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GERALDO ANDRADE DA SILVA FILHO

HIGHER SALARIES, MORE TEACHING, BETTER PERFORMANCE?

The effects of the introduction of the minimum salary for teachers in Brazil

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Tese apresentada ao Programa de Pós-Graduação da Escola de Economia de São Paulo da Fundação Getulio Vargas, como requisito à obtenção do título de Doutor em Economia de Empresas.

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À memória de minha irmã, Juliana

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ABSTRACT

The empirical literature has produced strong evidence that, after controlling for pupils' socioeconomic characteristics, teacher quality is the most important school factor in explaining pupil's performance in standardized tests. However, there is no consensus on how public school systems could improve teacher quality. Do higher salaries impact teacher quality? Brazilian federal government introduced in 2009 a national minimum base salary for public school teachers that triggered a noticeable exogenous increase in municipal teachers' salaries. The main objective of this dissertation is to assess the short-run impacts of a linear unconditional teacher salary hike on education quality. Due to the lack of secondary data for base teacher salary from 2008 to 2013, we had to carry out a survey with municipal department of education to gather information about teacher career structure and base salaries for that period. Based on our survey information, the first chapter investigates the compliance of municipal school systems with the national minimum salary for teacher law. We find that unobserved factors are determinant in explaining salary variability among municipalities and the compliance with the law, which supports our identification strategy based on difference-in-differences methods combined with propensity score matching. The second chapter focuses on the estimation of the impact of teachers' salaries hike on students' proficiency. According to these results, unconditional salary increase does not trigger better pupils' performance, at least in the short-run. Although impacts on pupils' learning have not been detected, some transmission mechanisms from salary increase to better education outcomes may have been activated. Thus, the main objective of the third chapter is to assess the impact of salary hikes on teachers' quality. We assess the impact of salary hikes on a proxy for teachers' quality, namely, their scores on *ENADE*, and on teaching career attractiveness, that could induce improvements in teacher quality in the long-run. Career attractiveness is measured by the quality of entrants into teaching profession related college courses, according to their *Enem* scores. In this last chapter, we apply a Triple-Differences model aiming at controlling for two kinds of potentially confounding trends: (i) changes in the performance of teachers (potential future teachers) across municipalities unrelated to the policy; and (ii) changes in performance of all teachers (students) living in municipalities affected by the new policy. Triple-differences estimates reveal mild effects of teachers' salary hikes on municipal teachers' quality and on the attractiveness of College courses related to teaching career.

Keywords:

Impact evaluation; minimum salary for teachers; proficiency; teachers' quality; attractiveness of teaching profession.

RESUMO

De acordo com a literatura empírica, há fortes evidências de que, após o controle de características socioeconômicas dos alunos, a qualidade dos professores é o fator mais importante para explicar o desempenho do aluno em testes padronizados. No entanto, não há consenso sobre como sistemas públicos de ensino podem melhorar a qualidade dos professores. Será que o pagamento de salários mais elevados a professores da rede pública impactam a qualidade dos professores nas escolas públicas? O Governo Federal brasileiro introduziu, em 2009, piso salarial nacional para os professores de escolas públicas, provocando um perceptível aumento exógeno dos salários dos professores municipais. O principal objetivo desta tese é avaliar os impactos de curto prazo da elevação linear e incondicional do salário do professor na qualidade da educação. Devido à ausência de dados secundários sobre o valor do salário-base de professores entre 2008 e 2013, tivemos que realizar um levantamento com as Secretarias Municipais de Educação para reunir informação sobre a estrutura da carreira docente e sobre os salários-bases nesse período. Com base em nossa pesquisa de campo, o primeiro capítulo investiga a conformidade dos sistemas municipais de ensino ao piso salarial nacional para professores de redes públicas. Encontramos que fatores não observáveis/observados são determinantes para explicar a variabilidade salarial verificada entre os municípios e o cumprimento da lei, o que embasa nossa estratégia de identificação com base em métodos de diferença em diferenças, combinados com pareamento com base em escore de propensão. O segundo capítulo centra-se na estimativa do impacto da elevação dos salários dos professores sobre a proficiência dos alunos de 5º ano do ensino fundamental municipal. De acordo com estes resultados, o aumento salarial incondicional não gerou uma expansão da proficiência escolar dos alunos, pelo menos no curto prazo. Embora não tenham sido detectados impactos na aprendizagem dos alunos, alguns mecanismos de transmissão do aumento salarial para melhores resultados educacionais podem já ter sido ativados. Assim, o principal objetivo do terceiro capítulo é avaliar o impacto dos aumentos de salário sobre a qualidade dos professores atuais e dos potenciais futuros professores. Avaliamos o impacto de aumentos de salário sobre o desempenho dos professores no ENADE, uma *proxy* de sua qualidade, e sobre a atratividade dos cursos de ensino superior associados à carreira docente. Essa atratividade é medida por meio da qualidade dos que entram nos respectivos cursos superiores, de acordo com seu desempenho no Enem. Neste último capítulo, aplicamos modelo de Tripla-Diferenças visando controlar dois tipos de potenciais fatores de confusão: (i) mudanças no desempenho dos professores (potenciais futuros professores) entre grupos de municípios, que foram submetidos ao tratamento e os que não foram tratados, que nada têm a ver com a política; e (ii) as alterações no desempenho de todos os professores (alunos) que vivem no município em que houve a elevação salarial devido à introdução da lei. As estimativas obtidas indicam que a elevação salarial gerou efeitos leves sobre a qualidade dos professores e sobre a atratividade dos cursos relacionados à carreira docente.

Palavras-chave:
Avaliação de impacto; piso salarial do professor; proficiência escolar; qualidade de professores; atratividade da carreira docente.

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LIST OF ACRONYMS AND ABBREVIATIONS

AC – State of Acre.

AL – State of Alagoas.

AM – State of Amazonas.

AP – State of Amapá.

ATT – Average Treatment Effect on the Treated.

BA – State of Bahia.

CE – State of Ceará.

CGU - *Controladoria-Geral da União*.

CPF – *Cadastro de Pessoas Físicas*.

DDD – Triple-Differences.

DID - Difference-in-Differences.

ENADE - *Exame Nacional de Desempenho dos Estudantes* (National Survey of Students' Performance)

Enem - *Exame Nacional do Ensino Médio*.

ES – State of Espírito Santo.

FAPESP - *Fundação de Amparo à Pesquisa do Estado de São Paulo*.

FNDE - *Fundo Nacional de Desenvolvimento da Educação*.

FUNDEB - *Fundo de Manutenção e Desenvolvimento da Educação Básica e de Valorização dos Profissionais da Educação* (Fund for Maintenance and Development of Basic Education and School Personnel Valuation).

FUNDEF - *Fundo de Manutenção e Desenvolvimento do Ensino Fundamental e de Valorização do Magistério* (Fund for Maintenance and Development of Fundamental Education and Teaching).

GDP – Gross Domestic Product.

GO – State of Goiás.

IBGE – *Instituto Brasileiro de Geografia e Estatística*.

INEP - *Instituto Nacional de Estudos e Pesquisas Educacionais Anísio Teixeira*.

IPTU – Imposto Territorial sobre Propriedade Urbana (tax on urban land ownership).

IPTW - Inverse Probability of being Treated Weighting.

IQ – Intelligence Quotient.

ITT - Intention to the Treatment.

IV – Instrumental Variable.

LDB - *Lei de Diretrizes e Bases da Educação*.

MA - State of Maranhão.

MG – State of Minas Gerais.

MS – State of Mato Grosso do Sul.

MT – State of Mato Grosso.

OECD - The Organisation for Economic Co-operation and Development.

OLS – Ordinary Least Squares.

PA – State of Pará.

PATT - Population Average Treatment Effect on the Treated.

PB – State of Paraíba.

PE – State of Pernambuco.

PI – State of Piauí.

PISA - Programme for International Students Assessment.

PNAD – *Pesquisa Nacional por Amostra de Domicílio*.

PPP - Purchase Power Parity.

PR – State of Paraná.

PROUNI - Program University for All.

PS – Propensity Score.

RAIS - *Relação Anual de Informações Sociais*.

RGPS – *Regime Geral de Previdência Social*.

RJ – State of Rio de Janeiro.

RN – State of Rio Grande do Norte.

RO – State of Rondônia.

RPPS – *Regime Próprio de Previdência Social*.

RR – State of Roraima.

RS – State of Rio Grande do Sul.

SAEB - *Sistema de Avaliação da Educação Básica* (Assessment System of the Basic Education).

SAT - Scholastic Assessment Test.

SC – State of Santa Catarina.

SE – State of Sergipe.

SiSU - *Sistema de Seleção Unificada* (Unified Selection System).

SP – State of São Paulo.

TO – State of Tocantins.

TSE – *Tribunal Superior Eleitoral* (Brazilian Electoral Superior Court).

UNDIME - *União Nacional dos Dirigentes Municipais de Educação* (National Union of Municipal Secretaries of Education).

UNESCO – United Nations Educational, Scientifical and Cultural Organization.

US/USA – United States of America.

2SLS – Two Stages Least Squares.

CONTENTS

GENERAL INTRODUCTION

In Brazil, after a significant increase of educational coverage indicators in the last two decades, the current challenge is to expand the quality of primary and secondary education. International standardized proficiency tests indicate that Brazilian students perform poorly compared to students of The Organisation for Economic Co-operation and Development (OECD) countries. In PISA 2012[1], for instance, with 65 participating countries and regions[2], Brazilian students placed in 58th position in Math, 56th in Reading and 59th in Science.

Poor quality education has very serious consequences. There is strong evidence that what individuals actually learned at school, not their years of schooling, explains differences in economic growth rates between countries[3]. The literature points to several factors that explain, in greater or lesser degree, learning and proficiency differences among students. After controlling for pupils' socioeconomic background, the most important school factor in explaining pupils' performance in standardized tests is teacher quality. Studies also show that improving teacher quality could significantly enhance the performance of low-scoring students[4].

Thus, an important policy issue is how countries can increase the quality of teachers. Several studies concluded that teacher quality is not explained by observable characteristics in terms of experience and schooling, but mainly by unobservable characteristics[5], making it even harder to promote teacher quality, particularly in public schools.

One way that teacher quality might be improved is by enhancing pay structure within the teaching profession. But existing studies do not provide a clear picture of the relationship between teacher salaries and teacher quality. Do higher salaries impact teacher quality? This is the main issue of this dissertation.

In Brazil, teacher salaries are lower than in alternative occupations, and there is evidence that poor performing students were attracted to teaching profession

[1] The Programme for International Students Assessment (PISA) is a triennial international standardized test which aims to evaluate education systems worldwide by testing the skills and knowledge of 15-year-old students. Since 2000, every three years, students from randomly selected schools worldwide take tests in three subjects: reading, mathematics and science.

[2] Around 510,000 students in 65 economies took part in the PISA 2012 assessment. China participates with 3 cities/regions and United Arabic Emirates with just one emirate, Dubai. Brazilian students scored on average 412 points in Reading (staying ahead of 12 countries/regions), against an average of 492 among OECD countries; 386 in Math (better than only three countries/regions), against 499 of OECD countries; and 405 in Sciences.

[3] Hanushek and Kimko (2000); Hanushek and Woessmann (2008, 2012).

[4] Chetty et al (2013).

[5] Hanushek (1986), Hanushek and Rivkin (2006, 2010).

(INEP, 2009 and 2010). But after the introduction of the minimum salary for teachers, there has been a noticeable increase in the real salary of municipal teachers and even their relative salaries were raised considerably, mainly in municipalities impinged by the law and even more in municipalities which complied with the law.

In the last decades Brazilian government introduced some initiatives aiming to raise the expenditures on basic education, and particularly on teachers' compensation[6], and also to redistribute resources around the territory according to the number of enrollees. Among those initiatives, stands out the establishment of the Fund for Maintenance and Development of Fundamental Education and Teaching (*FUNDEF*), which ran from 1997 to 2006, and was replaced by the Fund for Maintenance and Development of Basic Education and School Personnel Valuation (*FUNDEB*), which will last until 2020. These funds were established in order to reserve at least 60% of its amount of resources to the remuneration of teaching professionals.

Although there are legal requirements regarding the participation of expenses on compensation of teaching professionals in total *FUNDEB* resources, teacher salaries in the public school systems are set locally. The institution of the national minimum salary for teachers by Law 11,738, of July 16, 2008, reinforced the allocation of funds for the payment of teachers' salaries by establishing minimum compensation to basic education teachers from all Brazilian public school systems. After the law, teachers' salaries had increased considerably. We take advantage of this exogenous variation in teacher remuneration to assess its impacts on education quality and on the attractiveness of the teaching profession.

Can changes in teacher pay prompt teacher quality and consequently the quality of the education provided by the public sector or is salary increment effectless? Furthermore, can that observed increase in remuneration encourage more able individuals to enter the teaching profession?

This dissertation aims to contribute to the assessment of the policy of teachers' remuneration and its impact on Brazilian public education. Moreover, we intend to bring more empirical evidence about different schemes of teacher

[6] Teachers of Brazilian public schools earn on average less than what their richer countries counterparts receive. According to OECD (2012), the average annual remuneration of teachers of High Schools from OECD countries was US$ 41,182 in 2010, meanwhile, in Brazil, according to *PNAD* (2011) the average annual remuneration reached less than US$ 22,000, both values considering the Purchase Power Parity (PPP). Furthermore, the remuneration in Brazil was smaller than the observed in Chile (US$ 24,820).

remuneration, a crucial issue in the field of Public Economics, and particularly of Economics of Education.

The first chapter brings the investigation of the effect of the introduction of the minimum base salary on municipal teachers' base salary and on their total remuneration. It shows the rate of compliance of municipal school system with the law and presents an analysis of the factors that explain the probability of compliance. Moreover, chapter one presents also the investigation of what explains salary variability before the law enactment, in 2008, and after, in 2013, and assesses the impact of teacher salary hikes on teachers move from and into municipal school systems.

The second chapter assesses the impact of teacher salary hikes on 5th graders pupils' proficiency, a proxy for quality of education offered by municipal school systems.

In the third and last chapter, we investigate two kinds of transmission channels through which higher salaries could lead to better pupils' performance. Namely, the enhancement of teachers' effort through reduction of the number of teachers who combine teaching with other paid jobs and the increase of the frequency of teachers who correct pupils' homework; and the recruitment and/or retention of most skilled teachers, using teachers' scores in *ENADE*[7] as a proxy for skill. Furthermore, we evaluate the effect of salary increase on teacher career attractiveness through the scores in *ENEM* of the candidates aiming to enter into Pedagogy and Teaching Courses. This last investigation is justified by the potential future enhancement of teacher quality due to the increase on the attractiveness of teaching career higher salaries could imply.

[7] The acronym *ENADE* stands for *Exame Nacional de Desempenho dos Estudantes* in Portuguese (National Survey of Students Performance). Courses are split in three different groups which have their students' performance assessed every three years.

CHAPTER 1 - THE EFFECTS OF THE INTRODUCTION OF THE MINIMUM SALARY FOR TEACHERS ON SALARIES AND ON TEACHERS' MOVE

Abstract

The empirical literature has produced strong evidence that, after controlling for pupils' socioeconomic characteristics, teacher quality is the most important school factor in explaining pupil's performance in standardized tests. However, there is no consensus on how public school systems could improve teacher quality. Brazilian federal government introduced in 2009 a national minimum salary for public school teachers that triggered an exogenous increase in municipal teacher's salaries. The objectives of this chapter are twofold. The first objective is to investigate the compliance of municipal school system with the national minimum teacher salary law. We find that unobserved factors are determinant in explaining salary variability among municipalities and the compliance with the law. The second objective is to assess the impact of salary on retention and recruitment of teachers by municipal school systems, exploiting the exogenous variation of municipal teacher salary and teacher longitudinal data. Using difference-in-difference methods with selection on observables, we conclude that exogenous salary raise did not move teachers in the first years of the national teacher minimum salary policy.

1.1 Introduction

Teachers pay is the largest single budget item of any school system. In Brazilian municipalities, for instance, almost half of the education budget is spent with teachers' payroll or is supposed to be, considering Constitutional imposition[8]. Studies show that improving teacher quality could significantly raise the performance of low-

[8] Brazilian Constitution imposes that at least 25% of municipal revenues should be spent on education. About 20% of the revenues compose *FUNDEB* and 60% of those resources should be spent on teachers' pay. Therefore, at least roughly 48% of the budget should be spent on teachers' pay. However, according to *Controladoria-Geral da União* (*CGU*), the Brazilian Federal Internal Control Agency, of 124 audits done in randomly selected sub-national governments (120 municipalities and 4 states), only 83 sub-national governments observe the restriction of using at least 60% of the resources of *FUNDEB* in teachers' pay, about 2/3 of those scrutinized school systems, though. It is interesting to note that, according to our survey, a similar proportion of Brazilian municipal school systems comply with the national minimum salary.

scoring students[9] and, after controlling for pupils' socioeconomic background, the most important school factor to explain pupils' performance in standardized tests is teacher quality[10]. Thus, an important policy issue is how countries can increase the quality of teachers.

Studies also concluded that teacher quality is not explained by observable characteristics in terms of experience and schooling, but mainly by unobservable characteristics[11], making it even harder to promote teacher quality, particularly in public schools since public school systems salary schedules are generally based on observables. A vast literature shows that higher relative teachers' salaries increase the likelihood that an individual enters into teaching profession and reduce the likelihood that a teacher leaves the profession[12]. Imazeki (2005) found that teacher transfers between school systems respond most strongly when district salaries are increased relative to its nearby districts[13].

Teachers differ fundamentally from other school resources. Teachers have preferences about whether to teach, what to teach, and where to teach. Salaries are an important job attribute that likely affects teachers' decision. Hanushek et al (1999), exploring district salary differences in Texas, find small effect on teachers move, some effect on performance in certification, but no effect on student learning. But a large literature suggests that teachers respond to beginning salaries/wages[14]. Intuitively, offering higher salaries and/or better work conditions is a necessary condition for attracting high quality teachers. However, this condition is not sufficient since less motivated workers are induced to apply for the vacancy by higher salaries too. Dal Bó et al (2013), using a randomized experiment in Mexico, find that higher wages attract more able applicants as measured by their IQ, personality, and public service motivation. Thus, their results are against the hypothesis of adverse selection. Besides, they find that distance and worse municipal characteristics

[9] Chetty et al (2013).

[10] Hanushek et al (2005), Rockoff (2004) and Rivkin et al (2005). In the Brazilian context, Moriconi (2012), using value added data for the municipality of São Paulo, concludes that the variation of teacher effectiveness explains about 9% of all the students test scores variability, in a lesser degree than the variability in socioeconomic characteristics (15%), but in a higher degree than the variability in school characteristics (5%).

[11] Hanushek (1986), Hanushek and Rivkin (2006, 2010).

[12] Chevalier et al (2007), Zabalza et al. (1979), Dolton (1990), Dolton and van der Klaauw (1995 e 1999), and Dolton and Mavromaras (1994) for the United Kindom; and Stinebrickner (1998), Brewer (1996), Rees (1991), Mont and Rees (1996), Murnane and Olsen (1989 e 1990), Theobald (1990), and Theobald and Gritz (1996) for the United States.

[13] Unfortunately our data, based on a representative survey, does not allow us to test this hypothesis.

[14] See Boyd et al (2010) for references.

strongly decrease acceptance rates, but higher wages help bridge the recruitment gap in municipalities characterized by worse work conditions.

Results from a large empirical literature indicate that salaries paid to teachers are negatively related to their propensities to exit teaching profession and positively related to durations in first teaching positions[15]. More related to our approach, Falch (2011) examines the effect of salaries on teacher leaving decisions using a natural experiment. In Norway, teachers in schools with a lot of prior teacher vacancies received a salary premium of about 10% during 1993-94 to 2002-03. Using a school fixed effects model, he finds that the salary premium reduces the probability of voluntary quits by 6 p.p..

Besides salary, better work conditions, as revealed by research, reveal also to play a role in attracting high quality teachers. According to the literature, while school characteristics seem more salient than neighborhood characteristics, neighborhoods do affect teachers' choices. Boyd et al (2010) sum up previous literature findings in the context of USA and state that schools with large populations of poor, non-white and low-achieving students, on average, have more difficulty in attracting and retaining teachers. They conclude that the income of neighborhood residents and the amenities available near the school affect teachers' decisions of where to teach, particularly in urban areas with high population-density.

In the literature, there is also evidence that teachers who produce higher student achievement gains are at least as likely, and sometimes more likely, to stay in schools than their less effective peers (Boyd et al, 2010; Hanushek and Rivkin, 2010b). Boyd et al (2010) discovered that teachers who produced higher achievement gains and those with more experience were less likely to apply for transfer of schools in New York City district. Similarly, Hanushek and Rivkin (2010b) found that, in Texas, those who left a given school tended to be less effective than those who stayed.

Furthermore, it seems that teacher turnover harms student achievement. Ronfeldt et al (2011), using a unique identification strategy that employs grade-level turnover and two classes of fixed-effects models, estimate the effects of teacher turnover on New York City 4th and 5th grade student observations over 5 years. Their results indicate that students in grade-levels with higher turnover underperform and that this effect is stronger in schools with more low-performing and black

[15] See Dolton and van der Klaauw (1999) and Behrman et al (forthcoming) for a brief survey on this literature.

students. Moreover, they conclude that the negative effect of turnover runs beyond changing the composition in teacher quality.

In the other hand, there is a vast literature which investigates the effects of the minimum wage on labor market and particularly on labor supply, and is beyond this dissertation objectives review it. But, as far as we know, there is not any study that analyzes and assesses the impact of salary variation on teacher retention, recruitment or exits in the Brazilian context. A pre-requisite to properly address this question is a source of exogenous variation in salaries. We exploit the introduction of minimum salary for Brazilian public school teachers as an exogenous shock driving up teachers' salaries in some municipalities.

In Brazil, teacher salaries are lower than in alternative occupations, and there is evidence that poor performing students are attracted to the teaching profession (INEP, 2009 and 2010). But after the introduction of the teacher minimum salary in 2008, there has been a noticeable increase in the real salary of municipal teachers. We show evidence of an exogenous increase of teacher salaries due to the introduction of a mandatory minimum salary for teachers since 2009 by the federal government, and estimate the impact of salary hikes on retention and attraction of teachers by municipal school systems. Municipalities whose teachers' salaries were below the national minimum when the law was enacted experienced larger teachers' salary increases than the others during the period between 2008 and 2013.

Thus, the objectives of this chapter are twofold. First, we aim to investigate the compliance of municipal school systems with the national minimum teacher salary law. It is necessary to characterize compliers and non-compliers and investigate the role of selection on observables in explaining compliance with the law. After understanding compliance and characterizing treatment, as the second objective of this chapter, we estimate the impact of an exogenous salary raise on attraction and retention of teachers in Brazilian municipal school systems using teacher panel constructed with Brazilian School Census. In order to verify whether municipalities are complying with the law and the magnitude of salary variation due to the introduction of minimum salary regulation, we had to carry out a survey with municipal department of education and get information about teacher career structure and base salaries throughout the period since 2008.

The rest of the chapter is organized as follows. Section 1.2 presents some relevant institutional features of Brazilian municipal school systems. Section 1.3

discusses the data used, not only in this chapter, but also throughout this dissertation, and presents our survey methodology. Section 1.4 brings the investigation about compliance with the law. The identification strategy, not only for investigating teachers move, but that is common to all chapters of this dissertation is described in Section 1.5. Then, the results of the investigation whether salary hikes move teachers is presented in Section 1.6 and, finally, Section 1.7 concludes.

1.2 Institutional Background

Brazil is a federation with three government levels: federal, 27 state governments (one of which is a Federal District) and 5,564 municipalities. Brazil's Constitution states the responsibilities of each government level in guaranteeing public and free education for all their citizens. Specifically, municipalities must provide day-care, pre-school and primary education for their inhabitants.

Broadly, the Brazilian public system of basic education is characterized by a decentralized nature and by a federal funding scheme. Each of those government actors has its own public educational system and is responsible for its maintenance and for the administration of its funds and financial resources. In 2012 there were 50.5 Million Brazilians at school. According to *INEP* (2012), Brazilian municipal school systems were responsible for 45.9% of the enrolments in primary and secondary education and state school systems for 37.5%, showing the predominant role of public sector in providing basic education in Brazil. Mainly, municipalities offer day-care (63.1% of the enrollments), pre-school (74.2% of the enrollments), and from the 1st grade to the 5th grade of elementary school (68.2% of the enrollments). On the other hand, municipalities provide lower secondary education to just 39.5% of the students and their role is even smaller considering high school provision, with only 0.9% of the enrollments. Thus the focus of this study is on municipal school system and consequently on the primary school, corresponding to the 5 first years of schooling, a stage predominantly provided by municipalities.

A federal funding scheme guarantees a minimum amount of resource per pupil in each municipal and state school system. The Constitution reserves 25% of state and municipal taxes and 18% of federal taxes for education. Most part of these

resources makes up a fund, *FUNDEB*[16], in each state of the federation. Its resources distribution across public school systems is based on the quantity of pupils in each system[17]. According to the Constitution, at least 60% of the *FUNDEB* resources have to be spent with salaries of teachers and other professionals directly involved in teaching activities. Furthermore, each municipality is supposed to have a Municipal Council for Social Monitoring and Control of *FUNDEB*, a board composed of members of the government and the civil society[18] which has as its main duty to monitor and to control the distribution, transfer and use of resources from *FUNDEB* in the local context.

Brazilian municipal school systems employ 1.07 million teachers, 471,266 teach in primary school (62.4% of the total primary teachers) and 355,669 teach in lower secondary school (41.2% of the total secondary teachers). Considering that the total amount of all *FUNDEB* funds transferred to municipalities in 2012 summed R$ 64.88 billion, it is presumed that approximately R$ 38.93 billion were paid to municipal school teachers and other school staff directly involved in teaching activities in 2012.

The decentralized nature of the Brazilian public basic education system gives great organizational autonomy to sub-national governments in managing their educational systems. The maintenance of the system, including the definition of teacher career and payment structures and school curriculum content are decentralized. Therefore municipal teachers' salaries are decided by local governments. Until January 2009, the municipalities had established the salary of teachers independently of the Federal Government. After passing the Law No.11,738, of July 16th, 2008[19], the Federal Government began to set the minimum amount to be paid as base salary to the teachers of all public school systems.

[16] Portuguese acronym for Fund for Maintenance and Development of Basic Education and School Personnel Valuation (*Fundo de Manutenção e Desenvolvimento da Educação Básica e de Valorização dos Profissionais da Educação*). Roughly 20% of municipal and state taxes are allocated to *FUNDEB*. Apart from *FUNDEB*, according to the Brazilian Constitution, municipalities also have to spend in education 25% of their own collected taxes in education, so around 5% of the bunch of taxes has to be spent on education independently of *FUNDEB*.

[17] Federal government supplements state *FUNDEB* when is necessary to guarantee the minimum national value of resources per pupil. Consequently the discrepancy of the amount of resources per pupil between states is reduced after federal supplements. Since 2010, the total amount transferred by federal government to the 27 *FUNDEB* (one fund for each state and the Federal District) corresponds to 10% of the total resources put in all *FUNDEB*.

[18] Two representatives of the Executive Power of the Municipality; one representative of the teachers of the public school system; one representative of school principals; one representative of the administrative staff of the elementary and/or high schools; two representatives of parents of students; and two representatives of students, at least one of them indicated by the high school students association.

[19] The Constitutional Amendment No. 53, enacted in 2006, imposed that the National Plan for Education should establish a term for the definition of a minimum salary for teachers.

However, as will be discussed in the next sections, only part of the municipalities complies with the minimum base salary.

According to the law, the minimum teacher salary is adjusted yearly at the estimated rate of increase of all *FUNDEB* resources. From its institution to 2013, the national minimum salary for teachers was adjusted by 64.9% in nominal terms (R$ 950 to R$ 1,567 or US$ 519.13 to US$ 720.76)[20], a growth rate a bit larger than observed in the general minimum salary in the same period (63.4%). In real terms, considering the official inflation rate, the minimum salary for teachers grew 25.4% from 2008 to 2013, or 4.5% per year.

In October 2008, soon after the minimum salary law was enacted, the governors of five states, Mato Grosso do Sul, Paraná, Santa Catarina, Rio Grande do Sul, and Ceará, questioned the constitutionality of the law[21]. Just on April 6th, 2011, the Brazilian Supreme Court decided for the constitutionality of the law. There is a possibility that some municipalities and states waited for the Supreme Court decision and did not comply with the minimum salary until then.[22]

Until recently public school systems did not require a college degree as part of the qualifications to become a primary teacher, they used to demand from the candidates just a vocational diploma in teaching. Only since 2008 Brazilian public school systems are requiring a college degree from teacher candidates. Therefore, in almost all municipal school systems there are primary teachers with and without a college degree and some municipalities have different pay structures to each kind of teacher, with and without college diploma, operating like two sub-careers. Usually teachers with college diploma earn higher salaries.

Public school system's pay policy is based on salary formulae that reward teacher characteristics such as possessing graduation degree and master or post-graduation certificates, and, mainly, seniority. Despite its increasing adoption among developed countries, performance-based pay was almost nonexistent amongst municipal school systems in Brazil. In the period of analysis, only 2.3%, or 22 municipalities, among 955 who answered this survey question, adopt a system of pay based on performance[23]. Typically, teacher salary consists of two parts: (i) a base

[20] In US dolar, minimum salary for teachers grew by 38.8% in the period between 2008 and 2013.
[21] Direct Action of Unconstitutionality No. 4167, of October 2008.
[22] However, since the decision of the Supreme Court becomes unappealable only on 14th April of 2014, perhaps public officials had not felt themselves obliged to comply with the law beforehand.
[23] The state with more municipalities which has this kind of performance-based pay scheme is the state of Ceará, with 5 municipalities, among 39 respondents (12.8%). In addition to these municipalities of Ceará, other 7

salary, established according to the teacher's workload; and (ii) an additional part based on teacher's seniority and number of hours of graduate credits or graduation degree teacher has. Generally these rewards are calculated as a percentage of the base salary[24]. Thus, if the education and experience of the average teacher in a school system did not change from one year to the next, then average teacher pay would increase by the same percentage base salary had increased. In other words, when school systems raise the pay of teachers, they normally increase all the cells of these schedules by a fixed percentage.

According to the new law, every school system that were paying teachers a base salary of less than R$ 950 per 40 hours of work per week, or proportionally equivalent, must raise the salary on January 2009 by at least 2/3 of the difference to the established minimum value. The transition to new minimum base salary value should have been completed by January 2010, when the school systems must pay at least the minimum salary as a base salary to their teachers, which was R$ 1,024.67 at the time. Thus we applied those rules to detecting which municipalities comply with the law and to classify them into treatment and comparison groups as will be presented in the section *Methodology*.

1.3 Data

In Brazil, except for the *Relação Anual de Informações Sociais* (*RAIS*)[25], there is no comprehensive source of information about municipal teacher salary, and there is absolutely no information about their base salary. In order to determine whether municipal school systems comply with the national minimum salary for teachers we need a precise source of its teacher base salary. But in *RAIS* we get the employee's final remuneration, including some benefits and rewards for seniority, for instance.

municipalities in the state of São Paulo (out of 184 respondents), 2 in Santa Catarina (81 respondents), 2 in Piauí (49 respondents), and one in each of the states of Espírito Santo, Mato Grosso do Sul, Minas Gerais, Paraná, Rio Grande do Norte and Rondônia have performance-based pay scheme. Only 7 of those 22 municipalities have adopted such a scheme of compensation between 2007 and 2011, two editions of *Prova Brasil* used in this study. This extremely low number makes us confident in rejecting any influence of these schemes on results.

[24] Usually there is no discretion to award teacher's previous relevant experience. When hired, a municipal teacher receives a beginning salary which value depends on her/his diplomas, never on her/his other previous experiences.

[25] *RAIS* is an annual, matched employer-employee, administrative data set collected by the Brazilian Ministry of Labor. It is a panel of workers and firms, containing the universe of formal firms and workers.

Thus, to circumvent limitations of existing database, we carried out a survey with municipal departments of education in partnership with the *National Union of Municipal Secretaries of Education* (*UNDIME*[26]), to get precise information about teachers' beginning salaries and career structures.

In this section we present the survey methodology, some descriptive statistics and the dataset used throughout this dissertation. The data specific to certain chapter will be presented in a Data section on that chapter.

1.3.1 The Survey

The survey questionnaire, which was inserted in a web platform and put into the *UNDIME* website[27], consisted of questions about teacher career and remuneration in every January of the period 2008-2013[28]. The survey worked as follows. *UNDIME* sent electronic messages to its mailing list, composed of about 5,000 municipal departments of education and their heads. This message contains a presentation of the research project, an invitation for participation and a link to access the questionnaire in *UNDIME* website. Representatives of each municipal department of education, after registering into the survey web system, informing their name, position and telephone number and e-mail contacts, filled the survey questionnaire. *UNDIME* conditioned the partnership to confidentiality agreement. Municipal department of education was told that their identity would not be unveiled to third parties. Therefore we are not allowed to publicly identify municipalities or its representative in the database.

The first phase of the field research took place between May 17th and July 31st, 2013, and consisted of a pre-test. From *UNDIME* mailing contacts information, we constructed a stratified representative sample of 399 municipalities to participate in the pre-test, whose purpose was, first, to test the collection instrument and indicate further necessary improvements, and, second, to inform us the rate of participation

[26] Acronym in Portuguese for *União Nacional dos Dirigentes Municipais de Educação*, which is a non-profit organization supported by contributions of its members, almost 5,000 municipal departments of Education. Its mission is to coordinate, mobilize and integrate the municipal secretaries of education to improve public education. It organizes and promotes research, meetings, seminars and forums and, in addition, maintains contacts with unions, non-governmental organizations, social movements, and other entities of the civil society.

[27] *UNDIME* often carries out quick surveys about education issues and sometimes carries out broader surveys like ours. When asked to answer the questionnaire, the members of the municipal departments of Education were told that their identity and their municipality identity would not be disclosure and all the information would be displayed through averages or by group of municipalities. Furthermore, no information would be passed on to third parties. Therefore, because respondents were answering to their own peers, we believe that the survey brings us accurate information. Even though, we intend to do some consistency checks with other databases.

[28] A copy of the questionnaire used in the survey is available in the Appendix D.

through each sample stratum, taken in consideration to define the final representative sample. The second phase of the research has taken place from September 2013 until February 28th 2014.

Even though *UNDIME* has sent messages to all of its contacts and wanted that all of its members take part in the survey, we decided to stimulate the participation of municipalities included in a nationwide representative sample of municipal school systems. Based on the experience of the pre-test we have learned that we should check whether municipal departments of education had received the messages from *UNDIME* and, more importantly, we should encourage them into answering the web survey through telephone calls. Thus, to reduce the costs and the time spent in collecting data and to guarantee representativeness of the respondents, we focus on the participation of a nationwide representative sample. In order to guarantee that municipal school systems included in this sample actually had received the link to the web questionnaire, we tried to contact all of them and also tried subsequent contacts to reassure them the importance of completing the questionnaire until the end of the survey deadline.

In our survey with all municipal departments of education, 1,600 of them entered the questionnaire web system and answered at least one question and 1,111 reached the end of the questionnaire. However, only 905 school systems have informed beginning teacher base salaries of their primary schools observed at least in January 2008 and January 2009 or January 2010, necessary values for assessing salary variation in the period 2008-2010, which is the focus of our analysis.

It is important to clarify that making contact with municipalities from the Northeast region and, mainly, North region was much more difficult than making contact with municipalities of other regions. Facing the challenge of trying to contact municipal departments of education from Northern parts of Brazil, we asked several regional bureaus of *UNDIME* to help us in this task. After that we noticed that participation rate had increased in some states but not in others, where *UNDIME*'s mobilizing capacity seems weaker, such as AP, AM, PA, RR, MA, PE, AL and SE. The participation rate of out of the sample municipal department of education can be seen as a proxy of regional bureaus mobilizing capacity[29]. Another factor that helps to explain such timid participation among Northern and Northeastern municipal

[29] With the exception of regional bureaus in Acre and in Rondônia because all municipalities in those states have taken part in the stratified sample.

departments of education is their still restricted internet access and their poorer institutions.[30]

Table 1.1 shows participation rate amongst Brazilian states, considering the representative sample and out of the sample participants. From the representative sample we got 40.2% of participants. On the other hand, only 8% of the municipalities out of the sample informed their teacher salaries. The huge gap between those participation rates highlights the importance of our work of contacting municipal departments of education and stimulating their participation in the survey.

There are large differences in participation rate amongst Brazilian states and regions. Municipalities from South, Southeast and Mid-West reached higher participation rate, of about 55% of the representative sample against participation rate of 34.6% and 27.5% of Northern and Northeastern municipalities, respectively. Consequently, to restore sample representativeness, we had to calculate sample weights for each stratum and consider them in order to properly analyze the data.

[30] Some anecdotal evidence can be mentioned. Members of some municipal departments of education from Northeast Region have told us that members of the former administration destroyed administrative records about teacher pay, and others, from North, have told us they are having problems with internet access. From one Northeastern municipal department we have heard that the mayor has suffered an impeachment and all city head departments were dismissed. Few weeks later, in a second contact, the situation was still confused and the person we had the mobile-phone number, the only telephone number we had from that department of education, was not working at the department of education anymore.

Table 1.1 Regional and State distribution of participant municipalities

Region/State	# municipalities	Sample		Out of sample		Participation rate		
		part.	no part.	part.	no part.	sample	out of sample	total
N	**450**	**89**	**168**	**13**	**180**	**34.6%**	**6.7%**	**22.7%**
RO	52	26	26	0	0	50.0%	-	50.0%
AC	22	11	11	0	0	50.0%	-	50.0%
AM	62	6	28	0	28	17.6%	0.0%	9.7%
RR	15	4	9	0	2	30.8%	0.0%	26.7%
PA	143	11	56	1	75	16.4%	1.3%	8.4%
AP	17	3	10	0	4	23.1%	0.0%	17.6%
TO	139	28	28	12	71	50.0%	14.5%	28.8%
NE	**1793**	**158**	**416**	**68**	**1151**	**27.5%**	**5.6%**	**12.6%**
MA	217	14	57	2	144	19.7%	1.4%	7.4%
PI	224	27	38	5	154	41.5%	3.1%	14.3%
CE	184	22	34	7	121	39.3%	5.5%	15.8%
RN	167	22	34	15	96	39.3%	13.5%	22.2%
PB	223	21	35	13	154	37.5%	7.8%	15.2%
PE	184	15	50	5	114	23.1%	4.2%	10.9%
AL	102	7	61	1	33	10.3%	2.9%	7.8%
SE	75	9	47	0	19	16.1%	0.0%	12.0%
BA	417	21	60	20	316	25.9%	6.0%	9.8%
SE	**1668**	**134**	**121**	**136**	**1277**	**52.5%**	**9.6%**	**16.2%**
MG	853	33	29	59	732	53.2%	7.5%	10.8%
ES	78	25	32	3	18	43.9%	14.3%	35.9%
RJ	92	31	25	1	35	55.4%	2.8%	34.8%
SP	645	45	35	73	492	56.3%	12.9%	18.3%
S	**1188**	**105**	**81**	**78**	**924**	**56.5%**	**7.8%**	**15.4%**
PR	399	35	21	18	325	62.5%	5.2%	13.3%
SC	293	26	36	16	215	41.9%	6.9%	14.3%
RS	496	44	24	44	384	64.7%	10.3%	17.7%
MW	**465**	**93**	**76**	**33**	**263**	**55.0%**	**11.1%**	**27.1%**
MS	75	28	26	1	20	51.9%	4.8%	38.7%
MT	144	32	27	14	71	54.2%	16.5%	31.9%
GO	246	33	23	18	172	58.9%	9.5%	20.7%
Brazil	**5564**	**579**	**862**	**328**	**3795**	**40.2%**	**8.0%**	**16.3%**

1.3.2 Sample methodology[31]

Sample size was calculated assuming the following: (*i*) a standard deviation for the average *Prova Brasil* pupils' achievement test scores per municipality of about 55 points; (*ii*) a statistical power of 80%; (*iii*) a statistical significance level of 5%; (*iv*) an expected participation rate of 60% (which was adjusted to 50% after the pre-test); (*v*) that the intention of detecting differences of at least 10 points on the average

[31] Marcel Vieira, Statistician from the UFJF, was responsible for the sample design in our project supported by *Fundação de Amparo à Pesquisa do Estado de São Paulo - FAPESP* (FAPESP 2012/20237-2, "Impacto da elevação da remuneração do professor de educação básica sobre a proficiência dos alunos: levantamento de dados e análise econométrica").

Prova Brasil pupil's achievement test scores per municipality when statistically comparing the group of municipalities that complied with the minimum salary policy in 2009 (group 1) with those which did not comply (group 2)[32]; (*vi*) the selection of municipalities considering stratified simple random sample; and (*vii*) a design effect of 1.

An initial estimated survey sample size was then calculated as 1,130 municipalities, with 565 municipalities from each of the considered groups. The sample size for the pre-test was defined as 30% of the sample size estimated for the survey. Note that, after the realization of the pre-test, the survey sample size was inflated to 1,212 municipalities, considering the observed participation rate of 50%.

After the sample size estimation, a stratified simple random sample was selected. Municipalities were stratified by states, inclusion or not in the CONVIVA frame[33], and by size with capitals and municipalities with 100 thousand or more inhabitants, according to the 2010 Brazilian census, being classified in a 'large municipality' stratum and the remaining ones in a 'small and medium municipality' stratum. An exception was made for the state of São Paulo, where the criteria for a municipality to be classified in the 'large municipality' *stratum* has been having 200 thousands inhabitants or more.

