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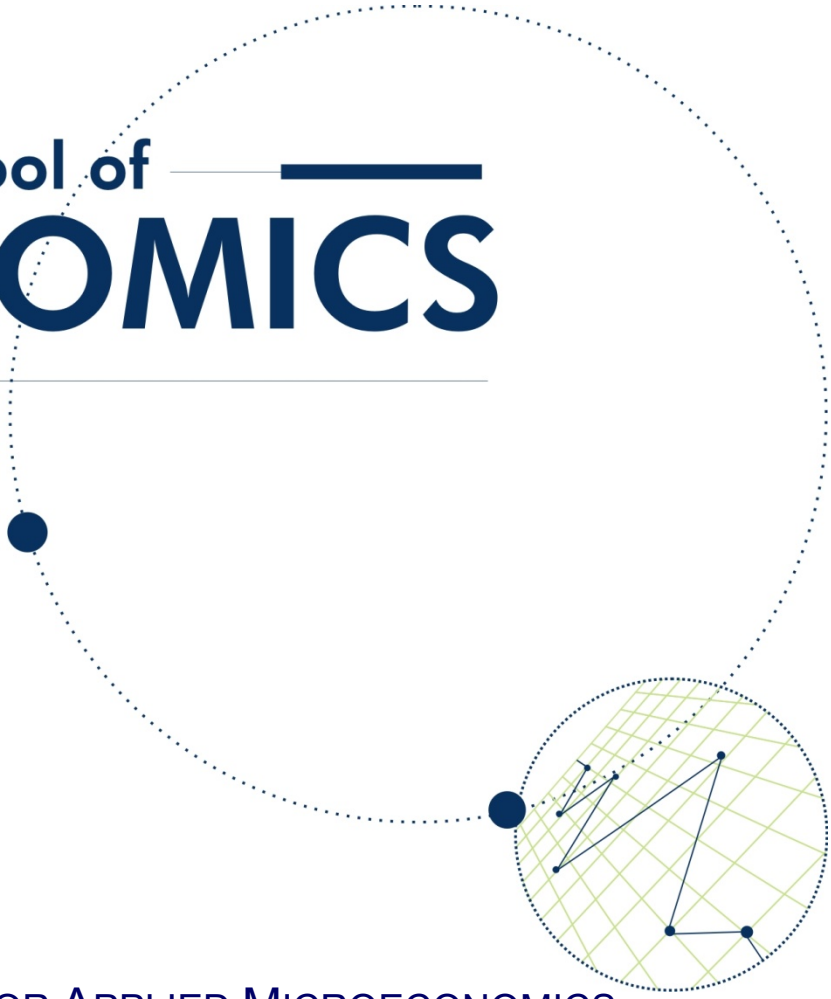

CENTER FOR APPLIED MICROECONOMICS

The Impact of Structured Teaching Methods on the Quality of Education in Brazil

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Abstract

This paper estimates the impact of the use of structured methods on the quality of education for students in primary public school in Brazil. Structured methods encompass a range of pedagogical and managerial instruments applied in the educational system. In recent years, several municipalities in the state of São Paulo have contracted out private educational providers to implement these structured methods in their schooling systems. Their pedagogical proposal involves structuring of curriculum content, development of teacher and student textbooks, and the training and supervision of teachers and instructors. Using a difference-in-differences estimation strategy, we find that the fourth- and eighth-grade students in the municipalities with structured methods performed better in Portuguese and mathematics than did students in municipalities not exposed to these methods. We find no differences in passing rates. However, we are unable to rule out of possibility that unobservable characteristics are driving this results.

JEL Codes: I21, I28.

Keywords: quality of education, structured methods, Brazil.

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I. Introduction

The quality of education in Brazil is low according to several international comparisons. For instance, Brazil ranked 53rd in mathematics proficiency among all 57 participating countries on the 2006 PISA Exam.[1] In an attempt to overcome this disadvantage, several policies have been adopted over the last fifteen years. Among the strategies espoused, the decentralization of educational systems was pervasive. The states transferred control of the primary school systems to the municipalities[2]. In some states, the municipalities now have the freedom to choose the pedagogical material that they teach and part of the curriculum content based on federal regulations. This autonomy includes the possibility of contracting educational services to private organizations. Particularly important for our purposes are some agreements in which private institutions are contracted to develop and provide textbooks for the students, pedagogical materials for the teachers that systematize classes, homework materials and answer keys, etc. The private firms also coach the teachers on the use of these materials. In the state of São Paulo during the last ten years, around one third of the municipalities have hired private institutions that have provided what has become known as *structured teaching methods* for the public system.

The purpose of this paper is to estimate the impact of structured teaching methods on the proficiency of students in the municipal school system in the state of São Paulo. The evaluation of this effect is relevant in itself for policy-making purposes. This is the first attempt to gauge the impact on proficiency of this institutional innovation. Moreover, this study is applicable to a wider field of interest in the economics of education with respect to at least two specific topics: (i) the debate regarding private vs. public school management; and (ii) the discussion of the relevance of inputs in the school production function.

