

**Education and socio-economic differentials:****A study of school performance in the Western Cape**

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**Servaas van der Berg & Ronelle Burger**  
**University of Stellenbosch**

**ABSTRACT**

*Not surprisingly, the education system is widely perceived to be the major tool to overcome human capital and labour market inequalities in South Africa. This paper addresses how well it accomplishes this.*

*The first part of the paper examines human capital differentials based on data from a variety of sources. These provide some perspective on educational attainment differentials, with particular emphasis on the Western Cape. However, the picture is complicated by information that quality differentials in education may be much larger and more enduring than attainment differentials.*

*The next question is whether the deficiency lies in inadequate resource availability in schools of the poor or whether it rather stems from inefficiencies in parts of the school system. This also relates to an important debate in the international economics of education literature, viz. to what extent school resources matter. The paper uses evidence on school performance nationally and in the Western Cape to consider whether schools in poor communities overcome human capital backlogs and, after standardising for socio-economic background, what role can be ascribed to availability of resources.*

*Even though the Western Cape may be atypical, the large differentials in performance between efficient and inefficient schools that we find raise important questions. One reading would indicate that the school system is presently incapable of substantially reducing inequality in the South African labour market, and that more resources by themselves do not offer a viable means of overcoming this shortcoming in education. This strengthens the case for targeted managerial interventions to reduce inefficiencies in the educational system, whilst weakening the case for resource shifts as the most urgent need.*

## Introduction

In a highly unequal society in which labour market inequalities largely have their origin in human capital differentials, it is not surprisingly that the educational system is seen as a major tool to overcome these inequalities. Does the South African educational system accomplish this?

- The first section of this paper will show that although human capital differentials are narrowing, this is not taking place at anything near the required rate to substantially reduce inequality.
- Thus, the next question, and the central question for this paper, is whether the deficiency lies in inadequate resources in schools of the poor, or rather stems from inefficiencies in those parts of the school system serving the poor. This also relates to an important question of debate in the international economics of education literature, viz. to what extent resources matter in schools, at least within certain ranges.<sup>1</sup> In the second section we will attempt to show that resources do matter, but often not as much as they should, due to inefficiencies in the school system.

This article builds on previous work (Van der Berg 2001a & 2002) by one of the authors, linking school performance as measured by matriculation pass rate to socio-economic background as measured by school fees and to inputs of teaching resources, for most schools in six of the provinces. The disturbing conclusion from that work was that the school system appears to still perform much as it did under apartheid: predominantly black<sup>2</sup> schools - although now better resourced - have not improved their matriculation output in quantitative (and indeed also qualitative) terms, whilst predominantly white schools - now less privileged in terms of teaching resources and containing more pupils from other race groups – are still performing as well as in the past. Thus, differentials between schools are largely unchanged, although the racial

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<sup>1</sup> See e.g. Hanushek (2002; 1996; and 1989); Case & Deaton (1998); Krueger (1997); Lee & Barro (1997); Card & Krueger (1992).

edge to the inequality has been reduced through the opening up of formerly white schools. It is also hoped that this paper will contribute to the growing attention by economics to issues of South African education.<sup>3</sup>

To move the analysis for this paper beyond the scope of the two earlier articles, we are compelled to narrow the regional focus in favour of a richer set of variables. It is notoriously difficult to obtain school level data to attempt to measure school performance in developing country context. Ideally, for an education production function at school level one requires well-measured educational performance data (e.g. performance in tests or examinations), full data about school level inputs (e.g. number and qualifications of teachers, physical resources and complementary inputs), and socio-economic data in order to standardise for such differentials that may influence performance.<sup>4</sup> The Western Cape dataset is more recent and provides access to a greater range of education input variables and more detailed measures of education outcomes. Amongst other things, the latter will enable us to test performance in Mathematics, which is useful because the variable can arguably serve as both a proxy for schooling quality and a predictor of pupils' future earnings.

We start off by looking at the convergence rate for human capital differentials.

## **A. Considering trends in human capital differentials**

### **A1. Trends in earning differentials**

The growing earnings function literature in South Africa<sup>5</sup> - and internationally - shows a tight relationship between education and labour market status and earnings. This is also illustrated by Figure 1, which shows that the small number of relatively

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<sup>2</sup> Predominantly black schools are schools where survey respondents indicated that more than 70% of the school's learners are black. The word predominantly will be used in this specific sense throughout the rest of this paper.

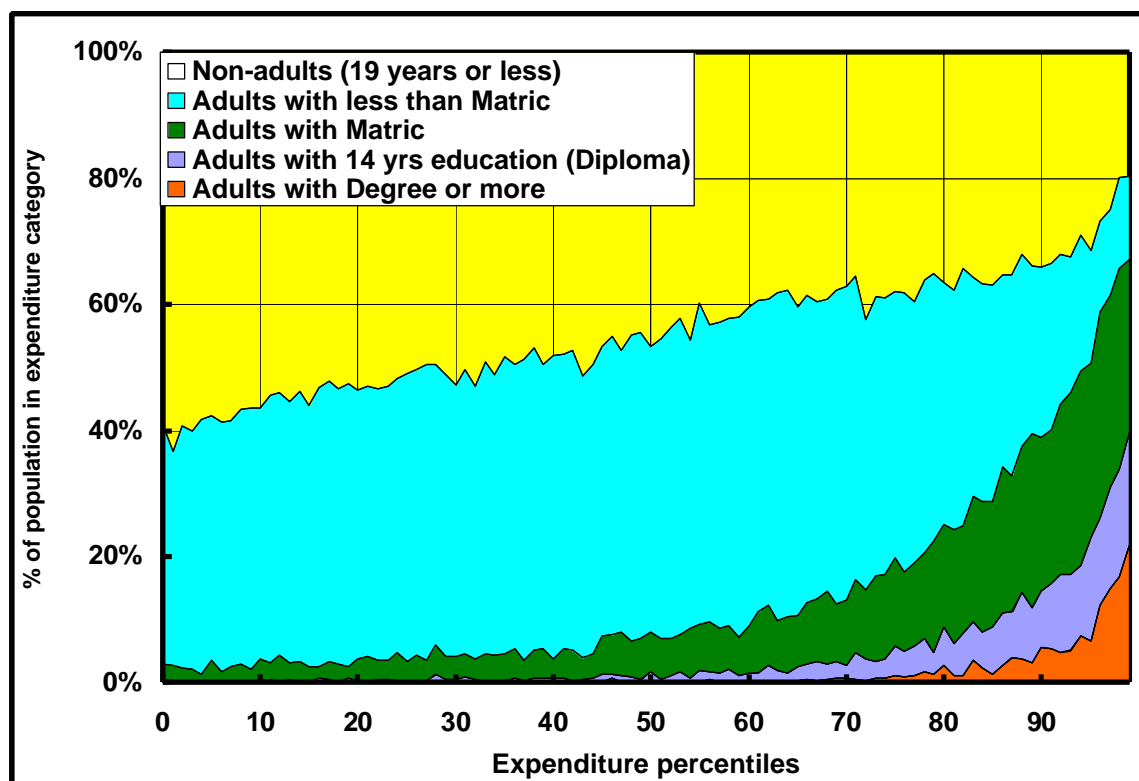
<sup>3</sup> See e.g. Anderson (2000); Anderson et al. (2001); Archer (1994 & 1995); Case & Deaton (1999); Case & Yogo (1999); Crouch & Mabogoane (1998a & 1998b); Donaldson (1992); Fisk & Ladd (2002); Kingdon & Knight (2002); Lam (1999); Moll (1996); Simkins (2002); Thomas (1996); Van der Berg (2001a & 2001b); and Van der Berg, Wood & Le Roux (2002).

<sup>4</sup> If, as is most preferable, one wants to measure the performance of schools in terms of cognitive value added, tests of the same learners at an earlier time also need to be included.

<sup>5</sup> See e.g. Mwabu & Schultz (1996); Winter (1998); Fallon & Lucas (1998); Hofmeyr (1998 & 2000); Hofmeyr & Lucas 1998; Moll (2000); Schultz & Mwabu (2000); Bhorat & Leibbrandt (2001); Kingdon & Knight (2001); and Chamberlain (2001)

well-educated adults (e.g. those with a degree) are concentrated at the upper end of the expenditure distribution. At least for 1995, a degree acted as an important guarantee of being near the top of the expenditure ladder.

**FIGURE 1: Distribution of total population by education over national expenditure percentiles, 1995**



Source: Calculated from OHS/IES95

Another way of considering this data is presented in Table 1, which shows that adults with degrees constitute only 1.6% of the total South African population, yet they are 10% of the population in the top decile. By contrast, adults with less than Matric are scarce in the higher rungs of the expenditure distribution.

