There are numerous examples of the limited impact of years of schooling on learning (see Glewwe and Kremer 2006; Hanushek and Woessmann 2008). Often these studies conclude that the school system, including teachers, comes up short in preparing students with the skills needed to succeed. Without exonerating schools and teachers, it can also be the case that the students, or a subset of them, come to schools with enormous disadvantages that could be offset through interventions in early childhood. One illustration of this possibility is provided in a study by Filmer and Schady (2009), which found that a scholarship program for lower secondary schools in Cambodia revealed no evidence that recipient children did any better on mathematics and vocabulary tests, despite an increase in enrollment and attendance of approximately 25 percentage points. The tests were administered 18 months after the program’s implementation, and so it is unlikely that the absence of a response reflects a premature assessment of a cumulative result (King and Behrman 2009). Moreover, the data provide no support to the possibility that overcrowding of classrooms accounts for the absence of a learning response. More likely, the results reflect the fact that by lowering the cost of schooling, the intervention induced students with lower-than-average expected economic returns to schooling to enroll.
This point is more general. As illustrated in figure 5.1, in many school systems, a large proportion of children do not even reach basic literacy until well into their primary school years, if ever. For example, 60 percent of Malian youth are not able to read a simple sentence until their sixth year of schooling. In three of the four countries illustrated, half the children have not reached this minimum competence until their fourth year of classes. Similarly, more children in a sample of children who had completed third grade in the Punjab of Pakistan could not add or subtract than could perform these basic math skills (Andrabi and others 2007). Clearly this indicates wasted resources as well as a likely contribution to early dropout rates of discouraged children.

These examples provide an entry to the theme of this chapter. Clearly, the absence of a tangible learning outcome implies an inefficient education investment. Moreover, although Filmer and Schady (2009) studied only lower-income students who were eligible for a scholarship, and, thus, they could not assess learning of children from prosperous families who enroll at the margin in response to other inducements, the results reported

**Figure 5.1 Proportion of 15- to 19-Year-Olds Who Can Read a Simple Sentence, by Highest Grade Completed**

![Graph showing proportion of 15- to 19-Year-Olds who can read a simple sentence by highest grade completed.](graph)

**Source:** Demographic and Health Surveys for the respective countries and years.
by Naudeau and colleagues in chapter 1 point to the possibility that cognitive capacity and income are correlated by the time a child reaches school age.

To the degree that this is the case, attempts to address the demand gap in access to and quality of primary or secondary schooling with programs such as conditional transfer programs will be hindered by the absence of effective interventions to preempt the loss of potential before preschool. This is consistent with theoretical expectations on the demand for schooling that, as is standard, presume that an unconstrained household will set marginal expected benefits from schooling to equal the costs. Phrased as such, however, the cognitive capacity perspective provides an additional dimension to the often debated and difficult-to-measure question of the relative returns to investing in demand-side interventions compared with supply-side approaches (Orazem, Glewwe, and Patrinos 2009). Although improving the quality of schools and teachers can be expected to have an impact on the demand for education, as will, in other circumstances, addressing imperfect information and credit markets, this chapter argues that a third and complementary approach to improving schooling outcomes is through improving the learning potential of students before they enroll in the first year of formal schooling.

The argument is presented, first, by briefly introducing a model of school outcomes that includes both the quality of schooling and the abilities of the child. These abilities may include those that are malleable as well as those that are less amenable to parental decisions or public interventions. Then this chapter discusses the link between the demand for basic schooling and the likely vulnerability of children before entering primary school. The discussion includes salient points in the literature on the relation of income to the demand for education. This is followed by a look at how nutrition may influence school readiness, and the following sections review how preschool programs may have a similar preparatory role for primary and subsequent education and the placement and demand for preschool programs. The final section concludes.

**How Might Early Childhood Development Influence the Demand for Education and Student Quality?**

The economic benefits of education are usually measured in terms of adult outcomes. These are often specified in earning functions or wage equations, although it is generally accepted that nonpecuniary benefits including improved health, reduced fertility, stronger citizenship, and an improved ability to care for children are also outcomes of educational investments. In the most basic models, wages or similar outcomes are considered functions
of years of schooling (S). As Hanushek and Woessmann (2008) discuss in their review, a key empirical question is how to distinguish the impact of schooling itself from ability, either by including measures of ability (A) or by comparing siblings as well as using similar econometric approaches. Ability can be measured in many ways and can include noncognitive and cognitive skills. The noncognitive skills include a range of socioemotional behavioral factors such as conduct, motivation, persistence, team work, and attitudes toward risk. Equation 5.1 summarizes this simple relation, indicating that wages increase proportionally as a function of years of school as well as ability:

$$\ln(Wages) = f[S, A]. \tag{5.1}$$

Taking this one step further, it is useful to consider learning per se (L) as distinct from schooling and to add various schooling inputs (I) that increase learning to the basic model:

$$\ln(Wages) = f[S(A, I), L(A, I), A]. \tag{5.2}$$

Expressed in words, equation (5.2) states the same dependence of wages on ability and years of schooling as equation (5.1) but also indicates that both years of school completed and learning are themselves dependent on the ability of the student as well as the inputs into the teaching process. It also emphasizes that ability affects earnings not only through learning but also through a range of behaviors and preferences that influence personality (Cunha and Heckman 2009).

Hanushek and Woessmann (2008) make two empirical observations that are relevant to this chapter. First, they report that the measured impact of years of schooling declines appreciably when learning is included in an estimate of wages at the individual level; in cross-country regressions of gross national product and schooling, measures of learning pick up virtually all the total impact of years of schooling. Second, ability affects both years of schooling and what is learned in school. Indeed, Heckman and Vytlacil (2001) maintain that it is not possible, over a wide range of variation in schooling and ability, to estimate the separate impacts of years of schooling obtained and that of ability in wage estimates.

The majority of models and of attempts to estimate the impact of ability, however, take ability as exogenous. To address the question of early childhood development (ECD), however, one needs a multiperiod model in which investments made in period 1 (preschool) affect the learning that occurs in school in period 2. Most of the returns to education accrue in a third period, postschool.