The novelty of this Brazilian experience is the development of a private market for structured teaching methods as demanded by the public sector. Although there is no

[1] See PISA (2006).
[2] For more details about the decentralization of the Educational System in Brazil, see Madeira (2008) and Leme et al (2009).

competition between municipal public schools, there is competition between private institutions to develop and provide structured methods to the municipal public school system. The use of the private system in public schools is not new. The existence of charter schools in the U.S., which became popular with some policymakers because they seem to share the benefits of private competition without sacrificing government control and supervision, may represent such a system. Charter schools include both public and private elements. On one hand, they are allowed independent development and decision-making. On the other hand, they are publicly financed, and the state is accountable for their performance[3]. Like charter schools, the schools in municipalities that use the structured teaching methods in Brazil are publicly funded and supervised but privately managed in terms of pedagogical and curricular decisions. However, they are broader than charter schools in the sense that they cover all public schools under the control of the municipality in question. Thus, there is no competition between "public" and "charter" schools within the municipality. However, in another sense, they are more restrictive because the decision-making power of the private institution is limited to pedagogical and curricular choices, including teacher coaching. Such a firm will not be able to make human resource allocation decisions such as those regarding the hiring and firing of teachers and principals or even the assignment of particular individuals to particular schools. These decisions are under the public authority of the municipality.

Recently, a debate has emerged regarding the impact of charter schools on student performance in the U.S. The results are mixed. Bettinger (2005) finds no difference in the mathematics and reading test score gains among 4th graders at charter and neighboring public schools in Michigan. Booker et al. (2007) find that students experience low test score growth in the first year in charter schools but that this period is followed by a catch-up period in the subsequent two to three years as compared to their expected performance in traditional public schools in Texas. Indeed, Carruthers (2010) shows that student proficiency is greater among more experienced charter schools. Ni (2009) finds that the introduction of charter competition negatively impacted student performance and school efficiency in traditional public schools in Michigan. Zimmer et al. (2011) find no different

[3] For a discussion of the advantages and shortcomings of charter schools see, e.g., Geske et al. (1997).

performance between students of charter and traditional public schools across seven states in the U.S. However, Hoxby and Muraka (2009), taking advantage of the random selection of charter school students in New York City, find a positive effect of charter schools on the mathematics and reading performance of third to eighth graders. Moreover, there is some evidence that charter schools enhance competition among public schools. Brooker et al. (2008) find a positive and significant impact of charter school district penetration on the achievements of traditional public school students in Texas. Dee and Fu (2004) show that pupil-teacher ratios in traditional public schools in Arizona increased after the introduction of charter schools. Hanushek et al. (2007) find that the relationship between the probability of exiting school and school quality is more acute for charter schools than for traditional public schools in Texas.

This paper also has relevance for the literature on the effectiveness of school inputs. The international evidence on the impact of school inputs on student outcomes, and particularly on the provision of pedagogical material, is ambiguous. Early studies, surveyed by Lockheed and Hanushek (1987), show that textbook provision was, on average, the most cost-effective program as compared to teacher training, interactive radio, technical schools, peer tutoring and cooperative learning in some developing countries. The World Bank (2002) reports similar studies; in the Philippines, the provision of multilevel material combined with parent and teacher partnerships had a positive impact, reducing drop-out rates and improving test scores. It also proved to be more cost-effective than the provision of textbooks alone. In Nicaragua, a textbook provision program that included monitoring of their use in the classroom had a positive effect on student scores but was less effective than a radio instructional program. A more recent study in Kenya reported on by Glewwe, Kremer, and Moulin (2007) shows that the provision of textbooks had a positive impact only on the performance of the top students. The impact of in-service teacher training on student performance is also ambiguous. Angrist and Lavy (2002) show that in-service training in Jerusalem improved the test scores of elementary public schools students and was more cost-effective than reducing class size or lengthening the school day. On the other hand, Jacob and Lefgren (2002) find no impact of marginal increases in in-service teacher training on the performance of students in the Chicago public school system. These results taken together seem to indicate that combined policies are more effective than

isolated ones, and this is the central feature of the structured teaching methods analyzed in this study. Curricular organization, the provision of pedagogical material and teacher training are joint components of the structured method programs.

Using a longitudinal dataset of municipalities, our results show (i) that municipalities that have adopted structured methods show higher average proficiency gains in mathematics and Portuguese for 4th and 8th graders than those that did not adopt such methods; and (ii) that the worst-performing municipalities in terms of proficiency exams (for all subjects with the exception of 4^{th}-grade mathematics) are those with the greatest gains from adopting structured methods. However, robustness tests suggest the possibility that unobserved municipal characteristics associated with proficiency changes may still affect the results over time.

This paper is organized as follows. Section two presents the data source. Section three discusses structured teaching methods that several São Paulo State municipalities have adopted in agreements with private teaching systems. Section four describes the dataset and the sample used in the analysis. Section five presents the empirical procedure and discusses the main results, possible spillover effects and a robustness check. Finally, the last section concludes.

II. Data Sources

In this section, we describe the data sources and the data collection process. We need three different sets of information: i) information on which municipalities have adopted structured methods, the years of adoption, the providers of the service and the school levels attended; ii) information on students outcomes such as proficiency and pass rates by municipalities; and iii) demographic and socio-economic characteristics of the municipalities. Because there is no unique source that contains all pieces of information needed, the data collection process involved different procedures.

In order to obtain information on municipalities that adopted structured methods and their extent and range, primary data were collected and constructed from different sources: a survey conducted in 2007 by the São Paulo State Audit Court (TCE) on educational

programs implemented in the municipalities.[4] To cross validate the TCE information, the Union of the São Paulo State Municipal Education Officials affiliates (UNDIME) sent questionnaires to the secretaries of education of the municipalities asking whether the municipality had contracted out the use of structured methods. Additionally to double-check the information from TCE and UNIDIME we further contacted directly all municipality that responded that had contracted out the teaching methods and also a 10% random sample of all municipalities that have responded that had not contracted out such services. Our final database has information on previous and standing agreements between municipality and the teaching system, as well as the period and scope (kindergarten, primary school, high school, and adult education).