Sample allocation of municipalities among the strata was aimed to be made uniformly among strata and disproportionally in the strata defined by the inclusion or not in the CONVIVA frame, considering a larger probability of selection for those municipalities listed in the CONVIVA frame. Moreover, municipalities classified in the 'large municipality' *stratum* were selected with certainty (probability of one). Such sample size adjustments guided by the sample allocation over the strata in addition to round procedures (to the next larger integer) in the sample size for each *strata* led to a final sample size of 1,441 municipalities.

After survey data collection procedures were concluded, sample survey weights were calculated, for each municipality, accounting for unequal selection probabilities and adjust for unit non response. Therefore, the use of the calculated

[32] This sample was originally designed to another article whose objective is to assess the impact of teacher salary raise on pupils' proficiency.

[33] CONVIVA is a web platform, administered by *UNDIME* with partnership of several Brazilian NGOs, whose main objective is to deliver, totally free of charges, information and management tools to Municipal Departments of Education in order to improve local education policies. As the members of Municipal Departments of Education need to inform valid email addresses to participate in the CONVIVA framework, we think that the probability of having our email messages been red, and consequently of receiving the questionnaires back would be higher than in the cases of municipalities that have not signed in CONVIVA's platform. Besides, the involvement in CONVIVA would be a proxy for quality of the department of education.

weights in data analysis procedures compensate for different selection probabilities and non-response and guarantees the property that weighted sample moments are consistent for population moments with respect to the joint sampling/non response probability distribution. Non response adjustment procedures adopted in this article assume a missing at random mechanism.

1.3.3 Dataset

The dataset used in this dissertation were obtained through the combination of several different data. In this first chapter it will be presented only the ones that are necessary to accomplish its objectives. In the next chapters only the data not yet presented in this first chapter will be presented and described.

The information about teacher salaries and municipal teacher career structures is provided by our survey with municipal secretaries of education. Also several educational database administered by *INEP* were source of relevant information and gathered the database: (*i*) 2008-2013 School Census provided information about school infrastructure, class size, quantity of teachers and pupils, student flow indicators, and teachers move; (*ii*) *Prova Brasil*[34] questionnaires brought information about school infrastructure and facilities, principals' and teachers' characteristics and pupils' socioeconomics background; (*iii*) *Pesquisa do Perfil do Dirigente Municipal de Educação 2010* was source of personal characteristics of the head of municipal department of education in charge when the law went into effect. From other Brazilian agencies we get: (*i*) information about municipalities' revenues and expenditures, including the amount used with teachers payroll, and basic education fund resources (*FUNDEB*) available for each municipality, were obtained from *Fundo Nacional de Desenvolvimento da Educação* (*FNDE*), an agency under the Ministry of Education; (*ii*) municipal socioeconomic indicators and institutional characteristics of the education sector from each municipality held by *IBGE*; (*iii*) information about the existence of municipality public retirement and pension system[35] provided by the Ministry of Social Security; and (*iv*) electoral and political information obtained from Brazilian Electoral Superior Court (TSE).

[34] *Prova Brasil* is a census-based bi-annual assessment of Portuguese and Mathematics achievement of primary and lower secondary school students in Brazil accompanied by four background surveys of students, teachers, principals and schools.

[35] The Special Social Welfare Policy (RPPS – *Regime Próprio de Previdência Social*), of contributive character, is the policy which guarantees a different scheme for retirement and pension payments to public servants in an effective position in the Union, the States, the Federal District and almost 2000 Municipalities, of a total of 5,564

One of the objectives of this chapter is to assess the impact of salary increase in teachers move. The municipal school systems teachers' proportions we analyze were calculated using School Census panel data from 2008 to 2011.

1.3.4 Descriptive Statistics

Our weighted representative sample represents well the entire population of Brazilian municipalities. Descriptive statistics that compare the weighted sample and the whole population of municipalities in respect to some socioeconomic characteristics, their school system budget, their school infrastructure and pupils' family socioeconomic background are available in the Appendix.

Table A.1 in the Appendix presents a comparison of our weighted sample and the whole population of municipalities in respect to some of their socioeconomic characteristics, their school system budget, their school infrastructure and pupils' family socioeconomic background and tests of its adherence to real population characteristics. Table A.1 shows that our sample data recovers almost identical distribution of municipalities through Brazilian Regions and, in terms of municipal socioeconomic characteristic, averages are quite similar between our sample and the population, but adult illiteracy rate (Panel A). Besides, the only difference in terms of school system characteristics is the proportion of municipal budget spent on education. The weighted sample reveals a bit smaller proportion of municipal budget spent on education. Municipal school infrastructure and facilities are similar between our weighted sample and the population of Brazilian municipal school systems, and there are statistically significant differences between our sample and the entire population only in part of the pupils' socioeconomic background variables (Panel B). Although our weighted sample slightly overestimates population socioeconomic status in some dimensions, we argue those differences are relatively small and do not taint the representation of the population by our sample. Finally, Panel C brings the same kind of comparison relatively to some variables of interest. Perhaps

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Brazilian municipalities. The remaining municipalities maintain their public servants connected to the General Social Welfare Policy (RGPS). The Special Policy has to observe the principles of financial and actuarial balance and is subject to the orientation, supervision, control and audit by the Ministry. We highlight three of the distinguished features between these policies: (*i*) in RPPS the retirement payments are equal to the last salary received and in RGPS are based on an average of the 80% higher salaries received; (*ii*) in RPPS the retirement benefits are readjusted according to salary growth (parity), and, in the other hand, RGPS has as readjustment rule the general inflation rate; and (*iii*) there is no cap of benefits and contributions in the RPPS, in contrast to RGPS which is characterized by caps on benefits and contributions (Brasil, 2009). Therefore we should expect harder times to public officials after the introduction of the national teacher's minimum salary in municipalities with RPPS and whose teacher base salaries were below the national minimum salary.

reflecting the higher level of socioeconomic status of their pupils' family, the estimates of test scores obtained through the weighted sample are above the national mean. However the differences between the sample and the population test scores variation almost disappear. They are null in the period 2005-2007 for both disciplines and the estimates are about 1 point higher than the national test score variation in both disciplines in the period 2007-2009, statistically significant at 10% level in Math and 5% in Portuguese, but they have very low economic significance.

According to our survey, the majority of Brazilian municipal school systems were impinged by the introduction of the national minimum salary. We find that actually 61.4%[36] of the Brazilian municipal school systems had any teacher base salary smaller than R$ 950 in 2008, and consequently were impinged by the law introduction. In 2011, the percentage of municipal school systems which were paying less than the legal minimum as a base salary fell 27 p.p., to 34.4% of Brazilian municipalities[37]. Even though there was a sharp reduction in the proportion of municipalities with minimum salaries below the national minimum, it is still a high proportion of non-compliance with the law. In 2013, 32.8% of Brazilian municipalities remain on the margin of the law[38]. Salaries are higher in the southern regions of Brazil, where less than half of its municipalities (46.1%) have been impinged by the national minimum salary for teachers. Meanwhile, in the northern and mid-western regions 78.8% of its municipalities have been impinged by the law. Figure 1.1 shows the histogram of the lowest value of each municipal school system base salary of beginning teachers in January 2008[39]. We see that the defined minimum salary (marked by the traced red line) was almost the national average according to our survey[40].

[36] With a linearized standard error of 1.8%, considering the complex sample design.
[37] With a linearized standard error of 1.9%, considering the complex sample design.
[38] With a linearized standard error of 1.9%, considering the complex sample design. Here we had to assume that base salaries remained constant between January and June of 2008, when the law was enacted or, if it had been raised, the lowest municipal base salary in June would be still below the established national minimum.
[39] Often the lowest base salary in each municipal school system is the one of the beginning teacher without college degree.
[40] Sample weights matter. The average of the municipal minimum base salary obtained applying sample weights (R$ 935.24 in 2008) is statistically different from the simple average (R$ 966.59 in 2008) at 1% level of significance.

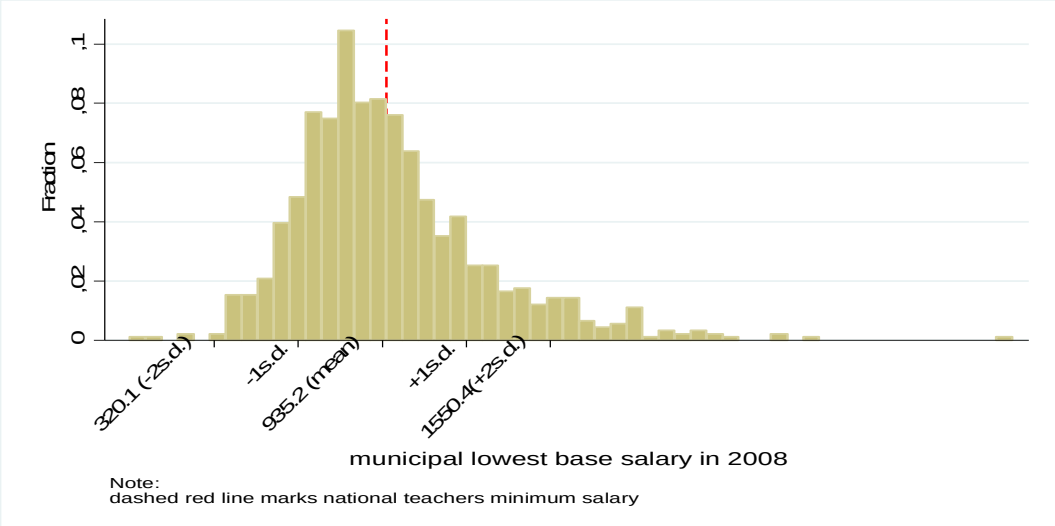


Figure 1.1 Histogram of lowest municipal base salary of beginning teachers in 2008

Just on April 6th, 2011, the Brazilian Supreme Court decided for the constitutionality of the law. There is a possibility that some municipalities and states waited for the Supreme Court decision and did not comply with the minimum salary until then. However our data do not reveal a strengthening of the decision by municipal school systems for compliance in 2012, soon after the decision of the Supreme Court. The proportions of compliers in 2012 and 2013 are similar to the proportion observed in 2010 and are slightly higher than proportions observed in 2009 and 2011 (see Table 1.2).

The institution of the minimum salary moved partially municipal teacher's salaries as shown by Figure 1.2. Looking at the distribution density of municipal lowest teacher base salary in the period from 2008 to 2013, we can see a decrease in the mass of municipalities that pay less than the national minimum salary for teachers as base salary and, at the same time, a progressive increase in the mass of school systems which pay exactly or nearly around the stipulated minimum from 2009 to 2013 (dashed red lines).

Table 1.2 Estimated proportion of compliance with the law by municipal school systems by year and the value of the national minimum salary for teachers

year	compliance rate	std error	95% interval		Obs	minimum salary for teachers (R$)	Economy minimum salary (R$)
2009	57,1%	2,5%	52,2%	61,9%	512	950,00	465,00
2010	61,3%	2,5%	56,4%	66,3%	510	1.024,67	510,00
2011	54,8%	2,6%	49,7%	59,9%	553	1.187,14	545,00
2012	62,1%	2,3%	57,6%	66,6%	655	1.450,75	622,00
2013	64,1%	2,4%	59,4%	68,9%	607	1.567,00	678,00

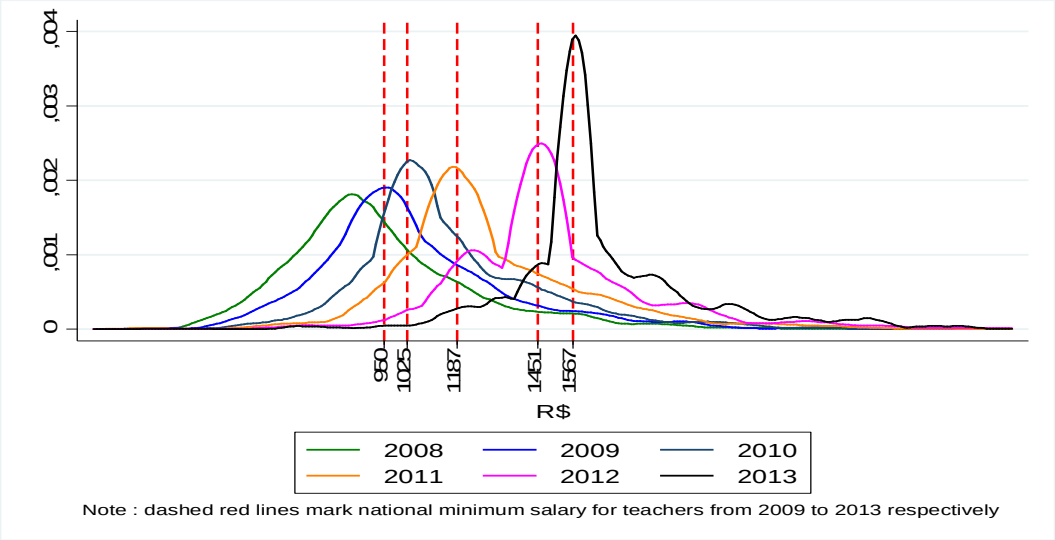


Figure 1.2 Distribution of Municipal minimum primary teacher base salary from 2008 to 2013

As noted before, there is a large range of teacher workloads among Brazilian school systems. Another limitation of the School Census database is that there is no information about teachers' contracts relatively their workload. Thus, in order to construct the municipal average teacher salary, we suppose that each workload, whether more than one existed in a certain school system, represents the same proportion of teachers. We make the simple average of all workloads of teachers distinguishing those with college degree from those without college degree, and, after that, to obtain the school system average salary we calculate the mean weighted by the proportion of teachers with and without college degree, according to the School Census. We argue that this hypothesis does not interfere in the analysis because the salary differences between different workloads are very small whether exist. Teacher

salary heterogeneity within school systems is mostly due to college and post-graduation degrees and tenure.

From 2008 to 2009, Brazilian municipalities raised average teacher base salaries on average by 12.9%[41], what represented a considerable gain in real terms for teachers since Brazilian economy has witnessed an annual inflation rate of 5.9% that year. However this base salary variation was very heterogeneous, with municipal school systems which complied with the law in 2009 presenting significantly higher rates: an average nominal rate of 23.8%, with an expressive real growth of 16.9%. On the other hand, the increase among non-impinged and non-compliers was 7.1% and 6.7%, respectively, between the annual inflation rate and the GDP growth in that year. Figure 1.3 shows the extremely different densities of the salary growth of distinct groups of municipalities in 2009, impinged, non-impinged and compliers with the law in 2009.

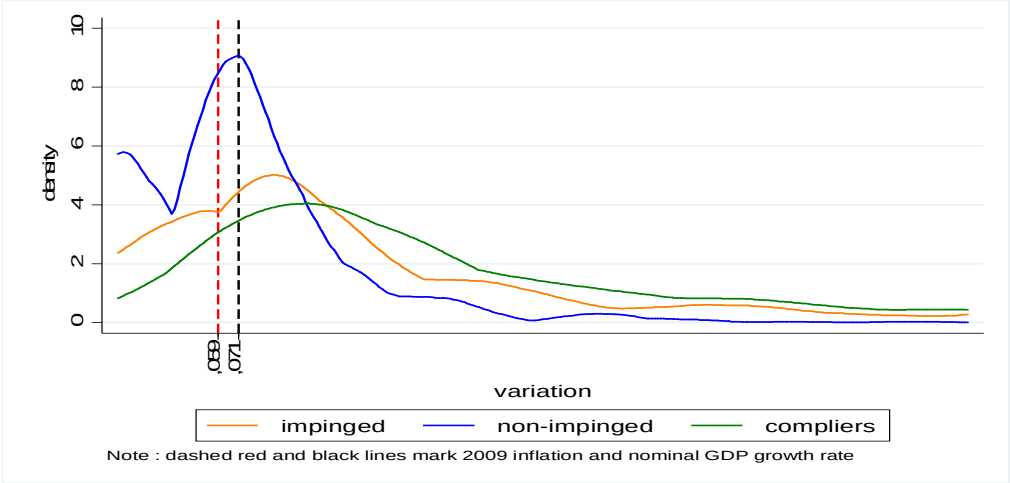


Figure 1.3 Density of average teacher salary variation between 2008 and 2009 by group of municipalities, (impinged, non-impinged and compliers)

From the introduction of the national minimum salary for public schools teachers to January 2013, the average teacher base salary in municipalities had grown 75.7%, which represents an increase of 33.6% in real terms. However, the growth was very heterogeneous among municipalities. According to our survey, the municipal school systems impinged by the law which comply with it at least during one year raised teacher base salary on average by 88.8%, from R$ 925.06 in 2008 to

[41] With a 95% of confidence interval that ranges from 11.6% to 14.2% considering the complex sample design. The mean of the average base salary of municipal school systems impinged by the law that complied with it increased from R$ 861.35 to R$ 1,044.76, with an increment of R$ 183.41. Meanwhile, the mean of the average base salary of municipal school systems not impinged by the law increased from R$ 1,344.68 to R$ 1,438.02, with an increment of R$ 93.34.

R$ 1,746.94 in 2013, against 49.9% of increase among municipal school systems that have not been impinged by the law or never complied with it (from R$ 1,004.14 in 2008 to R$ 1,504.97 in 2013). In real terms, compliers raised teachers' base salary 4.8 p.p. more yearly than non-impinged municipalities, 7.5% per year against 2.7% per year, respectively.

Up to this point it was made clear that the introduction of the national minimum salary for teachers moved considerably municipal teachers' base salary. In the next paragraphs we present and try to make a connection between the base salary and the total salary of municipal teachers and then we compare teachers' remuneration with total salary of other competing careers. Municipalities were characterized according to their status as impinged by the national minimum salary introduction and according to their compliance with the law.

Table 1.3 presents average base and total salaries of teachers, and shows the importance of the introduction of the minimum base-salary as a trigger for the growth of teachers' remuneration. Municipalities that were burdened by the law and complied with it raised teachers' base salary considerably more than municipalities that were not burned (always-takers) or those burdened but whose administration decided not to comply with the law (never-takers). School systems that complied with the law since 2009 raised teachers' base salary by R$ 916.12, or 105.1% between 2008 and 2013 (55.9% in real terms) against R$ 760.66, or 50.1% (14.1% in real terms) of increase in school systems that have not been impinged by the minimum salary introduction. The difference of 55 p.p. between base salary nominal growth rates of compliers and non-compliers is associated with a 62.8 p.p. gap between the total salary growth rates of these groups, according to *RAIS* data.[42]

The municipal school systems that comply with the law since 2010 present teachers' base salary and total salaries growth rates higher than any other category of municipal school system, with an average annual real growth rate of 13.2% in the period from 2008 to 2013. In the other hand, municipal school systems that have been impinged by the law but did not complied with it during any year of the period of analysis (called here never-takers) showed an average annual real growth rate of only 2.6%. However, the quantity of municipal school systems which complied with

[42] See, in the Appendix B, graphs that show the relation between the municipal teachers' remuneration mean (source: RAIS) and municipal base teachers' salary mean (source: author's survey). As soon as possible, we intend to test the adherence between these two database merging RAIS and School Census with the teacher CPF. Therefore we will be able to in fact expunge false information from RAIS.

the law since 2010 is very small (5%). Combined with the ones that complied with the law since 2009 they form a group representing 20.5% of the municipalities and present an annual real growth rate of 10.2%, still an expressive rate when contrasted with the annual real growth rate of *Others*, 2.9%. This last group is formed by municipal school systems that have not been impinged by the law (denominated here as always-takers) and those that have been impinged but decided not to comply with it (never-takers), whose teachers' salary annual rate of real growth was 2.9% and 2.6%, respectively.

Table 1.3 Comparison of average municipal teachers' base-salary, total salary and theirs growth rate in different categories of municipalities according to the compliance with the law (2008-2013)

Panel A - Base Salary							
Groups of municipalities according to the compliance with the law	**Base salary**					**Obs**	**Part. in total**
	2008 (R$)	**2013 (R$)**	**nominal growth 2008-2013**	**real growth 2008-2013**	**annual real growth**		
Any compliance 2009-2013	925,06	1.746,94	88,8%	43,6%	7,5%	627	74,1%
compliance since 2009, 2010 or 2011	904,66	1.829,87	102,3%	53,8%	9,0%	223	26,3%
compliance since 2009 or 2010	869,25	1.798,76	106,9%	57,3%	9,5%	164	20,5%
compliance since 2009	881,19	1.807,32	105,1%	55,9%	9,3%	126	15,4%
compliance since 2010	832,97	1.772,77	112,8%	61,8%	10,1%	38	5,0%
compliance since 2011	1.028,46	1.938,64	88,5%	43,3%	7,5%	59	5,8%
Others	1.356,62	2.039,81	50,4%	14,3%	2,7%	276	25,9%
always-takers	1.517,98	2.278,64	50,1%	14,1%	2,7%	197	17,8%
never-takers	1.004,14	1.504,97	49,9%	14,0%	2,6%	79	8,1%
Total	1.037,35	1.822,82	75,7%	33,6%	6,0%	906	100,0%

Panel B - Total Salary								
Groups of municipalities according to the compliance with the law	**Total salary**					**Obs (2008/ 2013)**	**Base salary/total salary**	
	2008 (R$)	**2013 (R$)**	**nominal growth 2008-2013**	**real growth 2008-2013**	**annual real growth**		**2008**	**2013**
Any compliance 2009-2013	1.236,48	2.773,85	124,3%	70,6%	11,3%	556/549	0,75	0,63
compliance since 2009, 2010 or 2011	1.146,47	2.395,15	108,9%	58,9%	9,7%	203/200	0,79	0,76
compliance since 2009 or 2010	1.065,97	2.341,82	119,7%	67,0%	10,8%	150/148	0,82	0,77
compliance since 2009	1.103,09	2.378,73	115,6%	64,0%	10,4%	116/114	0,80	0,76
compliance since 2010	946,43	2.228,29	135,4%	79,0%	12,4%	34/34	0,88	0,80
compliance since 2011	1.436,21	2.579,69	79,6%	36,6%	6,4%	53/52	0,72	0,75
Others	1.788,63	2.887,80	61,5%	22,8%	4,2%	247/255	0,76	0,71
always-takers	1.989,80	3.126,35	57,1%	19,5%	3,6%	177/181	0,76	0,73
never-takers	1.371,16	2.401,61	75,2%	33,2%	5,9%	69/73	0,73	0,63
Sample total	1.379,69	2.803,98	103,2%	54,5%	9,1%	803/804	0,75	0,65
Total	1.469,51	2.698,35	83,6%	39,6%	6,9%	4778/4761		

Source: Author's survey with municipal school systems and *RAIS* 2008 and 2013.
Note: "Any compliance 2009-2013" and "Others" are two broad groups distinguished just according to compliance status. "No compliance 2009-2013" is divided by two groups that are more informative here. Always-takers are municipal school systems that have not been impinged by the law in the period 2009-2013, i.e., municipal school systems that always had minimum base salary above the national minimum stipulated by law in the period 2008-2013. Never-takers are municipal school systems that were impinged by the law at least in one year in the period, but never have complied with the law.

Table 1.4 presents the average base and total salaries of teachers and compares teachers' remuneration to other competing careers, i.e. other municipal servants and individuals with higher education working in any other occupation but teaching (denominated here alternative careers), at the municipal level.

Table 1.4 Comparison of average municipal teachers' monthly remuneration and its growth rate with other activities in different categories of municipalities according to the compliance status

		Total	Sample total	Any compliance 2009-2013	Compliers since 2009, 2010 or 2011	Always-takers	Never-takers
average salary 2008 (R$)	Municipal primary teachers	1.469,51	1.379,69	1.236,48	1.146,47	1.989,80	1.371,16
	Private primary teachers	1.586,34	1.444,56	1.229,34	1.106,38	1.940,28	1.518,17
	Other municipal servants	1.092,16	1.075,11	996,49	911,44	1.465,22	971,77
	Alternative careers	2.419,46	2.388,99	2.266,66	2.147,68	2.990,18	2.184,93
average salary 2013 (R$)	Municipal primary teachers	2.698,35	2.803,98	2.773,85	2.395,15	3.126,35	2.401,61
	Private primary teachers	2.440,99	2.410,33	2.176,62	1.859,37	2.946,40	2.657,60
	Other municipal servants	1.803,86	1.811,60	1.729,42	1.624,24	2.261,62	1.618,96
	Alternative careers	3.388,28	3.358,78	3.292,84	3.253,39	3.755,35	3.121,62
salary increase (R$)	Municipal primary teachers	1.228,84	1.424,30	1.537,37	1.248,68	1.136,55	1.030,44
	Private primary teachers	854,65	965,77	947,28	752,99	1.006,12	1.139,43
	Other municipal servants	711,70	736,49	732,93	712,80	796,40	647,19
	Alternative careers	968,82	969,79	1.026,18	1.105,71	765,17	936,69
nominal growth 2008-2013	Municipal primary teachers	83,6%	103,2%	124,3%	108,9%	57,1%	75,2%
	Private primary teachers	53,9%	66,9%	77,1%	68,1%	51,9%	75,1%
	Other municipal servants	65,2%	68,5%	73,6%	78,2%	54,4%	66,6%
	Alternative careers	40,0%	40,6%	45,3%	51,5%	25,6%	42,9%
real growth 2008-2013	Municipal primary teachers	39,6%	54,5%	70,6%	58,9%	19,5%	33,2%
	Private primary teachers	17,0%	26,9%	34,6%	27,8%	15,5%	33,1%
	Other municipal servants	25,6%	28,1%	32,0%	35,5%	17,4%	26,7%
	Alternative careers	6,5%	6,9%	10,5%	15,2%	-4,5%	8,6%
average annual real growth	Municipal primary teachers	6,9%	9,1%	11,3%	9,7%	3,6%	5,9%
	Private primary teachers	3,2%	4,9%	6,1%	5,0%	2,9%	5,9%
	Other municipal servants	4,7%	5,1%	5,7%	6,3%	3,3%	4,8%
	Alternative careers	1,3%	1,3%	2,0%	2,9%	-0,9%	1,7%

In the period between 2008 and 2013, according to *RAIS* database, the average total salary of Brazilian municipal primary teachers increased considerably, from R$ 1,469.51 per month (about US$ 803) to R$ 2,698.35 (US$ 1,241)[43]. This represents a nominal growth of 83.6% (despite our sample revealed an increase even much larger, of 103.2%), 18.4 p.p. (34.7 p.p. according to our representative sample) stronger than the increase observed in the salary of other municipal agency employees, and 29.7 p.p. higher than the growth rate of private teachers' pay. There was an expressive rise of 39.6% (54.5%) in municipal primary teachers real salary, since the inflation rate in the period was 31.5%. In an annual basis, municipal primary teachers witnessed a real growth rate of their salary of 6.9% per year on average between 2008 and 2013, against 3.2% as annual real growth of private teachers' remuneration (9.1% and 4.9% per year, respectively, according to our sample)[44].

In 2008, average municipal teachers' salary was a little bit lower than private teachers' salary according to *RAIS* database, representing 0.93 of the average private primary teachers' remuneration. But after the introduction of the minimum salary for public teachers this relation jumped to 1.11 in 2013, with an eloquent relation of 1.27:1 in municipalities where municipal school systems comply with the law at least one year, departing from 1:1 in 2008. Meanwhile, in municipalities that already paid more than the minimum this relation evolved from 1.03:1 to 1.06:1.

The average salary of municipal primary teachers, despite the strong increase during the period, is still below the average remuneration of individuals with College diploma occupied in alternative careers. However, teacher remuneration shows convergence to salary of alternative occupations in the period of analysis according to *RAIS* database. Average municipal teacher remuneration in 2008 was 0.607 of the average remuneration in alternative occupations and reached 0.796 after only 5 years, an expressive convergence in such a short period of time.

It is interesting to note that even in municipalities which school systems have not been impinged by the law's enactment teachers' salary growth have been higher than the average of alternative careers' salary growth in the period. But the difference in favor of municipal teachers' salary is milder (3.6% per year against -0.9%) than in compliers municipalities (11.3% against 2.0%).

[43] The average exchange rate was R$ 1.83/US$ in 2008, and R$ 2.17/US$ in 2013.
[44] Our representative sample overestimates the salary growth rates of all categories.

Based on the descriptive statistics presented, we can infer that the institution of the minimum salary contributed for an increase in real terms of local teachers' salaries, mainly among impinged municipalities and more profoundly among compliers. Despite this, a significant part of municipalities did not comply with the national minimum salary for teachers, probably due to the absence of disciplinary punishment under the law, the discussion about its constitutionality and the existence of severe budget constraints in some local governments[45].

It is commonly argued that part of Brazilian public school systems in order to comply with the minimum base salary imposition has shrunk teacher salary schedule amplitude, increasing base salary more than total salary. Although there is some evidence of this kind of payment policy, our data do not reveal this behavior on the average of Brazilian municipalities. As shown in Table 1.3, the relation base salary-total salary had decreased, not increased from 2008 to 2013, as it would be expected if base salary increased more than total salary[46].

1.3.5 Characterizing treatment

In the whole dissertation we exploit quasi-experimental methods to assess the impacts of the policy of raising unconditionally teachers' salary. Those methods require the definition of treatment and respective comparison group, whose role is to simulate a counterfactual to the treatment. There are several ways to characterize treatment and determine whether each school system underwent treatment or not. Unfortunately we could not get salary of each teacher. Therefore we have to work with the average teacher beginning salary of each municipal school system in order to define treatment.

Our analysis will be divided in two different exercises. The objective of the first one is to assess the impact in the very short time, in the first year of the policy. The second exercise aims to estimate the impact in a bit longer term, in 2011 and in 2013.

In the **first exercise**, assessing the impact of the policy in the first year of implementation, 2009, it is easier to define treatment and treated units. In

[45] It is common in debates about the minimum salary for teachers the mention to a dilemma faced sometimes by municipal governors of choosing between the compliance with the Fiscal Responsibility Law, that stablishes restrictions to stipends on the labor force, and the Minimum Salary for Teachers Law. Because the former impose sanctions, naturally governors should tend to choose not to raise teacher salary when avoiding extrapolate fiscal responsibility legal constraint.

[46] However we do not test whether salary schedule amplitude had been shrunk.

characterizing treatment we look at each teacher sub-career (with and without college degree) of each school system and consider as treated units the school systems where at least one of the sub-careers had its salary raised supposedly because of the minimum salary introduction. In assessing the impact of teachers' salary hike in 2009 we use as comparison units municipal school systems not impinged by the law.

However, due to limitation of our database – we only observe salaries in January of each year, we are not sure whether municipal school systems complied with the law between February 2009 and December 2009. It is possible that some municipal systems complied with the minimum salary after January but still in 2009, and perhaps in time of affecting teaching and learning outcomes assessed by 2009 Prova Brasil, which was taken on November. Hence we include as treated municipal school systems that surely complied with the law in January 2010 and assessed the impact also using this alternative treated group in the first exercise.

On the other hand, characterizing treatment when we go further through time, to assess the impacts in 2011 and 2013, becomes a harder task to accomplish. Ideally, treated units would be all the municipal school systems which had been impinged by the law, complied with the minimum salary in 2009 and had stayed complying with it since then until 2013, the last year of our analysis. Untreated (comparison) group would be municipal school systems which had not been impinged by the law enactment, i.e. the ones that already paid at least the minimum to its primary teachers as a base salary. And once a certain municipal school system was not impinged by the law in 2008, it stays as not impinged in the subsequent years. However, even if it would be the case, we could not avoid some kind of contamination of the comparison group by the treatment in subsequent years. Due to the fact that the minimum salary is adjusted every year, school systems that have already paid more than this to their teachers as base salary if raised yearly salaries below the minimum salary increase rate eventually would become impinged by the law. Therefore, to be defined as comparison unit, dependently of its salary level in 2008, the school system should raise salary at rates perhaps higher than what would be in the absence of the policy, remaining as not impinged in all the period of analysis. As a result, we could not avoid some contamination of comparison units by the treatment, what introduce some downward bias into our estimates.

In this sense, it is possible, what is common actually, that one school system complies with the law one certain year and in the subsequent year, after the minimum salary has been adjusted, the same municipality do not comply with the law. For instance, among compliers in 2009, about one quarter do not comply with the minimum salary in 2010, and among compliers in 2010, almost 30% do not comply in 2011. Then, the law is not binding and compliance is not perennial either. Therefore, to compose the treated group in the **second exercise**, municipal school systems that complied with the law since at least January 2011 were selected. Comparison units would be municipal school systems that were not impinged by the law at least until 2011.

Table 1.5 Treated and untreated characterization for different exercises

	Treated		Untreated
	main	alternative	
1st year of the policy (2007-2009)	compliers in 2009 n = 276 units	compliers in 2009 or in 2010 n = 371 units	not impinged by the law in 2008 n = 395 units
3rd year of the policy (2007-2011)	compliers since 2009, 2010 or 2011 n = 221 units		not impinged by the law in 2008, 2009 and 2010 n = 294 units
5th year of the policy (2007-2013)	compliers since 2009, 2010 or 2011 n = 221 units		not impinged by the law in 2008, 2009, 2010, 2011 and 2012 n = 202 units

With this characterization of treatment and comparison groups, of the 276 municipal school systems treated in 2009, only 124 also composed the treatment group in 2011. Of the treated in 2009, 152 have ceased to comply with the law in 2010 and/or 2011 and consequently ceased to be part of the treatment group in 2011. Another 39 municipal school systems that had previously made up the comparison group (i.e. non-impinged by the law in 2008) composed the treatment group in 2011 and 58 municipal school systems that had been impinged, but did not comply with the law in 2009, came to comply with it in 2011. Considering the alternative treatment group, which includes those who certainly complied with the law from January 2010, the number of municipalities that had been impinged, but did not comply with the law in 2009, and began to comply with it in 2011 is now only 21. In this case, the quantity of municipalities in our sample that has been treated in 2009

increases to 371 and the number of units that composed the treatment group in 2009 and 2011 is increased to 161. As for the comparison group, of the 395 municipal school systems not impinged by the law in 2008, 294 remained in the comparison group in 2011, and 62 passed to not compose the comparison nor the treatment group in 2011. See Figure 1.4 for a graphic representation of treatment and comparison groups with a Venn Diagram.

In 2011 and 2013, treatment groups are the same. But the comparison group loses 92 units between 2011 and 2013, municipalities that by 2011 had not been impinged and come to be so in 2012 and/or 2013. It is important to clarify that municipalities of this group that comply with the law were not included as treated and were dropped from the analysis.

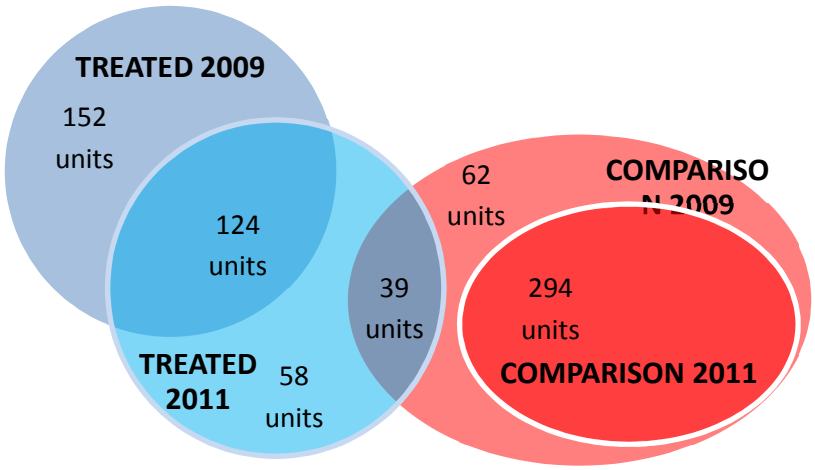


Figure 1.4 Graphic representation of treatment and comparison groups 2009 and 2011

Treatment and comparison groups are very different from each other considering almost all their characteristics. See in Tables A.3 and A.4 in Appendix A the comparison, including F-tests of the mean difference between treated and untreated groups in 2009 and 2011 and 2013, respectively. In sum, treated municipalities are less populated and poorer, presenting worse socioeconomic indicators, e.g. GDP, per capita GDP, adult illiteracy rate, proportion of population living in rural areas, total and per capita current revenues. They are in disadvantage also in terms of socioeconomic characteristics of 5th grade pupils and in terms of

school infrastructure and facilities. Their municipal school systems are more dependent on FUNDEB resources and their municipal administration spend relatively more with personnel than untreated municipal school systems. The statistically significant differences between treated and untreated, whatever the year of analysis, in the majority of their characteristics, justify the adoption of a selection on observables method combined with DID.

The growth rates of municipal teachers' base and total salaries in municipalities whose school system complied with the minimum salary law since 2009, 2010 or 2011 are much more similar among each other than those school systems that complied since 2012 or only in 2013.

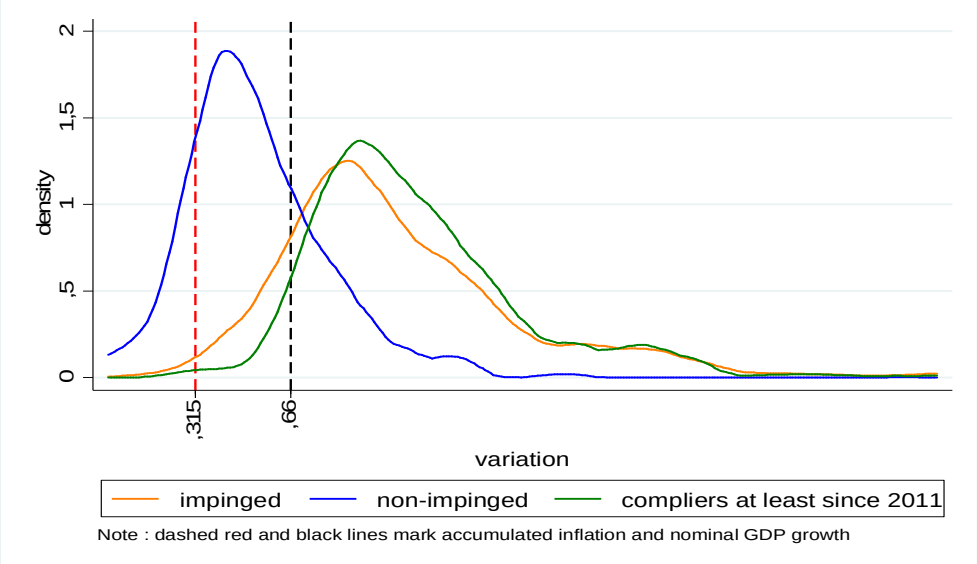


Figure 1.5 Density of average teacher base salary variation between 2008 and 2013 by group of municipalities

Figure 1.5 compares the density of average teacher salary variation between 2008 and 2013 of impinged and non-impinged municipal school systems. It shows that almost all the impinged ones raised their teacher salary above the accumulated inflation rate (31.5%) in the period and a vast majority raised it above the GDP growth rate (66.0%). Municipalities whose school system complied with the minimum salary for teacher since at least 2011 increase teachers' base salary even more than the group consisted of impinged municipalities as shown in Figure 1.5.[47]

[47] The distribution of teachers' base salary increase in Municipalities whose school system complied with the minimum salary for teacher since at least 2010 is almost coincident to the distribution of teachers' base salary increase in Municipalities whose school system complied with the minimum salary for teacher since at least 2011.

Finally we present, in Table 1.6, some statistics about the aggregate municipal teachers' proportions according to their status as stayers at the municipal school system from the previous year to the year of reference; droppers from the municipal system; entrants into the municipal system; entrants in the profession (fresh); former private teacher that entered into the municipal system; and teachers who have College diploma.

Table 1.6 Aggregate municipal teachers' proportions according to their status as stayers, droppers, entrants, fresh, former private teacher and College graduated

Teachers proportions	Year	Treated			Untreated			Dif-in-Dif
		mean	[95% Conf. Interval]		mean	[95% Conf. Interval]		
Stayers	2011	83,0%	81,5%	84,4%	82,4%	81,2%	83,7%	
	2008	79,7%	77,8%	81,5%	78,3%	76,5%	80,2%	
	Diff (p.p.)	3,3			4,1			-0,8
Droppers	2011	15,5%	14,2%	16,7%	16,8%	15,4%	18,2%	
	2008	16,7%	15,3%	18,1%	17,0%	15,3%	18,7%	
	Diff (p.p.)	-1,2			-0,2			-1,1
Entrants	2011	17,0%	15,6%	18,5%	17,6%	16,3%	18,8%	
	2008	20,3%	18,5%	22,2%	21,7%	19,8%	23,5%	
	Diff (p.p.)	-3,3			-4,1			0,8
Fresh	2011	5,6%	4,9%	6,3%	5,8%	5,0%	6,6%	
	2008	20,2%	18,2%	22,1%	21,6%	19,8%	23,5%	
	Diff (p.p.)	-14,6			-15,8			1,3
Former private	2011	0,9%	0,6%	1,2%	1,1%	0,8%	1,3%	
	2008	0,8%	0,6%	1,0%	1,5%	1,2%	1,8%	
	Diff (p.p.)	0,1			-0,4			0,6
College graduated	2011	64,9%	61,8%	68,0%	76,7%	73,4%	80,0%	
	2008	51,6%	48,5%	54,6%	65,7%	61,4%	69,9%	
	Diff (p.p.)	13,4			11,1			2,3

From these statistics, it is possible to take the following hypothesis to be examined latter on, using proper methodologies: (i) the proportion of teachers who are droppers fell after 2009 in treated municipalities relatively untreated ones; and (ii) the proportion of teachers with College diploma increase more among treated municipal school systems.

1.4 Explaining teacher salary variability across municipalities and compliance with the law

How are differences in teacher base salary amongst Brazilian municipal school systems and characteristics of municipalities and municipal school systems related? We test a wide spectrum of covariates.

Considering the national funding scheme of education, since the advent of *FUNDEF* in 1997, in each state there is a minimum expenditure per enrollee in public education school system according to the education level. Consequently, the differences in per pupil spending among school systems within each state are milder than differences observed across states. Therefore, the state where the municipal system is located is a good proxy of availability of resources. As expected, the region and, more specifically, the state where the municipal school system is located is the most important explanatory variable for teacher beginning base salary differences in 2008, before the introduction of the national minimum teacher salary, and respond to 36.6% of the teachers' salary variability across municipalities.