**TABLE 1: Share of non-adults and adults in various educational categories in the population and in the various expenditure categories, 1995**

Share of educational group in	Non-adults	Adults with less than Matric	Adults with Matric	Adults with Diploma (14 yrs)	Adults with Degree or more	Total population
<b>Total population</b>	44.0%	40.8%	10.0%	3.2%	1.6%	100.0%
<b>Poorest 20% (Quintile 1)</b>	56.3%	40.4%	2.6%	0.2%	0.0%	100.0%
<b>Poorest 40% (Quintiles 1 &amp; 2)</b>	53.4%	42.5%	3.2%	0.3%	0.0%	100.0%
<b>Quintile 2</b>	50.5%	44.6%	3.8%	0.4%	0.1%	100.0%
<b>Quintile 3 of SA population</b>	45.1%	47.3%	5.9%	0.9%	0.2%	100.0%
<b>Quintile 4 of SA population</b>	38.3%	46.5%	11.1%	2.9%	0.6%	100.0%
<b>Richest 20% (Quintile 5, Deciles 9 &amp; 10)</b>	31.6%	26.2%	24.8%	10.5%	6.4%	100.0%
<b>Richest 10% (Decile 10)</b>	28.2%	19.2%	28.5%	13.5%	10.0%	100.0%

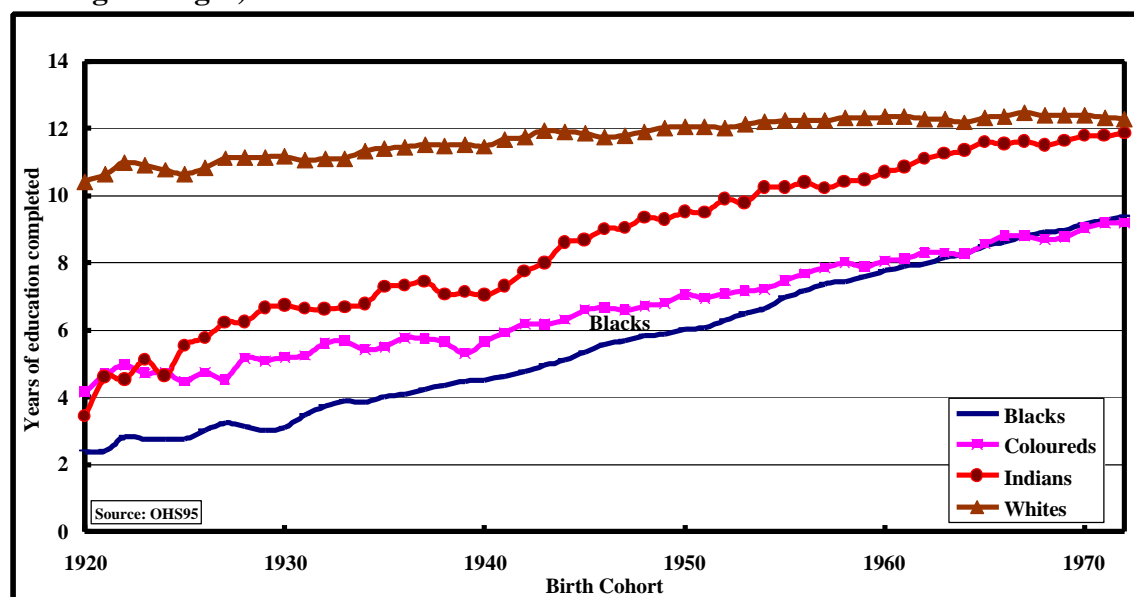
Note: Non-adults are here defined as people below 20 years of age

Source: Calculated from OHS/IES95

## A2. Trends in educational differentials

South African human capital differentials as measured by educational attainment data from the 1996 Census and various October Household Surveys (OHS) have been narrowing in the past few decades. This has been remarked upon amongst others by Lam (1999), who contrasts the narrowing racial educational attainment gap as measured by years of education completed in South Africa with that in Brazil, where progress has been much slower. Thus at least on the surface, it appears that inequality is declining. However, the picture is more complicated than that, as there is consistent information that shows that *quality* differentials in human capital may be much larger and more enduring than *attainment* differentials (Van der Berg *et al.* 2002), as some of the descriptive analysis will also illustrate.

**FIGURE 2: Mean years of education by race and birth cohort, 1995 (three year moving averages)**



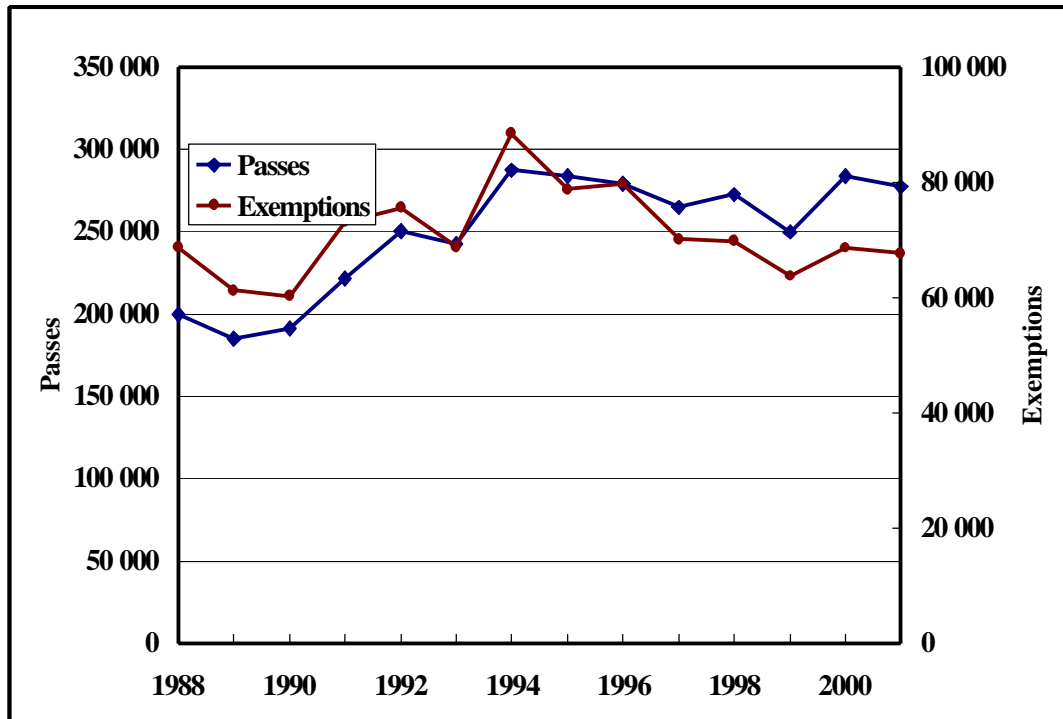
Source: Calculated from OHS/IES95

## A3. Trends in aggregate education output

South African education already takes a large share of national resources, placing South Africa at or near the top of the international league in terms of proportion of national resources (GDP) devoted to education spending. Since the transition to democracy, resources devoted to school education have increased considerably and large resource shifts have taken place to poorer schools (Van der Berg 2001b), yet outputs of successful matriculants or of those matriculating with university exemption are stagnating or declining (Figure 3). There seems to be a poor conversion of inputs

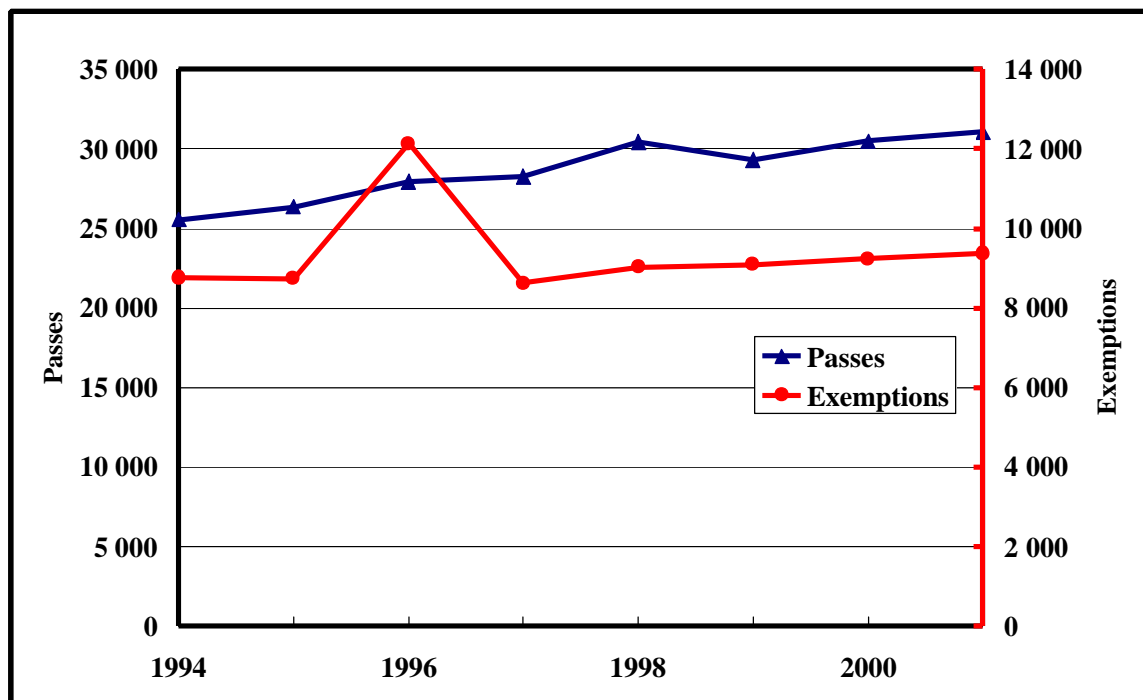
into educational outputs, i.e. in numeric terms educational outputs are only weakly related to educational resources.

