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RACE, EQUITY, AND PUBLIC SCHOOLS IN POST-APARTHEID SOUTH AFRICA: IS OPPORTUNITY EQUAL FOR ALL KIDS?

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Abstract

This paper examines dynamic changes in educational quality and equity differences in the public school system between Black and other racial groups in post-apartheid South Africa, using the ratio of learners to educators in each school, available from the School Register of Needs, 1996 and 2000. The analysis incorporates school- and community-level unobservables and the endogenous movement of learners. This paper shows that (1) the learner-educator ratios significantly differ between formerly Black and White primary and secondary schools in 1996 and 2000, and (2) in the adjustment of educators in response to changes in the number of learners in this period, there are significant differences between formerly Black and non-Black (White, Coloured, and Indian) primary schools. The opportunities for education in public schools are still unequal between Black and White children, even after apartheid. Given that school quality affects returns to schooling and earning opportunities in labor markets, the inequality causes income inequality between Black and White. The empirical result calls for stronger policy intervention to support Black schools and children in South Africa.

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Acknowledgments

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1. Introduction

In the transition from apartheid to a democratic society in South Africa after the first democratic national election in 1994, the government promised to provide equal opportunities for education to all racial groups and regions (Republic of South Africa 1996a, 1996b). However, as reported in the *Education Atlas of South Africa* (Bot, Wilson, and Dove 2000), there are still wide variations in major indicators of educational quality across regions. Given the clustered spatial distribution of racial groups in the country, it is not difficult to infer variations among children across different population groups. This paper uses recently available South African school census data from 1996 and 2000 to assess variations in educational quality across former population groups of public schools and dynamic changes in post-apartheid South Africa.

It is increasingly recognized inside and outside South Africa that under apartheid, Black schools, such as those in the former homelands, were totally inferior to White schools in terms of funding (Crouch 1996; Kriege et al. 1994; Marais 1995). Differences between Black and non-Black schools affected student achievement, particularly in numeracy (Case and Deaton 1999). Unless the government actively strengthens its support to former Black schools in allocating both budget and personnel, a vicious cycle of poverty and low-quality education will persist: children who cannot receive a sufficiently high quality of education are less likely to engage in regular employment and are more likely to suffer from low wages (see, e.g., Case and Yogo 1999). Since they cannot afford to live in well-off residential areas where high-quality schools are more likely to be located, such people are likely to stay in areas with low-quality schools. High residential rents also prohibit access to better schools and exacerbate this cycle, potentially contributing to the long-term poverty trap for Blacks in the country.

To study gaps in educational quality across population groups, this paper focuses on the ratio of students to teachers and other staff—the learner-educator ratio (LER). The data comes from school censuses—the School Register of Needs (SRN) in 1996 and 2000. In 1995, the government reached an agreement that ERs of 40:1 and 35:1 were to be achieved for primary and secondary schools, respectively, over the next five years. The LER can serve as a good indicator not only of the distribution of education quality but also of the effectiveness of policy interventions toward educational equity.

Recent qualified empirical works show significant effects of LER and class size on student achievement, although the literature contains some ambiguity (Hanusheck 1998). The difficulty in identifying the causality arises from potential endogeneity in classroom size[1] and unobserved fixed components specific to school and community, which are likely correlated with school input. For example, Lazear (2001) argues that the effect of LER on student achievement could be empirically ambiguous because of often unobserved heterogeneity in student quality, e.g., discipline. In his model, the optimal size (i.e., LER) increases as students' discipline increases, since the probability of disruption in a classroom decreases. To avoid such a correlation between LER and unobservable conditions, recent studies use exogenous variations in LER and class size to identify the effect on student achievement (see, e.g., Angrist and Lavy 1999; Case and Deaton 1999; Hoxby 2000; Krueger 1999). In these studies with exogenous variations in LER, the effect is found to be significant. In the context of South Africa, Case and Deaton (1999) show that among Blacks who were prohibited from migrating under apartheid, LER has a significant effect on student achievement particularly in numeracy, while it is not significant among Whites.

Table 1 compares mean LERs by population groups in both 1996 and 2000. A striking fact in the table is that the gap between formerly Black and White schools was not narrowed during the period. Formerly White schools kept their superior position in the post-apartheid period. Though more detailed statistical analysis is in Section 4, the difference between Black and White schools seemed quite persistent and stable.

[1] High levels of LERs are partly attributed to high grade repetition rates in South Africa. However, those who have repeated grades are likely to transit to labor markets (Yamauchi 2003, using KwaZulu-Natal Income Dynamics Study).

Table 1—Learner-educator ratios (LER) in 1996 and 2000, by population groups

	African	White	Coloured	Indian	New schools
Primary school					
LER 1996	36.211	26.151	28.736	27.753	39.673
LER 2000	31.465	25.790	29.996	32.806	40.833
Secondary school					
LER 1996	31.975	22.329	23.196	23.415	38.145
LER 2000	31.052	24.203	30.157	30.447	35.996

Note: Sample means are shown by population groups.

The LER gaps can have some long-term implications. For instance, school quality affects subsequent labor market outcomes (Card and Krueger 1996; Case and Yogo 1999; Dustman, Rajah, and Soest 2003). Based on Case and Yogo estimates of the impact of LER on returns to schooling investments, the marginal effect of LER on rate of returns is around -0.002. The mean gap of LERs between formerly Black and White primary schools was 10.060 in 1996 (Table 1), the equivalent of a 0.0201 reduction in the rate of returns. The reduction is substantial on the ground that the average rate of returns is 0.089-0.094 for men ages 24-28 in 1996. Thus, it is possible that the inequality in opportunities for education is transformed in the inequality in labor market earning opportunities in South Africa.[2]

The paper is organized as follows. Section 2 sets up a simple framework in which liquidity constraint is highlighted. Section 3 describes the data used in the analysis (SRN 1996 and 2000). First, the surveys particularly focus on school facility information, in addition to basic information such as the number of educators and learners.[3] However, they lack information on financial conditions and student performance. Second, to identify the former racial groups of those schools, SRN 2000 provides information on

[2] In South Africa, Yamauchi (2003) shows that grade repetition increases the probability of transition from school to labor market and that it adversely affects the employment probability particularly for men. Other conditions being equal, grade repetition is positively correlated with LER as more students remain enrolled longer.

[3] In previous studies using SRN 1996, Bot, Wilson, and Dove (2000) completed a district-wide characterization of school environments from various perspectives. The South African Department of Education (2002) conducted a provincial-level characterization of SRN 2000 and 1996 and described dynamic changes in South African education. In these studies, however, the data was not analyzed statistically.

former apartheid departments that governed the schools. By merging the two surveys, I can systematically track former apartheid departments. Third, the sample used in the analysis excludes the provinces of Gauteng, Mpumalanga, and Northern Cape, since they changed school registration codes (EMIS codes) after 1996, preventing an accurate merge of the 1994 and 2000 data sets.

Section 4 summarizes the empirical findings. First, LER distributions for former Black, White, Coloured, Indian, and other racial group schools are statistically different in both 1996 and 2000. In particular, the difference between former Black schools and White or Indian schools was statistically significant. A large number of formerly black schools exhibit LERs above the targets set by the government (40 and 35 for primary and secondary schools, respectively).

To identify how the number of educators was adjusted in response to changes in the number of learners, the estimation strategy takes into account both community- and school-level unobserved fixed components and the endogenously changing number of learners (fixed effect-instrumental variable estimation), using specifications directly drawn from the model in Section 2. There are some interesting results. First, the dynamic responses of educators to learners (with budget constraints) differ statistically across racial groups in primary schools, especially in the adjustment of subsidized educators. Formerly Black schools are more budget (liquidity) constrained than non-Black (White, Coloured, and Indian) schools in employing educators. Second, among secondary schools, the gaps are smaller than those found in primary schools. Interestingly, formerly White secondary schools do not show any significant dynamic adjustment to changes in the number of learners during this period, probably because their condition was already optimal. Third, in combined schools (both primary and secondary levels), the gaps between formerly Black and Indian or new schools are significant. This observation reflects the facts that combined schools are regionally concentrated in certain districts and there are few White schools of this type. Fourth, in the analysis restricted to nonsubsidized (privately employed) educators, the number of educators does not significantly respond to changes in the number of learners. In this sense, the liquidity constraint is more binding at the school level than at the government level. Concluding remarks are mentioned in the final section.

2. Framework

Setting

I discuss the optimal allocation (adjustment) of educators across schools under the assumption that the optimal LER is unique. To clarify assumptions that allow a specific model used in this section, Appendix A provides some discussion of the optimal LER in a more general setting.

Before describing the model, I factor out possible reasons for changes in classroom size. First, natural population growth contributes to cohort size and, therefore, the number of school-age children in a community. Second, after the abolition of apartheid, households could freely migrate from formerly Black areas to White areas. Third, parents could also send their children to live with distant family members, foster other children,[4] or send their children to private schools that belonged formerly to different population groups, even though these schools were not located in their residential area.

In response to cross-sectional differences and dynamic changes in the number of learners in public schools, it is desirable to optimize the number of educators to maintain efficiency in learning and equity among children. There are several scenarios. Consider a stationary environment in which the total number of learners does not change. If the local government coordinates employment of teachers and allocates them among schools with no transaction costs, the optimal ratio of learners to educators can be maintained, and LER will be equalized across schools.

[4] Zimmerman (2003) shows that fostering raises school enrollment in South Africa. The geographical movement of children is partly motivated by the desire to provide children with better educational opportunities.

If schools have discretion over the employment of educators independently of the local government (e.g., principals decide to employ teachers with approval by school boards made up of community leaders, parents, and educators), the adjustment of educators depends mostly on the financial condition of each school and, to a lesser extent, on decisionmaking in each school. Currently in South Africa, many public schools suffer from insufficient financial support from local and national governments. In this case, the equalization of LERS is not necessary. In other words, equalization of LERs is a necessary condition for, among other things, unitary decisionmaking (or interventions) by the government. Even if the local government suffers from budget constraints, unitary decisionmaking will lead to equalization of LERs.

In response to dynamic changes in the number of learners, budget constraints may matter at school and local and national government levels. Under unitary decisionmaking by the government, it is easy to transfer educators from one school to another to equalize ratios across schools, even in a dynamically changing environment. It is especially true in the post-apartheid regime, where people are "essentially free" to migrate. This is the optimal response to dynamic changes in the total number of learners. To maintain the current LER, however, the adjustment of educators (like that of capital stock) depends on the government's budget (liquidity) constraint, since the government needs new teachers.

However, when public schools do not receive government subsidies (e.g., private schools), the situation is more serious. Schools with binding budget constraints that cannot collect enough school fees from student households are likely to have great difficulty hiring more educators. Also, unlike unitary decisionmaking, there will be more variations in LERs across schools, in this case since financial conditions are likely different between schools. As a result, for quasi-privatized, budget-constrained public schools, LERs could vary widely in cross-section as well as time series.

A Simple Model

I set up a simple static model of school finances and the demand for educators to clarify intuitions on the roles of liquidity constraint, government subsidies, and government coordination in the determination of LER. Suppose there are a finite number of public schools under a government, and that each school maximizes the per-learner output from education, given its budget constraint, without government intervention. Assume that each school can employ educators freely and that the number of learners changes exogenously at each school (for example, due to migration and population growth).

Each school has its target LER in each period that maximizes the efficiency in education production,

$$y_{it} = y^* + \xi_{it},$$

where ξ_{it} is i.i.d. with zero mean and finite variance. Assume that y^* is small enough, and we ignore a negative range of y_{it}.[5] ξ_{it} could reflect transitory changes in school environments. For instance, when the curriculum is changed, schools temporarily need additional teachers until existing teachers can accommodate the change.

Let $e_i(L_i,H_i)$ denote an efficiency function, where L_i and H_i are learners and educators in school i, respectively. I assume the efficiency function takes a quadratic loss form,

$$e_i(L_i, H_i) = \left[1 - (y_{it} - \frac{L_i}{H_i})^2\right],$$

[5] The optimal LER can change as endowment and technology in education production vary across schools, if these factors alter the marginal productivity of educators. When other non-personnel inputs and LERs are substitutable, equal LERs are not necessary for equal education output. Conditions on price structure and production function are discussed in a more general setting in Appendix A.

where LER determines the learning efficiency.[6] The total educational outcome is defined as $e_i(L_i,H_i)L_i$. Each school has its static budget constraint, $q_iL_i + G_i >= wHi$, where q_i is the school fee, G_i is a subsidy from the government, w is wage rate (exogenous) for educators, and

$$H_i = H_i^s + H_i^u :$$

two types of educators, subsidized and nonsubsidized, H_i^s and H_i^u, respectively. By definition, the budget constraint can be separated into two constraints: (1) government subsidy constraint, $G_i >= wH_i^s$, and (2) school fee constraint, $q_iL_i >= wH_i^u$. Nonsubsidized teachers are paid only from school fees. However, since the quality of subsidized and nonsubsidized educators is the same under the above framework, the two budget constraints can be added together. Assume that the government decides the per-learner subsidy, g_i, so $G_i = g_iL_i$ and $g_i \geq 0$ for all i (government does not impose tax).

The school fee is bounded above by some limit, $\overline{q_i}(f)$, determined by socioeconomic circumstances f of the school. In particular, the fee is determined by income level and distribution.[7] In fact, school fees are determined by school boards consisting of educators and community leaders, such that most parents can afford to pay. Unless government subsidy g_i offsets $q_i(f)$, local condition f affects $\frac{L}{H}$. School maximizes the per-learner education output subject to the budget constraints:

[6] In the range of LERs below the target, the efficiency is increasing in LER. It is assumed that with positive externalities among peer students, an increase in class size raises efficiency. However, if this effect is negligible, the target level can be set arbitrarily small.

