Credit Constraints and the Racial Gap in Post-Secondary Education in South Africa

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Abstract:

This paper analyzes the impact of baseline household income and scholastic ability on post-secondary enrollment in South Africa. Using longitudinal data from the Cape Area Panel Study (CAPS), we analyze the large racial gaps in the proportion of high school graduates who enroll in university and other forms of post-secondary education. Our results indicate that baseline income and ability (measured by performance on the grade 12 matriculation exam) are strong predictors of post-secondary enrollment and statistically account for all of the black-white difference in enrollment. Controlling for parental education and baseline scholastic ability eliminates the estimated impact of household income on university enrollment, though it does not eliminate the impact of income on other forms of post-secondary enrollment. Two measures of short-term income variability do not have statistically significant effects on enrollment. The results suggest that credit constraints do not appear to be important in explaining university enrollment, arguably the most important determinant of later labor market earnings. Credit constraints may play a role in other types of post-secondary education, however, programs that we estimate to have large labor market returns.

Introduction

One of the key issues in economic research on post-secondary education in the United States is the extent to which credit constraints limit the ability of children from low-income families to attend college. While there is clear evidence that family income is strongly correlated with college attendance in the U.S., there are different interpretations of what that correlation means. One interpretation is that low-income families cannot afford to pay tuition and other costs of post-secondary education, a problem that could potentially be solved through fee reductions or financial aid. Another interpretation is that there are long-term educational disadvantages from growing up in a low-income family because children attend lower quality schools and have access to fewer educational resources. Under the second interpretation the policy challenge is more difficult, since financial aid and reduced tuition will not be sufficient to compensate for the cumulative educational disadvantage faced by students from low-income families.

There has been considerable research analyzing these issues in the United States. Using the National Longitudinal Survey of Youth (NLSY) 1979, Carneiro and Heckman (2002) show that the association between family income and college attendance is greatly reduced by controlling for Armed Forces Qualification Test (AFQT) scores. They conclude that the apparent effect of income is due more to early life resource disadvantage than to credit constraints. Using the same NLSY 1979 data, Keane and Wolpin (2001) also conclude that credit constraints have a small impact on college attendance, partly because low-income students are more likely to work. Updating Carneiro and Heckman's analysis with the 1997 cohort of the NLSY, Belley and Lochner (2007) find an increased impact of family income after controlling for AFQT scores. They conclude that credit constraints have become more important in the U.S. over time. Further evidence of credit constraints in the U.S. is provided by Lovenheim (2008), who estimates that increases in house values caused increased college attendance among families that would otherwise have been credit constrained.

This paper looks at the extent to which credit constraints affect post-secondary education in South Africa, with particular focus on the country's enormous racial gap in post-secondary enrollment. South Africa is an interesting setting in which to analyze the role of credit constraints in post-secondary schooling for several reasons. First, education levels are relatively high in the country, with almost universal primary education and with most students attending secondary school. The critical education margins for most South Africans today are completion of secondary school and entry into post-secondary schooling. Second, the country has enormous income differences between rich and poor. These differences, which are strongly associated with race, are considerably larger than income differences observed in the U.S. Third, although most post-secondary education options are government funded, the cost of attending post-secondary institutions is high, especially for those in the lowest income groups. Issues of affordability may therefore play an important role in determining who is able to enroll. Finally, the legacy of apartheid's "Bantu education" system continues to manifest itself in large differences in the quality of primary and secondary schooling received by students from different race and income groups. The apartheid government ran separate school systems for different racial groups, with enormous differentials in funding levels and in the design of the curriculum (Fiske and Ladd 2004). Although government funding levels were equalized across schools after 1994, there continue to be large racial differences in progress through school and ultimate educational attainment (Yamauchi 2005, Bhorat and Oosthuizen 2008, van der Berg 2007). As in the U.S. literature, disentangling short-run financial constraints from the long-run educational disadvantage associated with growing up poor is therefore very important in understanding inequality in post-secondary enrollment in South Africa.

We take advantage of longitudinal data from the Cape Area Panel Study (CAPS), a survey that began with about 4,800 14-22 year-olds in metropolitan Cape Town in 2002. In addition to detailed information on post-secondary education, household income, and other individual and household characteristics, CAPS administered a literacy and numeracy evaluation (LNE) to all respondents in Wave 1. Following the approach of Carneiro and Heckman (2002), these LNE scores allow us to at least partially control for baseline cognitive skills in analyzing the income of household resources on post-secondary enrollment.

A major focus of this paper is the comparison of schooling outcomes for African, coloured, and white youths. These three population groups were subject to very different treatment under apartheid. Whites had advantages in a wide range of areas, including significantly higher expenditures on schooling, privileged access to the labor market, unrestricted residential mobility, and better access to social services. Africans had the least access to services and the most restrictions on work and migration, with a large gap in expenditures on schooling. The coloured population, which is heavily concentrated in the Western Cape (including Cape Town), occupied an intermediate status under apartheid, with higher expenditures on schooling, fewer restrictions on residential mobility, and better access to jobs than Africans.

Empirical Patterns in Post-Secondary Education in South Africa

Table 1 uses the nationally representative Labour Force Survey (collected by Statistics South Africa) from 2000 and 2007 to analyze trends in educational attainment for 25-29 year-olds. One striking feature of the table is the large decline in the percentage with less than grade 9 education – from around 31% in 2000 to around 20% in 2007 – in both the African and coloured columns. This is a significant improvement in the bottom part of the schooling distribution. There has been much less improvement at the top of the distribution. The proportion of Africans with grade 12 or higher increased from 36% to 41%, but the proportion going beyond grade 12 increased only slightly – from 7.4% to 7.5%. These compare to 80% of whites getting at least grade 12 and 32% of whites going beyond grade 12 in 2007. Only 1.7% of 25-29 year-old Africans had a university degree in 2007, roughly the same as 2000, compared to 16% of whites. When we look at men and women separately (not shown), there is very little gender difference in any of the statistics in Table 1, a pattern found for most analyses of educational outcomes in South Africa (Anderson, Case, and Lam 2001; Lam, Ardington, and Leibbrandt 2011).