**FIGURE 3: Matriculation passes and exemptions, South Africa 1988-2001**



*Source: RIEP 20001 & Website of Department of Education*

Much of the national problems also apply at the provincial level in the Western Cape, even though the province performs by far the best in terms of matriculation results. The Western Cape pass rate (82.7%) and exemption rate (25.0) in 2001 were well above the national average (15.1% and 61.7% respectively). From 1994 to 2001 the Western Cape increased its share of national matriculation passes from 8.9 to 11.2%, and of exemptions from 9.9 to 13.9%, even though the province's performance in this regard was not spectacular (see Figure 4). Even more than at the national level, access to schools is no longer a major problem, as census and survey data show that virtually all children of school-going age are at school, at least to about age 15 or 16.

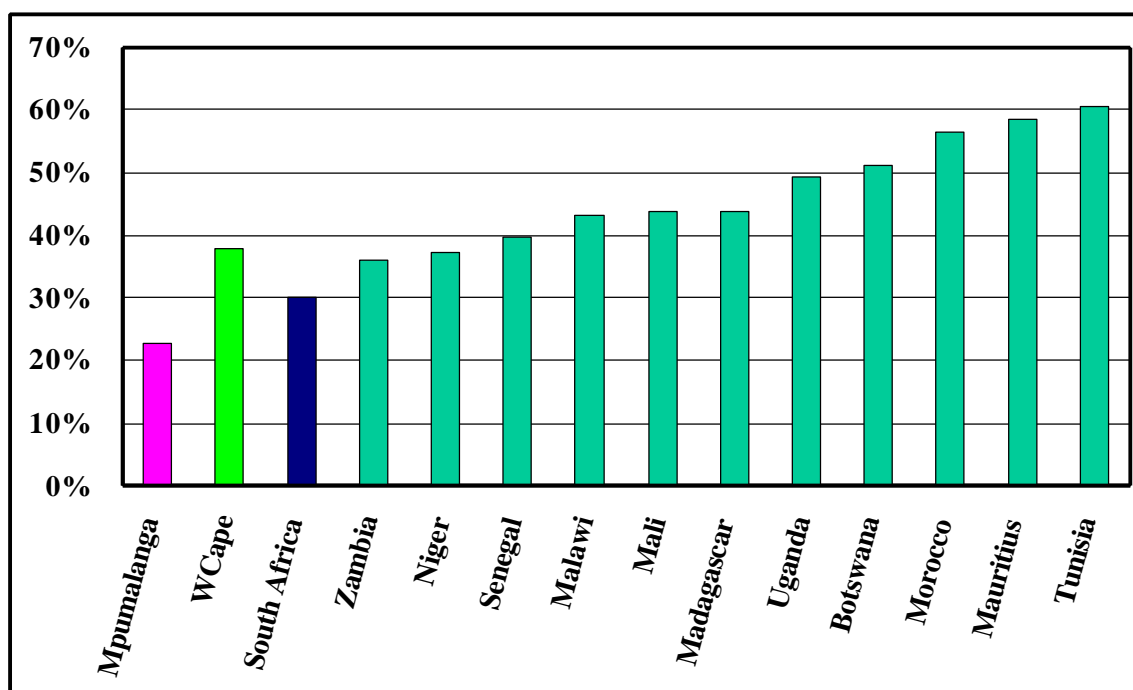
**FIGURE 4: Matriculation passes and exemptions, Western Cape 1994-2001**

Source: RIEP 20001

#### A4. Quality concerns and socio-economic differentials

Serious quality problems with output of the educational system are apparent from high matriculation failure rates (indicating lenient promotion policies at lower educational levels may be a problem), from poor performance in international tests, and by a small minority of matriculants electing to do subjects such as Science and Mathematics that are fundamental to further technical education that the labour market requires. Even the Western Cape's educational performance is far from ideal. This is well illustrated by the MLA Numeracy Test carried out in 1995 at the Grade 4 level in all provinces and in various African countries (Figure 5). Though the Western Cape performed best of all South Africa provinces and far better than the worst (Mpumalanga – also shown in the graph), its performance was only marginally better than two of the participating African countries, and worse than the other nine.

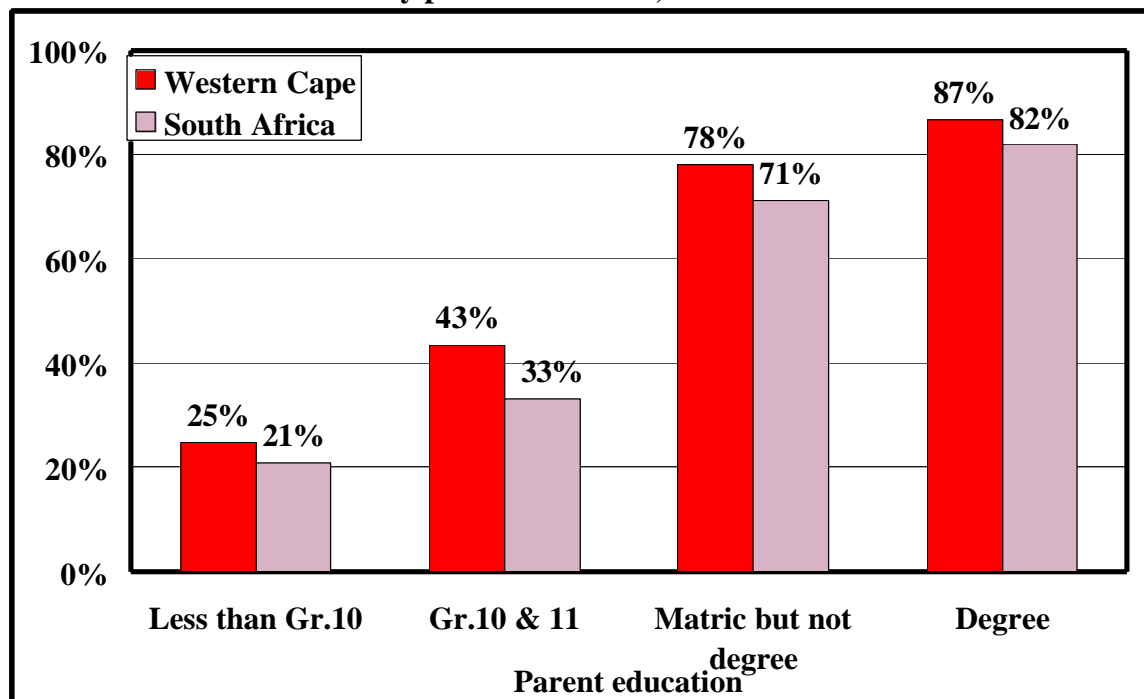
**FIGURE 5: Western Cape performance on Grade 4 MLA numeracy test in South African and African perspective, 1995**



Source: MLA survey

In addition, the education system still fails to reduce socio-economic inequalities. Most of the population are still in schools that under perform as measured by matriculation results, particularly in subjects most sought in the labour market. Figure 6 illustrates for the Western Cape that, amongst 20-24 year olds still resident with parents at the time of 1996 census, only 25% had matriculated in cases where the parent head of household had attained less than Grade 10. This rises to 44% where the parent had reached Grades 10 or 11, to 78% where the parent had matriculated and to 87% where the parent had a degree. Nationally, a similar pattern holds, as the figure shows. Clearly, parent education matters a great deal.