[7] For example, if community members vote for the school fee, it is determined by the median income.

$$\max_{x,q} E_t e_i(L_i, H_i) = \left[1 - (y_{it} - \frac{L_i}{H_i})^2 \right]$$
$$st. \qquad .$$
$$G_i >= wH_i^s$$
$$q_i L_i >= wH_i^u$$

Rearranging the budget constraint, we define $\phi(q_i(f); w, g_i)$:

$$\varphi(q_i; w, g_i) \equiv \frac{w}{q_i(f) + g_i} \leq \frac{L_i}{H_i}. \tag{1}$$

The LER is constrained below by the ratio of educator wage (per-educator cost) to the sum of the school fee and per-learner subsidy (per-learner revenue). When the school decides on the school fee and employs educators, the determination of the school fee is simple: $q_i^*(f) = \_q_i(f)$, i.e., collect the highest school fees.[8] In this model, I do not allow learners to drop out in response to an increase in school fees (i.e., inelastic enrollment).[9]

Suppose, now, that budget constraints are not binding. Then, the optimal solution is

$$x_i^* \equiv \frac{L_i}{H_i^*} = y^* > \varphi(-q_i(f), g_i; w).$$

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[8] Since 1996, the school fee at public schools is determined by school governing body (SGB), which consists of the principal, educators, parents (including community leaders), and sometimes learners. Therefore, the level of the school fee reflects community opinions. In the community-school governance, the school fee increases as the median of monthly household income increases and as the standard deviation of monthly household income decreases. The former result is consistent with the voting implication, while the latter implies that school fee determination is anti-inequality. In this sense, school governance is altruistic to poor families who have difficulty paying the school fee, but it potentially sacrifices school quality (Yamauchi and Nishiyama 2003).

[9] The proportion of students who could not pay the school fee, including both postponing payment and official exemptions, is positively correlated with the level of the school fee (see, e.g., Yamauchi and Nishiyama 2003).

In this case, $H_i = \beta^* L_i$, where $\beta^* = 1/y^*$. Next, consider the case where the budget constraint is binding: $y^* < \varphi(-q_i(f), g; w)$. In this case,

$$\begin{aligned} H_i &= \frac{1}{\varphi(-q_i(f), g_i; w)} L_i \\ &= \beta^* L_i + \left[\frac{1}{\varphi(-q_i(f), g_i; w)} - \beta^* \right] L_i \\ &= \beta^* L_i + \left[\frac{w}{-q_i(f) + g_i} - \beta^* \right] L_i, \end{aligned} \tag{2}$$

where $w < \beta^*(-q_i(f) + g_i)$. The second term is an efficiency loss in terms of educator size. The government will allocate the subsidies to those with binding budget constraints. Next, consider the government's allocation of school subsidies. Assume that the government maximizes the total educational output, $\sum_i e_i L_i$, subject to its budget constraint, but does not allocate any subsidy to those schools that are able to attain optimal ratios:

$$\max_{\{g_i\}_i} \sum_{i \mid y^* < \varphi(-q_i, 0; w)} \left[1 - (y^* - \frac{w}{-q_i(f) + g_i})^2 \right] L_i$$

$$s.t.$$

$$\sum_{i \mid y^* < \varphi(-q_i, 0; w)} g_i L_i \le G.$$

Without the government budget constraint, the necessary condition is

$$g_i^* = wy^* - -q_i(f).$$

In general, we have $2\left[y^* - \varphi_i(g_i) \right] \left[-\varphi'(g_i) \right] = \lambda$, where λ is the Lagrangian multiplier. From this, we also know that when $-q_i(f)$ decreases, g_i increases to compensate for gaps in the capability of collecting school fees (community endowment). In other words, LERs are equalized under the benevolent government's unitary decision.

So, without government intervention, LERs are determined by school-level liquidity (budget) constraints, provided that the best ratio is unique in all schools no matter what racial group they belong to. However, we expect that with active government interventions, the ratios will be equalized across all schools. In particular, the subsidy is allocated more to those schools with less favorable socioeconomic circumstances, that is, larger initial LERs.

Empirical Specification, Identification, and Estimation

In empirical implementation, I use a modified condition from equation (2):

$$H_{it} = \left[I\left(y^* > \varphi_{it}\right)\beta^* + I\left(y^* < \varphi_{it}\right)\gamma_{it}(p) \right] L_{it} + \mu_i + \varepsilon_{it} \tag{3}$$

$$\gamma_{it}(p) = \frac{1}{\varphi(-q_{it}(p), g_{it}(p); w)},$$

where $\beta^* \geq \gamma_{it}(p)$, p denotes population group and μ_i is the fixed effect that reflects unobserved school- and community-specific components. Here, local condition f is also represented by population group p. In the analysis using the SRN, the information on subsidies and school fees is not available. However, I assume the patterns in which these two variables are determined to differ across population groups. I estimate $\gamma_{it}(p)$ as a reduced form parameter in the estimation of equation (3).

In equation (3), as in many cross-section studies, it is likely that the number of learners correlates with the unobserved fixed component μ_i, which will bias the OLS estimate of the slope. For example, in communities experiencing rapid urbanization—where teachers can easily commute from urban centers and migration comes in—the numbers of learners and educators will increase simultaneously. In this case, OLS estimates are biased upward. Assuming that parameters do not change over the four years, once conditioning on cross-group differences, we difference them between two periods:

$$\Delta H_{i\in p} = \sum_{p} \gamma_p d(p) \Delta L_{i\in p} + \Delta\varepsilon_i , \tag{4}$$

where Δ is the differencing operator and $d(p)$ is an indicator variable of population group p. The shocks are assumed to be ex post in each period.

The parameter of interest represents the degree of liquidity constraint. As we will see in Section 4 (Distribution Comparison), the empirical distributions of LERs motivate the analysis of determinants for the observed LER gaps across population groups. However, naive comparisons of LER distributions cannot identify school and government behavior, i.e., how the educator side of the ratio changes in response to changes in classroom size, and how likely the liquidity constraint is binding in adjusting the number of educators. Changes in classroom size represent changes in fundamentals to schools or by the government that adjusts the number of educators.[10]

Since the main interest of this paper is differences in school behavior across population groups, I grouped schools into five groups: Black, White, Coloured, Indian, and others (new schools) in equation (4). I use race-group dummies to approximate differences in patterns where liquidity and subsidy constraints bind decisionmaking regarding the employment of educators. In the above framework, we cannot distinguish whether liquidity-cum-resource constraint is binding or the target ratio is different across the groups. I exclude the latter case here (see Appendix A). In the estimation, I also use magisterial district dummies to capture variations across population groups within districts in which schools and communities are more homogeneous than those in a whole province. By focusing on within-district, cross-race differences, I can identify how

[10] The approach I am taking looks similar to one used in studies of liquidity constraint in firms investment behavior. However, in this method, investment is regressed on changes in sales revenue that represent exogenous shocks. The null hypothesis is that changes in sales revenue have no effect on investment, without liquidity constraint.

differentially the liquidity constraint binds the decision on adjusting educator size across population groups. In the null hypothesis that all the budget is pooled over all population groups, the liquidity (budget) constraint should bind equally for all the groups.

The estimation of equation (4) requires additional consideration. It is possible for the past shock in educator size (ε_{i1}) to partly cause subsequent changes in the number of learners, $E[\Delta L_{iep}\varepsilon_{i1}] \neq 0$. Suppose that a positive shock to educator size increases the incentives for potential learners to attend the school. This positive correlation leads to a negative bias in the OLS estimator in equation (4). In this sense, the endogenous movement (decisionmaking) of learners influences the magnitude of the negative bias. Under this circumstance, it is likely that the true value of the slope is between a possibly upwardly biased estimate from the cross-section analysis [equation (3)] and a possibly downwardly biased estimate from the panel analysis [equation (4)].

To obtain consistent estimates in equation (4), I use instrumental variables for the change in learner size (FE-IV estimates). The instruments used in the estimation are all taken from the 1996 data: the number of classrooms, the number of learners, indicators of road access, building conditions, the interactions of these variables with population group dummies, and magisterial district dummies. Except for the number of learners in 1996, these variables are on school infrastructure, which we reasonably assume are difficult to change in a short period of time. The instrumentation wipes out the correlation between changes in learner size and past shocks (in 1996) in order to obtain a consistent slope estimate.

The first-stage results would be interesting on their own. Regressing changes in class size on the initial time conditions (including initial class size), we would know how students and households have moved across schools over the four years. If the number of learners has decreased at large schools in the initial stage, variations in class size would decrease. This occurs not only by voluntary movement of learners from one school to another, but also by government decisions to merge different schools or split large schools to equalize school size. Differences across population groups are also of our interest.

More technically, under the assumption that educator shock is ex post in each period, these predetermined instruments, Z_{i1}, need to be orthogonal to the shocks in both periods, and be correlated with subsequent changes in learners, namely $E\left[\varepsilon_{i1}Z_{i1}\right]=E\left[\varepsilon_{i2}Z_{i1}\right]=0$ and $E\left[\Delta L_i Z_{i1}\right]\neq 0$. The instruments are school facility characteristics that are difficult to change in the short run, except for the number of learners in 1996. There are two merits in the instrumental variable estimation. First, the endogenous movement of learners, correlated with the past shocks to educators, will be eliminated in the estimation, and therefore it would be possible to infer the (relative) magnitude of learner movement and the differences across population groups. Second, in FE-IV results, we obtain consistent estimates that, if our conjecture is correct, should be between the cross-section and FE-OLS estimates.

There is a delicate technical issue on the orthogonality condition. In reality, since the number of educators and learners were surveyed at the same time, it would be difficult to assume that the shock is realized later than when the 1996 learner size is determined. However, unless households in neighboring communities have the ex ante information on unpredictable changes in educator size, the assumption on the orthogonality of the 1996 learner size, and the 1996 shock to educators in 1996, can still hold.

Alternatively, if the current condition of school facility (e.g., building conditions) signals government subsidy in the future, the information on school facility could indirectly signal subsequent changes in educators. For example, bad building conditions likely receive more attention from the government and will receive more funding in the near future; then more educators can be employed. If this holds, the initial condition (instruments) could be correlated with the 1996 error term. However, it depends on the reliability of such a signal contained in the facility information (i.e., how predictable government behavior is in the future). If households have such signals, however, learner size can adjust accordingly. Hence, it is reflected in the first-stage regression in which the initial conditions explain subsequent changes in learner size.

3. Data—School Register of Needs

School Register of Needs, with its focus on school-facility conditions, was initially fielded in 1996. In that survey, trained fieldworkers attempted to visit all schools in the country and collected information from educators, mainly school principals. Although the survey's coverage was found to be imperfect (some schools were not successfully located during the survey preparation stage), it was the first systematic school census in the country. Schools were identified by school codes provided by provincial departments of education (EMIS codes) and by province codes, and also by latitude and longitude using a global positioning system.

Four years later, the National Department of Education conducted the second round of the survey. At this time, however, data were collected through questionnaires distributed to school principals. This means of data collection alerts us to possible errors in the recorded answers, especially those on facility conditions. For example, principals might want to underreport school facilities in the hope of obtaining additional funding. To minimize this problem, the questionnaire was designed to elicit only changes from 1996 conditions, which were described in the distributed form. Even with potential measurement errors and bias in some questions, the 2000 survey accomplished almost perfect coverage of schools in the country. In particular, fieldworkers visited those schools that were missed in SRN 1996. Unlike SRN 1996, the 2000 version does not include technical colleges and special schools, but completely covers all primary, secondary, and combined schools (for detailed discussions on SRN 2000 and 1996, see *Technical Reports on SRN 2000*, EduAction 2001).[11]

[11] The data that I use here were provided by EduAction, Durban, and the National Department of Education, Pretoria.

For the purpose of constructing panel data, it is important to note that EMIS codes are also available in SRN 2000. However, some provincial departments of education changed the EMIS codes after 1996, and the details of the code changes are not transparent. Therefore, I decided to use only provinces that use the same EMIS codes in 2000 as they did in 1996. Through this process, Gauteng, Mpumalanga, and Northern Cape were excluded from the sample in the analysis below.

Another important feature of SRN 2000 is that it asked about former departments that governed the schools under the apartheid regime. From this information, we can correctly identify the racial background of each school under the previous regime. The correspondence between former departments and population groups is as follows.

Black	Department of Education and Training (DET)
White	Department of Education and Culture: House of Assembly (HOA)
Coloured	Department of Education and Culture: House of Reprentatives (HOR)
Indian	Department of Education and Culture: House of Delegates (HOD)
Black	Bophuthatswana Education Department (BOP)
Black	Ciskei Education Department (CISKEI)
Black	Gazankulu Department of Education (GZK)
Black	KaNgwane Department of Education (KaNGWANE)
Black	KwaNdebele Department of Education (KND)
Black	KwaZulu Department of Education and Culture (KZ)
Black	Lebowa Department of Education (LEB)
Black	QwaQwa Department of Education (QWAQWA)
Black	Transkei Education Department (TRANSKEI)
Black	Venda Education Department (VENDA)
All races	New schools established under the new provincial education departments between 1994 and 2000

It is also true that under the post-apartheid regime, children of any racial origin can attend any school. In our analysis, those schools established after apartheid will be grouped as “new schools.” It should be noted here that, even though schools are sorted by former departments, the period that our analysis covers falls after apartheid. Therefore, all schools are technically raceless both in 1996 and 2000. However, as mentioned in the introduction, the reality of racial composition of learners has not changed substantially since apartheid (see, e.g., Annual School Survey 1999). The majority of formerly Black schools are still in communities that are predominantly Black, so students in those schools remain mostly Black as well. Some formerly White schools now accept children from Black families with relatively high incomes and residing with commuting distance. Therefore, although the focus on population groups is approximate, as it does not reflect exact racial composition in each school, it does capture the essence of social distance across racial groups in South Africa today.

However, the information on former departments is available only in SRN 2000, not in SRN 1996. It is therefore necessary to merge SRNs 1996 and 2000 by EMIS and provincial codes in order to group schools covered in SRN 1996 by population group. Through this merging process, excluding Gauteng, Mpumalanga, and Northern Cape for the reason mentioned above, nearly 10 percent of primary and secondary schools in SRN 1996 do not match those in SRN 2000. In the panel analysis on dynamic changes from 1996 to 2000, and in the cross-sectional analysis on differences across population groups even in SRN 1996, I use those schools that were correctly matched between SRN 1996 and SRN 2000.

In the preliminary stage of analysis, I have detected some incomplete data in SRN 1996, e.g., some schools did not report the number of classrooms. I tried not to use such incomplete variables from SRN 1996. However, since the number of classrooms is important as an instrument, I have used schools that have information on the number of classrooms even in non-instrumented cases.