Socioeconomic characteristics of the municipality, such as its population, per capita GDP, average individual income, the proportion of inhabitants in rural zone and adult illiteracy rate are also important and explain 16.7% of the variability. All those variables, when are put together, explain about 38.8% of the variability in municipal teacher beginning base salary in 2008.

Budgetary variables would be expected to explain the capacity of spending in education and then to explain part of the observed salary variability in 2008. A bunch of budgetary variables, including the proportion of current revenues that was spending in personnel in 2008[48], explain 15.9% of the variability. In fact, the contribution of the tax on urban land ownership (*IPTU*) to the total amount of current budget revenues is important factor to explain salary variability across municipalities, perhaps reflecting municipality richness and indicating the capacity of obtaining revenues for the local public administration. After including budgetary variables and variables that show civil society participation in municipal school system the explained part of salary variability raised to 43.4%.

[48] The Fiscal Responsibility Law (Complementary Law nº 101) enacted on the May 4th of 2000, imposes parameters to expenditure such as a limit of 54% to the proportion of current revenues spent in personnel in municipalities.

The municipal average private teacher salary explains alone 9.9% of the variability in salary of teachers of municipal school systems, but only less than a third of the municipalities have private schools, what reduces significantly our sample. Therefore we estimate a model without this variable.

There is high positive correlation between teacher salary and schools' infrastructure and facilities. A bunch of variables representing the characteristics of municipal schools in terms of infrastructure and facilities explain 21.1% of teachers' salary variability.

After the introduction of some school system characteristics in the model, such as its school infrastructure and facilities, and teachers' characteristics, the explained part of the variability in teachers' salaries across municipal school systems in 2008 increases to 48.4%. Finally, when pupils' socioeconomic characteristics are included, more 6.3 p.p. of the variability are explained. The whole bunch of observable characteristics is responsible for about 54.7% of the variability in the level of teacher beginning base salary amongst municipal school systems.

Therefore we conclude that the role of unobservable variables in explaining salary variability remains important. Do those determinants change after the introduction of an exogenous source of salary variation, i.e., after the introduction of the national minimum teacher salary? And do the same determinants explain selection to treatment?

After the introduction of the minimum base salary for teachers the explained part of teachers' salary variability explained by observables hugely decreased. The parcel of the variability explained by the state of location of the municipal school system falls from 36.6% to 19.8% in 2013, and by revenues and the proportion of current revenues that was spending in personnel in 2008 from 14.6% to 10.0%. The model with all covariates explains just 35.2% of the salary variability in 2013, a huge drop of almost 20 p.p. when compared to the variability explained in 2008 (54.7%). This drop is associated to the imposition of a minimum salary for teachers by law.

In order to explain the compliance to the law, we run a linear probability model with all covariates. All covariates explained only 44.1% of the probability of compliance with the minimum salary law in 2009 and 47.1% of the probability of compliance with the minimum salary law in 2009 or 2010. Therefore, unobservable/unobserved variables have an even more crucial role in selecting units

into treatment than in explaining salary differences amongst Brazilian municipal school systems before the law.

The main factors that explain the probability of compliance are institutional characteristics[49] of the school system that explain 15.3% of the probability of compliance with the law, considering the linear probability model. Socioeconomic characteristics of the municipalities, i.e. the state where municipal school system is located, the number of inhabitants, per capita GDP, per capita urban income, the proportion of inhabitants living in rural areas and adult illiteracy rate, are responsible for 14.9% of the explanation of the probability of compliance. Actually the state of location of municipalities alone is responsible for 13.7% of the explanation. The gap between municipal minimum teacher base salary and the minimum salary prescribed by the law in 2008 explains 8.7% of the probability of compliance with the law. Political covariates, such as the mayor's party, the proportion of councilors from mayor's political party and from political parties from the government coalition, and whether the mayor were reelected in 2008 municipal elections, explain another 5.9% of the probability of compliance.

Figure 6a, 6b and 6c show that the variation of municipal base salary from 2008 to 2009, to 2011 and 2013, respectively, increases sharply with the difference between the national minimum salary and municipal salary observed in 2008. The downward slope of local polynomial lines reflects unequivocally the instrument driving force in moving teacher salaries. The relationship between the instrument and salary variations seems non-linear.

[49] Those variables include class size and the variation of class size in the last year, whether municipality has an active education council, a *FUNDEB* council and an education plan, the way school principals are chosen, their salary, and according to principals' answers to *Prova Brasil* questionnaire, the proportion of schools that offer tutoring, are highly demanded, has a school educational project, whether this project had been formulated with teachers' participation, that have financial problems, that have inexperienced teachers, that suffered from teachers absenteeism, that do have pedagogical coordination, that had any interruption of its activity along the school year and that has a school council.

Figure 6a: Salary hikes 2008-2009

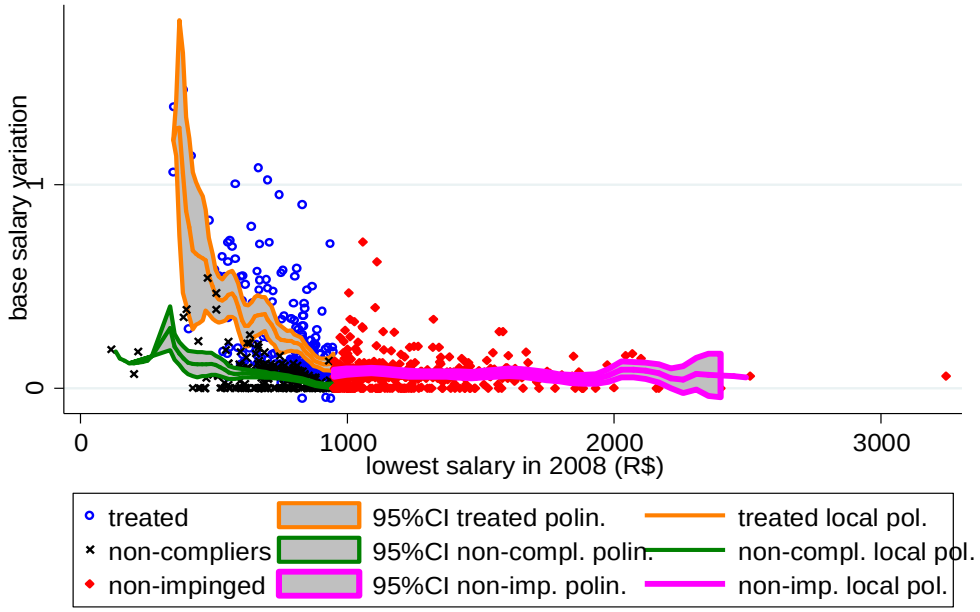
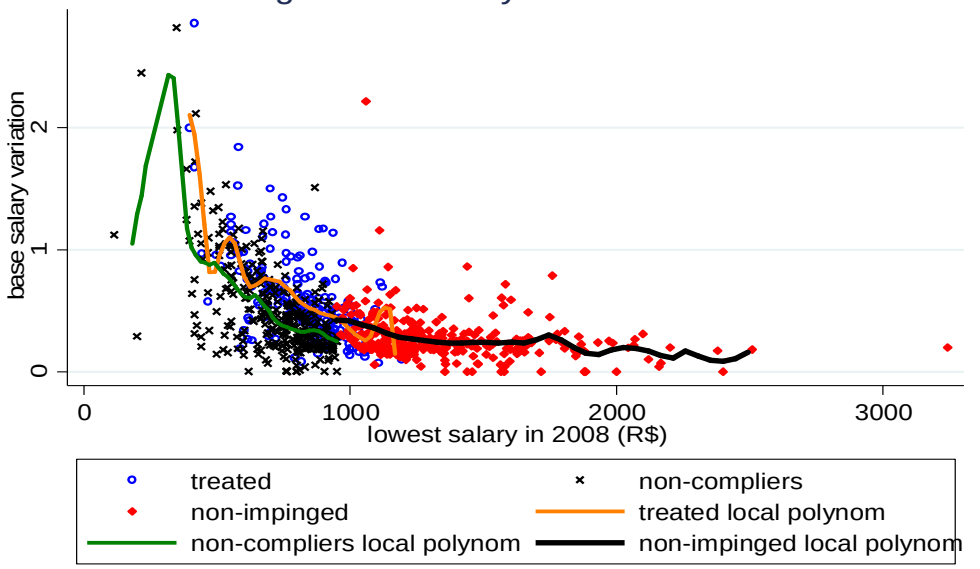


Figure 6b: Salary hikes 2008-2011



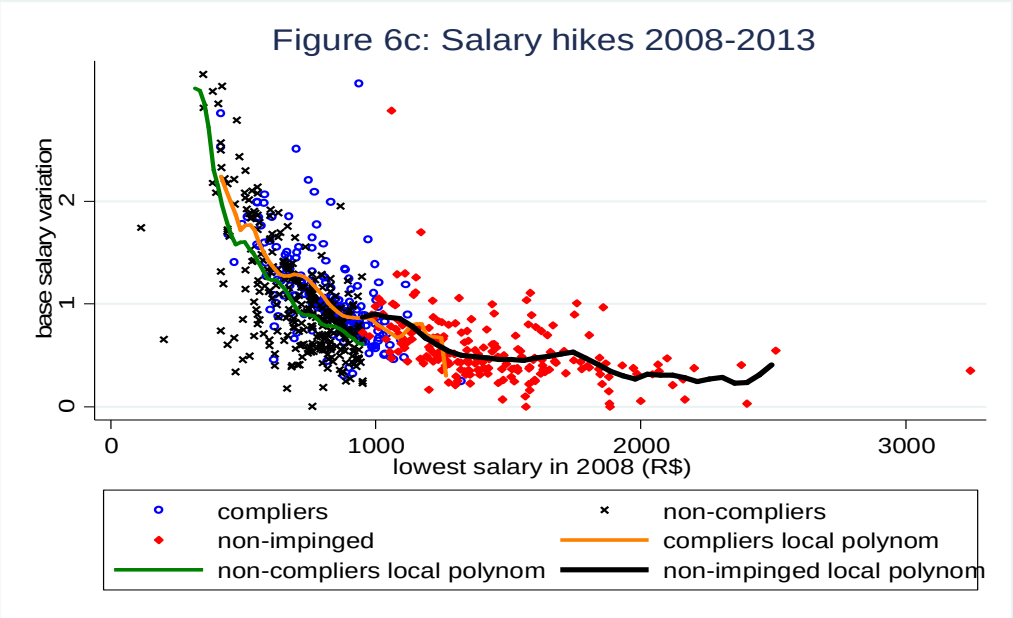


Figure 1.6 Salary hikes

OLS regressions of base teacher salary variation between 2008 (before the law) and 2013 on the distance between the stipulated minimum salary and 2008 base salary corroborate what Figure 1.6 reveals, i.e. that the longer the distance the higher the salary variation. According to the column (3) in Table 1.7 that shows results considering a non-linear relation between salary variation and the aforementioned distance, each R$ 10 more in terms of distance from the minimum salary to municipal base salary in 2008 on average is associated to 1.3 p.p. higher salary variation in the period 2008-2013.

Table 1.7 Regression of salary variation between 2008 and 2013 on distance from minimum salary (R$ 950,00) to municipal base salary in 2008

Dependent variable: base salary variation (2008-2013)	**(1)**	**(2)**	**(3)**	**(4)**
Distance	0.0009186 ***	0.0009138 ***	0.0013221 ***	0.0004326 ***
Squared distance			0.0000008 ***	0.0000039 ***
Constant	0.8654723 ***	1.036025 ***	0.7707572 ***	0.7103264 ***
Municipality characteristics and fiscal covariates		Yes		
# Obs	906	904	906	906
R^2	0.3448	0.423	0.4672	0.5089
F	(1, 904) = 188.28	(34, 869) = 13.65	(2, 903) = 157.67	(2, 903) = 256.28
Prob > F	0.0000	0.0000	0.0000	0.0000

Notes: *** p<0.01, ** p<0.05, * p<0.1
In model (3) the squared distance is introduced into the equation; in model (4) is included the squared distance only for positive values, i.e., only for municipalities impinged by the law enactment.

Surprisingly, covariates that reflect the fiscal situation of the municipality, such as total revenues, the contribution of each type of revenue to total revenues, the growth of total revenues in the last year, and the relation of expenditures with personnel to current revenues explain only 3.8% of the probability of compliance. It is common in debates about the minimum salary for teachers the mention to a dilemma faced sometimes by municipal governors of choosing between the compliance with the Fiscal Responsibility Law, that stablishes restrictions to stipends on the labor force, and the Minimum Salary for Teachers Law. Because the former impose sanctions, naturally school systems should tend to choose not to raise teacher salary when avoiding extrapolate fiscal responsibility legal constraint. However, the proportion of personnel payment in relation to municipal current revenue barely explains anything of the probability of compliance. All these five group of covariates mentioned earlier together explain 35.6% of the probability of compliance.

When school infrastructure and facilities are incorporated into the model, 40.0% of the probability of compliance is explained. And after including pupils' socioeconomic characteristics the explained part of the probability of compliance reaches 44.1%.

Other features and characteristics of municipal school system and municipality population could be very important to explain the propensity to comply with the minimum salary for teachers. It would be argued that the relative importance given to education by current ruler of the municipality and the secretary of education political power, convictions and experience are fundamental factors in explaining compliance with the law. Variables that are very difficult to measure. Trying to unveil at least part of the contribution of unobserved variables in explaining selection into treatment, we further add personal characteristics of Municipal Department of Education heads as explaining covariates. The source of those characteristics is another survey carried out by *INEP* with the partnership of *UNDIME* and UNESCO in 2010, *Perfil dos Dirigentes Municipais de Educação*.

When we merge our database with that other base, part of the original sample vanished, reducing the number of municipalities from 394 to only 229[50]. The explained part of the linear probability with this restricted sample rises to 61.8% without characteristics of the head of the municipal departments and to 68.7% after introducing those characteristics into the model. Thus some personal characteristics

[50] The number of municipalities which were impinged by the minimum salary for teacher law.

of the head of the Municipal Department of Education, such as gender, schooling, remuneration, being a politician (whether from a political party that supports the mayor or from an opposition party), being a former school principal, being from any docent career (whether of the same municipality, other municipality, the state system or private school), being or not a full-time head of department, being a former unionist increase the explained part of the compliance status among municipal school systems by only 6.9 p.p..

The important role played by unobserved and unobservable variables in explaining salary differences and compliance with the national minimum salary gives us support in applying Difference-in-Differences methods in the estimation of the impacts of salary raises on teachers move and in the estimations presented in the following two chapters.

1.5 Methodology

Unfortunately we do not have information about each teacher base and total salary. Then we could not link salary to teachers' decision of staying in the job and in the profession. Therefore we had to work with municipal beginning base salaries and had to focus on aggregate movements at the level of municipal school system. With the available information we were able to investigate if school systems which experienced higher teacher base salary increases have suffered less with teachers exit and if these school systems have attracted new teachers or teachers from the private sector.

It is difficult to disentangle the impact of the salary hike from effects of other kind of policy. A simple estimator based on the difference in means between treated and untreated groups would be tainted. The salary of teachers should be endogenous with respect to other policies of the school system and decided simultaneously with other policies. Besides, salary definition happens simultaneously with individuals' decision concerning teacher profession. Hence, in order to deal with the problems associated with endogeneity and simultaneity, the identification of an exogenous source of variation in teacher salaries is required to identify a causal

relation. We exploit the introduction of the national minimum salary for teachers, by federal law, as exogenous variation in teacher's pay.

In the present context, as the introduction of the minimum teacher salary was decided at the federal level and municipal leaders largely did not participate in the decision process, we argue that the salary hikes induced by the minimum salary introduction work as an exogenous source of salary variation. Thus it is possible to exploit this fact to identify the effect of teacher pay on teachers' decision about leaving job or the profession and their entries. Besides it can be investigated whether higher salaries attract teachers from other school systems, particularly from private sector, a hypothesis put up by Menezes-Filho and Pazello (2007).

However, as shown in the previous section, due to institutional characteristics of Brazilian school systems and the absence of explicit penalties for disobeying the minimum salary imposition or the existence of judicial appeals against the law, the assignment to treatment is not deterministic. Ultimately, to observe the law is a decision of the local administrators. Thus, not all municipal school system assigned to treatment underwent it. In other words, once assigned to treatment, municipalities self-select themselves to the treatment.

Such a decision can be greatly influenced by observable and unobservable characteristics of the municipality and its own school system. Considering what Brazilian Constitution determines, municipal teachers' salaries should be explained by municipal revenues; transfers received from *FUNDEB*, which are based on the number of enrollees in each municipal school system; and the number of teachers employed by the school system. On the other hand, salaries can also be explained by numerous other observed characteristics and even ones that are unobservable by the analyst, as the relative importance given to education by the current ruler of the municipality, or even by his/her predecessors, and the influence and bargaining power of local teachers' unions, just to mention two examples. The important role played by unobserved and unobservable variables in explaining salary differences and treatment status give us support in applying Difference-in-Differences (DID) methods in the estimation of the impacts of salary raises on pupils' performance.

Furthermore, to reduce self-selection bias we rely also on a selection on observables method. The use of an estimated propensity score helps in limiting bias associated to observed characteristics that are correlated to the treatment and to the potential outcome of interest at the same time. According to DuGoff et al (2014),

more than just essential for addressing confounding in observational studies, only propensity score methods combined with survey weights may lead to results generalizable to the survey target population when we have complex sample design. Not incorporating the survey weights would compromises external validity, such that outcomes would not be generalized to national figure. That paper clarifies the appropriate inferences for different propensity score methods and suggests guidelines for selecting an appropriate propensity score method based on a researcher's goal. Aiming to obtain consistent estimates, after estimating the propensity score using the kernel method[51], we calculate the ATT weights, according to Abadie (2005).

We follow the recommendation of DuGoff et al (2014) and include the survey weight as a predictor in the probit model chosen for propensity score estimation. As put by the authors, the survey weight may capture relevant factors, and perhaps variables related to the units' probability of responding to the survey and to undergo treatment. Furthermore, we agree that the propensity score model does not need to be survey-weighted, as we are not interested in generalizing the propensity score model to the population. However, in the outcome model we need to incorporate survey weights as we aim to estimate Population Average Treatment Effect on the Treated (PATT). The propensity score weights and survey weights are multiplied to form a new weight for the outcome regression. In that way, incorporating the complex survey, we estimate the effect of increasing teacher salary on the entire treated population.

The potential outcomes are determined by a set of covariates in addition to the treatment as in the following model:

$$Y_{it} = \alpha + \beta\, D_i + \delta\, \mathbb{I}\{t = T_1\} + \gamma \mathbb{I}\{t = T_1\} \cdot D_i + \rho' X_{it} + \varepsilon_{it}$$

where the dependent variable, Y_{it}, is a proportion of teachers of the municipal school system i in year t is explained by a constant (α); the treatment group fixed effect captured by the coefficient of an indicator variable which assumes value 1 if the

[51] Alternatively we use nearest neighbor matching as a robustness check. Results remained qualitatively the same. Asymptotically, all different matching techniques produce the same estimate because in large samples they all compare only the exact matches. However, in finite samples, they differ because of the way they construct counterfactual and choose the weights. There is a trade-off between the bias and variance of matching estimators. The nearest-neighbor matching minimizes the bias, as it chooses only the closest comparison group observation and assigns all the weight to it in constructing the counterfactual. In contrast, kernel matching assigns positive weights to several control units, what implies a greater bias. At the same time, kernel matching reduces the variance of the estimate.

municipal school system were treated and 0 otherwise, D_i; the common effect of the passage of time, represented by δ; the parameter of interest, γ, representing the impact of the treatment, the abnormal teacher salary hike, on the dependent variable; and a vector of covariates X that helps to explain the dependent variable. The model becomes complete with the error term, $\varepsilon_{\mathrm{it}}$. The aforementioned municipal school systems teachers' proportions we analyze are: (i) the proportion of teachers who stayed in the job of previous year; (ii) the proportion of teachers who exit the job of previous year; (iii) the proportion of teachers who entered into the profession; (iv) the proportion of teachers who were recruited in the year of reference; (v) the proportion of teachers who exit private school and entered municipal school system; and (vi) the proportion of teachers who have college degree.

In the OLS regression we weighted each observation using the following weights:

$\mathrm{weight_i} = \mathrm{iptw_i} \cdot \mathrm{sample\_weight_i}$,

where: $\mathrm{iptw_i} = \mathrm{D_i} + \left[\frac{(1-\mathrm{d_i})\widehat{\mathrm{p_i}}}{1-\widehat{\mathrm{p_i}}}\right]$ and $\widehat{\mathrm{p_i}}$ is the estimated propensity score of being treated.

The key identifying assumption is that γ would be zero in the absence of treatment after matching on the propensity score ($\mathrm{E}[\varepsilon_{\mathrm{it}}|\mathbb{I}\{\mathrm{t}=1\}\cdot \mathrm{D_{it}}, \mathrm{p_i}] = 0$).

The reader can see in the Appendix Figure C.1(C.5) and C.3(C.7), that shows the standardized bias across covariates before and after matching for treatment in 2009(2011 and 2013), and Figure C.2(C.6) and C.4(C.8), that compares PS balance between treated and untreated before and after weighting. It is possible to see that matching reduces bias and radically improves the balance of covariates across groups[52].

We get OLS estimates for the constant term, α, corresponding to the average performance of the comparison group at baseline; for β, representing time invariant differences between treatment and comparison groups; for δ, summarizing the way both groups are influenced by time; for γ, the average treatment effect (parameter of interest); and for ρ', the parameter vector associated with changes in covariates.

[52] For 2011 and 2013, the best balancing was achieved using a large bunch of covariates in the Probit model used to explain treatment. However, in this specification, 53 units (municipalities) out of 146 treated units were dropped because they stayed in the region without support. With a more parsimonious model the quantity of treated units without support reduced enormously, but the balancing becomes worse. We estimate ATT with this parsimonious model and the Kernel Propensity Score Method and the results obtained were very similar.

1.6 Estimating the effects of salary hike on teacher retention and transfers

The ultimate objective of the imposition of a national teacher minimum salary was to enhance the quality of the basic education provided by Brazilian public sector. The immediate purpose of the policy was to attract and avoid dropouts of teachers, mainly higher ability teachers.

Tables 1.8 and 1.9 show the estimates obtained with DID and IPTW-DID regressions for teachers move in 2010 and 2011, respectively. The impact of the policy on almost every teacher proportion we examined is not statistically different from zero, considering a statistical significance of 10%. The results are robust to specifications and to different ways to model selection on observables. We only find a statistically significant coefficient of ATT on two regressions showed in Table 1.8.

Result in column 6, for the effect on the proportion of teachers who dropped out the municipal school system in 2011, show a negative coefficient for ATT, statistically significant at 10% level, after applying IPTW weights, i.e. control for observables. As the teacher dropout (or exit) proportion among treated municipal school system was 19.04% in 2008, the salary hike induced by the introduction of the minimum salary cause a reduction of 3.16 p.p., corresponding to a reduction of 16.6%, or 0.35 standard deviation, on teacher dropout rate in treated municipal school system in 2011, the third year of the policy. However, the fact that in the same regression the coefficient associated to the fixed effect of treated group is positive and statistical different from zero make us see the result with caution[53]. It is possible that a mismatch brought by the propensity score weighting is driving the result.

Therefore, apparently, salary hikes were not strong enough to change significantly teachers' exits from and transfers to municipal school systems. In sum, we can say that the policy and salary hikes until 2011 were not able to undoubtedly change teachers' movement on aggregate.

[53] Result is robust to other kind of matching method. With Nearest Neighbor matching, the effect on the proportion of teachers that dropped municipal school systems remains similar (-3.9 p.p.) and statistical significant at 5% level. But, again, the estimated coefficient associated to the dummy of treatment is positive and significant at 5% level.

Table 1.8 Investigating the impact of salary raise on teacher retention, dropouts and recruitment - 2010

VARIABLES	(1) Stayers	(2) Stayers Full	(3) Stayers Full	(4) Exits	(5) Exits Full	(6) Exits Full	(7) Entrants	(8) Entrants Full	(9) Entrants Full	(10) Freshers	(11) Freshers Full	(12) Freshers Full	(13) Former private	(14) Former private Full	(15) Former private Full	(16) College graduated	(17) College graduated Full	(18) College graduated Full
ATT	0.00509	0.0115	-0.0186	0.00371	-0.000444	-0.0141	-0.00509	-0.0115	0.0186	-0.00313	-0.0123	-0.0156	0.00437*	0.00215	0.00137	0.00974	-0.0344	0.0202
	(0.0143)	(0.0142)	(0.0153)	(0.0143)	(0.0140)	(0.0161)	(0.0143)	(0.0142)	(0.0153)	(0.0123)	(0.0133)	(0.0139)	(0.00233)	(0.00253)	(0.00320)	(0.0393)	(0.0230)	(0.0290)
Treated	0.0125	-0.0186*	-0.0149	-0.0155	-0.00397	0.0179*	-0.0125	0.0186*	0.0149	-0.0101	0.0230**	0.0314***	-0.00539***	0.00116	-0.00276	-0.132***	0.00744	-0.0609***
	(0.0110)	(0.0111)	(0.01000)	(0.00947)	(0.0100)	(0.0107)	(0.0110)	(0.0111)	(0.01000)	(0.0111)	(0.0117)	(0.0105)	(0.00176)	(0.00187)	(0.00241)	(0.0256)	(0.0171)	(0.0176)
Time	0.0284***	0.0414	0.0781*	0.0142	-0.0563*	-0.0488	-0.0284***	-0.0414	-0.0781*	-0.127***	-0.132***	-0.212***	-0.00360**	0.00591	0.0112	0.0407	0.0401	-0.0312
	(0.0108)	(0.0394)	(0.0470)	(0.0105)	(0.0302)	(0.0470)	(0.0108)	(0.0394)	(0.0470)	(0.00915)	(0.0363)	(0.0532)	(0.00179)	(0.00590)	(0.0127)	(0.0271)	(0.0522)	(0.103)
Constant	0.783***	1.028***	-0.632	0.175***	0.0156	-0.752	0.217***	-0.0283	1.632	0.213***	0.194	1.989**	0.0142***	0.0221	-0.235	0.647***	0.766***	-0.0398
	(0.00827)	(0.216)	(1.057)	(0.00741)	(0.170)	(0.853)	(0.00827)	(0.216)	(1.057)	(0.00814)	(0.206)	(0.918)	(0.00139)	(0.0342)	(0.168)	(0.0180)	(0.282)	(1.300)
Observations	1,530	1,191	521	1,530	1,191	521	1,530	1,191	521	1,530	1,191	521	1,530	1,191	521	1,530	1,191	521
R-squared	0.022	0.292	0.778	0.009	0.293	0.726	0.022	0.292	0.778	0.275	0.462	0.804	0.012	0.245	0.676	0.060	0.758	0.934
Municipality characteristics		YES	YES		YES	YES		YES	YES		YES	YES		YES	YES		YES	YES
School system chracteristics		YES	YES		YES	YES		YES	YES		YES	YES		YES	YES		YES	YES
School Infrastructure		YES	YES		YES	YES		YES	YES		YES	YES		YES	YES		YES	YES
Pupils' characteristics		YES	YES		YES	YES		YES	YES		YES	YES		YES	YES		YES	YES
Weights			IPTW			IPTW			IPTW			IPTW			IPTW			IPTW

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Notes: 1) the proportion of stayers is obtained dividing the number of teachers who stayed in the same municipal system between the previous year and the year of reference by the quantity of teachers in that municipal school system.

2) the proportion of exits is obtained dividing the number of teachers who leave the municipal system in the passage of the previous year to the year of reference by the quantity of teachers in that municipal school system.

3) the proportion of entrants is obtained dividing the number of teachers who enter into a municipal system coming from another school system in the passage of the previous year to the year of reference by the quantity of teachers in that municipal school system.

4) the proportion of freshers is obtained dividing the number of teachers who were not teaching in the previous year and enter into a municipal system in the passage in the year of reference by the quantity of teachers in that municipal school system.

5) the proportion of former private is obtained dividing the number of teachers who enter into a municipal school system in the year of reference coming from private schools in the previous year by the quantity of teachers in that municipal school system.

6) the proportion of College graduated is obtained dividing the number of teachers who have a College diploma and enter into a municipal school system in the year of reference by the quantity of teachers in that municipal school system.

Table 1.9 Investigating the impact of salary raise on teacher retention, dropouts and recruitment - 2011

VARIABLES	(1) Stayers	(2) Stayers Full	(3) Stayers Full	(4) Exits	(5) Exits Full	(6) Exits Full	(7) Entrants	(8) Entrants Full	(9) Entrants Full	(10) Freshers	(11) Freshers Full	(12) Freshers Full	(13) Former private	(14) Former private Full	(15) Former private Full	(16) College graduated	(17) College graduated Full	(18) College graduated Full
ATT	-0.00795	-0.00296	-0.00379	-0.0106	-0.0108	-0.0316*	0.00795	0.00296	0.00379	0.0127	-0.000578	-0.00970	0.00578**	0.00492	0.00533	0.0230	-0.0160	0.0170
	(0.0177)	(0.0167)	(0.0170)	(0.0157)	(0.0152)	(0.0171)	(0.0177)	(0.0167)	(0.0170)	(0.0155)	(0.0160)	(0.0154)	(0.00293)	(0.00330)	(0.00357)	(0.0470)	(0.0256)	(0.0268)
Treated	0.0132	-0.0247*	-0.0232**	-0.00287	0.0211*	0.0220**	-0.0132	0.0247*	0.0232**	-0.0147	0.0267*	0.0327***	-0.00716***	-0.00154	-0.00440*	-0.141***	-0.0208	-0.0471**
	(0.0135)	(0.0135)	(0.0107)	(0.0117)	(0.0117)	(0.0107)	(0.0135)	(0.0135)	(0.0107)	(0.0141)	(0.0144)	(0.0109)	(0.00206)	(0.00225)	(0.00243)	(0.0300)	(0.0205)	(0.0195)
Time	0.0409***	0.0382	0.103**	-0.00185	-0.0270	-0.102**	-0.0409***	-0.0382	-0.103**	-0.158***	-0.127***	-0.260***	-0.00449**	0.00223	-0.00513	0.111***	0.137**	0.0841
	(0.0119)	(0.0392)	(0.0493)	(0.0116)	(0.0349)	(0.0517)	(0.0119)	(0.0392)	(0.0493)	(0.0108)	(0.0395)	(0.0497)	(0.00215)	(0.00885)	(0.0115)	(0.0328)	(0.0661)	(0.0933)
Constant	0.783***	-0.314	-0.650	0.170***	1.703***	2.247**	0.217***	1.314***	1.650*	0.216***	1.479***	1.753*	0.0151***	-0.0956	0.0139	0.657***	2.557***	1.224
	(0.00956)	(0.437)	(0.888)	(0.00869)	(0.547)	(1.119)	(0.00956)	(0.437)	(0.888)	(0.00978)	(0.481)	(0.925)	(0.00166)	(0.0993)	(0.150)	(0.0219)	(0.713)	(1.225)
Observations	1,030	828	540	1,030	828	540	1,030	828	540	1,030	828	540	1,030	828	540	1,030	828	540
R-squared	0.026	0.385	0.733	0.004	0.388	0.713	0.026	0.385	0.733	0.341	0.551	0.802	0.018	0.319	0.644	0.114	0.751	0.930
Municipality characteristics		YES	YES		YES	YES		YES	YES		YES	YES		YES	YES		YES	YES
School system chracteristics		YES	YES		YES	YES		YES	YES		YES	YES		YES	YES		YES	YES
School Infrastructure		YES	YES		YES	YES		YES	YES		YES	YES		YES	YES		YES	YES
Pupils' characteristics		YES	YES		YES	YES		YES	YES		YES	YES		YES	YES		YES	YES
Weights			IPTW			IPTW			IPTW			IPTW			IPTW			IPTW

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Notes: 1) the proportion of stayers is obtained dividing the number of teachers who stayed in the same municipal system between the previous year and the year of reference by the quantity of teachers in that municipal school system.

2) the proportion of exits is obtained dividing the number of teachers who leave the municipal system in the passage of the previous year to the year of reference by the quantity of teachers in that municipal school system.

3) the proportion of entrants is obtained dividing the number of teachers who enter into a municipal system coming from another school system in the passage of the previous year to the year of reference by the quantity of teachers in that municipal school system.

4) the proportion of freshers is obtained dividing the number of teachers who were not teaching in the previous year and enter into a municipal system in the passage in the year of reference by the quantity of teachers in that municipal school system.

5) the proportion of former private is obtained dividing the number of teachers who enter into a municipal school system in the year of reference coming from private schools in the previous year by the quantity of teachers in that municipal school system.

6) the proportion of College graduated is obtained dividing the number of teachers who have a College diploma and enter into a municipal school system in the year of reference by the quantity of teachers in that municipal school system.

1.7 Concluding remarks

Brazilian federal government introduced a national minimum base salary for teachers to be observed in every public school system from January 2009. This chapter contributes to a better understanding of the policy and its effects on teachers' labor market. The first objective of this chapter was to investigate the compliance of municipal school system with the national minimum salary for teachers and the effects of the law on teacher salary. We carried out a survey based on a representative sample of municipal department of education to get precise teacher base salaries of each municipal school system. The estimates obtained through our survey reveals that the institution of the minimum salary moved significantly base teacher salaries and, consequently, total teachers' salaries. Estimates show also that salary increase was harder in municipalities impinged by the law.

Our survey reveals that there are a high proportion of municipalities that do not comply with the law, a proportion similar to the proportion of municipalities that, according to *CGU*, do not observe the obligation of spending at least 60% of *FUNDEB* with teachers' pay. Considering a linear probability model, all covariates explained only 44.1% of the probability of compliance with the minimum salary law in 2009 and 47.1% of the probability of compliance with the minimum salary law in 2009 or 2010. The main factors that explain the probability of compliance are institutional characteristics of the school system followed by socioeconomic characteristics of the municipalities and the state of location of municipalities. Surprisingly, covariates that reflect the fiscal situation of the municipality explain only 3.8% of the probability of compliance.

Arguably, as a result of the introduction of minimum base salary for teachers, the explained part of teacher salary variability among municipal school systems fall considerably from 54.7% in 2008 to 35.2% in 2013, a huge drop of almost 20 p.p.. According to our estimates, the role of observable characteristics in explaining the compliance with the law is limited, even when we incorporate some characteristics of the head of the municipal department of education, what leaves considerable place for unobserved characteristics in explaining teacher salaries and the compliance with the law. Therefore, any attempt to assess the impacts of the exogenous salary variation brought by the introduction of the minimum salary, should rely on any method that control for unobservables.

Due to the lack of secondary data on municipal base teacher salary, we carried out a survey on teacher career and remuneration with a representative sample of Brazilian municipal school systems. Our survey contributes to a better understanding about which municipal school systems were impinged by the law and about the compliance of municipal school system with the national minimum salary for teachers and the effects of the law on teacher salary. The majority of Brazilian municipal school systems (61.4%) were impinged by the introduction of the national minimum salary and in 2013 there were a high proportion of municipalities that do not comply with the law, 32.8%. The main factors that explain the probability of compliance are institutional characteristics of the school system followed by socioeconomic characteristics of the municipalities and the state of location of municipalities.

The estimates obtained through our survey reveals that the institution of the minimum salary moved significantly base teacher salaries and, consequently, total teachers' salaries. Municipal school systems that complied with the law at least since 2011 (representing 20.5% of Brazilian municipalities) present an annual real growth rate of teachers' salaries of 10.2% in the period from 2008 to 2013, significantly above the growth rate verified in the others municipal school systems (2.9%). Although salaries change sharply, we do not find significant effects of the policy on teachers' labor market. In 2008, average municipal teachers' salary was a little bit lower than private teachers' salary according to *RAIS* database, representing 0.93 of the average private primary teachers' remuneration. But after the introduction of the minimum salary for public teachers this relation jumped to 1.11 in 2013, with an eloquent relation of 1.27:1 in municipalities where municipal school systems comply with the law at least one year, departing from 1:1 in 2008. Meanwhile in municipalities that already paid more than the minimum this relation evolved from 1.03:1 to 1.06:1.

Since the first year of the policy, municipal school systems which complied with the law raised salaries sharper than non-impinged ones and non-compliers. Thus we tried to answer if compliers perform better than non-compliers and non-impinged municipal school systems in retaining and attracting teachers. However estimates based on DID and selection on observables show null effects of the policy

on teachers move in its first years 2010 and 2011[54], except for the case of the proportion of teachers who exit from treated municipal school systems that seems to decrease due to the salary hike.

An exogenous salary increase would lead to an influx of new entrants, which would in turn favor downward moves in the equilibrium salary after some time, mainly considering the oligopsonistic characteristic of public school teacher market. Rational expectations models assume that agents take into account this feedback effect that would eventually take place. On the other side, static expectations models assume that agents ignore feedback effects, and therefore that entrants overreact to current shocks (Leigh, 2012). Our results are compatible with rational expectations models. Perhaps teachers anticipate that salaries in the public sector would converge sooner or later to the minimum salary stipulated nationally, annihilating any difference among public school systems salaries after some time. In that scenario, any gain capable of attracting teachers obtained in the short term should have been much higher than what teachers witnessed in the aftermath of minimum salary introduction.

It is crucial to investigate the salary necessary to change teachers' composition in the steady state in terms of their characteristics and quality. Future research should focus on the investigation of the factors that contribute to the individual decision about teaching based on a discrete choice model. With this model it would be possible to simulate potential teachers' decision and estimate the salary level necessary to change teachers' composition in the steady state in terms of their characteristics and quality.

[54] As a next step, we will extend our analysis to 2012 and we will enhance our identification considering salary increases relative to nearby municipalities.

