Educational Inputs and Student Outcomes in South Africa

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Plagiarism Declaration

This mini-dissertation is entirely my own work.

All quotations have been fully cited and referenced.

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Abstract

South Africa has a notoriously inefficient public schooling system. Levels of educational attainment and achievement are low given the large amount of resources devoted to schools. Improving student outcomes requires the examination of both family-back ground factors such as parental education and household income, as well as school-level factors such as class size and teacher quality. The influences of socio-economic status and of race also need to be considered. This dissertation builds on the work of Case and Deaton, Van der Berg and others, using data from the Cape Area Panel study. The data suggests that higher levels of parental education and income are associated with higher educational outcomes. Young adults who come from a higher socio-economic household are more likely to be enrolled, attain higher grades, achieve higher marks in examinations and score higher on the CAPS Literacy and Numeracy cognitive test than those of a lower socio-economic status. Parental education is strongly positively associated with better educational outcomes. The finding that young adults attend schools whose resource level parallels their socio-economic status presents a methodological problem. However, small class sizes and better educated teachers appear to foster better student outcomes. These results confirm earlier work by emphasising the importance of the link between the socio-economic background of a student and their educational outcome, as well as the positive effects that well resourced schools can have. The data suggests that further research into how to make the school system more efficient could be profitable.

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Abbreviations and Acronyms

CAPS	– Cape Area Panel Survey
CSR	– Class Size Reduction
DOE	– National Department of Education, South Africa
EMIS	– Educational Management Information System
GER	– Gross Enrollment Rate
HLE	- Heyneman-Loxley Effect
IEA	– International Association for the Evaluation of Educational Achievement
NER	- Net Enrollment Rate
OHS	– October Household Survey
OLS	– Ordinary Least Squares
SA	– South Africa
SALSS	– South African Living Standards Survey
SES	– Socio-economic Status
TIMSS	– Third International Mathematics and Science Study
TIMSS-R	– Third International Mathematics and Science Study-Repeat
USA	– United States of America
WCED	– Western Cape Education Department
YA	– Young Adult (between ages of 14 and 22)

Note: The terms student, learner and pupil are used interchangeably.

Introduction

South Africa's education system is notoriously inefficient. There is substantial spending on a system that by all accounts struggles to create opportunities for students. To understand how to improve efficiency, this dissertation builds on existing educational production research by adding data from the CAPS survey into a production function model.

This production function approach has limitations and is vulnerable to charges that it over simplifies the situation (e.g. Scheerens, 1992). However, production functions are a valuable tool to probe what influences student attainment and achievement. Inputs are thought of as both socio-economic characteristics of individual-based factors as well as school based factors. Outputs, or educational outcomes, are quantified as enrolment in school, attainment of grades, and achievement in cognitive test outcomes.

After reviewing the international literature on what makes for successful student outcomes, the next chapters turn to South African research on the subject. Data from the CAPS project is then introduced, firstly in a descriptive form and then in regression analysis. Two key variables are particularly useful for interpreting the CAPS data, namely race and socio-economic status. While race is no longer the basis for legal discrimination, it is still a factor in South African society. This is not surprising, as decades of race-based discrimination in government resource allocation allowed a paucity of human capital creation, which cannot be substantively altered in the short space of time since the end of apartheid. Despite the centrality of race in explanations of social phenomena in South Africa, there is a compelling argument for considering socio-economic status to be equally important in understanding educational l opportunity in post-apartheid South Africa. As Nattrass and Seekings (2001:14) conclude:

"South African inequality is not simply or even primarily inter-racial. Declining inter-racial inequality has not reduced overall inequality, and will not do so in future, because the factors that drive inequality have become increasingly significant at the intra-racial level."

Any exploration of educational experience in post-apartheid South Africa must be aware of the influence of socio-economic status. Consequently, the analysis in this dissertation of student outcomes data will focus on the impact of race and socio-economic status. The journey starts with the international data work on the impact of student's family background and educational

outcomes. Then the focus turns to international literature on schools and their efforts to improve student outcomes. Next, attention shifts to South Africa, with a discussion of the existing literature on improving outcomes. After this, the Cape Area Panel Study is introduced, and some descriptive elements of the results are discussed, followed by multivariate analysis.

Chapter One

The Influence of Family Background: The International Literature

Both family background and school-based factors have an impact on educational outcomes. Any approach that relies solely on one set of factors risks being viewed by serious researchers as an exercise in ideology rather than real-world schooling systems. As such, it would be difficult to sustain an argument premised on the assertion that schools do not matter at all, as schools often make available knowledge that students might not otherwise encounter.

The consequent debate in the mainstream literature is over the extent to which these two sets of factors can influence student outcomes, and how and when they intersect. The starting point in most discussions is the seminal Coleman Report (Coleman *et al* , 1966). It attacked one of the central concepts of progressive educational theory: the idea that schools can be effective in shaping the academic performance of students. The report startled many researchers by concluding that

"schools bring little influence to bear on a child's achievement that is independent of his background and general social context.; that this very lack of an independent effect means that the inequalities imposed on children by their home, neighbourhood and peer environment are carried along to become the inequalities with which they confront adult life." (Coleman et al, 1966:325)

In other words, family background is what should be of interest to those wishing to improve student performance. Family background is composed of thee closely linked effects, namely experiences that the young person has before they are old enough to attend school, the socio-economic status of the young person's family, and the household in which they live in.

1.1 Pre-school effects

Schools receive young people who have spent usually five or often more years in some form of a household. The impact of this crucial time is one of the important factors limiting what the school as an institution can do, as the teachers have to work with a certain amount of advantage or disadvantage that the young person has acquired by this time. Some researchers believe socio-economic status plays a major role in determining the skills set which young people bring to the school when the first enter. These researchers assert that parents of low socio-economic status raise children who will be at a disadvantage with respect to children of parents who have a higher socio-economic status.

Hart and Risley's (1995) pioneering work investigated this assertion. Previous research had shown that pre-school interventions produced only ephemeral improvements in intelligence tests or vocabulary scores. Hart and Risley wanted to go beyond the standard pre-school intervention programmes and their own previous work in this area. Few empirical studies had thus far been conducted , and so Hart and Risley's work marked an important attempt to understand perhaps the most crucial intervention the young child receives – the time he or she spends with their parents.

Hart and Riley studied forty-two families from upper, middle and lower socio-economic groups in the USA, with those on welfare added as the fourth and most disadvantaged group. Families in the study allowed the researchers to observe the parent-child interaction in their home setting for an hour every month from the time the children were nine months old to the time the children were three years old. Every detail, observation, sound and interaction was transcribed and recorded, resulting in a comprehensive collection of data.

Socio-economic status emerged as an important in determining the children's vocabulary size and growth rates. While Hart and Risley found that all parents talked to their children, and socialized the children to the best of their ability, the children from low socio-economic groups were exposed to a smaller range and number of words than those from more wealthy families. The professional group of families' children had an average recorded vocabulary size at age three of 2 176 words, and working class children 749 words. These differences were part of a broader disparity than vocabulary alone.

Hart and Risley refined their observations to construct an index of parenting skill, awarding points for using a wide vocabulary, using a high information content, using high rates of approval, asking rather than directing children and responding to what children said instead of just making demands. Points were used to construct a quantitative scale, in order to estimate some of the early impact of parenting styles. They found a correlation (r=.78) between the parenting index and Stanford-Binet intelligence quotient scores at age three.

For educational research, of key importance is whether these differences fade over time, as the many of the early intervention schemes effects did, or if they are more profound in their longer-term influence. Children were tested again when they were in grade three at nine and ten years old in an attempt to answer this question. Again, vocabulary and basic language skills were strongly related to their scores at three years old.

Hart and Risley's study shows that any research on school effects must take into account that schools have to work with children who have already been put at a substantial advantage or disadvantage, depending on the socio-economic status of their parents.

Recent large scale surveys have provided more evidence of the importance of socio-economic status on early school years. Lee and Berkam (2002) used data from the U.S. Department of Education's Early Childhood Longitudinal Study, Kindergarten cohort to show that there is a 60% gap between the mean cognitive test scores of the highest and the lowest SES group in the USA.

1.2 Socio-economic status

Socio-economic status is composed of various measures. The educational levels of parents play a large role, as does economic variables such as income and employment status. However, parental factors are entwined with household level factors such as the household size and structure, as well as household spending on education. Parental factors are in turn related to more broadly sociological factors that include gender, race and language.

The standard definition of socio-economic status in most studies has coalesced around measures of parental education, household income and household structure.

Parental education

The importance of the parental education to the education of their children is expressed in this extract from Haveman and Wolfe's review of the factors involved in educational outcomes (1995:1855):

'perhaps the most fundamental economic factor is the human capital of parents, typically measured by the number of years of schooling attained...this variable is included in virtually every study described [in this review]. *It is statistically and quantitatively important no matter how it is defined'*

The need to include parental education is not disputed, but what underlies the link between parental education and young adults' educational outcomes is contested. The argument for the importance of genetic endowment holds that parental education is a signal of the genetic ability of the parent that will be transmitted to the child.

The sum of these studies have established beyond doubt, at least in the psychological literature, that genetic factors play a role in intelligence – the debate is about the magnitude of this contribution, and to what extent it can be ameliorated or augmented by the quality of schooling received.

Plug and Wijverberg (2001) used a three-pronged strategy to investigate the intertwined factors of parental of income and genetic inheritance. By combing data on intelligence quotients and family income recorded in the Wisconsin Longitudinal Survey, they established a baseline effect on educational outcomes in 1975 and 1992. Next, they compared these to the outcomes for adopted children. The final step was to use components of family income that experienced random income shocks and the effects on educational outcomes of children in those families. These three approaches all show income as a significant factor in outcome and together lead to the conclusion that *'the results strongly suggest that the positive relation between family income and school success is causal and not quantitatively unimportant'* (Ibid, 2001:13)

In other words, the effects of household income was more important than the link between parental and children's intelligence tests in determining educational outcomes.

Household income

Household income is one of the most critical factor in educational success of young people. Survey data consistently shows that household wealth plays a major role in determining if the young people in that household are able to enrol in school, how many years of education they attain and their test scores. This is true both between countries and within countries. White's (1982) meta-analysis showed that family income is the largest single correlate with academic achievement.

Two developing countries illustrate the linking household income and educational outcomes, namely India and Argentina. Filmer and Pritchett (1998b:13) looked at the differences between the poorest forty percent of households and the richest twenty percent across India. In each of the twenty-five sub-national states surveyed, there was a substantially higher rate of enrolment and attainment for the richest households. The proportion of young people between the ages of 6 and 14 years old enrolled, with the exception of Kerela, was at a minimum, twenty percent more amongst rich than poor households. Attainment presented even greater disparities. The gap between the proportion of 15 to 19 year olds who completed at least grade 8 from rich households and poor households started at just under 40 %, and rose to 68 %. These sort of sub-national comparisons are useful as they involve a lower number of variables than cross-country studies. Turning to Argentina, Escudero and Marchionni (1999:13) show that income deciles correspond directly with school enrolment, with the percentage enrolment increasing with every increase in income decile.

The rich-poor gap in educational outcomes is repeated the world over. Filmer and Prichett (1998a) use national household survey data from a number of countries in the early to mid-1990s to show how pervasive these gaps have become. They constructed an asset index that could be used to compare across countries, labelling the poorest 40% of households as low income, the next 40 % as middle and the top 20 % as high income. Of the thirty-three countries with available data, everyone one of them showed large differences between the low, middle, and high-income households' enrolment and attainment rates.

An important example of these studies is by Behrman and Knowles (1997). They reviewed 42 studies conducted in 21 countries, and found that three-fifths of the indicators used showed a

significant relationship between the level of household income and the level of enrolment children from that household attained.

The reason that household income is so powerful is due to costs. One is the direct costs of schools, such as school fees, and the other is indirect costs of schooling that result from having a member of the household not generating an income. Two natural experiments have allowed researchers to investigate reasons behind the family income effect in situations where direct costs of schooling are negligible. A third case has given an opportunity to quantify the opportunity costs of going to school.

The first case is Sri Lanka, which has, since independence in 1945, had a government administered educational system that provides education at no direct cost to pupils or their families. There are no school fees and the state even pays for costs associated with school attendance such as textbooks and school uniforms from time to time. The result is that the main cost of going to school is the opportunity cost of not helping with housework, caring or sick relatives or entering the labour market in order to make household contributions, rather than direct costs.

Ranasinghe and Hartog (2002) used a cross sectional national data set to estimate the family backgrounds effect and household income effects given this policy. Outcomes were the status of enrolment for a child of an appropriate age and years of education attained. Their results suggest that family background effects maintain their explanatory power in this policy environment. Household income still has a *'positive and statistically significant effect on the schooling decision'* (ibid:629).

While the effects of family income are important, it has been argued that the elasticity of the income effect on education has been understated in the literature. Behrman and Knowles (1997) argue that empirical studies which show the income effect as positive but small have tended to underestimate the effect for three main reasons. The reasons they put forward are that firstly, income variables are often unreliable, secondly, that including other community factors may be accounting for some of the variable that actually due to income variation, and lastly, that school attainment measures are not refined enough to capture more subtle aspects of outcomes. Their paper attempts to correct some of these problems by using an unusually rich dataset from Vietnam. To overcome the first problem they work backwards from expenditure measures to

calculate income. This calculated measure yields *'much stronger associations'* (ibid) than reported income measures.

The second case that offers insight into the household income effect is the relatively recent introduction of no-fee primary schooling in Uganda. The Universal Primary Education programme was introduced in 1997 to try and provide primary education free in the whole of Uganda. Despite being allowing a maximum of four children per household, the program represented a significant investment by the state, and was accompanied by efforts to encourage female enrolment. Working around a limited dataset , Deininger (2003) managed to investigate the impact of the programme by comparing data from the 1992 and 2000 nationally representative household surveys. The programme was a success in terms of raising enrolment rates for children from low-income families, and had interesting implications for the factors of enrolment. The data showed parental income significantly increased both primary and secondary enrolment. The parental income effect on enrolment was reduced slightly from secondary schools, but not as much as it was for primary schools.

The opportunity cost of going to school is a factor in some developing countries. Children from very low-income families may have to contribute to household livelihood. In the third case, Mason and Khandker (1997:81) used survey data from Tanzania to calculate that children who attend school typically spent 25 to 50 % less time working in the household than those that do not attend school. By quantifying this using the prevailing wage, they conclude that the opportunity cost of attending primary school is two and half to three times more than the direct costs of schooling. While there is an opportunity costs for these households, not sending children to school is a short term solution, as the household then forgoes the higher future income of an educated young adult.

One strategy that households may use to overcome this impediment is credit. However, access to credit appears to be a major problem for low-income families. Jacoby (1994) has shown that many low-income families struggle to secure credit to enable children to continue being enrolled in school. Credit also enables households to keep children enrolled even when the household faces income shocks. Using ratios of private credit granted by banks to national income as a proxy for the degree of development of financial markets allows the comparison between countries where credit is more available than others. Dehejia and Gatti (2002) group countries accordingly and find that, after incorporating appropriate controls, in countries where credit is

more accessible, negative income shocks do not results in an increase in child labour rates. Enrolment is found to be higher when credit markets are more developed (Flug, Spilimbergo and Wachtenheim, 1998).