4. Empirical Findings

This section summarizes empirical results. Three types of empirical analyses are conducted. First, I statistically characterize the distributions of LER in 1996 and 2000 in different population groups. Cumulative distributions of LER are compared, and Kolmogorov-Smirnov tests are used for statistical comparisons of LER distributions of formerly Black schools with other schools. Second, to investigate the relationship between changes in educators and learners, I take a flexible non-parametric approach incorporating global shapes of the dynamic relationships. Third, in a panel analysis that differences out all fixed effects, I use FE-IV estimation to identify the relationship parametrically—correcting for endogenous changes in learners over time—and compare them across population groups in order to detect how likely budget constraints are binding the dynamic adjustment of educators.

Distribution Comparison

Figures 1 and 2 show LER distributions in public primary and secondary schools by 1996 and 2000, respectively. Primary (Grades 1-7), junior primary (Grades 1-4), and senior primary (Grades 5-7) are summed as primary schools, and secondary (Grades 8-12), junior secondary (Grades 8-10), and senior secondary (Grades 11-12) are grouped as secondary schools. In these figures, distributions are shown for different former population groups: Black (African), White, Coloured, Indian, and new schools.

For formerly Black and new schools, LER distributions have long upper tails. For the sake of display, the values of LER larger than 200 were omitted in these graphs, though there are substantial numbers of formerly Black and new schools in this range. On the other hand, the distributions are shown to be concentrated in the range of relatively small values for formerly White, Coloured, and Indian schools. This basic characterization of differences in LER distributions across former population groups is valid for all types of schools, primary and secondary. The main findings on cross-group differences are quite similar in both primary and secondary schools. Figure 2 also shows similar characteristics of the 2000 LERs.

To characterize stochastic dominance, Figures 3-6 display cumulative distributions of LER for formerly Black and one of the other schools: White, Coloured, Indian, and new schools for 1996 and 2000. For both primary and secondary, the LER of formerly Black schools stochastically dominates the others, except new schools. These observations confirm the previous findings on the gaps in LER across schools in former population groups.

Figure 1—Learner/educator ratio: Primary level

Figure 1a: 1996

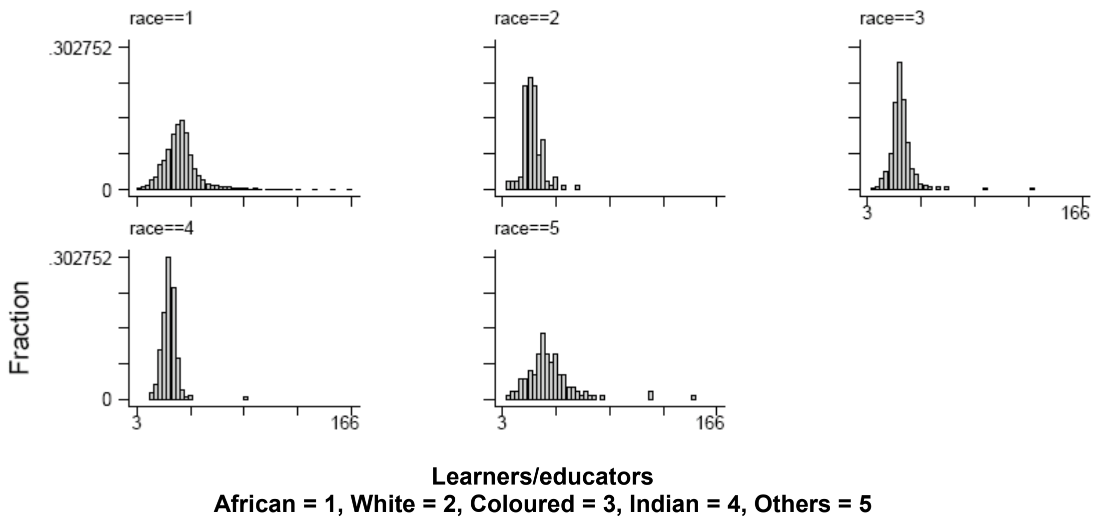


Figure 1b: 2000

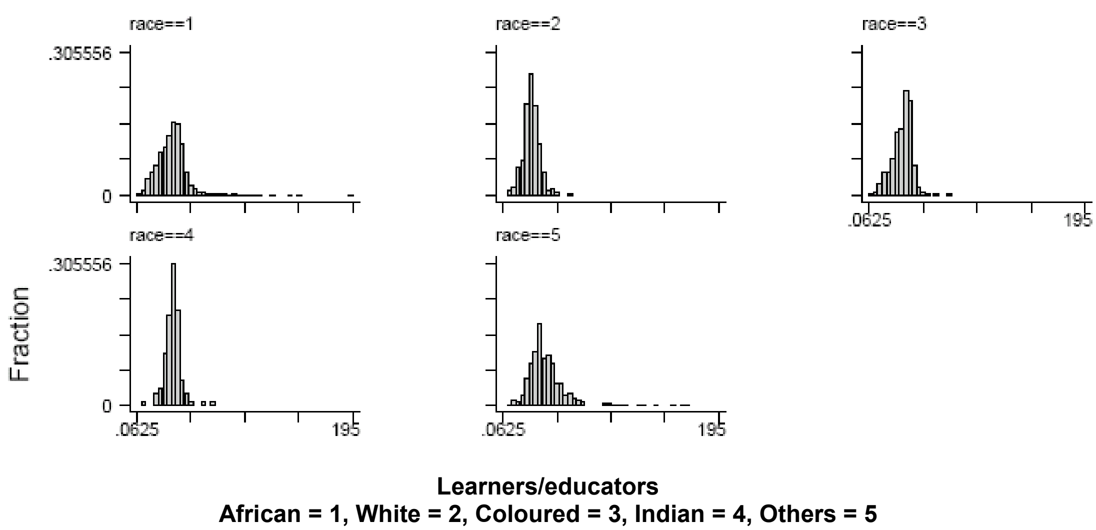


Figure 2—Learner/educator ratio: Secondary level

Figure 2a: 1996

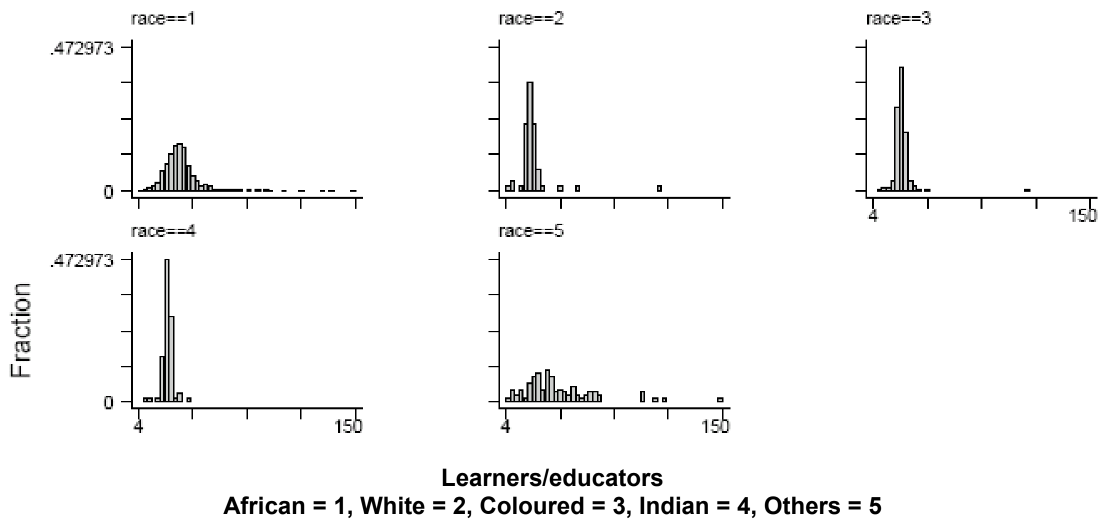


Figure 2b: 2000

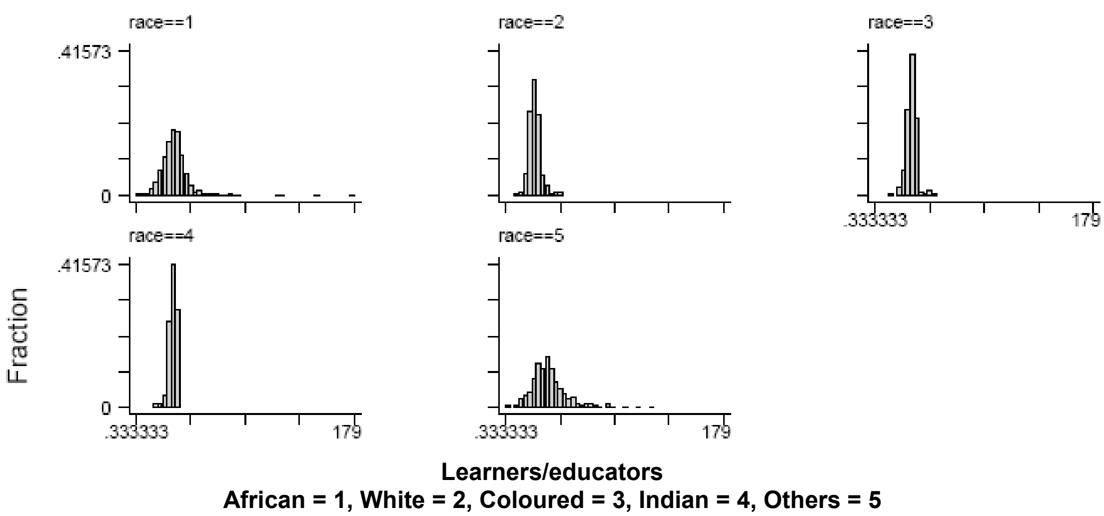


Figure 3—Cumulative learner/educator ratio, primary schools, 1996

Figure 3a.

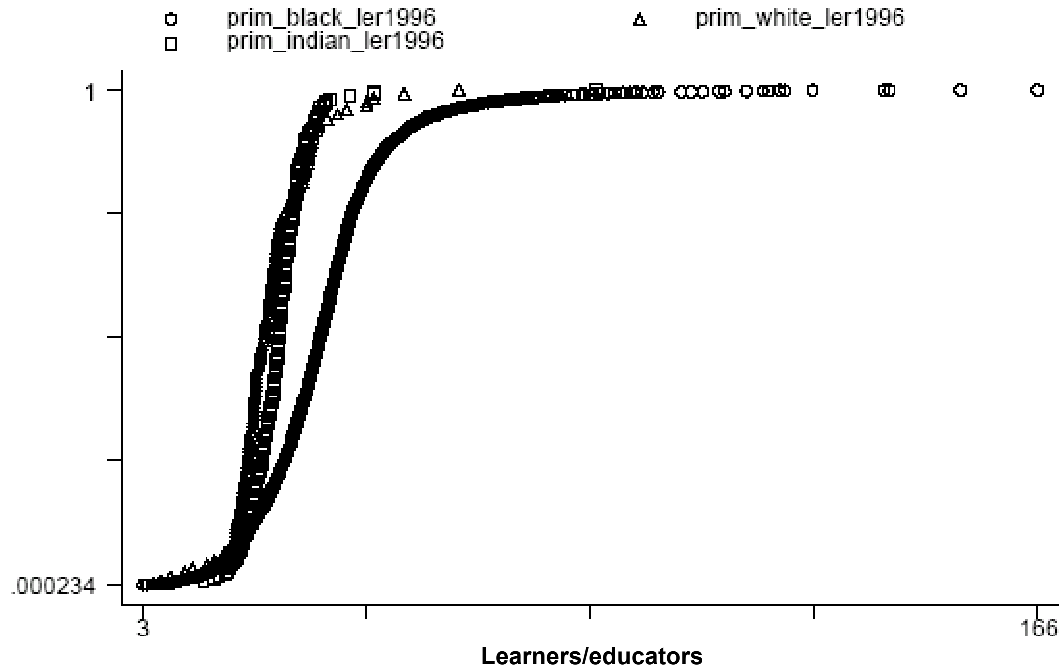


Figure 3b.

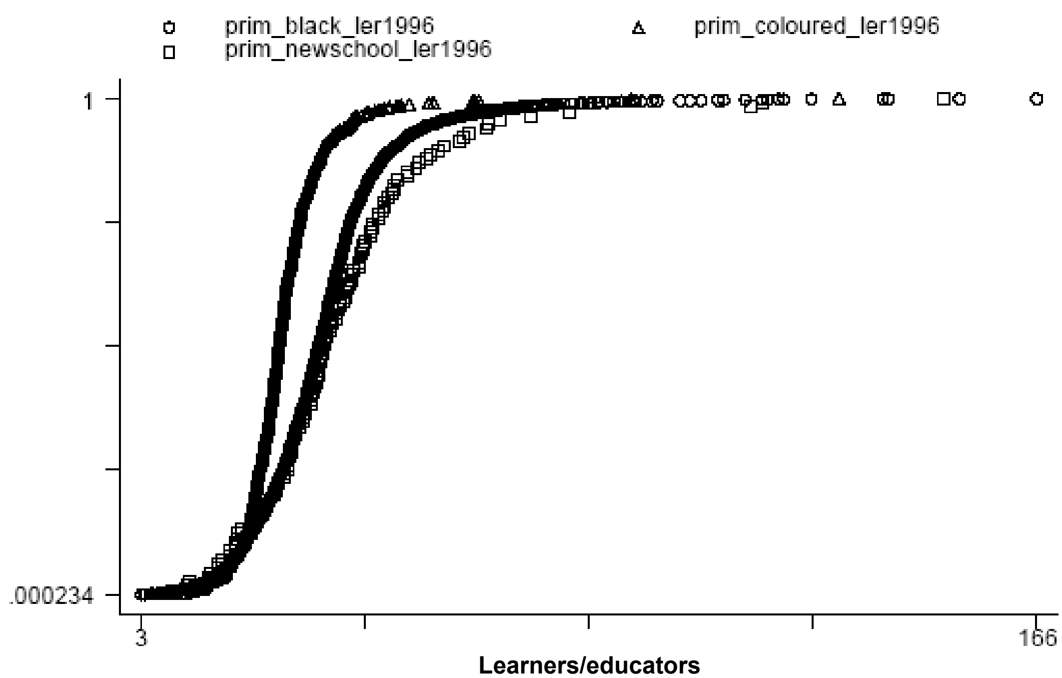


Figure 4—Cumulative learner/educator ratio, primary schools, 2000

Figure 4a.