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APPENDIX A – Descriptive statistics - comparison between groups

Table A.1 Characteristics of the population of Brazilian municipalities – estimated from the weighted sample *x* real distribution

PANEL A - Comparison between sample, out of the sample and real population according to localization

Region	Municipalities with less than 200,000 inhab					Municipalities with 200,000 inhab or more				
	sample (A)	sample (weighted) (B)	out of sample (C)	total (D)	diff (B)-(D)	sample (A)	sample (weighted) (B)	out of sample (C)	total (D)	diff (B)-(D)
# obs	840	840	4600	5440		67	67	57	124	
N	11.9	7.71	7.41	8.11	-0.0041	2.99	4.53	10.53	6.45	-0.0192
					(0,0101)					(0,0355)
NE	25.71	31.37	33.74	32.5	-0.0113	14.93	22.52	28.07	20.97	0.0156
					(0,0173)					(0,0626)
SE	27.5	30.35	29.87	29.5	0.0085	58.21	51.91	42.11	50.81	0.0110
					(0 ,0169)					(0,0762)
S	20.48	22.67	21.63	21.45	0.0121	16.42	13.21	17.54	16.94	-0.0373
					(0,0152)					(0,0553)
MW	14.4	7.9	7.35	8.44	-0.0054	7.46	7.83	1.75	4.84	0.0299
					(0,0103)					(0,0358)

PANEL B - Comparison between sample and the whole country according to characteristics

	sample (A)	sample (weighted) (B)	out of sample (C)	total (D)	diff (B)-(D)
Municipality characteristics					
# obs	907	907	4657	5564	
population (2007)	79,142	32,511	23,508	32,579	-68
st-dev	449,757	226,272	74,820	195,083	7,153
adult illiteracy rate (%)	13.9	15.4	16.6	16.2	-0,798**
st-dev	9.1	9.6	9.9	9.8	0.351
per capita GDP	10496.97	9061.274	9002.856	9246.459	-185.185
st-dev	8838.731	7301.328	10961.41	10657.84	367.189
RPPS	45.9%	35.8%	33.7%	35.7%	0.1%
					1.7%
School system characteristics					
# obs	902	902	4599	5501	
teachers pay/pupil (R$)	1457.37	1384.04	1380.19	1392.84	-8.80
st-dev	721.01	705.11	776.98	768.55	27.30
teachers pay/Fundeb resources (%)	72.499	71.647	71.687	71.820	-0.172
st-dev	12.271	12.002	12.337	12.329	0.441
budget spent on education (%)	28.727	28.937	29.893	29.702	-0,766**
	7.836	7.811	8.512	8.416	0.299
quantity of pupils	4200.5	2163.0	1841.5	2229.1	-66.1
st-dev	16932.0	8794.2	3882.5	7772.9	285.0
# obs	900	900	4578	5478	
Pupils' family background					
proportion of white pupils	36.6%	36.8%	35.6%	35.8%	1.0%
st-dev	16.6%	17.9%	17.5%	17.3%	0.6%
# obs	838	838	4149	4987	
possession of cars	36.4%	36.1%	33.5%	34.0%	2,16%**
st-dev	19.0%	20.4%	19.2%	19.2%	0.7%
# obs	838	838	4149	4987	
HH with fridge	91.2%	89.8%	88.0%	88.5%	1,27%***
st-dev	10.1%	11.0%	11.7%	11.5%	0.4%
# obs	838	838	4149	4987	
HH with internet access	12.5%	11.4%	10.7%	11.0%	0.3%
st-dev	9.1%	8.4%	8.4%	8.6%	0.3%
# obs	838	838	4149	4987	
mother with at least 12 years of shooling	25.5%	24.8%	24.3%	24.5%	0.3%
st-dev	10.4%	10.3%	11.6%	11.4%	0.4%
# obs	838	838	4147	4985	
live with both parents	61.7%	60.9%	59.7%	60.0%	0.8%
st-dev	14.0%	16.4%	17.2%	16.7%	0.6%
# obs	837	837	4132	4969	
School infrastructure and facilities					
# obs	900	900	4580	5480	
computer for pupils	2.381	1.931	1.791	1.888	0.044
st-dev	4.410	3.949	3.795	3.909	0.141
schools with internet access	27.3%	24.7%	22.9%	23.6%	1.2%
st-dev	34.5%	33.7%	33.6%	33.8%	1.2%
schools with science laboratory	3.7%	3.2%	2.9%	3.0%	0.2%
st-dev	13.5%	13.7%	11.6%	11.9%	0.4%
restroom with accessibility	10.3%	7.7%	7.1%	7.6%	0.1%
st-dev	19.9%	18.3%	17.3%	17.8%	0.6%

PANEL C - Comparison between sample and the whole country according to variables of interest

	sample (A)	sample (weighted) (B)	out of sample (C)	total (D)	diff (B)-(D)
2005 Math score	179.1188	179.4492	176.5691	177.004	2,4452***
st-dev	16.55392	17.35767	17.6978	17.53241	0.6958
# obs	741	741	3604	4345	
2007 Math score	189.508	189.7538	187.1653	187.5581	2,1957***
st-dev	18.706	20.514	20.409	20.151	0.755
# obs	836	836	4150	4986	
2011 Math score	207.888	208.049	204.684	205.219	2,83***
st-dev	23.057	24.872	25.625	25.241	0.93
# obs	857	857	4279	5136	
Math score variation (2005-2007)	10.53	10.30	10.51	10.51	-0.212
st-dev	12.47	13.72	14.42	14.10	0.559
# obs	738	738	3592	4330	
Math score variation (2007-2011)	18.590	18.546	17.131	17.377	1,16832*
st-dev	16.594	17.975	18.854	18.498	0.696858
# obs	817	817	4022	4839	
2005 Portuguese score	170.708	170.003	167.113	167.726	2,2772***
st-dev	16.322	17.054	17.026	16.960	0.675
# obs	741	741	3604	4345	
2007 Portuguese score	170.8865	170.4286	168.3505	168.7757	1,6529**
st-dev	16.44666	17.84729	17.67715	17.50095	0.656
# obs	836	836	4150	4986	
2011 Portuguese score	187.578	187.116	184.301	184.848	2,268***
st-dev	18.565	20.003	20.775	20.458	0.753
# obs	857	857	4279	5136	
Portuguese score variation (2005-2007)	0.245	0.267	1.078	0.936	-0.669
st-dev	10.732	11.417	12.276	12.029	0.476
# obs	738	738	3592	4330	
Portuguese score variation (2007-2011)	16.939	16.993	15.647	15.865	1,12778**
st-dev	13.818	15.188	15.440	15.185	0.574
# obs	817	817	4022	4839	
Proportion of full-time teachers (2007)	59.52%	60.41%	60.07%	59.98%	0.43%
st-dev	28.75%	29.83%	29.33%	29.23%	1.10%
# obs	837	837	4131	4968	
Proportion of full-time teachers (2011)	57.24%	57.83%	59.22%	58.89%	-1.06%
st-dev	28.66%	29.17%	29.64%	29.48%	1.10%
# obs	830	830	4122	4952	
variation full-time teachers (2007-2011)	-2.05%	-2.30%	-0.90%	-1.09%	-1.21%
st-dev	35.88%	36.05%	35.83%	35.83%	1.38%
# obs	794	794	3893	4687	

Table A.2 Proportion of impinged and non-impinged municipal school systems by Region/State (%)

Region/ State	burdened (or impinged) no	yes
North	33.5	66.5
AC	64.6	35.4
AM	37.7	62.3
AP	0.0	100.0
PA	20.0	80.0
RO	23.3	76.7
RR	82.1	18.0
TO	42.4	57.7
Northeast	16.2	83.8
AL	51.2	48.9
BA	6.9	93.2
CE	16.4	83.6
MA	35.7	64.3
PB	7.6	92.4
PE	6.5	93.5
PI	20.2	79.8
RN	12.2	87.8
SE	21.2	78.8
Southeast	56.4	43.6
ES	21.2	78.8
MG	31.2	68.8
RJ	65.8	34.2
SP	95.1	4.9
South	50.4	49.6
PR	39.1	60.9
RS	66.8	33.2
SC	40.2	59.8
Mid-West	31.7	68.3
GO	24.7	75.3
MS	46.7	53.3
MT	35.9	64.1
Total	**38.8**	**61.2**

Table A.3 Comparison of some characteristics between treated and untreated (2009) – estimated from the weighted sample

VARIABLES	Untreated (2009)		Treated (2009)		Obs.	F-test	Prob > F	
Panel A								
Math score (2007)	198.0	(1.579)	183.1	(1.219)	598	46.91	0.00	***
Port score (2007)	178.2	(1.387)	164.5	(1.068)	601	50.74	0	***
Base salary (2008) - R$	1,353	(20.43)	850.3	(10.10)	607	485.1	0	***
Base salary (2011) - R$	1,689	(22.92)	1,310	(14.25)	607	185.4	0	***
Base salary (2013) - R$	2,040	(26.45)	1,724	(15.14)	607	107.8	0	***
Panel B - Municipality characteristics								
MW	0.0733	(0.0101)	0.0693	(0.00826)	607	0.0485	0.83	
N	0.0718	(0.0203)	0.0760	(0.0167)	607	0.0138	0.91	
NE	0.131	(0.0263)	0.523	(0.0221)	607	86.34	0	***
S	0.295	(0.0235)	0.127	(0.0201)	607	15.53	0	***
SE	0.429	(0.0253)	0.205	(0.0194)	607	27.36	0	***
Inhabitants (2007)	56,390	(10,812)	22,955	(1,856)	607	9.110	0.00	***
GDP (2007)	1.032e+06	(306,475)	198,278	(25,450)	607	7.312	0.01	***
Per capita GDP (2007)	12,410	(590.4)	6,809	(287.3)	607	69.43	0.00	***
Adult illiteracy rate	10.95	(0.674)	19.15	(0.517)	607	70.34	0.00	***
Rural pop	26.14	(1.298)	35.42	(1.313)	583	24.24	0	***
Current revenues (2007)	7.700e+07	(1.874e+07)	2.366e+07	(2.051e+06)	607	7.944	0	***
Expenditure with personnel/curr rev (2008)	0.401	(0.00520)	0.415	(0.00476)	571	4.002	0	**
Prop. IPTU/curr ver (2007)	0.0327	(0.00334)	0.00798	(0.000908)	607	48.55	0.00	***
Prop. ISS/curr ver (2007)	0.0291	(0.00171)	0.0221	(0.00162)	607	8.504	0.00	***
Prop. FUNDEB/curr ver (2007)	0.127	(0.00442)	0.155	(0.00360)	607	18.15	0.00	***
Panel C - School system characteristics								
School with tutoring (2007)	0.800	(0.0228)	0.666	(0.0195)	596	16.33	0.00	***
Class size (2007)	21.96	(0.262)	20.14	(0.319)	607	17.47	0.00	***
Full-time-teacher (2007)	0.564	(0.0214)	0.635	(0.0191)	596	5.775	0.02	**
Teacher age	36.32	(0.234)	35.85	(0.188)	607	2.158	0.14	
Prop teacher with College degree	0.804	(0.0219)	0.738	(0.0154)	596	5.655	0.02	**
Unexperienced 5th grade teacher (2007)	0.308	(0.0185)	0.341	(0.0195)	596	1.449	0.23	
Teachers who correct Math HW (2007)	0.844	(0.00615)	0.831	(0.00706)	596	1.696	0.19	
Teachers who correct Port HW (2007)	0.836	(0.00719)	0.837	(0.00802)	595	0.00675	0.94	
Teachers strike after 2008	0.105	(0.0247)	0.207	(0.0313)	603	6.593	0.01	**

(continue)

Table A.3 Comparison of some characteristics between treated and untreated (2009) – estimated from the weighted sample (cont)

VARIABLES	Untreated (2009)		Treated (2009)		Obs.	F-test	Prob > F	
Panel D - School infrastructure								
Restroom with accessibility (2007)	0.150	(0.0182)	0.0382	(0.00568)	607	33.31	0.00	***
Science Laboratory (2007)	0.0514	(0.00969)	0.0137	(0.00385)	607	12.88	0.00	***
TI laboratory (2007)	0.314	(0.0248)	0.102	(0.0182)	607	45.72	0.00	***
Computer for pupils (2007)	3.657	(0.342)	0.862	(0.144)	607	55.24	0.00	***
Internet access (2007)	0.414	(0.0277)	0.147	(0.0186)	607	58.78	0.00	***
Library (2007)	0.542	(0.0266)	0.261	(0.0197)	607	60.67	0.00	***
Filtered water (2007)	0.770	(0.0214)	0.880	(0.0182)	607	11.32	0.00	***
No energy supply (2007)	0.0347	(0.00809)	0.0867	(0.0119)	607	11.71	0.00	***
Panel E - Pupils characteristics								
Pupils who work (2007)	0.152	(0.00488)	0.175	(0.00445)	596	11.13	0.00	***
Live with mother (2007)	0.219	(0.00754)	0.218	(0.00668)	596	0.00163	0.97	
Live with parents (2007)	0.639	(0.0117)	0.583	(0.00960)	596	11.24	0.00	***
Illiterate mother (2007)	0.0583	(0.00491)	0.0956	(0.00475)	596	26.02	0.00	***
Mother with High School (2007)	0.274	(0.00723)	0.240	(0.00579)	596	14.02	0.00	***
HH with computer and internet (2007)	0.156	(0.00701)	0.0835	(0.00390)	596	72.84	0.00	***
White pupils (2007)	0.457	(0.0134)	0.338	(0.00859)	596	46.74	0.00	***
HH with car (2007)	0.453	(0.0145)	0.281	(0.0105)	596	71.56	0.00	***
HH with laudry (2007)	0.612	(0.0178)	0.405	(0.0131)	596	65.04	0.00	***
HH with fridge (2007)	0.942	(0.00728)	0.873	(0.00592)	596	50.28	0.00	***
HH with housekeeper (2007)	0.116	(0.00352)	0.117	(0.00379)	596	0.0574	0.81	
Attended day care (2007)	0.340	(0.0109)	0.339	(0.0133)	596	0.00359	0.95	
Attended pre-school (2007)	0.792	(0.00775)	0.765	(0.00714)	596	5.752	0.02	**
Crowded HH (2007)	0.208	(0.00871)	0.268	(0.00776)	596	22.37	0.00	***
Age-grade gap (2007)	0.349	(0.0118)	0.460	(0.00966)	596	43.70	0.00	***
Encouraging parents (2007)	0.640	(0.0136)	0.562	(0.0102)	596	14.21	0.00	***
Prop of pupils who does Math HW	0.787	(0.00715)	0.786	(0.00753)	596	0.00142	0.97	
Prop of pupils who does Port HW	0.757	(0.00891)	0.759	(0.00826)	596	0.0307	0.86	

Table A.4 Comparison of some characteristics between treated and untreated (2011 and 2013) – estimated from the weighted sample

VARIABLES	Untreated (2011 and 2013)		Treated (2011 and 2013)		Obs.	F-test	Prob > F	
Panel A								
Math score (2007)	201.1	(1.873)	184.2	(1.510)	412	44.53	0.00	***
Port score (2007)	180.7	(1.575)	165.6	(1.331)	416	47.18	0	***
Base salary (2008) - R$	1,426	(24.64)	907.2	(14.37)	419	322.7	0	***
Base salary (2011) - R$	1,778	(26.18)	1,428	(21.24)	419	107.8	0	***
Base salary (2013) - R$	2,124	(30.62)	1,826	(21.15)	419	62.49	0	***
Panel B - Municipality characteristics								
MW	0.0464	(0.0109)	0.0909	(0.0118)	419	4.023	0.05	**
N	0.0585	(0.0252)	0.0735	(0.00766)	419	0.297	0.59	
NE	0.105	(0.0269)	0.515	(0.0263)	419	79.08	0	***
S	0.298	(0.0258)	0.0936	(0.0273)	419	16.21	0	***
SE	0.492	(0.0289)	0.227	(0.0241)	419	29.60	0	***
Inhabitants (2007)	63,109	(14,484)	31,238	(3,995)	419	4.382	0.04	**
GDP (2007)	1.263e+06	(419,249)	290,977	(46,643)	419	5.261	0.02	**
Per capita GDP (2007)	13,543	(761.6)	7,077	(416.1)	419	56.16	0.00	***
Adult illiteracy rate	10.09	(0.734)	19.21	(0.633)	419	68.02	0.00	***
Rural pop	24.49	(1.222)	36.24	(1.609)	396	33.56	0	***
Current revenues (2007)	9.068e+07	(2.554e+07)	3.188e+07	(4.100e+06)	419	5.095	0	**
Expenditure with personnel/curr rev (2008)	0.394	(0.00568)	0.421	(0.00629)	396	10.48	0	***
Prop. IPTU/curr ver (2007)	0.0336	(0.00284)	0.0112	(0.00221)	419	37.73	0.00	***
Prop. ISS/curr ver (2007)	0.0315	(0.00208)	0.0224	(0.00221)	419	8.729	0.00	***
Prop. FUNDEB/curr ver (2007)	0.122	(0.00501)	0.160	(0.00434)	419	25.55	0.00	***
Panel C - School system characteristics								
School with tutoring (2007)	0.828	(0.0244)	0.682	(0.0263)	412	15.62	0.00	***
Class size (2007)	22.00	(0.297)	20.97	(0.398)	419	3.752	0.05	*
Full-time-teacher (2007)	0.564	(0.0209)	0.630	(0.0234)	412	3.997	0.05	**
Teacher age	36.45	(0.279)	36.16	(0.224)	419	0.626	0.43	
Prop teacher with College degree	0.802	(0.0263)	0.748	(0.0243)	412	2.146	0.14	
Unexperienced 5th grade teacher (2007)	0.286	(0.0185)	0.373	(0.0244)	412	7.680	0.01	***
Teachers who correct Math HW (2007)	0.845	(0.00775)	0.823	(0.00833)	412	3.562	0.06	*
Teachers who correct Port HW (2007)	0.837	(0.00826)	0.825	(0.0108)	411	0.626	0.43	
Teachers strike after 2008	0.0942	(0.0272)	0.209	(0.0426)	419	5.193	0.02	**

(continue)

Table A.4 Comparison of some characteristics between treated and untreated (2011 and 2013) – estimated from the weighted sample (conclusion)

VARIABLES	Untreated (2011 and 2013)		Treated (2011 and 2013)		Obs.	F-test	Prob > F	
Panel D - School infrastructure								
Restroom with accessibility (2007)	0.163	(0.0226)	0.0545	(0.0123)	419	17.72	0.00	***
Science Laboratory (2007)	0.0555	(0.0122)	0.0177	(0.00633)	419	7.526	0.01	***
TI laboratory (2007)	0.348	(0.0281)	0.142	(0.0284)	419	26.69	0.00	***
Computer for pupils (2007)	4.318	(0.432)	1.145	(0.205)	419	42.02	0.00	***
Internet access (2007)	0.463	(0.0307)	0.181	(0.0253)	419	45.24	0.00	***
Library (2007)	0.567	(0.0303)	0.298	(0.0252)	419	37.49	0.00	***
Filtered water (2007)	0.757	(0.0248)	0.907	(0.0239)	419	14.34	0.00	***
No energy supply (2007)	0.0363	(0.0102)	0.0647	(0.00903)	419	3.885	0.05	**
Panel E - Pupils characteristics								
Pupils who work (2007)	0.146	(0.00559)	0.176	(0.00531)	412	14.44	0.00	***
Live with mother (2007)	0.218	(0.00919)	0.221	(0.00897)	412	0.0388	0.84	
Live with parents (2007)	0.648	(0.0122)	0.572	(0.0106)	412	16.75	0.00	***
Illiterate mother (2007)	0.0542	(0.00597)	0.101	(0.00654)	412	23.42	0.00	***
Mother with High School (2007)	0.280	(0.00789)	0.239	(0.00761)	412	14.57	0.00	***
HH with computer and internet (2007)	0.170	(0.00875)	0.0895	(0.00570)	412	53.33	0.00	***
White pupils (2007)	0.479	(0.0170)	0.333	(0.0117)	412	39.78	0.00	***
HH with car (2007)	0.481	(0.0186)	0.284	(0.0135)	412	58.22	0.00	***
HH with laudry (2007)	0.626	(0.0207)	0.393	(0.0191)	412	50.83	0.00	***
HH with fridge (2007)	0.953	(0.00694)	0.876	(0.00875)	412	45.58	0.00	***
HH with housekeeper (2007	0.113	(0.00412)	0.119	(0.00417)	412	1.230	0.27	
Attended day care (2007)	0.349	(0.0133)	0.345	(0.0177)	412	0.0433	0.84	
Attended pre-school (2007)	0.801	(0.00943)	0.762	(0.00877)	412	8.500	0.00	***
Crowded HH (2007)	0.199	(0.0106)	0.273	(0.00884)	412	24.56	0.00	***
Age-grade gap (2007)	0.323	(0.0134)	0.463	(0.0121)	412	50.60	0.00	***
Encouraging parents (2007)	0.653	(0.0173)	0.556	(0.0119)	412	14.89	0.00	***
Prop of pupils who does Math HW	0.785	(0.00734)	0.781	(0.00933)	412	0.106	0.75	
Prop of pupils who does Port HW	0.755	(0.00968)	0.764	(0.00920)	412	0.307	0.58	

APPENDIX B – Consistency between base teacher salary (author's survey) and teacher remuneration (*RAIS*)

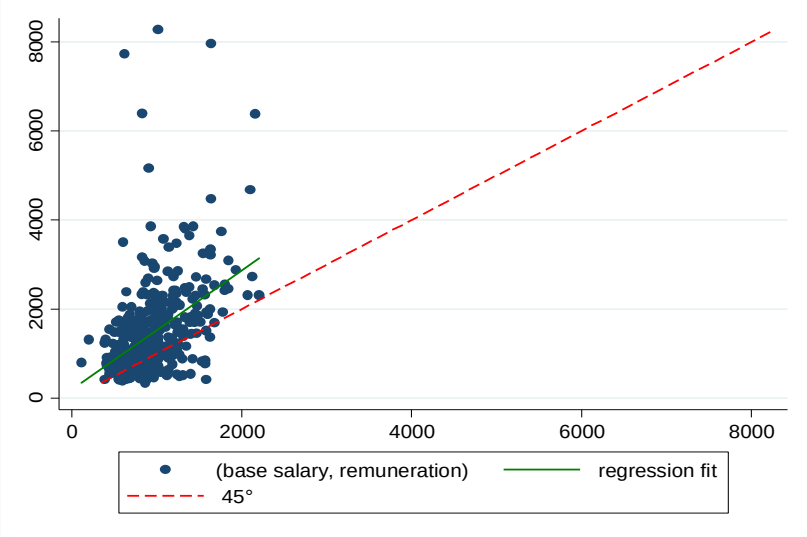


Figure B1 Teachers with contract of secondary schooling: Municipal primary teachers remuneration (RAIS) x Municipal base teacher salary - 2008

Note: 25.9% of the municipalities in our sample present average remuneration of municipal teacher without college diploma lower than base salary informed in our survey, what would be impossible to be true since base salary should be the floor of the remuneration. Those cases are represented by dots above the dashed red line (45º).

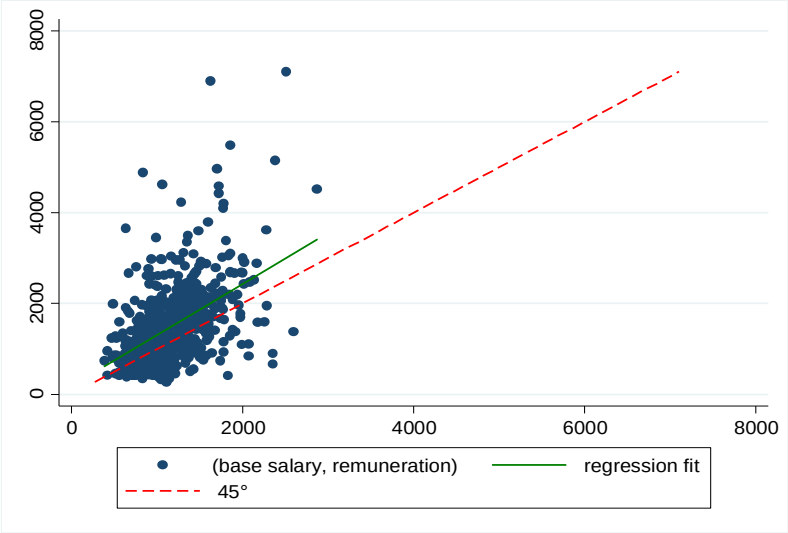


Figure B2 Teachers with contract of tertiary schooling: Municipal primary teachers remuneration (RAIS) x Municipal base teacher salary - 2008

Note: 35.4% of the municipalities in our sample present average remuneration of municipal teacher with college diploma lower than base salary informed in our survey, what would be impossible to be true since base salary should be the floor of the remuneration. Those cases are represented by dots above the dashed red line (45º).

APPENDIX C – Tests for covariates balancing between treated and untreated groups

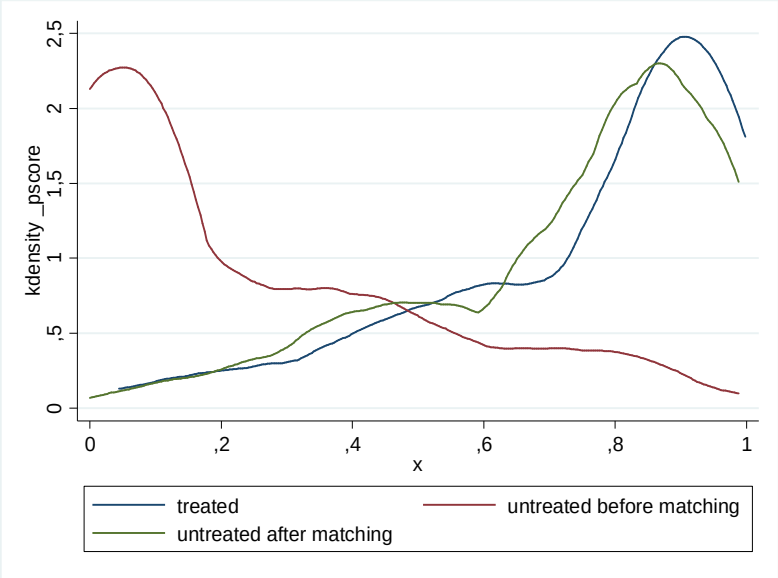


Figure C1 – Standardized bias across covariates – treatment for 2009 (matching method: Epanechnikov Kernel)

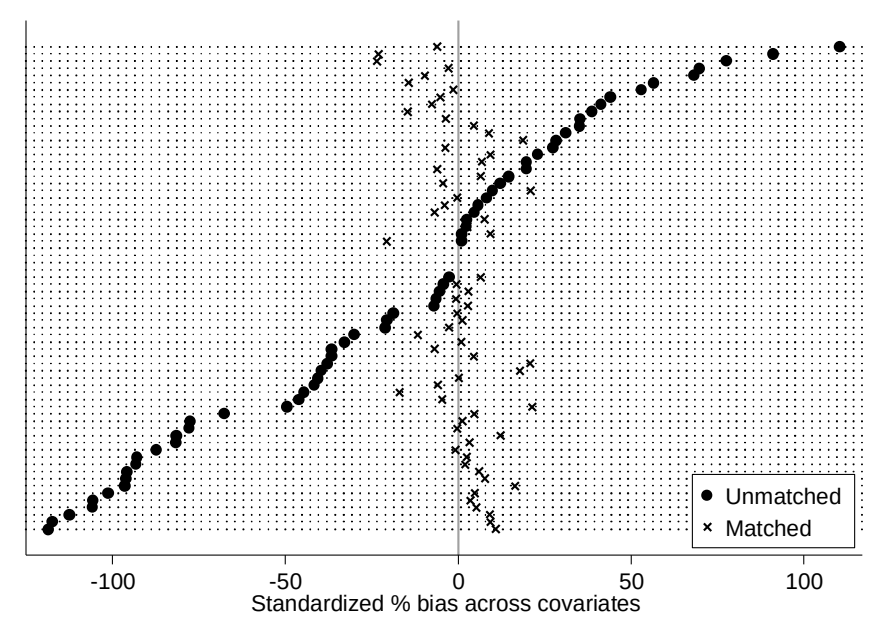


Figure C2 – Comparison of kernel densities of the estimated propensity score between groups – treatment for 2009 (matching method: Epanechnikov Kernel)

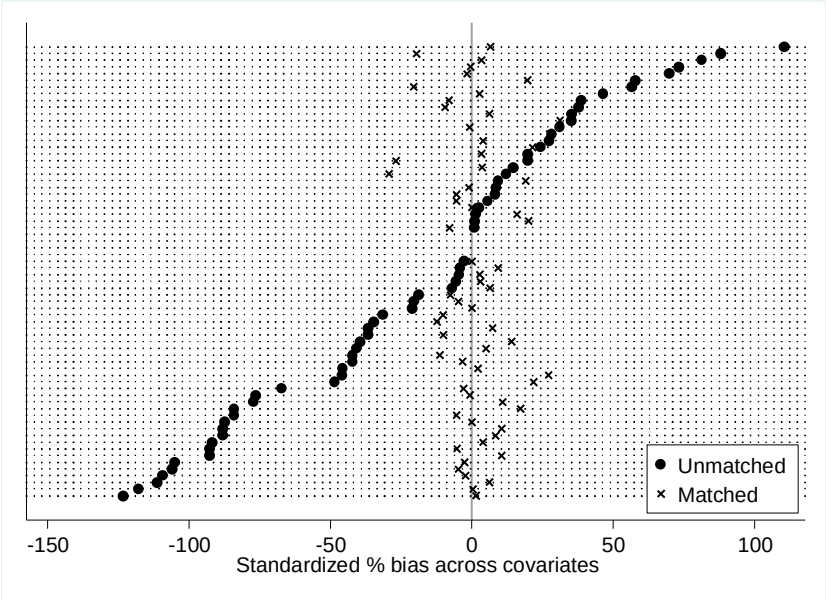


Figure C3 – Standardized bias across covariates – treatment for 2009 (matching method: Nearest Neighbor with reposition)

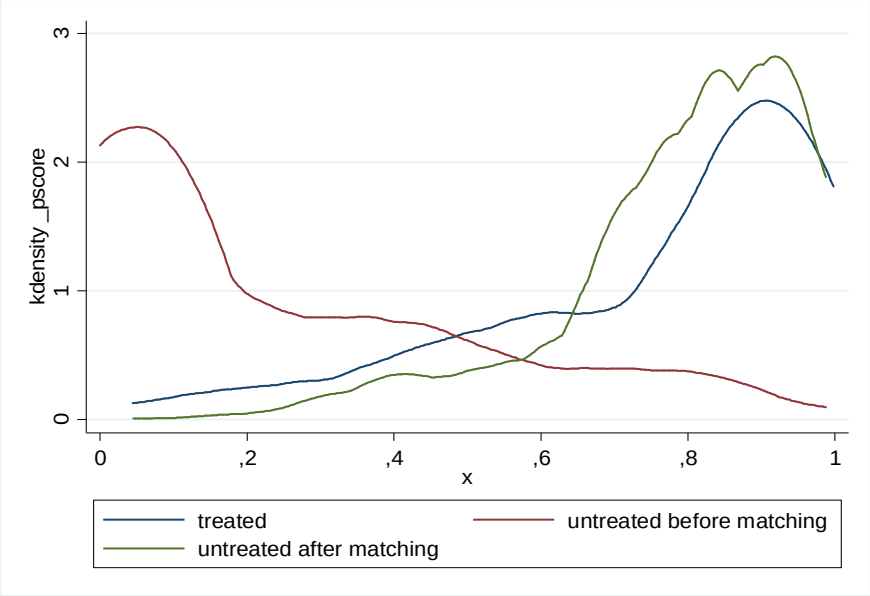


Figure C4 – Comparison of kernel densities of the estimated propensity score between groups – treatment for 2009 (matching method: Nearest Neighbor with reposition)

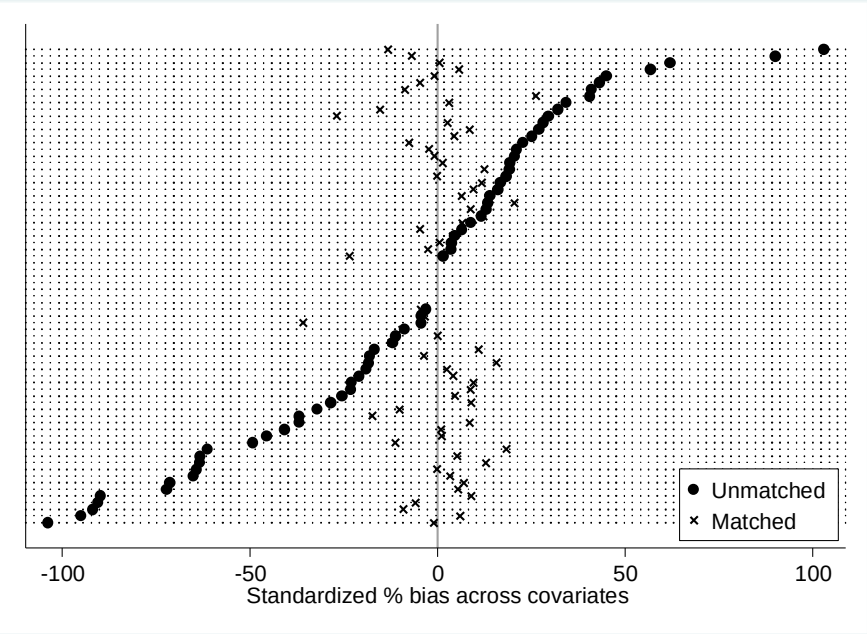


Figure C5 – Standardized bias across covariates – treatment for 2011 and 2013 (matching method: Epanechnikov Kernel)

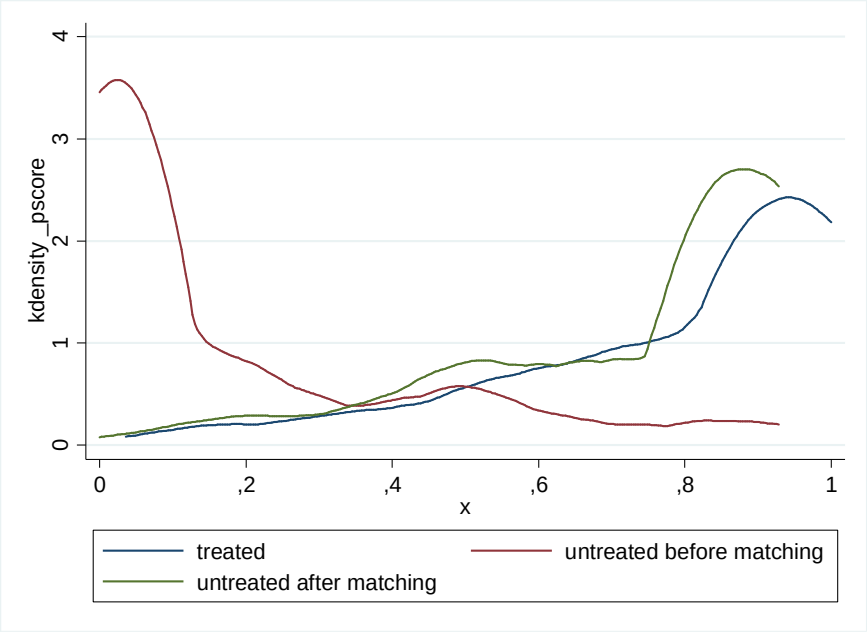


Figure C6 – Comparison of kernel densities of the estimated propensity score between groups – treatment for 2011 and 2013 (matching method: Epanechnikov Kernel)

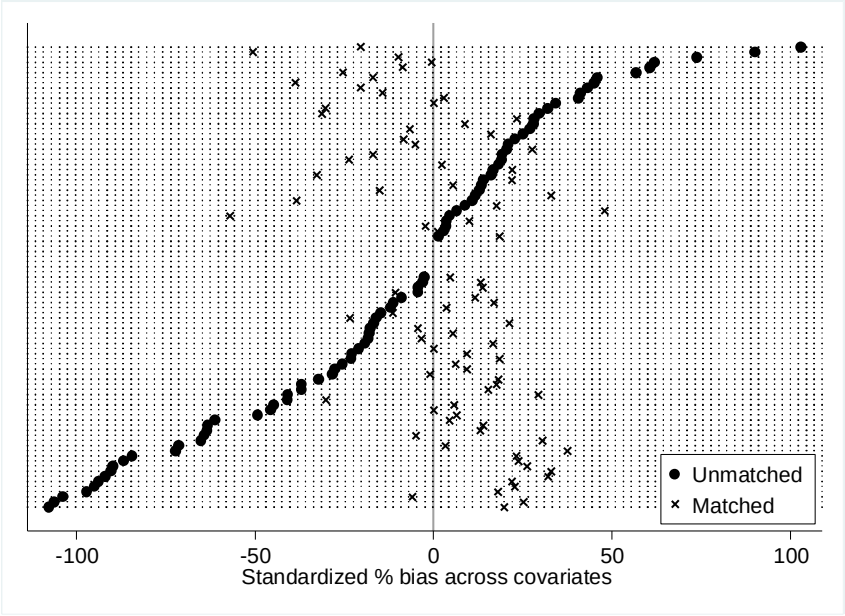


Figure C7 – Standardized bias across covariates – treatment for 2011 and 2013 (matching method: Nearest Neighbor with reposition)

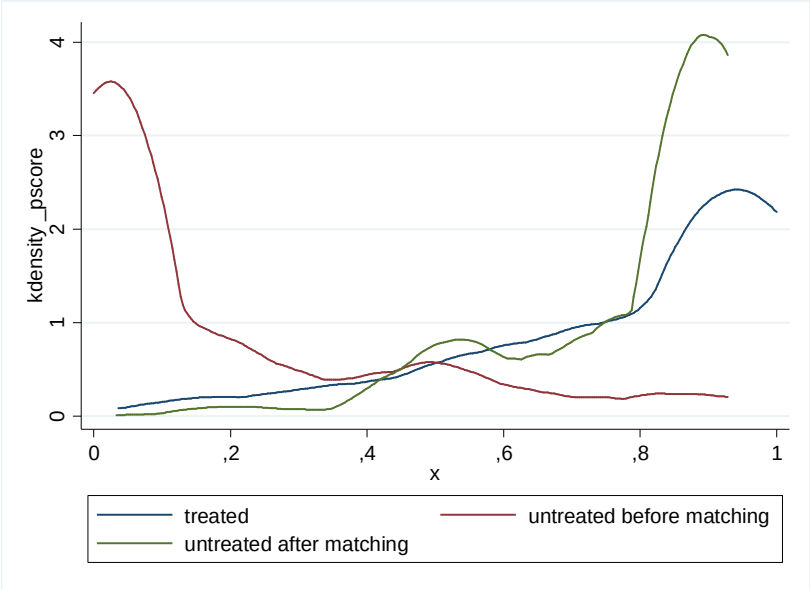


Figure C8 – Comparison of kernel densities of the estimated propensity score between groups – treatment for 2011 and 2013 (matching method: Nearest Neighbor with reposition)

APPENDIX D - Survey’s Questionary

Pesquisa sobre a carreira e remuneração de professores das redes públicas

Apresentação | Questionário

Apresentação

Nos últimos anos no Brasil, tem havido diversas iniciativas no sentido de expandir os recursos destinados à educação e, em particular, os destinados à remuneração dos profissionais que atuam diretamente na rede pública de educação básica. A Lei 11.738, de 16 de julho de 2008, instituiu o Piso Salarial Nacional para os Profissionais do Magistério da Educação Básica de todas as redes e sistemas públicos de ensino. Mas, até o momento, seus efeitos sobre a remuneração dos professores das diversas redes e sistemas de ensino são pouco conhecidos.

Este questionário destina-se a apoiar pesquisa acadêmica desenvolvida na Escola de Economia de São Paulo da Fundação Getúlio Vargas (EESP-FGV). O objetivo da pesquisa é justamente investigar efeitos da introdução do piso salarial do magistério público. Com as informações obtidas, pretende-se estudar as relações existentes entre a instituição do piso salarial, a remuneração dos professores e as contratações das redes e sistemas de ensino. Assim, a realização do trabalho requer informações sobre salário-base (vencimento) e remuneração bruta ou total dos professores de educação básica ao longo do período entre 2008 e 2013, bem como informações sobre a carreira dos professores municipais. Além das informações obtidas por meio deste instrumento, na pesquisa serão utilizadas as bases de dados do Instituto Nacional de Estudos e Pesquisas Educacionais Anísio Teixeira (Inep), do Ministério da Educação (MEC) e do Instituto Brasileiro de Geografia e Estatística (IBGE).

Conscientes da importância de se avaliar esta política pública, a União Nacional dos Dirigentes Municipais de Educação (Undime), a Fundação de Amparo à Pesquisa do Estado de São Paulo (Fapesp) e o Center for Applied Microeconomics (C-Micro/FGV) apóiam esta iniciativa.

Esclarecemos que as INFORMAÇÕES fornecidas NÃO SERÃO UTILIZADAS INDIVIDUALMENTE, isto é, não haverá identificação ou divulgação dos nomes dos municípios e ou dos responsáveis pelo preenchimento do questionário ou titulares dos órgãos responsáveis pelas respectivas redes ou sistemas de ensino. As informações serão tratadas e analisadas estatisticamente, sempre de forma agregada, o que IMPOSSIBILITARÁ A IDENTIFICAÇÃO, por terceiros, DOS MUNICÍPIOS aos quais as informações se referem.

Este instrumento de pesquisa se divide em seis (6) blocos de questões. No primeiro bloco, será solicitada a identificação do município e do respondente do questionário. As informações sobre o respondente servirão apenas para verificar a consistência e garantir fidedignidade das demais informações. O segundo bloco destina-se a obter informações gerais da rede ou sistema de ensino do município, e, o terceiro, a informações específicas sobre a carreira do magistério e os contratos de trabalho existentes entre a rede ou sistema de ensino e seus professores. No quarto bloco, deverão ser fornecidos o menor salário-base (ou vencimento) e a correspondente menor remuneração bruta (ou total) para as respectivas cargas horárias, de fato, verificados à época na rede ou sistema de ensino para cada um dos seguintes meses: janeiro de 2008, janeiro de 2009, janeiro de 2010, janeiro de 2011, janeiro de 2012 e janeiro de 2013. Há ainda dois últimos breves blocos de questões, o quinto, referente a eventual remuneração de professores com base no desempenho de estudantes, e, o sexto, referente a movimentos grevistas ou paralisações por parte de professores ocorridos no período entre janeiro de 2009 e dezembro de 2012.

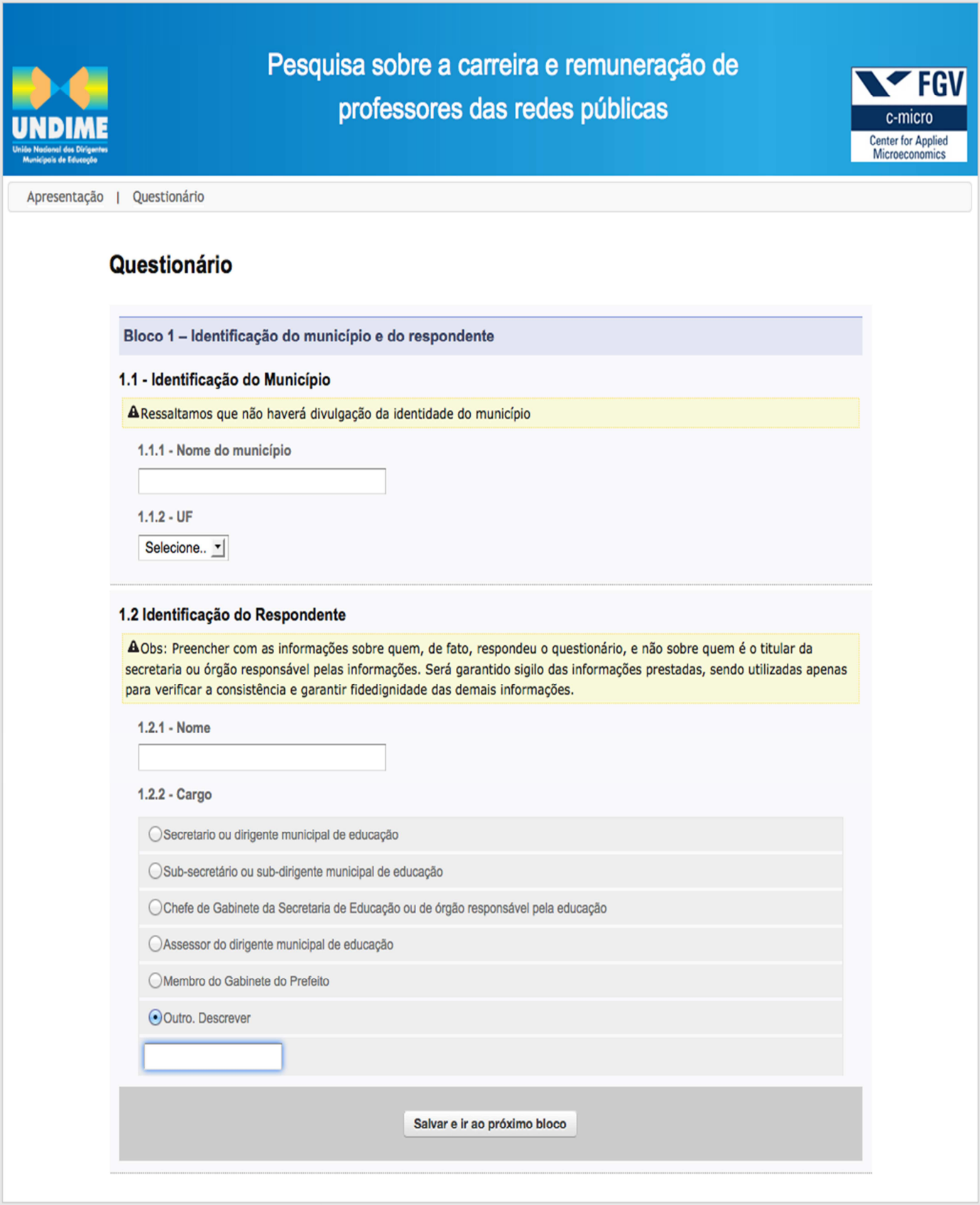
O potencial do presente estudo de propiciar o melhor entendimento e fornecer informações para a discussão sobre a política de remuneração e a carreira do magistério público será tanto maior quanto mais expressiva for a participação das redes e sistemas de ensino e quanto maiores forem seus esforços para responder este questionário. Sua participação é de fundamental importância.

