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# How schools and students respond to school improvement programs: The case of Brazil's PDE

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**Abstract**

This study uses rich empirical data from Brazil to assess how a government program (PDE) that decentralizes school management decisions changes what goes on in schools and how these changes affect student outcomes. It appears that the PDE resulted in some improvements in management and learning materials, but little change in other areas including evaluation and community relations. However, we find no evidence that schools' participation in the PDE improved student achievement. The results for grade passing are stronger. Students in PDE schools saw greater increases in grade passing rates than students in non-PDE schools during the period of our study. We also estimate a positive relationship between PDE spending and student gains for those schools in the program, especially for spending on teaching and learning materials and furniture. We find no benefit of electronics spending or spending on teacher training, two of the three largest areas of school investment.


*JEL classification:* 128

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## 1. Introduction

Most children in Latin America are enrolled in school, but there are serious questions about how much they learn there and how to improve their generally low academic performance. In Brazil, for example, household survey data show that more than 95 percent of primary school-aged children are now enrolled in school, even in the poorest regions such as the rural northeast (Souza & Guimarães de Castro, 2000). At the same time, primary education is marked by high rates of grade repetition and low levels of primary school completion (Guimarães de Castro, 2000). As a result,

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policymakers are devoting more attention to improving the effectiveness of educational delivery in schools (Carnoy, 2001).

One common approach to school improvement has been to decentralize educational decision-making. The theory behind this approach is that local decision-makers are better able to understand what their own schools need in order to improve student outcomes (Amaral Sobrinho & de Almeida Neto, 2001). Additionally, school personnel may become more committed to their schools when given more control over their work environments, and parents also may be able to monitor school quality better (de Carvalho & Jeria, 1999). Although decentralization has been a popular policy for school improvement in developing countries, we are not aware of empirical research that provides evidence on the effectiveness of such interventions (Hannaway, 1993). This paper presents such a study. Using unusually rich data from Brazil, we ask how decentralization policies change what goes on in schools and how these changes, in turn, affect student outcomes.

The Brazilian policy reform that we study is the Ministry of Education's *Plano de Desenvolvimento da Escola* (PDE) project, which was designed to help schools become more responsive to students and their communities (Xavier & Amaral Sobrinho, 1999). The designers envisioned the transformation of schools from rigid and unfocused bureaucracies to dynamic environments that maximize learning for all children (Amaral Sobrinho & de Almeida Neto, 2001). Under the PDE program—administered by the World Bank-financed Fundescola Project—schools identify their most serious problems and develop their own plans for addressing these needs. The Fundescola project then provides funds to support schools' goals. The project began in 1998 with an initial group of 401 schools in 9 states. In 2001 there were more than 5600 schools participating in the PDE program, and the total amount of investment exceeded 1 million dollars.

This paper asks two questions. How has the PDE changed what goes on in schools; and, how have these changes affected outcomes for children? The next section briefly summarizes how the program was implemented across schools.[1] Section 3 describes the results of analyses of the effects of the PDE program, and the final section concludes.

[1]For those readers interested in greater detail about how the PDE was implemented at the school level, they can contact the authors for a full analysis of the data.

## 2. Implementation

Quantitative evaluations of education projects traditionally rely on a dummy-variable approach to measure the impact of a given program on student outcomes. In such an approach the research estimates the average effect of the program on particular outcomes. We expand this approach by assessing how the PDE was implemented in schools. With information on implementation, we can better determine the mechanisms linking PDE participation with changes in student achievement and attainment.

Our analysis of implementation has two components. The first is primarily descriptive, using PDE documentation—collected by Fundescola, and referred to as the PDE database throughout this document—to describe schools' intentions and actions. We rely on the original PDE plan that each participant school completes upon entry into the program. With this information we can describe not only the areas that each school identifies as requiring attention, but also the basic strategy they intend to implement to address each need. We also incorporate planned expenditures undertaken in PDE schools together with a brief description of non-monetary actions. The expenditures are grouped into 10 general categories that include things like electronic items, teacher training and learning materials.

The second part of the analysis brings in the Brazilian National Institute for Education Research (INEP) database to compare PDE and non-PDE schools. From 1998–2001, INEP financed an ambitious longitudinal data collection in 176 PDE and non-PDE schools. The final database includes detailed information on the schools and students, as well as results from mathematics and Portuguese achievement tests for a cohort of students as they progress from the 4th through 6th grade. Students were tested at four points in time, April 1999, November 1999, November 2000, and November 2001.

The INEP data collection effort began with an original sample of 158 PDE and non-PDE schools. Fourth graders in these schools completed exams and questionnaires in April 1999 and November 1999, the beginning and end of the academic year. In fifth grade, students in 156 of these 158 PDE and non-PDE schools took tests in November 2000. By this time, many of the non-PDE schools the previous year had become PDE schools. As a result,

Table 1
Overview of the INEP sample

| State | Number of sample schools | Year of PDE entry | | | | |
|---|---|---|---|---|---|---|
| | | 1998 | 1999 | 2000 | 2001 | Non-PDE |
| Goiás | 35 (19.9) | 16 (45.7) | 3 (8.6) | 13 (37.1) | 0 (0.0) | 3 (8.6) |
| Mato Grosso do Sul | 37 (21.0) | 20 (54.1) | 0 (0.0) | 12 (32.4) | 0 (0.0) | 5 (13.5) |
| Pará | 35 (20.2) | 20 (57.1) | 0 (0.0) | 0 (0.0) | 4 (11.4) | 11 (31.4) |
| Pernambuco | 39 (22.2) | 0 (0.0) | 9 (23.1) | 3 (7.7) | 10 (25.6) | 17 (43.6) |
| Rondônia | 14 (8.0) | 5 (35.7) | 9 (64.3) | 0 (0.0) | 0 (0.0) | 0 (0.0) |
| Sergipe | 16 (9.1) | 0 (0.0) | 6 (37.5) | 9 (56.3) | 0 (0.0) | 1 (6.3) |
| TOTAL | 176 | 61 (34.7) | 27 (15.3) | 37 (21.0) | 14 (8.0) | 37 (21.0) |

*Source*: School PDE documents.
*Notes*: Numbers in parentheses are percentages; for "Number of sample schools" these are the percent of total sample; for other cells, these are the percentage of total in each state.

very few non-PDE schools remained in the original sample. The 2001 sample added 18 additional non-PDE schools to compensate for this change. The surveys and tests in November 2001 were applied to 6th graders in 172 PDE and non-PDE schools.[2]

Schools were not randomly assigned to the PDE program and to the control group. Instead, the control group was chosen by INEP to be similar to schools in the PDE program. Because of this, there is a concern that the schools in the control group started off differently from the schools that entered the PDE. We work to address this in the empirical analyses.

Table 1 provides a summary of the INEP sample and the distribution of schools by year of entry into PDE. We categorize schools into five groups based on their year of entry into the PDE program. The data in Table 1 show that almost half of the schools in the sample entered the PDE project by November, 1999. Most of these schools came from four states: Goiás, Mato Grosso do Sul, Pará and Rondônia. Pará and Pernambuco have the largest share of Non-PDE schools.

[2]The objective of the sampling strategy was to re-test the same students over time, generating a panel data set. Nevertheless, INEP sampled by grade in school so that some new students were introduced into the dataset each year and some dropped out. In addition, local restructuring created problems in schools that at subsequent testing dates did not offer the tested grade (at the time the sample was drawn all schools offered grades 1-8). Because of this, two schools that participated in the fourth grade testing did not participate in the fifth grade testing. In 2001, two additional sample schools did not participate as they no longer offered sixth grade. Finally the 18 non-PDE schools added in the November, 2001 sixth grade testing had not participated in any of the previous tests.

