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School quality, clustering and government subsidy in post-apartheid South Africa☆

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ABSTRACT

This paper examines a range of historical and geographic factors that determine the quality of public school education in post-apartheid South Africa. Empirical analysis shows, first, that population groups are still spatially segregated due to the legacy of apartheid, which implies that, given the positive correlation between school quality and school fees, quality education is concentrated in formerly white, coloured and Indian schools in areas where the majority is non-African. Second, school quality, measured by the learner–educator ratio, improves as school fee and government subsidy increase. In this sense, school fee can be decreased with an increase in government subsidy to maintain school quality. It is also shown that government subsidy is allocated to schools with lower quality and fees, increasing the number of subsidized teachers. To address the current imbalance, financial support to disadvantaged locales and schools should be strengthened further.

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1. Introduction

Geography becomes critical when access to opportunities is distributed unevenly over space. For example, when good schools are concentrated in urban areas, one must live in these areas to have good educational opportunities, and therefore good job prospects. In South Africa, which experienced more than 40 years of apartheid policies, different population groups were segregated in separate residential areas with unequal access to education. As a result, location was a critical factor. This paper examines how spatial factors, highly correlated with historical factors, are determining school quality in post-apartheid South Africa.

There are two kinds of factors that are relevant to the way in which school quality is determined. First, the legacy of apartheid imposes historical constraints on the spatial distribution of income and population groups. Good schools are located in selected areas. This has maintained inter-racial diversity in access to good education,[1] as well as racial and socio-economic homogeneity within neighborhoods.[2]

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[1] As van der Berg (2007) argues, race still remains a major factor to explain school performance. For accounts of the general situation in South African education, see Bloch, Chisholm, Fleish and Mabizela (2008), Bot, Wilson, and Dove (2000), Crouch (1996), Fleisch (2008), Kriege, Cairns, Makalima, and Scott (1994), and Shindler & Fleisch (2007).

[2] Yamauchi (2007) discussed the importance of observed heterogeneity in neighborhood in the context where agents learn about returns to schooling and decide schooling investment in children. Whether the society is heterogeneous or homogeneous has some dynamic implications.

Second, even if the mobility of populations was unrestricted after the abolition of apartheid, household-level financial constraints coupled with the imperfect credit market often prevents the poor from moving into those well-off areas that have better educational opportunities. Thus, the opportunity for better education is geographically correlated with land prices.[3] Even though African children can commute to formerly white schools, this incurs additional transportation and time costs for them. Accordingly, we aim to explore the impact of apartheid on the spatial distribution of quality education in the post-apartheid regime where the spatial mobility of people is legally unrestricted.[4]

This paper examines the above issue, asking how historical and location factors affect access to quality education in post-apartheid South Africa through the use of a unique database combining the 2002 school census and the 2001 South African Census Community Profile Database. With GIS information, this data enables us to jointly identify the location of school and to correlate that with local socio-economic characteristics.

Given the above mentioned spatial dependence, the role of government subsidy is expected to be large in creating equitable and equal access to education. I attempt to assess to what extent government subsidy disconnect the linkage between local resources and school quality, given that school fee determines school quality. For this purpose, I use school finance data from the province of KwaZulu Natal to analyze the dependence of school quality, measured by the learner–educator ratio, on school fee and government subsidy.

Recently in the context of South Africa, Selod and Zenou (2003) examined the role of school fee in screening children from different backgrounds in a spatial model, showing that whites tend to overprice education in order to limit black students. It is likely that a high school fee supports high school quality even in South African public schools as well as keeps the community and schools racially homogeneous. This paper also provides some answer to this question.

The paper is organized as follows. Section 2 discusses how school quality (inputs) can depend on local resources in South Africa. Section 3 describes empirical framework and data used in the analysis.

Empirical results are summarized in Section 4. First, some key spatial features of school fee distributions and population group compositions in South Africa are demonstrated and linked with the history of apartheid. School fees are significantly higher among formerly non-African schools and in the areas where white population dominated.

Second, while local population-group composition and former apartheid departments of education still have influence the way that school fees (and thus school quality) are determined at local public schools, the role of local income opportunity is also significant especially in large cities. Third, evidence from KwaZulu Natal shows that school fee and per-learner government subsidy improve school quality, decreasing learner–educator ratio, implying that more progressive allocation of subsidy improves the quality of schools located in under-resourced communities. Policy implications are discussed in the final section.

2. Dependence of school quality on local resources

School quality is a function of school inputs, which in the context of South Africa are determined by local resource availability (through school fee) and government subsidy. Here school quality does not mean learning achievements or educational outcomes. I suppose that the outcome is a function of not only school quality (inputs) including qualified teaching staff but also of students' family backgrounds, their own efforts and ability. This paper focuses on resources available to schools.

Distinguishing between school inputs and educational outcomes is important. To analyze the determinants of educational outcomes, it is necessary to use some outcome measures such as test score at the individual level or its school average. Qualified empirical analyses prove some significant causal effects of school inputs on the achievement (for example, Angrist and Lavy, 1999; Card & Krueger 1996; Case & Deaton, 1999; Dustman, Rajah, & Soest, 2003; Hoxby, 2000; Krueger, 1999), though the literature in general has mixed conclusions (Hanushek, 1998) and the causality seems to depend on subjects (Steele, Vignoles, & Jenkins, 2007).

In the context of South Africa, Case and Deaton (1999) shows that school resources, measured by learner–educator ratio, can explain test scores using the variations in the ratio from the apartheid regime.