Antecipadamente, agradecemos sua participação e colaboração.

Cristine Campos de Xavier Pinto
Professora da EESP/FGV

Geraldo Andrade da Silva Filho
Doutorando em Economia da EESP/FGV

Ir para o questionário



Pesquisa sobre a carreira e remuneração de professores das redes públicas

UNDIME
União Nacional dos Dirigentes Municipais de Educação

FGV c-micro Center for Applied Microeconomics

Apresentação | Questionário

Questionário

Bloco 1 – Identificação do município e do respondente

1.1 - Identificação do Município

⚠ Ressaltamos que não haverá divulgação da identidade do município

1.1.1 - Nome do município

1.1.2 - UF

Selecione..

1.2 Identificação do Respondente

⚠ Obs: Preencher com as informações sobre quem, de fato, respondeu o questionário, e não sobre quem é o titular da secretaria ou órgão responsável pelas informações. Será garantido sigilo das informações prestadas, sendo utilizadas apenas para verificar a consistência e garantir fidedignidade das demais informações.

1.2.1 - Nome

1.2.2 - Cargo

- ○ Secretario ou dirigente municipal de educação
- ○ Sub-secretário ou sub-dirigente municipal de educação
- ○ Chefe de Gabinete da Secretaria de Educação ou de órgão responsável pela educação
- ○ Assessor do dirigente municipal de educação
- ○ Membro do Gabinete do Prefeito
- ◉ Outro. Descrever

Salvar e ir ao próximo bloco

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Pesquisa sobre a carreira e remuneração de professores das redes públicas

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Apresentação | Questionário

Questionário

Bloco 1 gravado com sucesso!

Bloco 2 – Informações sobre a rede ou sistema de ensino.

2.1 - Houve mudança de dirigente municipal de educação desde a pesquisa "Perfil dos Dirigentes Municipais de Educação", realizada em 2010, em parceria da Undime com o Inep?

- ◯ Não. O dirigente é o mesmo da época da pesquisa mencionada.
- ◯ Sim. Houve troca de dirigente.
- ◯ Não se aplica. O município não participou da referida pesquisa.
- ◯ Não sei.

2.2 - No Ensino Fundamental, o Brasil possui duas formas básicas de ensino: por séries (anos) ou por ciclos de aprendizagem. O primeiro tipo pressupõe que cada aluno com desempenho insatisfatório seja reprovado ao final do ano letivo. No segundo tipo, os estudantes devem obter as habilidades e competências em um ciclo que, em geral, é mais longo do que um ano ou uma série. O Ensino Fundamental da rede ou sistema de ensino de seu município se estrutura na forma de ciclos?

- ◯ Sim.
- ◯ Não.

2.3 Na rede ou sistema de ensino de seu município há algum tipo de progressão automática de estudantes no Ensino Fundamental regular (fora da política de ciclos)?

- ◯ Sim.
- ◯ Não.

2.4 A rede ou sistema de ensino de seu município oferece:

- ☐ Educação Infantil – Creche
- ☐ Educação Infantil – Pré-Escola
- ☐ Ensino Fundamental – Anos Iniciais (até 5º ano ou 4ª série)
- ☐ Ensino Fundamental – Anos Finais (do 6º ano ao 9º ano ou 5ª série à 8ª série)
- ☐ Ensino Médio

Salvar e ir ao próximo bloco | Voltar ao bloco anterior

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Pesquisa sobre a carreira e remuneração de professores das redes públicas

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Apresentação | Questionário

Questionário

Bloco 2 gravado com sucesso!

Bloco 3 – Informações de Carreira do Magistério e o Contrato de Trabalho

3.1 - Na rede ou sistema de ensino de seu município há carreira específica para o magistério?

- ◯ Sim, com lei específica.
- ◯ Sim, mas não há lei específica para o magistério.
- ◯ Não.

3.4 - Quantos professores, dentre os que atualmente lecionam no Ensino Fundamental da rede ou sistema de ensino do município, foram contratados após janeiro de 2009?

3.5 - Sobre as contratações de professores realizadas após janeiro de 2009, informe:

3.5.1 - As datas de realização de concursos para professores efetivos.

mês/ano. ex: 01/2013

☐ Não houve concurso para contratação de professores do Ensino Fundamental após janeiro 2009.

1 -
2 -
3 -
4 -
5 -

3.5.2 - As datas de realização de processos seletivos para professores temporários.

mês/ano. ex: 01/2013

☐ Não houve concurso para contratação de professores do Ensino Fundamental após janeiro 2009.

1 -
2 -
3 -
4 -
5 -

⚠ A atividade docente engloba também ações de planejamento e realização de tarefas referentes à função pedagógica fora de sala de aula. As próximas questões referem-se à previsão contratual para o desempenho destas atividades. Mais comumente, os professores têm parte de sua carga horária reservada para o desempenho de atividades extraclasse. Em outras redes ou sistemas de ensino, os professores recebem gratificação ou complemento salarial relativo à hora-atividade extraclasse.

3.8 - Na rede ou sistema de ensino de seu município, há destinação de parte da carga horária semanal dos profissionais do magistério ao desempenho de atividades fora de sala de aula (excluindo o atendimento direto aos estudantes)?

- ◯ Sim.
- ◯ Não.

3.9 - Na rede ou sistema de ensino de seu município, os profissionais do magistério recebem gratificação ou complemento salarial para hora-atividade extraclasse?

- ◯ Sim.
- ◯ Não.

Salvar e ir ao próximo bloco | Voltar ao bloco anterior

Pesquisa sobre a carreira e remuneração de professores das redes públicas

Apresentação | Questionário

Questionário

Bloco 3 gravado com sucesso!

Bloco 4 – Salário-base (ou vencimento) e remuneração bruta (ou total) de professores

4.1 - Salário-base ou vencimento

4.1.1 - Anos iniciais do Ensino Fundamental

⚠No quadro abaixo, preencha o valor mínimo correspondente ao vencimento ou salário-base dos professores dos **anos iniciais do Ensino Fundamental** da rede ou sistema municipal de acordo com o enquadramento, em termos da formação, e carga semanal correspondente para cada mês solicitado. Entenda por valor mínimo: valor devido a professor em início de carreira quando houver esta situação funcional em sua rede ou sistema de ensino ou, caso contrário, informe o vencimento ou salário-base do(s) professor(es) com menor valor dentre todos com determinada carga horária semanal.

Professores com enquadramento de nível médio

Carga horária semanal	Salário-base (ou vencimento)					
	JAN 2008	JAN 2009	JAN 2010	JAN 2011	JAN 2012	JAN 2013
h	R$	R$	R$	R$	R$	R$

Adicionar outra carga horária

Professores com enquadramento de nível superior

Carga horária semanal	Salário-base (ou vencimento)					
	JAN 2008	JAN 2009	JAN 2010	JAN 2011	JAN 2012	JAN 2013
h	R$	R$	R$	R$	R$	R$

Adicionar outra carga horária

4.1.2 - Anos finais do Ensino Fundamental

⚠No quadro abaixo, preencha o valor mínimo correspondente ao vencimento ou salário-base dos professores dos **anos finais do Ensino Fundamental** da rede ou sistema municipal de acordo com o enquadramento, em termos da formação, e carga semanal correspondente para cada mês solicitado. Entenda por valor mínimo: valor devido a professor em início de carreira quando houver esta situação funcional em sua rede ou sistema de ensino ou, caso contrário, informe o vencimento ou salário-base do(s) professor(es) com menor valor dentre todos com determinada carga horária semanal.

Professores com enquadramento de nível médio

Carga horária semanal	Salário-base (ou vencimento)					
	JAN 2008	JAN 2009	JAN 2010	JAN 2011	JAN 2012	JAN 2013
h	R$	R$	R$	R$	R$	R$

Adicionar outra carga horária

Professores com enquadramento de nível superior

Carga horária semanal	Salário-base (ou vencimento)					
	JAN 2008	JAN 2009	JAN 2010	JAN 2011	JAN 2012	JAN 2013
h	R$	R$	R$	R$	R$	R$

Adicionar outra carga horária

4.1.3 - Educação Infantil

⚠No quadro abaixo, preencha o valor mínimo correspondente ao salário-base dos professores de **Educação Infantil** da rede ou sistema municipal de acordo com o enquadramento, em termos da formação, e carga semanal correspondente para cada mês solicitado.

Professores com enquadramento de nível médio

Carga horária semanal	Salário-base (ou vencimento)					
	JAN 2008	JAN 2009	JAN 2010	JAN 2011	JAN 2012	JAN 2013
h	R$	R$	R$	R$	R$	R$

Adicionar outra carga horária

Professores com enquadramento de nível superior

Carga horária semanal	Salário-base (ou vencimento)					
	JAN 2008	JAN 2009	JAN 2010	JAN 2011	JAN 2012	JAN 2013
h	R$	R$	R$	R$	R$	R$

Adicionar outra carga horária

4.2 - Remuneração bruta ou total

4.2.1 - Anos iniciais do Ensino Fundamental

⚠No quadro abaixo, preencha o valor mínimo correspondente à remuneração bruta ou total dos professores dos **anos iniciais do Ensino Fundamental** da rede ou sistema municipal de acordo com o enquadramento, em termos da formação, e carga semanal correspondente para cada mês solicitado. Entenda por valor mínimo: valor devido a professor em início de carreira quando houver esta situação funcional em sua rede ou sistema de ensino ou, caso contrário, informe a remuneração bruta ou total do(s) professor(es) com menor valor dentre todos com determinada carga horária semanal.

Professores com enquadramento de nível médio

Carga horária semanal	Remuneração bruta ou total					
	JAN 2008	JAN 2009	JAN 2010	JAN 2011	JAN 2012	JAN 2013
h	R$	R$	R$	R$	R$	R$

Adicionar outra carga horária

Professores com enquadramento de nível superior

Carga horária semanal	Remuneração bruta ou total					
	JAN 2008	JAN 2009	JAN 2010	JAN 2011	JAN 2012	JAN 2013
h	R$	R$	R$	R$	R$	R$

Adicionar outra carga horária

4.2.2 - Anos finais do Ensino Fundamental

⚠No quadro abaixo, preencha o valor mínimo correspondente ao vencimento ou salário-base dos professores dos **anos finais do Ensino Fundamental** da rede ou sistema municipal de acordo com o enquadramento, em termos da formação, e carga semanal correspondente para cada mês solicitado. Entenda por valor mínimo: valor devido a professor em início de carreira quando houver esta situação funcional em sua rede ou sistema de ensino ou, caso contrário, informe a remuneração bruta ou total do(s) professor(es) com menor valor dentre todos com determinada carga horária semanal.

Professores com enquadramento de nível médio

Carga horária semanal	Remuneração bruta ou total					
	JAN 2008	JAN 2009	JAN 2010	JAN 2011	JAN 2012	JAN 2013
h	R$	R$	R$	R$	R$	R$

Adicionar outra carga horária

Professores com enquadramento de nível superior

Carga horária semanal	Remuneração bruta ou total					
	JAN 2008	JAN 2009	JAN 2010	JAN 2011	JAN 2012	JAN 2013
h	R$	R$	R$	R$	R$	R$

Adicionar outra carga horária

4.2.3 - Educação Infantil

⚠No quadro abaixo, preencha o valor mínimo correspondente à remuneração bruta dos professores de **Educação Infantil** da rede ou sistema municipal de acordo com o enquadramento, em termos da formação, e carga semanal correspondente para cada mês solicitado.

Professores com enquadramento de nível médio

Carga horária semanal	Remuneração bruta ou total					
	JAN 2008	JAN 2009	JAN 2010	JAN 2011	JAN 2012	JAN 2013
h	R$	R$	R$	R$	R$	R$

Adicionar outra carga horária

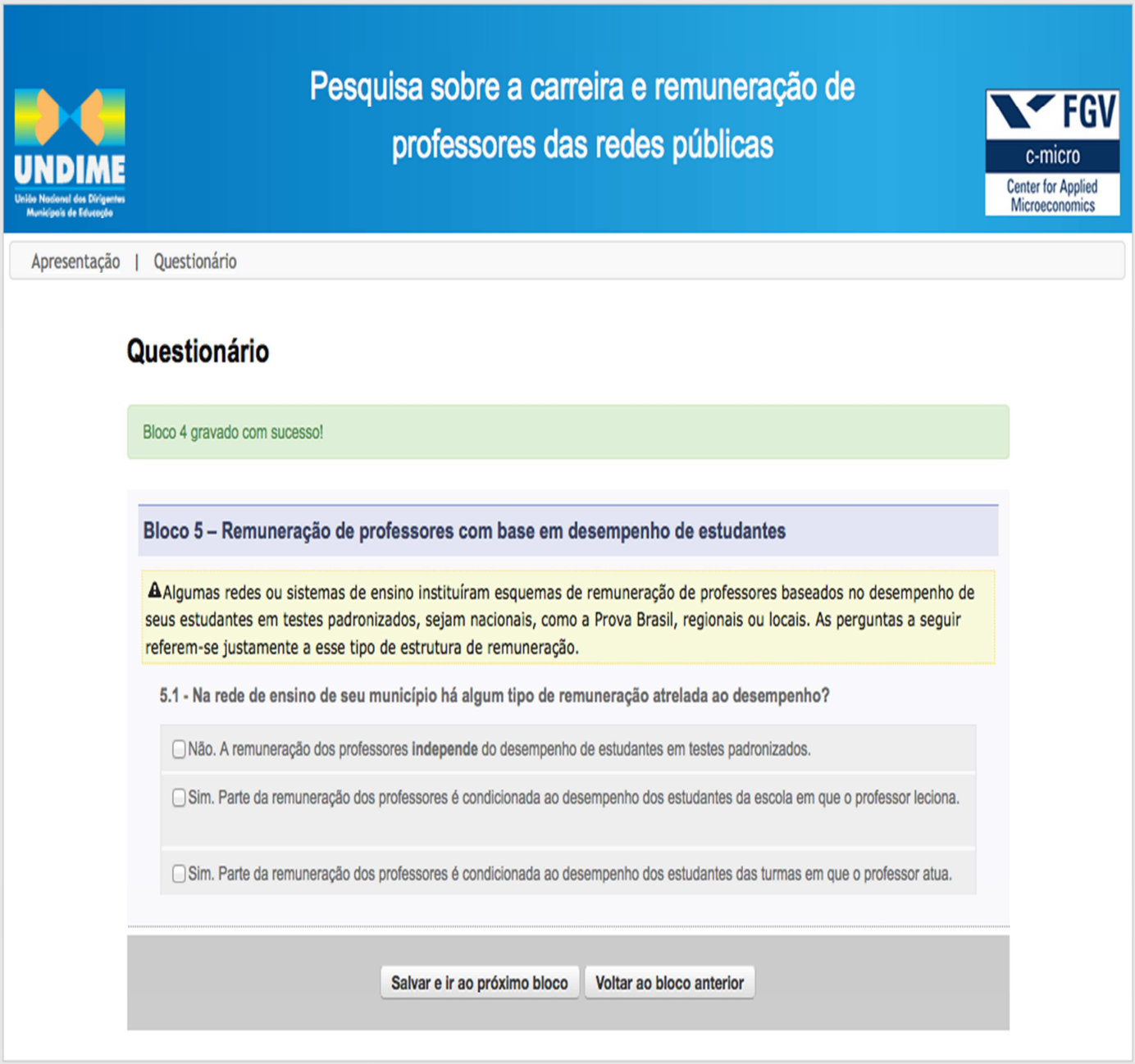
Professores com enquadramento de nível superior

Carga horária semanal	Remuneração bruta ou total					
	JAN 2008	JAN 2009	JAN 2010	JAN 2011	JAN 2012	JAN 2013
h	R$	R$	R$	R$	R$	R$

Adicionar outra carga horária

4.4 - No bloco 3, mais especificamente na questão 3.7, você informou haver contratos de professores que lecionam nos anos finais do Ensino Fundamental que estabelecem o cumprimento de horas-aula. Informe o valor pago por hora-aula a título de vencimento e de remuneração bruta aos professores de matemática e língua portuguesa dos anos finais do Ensino Fundamental no quadro abaixo.

Valor por hora-aula	Mês					
	JAN 2008	JAN 2009	JAN 2010	JAN 2011	JAN 2012	JAN 2013
vencimento	R$	R$	R$	R$	R$	R$
remuneração bruta ou total	R$	R$	R$	R$	R$	R$


UNDIME
União Nacional dos Dirigentes Municipais de Educação
Pesquisa sobre a carreira e remuneração de professores das redes públicas
FGV
c-micro
Center for Applied Microeconomics
Apresentação | Questionário
Questionário
Bloco 4 gravado com sucesso!
Bloco 5 – Remuneração de professores com base em desempenho de estudantes
Algumas redes ou sistemas de ensino instituíram esquemas de remuneração de professores baseados no desempenho de seus estudantes em testes padronizados, sejam nacionais, como a Prova Brasil, regionais ou locais. As perguntas a seguir referem-se justamente a esse tipo de estrutura de remuneração.
5.1 - Na rede de ensino de seu município há algum tipo de remuneração atrelada ao desempenho?
Não. A remuneração dos professores independe do desempenho de estudantes em testes padronizados.
Sim. Parte da remuneração dos professores é condicionada ao desempenho dos estudantes da escola em que o professor leciona.
Sim. Parte da remuneração dos professores é condicionada ao desempenho dos estudantes das turmas em que o professor atua.
Salvar e ir ao próximo bloco
Voltar ao bloco anterior
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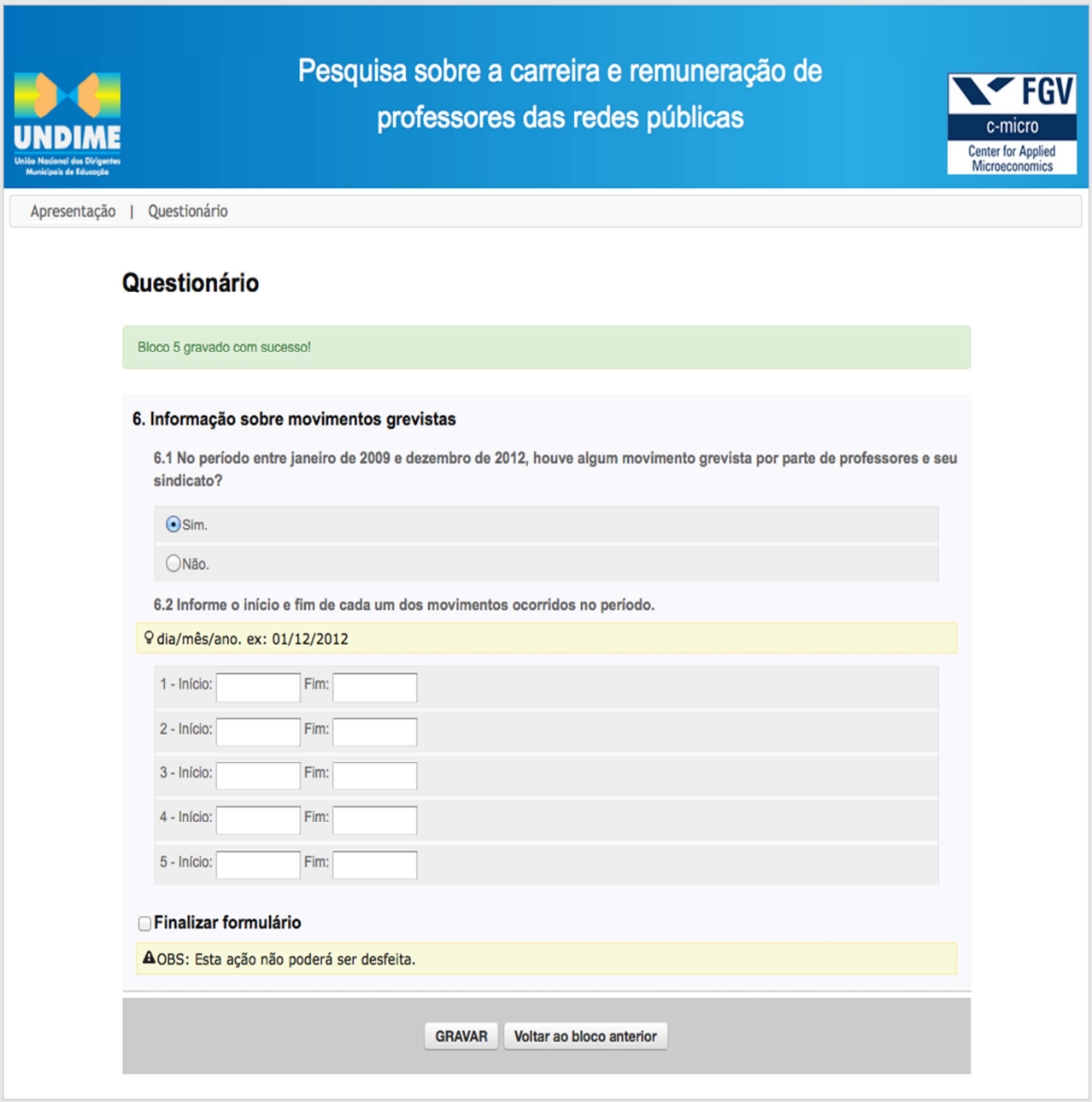
Pesquisa sobre a carreira e remuneração de professores das redes públicas
UNDIME
União Nacional dos Dirigentes Municipais de Educação
FGV
c-micro
Center for Applied Microeconomics
Apresentação | Questionário
Questionário
Bloco 5 gravado com sucesso!
6. Informação sobre movimentos grevistas
6.1 No período entre janeiro de 2009 e dezembro de 2012, houve algum movimento grevista por parte de professores e seu sindicato?
Sim.
Não.
6.2 Informe o início e fim de cada um dos movimentos ocorridos no período.
dia/mês/ano. ex: 01/12/2012
1 - Início: Fim:
2 - Início: Fim:
3 - Início: Fim:
4 - Início: Fim:
5 - Início: Fim:
Finalizar formulário
OBS: Esta ação não poderá ser desfeita.
GRAVAR
Voltar ao bloco anterior
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CHAPTER 2 – HIGHER TEACHERS' SALARY, BETTER PUPILS' PERFORMANCE? ASSESSING THE IMPACT OF HIGHER TEACHERS' SALARY ON PUPILS' PERFORMANCE

Abstract

The empirical literature has produced strong evidence that, after controlling for pupils' socioeconomic characteristics, teacher quality is the most important school factor in explaining pupil's performance in standardized tests. However, there is no consensus on how public school systems could improve teacher quality. The objective of this chapter is to estimate the impact of the unconditional teachers' salaries raise on students' proficiency using the exogenous increase in municipal teacher's salaries triggered by the introduction of a national minimum salary for public school teachers in Brazil. Municipalities whose teachers' salaries were below the national minimum experienced larger teachers' salary increases than the others between 2008 and 2013. We use difference-in-differences methods to control for fixed effects and selection on observables to balance treatment and comparison groups characteristics and, alternatively, an instrumental variable approach. Our estimates corroborate the conclusion of other recent empirical papers on the issue, that unconditional salary increase does not trigger better pupils' performance, at least in the short-run (five first years of the policy).

2.1 Introduction

Does higher teachers' salary lead to better pupils' performance? Answers to this question are still controversial. There are evidences in favor and against it. In a meta-analysis of 118 studies, Hanushek (2006) found 20 studies stablishing a significant positive relationship between teacher pay and student performance and seven stablishing a negative relationship, with the remainder finding a statistically insignificant relationship.

In the first seminal papers, researchers have estimated the direct impact of teacher pay on student outcomes usually through models with state and year fixed

effects, using data obtained from repeated cross-sections from US states. Card and Krueger (1992) explored the variability in teacher wages across states and time, and found that a 10% rise in teachers' wages led to a 0.1 p.p. increase in the rate of return to schooling for white males born between 1920 and 1949. Loeb and Page (2000) also used state-level variability in relative teachers' salaries from the 1960 to 1990, founding that an increase of 10% in the teachers' remuneration reduced the high school dropout rate a decade later by 3–4%. Hanushek et al (1999), exploring district salary differences in Texas, find small effect on teachers move, some effect on performance in teachers' certification, but no effect on pupils' learning.

Recently, two papers relied on more robust identification techniques and found no impact on average pupils' proficiency in the short-run. Pugatch and Schroeder (2014a, 2014b), exploited a geographic discontinuity in the policy implementation to assess the impact of a Gambian salary policy, which provides a salary premium of 30-40% to primary school teachers located in remote areas, on student performance, though the policy increased by 10 p.p. the proportion of qualified (certified) teachers and lowered the pupil-qualified teacher ratio by 61% of the mean in remote schools. Although they find no effects of the policy on average student performance, results are heterogeneous, with learning gains for students at the top of the distribution and losses for those at the bottom. Ree et al (2015) find no improvement in students learning outcomes after two and three years of a randomized experiment that doubled base teachers' salary in Indonesia public schools. Doubling base salary of teachers of randomly chosen areas implied an average teacher total salary 15% higher than of the non-beneficiary areas. According to that study findings, the policy improved teacher satisfaction with their income, reduced self-reported financial stress and reduced the incidence of teachers holding other jobs.

For the Brazilian context, at the best of our knowledge, there is just one study on the impacts of unconditional teacher remuneration on pupils' learning. Menezes-Filho and Pazello (2007) exploited the introduction in 1998 of a new funding scheme for public education (FUNDEF), which exogenously changed the amount of resources available to teachers' pay between public school systems within each Brazilian state. They concluded that the increase in salaries yielded a positive impact on pupils' proficiency in the first year of the policy. However, Menezes-Filho and Pazello (2007) get information about public systems teacher salary variation from

answers to the teachers' questionnaire of SAEB[55], which brings information of remuneration by ranges. The main drawback of that study was its scarce sample of public school systems. Besides, due to its self-reported nature and being declared according to ranges, SAEB questionnaire can introduce some uncertainty about salary variation magnitude.

In this chapter we take advantage of the exogenous increase of teacher salaries due to the introduction of the mandatory minimum salary for teachers in 2008 by the Brazilian federal government, and estimate the impact of salary hikes on pupils' test scores. As seen in the previous chapter, before the reform, municipal school systems used to set salaries autonomously. As seen in chapter one, in 2009, Brazilian municipalities raised average teacher base salaries on average by 12.9%[56], what represented a considerable gain for teachers in real terms, since Brazilian economy has witnessed an annual inflation rate of 5.9% that year. However this base salary variation was very heterogeneous, with municipal school systems which complied with the law in 2009 presenting significantly higher rates: an average nominal rate of 23.8%, with an expressive real growth of 16.9%. On the other hand, the salary increase among non-impinged and non-compliers was 7.1% and 6.7% in nominal terms, respectively. Figures that were between the annual inflation rate and the Brazilian nominal GDP growth rate in that year. From the introduction of the national minimum salary for public schools teachers to January 2013, the average teacher base salary in treated municipalities had grown 88.8% against 49.9% among municipal school systems that have not been impinged by the law. In real terms, compliers raised teachers' base salary 4.8 p.p. more yearly than non-impinged municipalities, 7.5% per year against 2.7% per year, respectively.

In this chapter, we discuss the results for 5th grade pupils obtained through difference-in-differences methods combined with propensity score matching, and alternatively through an instrumental variable approach. This chapter contributes to the growing literature cited above on the impacts of teacher salary increases in developing countries and particularly on the impacts of unconditionally salary increase.

[55] SAEB stands for *Sistema de Avaliação da Educação Básica*, which means Assessment System of the Basic Education. At that time, just a sample of municipalities and schools participate on the national assessment exam. The questionnaires were answered only by public teachers whose pupils took *Prova Brasil* exam.

[56] With a 95% of confidence interval that ranges from 11.6% to 14.2% considering the complex sample design.

Unfortunately we could not get each teacher salary and link teacher salary to classes and see her/his pupils' performance in standardized tests. Therefore we have to work with the average teacher salary variation of each municipal school system and the average pupil test scores in Mathematics and Portuguese. The method allows us to estimate the impact of undertaking the treatment defined as raising salaries in order to comply with the law.[57]

We compare treated units with a comparison group, and could not reject the hypothesis of a null effect of the treatment on pupils' proficiency in the first year of the policy (2009). However, one would argue that one year is not enough to reveal all policy potentialities and effects should come in a near future. Then we further estimate the impact of the policy using pupils' 2011 test scores and also 2013 test scores. For this purpose, besides the DID method we apply an IV approach.

Even though after almost five years of the introduction of the policy we do not find an effect of the policy on pupils' proficiency, it is possible that impacts are yet to be revealed after the operation and completion of some transmission channels which need more time to take place or to be completed. Even if the quality of new municipal school systems hires was very responsive to salary hikes, tenured teachers who entered teaching under a different salary regime would have little incentive to leave teaching when salaries are increased, and this would result in slow turnover and longer time to identify any change in educational outcomes caused by remuneration policy.

The rest of the chapter is organized as follows. Section 2.2 discusses the data used and shows some descriptive statistics. The methodology and identification strategy are described in Section 2.3 and results are shown in Section 2.4. Section 2.5 concludes.

[57] As argued by Loeb and Page (2000), "individual, classroom, or school-level data may be preferable to more-aggregate data when school inputs other than teacher wages are of interest because micro data can provide more-accurate information than aggregate data on the resources that are available to a particular student. For example, the classroom-level student/teacher ratio is a more accurate reflection of the resources available to a given student than is the district or state average of this variable. Wages differ from other school inputs, however, because wage scales are set at the district level and, thus, exhibit no independent variation at the individual, classroom, or school level. Within-district analyses of teacher wage effects will capture only differences in teacher experience and education." (p.397)

2.2 Data

Unfortunately not all of those 907 municipal school systems whose teacher salaries were informed by municipal department of education have statistics about pupils' test scores and *Prova Brasil* questionnaires. Part of the Brazilian municipalities had not their pupils' average score in *Prova Brasil* been calculated and publicized. Actually around 5 thousands municipalities had their 5th grade pupils' average scores in *Prova Brasil* 2011 publicized out of 5,564 municipalities[58]. The average score of the rest of municipalities were not calculated because *INEP* do not calculate them when less than 20 pupils and/or less than 50% of the enrollees of a school system had taken the test. When we consider other variables such as information about pupils' socioeconomic characteristics, teacher and schools characteristics and other information about the municipal school system, the representative sample reduces to 730 municipalities.

Table A.1 in the Appendix of Chapter 1 presents estimates for characteristics of the population of Brazilian municipalities obtained from the weighted sample and tests of its adherence to real population characteristics. See Chapter 1 for the description of the sample methodology. Before applying sample weights, there are significant differences between our sample of 907 municipal school systems and the whole country in most of the variables of interest and covariates. Sample weights strongly enhance the representativeness of the sample, approximating the sample characteristics to the characteristics of the population of municipalities. Thus we argue that our weighted sample represents well Brazilian municipal school system. Since not all sample municipalities have test scores for the years of analysis, we had to work in the present chapter with a trimmed sample, which is worse in representing the population characteristics in levels but quite good in representing it in the first difference. Since our ATT estimates rely on difference-in-differences methods (DID), we argue in favor of external validity of our results.

Table 2.1 shows that, considering treatment status in 2009, in general, untreated municipalities perform better than treated ones in all editions of *Prova Brasil* tests from 2005 to 2009. The differences between average test scores of treated units and untreated units are negative, with statistical significance at 1% level. However, the evolution of both groups between each edition is very similar, and

[58] Generally, the results of *Prova Brasil* are publicized in the end of the subsequent year, almost a year after pupils have taken the exam.

we cannot reject the null hypothesis that the differences between the tests scores variation of the groups from one edition to its subsequent are null according to adjusted Wald tests performed considering the complex survey design, what tells in favor of the common trend assumption before treatment needed to the identification of the impact of the policy through DID methods.

Table 2.1 Pupils' *Prova Brasil* test scores of treated and untreated groups (treatment status of 2009)

	Treated		Untreated		Difference				
	average score	# obs	average score	# obs	(Treated-Untreated)	Adjusted Wald test (Diff=0)			
Math 2005	173,72	230	186,58	264	-12,86	F(1, 369) =	43,03	Prob > F =	0,0000
Port 2005	163,73	234	177,96	259	-14,23	F(1, 372) =	61,22	Prob > F =	0,0000
Math 2007	183,40	340	197,91	359	-14,51	F(1, 570) =	54,74	Prob > F =	0,0000
Port 2007	164,79		177,93		-13,14	F(1, 573) =	56,42	Prob > F =	0,0000
Math score variation (2005-2007)	9,71	225	10,52	258	-0,813	F(1, 359) =	0,22	Prob > F =	0,6375
Port score variation (2005-2007)	1,152	231	0,092	257	1,060	F(1, 367) =	0,61	Prob > F =	0,4340
Math 2009	196,41	342	212,40	368	-15,99	F(1, 580) =	47,30	Prob > F =	0,0000
Port 2009	175,69	341	187,98	368	-12,29	F(1, 579) =	41,69	Prob > F =	0,0000
Math score variation (2007-2009)	13,19	331	14,74	353	-1,549	F(1, 555) =	0,83	Prob > F =	0,3612
Port score variation (2007-2009)	11,00	331	10,01	356	0,994	F(1, 557) =	0,56	Prob > F =	0,4544

Note: all averages were calculated and adjusted Wald tests were run considering complex survey design.

Table 2.2 shows the same statistics considering treatment status for 2011. Again, in general, untreated municipalities perform better than treated ones in all editions of *Prova Brasil* tests from 2005 to 2013. The differences between average test scores of treated units and untreated units are negative, with statistical significance at 1% level. However, the evolution of both groups between each edition is very similar, and we cannot reject the null hypothesis that the differences between the tests scores variation of the groups from one edition to its subsequent are null according to adjusted Wald tests performed considering the complex survey design. Again data favors the common trend assumption needed to the identification of the impact of the policy through DID methods.

Table 2.2 Pupils' *Prova Brasil* test scores of treated and untreated groups (treatment status of 2011)

	Treated		Untreated		Difference				
	average score	# obs	average score	# obs	(Treated-Untreated)	Adjusted Wald test (Diff=0)			
Math 2005	174,55	150	188,79	198	-14,24	F(1, 241) =	36,93	Prob > F =	0,0000
Port 2005	165,12	145	181,15	188	-16,03	F(1, 231) =	49,75	Prob > F =	0,0001
Math 2007	184,37	201	200,22	269	-15,85	F(1, 356) =	45,60	Prob > F =	0,0000
Port 2007	165,68	203	179,69	272	-14,02	F(1, 361) =	46,17	Prob > F =	0,0000
Math score variation (2005-2007)	10,96	147	10,46	192	0,502	F(1, 234) =	0,05	Prob > F =	0,8225
Port score variation (2005-2007)	1,82	144	-0,86	187	2,679	F(1, 229) =	2,62	Prob > F =	0,1068
Math 2011	200,35	208	218,77	274	-18,42	F(1, 369) =	40,49	Prob > F =	0,0000
Port 2011	181,69	207	195,92	278	-14,23	F(1, 371) =	36,24	Prob > F =	0,0001
Math score variation (2007-2011)	15,66	196	19,19	257	-3,527	F(1, 341) =	2,49	Prob > F =	0,1158
Port score variation (2007-2011)	16,27	198	16,54	264	-0,274	F(1, 349) =	0,02	Prob > F =	0,8825
Math 2013	201,59	206	219,60	272	-18,01	F(1, 364) =	32,21	Prob > F =	0,0000
Port 2013	185,56	202	200,12	269	-14,56	F(1, 357) =	27,81	Prob > F =	0,0000
Math score variation (2007-2013)	16,13	197	19,63	257	-3,50	F(1, 341) =	2,38	Prob > F =	0,1235
Port score variation (2007-2013)	18,97	195	20,44	257	-1,47	F(1, 339) =	0,68	Prob > F =	0,4116

Note: all averages were calculated and adjusted Wald tests were run considering complex survey design.

2.3 Methodology

When comparing the differences in average outcomes (e.g. pupils' performance) of treated and untreated school systems, it is difficult to disentangle the impact of the salary hike from the effect of other kind of policy. A simple estimator based on the difference in means between treated and untreated groups would be tainted. The salary of teachers should be endogenous with respect to other policies of the school system and to pupils' learning and decided simultaneously with other policies. In order to deal with the problems associated with endogeneity and

simultaneity, the identification of an exogenous source of variation in teacher salaries is required to assess a causal relation. We exploit the introduction of the national minimum salary for teachers, by federal law, as exogenous variation in teacher's pay.

In the present context, as the introduction of the minimum salary for teachers was decided at the federal level and municipal mayors and secretaries largely did not participate in the decision process, we argue that the salary hikes induced by the minimum salary introduction work as an exogenous source of salary variation. Thus it is possible to exploit this fact to identify the effect of teacher pay on pupils' proficiency.

However, as shown in the previous chapter, due to institutional characteristics of Brazilian school systems and the absence of explicit penalties for disobeying the minimum salary imposition or the existence of judicial appeals against the law, the assignment to treatment is not deterministic. Ultimately, to observe the law is a decision of the local administrators. Therefore, not all municipal school system assigned to treatment underwent it. In other words, once assigned to treatment, municipalities self-select themselves to the treatment.

Such a decision can be greatly influenced by observable and unobservable characteristics of the municipality and its school system. Considering what Brazilian Constitution determines, municipal teachers' salaries should be explained by municipal revenues; transfers received from *FUNDEB*, which are based on the number of enrollees in each municipal school system; and the number of teachers employed by the school system. On the other hand, salaries can also be explained by numerous other observed characteristics and even ones that are unobservable by the analyst, as the relative importance given to education by the current ruler of the municipality, or even by his/her predecessors, and the influence and bargaining power of local teachers' unions, just to mention two examples. The important role played by unobserved and unobservable variables in explaining salary variability inter-municipalities and treatment status, as seen in Chapter 1, give us support in applying DID methods in the estimation of the impacts of salary raises on pupils' performance.

We want to compare the performance over time in treated and untreated municipal school systems, trying to make them as similar as possible in a range of observable and unobservable characteristics. DID method allows one to control for fixed effects of school system and municipalities, helping in circumventing bias

associated with unobservable variables, potentially correlated with the decision of compliance, and that are constant over time.

Furthermore, to reduce self-selection bias we rely also on a selection on observables method. The use of an estimated propensity score helps in limiting bias associated to observed characteristics that are correlated to the treatment and to the potential outcome of interest at the same time. According to Du Goff et al (2014), more than just essential for addressing confounding in observational studies, only propensity score methods combined with survey weights may lead to results that would be generalized to the survey target population when we have complex sample design. Not incorporating the survey weights would compromises external validity, such that outcomes would not be generalized to national figure. That paper clarifies the appropriate inferences for different propensity score methods and suggests guidelines for selecting an appropriate propensity score method based on a researcher's goal. Aiming to obtain consistent estimates, after estimating the propensity score using a kernel method[59], we calculate the ATT weights, according to Abadie (2005).

We follow the recommendation of Du Goff et al (2014) and include the survey weight as a predictor in the probit model chosen for propensity score estimation. As put by the authors, the survey weight may capture relevant factors, and perhaps variables related to the probability of responding to the survey and to undergo treatment by the units. Moreover, we agree that the propensity score model does not need to be survey-weighted, as we are not interested in generalizing the propensity score model to the population. However, in the outcome model we need to incorporate survey weights as we aim to estimate Population Average Treatment Effect on the Treated (PATT). The propensity score weights and survey weights are multiplied to form a new weight for the outcome regression. In that way, we incorporate the complex survey design and assess the effect of increasing teacher salary on the entire treated population.

[59] Alternatively we use nearest-neighbor matching as a robustness check. Asymptotically, all different matching techniques produce the same estimate because in large samples they all compare only the exact matches. However, in finite samples, they differ because of the way they construct counterfactual and choose the weights. There is a trade-off between the bias and variance of matching estimators. The nearest-neighbor matching minimizes the bias, as it chooses only the closest comparison group observation and assigns all the weight to it in constructing the counterfactual. In contrast, kernel matching assigns positive weights to several control units, what implies a greater bias. At the same time, kernel matching reduces the variance of the estimate.

In our analysis we consider, as post-treatment results, pupils' test scores in *Prova Brasil* of 2009, taken in the end of the first school year after the introduction of the national minimum salary, and also *Prova Brasil* of two other editions, 2011 and 2013, the last version available of this nationwide proficiency exam which is taken every two years. As baseline, we always use tests scores of the 2007 edition, the last before the national minimum salary introduction. We estimate ATT for the first year of the policy and afterwards we estimate ATT for a larger time extension of the policy (three and five years). Due to its importance to policy analysis, we proceed to the estimation of the parameter of the Intention to the Treatment (ITT) as well.

In the first exercise, were considered as treated municipal school systems that were paying their teachers a base salary below the stipulated national minimum in 2008 and raised base salary in 2009 according to the law. We compare treated units with untreated municipal school systems, the group of all municipal school systems whose teacher salaries were above the national minimum in 2008.

The potential outcomes are determined by a set of covariates in addition to the treatment as in the following model:

$$Y_{it} = \alpha + \beta\, d_i + \delta\, \mathbb{I}\{t = 2011\} + \gamma \mathbb{I}\{t = 2011\} \cdot d_i + \rho' X_{it} + \varepsilon_{it}$$

where the dependent variable, Y_{it}, the average 5th graders test score of the municipal school system i in year t in Math or Portuguese is explained by a constant (α); the treatment group fixed effect captured by the coefficient of an indicator variable which assumes value 1 if the municipal school system were treated and 0 otherwise, d_i; the common effect of the passage of time, represented by δ ; the parameter of interest, γ, representing the impact of the treatment, the abnormal teacher salary hike, on the dependent variable; and a vector of covariates X that helps to explain the dependent variable. The model becomes complete with the idiosyncratic error term, ε_{it}.