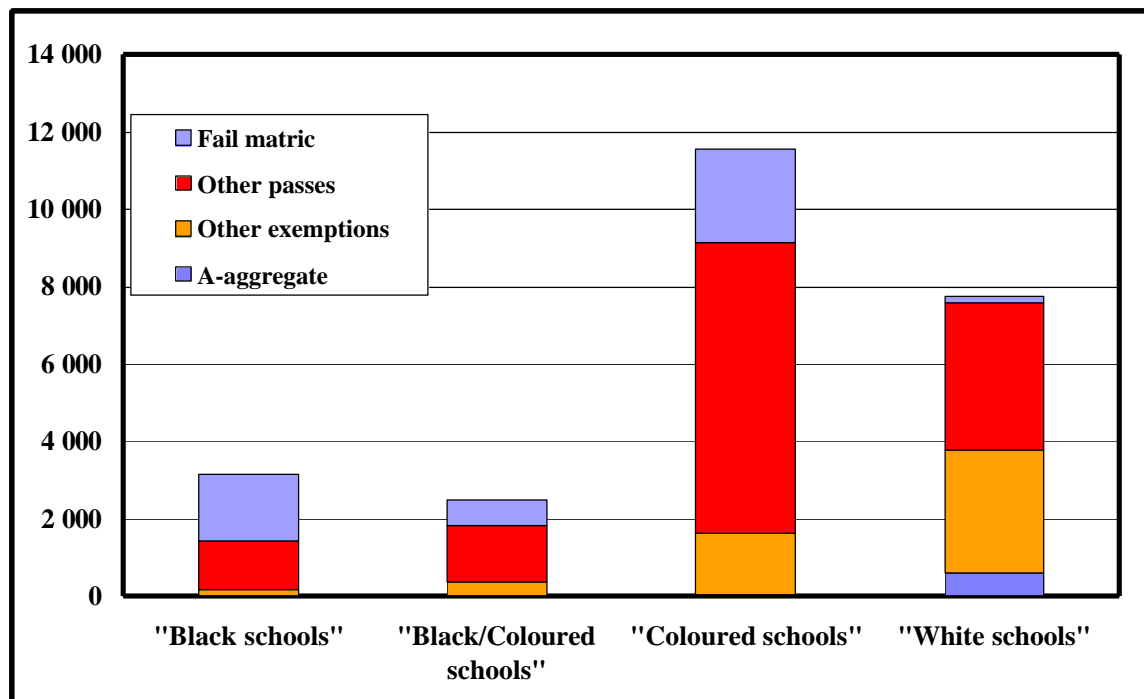
**FIGURE 6: Percentage of 20-24 age-group matriculated by parent education, 1996**



**Source:** Calculated from Census 1996 10% sample

Within the Western Cape, the effect of past patterns of privilege is still severely felt. Figure 7 shows that largely white schools still outperform others, and that very few A-aggregates (a measure of quality) were obtained in other schools. Even university exemptions, another less restrictive measure of quality, were highly concentrated in predominantly white schools. Of the almost 6 000 university exemptions in 1997, more than 60% were from predominantly white schools, versus only 2,5% from predominantly blacks schools. Thus entrance into universities perpetuates past patterns of privilege, and even more so if subject choice and performance at school are also considered. Failure rates are highest in predominantly black schools.

**FIGURE 7: School “race-type” by matriculation results, Western Cape 1997**

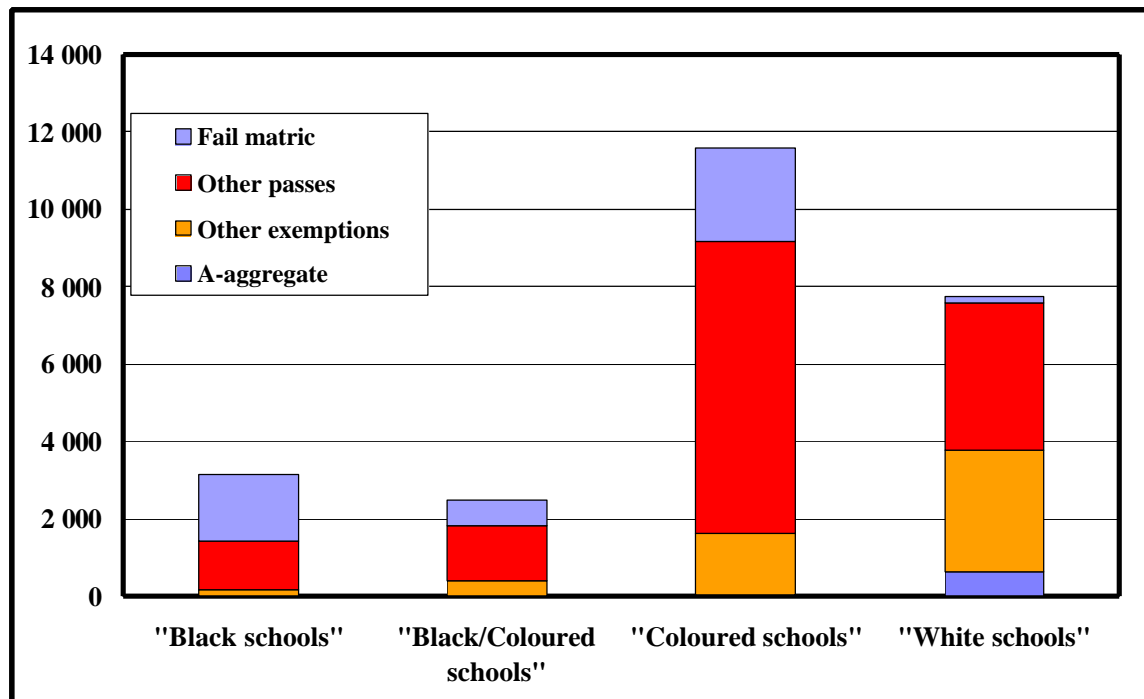


*Source: Calculated from Western Cape Education Department data*

#### **A5. The relationship between socio-economic background and educational performance**

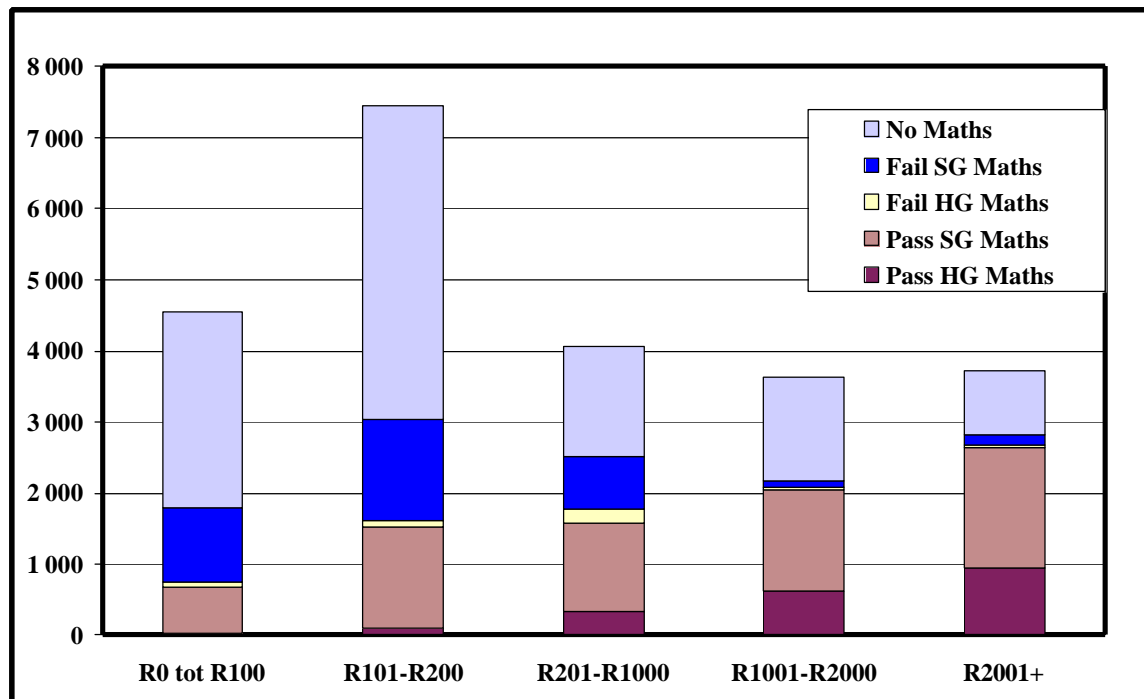
If socio-economic background as reflected in school fees is considered, a similar picture emerges. A-aggregate performances and university exemptions are very scarce in schools at the bottom of the socio-economic rung, and A-aggregates especially are concentrated in schools with fees above R1 000 per year, to which few poor children have access.

