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ABSTRACT

Even though school policy discussions in developing countries emphasize the need to increase the level of schooling attained, little is known about the decisions of individual students. This paper employs unique panel data on primary school age children in Egypt to estimate behavioral school dropout models. This work highlights the important interaction of school quality and grade completion. Specifically, holding constant the student's ability and earnings prospects, a student is much less likely to remain in school if attending a low quality school. This suggests that common arguments about a trade-off between quality and access to schools may misstate the real issue and lead to investment in too little quality. Further, because of this behavioral linkage, common estimates of rates of return to years of school will be overstated.

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I. Introduction

The problem of low school completion rates remains near the top of the policy agenda in most developing countries. This concern is actually generated by two different perspectives—the possibility of lost opportunities for society and the possibility of inefficiency in the provision of public schooling. Indeed, available evidence suggests that both factors may be operating. The difficulty from a policy perspective, however, is not uncertainty about the desirability of increasing school completion but instead a lack of fundamental information about why students drop out of school. This paper investigates the underlying causes of dropping out of school using an exceptionally rich data base on primary schools in Egypt. By exploiting longitudinal data on children in and out of school, this analysis provides unique insights into the various factors entering into the dropout decisions of students and thus provides information about the underlying behavior behind low levels of school completion in developing countries.

Policy interest in schooling has long been driven by an investment-benefit perspective. Virtually any method of calculating the returns to schooling investments indicates that schooling in developing countries has a high pay-off. Moreover, the pay-offs appear largest for lower levels of schooling (e.g., Psacharopoulos[1985]).[1] Yet even though schooling completion levels have been

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[1]There are, of course, a number of reasons to be cautious in the interpretation of commonly obtained rate of return estimates (see, for example, Behrman and Birdsall[1987]). Indeed, this analysis highlights the need for caution. Nevertheless, it appears that reasonable adjustments leave schooling as a high pay-off investment. This statement is not meant to say that expanding access to schooling is superior to quality improvement of schooling. Indeed, as Harbison and Hanushek[1992] argue, improving quality in schools in developing countries may have extraordinarily large pay-offs

increasing in much of the world, they remain low in an absolute sense. For example, as late as 1980, the average completion levels of adults age 25-29 in the lowest income countries was less than three years; for lower middle income countries, it is still less than five years (Lockheed and Verspoor[1991, p. 17]. The static schooling investment picture is amplified by recent analyses of economic growth which suggest that human capital, as measured by school attainment, is an important determinant of the rate of economic growth across countries (e.g., Lucas[1988], Romer[1990], Barro[1991]). Thus, it is disconcerting to find that significant numbers of students fail to complete primary schooling, let alone higher levels.

The second reason for concern about dropouts comes from a cost of education-efficiency perspective. If the objective is to get a given number of students through some level of schooling—say through the primary cycle, having students drop out earlier raises the cost of achieving the goal. Expenditures on drop-outs are "wasted" in the sense that dropouts do not contribute to meeting the goal, and the total cost of the system could be reduced if dropouts could be eliminated.[2]

Given the attention to school completion and dropout behavior, remarkably little is known about the underlying determinants of dropouts. While completion levels and aggregate data on the age-grade distributions of students provide some overall sense of the dropout situation, these do not allow investigation of underlying behavioral factors or institutional structures that are driving high dropout rates. Specifically, concentration on aggregate data masks all individual specific factors, while analysis of school completion levels cannot examine time-varying family or school factors. The key information needed is longitudinal data on individual students, but such panel data with relevant information about school circumstances has rarely been available.

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and may be a first-best policy solution.

[2]The labeling of resources spent on dropouts as wastage, while common, is obviously misleading. Those who dropped out presumably learned something and improved their skills by attending the school they did, even if they did not get as much benefit as they might have.

This paper presents new evidence about student dropouts. A special panel of data in primary school attenders and dropouts collected in Egypt in 1979 and 1980 provides the essential information to pursue the question. We use these data to infer how opportunities and schools combine to retain or lose students.

The fundamental concern is finding ways of reducing unproductive dropout behavior. Doing this, however, requires more than just mandating additional schooling, because that has been demonstrated not to work in either Egypt or many other countries that have attempted such a regulatory approach. Instead, it seems important to work on the underlying causes and forces that lead to a student's withdrawal from school.

A central feature of this analysis is an investigation of the role of school quality in affecting dropouts. To the extent that low quality schooling leads to dropouts, altering the character of the schools may be an effective way to keep students in school. The school policy debate in developing countries, however, generally does not consider this but instead centers on a perceived trade-off between wide access to schooling opportunities and developing high quality schools. This trade-off is seen as resulting directly from an underlying scarcity of resources which dictates either investing heavily in selected high quality schooling opportunities or making funds more generally available for basic (but lower quality) schooling for the entire population. Recent analysis by Harbison and Hanushek [1992] suggests, however, that this trade-off may not be relevant given current inefficiencies in the schools. Because school quality interacts with school completion rates of students, viewing the choices as reflecting access versus quality may be very misleading and may lead to very poor policy decisions.

Other policy discussions also depend crucially on the nature of individual behavior. If students dropout because of credit constraints that do not allow them to take care of productive investment opportunities, policies aimed at lessening the immediate cash pressures may be called for.

Finally, since one of the issues that arises is the differential treatment by gender, a variety of regulatory devices might be called for to equalize the opportunities faced by boys and girls. These potential policies, however, almost certainly go beyond the current array of mandatory attendance laws, which appear to be very poorly enforced.

II. Egyptian Schooling

A recent World Bank report (World Bank 1991) outlines several major problems that must be addressed in the primary schooling system in Egypt. The first set of problems is related to enrollment outcomes. Under existing law, attendance through the sixth grade of primary education is compulsory. However, primary school enrollment in the 1991-92 school year is only about 80 percent of the corresponding age cohort. Middle school enrollment represents less that 70 percent of its age cohort. The highest dropout rate, nearly 15 percent, occurs near the end of the primary cycle, with an additional 10-15 percent leaving school by the end of middle secondary school.

Significantly lower female enrollment rates are an added element of the problem. Gender inequalities persist as females remain outside the reach of formal education: 62 percent of females are illiterate, as opposed to 38 percent of men, and girls' primary school enrollment remained stuck at 45 percent of total enrollment from 1966-1986. In rural areas, enrollment rates of girls often do not exceed 50 percent of the age cohort and can be as low as 10 percent in some regions.

Geographical disparities in enrollment rates within Egypt raise another important policy concern. Specifically, as in many other developing countries, the majority of the primary school-age children who do not attend school are concentrated in rural areas where resource constraints appear most severe.

A second set of problems identified by the World Bank study revolve around the inputs of the public schooling system. For example, the construction rate of schools has lagged behind the identified demand and is insufficient to meet the objectives of decreased class size and reduced reliance on multi-shift teaching. Similar concerns relate to the "quality" of schooling, and of teaching in particular. Examples cited often include outdated curricula and superficial assessment techniques along with dependency on a set of textbooks that are themselves frequently outdated. The overall quality problem is thus summarized as being multifaceted: the combination of inadequate facilities and generally poor quality of teachers, teaching methods, and curricular content. Each of these problems appears to be fostered by a deficiency of core management skills.

The recent upsurge in private lessons for selected school children at all educational levels has also been identified as potentially exacerbating the overall problems of the schools. The concerns raised by this possible include a widening disparity in outcomes by income group, a reduced classroom effort by regular school teachers, and generally lessened support and resources for the schools.

