that school quality has a positive impact on educational attainment and on earnings. Second, focusing only on the effect of school quality on earnings through education tends to lead to an underestimate of the economic effects of school quality. The increases in earnings reported in this section reflect the "total" impact of school quality on earnings. That is, the direct effect of school quality on earnings as well as the effect of school quality through its influence on educational attainment and its influence on educational returns. Combining the results presented here with the previously assembled evidence provides substantial support for the claim that increases in school quality lead to higher earnings.

6. SUMMARY AND CONCLUSIONS

Educational expenditures account for over one-sixth of public sector expenditures in the developing world. Recently the emphasis has shifted from expanding access and increasing attainment to improving the quality of education. Yet, surprisingly little is known about the returns to investments in school quality.

In repose to this shortcoming, this paper used data from Honduras to examine the economic effects of school quality. Before summarizing the results, we must point out that while the data used in this paper may have been some of the best developing country data to address this issue it was subject to several drawbacks. First, our measures of school quality were municipal level-averages and despite controls for inter-municipality variation it is possible that some of these measures (e.g., electricity) reflected overall levels of infrastructure in a municipality and exaggerated the effects of school quality. Second, our data on school quality and earnings were contemporaneous and may have been subject to measurement error. We took several precautions to minimize errors and conducted several tests to examine the effects of these data shortcomings on our results. Notwithstanding these efforts, it is clear that the results should be interpreted keeping in mind the data constraints.

Turning to the results, our examination of the economic effects of school quality found that men educated in counties with better quality schooling earned significantly higher incomes than those men educated in counties with low-quality schools. Our findings were robust to a variety of specifications. In almost all our specifications the impact of three out of four of our school quality measures was statistically significant at at least the ten percent level. While the qualitative findings were clear, the magnitude of the school quality impact was harder to pin down. Also, the relative importance of the school quality measures for earnings and educational outcomes appeared to be quite different. While measures of crowding seemed to be particularly important for determining earnings outcomes, teacher quality and access to public services (provision of electricity) had a greater influence on educational attainment. Despite these inconsistencies, the overall flavor that emerged from our results was that the quality of schooling has a positive effect on labor market earnings.

The positive impact on earnings reported in this paper appears to be in marked contrast with the substantial body of literature that has used test scores as a measures of school quality effectiveness. The underlying reasons for this are not very clear. Perhaps the scrutiny of labor markets is simpler and more uniform than test instruments devised by researchers and educators.

As compared to the developed country literature on the school-quality earnings link, our paper falls in the category of papers that uses district level data, data on younger workers and from those educated in the 1960s. As pointed out in section II, studies with these characteristics and usually based on data from the United States, have often found insignificant school quality effects. Despite these similarities, the differences between the level of educational quality for the United States and Honduras suggests that such comparisons may not be very useful. The difficulties entailed in obtaining the appropriate data have limited the number of developing country studies that have examined the school quality-earnings link. The results reported in this paper are consistent with these few other pieces that have relied on data from developing countries. These papers and our work support the idea that school quality should be an important aspect of educational policy because labor markets recognize it as a productive investment and reward it with higher wages.

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Table 1
Variable Definitions and Descriptive Statistics

Variable	Label	Mean	Std. Dev.
Individual level variables			
TOTALINC	Monthly income in Lempiras	411.760	471.930
SCHOOL	Years of schooling	7.165	4.352
EXPER	Experience	11.440	6.436
MARRIED	Married = 1	0.288	0.453
MIGRANT	Migrant = 1	0.512	0.500
EAST	Resides in the East = 1	0.078	0.268
WEST	Resides in the West = 1	0.089	0.284
NORTH	Resides in the North = 1	0.370	0.482
SOUTH	Resides in the South = 1	0.104	0.305
CENTRAL	Resides in the Central area = 1	0.359	0.480
Municipal level variables			
PRO	Percentage of teachers with professional degrees	0.691	0.169
T_SCHOOL	Years of schooling – teacher	13.890	0.379
T_EXPER	Years of experience – teacher	13.300	2.168
ELECTRICITY	Percentage of schools with electricity	0.315	0.250
WATER	Percentage of schools with water	0.509	0.198
MGRADE	Percentage of multigrade schools	0.405	0.191
STTEACH	Student/teacher ratio	41.090	7.756
CLASSST	Class/student ratio	0.030	0.010
TABLEST	Table/student ratio	0.068	0.041
SCHFATH	Years of schooling - father	2.730	1.806
SCHMOTH	Years of schooling – mother	2.908	0.618
Observations		3691	