Looking at the last two rows of Table 1, African and coloured high school graduates are much less likely than whites to receive any kind of post-secondary schooling. The proportion of high school graduates aged 25-29 that had gone on to post-secondary education was 21% for Africans and 47% for whites in 2000, with declines for both groups between 2000 and 2007. The discrepancy is even larger for university attendance, since the vast majority of Africans who go beyond high school receive some kind of diploma or certificate rather than a university degree. The proportion of African high school graduates going on to receive a university degree was only 4.4% in 2000, declining to 4.2% in 2007. The percentage of white high-school graduates receiving a university degree also declined between 2000 and 2007 (this may reflect an increase in the proportion of young white university graduates who leave South Africa for some period of time rather than an actual decline in the proportion of whites going to university).

Research using data from the 1990s estimated high returns to secondary and post-secondary education in South Africa. Mwabu and Schultz (2000) found using 1993 data that Africans had higher returns than whites, with African returns to secondary education being nearly double the return for whites. Given the fact that the percentage of South Africans receiving post-secondary education has not increased since 2000, it is not surprising that the returns to post-secondary education continue to be high. Table 2 gives estimates of the returns to schooling by individual grade and post-secondary education level beginning at grade 10, based on the pooled 2000-2007

Labour Force Survey. The coefficients show the returns to completing a given level compared to the next lower level. Overall the returns are very high, even for grades less than high school completion. Africans with grade 10 earn 13% more than Africans with grade 9, controlling for a quadratic in age and a dummy for male. Africans with grade 12 (matric) earn 33% more than Africans with grade 11. Like Mwabu and Schultz (2000) found using 1993 data, we find that returns to grade 12 and above are higher for Africans than for whites.

The diploma/certificate category in Table 2 includes a variety of post-matric education that is outside universities. This includes universities of technology (technikons), vocational colleges, and other training programs. The returns to these non-university diplomas and certificates appear to be very high, at least given these conventional OLS estimates. Africans with a diploma have more than double the earnings of Africans with just matric. While the focus of this paper is on post-secondary enrollment rather than the returns to post-secondary schooling, the very large returns shown in Table 2 provide an important backdrop for our analysis. It seems clear that the very low post-secondary enrollment rates for non-whites shown in Table 1 are not due to low returns to post-secondary investments for non-whites.

Theoretical Background

As a theoretical foundation for our empirical analysis, we begin by assuming a standard human capital model of schooling decisions, and then discuss how it can illustrate key issues about education in South Africa. We assume that the decision of whether to enroll in a post-secondary institution is based on a comparison of the discounted present value of lifetime benefits with the costs. Consider a decision in period $t=0$ to attend a university that takes k years to complete, has tuition costs of C per year, and will raise subsequent earnings from Y_0 to Y_k. The difference between the present value of investing in university ($s=k$), subtracting off costs, and the present value of not attending university ($s=0$) is

$$PV(s=k)-PV(s=0)=\left[\int_k^\infty Y_k e^{-rt}dt-\int_0^k Ce^{-rt}dt\right]-\int_0^\infty Y_0 e^{-rt}dt=\frac{Y_k}{r}e^{-rk}-\frac{C}{r}\left[1-e^{-rk}\right]-\frac{Y_0}{r} \quad (1)$$

where r is the rate of interest. Equation (1) will be positive, implying that college raises subsequent earnings by enough to cover both the direct monetary costs and foregone earnings, when the following condition holds:

$$\frac{\ln\left(\frac{Y_k+C}{Y_0+C}\right)}{k}>r\,. \quad (2)$$

Equation (2) gives the condition under which any individual who could borrow money at the interest rate r should be willing to borrow to invest in k years of college. If we are considering one additional year of secondary school and C were zero, Equation (2) reduces to the familiar Mincer condition that an individual should continue in school for one more year if earnings increase by more than the rate of interest.

We are particularly interested in the extent to which financing constraints deter some individuals from attending college. One way to interpret credit constraints in the context of Equation (2) is an increase in the interest rate, implying that a higher expected increase in earnings is required to justify the investment. This means that a smaller percentage of the population will attend tertiary schooling and that those who do attend will be those with higher rates of return. In South Africa issues of financing schooling, especially at the tertiary level, are likely to be considerably more serious than in the U.S. Looking at reports in CAPS of fees paid by those attending post-secondary institutions in 2005, the mean fee paid by African students was around 8000 Rand per year (about US$2000 using Purchasing Power Parity adjustments). This is more than double the median annual per capita family income for African respondents of around 3500 Rand. Median total annual household income for African households was 17,500 Rand. Most

African households have few financial assets and limited ability to borrow. The fees paid by African students would be even higher if they attended higher quality institutions. Our review of fees charged by major tertiary institutions in Cape Town indicates that annual fees are about 13,000 Rand at technical colleges and about 18,000 Rand at universities. While some financial aid is available, the cost of financing tertiary education is likely to be a serious constraint on most African students.

Individuals may have access to different sources of credit at different interest rates. As pointed out by Lovenheim (2008), they presumably access these resources sequentially, with self-financing from household wealth being the lowest cost resource that is accessed first. For black South Africans, access to family or household members who are receiving the state old-age pension may be an important source of funding. The pension pays about 11,000 Rand per year, close to the typical cost of post-secondary schooling. A 20-year-old living with a pension-eligible grandparent may be better able to finance post-secondary schooling than a 20-year-old without access to a pension recipient. Below we explore the fact that age eligibility for the pension creates a potentially exogenous source of variation in household and extended family income that may affect post-secondary schooling decisions.

As discussed above, an important point of debate in the literature on credit constraints in post-secondary schooling has been whether the positive relationship between family income and college attendance in the U.S. is due to credit constraints or cumulative long-term effects of family background on variables such as early childhood development, school quality, and home learning environment. Carneiro and Heckman's (2002) found in the 1979 NLSY that the impact of family income on college attendance is greatly reduced when they control for AFQT scores and parental education. In terms of the simple model outlined above, lifetime disadvantage associated with growing up in a poor household may lead to lower cognitive ability at the age at which post-secondary schooling decisions are being made. Assuming that lower ability students have lower returns to post-secondary schooling, the left-hand side of Equation (2) will be reduced and investments in tertiary schooling will be less likely, even without any differences in the effective borrowing rate. An important advantage of CAPS is that the baseline literacy and numeracy evaluations make it possible to do the same kind of analysis done by Carneiro and Heckman and other papers in the U.S. literature. In addition to test scores and family income we are also able to control for parental education (even when parents are not co-resident) and a number of other important family background variables.