In order to obtain information on student proficiency, we used the Prova Brasil exam. Prova Brasil is the nationwide voluntary proficiency test for public school students in the 4th and 8th grades conducted by the Instituto Nacional de Estudos e Pesquisas Educacionais Anísio Teixeira of the Ministry of Education (INEP-MEC) ; we use the average proficiency scores of the municipal schools system from the tests conducted in 2005 and 2007, for Mathematics and Portuguese. Pass rates are from the school educational census also conducted by INEP-MEC every year.

Finally, we also use data from the Brazilian Demographic Census of 2000, conducted by Brazilian Census Bureau – IBGE, to obtain information on the municipalities' demographics and economic characteristics.

III. Private Teaching Systems and Structured Methods

Primary public education in Brazil is divided in two systems: one subordinate to the State educational authority (State schools) and the other to the Municipality educational authority (Municipal schools). In some municipalities, there are both state and municipal

[4] In 2007 TCE-SP asked the secretaries of education of the municipalities about their education programs which include a question whether they contracted educational firms and which were these firms. The website of TCE (www.tce.sp.gov.br) allows the access to each of the 645 questionnaires filled out by the municipalities..

schools. There are also muncipalities with only municipal or state schools. In the late 1990s, due to the strong incentives for decentralization and educational autonomy to the municipalities, agreements between private educational institutions and municipal public school systems started to be settled in some states in Brazil (mainly in São Paulo).

The pedagogical proposition of these private teaching systems involves the design of the curriculum and of the learning activities using learning materials (textbooks, instructor material, test banks, etc.) intended for students and instructors. Teaching systems also offer teachers instruction and pedagogic advice, including access to an education website along with the materials. It is worth noting that differences between agreements may lead to differences not only in the materials and training that the various teaching systems provide but also between different municipalities served by the same system. The amounts charged represent about 10% of the cost per student/year in the public sector.

Teaching systems present an integral set of learning materials with content for every subject and grade, prepared by the private providers. The contents are divided into textbooks covering regular periods (usually two months) and organized by grade and by subject. Therefore, the textbooks include content by subject and provide a class plan such that every two months one textbook will be completed covered. Furthermore, teaching systems also offer instructors support materials. In general, these materials are intended to clarify the class plan implied in student textbooks by offering instructors not only a suggested teaching sequence but also pedagogical strategies for each topic and supplemental activities to be undertaken with the students.

The private teaching systems also offer instructor training and advice services. In general, the providers meet every two or six months with all the teachers of the school public system. At these meetings, instructors from the teaching systems address different methodological strategies that can be used to convey the contents of the learning materials. Some teaching systems include bimonthly visits to classes to monitor instructors and address doubts they may have. Others offer a permanent consultant in each city to support instructors and track the entire teaching process.

They also provide interactive websites with supplemental activities, texts, documents and education-related articles, test-question banks. The instructors can also post questions and threads to discuss any subject related to the teaching activities. Some systems also offer online content for students.

It is important to note that each teaching system may have particular features that may vary across municipalities depending on the contract agreement.

Unlike schools that have adopted the privately supported systems, a regular public school in São Paulo is free to choose its pedagogical methodology in general. The principal and the teachers decide on the syllabus content (under federal regulation standards), the textbooks and supplemental materials, the tests and exams, the sequence of the curriculum content, etc. It is even possible for two different classes in the same grade and school to have different syllabi, textbooks, etc.

The state of São Paulo is divided in 645 municipalities**,** 79 of them having no municipal schools but only state schools. 396 municipalities have only municipal schools and 170 have schools in both systems. According to our dataset of all the 566 municipalities with municipal schools 189 contracted out private structured methods between 1999 and 2008. Over this period, 13 municipalities terminated their agreements but one resumed the agreement after one year. Therefore, in 2008, 177 municipalities (around 30 percent) had some kind of agreement in place, covering approximately 440,000 students, which represent 14 percent of students enrolled in municipal schools and 8 percent of all public school (state and municipal) enrollments.

Most of these municipalities (94%) have agreements for the 1st-4th grades; this is the education level with most students enrolled in municipal schools. Additionally, 75 percent of these municipalities adopt structure methods for kindergarten, and 51 percent do so for the 1^{st}-8^{th} or 5^{th}-8^{th} grades.

By 2008 there were 18 firms operating structured method systems adopted by the municipalities in São Paulo. The provider that covers the most number of municipalities was contracted out by 41.24% of all municipalities with private providers of structured

methods in 2008. The second and third largest providers represent 15.82% and 11.86%, respectively. They cover almost 69% of all municipalities with private providers. The Herfindahl–Hirschman Index of this market of municipalities is 0.22 which indicates a moderately concentrated market.

IV Sample Selection and Descriptive Analysis

Of all municipalities with municipal primary school, 479 participated in the 2005 and 2007 Prova Brasil exams. Since we use a difference-in-difference empirical strategy, we restrict our sample to municipalities that never contracted out structured method until 2005. Those sum up 393 municipalities. This is our selected sample. Of those, 59 contracted out private institutions in 2006 or 2007. These will form the treatment group.

In order to investigate whether the decision to participate in Prova Brasil is correlated with some observable characteristics of the municipalities, we computed the probability of a municipaility participation using a probit regression[5]. As shown in Table 1, the only variable significantly different from zero at 5% is the absence of state schools in the municipality. The average schooling of the population has a significantly positive associated at 10% level.