More directly van der Berg (2007) used matriculation test pass rates to analyze the effects of school resources and socio-economic factors on student learning performance. School fees, learner–educator ratio and average teacher salary significantly explain the matriculation pass rate. Interestingly former departments similarly explain the matriculation pass rate significantly. However, if the sample is restricted to formerly African schools, learner–educator ratio lost its statistical significance, which implies that resource variations within this group are not relatively large. School fee, correlated with local socio-economic factors (as discussed below), significantly explains the matriculation pass rate even within formerly African schools.[5]

[3] This point has not been seriously examined yet, though casual observations support this proposition.

[4] Yamauchi (2005) examined how learner-education ratio has changed in the period of 1996-2000, splitting the sample in formerly African, White, Coloured and Indian schools. He showed that a change in the number of educators is smaller in formerly African schools than formerly White schools, in response to a change in the number of learners, which implies that the former group has been more likely to face financial constraints.

[5] In his paper, he argues that historical factors, such as former departments, teachers' quality and school management are more important than school resources in determining school performance. Former departments are clearly correlated with matriculation pass rates. This tendency did not change even with progressive changes in school resource allocation in the post-apartheid regime. We argue that the ability to hire more better teachers depends on the community's

Mobility of students and dynamic nature of human capital formation raise other concerns. Since students especially at the secondary level in the post-apartheid regime can potentially more freely choose their schools, endogenous school choice (mobility across communities) can be an important factor that determines educational outcomes at the school level.[6] Similarly, since prior investments in human capital affect educational outcomes at later stages, schooling inputs and outcomes at the primary school level are expected to influence those at the secondary level.[7] While mobility of students can potentially weaken the spatial correlation between local factors and school outcomes, the dynamic production of human capital can strengthen the correlation.

To understand the linkage between school quality and local resources, we have to know the roles of school governing body (SGBs). SGBs, which consist of the principal, teachers, community leaders, parents, and in some secondary schools, learners, set school fees. Accordingly, school fees charged represent the community's ability to pay for education.[8] SGBs are playing a greater role even now when a recently revised funding reform was implemented, whereby provincial governments gradually allocate school subsidies, according to local poverty measures. To assess the quality of education, information on school fees charged at local public schools is drawn upon. In South Africa, school fees represent not only school quality, but also the likelihood of residents to be able to afford investments in schooling.

Until recently, government subsidies in South Africa have been limited, so financing of schools relies heavily on the collection of school fees – a user charge – from parents. The 1998 Norms and Standards for School Funding (No. 46) mentions,

Ironically, given the emphasis on redress and equity, the funding provisions of the Act appear to have worked thus far to the advantage of public schools patronised by middle-class and wealthy parents. The apartheid regime favored such communities with high-quality facilities, equipment and resources. Vigorous fund-raising by parent bodies, including commercial sponsorships and fee income, have enabled many such schools to add to their facilities, equipment and learning resources, and expand their range of cultural and sporting activities. Since 1996, when such schools have been required to down-size their staff establishments, many have been able to recruit additional staff on governing body contracts, paid from the school fund.

As discussed in Section 1, local resource availability is determined by historical and spatial factors, which are mutually correlated in the current empirical context (given limited government subsidies). Residential area choice is limited even now, so schools that are locally available to African children are largely formerly African schools, many of which are still historically disadvantaged. Schools in well-off areas can charge higher school fees, which finance school inputs, and, by doing this, can also avoid the enrollment of children from low-income families.

School fee represents the community's capability of financing local public schools. Yamauchi and Nishiyama (2005) analyzed the effect of local income distribution on the determination of school fee, showing that inequality decreases school fee. Thus, low-income groups in the community pull down school fee, which decreases school quality for all children in the community.[9]

If school inputs depend on local resources, to what extent does government subsidy disconnect the linkage between local resources and school quality? How effectively can progressive subsidy change the linkage of school quality to historically constrained local resource availability? In the analysis, we use learner–educator ratio as a measure of school quality (resource) to explore how local resource, approximated by school fee, and government subsidy can jointly determine the school quality.

There is a potential substitution (or trade-off) between local resources and government resources, both of which determine school inputs. If government subsidy completely equalizes unequal local endowments, school quality does not depend on local resources anymore. From policy viewpoints, it is our interest to know how differentially elastically our measure of school quality (learner–educator ratio) can change in response to changes in school fee versus government subsidy. In the following sections, we discuss the empirical framework, data, and results.

3. Empirical framework and data

3.1. School fee

To assess the effects of historical and spatial factors on school quality, I estimate the following equation in which log of school fee represents school quality.

$$\ln p_{jkt} = \alpha + x_{kt-s}\beta_1' + z_{jk}\beta_2' + \varepsilon_{jkt} \quad (1)$$

where $\ln p_{jkt}$ is log of school fee at school j in location (subplace) k at year t, x_{kt-s} is location factors such as local population composition and economic conditions at year s years prior to t, z_{jk} is historical factors of school j such as the former department, and ε_{jkt} is an error term. The novel feature of this approach rests in that location factors are discovered from merging school data and geographic database by GIS.[10]

income level (school fees), which is spatially clustered in the today's South Africa.

[6] van der Berg (2007) reports that students do not systematically move to better quality schools probably due to lack of information on school performance, and that moving to private schools is minor. However, this observation was based on Western Cape, so it is difficult to generalize.