Data: The Cape Area Panel Study

Our empirical analysis uses the Cape Area Panel Study (CAPS), a longitudinal survey in metropolitan Cape Town.[1] Wave 1, collected in 2002, included 4,752 young people aged 14-22. Cape Town has three predominant population groups – the distribution in the 2001 census was 48% coloured, 32% African/black, and 19% white. CAPS oversampled areas classified as predominantly African and white. Cape Town is the only major city in South Africa to have substantial numbers of white, coloured, and African residents, providing unique opportunities to study changes in inequality after the end of apartheid.

The Wave 1 young adult questionnaire, administered to up to three household members aged 14-22, covered a wide range of variables including schooling and work. It also included a literacy and numeracy evaluation (LNE) which features prominently below. We use 2005, the timing of Wave 3, as the endpoint for the transitions we analyze. Data from Wave 4, collected in 2006, and Wave 5, collected in 2009, is used to fill in data for respondents who were not interviewed in Wave 3. Table 3 gives information on sample size and attrition. There were 4,752 respondents in

[1] Details about CAPS, a collaborative project of the University of Cape Town and the University of Michigan, are available in Lam et al. (2008) and on the CAPS web site, www.caps.uct.ac.za.

Wave 1, with relatively equal numbers of African and coloured respondents as planned in the sample design. The white sample is considerably smaller, a result in part of a lower response rate.[2] Looking at the sample with data for 2005, the overall attrition rate was 16%, with significant differences across population groups. The African attrition rate is 18%, with most attrition due to migration back to the rural Eastern Cape province that is the main sending region for Africans in Cape Town. The coloured population has its roots primarily in Cape Town, a factor contributing to its lower 10% attrition. The 32% attrition for whites includes both migration out of Cape Town (including out of South Africa) and a significant number of refusals.

The bottom panel of Table 3 shows attrition among those respondents who were enrolled in grade 10, 11, or 12 in 2002. Since most of our analysis will focus on respondents who completed secondary school in 2002, 2003, or 2004, this panel shows the group at risk of being in our target sample. Attrition is lower among this group than it is for the overall CAPS sample, with attrition for all population groups combined of 12%.

Empirical Analysis

We begin our empirical analysis with an overview of some of the individual and household characteristics we will use in our regressions. Table 4 presents descriptive statistics for respondents who completed grade 12 in 2002, 2003, or 2004. Line 1 shows whether the respondent was enrolled in any kind of post-secondary education in 2005. The percentage enrolling in post-secondary education varies from 34% for Africans and coloureds to 63% for whites. Looking at specific types of postsecondary education in Lines 2-5, we see that while 42% of whites are enrolled in university in 2005, only 11% of Africans and 14% of coloureds are

[2] As in most South African household surveys, CAPS response rates were high in African and coloured areas and low in white areas. Household response rates were 89% in African areas, 83% in coloured areas, and 46% in white areas. Young adult response rates, conditional on participation of the household, were quite high, even in white areas. Given household participation, response rates for young adults were 93% in African areas, 88% in coloured areas, and 86% in white areas (Lam et al. 2008).

enrolled in university. Enrollment in technical universities (technikons) is more similar across races – 12% for Africans, 11% for coloureds, and 7% for whites. About 12% of Africans and 10% of coloureds are enrolled in the diverse range of other post-secondary education. A higher proportion of whites – 17% – are enrolled in these other types of post-secondary institutions. Below we will estimate regressions using both the full set of post-secondary institutions and the more narrowly defined university and technical university group of institutions.

An important feature of CAPS is the literacy and numeracy evaluation (LNE) that was administered to all youth respondents in Wave 1. The means and standard deviations of the combined literacy and numeracy score are reported in Line 14 of Table 4 (the score is standardized to zero mean and unit variance for the full sample of 14-22 year-olds). The LNE was a self-administered 45-question test that took about 20 minutes to complete. Respondents could take the test in English or Afrikaans. There was no version in Xhosa, the home language of most African respondents. The English language test was taken by 99% of African respondents, 43% of coloured respondents, and 64% of white respondents. In interpreting the results it is important to keep in mind that most white and coloured students took the test in their first language, while Africans took the test in a second language. It must also be noted, however, that English is the official language of instruction in African schools and is used for many tests such as the grade 12 matriculation exam. We use the LNE scores as a measure of cumulative learning at the time of the 2002 interview. Performance on the test reflects a combination of many factors, including innate ability, home environment, and the quantity and quality of schooling to that point. Table 4 shows the large racial differences in performance on this test. The mean score for Africans was 1.5 standard deviations below the mean score for whites. The standard deviation of African scores is 60% larger than the standard deviation of white scores.

The score on the grade 12 matriculation exam will feature prominently in our analysis below. We calculate the score based on respondent's answers to questions about performance on the multiple components of the exam, generating a score that goes from 1 to 8. We use an algorithm similar to that used by the University of Cape Town, which, like other universities, uses the matriculation exam results as the basis for admission decisions. A score of 5 roughly corresponds to the cutoff for eligibility for admission to university. As seen in Line 15 of Table 4, both Africans and coloureds have a mean below 5, while whites have a mean of 5.7. We will look at the distribution of these scores in more detail below.

Table 4 also presents information on the number of grades failed in Line 23. African students have failed an average of 0.64 grades by 2002, compared to 0.37 for coloureds and 0.16 for whites. As Lam, Ardington, and Leibbrandt (2011) show using CAPS data, there are high levels of grade repetition in black secondary schools, with grade repetition playing an important role in explaining racial gaps in ultimate educational achievement.

Given our interest in the impact of credit constraints, one of our key independent variables is household income. Lines 12 and 13 of Table 4 show the large differences in baseline household income per capita, as reported by an adult respondent in the Wave 1 household questionnaire. It is important to note that income is measured while the respondents are still in secondary school, making it an appropriate predictor of subsequent education outcomes. The mean for whites is about seven times greater than the mean for Africans. Related to these differences, the mean school expenditures in 2002 (when everyone in this group of respondents was still in secondary school) were about seven times greater for whites than for Africans. In addition to these enormous racial differences in baseline income and test scores, there are also large racial differences in parents' education. The mothers and fathers of African youth have around four years less schooling than the parents of white youth, with father's schooling missing for 44% of Africans[3].

We include in the regressions below two variables that are used as indicators of short-run changes in household financial resources. The first, shown in Line 6 of Table 4, is an indicator of household shocks. This is based on questions asked in Wave 3 in 2005. We define a negative shock as having occurred if the household experienced a death, job loss, loss of a grant or loss of support from outside the household, and if the household respondent reported that the shock had a moderate to severe financial impact on the household. Negative shocks were experienced by 13% of Africans, 12% of coloureds, and 6% of whites.