The World Bank study suggests that sustainable advances in the education sector in Egypt necessitate, inter alia, a greater investment in educational infrastructure, a better targeting of recipients at various stages, and greater attention to such issues as the inclusion of females, even as the twin goals of equity and efficiency are traded off. The recently adopted reforms in the Egyptian primary education sector attempt to follow generally the line of these recommendations.[3] The emphasis in the reforms is on improving school quality. For example, the reforms attempt to implement various innovative testing systems designed to break away from the tight linkage to outdated textbooks; they also attempt to adopt a broader learning approach which depends less on

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[3]Educational programs are homogeneous throughout Egypt, although the physical condition of schools, the skills of teachers, and the performance of students may differ widely. The primary school system of Egypt includes public schools and subsidized private schools, as well as unsubsidized private schools. The first two types of schools follow the centrally prescribed curriculum, and they do not charge any tuition. The private unsubsidized schools account for less that five percent of all primary school enrollment in Egypt.

theory and memorization but instead works to link schooling with the community beginning at an early age. Improved curricula are under preparation, and the school year has been extended to provide more teaching hours. An effort is underway to move the post-secondary training of the primary teachers to the level of a B.A. (from the currently required two years of post-secondary training).

The analysis here is designed to shed light on the efficacy of some of the proposed policy changes. It specifically delves into the interrelationship between school quality and goals for reduced dropout rates and increased school completion.

III. Overview of Model

The central focus of this work is the dropout decision of primary school students. Dropout decisions are directly related to school completion, but concentrating on these decision points permits more accurate characterization of the various time-specific factors underlying the behavior. And, while all students will eventually drop out of school, there is a clear *prima facie* case that doing so during the primary grades is nonoptimal from either a public or private viewpoint.

The opportunities facing the student both in and out of school are important to understanding school leaving. The underlying conceptual framework here is a simple optimization model on the part of the student. The student is seen as maximizing lifetime utility through the choice of schooling level. A key element of this choice is the earnings opportunity of the student, which is a function of the past and future schooling experiences of the student. But, market earnings for primary students are difficult to characterize and may be only one part of the overall school decision process. Moreover, the relationship between school experiences and earnings may not be completely clear. This section presents an overview of the basic approach and estimation strategy. The subsequent sections describe the results of the analyses of the various components.

The maximization of lifetime income with respect to years of schooling is a straightforward optimization problem that has been solved in various contexts. While details vary depending on the structure of the problem analyzed, the key idea is trading off foregone current earnings for enhanced future earnings. With perfect capital markets, the central result can generally be summarized by a simple optimal stopping rule for an individual: everything else equal, continue investing in schooling until i_s, the rate of return for s years of schooling, falls below the market interest rate on alternative investment options.[4] With borrowing constraints or imperfect capital markets, the magnitude of foregone earnings (Y_{today}) could also separately influence decision making, because some families may not be able to take advantage of high rates of return that involve large up front costs.

As it stands, however, this investment model is not easily implementable for empirical analysis. The formal analysis is conducted for an individual and ignores most personal and family factors that might interact with the rate of return derived from market work. It is frequently simply assumed that it is possible to employ this analytical structure related to individual stopping rules to explain differences in schooling across individuals, but the appropriateness of such a step deserves consideration. First, it is necessary to characterize nonschool factors that might enter into such schooling decisions, and the theoretical works seldom address these. Second, the relevant rate of return, i_s, pertains to each individual, and there is a presumption that this varies across individuals (consistent with variations in school completion in the population). Yet, dealing with this is difficult and seldom undertaken explicitly.[5] Typically, information is available on only the average returns to

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[4]The formal analyses have delved into a variety of aspects including the transition to on-the-job training, work-leisure decisions, and the like. Our concern here centers on the simple results with respect to formal schooling, and these predictions do not significantly vary with modeling structure.

[5]There are, of course, important exceptions. Theoretically, Becker[1975] considers individual variations in costs and benefits in describing the distribution of individual schooling decisions. Empirically, Willis and Rosen[1979] consider individually varying returns to different amounts of schooling. A thoughtful discussion and interpretation of existing work is found in Willis[1986].

schooling across groups of individuals, and any variations across individuals occur in highly structured ways.[6] (Clearly, if i_s is constant for individuals, variations in the choice of schooling level will be determined completely by considerations other than the foregone and future earnings opportunities that are included in the rate of return calculations). Even average earnings opportunities facing individual students may be difficult to characterize, because of thin markets and of significant selection problems, and it may be difficult to separate current from future earnings to the extent that they both vary by individual characteristics and by local labor markets.

Finally, and central to this discussion, it has been common to assume that schooling is homogeneous and directly measured by the length of time spent in school. Such an assumption, which greatly simplifies analysis by restricting attention to just the quantity margin, implies that the schooling investment decision is unrelated to quality differences among programs. On the other hand, it seems likely from the individual decision making view that there will be interactions of school stopping rules with quality. If school quality differs and if student performance has important subsequent implications for the labor market, one would expect variations in student dropout decisions to be directly related to the quality of the school. The more learning during any period of time, the more likely it is that a student will continue in school rather than dropout. This must be incorporated into empirical analysis.[7] Clearly, any problem definition that ignores school quality also contrasts sharply with the policy debate, where attention invariably concentrates on potential decisions about resources and quality for schools at different levels and in different areas.

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[6]For a consideration about ability, schools, and earnings, see Hause[1972].

[7]Similar problems arise with individual ability. With individual student abilities, the impact on school decisions depends on the relative strength of ability on subsequent school performance and on market opportunities. The original Ben-Porath formulation (Ben-Porath 1972) of the school investment decision had individual human capital as neutral, i.e., equally potent in the market and in school, but there is little empirical evidence on this proposition.

Here we maintain the conceptual starting point that the primary determinant of school completion and school dropout behavior at any point is the individual's rate of return from further schooling. The empirical implementation, however, presumes that all we will actually be able to measure is average earnings and returns. We will then examine directly the impact of the various individual-specific factors—school quality, individual specific earnings opportunities, ability, and other family influences—on the probability of dropping out of school. The starting point for the empirical analysis is:

$$\text{Prob(dropout)} = g(\overset{(?)}{\text{ability}}, \overset{(?)}{\text{achievement}}, \overset{(-)}{\text{school quality}}, \overset{(+)}{\bar{Y}_{\text{today}}}, \overset{(-)}{\bar{i}_s}, \mathbf{Z}) \qquad (1)$$

where **Z** represents other family and community factors influencing school completion and bars indicate averages over the relevant population. Ability and achievement have ambiguous effects on dropouts because they increase both current earnings possibilities and future earnings possibilities (through their impact on continued production of human capital). While the "conventional" assumption of neutrality (Ben-Porath[1972]) would imply no effect of ability or achievement on dropout behavior, this remains an empirical question. On the other hand, school quality, because it is expected to increase future benefits but not increase costs (or, at least, time costs of school), should unambiguously lower dropout probabilities for an individual. School quality and earnings opportunities, however, are not directly observed and must be inferred from available data. The next section discusses the measurement of school quality, while the following one considers earnings opportunities of students of primary school age.

A. School Quality

Virtually all analyses of school attainment, drop-out behavior, and the like ignore any differences across schools, essentially presuming that a year is a year when it comes to schooling. This presumption, however, is quite at odds with other detailed analyses of schooling when the focus is student performance (see the review in Harbison and Hanushek[1992]). Similarly, analyses of earnings opportunities of workers focus almost exclusively on quantity of schooling even though there are many suggestions that differences in school achievement may be very important in determining earnings alternatives.[8]

The approach here is to estimate directly variations in school quality. These are then employed to analyze the effect of school quality on individual student decisions about remaining in school.