[7] In a slightly different context, but highly relevant to this issue, Yamauchi (2008) showed significant effects of preschool nutrition intake (forming early childhood human capital) on schooling outcomes.

[8] See The 1998 Norms and Standards for School Funding (Republic of South Africa, 1998), which was announced in response to the South African School Act (Republic of South Africa, 1996).

[9] In different contexts, Foster and Rosenzweig (2001) and Chattopadhyay and Duflo (2004) show the importance of local governance in public investment decision-making.

[10] In the estimation, spatial dependence is not explicitly identified in the error term, beyond allowing clustered correlations within each subplace (robust standard errors).

The data come from two different sources. Local characteristics are taken from the Census 2001 Community Profile (Statistics South Africa: Stats SA). This database provides distributions of socio-economic characteristics in the Census 2001 at subplace level for the whole country.[11] It covers, for example, education, labor force, migration, settlement types, and population group compositions. Officially, subplace is defined as the smallest geographical unit available from the Census, by which we can identify the location as well as the characteristics.

GIS data available in school censuses can help identify in which subplace a school is located.[12] The school identification codes, EMIS, enable us to merge the Census 2001 subplace data and school censuses. School fees in 2001 are captured in the Annual School Survey 2002 (National Department of Education). The information on former education departments is available in the School Register of Needs 2000 (National Department of Education).

3.2. School quality

To answer the question of how the government can improve school quality and support the poor with spatial targeting, I estimate the following school production functions. In both specifications, we take first difference between two periods to wipe out school and location specific unobserved fixed effects.

$$\Delta y_{jk} = \gamma_0 + \gamma_1 \ln p_{jkt} + \gamma_2 \ln g_{jkt} + z_{jk}\zeta' + \Delta\xi_j, \quad (2)$$

and

$$\Delta Y_{jk} = \gamma_0 + \gamma_1 \ln p_{jkt} + \gamma_2 \ln g_{jkt} + \gamma_3 \Delta L_{jk} + \gamma_4 \ln p_{jkt}\, \Delta L_{jk} + \gamma_5 \ln g_{jkt}\, \Delta L_{jk} + z_{jk}\zeta' + \Delta\xi_j, \quad (3)$$

where Δ is difference operator, Y_{jk} is educator size, L_{jk} is learner size, y_{ik} is learner–educator ratio, and g_{jkt} is per-learner subsidy from the government.

Learner–educator ratio is used as a measure of school quality. However, we also admit that this measure can only partially capture the overall school quality, which is supplemented by other measures such as teaching facilities (classroom conditions—desks, blackboard), quality of school administration, and so forth. I constructed the learner–educator ratio from two school censuses in 1996 and 2000, which focus on school facility.[13] Since government subsidy allocation in principle had not changed before 2000, we assume that the subsidy reported for 2000 was basically applied to the period before 2000. Here z_{jk} includes former departments indicators.

I also test whether a change in learner size induces change in the number of educators who are privately employed in the community. To supplement the limited size of subsidized educators, community members can collect school fee and employ educators privately.

If the government allocates subsidy more to disadvantaged schools (that is, smaller educator size relative to learner size), potential bias in γ_2 would be upward since differenced ξ_{jt} are positively correlated with per-learner subsidy g_{jkt}. On the other hand, if government subsidy allocation increases inequality in the number of educators, I expect a downward bias in the estimate. However, since fixed unobservables are already differenced out, the systematic component of endogenous subsidy allocation has no impact on our estimates.

Finally, the determination of per-learner subsidy is also of our interest in the empirical analysis. Though one possible way to eliminate the bias mentioned above is to use instruments for g_{jkt}, identifying instruments are not available in the data. Therefore, I simply examine the effects of school fee, the initial LER, former departments, and school type and location fixed effects.[14]

For this analysis, we use school and community information from the province of KwaZulu Natal. School information comes from the Annual School Survey 1999 (DOE) and the KwaZulu Natal Department of Education's Norms and Standard database (KZN-DOE). The information on school fees in 1999–2000 is also received from the KZN Department of Education. In the province of KwaZulu Natal, therefore, we can track dynamic changes in school fee to check robustness of main findings.

To assess school quality, we use School Register of Needs 1996 and 2000 (DOE), which focus on school facility information, so that they are suitable to compute changes in learner–educator ratios and educator size from 1996 to 2000.[15]

Data on government subsidy is received from the KwaZulu Natal Department of Education (Norms and Standard database). Currently the funding reform has been undertaken in South African public education system, which attempts to allocate more funding to poor schools and communities on the basis of poverty ranking of schools and areas in each province. I use the information on actual funding in the period of January–March 2000, as the timing still was before the implementation of the funding reform so that we can assume that it represents the status quo in the period before 2000.

4. Empirical results

4.1. School fee, apartheid education departments and school neighborhood

This section clarifies some features of the public education system in South Africa, using school fees as a proxy for school quality. For this purpose, we need to be aware of

[11] I used a computer software that the Statistics South Africa invented to have the distributions of socio-economic variables in each subplace.

[12] Using the same datasets, Yamauchi and Nishiyama (2005) analyze the effect of local income distribution within subplace on school fee determination in public schools therein.

[13] Since measurement errors are reported on learner size in Annual School Surveys, we decided to use the 1996 and 2000 School Registers of Needs. The latter has a simplified questionnaire structure focusing on school facility information. Therefore, they are likely to have smaller measurement errors.

[14] Equation that determines subsidy is not spelled out here, though such an equation is estimated in Table 3 (Column 6).