We also use an indicator of whether there was a pension-eligible person as part of the respondent's household in the year the respondent completed grade 12. This is based on the household roster in the 2002 baseline survey. The South Africa Old Age Pension is an important part of the social safety net in South Africa, providing significant resources to many households. Until recently women became eligible for this non-contributory pension at age 60 and men became eligible at 65. Although there is a means test, it is non-binding for most African elderly. As seen in Line 8 of Table 4, 17% of Africans and 23% of coloureds had a pension-eligible person in their household when they graduated from high school.

Income, ability, and post-secondary enrollment

The top panel of Figure 1 presents lowess estimates of post-secondary enrollment in 2005 as a function of the log of 2002 household per capita income. We continue to use the sample of respondents that completed high school in 2002, 2003, or 2004. As a reference for the lowess estimates the bottom panel plots kernel densities for each population group, standardized so that the overall mean is zero. The kernel densities demonstrate the enormous racial differences in

[3] Parental schooling comes from the household questionnaire when the parent is co-resident, and is collected from the young adult directly when the parent is not co-resident.

income. A striking feature is the very small range in which the African and white income distributions overlap, with the coloured distribution sitting in between. In the ranges of income with significant densities, we see in the top panel that there is a strong positive relationship between income and enrollment in post-secondary education. While the white line is everywhere above the African line, the distance between the two lines is relatively small compared to the large mean difference in enrollment shown in Table 4. In the very small range where the African and white income distributions overlap the white enrollment advantage is quite small. This gives the first evidence that income differences play an important role in explaining the racial differences in post-secondary enrollment. It is also striking that African enrollment is higher than coloured enrollment across almost the entire income distribution.

It is important to recognize that the impact of income differs across the diverse range of post-secondary options. Figure 2 looks at the relationship between log per capita household income in 2002 and our three categorizations of post-secondary education – university, technical university, and other. Note that the strong income gradient shown for any type of enrollment in Figure 1 is due primarily to a strong relationship between income and university enrollment. For Africans, enrollment in university rises from about 10% around the African mean income of -0.5 to about 40% at the higher levels of the African income distribution. Income has a weaker and non-monotonic relationship with enrollment in technical universities and other post-secondary education. For Africans, there appears to be a negative impact of income on enrollment in technical and other starting a little above mean African income. Presumably this reflects the fact that there is a substitution into university at these higher income levels, with income being correlated with matric scores and the admission into university.

Figure 3 shows the relationship between matric scores and enrollment in the three categories of post-secondary education. The bottom panel shows the kernel density estimates of the distribution of scores for each population group. The top panel shows a strong positive relationship between the matric score and the probability of being enrolled in university in 2005, with some evidence of a kink at 5. The racial gap in university enrollment at any given matric score is quite small, especially in the range of overlapping distributions. Matric scores have a non-monotonic relationship with enrollment in technical universities, turning negative around the university exemption cutoff of 5. Matric scores tend to be negatively associated with enrollment in other types of post-secondary education, presumably reflecting the fact that these options are dominated by technical university or university when students can get admitted to those programs.

Regressions for university enrollment

This section presents regressions in which our dependent variable indicates that the respondent was enrolled in university in 2005, using the sample of respondents who completed grade 12 between 2002 and 2004. One of our key empirical questions is whether baseline household income is associated with university enrollment, and whether the coefficient on income declines when we control for variables such as matric scores and parental education. Table 5 presents OLS estimates of the linear probability model.

Regression 1 includes only dummies for coloured and white (African is the excluded category), along with a dummy for female, dummies for the year in which the respondent completed secondary school, and terms for age and age squared in 2002. As expected given the sample means in Table 4, the coefficient on coloured is slightly negative but statistically insignificant. The coefficient on white implies that whites have 29.6 percentage point higher probability of enrollment in university. Females have a slightly higher probability of university enrollment, but the coefficient is not statistically significant. The fact the females do at least as well as males in schooling outcomes in South Africa is consistent with previous studies at the primary and secondary levels (e.g. Lam et al. 2011).

Regression 2 adds the log of baseline household per capita income (rescaled to have mean zero) and its square to the regression. The coefficient on the linear term implies that a 10% increase in income implies a 0.8 percentage point higher probability of university enrollment, evaluated at the mean. The striking result in column 2 is that inclusion of household income in the regression causes the white coefficient to fall from 0.296 to 0.077, losing statistical significance. The coloured coefficient falls to -0.09, significantly different from zero at the 0.05 level.

In Regression 3 we add mother's schooling and father's schooling to the regression, an approach used by Carneiro and Heckman to pick up long-term disadvantage. We estimate positive effects of both parents' schooling, controlling for 2002 income. A one year increase on mother's schooling is associated with a 2 percentage point increase in the probability of university enrollment, with about twice as large a coefficient on father's education. Including parental schooling in the regression causes the the estimated impact of household income to drop dramatically and become statistically insignificant. It also causes the coefficient on the white dummy to become statistically insignificant, with a point estimate of only 0.01. Parental education could represent a number of mechanisms affecting post-secondary enrollment. It may be a good proxy for a household's permanent income, picking up the long-term effects of household resources on cumulative human capital. There may also be direct effects of parental education on children's learning that affects the probability of continuing to university. Whatever the mechanisms are that explain the impact of parental education, an important result for our purposes is that controlling for parental education causes the apparent effect of household income during the student's high-school years to essentially disappear.

Regression 4 adds the matriculation exam score to the regression. We use a linear spline with a change in slope at a matric score of 5, roughly the cutoff for admission into university. Matric scores are a strong predictor of post-secondary enrollment, but the effect is highly non-linear. The spline coefficients in Regression 3 of Table 5 imply that one additional point on the score raises the probability of enrollment in university by 4 percentage points in the 0-5 range, but raises the probability by another 24 percentage points for scores above 5 (in other words, the impact of moving from a score of 5 to 6 would increase the probability of university enrollment by 28 percentage points). Note that including the matric score cuts the coefficients on parental schooling roughly in half, though both coefficients are still statistically significant. The coefficient on baseline household income is now slightly negative, but still statistically insignificant. Controlling for parental education and the matriculation score have removed the apparent impact of income on university enrollment.