The estimation of school quality follows a very simple value-added model of achievement. Current achievement (A_t) is viewed as a function of current and past inputs both from the family (F_τ) and from schools (R_τ).[9] Additionally, individuals differ in ability (μ), assumed to be fixed over time, and achievement in each time period is subject to stochastic fluctuations (ϵ_τ). This implies that current achievement can be written (in linear form) as:

$$A_t = \alpha_t F_t + \alpha_{t-1} F_{t-1} + \ldots + \alpha_o F + \beta_t R_t + \beta_{t-1} R_{t-1} + \ldots + \beta_o R_o + \mu + \epsilon_t + \epsilon_{t-1} + \ldots + \epsilon_o \qquad (2)$$

At the same time, A_{t-1}, achievement in the prior time period, is a function of many of the identical resources by virtue of the cumulative nature of education:

$$A_{t-1} = \alpha_{t-1} F_{t-1} + \ldots + \alpha_o F + \beta_{t-1} R_{t-1} + \ldots + \beta_o R_o + \mu + \epsilon_{t-1} + \ldots + \epsilon_o \qquad (3)$$

This suggests that we can rewrite current achievement in terms of contemporaneous inputs and lagged achievement as in:

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[8]In developing countries, see, for example, Behrman and Birdsall[1983]; Knight and Sabot[1987]; Boissiere, Knight, and Sabot[1985]. For developed countries, see Bishop[1985]; Hanushek, Rivkin, and Jamison[1993].

[9]The discussion pertains to an individual student (i). The individual subscript is suppressed in this presentation.

$$A_t = \alpha_t F_t + \beta_t R_t + \gamma A_{t-1} + \epsilon_t \qquad (4)$$

The parameter representing the effect of A_{t-1} on A_t (γ) is not constrained to one for several reasons. First, the impact of past inputs may decline over time, implying, say, that the impact of the first grade teacher may be more important in determining first grade achievement than third grade achievement. Second, gains in achievement may be more difficult to obtain as achievement grows, implying some decreasing returns to initial achievement levels.[10] Third, in actual application it is common to employ test measures of achievement, and these test measures are not necessarily based on the same scale of measurement.

Equation (4), the basic value-added form, offers considerable simplification for both data collection and estimation. With this formulation, one need observe just past achievement and the intervening school and family inputs. Further, ability (μ), which is generally viewed as unobservable, drops out of the value-added representation.

Past work has demonstrated that differences in schools are very important but does not provide any clear indication of how school quality can be reliably measured (see the summary in Harbison and Hanushek[1992]). Therefore, the approach here is to estimate unconstrained differences across schools by including a dummy variable for each school as in:

$$A_t = \gamma A_{t-1} + \alpha_t F_t + \sum \delta_i S_i + \epsilon_t \qquad (5)$$

where $S_i = 1$ if the student attends school i and $=0$ otherwise.

The δ_i's from this covariance structure are then the mean achievement growth in each school after allowing for other student-specific differences. These are interpreted as a measure of school quality across the sampled schools, and they are used directly in the estimation of the student dropout models.

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[10] The estimation below employs log-linear formulations that allow a form of decreasing returns to inputs.

This value-added characterization of the achievement relationship does not, however, avoid all complications. Specifically, when it comes to estimation, there are concerns about both the accuracy of measurement of prior achievement (A_{t-1}) and the possibility that prior achievement is correlated with the error in the equation (ϵ_t).[11]

The faulty measurement of prior achievement can be thought of as arising from observations ($\tilde{A}_{t-1}$) that differ from the true achievement by a random error, ν, as described in Equation (6):

$$\tilde{A}_{t-1} = A_{t-1} + \nu_{t-1} \qquad (6)$$

The presence of such measurement error will generally lead to biased estimates of all of the parameters in Equation (5), even when ν_{t-1} has mean zero. This situation is frequently hypothesized because of the widespread impression that measuring individual achievement is difficult and subject to considerable uncertainty.[12] Alternative treatments for dealing with this problem are generally available, including direct correction of the measurement error variance and the use of instrumental variables.[13]

The second concern is that ϵ_t will be correlated with A_{t-1} when the ϵ_τ's are correlated over time. Such correlations, which could result from unmeasured individual or family factors that are not captured by μ, also lead to inconsistent estimates of the model's parameters. Again, however, if

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[11]Both of these problems could be avoided if it were plausible to constrain the parameter on A_{t-1} to equal one so that the achievement model could simply be estimated in terms of ΔA. But, as described above, this is inappropriate in the context of the achievement models considered here.

[12]Note that measurement error in current achievement, A_t, can be subsumed in the equation error and generally causes no special statistical problems.

[13]If the variance of the measurement error is known, the estimation can directly incorporate this, yielding consistent estimates of all parameters. While information about measurement error is rarely available, the special characteristics of test measures of achievement at times provide this possibility through use of test reliability estimates. When done in the past, however, it has not led to significant changes (Hanushek[1992]).

suitable instruments for A_{t-1} can be found, it is possible to correct the estimation for these problems of endogeneity.

B. Opportunities Outside School

To understand dropout behavior, it is necessary to characterize the options facing the student. One important element is the earnings possibilities outside of school. Even though we are talking about primary school children, it is clear that they have real earnings possibilities, particularly in the agrarian parts of the economy. The basic structure involves estimation of an earnings model that varies systematically with the student's schooling, experience, ability, and labor market location. In this, we concentrate on the immediate work opportunities as characterized by children of primary school age who have been working in the market.

The estimation employs a sample of prior dropouts who are working in the market for pay to understand the earnings opportunities of current students. While little is known about the earnings possibilities facing primary school children, the basic structure of the model employed simply adapts a standard earnings function:

$$Y = f(\text{achievement, ability, experience, school attainment, } \mathbf{X}) \tag{7}$$

where **X** is a vector of other income generating characteristics.

Many children, however, do not enter the formal labor market after leaving school. Instead they tend to work in the home, on the family farm, and the like. This presents two complications for the analysis. First, those working in the market probably are not a random sample of all dropouts, implying that the earnings of just those working might not fully describe the potential earnings of all prospective dropouts. Second, the value of alternative activities—i.e., nonschool, nonlabor market activities—undoubtedly figures into dropout decisions. But, lacking direct market information or other ways of valuing nonmarket activities, it is difficult to develop consistent measures of this might vary across individual students.

For this analysis, we deal with both problems through incorporating information on the probability of labor market activities. The statistical models, which characterize how these probabilities vary across sampled children, provide a means of correcting for the potential sample selection biases. They also provide direct information about other opportunities facing students, suggesting that the probability on nonmarket activities itself contains potentially useful insights into alternatives.

The analysis of market earnings for children provides two kinds of information for the analysis of dropout behavior. First, it offers a characterization of the short term earnings potential facing students. Second, it provides direct estimates of the split between market and nonmarket activities and, specifically, of the chances of engaging in market work.

The basic dropout model thus builds on the prior estimation of Equations (5) and (7), and the empirical specification of Equation (1) becomes:

$$\text{Prob(dropout)} = g(A_t, AB_t, \hat{Y}, \hat{\delta}, \hat{\phi}, W) \tag{8}$$

where individual achievement level (A_t), individual ability (AB_t), and other important factors (**W**) combine with estimated earnings opportunities ($\hat{Y}$), estimated school quality ($\hat{\delta}$), and estimated probability of market work ($\hat{\phi}$) to determine dropout probabilities.

IV. Estimation Samples

We use in this study data collected in a longitudinal survey of primary school students in Egypt during two academic years, 1978/79 and 1979/80. The survey was part of the Egyptian Retention Study financed by the World Bank. The principal objective of the study was to examine skill retention among dropouts with special attention directed at urban/rural and male/female differences.

Three key elements of the data base make it uniquely well-suited to our task: 1) the provision of repeated observations on children of primary school age; 2) the collection of data on children both in and out of school; and, 3) the extensive testing of children to determine their cognitive achievement and ability. The next section discusses the general sampling design. Following that, there is a description of how the various basic samples of the data collection project are combined into the analytical samples used for the various purposes.