[15] In this analysis, we need information on school fee and government funding as key explanatory factors. Since the latter is only available in the province of KwaZulu Natal, we restrict our analysis to the province.

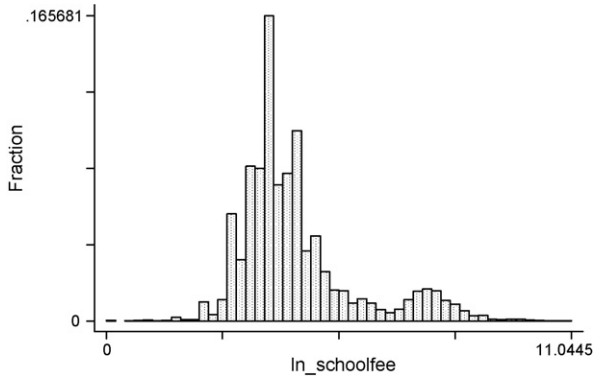

Fig. 1. Distribution of log annual school fee.

the history of modern South Africa. Two factors are important here. The first factor is the segregation policy adopted in apartheid education, by which population groups were separated from each other in various dimensions. In public education, different departments were responsible for different population groups, and children from different population groups were segregated in separate schools. The second factor is the spatial distribution of residential areas and school locations. Due to the apartheid segregation policy, different population groups were not allowed to live in the same area. Thus, formerly white schools are located in formerly whites areas.

Fig. 1 depicts the distribution of annual school fees charged at public schools in 2001 (weight being learner size). Mean school fee is 431.72 Rand, while median is 50 Rand, which implies that the distribution is highly skewed. Interestingly the graph exhibits a clear bimodal distribution, showing that a group of public schools charge higher fees than the majority do. It is also possible that their locations have certain characteristics in common.

Fig. 2 depicts school fee distributions for population groups defined by the former education departments to illustrate the impact of apartheid on school fee distribution. In South Africa before 1994, Department of Education and Culture: House of Assembly (HOA), House of Representatives (HOR), and House of Delegates (HOD) governed white, coloured and Indian schools, respectively, throughout the country. Transvaal Education Department (TED) represented white schools in Gauteng province. Schools established after 1994 are categorized as a new group. These figures clearly show the importance of historical influence from the former regimes. Those schools, formerly under the control of HOA, HOR, HOD and TED (white, coloured, and Indian), charged higher school fees than other groups. The finding suggests that, given that school fees are positively correlated with school quality, formerly whites, coloured and Indian schools provide higher quality education than the majority of formerly African schools do.

Next, the relationship between former departments and population group composition in school neighborhoods is demonstrated. Table 1 shows the proportions of African, whites, coloured and Indian/Asian populations in the Census subplace of school location. Note that the population group compositions are computed from the Census 2001 Community Profile Database, whereas former departments are of the apartheid regime before 1994.

It is interesting to confirm that formerly white schools are located in subplaces where the population of whites is still the majority. Similarly, formerly Indian-schools are in subplaces where the majority population is Indian. Formerly coloured schools are in coloured and white-dominanted areas, respectively. Schools under the other former departments for African population are located in

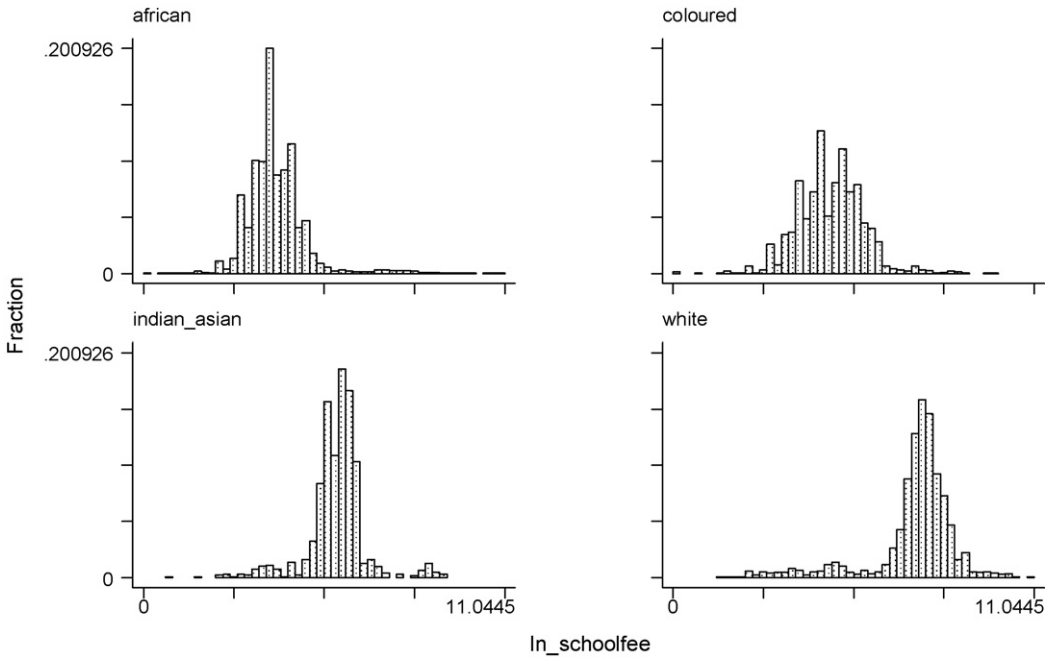

Fig. 2. Former department groups and log annual school fee.