Looking at the race dummies in Regression 4, the coefficient on the white dummy is now negative and statistically significant at the 5% level. Taken literally, the coefficient implies that when we control for baseline income, parental education, and matriculation exam scores, whites have a 12 percentage point *lower* probability of enrolling in university education than Africans. In interpreting this result it is important to keep in mind the distributions of income and matric scores shown in Figures 1 and 3. There is very little overlap in the African and white distributions, making it difficult to estimate what whites would do if they had African characteristics (and vice versa). Our result is very similar to the results found in Lam, Ardington, and Leibbrandt (2011), where including controls for income and LNE scores causes a negative estimated effect of being white on progress through secondary school. While the result must be interpreted with caution, it suggests that baseline income and scholastic ability play a major role in explaining racial differences in university enrollment.

Estimating the impact of changes in income

The regressions discussed above suggest that the apparent effect of household income on the university enrollment may be picking up the effect of parental education and the cumulative learning that higher-income students had when they were finishing secondary school. This is important from a policy perspective, since policies such as reduced university tuition or financial aid programs will not be able to compensate for the cumulative educational disadvantages associated with growing up in a poor household.

In order to see whether credit constraints are affecting the ability of young people and their families to finance university education, we would ideally like to observe short-term changes in income and estimate the impact of those changes on post-secondary enrollment. Column 5 of Table 5 uses two measures of short-term income changes available in CAPS. The first is the household shock variable discussed above, indicating whether the household experienced a negative financial shock between 2002 and 2005. This is intended to measure unexpected declines in income, and should therefore have a negative impact on enrollment if credit constraints are binding. As seen in Column 5, the coefficient on the household shock variable has the predicted negative sign. It is very imprecisely estimated, however, and we cannot reject that it is zero at conventional significance levels. We also use an indicator of whether there was a pension-eligible household member in the year the respondent graduated from high school. Since the pension is an expected change in income this may have a different effect than an unexpected household shock. The estimated effect of a pensioner is positive, as predicted, but the coefficient is imprecisely estimated and is statistically insignificant. One interpretation of the insignificant coefficients on the household shock and presence of a pensioner is that there really is no effect of short-term income changes on enrollment. This could mean that credit constraints are not a serious factor in enrollment. Unfortunately we cannot rule out the possibility that the shock and pension variables are too imperfect as measures of short-term income variation to detect the actual effect.

Predicting other post-secondary education

In Table 5 our measure of post-secondary enrollment is limited to university enrollment. As shown in Figures 1 and 2, the relationship between income and post-secondary enrollment appears to be different for technical universities and other non-university programs, including things like short-term certification programs. Table 6 presents regressions in which the outcome is post-secondary enrollment conditional on not enrolling in university. One motivation for these regressions is that they might be viewed as describing the admission and enrollment decision process for those who are not able to be admitted into university. We present the same specifications shown in Table 4, beginning with simple race dummies and then adding controls for family background and matriculation exam performance.

Looking at Regression 1, the simple unadjusted racial gap in non-university enrollment is considerably smaller than the gap in university enrollment. Conditional on not enrolling in university, whites are 13.6 percentage points more likely than Africans to enroll in some other type of post-secondary education. As in Table 5, this gap completely disappears when we control for household per capita income in 2002 in Regression 2. Unlike Table 5, however, the apparent impact of income does not disappear when we add parental education to the regression. We continue to estimate a significant impact of baseline income on non-university enrollment even when we include the full set of regressors in Column 5.

Another important difference between Table 6 and Table 5 is the impact of grade 12 matriculation exam scores on enrollment. We estimate that a one point increase in the score is associated with a 5.6 percentage point increase in the probability of enrollment in the 0-5 score range, slightly above the 4.4 percentage point increase in Table 4 (though the difference is not statistically significant). But in Table 6 there is no additional increase in the impact of test scores above a score of 5, unlike the large increase in slope estimated for university enrollment in Table

5. This is consistent with the pattern shown in Figure 3. While the enrollment-matric score gradient is very steep above a score of 5 for university enrollment, there is a much weaker relationship between the matric score and enrollment in other types of post-secondary education, conditional on not enrolling in university. It is also noteworthy that adding matric scores only slightly increases the R^2 in Table 6, it had a very large impact on the R^2 for university enrollment in Table 5.

As in Table 5, our estimates of the impact of short-term income changes on enrollment are not statistically significant in Table 6, although the coefficients have the predicted signs. The point estimate for the impact of having a pensioner in the household is almost twice as large in the non-university regressions as in the university regressions, consistent with the possibility that credit constraints are more important for non-university post-secondary education, though the difference is not statistically significant.

The most striking difference between Table 5 and Table 6 is that in Table 6 we estimate a statistically significant impact of baseline household income (measured when the respondents were near the end of secondary school) on enrollment in non-university post-secondary education, even after controlling for parental education and grade 12 matriculation exam scores. This suggests that credit constraints may play a role in the broader forms of post-secondary education, even though they do not appear to be important for university enrollment. This may indicate that universities have adopted financial aid programs that successfully compensate for income differentials among those who succeed in getting admitted, while other forms of post-secondary education do not have similar financial assistance. Performance on the grade 12 matriculation exam is much less important for non-university programs, suggesting that to some extent income rather than ability is determining attendance in these programs. As shown above, the earnings returns to these non-university programs appear to be quite high, so this an important dimension of the post-secondary environment.

Returning to the issue of the racial gap in post-secondary education, our results suggest that credit constraints have very little impact on the racial gap in university enrollment. Our regressions in Table 5 suggest that making universities free, for example, would not change the large racial gap in university enrollment, holding constant the large differences in grade 12 matriculation exam performance and parental education. Credit constraints may play a somewhat larger role in explaining the racial gap in other forms of post-secondary education. Our result in Table 6 imply, for example, that holding constant matric scores and parental education, a 20% increase in baseline household per capita income would imply a 1 percentage point increase in non-university post-secondary enrollment. Given the very large gap between white and African incomes in our sample, this is an economically important effect.

Summary and Conclusions

Our panel data from Cape Town indicate that there is a strong positive relationship between the household income experienced by students when they were finishing secondary school and their later enrollment in post-secondary education. Given the large impact of income on university enrollment and the enormous income differences between whites and Africans, income experienced during late high school can in and of itself statistically account for the entire 30 percentage point racial gap in university enrollment. This apparent effect of household income on subsequent post-secondary enrollment may pick up a wide variety of effects. On the one hand it may indicate that credit constraints limit the ability of low-income students to continue their studies after secondary school. On the other hand it may simply pick up the cumulative effects of income experienced since birth on human capital acquired by the end of secondary school.