Such a multiperiod model can be used to investigate the impact of programs in the initial period ($E_1$) and household characteristics ($X_1$) on ability
before entrance into school. As expressed in equation (5.3), ability is assumed to respond to these programs:

\[ \frac{\delta A}{\delta X} > 0 \text{ and } \frac{\delta A}{\delta E} > 0. \quad (5.3) \]

Furthermore, household characteristics are generally defined such that ability increases in response to these characteristics. For numerous practical applications, ability may be assessed in terms of school readiness, although this is not always how ability is defined.

A multiperiod approach is also needed to study whether outcomes in the initial period influence the amount of learning in school, as well as any tendency to drop out early. Equation (5.4) shows this relation of learning and skills to ability in the initial period:

\[ \frac{\delta L}{\delta A} > 0 \text{ and } \frac{\delta S}{\delta A} > 0. \quad (5.4) \]

If positive, as illustrated here, equation (5.4) implies that gaps in skills widen over time. Moderately sized delays in school readiness, then, would lead to major differences in school outcomes over the years of primary and secondary education and would be consistent with what Cunha and Heckman (2009) call self-productivity.

Moreover, a multiperiod model of schooling could be used to determine if programs in primary and secondary schools offset initial cognitive development delays or, alternatively, whether the children entering school with higher ability benefit more from the quality of the school: That is, how does the contribution of different investments in education depend on the ability of the student? This is shown in equation (5.5), which measures whether the impact of an investment in the second period is higher for more able students:

\[ \frac{\delta_2 L}{\delta_2 A} > 0 \text{ and } \frac{\delta_2 S}{\delta_2 A} > 0. \quad (5.5) \]

If the relationships in equation (5.5) are positive, as shown here, then investments in a later period have a larger return for higher-ability students than for children with lower ability. Cunha and Heckman (2009) refer to this as dynamic complementarity. As economic efficiency implies larger investments where the returns are highest, complementarity implies allocating more resources to the higher-performing students.

Moreover, if ability is itself responsive to earlier investments, then earlier investments increase the return to later ones, through self-productivity. However, whether dynamic complementarity will magnify inequality is an empirical question. Conceptually, there may also be inputs in schooling that substitute for early child investments and, thus, compensate for limited amounts of inputs earlier. Indeed, researchers have found positive impacts of compensatory interventions in primary education in Latin American countries (see, for example, McEwan 2008; Shapiro and Trevino 2004).
In such a case, equation (5.5) will imply that as ability increases, the returns to some current inputs are actually smaller than they are for lower-ability students, and the relationship in the equation would be negative.

Thus, under quite plausible assumptions and in keeping with much of the current evidence, complementarity and self-productivity imply that early investments can address both equity and efficiency: that is, if programs are effective at addressing the loss of potential that occurs early in childhood, these programs may both increase the returns to schooling and deliver most of the benefits to households with lower-than-average endowments. If, however, these investments are neglected and ability gaps occur in early childhood, then investments in schooling will generally involve a trade-off between equity and efficiency. With early gaps in ability, complementarity and self-productivity imply that the most productive investments in schools will be aimed at the higher-ability students; addressing the needs of the students with lower ability will lower average returns.

Any estimation of the impact of endogenous ability on either schooling outcomes in period two or outcomes for adults in period 3 (for example, wages) must confront the challenge of identifying the inputs in the separate stages. For example, it is clearly difficult to separate causes of malnutrition and early cognitive impairment from other causes of poor basic schooling that will also affect lifetime productivity; stimulation of preschoolers and subsequent educational attainments both reflect household decisions regarding investments in children. Generally, to control for such behavioral determinants it is necessary that the data from earlier periods of heightened vulnerability contain information on programs that are not correlated with subsequent household schooling choices yet have a measurable influence on early cognitive development. Alternatively, such identification requires economic- or weather-related shocks in the initial period that are of sufficient magnitude and persistence to affect a child’s development yet are sufficiently transitory not to affect subsequent schooling decisions directly.

Although randomized experiments can provide the identification for specific interventions, the data requirements are intimidating. Moreover, in many cases one is interested in understanding a finer breakdown than the three-period model mentioned above. For example, one might want to distinguish whether a preschool program for children four and five years of age can compensate for cognitive development delays in a child during the first three years of life. Whether or not this compensation occurs, it is then important to indicate how such preschool programs prepare a child for later schooling. Although the value of such a research program is readily apparent, its execution is stymied by the fact that analyses of preschool-aged populations are often unable to follow children through their school years, never mind into long-term (adult) outcomes. Conversely, adult attainments usually have limited data on childhood conditions.
Thus, the development of the knowledge base on long-term outcomes of ECD interventions is still in its early stages. However, an increasing body of research is explaining how gaps in skills manifest in different settings (as summarized in equation [5.3]). Evidence for how much ability, widely defined, responds to specific programs as well as to household characteristics is discussed in Naudeau and colleagues (chapter 1) and Walker (chapter 4). Less evidence is at hand for self-productivity and complementarity. The latter is a particular focus of this chapter, which explores the role of preschool programs in low-income settings.

A few relatively small studies carry a large weight in the literature, with developed countries dominating the evidence. Most noteworthy are the studies of programs in the United States reviewed and elaborated upon in Cunha and others (2006). This literature attempts to delineate the age patterns of skills formation and responses to interventions. Research from psychology and neurology indicates that critical periods of formation exist very early in a child’s life. For some skills, the window of opportunity for full development is in the first three years of life (Shaklee and Fletcher 2002; Shonkoff and Phillips 2000); other abilities, including noncognitive skills, may be relatively malleable later in an individual’s life (Cunha and Heckman 2009). One key stylized fact from this literature is the observation that income matters in the sense that children are not able to purchase a favorable family environment but, further, that it is possible to partially compensate for adverse family conditions (Cunha and others 2006). However, the later the remediation, the less effective it is.

Nevertheless, although this knowledge base is building upon interdisciplinary foundations, its application to a wide range of social and economic settings is still problematic. Recent reviews have increased the understanding of early interventions in low-income (Engle and others 2007) and middle-income (Vegas and Santibañez 2010) settings, but the data and analytical challenges remain daunting. For example, relatively few full-scale programs reveal both what works in a systematic manner and what it might cost to achieve such results. Of course, costs matter in two related ways.