1.3 Household size and composition

The size of the household that a young person comes from is theorized to impact on their educational outcomes. The logic is that the household has a limited amount of resources and that more young people means that these resources have to be divided further, which in turn has an effect on educational outcomes. This is known as the resource dilution hypothesis, and has a great deal of empirical support, net of parental education, income and age (e.g. Blake, 1992). In the words of Downey (1995:747) the inverse relationship between household size and resources available is *'substantial, consistent and highly generalizable.'*

However, there is some question over how this applies to the cultural settings of developing countries. In Botswana, family size has no influence on young females' educational attainment (Fuller, Singer and Keiley, 1995). While in other developing countries, Shreeniwas (1997) found that the there was an inverse relationship between family size and attainment in Malaysia. Contrary to Downey, it does not seem generalizable to all developing countries. It is not only size that matters, but also structure.

The structure of a household refers to how a household makes resource allocation decisions. There are contesting views on the optimal way to model household decision-making. The unitary or common preferences model assumes that the members of the household all have a common preference for consuming the same goods. It also assumes that the decision makers in the household make decisions based on this preference. The unitary model has fallen out of favour in recent years with the recognition that households are more complex (Basu, 2000). The collective model does take this complexity into account. In this model, different decision makers in the household have preferences that are not always congruent.

One of the strongest influences on household resource allocation decisions is the gender of the household head. Female headed households have been found to spend more on education than male headed households, after controlling for socio-economic factors, in Bangladesh, Egypt and Indonesia (Quisumbing and Maluccio, 2000:43). Another study by Lloyd and Blanc (1996) used

Demographic and Health Surveys from seven countries in sub-Saharan Africa to probe this point. They found that having a female head of the household rather than a male head of the household was associated with a higher enrolment rate in Kenya, Cameroon, Niger, Malawi, Namibia and Zambia.

Simply being a female child is enough to impact education outcomes in many countries, especially in Northern Africa and the Middle East. In the developing world, there is variation in gender disparities. In Africa and South Asia females are at a disadvantage to a far greater degree than in South America. A country as huge as India has levels of male enrolment 16 % higher than female enrolment (Filmer, 1999:4) and in many parts of Africa, there is an even greater difference. Benin males have an enrolment rate 63 % higher than females (ibid). Being a developing country does not equate with necessarily having low female enrolment – South America largely achieved gender equity. For instance, Columbia has a male enrolment rate fractionally behind that of females (ibid).

Conclusion

The literature since Coleman shows that there are complex influences educational attainment and achievement. Parents have important impacts on children even before their children enter school. Genetics, parental styles and socio-economic status of parents have all been shown to be in varying degrees, significant to outcomes. Coleman's arguments still have a powerful impact. His emphasis on the centrality of parents and households remains, but schools still have critical roles to play in developing countries.

Chapter Two

The Influence of School Effects

The idea that schools-based inputs might not be the chief determinates of student success runs contrary to the dominant modes of thinking in many educational circles. The publication of such reports lead to a proliferation of work attempting to show that Coleman had understated the case for school effects.

The first point of contention was Coleman's methodology. Brookover *et al* (1978) was one of the first critics of the report. They argued that Coleman had neglected the importance of the normative factors such as *'school climate'*. Brookover et al suggested student achievement was due to school social environment rather than purely socio-economic background. This perspective corresponded with the work of Mortimore (1977) who emphasized that schools were institutions, and that the atmosphere and ethos of the school could make a difference to student achievement.

School effects research was firmly established with the work of Edmonds and Frederiksen (1979), who investigated American schools that had higher levels of student achievement than might be expected given the low-income status of the students. These schools were identified as anomalies where there was socio-economic deprivation, but high levels of student achievement. Methodological issues aside, in many ways this work was a key part of school-effect research tradition that emphasized that schools can have a positive effect.

Another powerful challenge to the Coleman perspective came from English researchers. Rutter *et al* (1979) investigated the achievement of students who came from a low-income region of London. They tracked students through different high schools, finding that the school they attended did make a difference to their test scores, even with statistical controls for any minor variations in family background. Mortimore *et al* (1988) later offered corroborating work which focused on primary schools in the United Kingdom over a nine-year period.

More recent longer-term research appears to have confirmed the swing away from Coleman. A key example is the decade long study by Teddie and Stringfield (1993). Their research, the

Louisiana School Effectiveness study found that '*schools also play major roles in individual student achievement*' (ibid:26). In other words, '*school context is important*' (ibid:27).

Large-scale studies this have not completely finalized the matter. The current literature is still reverberating from a scorching debate that developed in the late 1990s. Hanushek emerged as the most prominent proponent of school ineffectiveness, or the resources do not make a difference argument. His prolific publications (e.g. Hanushek, 1997,1999) attracted strong challenges. Perhaps the most polemical exchanges have been with Hedges *et al*, whose research team crystallized their work in an article by Greenwald, Hedges and Laine (1996a), where they presented a meta-analysis of sixty studies, coming to the conclusion that a broad range of school resources were positively related to academic achievement. Hanushek (1996) immediately responded by criticizing their methodology, and sample selection they had used. Inevitably, Greenwald, Hedges and Laine (1996b) countered by defending the soundness of their method and reiterated that their conclusion was valid. This important research will be discussed in more detail with regards to class size being one of the chief school based inputs.

Meanwhile, the work of Ferguson and Ladd (1996) showed that the case for school effectiveness was building momentum. Building on initial studies by Ferguson (1996), they worked with large amounts of data from the Texas schooling system showing that the quality of schooling accounted for a large amount of variation between school districts on state-wide tests. They concluded that measurable inputs did affect student learning.

By the end of the decade, Ladd, Sobol, and Hansen (1999:142) had found a way to ameliorate the conflict. They point out that Hanushek himself states that 'he cannot find *systemic relationships* between variables on school resources and student performance' (original emphasis) and they remind us that '*this is quite different from saying that schools and their attributes never matter.*' (ibid). Ferguson and Ladd (1996) also show that neither side focuses much attention to the methodological merits of the studies they use. They believe this is especially a problem for the production function approach literature.

The nascent consensus seems to be that schools do indeed make a difference, but are constrained by the powerful effects of socio-economic influences. Of course, this is still a very measured and cautious consensus. The extent of the size of school effects remains an issue of contention, as does the consistency of scores on different outcomes (Sammons, 1999).

While the field was maturing in the developed world, researchers turned their attention to the developing world, asking if the family-background and school effect mix would be different. Developing countries, by definition, have fewer resources that can be devoted to education systems. Given the different resource profiles and very often the differing cultural and social systems between developing and developed counties, it is not surprising that the effects mix is not the same in these two groups. Heyneman and Loxley (1983:1176) investigated this difference and found that

"*the principle distinction lies in the differences among countries in the power of socio-economic status variables*".

The proportion of educational outcome variation explained by socio-economic status was highest in high-income countries and lowest in low-income countries. The authors put forward three possible explanations:

"(1) a lack of variance in pupil socio-economic status in low-income countries, (2) pre-selectivity of low socio-economic pupils to due to high dropout and repetition rates in low-income countries, and, (3) high levels of multicollinearity between socio-economic status and school quality in low income countries" (ibid:1176)

The first point is another way of stating that those enrolled in schools in developing countries are already of a certain socio-economic status, and implies that those from the most low-income groups within those countries are not part of the calculation. This point does not transfer well to a developing country like South Africa that has relatively high enrolment rates. It could be more appropriate to secondary school analysis as dropout rates increase. In South America, children from poor households enrol in first grades, but drop out very quickly, and in Sub-Saharan Africa, most children form poor households do not enrol in school in the first place.

There are other problems with doing comparative studies amongst developing countries, such as the specification of socio-economic status Despite these limitations, Fuller's (1987) influential review concludes that '*much of this empirical work suggests that the school institution exerts a greater influence on achievement within developing countries compared to industrialized nations, after accounting for the effect of pupil background*' (ibid:255).

School-based factors are estimated to explain '*between two and three times the amount of achievement variance that then can be found in high income countries'* (Heyneman and Loxley, 1982:19)

Heyneman and Loxly's cross-country study confirmed what has been dubbed the Heyneman-Loxley Effect (HLE). The HLE describes how the 'schools effect' is more powerful in developing countries than developed ones. Heyneman and Loxeley (1982) reworked data from the IEA data that had been collected in some of the pioneering work in large, cross-national educational studies conducted in 1973. Their fundamental thesis had not been tested for sometime until Baker, Goesling and Letendre (2002) took advantage of the TIMSS data collected in 1994/5 to take another look at the HLE. They replicated the approach that Heyneman and Loxley took, using variables on achievement from the standardized TIMSS tests, and additional data from TIMSS that included data on SES, individual data such as age and school resource quality indicators. Their results are quite startling and are worth quoting at length:

"the main part of the HL effect has vanished...larger family-background effects relative to smaller school effects are evident across most of the 36 nations, and consequently there is no association between family-background effects and national wealth in the 1990s data, as there was in the 1970s data."(Baker *et al*, 2002:302)

"In all of the countries in the sample, family-background variables are much more significant predictors of student achievement than are school resource variables. The significant effects of family background persist even after controlling for quality of school resources and national levels of economic development"(ibid:304)

"*Indeed, our argument here suggests a continuum running from dominant school effects to dominant family effects, varying by degree to which poor nations incorporate minimum standards of school quality throughout the nation."* (ibid:307)

The phenomenon of a diminished HLE is complicated by an analysis of the TIMSS data by Hanushek and Luque (2002), who find that school resources have no effect on school outcomes.

If schools do have some value and so merit investment, the question becomes how to allocate resources in the most effective and efficient manner to produce positive student outcomes. The

most expensive school resource is teachers, and so it is natural that the discussion on how to allocate school level resources centres on teachers. This has ramifications for class sizes and school sizes. It is also important to look at what effect alternative expenditures such as textbooks, have on student achievement.

The Class-Size Debate

Class size is a key variable that is often used as a proxy measure for general school resources. Indeed, in most education systems, spending on personnel accounts for the vast majority of school expenditure. After capital costs such as actually building the school, the salaries of teachers are what really make up the running costs of a school. As such, issues of class size are at the centre of the 'do school resources matter' debate. The discussion has become very political, especially in the USA, where a proliferation of privately funded institutes promote particular views, and often attempt to present what they claim to be independent and objective research to back their assertions.

The debate has been framed in terms of proponents of class size reduction (CSR) who believe that smaller class have positive effects on student outcomes against those that do not believe these benefits exist. Theories are put forward to explain the benefits generally involve some sort of reduction in the dilution of teachers' time and attention. Opponents of class size reduction argue that that there is no clear evidence to support the attention dilution hypothesis. They believe that resources are not the problem in schools and resources can be better allocated by spending on school factors other than CSR. Both sides have accused each other of being ideologically blinkered. Those in favour of CSR are accused of being funded by teachers unions, as more teachers would have to be employed, while those opposing CSR are said to be influenced by conservative think tanks.

Many aspects of educational research are hotly contested, but because of these reasons, few have been marked by the volume and intensity of that which surrounds class size. Before turning to the evidence, note must be made of the difference between pupil-teacher ratios and class size. Pupil-teacher ratios are calculated by dividing the total number of pupils at a school by the number of teaching staff. The result somewhat overstates the true ratio, as it does not take account of the fact that not all those classified as teachers are involved in actual classroom teaching, but are involved in administrative work (e.g. Achilles, Finn and Pate-Bain, 2002)

There are three sources of data on CSR. The first is meta-analysis of survey data, the second individual survey data studies, and the third is data from experimental research. The best way to start is by looking at meta-analysis, in order to gain an overview of the survey work, and then to examine two of the larger and better quality studies. The debate then moves to two large-scale and expensive experiments which attempt to provide an unambiguous answer.

Class size survey research and very small experiments had been taking place for quite some time, but were often done without rigid methodology. Meta-analysis is a method of quantitatively synthesizing empirical research using sophisticated analytical and statistical frameworks. It emerged in fields such as psychology and statistics in the 1970s as a way of combining information about effect sizes and probabilities. Meta-analysis gained prominence in educational research with the works of Glass and Smith (1979) and shortly afterwards, Glass, Cahen, Smith, and Filby (1982). Meta-analysis became a field in its own right with the publication on methodology for meta-analysis by Hedges and Olkin (1985).

Meta-analysis has been critical to the growing influence of research synthesis. Its influence has become such that, in the words of the leaders of the field of meta-analysis of education, '*today the summarization and integration of studies is viewed as a research process in its own right: it is held to scientific standards and applies the techniques for data gather and analysis developed for its unique purpose*" (Cooper and Hedges, 1994:7). There have been important criticisms of meta-analysis, but supporters of the method have been aware of these and have refined their approaches (e.g. Glass, 2000). Of course, not all works of meta-analysis apply the same amount of rigor and openness in their approaches, nor do they reach the same conclusions about issues such as CSR.

Meta-analysis has shifted the school-resources debate onto a new level. Instead of disputing individual study results, disagreements now centre on two key parts of meta-analysis. Firstly, the choice of which studies are included obviously has a profound effect on the results that a review will show. The criteria for inclusion have become the starting point for many disagreements over specific studies, and a general point about meta-analysis. For instance, if a review is based only studies that are published in peer-reviewed journals or books to attempt to ensure some sort of initial quality assurance. This procedure opens makes a review vulnerable to charges of publication bias – the tendency for authors to submit, and journal to select to publish, reviews that show stronger results over those that show no result.

Secondly, a meta-analysis might include studies that cannot be compared. An instance of this was Glass *et al* 's early reviews, which came to the conclusion that class size did matter. They combined results from 77 empirical on class size and pupil achievement, finding that smaller classes were associated with better student outcomes. Outcomes were stronger for classes with fewer than 15 pupils. There were criticisms that some of the studies included were not of realistic class size, and that some of the comparisons were of large classes versus individual tutoring. Slavin (1989) went over the studies that Glass *et al* had included using a different inclusion criteria. Salin's criteria were that studies had to look at effects over a year, had to involve substantial differences in class size and had to include a control group. He found only a few studies that met this criteria , and using these came to the conclusion that the effect size was positive but small. Despite these, the Glass et al's reviews remained influential.
Another illustration of the caution necessary when combining studies is cluster analysis, employed by Robinson (1990) in a review of 100 studies cautioned that CSR effects were not uniform and varied by grade, and student characteristics.

Around the time of meta-analysis was gaining prominence, the work of prolific and controversial reviews of school resources by Hanushek (e.g. 1986,1996,1997,1998) started to become the point of departure for class size issues. Hanushek (1998:1) in a typical review, concludes that the *"evidence about improvements in student achievement that can be attributed to smaller classes turns out to be meagre and unconvincing"*. His reviews are generally based on three parts, one of which is a review of USA production function data on the link between class size and pupil achievement.