Following the approach of Carneiro and Heckman (2002), we show that controlling for grade

12 matriculation exam scores and parental education completely eliminates the apparent effect of baseline income on university enrollment. The impact of matric scores on university enrollment is very large once students reach the cutoff of 5 that is required for most university enrollment.

We use two indicators of short-term income variation in order to look more directly for effects of credit constraints on post-secondary enrollment. The first measure, an indicator that the household experienced a negative financial shock between 2002 and 2005, has the predicted negative coefficient but is not statistically significant. The second measure, an indicator of whether a household member received South Africa's generous old-age pension at the time the respondent graduated from high school, has the predicted positive coefficient but is also statistically insignificant. Taken literally, these results suggest that short-term income fluctuations do not have a significant impact on university enrollment. This may mean that credit constraints and the ability to finance education do not play an important role in explaining post-secondary enrollment rates in South Africa. We do not want to push this interpretation too hard, however, since these are somewhat imperfect measures of short-term income changes.

We are more confident with what our results imply about long-term socio-economic disadvantage and racial differences in university enrollment. Our regressions imply that the very large racial gap in university enrollment can be entirely explained by a combination of household income and cognitive ability measured at the end of high school. When we control for parental education, baseline income, and grade 12 matriculation exam scores, our regressions imply that Africans would actually have 12 percentage point *higher* university enrollment than whites if Africans had the same characteristics as whites. While this may overstate the extent to which we can explain the racial gap in enrollment, the results clearly suggest that a policy of lowering tuition or increasing financial aid would have only a very modest impact, if any, on the racial gap in university enrollment. Given the large racial gap in cognitive ability at the end of high school, financing constraints appear to be a relatively small component of the racial gap in university enrollment.

This same set of variables can also fully explain the racial gap in other types of post-secondary education, conditional on not enrolling in university. In the case of non-university enrollment, however, we do find a significant impact of baseline household income on enrollment, even after controlling for parental education and matriculation exam scores. This suggests that credit constraints may be a factor in explaining the racial gap in post-secondary education outside of university. Given what appear to be large economic returns to these types of post-secondary education, this could have important implications for inequality in the South African labor market.

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Table 1. Highest level of education for 25-29 year-olds, South Africa Labour Force Survey 2000 and 2007

	African		Coloured		White	
Highest grade completed	**2000**	**2007**	**2000**	**2007**	**2000**	**2007**
Less than Grade 9	31.1	20.2	32.9	20.7	2.6	2.1
Grade 9	8.0	9.0	10.4	8.9	1.6	3.6
Grade 10	10.3	11.6	12.6	14.9	10.1	9.1
Grade 11	14.8	18.4	8.4	10.7	8.5	5.7
Grade 12	28.4	33.3	27.8	38.1	41.1	47.1
Post-matric diploma/certificate	5.8	5.8	4.0	5.3	19.1	16.3
University degree	1.6	1.7	3.9	1.4	17.1	16.2
At least Grade 12	35.8	40.8	35.7	44.8	77.2	79.6
Beyond Grade 12	7.4	7.5	7.9	6.8	36.1	32.5
% of Grade 12 going further	20.6	18.5	22.2	15.1	46.8	40.8
% of Grade 12 completing university	4.4	4.2	10.9	3.2	22.1	20.3
Observations	9,176	6,655	1,240	1,045	673	372

Table 2. Returns to schooling, men and women aged 25-59, South Africa Labour Force Survey 2000-2007

Grade level	African	Coloured	White
Grade 10	0.126	0.271	0.236
	[0.013]***	[0.027]***	[0.065]***
Grade 11	0.216	0.349	0.403
	[0.012]***	[0.029]***	[0.042]***
Grade 12	0.331	0.408	0.089
	[0.011]***	[0.027]***	[0.035]**
Diploma/certificate	1.088	0.898	0.277
	[0.012]***	[0.033]***	[0.023]***
University degree	0.552	0.563	0.419
	[0.020]***	[0.054]***	[0.028]***
Observations	158,653	30,980	14,237
R-squared	0.33	0.39	0.18

Standard errors in brackets; **significant at 5%; ***significant at 1%; also in regression: age, age squared, dummies for grades 1-9, male, year, and province; coefficient is return relative to next lower level

Table 3. Young adult response rates in the Cape Area Panel Study

Population Group	Wave 1 sample size	Sample observed in 2005	Response rate to 2005
(1)	(2)	(3)	(4)
Full sample			
African	2151	1773	82.4%
Coloured	2005	1803	89.9%
White	596	405	68.0%
Total	4752	3981	83.8%
Respondents in grade 10, 11, or 12 in 2002			
African	669	574	85.8%
Coloured	583	552	94.7%
White	218	170	78.0%
Total	1470	1296	88.2%

These observations may be taken from Wave 3, 4, or 5. Column 4 is the ratio of Column 3 to Column 2.

Table 4. Descriptive statistics, CAPS Waves 1-5, CAPS respondents who completed grade 12 in 2002, 2003, or 2004

	Variable	African (N=230)		Coloured (N=311)		White (N=139)	
		Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
1	Any post-secondary enrollment in 2005	0.344	0.476	0.344	0.476	0.649	0.479
2	University enrollment in 2005	0.109	0.312	0.137	0.345	0.415	0.495
3	Technikon enrollment in 2005	0.118	0.323	0.107	0.310	0.070	0.256
4	University or Technikon enrollment in 2005	0.227	0.420	0.244	0.430	0.485	0.502
5	Other post-secondary enrollment in 2005	0.118	0.323	0.100	0.300	0.165	0.372
6	Household shock between 2002 and 2005	0.128	0.335	0.120	0.326	0.056	0.230
7	Household shock missing	0.163	0.370	0.079	0.270	0.184	0.389
8	Household pensioner at year of graduation	0.168	0.375	0.231	0.422	0.056	0.231
9	Graduated 2002	0.321	0.468	0.353	0.479	0.396	0.491
10	Graduated 2003	0.400	0.491	0.373	0.484	0.343	0.477
11	Graduated 2004	0.304	0.461	0.284	0.452	0.276	0.449
12	Household per cap income	586	813	1383	1224	3834	2576
13	Log hh per cap income (zero mean)	-0.460	1.002	0.617	0.810	1.728	0.720
14	Standardized LNE total score	-0.026	0.720	0.619	0.587	1.355	0.444
15	Matriculation exam score	3.568	1.306	4.023	1.296	5.717	1.625
16	Age in 2002	17.90	1.73	17.04	1.31	17.05	1.23
17	Female	0.535	0.500	0.580	0.494	0.517	0.502
18	Mother's education (grades completed)	8.982	3.279	9.624	2.773	13.000	1.877
19	Father's education (grades completed)	8.683	3.896	9.939	3.023	13.171	2.092
20	Mother's education missing	0.124	0.330	0.028	0.164	0.034	0.182
21	Father's education missing	0.444	0.498	0.226	0.419	0.058	0.234
22	Annual school expenses in 2002 (rands)	1,269	4,780	1,441	3,787	6,854	6,616
23	Number of grades failed by 2002	0.644	0.809	0.369	0.658	0.155	0.484