### 2.1. The PDE plans: what do schools intend to do?

When PDE schools first enter the program they are required to complete a document designed to guide them through the initial self-evaluation phase and prepare them for addressing their most pressing needs. Most schools cite problems with academic achievement, grade failure and dropout rates as priorities for intervention. Other problems include low community and parental participation and inadequate teaching methods.

To help schools design plans to address their needs, the PDE requires schools to focus their plans on two or three "Effectiveness Factors," one of which is effective teaching and learning, and then to list several requirements that are important elements of each Effectiveness Factor. PDE schools choose their second and (optional) third Effectiveness Factors from a list of general areas detailed in the PDE manual. The second choice of the schools in our sample was almost always Participative Management. Variation comes in the third Effectiveness Factor; the most common areas selected by schools were School Climate and Parental Involvement in the School. Some schools choose Human Resource Development.

The prevalence of Participative Management as an Effectiveness Factor argues for a closer inspection of the kinds of requirements schools chose to focus on within this area. Schools were given six options for these requirements. Most schools chose to improve participative management by focusing on creating clear objectives (61.1 percent), organizing routines (58.9 percent), and upgrading the School Council (47.8 percent). Far fewer chose

adequate provision of funds (1.1 percent), involvement in choice of director (10.0 percent) or planning of actions (34.4 percent).

After schools decide on their Effectiveness Factors, they develop a more specific plan for action and assign a cost to each action. For example, a school interested in improving the teaching and learning environment may identify "concentrating on the critical subjects" as a strategy, and have "reducing from 38.5 percent to 15.0 percent the rate of grade failure in seventh and eighth grade mathematics" for a goal. For each goal, schools identify a series of necessary *actions*. The lists of actions that accompany each goal can be divided into those actions that require cash disbursements, such as buying pedagogical materials or paying for teacher training, and those actions that do not, such as setting up a monthly meeting between teachers to discuss a specific pedagogical issue, or creating a registry for parents to sign when they come for meetings.

Several patterns emerge. First, there is considerable variation by state in terms of the number of actions undertaken by schools. PDE schools in Pará averaged 13.1 actions, while in Mato Grosso do Sul more than 26 actions were included in each PME. PDE schools in Pará had the highest levels of financing, on average about R$13,300, while Mato Grosso do Sul had the lowest average at roughly R$10,000. To facilitate inter-year comparisons, all expenditures are in 2001 Reais. When school averages are divided by enrollment, Goias has the lowest expenditure per capita; and Mato Grosso do Sul, the highest.

When we divided the expenditures to implement these actions into categories, we found that about 30 percent of the PDE funds had been devoted to buying electronic equipment, and within this general category the miscellaneous sub-category was almost always the largest component (including TVs, CD-Rom players, etc.). Only in Rondônia did schools consistently use PME funds to acquire computers. Another 25 percent of the average budget went to learning and teaching materials. PDE schools in Mato Grosso do Sul and Rondônia were the largest spenders in these two categories. Of the remaining materials and services, school materials made up the largest component of PME expenditures in 1999. Finally, teacher training made up about one quarter of total PME expenditures. The amount devoted to training in methodology and specific topics (other than specific subjects) changes little by state. Some states—namely Goiás—used more for training teachers in the specific subjects (language, math, etc.).

We repeated the expenditure categorization exercise for the 2000 and 2001 PDE participants. Eighty-nine sample schools from all six states were filing PME action plans by 2000. The total number of actions, financing and per-student averages do not differ substantially between 1999 and 2000. The average PME devoted roughly the same percentage of resources to each of the ten categories in 2000 as in 1999. In 2001 there was a slight decrease in overall PME financing, but the difference is not very large and the distribution is similar.

The actions detailed in the PMEs are not limited to those that require Fundescola or local and state education authorities to provide monetary financing. PME action summaries also contained a large number of non-monetary actions, often involving meetings or in-school activities in which no materials were required and participants received no remuneration. Unfortunately, there are no records of these actions other than what the schools wrote down in their PMEs.

### 2.2. Comparing schools using survey data

The previous sections provide a brief description of the goals and actions of schools in the PDE. However, other schools may be undertaking similar strategies. In order to identify the effect of the PDE program itself, we compared schools in the program to a group of other schools using information from 2001 INEP surveys of teachers, school directors, parents, and students.

These surveys show that teachers in PDE schools have a significantly better opinion of their schools' physical conditions, school improvements, relations with the school's director and student-centered teaching than teachers in non-PDE schools, and that this is not the result of the geographical composition of the two samples. But the positive difference is concentrated in the earliest set of PDE schools—those longest in the program. The original group of PDE schools that entered the program in 1998 scored consistently higher than all other groups. This could be due to the fact that the PDE is exerting a positive effect on these outcomes, and these schools have had the longest amount of time to realize these gains. Alternatively, the observed differences may be attributable to the composition of this original group, and have little to

Table 2
Multivariate analysis: covariates of teacher responses

| Predictor variable | Physical conditions | Improvements | Director relations | Student-centered |
|---|---|---|---|---|
| *State controls*[a] | | | | |
| Goiás | −0.14 | 0.10 | 0.01 | 0.04 |
| Mato Grosso do Sul | 0.62** | 0.12 | −0.04 | 0.10 |
| Pará | −0.27 | −0.03 | −0.15 | −0.10 |
| Rondônia | −0.65* | −0.16* | −0.49** | −0.38** |
| Sergipe | −0.48* | −0.11 | −0.48** | −0.21 |
| *School characteristics* | | | | |
| Average parental education | −0.33 | −0.07 | −0.33 | 0.11 |
| Average household SES | 0.04 | −0.01 | 0.04 | 0.02 |
| Time in PDE program | 0.02*** | 0.01*** | 0.01*** | 0.01** |
| Number of schools | 170 | 170 | 171 | 171 |
| F | 7.66 | 4.74 | 4.03 | 4.26 |
| Adjusted $R^2$ | 0.240 | 0.151 | 0.125 | 0.133 |

*Source*: INEP data collection, November 2001.
*Notes*: *** Difference in mean is statistically significant at 0.01 level; ** at 0.05 level; * at 0.10 level.
[a]Excluded category: Pernambuco.

do with actual PDE participation. In order to assess the PDE effect we used multivariate analysis to estimate the effect of the PDE on the school environment.

Table 2 presents multivariate estimates of the covariates of four aggregated teacher responses about their schools. These data come from teacher responses about a series of questions covering access to materials, relations with director, improvements during the last 2 years, and the school's focus on student-centered learning. The idea here is simple. By analyzing each of these school averages as a function of regional controls and school characteristics (average parental education and SES) we can have greater confidence that observed relationship between PDE exposure and teacher attitudes about these processes in their schools is attributable to the PDE and not to pre-existing differences in the makeup of the schools or the populations they serve. Rather than use dummy variables for each group of PDE schools (compared to the control group of non-PDE schools), we use a linear term measuring the number of months the school has been in the program.

The results in Table 2 show that few of the state controls are statistically significant, as Rondônia and Sergipe appear to be the only consistent predictors (both negative in relation to the excluded category, Pernambuco). We also see evidence that PDE participation may be responsible for the differences we observe in teacher attitudes about their schools, and not due to compositional differences between PDE and non-PDE schools. For example, the results in Column 1 show that for each month increase in time in the PDE program the average teacher sentiment regarding the physical conditions of the school increases by 0.01. For each year of PDE participation the teacher evaluation of the physical conditions increases by roughly 0.12. We see that the PDE effect is robust to the inclusion of these other variables. Because the multivariate framework does not substantively change the interpretation of the comparison between PDE and non-PDE schools, for simplicity of presentation, we stick with *t*-tests for the remaining comparisons.