The first part of Hanushek's reviews usually make the argument, also put forth by Tomlinson (1990) that expenditure, and expenditure on teachers in particular, has increased in real terms in the USA, yet student's standardized test scores have remained stagnant over the past few decades – the widely accepted notion of the productivity collapse in American schools. This is something of a specious stance for a number of reasons.

In the first instance, aggregate level variables are difficult to control for, as so many possible variables have changed that might affect student outcomes. Secondly, the funding increases have actually been about half as much as usually mentioned, and much of this has gone to special

education or other programmes that do not have a direct impact on test scores (Rothstein and Miles, 1995).

The second part of Hanushek's argument often rests on his finding that there is no significant correlation between class size and outcomes using international data. International work on class size has largely been based on TIMSS and TIMSS-R. However, while the appeal of a standardized outcomes measure is strong, it is difficult to argue that other factors are held constant. Countries vary tremendously in factors that have an impact on outcomes, and one should be exceedingly cautious about making these sorts of comparisons.

The third and most contentious part of Hanushek's argument is the econometric meta-analysis method he uses. The objections to Hanushek have been lead by Greenwald, Hedges and Laine (1996a). His reviews are accused of not meeting the standards of a rigorous analysis on the following grounds:

Firstly, Hanushek's method of synthesizing studies is said to be vote counting of estimates, not studies. He is accused of simply categorizing the significance and direction of estimates. This, according to Hedges *et al* is a poor procedure for summing results. Hanushek believes that meta-analysis is not appropriate to this sort of research, and that his simple counting of estimates rather than studies is the only reliable method. To do otherwise, in his opinion, would be to use procedures '*applicable to circumstances very different from the present ones.*' He argues that those doing meta-analysis '*... assume that all of the schooling situations are identical.*'(Hedges et al,1996a:398). By implication, meta-analysis is unnecessary for looking at class size effects and the conclusions drawn using the methods wrong. Hedges *et al* counter by saying that meta-analysis experts generally do not view combining studies with different characteristics as problematic.

Secondly, the issue of how samples are selected is again a point of contention. Both sides accuse each other of selective sampling, but there are two points on which Hanushek's work is severely compromised. One is that he counts production functions from within one study as separate units of analysis. He states that the 377 separate production function estimates used to draw his conclusions for his 1998 review are based on 90 individual publications. This approach leads to misleading results, because, as Hedges et al (1996a:414) put it '*information content is primarily a property of the dataset, not the analysis*'.

Krueger (2002) takes these criticisms even further by breaking down how Hanushek has misrepresented the literature in his 1997 review. Nine studies with seven estimates make up 15 percent of the number of total studies, but 123 of the estimates that Hanushek uses – nearly 44 %. Further investigation of these nine studies shows that are some serious misgivings about sample size and controls in these studies. His choosing of estimates within studies is also suspect, something Hanushek (1998:20) admits is subjective when he states that '*Some judgment is required in selecting from among the alternative specifications.*' Krueger (2002:8) illustrates that this 'researcher discretion' is used to distort the conclusions of studies that show a positive relationship between smaller class size and achievement.

The other point is that Hanushek does not disclose his selection criteria for including studies. Hedges *et al*'s review finds that class size is related to better outcomes, and they publish their five criteria for study selection (ibid,1996a: 364) as well as including the references in their bibliography for all the studies used. It is worthwhile seeing what happens when applying Hedges *et al*'s rules to Hanushek's reviews and counting each study independently. Using their rules for inclusion, nine of Hanusheks(1989) survey of 38 studies (but more production functions) ,did not qualify for inclusion and the number coefficients in the remaining studies was reduced by more than half.

A re-examination of Hanushek's 1997 review, after adjusting for the selection of estimates, shows that the even the studies he used show a strong and consistent benefit of smaller classes (Krueger,2002:15). Hanushesk (2002:54) responds by saying the Krueger's reanalysis '*achieves different results by emphasizing low-quality estimates*'. This is slightly ingenious, as Krueger is using Hanushek's sample, but in a more equal way.

In short, careful reviews and rigorous meta-analysis of survey data show that reduced class size is associated with better student outcomes. To explore this conclusion, and reduce the number of variables, educational researchers have conducted some experiments where the dependent variable is student achievement and class size is the explanatory variable.

Experiments

One of the ground breaking early class size studies was Project Prime Time, a CSR initiative in the American state of Indiana that started in 1981 as a pilot project and then expanded to eventually include the entire state schooling system. Studies of the impact of the changes have shown a positive effect on class size (Lapsley and Daytner, 2002). However, the project started out as a pilot program and then expanded without there ever being a control group. A more definitive study was needed to try and establish with some degree of confidence whether small classes really were beneficial.

The definitive study to date has been the Tennessee Student/Teacher Achievement Ratio, known as Project STAR. This involved a large number of students in the state of Tennessee public schooling system, and aimed to establish if CSR did make a difference. Substantial financial support from the Tennessee legislature allowed researchers the resources to conduct a thorough investigation. Project STAR was specifically designed to be as close to experimental trial conditions as possible in a non-laboratory setting:

- It had a control group and an experimental group. The control group had the usual number of students per class of between 22 and 25. The experimental group was had between 13 and 17 students. In addition there was a third group that was a regularly sized class that was assigned a teaching assistant that assisted the teacher but did not do any actual classroom teaching.

- Previous research was used to inform the design of the study. The incorporation of Glass and Smith's estimate of a small class consisting of 15 pupils as the size of the experimental class being the best example.

- There was random assignment of students and teachers to either the control or experimental groups to ensure that socio-economic and individual level factors were controlled.

All schools in Tennessee were invited by the head of the state education department to participate (Word *et al*, 1998). There were 180 schools which expressed an interest in being part of the study, but only 100 met the size requirements of having enough children in kindergarten to make

up the three groups. A total of 79 schools were selected to give a mix of urban, rural, inner city and suburban. To control for the Hawthorne Effect, school systems with a school participating were matched with a similar school in their district that was not participating, but whose students would write the same assessment tests that the students in Project STAR did.

In the first year there were 128 small classes with about 1900 students, 101 regular classes with about 2300 students and 99 regular size classes with teaching aides. The schools comparison group was made out of 51 regular classes with about 1100 students, in 22 different schools (Ibid).

The longitudinal aspect meant that the project continued until the students were in the third grade. After these four years the students all went to regular classes, but their test scores continued to be monitored in follow-up evaluations.

Project STAR was carefully designed and well funded, and had every chance of making a seminal contribution to this central debate in educational research. Word *et al*, a consortium of academics from four Tennessee universities, and Finn, an expert on education experimental design, collaborated to write the official report. Reanalysis were provided by a number of researchers including Hanushek as well as Krueger and Mosteller.

Project STAR Results

The official report found that students in smaller classes scored better than those in regular classes for every year, but the effect size was largest in the early grades. They found that teacher assistants were beneficial, but did not produce as large an increase as the CSR (Word *et al*, 1998). The follow up report of STAR students in the 10^{th} grade by Pate-Bain *et al* (1997) found there was not a statistically significant difference in standardized test scores between those who had been in the smaller class. However, those who had been in small classes showed better marks in their high school courses.

The reception given to the results of Project STAR illustrates some of the challenges that educational research faces. As perhaps one of the best funded and most methodologically sound experiments ever conducted in education, publication of the results was by no means the final word on CSR. Mosteller's (1995) concluded that STAR was one of the most reliable educational experiments done to date.

Finn and Achilles (1990) were at vanguard of the positive reviews and once again, Hanushek and Krueger have been amongst the leading figures in the interpretation. As would be expected, Hanushek (1998) argues that the effects are negligible, and Kruger (1998) argues that they are significant.

The nascent consensus over Project STAR seems to be that while it was by no means a perfect experiment, it provides some of the most carefully obtained data to show that small classes are more effective in raising student achievement, almost certainly at the earlier grades, but perhaps not quite as much in later grades. Students from low SES groups also benefited more than those from higher SES groups. Most researchers would also agree that STAR did not show that CSR is effective under all conditions.

STAR did illustrate some of the conditions needed for CSR to be effective. These include a supply of qualified teachers to fill the increased posts that become available with this kind of policy. Space for additional classrooms can also become a problem. Apart from the physical hurdles, it is often difficult to gauge if student achievement changes are due to CSR or some exogenous variable. The possibility of exogenous variables present serious challenges to CSR research, which are very much evident if one compares two of the most comprehensive applications of CSR to flow from the influence of Project STAR: the large interventions in the American states of Wisconsin and California.

Project STAR applications

The state of Wisconsin sponsored a pilot study in smaller classes called the Student Achievement Guarantee in Education , or Project SAGE. It ran for five years, starting in 1996 with classes in 30 schools in 21 districts. The project was not as well funded as Project STAR and so lacked a number of the controls that STAR used to increase the validity of its results. Most importantly, there was not random allocation of students to smaller and regular classes (Molnar *et al*,1999). Comparison schools were not pair matched, but drawn from the same districts.

The effect sizes found were not as impressive as those in Project STAR, but it was still found that smaller classes are more effective in raising test scores. In addition, Project SAGE surveyed teachers and found that they strongly endorsed the reductions, saying that they were able to send

more time with each student (Molnar et al, 1999). Criticism has been limited, with Hurtz (2000) providing a poorly reasoned accusation of bias. Project SAGE has grown to a state wide project open to all public schools in Wisconsin.

An even larger application of CSR was California's initiative in the mid-1990s. The state was prompted by Californian students' poor showing in the national assessment test. Propitious economic circumstances lead to the state of California being in a financial position to implement the findings from Project STAR on a large scale, in a state with the largest average class size. The programme was implemented in 1996, starting at grade one and then moving up to grade three, with the aim of reducing the average class size to less than 20. Results did not show significant changes (Bohrnstedt and Stecher, 2002). Small improvements were found, but could not be casually attributed to the class size reductions by the consortium of research organizations that worked with the education department.

CSR has shown some strong positive results. Some results remain ambiguous in developing country contexts. For instance, Fuller and Clarke (1994)'s tallying of studies involving average class size in developing countries found that nine out of 26 showed significant effects in primary schools, and only two out of 22 showed significant effects in secondary schools.

In conclusion, it does appear possible to make more informed statements about CSR on the basis of research synthesis and experimental results. Class size reduction does benefit students, but not all students and grades as much as others. At the same time, care also needs to be taken over the quality of the additional teachers and the provision of teaching facilities.

Textbooks

Textbooks have been surpassed in terms of content volume by digital publications but still remain an efficient and accessible way of storing knowledge. In environments were the teacher's knowledge is sub-standard, the textbook can be a more important source of reliable knowledge. Intuitively, it makes sense that textbooks should have a positive effect on student outcomes in the developing world. In practice, the situation is not so straightforward.

Fuller and Clarke's (1994) review found 19 out of 26 studies of primary schools and 7 out of 13 of studies involving secondary schools reported significant effects of textbooks on test scores in developing countries.

Studies examining textbook effects are a good example of the omitted variable problem in that they are retrospective – by looking back at schools, there could be another reason that the schools have textbooks that is also a cause of improving test scores. There are two randomized trials in South American and a more recent one in Africa that attempt to overcome some of this problem.

Jamison, Searle, Galda and Heyneman (1981) gave 20 classrooms in Nicaraguan schools mathematics workbooks, and used another 20 as controls. The students with workbooks did better than the control group. A detailed trial in Kenya by Glewwe, Kremer and Moulin (1998) monitored the effect of charity's provision of textbooks in 25 primary schools chosen at random from a group of 100. They find no significant average effect on post-intervention scores for those that did receive textbooks. However, the students who scored in the top two quintiles in the pre-intervention test improved their scores by a small, but significant margin.

The main problems with supplying textbooks are financial and logistical, but in sum they do represent an important base for learning, whatever the curricular approach used.

School-based factors illustrate the importance of the adage that *correlation is not causation*. Aside from poorly constructed and controlled research, attributing correlation to causation is one of the leading causes of spurious school effects research. For instance, Myhrvold *et al* (1996) found that air quality can be correlated with student performance

Summary

The international literature has explored the post-Colman world in substantial detail. Enrolment has been a focus of investigations as actually being in school is the first step towards attainment and achievement. The main line of investigation is household influences. There is strong consensus that parental income and household wealth are key determinates of successful outcomes. The mechanism of the wealth-enrolment link appears to be a simple one, in that richer families can pay both the direct and indirect costs of schooling as well as the opportunity cost of having a child enrolled. Educational economics may not have many absolutes, but household

income and enrolment link comes closed to being considered a certainty. There may be some hidden variables such as parent's valuing of education, but this is not measured in the current international literature.

Attainment and achievement can be conceptualized as 'in-schools' variables. Once again, household factors feature, but investigators shift the emphasis to school factors. The key variable here is class size. The literature is controversial, but the experimental data appears to edge out in favour of smaller classes. Basic infrastructural factors that enable an educational environment are important such as textbooks have been found to play a role.

Many of the large school studies or research has been conducted in Europe or the USA. The HL effect showed that the mix of influence factors tips towards schools in developing countries. This fits the explanation that schools in the developing world have a greater variety of resources than in the developed world. While polemical around the edges, the core of international literature has shown that

- Family resources, especially income, matter
- Basic infrastructure in developing countries matters.
- Schools can have an effect on improving student outcomes.

South Africa is an unusual case in that there is a huge variation in the school resources, home environments, and socio-economic conditions. South African literature faces the challenge of interpreting a massively complex social and economic environment.

International Literature		
Study	*Dependent Variables*	*Explanatory Variables*
Family Background – Pre School		
Hart and Risley's (1995)	Vocabulary	Socio-economic class
		Parental Education
Plug and Wijverberg (2001)	School success	Parental income
Filmer and Pritchett (1998b)	Enrolment, Attainment	Household Income
Argentina, Escudero and Marchionni (1999)	Enrolment,	Household Income Decile
Filmer and Prichett (1998a)	Enrolment	Household Asset Index
Behrman and Knowles (1997) (Review 42)	Enrolment	Household Income
Taubman (1989)	Attainment	Parental Income
Ranasinghe and Hartog (2002)	Enrolment, Attainment	Family background and income
Deininger (2003)	Enrolment	Parental Income
Dehejia and Gatti (2002)	Enrolment	Access to credit
Fuller, Singer and Keiley, 1995	Female Edu Attainment	Family Size
Quisumbing and Maluccio	Household Edu Spending	Female headed households
Lloyd and Blanc (1996)	Hh edu spending	Female headed households
School-based		
Brookover *et al* (1978)	Achievement	School Climate
Hanushek 1996, 1998	Achievement	Per-pupil Spending
	Achievement	Pupil-Teacher ratios
Greenwald, Hedges and Laine (1996a)	Achievement	Per-pupil spending, Pupil Teacher Ratios
Ferguson and Ladd (1996)		
Fuller's (1987)	Achievement in developing countries	School- based factors
Heyneman and Loxley (1982	Achievement in developing countries	School-based factors
Baker, Goesling and Letendre (2002)	TIMSS-R scores	Family background
Glass, Cahen, Smith, and Filby (1982)	Achievement	Class Size
Hnaushek (e.g. 1998)	Achievement	Class Size
Word *et al*, 1998 (Project STAR)	Achievement	Class Size
Howley and Bickel (1999)	Achievement	School Size
Fuller and Clarke (1994)	Test scores	Textbooks
Glewwe, Kremer and Moulin (1998)	Test Score	Textbooks

Chapter Three

Student Outcomes in South Africa: The Existing Literature

Any analysis of the South African schooling system must start by noting the central influence apartheid policies had in the allocation of resources to racial groups.