A. Basic Sampling Schemes[14].

The sample was drawn from the population of primary school students and dropouts during school year 1978/79. In a two-stage stratified design, a random sample of primary schools was drawn first[15]. Within each school, random samples of students currently attending grades three through six and dropouts who had attended the same grades between 1975 and 1978 were selected. Sampling rates for schools and students varied with the rural/urban location of the school. Nominal sampling rates for dropouts from the sample schools were set at 100 percent in each school. The realized sample included 8,570 usable observation on test scores. In addition, 1,808 dropouts of an estimated 2,747 were located and included in the sample.

In the second year, a subsample (one third) of the 1978/79 sample was drawn from the sample schools. Inschoolers were taken from those who continued in school in fourth, fifth, and sixth graders in the 1979/80 school year. Students who had completed the sixth grade at the end of the initial school year (1978/79) were omitted. In total, 1,976 students were both located and tested in the 1980 follow-up. The corresponding 1979/80 dropout sample consisted of all members of the

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[14]A complete description of the background for the data collection along with the details of sampling can be found in Swanson[1988].

[15]Sixty schools, half urban and half rural, were selected out of a population of approximately 10,000 schools.

previous dropout sample that could be relocated and tested in 1980. Further, all "new" dropouts (from school year 1978/79) and any additional "old" dropouts (who had not been located in the previous year) were included. In total, 1,725 dropouts were included in the 1979/80 sample.

Seven skill-specific achievement tests and two ability, or "intelligence," tests were developed for the survey. There are four literacy skill tests: Reading A and Reading B measure reading skills; Writing A and Writing B require the child to write words, sentences, and, finally, an entire paragraph. The three numeracy tests included: a simple operation test (28 problems), a problem solving test (fourteen "story" problems), and an elementary geometry test (eight problems). The two intelligence tests were intended to capture non-curriculum dependent measures of the child's skills. The verbal intelligence test consisted of thirty items; the nonverbal test was composed of thirty-five multiple-choice items.

In the first year, all nine tests were assigned to the dropout sample, while inschoolers were assigned only those tests considered appropriate to their grade level.[16] In 1979/80, all nine achievement and intelligence tests were assigned to every member of the sample.[17]

In addition to the achievement tests, four questionnaires were employed in 1978/79 to collect information about students, their families, their schools and their associated community. In the second year two additional questionnaires were used to collect information about the child's school record, family background, work experience and attitudes towards school.

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[16]The tests were designed to be appropriate for different grade levels: the Reading A, Writing A, simple operations and problem solving tests given children in grade 4 or lower; the Reading B, Writing B, and the three mathematics tests were given in the higher grades. Testing was done in one session. Inschoolers were tested in their classrooms during regular school hours, while dropouts were brought to school for special sessions. For details, see Swanson[1988].

[17]Testing was conducted under conditions similar to those in the previous year. In both years, field work commenced in the last week of January and was completed by the end of April.

B. Analytical Samples.

We make use of three different analytical samples in this study. The descriptive statistics for each sample are found in Appendix Table A1.

The first, the "school quality" sample, includes 2,437 students, which represents all 1979/80 inschoolers with usable test scores in both years and with complete background data.[18] This sample is used to estimate school quality for each of the 60 schools (as specified in Eq. 5). Six percent of the students are at third grade, 42 percent at fourth grade, 33 percent at fifth grade and the rest at sixth grade in 1980. For all three samples, we use the sum of the scores on the Reading A and simple operations tests as our measure of the student's scholastic achievement. The mean achievement score is 20 in 1979 and 24.5 in the following year.

The second, the "earnings" sample, includes all the old dropouts (1979 or earlier) and new dropouts (1979/80) who have usable achievement and other basic data. This sample is comprised of 3,051 dropouts. Of these, 648 individuals work in the formal market and provide information on labor market work and wages. This combined sample is used to estimate earnings functions and the probability of market work. Of those engaged in market work, forty-six percent are urban children, their mean age is 13 years, on average they have been out school for about four years when observed in 1980, and most of them (85 percent) are males. The urban and rural components in this sample have the same age and sex means, but the urban children have more years of schooling attained, staying in school one more year than their rural counterparts, and their mean score on the ability tests is 22, twice that of rural children (11). The mean wage rate is 38.4 piaster a day, and it is larger in rural areas (36.1) than in urban areas (32.8).

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[18]These sample sizes are subsequently reduced in the instrumental variables estimation because of missing data for the instruments. See Table 1, below.

The last, the "observed dropout" sample, includes all inschoolers of 1978/79 who have also been tested in the second year, forming a panel data set. This sample of 2,040 students includes both students who remained in school in 1979/80 and those who dropped out (9 percent) in that year. The share of urban and female students in this sample is higher than in the earnings sample which relied on sampled dropouts since 1975.

V. Basic Empirical Results

In describing the results, we first present the basic estimates of the school quality and market earnings models and then turn to the overall dropout models.

A. School Quality.

Table 1 includes estimates of the basic achievement model. This estimation employs the value-added structure in Eq. 5. The current and prior achievement measures are the sum of scores on the basic reading and mathematics computation tests. The model is estimated in log-log form with separate dummy variables for each school.[19] The other explanatory variables in these models include mother's and father's education and the grade level of the student.

The basic model was estimated in four different ways. The first column employs ordinary least squares to estimate the basic value-added model. The remaining three present instrumental variables estimates that address the potential problems delineated previously. In the simple measurement error model of Equation (6), the independent information on measured student ability is used as an instrument. This is essentially a multiple measure model where it is presumed that any errors in measuring ability are generated by a different process than those in measuring achievement but that true ability and true achievement are correlated. An alternative instrument

[19]The actual estimation in the table presents estimates as deviations from the Taha Hussein urban school. Since all that can be estimated is variations across schools, it does not matter which school is chosen as the basis for comparison.

Table 1. Achievement Value Added Models: 1980
(t-statistics in parentheses)
Dependent Variable: $LnACHIEVE_t$

Input	(1)	(2)	(3)	(4)
$LnACHIEVE_{t-1}$	0.378 (24.02)	0.758 (23.16)	0.715 (4.06)	0.770 (22.44)
Grade 4	0.279 (6.23)	0.044 (0.85)	0.060 (0.46)	-0.013 (-0.24)
Grade 5	0.373 (7.91)	0.002 (0.04)	0.029 (0.15)	-0.626 (-1.01)
Grade 6	0.325 (6.59)	-0.068 (-1.11)	-0.029 (0.15)	-0.117 (-1.79)
Mother's Education	0.008 (0.63)	-0.012 (-0.89)	-0.011 (-0.68)	-0.015 (-1.07)
Father's Education	0.022 (2.92)	0.005 (0.55)	0.006 (0.51)	0.003 (0.34)
Constant	1.724 (21.17)	0.891 (8.22)	0.998 (2.64)	0.919 (7.93)
F-test School equality	6.42	5.23	9.03	4.72
R^2	0.45	0.31	0.39	0.32
observations	2437	2437	2221	2172
Estimation	OLS	IV[a]	IV[b]	IV[c]

Notes:

a. Test measurement error model: ln $Ability_{t-1}$ as instrument.

b. Endogeneity of $Achieve_{t-1}$: prior teacher characteristics as instruments.

c. Combined measurement error and endogeneity: ln $Ability_{t-1}$ and teacher characteristics as instruments.

formulation—column 3—concentrates on the identification problems arising from correlated equation errors (the ϵ_r's). This estimation uses data on characteristics of prior teachers (1978/79) as instruments for A_{t-1}. Specifically, the years of experience, qualification level, and seniority in school of the 1979 teacher are employed as instruments. Finally, the instruments for both the measurement error and serial correlation models are combined in the last column of Table 1.