There are few significant differences that emerge from the directors' questionnaires except that they agree with teachers that PDE schools are better equipped with teaching and learning materials and that they make more use of teacher training. Parents from PDE schools are less likely to want to move their children to another school, although the same pattern as before is evident with the largest difference coming from PDE schools that entered the program in the first year. The results for parent–teacher meetings appear to contradict to some extent what we found with teachers and directors. PDE-school parents indicate that they had been invited to—and had attended—more parent–teacher meetings than their counterparts in non-PDE schools during the 2001 school year. Another method of measuring parental involvement in the school is to ask about monetary contributions

or volunteer work. For the former, PDE-school parents are more likely to contribute money to the school; there are no significant differences in time spent in the school. Consistent with teachers, significantly more parents with children in PDE schools responded that they have seen improvements in school organization.

In addition to describing their schools and the changes in their schools over the past 2 years, teachers and administrators in PDE schools responded to questions asking them to directly assess the PDE program. The results for the directors show that directors are very positive about the PDE experience. The first group of PDE participants again is the most positive about their experiences. The areas that directors point to as being most successful under the PDE are school organization and student learning. They are less sanguine about how the PDE has affected rates of grade repetition and failure, relations with parents, and relations with the Secretary of Education. In comparison to directors, teachers are less positive about their PDE experience.

Summarizing, we find evidence that the PDE program did affect the schools that participated. In particular, the program appears to have improved school management and available materials. There is little evidence that the program affected school–community relationships.

## 3. Student outcomes

The previous section provides evidence that the PDE affects what goes on in schools; yet, we do not know whether these changes resulted in positive outcomes, for students. This section addresses the effect of the PDE on student outcomes including achievement, attendance, and progression through school.

### *3.1. Data overview*

#### *3.1.1. Dependent variables*

The data collected by INEP between 1999 and 2002 allow us to analyze the impact of the PDE program on academic achievement as measured by Portuguese and mathematics exams applied to a cohort of students beginning in April 1999. We also assess grade passing and desertion using school averages taken from school census data. Attendance is measured by the number of absences reported during the school year, and is collected for each student with test score data during 1999, 2000 and 2001. For achievement and attendance the unit of analysis is always the individual, which allows for the most complete treatment of the myriad factors that affect each outcome. For our other outcomes, such as repetition rates, school averages based on beginning and end of year school census data are our only available unit.

#### *3.1.2. Independent variables*

We use four groups of independent variables: (1) PDE exposure; (2) individual student and family characteristics; (3) teacher and school characteristics; and (4) measures parents' school selection. For PDE exposure we use a series of dummy variables based on year of entry into the PDE, similar to the groupings in the implementation analysis above.

Student and family characteristics include student gender, family SES and the mother's education. Family SES is measured by summing up a series of possible household possessions. For the mother's education, we use dummy variables corresponding to levels of education ranging from "without formal education" to "complete higher education." All data for student and household characteristics come from the student questionnaires.

For schools, teachers, and community characteristics, we incorporate a number of variables. From the School Facilities Survey (LSE) for 1996-97 and 2001, we use the percentage of teachers in the school with college education as a measure teacher quality. From the school principal questionnaire we construct two director variables, one that measures the experience of the director, and the second, that measures his or her education (whether the director had tertiary education). Finally, we use state dummies to control for unobserved components of both school quality and household SES.

The multivariate approach aims at controlling for pre-existing differences across schools. The above controls are a first step in doing this. In order to improve our ability to control for differences we include measures from a series of variables that ask parents why they choose to send their child to the particular school. These variables should capture some of the differences in important measures such as parent involvement and interest in education that are not covered by the demographic measure that we have. If these variables explain differences between PDE and non-PDE schools, they may signal unmeasured differences for which we are not adequately adjusting. If we see no relationship

between these measures and PDE participation, we would be less concerned that selection bias and omitted variables are driving our results. These variables are discussed in more detail below.

### 3.2. Methodological framework

This section presents a series of statistical models that we use to evaluate the PDE in each of the student outcomes.

#### 3.2.1. Academic achievement

To analyze the effect of the PDE on academic achievement, we use the last test applications in Portuguese and mathematics in November 2001 as the dependent variable. In some models we use the most recent exam, i.e. November 2000, as a control. In others, we use the 1999 application in order to assess change over a longer time period. Our estimates are based on the following model:

$$A_{i1} = \alpha_0 + \beta_1(A_{t-m})_{i1} + (\mathrm{PDE})_{i1}\beta_2 + (H)_{i1}\beta_H + (S)_{i1}\beta_s + \varepsilon_{i1}, \quad (1)$$

where $A$ is achievement for individual $i$ in subject $l$ (math or Portuguese), $A_{t-m}$ is achievement in time minus $m$ years, PDE is a series of dummy variables for PDE exposure, $H$ represents a vector of student and household characteristics, and $S$ represents a vector of school, teacher, and community characteristics. Because students are grouped in schools, all estimates are clustered to adjust the standard errors for this grouping.

In addition to the model described above, we run two alternative specifications. The first alternative includes controls for parent selection of schools. This represents an important component of our analysis, because relatively few project evaluations have measures that allow the researcher to assess sample selection as clearly. We also run a series of specifications that look only at schools that have participated in the PDE program. These models assess the effect of overall PDE expenditure and PDE expenditures by category on student achievement. The framework for these analyses is similar to that in Eq. (1).

#### 3.2.2. Grade passing and desertion rates

In addition to achievement, grade passing and desertion rates are important outcomes in Brazil, where many students leave the primary school system before completing the cycle or spend several years in the earliest grades due to repetition. Brazil has been a world leader in collecting data at the school level that accurately separates desertion from repetition episodes.[3] These data allow us to look at these outcomes. The interpretation of the results is not as straightforward as it is for achievement. For example, schools can increase pass rates by simply passing more students (lowering the bar). On the other hand, they can make improvements in teaching and learning, which in turn raise achievement levels and allow more students to pass without adjusting the evaluation regime. An "artificial" increase in pass rates, i.e. one that is not related to improvements in academic achievement, may have different implications than one that appears to result from students learning more.[4] Unfortunately, from an investigative standpoint, disentangling these different effects is difficult.

Our statistical model regresses school averages (for grades 1–8 and 5–8) for desertion and grade passing onto many of the same variables included in our estimations for achievement. The specification is

$$P \text{ or } D_{2000} = \alpha_0 + \beta_1(P/D_{1998}) + (\mathrm{RC})\beta_{\mathrm{RC}} + (\mathrm{PDE})\beta_{\mathrm{PDE}} + (H)\beta_H + (S)\beta_S + \varepsilon_{i1}, \quad (2)$$

where $P$ refers to the average for grade passing and $D$ refers to desertion during the 2000 school year. We include grade passing and desertion rates from the baseline year (1998) as a regressor in the same fashion that we used individual incoming test scores as controls in the previous section. The regional controls (RC) are state dummies corresponding to the included states. These controls may be capturing

[3] When students drop out during the school year they are classified, at least for that year, as dropouts. However, if they return to school the following year they are, in reality, grade repeaters. This is, of course, a different outcome than those who failed the grade and repeated. With data collected at the end of the year and at the beginning of the year it is possible to classify students with more precision. Brazil collects these data by grade and school.