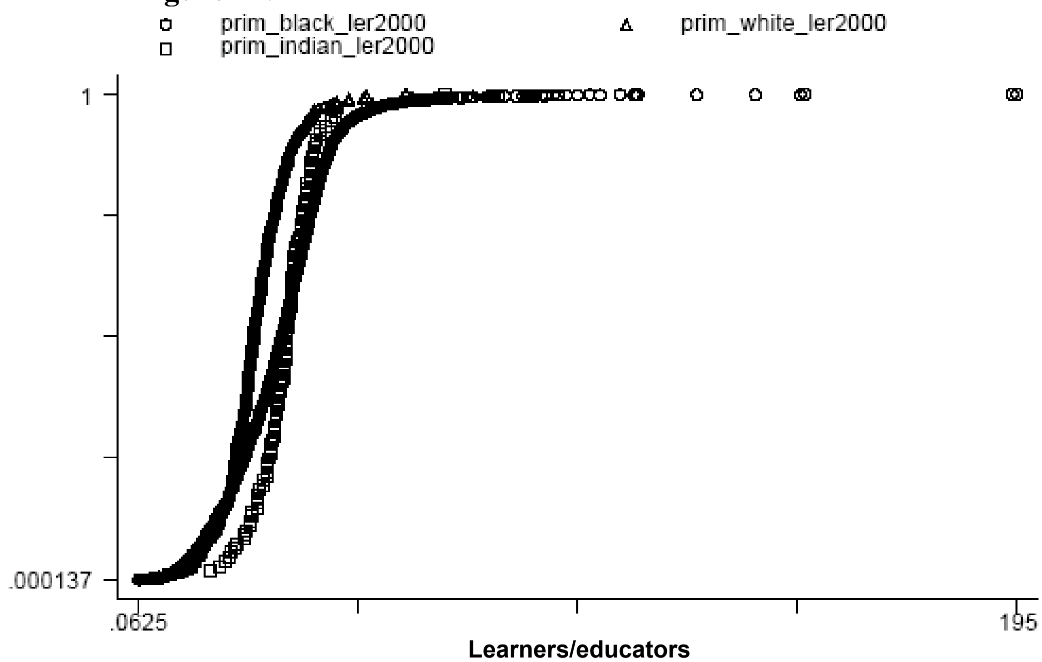


Figure 4b.

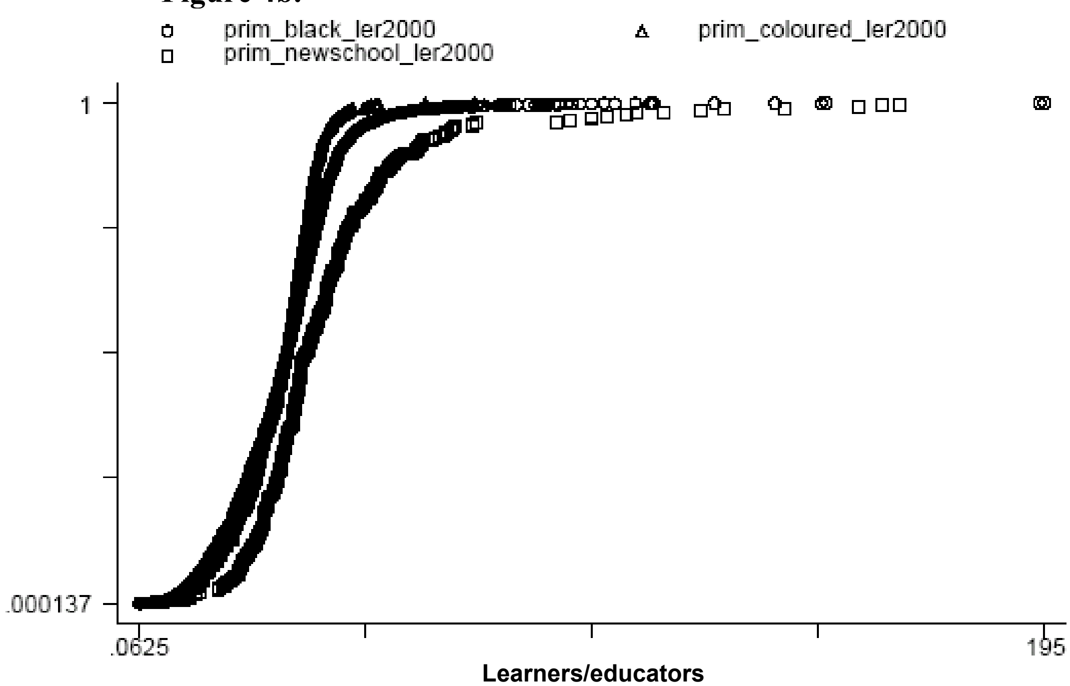


Figure 5—Cumulative learner/educator ratio, secondary schools, 1996

Figure 5a.

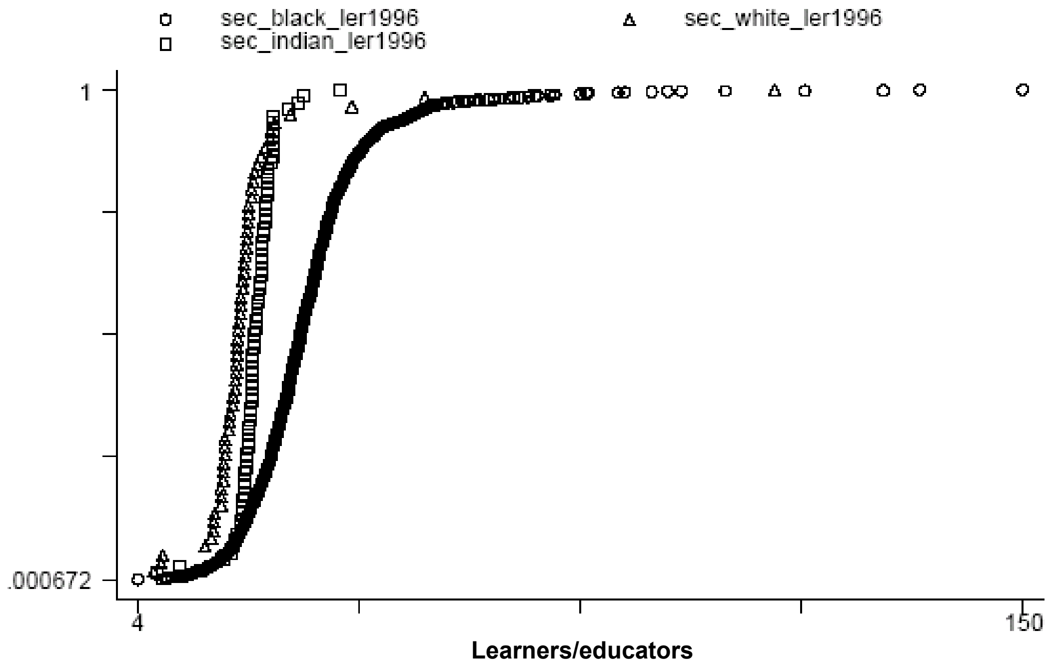


Figure 5b.

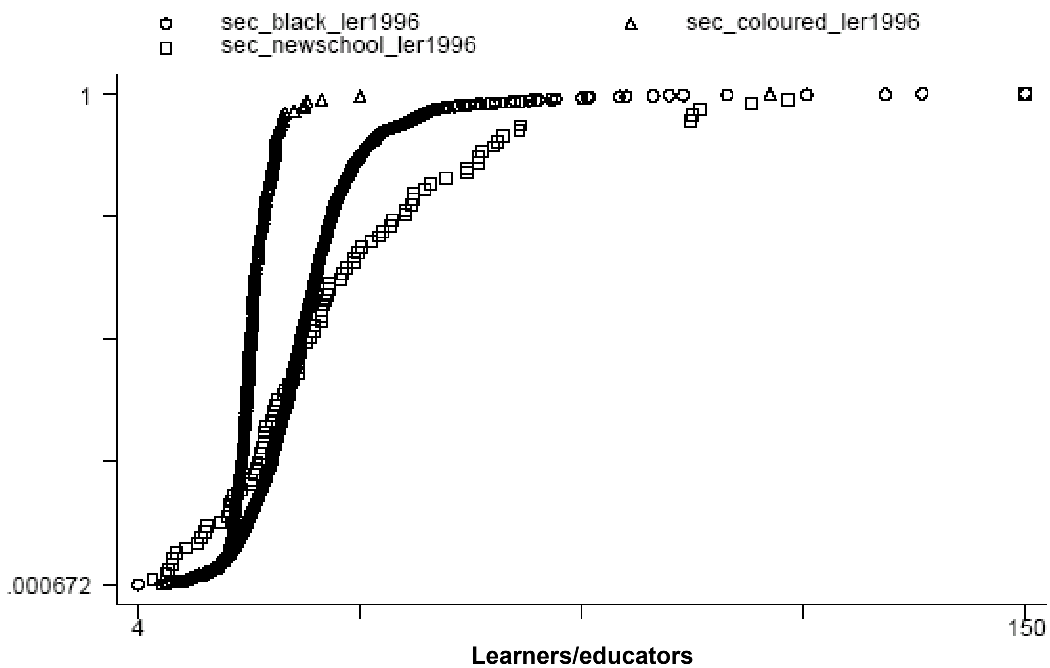


Figure 6—Cumulative learner/educator ratio, secondary schools, 2000

Figure 6a.

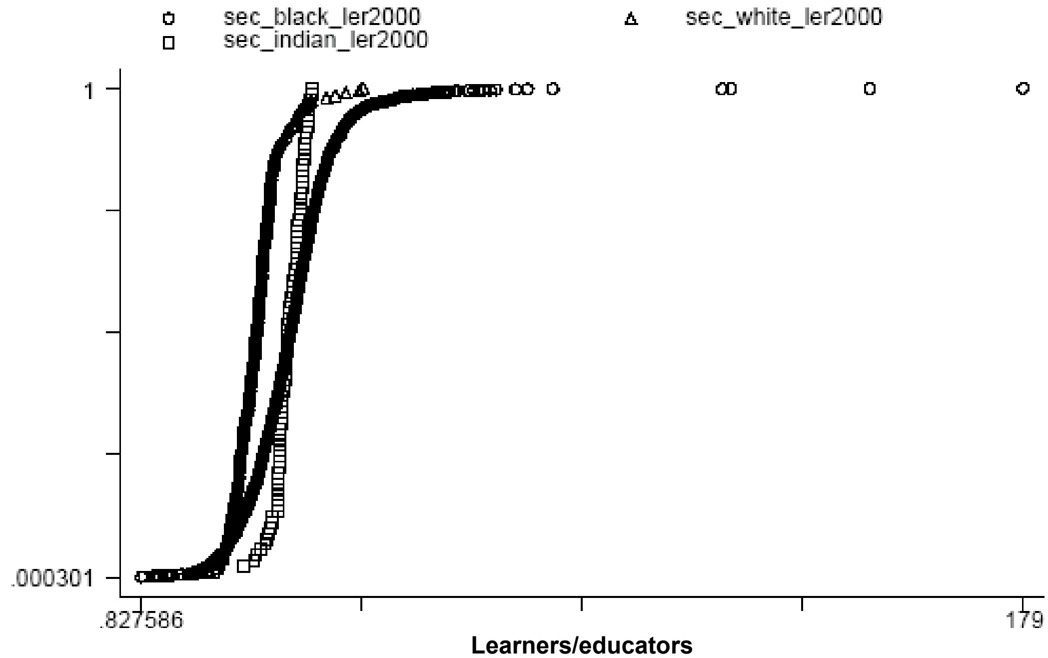
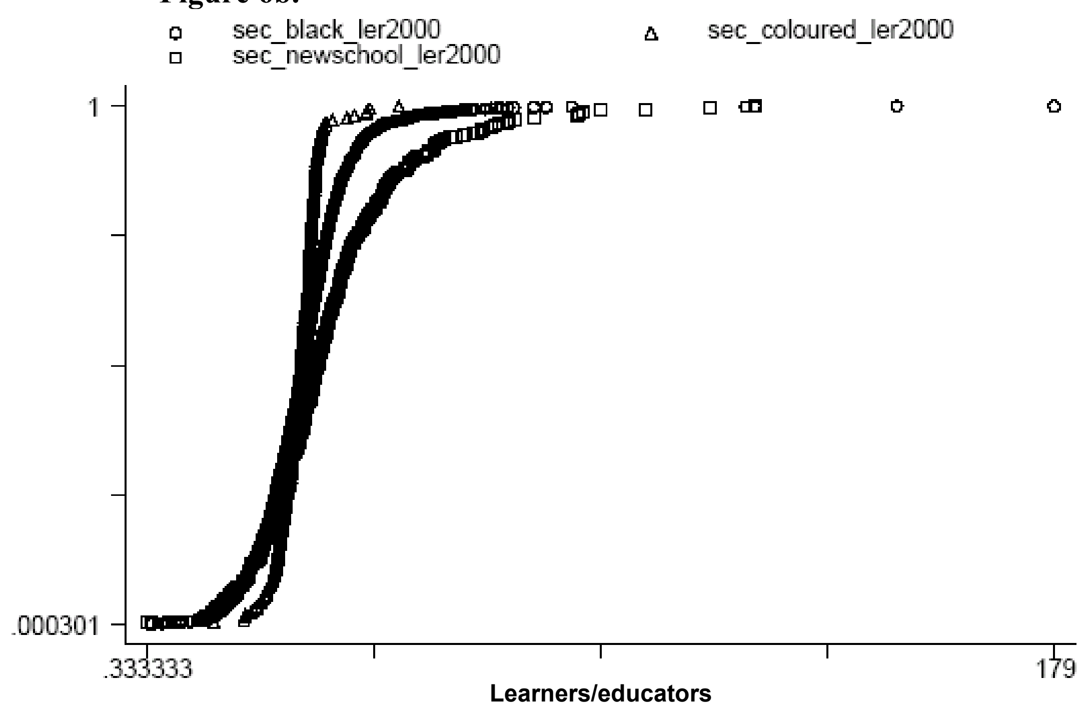


Figure 6b.



To statistically characterize differences in the LER distribution between formerly Black schools and the other schools, I use Kolmogorov-Smirnov tests (shown in Tables 2a and 2b). Table 2a shows two basic findings. First, in the country as a whole, the LER distributions of Black primary and secondary schools are statistically different from those of White, Coloured, and Indian schools in 1996 and 2000. In particular, the test statistics show that the distance between Black and White has not been narrowed from 1996 to 2000.