Table 1

After including the additional control variables municipality's per capita revenue and expenditures in education based on the population of school age, the sample size drops to 360 municipalities. We find that the per capita revenue of the municipality is positively associated with the probability of participating in the exam.

[5] For this analysis, we include all municipalities.. Of those, 458 have information on the analyzed characteristics (% pop 7-14 years old; pop. average schooling; pop per capita income; % of poor pop.;municipalities with only school municipal system, Prova Brasil scores and passing rates).,

We conjecture that richer and more educated populations demand higher quality of education and this is reflected the municipality authority choice in participating in Prova Brasil. Moreover, since the São Paulo State school system did not participate in the 2005 exam, municipalities with both state and local school systems may have chosen to not participate due to economies of scale of the exam logistics.

The characteristics of our selected sample are presented in Table 2. We use data from the 2000 Brazilian Census. It shows that the treatment and comparison municipalities are very similar in terms of average schooling, the percentage of poor in the population, the percentage of the population that is of school age. Moreover, we observe that both groups have similar 4th graders Prova Brasil scores and 1st to 4th grades average passing rates in 2005.[6] The main differences are the size of the population, the education expenditure and the presence of state-schools. The municipalities that adopted structured methods are smaller, expend more in education and are less likely to have both school systems.

Table 2.

To further investigate the differences between treatment and comparison municipalities, we run a probit model controlling for the same pre-treatment variables discussed in Table 2. The results shows that the only the absence of state schools is significantly associated with the likelihood of adopting structured methods.

We speculate that the facts of being smaller and not having a state-school system are associated with lower municipality capacity to manage a public education system since it requires a minimal scale to training teachers, principal and deal with the logistics of organization and material distribution. Therefore, those small municipalities may prefer to delegate these services to private contractors.

It is important to notice that both treatment and comparison groups have similar characteristics previous to the introduction of structured methods, particularly they have comparable pre-treatment educational outcome variable (proficiency and passing rates).

[6] Passing rate is defined as the proportion of students that are enrolled in grade *g* in a given year *t* that are approved to pass to grade *g+1* in *t+1*

Furthermore, we observe that after the introduction, the treated municipality experience greater test scores. For instance, in 2005 the students in the 4th grade in the treated (comparison) municipalities scored 192.86 (195.15) in the Mathematics exam. In 2007 they scored 210.25 and 207.83, respectively.

Table 3

V. Results

V.1 Estimation Procedure.

The impact estimation is based on the following fixed-effect regression using 2005 and 2007 data:

$$y_{it} = \ddagger + \%\!\!\!o d_{it} + \check{S}T_t + \text{`}_i + u_{it} \qquad (1)$$

where y_{it} is one of the variables of interest (municipal weighted average of passing rates, municipal average of Math and Portuguese proficiencies) for municipality i in year t (2005 and 2007), d_{it} is a dummy that assumes a value of 1 if municipality i had a structured method in place in year t, the indicator variable T_t equals 1 if the year is 2007 and zero if it is 2005, λ_i is the municipality fixed effect that captures municipal-specific time-invariant unobserved heterogeneity and u_{it} is the error term. We are interested in the coefficient β. It captures the additional gain of the treatment group relatively to the comparison municipalities (the difference-in-differences estimator).

We implement this procedure for the 4th and 8th graders, separately. For the former, the treatment is composed by 54 municipalities that introduced structured methods in 2006 and 2007 including in the 4th grade; the comparison group is formed by all municipalities with municipal schools with 4th graders without structured methods. They encompass 332 municipalities. For the 8th graders, the treatment is composed by 26 municipalities that that introduced structured methods in 2006 and 2007 including in the 8th grade; the comparison

group is formed by all municipalities with municipal schools with 8th graders without structured methods. This group is composed by 100 municipalities.

V.2. The Average Impact of Structured Methods

Table 4 shows the regression results for the 4th and 8th grades, separately. The outcomes analyzed are weighted average passing rates of students in the 1st-4th grades and 5th-8th grades and the scores on the Prova Brasil exam (Math and Portuguese). The results indicate that the impacts on passing rates are positive but only statistically significant at 10% level for the 5th to 8th grades (3 percentage points)[7]. The results also show a positive impact of 5.3 and 3.4 points on 4th-grade Mathematics and Portuguese Prova Brasil exam scores, respectively. Those figures are statistically significant different from zero at 5% level. For 8th graders, the impact on the Prova Brasil exam mathematics and Portuguese scores are also positive at 8.6 and 5.5 points, respectively.[8]

Those results are sizeable. In 2005, the nationwide student standard deviation for Portuguese and Mathematics scores was approximately 40 points in each case for both 4th and 8th graders. Therefore, the impact of adopting structured method agreements corresponds to about 10 percent of the standard deviation. For example, the impact on 4th grade math scores is 5,3/40 = 0.1325. Comparing to the variance between municipalities, the impact of the structured method for the 4th grader on Math is 5.3/14.13=0.375.

Table 4

Since there are different providers of structured methods, one could argue that there are idiosyncratic characteristics of each provider that could be both correlated with the municipality choice of the provider and the student outcomes. Unfortunately, we do not observe municipalities change the provider between 2005 and 2007, therefore it is not possible to include both municipality and provider fixed-effects. Besides, the effects

[7] The aggregated weighted passing rates were computed using the proportion of student in each grade as weight. In this new version we make it clear in the text. We decided to use the average across grades within each cycle (1st to 4th and 5th to 8th) since the students in these grades were all treated in the municipalities by the structured methods. Nevertheless, we run the regressions for passing rates for the 4th and 8th grades alone. The results were qualitatively the same. The point estimated are 1.13 for the 4th grade and 2.31 for the 8th, both are statically insignificant at 10%.