Apartheid policies created different education departments based on racial grounds, and funded them disproportionately. The result was highly inequitable a public schooling system. Black students from low-income families had access to schools administered by poorly funded departments. Their white counterparts had access to a better-resourced public schooling system.

These funding patterns did start to slowly change in the mid-1970s and 1980s as the state started to increase funding to the schooling system. The increase is evident in the work of Fredderke, de Kadt and Luiz (2000) who illustrate the distribution of resources in the South African schooling systems from 1910 to 1993. Fedderke and Luiz (1999) fitted the data behind these long-term trends to time-series analysis. After controlling for GDP per capita growth and political instability, the authors find that pupil-teacher ratios have a significant influence on aggregated matriculation pass rates. They find less pupil-teacher ratio variation in schools previously reserved for whites.

Current production function analysis

There are two main approaches to the analysis of inputs and educational outcomes in the South African public schooling system. The first focuses on aggregating individuals as the level of analysis, and is based on survey data. The second group uses aggregate data with schools as the unit of analysis.

In the first group, input variables are recorded on an individual or household level. These typically include detailed socio-economic measures of the household, as well as demographic data such as household composition. Information about individuals' parental education and

income is commonly collected. Some surveys ask about individuals' experience of school-based inputs such as class size. Outputs include measures of school enrolment status, educational attainment and achievement, with a few surveys have included basic cognitive skills tests. Key sources of this type of data include the SALSS, which was the first nationally representative household survey conducted in South Africa. The Southern African Labour and Development Research Unit of the University of Cape Town, in conjunction with the World Bank, undertook SALSS in 1993. It was not specifically a survey on education, but was well constructed and including a short cognitive skills test. The October Household survey is another source of South African data.

For the second group, school level input variables include school-based resources such as class size and facilities, as well as teacher quality variables. Outputs are usually the matriculation pass rate and matriculation exemption rate. A weakness of this approach is that socio-economic conditions of pupils attending school cannot be established and are generally controlled by a proxy such as the community's level of poverty in an attempt to isolate school effects. Key data sources for these studies are the provincial Educational Management and Information System (EMIS) units, national matriculation examination data published by the national department of education, the Register of School Needs and independent agencies such as the Education Foundation.

These two groups offer slightly different ways to explore the relationship between educational inputs and outputs in South Africa. The survey data perhaps offers better insight into family background, while the school-based data allows more rigorous examining of the differences of school effects.

The main works based on individual level data are those by Case and Deaton (1999), who use the SALSS data, by Anderson, Case and Lam (2001), who use the SALSS and the OHS and by Anderson (2000). Each is worth investigating from an input effect side and then by dividing into enrolment and attainment outcomes on one side and achievement on the other.

Case and Deaton (1999) find that household resources do not effect the attainment of white children, but does have impact for black children. The education of the head of the household is found to influence both black and white attainment.

Anderson, Case and Lam(2001) found a strong positive relationship between parental level of education, as well as separately by mother and father, and how many years children were formally educated for. Burns (2000) used a follow-up of the SALSS study (the KIDS study) and also found that there was a strong effect. Similarly, Fuller and Liang (1999) find a significant relationship between mother's education levels and daughter's attainment using the SALSS dataset.

South Africa is one of many developing countries in which parental education is vital to educational outcomes. Lam (1999) compared South African attainment levels with those of Brazil, a country with a similarly marked gap between rich and poor. He used the OHS 1995 to establish that if mother's education is controlled for, there is virtually no attainment gap between races. This analysis shows that children of parents who have low levels of education have more years of attainment than Brazilian children in the same position.

Maharaj, Kaufman and Richter (1998) also used the SALSS and SRN data to confirm that attainment was influenced by household level factors household income and size. Family structure, after controlling for socio-economic conditions, does have an effect on enrolment and attainment in South Africa, according to Anderson (2000). The highest degree of advantage is for children who live in the same household as both their genetic parents. He shows that children who do not live with a genetic parent have less spent on their education.

Anderson (2000) looked at family structure and educational outcomes using the 1995 OHS The strongest positive effect on enrolment is for children living with both parents over children living in a household setup where this is not the case. Children in households where neither parent is present attain the lowest levels of educational achievement. This is confirmed by Case and Deaton's finding that *'both household expenditure and education of the household head have large and significant effects on children's educational attainment.*' (Case & Deaton, 1999:1061)

The same study showed expenditure on school fees and education related items to be effected by family structure, however the effect is weaker than the effect on enrolment.

School level resources

Case and Deaton (1999) make the point that under apartheid, black families had little influence over where they could live, and no political mechanism to lobby for better quality school, and that this reduces some of the extraneous effect of these influences. Consequently, their regressions show weak effects of family background variables on district level pupil-teacher ratios.

Class size has a greater variety in South Africa than in many countries due to the skewed resourcing of the different apartheid schooling systems. This presents an interesting opportunity for researchers. Case and Deaton's estimates use pupil-teacher ratios derived from merging data on pupil-teacher ratios (by race) for a given magisterial district[1] to the location of the household in the survey by matching the race of the head of the household. They then use this ratio as a proxy for school resources. Dividing the respondents by race, lower pupil-teacher ratios are a '*strong and significant* '(ibid:1073) predictor of higher attainment. It is also significantly associated with enrolment status (CandD:1075), a finding echoed by Maharaj *et al* (1998), who found pupil-teacher ratios are significantly associated with student levels of attainment.

Achievement outcomes

Literacy and quantitative skills test are used to gauge achievement outcomes in survey data. The SALSS included a fourteen question test, made up of comprehension style questions and a computation section. This test has provided a convenient output measure for three slightly different studies.

The first study is by Case and Deaton, who use a sub-sample of individuals between ages 13 and 18 years old, breaking down the sample into a large black group and a smaller white sample. Lower pupil/teacher ratios, education of the household head and household financial resource all have a positive effect in regressions. Later regressions include educational attainment, which is shown to have a strong effect on test scores.

The second analysis is by Van der Berg, Wood, and le Roux (2002). Their approach was to use the data to trace the influence of socio-economic variables on test-takers. They did this using a

[1] Drawn from The Education Atlas of South Africa (1994)

sample size of 2 179 individuals, and found that urban students scored higher than rural ones on a consistent basis. Household expenditure was also directly related to better scores. Regressions showed that socio-economic background had an influence on test scores separate from educational attainment. In other words, socio-economic factors impacted on test scores when education was held constant.

Schools as a unit of analysis

Studies that use schools as the unit of analysis have more refined measures of school quality, and generally use approximations of socio-economic conditions. They are not able to address individual variation in family background much detail. Three national studies use data based n school-level data.

Crouch and Magobane (2001) attempt to isolate what cannot be explained by socio-economic backgrounds and school resources. They attribute this residual to management factors. Crouch and Magobane use data from matriculation examinations averaged by school, sourced from EMIS data, the SRN and some of the national DOE data on schools' socio-economic conditions. Their data is only for Gauteng and the Northern Cape provinces. In addition to both family resources and school resources, they identify *'contextual poverty'* (ibid:3) as a factor influencing achievement outcomes. Using statistical controls to equalize resources, their results indicate that schools in areas of widespread poverty score 20 percentage points lower on matriculation examinations than schools school in better socio-economic areas. Another intervening factor is whether the school was previously part of the ex-Department of Education and Training. Of the school factors, Crouch and Magobane (2001) find a more significant influence for the quality of educators rather than the pupil-teacher ratios. The quality of teachers is measured by average years of qualifications of the teachers per school. Each extra year of teacher qualification, according to their regression, increases matriculation pass rates by 16 %. They state that teacher qualifications seem to be "*by far, a more important factor than any ratio, or any other cost-related resource factor*" (ibid:6).While this finding is interesting, it needs to be treated, as the authors admit, with a fair degree of caution for a number of reasons. For one thing, their measure of poverty in their regressions was not for individuals or schools, but for quite wide areas. Also, their outcome measure is a broad measure of matriculation results, which tends to smooth over the wide disparities between subjects, some of which are less associated with school factors.

Van der Berg (2002a) examines secondary schools in all the provinces, except Mpumalanga and the Eastern Cape. He looks at school-level 1999/2000 matriculation exam results by running a regression with a number of school based factors. School fees are used as a proxy for socio-economic background, as are class size for school quality. Average teacher salary stands as a rough measure of teacher quality. Both of these factors are highly significant for all schools in his regression. The author makes the point that resources do matter, especially in schools that he classifies as having a majority of black pupils. The school fees coefficient illustrates this by being three times larger when applied to in black majority schools than other schools. However, these factors still leave a large amount of variation unexplained, something that Van der Berg attributes to managerial factors.

The Western Cape has a high quality of educational data collection, and hence is the focus of two studies of school-level data. While the Western Cape has consistently had higher achievement rates than the rest of the country, the more extensive data compiled allows more variables to be considered than might be the case with national data.

Van der Berg (2002b) uses high schools in the Western Cape to examine influences on an overall matriculation achievement index and a mathematics index that he constructs. The overall index was significantly influenced by a poverty index of the area surrounding the school, the pupil-teacher ratio, school fees and average teacher qualifications index. Changing the dependent variable to the mathematical index, pupil-teacher ratios become insignificant.

Fiske and Ladd (2003) present two models of matriculation outcomes determinates in the Western Cape, one for all schools, and one with dummies for former apartheid education departments. The dependent variable is matriculation pass rate by school, where matriculation endorsements are weighted at 1.33 of an ordinary pass. Both models show pupil-teacher ratio as significant, as well as average teacher qualification. Teacher variables include the percentage of teachers with less than 13 years of education, which has a significantly negative effect on the model that does not incorporate former apartheid departments. On the family background side, the community poverty index has a negative effect and school fees a positive effect, with both being significant.

Summary

The South African literature yields findings largely congruent with international studies. On the school side, these studies show the powerful effects of skewed resourcing of the public schooling system still persist in unequal outcome. The studies in this chapter illustrate that pupils in schools with larger class sizes, and teachers who are poorly educated, have lower levels of educational outcomes. Also consistent with the international literature, are the results showing a correlation between household income and educational enrolment and achievement outcomes. The studies repeatedly show that young people in South Africa tend to attain fewer years of education and lower levels of educational achievement if they come from low-income families.

The existing literature in South Africa largely confirms what has been shown internationally. Enrolment rates are associated with household factors such as the household head's education and socio-economic background. Attainment is related to pupil-teacher ratios, amongst other factors. Achievement outcomes, largely measured by test scores and some by matriculation results, show strong associations.

South African Literature		
Study	*Dependent Variables*	*Explanatory Variables*
Case and Deaton (1999)	Enrolment rate	Pupil-Teacher Ratio
		Female Dummy
		Household head education
		Expenditure per hh member
		Household Size
	Years of Completed Edu	Gender
		Hh size
		hh resources
		Dummies for urbanization and province
		Education of head of hh
	Literacy Survey	Years of completed edu
		Age (in col 1 not col 2)
		Pupil-Teacher Ratio
		Head of house completed edu
		expenditure per hh member
		Library
Anderson, Case and Lam (2001)	Years of Schooling	
	Children's Schooling	Mother's Schooling
Fedderke and Luiz (1999)	Teacher Educator Ratio	
	Spending per Pupil	
	Matriculation Pass Rate	
Maharaj, Kaufman and Richter (1998)	SALSS Literacy	Household Income
	Attainment	Pupil-Teacher Ratios
		Household Size
Anderson (2000)	Enrollment	Family Structure
Van der Berg, Wood, and le Roux (2002)	SALSS Literacy	Urban/Rural
		Socio-Economic background
Fiske and Ladd (2002)	Matriculation Pass Rates in WC	Learner Educator Ratio
		Average Qualifications
		Percent Unqualified Teachers
		School Governing Body Paid
		Community Poverty
		School Fees
		School Resources
		Exdept control
Crouch and Magobane (2001)	Aggregate Matriculation Pass Rate	Family Resources
		School Resources
		Community Poverty
Van der Burg (2002a)	Matriculation Pass Rate	Community Poverty
		Pupil-Teacher Ratio
		School Fees
		Average Teacher Qualifications

Chapter Four

Evidence from the Cape Area Panel Study

4.1 The CAPS Study

This section presents data obtained from the educational outcomes section of the CAPS study, with additional data derived from WCED information. The chapter builds on the existing literature on educational outcomes in South Africa by adding some additional dimensions made possible by the dataset. These dimensions include detailed breakdowns of outcomes by race, socio-economic status, and household characteristics.

CAPS was conducted by the Centre for Social Science Research at the University of Cape Town. The first wave of the panel was conducted in late 2002, with the second wave due for 2005. It consists of two survey instruments, namely a household questionnaire[2] and a separate questionnaire for young adults. The household survey included questions relating to demographics and migration, schooling, work and income of all individuals living in the house. Characteristics of the household including physical facilities of the property, size of house, ownership as well as income, expenditure and debt for the household were recorded.

A further questionnaire[7] was administered to those identified as young adults between the ages of 14 and 22. The Young Adult questionnaire was administered to young people in household who fell into the appropriate age category. Questions covered living arrangements, schooling, employment and first work experience, health and fertility, parental characteristics and involvement, childhood influences and time allocation. While the questions provided a detailed information source, any analysis of survey data, and especially one that details with educational inputs, must proceed with a degree of caution.

[2] Both are available on-line at http://www.uct.ac.za/depts/cssr

Methodological considerations

A number of considerations need to be acknowledged when using the data. Perhaps the most pertinent is that data is only available for first wave of the study. Consequently, some of the data is retrospective, which leads to issue of reliability. Another important consideration is that the survey is based on the Cape area, an area that is atypical of South Africa. The Western Cape has higher levels of income and education than other provinces. For instance, 22 % of South African adults aged 20 and older nationally had no education, while this was the case only in 5 % of the Western Cape population (StatsSA,2003). Given these limitations, the data still offers the opportunity to make worthwhile observations and provide some pointers to the many questions about how to improve student outcomes in South Africa.

The other key methodological concern lies with the endogeneity of modelling educational inputs and the presence of hidden variables, especially those surrounding parental financial endowment and parental school choice. In general, the educational production function model is far from perfect. Monk (1990) has identified limited variation and variables moving together as the primary potential problems. Limited variation is not as much of problem in South Africa as in the American environment that Monk deals with. Class size, for instance, does not vary to the same degree in the American public schooling system as it does in South Africa. The next problem of dependent variables being correlated is a significant issue with regards to socio-economic and school factors. Well-educated individuals tend to earn more and so have higher household incomes, and tend to move to schools that are of a higher quality. As illustrated in the previous chapters, researchers have been well aware of these problems in educational research (Buchman, 2002) and the best strategy is to acknowledge their existence and proceed with due care.