First, the relative efficiency of investments in early interventions depends not only on the responsiveness of the child to an intervention—that is, the magnitude of equation (5.3)—but also on the cost of providing the necessary inputs. For example, although the longitudinal study of the Perry preschool program in the United States has contributed greatly to our understanding that the returns to human capital investments decline with the age of the individual, that program cost $9,785 in 2004 dollars per child per year (Cunha and others 2006).

Second, even with a favorable benefit-to-cost ratio, the fiscal envelope for a country may make a full-scale investment problematic. This is illustrated by the experience of Bolivia’s Proyecto Integral de Desarrollo
Infantil (PIDI; Integrated Project of Child Development). That program was found to have a benefit-to-cost ratio between 1.7 and 3.7 (Behrman, Cheng, and Todd 2004). The program, however, was discontinued earlier than planned and a portion of the World Bank credit returned unspent. Although a few institutional reasons contributed to this decision, fiscal concerns also played a role. At the time of the evaluation, the cost of the PIDI program was approximately $43 per month per child for a combination of full-time day care, nutritional inputs, and systematic learning environments for low-income children aged 6–72 months. Although this was clearly less than the cost for the Perry program, these costs were incurred at a time when the country’s annual gross domestic product per capita was approximately $800.

How Do Initial Household Resources Influence the Benefits of Subsequent Schooling? The Role of Income

Numerous studies have looked at the demand for education. For example, Behrman and Knowles (1999) review 42 studies and find only a modest relation of income and schooling attainment, but they also maintain that many of the results reported in the literature likely underestimate the association of income and schooling. Behrman and Knowles also point out that on theoretical grounds demand for education is not necessarily expected to be determined by income. They review the conditions under which one might expect the demand for education to be neutral with respect to income. As is often the case, these conditions include the assumption that markets—in particular, markets for credit—function perfectly. Additionally, for there to be no income gradient in demand, it is generally assumed that prices and quality do not differ by wealth. However, such an income gradient in prices or quality might be present if policies lead to better schools in more wealthy neighborhoods. It is also assumed that access to information is costless or otherwise distributed so that wealth is not a factor in its dissemination. If these assumptions do not hold (and several empirical studies suggest they do not), an income gradient may be present in investments in schooling even if the benefits of schooling are uncorrelated with income.

Additionally, in general it is assumed that for schooling to be uncorrelated with income it should be a pure investment: that is, if a current consumption element is influencing the demand for education, then the demand for schooling will resemble the demand for any other component of household utility rather than a pure investment. Many other reasons explain, however, why the pure investment returns to schooling would differ by household wealth that reflects neither the price of schooling nor the
utility derived directly. In particular, if the actual average returns from schooling are correlated with income, then demand will reflect these differences. This takes the discussion back to the likelihood that the knowledge obtained in school (hence the economic returns) differs according to the ability of the student and, furthermore, that an income gradient is found in capacity to benefit from school that occurs before primary school. Taken together, these features will result in lower expected returns to schooling for children in settings where cognitive capacity is also low. This will be manifest in a lower demand for schooling in these settings.

Indeed, a comparison of scores from the Programme for International Student Assessment for 14 countries indicates the poorest quintile of students in each country scored lower than the wealthiest quintile of students (World Bank 2006). Only 15-year-old students participate in this assessment. Because many students drop out of school before age 15, the results may reflect a selection bias over the full population. However, this would not introduce a bias among the test takers. Thus, the difference across income groups does not reflect differences in ability that lead to dropping out at an earlier age. Instead, under the assumption that there is an income gradient in school dropout rates in many of the countries studied (though some countries successfully enforce mandatory schooling), these scores are likely to underestimate the achievement gap.

The proposition that household inputs might complement the resources provided by a school is not controversial, although it is hard to isolate the effects of household wealth on schooling. Suppose that more able parents both earn more and have children that inherit their ability; then, on average, children from wealthier households will do better in school. In this case, however, it is innate ability per se, and not wealth, that accounts for the higher returns from schooling and, ultimately, more schooling demand. If, however, a portion of the impact of wealth on schooling is through an input that is purchased rather than inherited, then one would like to identify the input and provide it—or a close substitute—to lower-income students.

What inputs that may be purchased influence the returns from schooling? Can certain interventions affect what has been traditionally considered as inherited ability? Clearly interventions in early childhood, including nutrition, cognitive stimulation, and preschool education, can preempt the cognitive delays experienced on average by children born into socioeconomically disadvantaged households (Engle and others 2010). However, before elaborating on a range of such interventions, it is worthwhile to discuss one alternative to preventing such delays: the possibility of offsetting them within the formal primary and secondary school system. In other words, if, instead of self-productivity, convergence is observed or if there are substitutes for preschool ability instead of dynamic complementarity,
then the decision whether to invest early or later is a different economic argument than if the preschool period is critical.

Are differences in cognitive development between children of wealthy and poor households at the time of preschool entry sustained throughout the school years and beyond? Empirical research suggests that providing extra resources to schools enrolling disadvantaged students can help compensate for students’ early disadvantages (Cook and Evans 2000; McEwan 2008). Compensatory education programs that provide extra resources, such as materials, infrastructure, grants, teacher training, or pedagogical support, to schools enrolling disadvantaged children do exist. In the United States, programs such as Chapter 1 of the Elementary and Secondary Education Act of 1965 and Head Start, a preschool program targeted to socioeconomically disadvantaged children, have provided resources to disadvantaged students early in their school careers. Although evaluations of Chapter 1 programs showed immediate improvement in student test scores, the effects lasted only a year. In the case of Head Start, students showed noticeable improvement in test scores and dropout and repetition rates, but again, the effects dissipated by the third grade, and Head Start students were no more likely than other students to complete high school. These findings suggest that compensatory programs such as Head Start may need to stay in place for longer periods to produce long-term effects (Shapiro and Trevino 2004).