**FIGURE 8: Matriculation results by school fee category, Western Cape 1997**



*Source: Calculated from Western Cape Education Department data*

The patterns are quite similar with respect to performance in Mathematics, a critical subject for further education. As can be seen, a surprisingly large proportion of pupils even amongst more affluent schools elect not to do Mathematics or to take it at the Standard Grade, thus closing the door on possible further studies in the Natural Sciences, Engineering, Medicine and some other fields. Of the just over 2 000 pupils who passed Mathematics at the Higher Grade in 1997, 80% were from schools with school fees above R1 000, and a slightly higher proportion, 83%, from predominantly white schools. In contrast, only 20 pupils (1% of the total) from predominantly black schools passed Mathematics at the Higher Grade.

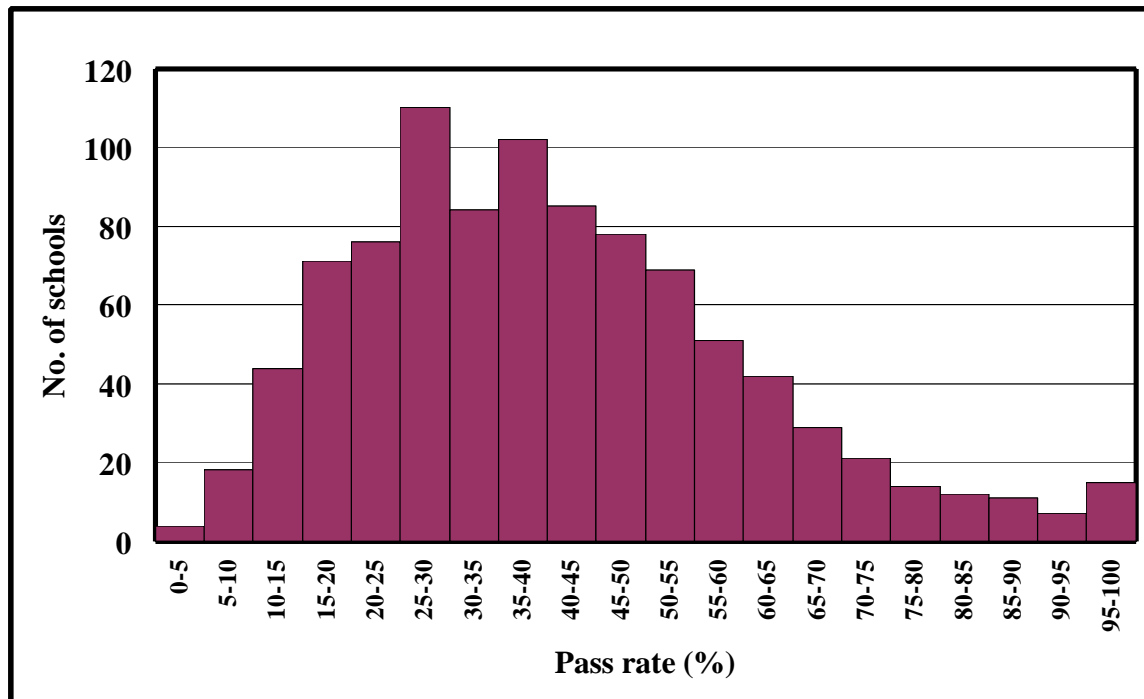
**FIGURE 9: Mathematics results by school fee category, 1997**

Source: Calculated from Western Cape Education Department data

In the Western Cape as well as nationally, the problem of poor aggregate educational performance is mainly one of inadequate performance in a large part of the school system that has historically been neglected. However, within the same category of schools, many perform quite well. Figure 10 shows that many very poor<sup>6</sup> predominantly black schools in the six provinces for which we had data had performed fairly respectably in terms of matriculation pass rates, but in the vast majority (71%) of such schools, more than half of all pupils failed matriculation.

<sup>6</sup> This here refers to schools where school fees are below R30 per annum.

**FIGURE 10: Frequency distribution of pass rates amongst predominantly black schools with fees of R30 or less, 1999-2000**

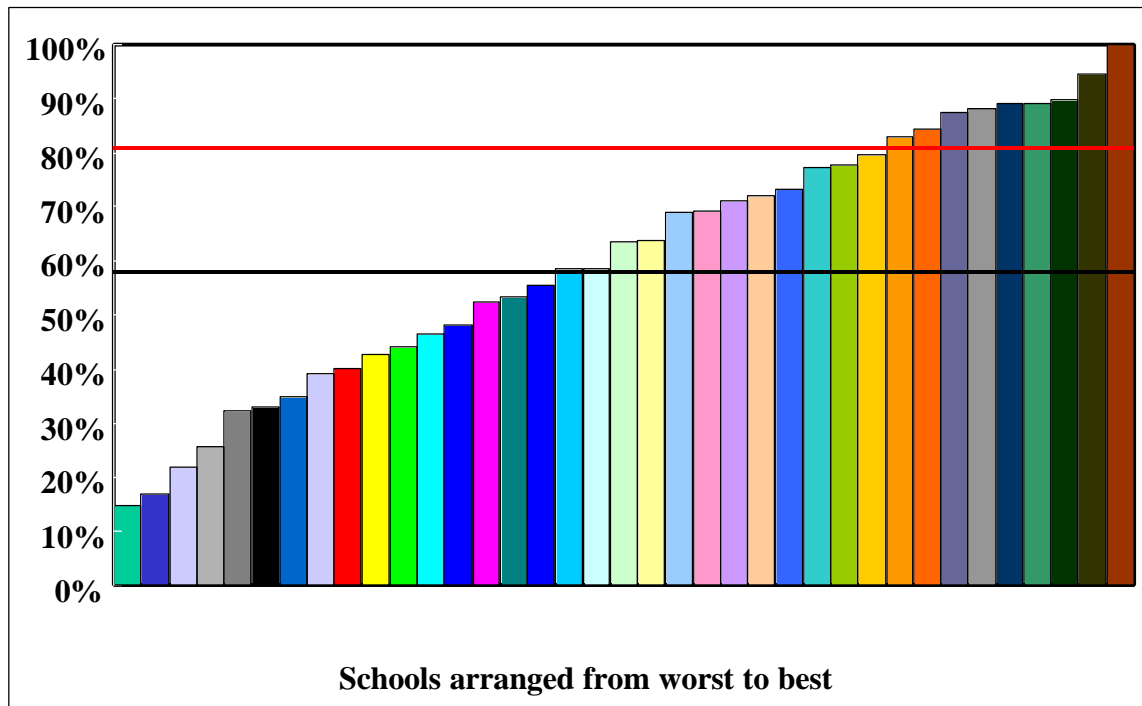


*Source: Calculated from Department of Education data*

Figure 11 shows the 37 Western Cape schools which in 1997 were all poor in terms of having school fees below R100; all were serving mainly the historically disadvantaged, with similar poor resources and similar levels of past neglect. Yet performance varied dramatically, as the figure shows. Nine of these schools even had pass rates that exceeded the provincial average (shown by the upper horizontal line; the lower black line shows the average pass rate for such poor schools).

The next section will consider a range of different explanations for this variation in performance within socio-economic group, examining school performance's empirical relationship with resource investments and the efficiency in the use of resources.

**FIGURE 11: Matriculation pass rates amongst poor schools (school fees below R100) arranged from worst to best performance, Western Cape 1997**



Source: Calculated from Western Cape Education Department data

## B. Resource allocation and efficiency as determinants of school performance

Section A's descriptive analysis accentuates the need to understand what is happening at school level in order to get a grip on likely future trends with regard to socio-economic differentials in the labour market. But though useful, a perspective at the level of individual or samples of schools is inadequate. What is required is a systematic and quantitative perspective of school level performance. Such studies have thus far been scarce in South Africa.

We had at our disposal two datasets, pieced together from data provided by the various Departments of Education:

- The first dataset<sup>7</sup> contains data from most schools in six provinces. It relates to a few school level variables for 1997, and matriculation pass rates for 1999 and 2000. Because there is a lag between inputs and outputs in the school system, and resource as full as racial composition shifts are slow, the gap between 1997 and

<sup>7</sup> See Appendix A for a list of the variables in dataset 1.

1999/2000 was not regarded as serious. Indeed, previous analysis showed that the data performed well in terms of both representativeness and presenting systematic patterns of results. (Van der Berg, 2002)

- The second, more detailed school level dataset<sup>8</sup> for the Western Cape allows a deeper analysis, because more variables are available to measure both socio-economic background and school performance.<sup>9</sup> Even though the Western Cape may be atypical in that Matric pass-fail ratios are considerably higher than elsewhere, patterns of differentials in performance between efficient and inefficient schools are likely to be similar as for South Africa as a whole.

