Education Returns Across Quantiles of the Wage Function: Alternative Explanations for Returns to Education by Race in South Africa

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A challenge facing the new South African government is how to expand and improve the educational opportunities of its population, particularly those of the less-educated non-whites. One concern is that there be private demand to use efficiently any increase in school services. If, however, private wage returns are sufficiently high to these forms of increased education, it is expected that students and their families will compete for these services.

Consequently, we start by reviewing ordinary least-squares (OLS) estimates, based on a 1993 household survey of South Africa, of the private mean wage returns on education of men within four racial groups: African (black) (75 percent), colored (mixed race) (8 percent), Indian (3 percent), and white (14 percent). We then examine how the previous government’s rationing of education to Africans may distort estimated returns and affect their future levels as the supply of educated Africans increases.

I. Wage Returns

Several explanations can be offered for the variation in returns to education across race groups in South Africa, which may have im-

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1 The returns to education for women are also explored in Mwabu and Schultz (1995) and are roughly parallel to those described here, being somewhat higher for African women than men, and lower for white women than men. Because more complex selection mechanisms may explain which women are in the wage labor force than in the case of men, we focus here only on males for the two largest and educationally most disparate race groups: Africans and whites. Sample selection bias is found to not change these results.

2 If relative supply were a major factor in returns, one might also expect that differences in the relative supply of educated workers would help to explain differences in education-wage differences across age groups of Africans and whites. But the relative supplies and returns are not very different for the three age groups analyzed: 16–29, 30–49, and 50–65, and the returns are highest for the youngest group of Africans.
A second hypothesis is that the average quality of a specific level of education, measured by worker market productivity, decreases as the proportion of the population so educated increases. The allocation of enrollment positions in a school system is typically determined by a combination of mechanisms that reflect both the student’s ability and socioeconomic background, for wealthier parents are willing to pay higher school fees and other “contributions” and willing to invest more in preparing their children outside of school (i.e., tutoring and preschool inputs). National standardized examinations have in the past dealt with the excess African demand for secondary and higher education. One interpretation of the high returns to African education shown in Figure 1 is that the exams set ability standards for passing above the market equilibrium level for Africans. Unwillingness to expend public resources to expand and improve the educational system for Africans could account for this outcome. As rationing by examination is relaxed in the future, and as a larger proportion of Africans continue to secondary and higher education, the average ability of more educated Africans may decline. This could depress the future returns to their education. With this source of nonhomogeneous students, the wage returns to education might be expected to decline for better-educated Africans more rapidly than could be explained by the increase in (homogeneous) supplies alone.

The second hypothesis may lead to the view of a depletable stock of educable students; it is implicitly used in most arguments for a higher-quality elite educational system versus a mass educational system. It can be empirically explored with quantile regression, given a simple interpretation of the causes for the wage residual. Assume that the residual from a standard semilog wage function (Jacob Minzer, 1974) represents the productive capacities of the worker that are omitted from the complete model, or “ability.” Our wage function includes a spline in years of education at the three levels of the school system, potential postschooling experience, experience squared, and residence in rural areas in contrast with urban/suburban areas. “Ability” increases log-wages, but not necessarily uniformly across educational attainments. One conjecture is that education and ability are complements in their capacity to enhance the productivity of the worker, although the evidence for this is limited. By estimating quantile wage regressions (Roger Koenker and Gilbert Bassett, 1978; Moshe Buchinsky, 1994; Gary Chamberlain, 1994), it is possible to determine whether the estimated rate of return to education is higher at higher deciles in the distribution of wage residuals, consistent with the hypothesis that education and ability are complementary.

Because ability and education or other covariates may not be independent, the errors in the deciles may be heteroscedastic, and the quantile regression variances may be biased. Therefore, bootstrap estimates of the asymptotic variances of the quantile coefficients are calculated with 20 repetitions (see e.g., Bradley Efron, 1979; Chamberlain, 1994) and are used in the reported asymptotic t ratios.

II. Data and Results

We use data from the 1993 Project for Statistics on Living Standards and Development (PSLSD) collected by the South African Labour and Development Research Unit (SALDRU) at the University of Cape Town in collaboration with the World Bank. A national sample of 43,974 individuals from 9,000
households was drawn randomly from 360 sample clusters and interviewed during the period August through December 1993. The survey instruments and the sampling methods are described in SALDRU (1994). The sample analyzed here is restricted to wage-earners, aged 16–65, for a total of 2,364 African and 653 white males (see Mwabu and Schultz [1995] for results on all race and gender groups).