Table 2
Impact of School Quality on Earnings
(Std. Errors)

	(1)	(2)	(3)	(4)	(5)	(6)
CONSTANT	3.962	3.993	3.746	3.746	3.792	3.456
	(0.052)	(0.088)	(0.144)	(0.150)	(0.214)	(0.301)
Years of Schooling (SCHOOL)	0.138	0.122	0.147	0.147	0.117	0.168
	(0.003)	(0.004)	(0.013)	(0.017)	(0.005)	(0.032)
Percentage of teachers with professional degrees	.	.	.	.	-0.114	-0.017
					(0.115)	(0.220)
Percentage of schools with electricity	.	.	.	.	0.223	0.109
					(0.110)	(0.135)
Student/teacher ratio*10	.	.	.	.	-0.042	0.003
					(0.023)	(0.004)
Class/student ratio	.	.	.	.	1.086	1.485
					(0.301)	(0.525)
SCHOOL*Percentage of teachers with professional degrees	.	.	-0.013	-0.013	.	-0.011
			(0.013)	(0.015)		(0.028)
SCHOOL*Percentage of schools with electricity	.	.	0.017	0.017	.	0.012
			(0.009)	(0.010)		(0.013)
SCHOOL*Student/teacher-ratio*10	.	.	-0.008	-0.008	.	-0.010
			(0.002)	(0.003)		(0.005)
SCHOOL*Table/student-ratio	.	.	0.091	0.091	.	-0.058
			(0.039)	(0.039)		(0.072)
R^2	0.362	0.387	0.394	0.394	0.394	0.396
Returns to education at $\overline{Q}$	.	.	0.117	0.117	0.117	0.117
			(0.004)	(0.004)	(0.005)	(0.004)
Returns to education at $\overline{Q}+\sigma_Q$	.	.	0.129	0.129	0.117	0.124
			(0.004)	(0.004)	(0.005)	(0.005)
Returns to school quality at $\overline{S}$ and $\overline{Q}$						
$(\partial Y/Y)\ \partial$ Percentage of teachers with professional degrees	.	.	-0.097	-0.097	-0.114	-0.099
	.	.	(0.096)	(0.106)	(0.115)	(0.114)
$(\partial Y/Y)\ \partial$ Percentage of schools with electricity	.	.	0.124	0.124	0.223	0.194
			(0.068)	(0.070)	(0.110)	(0.107)
$(\partial Y/Y)\ \partial$ Student/teacher-ratio*10			-0.055	-0.055	-0.042	-0.044
			(0.020)	(0.020)	(0.023)	(0.020)
$(\partial Y/Y)\ \partial$ Table/student-ratio			0.651	0.651	1.086	1.073
			(0.281)	(0.279)	(0.301)	(0.301)

Notes: Sample size - 3691. Estimates in columns 2-6 include controls for experience, marriage, migratory status, region of residence and a selection correction term for migrant endogeneity. In addition, estimates in columns 3-6 include five variables that control for inter-municipal variation in wealth. Standard errors in columns 4-6 are corrected for heteroscedasticity and for intra-municipal error correlation. Returns to education and school quality are computed at the means of the schooling ($\overline{S}$) and school quality ($\overline{Q}$) variables.