[4] This is *not* to say that an artificial reduction is insignificant. First, our ability to determine the degree to which failure rates are related to achievement is limited by the fact that our tests are not perfect measures of learning in the school. Furthermore, just getting pupils from grade to grade in Brazil, and thereby increasing the demand (in theory) for higher levels of education, may be another important outcome. But the PDE project, and the PDE schools themselves (according to their plans), appears to envision achievement increases as a *necessary* component of any plan to reduce repetition and dropout rates.

any number of influences, including regional differences in the calculation of repetition and desertion rates. The vector of PDE variables refers again to the series of PDE dummy variables reflecting when the school entered the project. The $H$ vector refers to background controls and the $S$ vector includes teacher education, class size and percent of students enrolled in night classes.

The $S$ vector also includes the school average on the INEP exams at the end of the 2000 school year. The reason for using this variable is to see if academic achievement in the school, as measured by achievement averages in fifth grade in 2000, has any relation with passing or desertion rates. This is an especially important question if we consider the different "paths" that the PDE program may affect failure or desertion. If PDE schools have succeeded in raising achievement, then lower levels of grade failure may be attributable to more learning taking place. By including the INEP test score averages, we can partially control for the mechanism linking PDE participation with our outcomes. If a PDE effect still is evident, even when controlling test scores, it is suggestive of the "artificial" reduction in grade failure referred to earlier.

#### 3.2.3. Student absences

The final component of the analysis focuses on the determinants of student absences. One indicator of "success" in the PDE is that students attend more frequently, either because the learning environment is more productive or a generally positive climate makes them want to come to school. This outcome is similar to the grade passing and desertion outcomes and, from an evaluation standpoint, the challenge remains the same: isolate the PDE effect on absences. We proceed by estimating multiple regression equations using individual student data similar to those used before with individual test scores. The equations take the form:

$$\mathrm{AT}_{i1} = \alpha_0 + \beta_1(A)_{i1-1} + (\mathrm{PDE})_{i1}\beta_2 + (H)_{i1}\beta_H + (S)_{i1}\beta_s + \varepsilon_{i1}, \quad (3)$$

where attendance (AT) for student $i$ in time 1 is measured as a function of PDE exposure, household characteristics, and school characteristics. We estimate Eq. (3) separately for 1999, 2000 and 2001. Note that we also include the student's test score from the previous year (for 1999 from April, 1999). This acts as a control for ability and helps sharpen the measurement of the impact of other variables (notably the PDE exposure).

### 3.3. Results

#### 3.3.1. Achievement results

Tables 3 and 4 give the estimates of the PDE effect on student achievement. We find no effect of the PDE in any specification, though other measures, such as mothers' education, SES, and the percent of teachers with a college degree do show positive effects on mathematics performance. Because we do not find a PDE effect on achievement, the importance of the parent selection variables is not as great. However, we do find that parents who made the specific choice of school—for example, because of the school organization—have children who make greater gains in Mathematics. Similarly, students whose parents say that they chose the school because there were no available spots in other schools make substantially lower (significant) gains in the Portuguese test than students whose parents indicated other reasons for choosing their children's school.

While we find no evidence of an effect of participation in the PDE, we do find that within the group of schools in the PDE program, students in schools that received greater funds performed better on the tests of Mathematics and Portuguese. The results in Table 5 show that controlling for student socio-economic background, teacher and principal characteristics, and state in which the school is located, the total PDE funds spent per student has a positive effect on both the Mathematics and Portuguese gain scores. An additional Real of PDE funds spent per student in a school is associated with 0.16 points additional gain in Portuguese score and a 0.07 additional gain in math score. This suggests that although the existence of a PDE program in a school may not have any significant effect on achievement, among PDE schools, the more that is spent in the PDE program, the greater the gains in achievement, especially in language.

In Table 6 we show the results of estimations of the effect of types of spending by schools. Two types of spending have a significant effect on Portuguese gain scores: spending on learning materials and on school furniture. That effect of spending on furniture is large, 1.83 additional points in gain for an additional Real of spending; and the effect of the spending on teaching materials is small, 0.3 points for an additional Real of spending. The mathematics gain score equation shows a small positive effect on gain score of learning materials,

Table 3
Regression estimate of PDE effect, dependent variable, mathematics test score of November 2001, error terms corrected for clustering

| Exogenous variables | Model 1 | Model 2 | Model 3 |
|---|---|---|---|
| Control test score | | | |
| Math test score of November 1999 | 0.47 (44.75)*** | 0.45 (42.73)*** | 0.45 (42.39)*** |
| PDE variable | | | |
| School Group 2 | −0.25 (0.42) | 0.55 (0.90) | 0.63 (1.06) |
| School Group 3 | −0.30 (−0.42) | −0.79 (1.15) | −0.42 (0.55) |
| School Group 4 | −0.59 (0.58) | 1.32 (1.16) | 1.08 (0.85) |
| School Group 5 | −0.24 (0.29) | 0.29 (0.39) | 0.82 (0.78) |
| Student background | | | |
| Mother without formal education | −1.87 (2.14)** | −2.28 (2.53)** | −2.20 (2.45)** |
| Mother with <4 grade | −0.71 (1.61) | −0.55 (1.22) | −0.56 (1.25) |
| Mother with >8 grade but incomplete | 0.45 (0.93) | 0.57 (1.16) | 0.47 (0.95) |
| Mother with complete high school | 0.80 (1.72)* | 0.72 (1.50) | 0.69 (1.41) |
| Mother with incomplete higher ed | 1.10 (1.23) | 0.78 (0.88) | 0.72 (0.80) |
| Mother with complete higher ed | 0.52(0.73) | −0.07 (0.09) | −0.15 (0.22) |
| SES index | 0.05 (2.24)** | 0.002 (0.07) | −0.002 (−0.07) |
| Gender: Female | −1.09 (3.17)*** | −1.11 (3.22)*** | −1.14 (3.31)*** |
| School characteristics | | | |
| Utilities index | | −0.06 (−0.17) | 0.03 (0.08) |
| % Math teachers with college education | | 3.84 (3.98)*** | 3.77 (3.68)*** |
| Principal experience as principal of school < 5 yr | | 0.04 (0.08) | −0.10 (0.18) |
| Principal with tertiary education level | | 0.91 (1.24) | 0.67 (0.86) |
| Geographic area | | | |
| Goias | | 1.44 (1.63) | 0.69 (0.78) |
| Mato Grosso do Sul | | 0.86 (0.92) | 0.13 (0.14) |
| Para | | −1.46 (1.64) | −1.79 (2.11)** |
| Pernambuco | | −2.70 (2.54)** | −3.26 (3.16)*** |
| Sergipe | | −0.30 (−0.27) | −0.80 (0.81) |
| School selection | | | |
| Siblings already study in the school | | | −1.46 (−0.74) |
| Well-organized school | | | 3.45 (1.78)* |
| Best school of the neighborhood | | | 2.54 (1.17) |
| School offers every grade | | | 1.60 (0.93) |
| School located near work or house | | | 0.01 (0.00) |
| No available spots in other schools | | | 0.16 (0.09) |
| No spots other than at good schools | | | −2.13 (−0.47) |
| Constant | 23.99 (31.88)*** | 22.54 (17.56)*** | 22.17 (12.58)*** |
| Number of observations | 4,919 | 4,566 | 4,552 |
| $R^2$ | 0.42 | 0.43 | 0.43 |

*Source*: INEP and PDE databases. Robust *t*-statistics in parentheses.
*Notes*: *** Statistically significant at 0.01 level; ** at 0.05 level; * at 0.10 level.