Young adults have access to school-based resources according to economic and social patterns, rather than random allocation. Economically, higher income household can afford to pay higher school fees. In social terms, parents who value education make an effort to place their children in what are perceived to be better schools. Young adults from higher socio-economic classes are more likely to attend better-resourced schools, and the converse for those on the opposite end of the scale.

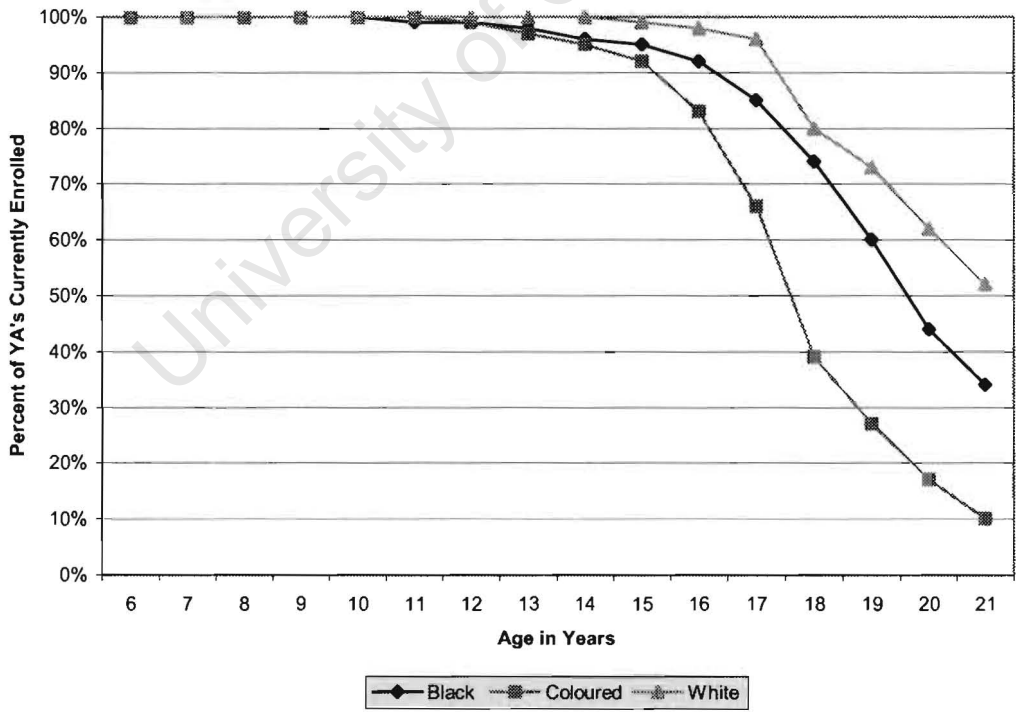
Descriptive Results

This chapter uses a prism of three types of educational outcomes, namely enrolment, attainment and achievement. The chapter that follows uses multiple regression analysis to attempt to unravel some of the correlates of successful and unsuccessful outcomes. The individual and household level data is enriched by school level data from the WCED making it possible comment about this level of resource allocation and its impact on outcomes.

4.2 Enrolment

The South African Schools Act (1996) provides for compulsory education until the learner reaches the age of 15, or the ninth grade. There is a large drop off after age fifteen, which continues with age progression. Overall, the enrolment rates are comparable to other studies on South Africa such as Case and Deaton. However, these enrolments are not uniform across different groups in South African society, as the Figure 1 illustrates.

Figure 1: Young Adults Educational Enrolment, by Race



The most obvious fact to emerge is the racial disparity. By age 18 there is a large gap between the groups, with a greater than 20 % gap between black and white young adults. The Coloured YA enrolment rate is low, with nearly half of coloured 18 year old respondents not enrolled. The low coloured enrolment can be investigated further by looking at income groups for coloured young adults only in Table 1. The break down of enrolment by income parallels the differences shown in Figure 1.

Table 1: School Enrolment Rates by Age , Coloured YAs

	Low Income		Income Quintile		High Income
Age	**1**	**2**	**3**	**4**	**5**
14	83	90	100	100	100
15	53	75	90	92	97
16	50	68	61	88	95
17	60	31	38	70	87
18	28	36	14	59	59
19	13	12	27	28	54
20	0	14	5	20	33
21	0	5	5	15	26
22				5	8
N=1664					

Higher household incomes are associated with substantially higher rates of school enrolment. The difference between enrolments for higher income groups and the bottom quintiles is particularly striking. This suggests important income effects within race groups as being associated with major enrolment opportunities. If income effects are important, the same trend would be evident when looking at data for black young adults. Table 2 shows that household income is clearly related to enrolment.

Table 2: School Enrolment rates by Age, Black YAs

	Low Income		**Income Quintile**		High Income
Age	1	2	3	4	5
14	96	98	96	95	100
15	96	98	95	86	100
16	82	96	87	100	100
17	87	77	88	90	100
18	70	87	77	77	91
19	60	57	67	65	100
20	28	33	43	52	70
21	30	22	21	52	45
22	30	13	21	34	36
n=1791					

A comparison with the coloured enrolment (Table 1) shows that enrolment rates are higher across all income quintiles for black respondents. Higher income quintiles show consistently higher enrolment. Being in the top quintile is associated with very high rates of staying at school for those in late adolescence. If race is set aside, and only household income is examined, Table 3 shows the clear relationship between household income and enrolment.

Table 3: Enrolment by Age and Household Income Quintile, All

	Low Income		**Income Quintile**		High Income
Age	1	2	3	4	5
14	96	98	96	95	100
15	96	98	95	86	100
16	82	96	87	100	100
17	87	77	88	90	100
18	70	87	77	77	91
19	60	57	67	65	100
20	28	33	43	52	70
21	30	22	21	52	45
22	30	13	21	34	36
n=1791					

This centrality of household income confirms the importance placed by the literature, both internationally and in SA, on the influence of socio-economic status on attending school. There are often numerous, and intertwined reasons for this. One of the most important to consider is that higher income households send their young adults to higher quality schools. A relatively crude way of measuring this is to look at the average class sizes that those who were enrolled at certain age faced compared with those who where no enrolled, as set out in Table 4.

Table 4: Class Size by Currently in School, All

	Enrolment Status	
Age	Yes	No
14	33	33
15	32	30
16	31	28
17	33	29
18	32	30
19	35	32
20	30	34
21	32	32
22	32	31
n=1283		

The obvious problem with Table 4 is that comparing the average class sizes of those that are not enrolled is that they by definition do not have a class size for that year. Hence it is difficult to give much significance to the small differences that we see. Another way of estimating school quality is to look at teacher quality. In table 5, teacher quality is understood by using teacher qualifications as a measure of quality, with the YAs divided into those enrolled and those not enrolled by age. As with the class size table, no clear pattern emerges.

Table 5: Teacher Qualification by Age, All

Years	Currently in School	
YA Age	Yes	No
14	13.8	13.7
15	13.9	13.6
16	14.1	13.8
17	13.9	13.9
18	13.9	13.9
19	13.9	14
20	13.8	14
21	13.9	14
22	13.7	14
n=1283		

4.3 Attainment

Attainment is the amount of education obtained and is most commonly measured this is the number of years of education successfully passed. The appropriate number of years of education for each age is set out by the national Department of Education. The admissions policy for ordinary public schools (1998) states "*the statistical age norm per grade is the grade number plus 6* ". A learner would have to be enrolled for a whole year as well as pass the year to be admitted to the next grade level. However, there may be other reasons for falling behind apart from failing the year, namely the opportunity cost of a having a member of the household go to school when they could be earning an income for the household.

Given the differences in enrolment, it would be expected that black and coloured YA attainment rates lag white YA attainment. Table 6 shows these racial differences in educational attainment at each age. By age 14 white YAs are already one year ahead of their peers in attainment, an advantage that is extended by age 18 to nearly two years over black YAs aged 18 and one year over coloured respondents of the same.

Table 6: Years of Educational Attainment, by Age and Race

	Average Years of Educational Attainment			
Age	Black	Coloured	White	Official grade completed
14	6.37	7.12	7.12	8
15	7.15	7.77	8.09	9
16	8.04	8.59	9.11	10
17	8.56	9.16	10.08	11
18	9.23	10.06	11.09	12
19	9.60	10.32	11.92	
20	10.05	10.46	12.26	
21	10.23	10.46	12.48	
22	10.43	10.43	12.89	
N	1800	1645	415	

Another way of presenting the racial differences is by percentage distribution by race of the highest grade attainment. Table 8 shows the average reported years of attainment of 18 year olds for each racial group.

Table 8: Distribution of Years of Attainment for 18 year olds, by Race

Percent			
	Black	Coloured	White
Attainment Level			
4	1.5	0.5	0
5	3.7	1.2	0
6	8.7	4.5	1.9
7	11.2	13.5	9.1
8	17.6	19.7	14.4
9	17.6	17.5	11
10	14	14.4	17.1
11	12	9.6	12.7
12	11.2	16.0	26.9
13	0.6	1.7	2.4
14	0.8	1.2	4.1
n=3860			

These differences prompt two lines of investigation .The first asks if the differences in attainment that emerge by racial grouping, are in fact due to differences in household income, the importance of which was clearly established with regard to enrolment. In other words, the question is if, regardless of race, high-income groups obtain more education than their less well off counterparts.

The second asks if the differences evident by age 14 stretch back to earlier ages. Another way of putting this is to ask the question: do some groups enter schools at earlier age and maintain that advantage, or do they start roughly equal and some groups advance faster or than others?

The best way to investigate these points is by correlating attainment with age, dividing each race group into household income quartiles.

The results in Figure 2 illustrate the advantage in attainment that comes from being in household income quintile 4 or 5, regardless of race. This supports the argument that household income has as powerful an association as race in understanding attainment advantages. Figure 2 also shows that different income and racial groups start at similar points at age 6, but follow different trajectories. A closer look at the income quartiles for black YAs is shown in Figure 3, further illustrating the clear income hierarchy of intra-racial advantage.

Figure 2: Attainment, Black and Coloured YAs

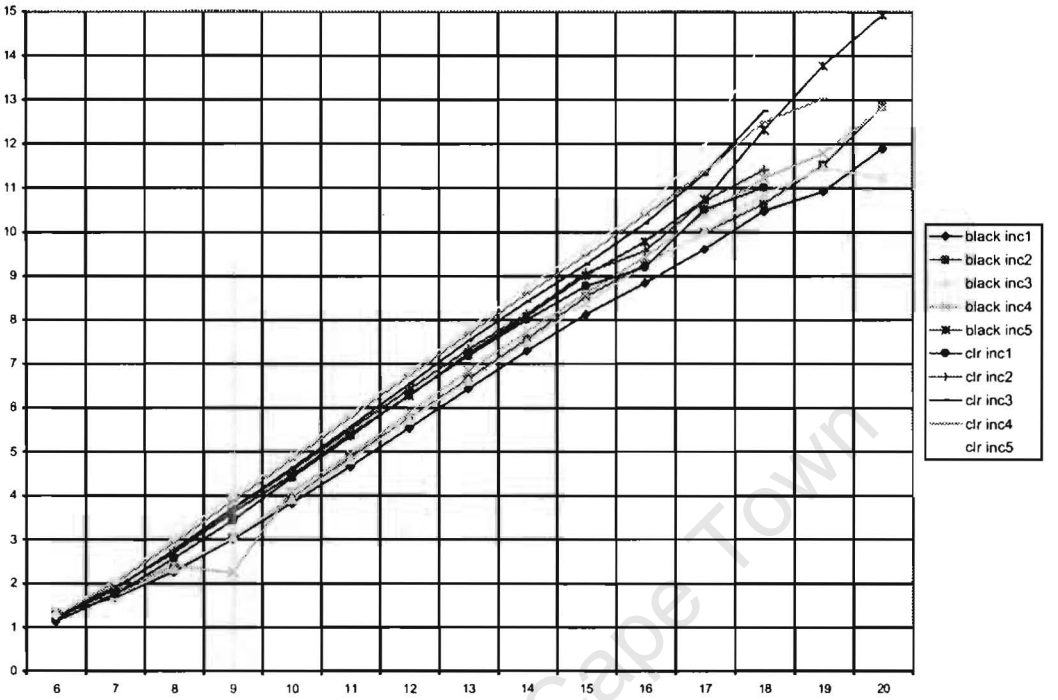
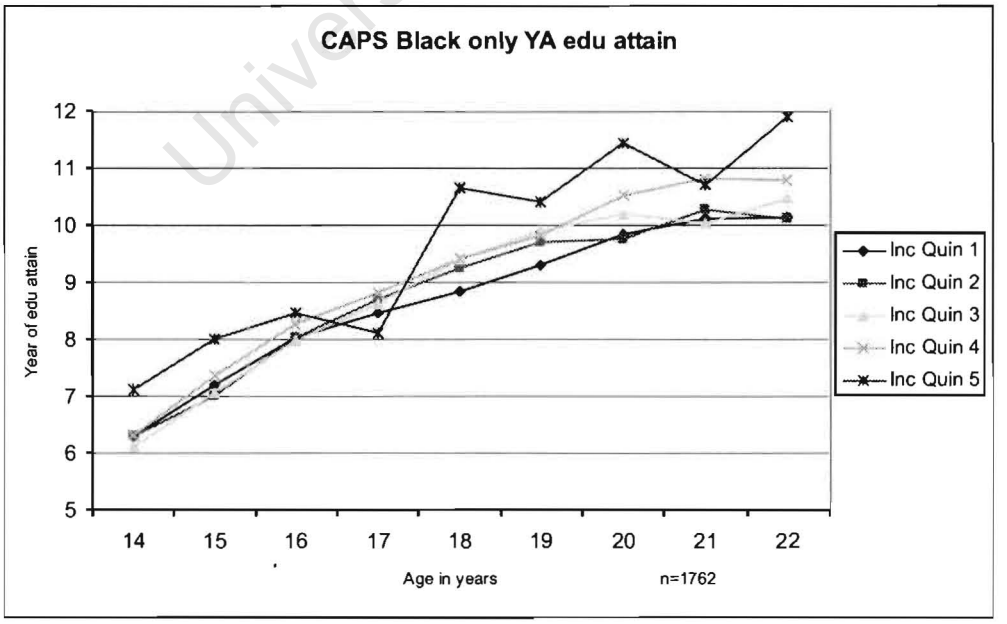


Figure 3: Attainment, Black YAs



It is useful to compare these results with those found in the 1993 SALSS data. Seekings (2003:49) analysed attainment by using a class perspective. He classifies the data into five class categories on '*the basis of the employment relationship*'(ibid:17). Considering only black YAs finds comparable patterns to this data, as there is a difference in attainment between the children of parents in the semi-professional class and children from upper-class famlies.