In the OLS regression we weighted each observation using the following weights:

$$weight_i = iptw_i \cdot sample\_weight_i$$

where: $iptw_i = d_i + \left[\frac{(1-d_i)\widehat{p_i}}{1-\widehat{p_i}}\right]$ and $\widehat{p_i}$ is the estimated propensity score of being treated.

The key identifying assumption is that γ would be zero in the absence of treatment after matching on the propensity score ($E[\varepsilon_{it}|\mathbb{I}\{t = 1\} \cdot d_{it}, p_i] = 0$).

We get OLS estimates for the constant term, α, corresponding to the average performance of the comparison group at baseline; for β, representing time invariant differences between treatment and comparison groups; for δ, summarizing the way both groups are influenced by time; for γ, the average treatment effect (parameter of interest); and for ρ', the parameter vector associated with changes in covariates.

For the consistency of the DID estimator, it is necessary to satisfy two conditions: (i) if there was no treatment, treated and untreated (or comparison) groups would evolve in the same way considering the potential result; and (ii) unobservable characteristics remain constant over time within groups or change across time in the same magnitude in both groups. The first requirement is not testable, but it can be argued favorably if the evolution of the dependent variable was shown similar across groups prior to treatment. As shown in Tables 2.1 and 2.2, there is no significant difference in scores tendency between groups. Both Math and Portuguese test scores variation in the previous period of time (2005 to 2007) are not statistically different between groups.

Despite being important, controlling for unobserved characteristics would not be enough to overcome the endogeneity problem. Therefore, additionally to the selection on observables method already described, we adopt an instrumental variable approach to try to overcome this problem. Relying on the exogeneity of the value of the national minimum salary and the variability of the distances between the national minimum base salary and the municipal school system base salary when the minimum salary was instituted, we can construct an instrument for the base salary observed in 2011 or 2013. The idea is to exploit the interaction of municipal salary gap to the minimum salary with the timing of its introduction.[60]

Consider the following simplified model of the average pupils' proficiency of municipal school system i, explained by a vector of observable characteristics, X_i, and by their teachers' remuneration, W_i,

$$y_i^t = \alpha + \beta X_i^t + \gamma W_i^t + \theta_i + \delta^t + \varepsilon_i^t \quad (1)$$

[60] We exploit differential changes in treatment rate across groups over time as a source of variation to capture treatment effects. Chaisemartin (2014) shows that the identification of this model requires stronger assumptions than those of the standard difference in differences model. Besides common trends assumptions, the effect of the treatment should be the same in the treatment and in the control groups, at least in some subpopulations.

where θ_i is municipality fixed-effect and δ^t is time fixed-effect, and standard errors are clustered at the municipality level, so that the error term is allowed to have an arbitrary correlation within municipalities over time.

Municipality fixed-effects, despite being important for controlling for unobserved characteristics, would not be enough to overcome the endogeneity problem. Municipal teachers' salaries observed in 2008, at the time of the institution of the minimum salary, is likely to be a direct function of budgetary conditions and policies being run in the school system at that point in time as well as a function of the strength of teachers' unions in the region, which may in turn have an independent impact on pupils' proficiency.

To deal with the endogeneity of teacher salary (W_i^t) we propose an exogenous instrument. The value of the distance between the national minimum salary and each municipal base salary observed in 2008 interacted with time dummy works as an instrument for the base salary paid in 2011, determining the Z_i variable, correlated with the treatment variable, W_i^{2011}, earnings in 2011, and not correlated with the error term, or unobservable component of the model expressed in (1). Thus, we have: $Z_i = I\{t = 2011\} \cdot (\overline{W} - W_i^{2008})$, where $\overline{D}$ is the national minimum salary stipulated in 2008 for being observed in 2009, and $I\{t = 2011\}$ is the indicator variable of year 2011[61].

For the validity of the proposed instrument, the exclusion restriction would require that proficiency observed in 2011 is explained by salary in 2008 only through salary in 2011.

We run two different estimation procedures, a two stage least squares estimator (2SLS) with and without fixed effects of municipal school system[62]. In one specification standard errors were clustered at the municipality level, so that the error term is allowed to have an arbitrary correlation within municipalities over time. The

[61] Alternatively we use a dummy instrument such as: $Z_i = \begin{cases} 1 \; se \; (\overline{w} - w_i^{2008}) > 0 \\ 0 \; se \; (\overline{w} - w_i^{2008}) \leq 0 \end{cases}$, where $\overline{w}$ is the national minimum salary, and w_i^{2008} is the salary observed in 2008 in municipality i.

[62] Investigating the effects of unionization on salaries, Robinson (1989) makes a comparison between instrumental variables estimators and control function estimators and concludes that the simpler fixed effects model may be a good approximation for the union problem. As the union problem involves a selection problem that in some aspects resembles the selection to compliance to the law in our case, we argue that fixed effects model can be a good approximation in the present context as well.

drawback of this procedure is that we could not take into account the complex nature of our sample and were able just to consider sample weights[63].

2.4 Results

We begin presenting results of the first exercise, the estimation of ATT on pupils' proficiency in 2009, the first year of the national minimum salary policy. Table 2.3 shows results of the analysis of the impact of the salary increase on Portuguese test scores. Applying sample weights the coefficient of the interaction term becomes positive, but it remains statistically insignificant even considering the full model (column (7)).

Table 2.3 Effect of teacher salary increase on Portuguese test scores 2007-2009

Variables	Portuguese						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
ATT	-0.327	0.945	0.954	0.716	1.473	1.690	2.022
	(2.102)	(3.827)	(2.306)	(2.311)	(1.761)	(1.695)	(1.657)
Treated	-14.08***	-14.65***	-1.895	-2.176	-0.856	-0.646	-0.569
	(1.486)	(2.264)	(1.883)	(1.925)	(1.603)	(1.535)	(1.498)
Time	9.445***	9.709***	9.649***	9.911***	9.002***	8.363***	8.896***
	(1.337)	(2.750)	(1.532)	(1.523)	(1.297)	(1.282)	(1.260)
Constant	178.4***	178.8***	172.2***	174.8***	101.0***	98.07***	107.5***
	(0.945)	(1.620)	(1.940)	(2.514)	(15.81)	(16.66)	(17.59)
Observations	944	872	872	872	872	872	872
R-squared	0.220	0.192	0.644	0.647	0.777	0.784	0.793
F test	0	0	0	0	0	0	
Sample weights		Yes	Yes	Yes	Yes	Yes	Yes
Municipality characteristics			Yes	Yes	Yes	Yes	Yes
Fiscal covariates				Yes	Yes	Yes	Yes
Pupils' characteristics					Yes	Yes	Yes
School Infrastructure						Yes	Yes
School system characteristics							Yes

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

For Math, results are qualitatively similar as presented in Table 2.4. We do not find any effect of salary increase on 5th graders proficiency on Math.

[63] We estimated this IV-DID model using *Stata* command *xtivreg2*, that is not supported by the package of commands *svy* which take into account complex sample designs.

Table 2.4 Effect of teacher salary increase on Mathematics test scores 2007-2009

Variables	Mathematics						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
ATT	-2.636	-1.127	-1.167	-1.309	-0.194	0.361	0.654
	(2.557)	(4.662)	(2.780)	(2.766)	(2.180)	(2.132)	(2.118)
Treated	-16.14***	-16.35***	-0.155	-0.766	0.202	0.385	0.649
	(1.808)	(2.650)	(2.339)	(2.354)	(1.958)	(1.910)	(1.884)
Time	12.94***	13.81***	13.92***	14.27***	12.72***	11.80***	12.70***
	(1.627)	(3.262)	(1.868)	(1.817)	(1.658)	(1.654)	(1.643)
Constant	197.9***	199.0***	185.7***	190.6***	93.13***	90.38***	92.05***
	(1.150)	(1.863)	(3.893)	(3.911)	(19.43)	(20.67)	(22.48)
Observations	944	872	872	872	872	872	872
R-squared	0.228	0.191	0.641	0.647	0.754	0.761	0.770
F test	0	0	0	0	0	0	
Sample weights		Yes	Yes	Yes	Yes	Yes	Yes
Municipality characteristics			Yes	Yes	Yes	Yes	Yes
Fiscal covariates				Yes	Yes	Yes	Yes
Pupils' characteristics					Yes	Yes	Yes
School Infrastructure						Yes	Yes
School system characteristics							Yes

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

As a robustness check, we run a DID model combined with propensity score matching. We estimate a propensity score (PS) of being treated with a probit model using two different matching procedure, Epanechnikov Kernel and Nearest Neighbor Matching. Then the estimated PS was applied in the construction of new sample weights. In both cases, aiming to recover the ATT, we follow Abadie (2005) and weighted the observations in regression with the Inverse Probability of being Treated Weighting (IPTW).

Tables 2.5 and 2.6 present results for Portuguese and Math test, respectively. The statistical insignificance of the coefficients of the interaction term remains even after controlling for observables[64].

[64] Results are robust to other propensity score matching methods. See in the Appendix results for Nearest Neighbor Matching.

Table 2.5 Effect of teacher salary increase on Portuguese test scores 2007-2009, controlling for selection on observables (IPTW-DID)

Variables	Portuguese						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
ATT	-0.327	3.553	3.583	2.763	3.154	3.278	2.513
	(2.102)	(4.570)	(2.608)	(2.677)	(2.295)	(2.104)	(2.291)
Treated	-14.08***	2.395	0.332	0.705	1.045	0.557	1.199
	(1.486)	(2.716)	(1.746)	(1.831)	(1.800)	(1.612)	(1.601)
Time	9.445***	6.203*	5.716***	6.249***	5.848***	5.451***	6.305***
	(1.337)	(3.689)	(2.110)	(2.202)	(2.154)	(1.977)	(2.211)
Constant	178.4***	161.7***	160.4***	161.3***	97.90***	105.6***	91.42***
	(0.945)	(2.151)	(1.813)	(4.970)	(18.77)	(18.37)	(22.10)
Observations	944	800	800	800	800	800	800
R-squared	0.220	0.071	0.649	0.654	0.743	0.758	0.768
F test	0	0.000203	0	0	0	0	
Sample weights		IPTW	IPTW	IPTW	IPTW	IPTW	IPTW
Municipality characteristics			Yes	Yes	Yes	Yes	Yes
Fiscal covariates				Yes	Yes	Yes	Yes
Pupils' characteristics					Yes	Yes	Yes
School Infrastructure						Yes	Yes
School system characteristics							Yes

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 2.6 Effect of teacher salary increase on Mathematics test scores 2007-2009, controlling for selection on observables (IPTW-DID)

Variables	Mathematics						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
ATT	-2.636	4.178	4.105	3.032	3.145	3.399	2.417
	(2.557)	(5.094)	(2.997)	(3.013)	(2.675)	(2.568)	(2.763)
Treated	-16.14***	3.388	0.383	1.052	1.600	1.040	2.131
	(1.808)	(3.066)	(2.197)	(2.247)	(2.230)	(2.124)	(2.173)
Time	12.94***	7.464*	7.047***	7.915***	7.286***	6.602***	7.869***
	(1.627)	(3.873)	(2.344)	(2.356)	(2.401)	(2.293)	(2.507)
Constant	197.9***	179.1***	171.1***	173.8***	95.33***	103.5***	72.76***
	(1.150)	(2.329)	(1.825)	(5.759)	(21.72)	(21.64)	(25.38)
Observations	944	800	800	800	800	800	800
R-squared	0.228	0.076	0.630	0.639	0.708	0.720	0.739
F test	0	0.000118	0	0	0	0	
Sample weights		IPTW	IPTW	IPTW	IPTW	IPTW	IPTW
Municipality characteristics			Yes	Yes	Yes	Yes	Yes
Fiscal covariates				Yes	Yes	Yes	Yes
Pupils' characteristics					Yes	Yes	Yes
School Infrastructure						Yes	Yes
School system characteristics							Yes

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Trying to measure the effect of the policy independently on the compliance with the law, we also estimate the Intention to the Treatment (ITT) in the year 2009, but the estimated coefficients are statistically insignificant too. Table 2.7 shows the results for the basic specification, the full model and also results controlling for observables for 5th graders' Portuguese and Math test scores.

Table 2.7 Intention to the Treatment for Portuguese and Mathematics test scores (DID and IPTW-DID)

Variables	Portuguese				Math			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ITT	-0.327	2.022	3.553	2.513	-2.636	0.654	4.178	2.417
	(2.102)	(1.657)	(4.570)	(2.291)	(2.557)	(2.118)	(5.094)	(2.763)
Impinged by the law	-14.08***	-0.569	2.395	1.199	-16.14***	0.649	3.388	2.131
	(1.486)	(1.498)	(2.716)	(1.601)	(1.808)	(1.884)	(3.066)	(2.173)
Time	9.445***	8.896***	6.203*	6.305***	12.94***	12.70***	7.464*	7.869***
	(1.337)	(1.260)	(3.689)	(2.211)	(1.627)	(1.643)	(3.873)	(2.507)
Constant	178.4***	107.5***	161.7***	91.42***	197.9***	92.05***	179.1***	72.76***
	(0.945)	(17.59)	(2.151)	(22.10)	(1.150)	(22.48)	(2.329)	(25.38)
Observations	944	872	800	800	944	872	800	800
R-squared	0.220	0.793	0.071	0.768	0.228	0.770	0.076	0.739
Sample weights		Yes	IPTW	IPTW		Yes	IPTW	IPTW
Municipality characteristics		Yes		Yes		Yes		Yes
Fiscal covariates		Yes		Yes		Yes		Yes
Pupils' characteristics		Yes		Yes		Yes		Yes
School Infrastructure		Yes		Yes		Yes		Yes
School system characteristics		Yes		Yes		Yes		Yes

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Our second exercise was to investigate if there is any impact of the salary hike on the proficiency pupils of the 5th grade after three school years from the institution of the policy. Using DID methods, we do not find any statistically significant impact of the policy on 5th graders' Portuguese test scores (Table 2.8) and 5th graders' Math test scores (Table 2.9).

Table 2.8 Effect of teacher salary increase on Portuguese test scores 2007-2011

Variables	Portuguese						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
ATT	-0.257	-0.0808	-0.141	-0.107	0.759	0.657	0.983
	(2.221)	(3.857)	(2.352)	(2.320)	(1.908)	(1.863)	(1.820)
Treated	-14.01***	-15.62***	-5.042***	-5.169***	-3.584**	-3.482**	-3.315**
	(1.572)	(2.240)	(1.837)	(1.836)	(1.561)	(1.518)	(1.446)
Time	16.26***	16.04***	15.92***	16.10***	10.89***	9.947***	10.45***
	(1.458)	(2.734)	(1.616)	(1.595)	(1.429)	(1.488)	(1.515)
Constant	180.0***	180.8***	166.1***	166.6***	113.9***	106.6***	112.3***
	(1.033)	(1.607)	(5.230)	(6.090)	(13.04)	(14.19)	(18.60)
Observations	854	824	824	824	817	817	775
R-squared	0.308	0.292	0.645	0.649	0.771	0.777	0.788
F test	0	0	0	0	0	0	
Sample weights		Yes	Yes	Yes	Yes	Yes	Yes
Municipality characteristics			Yes	Yes	Yes	Yes	Yes
Fiscal covariates				Yes	Yes	Yes	Yes
Pupils' characteristics					Yes	Yes	Yes
School Infrastructure						Yes	Yes
School system characteristics							Yes

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 2.9 Effect of teacher salary increase on Mathematics test scores 2007-2011

	Mathematics						
Variables	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**
ATT	-2.098	-0.832	-1.300	-1.115	-0.0416	-0.00873	0.631
	(2.660)	(4.563)	(2.869)	(2.841)	(2.233)	(2.172)	(2.173)
Treated	-15.63***	-17.54***	-4.145*	-4.382**	-2.613	-2.691	-2.553
	(1.883)	(2.573)	(2.178)	(2.178)	(1.797)	(1.783)	(1.740)
Time	18.43***	16.84***	17.43***	17.33***	11.31***	10.25***	11.46***
	(1.752)	(3.428)	(2.074)	(2.084)	(1.844)	(1.937)	(1.975)
Constant	199.5***	201.1***	184.0***	183.9***	116.6***	110.7***	116.6***
	(1.240)	(1.923)	(6.442)	(7.503)	(16.57)	(19.90)	(22.39)
Observations	846	817	817	817	810	810	766
R-squared	0.284	0.255	0.610	0.613	0.740	0.749	0.759
F test	0	0	0	0	0	0	
Sample weights		Yes	Yes	Yes	Yes	Yes	Yes
Municipality characteristics			Yes	Yes	Yes	Yes	Yes
Fiscal covariates				Yes	Yes	Yes	Yes
Pupils' characteristics					Yes	Yes	Yes
School Infrastructure						Yes	Yes
School system characteristics							Yes

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

As previously, as a robustness check, we run a DID model combined with propensity score matching. We estimate a propensity score (PS) of being treated with a probit model using two different matching procedure, Epanechnikov Kernel and Nearest Neighbor Matching. Then the estimated PS was applied in the construction of new sample weights. Procedures were the same as previously adopted. Tables 2.10 and 2.11 present results for Portuguese and Math test, respectively. The statistical insignificance of the coefficients of the interaction term remains even after controlling for observables[65].

[65] Results are robust to other propensity score matching algorithm. See in the Appendix results for Nearest Neighbor Matching.

Table 2.10 Effect of teacher salary increase on Portuguese test scores 2007-2011, controlling for selection on observables (IPTW-DID)

Variables	Portuguese						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
ATT	-0.257	-0.267	-0.403	0.235	-2.098	-0.299	-1.332
	(2.221)	(12.70)	(3.562)	(3.249)	(3.338)	(2.828)	(2.763)
Treated	-14.01***	6.950	-3.059	-4.362*	-3.669*	-3.293*	-2.543
	(1.572)	(5.691)	(2.564)	(2.398)	(2.032)	(1.897)	(1.843)
Time	16.26***	15.27	14.90***	14.28***	11.49***	10.35***	12.56***
	(1.458)	(12.04)	(2.587)	(2.200)	(3.202)	(3.753)	(3.219)
Constant	180.0***	165.0***	156.5***	156.5***	104.1***	88.34***	106.1***
	(1.033)	(5.202)	(3.420)	(5.942)	(20.53)	(24.52)	(29.60)
Observations	854	570	570	570	570	570	538
R-squared	0.308	0.157	0.700	0.720	0.813	0.829	0.855
F test	0	1.14e-05	0	0	0	0	
Sample weights		IPTW	IPTW	IPTW	IPTW	IPTW	IPTW
Municipality characteristics			Yes	Yes	Yes	Yes	Yes
Fiscal covariates				Yes	Yes	Yes	Yes
Pupils' characteristics					Yes	Yes	Yes
School Infrastructure						Yes	Yes
School system characteristics							Yes

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 2.11 Effect of teacher salary increase on Mathematics test scores 2007-2011, controlling for selection on observables (IPTW-DID)

Variables	Mathematics						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
ATT	-2.098	4.090	3.698	4.903	-2.510	-1.642	-3.901
	(2.660)	(15.48)	(4.940)	(4.202)	(4.516)	(4.043)	(3.984)
Treated	-15.63***	7.583	-4.128	-6.262*	-3.407	-2.492	-1.089
	(1.883)	(5.269)	(3.994)	(3.640)	(3.135)	(2.853)	(2.825)
Time	18.43***	10.95	11.06***	9.403***	13.43***	14.00***	16.44***
	(1.752)	(14.79)	(3.742)	(2.942)	(4.034)	(5.339)	(4.580)
Constant	199.5***	183.7***	175.3***	170.7***	130.9***	138.3***	138.2***
	(1.240)	(4.444)	(3.760)	(7.019)	(27.07)	(31.90)	(37.16)
Observations	846	566	566	566	566	566	534
R-squared	0.284	0.105	0.602	0.636	0.752	0.768	0.798
F test	0	1.30e-06	0	0	0	0	
Sample weights		IPTW	IPTW	IPTW	IPTW	IPTW	IPTW
Municipality characteristics			Yes	Yes	Yes	Yes	Yes
Fiscal covariates				Yes	Yes	Yes	Yes
Pupils' characteristics					Yes	Yes	Yes
School Infrastructure						Yes	Yes
School system characteristics							Yes

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

For 2013, we could not reject the hypothesis that ATT for Math and Portuguese are null in the simplest model (columns (1) and (7)) and whatever the

group of covariates we control for, as shown in Table 2.12. One concern with the estimation from the simplest model comes from the fact that the coefficient of the dummy which characterize treated units is statistically significant at 1% level. As shown in section 2, treatment and comparison groups are very distinct from each other in observables characteristics, what is probably reflected in poorer performance of treated municipal school systems along the time. When we control for the covariates, the coefficient losses statistical significance, what reveals the importance of the controls for the analysis.

Table 2.12 Effect of teacher salary increase on Math and Portuguese test scores 2007-2013

Variables	Math						Port					
	(1)	(2)	(3)	(4)	(5)	(6)	(1)	(2)	(3)	(4)	(5)	(6)
ATT	-4.055	-3.891	-3.589	-2.019	-2.690	-1.668	-1.922	-1.645	-2.040	-0.628	-0.932	0.997
	(4.774)	(2.828)	(2.759)	(2.169)	(2.139)	(2.402)	(4.137)	(2.369)	(2.279)	(1.787)	(1.739)	(1.864)
Treated	-18.01***	-0.770	-0.312	0.878	1.221	1.505	-16.29***	-1.851	-1.219	-0.181	0.0305	-0.0153
	(2.500)	(2.214)	(2.077)	(1.739)	(1.752)	(1.691)	(2.126)	(1.809)	(1.679)	(1.495)	(1.475)	(1.400)
Time	18.65***	18.33***	22.10***	7.835*	6.954*	4.778	19.96***	19.30***	23.50***	10.12***	8.462**	9.704**
	(3.617)	(1.893)	(2.336)	(4.188)	(4.161)	(5.569)	(3.050)	(1.565)	(1.898)	(3.489)	(3.417)	(4.591)
Constant	201.2***	180.2***	191.1***	157.4***	142.4***	198.6***	180.7***	161.3***	172.1***	127.4***	119.6***	154.5***
	(1.845)	(6.609)	(11.03)	(19.17)	(21.48)	(63.91)	(1.556)	(5.506)	(9.938)	(15.55)	(15.98)	(51.49)
# Obs.	850	850	850	850	850	764	850	850	850	850	850	764
R-squared	0.247	0.629	0.641	0.772	0.778	0.815	0.297	0.676	0.685	0.829	0.834	0.861
F test	0	0	0	0	0	0	0	0	0	0	0	0
Sample weights	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Municipal. charact.		Yes	Yes	Yes	Yes	Yes		Yes	Yes	Yes	Yes	Yes
Fiscal covariates			Yes	Yes	Yes	Yes			Yes	Yes	Yes	Yes
Pupils' charact.				Yes	Yes	Yes				Yes	Yes	Yes
School Infrastr.					Yes	Yes					Yes	Yes
School system charact.						Yes						Yes

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

In order to improve our identification, we adopt a selection on observables method combined with the DID. We estimate a propensity score (PS) of being treated with a probit model using two different matching procedure, Epanechnikov Kernel and Nearest Neighbor Matching. Then the estimated PS was applied in the construction of new sample weights. In both cases, aiming to recover the ATT, we follow Abadie (2005) and weighted the observations in regression with the Inverse

Probability of being Treated Weighting (IPTW) Figures C.6 and C.8 in Appendix of Chapter 1 compares PS balance between treated and untreated before and after weighting using two different matching methods.

Table 2.13 Effect of teacher salary increase on Mathematics test scores 2007-2013, controlling for selection on observables (IPTW-DID)

Variables	Mathematics											
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
ATT	8.964	8.692*	-1.972	-1.835	-1.178	-1.328	10.20	9.692*	-3.553	-3.834	-3.662	-5.435
	(16.81)	(4.856)	(4.992)	(3.947)	(3.520)	(2.685)	(17.79)	(5.204)	(5.417)	(4.537)	(4.073)	(3.286)
Treated	7.461	-4.262	-0.622	0.455	0.336	1.902	9.542*	-3.966	0.0644	1.342	1.254	0.916
	(5.168)	(4.043)	(3.914)	(2.968)	(2.631)	(1.670)	(5.149)	(4.550)	(4.303)	(3.407)	(3.231)	(1.851)
Time	10.55	8.914***	26.05***	5.872	3.127	8.932	9.310	6.790*	27.09***	5.234	4.036	22.86**
	(16.11)	(3.231)	(3.924)	(6.938)	(7.434)	(8.013)	(17.10)	(3.661)	(4.404)	(8.110)	(8.745)	(9.991)
Constant	183.6***	172.0***	162.3***	173.1***	179.9***	295.6**	181.5***	162.8***	166.3***	193.9***	202.1***	103.3
	(4.345)	(4.507)	(11.57)	(23.82)	(34.56)	(119.2)	(4.334)	(7.837)	(9.952)	(27.43)	(41.32)	(154.5)
Observations	596	596	596	596	596	540	260	260	260	260	260	228
R-squared	0.133	0.656	0.731	0.829	0.838	0.897	0.162	0.666	0.755	0.838	0.849	0.919
Sample weights	IPTW	IPTW	IPTW	IPTW	IPTW	IPTW	IPTW	IPTW	IPTW	IPTW	IPTW	IPTW
PScore	Kernel	Kernel	Kernel	Kernel	Kernel	Kernel	Nearest neighbor	Nearest neighbor	Nearest neighbor	Nearest neighbor	Nearest neighbor	Nearest neighbor
F test	1.27e-08	0	0	0	0	0	8.23e-10	0	0	0	0	0
Municipal charact.		Yes	Yes	Yes	Yes	Yes		Yes	Yes	Yes	Yes	Yes
Fiscal covariates			Yes	Yes	Yes	Yes			Yes	Yes	Yes	Yes
Pupils' charact.				Yes	Yes	Yes				Yes	Yes	Yes
School Infrastr.					Yes	Yes					Yes	Yes
School system charact.						Yes						Yes

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

The result of the estimation through the IPTW-DID model is shown in Table 2.13, for municipal average score in Math, and Table 2.14, for municipal average score in Portuguese. Despite a statistically significant ATT coefficient at 10% level obtained for Math, in columns (2) and (8), the result were not robust to the addition of more covariates in the model, and eventually, in the full model, the point estimate becomes negative, but without statistical significance. For Portuguese the same happen only in the case of Nearest Neighbor Matching (column (8)).[66]

[66] The best balancing was achieved using a large bunch of covariates in the Probit model used to explain treatment. However, in this specification, 53 units (municipalities) out of 146 treated units were dropped because they stayed in the region without support. With a more parsimonious model the quantity of treated units without support reduced enormously, but the balancing becomes worse. We estimate ATT with this parsimonious model and the Kernel Propensity Score Method and the results obtained were very similar.

Table 2.14 Effect of teacher salary increase on Portuguese test scores 2007-2013, controlling for selection on observables (IPTW-DID)

Variables	Portuguese											
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
ATT	6.183	5.941	-0.0897	0.0639	0.0685	0.615	6.821	6.394*	-0.909	-0.817	-0.930	-1.377
	(15.02)	(3.631)	(3.848)	(3.107)	(2.652)	(2.358)	(15.97)	(3.833)	(4.192)	(3.687)	(3.064)	(2.966)
Treated	6.776	-4.127	-2.100	-1.084	-1.020	0.965	8.718	-4.163	-2.276	-1.144	-1.521	-0.0698
	(5.579)	(2.752)	(2.693)	(2.194)	(1.884)	(1.495)	(5.760)	(3.054)	(2.977)	(2.617)	(2.255)	(1.711)
Time	15.84	14.38***	25.60***	6.351	6.013	13.84*	15.20	13.13***	26.77***	4.948	5.652	23.57***
	(14.37)	(2.141)	(3.071)	(5.801)	(5.708)	(7.151)	(15.33)	(2.381)	(3.444)	(6.821)	(6.762)	(8.737)
Constant	164.8***	152.4***	151.4***	124.6***	123.0***	223.9*	162.9***	147.6***	156.1***	139.8***	153.7***	-29.79
	(5.086)	(4.117)	(9.145)	(17.45)	(26.88)	(114.3)	(5.285)	(6.124)	(7.665)	(20.14)	(33.17)	(134.2)
Observations	596	596	596	596	596	540	260	260	260	260	260	228
R-squared	0.198	0.738	0.774	0.872	0.884	0.923	0.225	0.750	0.793	0.879	0.892	0.941
Sample weights	IPTW	IPTW	IPTW	IPTW	IPTW	IPTW	IPTW	IPTW	IPTW	IPTW	IPTW	IPTW
PScore	Kernel	Kernel	Kernel	Kernel	Kernel	Kernel	Nearest neighbor	Nearest neighbor	Nearest neighbor	Nearest neighbor	Nearest neighbor	Nearest neighbor
F test	2.17e-09	0	0	0	0	0	5.78e-10	0	0	0	0	0
Municipal charact.		Yes	Yes	Yes	Yes	Yes		Yes	Yes	Yes	Yes	Yes
Fiscal covariates			Yes	Yes	Yes	Yes			Yes	Yes	Yes	Yes
Pupils' charact.				Yes	Yes	Yes				Yes	Yes	Yes
School Infrastr.					Yes	Yes					Yes	Yes
School system charact.						Yes						Yes

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Alternatively we estimate ATT using an IV approach as described in Methodology section. Columns (1), (2), (5) and (6) of Table 2.15 present results for the 2SLS estimator for Mathematics and Portuguese test scores, taking into account our complex sample design. We could not reject the null hypothesis that the increase of teachers' salary does not impact pupils' Math and Portuguese test score for all two models, i.e. for a binary and a continuous instrument. The first stage becomes better when we include municipal school system fixed-effects in the model (column 3 and 4 for Math and 7 and 8 for Portuguese). Statistical tests show that instruments are strong in all specifications. The continuous instrument, as expected, performs relatively better than the discrete one.

Table 2.15 Effect of teacher salary increase on Mathematics and Portuguese test scores 2007-2013 (IV-DID)

Variables	Mathematics score				Portuguese score			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Base salary	-0.00194	0.000265	0.0112	0.00666	0.00425	0.000682	0.0135	0.00869
	(0.00836)	(0.00446)	(0.0112)	(0.00839)	(0.00656)	(0.00374)	(0.0107)	(0.00643)
Constant	158.1***	158.2***			137.7***	137.5***		
	(15.77)	(15.75)			(13.19)	(13.25)		
Observations	1,366	1,366	1,338	1,338	1,359	1,359	1,324	1,324
R-squared	0.764	0.765	0.676	0.685	0.809	0.809	0.765	0.777
Complex sample design	Yes	Yes			Yes	Yes		
Instrument	binary	continuous	binary	continuous	binary	continuous	binary	continuous
# Municipalities			669	669			662	662
Municipalities FE			Yes	Yes			Yes	Yes
First stage								
Instrument coefficient	-172.5701	-0.4972	143.7397	0.2731	-177.1534	-0.4963553	128.47	0.26685
	(35.693)	(0.05506)	(28.773)	(0.0499)	(36.0226)	(36.0226)	(30.0938)	(0.0509)
R-squared	0.7263	0.7449	0.9037	0.9057	0.7250	0.7428	0.9032	0.9058
Kleibergen-Paap rk LM statistic			24.08	23.531			18.601	21.759
Kleibergen-Paap rk Wald F statistic			24.956	29.926			18.224	27.463

Note: (3), (4), (7) and (8) were estimated using Stata command xtivreg2, that is not supported by the package of commands svy which take into account complex sample designs.

Standard errors in parentheses, robust to clustering at municipal level for models with municipalities fixed effects.

*** p<0.01, ** p<0.05, * p<0.1

2.5 Concluding remarks

This chapter allows us to conclude that after almost five years of the introduction of the policy of minimum salary for teachers there were no effect of the policy on pupils' proficiency. However it is not possible to undoubtedly state that raising teachers' salaries linearly and unconditionally is wasteful. Furthermore, even if the quality of new municipal school systems hires was very responsive to salary hikes, tenured teachers who entered teaching under a different salary regime would have little incentive to leave teaching when salaries are increased, and this would result in slow turnover and longer time to identify any change in educational outcomes caused by remuneration policy.

The results corroborate the conclusion of other empirical papers recently published on this issue, Ree et al (2015) and Pugatch and Schroeder (2014a, 2014b), that unconditional teachers' salary raise do not trigger better educational outcomes, at least in the short run.

Although impacts on pupils' learning have not been detected, some transmission mechanisms from salary increase to better education outcomes may have been activated and need more time to take place or to be completed. In the next chapter we investigate some of the possible transmission channels with the intention of bring more light to the future and potential impacts of the public systems teacher remuneration policy.

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APPENDIX

Table A.1 Effect of teacher salary raise on Portuguese test scores 2007-2009, controlling for selection on observables (IPTW-DID), using Nearest Neighbor matching

Variables	Portuguese						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
ATT	-0.327	3.754	3.790	3.255	3.693	3.788	2.305
	(2.102)	(4.500)	(2.725)	(2.882)	(2.516)	(2.330)	(2.532)
Treated	-14.08***	4.598*	0.269	0.532	1.422	1.003	1.766
	(1.486)	(2.695)	(1.932)	(1.994)	(1.969)	(1.738)	(1.722)
Time	9.445***	6.002*	5.467**	5.824**	5.767**	5.508**	6.897***
	(1.337)	(3.573)	(2.282)	(2.460)	(2.428)	(2.313)	(2.611)
Constant	178.4***	159.5***	202.5***	203.7***	139.6***	141.6***	128.6***
	(0.945)	(2.226)	(3.058)	(4.221)	(20.74)	(20.51)	(24.57)
Observations	944	430	430	430	430	430	430
R-squared	0.220	0.107	0.647	0.650	0.734	0.746	0.759
F test	0	4.74e-06	0	0	0	0	
Sample weights		IPTW	IPTW	IPTW	IPTW	IPTW	IPTW
Municipality characteristics			Yes	Yes	Yes	Yes	Yes
Fiscal covariates				Yes	Yes	Yes	Yes
Pupils' characteristics					Yes	Yes	Yes
School Infrastructure						Yes	Yes
School system characteristics							Yes

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table A.2 Effect of teacher salary raise on Mathematics test scores 2007-2009, controlling for selection on observables (IPTW-DID), using Nearest Neighbor matching

Variables	Mathematics						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
ATT	-2.636	4.784	4.678	3.880	3.959	4.354	2.668
	(2.557)	(4.851)	(3.062)	(3.170)	(2.919)	(2.832)	(3.060)
Treated	-16.14***	6.044**	0.235	0.939	2.096	1.565	2.787
	(1.808)	(3.059)	(2.465)	(2.477)	(2.512)	(2.393)	(2.413)
Time	12.94***	6.858*	6.406**	7.175***	6.933**	6.185**	7.939***
	(1.627)	(3.518)	(2.480)	(2.609)	(2.740)	(2.714)	(3.007)
Constant	197.9***	176.4***	230.3***	234.3***	152.9***	152.9***	122.0***
	(1.150)	(2.448)	(10.21)	(11.47)	(25.79)	(24.78)	(28.69)
Observations	944	430	430	430	430	430	430
R-squared	0.228	0.115	0.625	0.630	0.696	0.705	0.727
F test	0	1.65e-06	0	0	0	0	
Sample weights		IPTW	IPTW	IPTW	IPTW	IPTW	IPTW
Municipality characteristics			Yes	Yes	Yes	Yes	Yes
Fiscal covariates				Yes	Yes	Yes	Yes
Pupils' characteristics					Yes	Yes	Yes
School Infrastructure						Yes	Yes
School system characteristics							Yes

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

CHAPTER 3 – HIGHER SALARIES, MORE TEACHING? WHETHER CHANGES IN TEACHER PAY ENCOURAGE MORE ABLE INDIVIDUALS TO ENTER THE TEACHING PROFESSION

Abstract

In Brazil, not only teachers' salaries are lower compared to alternative occupations, but also poor performing students seemed to be more likely to pursue a teaching career. However, after the introduction of the minimum salary for teachers, there have been increases in both the real salary of municipal teachers and their relative salaries. These changes were most noticeable in municipalities affected by the minimum salary law, particularly among those municipalities that complied with the law. The main objective of this chapter is to assess the impact of salary hikes on teachers' quality and on potential future teachers' quality. We assess the impact of salary hikes on a proxy for teachers' quality, namely, their *ENADE* scores, and on the teaching career attractiveness. The latter may induce improvements in teachers' quality in the long-run. In this last chapter we apply a Triple-Differences model aiming at controlling for two types of potentially confounding trends: (i) changes in the performance of teachers (potential future teachers) across municipalities unrelated to the policy; and (ii) changes in performance of all teachers (students) living in municipalities affected by the new policy. Triple-differences estimates reveal mild effects of teachers' salary hikes on municipal teachers' quality and on the attractiveness of courses related to teaching career.

3.1 Introduction

Previous chapter shows that unconditional salary raise is not effective in increase pupils' performance, at least in the short-run. Although impacts on pupils' learning have not been detected, some transmission mechanisms from salary increase to better education outcomes may have been activated. Generally, the transmission channels may be associated to the intensive margin, with more effort

made by teachers, and to the extensive margin with the recruitment of more effective teachers.

Understanding the transmission channels through which higher salaries could lead to better pupils' learning is an important issue. A vast literature shows that higher relative teachers' salaries increase the likelihood that an individual enters teaching profession and reduce the likelihood that a teacher leaves the profession[67]. Furthermore, Leigh (2012) models the relationship between current teacher salaries and the academic aptitude of potentially future teachers, seen as those who were entering teacher education courses, and finds that a 1 per cent rise in the salary of a starting teacher boosts the average aptitude of potentially future students of teaching related College courses by 0.6 percentile ranks.

The main objective of this chapter is to assess the impact of salary hikes on teachers' quality. Although we did not find evidence of pupils learning improvement, we first assess the impact of teacher salary hike on teacher behavior. We show that teachers did not respond to salary hikes making more effort correcting pupils' homework and did not interrupted their participation in other concurrent working activities in the first five years of the policy. Then we proceed to the assessment of the impact of salary hikes on a proxy for teachers' quality, namely, their scores on *ENADE*, and on teaching career attractiveness, that could induce improvements in teacher quality in the long-run.

It is very common to hear or read that teachers' remuneration in Brazil is low and teaching is not an attractive career[68]. Researchers have shown that poor performing students and with poorly socioeconomic background were attracted to the

[67] Chevalier et al (2007), Zabalza et al. (1979), Dolton (1990), Dolton and van der Klaauw (1995 e 1999), and Dolton and Mavromaras (1994) for the United Kindom; and Stinebrickner (1998), Brewer (1996), Rees (1991), Mont and Rees (1996), Murnane and Olsen (1989 e 1990), Theobald (1990), and Theobald and Gritz (1996) for the United States.

[68] Tartuce et al (2010) presents the results of a research, whose objective was to investigate the attractiveness of the teaching career in Brazil from the viewpoint of students in the final year of secondary education. The study was carried out in public and private schools in large and medium-size cities in different regions in Brazil. The data used for the analyses originated from two sources: a questionnaire and discussion groups. The results show that rejection of a teaching career is a recurrent theme among the young people involved in the research. The justifications of the students for the lack of attractiveness of the career are related to the absence of a personal identification with teaching, the social and financial conditions associated with exercising the profession, the students' own school experience and family influence. Only 2% of 1.501 interviewed students point Pedagogy or Teaching as first option in higher education entrance exam, with a majority of women (77%) and blacks and people of mixed race (48%). Among them, the higher the parents' education level, the lower the intention of being a teacher. And 87% of these students attend public secondary schools.

teaching profession (Louzano et al, 2010; INEP, 2009 and 2010; Gatti and Barretto, 2009[69]).

However, in the last couple of decades, in Brazil, there were several initiatives that aimed at increasing the resources for education and in particular those for teachers' pay. Among which stands out the establishment of the Fund for Maintenance and Development of Fundamental Education and Teaching (*FUNDEF*), which ran from 1997 to 2006, and was replaced by the Basic Fund for Maintenance and Development of Education and School Personnel Valuation (*FUNDEB*), which will last until 2020. These funds were established in order to reserve at least 60% of its amount of resources to the remuneration of teaching professionals of primary and lower secondary teachers in the case of *FUNDEF* and also of upper secondary and pre-primary teachers in the case of *FUNDEB*.

Between 1995 and 2006, according to Louzano et al (2010), using *PNAD* database, the relative remuneration of public school teachers jumped from a value 62% lower than the average of other private workers to a value only 17% less than the average of this last group of workers.

As seen in the first chapter of this dissertation, although there are legal requirements regarding the participation of compensation expenses of teaching professionals in total *FUNDEB* resources, teacher salaries in the public school systems are set locally. The institution of the national minimum salary for teachers by the Law 11,738, of July 16, 2008, reinforced the allocation of funds for the payment of teachers' salaries by establishing minimum base salary to basic education teachers from all Brazilian public school systems. Since then municipal schools teacher's compensation is increasing heavily not only in real terms, but also relatively others careers.

In an annual basis, municipal primary teachers witnessed a real growth rate of their salary of 6.9% per year on average between 2008 and 2013, against 3.2% and 1.3% of the remuneration of private teachers and of the remuneration in other occupation in the private sector as annual real growth, respectively. Then teacher remuneration shows convergence to salary of alternative occupations in the period of analysis. According to *RAIS* data, the ratio of the average municipal teacher remuneration to the average remuneration in alternative occupations grew from

[69] Gatti and Barreto (2009) shows that 39% of students of Teaching Courses who answered *ENADE*'s questionnaire in 2005 belonged to families whose per capita income were up to three minimum salaries.