0.23 additional points of gain score for an additional Real of additional spending. It is more compelling to believe that spending on learning or teaching materials would have an effect on students' achievement, but it may also be possible that additional chairs and desks in low income schools would have a positive effect on achievement, particularly if classrooms are crowded (Harbison and Hanushek, 1992).

In summary, then, we find that overall reported PDE spending does have a positive effect on student achievement—more on Portuguese than on mathematics—and that the only spending categories that have a significant effect are learning materials for Mathematics and Portuguese and classroom and school furniture for Portuguese. The furniture effect is especially large. Also important is that most of the categories of spending had no significant effect on student achievement gains in the 2 years, November 1999–November 2001.

### 3.3.2. Other outcomes

We now turn to analysis of how the PDE project has affected other schooling outcomes. High rates

Table 4
Regression estimate of PDE effect, other specifications

| Dependent variable | Portuguese test score of November 2001 | | |
|---|---|---|---|
| PDE variable | | | |
| School group 2 | −2.06 (1.71)* | −0.81 (0.63) | −0.56 (0.44) |
| School group 3 | −1.76 (1.24) | −2.33 (1.54) | −1.60 (1.03) |
| School group 4 | −1.39 (0.69) | 2.40 (1.02) | 2.88 (1.13) |
| School group 5 | −2.08 (1.32) | −1.22 (0.68) | −0.86 (0.40) |
| Dependent variable | Math test score November 2001 (control November 2000) | | |
| PDE variable | | | |
| School group 2 | −0.21 (0.34) | 0.82 (1.32) | 1.05 (1.71)* |
| School group 3 | −0.11 (0.16) | −0.92 (1.36) | −0.43 (0.55) |
| School group 4 | −0.92 (0.88) | 1.34 (0.99) | 1.63 (1.28) |
| School group 5 | −0.56 (0.75) | 0.18 (0.21) | 1.21 (1.10) |
| Dependent variable | Portuguese test score November 2001 (control November 2000) | | |
| PDE variable | | | |
| School group 2 | −1.53 (1.63) | −0.48 (0.45) | −0.36 (0.33) |
| School group 3 | −1.43 (1.24) | −1.47 (1.09) | −1.00 (0.68) |
| School group 4 | −0.45 (0.27) | 1.08 (0.50) | 1.83 (0.81) |
| School group 5 | −1.78 (1.44) | −1.23 (0.89) | −0.88 (0.57) |

*Source*: INEP and PDE databases.
*Notes*: All variables from Table 15 included. Robust *t*-statistics in parentheses.
*** Statistically significant at 0.01 level; ** at 0.05 level; * at 0.10 level.

Table 5
Test score, November 2001, as function of total PDE spending

| Independent variable | Mathematics | Portuguese |
|---|---|---|
| Total Reais spent per student | 0.07 (3.09)*** | 0.16 (2.88)*** |
| Test score of November 1999 | 0.46 (39.42)*** | 0.59 (31.15)*** |
| Mother education: without education | −2.59 (2.52)** | −3.35 (2.03)* |
| Mother education: < 4 grade | −0.63 (1.28) | −0.76 (0.89) |
| Mother education: > 8 grade but incomplete high school | 0.22 (0.42) | −0.69 (0.96) |
| Mother education: complete high school | 0.51 (0.94) | 1.30 (1.76)* |
| Mother education: incomplete higher education | −0.04 (0.04) | −1.08 (0.85) |
| Mother education: complete higher education | 0.03 (0.03) | −2.44 (2.18)** |
| SES index | −0.02 (0.62) | −0.22 (5.09)*** |
| Gender: Female | −1.16 (3.22)*** | 10.15 (16.38)*** |
| Utilities index | −0.42 (1.10) | −0.25 (0.29) |
| Percentage of teachers with college education | 3.41 (3.44)*** | 5.13 (2.02)** |
| Principal experience as principal in this school: < 5 years | −0.29 (0.50) | 0.98 (0.96) |
| Principal with tertiary education level | 0.987 (1.10) | 1.57 (0.82) |
| Goias | 2.13 (2.19)** | 2.63 (1.18) |
| Mato Grosso do Sul | 0.52 (0.54) | −0.77 (−0.30) |
| Para | −1.27 (1.40) | 0.22 (0.11) |
| Pernambuco | −1.89 (1.66)* | −1.84 (0.77) |
| Sergipe | 0.818 (0.69) | 2.53 (1.06) |
| Percentage of total primary enrollment that is in night school | −0.04 (1.88)* | −0.05 (0.98) |
| Average student–teacher ratio 2001 | −0.02 (0.32) | −0.06 (0.50) |
| Constant | 22.97 (10.07)*** | 19.63 (4.65)*** |
| Observations | 3,871 | 3,905 |
| Adjusted $R^2$ | 0.44 | 0.36 |

*Source*: Information on primary enrollment that is night school and student–teacher ratios come from the 2001 School Census Data (Brazilian Ministry of Education). The rest of the variables were obtained from Fundescola's PDE questionnaires.
*Notes*: *t*-statistics in parentheses are calculated using robust standard errors, corrected for clustering.
*** Statistically significant at 0.01 level; ** at 0.05 level; * at 0.10 level.

Table 6
Test score, November 2001, as function of PDE spending by area

| | Mathematics | Portuguese |
|---|---|---|
| Reais in electronics per student | 0.07 (0.59) | 0.18 (0.85) |
| Reais in learning materials per student | 0.23 (1.70)* | 0.01 (0.06) |
| Reais in teaching materials per student | −0.08 (0.86) | 0.30 (1.66)* |
| Reais in school materials per student | 0.06 (0.66) | 0.03 (0.15) |
| Reais in activities materials per student | −0.12 (−0.39) | 0.12 (0.19) |
| Reais in meetings with parents, teachers & students per student | 0.02 (0.03) | 0.87 (0.81) |
| Reais spent in furniture per student | 0.37 (0.71) | 1.83 (2.25)** |
| Reais spent in services per student | −0.36 (−0.93) | −0.33 (0.38) |
| Reais spent in teacher training per student | −0.002 (0.03) | −0.023 (−0.14) |
| Reais spent in functionary training per student | 0.06 (0.20) | 0.09 (0.10) |
| Test score of November 1999 | 0.45 (42.72)*** | 0.64 (35.73)*** |
| Mother education: without education | −2.42 (−2.74)*** | −3.22 (2.25)** |
| Mother education: < 4 grade | −0.57 (−1.27) | −0.682 (0.81) |
| Mother education: > 8 grade but incomplete high school | 0.50 (1.01) | −0.25 (0.33) |
| Mother education: complete high school | 0.73 (1.48) | 0.97 (1.39) |
| Mother education: incomplete higher education | 0.64 (0.72) | −1.58 (1.33) |
| Mother education: complete higher education | −0.13 (−0.18) | −2.73 (2.41)** |
| SES index | −0.0002 (−0.01) | −0.16 (4.06)*** |
| Gender: Female | −1.13 (−3.31)*** | 4.63 (7.47)*** |
| Utilities index | −0.14 (−0.41) | 0.08 (0.09) |
| Percentage of teachers with college education | 4.06 (3.92)*** | 3.38 (1.15) |
| Principal experience as principal in this school: < 5 years | 0.38 (0.73) | 1.56 (1.50) |
| Principal with tertiary education level | 0.96 (1.24) | 2.58 (1.58) |
| Goias | 1.47 (1.47) | 5.10 (2.03)** |
| Mato Grosso do Sul | −0.42 (−0.41) | 0.99 (0.33) |
| Para | −1.21 (−1.31) | 0.56 (0.21) |
| Pernambuco | −1.56 (−1.28) | −1.15 (−0.37) |
| Sergipe | −0.18 (−0.18) | 2.27(0.78) |
| Percentage of total primary enrollment that is in night school | −0.01 (−0.75) | −0.06 (1.25) |
| Average student-teacher ratio 2001 | −0.08 (−1.66)* | −0.08 (−0.73) |
| Constant | 25.10 (11.75)*** | 18.98 (4.44)*** |
| Observations | 4,566 | 3,886 |
| Adjusted $R^2$ | 0.43 | 0.44 |