Evidence from Latin America also indicates that compensatory programs and extended school days can improve student learning, reducing failure, repetition, and dropout rates and are especially effective for indigenous students. Compensatory programs provide targeted resources, such as didactic materials, small grants, or special support to teachers, to poor or struggling schools. Mexico’s Consejo Nacional de Fomento Educativo (CONAFE; National Council of Education Promotion) provides extra resources to disadvantaged schools and supports rural secondary students in telesecundaria (distance learning) education. Shapiro and Trevino’s (2004) evaluation of the CONAFE program and its impact on student test scores shows that the program is most effective in improving primary school math learning and secondary school Spanish learning. In Chile, indigenous students obtain lower test scores, on average, than nonindigenous students. McEwan (2008) studied the changes in the test score gap between two cohorts of Chilean eighth graders in the late 1990s and found that the gap declined by 0.1 to 0.2 standard deviation. His analysis suggests that the most plausible explanation is related to Chile’s large-scale school reforms that were targeted at low-achieving schools and students. Mexico’s CONAFE program and Chile’s school reforms both appear to have had positive effects on indigenous student learning. Because schools appear to play the largest role in the test score gap between indigenous and nonindigenous children, it is no surprise that school-based compensatory programs would help to
reduce this gap. To the degree that this is the case, the preschool period is sensitive but not the only means to close ability gaps. However, it remains likely that the costs of compensatory programs—when they can be found—exceed those for preschool programs.

In general, moreover, economists and education specialists have found isolating the inputs that contribute to learning in school to be challenging. Banerjee and others (2007) suggest that one reason for this is that the effectiveness of inputs depends on the background of the student. For example, Glewwe, Kremer, and Moulin (2009) observe that the provision of textbooks in rural Kenya did not raise scores on average, although this intervention did have a favorable impact for those students with the highest initial test scores. This, then, is consistent with dynamic complementarity, which exacerbates initial inequality of skills.

In contrast, Banerjee and others (2007) find that specific remedial interventions aimed at children scoring lowest in basic skills can close performance gaps. Their examples of tutoring by community-based instructors and of computer-assisted training in India, then, provide relatively unique examples of programs at the primary level that substitute for earlier inputs into learning. Moreover, these examples appear inexpensive. The data are not yet sufficient to assess whether such programs are cost-effective relative to preschool programs. Indeed, given the novelty of this particular finding, the evidence can more likely be considered a second-chance approach rather than a preferred strategy.

To summarize the main points of this section: Although theory posits that investments in schooling may be neutral to income, the assumptions required for this to hold are unlikely to prevail. One key issue is that the returns to schooling may differ by income as reflected in equation (5.4); as verified by the evidence in chapter 1, ability or preschool readiness differs appreciably by asset levels. Thus, one explanation for differences in demand for schooling by income is the lagged effect of differences in ECD. Therefore, in the absence of effective preschool programs or a wide range of inputs in primary school that would offset this absence or both, schooling achievement will track a child’s initial environment.

### How Do Initial Household Resources Influence the Benefits of Subsequent Schooling? The Role of Nutrition

With a few notable exceptions, the evidence for the contribution of child nutrition on economic productivity as mediated through cognitive capacity is based on indirect inferences, albeit with fair consistency and regularity of these results. For example, extensive evidence exists that nutrition affects cognitive capacity of children as well as little doubt that cognitive
(and noncognitive) ability contributes to school performance, and through this channel, one can infer the impact of nutrition on wages.6

The understanding of the role of health on schooling has been bolstered by a growing body of longitudinal studies that confirm the hypothesis that nutritional shocks in early childhood affect subsequent schooling. This section briefly discusses some of this evidence that relates nutritional status of young children to school outcomes later in life. For example, during droughts in Zimbabwe in 1982–83 and 1983–84, infants less than two years old—the period a child is most vulnerable to health shocks—had higher undernutrition (or stunting rates) attributable to the deficient rainfall. By 2000, these children had completed fewer grades of school. In this case, the economic costs of childhood stunting were estimated as a 14 percent reduction in lifetime earnings (Alderman, Hoddinott, and Kinsey 2006). Similar results have been reported from droughts in Tanzania (Alderman, Hoogeveen, and Rossi 2009) and from changes in health policy in South Africa (Yamauchi 2008).

Families may use assessments of children’s cognitive capacity when determining whether to start or continue investing in schooling (Akresh and others 2010). Such schooling decisions may be mediated, in part, by schools or caregivers using the child’s size as a marker for school readiness. Additionally, or alternatively, a child’s stature relative to his or her age may be an observable (both to the researcher and to the household) indicator of cognitive capacity. However, even longitudinal studies indicating the impact of early childhood malnutrition stemming from economic and weather shocks on subsequent schooling do not directly address the question of whether nutrition interventions delivered to a broader population outside a short-term crisis situation will have a similar favorable impact on cognitive capacity and schooling. Many subtle differences are found in the range of impacts of malnutrition, in regard to both the nature and timing of nutritional shocks; for example, the trimester in which a pregnant woman is affected by a nutrient deficiency will influence the consequences for the child when he or she is an adult. Thus, inferences about malnutrition stemming from one of many possible causal pathways are only partial predictors of the impact on cognitive development of different interventions aimed at improving a child’s nutritional status.7 A pair of studies followed children who received nutritional supplements as children to adulthood and followed a randomly selected control group for a quarter century (Hoddinott and others 2008; Maluccio and others 2009). The studies provide some verification that the indirect inferences of the impact of nutrition on schooling and earnings based on economic and weather shocks are not misleading in regard to potential programmatic impacts. When the treated individuals were between 25 and 42 years old, both women and men had higher scores on cognitive tests than did their peers in the control group. Moreover,
those men who had received the supplements before the age of three earned on average 44 percent higher wages. This is on the higher end of the range derived indirectly or from studies that compare twins with different birth weights. A significant increase of wages for women in this cohort was not seen—perhaps because of limited wage opportunities in the communities—but increases in schooling attainment for women were identified.

Field, Robles, and Torero (2009) provide another study that confirms that predictions based on inference going from nutrition to schooling via an intermediate result on the correlates of cognitive capacity are borne out in tracking studies. A number of cross-sectional studies have shown that iodine deficiency can affect brain development. For example, a meta-analysis indicates that individuals with an iodine deficiency had, on average, IQs that were 13.5 points lower than comparison groups (Grantham-McGregor, Fernald, and Sethuraman 1999). Consistent with this evidence, Field, Robles, and Torero (2009) show that a decade and a half after mothers in Tanzania received iodine supplementation their children had, on average, 0.35–0.56 years of additional schooling, and the impact was greater for girls. Although this study was not a randomized experiment, the authors constructed a counterfactual by comparing sibling and age cohorts in the context of a rollout of a discrete program. This study provides evidence of inputs in the first early childhood period that increase school investments and presumably (though not measured in the cited paper) learning. It also is relevant to the distinction of periods that are critical or sensitive for inputs. To summarize, newly available data confirm that malnutrition stemming from both chronic poverty as well as acute crises can have serious implications for subsequent schooling. This is regularly shown in cross-sectional studies, only a few of which have been referenced here. Thus, investments in nutrition can have major economic returns, even in environments in which improvements in health care reduce the worrisome link between malnutrition and the risk of child mortality.