We analyse these datasets in an attempt to better understand school level performance in the Western Cape. Based on previous research, we hypothesise that schools in poor communities do not overcome human capital backlogs on any appreciable scale, due to a combination of inadequate resources and inefficiency of resource use in poor schools. Thus we set out to evaluate - after standardising for socio-economic background - to what extent school performance amongst Western Cape schools is determined by availability of resources or what part is rather to be explained by inefficiency of resource use. The latter cannot be measured directly, but can be inferred mainly from the nature and magnitude of the residual - that part of school performance not accounted for by socio-economic background or resources - or indirectly from the racial composition of the school, which by reflecting past patterns of privilege is also likely to be highly correlated with management experience and skills.

The next section will examine empirical relationships of school performance with socio-economic indicators and resource investments on a national level, using the first dataset. The focus will be on the position of the Western Cape in the national sample.

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<sup>8</sup> See Appendix B for a list of the variables in dataset 2.

<sup>9</sup> We had access to symbols each school attained in Matric per individual subjects. We used this to construct an overall performance index and a mathematics performance index.

### **B1. Comparing Western Cape school performance to national data**

At the national level, regression analysis<sup>10</sup> has shown that the performance of schools as measured by matriculation pass rates is influenced by the socio-economic background of pupils (measured by school fee levels)<sup>11</sup>, by the availability of teachers (pupil-teacher ratio), by teacher quality (as reflected in their average salary levels), and by the racial composition of schools (equation 1 in Table 2)<sup>12</sup>. Racial composition can be interpreted as reflecting the continued effect of history on school performance. Thus, predominantly black schools still appear to be functioning comparatively poorly - even after controlling for their lower socio-economic background and higher pupil-teacher ratios.

After allowing for the effect of other influences on school results, including racial composition of schools, the Western Cape outperforms equivalent schools nationally by almost 8% (see equation 2 in Table 2). Equation 3 tries to identify the source of the improved performance by using interaction effects. It finds that predominantly coloured schools in the Western Cape outperform the national average for similar schools by 10.1%, and white schools by 6.7%, although the statistical relationship is weaker. Black schools in the Western Cape did not perform statistically significantly better than nationally.

Equation 4 demonstrates the impact of interaction effects between Western Cape location and measures of socio-economic background and teacher inputs. Here it is evident that, compared to other provinces, socio-economic status as measured by school fees has a somewhat smaller impact on performances in the Western Cape than nationally, although not statistically very significant. Also, the availability and quality of teachers seem to have a greater effect in the Western Cape than nationally (although for the pupil-teacher ratio the statistical significance is weak). Equation 5 continues this line of investigation by dropping the first two interaction effects and retaining only the quality of teachers, which again is highly significant.

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<sup>10</sup> A significance level of 95% was used for all regressions in this paper.

<sup>11</sup> Note that the variable here refers to *school fees collected* whereas in Section A.2 it referred to *school fees as set* by the school governing body.

<sup>12</sup> There is a more extended discussion of these results in Van der Berg 2001a & 2002

**TABLE 2: Regressions showing Western Cape schools  
within the national sample (dependent variable= Pass rate)**

	<b>Equation 1:</b>	<b>Equation 2:</b>	<b>Equation 3:</b>	<b>Equation 4:</b>	<b>Equation 5:</b>
<b>School fees per pupil</b>	.012775*** (11.9)	.0131657*** (12.31)	.013277*** (12.33)	.013725*** (12.31)	.013142*** (12.3)
<b>Pupil-teacher ratio</b>	-.10238** (-2.56)	-.1317211*** (-3.27)	-.120385*** (-2.980)	-.116283** (-2.82)	0.04032 (0.001)
<b>Teacher salary</b>	.000375*** (7.35)	.0003358*** (6.51)	.0003496*** (6.76)	.000336*** (6.5)	.000332*** (6.43)
<b>School race composition:</b>					
Dummy >70% coloured pupils	27.8585*** (17.50)	22.9404*** (12.00)	20.9081*** (7.69)	21.348*** (10.55)	22.9615*** (12.11)
Dummy >70% Indian pupils	29.1935*** (12.03)	29.5404*** (12.21)	28.9239*** (11.73)	29.4888*** (12.2)	29.5804*** (12.23)
Dummy: >70% white pupils	33.1466*** (18.05)	32.5207*** (17.72)	32.2477*** (16.95)	32.030*** (17.35)	32.5291*** (17.73)
Dummy mixed school (no race group >70%)	23.0368*** (15.13)	22.8271*** (15.05)	23.0476*** (15.13)	22.663*** (14.93)	22.8435*** (15.06)
Dummy Other schools (race unknown)	36.4631*** (19.3)	30.6278*** (13.5)	26.658*** (6.41)	29.6339*** (12.73)	30.3808*** (13.31)
<b>Dummy: Western Cape</b>		7.55337*** (4.61)			
<b>Interaction effects:</b>					
Western Cape & School fees per pupil				-0.00509 (-1.78)	
Western Cape & Pupil-teacher ratio				-0.28816 (-1.88)	
Western Cape & Teacher salary				.000199*** (3.34)	.0000804*** (4.71)
Western Cape & predominantly black school			2.2821 (0.78)		
Western Cape & predominantly coloured school			10.1463*** (3.21)		19.473*** 4.22)
Western Cape & predominantly Indian school			16.6925 (1.46)	18.5979*** (4.01)	
Western Cape & predominantly white school			6.7416 (1.73)		
Western Cape & other school			11.9109** (2.71)		
<b>Constant</b>	15.057*** (3.32)	19.1211*** (4.15)	17.6977*** (3.84)	18.59787*** (4.01)	19.473*** (4.22)
<b>Observations (n)</b>	2770	2770	2770	2770	2770
<b>R<sup>2</sup></b>	0.5565	0.5599	0.5601	0.5609	0.5600
<b>Adjusted R<sup>2</sup></b>	0.5552	0.5584	0.5581	0.5591	0.5586

Table 3 contains equations measuring the effect of the various variables referred to above in Western Cape schools only. Given smaller heterogeneity of experience within the Western Cape, it is unsurprising that the coefficient of determination (adjusted  $R^2$ ) is much higher in this Table (in both cases 0.67) than in the equivalent (first) equation in Table 2 (in all five cases 0.56). This implies that about two-thirds of the variation in performance between schools in the province can be explained by variables reflecting socio-economic status, teacher resources and racial composition. It is noticeable from Equation 1 that the pupil-teacher ratio is not a statistically significant predictor of Matric performance, keeping all other factors constant, thus it is dropped in Equation 2.

**TABLE 3: Regressions of performance in Western Cape schools (dependent variable= Pass rate)**

	<b>Equation 1:</b>	<b>Equation 2:</b>
<b>School fees per pupil</b>	.006641** 2.84	.006649** 2.84
<b>Pupil-teacher ratio</b>	-0.20486 -1.5	
<b>Teacher salary</b>	.000696*** 3.96	.0006672*** 3.81
<b><u>School race composition:</u></b>		
Dummy>70% coloured pupils	26.7021*** 8.78	29.44939*** 12.1
Dummy >70% Indian pupils	39.2298*** 4.58	41.97406*** 5.00
Dummy: >70% white pupils	36.9238*** 8.32	40.12903*** 10.29
Dummy mixed school (no race group >70%)	29.7553*** 6.71	31.7082*** 7.47
Dummy Other schools (race unknown)	35.2716*** 10.9	37.8830*** 13.86
<b>Constant</b>	-7.63494 -0.46	13.75238 -0.86
<b>Observations (n)</b>	239	239
<b>R<sup>2</sup></b>	0.6728	0.6696
<b>Adjusted R<sup>2</sup></b>	0.6614	0.6595

From the national level dataset, the above analysis with the aid of the few variables available has thus shown that the Western Cape does perform better than nationally, given socio-economic background, teacher resources, and racial composition, and that particularly coloured schools (mainly former House of Representatives schools) fare somewhat better in the Western Cape than equivalent schools nationally. Within the

Western Cape, too, the preliminary analysis has shown that school fees play less of a role than elsewhere, whilst teacher quality matters more, and the teacher-pupil ratio does not appear to be all that important. This latter may be, however, because the range is somewhat less than nationally.

In order to deepen our analysis of school performance in the Western Cape, we turn to an analysis of the second dataset

## B2. Examining school performance in the Western Cape

In this section we examine the attainment differentials of a sample of 242 high schools in the Western Cape with the aim of studying its empirical relationship with resource allocation to that of the efficient use of allocated resources, controlling for socio-economic background.