Table 2b shows provincial-level results on Kolmogorov-Smirnov tests. In provincial levels, I find that the results differ between provinces in 1996 and 2000. In 1996, the distance between Black and White primary schools is found to be significant in many provinces, except Free State and North West, where the distances to Coloured, Indian, and others are also insignificant. In 2000, however, Black and White primary schools are significantly different in all provinces. In this sense, the difference remains quite robust between Black and White in post-apartheid South Africa. In secondary schools, findings are stronger than those on primary schools. In Free State and North West, where Black and White are not different in primary schools, the distance is statistically significant in both 1996 and 2000.

Hence, the findings clearly confirm our prior perception that formerly Black schools, at both primary and secondary levels, have not improved relative to formerly White schools, even under the post-apartheid government. This does not directly imply that Black children in the country suffer more from low educational quality than White children. In post-apartheid South Africa, no schools may discriminate based on children's racial origin, and children of any racial origin are selectively admitted. However, since most communities are still racially homogeneous, the former population group (available from the 2000 SRN) still represents the majority at the school level.

Table 2—Tests on distribution comparison: Two-sample Kolmogorov-Smirnov test for equality of distribution functions—D values (p values), South Africa and by province, 1996 and 2000

Table 2a—South Africa (excluding Gauteng, Mpumalanga, and Northern Cape)

		White		Coloured		Indian		New schools	
Primary	1996	0.5019	(0.000)	0.4185	(0.000)	0.5156	(0.000)	0.1348	(0.026)
	2000	0.3370	(0.000)	0.1279	(0.000)	0.1843	(0.001)	0.2208	(0.000)
Secondary	1996	0.6729	(0.000)	0.6228	(0.000)	0.6677	(0.000)	0.2157	(0.000)
	2000	0.5202	(0.000)	0.2565	(0.000)	0.2710	(0.000)	0.1949	(0.000)

Notes: The numbers on the left are D values of Kolmogorov-Smirnov statistics, and the p values are in parentheses. The distributions of White, Coloured, Indian, and new schools are compared to Black schools.

Table 2b—By provinces

Province		White		Coloured		Indian		New schools	
Eastern Cape									
Primary	1996	0.5074	(0.000)	0.5037	(0.000)	n.a.		0.3454	(0.006)
	2000	0.2917	(0.001)	0.1971	(0.000)	0.6399	(0.235)	0.2583	(0.000)
Secondary	1996	0.6977	(0.002)	0.5803	(0.000)	0.7017	(0.598)	0.2643	(0.035)
	2000	0.4953	(0.000)	0.2194	(0.067)	0.5442	(0.877)	0.1564	(0.007)
Free State									
Primary	1996	0.2152	(0.152)	0.1152	(0.516)	0.4504	(0.154)	0.3495	(0.024)
	2000	0.2140	(0.168)	0.1506	(0.234)	0.6553	(0.010)	0.4138	(0.000)
Secondary	1996	0.6217	(0.000)	0.7205	(0.001)	0.9379	(0.243)	0.2531	(0.917)
	2000	0.5099	(0.000)	0.3220	(0.055)	0.9634	(0.216)	0.6391	(0.000)
KwaZulu Natal									
Primary	1996	0.5521	(0.001)	0.1284	(0.331)	0.6604	(0.000)	0.2115	(0.549)
	2000	0.5798	(0.000)	0.0792	(0.628)	0.3036	(0.000)	0.2013	(0.000)
Secondary	1996	0.7227	(0.000)	0.6012	(0.000)	0.6141	(0.000)	0.2212	(0.873)
	2000	0.6592	(0.000)	0.2141	(0.152)	0.4566	(0.000)	0.2577	(0.000)
Northern Province									
Primary	1996	0.7360	(0.000)	0.5039	(0.148)	0.9753	(0.201)	0.2545	(0.010)
	2000	0.2988	(0.005)	0.3184	(0.838)	0.7742	(0.465)	0.4093	(0.000)
Secondary	1996	0.9194	(0.000)	n.a.		0.9964	(0.183)	0.2582	(0.004)
	2000	0.4068	(0.014)	0.4549	(0.662)	n.a.		0.2743	(0.000)
North West									
Primary	1996	0.5789	(0.032)	0.2244	(0.587)	0.3581	(0.218)	0.2008	(0.382)
	2000	0.2152	(0.576)	0.3739	(0.022)	0.2901	(0.260)	0.2875	(0.001)
Secondary	1996	0.8347	(0.001)	0.5785	(0.829)	0.8760	(0.319)	0.3361	(0.391)
	2000	0.5670	(0.000)	0.7050	(0.154)	0.4330	(0.729)	0.2160	(0.493)
Western Cape									
Primary	1996	0.8714	(0.000)	0.7492	(0.000)	0.9302	(0.001)	0.5168	(0.011)
	2000	0.7448	(0.000)	0.4732	(0.000)	0.7778	(0.024)	0.3333	(0.030)
Secondary	1996	0.9375	(0.000)	0.8548	(0.000)	0.9688	(0.025)	0.5417	(0.253)
	2000	0.8141	(0.000)	0.3774	(0.000)	0.3182	(0.871)	0.1773	(0.923)

Notes: The numbers on the left are D values of Kolmogorov-Smirnov statistics, and the p values are in parentheses. The distributions of White, Coloured, Indian, and new schools are compared to Black schools.

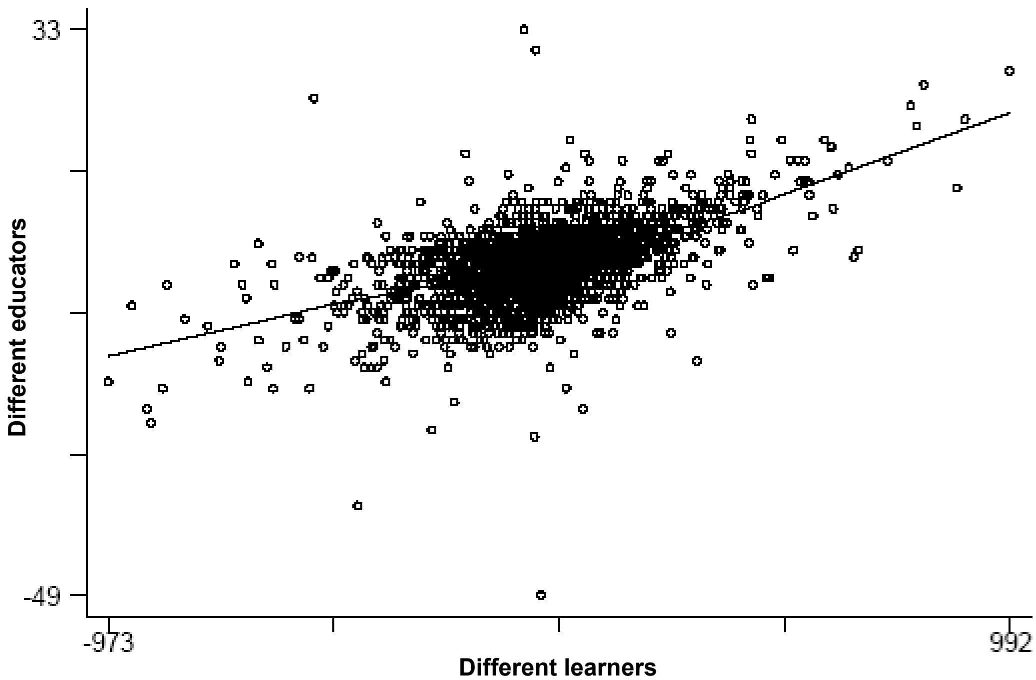
Nonparametric Approach

To cope with variations in the slope parameter across population groups and regions, and possibly at various levels of learner changes, I sort them by population groups to the extent that the sample size of each group can permit analysis. In preliminary analyses, I found that if I use primary and secondary schools separately, sample sizes for non-Black schools at provincial levels became too small to obtain reliable nonparametric results.

On Black secondary schools by provinces, it is also found that changes in numbers of educators responded to those in learners positively in all provinces. However, except KZ, the variations in numbers of educators seem to be larger in this case than those in primary schools. This finding is again consistent with a result in Table 6 that the effect of LER 1996 on changes in numbers of educators is much larger in secondary schools (around 0.22) than primary schools (0.09-0.10). In this sense, the equity-improving interventions were larger in secondary schools, and worked to narrow the gaps across schools.

Figures 7a-7f depict the relationships between changes in primary-school educators and learners in 1996-2000 for all races and for different racial groups. The samples I use in this exercise are constructed as follows. Among schools that are successfully matched between SRN 1996 and 2000 by EMIS and province codes, I only use those classified as state or state-aided as funding types in 1996, those with learner changes in the range of -1,000 to 1,000, and with educator changes in the range of -100 to 100. I dropped observations with missing values in the total number of educators in 1996 or 2000. Primary schools include normal primary (Grades 1-7), junior primary (Grades 1-4), and senior primary (Grades 5-7) in the 1996 survey. Similarly, secondary schools also include normal secondary (Grades 8-12), junior secondary (Grades 8-10), and senior secondary (Grades 11-12) in 1996. If schools changed the range of grades during the period, they experienced large increases or decreases in numbers of learners.

Figure 7a—Different educators versus different learners: Primary



Note: Lowess smoother, bandwidth = .8.