[8] These results are significant at 5 and 10% level for Math and Portuguese, respectively.

estimated in Table 4 are the average impact across all providers. It is possible that those effects are heterogeneous among the providers and the average impacts maybe driven by some of them. In order to investigate that we run the regressions with interactions between the treatment variable and providers indicator variables, we create six provider indicator variable. Provider 1 is the main provider; provider 2 is the second and so on until provider 5. The last one is all the other minor providers.

The results are presented in Table A1 in the appendix. Indeed, we do observe that the effects are different across providers and provider 1 seems to present the greater impacts. However, it is important to note that the fact that some of other providers have few contracts may enlarge the standard errors of the coefficients associated with those providers affecting the significance of them.

V.3. The Heterogeneous Effect of the Starting Point

This section extends the analysis of the impact of structured methods on student proficiency to determine whether the impact varies for municipalities with different initial levels of proficiency. The question is whether structured methods have a greater impact on municipalities with higher or lower initial Prova Brasil exam scores. To check this, we extend equation (1) to include the interaction of 2005 Prova Brasil scores with the treatment group.

The estimated regression is:

$$y_{it} = \ddagger + \%od_{it} + \varphi d_{it} PB_{i05} + \check{S}T_t + \text{`}_i + u_{it} \qquad (2)$$

where PB_{i05} is the score of municipality i in the 2005 Prova Brasil exam. We interact the score with the indicator variable d_{it}.

Table 5 shows that the interaction is not statistically significant for 4th grade mathematics Prova Brasil scores, but is significant for Portuguese Prova Brasil scores with a negative impact. This means that the impact is greater for less proficient municipalities. Similar results are found for the 8th grade scores. However in this case, the interaction is negative and significant for the Math scores only.

Table 5

The Prova Brasil exam score for which the marginal effect is zero is 194 points (4th Grade Portuguese). 86 percent of municipalities with structured methods score below this threshold. For 8th grade mathematics the score is 254 and covers almost 90 percent of the treated municipalities. We conjecture that the structured method may be more effective especially for those students with weak background formation and or teachers and principal with lower teaching and managerial capacities. Given that, it is not surprising that municipalities with lower pre-treatment scores benefit more from the introduction of the structured methods[9].

V.4. The Effect of Accumulated Exposure to Structured Methods

This section investigates the impact of years of exposure to structured methods on student proficiency. We attempt to determine the existence of cumulative effects of student exposure to structured methods over time. In this exercise, the comparison group becomes the set of all municipalities without methods in 2007 and we build two alternative treatment groups. The first one contains municipalities whose contracts started in 2005. For these, 4th graders had only been exposed to structured methods for one year at the time of the 2005 Prova Brasil exam. The exposure increased to 3 years for the 4th graders in 2007 Prova Brasil exam. We label these groups as 1 vs. 3 years. The second group is made up of municipalities that adopted methods in 2004 and whose 4th graders therefore had two years

[9] We also run a specification including interaction between the structural method indicator variable and quartile dummies of 2005 Prova Brasil scores. We find similar results with the previous exercise: for the 4th grade in Math there is no significantly different impacts for the quartiles; for Portuguese, we find larger impacts for the first quartile. For the 8th grade, we find the reverse, i.e., no heterogeneous impacts for Portuguese and larger impacts for the first quartile in Math.

of exposure by the 2005 Prova Brasil exam and four years of exposure for the 4th graders by the 2007 Prova Brasil exam. These groups are labeled 2 vs. 4 years.[10]

The effect was estimated with the difference-in-differences method. The treatment group's different results in 2007 and 2005 can be traced to two factors: duration of exposure to the method and the time/cohort effect itself. Assuming that the time/cohort effect is the same for the treatment and comparison groups, our estimator identifies the exposure effect. The estimation with the first group (3 years vs. 1 year) identifies the effect of exposure from the 2nd to the 4th grade relative to exposure in the 4th grade only. The estimation done with the second treatment group (4 years vs. 2 years) indicates the effect of 1st-4th grade exposure relative to 3rd-4th grade exposure.

The results can be seen in Table 6. The gain in mathematics scores is 4.6 points for the first group (3 vs. 1) and 5.5 points for the second group (4 vs. 2). The results for Portuguese are 1.61 for group 3 vs. 1 and 2.25 for group 4 vs. 2. These results, however, are not statistically different from zero.

Table 6

Taken together, the evidence indicates that exposure over time generates gains in mathematics scores. Note that this exercise refers only to differences between different exposures to the method between the 1st and 4th grades.

V. 5 Spillover Effects

The adoption of structured methods by the schools in the municipal educational system raises the question of spillover effects. These effects could be on the schools that belong to other educational systems, private or state-managed, due to competition between them. The effects could be also on the other grades in the schools in the municipal system in the case of partial adoption of the structured methods. The share of common resources

[10] For this exercise, the treatment groups are composed by municipalities that had structured method regardless of the grade. We did that for the sake of sample size. For the 3 vs 1 year, there are 29 treated municipalities for the 4 vs 2 years, there are 19 treated municipalities.

such as same principal, teachers and staff may spill over the other grades in the same school.