Arguing that pass-fail measures are too binary to accurately reflect the relative performance of schools, we use an overall and mathematical performance index constructed from the last three years' subject results as a measure of school performance.<sup>13</sup> As can be seen from Figure 12 below, the correlation between the performance index and the pass rate is high,<sup>14</sup> but the graph illustrates the improved

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<sup>13</sup> An overall performance index and a mathematical performance index were constructed based on the Swedish points system commonly used to calculate entry eligibility for South African universities. The mathematical performance index was constructed using the following formula for an index of subject performance:

$$S_{in} = \frac{S_{in2001} + S_{in2000} + S_{in1999}}{3}$$

$$\text{with } S_{in} = \frac{5HGA + 4(HGB + SGA) + 3(HGC + SGB) + 2(HGD + SGC) + HGE + SGD}{\text{learners per subject}}$$

where *HGA*, *HGB*, etc. and *SGA*, *SGB*, etc. represent an A, B, etc. in a higher grade and standard grade subject respectively. The index thus has a maximum possible value of 5 (if all pupils taking the subject achieve an A in the Higher Grade) and a minimum of 0 (all pupils taking the subject achieve less than and E at the Higher Grade or a D at the Standard Grade level).

The overall performance index of a school was calculated by:

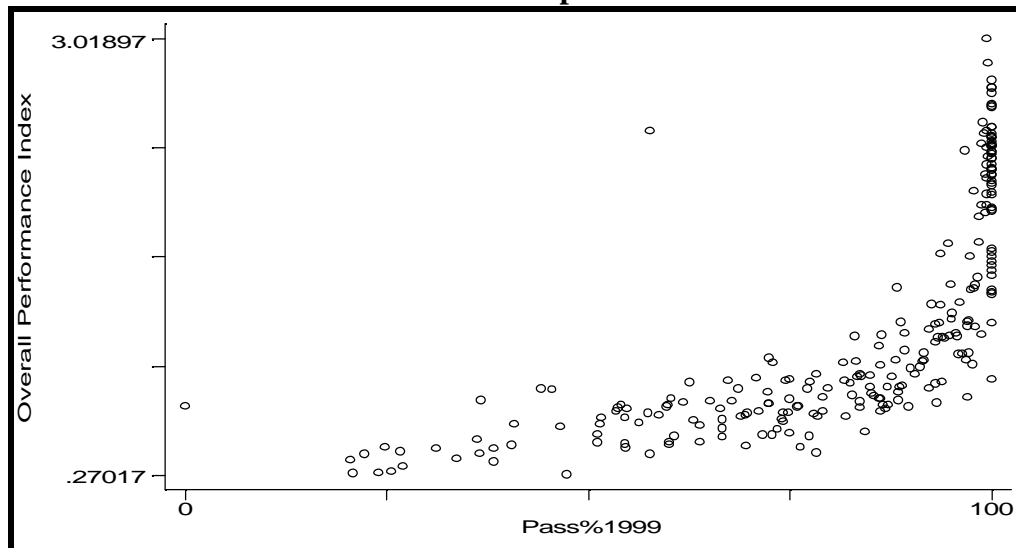
$$O_i = \frac{\sum S_{in}}{n}$$

where *n* represents the number of subjects offered by school *i*.

<sup>14</sup> The correlation coefficients for the log of these indices and the 1999 and 2000 pass rates range between 0.71 and 0.82. The correlation coefficient for the mathematical performance index and the overall performance index is 0.9209.

discriminatory ability of the index - especially at the top end of the scale - and thus provides evidence in support of using it.

**FIGURE 12: 1999 Pass rate vs. Overall performance index for Western Cape schools**



This section will describe four empirical school performance models. Firstly, we estimated two models using the full sample of schools with the overall performance index and the mathematical performance index as the respective dependent variables. After examining the shared characteristics<sup>15</sup> of the five race-based dummies, the sample was divided into three smaller, race-based samples: i) “other”<sup>16</sup> and predominantly white schools; ii) predominantly coloured and black schools and iii) mixed schools. The third group’s sample size was inadequate and thus models were only estimated for the first two groups. Due to expected non-normality of the full sample, because of the historical relationship between race, socio-economic background, education spending and educational attainment, the focus will be on the second pair of models that examines causal factors within these smaller race-based samples.

<sup>15</sup> For more details on the characteristics of the “other” and predominantly white schools group versus the group of predominantly black and coloured schools, refer to Table 5.

<sup>16</sup> The group “other” refers to schools that chose to not provide data on learners’ race. Based on the characteristics of the group, it was decided to include it in a sample with predominantly white schools.

### **B2.1 Full-sample models examining determinants of overall and mathematical performance in the Western Cape**

Table 4 below outlines the first set of models. Five of the variables available in the dataset<sup>17</sup> were found to have a significant association with the overall Matric exam performance of schools: i) whether the school was predominantly white, ii) the school fees per learner, iii) a poverty index<sup>18</sup> for the surrounding area, iv) the pupil-teacher ratio and v) an index measuring the average qualifications of the teachers at the school. The effects of both the poverty index and the qualifications index are non-linear, with the effect of poverty being greater at lower levels and the qualifications being more important at higher levels. The first four of these variables were also found to be significant when regressed on the mathematical performance index. The coefficient of the pupil-teacher ratio was not significant when included in the mathematical performance index regression.

The following variables from the dataset were not found to be significant when added to the models detailed above (the t-statistics of each of these variables when included in respectively the current overall and mathematical performance model is added in brackets behind each variable): i) whether the school consisted of predominantly black learners (-1.867, -0.509), ii) whether the school was predominantly coloured (-1.554, -1.320), iii) an interaction variable for the pupil-teacher ratio and predominantly black schools (-1.771, -0.553) and iv) an index representing the physical endowments<sup>19</sup> (1.697, -1.273) of the school. The pupil-teacher ratio and the square of the index of average teacher qualification both yielded insignificant t-stats (-1.273 and 1.697) when added to the mathematical performance model.

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<sup>17</sup> See Appendix B for a description of the dataset

<sup>18</sup> The poverty index for the area surrounding the school was constructed by the Western Cape Education Department for purposes of applying the schools Norms and Standards legislation, which required that poorer schools be identified so that they could receive additional funding for non-teacher resources. The index is based mainly on income in areas surrounding the school, but also considers functional literacy, water provision and unemployment.

<sup>19</sup> Like the poverty index, the physical index was constructed for the Norms and Standards identification of poor schools. It is based on scores given to various aspects related to the quality and adequacy of school buildings, but in the Western Cape it has little discriminatory value.

**TABLE 4: Examining the overall and mathematical performance of schools in the Western Cape**

	Overall performance				Mathematical performance <sup>20</sup>			
	Coeff	S.E.	t-value	P> t	Coeff	S.E.	t-value	P> t
<b>Dummy &gt;70% white learners</b>	0.1981	0.0871	2.366	0.019	0.4036	0.1188	3.397	0.001
<b>School fees per learner</b>	0.0002	0.0001	2.919	0.004	0.0002	0.0001	2.429	0.016
<b>Poverty index</b>	-2.4607	0.3947	-6.235	0.000	-4.2219	0.5166	-8.172	0.000
<b>Poverty index squared</b>	0.9122	0.3773	2.418	0.016	2.5240	0.5009	5.039	0.000
<b>Index of average teacher qualification</b>	-6.0670	2.3017	-2.636	0.009	0.8158	0.4103	1.989	0.048
<b>Index average teacher qualification squared</b>	4.5951	1.5849	2.899	0.004	<i>Not significant</i>			
<b>Pupil-teacher ratio</b>	-0.0112	0.0064	-1.864	0.064	<i>Not significant</i>			
<b>Constant</b>	4.3978	0.8405	5.232	0.000	1.4981	0.3702	4.047	0.000
<b>Observations (n)</b>	242				241			
<b>R<sup>2</sup></b>	0.7729				0.6773			
<b>Adjusted R<sup>2</sup></b>	0.7661				0.6704			

Two other variables, the age of teachers and their experience, were also omitted from the described models. The average experience of teachers was not robustly significant and when significant, it had a negative coefficient. The age of teachers was only significant in the absence of the index of average teacher qualifications, and yielded a poorer overall fit than a regression with the latter variable.

As mentioned previously, the non-normal distribution of the full sample makes it difficult to evaluate the relative impact of resource allocation versus efficient use of resources in a general model. The non-normality of the sampling distribution is a problem because most diagnostic tests presume independent and identically distributed samples. Hence, it makes more sense to ask the question about the relative explanatory power of resource allocation versus efficiency in two separate models,

<sup>20</sup> An alternative index of mathematical performance was calculated by replacing the learners-per-subject numerator with the total number of matriculants in the school. In regressions with this alternative index of mathematical performance, the predominantly white schools dummy, the poverty index and the average level of teacher qualification remained significant, but the school fees per learner variable was not significant. The adjusted R-squared was 0.53.

evaluating the impact of determinants of school performance for predominantly black and coloured schools and predominantly white and “other” schools independently. The table below provides evidence in support of modelling these two groups separately.