Figure 7b—Different educators versus different learners: Primary—African

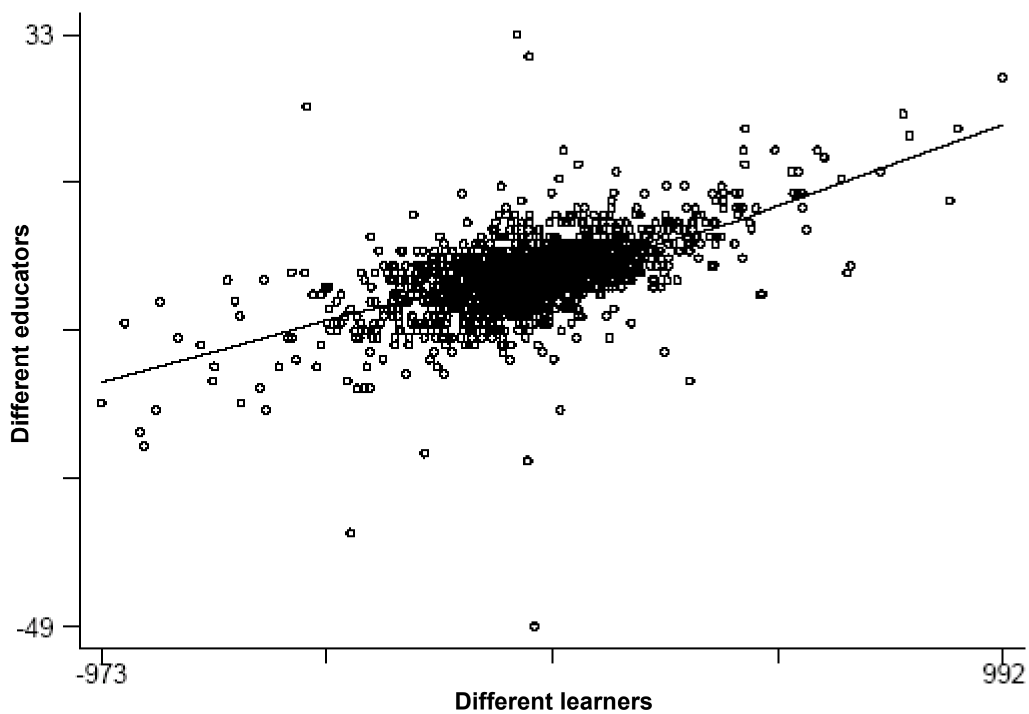


Figure 7c—Different educators versus different learners: Primary—White

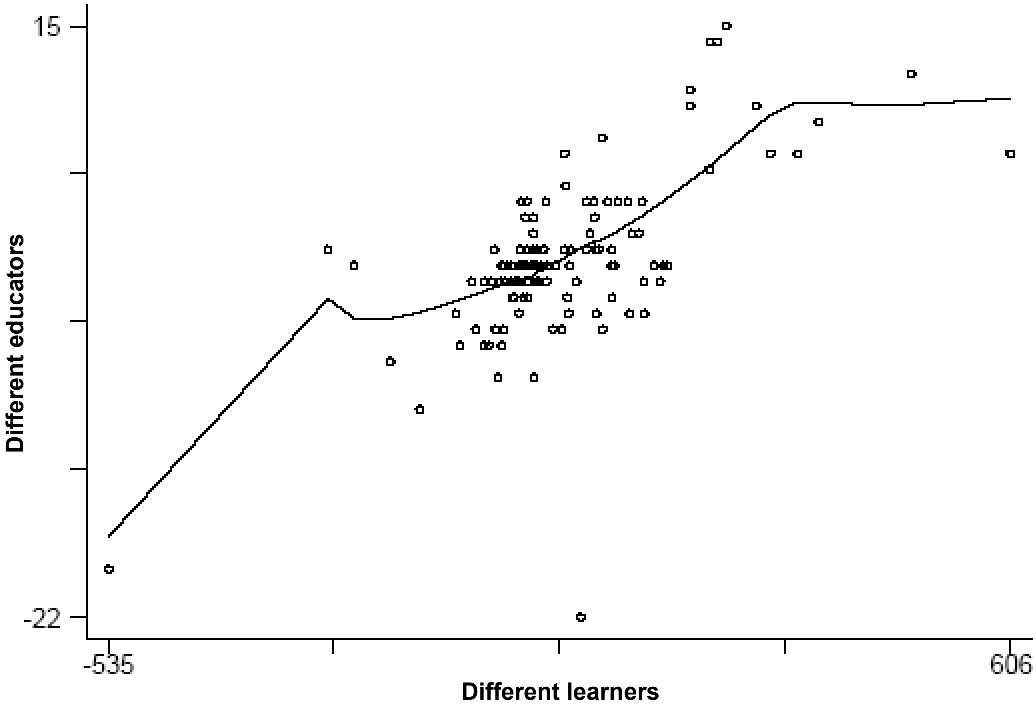


Figure 7d—Different educators versus different learners: Primary—Coloured

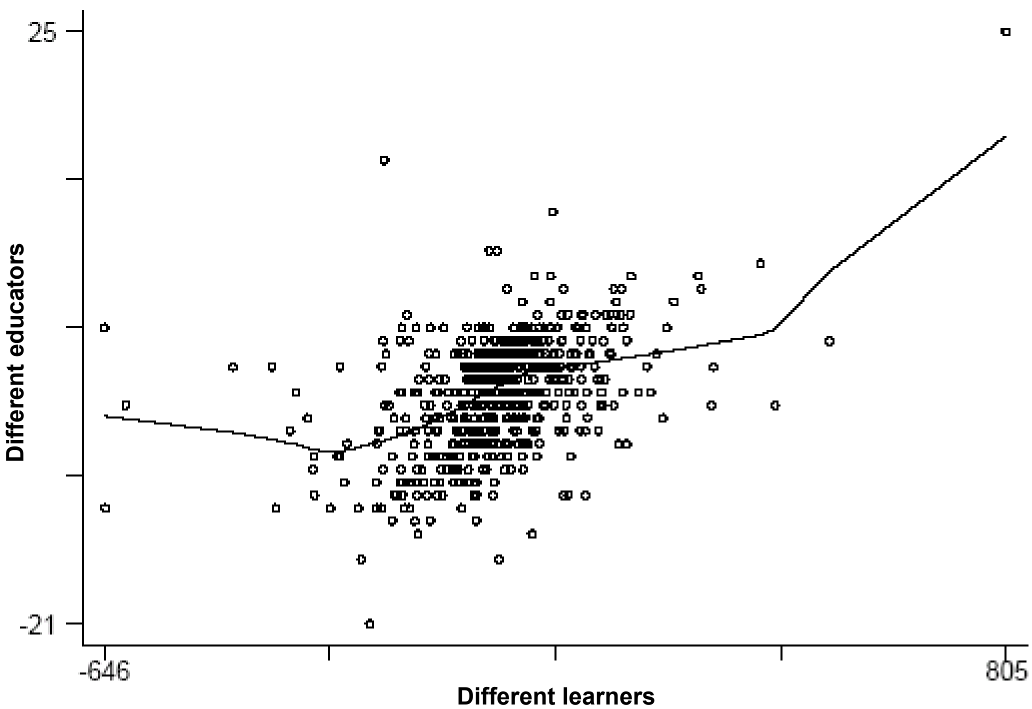


Figure 7e—Different educators versus different learners: Primary—Indian

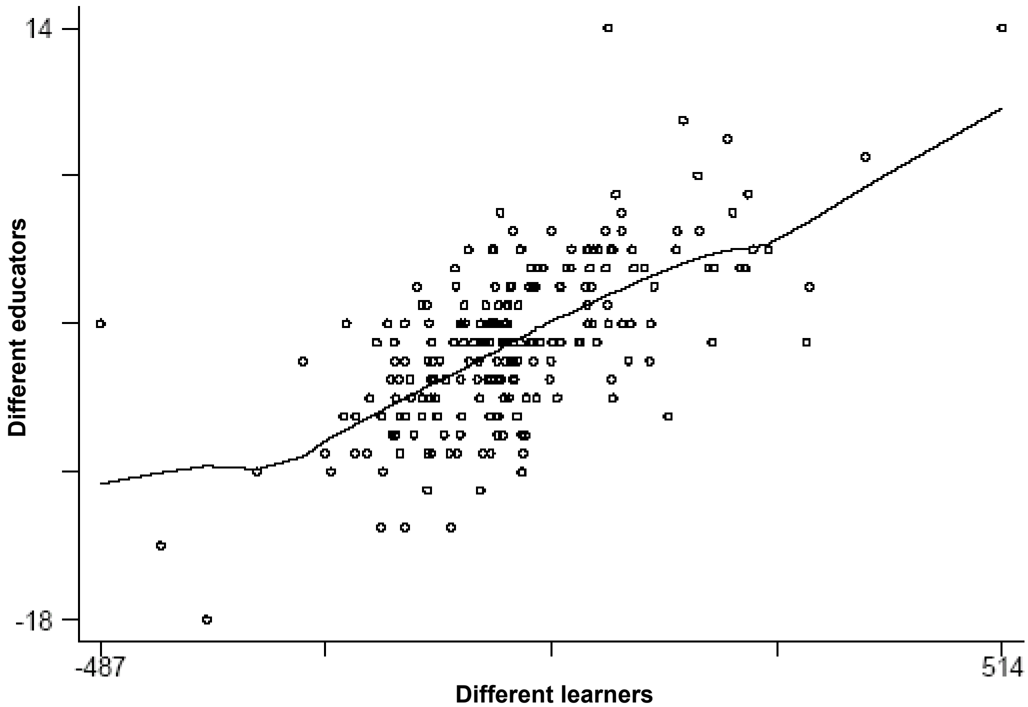
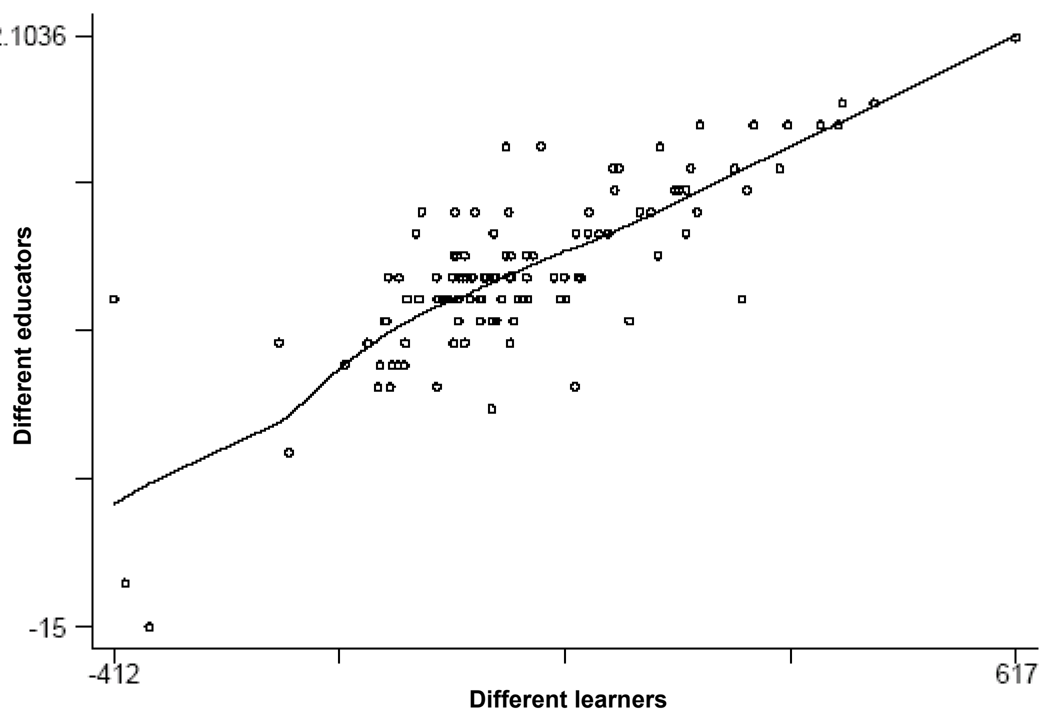


Figure 7f—Different educators versus different learners: Primary—New schools



In Figure 7a, the relationship is close to linear, but shows a slightly convex shape. However, it is asymmetric between when class size increases and decreases. The response of educators to increases in class size is larger than that for decreases in class size. In Figure 7b, in Black schools, we have the same observations. However, for White, Coloured, and Indian schools, nonlinearity becomes very strong (Figures 7c, 7d, and 7e). In White schools, while most observations are concentrated in small learner-size changes, the overall shape in the dynamics is kinked with concavity. Among Coloured and Indian schools, however, the relationship is kinked and convex. Observations in these groups are also concentrated in small changes. In new schools that were established after 1994, it is nearly a straight line (Table 7f).

Figures 8a-8f depict the cases of secondary schools. As in the case of primary schools, a nearly linear but slightly convex relationship is observed in all schools in the country (Figure 8a). The basic relationship holds among Black schools (Figure 8b). Figure 8c shows White schools: it looks strikingly similar to the case of primary schools. Though observations are less concentrated in small class size changes than primary schools, the shape is kinked and concave. Strikingly, the number of educators does not respond enough to large changes in numbers of learners, but it does respond to small changes. Since the number of observations with large changes of learners is small, the nonparametric averaging procedure becomes sensitive to particular observations. For this reason, we should focus our attention on the range of reasonably small changes.

One interesting observation from all these figures is that the cross-school variations in educator changes are quite large. The variations are large even with small changes in numbers of learners. One way to explain this observation is that government interventions narrow the initially existing differences in LER not directly responding to changes in class size. Alternatively, even without the government intervention, schools might have made efforts to weaken the liquidity (budget) constraints to adjust the number of educators. In either case, we expect that larger 1996 LERs induce larger subsequent increases in educators. To test this point, I switch to parametric estimation.