While the CAPS data does not yet include occupation-based class categories, the household income data provides a useful proxy for class. The means that this indicator is calculated using income for whole house reported by a person who is knowledgeable about the household as well as being a member of that house.

Aside from the importance of household income groupings, the literature shows that one of the most critical factors in educational attainment of young adults is the education that their parents received.

Figure 4: YA Attainment by Mother's Education

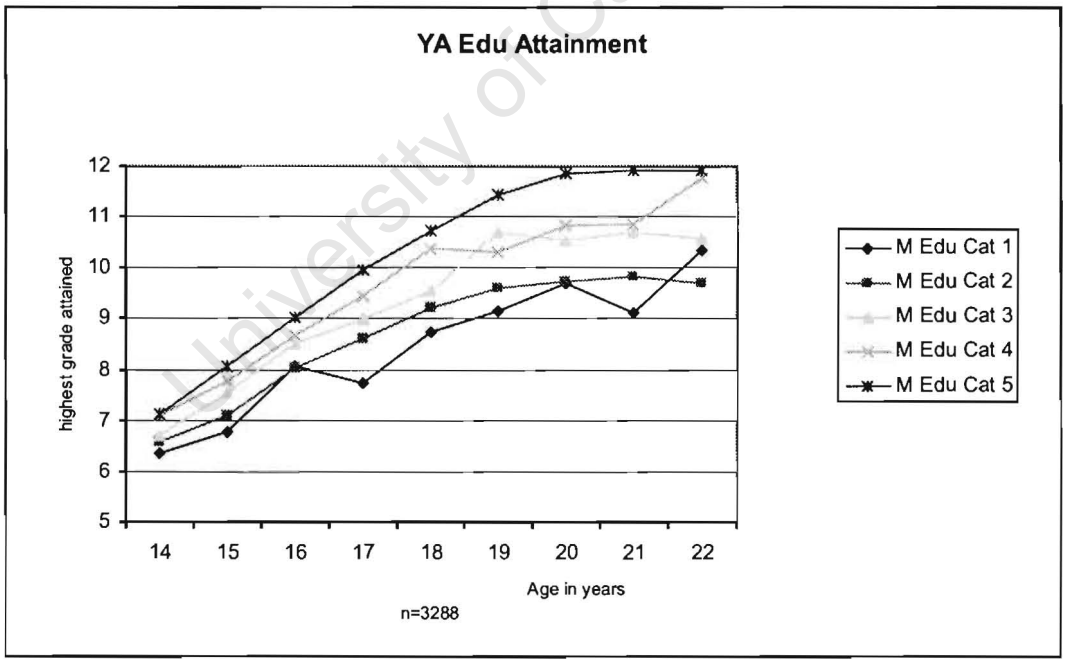
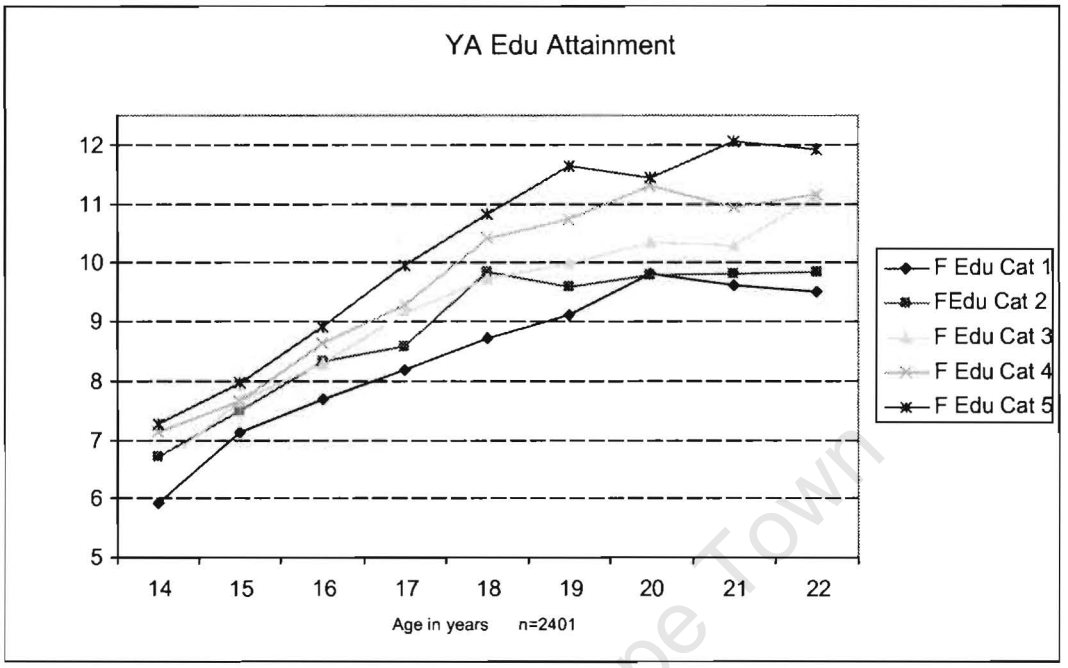


Figure 5: YA Educational Attainment by Father's Education



The association of their mothers and fathers' education and that of the father with young adults' educational attainment is starkly shown in Figures 4 and 5. Children whose parents have more education are at an attainment advantage at every age. These findings are in line with international work that shows parental education to be a key part of educational outcomes.

School based factors and attainment

Advocates of effective schools put forward the belief that high quality teachers, small classes and other factors help students to stay at school and progress into higher grades. Teacher's experience, holding race constant is examined in Table 9 and Figure 7. Table 9 shows a marginal association between teacher quality on years of attainment for coloured YAs. Figure 7 looks at attainment for black YAs by teacher quality, measured as years of experience.

Table 9: YA Attainment by Teacher Experience, Coloured YAs

	Less Teacher experience Cat More		
YA Age	3	4	5
16		8.3	8.4
17	8.3	8.7	8.8
18	9.5	9.9	10.1
19	10.1	10	10.5
20	9.9	10.4	10.5
21	10.6	10.3	10.5
22	10.3	10.5	10.5

Figure 7: Attainment by Teacher Quality Catagory, Black YAs

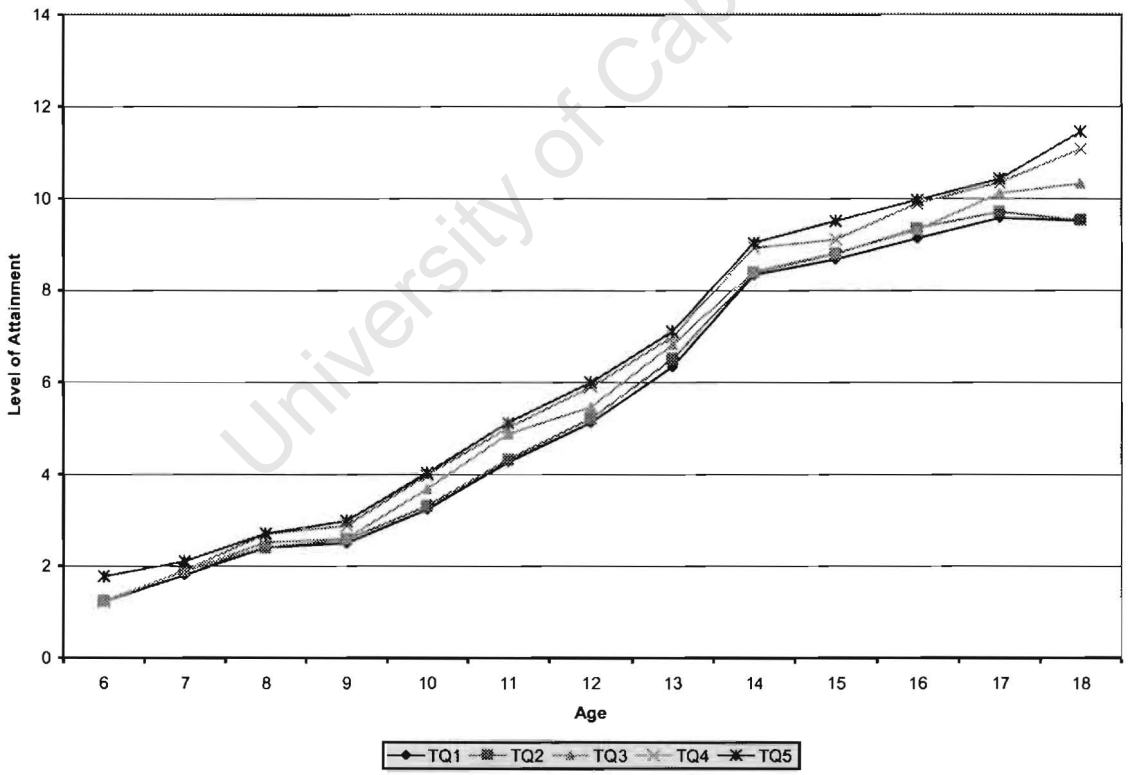


Figure 7 shows largely parallel lines, suggesting that those with better teachers enjoy a consistent advantage right throughout their time at school. This trend might be a result of sorting in that the

most experienced and high quality teachers are attracted to better schools. Indeed, the old educational departments can provide categories to breakdown the differences between YAs. Table 10 shows that attending an ex-CED school is associated with having an average of one more year of educational attainment than attending an ex-DET school.

Table 10: Student Educational Attainment, By School Ex-department

	Mean	Standard Deviation	Frequency
CED	9.9	1.9	145
DET	8.8	2.1	493
HOR	9.5	2.1	627
Total	9.3	2.1	1265

After considering enrolment and attainment, which are measures of educational output quantity, attention can be turned to measure of quality, namely achievement outcomes. Before doing so, CAPS offers a chance to gather some information on mathematics outcomes.

Maths attainment and achievement tables

Recent emphasis on taking mathematics in higher grades has had little effect, as Table 11 illustrates.

Household income has been shown to be strongly associated with higher attainment, and the same would be expected for mathematics attainment. Holding the current grade enrolled constant gives an opportunity to see the link between household income and mathematical attainment. There seems to be less variation between income groups than in other educational outcomes. Most of the differences are about half a year in difference between the mean years completed for the highest and lowest income groups. It is worth noting YAs who progressed to upper level tertiary studies took mathematics to a high grade level.

Table 11: Highest grade of Mathematics, by Household income quartile

	Low Income		**Income Quintile**		High
	Income				
Attainment	1	2	3	4	5
5	4.5				
6	5.5	5.8	5.8		
7	6.7	6.3	6.4	6.7	
8	7.2	7.2	7.6	7.5	7.8
9	8.5	8.5	8.6	8.5	8.7
10	8.5	9	9	9.1	9.2
11	9.4	9.5	9.8	9.5	10
12	9.9	9.5	10.3	10.5	10.7
13			7.5	10.5	10.6
14	11.40	10.3	10.6	11.4	11.2

Table 12: Teacher Qualifications category by Student Race

Teacher Qualification Category	Black YA	Coloured YA	White YA
Less 1	7.1	7	
2	7.7	9.9	
3	9.3	9.4	
4	9.3	9.4	
5	9.1	9.4	10.1
More 6		9.8	10.2
N=1274			

On the school side, having better teachers and smaller classes have been linked to more attainment. For black YAs, having one highly qualified teacher is associated with two extra years of mathematics study, and for coloured YAs with more than two years. Turning to class size, the link is less obvious. Smaller classes do not appear to be correlated with taking mathematics to a higher grade, as can be seen in Table 13.

Table 13: Mathematical Grade Attainment by Class Size

Average of highest grade attained			
Class Size Category	Mean	Standard Dev.	Frequency
Smaller1	8.7	1.8	107
2	9.4	1.6	155
3	9	1.9	266
4	8.5	2.4	134
5	9	2.1	134
Larger 6	8.5	2.2	294

Table 14: Matriculation Points Scores for Mathematics only, by Race

	Mean	Standard Deviation	N
Black	2.3	1.7	121
Coloured	2.9	1.5	160
White	5.4	1.72	114

Students who take mathematics to matriculation, provide an opportunity to measure achievement. Table 14 illustrates the quality of mathematical achievement using the mean matriculation point score for mathematics. White YA s score more than double the amount of points that black YA s do. This has implications for the quality of mathematics teaching in ex-DET schools.

Mathematics attainment and achievement outcomes appear not be a special case, and follow the larger themes that emerge when investigating attainment.

4.4 Achievement outcomes

Achievement outcomes are worth considering in some detail for the reason that they measure the *quality* of educational outcome as opposed to enrolment or attainment, which are measures of the quantity of education. Many studies equate attainment with achievement, in that years of education is used as a measure of educational achievement. However, schools are not equal, and five years attained at a poorly resourced school with large classes and poor quality teachers might not equip a young adult with the same cognitive skills that a well-resourced school would.

Two achievement outcomes measures are available to help understand what resources are associated with higher quality education. The first consists of a subset of YAs who have taken the matriculation examination, and the second measure is the score derived from the literacy and numeracy tests administered to those YAs who consented to take them.

Matriculation Examinations

The annual matriculation examinations written at the end of Grade 12 are currently the only achievement outcome in the South African schooling system. The examinations are a controversial instrument, with clear advantages and disadvantages (Taylor, 1999). The most salient criticism is that such a low percentage of young people attain sufficient levels of schooling to be eligible to write matriculation exams. While there maybe drawbacks, matriculation examinations do, however, offer an accessible measure of achievement outcomes in a country that has a paucity of outcomes measures. The national department of education has moved to implement new measures at different stages of the school system, but until those have been implemented, matriculation examinationss remain valuable. Matriculation examinations do have a degree of validity and the performance of the provinces in the TIMSS assessment was largely consistent with provincial matriculation results. Matriculation results have also been shown to be roughly consistent with undergraduate university performance. (Mitchell *et al*, 1997). In short, matriculation exams fall short of ideal, but do provide some sort of outcome indicator for the schooling system (Seekings, 2002).

Matriculation examinations offer an insight into quality outcomes, as attainment is held constant because matriculation examinations are always written at the end of Grade 12. Possible matriculation outcomes are

1) Fail
2) Pass
3) Passing with an exemption (also known as an endorsement)

Table 15: Matriculation Exam Pass Rates, All

Age	Any type of pass	Passed with exemption
17	57	
18	89	31
19	90	32
20	85	24
21	84	30
22	82	28
n=827		

The pass rate given in Table 15 and is largely consistent with Western Cape result, the highest of the nine provinces (Lombard,2001).A more sophisticated understanding of matriculation outcomes employs a matriculation points system, in which points are awarded for the symbol obtained in a particular subject. In this analysis, the matriculation symbols that young adults reported for each subject were converted to points using the Swedish system. Eight points are awarded for a higher grade A, seven for a higher grade B. For subjects taken on the standard grade, six points are awarded per A symbol and five points for a B symbol . This is similar to the system used by universities for their admission decisions and Huysamen (2003) has found that this is an optimal system for university admissions.