Table 1
Population group compositions in school neighborhood.

	Obs	Mean	Std Dev	Min	Max
Primary schools:					
African					
Proportion African	13359	.9442374	.1376764	0	1
Proportion White	13359	.0386878	.1017163	0	1
Proportion Coloured	13359	.0144011	.0679492	0	.9874739
Proportion Indian/Asian	13359	.0026737	.0303421	0	.9637306
White					
Proportion African	983	.3257602	.3057272	0	1
Proportion White	983	.5418614	.3102345	0	.9710921
Proportion Coloured	983	.1059982	.2009087	0	.9740787
Proportion Indian/Asian	983	.0263803	.0571967	0	.6671807
Coloured					
Proportion African	1378	.2563067	.3321149	0	1
Proportion White	1378	.1023137	.1501915	0	1
Proportion Coloured	1378	.6316433	.3432725	0	1
Proportion India/Asian	1378	.0097363	.0498904	0	.8288214
Indian/Asian					
Proportion African	331	.3177387	.3230634	.0034247	1
Proportion White	331	.0607398	.1713729	0	.8977141
Proportion Coloured	331	.0482009	.1383091	0	.9862803
Proportion Indian/Asian	331	.5733206	.3796239	0	.9885057
Secondary schools:					
African					
Proportion African	4475	.9604805	.1489296	0	1
Proportion White	4475	.0249173	.1126637	0	1
Proportion Coloured	4475	0100202	.0649181	0	.9798253
Proportion Indian/Asian	4475	.004582	.0447487	0	.9756098
White					
Proportion Africa	439	.281697	.2692092	0	1
Proportion White	439	.5917889	.2862688	0	1
Proportion Coloured	439	.0990783	.1792077	0	.9653361
Proportion Indian/Asian	439	.0274358	.0466701	0	.3062209
Coloured					
Proportion African	270	.1625991	.2753492	0	1
Proportion White	270	.1162389	.2441152	0	.9690049
Proportion Coloured	270	.7080628	.3575151	0	.9976985
Proportion Indian/Asian	270	.0130991	.0312058	0	.3442088
Indian/Asian					
Proportion African	102	.1836393	.2368411	.0057471	1
Proportion White	102	.036181	.1496807	0	.9404537
Proportion Coloured	102	.0538794	.1605563	0	.9826432
Proportion Indian/Asian	102	.7263002	.3122672	0	.9885057

The proportion of each population group is used in the Census subplace where a school is located.

highly predominantly African residential areas. Details of the distributions are shown in Table A.1 in the online supplementary document.

To disentangle the spatial relationship between school fees and population composition, Fig. 3a shows Kernel regression line linking school fees to the proportion of whites in a given subplace. Given the fact that the mobility of African population compared to formerly white residential areas was prohibited in the apartheid regime and is still limited now due to financial reasons, the proportion of white population tells us whether a particular school is located in a formerly white area.

Interestingly, in Fig. 3b, the distribution falls into two groups (concentrations). Higher school fees are likely to be charged in the areas where the majority population is white.[16] Therefore, Fig. 3 (together with Fig. 2 and Table 1) demonstrates not only the systematic segregation policy in the apartheid regime education system, but also that location factors and spatial segregation of different socio-economic groups (correlated with population groups) are important in determining opportunities for quality education in the next generation.

4.2. The effects of local characteristics on school fee

Table 2 shows two sets of results in: (i) South Africa as the whole; and (ii) metropolitan areas (Johannesburg, Cape Town and Durban) where population inflow into the cities has been large since 1994. Each specification includes district fixed effects.

First, the points observed in the previous section are confirmed, namely that former education departments and the proportion of white population in subplace influence

[16] Africans move into formerly Whites residential areas, while Whites do not move into predominantly African residential areas. In some exceptions such as in the downtown of Johannesburg, the inflow of African population wiped out Whites residents (business), who moved to new suburban areas.

Table 2
Determinants of school fee.