Figure 8a—Different educators versus different learners: Secondary

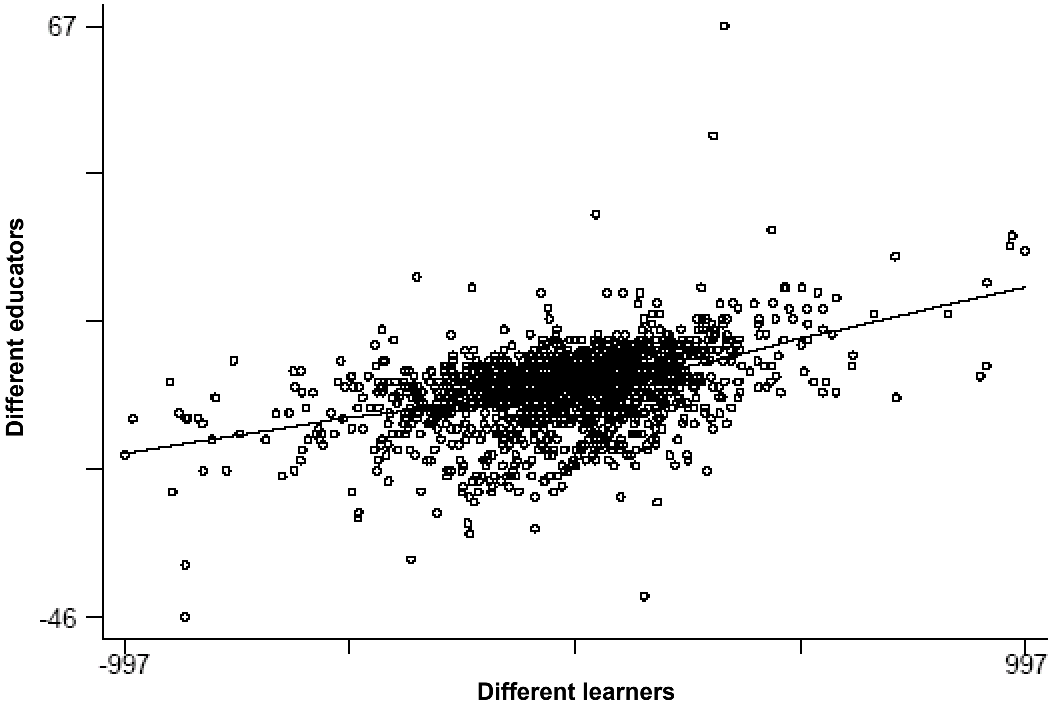


Figure 8b—Different educators versus different learners: Secondary—African

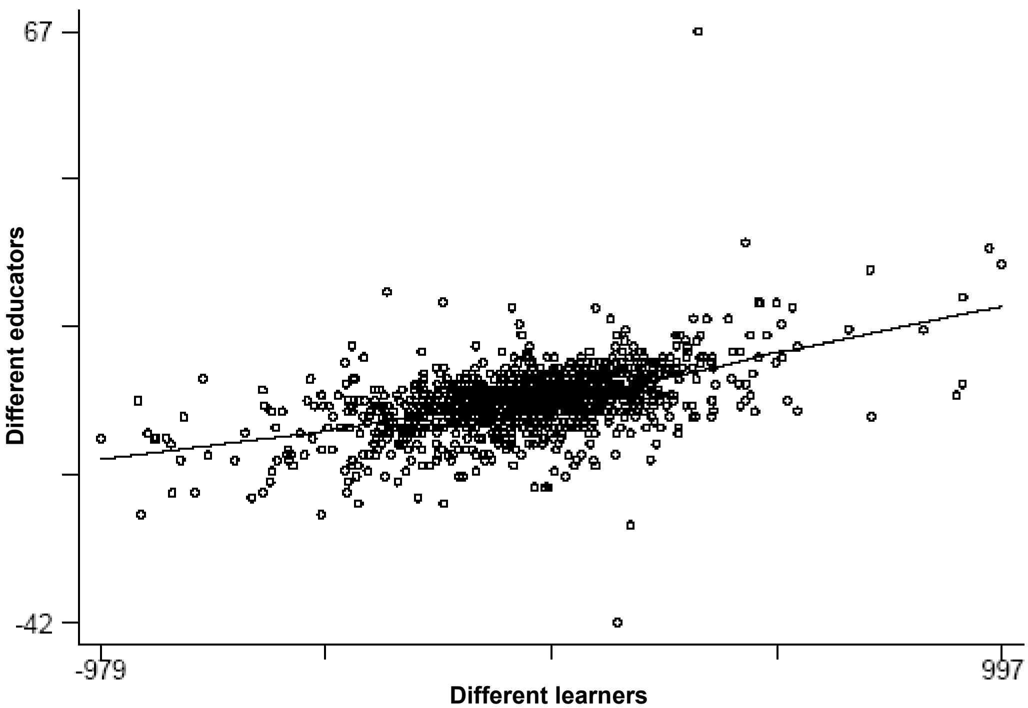


Figure 8c—Different educators versus different learners: Secondary—White

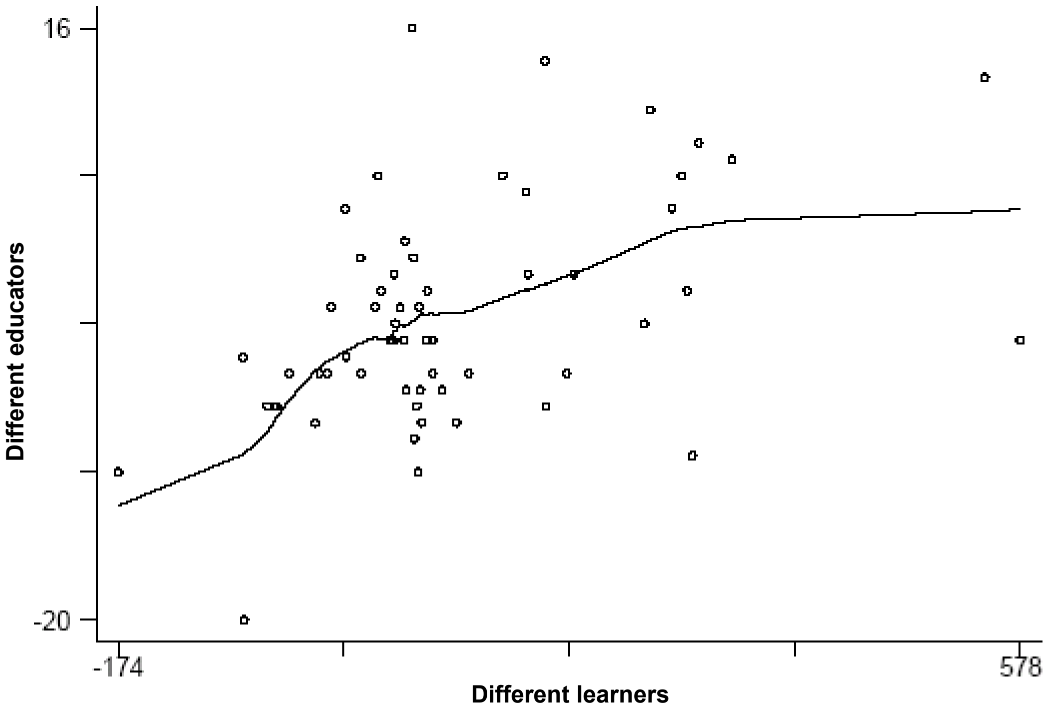


Figure 8d—Different educators versus different learners: Secondary—Coloured

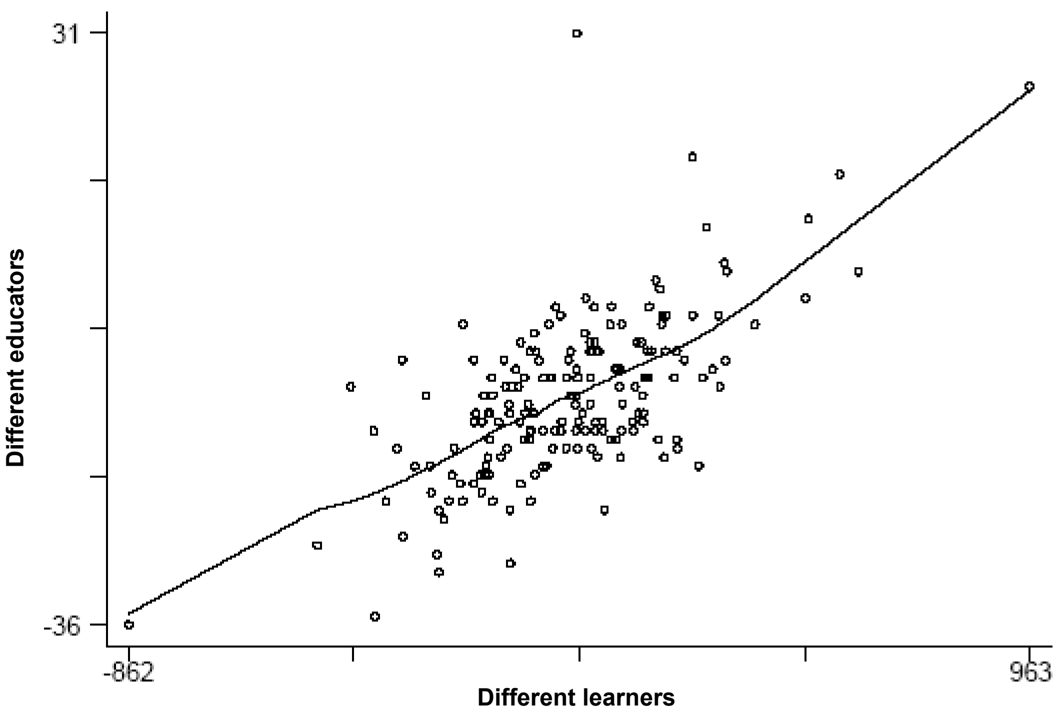


Figure 8e—Different educators versus different learners: Secondary—Indian

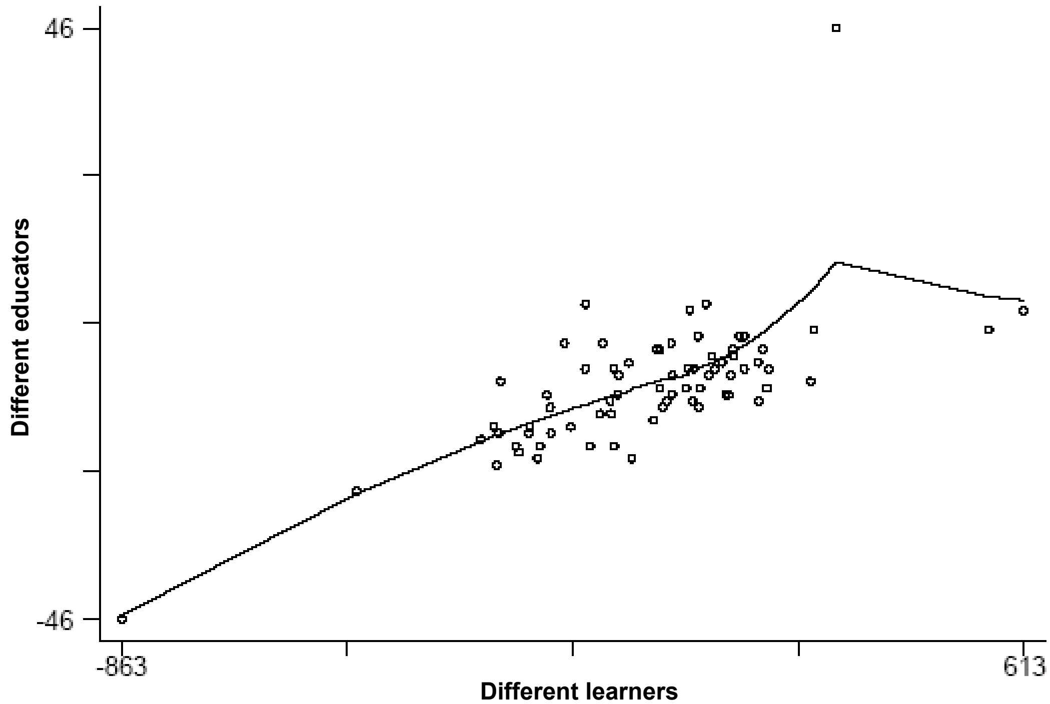
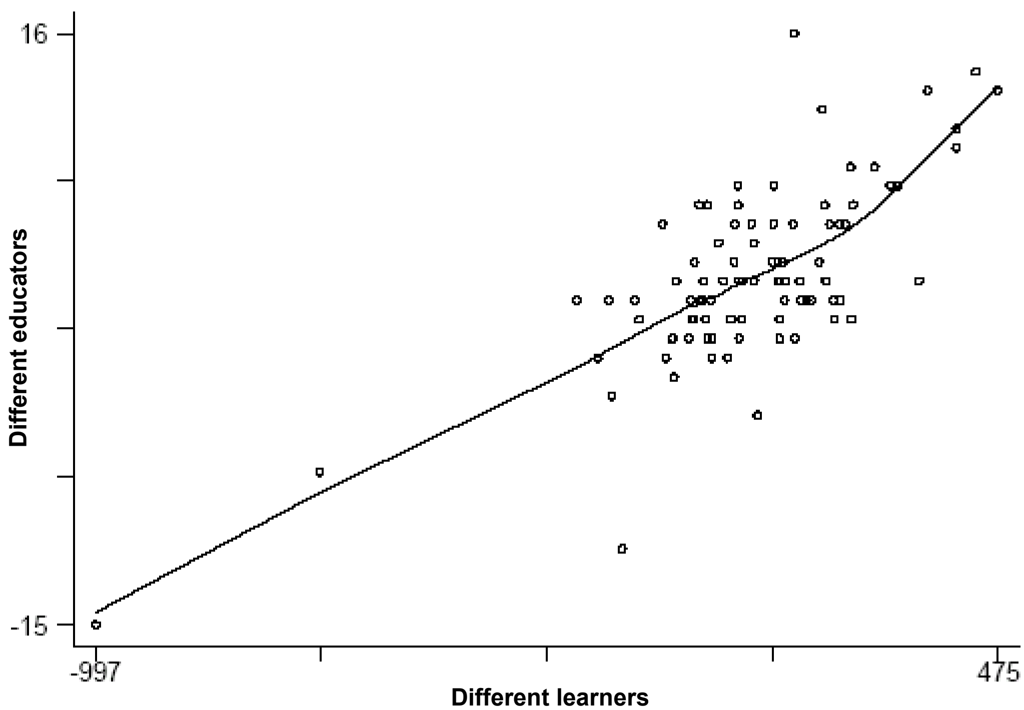


Figure 8f—Different educators versus different learners: Secondary—New schools



Fixed Effect, Instrumental Variable Estimation

This section shows the estimation results, taking into account community- and school-level unobservable fixed components and the endogeneity of over-time changes in the number of learners. To deal with the fixed effects, I difference out the fixed effects between 1996 and 2000, using changes in the number of educators and learners. Even in this differenced form, district-level dummies are included to control district-wide common changes in this period. The focus of this exercise is on the differences across population groups in the response of the number of educators to changes in the number of learners. With district-level dummies, this procedure essentially tries to identify cross-group variations in the educator adjustment within each district.

This identification strategy calls for an attention on the spatial residential pattern in South Africa, i.e., residential pattern is segregated by racial groups. In the former homeland districts, for example, most communities are predominantly Black, so there are few formerly White schools. This situation makes it difficult to identify gaps in school behavior between formerly Black and White schools. However, considering that socioeconomic circumstances are so diverse in different districts in the country, it is more important to control the district-wide heterogeneity in terms of learners' movement and school decisionmaking.

We also need to consider a possible correlation between past shocks to educators and subsequent changes in numbers of learners over time. If so, the OLS estimates in the differenced forms will provide negatively biased estimates of the slopes. In this section, I not only difference out the fixed effects but use instrumental variables available from 1996 so that consistent estimates of the slopes are obtained. The details were already discussed in Section 2. The results are summarized in Tables 3a and 3b for primary and secondary schools, respectively. I also decompose the educators into two categories: subsidized and nonsubsidized.

Columns 1 and 2 in Table 3a show the response of the number of all educators to changes in the number of learners, without and with instruments. First, the number of

Table 3a—Dynamic response: Public primary schools

Dependent variable: Difference in educators

	All educators		Subsidized		Nonsubsidized	
	FE	**FE-IV**	**FE**	**FE-IV**	**FE**	**FE-IV**
Difference in learners	0.0068	0.0038	0.0065	0.0038	0.0003	-0.00001
	(3.13)	(2.29)	(3.14)	(2.27)	(1.04)	(0.03)
*White	0.0107	0.0626	0.0044	0.0496	0.0063	-0.0075
	(2.89)	(3.84)	(1.050	(3.01)	(3.41)	(0.81)
*Coloured	0.0018	0.0367	0.0018	0.0202	-0.00007	-0.0015
	(0.61)	(2.27)	(0.69)	(2.68)	(0.13)	(1.04)
*Indian	0.0094	0.0289	0.0079	0.0405	0.0015	-0.0123
	(4.75)	(3.40)	(4.26)	(4.26)	(2.04)	(2.93)
*New schools	0.0167	0.0258	0.0159	0.0568	0.0008	-0.0053
	(1.72)	(2.05)	(1.62)	(2.19)	(0.57)	(1.68)
*Indicator increase	0.0122	-0.0313	0.0120	-0.0374	0.0003	0.0128
	(3.96)	(2.59)	(3.90)	(2.63)	(0.54)	(2.53)
Hausman-Wu (chi-square)		56.93		53.18		16.99
p-value		0.0000		0.0000		0.0746
Number of observations	4,663	4,663	4,663	4,663	4,663	4,663
R-square	0.3823	n.a.	0.4028	n.a.	0.1666	n.a.

Notes: The numbers in parentheses are t values. All specifications include race and district dummies. Robust standard errors are used with district-level clusters. In Columns 2, 4, and 6, the instruments are the number of classrooms, the number of learners, building condition indicators, road access indicators—all in 1996, interacted with population group dummies, population group dummies, and district dummies.

Table 3b—Dynamic response: Public secondary schools

Dependent variable: Difference in educators

	All educators		Subsidized		Nonsubsidized	
	FE	**FE-IV**	**FE**	**FE-IV**	**FE**	**FE-IV**
Difference in learners	0.0087	0.0118	0.0081	0.0108	0.0005	0.0009
	(4.60)	(4.48)	(4.35)	(4.07)	(1.53)	(1.27)
*White	-0.0069	-0.0116	-0.0087	-0.0092	0.0018	-0.0024
	(2.51)	(3.94)	(2.98)	(1.64)	(1.71)	(0.63)
*Coloured	0.0133	0.0188	0.0126	0.0171	0.0007	0.0018
	(3.23)	(1.99)	(2.83)	(1.79)	(0.84)	(0.93)
*Indian	0.0112	-0.0035	0.0096	-0.0048	0.0017	0.0014
	(1.25)	(0.37)	(1.06)	(0.51)	(1.67)	(0.43)
*New schools	0.0023	-0.0005	0.0015	-0.0017	0.0008	0.0012
	(0.99)	(0.16)	(0.63)	(0.49)	(1.14)	(1.31)
*Indicator increase	0.0080	0.0050	0.0079	0.0078	0.00005	-0.0028
	(2.36)	(0.52)	(2.26)	(0.77)	(0.06)	(0.72)
Hausman-Wu (chi-square)		2.17		4.23		22.87
p-value		0.9978		0.9627		0.0184
Number of observations	1,646	1,646	1,646	1,646	1,646	1,646
R-square	0.5209	0.5063	0.5300	0.5169	0.3658	0.3425

Notes: The numbers in parentheses are t values. All specifications include race and district dummies. Robust standard errors are used with district-level clusters. In Columns 2, 4, and 6, the instruments are the number of classrooms, the number of learners, building condition indicators, road access indicators—all in 1996, interacted with population group dummies, population group dummies, and district dummies.

educators responds positively to an increase in the number of learners. Second, in this basic specification, differences from Black schools are all significant. As the number of learners increases, the number of educators increases more largely in White, Coloured, Indian, and new schools than in Black schools. Third, the interaction of changes in number of learners with the indicator of learners' increase shows some asymmetry in the educators' adjustment. However, the signs of this asymmetric effect are not the same in noninstrumented and instrumented cases. Fourth, the endogeneity of changes in number of learners was significant in Hausman-Wu test, and the comparison of parameter estimates proves downward bias.