The estimation methodology has its largest effect on the estimated coefficient for A_{t-1}. This is expected because both potential problems would be expected in this situation to bias this parameter toward zero. Nevertheless, in each of the instrumental models, the estimated coefficient on prior achievement is significantly different from one. Further, the very imprecise estimate of the coefficient on prior achievement (and the other coefficients in the model) in column 3 suggests that the prior teacher characteristics are not particularly good instruments. This of course should be expected because of the extensive accumulated evidence about the limited relationship between specific teacher resources and student performance (Harbison and Hanushek 1992).

There is little evidence to suggest that parental background affects value-added. With one exception (in the OLS estimation of column 1), neither mother's nor father's education is significant, and the estimated effect is uniformly small. Preliminary estimation included a wider range of characteristics of the family (income, wealth, and family size), but none proved to be significant and only the more parsimonious results are presented here. This of course does not imply that differences in family inputs are totally unimportant. Their impact on achievement growth rates cannot be detected, but family factors clearly enter into the starting level of achievement, A_{t-1}.

At this point, no attempt is made to explain why some schools appear to do better than others. The primary use of these models is to provide a direct estimate of differences in school quality as derived from value-added models of achievement.[20]

The key finding of this estimation is that sampled schools are clearly very different in terms of quality. The precise quantitative estimates of school quality vary somewhat with the estimation method, although they are always highly correlated. The estimated quality measures from the simple OLS estimates (col. 1) and the most complete instrumental estimates (col. 4) have a simple correlation of .79, and, perhaps more importantly, the identification of the top and bottom quartiles of schools is very consistent across estimation method. In the subsequent analysis, we rely on the conceptually superior estimates from the full instrumental procedure, although the dropout models (below) are qualitatively invariant to the precise estimation of the school quality differences. The addition of the school dummy variables raises the explained variance in achievement from .36 to .45 in the OLS model and from .25 to .32 in the full instrumental variable model. The F-statistics in Table 1, against the null hypothesis of homogeneous schools, confirm that there are significant differences among the sampled schools.

The estimates indicate that growth in achievement can be dramatically different depending on the specific school. Table 2 displays descriptive statistics for all schools and for schools divided by urban and rural location. The range is instructive: One school has 37 percent higher achievement growth than the base school while, at the other end of the range, we find that a school that has about

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[20]Note also that the school differences estimated here may also include some local community factors that are constant for all students in a given school. The urban samples do include multiple schools within the same city, however, so any community factors would necessarily be very local. For our purposes here, it is not necessary to identify the various causes of one school's being better than another. All that is needed is knowing how different they are. Subsequent policy analysis could, however, benefit from better definition of the underlying causes of quality differences.

Table 2. Distribution of Estimated School Quality
(Proportional deviations from Taha Hussein School)

	All schools	Urban	Rural
Mean	-.014	.046	-.074
Minimum	-.46	-.27	-.46
Maximum	.37	.29	.37

46 percent lower growth.[21] This implies that one year in the best school can be equivalent (in expected achievement gain) to more than two years in the worst school. This magnitude of difference obviously can have a huge effect on the achievement of a student when compounded over just primary schooling, and it implies that the rate of return to a year of individual schooling investment could vary systematically.

Table 2 also indicates that the average quality of urban schools is some 12 percent above that of the sampled rural schools. Nevertheless, the distributions show considerable overlap with both the best school and the worst school identified as being in the rural areas.

The presumption in subsequent sections is that these estimates accurately reflect quality differences among schools and that students and their parents can gauge the differences that exist. We return to this later.

B. Earnings Opportunities.

The earnings estimation relies on actual pay and characteristics for a sample of working children who would have been in primary school had they not dropped out of school between 1974 and 1979. In all of the analysis, the sample of young workers is stratified into urban and rural samples in order to capture fundamental differences in the structure of the labor markets. In part of the analysis, the urban sample is further subdivided into the Cairo area and the remaining urban areas of the country, although, because the samples get very small, we concentrate on the basic rural/urban split of the samples. For each stratification, a common log-linear earnings function is estimated. Table 3 presents the basic earnings estimates using OLS techniques for the sample of all working

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[21]Note that, when achievement is measured in logarithms, the school-specific coefficient (times 100) is approximately the percentage deviation from the base school. With the OLS estimation, the range of the school quality estimates is virtually identical, going from -.38 to +.39.

Table 3. Income Models -- All Working Dropouts: OLS Estimates

Variable	Rural	Urban		
		Total	Cairo	NonCairo
Male	0.422 (4.5)	0.333 (2.2)	-0.018 (-0.1)	0.641 (2.8)
LnACHIEVE	0.024 (0.7)	0.107 (2.6)	0.069 (1.4)	0.144 (2.0)
Highest Grade	0.050 (1.4)	0.122 (2.5)	0.187 (2.8)	0.086 (1.2)
Experience (time out of school)	0.033 (1.2)	0.022 (0.7)	0.082 (1.9)	0.010 (0.18)
Constant	2.804 (12.9)	2.451 (7.6)	2.444 (5.7)	2.218 (4.7)
R^2	0.08	0.07	0.08	0.09
observations	348	297	151	146

dropouts in 1980. Subsequent analysis considers joint estimation of the probability of market work and the earnings functions.

While the models explain a relatively low portion of the overall variance in wages, the estimated parameters are quite consistent with expectations. Moreover, the wage data are likely to contain considerable measurement error in addition to simply unexplained variations in wage rates. Even though this is a young and inexperienced group of workers, it is possible to identify several key relationships and, particularly, the effects of schooling.

The estimates indicate that males consistently earn some 33-42 percent more than females in market work for pay. This differential is quite similar across urban and rural areas, although the premium appears largest in rural areas. The gender differential is very imprecisely estimated in the small Cairo sample, although the nonCairo urban sample suggests even larger male-female differences.

In neither urban or rural settings is it possible to detect an experience (time since dropout) effect. The estimated relationship with experience is generally small and statistically insignificant, although the effects in Cairo may be larger. The point estimates for the Cairo labor market indicate an 8 percent premium for each year of experience outside of school but this is considerably above any of the other estimates.[22]

The key to the models for our purposes is the interaction of earnings and schooling. This interaction is found along both the quality (achievement) and the quantity (highest grade) margins. In quality terms, achievement differences are directly translated into earnings differences in urban areas. Perhaps the most notable difference between the urban and rural settings is that there apparently is not

[22]Note, however, that we do not have actual labor market experience. Instead we simply have time since dropped out of school. In the Cairo area, where work in the labor market is more likely for these drop outs, the estimated effect could be closer to an actual experience premium. In other words, measurement error for actual experience in the other labor markets may bias their coefficients toward zero.

a premium paid for more cognitive skills in rural areas. This finding would be consistent with a labor market situation where urban jobs were more skilled and where rural jobs were weighted toward manual labor.

More years of schooling yield higher immediate earnings to dropouts—quite clearly so in urban areas. An additional year of schooling is associated with 12 percent higher earnings in urban areas and 5 percent higher earnings in rural areas. The rural earnings effect is, however, imprecisely estimated and is not statistically significant.

Models like those in Table 3 except substituting the ability measures for achievement are also estimated. These models are virtually indistinguishable in all respects. The achievement and ability measures are correlated in the range .65-.75, depending on the year and the precise sample.[23]

Finally, these earnings models have been estimated jointly with models (described below) of the probability that any dropout works for wages in the market. These models, estimated by maximum likelihood techniques assuming normally distributed errors, are very imprecisely estimated. While the probability of market work can be characterized in a reasonable manner, the earnings relationships are not well estimated in this joint manner. Further, these estimation problems appear to be more than simple identification problems for the probability and earnings models but instead reflect the small samples and correlations among the variables.[24] These estimation problems are consistent

[23]The term "ability" is often taken to imply a fixed individual-specific factor. However, the evidence here suggests that it is best thought of as another, perhaps broader, measure of achievement. Specifically, school quality models similar to those in Table 1 except that they employed ability instead of achievement were estimated with OLS. The estimates of school quality from the ability and the achievement models were correlated .71. In other words, schools that were good at increasing achievement were also good at increasing ability—and the interpretation of a fixed ability term appears inappropriate.