Dependent: log of annual school fee (Rand)						
Sample:	SA	Metro	SA	Metro	SA	Metro
Local population group composition:						
Prop African	−0.474 (5.77)	−0.500 (3.66)			−0.412 (4.97)	−0.205 (1.32)
Prop Whites	0.942 (9.04)	1.424 (6.73)			0.674 (6.44)	0.792 (3.57)
Economic variables						
Ln mean household income			0.171 (11.25)	0.585 (5.19)	0.031 (2.71)	0.213 (2.47)
Av years of schooling			0.154 (22.52)	0.172 (4.17)	0.071 (14.39)	0.084 (2.68)
Unemployment rate			−0.140 (2.94)	−2.179 (5.76)	0.008 (0.22)	−0.631 (2.10)
Former Apartheid departments:						
BOP	0.184 (3.37)				0.060 (1.78)	
CISKEI	0.114 (0.71)				0.073 (0.46)	
DET	−0.434 (10.78)	−0.139 (0.80)			−0.419 (10.45)	−0.234 (1.39)
GZK	−0.092 (1.63)				−0.082(1.58)	
HOA	1.654 (18.89)	1.909 (7.44)			1.662 (18.99)	1.815 (7.24)
HOD	0.650 (7.52)	0.777 (3.85)			0.620 (7.22)	0.599 (3.01)
HOR	−0.130 (1.92)	0.387 (1.96)			−0.113 (1.67)	0.325 (1.69)
KND	−0.040 (0.55)	0.066 (0.36)			−0.069 (0.97)	0.006 (0.03)
KZ	−0.330 (3.38)				−0.331 (3.35)	
KANGWANE	−0.134 (2.97)	0.156 (0.79)			−0.126 (2.80)	0.107 (0.56)
LEB	−0.063 (1.52)	−0.369 (1.87)			−0.074 (1.86)	−0.438 (2.25)
QWAQWA	0.611 (4.58)				0.564 (4.20)	
TED	1.819 (17.69)	2.136 (8.33)			1.865 (18.42)	2.015 (8.05)
TRANSKEI	−0.100 (0.95)				−0.087 (0.83)	
VENDA	−0.032 (0.33)				−0.050 (0.52)	
Location types:						
Urban (%)	0.721 (22.60)	0.569 (5.74)	0.901 (17.80)	−0.323 (1.94)	0.535 (16.39)	0.137 (1.12)
Informal (%)	0.568 (10.73)	0.523 (4.79)	0.738 (10.71)	0.563 (3.39)	0.534 (10.69)	0.447 (3.75)
Industrial (%)	0.868 (7.82)	0.761 (3.27)	0.570 (2.72)	−0.503 (1.38)	0.758 (6.57)	0.464 (1.81)
Institutional (%)	0.823 (5.29)	0.902 (3.12)	0.513 (1.99)	0.186 (0.41)	0.520 (3.29)	0.443 (1.59)
Hostel (%)	0.811 (5.31)	0.248 (0.91)	0.055 (0.19)	−0.481 (0.88)	0.682 (4.49)	0.054 (0.20)
Population density	−8.31E−06 (1.72)	−0.00002 (2.01)	−0.0001 (12.94)	−0.00002 (1.77)	−9.27E−06 (2.02)	1.01E−06 (0.13)
R^2	0.6881	0.7939	0.5571	0.6741	0.6934	0.8046
# obs.	18564	1805	18509	1804	18509	1804

Numbers in parentheses are absolute *t* values, using robust standard errors with Census subplace clusters. All specifications include district fixed effects, and school type dummies (primary and secondary; combined as the omitted case). For former education departments, schools established under the new department since 1994 are omitted as the benchmark case (new education department: 13). Population groups associated with schools governed under different former departments are: Whites – Department of Education and Culture: House of Assembly (HOA); Coloured – Department of Education and Culture: House of Representatives (HOR); Indian – Department of Education and Culture: House of Delegates (HOD); African – Department of Education and Training (DET); African – Bophuthatswana Education Department (BOP); African – Ciskei Education Department (CISKEI); African – Gazankulu Department of Education (GZK); African – KaNgwane Department of Education (KaNGWANE); African – KwaNdebele Department of Education (KND); African – KwaZulu Department of Education and Culture (KZ); African – Lebowa Department of Education (LEB); African – QwaQwa Department of Education (QWAQWA); African – Transkei Education Department (TRANSKEI); African – Venda Education Department (VENDA); Whites – Transvaal Education Department (TED).

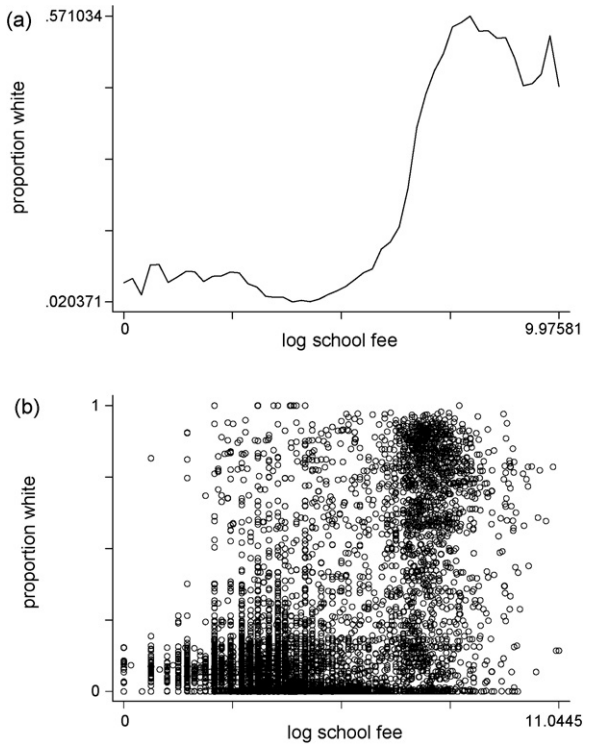

Fig. 3. (a and b) School fee and proportion of white population in subplace.

the ability to pay for education quality. Second, the implications of Section 3 are tested here. Income opportunities are measured by average household income, the average years of schooling in the population of ages 20–64, and the unemployment rate. To characterize economic values of residential areas, the distribution of settlement types and population density from the Census 2001 are used.

Column 1 has factors that represent apartheid regime and residential area types. First, the proportions of African and whites populations have significant negative and positive effects on school fees, respectively. Coloured and Indian/Asian cases have been omitted. It is clear that spatial segregation of population groups significantly affects school fees.

Second, schools formerly under HOA, HOD and TED charge significantly higher school fees. The omitted case here is schools established after 1994 under the new education department. Combined with previous segregations in residential locations, apartheid still influences school quality.

Third, the distribution of residents that live in urban, informal, industrial, institutional or hostel settlements significantly alter school fees. Omitted cases include sparse, tribal, farm or small holding types. Therefore, schools in urban areas are likely to charge higher school fees, leading to higher education quality. The effect of population density is, however, insignificant.