Table 3
Impact of School Quality on Earnings – Specification Checks
(Std. Errors)

	(1)	(2)	(3)	(4)	(5)
Years of schooling (SCHOOL)	0.147	0.147	0.173	0.138	0.174
	(0.017)	(0.016)	(0.066)	(0.015)	(0.065)
SCHOOL*Percentage of teachers with professional degrees	-0.013	-0.015	-0.014	-0.012	-0.014
	(0.015)	(0.014)	(0.014)	(0.014)	(0.014)
SCHOOL*Percentage of schools with electricity	0.017	0.018	0.015	0.035	0.033
	(0.010)	(0.009)	(0.009)	(0.015)	(0.014)
SCHOOL*Student/teacher ratio*10	-0.008	-0.008	-0.008	-0.010	-0.010
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
SCHOOL*Student/table ratio	0.091	0.084	0.096	0.139	0.128
	(0.039)	(0.038)	(0.040)	(0.049)	(0.049)
Years of schooling-father	.	0.010	.	.	0.011
		(0.007)			(0.007)
Years of schooling-mother	.	0.011	.	.	0.006
		(0.019)			(0.019)
SCHOOL *Years of schooling-teacher		.	-0.002	.	-0.003
			(0.004)		(0.004)
SCHOOL*Years of experience-teacher		.	0.001	.	0.000
			(0.001)		(0.001)
SCHOOL*Percentage of schools with water		.	.	0.009	0.009
				(0.014)	(0.014)
SCHOOL*Percentage of multigrade schools		.	.	0.040	0.039
				(0.016)	(0.016)
SCHOOL*Class/student ratio		.	.	-0.389	-0.346
				(0.269)	(0.273)
R^2	0.394	0.395	0.394	0.395	0.396
Returns to education at $\overline{Q}$	0.117	0.117	0.117	0.118	0.118
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Returns to education at $\overline{Q}+\sigma_Q$	0.129	0.129	0.129	0.144	0.142
	(0.004)	(0.004)	(0.006)	(0.007)	(0.007)
Returns to school quality at $\overline{S}$ and $\overline{Q}$					
$(\partial Y/Y)\,\partial$ Percentage of teachers with professional degrees	-0.097	-0.106	-0.102	-0.085	-0.097
	(0.106)	(0.103)	(0.103)	(0.098)	(0.098)
$(\partial Y/Y)\,\partial$ Percentage of schools with electricity	0.124	0.128	0.111	0.250	0.238
	(0.070)	(0.068)	(0.070)	(0.107)	(0.103)
$(\partial Y/Y)\,\partial$ Student/teacher ratio	-0.055	-0.054	-0.058	-0.073	-0.072
	(0.020)	(0.020)	(0.020)	(0.020)	(0.020)
$(\partial Y/Y)\,\partial$ Table/student ratio	0.651	0.604	0.689	0.994	0.915
	(0.279)	(0.274)	(0.287)	(0.352)	(0.354)

Notes: Sample size - 3691. The functional form of the regression specification is based on equation (4). All estimates include controls for experience, marriage, migratory status, region of residence, a selection correction term for migrant endogeneity and five variables that control for inter-municipal variation in wealth. Standard errors are corrected for heteroscedasticity and for intra-municipal error correlation. Returns to education and school quality are computed at the means of the schooling ($\overline{S}$) and school quality ($\overline{Q}$) variables.

Table 4
Impact of School Quality on Earnings – Specification Checks
(Std. Errors)