Applying this points system to the data on YA matriculation results, the points systems gives an approximately normal distribution of scores, as seen in Figure 8. While the sample is relatively small, there are various ways of understanding the score distribution. Holding attainment constant allows comparisons along racial and income lines. Table 16 shows that the average white YA achieves eleven points more in exams than the average black YA who writes matriculation. A large standard deviation for white YAs indicates these scores are fairly widely distributed. More refined analysis with income groups for each race is unfortunately not possible with the small data sub-set. However, household income does show a strong correlation with income, as can be seen from Table 17. Those in the top income category enjoy a four-point lead over those in the first quartile and nearly eight over the second quartile. This is the points equivalent of an additional higher grade A symbol.

As with attainment, after race and income, the literature predicts that parental education plays a large role in influencing the quality of student achievement.

Figure 8 : Matriculation Exam Points Scores

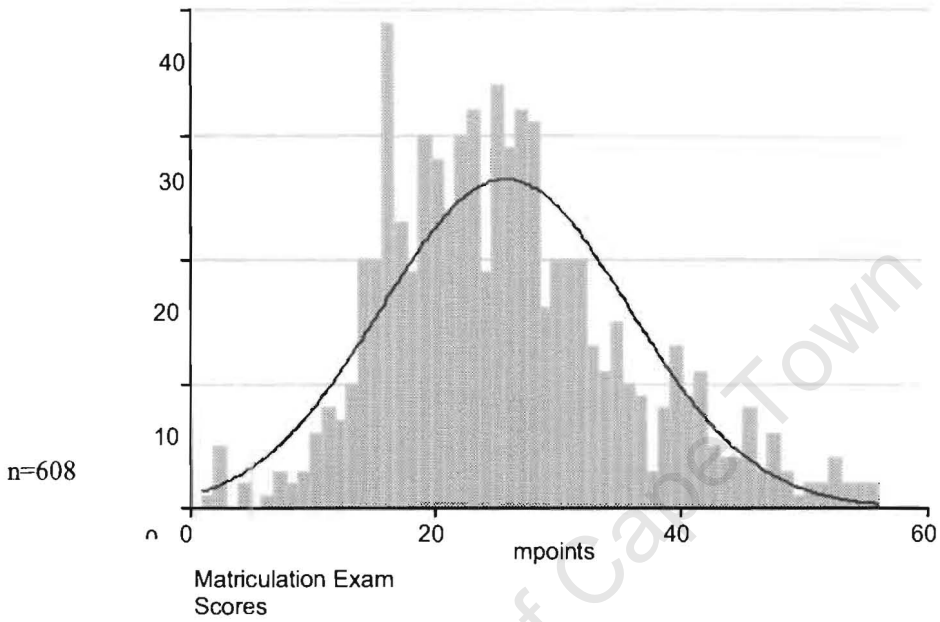


Table 16: Matriculation Exam Points Scores, by Race (All students who wrote)

	Mean	Standard Deviation	Frequency
Black	21	7	231
Coloured	26	8	302
White	32	11	149

Table 17: Matriculation Exam Points Scores, by Household Income Quintile

Income Quintile	Mean	Standard Deviation
1	24	12
2	21	7
3	23	8
4	24	9
5	28	10

Table 18 presents matriculation scores by the educational category of the mother of the YA, and controls for income quartile. As the level of mother's education increases, the trend appears to be that matriculation points scores increase. Even though income quintiles are controlled for, mother's education does not correlate perfectly with income. The fathers' educational level and income, shown in Table 19, are more closely correlated and so would provide slightly stronger support for the positive effects of parental education that are independent of income effects. The results in Table 19 show the positive link with father's education. Even the bottom two quintiles experience significantly better matriculation results as their fathers' educational level increases.

Table 18: Matriculation Points Score By Mothers' Educational Level

Mother's Educational Cat.	Lower Household Income Quartile 1	2	3	4	Higher 5	Total
Less 1	16	20	21	23		*19*
2	21	20	24	21	19	*21*
3	24	21	22	23	25	*23*
4	22	21	21	23	27	*24*
More 5	34	24	27	30	31	*30*
Total	*25*	*22*	*23*	*24*	*29*	*25*
n=559						

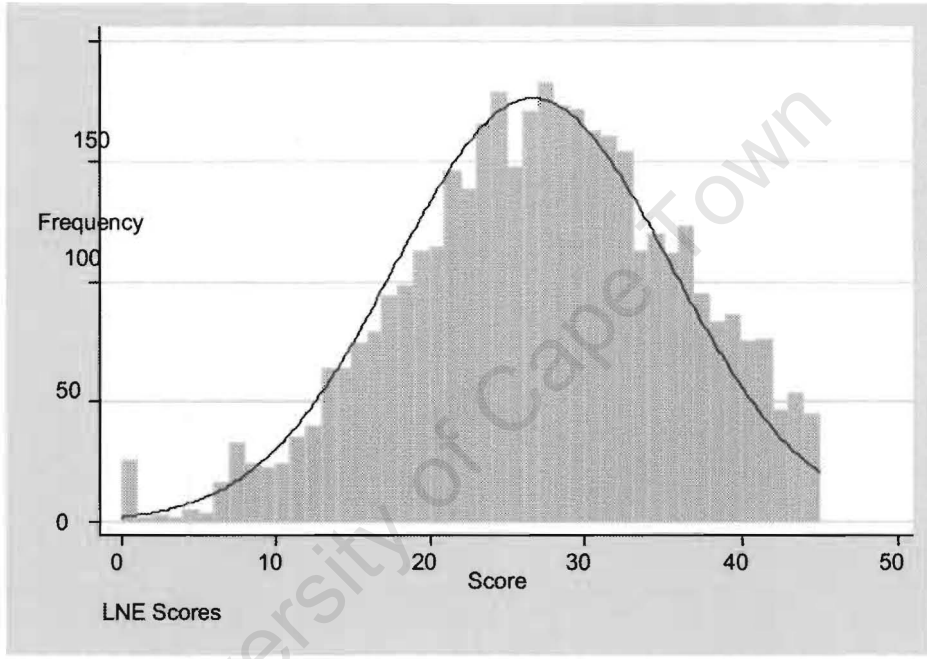
Table 19: Matriculation Points Score By Fathers' Educational Level

Father's educational category	Low Income **Income Quintile** 1	2	3	4	High Income 5	**Total**
Less 1	16	17	24	20	23	*19*
2	23	22	21	23	22	*22*
3	23	21	22	22	26	*23*
4	30	29	24	24	27	*25*
More 5	34	23	29	28	31	*30*
Total	*28*	*22*	*24*	*25*	*29*	*26*
n=449						

Matriculation points analysis show that household income and parental education matter for the quality of achievement. However, matriculation is limited as it is only administered at the end of grade 12, and so does not provide data on students who in other grades or have dropped out of school. A cognitive skills test is needed to explore educational quality outcomes more thoroughly.

Literacy and Numeracy Evaluations

Figure 9: LNE Whole Scores, All YAs (n=3910)



LNE scores were calculated by awarding one point per correct answer on the 45 question multiple-choice test. Missing or incorrect answers were given zero and there were no half or negative marks. As Figure 9 shows, the results followed a normal curve, with a mean of 26 and a standard deviation of 8 points. The test was administered as one integrated paper, but the composite score was divided here for analytical purposes into literacy and numeracy scores here for analytical purposes. Numeracy questions had a maximum score of 22 and literacy of a maximum score of 23. The high number of zero scores is something of an anomaly. This could be the result of some young adults not being able to understand the test at all, or is perhaps an error in the data.

The above represents a wealth of data, yielding achievement information on home background, and school factors that are associated with higher score outcome.

Table 20 has a large amount of information, providing comments on he first is a comment on the acquisition of language skills at an early age, and the second refers to the ability of school to influence numeracy achievement to a greater degree than literacy skills.

The literature on early language acquisition is convincing on the importance of family background to the development of young children's vocabulary and competency with language. If the language portion of the LNE is used as a rough substitute for the more sophisticated language ability tests used in studies such as Hart and Risley (1995), we can make a few comments on the advantages that some groups might enjoy before they reach school. Re-visiting these groups in the second part of the panel study would be the ideal manner of investigating school impacts, but in the absence of this data, we compare younger with older groups.

It is interesting to note that years of education appear to raise numeracy skills more powerfully than literacy skills. An argument in favour of school attainment being a cause of improved cognitive skills can be constructed by arguing that schools are responsible for the faster improvement in numeracy skills than in literacy skills. This rests on the belief that language skills are largely a function of the home environment, while parents are unlikely to teach their children the mathematical skills that they would be acquiring at school.

Support for this is offered in Table 21, by quantifying and comparing the rates of increase in literacy as opposed to numeracy skills. The literacy score increase by 70 % from Grade 4 to Grade 12 for average black YA, but numeracy scores increase by 230 %. The improvement is even more marked for coloured YAs, who have an increase of 70 % in literacy, but a 600 % increase in numeracy scores. The average white YA shows only a 10 % literacy improvement from grade 6 to grade 12 and a 100 % numeracy improvement. Numeracy is a skill that is generally gained at school rather than language competency, a skill that is primarily acquired in the home. The greater improvement for both groups in numeracy rather than literacy suggests that schools do have an impact on improving achievement scores. School factors will be broken down further after looking at some home influences.

Table 20 : Mean Literacy and Numeracy Scores, by Current Grade and Race

Literacy	Black	Coloured	White	**Numeracy**	Black	Coloured	White
Gr4	10	11		**Gr4**	3	2	
Gr5	12	12		**Gr5**	4	3	
Gr6	13	14	18	**Gr6**	5	4	9
Gr7	14	16	20	**Gr7**	6	7	16
Gr8	15	17	20	**Gr8**	6	8	16
Gr9	15	18	20	**Gr9**	7	9	17
Gr 10	15	18	20	**Gr 10**	7	11	16
Gr11	16	19	20	**Gr11**	8	12	17
Gr12	17	19	20	**Gr12**	10	14	18

Index Values of Changes

Literacy	Black	Coloured	White	**Numeracy**	Black	Coloured	White
Gr4	1	1.0		**Gr4**	1	1	
Gr5	1.2	1.1		**Gr5**	1.3	1.5	
Gr6	1.3	1.3	1.0	**Gr6**	1.7	2	1
Gr7	1.4	1.5	1.1	**Gr7**	2.0	3.5	1.8
Gr8	1.5	1.5	1.1	**Gr8**	2.0	4	1.8
Gr9	1.5	1.6	1.1	**Gr9**	2.3	4.5	1.9
Gr 10	1.5	1.6	1.1	**Gr 10**	2.3	5.5	1.8
Gr11	1.6	1.7	1.1	**Gr11**	2.7	6	1.9
Gr12	1.7	1.7	1.1	**Gr12**	3.3	7	2.0

Table 21: Numeracy Scores by Highest Grade Attained and Household Income Quartile

	Less		**Income**		More
Educational Attainment	1	2	3	4	5
5		1.4	0.9		
6		1.1	0.8	1.2	
7		0.9	1.2	1.2	
8		1	1	0.9	1.6
9		1	1	1.1	1.2
10		1	0.9	1.1	1.6
11		0.9	1	0.8	1
12		0.9	1.1	1.1	1.2

Higher household income have become associated with better outcomes, and numeracy scores are no exception. Converting numeracy scores to an index value allows the comparison of the changes associated with household income against the changes associated with increased parental education. Increases in numeracy scores appear to be as strong for increased parental education as for household income. Parental education can be approached with Table 22, which represents numeracy scores for black YAs. It starkly illustrates how having a mother who from a more advanced educational category is associated with better scores.

Table 22: Numeracy Score Index,, by Educational Attainment and Mother Educational category, Black YAs

Black only	Less	**Mother's Educational Category**			More
Edu Attainment	1	2	3	4	5
6	1	0.6	0.7	0.7	0.8
7		1	0.9	1.	1.1
8	1	1.2	1.3	1.4	1.7
9	1	1	1	1	1.3
10	1	1.3	1.3	1.3	1.3
11	1	1.4	1.3	1.3	1.8
12		1	1.1	1.1	1.4

Parental education must also be considered in the light of household structures. Table 23 suggests that there is no clear trend that can be interpreted as a supporting the argument that YAs with parents who live together have higher scores. This data does not include young adults who do not live with either parent. This is in contrast to some of the findings in the South African literature.

Table 23: Average LNE Combined Scores by Educational Level and Parental Residence Status, Black YAs

Education Attainment	Both parents resident	
	Yes	No
4	15	13
5	17	16
6	29	18
7	21	21
8	21	21
9	22	22
10	24	23
11	26	24
12	26	28
13	30	25
14	32	31

School-based factors have been influential in nearly all of the educational outcomes examined so far. It is would not be surprising if measures of school resources such as school fees, indexes of poverty in communities surrounding schools, as well as the traditional measures of class size and teacher quality, are associated with test scores.

Table 24: Mean Numeracy Scores, by School Poverty

	Low Poverty		**Poverty Index**		High Poverty
Edu Attainment	**1**	**2**	**3**	**4**	**5**
7	9	6	6	6	6
8	12	8	7	6	5
9	12	9	8	7	6
10	14	9	8	8	8
11	14	12	10	10	7
12	16	14	12	11	9
n=1089					

Table 25: Mean Numeracy Scores by School Fee category

	Low		**School Fees**		High
	1	2	3	4	5
YA edu attain					
7	6.15	6.86	5.71	6.8	9.83
8	5.45	6.46	7.27	10.6	12.05
9	6.83	7	9.44	10.8	12.5
10	8.01	8.01	8.93	10.35	16.12
11	8.1	9	11.52	14.33	14.66
12	10.09	11.82	13	13.85	17.07
N=1089					

Class size (Table 26) and teacher quality (Table 27) remain touchstones of school-based resources. Larger classes seem to produce lower numeracy as well as literacy scores. Improved teacher quality appears to link to better scores, but the association is greater at higher grades.

Table 26: Teacher quality and score (holding grade constant)

	Smaller Larger	Class Size Category			
Educational Attainment	**1**	**2**	**3**	**4**	**5**
7	7	6	7	7	5
8	7	7	8	6	5
9	9	7	9	11	6
10	10	10	10	6	9
11		10	13	9	8
12	12	13	13	12	12
N=924					

Table 27: Numeracy Scores and Teacher Quality Category

	Less Teacher Quality More				
Educational Attainment	**1**	**2**	**3**	**4**	**5**
7	6	5	6	7	6
8	6	5	5	8	8
9	7	6	7	8	8
10		6	7	9	9
11		8	7	9	12
12			12	12	13

The data from CAPS is consistent with the earlier work on South African education. This chapter presented data showing that young adults who come from backgrounds of high socio-economic status have higher levels of attainment, and achieve higher scores in matriculation examinations as well as in cognitive test measures. Black young adults fall behind coloured and white young adults at an early age as measured by attainment outcomes.

The next chapter uses regression analysis to more fully explore the relationship between important inputs and successful outcomes.