V.5.1 Impact for the State System

To test whether the adoption of structured methods stimulated some kind of competition in the other educational systems, we compared the results for the schools in the state system. We cannot test for private schools because they do not participate in Prova Brasil. We restricted the analysis to municipalities with both local and state schools and we compare the Prova Brasil scores achieved by schools in the state system in municipalities adopting structured methods in 2006-2007 with the scores in the state system of municipalities without structured methods by that time. Since state schools are not directly exposed to the structured methods, the comparison of their results with those of the municipal systems that are directly exposed to the methods helps interpreting the results. If the adoption of structured methods affects student proficiency in both systems, these results support the hypothesis of spillover effects. No effects on state schools suggest that there are no spillover effects of structured methods. [11]

The results are presented in the panel A of Table 7. It shows that proficiency gains for state schools 4th graders in municipalities that have adopted structured methods do not differ from those of state schools in non-structured method municipalities. More specifically, the estimated changes are negative but not statistically different from zero. This result suggests that there are no spillover effects.

We also compare these results with those for municipal schools in this same sample of municipalities. The results are not statistically significant for mathematics, and they are significant for Portuguese only at 10% level. However, the magnitude of the points estimated are similar to those found in Table 4. These results suggest that are no spillover

[11] This test could also be interpreted as a robustness test for the impact of unobservable characteristics, preferences, social norms, etc. of municipalities that are both associated with proficiency changes and the adoption of structured methods. Assuming that these unobservable characteristics are mainly responsible for proficiency changes in the treatment group, they should also affect changes in the state schools found in the treatment group's municipalities.

effects, although we cannot rule out the possibility that the lack of statistically significant effect may be due to the smaller sample size.

Table 7

V.5.2 Impact for 8th Graders in Municipalities with Structured Methods

In this exercise, we compare the proficiency of 8th graders in municipalities that adopted methods up to the 4th grade with the proficiency of 8th graders in municipalities with no methods. The assumption is that no student in either group is exposed directly to structured methods but former one is indirectly exposed. Therefore, this second test restricts the treatment group to municipalities adopting structured methods in 2006 and 2007 with the exclusion of those with methods for the 5th to 8th grades. The control group is made up of municipalities with no structured methods by 2007. The difference-in-differences is estimated for 8th grade Mathematics and Portuguese Prova Brasil exam scores. A positive and significant result for would support the hypothesis of spillover effects of structured methods inside the municipal system. [12]

The panel B of Table 7 shows that the effects on 8th Grade Prova Brasil exam scores are not statistically different from zero. We also compare these results those for 4th graders for that were directly affected in this same sample of municipalities. The results are not statistically significant different from zero either. However, the estimated scores are similar to those seen in the general estimation. Similarly to the previous exercise, these results suggest that are no spillover effects, although we cannot disregard the possibility that no effect result may be due to the smaller sample size.

V.6. Robustness Tests

V.6.1 Results for Municipalities Adopting Methods in 2008

[12] This test can also be interpreted as a robustness test for unobserved characteristics of municipalities and municipal education systems associated with proficiency changes and the adoption of structured methods

This robustness test attempts to investigate whether a selection bias exists in the adoption of structured methods. To perform this test, we use a control group made up of municipalities that adopted methods from 2008 only (i.e. after the 2007 Prova Brasil exam). The comparison group is made up of municipalities that did not have methods in place by 2008. Note that this exercise tests the identification assumption that the treatment group has the same trend of the comparison group in the absence of treatment.

The results shown in Table 8 indicate that these municipalities showed greater performance gains in 4th Grade mathematics and Portuguese scores than did the control group. Also, this group's score gain was far superior to that shown by the group made up of municipalities that did in fact adopt methods in 2006-2007. Thus, municipalities that decided to enter into agreements with private teaching systems in 2008 were those that showed the greatest proficiency gains in 2005 and 2007. Therefore, we are unable to rule out of possibility that unobservable characteristics are driving this results[13].

Table 8

V.6.2 Results for Enrollment

This exercise tests if there were any composition changes in the distribution of students across school systems: municipal, state and private schools. It is possible that the introduction of structured methods attracts (or repeals) the most (the less) able or more (less) interested students. In this case, the effect found previously may be due to the selection process of the best students. In order to investigate the existence of these composition effects, we test the impact of the introduction of the methods on primary education (1^{st} to 8^{th} grades) enrollment shares of the three different systems (private, municipal and state).

[13] To check if our results are robust to different specifications, we combined propensity matching with the differences-in-differences methods (Matching difference-in-differences – MDID). Using the most restrictive matching (one-to-one), we end up with smaller sample (78 municipalities – 43 treated and 35 control group). Since we do not have complete information for all municipalities, for the matching equation (the same as in Table 3) we end up losing 15 treated municipalities. Nevertheless, the point estimated are very close to the one we find with whole sample. It is important to notice that the reduced samples in the MDID turn the coefficient insignificant. As we increase the sample by matching the treated municipalities with more nearest neighbors, the results become even closer to the original differences-in-differences one and the coefficients become significant, as expected.

The regression estimated follows equation (2) using the enrollment shares as the dependent variables. The results are presented on Table 9. They show that there were no statistically significant effects of the treatment of the distribution of enrollment across school systems.

Table 9

VI. Conclusion

This study attempts to assess the impact of the adoption of structured methods on students' proficiency and passing rates in São Paulo State municipal schools. The evidence suggests that compared to municipalities that did not adopt structured methods, the treated municipalities present higher proficiency in 2007, higher proficiency gains from 2005 to 2007 and no difference in passing rates. Furthermore, we find that the worst-performing municipalities on proficiency exams (with the exception of 4th grade mathematics) are those with the greatest gains from adopting structured methods. However, a robustness test suggests the possibility that unobserved municipal characteristics associated with proficiency changes over time may affect the results.