How Do Initial Household Investments Condition the Benefits of Subsequent Schooling? The Role of Early Childhood Education Programs

The research discussed above and in chapter 1 has shown that the cognitive development pathways of children differ by household income and nutrition. Elsewhere in this volume, Walker (chapter 4) discusses how few programs have managed to prevent a growing gap in cognitive potential in the first few years of life. Moreover, this chapter references limited evidence that targeted programs in school can partially offset this gap. However, a key question for this study is the extent to which educational interventions
in the years immediately before primary school entry can help reduce these gaps so that socioeconomically advantaged and disadvantaged children have equal opportunity to reap the returns from schooling. The evidence base for this includes numerous studies of the long-term benefits of preschool programs aimed at disadvantaged children, albeit generally from developed countries. For example, Chetty and others (2010) tracked a cohort of children who were randomized to different preschool (kindergarten) classrooms and concluded that they benefited from smaller classes and more experienced teachers. Although grades improved according to the quality of the program when tested in early years, this gain attenuated over time. However, earnings, home ownership, and similar outcomes at age 27 were strongly related to these initial test scores. The authors conclude that the higher earnings associated with early school quality reflect changes in social and emotional behavior, changes that economists often refer to as improved noncognitive skills.

The phenomenon reported in Chetty and others (2010) that early education programs lead to improved scores on tests designed to measure cognitive development that last for only a few years is commonly observed and contributes to the emphasis on noncognitive skills. Even with such attenuation, however, because learning is cumulative—that is, it is a product of time and ability integrated over time—even a temporary gain in cognitive ability will lead to increased learning. Plausibly, the gap in reading illustrated in figure 5.1 would be smaller, even with a short-term boost in cognitive capacity.

Looking at a younger cohort, Currie and Thomas (2000) found that children who participated in Head Start did better later in school than their siblings who did not benefit from the preschool intervention. Deming (2009) as well as Carneiro and Ginha (2009) replicated the Currie and Thomas study using more recent data for the same children. Employing different identification strategies, the two recent studies found positive effects of the preschool intervention on outcomes measured during the adolescence years (Almond and Currie 2010).

Less is known, however, about broad-based preschool programs in middle- and low-income settings. In part, this reflects the difficulty in identification of the impact of program specifics from the impact of self-selection. For example, comparisons of subsequent school achievement for those who went to preschool with those who did not often merely show that if a family values education—reflecting unobserved household characteristics—subsequent school performance generally improves.8

Recent papers from Latin America address the problem of self-selection by comparing cohorts of children during periods of expansion of services. For example, Berlinski, Galiani, and Manacorda (2008) use the fact that as Uruguay expanded its preschool provision, attendance in such programs
increased, to identify the impact of such programs on school achievement. By comparing siblings and cohorts, the authors find that by the time a child reached age 15, those who attended preschool accumulated 0.8 years more education. Given concern for selection bias, it is noteworthy that this result is robust to alternative methods of estimation whether using ordinary least squares regressions, intrafamily fixed effects, or instrumental variables regressions. However, little difference was seen in overall impact whether a child attended a single year of preschool or more. From a standpoint of offsetting early cognitive gaps, it is noteworthy that the impact of preschool attendance was largest for those children from households with less education. The authors also indicate that those who did not attend preschool had a higher rate of grade repetition. Finally, the authors venture a range for an estimate of the benefit-to-cost ratio for preschool education. The lowest of these—that for the highest assumed discount rate of future earnings—is 3.2.9 Thus, for every dollar spent on preschool education an increase is estimated in the stream of future earnings of at least $3. When the discount of future earnings is less, the benefit-to-cost ratio was estimated at 19.1.

Another study used a similar strategy of an exogenous increase of supply to identify an increase in demand for participation in preschool in Argentina (Berlinski, Galiani, and Gertler 2009). Baseline preschool enrollment in the initial years of the time period studied was less than 50 percent (compared with more than 80 percent in the Uruguay study) and increased to 65 percent by the end of the period. The authors use the expansion of preschool classrooms, rather than a direct measure of the participation in the opportunity,10 to indicate the impact of preschool programs. They find that an increase of one preschool place per child increases test scores in mathematics and Spanish by 0.23 standard deviation, an increase they compare to the reported impact in the literature for a decrease of 10 students per primary classroom.

Bernal and others (2009) provide similar evidence using the capacity of early childhood care and education programs at the municipal level as an instrument to understand participation in a preschool program that improved school achievement in the fifth grade. This study of the income-targeted program for children from birth to age six in Colombia, Hogares Comunitarios de Bienestar Familiar (Community Homes of the Institute of Family Welfare), also noted that children who were in the program and had at least 16 months of participation had better nutritional status and psychosocial development and performed higher on tests of cognitive development than a control group matched using propensity score matching. Similar results were found using the length of exposure to identify program impact. Whether or not the childcare provider (the “community mother”) had received training on ECD was also found to be a significant determinant of the observed program effects.
Rodrigues, Pinto, and Santos (2010) also use the supply of day care and preschool (kindergarten) facilities in municipalities in Brazil, as well as the average incidence of contagious diseases among children at preschool age, as instruments to explain the decision to send children to preschool institutions. As with the studies reported above, they find that preschool attendance led to higher school performance, in this case as revealed by math test scores. Indeed, they find their results to be directly comparable to those from Argentina (Berlinski, Galiani, and Gertler 2009). Moreover, the results are robust to an alternative approach using a panel of schools and inferring causality based on the variation of the proportion of children starting school after either kindergarten or preschool.