Column 2 considers metropolitan areas. Although qualitatively similar results were obtained, the magnitude of the parameter estimates for the proportions of African and white populations is greater than those in Column 1. In this sense, population group compositions at the subplace level seem to be more influential in the large cities. Similarly, the effects of HOA, HOD and TED are larger than those in Column 1. Hence, it appears that the past apartheid regime affects school fees more significantly in these metropolitan areas than in the country on average. Population composition, however, is highly correlated with income and level of education.

Columns 3 and 4 focus on factors that represent income opportunities. These variables are expected to be significant if the credit market is imperfect. In the country as a whole, the mean household income and average years of schooling (age 20–64) significantly increase school fees, while the unemployment rate significantly decreases school fees. These results are consistent with the predictions of our simple model in Section 2.

In Column 4, the sample is restricted to Johannesburg, Cape Town and Durban. Mean household income, average years of schooling and the unemployment rate significantly affect school fees. The income effect is greater here than that in the country on average. Consistent with the previous findings on population composition in metropolitan areas, income gap correlated with population composition matters more in metropolitan areas than the national average. In contrast, the effects of settlement types become weaker in metropolitan areas.

Finally, Columns 5 and 6 include apartheid regime and income opportunity factors. Column 5 shows that both factors matter significantly. The magnitude of impacts, however, differs between the two. While population group composition remains as influential as those in Columns 1 and 2, the effects of mean household income, average years of schooling and the unemployment rate become much smaller in magnitude than those found in Column 3. That is, even though financial and labor-market constraints in the current regime seem to be significant, historical factors originating from the apartheid system (partly correlated with income opportunities) are more significant in the way that they constrain the ability to pay for school quality and the quality of schooling investments in the next generation.

In metropolitan areas (Column 6), however, the effect of African proportion decreases nearly by a half (from −0.412 to −0.205) and becomes insignificant, while the effect of average income increases from 0.031 to 0.213 and is thus significant. Socio-economic factors matter more in these large cities than the country average.

4.3. School quality, local resources and government subsidy

This section summarizes estimation results on school quality determination. School quality is measured by learner–educator ratio (LER) and the sensitivity of educator size to changes in learner size, which we construct from the School Register of Needs (SRN) 1996 and 2000. An increase in LER means a decrease in school quality.

Yamauchi (2005) shows that changes in educator size in response to changes in learner size are larger in formerly non-Black schools than in formerly Black

schools in post-apartheid South Africa, which indicates that many formerly Black schools are still liquidity constrained.[17]

In the education function that we estimate, inputs are (log transformed) school fee and per-learner funding from the government. As discussed in previous sections, school fee in 1998 is taken from the Annual School Survey 1999. School funding information comes from the KwaZulu Natal Department of Education.

Table 3 shows our empirical results. Columns 1–3 use school fees in different years. The dependent variables are changes in LER from 1996 to 2000. Former population group, school type and circuit indicators are controlled. Parameters of our interest are those on school fee and per-learner funding. In these columns, the effects of these revenue conditions are significant and negative. Thus, better school financial situation improves school quality. In a preliminary analysis, log school fee in 2000 was included but its effect on dynamic change in LER 1996–2000 was insignificant. Column 3 uses per-learner total revenue (excluding government funding), which also has a significant and negative effect on learner–educator ratio.

In the above results, the marginal effect of log per-learner subsidy is quantitatively larger than that of log school fee. Though these two variables are inter-related due to the progressive allocation theme of government subsidy, this result encourages the intervention to alter school inputs to create more equal school environments.

In Columns 4 and 5, we test how school financing can change the number of privately employed educators (non-subsidized educators), controlling changes in learner size. First, an increase in learner size increases the number of those educators. Second, log of school fee 1998 increases non-subsidized educator size, while the government funding decreases the change. Third, most interestingly, the interaction term of log school fee and change in learner size shows a significant positive effect, which implies that with a higher school fee (ability to pay for schooling in the community), an increase in the number of learners can be accommodated by an increase in privately paid educators. These results are consistent with the prediction that communities that are capable of paying for schooling investments will increase the quality of education for the next generation with their own resources.

In the last column, per-learner funding is regressed on the 1998 school fee and 1996 LER with fixed effects of former population groups, school types and circuits. The

Table 3
Learner–educator ratio and government subsidy.

Dependent	Change in learner–educator ratio 1996 to 2000				Change in non-subsidized educators 1996 to 2000		Log per-learner government funding Jan to March 2000
Log school fee 1998	−0.4204 (1.76)				0.6870 (8.25)	0.7249 (8.48)	−0.1061 (11.73)
Log school fee 1999		−0.6994 (2.31)					
Log per-learner total revenue 1998			−0.5481 (1.91)				
Log per-learner government funding [January 01, 2000 to March 31, 2000]	−8.2887 (10.22)	−8.2919 (10.35)	−7.8244 (9.52)		−0.3378 (3.92)	−0.3341 (3.68)	
Change in learner size					0.00035 (2.19)	−0.0034 (1.00)	
Change in learner size × log fee 1998						0.0013 (2.75)	
Change in learner size × log funding 2000						−0.00048 (0.92)	
LER 1996							0.0021 (2.92)
School type fixed effects	Yes	Yes	Yes		Yes	Yes	Yes
Former department fixed effects	Yes	Yes	Yes		Yes	Yes	Yes
Circuit fixed effects	Yes	Yes	Yes		Yes	Yes	Yes
Number of observations	3933	3947	3951		4011	4011	3933
R^2	0.1622	0.1315	0.1588		0.4432	0.4569	0.6085

The numbers in parenthesis are absolute t values based on Huber standard errors with circuit clusters. The sample has schools with positive numbers of educators and learners in both 1996 and 2000, classrooms in 1996 recorded in SRN, and funded or aided from the government.