[24]The earnings models exclude the individual's age, presence and health of father and health of mother, and family wealth, factors which are expected to determine the locus of the person's activities but not the wage received in the market. Note, however, that these identifying restrictions are confounded by the close relationship between age and school completion and experience.

with some previous experience[25] and lead us to concentrate on the OLS estimates, which are very consistent with expectations. The maximum likelihood estimates of the earnings model, the probability of market work, and the subsequent school dropout models are, however, presented in Appendix Tables A2-A4. Importantly, the other primary determinants of dropout behavior (excluding earnings opportunities) are very consistently estimated and reasonably independent of the choice of earnings estimation technique.

C. Probability of Market Work.

The remaining component of the first stage analysis is consideration of the work activities of primary school age children. Of those out of school, a large portion do not work for wages in the market. Only 14 percent of the rural dropouts and 17 percent of the urban dropouts report a wage for market work, but the chance of working varies sharply across the population. Table 4 presents estimated probit models of the determinants of market work.

Market work is considerably more likely for males than females. Moreover, this effect is stronger in urban areas. As would also be expected, market work increases with age and with prior experience (length of time out of school). The average sampled dropout is 11 years old (with a standard deviation of about 2.5 years). Each year of age increases the probability of working for pay by some .02 in urban areas, and with each additional year out of school the probability goes up by .10.[26] The effect of experience is quite similar across urban and rural labor markets, but any effect of age is less pronounced in rural areas—presumably because of the importance of working on the family farm.

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[25]See the debate in Hay and Olsen (1983), Hay, Leu, and Rohrer (1987), Duan *et al.*(1983), Duan *et al.* (1984), Manning, Duan, and Rogers (1987), and Leung and Yu(1992).

[26]Changes in probabilities are calculated at the sample mean probability, both here and in the subsequent discussion of drop out behavior.

Table 4. Probability of Working in Market: Probit Estimates

Variable	Rural	Urban		
		Total	Cairo	nonCairo
Male	0.990 (9.00)	1.783 (13.18)	1.832 (8.15)	1.796 (10.34)
Age	0.020 (0.94)	0.083 (3.54)	0.078 (2.49)	0.053 (1.37)
Experience (time out of school)	0.345 (12.24)	0.404 (13.18)	0.469 (8.23)	0.433 (10.58)
Father deceased	0.450 (2.41)	-0.330 (-1.23)	-0.275 (-0.61)	-0.327 (-0.95)
Health limitation - father	-0.154 (-0.89)	0.404 (1.72)	0.894 (1.76)	0.514 (1.80)
Health limitation - mother	0.082 (0.36)	-0.188 (-0.56)	-0.554 (-0.44)	-0.043 (-0.12)
Wealth	-1.253 (-4.17)	-0.332 (-1.32)	-0.078 (-0.20)	-0.487 (-1.44)
Constant	-2.565 (-9.30)	-3.828 (-11.40)	-3.879 (-7.96)	-3.693 (-7.46)
Observations	1606	1445	667	787

The potential impact of opportunities on the farm is reinforced by the estimated effect of wealth. Wealthier families (identified by land ownership and possessions in the home) tend to keep dropouts out of the market in rural areas, but any such effect is statistically insignificant and quantitatively much smaller in urban areas.

Finally, the effect of parental health status is mixed. The only statistically significant effect on market work is found in rural areas, where children with a deceased father are noticeably more likely to enter the formal labor market. This presumably reflects the necessity of providing monetary support for the family when the head of the household cannot. In urban areas, a child whose father has health limitations tends to work in the market more frequently. The remainder of the health status factors are insignificantly different from zero.

The market work models were also estimated jointly with the income models through maximum likelihood methods. These results, presented in Appendix Table A3, are quantitatively very similar in terms of coefficients and precision of estimation to those from the probit estimation.

The interpretation of these models is that the probabilities provide some indication of where children's time is more valuable. When younger and less experienced, children tend to work in the home, but they move into the formal labor market as they age and as necessity dictates. The lower the probability of market work, the more relatively valuable other activities are.

D. School Dropout Behavior.

The final and most important component is to look specifically at the dropout decision. To do this, we begin with the sample of all in-school children in 1979 and attempt to understand why some dropout by 1980 while some remain in school. We estimate probit models of the form of Equation 8 where we substitute in the predicted schooling and earnings opportunities from the previous models. Overall, 10.2 percent of the sampled 2,042 students dropout before completion of the next school year, and the aggregate dropout rate is higher in rural than in urban areas.

Table 5 presents alternative estimates of dropout models. These differ in two ways: by the precise measure of predicted earnings opportunities facing the student and by whether or not the probability of market work is included directly in the model. The first column predicts earnings ($\hat{Y}$) on the basis of the urban and rural models in Table 3; the second column employs the division into the three labor markets of rural, Cairo, and other urban in calculating predicted income.[27] The first two columns do not include estimated probabilities of market work; the final two columns then include the estimated individual-specific probability of market work ($\hat{\phi}$) predicted from Table 4 and relying on the labor market definition corresponding to the source of estimated income. The models also include the direct estimates of school quality ($\hat{\delta}$) corresponding to school specific achievement growth in Table 1.

We emphasize the results that are found in the first and third column of Table 5; these correspond to estimated earnings based on the simple urban-rural split instead of the finer split of labor markets. The imprecision of the earnings estimates in the latter case, which were apparent before, also reappear when employed in the dropout models.

The overall results related to the key aspects of individual achievement and of school quality are very consistent across the estimated models. Inclusion of the probability of market work does alter some of the quantitative results, but the pattern and general interpretation is unaffected.

The models indicate that males are less likely to drop out of school, a finding that is totally unsurprising in Egypt. Egypt's Muslim society has traditionally had lower schooling for females along with less labor market attachment and lower wages if working. Moreover, the school dropout

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[27]In each case, predicted earnings are derived from the relevant earnings equation based on the student's 1979 residence. An alternative formulation was investigated to permit rural students to also consider opportunities if they moved to an urban area. It is very difficult, however, to distinguish between the effects of rural and urban opportunities for these students, and this effort was not pursued further.

Table 5. Estimated Dropout Models: OLS Income Estimates
(t-statistics in parentheses)

Variable	Labor Market Definition			
	Rural-Urban	Rural-Cairo-nonCairo	Rural-Urban	Rural-Cairo-nonCairo
Male	-2.388 (-7.44)	-0.495 (-3.8)	-4.911 (-9.9)	-1.388 (-7.2)
Urban	-0.428 (-3.15)	0.123 (1.2)	-1.487 (-7.7)	-0.185 (-1.4)
Grade 4	-1.463 (-5.3)	-2.106 (-8.8)	-1.069 (-3.0)	-1.925 (-6.8)
Grade 5	-2.090 (-7.8)	-2.278 (-9.4)	-2.067 (-5.9)	-2.192 (-7.7)
Grade 6	-2.498 (-10.2)	-2.526 (-12.1)	-2.934 (-8.5)	-2.746 (-10.8)
Predicted Earnings ($\hat{Y}$)	5.761 (7.1)	0.758 (3.2)	7.914 (7.39)	0.107 (0.4)
LnACHIEVE	-0.607 (-8.2)	-0.343 (-6.1)	-0.783 (-8.2)	-0.367 (-5.6)
LnABILITY	-0.400 (-6.1)	-0.361 (-5.6)	-0.250 (-3.0)	-0.215 (-2.8)
Wealth	0.192 (0.82)	0.124 (0.5)	1.282 (4.3)	1.277 (4.4)
School Quality - ($\hat{\delta}$)	-0.886 (-3.1)	-1.033 (-3.7)	-1.478 (-4.0)	-1.396 (-4.0)
Prob(Mkt Work) - ($\hat{\phi}$)	-	-	23.23 (12.7)	23.532 (11.4)
Constant	15.432 (-6.2)	0.059 (0.1)	-22.721 (-6.9)	0.963 (1.0)
observations	2042	2042	1965	1965

probabilities are significantly less in urban areas, perhaps because of clearer demands for more advanced labor market skills.