These results are in line with most of the empirical literature related to charter schools which finds no conclusive evidence of their impact on proficiency. We do not find evidence of positive spillover or competition effects of these methods. Within the same municipalities, 8^{th} grade students indirectly affected only by the adoption of structured methods do not present a significant gain in proficiency compared to those not even indirectly affected. Additionally, state schools in municipalities that adopted the methods did not benefit either.

Our results are also in line with the main conclusions of the school production function literature. Assuming that our results capture a causal effect of the structured method on proficiency, they suggest that combining materials, teacher training and parents and teachers efforts is effective in raising students' proficiency. On the other hand, our results contradict the part of the literature that finds positive impacts of inputs only for top

students. We find that, for the majority of proficiency measures analyzed, the effects are more pervasive in bottom-ranked schools.

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Table 1: Probit Model - Participation in Prova Brasil 2005

Variables	Marginal Effects	Marginal Effects
Population (100000 hab.)	0	-0.011
	0.000	-0.021
% Population 7 to 14 years old	-0.521	0.002
	-0.549	-0.904
Population average schooling	0.0644*	0.072*
	-0.034	-0.045
Population per capita income	-0.001	-0.001
	0.000	0.000
% of Poor in population	-0.019	-0.099
	-0.216	-0.314
Only school municipal system	0.130**	0.02** ($x10^{-3}$)
	-0.042	-0.030
educ. expend. (R$1000) / school age child.		-0.070
		-0.030
Per capita municipal revenue		0.168***
		-0.062
Y predicted	85.63	85.15
Pseudo R^2	0.0315	0.072
N	458	360

Note * p< 10%; **p< 5%; ***p< 1%; Standard errors in parentheses.

Table 2 : Municipality Characteristics

	Without Structured Methods in 2007			Structured Methods in 2006 and 2007		
	Mean	SD	N	Mean	SD	N
Total population (1000 hab)	53.37	115.38	332	28.42	38.31	59
% Population poor	0.21	9.43	331	0.2	8.57	58
Years of schooling	5.37	0.92	331	5.32	0.77	58
Per capita income	278.28	85.73	331	282.25	106.38	58
% Population 7 to 14 years old	0.14	0.03	332	0.14	0.03	59
Per capita revenue	1663.28	690	263	1764.59	821.07	45
School age per capita education expenditure	2203.5	1142.22	266	2656.16	1747.14	43
School municipal system only	0.684	0.466	332	0.814	0.393	59
Prova Brasil 2005 Mathematics 4^{th} grade	195.15	14.13	332	192.86	10.59	59
Prova Brasil 2005 Portuguese 4^{th} grade	185.93	12.44	332	184.65	9.25	59
Prova Brasil 2007 Mathematics 4^{th} grade	207.83	19.14	332	210.25	19.2	59
Prova Brasil 2007 Portuguese 4^{th} grade	186.5	14.3	332	188.57	13.08	59
Average passing rate 2005 1^{st}-4^{th} grades	91.43	5.35	332	90.84	5.61	59
Average passing rate 2007 1^{st}-4^{th} grades	92.76	4.88	332	92.8	4.76	59

Source: population, years of schooling, per capita income: Censo Demográfico 2000-IBGE;
% poor – IPEADATA; revenue and education expenditure: Fundação SEADE; INEP/MEC

Table 3: Probit Model - Structured Method (2006-2007)

	Marginal Effects	**Marginal Effects**
Passing rate 1st to 4th grades	-0.00262	-0.00433
	(0.00317)	(0.00342)
Prova Brasil 2005 mathematics	-0.00416	-0.00456
	(0.00271)	(0.00304)
Prova Brasil 2005 Portuguese	0.001749	0.002273
	(0.00313)	(0.00345)
Population	-0.00054	-0.00028
	(0.00038)	(0.00037)
% Population 7 to 14 years old	-0.55271	0.727242
	(0.65191)	(100.714)
Average years of schooling	-0.02094	-0.03769
	(0.04358)	(0.04814)
Average per capita income	0.000334	0.000426
	(0.00041)	(0.00047)
% Poor population	-0.23701	-0.5033
	(0.28066)	(0.34432)
School municipal system only	0.06095	0.075361*
	(0.0413)	(0.04665)
School age per capita education expenditure		0.00003
		(0.00002)
Per capita revenue		-0.00005
		(0.00004)
Y predicted	13.64	12.08
Pseudo R^2	0.0416	0.0739
N	389	302

* p< 10%; **p< 5%; ***p< 1%.; Standard errors in parentheses.

Table 4: Municipal Fixed-Effect Regression: Restricted Sample

	4th Grade			8th Grade		
	Passing Rate (1st-4th)	**Mathematics**	**Portuguese**	**Passing Rate (5th-8th)**	**Mathematics**	**Portuguese**
Structured method	0,582	5,301**	3,383**	2,893*	8,611**	5,457*
	(0,682)	(2,377)	(1,692)	(1,730)	(3,385)	(3,103)
2007	1,342***	12,679***	0,569	1,561**	3,031**	6,986***
	(0,255)	(0,889)	(0,633)	(0,633)	(1,239)	(1,136)
Constant	91,350***	194,860***	185,781***	86,492***	246,146***	227,945***
	(0,167)	(0,583)	(0,415)	(0,433)	(0,847)	(0,777)
Observations	772	772	772	263	263	263

Note: *** p<0.01. ** p<0.05. * p<0.1
Standard errors in parentheses.