Of course, a wider range of studies have assessed the impact of preschool programs using plausible identification strategies (Engle and others 2010; Nores and Barnett 2010). Many of these papers measure significant outputs in terms of changes in indicators of cognitive or noncognitive ability. Most of these studies contrast, however, with the four studies from Latin America discussed above in that they generally do not directly address the question of how investments in preschool affect subsequent schooling outcomes. The output measured in most studies of preschool programs is reported in effect sizes of developmental scores. Such indicators may provide insight into the program effectiveness for outcomes in early childhood, in keeping with equation (5.3), but they often do not have the data to determine the impact of these changes in ability on schooling outcomes (equations [5.4] and [5.5]), which in turn can be used to calculate impacts on future earnings in keeping with equation (5.2).

One recent study that addresses equations (5.4) and (5.5), albeit not in a manner that can easily be mapped to school outcomes, looks at self-productivity of skills in India using a panel covering children in Andhra Pradesh (Helmers and Patnam 2010). The skills measured in this study are latent variables based on indicators of both cognitive and noncognitive (personality) ability, and the model is identified through a recursive structure using parental investments rather than by an experimental design. The study shows that cognitive ability in one period (age eight in this study) both is responsive to parental investments and has a positive impact on cognitive ability four years later. Moreover, the analysis finds that early cognitive ability influences subsequent noncognitive ability, an indication of self-productivity. As Cunha and Heckman (2010) explain, self-productivity occurs when the skills acquired in one period persist into future periods, which suggests that skills are both self-reinforcing and cross-fertilizing.

Another benefit-to-cost study of early child education is based on a long-term panel from Turkey (Kaytaz 2005), which looked at the beneficiaries of an intervention that differed from conventional preschool programs in
which teachers or caregivers worked with the children who attended the center. Instead, the program trained parents to improve the home learning environment for their children. The benefit-to-cost estimates reported in this study for center-based parental training using plausible discount rates of 10 and 6 percent were 4.25 and 6.37, respectively. The benefit-to-cost estimates for the home-based parental training using the same discount rates of 10 and 6 percent were 5.91 and 8.74, respectively. These benefits are based on the increase in schooling (and reduced dropout rates) and the expected increase of earnings that can be inferred from these levels of schooling; the earnings of the beneficiaries were not collected. These estimates do not include any increased learning per year of school, and, thus, as Kaytaz indicates, they are lower-bound estimates.

As indicated in this section, recent studies from middle-income settings have replicated results from a few U.S. programs that show enduring impacts of preschool programs. These studies move beyond evidence of contemporary changes in measures of cognitive capacity. With data for the impact on increased schooling or earning, it is possible to venture benefit-to-cost estimates of investments in preschool programs. These prove to be quite favorable.

**Equity in Access to Early Childhood Education**

Although preschool programs may improve subsequent school performance, in many settings those who are most likely to receive it are those who need it least. It is clear that attendance in preschool programs is associated with the education and wealth levels of the household and especially the mother’s education. For example, a study of Maternal Infant Child and Demographic and Health Surveys from 52 countries covering the period between 1999 and 2003 found a consistent wealth gradient (Nonoyama-Tarumia, Loaiza, and Engle 2009). The study found that, for children three and four years old, 33 country-specific coefficient estimates of the impact of wealth on preschool attendance are significantly positive and only 2 are negative, whereas 12 are not significantly different from zero. The estimates for children 5 and 6 years old\(^{11}\) have 25 significantly positive coefficients, with no coefficients that have negative signs, and 5 that were not significant. Maternal education is even more consistently positively associated with participation in organized learning for young children; for the younger cohort, in 18 data sets primary education of the mother was positively associated with preschool program, and only 1 had a negative association. No significantly negative coefficient estimates were found for secondary or higher education and 36 positive ones. A similar strong pattern favoring enrollment in urban areas and for girls was noted.
Nonoyama-Tarumia, Loaiza, and Engle (2009) acknowledge certain challenges to assessing reported preschool participation in cross-country settings. For example, the age of primary schooling, and hence the age of preschool, differs, as does the duration of programs. Even the concept of organized preschool programs relative to day care is not uniform across countries. Finally, as with many school databases, the information in public records may exclude private schools, a major component of preschool programs. Nevertheless, the patterns in the study by Nonoyama-Tarumia, Loaiza, and Engle are confirmed with other data. For example, more recent data from Latin America and the Caribbean indicate that, in a large group of countries, substantial differences by socioeconomic background in access to preschool persist (figure 5.2).

Although this pattern is in keeping with what is known about schooling at all levels, the income or wealth disparity in preschool education is often substantially greater than the gap in primary enrollments. Figure 5.3 presents the ratio of school enrollments in preprimary to primary education by developing world regions for 2007, the most recent year for which data are available. Were the gaps in access equal for preschool and primary education, these ratios would equal 1. As figure 5.3 shows, however, the disparity

Figure 5.2 Ratio of Preprimary School Enrollment Rates, First to Fifth Quintile of Household Income, Latin America and the Caribbean, 2007

in access to preprimary education is much greater than access to primary, especially in Sub-Saharan Africa and the Middle East and North Africa.

This pattern is confirmed with an analysis of data from 2005 covering 27 low- and middle-income countries. In only four of those countries was the ratio of preprimary wealth gap to primary greater than 0.5. The closer this ratio is to one, the more preprimary enrollment patterns resemble those in primary. For three of those countries—Bangladesh, Belarus, and Thailand—this was because the poorest quintile had preschool enrollment rates at least 70 percent of that for the wealthiest, whereas in Ghana the poor had preschool enrollments less than a third those of the wealthiest but also relatively low primary enrollments compared with the more prosperous households. For 21 of these 27 countries, the poor had preschool enrollment rates less than a third those of the wealthiest, although for 16 of these countries the poor were at or nearly at universal primary school initiation (that is, more than 95 percent of the poor were reported as having enrolled in primary school).

Although preschool enrollments currently favor the relatively well-off, it is not necessarily the case that increased public investment in preschool will follow this pattern. For one thing, globally, much of the demand for

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**Figure 5.3 Ratio of Gross Enrollment Rates in Preprimary and Primary School, by Region, 2007**

Source: World Development Indicators.
preschool is addressed by the private sector. Moreover, Lanjouw and Ravallion (1999) argue that even when the average benefit incidence favors the nonpoor, marginal investments may favor low-income households. The distribution of the benefits of such marginal incidence depends, in part, on whether the public investments are focused primarily on increasing the quality of existing services and lowering their price or whether the investments are aimed primarily at expanding coverage (Younger 2003). As preschool enrollments saturate for the well off—that is, at some point there can be no increase in attendance rates—expansion of enrollments generally favors the initially excluded group. The distribution of expenditures on increased quality is less predictable.