The grade dummy variables are included simply because the models indicate the probability of dropping out, conditional upon reaching any given grade. One would expect these overall probabilities to vary with grade. The left out category is grade 3. Other things equal, a student that progresses past grade three is less likely to dropout during any year than those in grade 3, and this effect remains unabated through primary school.

Predicted earnings, as discussed, are difficult to interpret since it is difficult to separate current from future income effects, implying that these are really reduced form results of how income affects dropout behavior. The models indicate quite clearly that higher current earnings opportunities on net entice students out of school and into the labor market. Moreover, a higher estimated probability of entering market work upon dropping out ($\hat{\phi}$) also increases very significantly the probability of dropping out. Thus, the immediate pull of the market, even for these very young students, is quite important in the school completion decision.

It is interesting to see how individual skills enter into the decision. Both higher achievement and higher ability lessen the probability of dropping out.[28] The effect of achievement is somewhat complicated, however, since higher achievement raises the current earnings possibilities of the individual (at least in urban areas), but it also paves the way to even higher future achievement. An extension of a Ben-Porath-like neutrality assumption might suggest that these two effects balance each other so that individual achievement would not have any direct effect on dropouts. Indeed, in urban areas this holds quite closely: From column 2 of Table 3 and column 1 of Table 5, we calculate the

[28] Achievement and ability are measured in 1979, prior to the decision to drop out or remain in school in 1980. It is still possible, however, that causality is confused in some instances. If a student stopped studying in school or simply did not try hard to complete the tests in anticipation of dropping out in 1980, dropout behavior could lead to lower achievement. It seems doubtful, however, that this is a major problem.

net effect in urban areas of a change in (log) achievement as $-.607 + 5.761 \cdot .107 = -.012$, or almost complete neutrality. For rural areas, however, the net effect is $-.607 + 5.761 \cdot .024 = -.468$; higher achievement unambiguously acts to hold rural children in school. The results about school retention of the higher achievers are strengthened for both urban and rural schools when ability differences are considered. If ability is thought of as simply a broader achievement measure, the effects will be additive, and the estimated dropout models clearly indicate that dropout rates fall with more cognitive skill.

Perhaps the most novel feature of this estimation is the direct investigation of school quality ($\hat{\delta}$) on dropout behavior. These results suggest strongly that high quality schools in and of themselves serve to retain students and to prevent dropouts. Independent of the student's own achievement and ability level, better schools directly increase the probability that a student will stay in school. School quality is separately estimated and not based on simple survey questions about perceptions, but the evidence does indicate that parents and children can observe quality differences and find them important. Moreover, it must be emphasized that school quality is estimated from value-added models so that this effect is not the result of confusion with better students.

The magnitude of the school quality effect is significant. If all of the schools could be moved up to the quality of the top school, the average dropout rate is predicted to fall from .102 to .056. Such changes in primary school drop out rates would have enormous impacts on school completion, since the annual drop out rate is cut by forty-five percent. The estimated cut in drop out probabilities is even larger in the model that includes the probability of market work (column 3). There, the effect of upgrading all schools is to reduce the dropout probabilities below .035, or by two-thirds.

These results have powerful policy implications, because it adds further support to the idea that developing quality schools should be the number one goal. Moreover, upgrading school quality should be pursued even if expanding access and completion rates is taken as the primary goal of policy. The analysis of Brazilian schools by Harbison and Hanushek[1992] found that high quality schools had an efficiency pay-off resulting largely from increasing promotion rates through school. There, improved school quality yields gains that permit expansion of schooling more generally. In other words, there is no necessary trade-off of quality and access given the current inefficiency of the operation. This finding is reinforced by subsequent investigation of grade repetition in Brazil which considers directly quality improvement versus regulatory solutions such as mandatory promotion (Gomes-Neto and Hanushek[forthcoming]).

The work here for Egypt fills in the other half of the "wastage" problem, the importance of quality schools for preventing dropouts. Higher quality schools significantly lower the probability that a will leave during primary schooling, thus increasing average completion years.

Finally, without consideration of market work, family wealth differences have an insignificant effect on dropout decisions. When the probability of market work is included in the models, the direct effect of wealth is to increase dropout probabilities. This direct effect is, however, offset by the fact that increased wealth decreases the chances of market work—significantly so in rural areas. This apparently anomalous result is probably also complicated by imprecision of measurement.[29]

Somewhat surprisingly, individual drop out rates do not appear to be sensitive to parental education levels. When the dropout models included mother's and father's years of schooling (not shown), no significant effects were found. This result is quite different from that of Lillard and Willis[1992] which found strong intergenerational transmission of schooling differences in their analysis of Malaysian schooling. It is clear that average schooling levels of parents in our Egyptian sample is very low and displays little variation.

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[29]Family wealth is measured by the proportion of the following items: running water, electricity, radio, reading material, and home ownership. Because these crude measures of wealth might have different meanings in urban and rural settings, the effect of wealth was estimated separately for urban and rural areas. In all cases, however, wealth had a statistically insignificant effect on dropout probabilities when the probability of market work was excluded from the dropout model.

The dropout models were also estimated with the predicted earnings that came from the jointly estimated earnings and market work models. The results of this (Appendix Table A4) are virtually identical except that higher predicted earnings point to lower dropout rates, the opposite of that in Table 5. The imprecisely estimated earnings models from the joint modeling, however, indicate that the results in the dropout models are probably largely reflecting simple aggregate urban-rural differences.

V. Conclusions

A simple set of conclusions stands out in this analysis. Higher skilled individuals—children with greater ability and achievement—tend to be the ones who stay in school. Lower skilled individuals tend to leave school early.

But, holding constant the individual's ability and achievement, a student attending a higher quality school will tend to stay in school. A student attending a lower quality school is more likely to drop out and complete fewer grades. The finding about the effects of school quality on completion rates provides more evident that the frequently discussed equity-quality trade-off is misstated. The trade-off that is identified arises from simple consideration of the budget constraint facing schools; money spent on quality reduces that available for expanding the number of school positions available. This simple budget analysis, however, ignores the complementarity of quality and efficiency in production.

Bringing all schools up to the best quality school would reduce the dropout rate estimated in the sampled Egyptian schools by forty-five to as much as seventy percent. Of course, making such quality adjustments may be difficult because this analysis has not identified the specific school factors that add up to variations in school quality. Neither has it estimated the cost that might be incurred in adjusting schools. Nevertheless, the importance of school quality is very clear.

Quality interactions with individual student decisions about leaving school have important implications for conventional analyses of school investment. Standard rate of return calculations based solely on quantity of schooling are likely to be misleading because they ignore school quality which improves earnings opportunities and which is positively correlated with quantity completed by individuals. The rate of return to pure quantity of schooling is almost certainly overestimated when quality is ignored, implying that standard policy prescriptions based on just simple quantity returns might lead to suboptimal policies. For example, a policy of significant expansion of schooling made budgetarily viable by employing poor quality schools might never yield the gains forecast by standard rate of return estimates.

The feedback of quality to school completion has strong implications for policy in developing countries. Every effort should be made to improve school quality. If that is done, attendance and completion will follow.