Table 5: Estimation of Interaction Between Structured Method Effect and 2005 Proficiency: Municipal Fixed Effect Regression. Restricted Sample

	4th Grade		8th Grade	
	Mathematics	**Portuguese**	**Mathematics**	**Portuguese**
Structured method	4,131	70,228**	149,904***	56,892
	(40,512)	(31,138)	(56,937)	(55,312)
Structured method x BE 2005	0,006	-0,362**	-0,578**	-0,227
	(0,209)	(0,168)	(0,232)	(0,243)
2007	12,679***	0,569	3,031**	6,986***
	(0,890)	(0,630)	(1,211)	(1,136)
Constant	194,860***	185,781***	247,548***	229,500***
	(0,584)	(0,413)	(0,794)	(0,745)
Observations	772	772	225	225

Note: *** p<0.01. ** p<0.05. * p<0.1
Standard errors in parentheses.

Table 6: Estimation of the Effect of Accumulated Exposure to Structured Methods: Municipal Fixed Effect Regression. 4th Grade

	3 years vs. 1 year		4 years vs. 2 year	
	Mathematics	**Portuguese**	**Mathematics**	**Portuguese**
Structured method	4,595**	1,615	5,515**	2,248
	(1,905)	(1,372)	(2,163)	(1,527)
Constant	12,679***	0,569	12,679***	0,569
	(0,540)	(0,389)	(0,503)	(0,355)
Observations	1.083	1.083	1.053	1.053

Note: *** p<0.01. ** p<0.05. * p<0.1
Standard errors in parentheses.

Table 7: Spillover Effects

	A. Spillover to State Schools			
	State Schools		Municipal Schools	
	Mathematics	**Portuguese**	**Mathematics**	**Portuguese**
Structured Method	2,700	0,467	4,322	3,324*
	(3,512)	(3,277)	(2,635)	(1,879)
2007	6,477***	-5,972***	13,069***	0,598
	(0,988)	(0,922)	(1,642)	(1,171)
Constant	189,644***	184,453***	193,525***	185,701***
	(0,648)	(0,605)	(0,900)	(0,642)
Observations	217	217	327	327
	B. Spillover to 8th Grade			
	8th Grade		4th Grade	
	Mathematics	**Portuguese**	**Mathematics**	**Portuguese**
Structured method	-1,522	2,111	3,998	3,114
	(5,073)	(4,911)	(3,077)	(2,232)
2007	5,032***	8,346***	13,683***	0,972
	(1,058)	(1,024)	(0,831)	(0,603)
Constant	247,82***	228,95***	195,64***	186,71***
	(0,873)	(0,845)	(0,614)	(0,445)
Observations	350	350	987	987

Note: *** p<0.01. ** p<0.05. * p<0.1
Standard errors in parentheses.

Table 8: Robustness Test Using 2008 Adopters as Treatment Group:
Municipalities with Structured Method in 2008 Only

	4th Grade	
	Mathematics	**Portuguese**
Structured method	9,314**	8,503***
	(4,561)	(3,194)
2007	12,314***	0,236
	(0,903)	(0,632)
Constant	195,071***	185,887***
	(0,627)	(0,439)
Observations	667	667

Note: *** p<0.01. ** p<0.05. * p<0.1
Standard errors in parentheses.

Table 9: Effects on Enrollment Share Across School Systems

	Private Schools	**Municipal Schools**	**State Schools**
Structured Method	0,075	-0,060	-0,016
	(0,051)	(0,047)	(0,042)
2007	0,158***	-0,069***	-0,089***
	(0,019)	(0,018)	(0,016)
Constant	0,059***	0,518***	0,423***
	(0,012)	(0,012)	(0,010)
Observations	772	772	772

Note: *** p<0.01. ** p<0.05. * p<0.1
Standard errors in parentheses.

APPENDIX

Table A1: Muncipal Fixed-Effect Regression: Heterogeneous Effects by Main Providers

		4th Grade			8th Grade		
		Pass Rate (1st-4th)	Mathematics	Portuguese	Pass Rate (5th-8th)	Mathematics	Portuguese
Interactions of Structured Method with							
	Provider 1	0,783	6,416*	5,752**	7,439**	20,814***	13,034**
		(1,071)	(3,728)	(2,657)	(3,174)	(6,086)	(5,718)
	Provider 2	1,103	1,292	-0,673	-2,336	3,714	0,139
		(1,571)	(5,470)	(3,898)	(3,174)	(6,086)	(5,718)
	Provider 3	1,301	0,548	0,018	5,089	-3,311	3,854
		(1,777)	(6,184)	(4,407)	(4,443)	(8,521)	(8,006)
	Provider 4	0,433	7,246	1,406	0,739	19,619	12,084
		(2,340)	(8,144)	(5,804)	(6,252)	(11,989)	(11,265)
	Provider 5	5,608*	28,511**	13,686*	4,239	-3,721	-3,551
		(3,299)	(11,483)	(8,184)	(4,443)	(8,521)	(8,006)
	Others	-1,350	4,703	3,379	1,789	12,754	8,234
		(1,367)	(4,758)	(3,391)	(4,443)	(8,521)	(8,006)
2007		1,342***	12,679***	0,569	1,561**	3,031**	6,986***
		(0,255)	(0,889)	(0,633)	(0,632)	(1,211)	(1,138)
Constant		91,350***	194,860***	185,781***	86,416***	246,009***	227,851***
		(0,167)	(0,583)	(0,415)	(0,434)	(0,832)	(0,781)
Observations		772	772	772	263	263	263

Note: *** p<0.01. ** p<0.05. * p<0.1
Standard errors in parentheses.

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