Table 5. OLS regression for probability of enrollment in university in 2005, CAPS respondents who completed grade 12 between 2002 and 2004

Variable	(1)	(2)	(3)	(4)	(5)
Coloured	-0.0152	-0.0952**	-0.0684*	-0.0492	-0.0599*
	[0.0385]	[0.0439]	[0.0392]	[0.0308]	[0.0319]
White	0.296***	0.0766	0.00957	-0.118**	-0.125**
	[0.0611]	[0.0834]	[0.0761]	[0.0563]	[0.0561]
Female	0.0126	0.00872	0.0145	-0.0260	-0.0277
	[0.0396]	[0.0381]	[0.0348]	[0.0281]	[0.0281]
Log hh per cap income (zero mean)		0.0817***	0.0170	-0.00162	-0.000737
		[0.0189]	[0.0183]	[0.0129]	[0.0133]
Log hh per cap income squared		0.0194	0.00676	-0.0122	-0.0116
		[0.0124]	[0.0118]	[0.0100]	[0.0101]
Mother's schooling			0.0191***	0.0104*	0.0102*
			[0.00668]	[0.00566]	[0.00571]
Father's schooling			0.0410***	0.0249***	0.0251***
			[0.00811]	[0.00669]	[0.00664]
Matric score spline 0-5				0.0436***	0.0468***
				[0.0132]	[0.0134]
Matric score spline 5-8 (change in slope relative to 0-5)				0.240***	0.235***
				[0.0373]	[0.0373]
Household shock between 2002 and 2005					-0.0301
					[0.0386]
Household pensioner at year of graduation					0.0376
					[0.0404]
Observations	564	563	563	563	563
R-squared	0.142	0.186	0.280	0.503	0.507

Notes: Robust standard errors in brackets. * significant at 10%; ** significant at 5%; *** significant at 1%. All regressions also include quadratic in baseline age and dummy variables for year of graduation. Regressions that include parental schooling and household shock variables also include dummy variables for missing parental schooling and household shock information.

Table 6. OLS regression for probability of enrollment in post-secondary education in 2005, conditional on not enrolling in university, CAPS respondents who completed grade 12 between 2002 and 2004

	(1)	(2)	(3)	(4)	(5)
Coloured	-0.0272	-0.121**	-0.103*	-0.101*	-0.106*
	[0.0512]	[0.0594]	[0.0589]	[0.0597]	[0.0590]
White	0.136*	-0.0704	-0.0960	-0.110	-0.121
	[0.0801]	[0.107]	[0.105]	[0.109]	[0.107]
Female	0.0253	0.0243	0.0264	0.0204	0.0234
	[0.0477]	[0.0467]	[0.0467]	[0.0461]	[0.0459]
Log hh per cap income (zero mean)		0.0862***	0.0593**	0.0459	0.0508*
		[0.0257]	[0.0298]	[0.0294]	[0.0292]
Log hh per cap income squared		0.0116	0.0116	0.00367	0.00659
		[0.0143]	[0.0151]	[0.0152]	[0.0152]
Mother's schooling			0.0246**	0.0236**	0.0225**
			[0.0103]	[0.0101]	[0.0101]
Father's schooling			0.00170	0.00197	0.00109
			[0.0111]	[0.0106]	[0.0106]
Matric score spline 0-5				0.0562**	0.0583**
				[0.0263]	[0.0254]
Matric score spline 5-8 (change in slope relative to 0-5)				-0.00947	-0.0173
				[0.0891]	[0.0889]
Household shock between 2002 and 2005					-0.0272
					[0.0663]
Household pensioner at year of graduation					0.0666
					[0.0601]
Observations	467	466	466	466	466
R-squared	0.039	0.068	0.088	0.106	0.111

Notes: Robust standard errors in brackets. * significant at 10%; ** significant at 5%; *** significant at 1%. All regressions also include quadratic in baseline age and dummy variables for year of graduation. Regressions that include parental schooling and household shock variables also include dummy variables for missing parental schooling and household shock information.

Figure 1. Proportion enrolled in post-secondary education in 2005, by 2002 household per capita income, CAPS respondents who completed grade 12 in 2002, 2003, or 2004