While this analysis has not considered repetition, the effects of quality on repetition are likely to reinforce these results. Lower quality schools tend to retain students in grade—because they have not accomplished as much as they progress through school (see Harbison and Hanushek[1992] and Gomes-Neto and Hanushek[forthcoming]). Grade repetition then limits overall access to schools, because repeaters are taking up positions in schools that could otherwise be used by an expanded group of students. In simplest terms, if wastage is a concern in developing countries, as it should be, the best way to deal with it appears to be through school improvement.

This paper has not addressed the issue of how schools can be improved, and that is not an easy task. Nevertheless, pursuing that objective should be given high priority, even when policy makers are more directly concerned about wastage, school completion, and the like.

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Table A1: Descriptive Statistics for Analytical Samples

A. School Quality Sample (n=2,437)

Variable	Mean	Standard Deviation	Description
Achievement - 1980	24.4[a]	1.82	Raw test score on Reading A + Simple Operations Tests - 1980
Achievement - 1979	20.8[a]	2.05	Raw test score on Reading A + Simple Operations Tests - 1979
Grade 4	.42	.49	=1 if student in grade 4; =0 otherwise
Grade 5	.33	.47	=1 if student in grade 5; =0 otherwise
Grade 6	.20	.40	=1 if student in grade 6; =0 otherwise
Father's education	1.79	4.1	years of schooling
Mother's education	.53	2.2	years of schooling

Note: a. geometric mean of achievement.

B. Earnings Sample — Market Work

Variable	Rural (n=1,606)		Urban (n=1,445)		Description
	Mean	Stnd. Dev.	Mean	Stnd. Dev.	
Male	.622	.49	.515	.50	=1 if male; =0 if female
Age	11.24	2.62	11.2	2.38	Age in years - 1979
Experience	2.09	2.37	1.39	2.04	Years since left school
Father deceased	.072	.26	.057	.23	=1 if father deceased; =0 otherwise
Health limit - father	.098	.30	.068	.25	=1 if father has health limitation; =0 otherwise
Health limit - mother	.034	.18	.022	.15	=1 if mother has health limitation; =0 otherwise
Wealth	.468	.18	.643	.21	Proportion of running water, radio, electricity, reading material, home ownership by family
Market Work	.145	.35	.166	.37	=1 if work in market for pay; =0 otherwise

C. Earnings Sample — Income Estimation

Variable	Rural (n=348)		Urban (n=297)		Description
	Mean	Stnd. Dev.	Mean	Stnd. Dev.	
Male	.833	.37	.889	.31	=1 if male; =0 if female
Highest grade	4.81	1.08	5.03	1.07	Highest grade of school completed
Experience	4.43	1.31	3.58	1.63	Years since left school
Achievement - 1979	8.95[a]	3.23	15.59[a]	3.21	Raw test score on Reading A + Simple Operations Tests - 1979
Market Income	36.42[a]	1.94	41.85[a]	2.29	Income in piasters per day

Note: a. Geometric mean.

D. Observed Dropout Sample (n=2,042)

Variable	Mean	Standard Deviation	Description
Male	.595	.49	=1 if male; =0 if female
Urban	.494	.50	=1 if urban; =0 if rural
Grade 4	.339	.474	=1 if grade 4 in 1979; =0 otherwise
Grade 5	.304	.46	=1 if grade 5 in 1979; =0 otherwise
Grade 6	.315	.46	=1 if grade 6 in 1979; =0 otherwise
Predicted Earnings	30.88[a]	1.23	Predicted earnings; Table 4, col. 1, 2
Achievement - 1979	20.42[a]	2.05	Raw test score on Reading A + Simple Operations Tests - 1979
Ability - 1979	20.94[a]	1.96	Raw verbal + nonverbal ability test score - 1979
Wealth	.586	.22	Proportion of running water, radio, electricity, reading material, home ownership by family
School Quality	-.013	.17	Estimated school quality; Table 1, col. 4
Prob(Mkt Work)	.035	.04	Estimated probability of market work; Table 3, col. 1, 2
Dropout	.105	.31	=1 if school drop in 1979/80; =0 otherwise

Note: a. Geometric mean.

Table A2. Income Models -- All Working Dropouts: Maximum Likelihood Estimates

Variable	Rural	Urban		
		Total	Cairo	NonCairo
Male	0.322 (1.51)	-0.157 (-0.62)	4.267 (3.84)	3.031 (1.32)
LnACHIEVE	-0.001 (-0.01)	0.040 (0.65)	-0.499 (-1.04)	0.469 (0.61)
Highest Grade	0.052 (1.09)	0.066 (1.24)	-0.026 (-0.28)	0.114 (1.32)
Experience (time out of school)	-0.036 (-0.48)	-0.102 (-1.70)	0.133 (1.68)	0.036 (0.41)
Constant	3.421 (4.3)	4.256 (6.48)	-0.065 (-0.57)	-0.017 (-0.08)
observations	232	240	113	127

Table A3. Probability of Working in Market: MLE

Variable	Rural	Urban		
		Total	Cairo	nonCairo
Male	0.986 (9.06)	1.762 (14.66)	1.772 (8.91)	1.796 (11.35)
AGE	0.025 (1.53)	0.083 (5.80)	0.094 (4.78)	0.053 (1.87)
Experience (time out of school)	0.343 (10.66)	0.401 (12.02)	0.443 (7.46)	0.433 (9.39)
Father deceased	0.506 (2.83)	-0.372 (-1.50)	-0.412 (-0.83)	-0.327 (-1.00)
Health limitation - father	-0.185 (-1.07)	0.479 (2.46)	0.876 (1.63)	0.514 (1.96)
Health limitation - mother	0.036 (0.12)	-0.402 (-0.84)	-0.682 (-0.13)	-0.043 (-0.09)
Wealth	-1.212 (-3.81)	-0.365 (-1.45)	-0.269 (-0.67)	-0.487 (-1.37)
Constant	-2.632 (-11.45)	-3.790 (-14.56)	-3.854 (-9.40)	-3.693 (-9.39)
observations	1606	1445	667	787

Table A4. Estimated Dropout Models: MLE Income Estimates
(t-statistics in parentheses)

Variable	Labor Market Definition			
	Rural-Urban	Rural-Cairo-nonCairo	Rural-Urban	Rural-Cairo-nonCairo
Male	0.060 (0.6)	0.032 (0.3)	-1.589 (-7.5)	-0.397 (-2.2)
Urban	2.022 (8.4)	0.142 (1.4)	-0.469 (-1.1)	-0.574 (-3.9)
Grade 4	-2.513 (-10.3)	-2.293 (-9.7)	-2.017 (-7.0)	-2.041 (-7.5)
Grade 5	-2.542 (-10.2)	-2.357 (-9.8)	-2.269 (-7.8)	-2.148 (-7.8)
Grade 6	-2.595 (-12.4)	-2.468 (-12.2)	-2.887 (-11.2)	-2.779 (-11.6)
Predicted Earnings ($\hat{Y}$)	-2.580 (-8.8)	-0.674 (-3.5)	-0.126 (-0.2)	-2.014 (-5.5)
LnACHIEVE	-0.262 (-4.8)	-0.268 (-4.9)	-0.376 (-5.7)	-0.356 (-5.6)
LnABILITY	-0.318 (-4.7)	-0.357 (-5.5)	-0.190 (-2.4)	-0.196 (-2.5)
Wealth	0.206 (0.8)	0.244 (1.1)	1.134 (3.9)	0.744 (2.7)
School Quality - ($\hat{\delta}$)	-1.078 (-3.8)	-0.800 (-3.0)	-1.449 (-4.2)	-1.032 (-3.2)
Prob(Mkt Work) - ($\hat{\phi}$)	-	-	20.180 (10.4)	12.994 (11.1)
Constant	12.072 (10.5)	4.769 (6.4)	2.106 (1.1)	9.140 (6.7)
observations	2042	2042	1965	1965