In columns 3 and 4 where I use only subsidized educators, basic findings that obtained in all educators hold. Columns 5 and 6 show the case of nonsubsidized educators. Though most estimates are insignificant, and we cannot detect significant endogeneity, most of the estimates show upward bias. This implies that the shock to the numbers of nonsubsidized educators in 1996 may decrease the subsequent increase in class size. This observation creates some interesting questions, but since Hausman-Wu test shows only weak differences in the estimates, it is dangerous to go further. Contrary to the previous cases, the number of nonsubsidized educators increases more significantly when the class size increases than when it decreases.

Appendix B, Table 5 shows the first-stage regression results on the effects of the initial conditions on subsequent changes in class size. The table only shows the estimates of the numbers of learners and classrooms in 1996. Columns 1 and 2 show results on primary and secondary schools, respectively. The benchmark case is a Black school in both cases. In formerly Black primary schools, a larger number of classrooms will accommodate more learners while a larger initial class size will reduce subsequent growth of class size. Therefore, class sizes converge over time. Interestingly, the convergence is largest among Black schools. The difference between White and Coloured schools is statistically significant. Analogously, the classroom effect is the largest among Black schools. Thus, even though liquidity constraint is most likely binding among Black schools, the dynamic changes in class size are equalizing class sizes most strongly in Black schools.

Table 3b displays the estimation results for secondary schools. The results are very different from those in primary schools. The benchmark response of Black school educators is significant in all three cases. Contrary to primary school cases, the endogeneity of the changes in number of learners was not detected statistically. First, except for White schools, there are not significant differences in the educator adjustment behavior from Black schools. Second, very interestingly, the response of the White school educators to changes in the number of learners is smaller than the benchmark Black school case. Adding the two estimates gives a nearly zero response in White schools. This drastic difference from the primary school case suggests that at the secondary level, the educator size has been close to optimal among White schools, so that even in response to relatively small changes in class size, schools do not adjust the number of educators significantly. Third, however, Coloured schools show stronger responses than Black schools. There seem to be larger behavioral variations across different population groups in secondary schools than primary schools. Fourth, except the nonsubsidized educator case, changes in the number of educators are larger when the learner size increases than when it decreases.

The first-stage results on learner size change in secondary schools are shown in Appendix B, Table 5, Column 2. We confirm similar results on the effects of the initial conditions on learner size changes. The more classrooms and the fewer learners, the more increase in learner size. Interestingly, the differences between Black and White and/or Indian schools differ from the primary school case. The convergence effect of learner size is nearly twice as large among White and Indian schools as Black schools. The classroom effect is also 3-4 times larger among White and Indian schools. This suggests that school quality differentiation within White and Indian schools cannot be ignored.

5. Conclusions

Our empirical results show that opportunities for education in public schools are still unequal between Black and White children in South Africa, even after apartheid. The ratios of learners to educators in public primary and secondary schools statistically differ between Black and White groups. Strikingly, during the period 1996–2000, the overall differences in the distribution have not changed, and in some cases the gaps have increased for secondary schools. The inequality in opportunities for education could lead to persistent inequality in labor markets and earnings opportunities in South Africa.

The dynamics of school education also demonstrate strong inequity between population groups. Changes in the number of educators respond to changes in the number of learners in all population groups at primary school level. However, the dynamic adjustment of educators is significantly larger for formerly White, Coloured, Indian, and new schools than for Black primary schools. On the other hand, at the secondary school level, the results do not display significant apartheid-type inequity. In the case of White schools, the number of educators does not respond to changes in the learner size, probably because of the superior initial condition.

One possible reason why LER had not converged even after the abolition of apartheid is that the school fee charged at formerly White schools increased to shut out the entry of Black children (Selod and Zenou 2003). This screening mechanism could possibly explain changes in class size and partially why LER had not converged rapidly. Analysis of this point is, however, beyond the scope of this paper.

Our empirical results call for stronger policy support to Black primary schools and children, which promises the human-capital-based reduction of apartheid-created poverty, inequity, and inequality in South Africa.

Appendix A: General Education Production Technology

In this section, I discuss a general education production technology with multiple inputs. Suppose that educators H and other nonpersonnel inputs X (such as building and computer facilities) are inputs to education production. In addition, endowment affects education output. As a benchmark, assume that factor markets for educators and other nonpersonnel inputs are perfect, and that the quality of educators is the same.

Assume that per-learner education output is given as

$$e = e(\theta h, x, u),$$

where h and x are per-learner educators and nonpersonnel inputs, respectively, θ is the quality of educators, and u is school-level and/or community-level endowment. Note that here, the ratio of educators to learners (ELR) is h. Simple maximization problem at school level is

$$\max_{h,x} e(\theta h, x, u) \quad s.t. \quad w\theta h + px \leq q + g,$$

where p is price for nonpersonnel inputs, w is educators' wage, q is per-learner school fee, and g is per-learner government subsidy. It is assumed that higher educators' quality augments wage and productivity. The necessary condition is $e_h/e_x = w/p$, where e_h and e_x are marginal productivity for h and x, respectively. Note that θ does not affect the condition, as it changes e_h and w proportionally. With Cobb-Douglas function, for example, it is necessary that the optimal ratio of h and x is constant. The assumption that w/p is the same in all regions leads to a unique ratio of h and x across all schools.

Endowment (technology), u, can augment h and x. If an increase in u causes Hicks neutral shifts, the optimal ratio of h to x will be constant. If u augments h, the optimal ratio could be lower with a higher u, given constant w/p. Often cited findings that h matters among minority and disadvantaged groups (with smaller u) imply that e_h is diminishing as u increases ($e_{hu} < 0$). In the situation of South Africa, since formerly

White schools have a higher endowment u than Blacks, it is predicted that h for formerly White schools (residential areas) is smaller than for Black schools, given constant w/p. This, however, contradicts the fact that LER is smaller for formerly White schools than Black schools.

If $e_{hu} > 0$ (i.e., h and u are complementary), a higher endowment makes h more productive. Since White areas are well endowed, the optimal ratio of h to x could be larger than that for Black residential areas. This can potentially explain the LER gaps between White and Black schools. An empirical question is how much of the observed variations in LER could be attributed to the unobserved endowment.

In terms of the model in Section 2, we may interpret the endowment u as local condition f, which affects school fee charged and therefore liquidity constraint. If u constraints $-q(f)$, it also limits h from above. In Section 2, the quadratic loss function assumes that e_h diminishes as u (or q) increases. Therefore, it is implicitly assumed that $e_{hu} < 0$.

We consider two other special cases in which either wage or quality of educators is differentiated across regions (schools). Suppose that the average quality of teachers hired in Black schools is lower than that in White schools and that wage paid is the same. In this case, the optimal ratio of h to x for White schools should be larger, since $\theta e_h/e_x = w/p$, where $\theta > 1$. Similarly, wage for teachers in urban areas can be generally higher than that in nonurban areas. Without quality difference, other things being equal, the optimal ratio of h to x should be smaller in urban areas where White schools are mostly located, i.e., $e_h/e_x = \theta w/p$, where $\theta > 1$. The second case contradicts our observation that h is larger among White schools. The two special cases were assumed out in the analysis.

Finally, government policy depends on the observability of local endowment when it tries to achieve equal output. It is necessary to take into account the endowment distribution in order to achieve equal education output e. With imperfect information on the endowment, the government needs conditioning on observables when it forms the expectations on *u*.

In Section 2, the model (1) assumed that factor markets are perfect, (2) assumed that the quality of educators is the same, and (3) ignored nonpersonnel inputs. The focus of analysis is to highlight the situation where schools and/or the government attempt to achieve the optimal LER, y_{it}, with liquidity constraint. For simplicity, the model also assumed out a possibility that idiosyncratic endowment can affect the optimal level of LER at school or community level. This is important, since this makes β^* heterogeneous across schools and communities. With this modification, it would be difficult to identify the effect of liquidity constraint. In the empirical analysis, therefore, we assume that the (unobserved) heterogeneity of the optimal LER (β^*) due to (unobserved) endowment is relatively smaller than that attributed to liquidity constraints.

Appendix B: Tables

Table 4—Summary statistics

Variable	Number of observations	Mean	Standard deviation	Minimum	Maximum
Public primary schools					
Learners 1996	6,214	400.0599	366.1124	3	5,292
Educators 1996	6,234	11.62624	10.11832	1	68
Learners/ educators ratio 1996	6,168	34.02758	16.88301	1	536
Learners 2000	9,170	305.1333	307.7398	1	3,711
Educators 2000	9,422	9.066546	11.68714	1	805
Learners/ educators ratio 2000	9,170	31.55526	16.26099	0.0625	729
Public secondary schools					
Learners 1996	2,049	660.4461	399.2136	8	2,945
Educators 1996	2,046	23.33382	14.78122	1	90
Learners/ educators ratio 1996	2,035	30.48634	12.53213	1	150
Learners 2000	4,316	578.0461	350.3784	1	2,648
Educators 2000	4,455	19.08485	11.46771	1	94
Learners/ educators ratio 2000	4,316	31.18687	10.08921	0.3333	179
Public primary schools					
Difference in learners	5,366	-24.07697	161.6493	-3,986	2,692
Difference in educators	5,572	-0.6281407	4.100372	-49	104
Public secondary schools					
Difference in learners	1,830	-21.81639	231.2277	-2,225	1,014
Difference in educators	1,913	-1.934135	7.070909	-46	67

Notes: Sample does not include Gauteng, Mpumalanga, and Northern Cape provinces. Primary schools in 1996 include normal primary (Grades 1-7), junior primary (Grades 1-4), and senior primary schools (Grades 5-8). Secondary schools in 1996 include normal secondary (Grades 8-12), junior secondary (Grades 8-10), and senior secondary schools (Grades 10-12). Primary schools in 2000 refer to those with lowest grade > = 1 and highest grade < = 7. Secondary schools in 2000 refer to those with lowest grade > = 8 and highest grade < = 12. Public schools in 1996 include state and state-aided schools, and in 2000 are schools that answered public.

Table 5—Learner size change

Dependent variable: change in learner size from 1996 to 2000

	Primary	Secondary
1996 Learner size	-0.326	-0.355
	(4.42)	(7.80)
* White	0.270	0.360
	(2.99)	(1.71)
* Coloured	0.204	0.117
	(2.54)	(1.15)
* Indian	0.158	-0.277
	(1.33)	(2.56)
* New schools	0.217	-0.223
	(1.68)	(1.86)
1996 Classroom	7.340	2.860
	(2.64)	(2.29)
* White	-6.570	10.193
	(2.31)	(2.12)
* Coloured	-5.980	1.165
	(2.07)	(0.43)
* Indian	-7.939	11.119
	(2.19)	(2.86)
* New schools	-8.121	4.461
	(1.45)	(0.63)
R-squared	0.3010	0.4682
Number of observations	4,663	1,646

Notes: The numbers in parentheses are absolute t values. Included are race dummies, building condition indicators, road access indicators, both interacted with race dummies, and district dummies, in addition to the variables shown above. These are instruments used in the first stage.

References

Angrist, J., and V. Lavy. 1999. Using Maimonides' rule to estimate the effect of class size on scholastic achievement. *Quarterly Journal of Economics* 114 (2): 533-575.

Bot, M., D. Wilson, and S. Dove. 2000. *Education atlas of South Africa 2000*. Houghton: The Education Foundation.

Card, D., and A. Krueger. 1996. Labor market effects of school quality: Theory and evidence. NBER Working Paper No. 5450.

Case, A., and A. Deaton. 1999. School inputs and educational outcomes in South Africa. *Quarterly Journal of Economics* 114 (3): 1047-1084.

Case, A., and M. Yogo. 1999. Does school quality matter?: Returns to education and the characteristics of schools in South Africa. NBER Working Paper No. 7399.

Crouch, L. 1996. Public education equity and efficiency in South Africa: Lessons for other countries. *Economics of Education Review* 15 (2): 125-137.

Department of Education. 2002. *Report on the school register of needs 2000 survey*. Pretoria.

Dustman, C., N. Rajah, and V. Soest. 2003. Class size, education, and wages. *Economic Journal* 113 (2): F99-F120.

EduAction. 2001. *Technical report: School register of needs 2000 survey*. Durban.

Hanusheck, E. 1998. Conclusions and controversies about the effectiveness of school resources. *Federal Reserve Board of New York Economic Policy Review* 4 (1): 11-27.

Hoxby, C. 2000. The effects of class size on student achievement: New evidence from natural population variation. *Quarterly Journal of Economics* 116 (4): 1239-1286.

Kriege, D., S. Cairns, B. Makalima, and D. Scott. 1994. *Education atlas of South Africa.* Durban: Education Foundation.

Krueger, A. 1999. Experimental estimates of educational production functions. *Quarterly Journal of Economics* 114 (2): 497-532.

Lazear, E. P. 2001. Educational production. *Quarterly Journal of Economics* 116 (3): 777-804.

Marais, M. 1995. The distribution of resources in education in South Africa. *Economics of Education Review* 14 (1): 47-52.

Republic of South Africa. 1996a. *National education policy act.* Pretoria.

________. 1996b. *South African schools act.* Pretoria.

Selod, H., and Y. Zenou. 2003. Private versus public schools in post-apartheid South African cities: Theory and policy implications. *Journal of Development Economics* 71 (2): 351-394.

Yamauchi, F. 2003. Early transition from school to market: Labor market consequences of grade repetition in South Africa. International Food Policy Research Institute, Washington, D.C. Photocopy.

Yamauchi, F., and S. Nishiyama. 2003. Democracy, governance, and poverty dynamics: Community and school financing in South Africa. International Food Policy Research Institute, Washington, D.C. Photocopy.

Zimmerman, F. 2003. Cinderella goes to school: The effects of child fostering on school enrollment in South Africa. *Journal of Human Resources* 38 (3): 557-590.

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