[17] The difficulty in identifying the causality arises from potential endogeneity in learner size and unobserved fixed component specific to school and community, which is likely correlated with school inputs. For example, Lazear (2001) argues that the effect of LER on student achievement could be empirically ambiguous because of (often unobserved) heterogeneity in students' quality, that is discipline. In his model, the optimal size of class (that is, LER) increases if students' discipline improves, since the probability of disruption in a classroom decreases. To avoid such a correlation between LER and unobservables, recent studies use exogenous variations (changes) in LER and class size to identify the effect on student achievement.

estimate shows that in 2000, the initially less-endowed schools (and also areas) were likely to receive more funding from the government.

5. Conclusions

Neighborhood factors matter in South Africa as agents with similar socio-economic backgrounds are likely to be clustered over space. This happens partly because apartheid created inequality in income opportunities (correlated with population groups) and also introduced spatial segregation by population group, and partly because even after the abolition of apartheid, financial constraints became important in residential location choice, which determines access to income and educational opportunities.

This paper examined historical and spatial factors that determine quality education and the community's capacity to finance education in post-apartheid South Africa where apartheid policies had contributed to the spatial segregation of population groups and differential education and income opportunities. Our findings show that both historical constraints as well as financial constraints matter in terms of access to quality education. First, population group compositions created by apartheid (especially proportions of Africans and whites) at subplace level and the former apartheid departments of education significantly affect school fees, and therefore quality of education. A higher school fee is charged in residential areas with a large proportion of white population. Second, average income, schooling and unemployment rate at the Census subplace level also influences the determination of school fees, which implies the existence of an imperfect credit market.

Migration to cities became unrestricted without legal constraints after the abolishment of apartheid, and thus income mobility is now more dynamic in urban areas. This is reflected in the result that financial constraints are more important and population composition is less important in large cities. In this process, relatively rich households can move to well-off (that is, formerly white) residential areas to send their children to better schools, which was formerly prohibited. This is happening in the areas surrounding large cities.

In contrary to the wide-spread pessimism on the progressive role of government subsidy, this paper also demonstrated that government subsidy can improve the quality of school, despite the fact that school quality largely depends on local resource availability. Government subsidies, if progressively allocated to schools enduring poorer resource base and lower quality, can potentially disconnect the linkage between local resources and school quality. To narrow the current imbalance, however, it appears that the government should increase financial and personnel support to disadvantaged locales and schools, by targeting specific areas as its progressive subsidy allocation has recently begun to do.

In this paper, we did not incorporate more qualitative factors such as the quality of teachers and school management. It is becoming a puzzle in South Africa why student achievements still widely differ across population groups despite the equalization of school inputs such as measured by learner–educator ratio, though very gradual. There seems to a great need to pay equal or more attention to qualitative inputs in the school system in addition to the highly progressive subsidy allocation.

Appendix A. The 1998 Norms and Standards for School Funding

Sections that are relevant to this paper are

45. The SASA (South African School Act) imposes a responsibility on all public school governing bodies to do their utmost to improve the quality of education in their schools by raising additional resources to supplement those which the state provides from public funds (section 36). All parents, but particularly those who are less poor or who have good incomes, are thereby encouraged to increase their own direct financial and other contributions to the quality of their children's education in public schools. The act does not interfere unreasonably with parents' discretion under the law as to how to spend their own resources on their children's education.

46. Ironically, given the emphasis on redress and equity, the funding provisions of the Act appear to have worked thus far to the advantage of public schools patronised by middle-class and wealthy parents. The apartheid regime favored such communities with high-quality facilities, equipment and resources. Vigorous fund-raising by parent bodies, including commercial sponsorships and fee income, have enabled many such schools to add to their facilities, equipment and learning resources, and expand their range of cultural and sporting activities. Since 1995, when such schools have been required to down-size their staff establishments, many have been able to recruit additional staff on governing body contracts, paid from the school fund.

47. Poor people, on the other hand, especially in former homeland areas, have contributed a disproportionate share of their incomes over many decades to their building, upkeep and improvement of schools, through school funds and other contributions, including physical labour. All too many schools in poor rural and urban working-class communities still suffer the legacy of large classes, deplorable physical conditions, and absence of learning resources, despite a major RDP National School Building Programme, and many other projects paid directly from provincial budgets. Yet the educators and learners in poor schools are expected to achieve the same levels of learning and teaching as their compatriots.

48. Such contractions within the same public school system reflect past discriminatory investment in schooling, and vast current disparities in the personal income of parents. The present document addresses these inequalities by establishing a sharply progressive state funding policy for ordinary public schools, which favours poor communities.

Data sources

1. Census 2001 Community Profile Database (Statistics South Africa).
2. Annual School Survey 2002 (National Department of Education).
3. School Register of Needs 1996 (National Department of Education).
4. School Register of Needs 2000 (National Department of Education).
5. KwaZulu Natal Department of Education Norms and Standard Database.

Appendix B. Supplementary data

Supplementary data associated with this article can be found, in the online version, at doi:10.1016/j.econedurev.2010.08.002.

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