Error terms corrected for clustering.
*Source*: Information on primary enrollment that is night school and student–teacher ratios come from the 2001 School Census Data (Brazilian Ministry of Education). The rest of the variables were obtained from Fundescola's PDE questionnaires.
*Notes*: *t*-statistics in parentheses are calculated using robust standard errors *** statistically significant at 0.01 level; ** at 0.05 level; * at 0.10 level.

of grade failure and desertion are a reality in many Brazilian schools, and few topics have received more attention in education policy circles. Student absences are a related problem, although much less empirical evidence exists about this problem in Brazil.

Table 7 presents means and standard deviations for grade passing, school desertion and absenteeism. For grade passing and desertion the numbers refer to school averages for grades 1–8. Each is calculated by dividing the total number by the enrollment for that year. For student absences the data are averages for the students who took the INEP exams for each year. We have data for three years for each outcome: for grade passing and desertion rates, the means (by school category) are during 1998, 1999, 2000, while for absences we have data for 1999, 2000 and 2001. The use of the first year (1998) is to establish a baseline for comparisons of the passing and desertion outcomes; since, by the end of 1998, no schools were actually implementing PDE plans (although some were ready to begin shortly thereafter).

Table 7 shows why grade failure, desertion and—to a lesser extent—student absences receive so much attention in Brazilian policy circles. On average less than 70 percent of students passed their grade during the 1998 school year, and between 10 and 16

Table 7
Descriptive statistics: grade failure, desertion and student absences

| | School category | | | |
|---|---|---|---|---|
| | PDE 1998 | PDE 1999 | PDE 2000 | Non-PDE |
| Number of schools in sample | 60 | 26 | 37 | 49* |
| During 1998 school sear | | | | |
| Grade passing 1–8 | 72.6 (9.5) | 65.6 (9.6) | 66.5 (9.8) | 68.2 (9.7) |
| School desertion 1–8 | 10.2 (6.6) | 16.5 (9.2) | 17.0 (9.7) | 14.9 (7.9) |
| During 1999 school year | | | | |
| Grade passing 1–8 | 80.3 (13.3) | 70.8 (10.3) | 71.4 (14.6) | 71.5 (11.0) |
| School desertion 1–8 | 11.5 (11.7) | 16.0 (9.8) | 15.5 (13.2) | 17.0 (11.2) |
| Student absences | 9.9 (16.9) | 15.6 (21.9) | 16.5 (31.1) | 12.6 (13.2) |
| During 2000 school year | | | | |
| Grade passing 1–8 | 74.3 (13.4) | 67.0 (11.6) | 68.5 (12.4) | 66.8 (11.4) |
| School desertion 1–8 | 14.4 (13.7) | 19.6 (11.2) | 17.1 (10.6) | 17.4 (11.2) |
| Student absences | 10.6 (13.5) | 11.9 (15.2) | 11.9 (15.5) | 9.4 (10.2) |
| For 2001 year | | | | |
| Student absences | 10.3 (15.9) | 10.5 (12.9) | 10.9 (13.1) | 9.6 (14.9) |

*Source*: INEP School Census Files, various years.
Notes: Standard deviations in parenthesis. For grade passing and school desertion these are school averages for grades 1–8. Student absences are averages for students for the school year.
*For comparisons of means in following tables the non-PDE category for 1999 includes the PDE 2000 schools, whereas for 2000 it only includes the PDE schools that entered the program in 2001 and the control schools.

percent deserted during the 1998 year. The grade passing rate went up across the board in 1999, but came down in 2000 for all four groups of schools. Previous research in developing countries, including Brazil (see Duryea & Arends-Kuenning, 2001), has demonstrated that enrollment patterns are at least partially explained by changes in general economic conditions; however, it is difficult to imagine that economic conditions facilitated such differences during these three years. There is less inter-temporal variation for desertion rates, which increased throughout the period. The increasing desertion rate may be attributable to increasing enrollments of older Brazilians in night classes during this period. For student absences we see averages of between 10 and 17 absences during 1999 and a steady decline throughout this period. The decline may reflect sample, in that the data are only collected for the students who took the INEP exams and with each year it is a more select group that would be expected to miss fewer days.

Another result from Table 7 is that the PDE schools, on average, appear to have less desertion and repetition. The most important year to look at is 1998, since this was before implementation of the PDE. The early entry group (PDE 1998) stands out with higher pass rates and less desertion than the other groups. There is much less difference between the non-PDE schools and the later PDE entrants. In fact, pass rates and desertion rates look better for the non-PDE group than for the other PDE schools.

Table 7 shows that all three categories of PDE schools experienced increases in grade passing between the end of 1998 and the end of 1999, and these increases were all larger than that for the control group. The largest difference in passing rates between years is found for the PDE 1998 schools. However, while the sample means show benefits for the PDE schools none of these changes are statistically different from those for schools that did not participate in the PDE program.

When we look at school desertion, the results are somewhat different than the results for grade passing. The 1998 PDE entry schools have lower rates of grade desertion in both years, and these raw differences are significantly different from the remaining schools. The remaining PDE categories have desertion rates that are near (or even higher) than the control schools. There is no evidence that PDE schools made greater progress over time in school desertion than did non-PDE schools.

Next we consider these outcomes in a multivariate framework. The model considers school averages in 2000 for grade passing and desertion as a function of a small group of control variables and dummy variables for year of PDE entry. The model is quite similar in structure to other multivariate models estimating achievement. The main difference is that the level of analysis is school averages. This limits our ability to take full advantage of the INEP data set, for two reasons. First, we are not considering an individual-level outcome so we cannot take full advantage of student and parent questionnaires that detail differences between students. Second, the use of school averages greatly reduces our degrees of freedom, so the number of independent variables must be limited in order to maintain the precision of our statistical estimates.

The additional independent variables that are included in each model deserve mention. In order to control for differences between our PDE and non-PDE schools that may predate program participation, we include the school average grade passing or desertion in 1998. This makes it possible to sharpen the analysis of the remaining variable effects on each outcome in the years subsequent to this "baseline." We also include a series of region controls that may capture unobservable differences in school quality, labor markets, economic conditions, etc. More specific differences in school populations are captured by averages for parental education and family SES (measured in 2001 by INEP) and the percent of students who are enrolled in night classes. Other differences in schools are captured by the average student–teacher ratio in the school and the percent of teachers with college education (both measured in 2001). Finally, each school's average from the 2000 application of standardized exams by INEP is included in order to control for differences in learning. Table 8 presents means, standard deviations and definitions for each variable included in the analysis.