The mean-log-wage equation (i.e., OLS) is first estimated conditional on the specification described above and then calculated for the median individual and other deciles of the residuals by minimizing the sum of absolute deviations of the residuals from the conditional function (Chamberlain, 1994). In comparison with the OLS estimates, the quantile regressions reduce sensitivity to outliers and inform us how returns vary across quantiles. The full estimates and sample statistics are available from the authors upon request. The return coefficients on the three levels of schooling for African and white males are summarized in Figures 2 and 3 with their bootstrap standard errors. For example, the estimated secondary-school return to whites in the lowest decile is 0.25, with a standard error of ±0.05. To assess

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**Figure 2. Decile Wage Returns to African Male Education, by School Level**

*Note: Lighter-shaded areas indicate ±1 SE.*

**Figure 3. Decile Wage Returns to White Male Education, by School Level**

*Note: Lighter-shaded areas indicate ±1 SE.*
the significance of the covariance, the linear relationship between the quantile returns and the quantile numbers is estimated by generalized least squares, where the weights are the inverse of the bootstrap estimates of the standard error of the quantile coefficient.

Among Africans there is no significant tendency for the returns to increase linearly with deciles, from bottom to top, as would be implied by a tendency for "ability" to bias returns upward. On the contrary, returns for Africans decline with increasing decile (slope = \(-0.079, t = 3.68\)) at higher education and are not linearly related to decile at the secondary level (\(-0.002, t = 0.07\)). Among whites the return to higher education increases significantly with decile (0.061, \(t = 2.85\)), from 9 percent at the bottom, 0.1 decile, to 18 percent at the top, 0.9 decile. This is evidence that the omitted factors that we have called ability complement higher education for whites, given the conventional semilog specification of the wage equation. However, returns to secondary schooling are strongly negatively related to decile (\(-0.250, t = 7.46\)) among whites, being 0.25 at the 0.1 decile and insignificantly different from zero for the top three deciles. In this case, where 93 percent of white males have some secondary schooling and 63 percent graduated, the returns to this school level are concentrated among the lower deciles. According to our framework, this implies that secondary education for whites is a substitute for ability, at least among the less able. But at the much lower levels of educational achievement of Africans, where 49 percent start but only 12 percent complete secondary school, there is no statistically significant relationship between our proxy for ability and returns to secondary schooling across deciles. At the primary level, where 13 percent of Africans still have no education and 61 percent complete primary school, returns are highest among the Africans who are in the lower deciles of the residuals, that is, among the least able (\(-0.150, t = 11.4\)).

For comparison, the decile pattern of returns to education in the United States are reported by Chamberlain (1994) for 1979 and 1987 and by Buchinsky (1994) for selected years from 1963 to 1987. Chamberlain calculates one return for all levels of education and notes that this average return increases from 1979 to 1987 more in the top deciles than in the bottom. Buchinsky (1994) finds different patterns in returns across deciles depending on the experience group.

III. Conclusions

Private wage returns to schooling in South Africa in 1993 were twice as high for non-whites as for whites, and the returns were higher at more advanced levels of schooling for both races. For example, mean wage returns for African males are on the order of 27 percent for higher education and 16 percent for secondary education, whereas for white males they are 15 percent and 8 percent, respectively. Wage returns are then evaluated for the median individual and other deciles of the residuals based on the same wage function (Chamberlain, 1994). If the residuals are interpreted as unobserved ability, and returns increase (decrease) across deciles, from bottom to top, this suggests that schooling and this measure of residual ability are complements (substitutes) in enhancing worker productivity.

The quantile regression estimates of returns at the higher and secondary levels summarized in Figures 2 and 3 show that, among Africans, returns do not increase by their decile in the distribution of residuals. Among whites, returns to higher education increase significantly from 9 percent to 18 percent. We interpret this as evidence that ability and higher education are complements for whites, one-third of whom obtained this form of education. According to this quantile regression, it is efficient, in terms of maximizing private wage returns, to shift higher-education enrollments from whites to Africans, other things equal.

On the other hand, at the lower tail of the educational distribution, where 95 percent of white males have some secondary schooling, the lower half of the ability distribution gains the most from obtaining more secondary schooling, leading us to conclude that schooling and ability are in this polar case substitutes. Similarly, schooling and ability are substitutes for African males at the primary level. For the group, returns are about 10–13
percent for the lower half of the deciles, and they diminish for the upper half. These quantile estimates confirm that there would be significant returns to extending primary education to the less educated and perhaps less able Africans, despite their low mean returns (i.e., 8 percent). Extending secondary schooling to the less able whites who might not otherwise complete this course is justified on the same grounds.

Overall, these estimates of schooling returns suggest that maximizing private returns to schooling would require expanding higher and secondary education for the African population. This privately efficient use of public resources would also benefit the disadvantaged racial group and thus reduce racial inequality. However, assigning priority to educational investments with higher private wage returns also promises to increase inequality within each race group, at least in the short run, until returns to higher levels of education fall to long-run equilibrium levels. To avoid increasing wealth inequalities in this context, tuition might be raised in higher education to recover public costs and used to fund the expansion of African enrollments. A means-tested educational loan program could help finance higher educational investments more equitably among those students who are credit constrained.

REFERENCES