0.607 in 2008 to 0.796 in 2013, an expressive convergence in such a short period of time (see Chapter 1). The gap was reduced by almost half in only five years.

Despite presenting lower remuneration than the average of alternative careers, the attractiveness of docent careers is enhanced by employability. According to Neri (2013), using the Population Census 2010 database, Pedagogy and/or Teaching is in the 8th place among 48 college careers in terms of employability, after controlling for gender, age, size of municipality of residence, and state of residence. This high employability could explain why, as presented in Gatti and Barreto (2009), about 20% of the students of Pedagogy and Teaching answered that had chosen the course in order to have an outside option if not able to get other occupation.

Theoretically and empirically, there are many factors influencing teacher's (or any employee's) effort. Among these factors, the economic literature presents evidence that higher unemployment rates are associated with higher levels of effort among employees[70]. Microeconomic theory states that more effort is associated to higher costs. So, in order to put more effort in an activity or task, the agent needs to be properly compensated. There are at least two channels through which higher salaries could affect teaching quality. Firstly, better paid teachers can devote more time or effort to teaching activity, for instance, allocating more time to the preparation of lessons.

There are evidences from Experimental Economics that higher wages are associated with greater level of effort on the part of employees. Fehr, Kirchsteiger and Riedl (1993) and Fehr and Falk (1999) reported experiments in which participants in the role of employees showed less effort when receiving lower wages even when the lesser effort entailed greater cost to themselves. Moreover, the preference for fairness or reciprocity induces workers to work harder in response to higher wages (efficiency wages as in Akerlof and Yellen, 1990). Field and laboratory experiments indicate that this response tends to be greater the more common are feelings among workers of unfair treatment by employers. As teacher salary in Brazil is considered low, it is likely that the feeling of injustice among workers would be

[70] See Blinder and Choi (1990) and Agell and Lundborg (1995).

common. Thus, it may be that gift-exchange effects occur when teachers' salaries are raised (Fehr et al, 2009)[71].

In response to salary hikes, some teachers may quit other secondary paid job that they may have and dedicate more time to teaching activities, as confirmed by the randomized experiment studied in Ree et al (2015). Furthermore, teachers would be less tired and stressed when performing their work[72]. Consequently, they would become much more productive. This channel is difficult to test as teachers' effort and time devoted to teaching activities are difficult to observe or measure.

We test the effect of salary hikes on the proportion of full-time teachers and other indirect sources of teacher effort. There is a vast literature assessing the effects of performance based payments on teachers' effort, but, to the best of our knowledge, only Ree et al (2015) test such effect when salaries are raised linear and unconditionally for the Indonesian context. Ree et al (2015), assessing the impacts of a randomized remuneration policy, found that doubling base teacher salary reduced the incidence of teachers holding other jobs in 18%. They conclude that no evidence of meaningful positive impacts on pupil learning from intensive margin increases were found, contradicting gift-exchange and efficiency wage models of employee behavior.

The second channel is related to recruitment and retention of more effective teachers, i.e., to changes in extensive margin of teacher quality. Results from a large empirical literature indicate that salaries paid to teachers are negatively related to their propensities to exit teaching profession and positively related to durations in first teaching positions[73]. Intuitively, offering higher salaries and/or better work conditions is a necessary condition for attracting high quality teachers. However, this condition is not sufficient since less motivated workers are induced to apply for the vacancy by higher salaries too[74]. Dal Bó et al (2013), using an experiment in Mexico, find that higher wages attract more able applicants as measured by their IQ, personality, and

[71] However, laboratory experiments have a short-run nature. Therefore, even that these experiments show evidence of the theory of gift-exchange we do not know if they would be sustainable in the long-run (Levitt and List, 2007 and Jayaraman et al, Forthcoming).

[72] Ree et al (2015) found also a reduction in self-reported financial-stress of teachers.

[73] See Dolton and van der Klaauw (1999) and Behrman et al (forthcoming) that present a brief survey on this literature. More related to our approach, Falch (2011) examines the effect of salaries on teacher leaving decisions using a natural experiment approach. In Norway, teachers in schools with a lot of prior teacher vacancies received a salary premium of about 10 percent during 1993-94 to 2002-03. Using a school fixed effects model, he finds that the salary premium reduces the probability of voluntary quits by six percentage points.

[74] As put by Dal Bó et al (2013), particularly in the context of public service, two characteristics of a candidate would promote performance: her/his ability to perform (denominated by authors as "raw quality") and her/his desire to perform.

public service motivation. Thus, their results are against the hypothesis of adverse selection[75]. Besides, they find that distance and worse municipal characteristics strongly decrease acceptance rates, but higher wages help bridge the recruitment gap in municipalities characterized by worse working conditions.

Does the same phenomenon happen when the public sector is recruiting teachers? The studies that estimate the relationship between financial incentives and measures of teacher aptitude finds a positive correlation. There is evidence that high quality teachers respond to financial incentives such as bonuses payment based on performance. However, in the absence of pay for performance schemes, Behrman et al (forthcoming) simulations based on their estimated model show that increasing the Chilean municipal teachers wage by 20% would increase the number of certified teachers, but would not increase the "quality" of teachers employed, as the higher wage also would attract lower productivity types into the teaching profession[76]. This result corroborated Mansky (1987) which concluded that, in the absence of a minimum ability standard, increases in teacher earnings would yield higher teaching force recruitment but minimal improvement in the average academic ability of teachers. According to Mansky (1987), only the imposition of a minimum ability standard combined with sufficient salary increase would improve average teacher ability.

Metzler and Woessmann (2012) states that one of the few attributes of teachers that is correlated with the performance of students are their academic skills, as measured by performance on standardized tests. Guimarães et al (2013), in Brazilian context, find evidence that teachers with higher content knowledge have a greater impact on the math test scores of their students, an effect that is even larger at the school-level. Fernandes (2013), although his main conclusion was that teachers' didactic skills are the most important factor in enhancing students' performance, corroborated the relevance of teacher's content knowledge to explain pupils' performance with a different dataset for a different region of Brazil. Several studies show that higher wages lead to increasing quality of teachers as measured

[75] As in Delfgaauw and Dur (2007).

[76] As stressed by the authors, the main distinction between municipal wage offers and private schools wage offers is that the municipal sector has a rigid schedule in which everyone is paid according to their teaching experience and not according to teaching ability. Their simulations show that setting the municipal wage schedule equal to the wage offer function used in the private voucher sector, which distinguishes among productivity types, would generate increases in teacher quality within the municipal sector, at the expense of lower teacher quality in the private voucher sector.

by their scores on standardized tests such as the SAT[77], or cause the increase of the students' scores. However, the positive effect of salary increases not based on performance is more controversial[78]. This chapter's findings contribute to this debate.

Well founded in positive and statistically significant correlation between teachers' test scores in *ENADE* and pupils' test scores in *Prova Brasil* and between salaries and teachers' test scores, we compare the performance in *ENADE* of teachers working in municipal school system which had experienced salary hikes with the performance of teachers in municipalities that had not taken the treatment.

Considering that entrance into higher education is a competitive process and there are not enough vacancies to all demanders, the course choices of high-ability students will affect the choices available to low-ability students. If high-ability students switch to a particular course, the minimum entry standard for that course will rise, preventing low-ability students from enrolling. The test score distribution in teacher education courses therefore reflects the number of available places in these courses, and the demand by students. Observed salary or perceived relative salary, considering other careers, is a relevant factor in explaining college major decision or any course attractiveness. It is arguable that in more attractive careers, that are more competitive, the minimum entry standard for that course is higher. Then it is possible to infer the effect of salary increase on attractiveness of the docent career in the Brazilian context using entrance exam scores of students in teaching related courses and its relation to other courses.

The next section of this chapter brings features of the methodology that have not been presented previously. The third section presents data used in this chapter that have not been showed in the first two chapters. Section 3.4 brings the results in three sub-sections, the first gives the estimation of the impact of salary hike on teachers' effort, the second presents results of the impact on the proxy of quality of teachers of municipal education systems, and third shows the results of the impact on the attractiveness of teacher related College courses. Section 3.5 concludes.

[77] Such as Ballou and Podgursky (1995).

[78] See Hanushek et al. (1999) and Menezes-Filho and Pazello (2007). Menezes-Filho and Pazello (2007) pointed out the better retention and recruitment, afforded by salary raise, as a probable cause for the positive estimated effect on students test scores.

3.2 Methodology

To observe and measure employees' effort is a very complex task. In order to investigate the impact of salary hikes on teachers' effort we rely on two proxies of teachers' effort: (i) the proportion of full-time teachers, according to teachers self-report; and (ii) the proportion of teachers who correct pupils' homework, according pupils' self-report. The proportion of full-time teachers was calculated based on the answers of teachers of the 5th grade to the following question in *Prova Brasil* questionnaire:

15 - Besides your occupation as a teacher in this school, do you have another occupation that contributes to your personal income?

(A) Yes, in the field of Education.

(B) Yes, in other field.

(C) No.[79]

Teachers who answered the alternative (C) were considered full-time teachers. Afterwards we calculate proportions of full-time teachers in each municipal school system before and after the salary hike caused by the law enactment.

The proportion of teachers of the municipal school system who correct pupils' homework was calculated from 5th grade pupils' answer to the following question of *Prova Brasil* pupils' questionnaire:

41 (43) – Your teacher correct your Language (Math) homework?

(A) Always or almost always

(B) Sometimes

(C) Never or almost never[80]

Using these questions we were able to construct the proportion of pupils whose teacher correct always or almost always their homework before and after the salary hike caused by the law enactment.

We implement and estimate the impact of salary hike on teachers' behavior through a Difference-in-Differences model and IPTW-DID model, as done in Chapter two.

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[79] Author's translation from the question in Portuguese: *Além da atividade como docente nesta escola, você exerce outra atividade que contribui para sua renda pessoal? (A) Sim, na área de educação; (B) Sim, fora da área de educação; (C) Não.*

[80] Author's translation from the question in Portuguese: *O(A) professor(a) corrige o dever de casa de Língua Portuguesa (Matemática)? (A) Sempre ou quase sempre; (B) De vez em quando; (C) Nunca ou quase nunca*.

Following the literature, teachers' quality was measured by their scores in higher education graduation exam, namely teachers' scores in *ENADE*[81], a yearly College exam taken by first year (freshmen) and senior students. The exam is composed by two components, general formation component, intending to assess student general knowledge, and major-specific component, aiming to verify the learning of content, skills and competence required for the specific career or profession.

Aiming to test for the Brazilian context if the cognitive knowledge of teachers, especially related to the content of the subjects taught, is an important determinant of pupils' outcome in Brazil, we investigate whether the performance in *ENADE* correlates the performance of their pupils in *Prova Brasil* exams. In order to investigate this hypothesis, we estimate the following regression model by Ordinary Least Squares (OLS):

$$pupils\_score = \alpha + \beta \cdot X_{school} + \delta \cdot X_{pupils} + \sigma \cdot X_{teach} + \gamma \cdot teach\_score + \varepsilon$$

where X_{school} represents the vector of school characteristics, X_{pupils}, is the vector of pupils' characteristics and X_{teach}, is the vector of teachers' characteristics. The parameter of interest is γ which reflects the relation between teachers' test scores and their pupils' test scores.

Next we test whether the variability of teachers performance in ENADE can be explained by salary differentials observed between municipal school systems around the country. Again we estimate this partial correlation by OLS using the following model:

$$teach\_score = \alpha + \theta X_{system} + \sigma X_{teach} + \phi w_{teach} + \upsilon$$

where X_{system} is a vector of characteristics of the municipal school system; X_{teach} represents the vector of teachers' characteristics and w_{teach} is municipal teacher's salary.

After these two procedures, we obtain estimates for γ and ϕ, consisting of partial correlations between the performance of teachers and their pupils on tests and between teachers' performance and their remuneration.

[81] The acronym *ENADE* stands for *Exame Nacional de Desempenho dos Estudantes* in Portuguese (National Survey of Students Performance). Courses are split in three different groups which have their students' performance assessed every three years.

In Brazil there is not certification for teaching. According to the Law No. 9,394, of December 20th, 1996 (*Lei de Diretrizes e Bases da Educação - LDB*), and specifically its article 62, every individual who has a high education diploma in Teaching[82] and Pedagogy is able to entering the teaching profession. Also, for early childhood education and primary education are accepted teachers with a vocational diploma in teaching. However, the same law in its article 87, part of the transitional provisions, establishes the obligatory of high education degree as part of the requirements to become a teacher in public basic education systems after 10 years from the enactment of the law. It was just since 2008 that a college degree is required of teacher candidates. However until now there are teachers without higher education diploma hired before 2008. Therefore, in almost all municipal school systems there are primary teachers with and without a college degree.

At least since the enactment of LDB public education systems prompt their teachers to get a college diploma. In 1991, about 20% of public teachers had higher education degree. In 2006, this number had increased to about 60% and in 2013, 88.0% of the public teachers had higher education degree. Then during the 2000's it has been usual to find municipal teachers as college student and consequently find them among *ENADE* applicants in 2005, 2008 and 2011.

Each year more than 220 thousands professionals graduated in Teaching and Pedagogy enter the labor market after graduation in university or college, more than 20% of the total of graduates in higher education[83].

To compare *ENADE* scores between different editions we use linear equating[84]. Raw scores were normalized and then transformed into a 0-10 scale in the following way. Firstly we normalized scores:

$n_{it} = \frac{Enade_{ist} - \overline{Enade_{st}}}{\hat{\sigma}_{st}}$, where $Enade_{ist}$ is the score of individual i; $\overline{Enade_{st}}$ is the average of all students of course s and edition t ; and $\hat{\sigma}_{st}$ is the standard deviation of course s in edition t of *ENADE*.

Afterword, we transform n_{it} into 0-10 scale using the following formula: $n_{it}^{10} = \frac{n_{it}+3}{6} \cdot 10$. In this kind of transformation, it is assumed that almost all n_{it} is such

[82] Here Teaching relate to the translation of *Licenciatura*, high school course that besides the instruction on its main subject, as Languages, History, Geography, Sociology, Biology, Mathematics, Physics, Chemistry etc, has part of it focused on didactic subjects, practical and theoretically.
[83] Nascimento et al (2014).
[84] In a next version of this work we intend to use equipercentile equating, a more appropriate way of equating as it avoids out-of-range scores and is not group-dependent.

that its distribution support ranges from minus 3 standard deviations to plus 3 standard deviations: $-3 \leq n_{it} \leq 3$.

We use a unique dataset built after merging two well-known databases administered by *INEP*, data about teachers from *School Census* and from *ENADE*. We find municipal primary school teachers in the database of *ENADE* 2005, 2008 and 2011. We choose these three *ENADE* data sets because on those years courses related to teaching profession were assessed[85]. We considered that the chance of finding teachers among 2005, 2008 and 2011 *ENADE* participants were considerably higher, mainly primary teachers.

Furthermore, teachers whose students took *Prova Brasil* in 2011 were identified in 2005 and 2008 *ENADE* database. Therefore we could connect teachers' test scores in *ENADE* with their students' test scores in *Prova Brasil*. We merged this resulting data with our data of teacher salaries. Then we can associate a proxy for teacher quality (*ENADE* scores), with a proxy of teacher effectiveness (students test scores), and, finally, with teacher salaries and the municipal school system treatment status. We implement and estimate the impact of salary hike on teachers' quality through Difference-in-Differences and Triple-differences models, which will be described further.

In the Brazilian context, as in most European and Latin American countries, and Australia though not in the US, students must choose their college major at the time of entry into university. All federal universities, as well as some state and private universities, use the National Secondary Education Examination (*Exame Nacional do Ensino Médio* - *Enem*) at least as part of the selection criteria to fill vacancies.

The *Enem* was created in 1998 with the objective of evaluating student performance at the end of basic education. Recently the functions of this exam were extended, mainly due to its use for getting federal government scholarships for private higher education. Since 2004, with the creation of *PROUNI* (Program University for All), the exam is an instrument for selection to scholarships and progressively become a central selection mechanism for admission to higher education institutions. As each institution is free to define its own selection criteria,

[85] In 2005, took the exam students of Architecture and Urbanism, Biology, Social Sciences, Computer Science, Engineering (in eight different fields), Philosophy, Physics, Geography, History, Languages, Mathematics, Pedagogy and Chemistry. In 2008, took the exam students of the same courses and of some recently opened shorter term courses of technologists. In 2011 were included the courses of Physical Education, Music and Visual Arts.

there are different ways of taking *Enem* scores into account. The score in *Enem* can be used as a bonus in the entrance exam, as a first phase of the selection process with or without the Unified Selection System (*SiSU*)[86], and finally, as the sole criterion for selecting remaining vacancies. Also, since 2009 *Enem* is a high school certificate. Therefore, due to the expansion of *Enem* purposes, the number of subscribers increased from 1.5 million in 2004 to 3 million in 2005, to 4.1 million in 2009, to 5.8 million in 2012 and finally to more than 8.7 million students in 2014.

Since 2009, when it was modified, *Enem* scores are calculated based on item response theory (IRT) and the exam is composed by five tests, four objective tests: (i) Humanities and its Technologies (History, Geography, Philosophy and Sociology); (ii) Natural Sciences and their Technologies (Chemistry, Physics and Biology); (iii) Languages, codes and their technologies (Portuguese Language, Literature, Foreign Language - English or Spanish, Arts, Physical Education and Information Technology and Communication); and (iv) Mathematics and its technologies; and one Writing test.

Naturally, as *Enem* have been increasingly taken as part of the mechanism of selection to higher education courses, its test score distribution reflects the number of available places in these courses, and the demand by students. Assuming that there were not drastic changes in available places in teacher education courses, to test whether these courses become more attractive in recent years, we look at freshmen scores in *Enem* as a measure of competitiveness and attractiveness of these courses.

If an impact of the policy on freshmen scores in *Enem* were to be found, it would be arguable that the policy would affect potential future teachers' quality. We implement and estimate the impact of salary hike on the attractiveness of teaching career through a DID model, and through a Triple-differences as an alternative and robustness check, as in the case of the investigation of the effects on teachers' quality.

The potential outcomes are determined by a set of covariates in addition to the treatment as in the following model[87]:

[86] There are different ways of taking *Enem* scores into account. The score in *Enem* can be used as a bonus in the entrance exam, as a first phase to fill vacancies with or without the Unified Selection System (*SiSU*) and finally, as the sole criterion for selecting the remaining vacancies. *SiSU* is the acronym for *Sistema de Seleção Unificada*, a mechanism for selection to public high education institutions introduced in 2009 and that have been expanding year after year since then, with the inclusion of new institutions.

[87] The following description is suited to the case of the assessment of the effects of the policy on teachers' quality.

$$Y_{imt} = \beta_0 + \beta_1 D_m + \beta_2 \mathbb{I}\{t = T_1\} + \boldsymbol{\gamma} D_m \cdot \mathbb{I}\{t = T_1\} + \rho' X_{imt} + \varepsilon_{imt}$$

where the dependent variable, Y_{imt}, the score of student i in the municipality m in year t, is explained by a constant (β_0); the treated group fixed effect, captured by the coefficient on a dummy variable, D_m; the common effect of the passage of time, represented by β_2; the parameter of interest, $\boldsymbol{\gamma}$, representing the impact of the treatment, the abnormal teacher salary hike (denoted by $D = 1$), on the dependent variable; and a vector of covariates X that helps to explain the dependent variable. The model becomes complete with the error term, $\varepsilon_{\mathrm{imt}}$.

Just for didactic purpose, as a matter of making the interpretation of the following DDD easier later on, think of a model without covariates. The OLS estimate of the coefficient of interest, $\boldsymbol{\gamma}$, the coefficient on the interaction term, $D_m \cdot \mathbb{I}\{t = T_1\}$, would be expressed as follows:

$$\hat{\gamma}_{DD} = \left(\bar{y}_{m_T,1} - \bar{y}_{m_T,0}\right) - \left(\bar{y}_{m_U,1} - \bar{y}_{m_U,0}\right)$$

where $\bar{y}_{m_T,t}$ represents the average score of students in treated municipality in period t $(t = 0,1)$, and $\bar{y}_{m_U,t}$ represents the average score of students in untreated municipality in period t $(t = 0,1)$.

We run the OLS regression for Pedagogy students and Teaching courses students separately. The standard error for the OLS DID estimator $\hat{\gamma}_{DD}$ is obtained including a heteroskedasticity-robust standard error, clustered by municipality. It is straightforward to add additional covariates and inference robust to heteroskedasticity.

A more robust analysis than of the DID analysis presented earlier can be obtained by Triple-differences (DDD) using as control both a different municipality and a control group within the treatment municipality. In this case, the control group within treatment municipality is composed by students that entered in other courses not related to teaching profession, i.e., all others except for Pedagogy and Teaching courses (*licenciaturas*). Consider the following model:

$$Y_{imt} = \beta_0 + \beta_1 D_m + \beta_2 \mathbb{I}\{curso_i = pedag\ ou\ licenc\} + \beta_3 D_m \cdot \mathbb{I}\{curso_i = pedag\ ou\ licenc\} + \delta_0 \mathbb{I}\{t = T_1\} + \delta_1 \mathbb{I}\{t = T_1\} \cdot D_m + \delta_2 \mathbb{I}\{t = T_1\} \cdot \mathbb{I}\{curso_i = pedag\ ou\ licenc\} + \boldsymbol{\gamma} D_m \cdot \mathbb{I}\{t = T_1\} \cdot \mathbb{I}\{curso_i = pedag\ ou\ licenc\} + \rho' X_{imt} + \varepsilon_{imt}$$

where the dependent variable, Y_{imt}, the score of student i in the municipality m in year t, is explained by a constant (β_0); the fixed effect, independent of time and common to all the group of treated municipalities, captured by the coefficient on a dummy variable, D_m; the common effect of the passage of time, represented by δ_0; the effect of the passage of time common to all groups within the treated group, δ_1; the difference in the effect of the passage of time between potential future teachers and non-potential teachers, δ_2; the parameter of interest, $\boldsymbol{\gamma}$, representing the impact of the treatment, the abnormal teacher salary hike, on the group affected by the treatment in treated municipalities; and a vector of covariates X that helps to explain the dependent variable. The model becomes complete with the error term, ε_{imt}.

Again, just for didactic purpose, think of a model without covariates. The OLS estimate of the coefficient of interest, $\boldsymbol{\gamma}$, the coefficient on the triple interaction term, $\mathrm{D_m} \cdot \mathbb{I}\{\mathrm{t} = \mathrm{T_1}\} \cdot \mathbb{I}\{\mathrm{curso}_i = \mathrm{pedag\ ou\ licenc}\}$, may be expressed as follows:

$$\hat{\gamma}_{DDD} = [(\bar{y}_{m_T,G_T,1} - \bar{y}_{m_T,G_T,0}) - (\bar{y}_{m_U,G_T,1} - \bar{y}_{m_U,G_T,0})] - [(\bar{y}_{m_T,G_U,1} - \bar{y}_{m_T,G_U,0}) - (\bar{y}_{m_U,G_U,1} - \bar{y}_{m_U,G_U,0})]$$

The DDD estimate starts with the time change in averages for the potential future teachers (G_T) in the treatment municipality (m_T), then nets out the change in means for potential future teachers (G_T) in the control municipality (m_U), then the change in means for the non-potential future teachers (G_U) in the treatment municipality (m_T), and finally the change in means for the non-potential future teachers (G_U) in the control municipality (m_U).

The objective is that this procedure controls for two kinds of potentially confounding trends: (i) changes in the performance of potential future teachers across municipalities (that would have nothing to do with the policy) and (ii) changes

in performance of all students living in the policy-change municipality. Possibly due to other municipal policies or to the conditions of the offer of higher education vacancies that affect every student's performance in *Enem*, or municipality-specific changes in the education or economy that affect every student's performance.

As in the DID case, the standard error for $\hat{\gamma}_{DDD}$ is obtained including a heteroskedasticity-robust standard error, clustered by municipality. Again it is straightforward to add additional covariates and inference robust to heteroskedasticity.

3.3 Data

It was not possible to find teachers from all municipal school systems presented in our representative sample with scores in *ENADE*. As shown in Table 3.1, 94.1% of treated and 98% of untreated municipalities of our sample have at least one teacher whose scores were obtained in ENADE database. However, only 86% of treated municipalities and 73.5% of untreated ones have teachers in ENADE database in both years of analysis, 2008 and 2014. Although we lost part of our original sample, almost 80% of the sample is represented in ENADE database, what allows the assessment of the impact of salary hike on teachers' quality using teachers' content knowledge as a proxy.

Table 3.1 Quantity of treated and untreated municipalities in total sample and with teachers found in *ENADE* database

Municipalities	total sample	with teachers on Enade					
		total		in both years: 2008 and 2014		only in the year 2008	only in the year 2014
Treated	221	208	94.1%	190	86.0%	1	16
Untreated	294	288	98.0%	216	73.5%	1	71
Total	515	496	96.3%	406	78.8%	2	87

In this context, are considered treated all compliers since 2009, 2010 or 2011. Untreated are all municipality whose school system had not been impinged by the law from 2008 till 2011

A total of 61,360 matches between primary teachers and school systems formed after the enactment of the law introducing the national minimum salary for

teachers were composed by teachers found in the database of *ENADE* 2005, 2008 and 2011 (see Table 3.2). Of those matches, 34,711 involved municipal school systems, about 2.4% of total Brazilian municipal teachers-school system matches. Another 60,594 matches with individuals found in *ENADE* database were formed by teachers who were working in the same municipal school system in 2008 and 2014. Then we assumed they continued in the profession after the law, 43,420 among those matches involved municipal school systems (3.0% of matches). And finally 13,864 matches with individuals in *ENADE* data were destroyed after the introduction of the minimum salary, 8,938 of those associated to municipal systems vacancies.

About 3% of all the school system-teacher matches in 2008 and about 4% in 2014 are composed by teachers found in *ENADE* database. The exact numbers are: 8,544 matches of primary teacher-municipal school system in a total of 281,987 matches that exist in treated and untreated municipal school systems in 2008 and 17,510 matches of primary teacher-municipal school system in a total of 440,939 matches that exist in treated and untreated municipal school systems in 2014 were found in ENADE database.

Table 3.2 Matches of primary teachers found in *ENADE* and municipal school systems

Matches school system-primary teacher in ENADE	Total	Municipal systems	Sample				
			total	impinged	non-impinged	treated 2011	untreated 2011
created after law	61,360	34,711	12,555	2,842	9,713	2,037	8,376
continued	60,594	43,420	25,109	8,345	16,764	2,419	4,678
destroyed after law	13,864	8,938	2,293	1,117	1,176	584	863
Total	135,818	87,069	39,957	12,304	27,653	5,040	13,917

Source: author's calculations, based on School Census 2008 and 2014, *ENADE* 2005, 2008 and 2011 database and *Pesquisa sobre Carreira e Remuneração de Professores das Redes Públicas*.

Table 3.2 shows the quantity of teachers found in *ENADE* database who are involved in matches with municipal school systems and also their characterization as treated or untreated, according to the municipal school system status for the year 2011. Teachers are characterized as treated if their employer complied with the law since 2009, 2010 or 2011. On the other hand, comparison teachers are employed by municipal school systems that have not been impinged by the law at least until 2011 because they pay at least the national minimum as base teacher salary.

Table 3.3 Municipalities in the sample and with teachers observed in *ENADE* database according treatment status

	Sample Municipalities		Municipalities with teachers in *ENADE*				Matches Teacher-Municipal School System	
	untreated (A)	treated (B)	untreated (C)	treated (D)	untreated ((C)/(A))	treated ((D)/(B))	untreated	treated
North	24	23	20	20	83.3%	87.0%	625	239
RO	4	3	4	3	100.0%	100.0%	30	50
AC	4	0	4	0	100.0%		68	0
AM	1	0	0	0	0.0%		0	0
RR	3	0	3	0	100.0%		435	0
PA	2	5	2	5	100.0%	100.0%	68	112
AP	0	0	0	0			0	0
TO	10	15	7	12	70.0%	80.0%	24	76
Northeast	19	96	15	80	78.9%	83.3%	298	1836
MA	3	9	3	9	100.0%	100.0%	33	339
PI	4	12	3	12	75.0%	100.0%	33	80
CE	2	16	0	10	0.0%	62.5%	0	329
RN	4	10	3	6	75.0%	60.0%	109	49
PB	0	16	0	10		62.5%	0	48
PE	2	11	2	11	100.0%	100.0%	35	287
AL	2	3	2	3	100.0%	100.0%	19	40
SE	1	5	1	5	100.0%	100.0%	18	181
BA	1	14	1	14	100.0%	100.0%	51	483
Southeast	146	41	139	34	95.2%	82.9%	9621	912
MG	22	24	20	18	90.9%	75.0%	823	170
ES	4	5	4	5	100.0%	100.0%	69	317
RJ	16	5	16	5	100.0%	100.0%	3149	177
SP	104	7	99	6	95.2%	85.7%	5580	248
South	84	18	75	17	89.3%	94.4%	2764	496
PR	25	8	25	7	100.0%	87.5%	1858	398
SC	11	4	9	4	81.8%	100.0%	51	66
RS	48	6	41	6	85.4%	100.0%	855	32
Mid-West	21	43	21	42	100.0%	97.7%	609	1558
GO	7	13	7	13	100.0%	100.0%	179	579
MS	9	16	9	15	100.0%	93.8%	354	93
MT	5	14	5	14	100.0%	100.0%	76	886
Total	**294**	**221**	**270**	**193**	**91.8%**	**87.3%**	**13917**	**5040**

Source: author's calculations, based on School Census 2008 and 2014, *ENADE* 2005, 2008 and 2011 database and *Pesquisa sobre Carreira e Remuneração de Professores das Redes Públicas*.

As already shown, it was not possible to find teachers of all municipal school system of our sample in *ENADE* database. Table 3.3 brings information about the quantity of matches which have teachers with *ENADE* score and the distribution and the quantity of matches among regions and states, considering treatment status. 89.9% of municipal school systems characterized as treated or untreated has at least one primary teacher who was found in *ENADE* database, 91.8% of all treated school systems and 87.3% of all untreated.

The Northern regions are relatively worse represented in the sample of matches of teachers and school system, with 85.1% and 82.6% of municipalities of the North and Northeast, respectively, presented in our initial sample having matches with teachers in *ENADE* database. Meanwhile the South region has 90.2% of its municipal school system represented in the sample with teachers with scores in *ENADE*, and the Southeast, 92.5%. Mid-West region has the highest participation rate, with 98.5%, and with the total of its untreated municipal school system represented in *ENADE* database.

In total 18,957 matches with municipal primary teachers with scores in *ENADE* were found, 5,040 matches in treated municipal school systems and 13,917 in untreated municipal school systems, what represents around 2% of total matches (1.6% considering 2014 total matches and 2.5% if considering 2008 total matches – see Table 3.4).

Table 3.4 Distribution of matches with teachers with scores in *ENADE* among Brazilian regions and participation of matches with *ENADE* relatively total matches in 2008 and 2014

	Distribution of matches with ENADE			**Matches with ENADE relatively total 2008 matches**		**Matches with ENADE relatively total 2014 matches**	
	untreated	treated	total	untreated	treated	untreated	treated
North	4.5%	4.7%	4.6%	14.2%	6.3%	9.1%	4.8%
Northeast	2.1%	36.4%	11.3%	3.5%	5.4%	3.8%	5.5%
Southeast	69.1%	18.1%	55.6%	2.2%	4.1%	3.5%	5.1%
South	19.9%	9.8%	17.2%	3.0%	4.5%	4.0%	3.9%
Mid-West	4.4%	30.9%	11.4%	2.9%	2.8%	4.9%	4.3%
Brazil	100.0%	100.0%	100.0%	2.6%	4.2%	3.8%	4.8%

Source: author's calculations, based on School Census 2008 and 2014, *ENADE* 2005, 2008 and 2011 database and *Pesquisa sobre Carreira e Remuneração de Professores das Redes Públicas*.

According to Table 3.4, roughly, the distribution of matches with teachers found in *ENADE* database follows the distribution of municipal school system around the country. There is a large concentration of matches with teachers found in *ENADE* in treated municipal school system located in the Northeast and Mid-West regions and in untreated municipal school system in Southeast and South regions. This phenomenon was expected since these are the regions of concentration of treated and untreated municipal school system respectively.

Relatively all the existing matches, the North region is the more frequently represented in *ENADE* database, probably because in that region teachers more

frequently do not already had a higher education diploma before the introduction of the minimum salary for teachers.

Teachers were more frequently found in *ENADE* database in matches involving treated municipal school system (4.8% of total matches considering 2014 and 4.2% if consider 2008 matches, while in untreated municipal school systems only 3.8% and 2.6%, respectively, of the matches has teachers with score in *ENADE*).

Table 3.5 shows the distribution of teachers who took *ENADE* exam in 2005, 2008 and/or 2011 according to their major in Higher Education. Pedagogy is the most predominant major among teachers, but this predominance is higher among primary teachers and even higher among municipal primary school teachers. It is interesting to note that while the participation of Pedagogy as the major of teachers decreased between 2008 and 2014, its participation increases among primary teachers and among municipal primary teachers.

Among municipal primary teachers in 2014 found in *ENADE* database, 70% was studying to get a major in Pedagogy when taken the exam, and in 2008 the proportion was of 64% of teachers (see Table 3.5). After Pedagogy, the most popular major among municipal primary teachers is Languages with a proportion of 14.8% in 2008 and 11.8% in 2014, followed by History, with a proportion of 5.1% and 3.5%, respectively, and Math (4.6% and 3.1%, respectively).

In the period of analysis, there were significantly increase in the scores of teachers in activity according to the merging of School Census data and *ENADE* database. When we calculate the average score of teachers in *ENADE* we see an increasing tendency between 2008 and 2014. Table 3.6 shows average scores (measured in terms of standard deviation) of teachers in activity in 2008 and 2014 who were found in *ENADE* database in the two most frequent courses (Pedagogy and Languages) and the absolute variation in scores between 2008 and 2014. The statistics also show that the representative sample underestimates a bit the teachers' scores in both courses and both components, the major-specific and the general formation component. For instance, in 2008, Pedagogy senior students score in major-specific component, on average, 5.5118 points according to the complex sample design against 5.5482 points if taking teachers of all municipalities into account.

Table 3.5 Distribution of teachers found in *ENADE* database according to their major

Major	All teachers-school				Primary teachers				Municipal primary teachers			
	2008		2014		2008		2014		2008		2014	
Pedagogy	63,726	53.3%	145,680	48.2%	27,944	63.8%	64,288	69.9%	19,205	64.0%	39,947	70.0%
Languages	17,666	14.8%	44,116	14.6%	6,555	15.0%	11,232	12.2%	4,456	14.8%	6,714	11.8%
History	6,473	5.4%	18,080	6.0%	2,061	4.7%	2,792	3.0%	1,531	5.1%	1,997	3.5%
Math	8,467	7.1%	22,032	7.3%	1,891	4.3%	2,657	2.9%	1,369	4.6%	1,790	3.1%
Biology	6,178	5.2%	17,651	5.8%	1,615	3.7%	2,402	2.6%	1,184	3.9%	1,601	2.8%
Geography	4,950	4.1%	13,934	4.6%	1,217	2.8%	1,564	1.7%	894	3.0%	1,112	1.9%
Physical Education	1,400	1.2%	6,853	2.3%	530	1.2%	2,839	3.1%	242	0.8%	1,518	2.7%
Others	8,823	7.4%	29,730	9.8%	1,357	3.1%	2,900	3.2%	748	2.5%	1,550	2.7%
No information	1,776	1.5%	4,364	1.4%	634	1.4%	1,340	1.5%	401	1.3%	810	1.4%
Total	119,459		302,440		43,804		92,014		30,030		57,039	

Major	Municipal primary teachers in 2008 and 2014				Municipal primary teachers only in			
	2008		2014		2008		2014	
Pedagogy	13,434	63.7%	14,893	66.7%	6,021	67.4%	25,578	73.7%
Languages	3,309	15.7%	3,181	14.2%	1,257	14.1%	3,653	10.5%
History	1,094	5.2%	1,061	4.8%	440	4.9%	964	2.8%
Math	851	4.0%	801	3.6%	334	3.7%	792	2.3%
Biology	869	4.1%	822	3.7%	321	3.6%	793	2.3%
Geography	654	3.1%	606	2.7%	239	2.7%	521	1.5%
Physical Education	141	0.7%	191	0.9%	99	1.1%	1,328	3.8%
Others	736	3.5%	1,550	3.4%	223	2.5%	1,047	3.0%
No information	4	0.0%	26	0.1%	4	0.0%	35	0.1%
Total	21,092	100%	22,328	100%	8,938	100%	34,711	100%

Source: author's calculations, based on School Census 2008 and 2014, *ENADE* 2005, 2008 and 2011 database and *Pesquisa sobre Carreira e Remuneração de Professores das Redes Públicas*.
Note: All estimates consider complex sample design.

In the other hand, the representative sample overestimates a bit the variation of teachers' scores between 2008 and 2014 in both courses and both components, the major-specific and the general formation component. The estimated absolute variation of average scores is 0.0708 points if complex sample design is taken into account but only 0.048 points considering all teachers found in *ENADE* database.

In all components of both courses and for both types of students, senior or freshmen, there were a significant increase in the performance of teachers between 2008 and 2014, whether we consider all municipalities or the municipalities in the sample (taking into account the complex sample design). See the fourth and eighth columns of Table 3.6, with the absolute variation of scores, all with positive magnitudes.

Table 3.6 Average scores of teachers in activity in 2008 and in 2014 in the two most frequent courses taken by teachers

Component	students	All municipalities					Municipalities in the sample				
		2008		2014		Abs. variation (B)-(A)	2008		2014		Abs. variation (D)-(C)
		# obs	aver. score (A)	# obs	aver. score (B)		# obs	aver. score (C)	# obs	aver. score (D)	
Pedagogy Students											
Major-specific	seniors	39971	5.5482	99407	5.5962	0.0480	12726	5.5118	39825	5.5825	0.0708
component	freshmen	21847	4.2090	42423	4.5637	0.3547	7717	4.0696	18026	4.5994	0.5298
General formation	seniors	38024	5.2985	94647	5.3846	0.0861	12054	5.2734	37974	5.3843	0.1108
component	freshmen	21610	4.1793	41914	4.6262	0.4469	7606	4.0514	17784	4.6915	0.6402
Languages Students											
Major-specific	seniors	12021	4.8305	33072	5.3875	0.5570	2563	4.6425	10681	5.4401	0.7977
component	freshmen	4806	3.8574	9522	4.7555	0.8982	1111	3.8412	3268	4.8424	1.0012
General formation	seniors	12008	4.7703	33040	5.3666	0.5963	2561	4.5004	10668	5.4294	0.9290
component	freshmen	4785	3.7344	9487	4.8525	1.1180	1102	3.7277	3255	4.9436	1.2159

Source: author's calculations, based on School Census 2008 and 2014, *ENADE* 2005, 2008 and 2011 database and *Pesquisa sobre Carreira e Remuneração de Professores das Redes Públicas*.
Note: See Methodology section for the formula of scores.

However the examination of the evolution of the average score of teachers graduating in Pedagogy during the period of analysis in treated and untreated municipal school systems reveals no consistent differences among these groups of municipalities. According to Table 3.7, teachers of untreated municipal school systems as seniors in Pedagogy perform better than their counterparts in treated municipalities both in major-specific and general formation components, not just who were teaching in 2008 but also in 2014, after the salary hike caused by the minimum salary introduction. When we compare the evolution of average scores of teachers of these two groups of municipalities as Pedagogy students, those matched with treated municipal school systems performed better as seniors (the majority of teachers) in major-specific component of the exam (0.025 points higher increase) but worse in the general formation component (0.064 points lesser increase). In the other hand, those matched with treated municipal school systems performed worse as freshmen both in major-specific component and in the general formation component of the exam (0.558 and 0.614 points lesser increase, respectively).

Table 3.7 Comparison of the average 2008 and 2014 teachers' scores in Pedagogy *ENADE* in treated and untreated municipalities and municipal school systems

Panel A - All school systems												
		untreated municipalities					treated municipalities					
		2008		2014			2008		2014			
Component	students	# obs	aver. score (A)	# obs	aver. score (B)	Abs. variation (B)-(A)	# obs	aver. score (C)	# obs	aver. score (D)	Abs. variation (D)-(C)	diff-diff (D)-(C) - (B)+(A)
Major-specific	seniors	6930	5,6312	27983	5,7042	0,0730	2737	5,3953	5955	5,5337	0,1384	0,0654
	freshmen	4680	4,2227	13578	4,7783	0,5556	1256	4,2560	2131	4,4567	0,2008	-0,3548
General formation	seniors	6628	5,3652	26876	5,4837	0,1185	2538	5,2110	5535	5,3623	0,1514	0,0329
	freshmen	4596	4,2077	13388	4,8860	0,6783	1247	4,3312	2107	4,6072	0,2761	-0,4023
Panel B - Municipal school systems												
		untreated municipal school system					treated municipal school system					
		2008		2014			2008		2014			
Component	students	# obs	aver. score (A)	# obs	aver. score (B)	Abs. Variation (B)-(A)	# obs	aver. score (C)	# obs	aver. score (D)	Abs. variation (D)-(C)	diff-diff (D)-(C) - (B)+(A)
Major-specific	seniors	3064	5,7145	13418	5,8799	0,1653	1617	5,3102	3717	5,5004	0,1902	0,0248
	freshmen	1869	4,1345	5842	4,9256	0,7911	785	4,2015	1275	4,4351	0,2336	-0,5575
General formation	seniors	2945	5,3611	12787	5,5968	0,2357	1534	5,1637	3438	5,3353	0,1716	-0,0641
	freshmen	1830	4,0766	5761	5,0070	0,9303	778	4,2660	1262	4,5828	0,3168	-0,6135

Source: author's calculations, based on School Census 2008 and 2014, *ENADE* 2005, 2008 and 2011 database and *Pesquisa sobre Carreira e Remuneração de Professores das Redes Públicas*.
Note 1: See Methodology section for the formula of scores.
Note 2: All estimates consider complex sample design.