For each outcome we present two estimations. The first includes students in grades 1–8, while the second focuses on grades 5–8. We choose to examine these two groups because the test score averages we have are for grade sixth grade so the 5–8 category averages may be more closely related to our measure of achievement. The model is a demanding test of the PDE effect on these outcomes, since we are controlling for a number of possible paths that may account for differences in rates of grade passing or desertion. For example, if PDE schools have better educated teachers, or more affluent populations, then these controls may capture whatever differences exist between the PDE schools and the rest of the sample and "wash out" the PDE effects that are measured by each PDE dummy variable. Also, if PDE schools have succeeded in raising achievement, which in turn is raising pass rates or reducing desertion, then once again the marginal PDE effect on each outcome may be quite small in this specification.

The multivariate work is presented in Table 9 with the covariates of grade passing and desertion. Not surprisingly, the incoming (1998) averages for both outcomes are significantly related to the 2000 averages. A one percent increase in 1998 grade passing predicts about a half point higher grade passing rate in 2000. For desertion the relationship between previous desertion and current (2000) desertion is stronger, but still far from a one-to-one effect. The remaining results highlight some of these other effects. First, there is some regional variation, although most of the state control coefficients are not significantly different from zero. Average parental education and family SES in the school are also not associated with school averages for passing and desertion, but remember that this is the case when controlling other variables in the model. One result that is not surprising is that each percentage increase in the number of students enrolled in night classes is associated with about a 0.20 percentage point decrease in pass rates and the same size increase in desertion rates.

The variables of particular interest in Table 9 are the PDE dummy variables. We see that for grade pass rates the PDE schools have statistically significant—and positive—effects. For example, for the year 2000 the pass rate for students in grades 5–8 was almost 10 percent higher in the PDE 1998 schools compared to the non-PDE schools. For the other PDE groupings the coefficients for grade passing are positive, significant, and almost as strong as for the 1998 group. When we turn to the desertion estimations we find a similar trend in that PDE schools have lower desertion rates controlling for observable differences, however, very few of the coefficients are statistically significant at traditional levels.

We are left only to speculate about the mechanisms that explain why the PDE schools have higher marginal pass rates. One very important mechanism that may account for differences in pass rates—academic achievement—is controlled for in the

Table 8
Multivariate analysis: variable definitions, means, and standard deviations

| | Definition | Descriptives | |
|---|---|---|---|
| | | Mean | Standard deviation |
| *Outcomes* | | | |
| 2000 average 1–8 grade passing | School average for all grades | 69.6 | 12.7 |
| 2000 average 5–8 grade passing | School average for grades 5–8 | 67.9 | 13.7 |
| 2000 average 1–8 desertion | School average for all grades | 16.7 | 11.9 |
| 2000 average 5–8 desertion | School average for grades 5–8 | 18.5 | 12.7 |
| *Independent Variables* | | | |
| 1998 average 1–8 grade passing | "Baseline" average | 68.6 | 10.0 |
| 1998 average 1–8 desertion | "Baseline" average | 14.1 | 8.6 |
| *State controls* | | | |
| Goiás | | 19.1 | — |
| Mato Grosso do Sul | | 20.6 | — |
| Pará | | 19.3 | — |
| Pernambuco (excluded) | | 22.5 | — |
| Rondônia | | 8.0 | — |
| Sergipe | | 11.5 | — |
| *School controls* | | | |
| PDE 1998 | Entered PDE before May 1999 | 38.4 | — |
| PDE 1999 | Entered PDE between May 1999 and November 1999 | 17.0 | — |
| PDE 2000 | Entered PDE between November 1999 and December 2000 | 22.8 | — |
| Non-PDE | Not in PDE as of December 2000 | 21.8 | — |
| *Additional controls* | | | |
| Average family SES | Average sum of family house-hold possessions | 13.9 | 2.8 |
| Average parental education | School average percent of parents with high school or higher | 42.6 | 16.0 |
| Percent enrolled in night school | Percent of grades 1–8 that are enrolled in night classes | 13.9 | 13.7 |
| Average student–teacher ratio | School average ratio for all grades | 34.9 | 5.6 |
| Average teacher education | School average percent of Teachers with college Education | 61.6 | 21.6 |
| Average test scores, 11/2000 | School average (math and Portuguese) on INEP's November 2000 test | 57.2 | 5.8 |

*Source*: Ministry of Education and INEP data collection (various years).

model. The results are as expected, as schools with higher achievement are passing more pupils and schools with lower achievement have higher desertion. We can at least partially rule out the PDE effect being attributable to relative differences in achievement. Another possibility is that these differences are somehow "artificial," and that they simply reflect an institutional effort on the part of PDE schools to reduce grade failure.[5] For example, many PDE schools listed reducing failure rates as one of their goals when they first constructed their PDE plans. This outcome—unlike other outcomes such as academic achievement and desertion—may be the result of "lowering the bar" and permitting students who may fail in other schools to pass. It is also possible that PDE exposure has forced schools to take a more student-centered approach to evaluation decisions. Again, our ability to get at what lies behind these observed differences in grade passing rates between PDE and non-PDE schools is quite limited; but, given the importance this issue (grade completion) has received in Brazil and other developing countries, the significance of this result should not be understated.

Finally, we look at absences, which we collapse into four categories: 0 absences, 1–3 absences, 4–17 absences and 18 or more absences. We do this because we are concerned about outliers in the student absences data file, as a handful of students have very high number of absences. These outliers can have a large effect in the linear model, and one way to deal with this is to make the outcome ordinal

[5]Although an artificial change (i.e. one that is unrelated to learning as we are measuring it) should not be discounted entirely, especially if it signals a systemic commitment to increasing student flows through the primary cycle that, in turn, prepares the ground for expansion of additional levels of schooling (Carnoy, 2001).

Table 9
Multivariate analysis: covariates of 2000 grade passing and desertion rates

| | Grade passing: | | Grade desertion | |
|---|---|---|---|---|
| | Grades 1–8 | Grades 5–8 | Grades 1–8 | Grades 5–8 |
| 1998 average 1–8 grade passing | 0.46 (4.38)*** | 0.45 (4.14)*** | — | — |
| 1998 average 1–8 desertion | — | — | 0.54 (4.19)*** | 0.65 (5.13)*** |
| State controls[a] | | | | |
| Goiás | −9.17 (−1.50) | −14.6 (−2.32)** | 7.56 (1.32) | 8.88 (1.58) |
| Matto Grosso do Sul | −0.13 (−0.02) | −7.75 (−1.37) | −5.79 (−1.13) | −3.60 (−0.72) |
| Pará | −3.00 (−0.79) | −3.55 (−0.91) | −0.14 (−0.04) | −1.60 (−0.46) |
| Rondônia | −6.58 (−1.20) | −8.42 (−1.48) | 4.91 (0.96) | 3.44 (0.69) |
| Sergipe | −11.10 (−2.59)*** | −16.22 (−3.66)*** | 2.48 (0.57) | 3.84 (0.91) |
| PDE 1998 | 6.11 (1.98)** | 9.93 (3.11)*** | −0.57 (−0.20) | −2.99 (−1.06) |
| PDE 1999 | 7.24 (2.23)** | 6.56 (1.96)** | −3.91 (−1.30) | −4.53 (−1.53) |
| PDE 2000 | 5.89 (1.68)* | 7.89 (2.18)** | −3.28 (−1.01) | −5.26 (−1.64)* |
| Average family SES | 0.33 (0.42) | −0.24 (−0.29) | 0.29 (0.40) | 0.61 (0.85) |
| Average parental education | −3.86 (−0.34) | 1.69 (0.15) | −1.70 (−0.16) | −6.36 (−0.63) |
| Percent enrolled in night school | −0.16 (−2.10)** | −0.23 (−2.90)*** | 0.17 (2.39)** | 0.21 (2.89)** |
| Average student–teacher ratio | 0.06 (0.35) | 0.36 (1.88) * | −0.04 (−0.25) | −0.22 (−1.27) |
| Average teacher education | −0.73 (−1.51) | −1.25 (−2.51) ** | 0.40 (0.87) | 0.57 (1.30) |
| Average test scores 11/2000 | 0.45 (1.96)** | 0.68 (2.85)*** | −0.35 (−1.59) | −0.45 (−2.14)** |
| Constant | 12.75 (0.83) | −0.33 (−0.02) | 22.93 (1.62) | 32.71 (2.36)** |
| Sample size | 153 | 153 | 153 | 153 |
| Adjusted $R^2$ | 0.41 | 0.45 | 0.41 | 0.50 |

