



Cognitive skills among children in Senegal: Disentangling the roles of schooling and family background

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ABSTRACT

We use unique data to estimate the determinants of cognitive ability among 14–17-year olds in Senegal. Unlike standard school-based samples, tests were administered to current students as well as to children no longer – or never – enrolled. Years of schooling strongly affects cognitive skills, but conditional on years of school, parental education and household wealth, as well as local public school quality, have surprisingly modest effects on test performance. Instead, family background primarily affects skills indirectly through its impacts on years of schooling. Therefore closing the schooling gaps between poor and wealthy children will also close most of the gap in cognitive skills between these groups.

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1. Introduction

The benefits to economic development of investments in human capital, and particularly investments in schooling, are virtually universally accepted. This understanding has spawned an enormous empirical literature on the household and policy determinants of investments in schooling. Underlying most of this research, which usually employs standard household surveys, is the assumption that the quantity of schooling (or sometimes, simply enrollment status) is a reliable representation of the level of human capital, that is, the cognitive skills that education is assumed to impart. However, cognitive outcomes will in general be determined not just by years of schooling but also by the quality of schooling as well as by the level and quality of non-school ‘home’ inputs into human capital production. These factors are often correlated with schooling attainment, so that differences in actual human capital between individuals are likely to be wider than differences in their schooling. They are also likely to

be correlated with household income or wealth, so that observed wealth-related disparities in schooling attainment may underestimate actual human capital investment gaps between poor and well-off children. For the same reason, econometric estimates of the effects of income or wealth on children’s schooling, and potentially of other factors as well, will not measure the true impacts on children’s human capital.

In this paper we use unique data on a cohort of 14–17-year olds in Senegal to estimate the relationship of schooling and human capital as measured by test scores. The analysis addresses the following questions: (1) What are the relative contributions of schooling attainment, local school quality, and household characteristics to human capital accumulation, and do these differ for girls and boys? (2) Do household and school characteristics affect human capital primarily through their effects on schooling duration or through learning conditional on the level of schooling? (3) How much will closing the gaps in schooling between poor and well-off children, and between girls and boys, contribute to closing gaps in human capital along these dimensions? Put another way, how much of the cognitive skill advantages of well-off children and boys is due to greater grade attainment and how much to differences

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in school and household environments or in the response to these environments?

The *Education et Bien-être des Ménages au Sénégal* (EBMS) survey was designed to meet several difficult methodological challenges to answering these questions. The first is the need to have direct measures of human capital (test score data) for a representative sample of children. Academic tests of children in developing countries (e.g., Das et al., 2004; Michaelowa, 2001; Tan, Lane, & Coustere, 1997), as in developed countries, almost always involve school-based samples, whereby tests are administered in class to a sample of children in a given grade. However, where non-enrollment or (for higher grades especially) dropout is prevalent, the use of in-school samples very likely leads to sample selection biases, because the sample of children tested will not be not representative of all children or even of those children who ever attended school. Further, such school-based surveys usually collect at best only rudimentary information on the households of the pupils tested. Beyond the fact that the impacts of household characteristics on learning are of intrinsic interest, their omission will bias even conditional estimates of the effects of school factors such as teacher quality on skills of currently enrolled children unless home inputs are uncorrelated with school resources.

The EBMS survey is unusual in that it was designed to test a representative random sample of children, including children who are currently enrolled, formerly enrolled, and who never enrolled in school. Tests were given in written French and math, oral math, and 'life skills'. Further, the test information was matched both to detailed school surveys and to household surveys with information on the full range of factors potentially affecting schooling and cognitive outcomes.¹

Like a number of other countries in West Africa (primarily Francophone countries), Senegal has had difficulty meeting key education objectives such as universal primary enrollment. The gross primary enrollment ratio in 2002 was just 75%.² Repetition rates are very high while primary completion rates are very low both for boys (53%) and especially, girls (44%). In addition to significant gender gaps in schooling investments, there are large gaps along wealth and location dimensions. It is of substantial policy interest to understand how well these schooling attainment differences proxy difference in actual human capital, and conversely, how effective a policy of closing schooling attainment gaps will be in closing gaps in skills.

The remainder of this paper is organized as follows: Section 2 presents the conceptual framework and empirical strategy used in this paper. Section 3 discusses the EBMS data. The determinants of test scores are reported in Section 4. This section also presents results of several simulations: of the effects of reductions in wealth- and gender-related schooling disparities on gaps in cognitive skills; and of the

comparative static effects of changes in various factors on cognitive skills, accounting for direct effects on test performance and indirect effects operating through changes in schooling. The last section summarizes and discusses policy implications of the results.

2. Conceptual framework and methodology

Cognitive ability as measured on tests is expected to be positively related to the level of schooling an individual attains, but also to school quality and family characteristics such as wealth and parental education. The model underlying our analysis of the determinants of test scores is formally similar to frameworks for analyzing the impact of education on earnings that adjust for variation in school quality (see Behrman & Birdsall, 1983; Card & Krueger, 1992). Using the terminology of Behrman and Birdsall, we assume that human capital is a function of 'effective schooling'. In the present case, effective schooling for the i th child is a function of actual years of schooling (S_i) as well as school characteristics ('quality' or Q_{ij}) and household characteristics (X_i) such as parental education and assets, and unobserved individual ability A_i , i.e., $f(S_i, Q_{ij}, X_i, A_i)$. Using j to index the local school we can specify a production function for human capital H_i

$$H_i = aX_i + bf(S_i, Q_{ij}, X_i, A_i) + e_i \quad (1)$$

where e_i is a random disturbance term and H_i is measured by the standardized test score (individual score minus mean score over the standard deviation). X_i is assumed here to have effects on human capital independent of its impact through school effectiveness. In particular, knowledge of life skills and oral math can plausibly be transmitted from educated parents independently of whether or how much formal education occurs.

A general specification for the effective schooling function $f(S_i, Q_{ij}, X_i, A_i)$ would be one allowing for interactions among the arguments, yielding

$$bf(S_i, Q_{ij}, X_i, A_i) = b_1S_i + b_2Q_{ij} + b_3X_i + b_4A_i + b_5S_iQ_{ij} + b_6S_iX_i + b_7S_iA_i + b_8Q_{ij}X_i + b_9Q_{ij}A_i + b_{10}X_iA_i \quad (2)$$

Higher school quality Q_{ij} raises effective schooling for a given level of schooling S_i ($b_2 > 0$) and presumably has larger total impacts the more years a child attends ($b_5 > 0$). We might expect similar patterns for parental education, since more educated parents will be better able to assist children with their schoolwork. Similarly, X_i also includes household-provided inputs such as notebooks and electric lighting for evening study; these inputs (proxied by the overall asset wealth of the household in our models) also raise learning outcomes given S_i . With respect to interactions of Q_{ij} and X_i , specific school inputs captured by Q_{ij} may be complements or substitutes with home inputs in the production of human capital, i.e., b_8 may be positive or negative.

Substituting into Eq. (1) and rearranging yields

$$H_i = a'X_i + b_1S_i + b_2Q_{ij} + b_5S_iQ_{ij} + b_6S_iX_i + b_8Q_{ij}X_i + e'_i \quad (3)$$

¹ Glewwe and Jacoby (1994) is a rare example of an analysis that attempts to overcome the limitations of standard data, combining as we do population-based sampling with cognitive testing.

² This and other country level statistics were obtained from World Bank (<http://www.worldbank.org>, Data and Country Statistics).

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