**TABLE 5: Comparing characteristics of predominantly black or coloured schools vs. predominantly white and “other” schools in the Western Cape**

	Predominantly black and coloured schools		“Other” and predominantly white schools		Full sample	
	Mean	S.d.	Mean	S.d.	Mean	S.d.
Average performance	0.7255	0.2432	1.654	0.675	1.196	0.6938
Poverty index	0.7170	0.1353	0.3427	0.2249	0.5285	0.2631
School fees per learner	62.4983	91.4438	508.4907	519.7574	303.0123	452.0186

## **B2.2 Race-based models examining determinants of overall performance in the Western Cape**

According to the model for the predominantly white and “other” schools, the performance of a school is explained by its poverty index, the pupil-teacher ratio and the index for average teacher age.<sup>21</sup> The adjusted R-squared is 0.70. By multiplying the coefficient by the standard deviation of the variable it is possible to get a rough comparison of the relative impact of the three variables. According to this measure, one standard deviation improvement in the poverty index has the greatest impact (-0.41) followed by the pupil-teacher ratio (-0.18) and the index for the average teacher age (0.16). The pupil-teacher ratio and the index for average teacher age can both be categorised as resource allocation variables. Thus, controlling for socio-economic background, it can be concluded that resource allocation – by name, experienced teachers – matters in “other” and predominantly white schools.

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<sup>21</sup> The proportion of white learners (0.732), the proportion of coloured learners (1.489), the proportion of black learners (0.657), school fees per learner (0.551) and the physical index (-1.513) were added to the existing model, but the variables were found to be insignificant. Average years of teacher experience and the index of average teacher qualifications did not contribute significantly to the existing model, even when replacing the average teacher age index. We tested for non-linearity in the poverty index and also the teacher qualification variable, but found no evidence of it in the smaller sample. This provides evidence for attributing the non-linearities in the full sample regression to sampling issues.

**TABLE 6: Examining the overall performance of “other” and predominantly white schools in the Western Cape**

	Coefficient	S.E.	t-value	P> t
Poverty index	-1.5448	0.2356	-6.556	0.000
Pupil-teacher ratio	-0.0326	0.0105	-3.096	0.003
Index for average teacher age	0.9622	0.2780	3.462	0.001
Constant	2.5003	0.3247	7.700	0.000
Number of observations	108			
R-squared	0.7059			
Adjusted R-squared	0.6974			

Table 7 below summarises a model for the performance of learners from predominantly black and coloured schools. It includes only the poverty index and school fees per pupil as explanatory variables and at 0.33 the coefficient of determination (adjusted R-squared) is dramatically lower than for the white and “other” schools group.<sup>22</sup> Comparing the two variables by multiplying the coefficients with their standard deviations, the impact of a standard deviation improvement in the poverty index (1.35) is shown to dominate that of average school fees (0.36)<sup>23</sup>.

**TABLE 7: Examining the overall performance of predominantly black and coloured schools in the Western Cape**

	Coefficient	S.E.	t-value	P> t
School fees per learner	0.0008	0.0023	3.399	0.001
Poverty index	-0.8522	0.1387	-6.186	0.000
Constant	1.2941	0.1045	12.390	0.000
Number of observations	119			
R-squared	0.3408			
Adjusted R-squared	0.3295			

The resource allocation variables in our dataset fail to contribute substantially to the explanation of black and coloured schools results: the pupil-teacher ratio (0.504), the physical index (0.472), the index for average teacher qualification (1.579), and the average years of experience of teachers (1.431) all yielded statistically insignificant coefficients.

<sup>22</sup> It was possible to improve further the overall performance of the model by also including race variables for the proportion of black and coloured pupils in the school, but this would add little to our overall understanding of school performance.

<sup>23</sup> Interestingly, the correlation coefficient for the poverty index and school fees per learner is  $-0.63$  for the whole sample, but only  $-0.19$  for the predominantly black and coloured schools.

Coupled with the low explanatory power of this model, this could point to a substantial role for omitted variables such as the availability of basic teaching resources (e.g. blackboards, textbooks, writing pads, pens and pencils) and also managerial efficiency in the predominantly black and coloured schools. According to these findings, additional investment in teacher quality or quantity is unlikely to yield large improvements in Matric results for this group before the required complementary resources and appropriate managerial skills and incentives structure are in place.

The findings are in line with the results of a comparable study by Crouch and Mabogoane (1998b)<sup>24</sup>, who found that Matric results had a strong and positive correlation with the school's poverty index, a dummy for formerly DET-administered schools and the qualifications of the teachers. Our research would suggest that the qualifications of teachers might not remain a significant determinant if the sample of formerly DET-administered schools is modelled separately.

Crouch and Mabogoane found that weaker, but still significant correlations existed between school performance and what they termed "strongly cognitive resources", i.e. books, the adequacy of media centre material and whether computers were used for teaching. Pupil-teacher ratios, the condition of school buildings and other resources were not significantly correlated with Matric results.

They attributed the unexplained residual – ranging from 20% to 30% - to differences in the quality of management. Interpreting the DET-administered school dummy as essentially being a dummy for management, they concluded that management may account for around 50% of the variation in school performance.

## **Conclusion**

In the first section it was argued that the school system is presently incapable of substantially reducing inequality in the South African labour market because of its inability to reduce inequalities in educational output in any major and systematic way

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<sup>24</sup> As quoted in Taylor (2001).

in a relatively short time frame. This is indeed worrying, considering the huge socio-economic inequalities existing in South Africa and the dire need to reduce them.

The second section supports the conclusion from the first section in two ways. Firstly, it was shown for the Western Cape that the large output differentials largely follow past racial patterns. Poor schools with predominantly black and to a lesser extent coloured pupils do much worse than others. Moreover, it was shown that investments to improve teacher quantity and quality are unlikely to offer a viable means of overcoming these shortcomings in education before shortages in complementary teaching materials are addressed and the appropriate management and incentive structures are in place.

This strengthens the case for targeted managerial interventions to reduce inefficiencies in the educational system, whilst weakening the case for resource shifts as the most urgent need. More than resource investments will be required to enable the educational system to make the essential contribution to overcoming labour market inequalities.

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**APPENDIX A: List of variables in Dataset 1**

<b>Variable</b>	<b>Description</b>	<b>Year(s)</b>
Pass rate	Average pass rate of each school over two years	2000, 1999
Pupil-teacher ratio	Pupils per publicly remunerated teacher	1997
Teacher salary	Average salary per publicly remunerated teacher, a measure of both the qualifications and experience of teachers	1997
Teacher cost per pupil	The cost of remuneration of teachers in a school expressed relative to the number of pupils, i.e. combining the previous two variables	1997
Race dummies (predominantly black, coloured, Indian or white)	Dummies if the dominant group of students in a school comprise more than 70% of pupils	1997
Race dummy: "Mixed"	Dummy if no single group comprises more than 70% of pupils	1997
Race dummy "other"	Dummy if the racial composition was not provided, something that is quite common amongst schools in the Western Cape	1997
Wrote	The number of pupils who wrote matric in 1999, used as a weighting factor (the number who wrote in 2000 was not available)	1999

**APPENDIX B: List of variables in Dataset 2**

<b>Variable</b>	<b>Description</b>	<b>Year(s)</b>
Index for mathematical performance	Constructed from three years' mathematics symbol results for schools (Formula in text)	2001, 2000, 1999
Alternative index for mathematical performance	Constructed from three years' mathematics symbol results for schools (Formula in text)	2001, 2000, 1999
Index for overall performance	Constructed from three years' subject symbol results for schools (Formula in text)	2001, 2000, 1999
Poverty index	Poverty index of area around school (from Norms and Standards)	2000
Physical index	Physical condition of the school building	2000
Index for average years of experience for teachers	Index calculated as $\frac{x - \min}{\max - \min}$ , using average REQV of teachers. According to the budget Brief 52 one needs a REQV of 13 in order to be a qualified teacher. Highly qualified teachers have more than a REQV of 13.	2000
Pupil-teacher ratio	Number of pupils divided by number of teachers in the school	2000
Index for average age of teachers	Index calculated as $\frac{x - \min}{\max - \min}$ , using average age of teachers in school	2000
School fees per learner	Collected income of school divided by the number of learners	1997
Dummy for predominantly African schools	A dummy identifying all schools that indicated that more than 70% of their pupils were African.	1997
Dummy for predominantly Coloured schools	A dummy identifying all schools that indicated that more than 70% of their pupils were Coloured	1997
Dummy for predominantly White schools	A dummy identifying all schools that indicated that more than 70% of their pupils were White	1997
Dummy for "other" schools	A dummy identifying all school that indicated their pupils are "other"	1997
Dummy for mixed schools	A dummy identifying all schools which indicated that less than 70% of their pupils were from one race group	1997
Proportion of African learners in school	Share of school's learners that are African	1997
Proportion of Coloured learners in school	Share of school's learners that are Coloured	1997
Proportion of White learners in school	Share of school's learners that are White	1997