*Source*: Ministry of Education and INEP data collection (various years).
*Notes*: *t*-statistics in parentheses.
*** Statistically significant at 0.01 level; ** at 0.05 level; * at 0.10 level.
[a]Excluded category: Pernambuco.

Table 10
Multivariate analysis: ordered probit estimates of student absences (1999–2001)

| | Year | | |
|---|---|---|---|
| | 1999 | 2000 | 2001 |
| Previous test score | −0.004 (−3.79)*** | −0.002 (−1.89)* | −0.001 (−1.29) |
| Female | −0.10 (4.37)*** | −0.18 (−5.34)*** | −0.10 (−4.02)*** |
| State controls[a] | | | |
| Goiás | −0.48 (−1.89)* | −0.06 (0.25) | 0.44 (1.30) |
| Mato Grosso do Sul | 0.18 (0.90) | 0.45 (2.26)** | 0.79 (2.83)*** |
| Pará | −0.46 (−3.30)*** | −0.20 (−1.19) | −0.47 (−1.58) |
| Rondônia | −0.19 (−0.66) | −0.17 (−0.70) | 0.21 (0.72) |
| Sergipe | 0.28 (1.58) | 0.10 (0.55) | 0.08 (0.36) |
| Time in PDE | −0.01 (−2.00)** | 0.004 (0.88) | −0.003 (−0.56) |
| Average SES | −0.03 (−0.81) | −0.03 (−0.97) | −0.08 (−1.46) |
| Percent college | −0.23 (−0.95) | 0.03 (0.11) | −0.31 (−1.06) |
| Parental education | 0.24 (0.50) | 0.19 (0.34) | 1.07 (1.24) |
| Sample size | 10,385 | 6,686 | 9,830 |
| Pseudo $R^2$ | 0.032 | 0.021 | 0.025 |

*Source*: INEP Data collection (various years).
*Notes*: *t*-statistics in parentheses are calculated using robust standard errors.
*** Statistically significant at 0.01 level; ** at 0.05 level; * at 0.10 level.
[a]Excluded category: Pernambuco.

rather than linear. We also assess the average number of absences reported for math and Portuguese. In 1999 these are identical numbers, but for 2000 and 2001 there are some differences by subject. The statistical models that are fit for student absences are more parsimonious than our previous work with test scores. This is because far fewer parameters are significant predictors of this particular outcome and we choose not to include them in the final model.

Table 10 presents the results from an ordered probit for student absences. Ordered probit coefficients are notoriously difficult coefficients to interpret; as a result we focus on the direction of effect and the statistical significance.[6] We find few significant predictors of absences. Student achievement in the previous year is a negative predictor. Girls are also significantly less likely to be absent. The other controls for states and school characteristics are generally insignificant. The variable of interest measures time in PDE. It is significant (and negative) for 1999 absences only. For the other years there is no significant PDE effect. So this effort to link the PDE with student attendance intensity provides some tenuous evidence that students in PDE schools attend more frequently, but the limitations of the data make this less convincing than the other analyses.

## 4. Conclusions

Decentralization of education decision making is a popular policy for improving school performance, especially in developing countries. However, we know very little about the effects of such policies. This study provides initial evidence.

The surveys of PDE schools taken in Brazil between April, 1999 and November 2001 provide researchers with a wealth of longitudinal data on urban public schools in Brazil catering mainly to low-middle and low-income families. The surveys allow us to evaluate the impact of the PDE program on various school outputs on organizational change in the schools and on various outcomes for students. The longitudinal character of the data makes it possible to assess results on the basis of value added in student achievement, of gains in promotion and desertion rates, and of numbers of student absences. In assessing the impact of the PDE program, we can control for individual student family background, the resources available to schools, and conditions in the six Brazilian states surveyed that may be particular to the states.

Looking at the PDE program, we find, not surprisingly, that schools identify academic achievement, grade failure, and dropout rates as particular priorities for the school to address. Schools are also concerned about low community and parental participation and inadequate teaching methods. In order to improve teaching and learning, teachers and administrators point to the need to organize and integrate their curriculum, to improve teaching, and to continuously evaluate students. The schools in this study also identified the need to improve school management, particularly by creating clear objectives, organizing routines and upgrading the school council.

We were able to compare schools in the program with others to assess whether schools were meeting these objectives. In general, it appears that the PDE resulted in some improvements in management and learning materials, but little change in other areas including evaluation and community relations.

How did these changes affect student outcomes? We find no evidence to show that participation in the PDE improved student achievement. We do estimate a positive relationship for those schools in the program between PDE spending and student gains, especially for spending on teaching and learning materials and furniture. We find no benefit of electronics spending or spending on teacher training, two of the three largest areas of investment.

While we do not find an effect of the PDE program on achievement, achievement is a notoriously difficult outcome to influence. The results for grade passing are stronger. Students in PDE schools saw greater increases in grade passing rates than students in non-PDE schools during the period of our study. Unfortunately it is difficult to assess the

[6] The problem with the ordered probit is that the effect of each variable on each level of the outcome may be different. For example, variable $x$ may predict a higher probability of having 1–3 absences versus 0 absences, whereas it may be a negative predictor of having 4–17 absences versus 1–3. Since the densities of the various outcomes that make up the ordinal range are different, the only two outcomes where the signs of the effects are certain are the first and last outcomes. For outcomes in the middle of the range it is not always true that a negative coefficient predicts a negative likelihood of that particular part of the range. The solution to this is to present the marginal effects of each variable at each level of the ordered outcome. This is a time consuming process that is not justified in this case because of the paucity of significant parameters (especially the PDE variable that is most of interest).

welfare effects of such a change. The schools may simply have made it easier to pass a grade. This increased ease of moving on to the next grade may benefit the students in the long run, or it may hurt them.

We need to note several caveats to these results. The first is that schools in Brazil continued to sign onto the PDE program during the period that the schools and students were being surveyed. We could account for the time the school was in the PDE program, but unfortunately the number of schools in the original sample that were not in the PDE program by November 2001 was very small (15). This made it more difficult to make a meaningful comparison between PDE and non-PDE schools over the whole period. Furthermore, the survey was not very successful in getting teachers to complete the questionnaires. This means that information about teachers in the sampled schools is very incomplete, limiting the use of such data in the production function estimates. If better information were available on teacher characteristics in PDE and non-PDE schools, our results might be somewhat different, and school effects, possibly much larger.

That said, the data we have been able to use are far richer than most data available to analyze the effects of major educational reforms such as decentralization of education decision-making. This study provides evidence that this policy can affect what goes on in schools and, in turn, student outcomes. The welfare implications of these effects are yet to be seen.

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