Chapter Five

Basic Multivariate Analysis of CAPS data

The international and local literature has considered a huge variety of variables that might be related to student outcomes. The following five core explanatory variables have emerged as the most worthy of being included in the model:

On the family background side: 1) household income level, 2) parental education, 3) household size and on the school side, 4) class size and 5) teacher quality. Controls need to be included for age and for being female, and in some instances a dummy for attending a school that was a part of the old DET system. A model using these variables should explain a reasonably high proportion of the variation in educational outcomes. The advantage of this model is that it uses household data matched with YA data, and incorporates data about schools that are relevant to the individuals.

The explanatory variables used in this model are similar to those used by Case and Deaton (1998). There is a mix of family background variables, and school based variables, with age an important controlling variable. Family variables are represented by gender, father's education, household income and household size. The two school-based variables are the key indicators of resources available. Class size is self reported by the YAs, and the teacher quality is the average years of qualifications for teachers at the particular school that the YA listed as the last school attended.

This model can be applied to the three main categories of educational outcomes using the CAPS data. The core model is shown below and the regression tables are shown in the appendix.

Core Model	
Dependent Variables	*Explanatory Variables*
Enrolment	Household Income
Attainment	Mother's Education
Achievement	Household Size
	Teacher Qualifications
	Class size
	Female dummy
	Age dummy

Dependent Variable: Enrollment

Enrollment as a dependent variable in this analysis is classified as zero for those not attending school and one for those enrolled. This might not be ideal, as it is possible that some YAs may say that they were enrolled, but did not actually attend school. Using this type of dependent variable makes it necessary to use a logistic regression.

Regression Table One offers reveals some interesting points. In all of the equations, age is a significant and powerful effect, something that is entirely expected. Significance in family based variables is confined to education of the father (defined here as genetic father, both resident and non-resident in the YAs' household), with household income not demonstrating significant effects. Gender does not appear to be important in enrollment, while household size is significant.

On the school-based side, while class size coefficients are relatively high, they are not significant. Teacher quality emerges as having a significant negative effect on enrollment. The most appropriate interpretation of this is that those with better quality teachers leave school at the appropriate age, whereas those with poor quality teachers are more likely to stay enrolled in school, but are not progressing to higher grades.

Dependent Variable: Attainment

Once enrolled, to continue to a higher grade takes further resources than simply attending school and regression. Regression Table Two attempts to investigate some of these using years of educational attainment as the dependent variable. Age is incorporated as a dummy variable in all the regressions except H. School-based factors are limited to class size due to the fact that the data on teacher quality was not substantial enough to work with in this section. Class size appears in all the regressions and has a consistently negative relationship to years of attainment. In other words, the larger the class of the school that the YA attended, the lower their level of educational can be expected to be. Aside from class size, family-based factors are important here. Fathers' education is included in regression C, but mothers' education is used elsewhere in an attempt to side step the close correlation between household income and fathers' education. Both parents' education is associated with more years of education. Household income is significantly positively related to the outcome, but its effects diminish with the introduction of mothers' education. It is interesting to note that being female appears to have a positive effect on

attainment. Household size is again associated with poorer educational outcomes, and is significantly negatively associated with the number of those living in the household.

Regression Table Two is based on all YA s. To remove some of the variation introduced by race, the next regression shown in Regression Table Three, examines black YA s only. Isolating black YAs and applying the same regression yields the same pattern of significances and sign of coefficient as was shown when the whole YA sample was investigated.

Attainment offers some starting points for investigating the quantity of education in South Africa. The next set of regressions shift to looking at the quality of this attainment.

Dependent Variable: Achievement in Literacy and Numeracy Scores

Achievement is split into literacy scores and numeracy scores dependent variables. The explanatory variables are family-based inputs of mother education, household income, and household size. School-based factors are class size and teacher quality.

The number of years of education does have a robust association with scores for numeracy and literacy. This suggests that using years of attainment as a proxy for quality of education is not unjustified. Higher mothers' education is linked to higher scores, and household income appears to have strong ties to scores. YAs from larger households tend to have lower scores. Being female is associated with higher literacy scores, but with lower numeracy scores.

An extra series of data on the administrative departments that schools were previously under allows the addition of a dummy variable, for being an ex-Department of Education and Training school, to the school-based factors. Better teacher quality is associated with higher scores for both scores. Teacher quality has emerged as a consistently positive factor in better outcomes. This is in line with Class size is negatively related to literacy scores and numeracy scores. Attending a school that was part of the old DET system is significantly and negatively correlated with scores. Again, this managerial factor appears to impact on student achievement.

Another group of variables worth exploring are the ones used by Van der Berg, Wood and Le Roux (2002) . They regressed quantitative scores using SALSS data. Using black YAs only, regression Table Six follows similar variables, and is similarly explanatory.

The regression analysis results are line with international work and the current findings in South Africa. The core model succeeds in establishing a reasonable degree of explanatory power.

Household income is perhaps the key variable in this model. The variable certainly is measuring some variability from unmeasured variables. However, it shows that for many households in the data, schooling costs are too high. This is intuitive in a country with such high unemployment rates, where often there are only a few breadwinners in a large household. Savings rates are also very low, suggesting that without income, households might not able to afford the opportunity cost of not receiving some sort of income from a household member. This dovetails well with the clear link between increasing household size and decreasing educational outcomes.

Parental education is positively associated with all of the outcomes measurements. Mothers' education and fathers' education are shown to be associated with better outcomes for YAs in enrolment, attainment and achievement. Parental education is a complex variable, which may incorporate parents' preference for education, and historical access to education. Education levels are also closely linked to earnings ability, and so some of the variation in education may be accounted for by the household income variable.

Having a larger household is associated with having worse outcomes in all of the outcomes measures. YAs from large household appear to be suffering from a resource dilution constraint.

Race still has a profound ability to predict overall educational outcome, but intra-racial data shows that black and coloured YAs from high income households, as well as those with educated parents, enjoy successful outcomes. The group with the most problematic access to, and success in, education are those from the lowest socio-economic groups. The lack of successful outcomes for household income quintiles one and two suggest that some groups are stuck in a cycle of poverty and poor educational outcomes. This is especially true of Black YA s in the lowest household income group.

On the school-variable side, the model illustrates that school variables do count, as the HLE would predict. Teacher quality is shown as significantly positively related to outcomes. In conjunction with the class size finding, this variable indicates that it is not just quantity of

teachers that matter, but the quality. Improving teacher quality appears to offer a potentially good investment if teacher training could be extended to under-qualified teachers. This is an area that might warrant further investigation. Class size is consistently negatively related to outcomes. Class size is clearly operating as a proxy for broader resources as well as a basic input variable. Resources appear to matter if measured by class size, and this model adds to the body of work showing that class size does count.

This model has confirmed that some key variables are associated with better educational outcomes. Educational outcomes in South Africa are not an unresponsive to inputs. While the key input is the socio-economic status of the student, this does not mean that schools do not have an impact. The results illustrate that school variables are related to outcomes to a sufficient degree to be worthy of attention.

Finding a way to decrease the costs of schooling is a potentially profitable investment, given the importance of the household income variable. A viable educational credit market could be helpful in making educational opportunity more widely available. The existence of inequalities from the earliest grades suggests that pre-school programmes and learning programs might be beneficial to closing the outcomes gap. More teacher training could also be a good way to help outcomes, as would smaller classes. Which one of these chosen is less important than the fact that serious attention must be paid to decreasing costs for students in the South African schooling system.

Chapter Six

Conclusion

Improving the South African public schooling system is no easy task. To do so requires an understanding of the factors that raise educational outcomes. The international literature has shown that although family based factors are important, schools have a vital role in mediating these outcomes. Educational research has become more rigorous over the past decade, and is starting to make it possible for policy to become more evidence-based.

Numerous data sources show that there are major challenges facing the schooling system. There are serious shortcomings such as problematic educational outcomes for those in the poorest household income groups, and poor school quality for those who do manage to attend schools in poverty stricken areas.

Many challenges, especially with regard to family-factors, are deeply structural. However, improvements in the schooling system could have a positive impact on outcomes. Data collected here points towards the improvement in student outcomes that could stem from more highly trained teachers and smaller classes, as well as innovative approaches to reducing the costs of schooling to young people and households.

Wise investments in the school system could help improve outcomes. To help do this, more research is needed to focus on how to improve the *quality* of resources available to the young people of South Africa.

Appendix

Regression Table One: Enrollment

Dependent variable: In school status (0=Not in school 1= In school)						
	Equation					
	a	B	C	d	E	f
Explanatory Variables						
Age (years)	-0.6	-0.6	-0.62	-0.63	-0.64	-0.7
	-29.3	**-28.9**	**-22.9**	**-20.1**	**-20**	**-12.1**
Class size (log)	-0.39	-0.37	-0.24	-0.3	-0.26	0.72
	-3.1	-2.9	-1.4	-0.1	-1.4	1.6
Female (dummy)		-0.01	-0.07	-0.06	-0.59	-0.23
		-0.01	-0.6	-0.5	-0.4	-1
Father's years of edu.			0.13	0.1	0.09	0.08
			8.2	**5.2**	**4.8**	**2.2**
Household Income (log)				-0.073	-0.05	-0.08
				-1.1	-0.7	-0.6
HhSize (log)				-0.25	-0.39	
					-1.9	
Teacher quality						-0.22
						-1.04
n	3838	3726	2449	1784	1784	619
pseudo- R2	0.25	0.25	0.28	0.28	0.28	0.33

Note: All z-values in bold indicate p<0.05

Regression Table Two: Attainment

Dependent Variable: Years of Educational Attainment								
	Equation							
Explanatory	A	B	c	d	E	f	g	h
age 15	0.77	0.75	0.81	0.75	0.74	0.77	0.78	
	6.8	**6.8**	**6.5**	**6.9**	**6.9**	**7.2**	**7.3**	
age 16	1.62	1.6	1.6	1.68	1.63	1.7	1.7	
	14.5	**14.5**	**12.6**	**15.6**	**15.2**	**15.8**	**15.9**	
age 17	2.23	2.19	2.31	2.3	2.21	2.3	2.29	
	20.3	**20.3**	**18.7**	**21.6**	**21**	**21.8**	**21.8**	
age 18	3.01	2.94	3.19	3.04	2.95	3.03	3.01	
	27.1	**26.9**	**25.9**	**28.1**	**27.7**	**28.1**	**28.1**	
age 19	3.32	3.27	3.45	3.43	3.32	3.46	3.43	
	29.6	**29.5**	**26.9**	**31.2**	**30.8**	**31.6**	**31.5**	
age 20	3.6	3.54	3.75	3.77	3.6	3.79	3.74	
	31	**30.9**	**29.1**	**33.3**	**32.3**	**33.6**	**33.2**	
age 21	3.71	3.64	3.81	3.83	3.69	3.84	3.8	
	31	**30.7**	**28.1**	**32.6**	**32**	**32.9**	**32.6**	
age 22	3.77	3.64	3.88	3.91	3.72	3.95	3.87	
	30.6	**29.7**	**27.3**	**31.6**	**31.1**	**32.2**	**31.6**	
Age								0.51
								46.4
Class size		-0.97	-0.64	-0.68	-0.76	-0.58	-0.53	-0.53
		-12.18	**-7.17**	**-8.44**	**-9.59**	**-7.12**	**-6.49**	**-6.3**
Father education			0.16					
			18					
Mother education			0.17		0.14	0.13	0.13	
				19.2		**16.3**	**14.7**	**14.3**
Hh Income					0.12	0.08	0.09	0.09
					14.3	**9.6**	**10.7**	**10.3**
Female						0.39	0.39	0.4
							7.7	7.7
Hh Size							-0.35	-0.33
							-6	**-5.5**
N	3864	3779	2481	3337	3779	3242	3242	3242
Adjusted R2	0.37	0.39	0.49	0.46	0.43	0.49	0.5	0.47

Note: All t-values in bold indicate $p<0.05$

Regression Table Three: Attainment, Black YAs

Dependent Variable: Attainment		
Black YAs	a	t-value
Age	0.51	**30.4**
Class size	-0.44	**-3.6**
Mother edu	0.12	**9.2**
Income	0.05	**3.1**
Female	0.46	**5.6**
Hh Size	-0.18	**-2.1**
N	1473	
adj- R2	0.43	

Note: All t-values in bold indicate p<0.05

Regression Table Four: Literacy Scores, for all YAs

Dependent Variable: Literacy Score						
	a	b	c	d	e	f
Explanatory Variable						
YA Educational	0.7	0.59	0.53	0.49	0.41	0.48
	26.2	**21.3**	**16.1**	**14.5**	**7.4**	**8.1**
Mother's Years of Education	0.28	0.14	0.14	0.07	0.09	
		14.7	**6.2**	**5.7**	1.7	**2.3**
Household Income			0.78	0.83	0.43	0.26
			11.5	**11.7**	**3.4**	**1.95**
Female (dummy)				0.23	0.36	0.23
				1.6	1.64	1.01
Household Size (Log)				-0.5	-0.47	-0.37
				-3.3	-1.9	-1.4
Teacher Quality				0.58	0.41	
					6.4	**4.2**
Class Size						-0.38
						-5.2
n	3872	3418	2551	2475	873	**745**
Adjusted-R2	0.15	0.2	0.2	0.2	0.21	0.24

Note: All t-values in bold indicate p<0.05

Regression Table Five: Achievement – Numeracy scores for all YAs

Dependent Variable: Numeracy Score								
Equation	a	b	C	d	e	f	G	h
Explanatory Variables								
YA Education	1.21	1.04	0.9	0.9	0.84	0.7	0.85	0.81
	31.3	**25.4**	**20.1**	**19.8**	**18.2**	**9.1**	**10.6**	**11.2**
Mother's Edu	0.54	0.24	0.23	0.19	0.2	0.21	0.25	
		18.8	**7.4**	**7.2**	**6**	**3.7**	**3.6**	**4.7**
Hh Income			1.36	1.32	1.48	0.84	0.84	0.57
			14.6	**13.9**	**15.4**	**4.9**	**4.4**	**3.2**
Female (dummy)				-0.59	-0.54	-0.53	-0.66	-0.51
				-14.9	**-2.9**	**-1.7**	**-1.9**	-1.7
Hh size (Log)					-1.66	-1.61	-1.42	-1.51
					-8.1	**-4.6**	**-3.7**	**-4.4**
Teacher Quality					0.68			
					5.5			
Class size							-0.32	
							-3.2	
Ex-department DET (dummy)								-2.37
								-7
n	3872	3418	2551	2475	2475	873	745	873
Adjusted-R2	0.2	0.27	0.28	0.28	0.3	0.28	0.25	0.29

Note: All t-values in bold indicate p<0.05

Regression Table Six: Replication of Van der Berg's (2002) Model

	All YAs	Black YAs	Coloured YAs
Equation	a	b	c
YA Edu Attainment	1.03	0.76	1.21
	25.4	**14.8**	**20.3**
Urban (dummy)	2.36	0.962	2.38
	11.2	**4.3**	**2.7**
Mother's Edu Attainment	0.48	0.11	0.37
	16.7	**3.3**	**8.1**
n	3389	1515	1456
adj-R2	0.29	0.15	0.28

Note: All t-values in bold indicate p<0.05

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