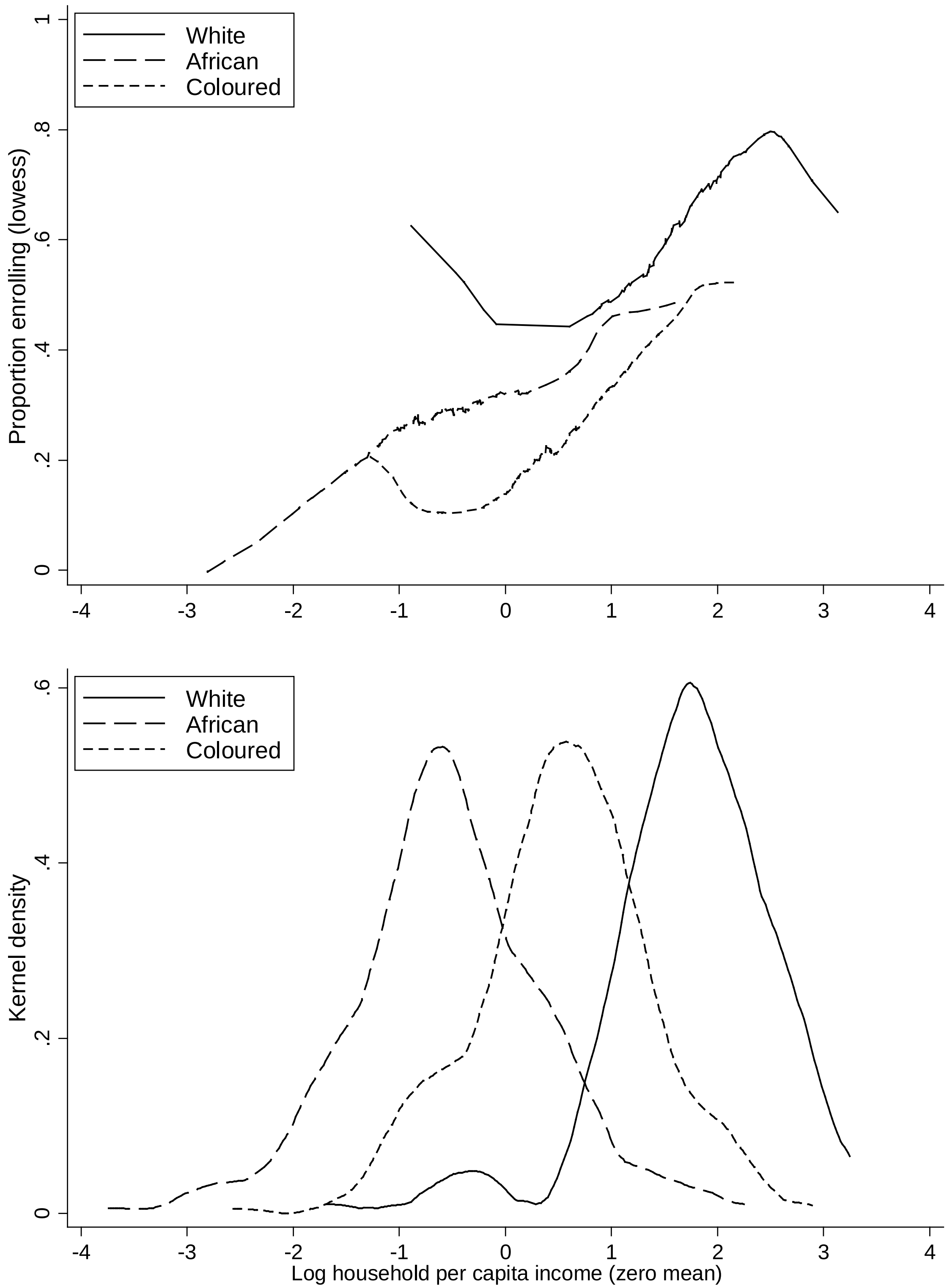

Figure 2. Proportion enrolled in different levels of post-secondary education in 2005 by 2002 per capita household income

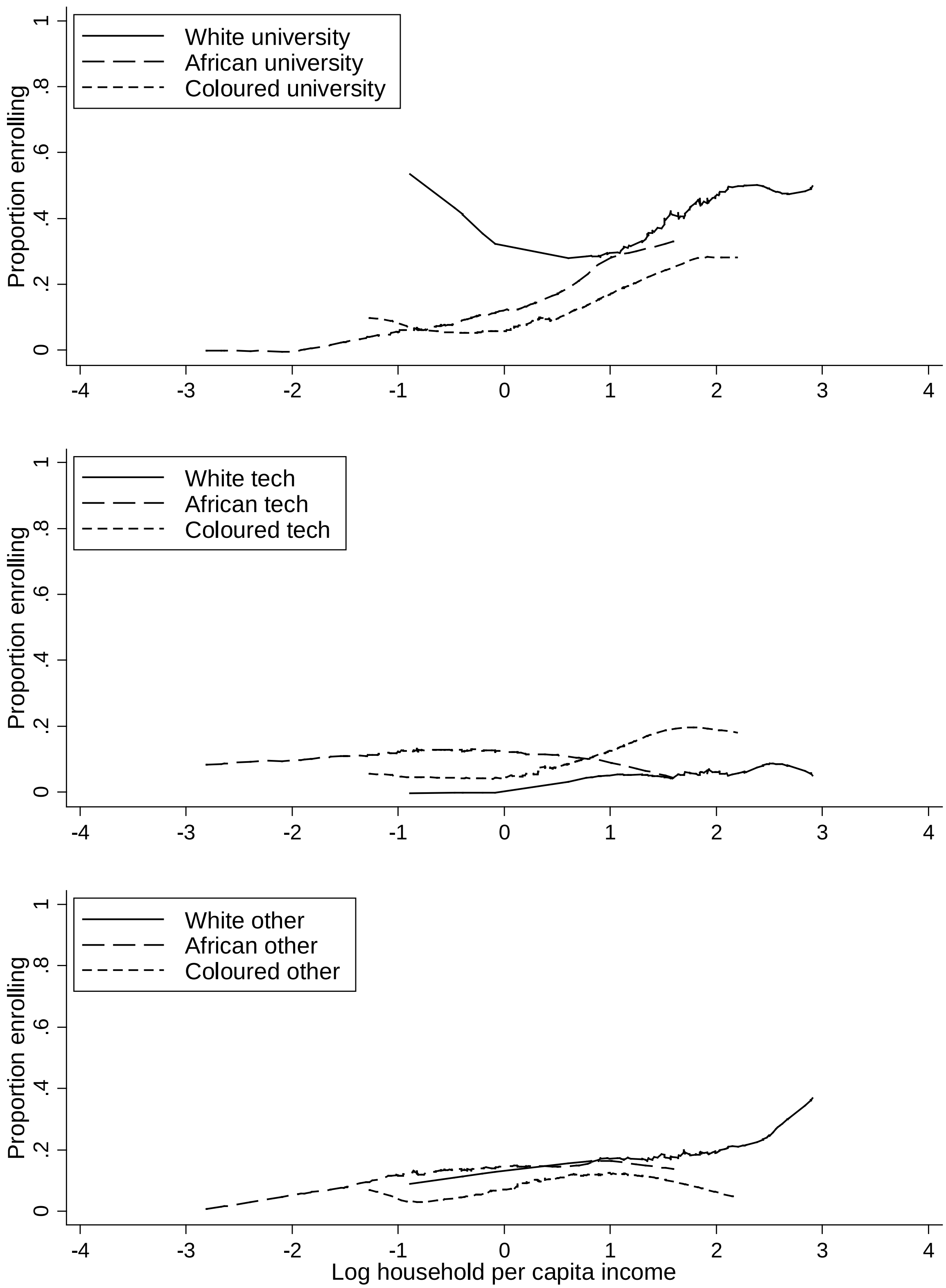

Figure 3. Proportion enrolled in post-secondary education in 2005, by grade 12 matriculation exam score, respondents who completed grade 12 in 2002, 2003, or 2004