	(1)	(2)	(3)	(4)	(5)
Years of schooling	0.117	0.117	0.115	0.118	0.114
	(0.005)	(0.005)	(0.005)	(0.005)	(0.006)
Percentage of teachers with professional degrees	-0.114	-0.126	-0.138	-0.108	-0.135
	(0.115)	(0.111)	(0.113)	(0.116)	(0.112)
Percentage of schools with electricity	0.223	0.225	0.323	0.298	0.322
	(0.110)	(0.106)	(0.125)	(0.135)	(0.135)
Student/teacher ratio *10	-0.042	-0.041	-0.057	-0.047	-0.049
	(0.023)	(0.021)	(0.020)	(0.020)	(0.020)
Table/student ratio	1.086	1.022	1.243	1.233	1.106
	(0.301)	(0.286)	(0.352)	(0.396)	(0.387)
Years of schooling-father	.	0.010	.	.	0.010
		(0.006)			(0.006)
Years of schooling-mother	.	0.009	.	.	0.010
		(0.018)			(0.019)
Years of schooling-teacher	.	.	-0.064	.	-0.063
			(0.031)		(0.032)
Years of experience-teacher	.	.	0.018	.	0.019
			(0.012)		(0.022)
Percentage of schools with water	.	.	.	0.017	0.016
				(0.109)	(0.118)
Percentage of multigrade schools	.	.	.	0.225	-0.011
				(0.140)	(0.238)
Class/student ratio	.	.	.	-1.366	1.610
				(2.159)	(3.081)
R^2	0.394	0.394	0.395	0.394	0.396

Notes: Sample size - 3691. The functional form of the regression specification is based on equation (7). Estimates include controls for marriage, migratory status, region of residence, a selection correction term for migrant endogeneity, and five variables that control for inter-municipal variation in wealth. Standard errors are corrected for heteroscedasticity and for intra-municipal error correlation.

Table 5
School Quality and Earnings – Quantile Regressions
(Std. Errors)

	10	25	50	75	90
Years of Schooling	0.103	0.111	0.121	0.124	0.134
	(0.006)	(0.004)	(0.003)	(0.003)	(0.005)
Percentage of teachers with professional degrees	-0.181	-0.251	-0.129	-0.045	0.114
	(0.159)	(0.095)	(0.084)	(0.104)	(0.749)
Percentage of schools with electricity	0.224	0.093	0.094	0.086	0.096
	(0.096)	(0.081)	(0.060)	(0.090)	(0.125)
Student/teacher ratio*10	-0.005	-0.035	-0.035	-0.048	0.004
	(0.039)	(0.024)	(0.015)	(0.020)	(0.032)
Student/table ratio	1.311	0.991	0.997	0.394	0.862
	(0.688)	(0.357)	(0.221)	(0.278)	(0.417)
Psuedo R^2	0.181	0.233	0.287	0.324	0.340