Berlinski, Galiani, and Manacorda (2008) present evidence for the expansion of enrollments over more than a decade of investments. They indicate that as the supply of preschool services in Uruguay increased between 1989 and 2000, participation in preschools increased by 12 percentage points so that well over 90 percent of all children attended preschool by the end of the period. Because the majority of children excluded from preschool at the start of the period studied came from low socioeconomic households, the expansion narrowed the participation gap. Similarly, the placement of the 3,754 new preschool classrooms that Argentina constructed between 1993 and 1999 was disproportionately where preschool enrollment was lowest (Berlinski, Galiani, and Gertler 2009).

Noteworthy, these two countries have the ratios of preschool enrollments for children aged five to six that are closest to 1 in figure 5.2. Although it is tempting to interpret the investments in preschool as a form of dynamic substitutability—in contrast with the dynamic complementarity discussed above—in fact, the gap is closed not by inputs in basic schooling (as in equation [5.5]) but by programs in the preschool period. Thus, the results are a step toward supporting the premise of this study: that preschool investments can contribute to intergenerational equity by increasing the returns to formal schooling.

Many countries aim at the universal provision of preschools, often motivated by a human rights–based perspective. South Africa, for example, explicitly references the Declaration of the Rights of Children in its ECD policy (Biersteker 2010). The rollout, however, has been more rapid in the provinces with higher capacity, thus delaying the potential impact on equity. In partial contrast, Chile has introduced a national ECD policy, Chile Crece Contigo (Grow Together), that is also motivated by a rights-based approach but that aims at focused or priority access to services for children in the most vulnerable 40 percent of the population (Valderrama and Raczynski 2010). Although the program seeks to foster comprehensive development of children by guaranteeing universal support for biological, cognitive, and psychosocial development for all children, the focused
nature of the strategy is designed to prioritize expenditures. Thus, the focusing of services differs from targeting—which often seeks to exclude a relatively well-off population from a program or from state subsidies—but nevertheless has a poverty orientation in its conceptualization.

Two final points are relevant to the question of whether preschool programs can close gaps in learning. First, although the current evidence documenting dynamic complementarity or substitutes is too limited to allow a firm statement as to what is needed at the primary school level to make the most of preschool inputs, the observation by Currie and Thomas (2000) that the benefits of Head Start depend, in part, on the quality of the school system in which the child subsequently enrolls can almost surely be generalized to other countries.\textsuperscript{12}

Second, although it is similarly the case that the evidence base remains limited, the generalization that the quality of the preschool experience is more relevant than mere attendance is intuitive. The challenge is to ascertain what constitutes a quality program. Nores and Barnett (2010, 279), for example, conclude their meta-analysis with the observation that “program design matters but there is a lack of clarity about what dimensions matter how much and for what reasons.” Most studies that inquire into the question indicate that formal schools do better than nonformal ones, although even the latter have positive benefits (Engle and others 2010). Seldom, however, do the available studies control for self-selection into programs; far more common are value-added studies that look at changes in skills over time as in the study by Malmberg, Mwaura, and Sylva (2011), which assessed madrasas in East Africa relative to other preschools, or Rao and Person’s (2007) appraisal of formal and informal preschools in Cambodia. In contrast, Rolla and others (2006) were able to randomly assign kindergarten children to different interventions designed for lagging students. As with the Banerjee and others (2007) study for slightly older students, this study found that tutoring improved scores and was more beneficial than providing classroom teachers with more materials.

In addition to more studies of this nature, studies that assess the cost of different programs and help guide interventions can be instructive, particularly in settings where budgets are so limited that primary classrooms have upwards of 50 students.\textsuperscript{13} Current data for preschool programs in very low-income countries are limited. One study, by Jaramillo and Mingat (2008), presents estimates from four African countries with the caveat that the sample cannot be considered representative. In these four countries—Benin, Cameroon, Côte d’Ivoire, and Niger—the cost per preschool child ranged from 20 percent higher than the cost per primary pupil to twice as much. Jaramillo and Mingat estimate that the ratio of preschool to primary school cost for all of Africa is 1.37. Because the average preschool pupil-to-teacher ratio in Africa was reported at 27.2 and the comparable ratio was
44.6 in primary school, the cost per preschool teacher must be lower than the salary for primary teachers to reach this ratio of costs. Jaramillo and Mingat also report that the cost per pupil in public preschool programs in four other African countries ranges from twice the cost in community programs to five times as much. Both the differences in community cost and the differences in costs per teacher may also be indicative of differences in service quality, but it is likely that reliable estimates of the relationship between costs and quality for preschools will not be available for quite some time.

One other statistic from Jaramillo and Mingat (2008) is noteworthy: The cost per preschool student in Africa was reported to be 17 percent of per capita GNP. This is quite close to the ratio of the Perry preschool program to the GNP in the United States. The unit costs of preschool as a percentage of average income reported in either the Perry preprogram or Jaramillo and Mingat, however, are higher than that in Uruguay, as can be inferred from the Berlinski, Galiani, and Manacorda (2008) calculations of the benefit-to-cost ratio for preschool investments. The costs in that program are in the range of only 5 percent of per capita GNP, although, of course, they are higher in absolute value than the unit costs in Africa.

Three key observations are found in this section. First, income disparities in enrollments in preschool exceed the remaining divergence in primary school enrollments. Second, although there is relatively little information on the degree to which this gap reflects supply of placements or demand for the programs, concerted efforts to expand public availability of preschool can close this gap appreciably. Finally, the section notes the paucity of information on what is needed to increase the quality of preschools, especially where public resources are highly constrained.