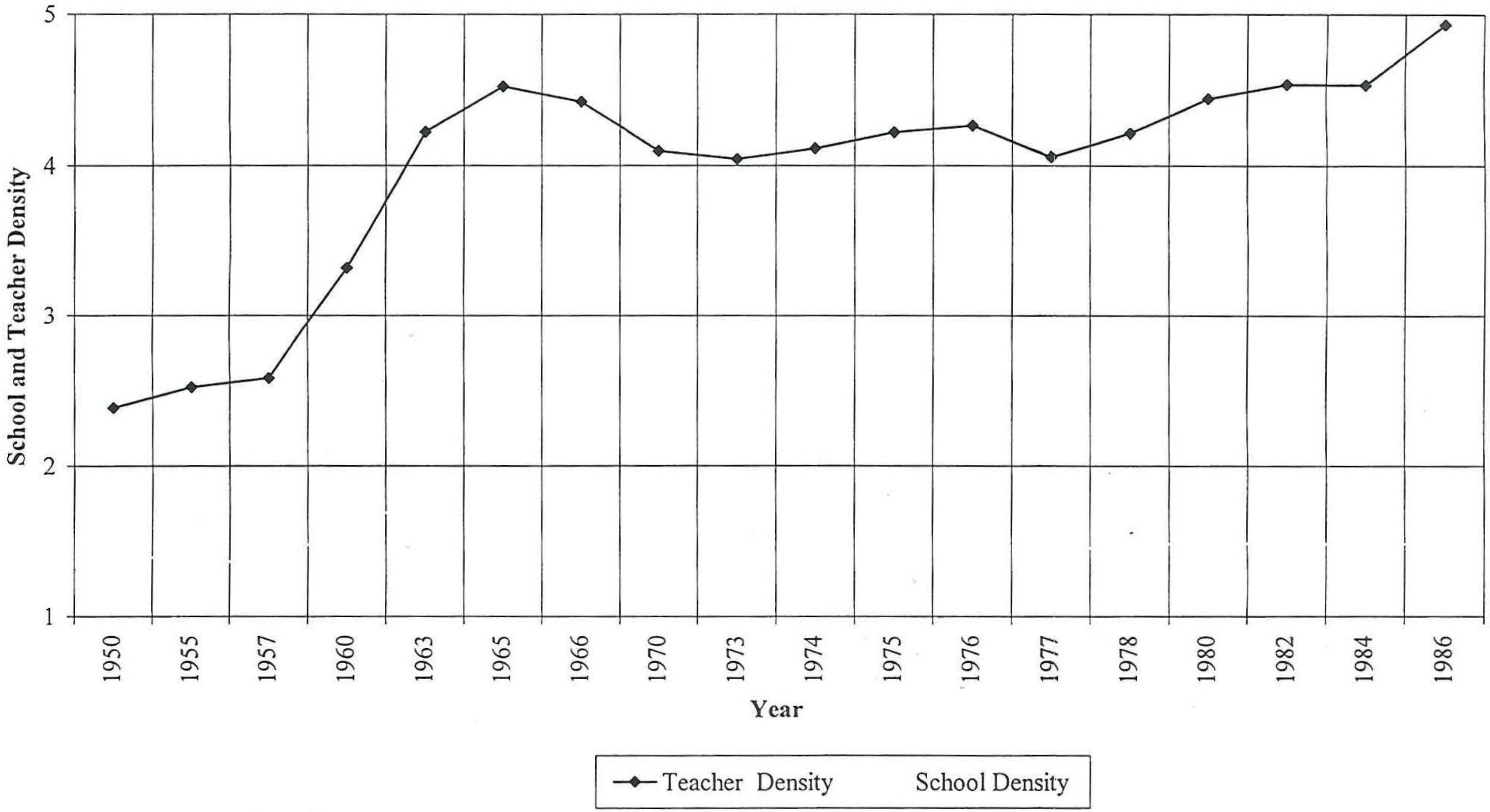
Notes: Sample size – 3691. The functional form of the regression specification is based on equation (7). Estimates include controls for experience, marriage, migratory status, region of residence, and five variables that control for inter-municipal variation in wealth. Standard errors are estimated using hundred bootstrap replications.

Table 6
Impact of School Quality on Education and Earnings
(Std. Errors)

	(1) Schooling	(2) Reduced form earnings	(3) Effect on years of schooling (ΔQ – one std. dev.)	(4) Effect on earnings via impact on schooling (%)	(5) Effect on earnings based on column 2 estimates (%)
Percentage of teachers with professional degrees	1.018 (0.649)	-0.110 (0.162)	0.172 (0.110)	2.01	-1.86 (2.74)
Percentage of schools with electricity	1.116 (0.439)	0.858 (0.187)	0.280 (0.110)	3.28	21.5 (4.70)
Student/teacher ratio	-0.011 (0.013)	-0.094 (0.003)	0.090 (0.099)	1.05	7.36 (2.52)
Table/student ratio	1.174 (1.807)	1.526 (0.518)	0.048 (0.074)	0.56	6.27 (2.13)
R^2	0.150	0.209	.	.	.

Notes: Sample size - 3691. The schooling regression includes controls for marriage, migratory status, region of residence, and five variables that control for inter-municipal variations in wealth. Reduced form earnings estimates include controls for experience, marriage, migratory status, region of residence, a selection correction term for migrant endogeneity, and five variables that control for inter-municipal variation in wealth. Standard errors are corrected for heteroscedasticity and for intra-municipal error correlation.

Figure 1: School and Teacher Density in Honduras



Sources: Several issues of the *Economic Survey of Latin America and the Caribbean*, United Nations, Santiago, Chile. *Economic and Social Progress in Latin America*, Inter-American Development Bank, Washington D.C., and the UNESCO *Year Book of Education,* Paris.