Conclusions

In their recent research review, Cunha and Heckman (2010) posit that there is no equity-efficiency trade-off for investments in early childhood, although it often does hold for schooling investments later in life. Preschool investments focused on the poor not only help to offset the handicap of the limited assets at their disposal, but also turn out to have higher rates of return than other plausible programs. These investments include an array of programs to improve the nutrition of pregnant women and children in the first three years of the latter’s lives, as well as to promote a stimulating environment for these children. Programs to expand preschool availability may have a somewhat lower rate of return than these earliest investments; although the evidence base is too thin to comfortably state this as a widespread pattern, the available data point to high rates of return for investments aimed at this age group as well.
Although there are a wide range of studies on the demand for primary and secondary school, less is known about the degree to which this demand reflects a failure to reach full potential in the preschool period. Nor have programs designed to stimulate demand for preschool services received the level of attention that has been devoted to demand for primary education. Plausibly, transfer programs linked to preschool enrollment will have an impact similar to what has been noted for transfer programs and fee waivers for primary enrollment. Indeed, given the overall positive impact of preschool programs studied and the remaining gap in preschool participation, it appears that efficiency and equity could simultaneously be promoted by shifting the focus of conditional cash transfer (CCT) programs from primary school attendance to preschool attendance. Demand-side programs aimed at primary school participation (where the rates of school initiation are often greater than 90 percent) may be less effective than similar transfers with a requirement of preschool participation. This is particularly relevant in Latin America, where CCT programs are present in virtually every country and where preschool programs are similarly well established. Such a shift is unlikely to have any negative consequences for the educational objectives of CCT programs; it is hard to picture a child attending preschool and not going on to primary school even if the cash incentive is greater for the former.

However, cash transfers are not the sole way to promote the natural link of equity and efficiency that early child education presents. As indicated, if gaps in cognitive and noncognitive skills are related to household resources and if they persist into school-age years under very plausible assumptions about educational systems, these gaps will remain, and perhaps widen, throughout the child’s youth. Although remedial education programs may reduce such gaps, the limited data for the costs of such programs in developed countries imply that it is far more efficient to address the gaps at an early age. In the poorest countries, increasing investments in early childhood education will be critical to improving the learning outcomes and completion rates of students in basic and secondary education. In this sense, it is promising that in the recent meetings of the Education for All-Fast Track Initiative, it was recommended to increase funding to expand early childhood education in the poorest countries in the world, those that qualify for grants from the International Development Agency.

In many countries preschool education is mainly provided by the private sector and nongovernmental organization providers. This is changing in many middle-income countries, but it is still common that the expansion of services first reaches those children who require such programs the least. Thus, prioritization of public support can also promote equity of outcomes of the full education system. This implies a continuum of programs from transfers to focused investments in parenting education and preschool
programs that link education policy with other sectors, including health and social protection. Because many preschool programs that include health interventions are targeted partially on the basis of nutritional status, this serves as a reminder that ECD is inherently cross-sectoral.

A final observation on such preschool programs is that the recognition of their role in increasing school readiness is only a first step. Preschool programs are unlikely to be effective if they are merely bringing primary school curriculum to younger children; they are unlikely to be affordable and sustainable in very low-income settings if they use the same resources as those currently devoted to primary and secondary schooling. This is a particular concern where trained teachers are scarce and where such training is often geared toward rote learning and a narrow set of skills.

Thus, having both technical and financial resources for measuring the quality of ECD interventions is a priority for developing countries. Similarly, evidence-based guidance for countries as to the institutional and governance arrangements that are most effective in ensuring access to quality ECD programs is needed. These two challenges should be at the top of the development agenda for ECD.

In many countries ECD is promoted as a rights-based service (with universal coverage as an objective), rather than as a program designed to compensate a subpopulation for gaps in the child’s home environment or to offset consequences of early malnutrition. This chapter has explored the overlap of equity and efficiency by reviewing the coverage of ECD programs in various countries throughout the world using household surveys. The chapter also has presented evidence about the variation in responses to ECD programs by households from different income or wealth groups. In low-income countries both demand for, and supply of, ECD programs are limited, and direct competition is seen for limited human resources in education and health systems. In middle-income countries, more programs exist, but gaps remain in access between children from different socioeconomic, ethnic, or racial backgrounds. This chapter has considered the degree to which ECD—already considered an element of education and health strategies in many countries—can also be viewed as a component of poverty reduction and social protection strategies.

Notes

1. Hanushek and Woessmann (2008) refer to this learning as cognitive skills, but it is a very different concept of cognitive skills than is used in this volume. Nor is it necessary that learning refer to cognitive skills alone (even if most measurement focuses on these); noncognitive ability is regularly shown to have a significant impact on earnings and other outcomes.
2. This is the flavor of the oft-cited model of Cunha and Heckman (2007). See also Behrman, Glewwe, and Miguel (2007).
3. Cunha and Heckman (2009) use a different approach to uncover the time frame of family inputs into cognitive and noncognitive development utilizing cross-equation restrictions and a set of proxy measurements for latent skills.
4. Cunha and Heckman (2009) call a period critical if after the period an input has no measurable impact. A sensitive period for a skill is when that period has the highest response to an input, but at a later date some increase of the skill is nevertheless possible.
5. The point is also made by Filmer and Pritchett (2001), who use a wealth index as an alternative to measures of income or expenditures and, thus, avoid the bias toward zero from measure errors in these variables.
7. This is in keeping with the observation that identification using natural experiments provides local treatment effects (Angrist and Imbens 1994). In this example, the causal inference from such estimates pertains to those individuals who were directly affected by the shocks rather than to the larger population.
8. See Almond and Currie (2010) for an analysis of the methodological challenges to separating preferences from program impacts and how recent research has addressed them.
9. Discounted future benefits are used because a dollar now—which can be invested and thus earn a positive rate of return—is worth more than a dollar at a later date. Economists generally agree on the need for such a discount, but there is no universally accepted rate for making such an adjustment; hence, a range of estimates are commonly reported.
10. However, they also argue that they cannot reject the hypothesis that each new place increases preschool enrollment by one student.
11. The study excluded cases in which primary school begins by age 6.
12. Equation (5.5) can be viewed as the impact of school readiness on the returns to school inputs or, equally, the impact of school inputs on the returns to preschool ability. Mathematically these two interpretations of the second derivative of a learning production function cannot be distinguished.
13. Randomized trials of preschool programs in Cambodia and Mozambique supported by the Spanish Impact Evaluation Trust and the U.K.’s Department for International Development are currently in the field.
14. It is not clear in the tables why the data for these four countries are not included with the information on the costs for the other four countries.

References