From 2008 to 2014 according to their performance on *ENADE*, in both its components, there was an increase in the quality of municipal teachers who took the exam. However, surprisingly, the increment was higher in untreated municipalities (see Tables 3.8 and 3.9). Meanwhile, in the same period, among private teachers who took the *ENADE*, there was a reduction in average scores on Major-specific component in treated municipalities, against an increase in untreated municipalities. On General Formation component, the group of private teachers of both types of municipalities has witnessed an increase in their average scores (see Table 3.9).

Table 3.8 *ENADE* average score on Major-Specific component of teachers from municipal and private school systems in treated and untreated municipalities (2008 and 2014)

Group	Year	Average score	Std. Dev.	Linearized Std. Err.	[95% Conf.	Interval]
Municipal teachers	2014	4,95438	1,575356	0,0321063	4,891451	5,017308
in treated	2008	4,63437	1,447862	0,0439841	4,548158	4,720583
Diff (2014-2008)		0,32001				
Municipal teachers	2014	5,544742	2,378696	0,0202924	5,504969	5,584515
in untreated	2008	4,961432	2,456511	0,0389605	4,885067	5,037798
Diff (2014-2008)		0,58331				
Diff-in-Diff		-0,2633				
Private teachers in	2014	5,261587	2,004777	0,0419835	5,1793	5,343875
treated	2008	5,319138	2,397582	0,0772762	5,16767	5,470606
Diff (2014-2008)		-0,05755				
Private teachers in	2014	5,245421	2,580886	0,0180806	5,209983	5,280859
untreated	2008	5,047603	2,956606	0,0335213	4,981898	5,113307
Diff (2014-2008)		0,197818				
Diff-in-Diff		-0,25537				
DDD		**-0,00793**				

Note: all statistics considered complex survey design.

Table 3.9 *ENADE* average score on General Formation component of teachers from municipal and private school systems in treated and untreated municipalities (2008 and 2014)

Group	Year	Average score	Std. Dev.	Linearized Std. Err.	[95% Conf.	Interval]
Municipal teachers	2014	4,902	1,688	0,037	4,829	4,974
in treated	2008	4,558	1,593	0,050	4,459	4,657
Diff (2014-2008)		0,344				
Municipal teachers	2014	5,420	2,419	0,021	5,378	5,462
in untreated	2008	4,799	2,482	0,041	4,718	4,880
Diff (2014-2008)		0,620				
Diff-in-Diff		-0,277				
Private teachers in	2014	5,244	2,145	0,046	5,153	5,335
treated	2008	5,160	2,418	0,081	5,001	5,319
Diff (2014-2008)		0,084				
Private teachers in	2014	5,244	2,730	0,019	5,206	5,282
untreated	2008	4,970	3,011	0,035	4,901	5,039
Diff (2014-2008)		0,274				
Diff-in-Diff		-0,190				
DDD		**-0,087**				

Note: all statistics considered complex survey design.

According to the Census of Higher Education, shown in Table 3.10, between 2010 and 2013, vacancies in higher education institutions grew 9.9%, but in Pedagogy and teaching courses there were a decrease in vacancies in the period. Generally there is more demand to higher education than vacancies. Between 2010 and 2013 the relation applicants per vacancy in Brazilian higher education institutions increased from 2.15 to 3.48, corresponding to an increment of 62.2% in the ratio, very similar to the increment verified in Pedagogy courses (61.5%, from 1.4 to 2.27 applicants per vacancy). Also, the number of applicants in Pedagogy grew considerably by 50.3%. Although this increments in the ratio and in the quantity of applicants, Pedagogy courses are less competitive than the average and particularly than Teaching courses which had an applicant-vacancy ratio of 3.83 in 2013. Teaching courses witnessed an increase in applicant-vacancy ratio considerably smaller, only 16.1%, from 3.3 to 3.83 (see Table 3.8).

Table 3.10 Vacancies offered in Brazilian Higher Education Institutions in 2010 and 2013, applicants, applicants per vacancy, individuals and freshmen who took *Enem* in previous year

Year/ major	Vacancies offered	Applicants		Applic./ vacanc	Freshmen		Individuals who took Enem in the previous year (A)	Freshmen who took Enem in the previous year (B)	Freshmen		
		#	part.		#	part.			prop. who took Enem (B)/(A)	part. in total	female prop.
2013											
Pedagogy	178,186	403,790	3.4%	2.27	95,662	4.9%	125,298	63,802	50.9%	5.1%	90.3%
Teaching Courses	346,152	1,324,243	11.1%	3.83	173,333	8.9%	264,645	128,966	48.7%	10.4%	53.9%
Others	2,905,377	10,217,046	85.5%	3.52	1,682,701	86.2%	1,792,777	1,036,040	57.8%	83.5%	55.6%
Total	3,429,715	11,945,079	100%	3.48	1,951,696	100%	2,182,720	1,241,340	56.9%	100%	57.2%
2010											
Pedagogy	191,366	268,571	4.0%	1.40	85,861	5.4%	101,572	51,073	50.3%	5.9%	91.1%
Teaching Courses	524,338	1,728,033	25.8%	3.30	268,995	16.9%	316,720	164,380	51.9%	18.9%	67.5%
Others	2,404,488	4,702,298	70.2%	1.96	1,235,356	77.7%	1,233,589	694,713	56.3%	79.9%	55.5%
Total	3,120,192	6,698,902	100%	2.15	1,590,212	100%	1,551,464	869,209	56.0%	100%	57.8%

Source: Census of Higher Education 2010 and 2013, and *Enem* database 2009 and 2012.

Even after a significant rise in the ratio applicant-vacancy, Pedagogy is still a course characterized by low competition among candidates. Figure 3.1 shows the comparison between the distribution of average scores on 2012 *Enem* objective test of freshmen studying Pedagogy, Teaching Courses and other courses. We see that Pedagogy students perform more poorly than Teaching Courses students who perform worse than students of other courses. Barely a Pedagogy student would pass for Medicine, whose students present extremely high *Enem* scores. The comparison using 2009 scores are quite similar.

The proportion of freshmen studying Pedagogy and Teaching courses who took *Enem* in the previous year are quite similar in 2010 and 2013, drifting around 50%, as seen in Table 3.10. Therefore, we are able to compare scores in *Enem* of freshmen studying Pedagogy and Teaching courses in 2012 against 2009.

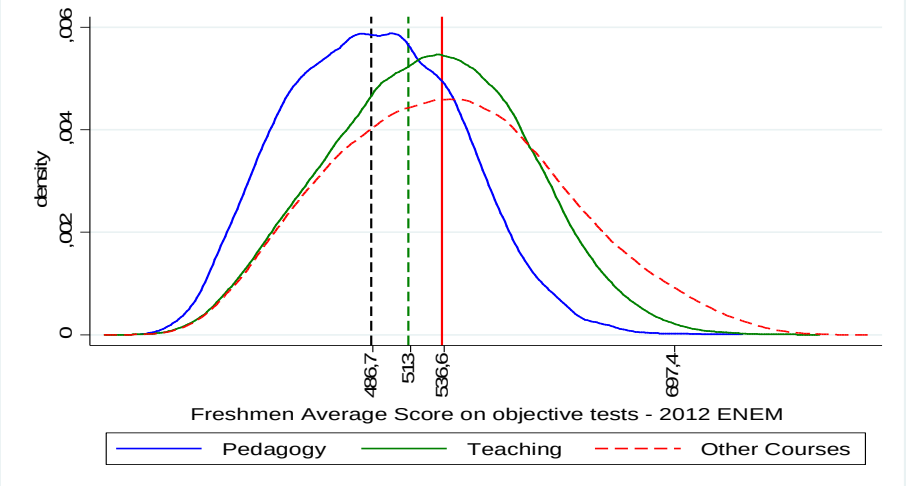

Figure 3.1 Distribution of 2012 Enem scores on objective tests of 2013 Freshmen according to their major (Pedagogy, Teaching Courses and others)

Source: author's estimation based on *Enem* 2012 database.
Note: values marked on x-axis are the mean scores of Pedagogy, Teaching, other courses in general and Medicine (frequently the most competitive course), respectively.

Table 3.11 shows that new students of Pedagogy and Teaching courses increased their average scores on objective tests relatively to the students of other courses by 1.2% and 0.6%, respectively, from 2009 to 2012. In the other hand, on Writing, their average scores have decreased relatively students of other courses by 6.7% and 3.3%, respectively, in the same period.

The test on which potential future teachers, studying Pedagogy or Teaching courses, perform more badly is Math, on which discipline their average scores are

84.6% and 91.4% of the average score of students of all other courses, respectively[88].

Table 3.11 Scores of Pedagogy and Teaching courses' freshmen in *Enem* by tests (2009 and 2012) – other courses=100

Major	Stats	Nature		Humanities		Portuguese		Math		Average - objective tests			Writing		
		2009	2012	2009	2012	2009	2012	2009	2012	2009	2012	var (%)	2009	2012	var (%)
Pedagogy	mean	87.8	89.8	89.9	92.4	92.0	93.9	86.5	84.6	89.0	90.1	1.2%	97.3	90.8	-6.7%
	sd	77.4	70.9	84.1	86.2	89.4	92.1	65.4	76.2	78.5	80.3	2.2%	90.7	94.8	4.5%
	min	100.0	100.0	100.0	100.0	100.0	100.0	100.8	100.0	100.3	100.0	-0.3%			
	max	90.4	86.2	96.5	91.5	97.4	90.8	87.8	93.7	92.8	90.6	-2.4%	100.0	100.0	0.0%
	p25	89.2	92.4	90.4	92.9	92.0	93.8	90.9	84.8	90.6	91.0	0.4%	95.5	91.3	-4.3%
	p50	88.2	90.2	89.0	92.9	91.7	94.4	88.1	84.0	89.2	90.3	1.2%	96.2	92.9	-3.4%
	p75	87.2	88.1	89.0	92.0	91.6	94.0	83.5	84.4	87.8	89.5	1.9%	96.7	93.9	-2.8%
Teaching courses	mean	93.8	94.8	95.8	96.9	96.4	97.1	91.8	91.4	94.5	95.0	0.6%	99.6	96.3	-3.3%
	sd	86.6	82.6	91.7	91.6	94.6	95.4	80.4	87.1	88.0	88.7	0.8%	91.9	94.5	2.8%
	min	100.0	100.0	100.0	100.0	100.0	100.0	100.8	100.0	100.3	100.0	-0.3%			
	max	95.2	91.0	97.5	94.2	100.0	97.6	97.5	100.0	97.5	95.8	-1.8%	100.0	100.0	0.0%
	p25	94.9	96.6	96.3	97.6	96.6	97.3	94.3	91.3	95.5	95.7	0.2%	100.0	95.7	-4.3%
	p50	94.1	95.1	95.5	97.2	96.4	97.4	92.7	91.3	94.7	95.2	0.5%	100.0	96.4	-3.6%
	p75	93.4	93.7	95.2	96.5	96.2	97.0	89.3	91.3	93.5	94.6	1.1%	96.7	97.0	0.3%

Source: Author's estimates based on *Enem* database.

Note: **sd** corresponds to standard deviation; **min** and **max** are the minimum score obtained by students; **p25**, **p50** and **p75** are the values associated to the 25th percentile, the median, and the 75th percentile, respectively.

Table 3.12 presents *Enem* average scores on objective tests for students of teaching profession related courses and of other courses in treated and untreated municipalities. It is possible to take the following facts from the broad picture: (i) *Enem* average scores dropped from 2009 to 2012, perhaps at least in part due to the large increment in the quantity of students taking the Exam from 2009 to 2012 and the phase out of the Exam as entrance exam to College countrywide; (ii) the decrease in the average scores were harder in untreated municipalities; (iii) the only group that do not witnessed a drop in their scores on objective tests was teaching courses students resident in treated municipalities; and (iv) the decrease in objective tests scores, whether it happens, were lesser among teaching profession related courses than in other courses, independently on where students study.

[88] See the statistics in the Appendix.

Table 3.12 *Enem* average score on objective tests for different groups of students in treated and untreated municipalities (2009 and 2012)

Group	Year	Average score	Std. Dev.	Linearized Std. Err.	[95% Conf.	Interval]
teaching careers in	2012	512.023	53.509	0.556	510.934	513.112
treated	2009	513.289	54.953	0.769	511.782	514.796
Diff (2012-2009)		-1.266				
teaching careers in	2012	518.107	71.598	0.497	517.132	519.082
untreated	2009	539.469	79.144	0.507	538.476	540.463
Diff (2012-2009)		-21.362				
Diff-in-Diff		20.096				
other careers in	2012	534.872	70.561	0.293	534.298	535.446
treated	2009	542.417	73.316	0.477	541.483	543.351
Diff (2012-2009)		-7.545				
other careers in	2012	544.721	86.440	0.189	544.350	545.093
untreated	2009	561.492	95.298	0.235	561.031	561.952
Diff (2012-2009)		-16.771				
Diff-in-Diff		9.225				
DDD		**10.871**				

Note: all statistics considered complex survey design. Inep addopts IRT for Enem scoring.
Source: Author's estimates based on *Enem* database.

Table 3.13 *Enem* average score on Writing test for different groups of students in treated and untreated municipalities (2009 and 2012)

Group	Year	Average score	Std. Dev.	Linearized Std. Err.	[95% Conf.	Interval]
teaching careers in	2012	538.1996	121.3094	1.2852	535.6806	540.7185
treated	2009	623.6265	116.5808	1.6537	620.3853	626.8678
Diff (2012-2009)		-85.4269				
teaching careers in	2012	537.2591	154.3825	1.1216	535.0607	539.4574
untreated	2009	634.3965	159.7044	1.0669	632.3053	636.4876
Diff (2012-2009)		-97.1374				
Diff-in-Diff		11.7105				
other careers in	2012	561.7552	146.3194	0.6293	560.5217	562.9887
treated	2009	636.2243	140.6536	0.9476	634.3671	638.0815
Diff (2012-2009)		-74.4691				
other careers in	2012	561.0165	170.9314	0.3866	560.2588	561.7742
untreated	2009	631.8	176.7825	0.4442	630.9293	632.6707
Diff (2012-2009)		-70.7835				
Diff-in-Diff		-3.6856				
DDD		**15.3961**				

Note: all statistics considered complex survey design. Inep addopts IRT for Enem scoring.
Source: Author's estimates based on *Enem* database.

Table 3.13 presents *Enem* average scores on writing test for students of teaching profession related courses and of other courses in treated and untreated

municipalities in 2009 and 2012. As what happened on objective tests, *Enem* average scores on writing dropped significantly from 2009 to 2012. On writing, all groups witnessed a drop in their average scores and teaching courses students suffered more from this phenomenon, especially those from untreated municipalities.

In 2012 *Enem*, the distribution of Pedagogy students has changed just a little, with only a slight improvement in their performance on objective tests. Only 0.5% of Pedagogy students came from the top 10% students (0.1 p.p. higher than in 2009), and 4.4% came from the 4th quartile (0.5 p.p. higher than 2009). From 2009 to 2012 there was an increase of 1.1 p.p. on the rate of freshmen of Pedagogy coming from the half freshmen with better performance in the *Enem* (from 22.4% to 23.5%). At the bottom of the distribution, the percentage derived from the 1st quartile fell 0.5 p.p., to 44.9%.

However, the evolution of the distribution of Pedagogy entrants in terms of tests performance between 2010 and 2013 was very different between individuals residing in municipalities that were affected by the national minimum salary for teachers law, i.e. whose base teachers' salary in 2008 was lower than R$ 950, and that raised salaries in order to comply with the new legislation during at least the next three years, and municipalities not affected by the law, i.e., those who were already paying more than the minimum salary as base salary for municipal teachers in the period 2008-2011. Among the first group of municipalities, their residents who started Pedagogy course more often came from lower quartiles of the distribution of *Enem* scores that among the residents of the municipalities not affected by the law, as shown in Table 3.14.

From 2010 to 2013, there was a relative improvement of the position in the distribution of scores among the residents of the municipalities impinged by the law. The proportion of students positioned in the quartiles on the right of the distribution decreased for both groups of municipalities. However, during this period, the portion of Pedagogy students from the affected municipalities who came from the 1st quartile of the distribution fell 17.5 p.p., while in the case of municipalities not impinged by the law there was an increase of 8.9 p.p.. Among those students positioned in the 2nd quartile, the opposite occurred, with an increase of 19.8 p.p. (to 52.2%) among students living in impinged municipalities and law-abiding, vis-à-vis an almost stability among the students resident of municipalities not impinged by the law (33.9% to 34.1%).

Table 3.14 Distribution of Pedagogy and Teaching Courses students according to their *Enem* scores in objective tests

Quartile or decile	2010				2013				Var (2013-2010) in p.p.	Diff: treated-control
	Objective tests scores		Students from each quartile or decile		Objective tests scores		Students from each quartile or decile			
	min	max	%	quant	min	max	%	quant		
Pedagogia				37,240				49,685		
1st quartile	317.3	450.4	45.4%	16,896	324.2	441.1	44.9%	22,302	-0.48	
Treated			48.7%	1,143			31.2%	1,181	-17.56	-26.48
Controls			36.3%	3,295			45.2%	4,368	8.92	
2nd quartile	450.4	497.7	32.3%	12,017	441.1	485.6	31.6%	15,715	-0.64	
Treated			32.4%	759			52.2%	1,977	19.81	19.58
Controls			33.9%	3,078			34.1%	3,297	0.23	
3rd quartile	497.7	545.1	18.5%	6,893	485.6	530.3	19.1%	9,472	0.55	
Treated			16.1%	378			14.0%	531	-2.10	3.71
Controls			23.1%	2,102			17.3%	1,674	-5.82	
4th quartile	545.1	802.4	3.9%	1,434	530.3	744.8	4.4%	2,196	0.57	
Treated			2.8%	66			2.7%	101	-0.15	3.18
Controls			6.7%	613			3.4%	330	-3.33	
10th decile	584.0	802.4	0.4%	153	565.4	744.8	0.5%	273	0.14	
Treated			0.2%	4			0.1%	3	-0.09	0.36
Controls			0.8%	77			0.4%	38	-0.45	
Licenciaturas				92,077				106,954		
1st quartile	311.2	487.9	25.6%	23,578	298.9	476.4	25.3%	27,018	-0.35	
Treated			29.0%	2,009			28.2%	2,770	-0.82	-8.20
Controls			16.3%	3,213			23.7%	4,155	7.38	
2nd quartile	487.9	542.4	28.8%	26,490	476.4	526.2	28.6%	30,573	-0.18	
Treated			30.8%	2,138			30.3%	2,977	-0.57	-5.94
Controls			23.3%	4,589			28.7%	5,027	5.36	
3rd quartile	542.4	593.6	28.4%	26,186	526.2	573.9	28.3%	30,221	-0.18	
Treated			26.5%	1,838			29.5%	2,903	3.00	4.54
Controls			31.7%	6,238			30.2%	5,286	-1.54	
4th quartile	593.6	820.9	17.2%	15,823	573.9	798.7	17.9%	19,142	0.71	
Treated			13.7%	948			12.1%	1,187	-1.61	9.59
Controls			28.6%	5,626			17.4%	3,049	-11.20	
10th decile	638.3	820.9	3.8%	3,533	612.8	798.7	4.1%	4,360	0.24	
Treated			2.4%	168			1.4%	134	-1.06	4.04
Controls			8.2%	1,613			3.1%	543	-5.10	

Source: Enem 2009 and 2012 and Census of Higher Education 2010 e 2013.

3.4 Results

This section brings the results divided in three sub-sections, the first gives the estimation of the impact of salary hike on teachers' effort, the second presents results of the impact on the proxy of quality of teachers of municipal education systems, and third shows the results of the impact on the attractiveness of teacher related College courses.

3.4.1 Effect on Teachers' Effort

In this dissertation, the investigation of the impact of salary hikes on teachers' effort relies on two proxies of teachers' effort: (i) the proportion of full-time teachers, according to teachers self-report; and (ii) the proportion of teachers who correct pupils' homework, according pupils' self-report to *Prova Brasil* questionnaires.

We begin presenting the impact of teachers' salary increase on the proportion of full-time teachers, considering the period of time from 2008, before the law, and 2013, after five years of the law. Results of the models brought by Table 3.15 are very unstable. The simplest model shows a negative coefficient statistically insignificant and, after introducing municipality characteristics as covariates, it became significant at 10% level, but become insignificant again after the addition of more covariates into the model. The full model shows an ATT coefficient with positive signal, but again without statistical significance. In order to test the robustness of these results, we estimated the effect of the policy on the proportion of full-time teachers through a DID model controlling for observables (IPTW-DID), whose results are shown in Table 3.16. Again, the estimated coefficients are very unstable across the different specifications and propensity score matching method. The conclusion is that salary hikes do not impact on the proportion of full-time teachers in treated municipal school systems.

Table 3.15 Effect of salary hikes on the proportion of full-time teachers in the municipal system (2007-2013)

VARIABLES	Proportion of full-time teacher					
	(1)	(2)	(3)	(4)	(5)	(6)
ATT	-0.0782	-0.0744*	-0.0628	-0.0467	-0.0436	0.0169
	(0.0481)	(0.0424)	(0.0426)	(0.0415)	(0.0418)	(0.0433)
Treated	0.100***	0.0784***	0.0681**	0.0591*	0.0606**	0.0289
	(0.0296)	(0.0302)	(0.0305)	(0.0305)	(0.0302)	(0.0280)
Time	0.000159	-0.00788	-0.0353	-0.00159	0.0132	0.102
	(0.0319)	(0.0280)	(0.0338)	(0.0734)	(0.0751)	(0.0957)
Constant	0.557***	0.538***	0.361***	0.346	0.723**	-0.0550
	(0.0204)	(0.0787)	(0.123)	(0.350)	(0.365)	(1.182)
Observations	848	848	848	848	848	764
R-squared	0.024	0.152	0.159	0.213	0.238	0.354
Complex sample design	Yes	Yes	Yes	Yes	Yes	Yes
Municipality characteristics		Yes	Yes	Yes	Yes	Yes
Fiscal covariates			Yes	Yes	Yes	Yes
Pupils' characteristics				Yes	Yes	Yes
School Infrastructure					Yes	Yes
School system characteristics						Yes

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 3.16 Effect of salary hikes on the proportion of full-time teachers in the municipal system (2007-2013), controlling for observables (IPTW-DID)

Variables	Proportion of full-time teachers											
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
ATT	-0.146	-0.148**	-0.117*	-0.104*	-0.0988*	-0.0301	-0.151	-0.155**	-0.124*	-0.109	-0.110	-0.0450
	(0.130)	(0.0705)	(0.0689)	(0.0615)	(0.0565)	(0.0438)	(0.139)	(0.0737)	(0.0716)	(0.0712)	(0.0679)	(0.0577)
Treated	0.0107	0.0660	0.0626	0.0785*	0.0865**	0.0653**	-0.00114	0.0545	0.0563	0.0710	0.0754	0.0704**
	(0.0660)	(0.0507)	(0.0529)	(0.0463)	(0.0409)	(0.0288)	(0.0712)	(0.0606)	(0.0654)	(0.0552)	(0.0491)	(0.0309)
Time	0.0654	0.0571	-0.0339	-0.0578	-0.0476	0.0734	0.0704	0.0564	-0.0612	0.000731	-0.00633	0.292*
	(0.117)	(0.0485)	(0.0606)	(0.124)	(0.130)	(0.149)	(0.127)	(0.0545)	(0.0671)	(0.149)	(0.153)	(0.176)
Constant	0.611***	0.644***	0.564***	0.975**	0.998	-0.108	0.623***	0.625***	0.460**	1.101**	1.059	-3.551
	(0.0572)	(0.104)	(0.196)	(0.430)	(0.615)	(1.875)	(0.0630)	(0.102)	(0.204)	(0.455)	(0.710)	(3.485)
Observations	594	594	594	594	594	539	258	258	258	258	258	227
R-squared	0.038	0.257	0.292	0.399	0.440	0.656	0.050	0.269	0.320	0.459	0.508	0.744
Sample weights	IPTW	IPTW	IPTW	IPTW	IPTW	IPTW	IPTW	IPTW	IPTW	IPTW	IPTW	IPTW
PScore	Kernel	Kernel	Kernel	Kernel	Kernel	Kernel	Nearest neighbor	Nearest neighbor	Nearest neighbor	Nearest neighbor	Nearest neighbor	Nearest neighbor
Municipal charact.		Yes	Yes	Yes	Yes	Yes		Yes	Yes	Yes	Yes	Yes
Fiscal covariates			Yes	Yes	Yes	Yes			Yes	Yes	Yes	Yes
Pupils' charact.				Yes	Yes	Yes				Yes	Yes	Yes
School Infrastr.					Yes	Yes					Yes	Yes
School system charact.						Yes						Yes

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

The results for the effect of the policy on the proportion of teachers who correct pupils' Math and Portuguese homework, according pupils' self-report to *Prova Brasil* questionnaires are qualitatively the same, i.e. we do not find any impact on this measure of teacher effort, as shown in Table 3.17. Our results contradicts results obtained by Ree et al (2015) who concludes that the program of teacher certification in Indonesia have reduced the proportion of teachers holding second jobs.

Table 3.17 Effect of salary hikes on the proportion of teachers in the municipal system who correct pupils' homework according to pupils' self-declaration (2007-2013)

Variables	Portuguese						Math					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
ATT	-0.0136	-0.0125	-0.00988	-0.0276**	0.0224	-0.0384***	-0.0206	-0.0189	-0.0167	-0.0134	-0.1644	-0.0341**
	(0.0211)	(0.0158)	(0.0145)	(0.0127)	(0.0230)	(0.0126)	(0.0129)	(0.0131)	(0.0116)	(0.0117)	(0.0207)	(0.0139)
Treated	-0.0188	0.0132	0.0140	0.0160*	0.0115	0.0309***	-0.0196**	0.00312	-0.00209	-0.00773	0.0176	0.0229***
	(0.0140)	(0.0112)	(0.00870)	(0.00866)	(0.0137)	(0.0085)	(0.00927)	(0.0103)	(0.00910)	(0.00878)	(0.0137)	(0.0087)
Time	-0.00198	-0.00442	0.00708	-0.0155	-0.0514	-0.0515	0.0188**	0.00678	0.0233	0.0118	0.0163	0.0060
	(0.0145)	(0.00983)	(0.0237)	(0.0306)	(0.0162)	(0.0419)	(0.00879)	(0.00872)	(0.0219)	(0.0300)	(0.0137)	0.0437
Constant	0.831***	0.660***	0.598***	0.659**	0.697***	1.024*	0.531***	0.679***	0.311***	0.572	0.6974	0.1483
	(0.00759)	(0.0219)	(0.115)	(0.313)	(0.0506)	(0.5793)	(0.0291)	(0.0249)	(0.119)	(0.386)	(0.0328)	(0.6579)
Observations	850	850	850	764	594	540	850	850	850	764	594	540
R-squared	0.017	0.304	0.598	0.646	0.6834	0.8455	0.279	0.237	0.517	0.574	0.4915	0.772
Sample weights	Yes	Yes	Yes	Yes	IPTW	IPTW	Yes	Yes	Yes	Yes	IPTW	IPTW
Municipality characteristics		Yes	Yes	Yes	Yes	Yes		Yes	Yes	Yes	Yes	Yes
Fiscal covariates			Yes	Yes		Yes			Yes	Yes		Yes
Pupils' characteristics			Yes	Yes		Yes			Yes	Yes		Yes
School Infrastructure			Yes	Yes		Yes			Yes	Yes		Yes
School system characteristics				Yes		Yes				Yes		Yes

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

3.4.2 Effect on Teachers' Quality

Following the international literature, in the absence of a direct measure of teachers' quality, the effect of unconditional salary hikes on teachers' quality is estimated using *ENADE* test scores as a proxy. We implement and estimate the impact of teacher salary hike on municipal teachers' quality through a Difference-in-Differences and Triple-Differences models, getting an Average Treatment Effect on the Treated (ATT).

Table 3.18 DID estimates, in the municipal level, for effects on average municipal teachers' quality (measured by *ENADE* scores, all majors grouped) – 2008-2014

Variables	All majors - General formation					All majors - Major-specific component				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
ATT	-0.124	-0.129	-0.106	-0.0164	-0.0164	0.0181	0.000664	0.0182	0.0888	0.0904
	(0.234)	(0.212)	(0.192)	(0.197)	(0.196)	(0.234)	(0.210)	(0.195)	(0.198)	(0.198)
Treated	-0.115	-0.0255	0.0839	0.0260	0.0186	-0.330*	-0.201	-0.0307	-0.0674	-0.0701
	(0.178)	(0.169)	(0.166)	(0.171)	(0.173)	(0.171)	(0.162)	(0.157)	(0.161)	(0.162)
Time	0.170	-0.0906	-0.0714	-0.191	-0.205	0.0931	-0.237	-0.221	-0.320	-0.325*
	(0.187)	(0.195)	(0.181)	(0.192)	(0.192)	(0.185)	(0.196)	(0.186)	(0.197)	(0.196)
Pedagogy		0.132	-0.121	0.0128	0.0192		0.939**	0.710	0.826*	0.828*
		(0.551)	(0.569)	(0.565)	(0.564)		(0.423)	(0.446)	(0.442)	(0.441)
History		0.220	0.359	0.582	0.578		0.730	0.882	0.971	0.981
		(0.696)	(0.705)	(0.697)	(0.698)		(0.605)	(0.615)	(0.619)	(0.616)
Biology		-0.0472	-0.133	0.0962	0.0948		0.723	0.723	0.845	0.850
		(0.720)	(0.698)	(0.712)	(0.711)		(0.515)	(0.530)	(0.527)	(0.525)
Geography		1.414	1.639*	1.907**	1.910**		2.381***	2.678***	2.773***	2.775***
		(0.951)	(0.936)	(0.930)	(0.925)		(0.775)	(0.765)	(0.758)	(0.756)
Languages		-0.759	-0.629	-0.458	-0.454		0.0807	0.251	0.366	0.372
		(0.593)	(0.588)	(0.593)	(0.593)		(0.459)	(0.462)	(0.467)	(0.467)
Math		0.0613	-0.203	-0.591	-0.597		0.782	0.563	0.554	0.563
		(0.686)	(0.709)	(0.627)	(0.627)		(0.498)	(0.526)	(0.532)	(0.530)
Physical Education		0.301	0.281	0.492	0.485		1.295	1.246	1.420	1.413
		(1.167)	(1.236)	(1.227)	(1.224)		(0.890)	(0.937)	(0.955)	(0.954)
Constant	4.922***	7.248***	8.236***	8.019***	8.104***	5.110***	5.789***	6.655***	6.612***	6.600***
	(0.141)	(0.795)	(0.795)	(0.788)	(0.857)	(0.137)	(0.621)	(0.640)	(0.646)	(0.704)
Observations	804	804	804	794	793	804	804	804	794	793
R-squared	0.008	0.161	0.226	0.241	0.242	0.019	0.212	0.271	0.280	0.281
Teachers characteristics	No	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes
Municipality characteristics	No	No	Yes	Yes	Yes	No	No	Yes	Yes	Yes
Market salaries (RAIS)	No	No	No	Yes	Yes	No	No	No	Yes	Yes
School system characteristics	No	No	No	No	Yes	No	No	No	No	Yes

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

The regressions were run in the municipal and the individual level and weighted by municipal weights calculated to restore country representativeness of the base salary sample. Variables in the municipal level were obtained just averaging out all teachers of each municipal school system. We start presenting results from DID model in the level of municipalities. Table 3.18 presents results for the estimated ATT, using DID estimator, on scores in the general formation and major-specific components of *ENADE*, considering teachers from all majors grouped. Table 3.19

presents the results considering just teachers with major in Pedagogy, which course is the most frequent major of the primary teachers found in *ENADE* (about 70%, as seen in Table 3.5), in the level of municipalities.

In both tables, the first and sixth columns show the estimates for the simplest model, without any covariates. In the case of the general formation component, we see a surprisingly negative ATT point estimate, although without statistical significance, in the case of all majors grouped, signal remains when we added covariates in the model. Meanwhile, the inclusion of covariates in the regression for Pedagogy graduates only caused a change in the signal of the ATT point estimate. However, all estimates for ATT are statistical insignificant, even in the full model, after controlling for some individual characteristics, some municipality characteristics, average formal market salaries and some school system features[89].

Table 3.19 DID estimates, in the municipal level, for the effects on average municipal teachers' quality (measured by *ENADE* scores, Pedagogy) – 2008-2014

Variables	Pedagogy - General formation component					Pedagogy - Major-specific component				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
ATT	-0.0215	-0.0291	-0.0217	0.0424	0.0513	0.0832	0.0601	0.0503	0.121	0.127
	(0.307)	(0.297)	(0.281)	(0.279)	(0.278)	(0.294)	(0.279)	(0.266)	(0.266)	(0.265)
Treated	-0.0830	-0.0361	-0.0593	-0.102	-0.119	-0.289	-0.203	-0.115	-0.159	-0.177
	(0.233)	(0.230)	(0.251)	(0.255)	(0.256)	(0.207)	(0.201)	(0.209)	(0.210)	(0.212)
Time	-0.0274	-0.133	-0.175	-0.373	-0.396*	-0.0168	-0.298	-0.287	-0.483*	-0.518**
	(0.224)	(0.218)	(0.223)	(0.232)	(0.227)	(0.223)	(0.246)	(0.244)	(0.259)	(0.257)
Constant	5.111***	8.556***	9.082***	9.135***	9.331***	5.303***	8.058***	8.626***	8.706***	8.982***
	(0.176)	(0.774)	(0.716)	(0.724)	(0.877)	(0.159)	(0.676)	(0.636)	(0.639)	(0.725)
Observations	724	724	724	717	716	730	730	730	723	722
R-squared	0.001	0.097	0.154	0.167	0.170	0.008	0.124	0.170	0.181	0.184
Teachers characteristics	No	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes
Municipality characteristics	No	No	Yes	Yes	Yes	No	No	Yes	Yes	Yes
Market salaries (RAIS)	No	No	No	Yes	Yes	No	No	No	Yes	Yes
School system characteristics	No	No	No	No	Yes	No	No	No	No	Yes

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

[89] From now on, the following covariates are added in the full model: teacher's gender and age, whether teacher were senior or freshmen when took the exam, whether already has a college diploma, a post-graduation, or a master or PhD degree, fixed effects related to specific majors (only in the case of all majors regression), municipal population, GDP and per capita GDP, region where municipality is located (only in models without municipality FE), the average salary of all formal employee and of all college graduated employee, the quantity of municipal primary teachers in activity, the quantity of municipal primary students and the average primary school class size.

Table 3.20 DID estimates, in the teachers level, for effects on municipal teachers' quality (measured by *ENADE* scores, all majors grouped) – 2008-2014

Variables	Major-specific component						General Formation component					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
ATT	-0.158***	-0.158**	-0.0839	-0.0605	-0.0274	-0.0169	-0.166***	-0.166**	-0.118*	-0.0870*	-0.0546	-0.0504
	(0.0435)	(0.0757)	(0.0691)	(0.0457)	(0.0481)	(0.0500)	(0.0481)	(0.0762)	(0.0678)	(0.0470)	(0.0490)	(0.0487)
Time	-0.196***	-0.196	-0.154	0.0792	0.0607	0.0533	-0.145***	-0.145	-0.0967	0.120	0.104	0.0982
	(0.0362)	(0.120)	(0.101)	(0.0873)	(0.0890)	(0.0881)	(0.0398)	(0.122)	(0.104)	(0.0966)	(0.0999)	(0.0997)
Treated	0.350***	0.350***	0.113*	0.0645	-0.0385	-0.0306	0.372***	0.372***	0.196***	0.132***	0.0507	0.0503
	(0.0277)	(0.0685)	(0.0675)	(0.0430)	(0.0484)	(0.0475)	(0.0290)	(0.0677)	(0.0647)	(0.0421)	(0.0469)	(0.0472)
Pedagogy			0.314***	0.263***	0.274***	0.289***			0.0219	-0.0254	-0.0156	-0.00385
			(0.0632)	(0.0699)	(0.0706)	(0.0701)			(0.0874)	(0.0915)	(0.0922)	(0.0923)
History			-0.0574	-0.0200	-0.00986	0.0133			-0.204	-0.164	-0.154	-0.138
			(0.0960)	(0.0958)	(0.0980)	(0.0977)			(0.125)	(0.122)	(0.124)	(0.125)
Biology			-0.202	-0.169	-0.157	-0.138			-0.466***	-0.431***	-0.420***	-0.406***
			(0.124)	(0.117)	(0.117)	(0.117)			(0.162)	(0.152)	(0.154)	(0.153)
Geography			-0.249**	-0.205*	-0.198	-0.185			-0.423***	-0.375**	-0.367**	-0.358**
			(0.121)	(0.121)	(0.123)	(0.124)			(0.153)	(0.151)	(0.153)	(0.153)
Languages			0.0255	0.0584	0.0684	0.0856			-0.206	-0.172	-0.161	-0.149
			(0.114)	(0.111)	(0.113)	(0.114)			(0.141)	(0.137)	(0.138)	(0.139)
Math			0.0402	0.0594	0.0739	0.0952			-0.143	-0.119	-0.110	-0.0953
			(0.0924)	(0.0933)	(0.0951)	(0.0969)			(0.126)	(0.126)	(0.127)	(0.129)
Physical Educ			0.0682	-0.00909	-0.00155	0.0174			-0.00145	-0.0421	-0.0398	-0.0235
			(0.0805)	(0.0925)	(0.0932)	(0.0944)			(0.176)	(0.201)	(0.196)	(0.198)
Constant	-0.0231	-0.0231	0.528***	0.742***	0.757***	0.398**	-0.120***	-0.120	0.637***	0.877***	0.899***	0.689***
	(0.0242)	(0.0996)	(0.0908)	(0.104)	(0.108)	(0.191)	(0.0254)	(0.0947)	(0.120)	(0.144)	(0.147)	(0.241)
# Obs	44,145	44,145	44,142	44,142	44,038	44,031	43,250	43,250	43,243	43,243	43,141	43,134
R-squared	0.024	0.024	0.094	0.114	0.115	0.119	0.020	0.020	0.065	0.083	0.084	0.086
Cluster	No	Munic	Munic	Munic	Munic	Munic	No	Munic	Munic	Munic	Munic	Munic
Individual character.	No	No	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes
Municipal charac.	No	No	No	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes
Market salaries (RAIS)	No	No	No	No	Yes	Yes	No	No	No	No	Yes	Yes
School system charact.	No	No	No	No	No	Yes	No	No	No	No	No	Yes
Complex sample design	Yes	No	No	No	No	No	Yes	No	No	No	No	No

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

In the individual level we estimate the effects using DID and DDD. In the DDD, we adopt as control both a different municipality (not impinged by the law) and a

control group within the treatment municipality, composed by individuals not benefited by the policy (at least not directly benefited[90]).

Tables 3.20 and 3.21 show DID estimates for ATT on teachers' *ENADE* scores by component for all majors and for only Pedagogy major, respectively. Results for the simplest model are presented in columns (1) and (2), for teachers of all majors, and (7) and (8) for only teachers with major in Pedagogy. The difference between (1) and (2) or (7) and (8) is that the first model considers the complex sample design of the representative sample and the second presents a clustered standard error in the municipal level. Columns (3)-(6) and (9)-(12) bring results for the same model of (2) and (8), respectively, added by groups of covariates. One concern with this estimation procedure comes from the fact that the coefficient of the dummy which characterize treated units is statistically significant in some of the specifications. As shown in previous chapter, treatment and comparison groups are very distinct from each other in observables characteristics. The fact that the coefficient of the treatment status dummy losses its statistical significance in the full model regression reveals the importance of the inclusion of all controls into the model.

The DDD model can improve identification of the impact of the policy on teachers' quality. Besides the control for changes in the quality of teachers across municipalities unrelated to the policy, it also controls for changes in quality of all teachers in the policy-change municipality. Possibly due to other municipal policies or to the conditions of the higher education offer that affect every student's performance in *ENADE*, or municipality-specific changes in the education or economy that affect every teachers performance independently of their employee. In this case, the control group within treatment municipality is composed by teachers of all school systems but municipal system or just private school systems, depending on the specification.

[90] In fact, it is possible that private school system teachers had been beneficiaries of the policy too. However, as RAIS data shows, municipal primary teachers remuneration have increased significantly relatively private teachers remuneration supposedly due to the minimum salary introduction, we argue that even whether the benefits of the policy had spilled over private teachers, municipal teachers have benefited much more from it.

Table 3.21 DID estimates, in the teachers level, for effects on municipal teachers' quality (measured by *ENADE* scores, Pedagogy) – 2008-2014

Variables	Major-specific component						General Formation component					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
ATT	-0.129**	-0.129	-0.0762	-0.0273	0.0275	0.0427	-0.172***	-0.172*	-0.130	-0.0529	-0.00391	0.00497
	(0.0557)	(0.0968)	(0.0878)	(0.0669)	(0.0642)	(0.0651)	(0.0590)	(0.0912)	(0.0832)	(0.0637)	(0.0626)	(0.0634)
Time	-0.0875*	-0.0875	-0.0771	0.0157	-0.0278	-0.0407	0.00662	0.00662	0.0232	0.0341	-0.00471	-0.0151
	(0.0454)	(0.149)	(0.127)	(0.0959)	(0.0850)	(0.0809)	(0.0481)	(0.137)	(0.122)	(0.0883)	(0.0778)	(0.0757)
Treated	0.298***	0.298***	0.0858	0.0273	-0.148**	-0.137**	0.335***	0.335***	0.179**	0.0876	-0.0606	-0.0615
	(0.0334)	(0.0843)	(0.0839)	(0.0564)	(0.0634)	(0.0635)	(0.0330)	(0.0787)	(0.0786)	(0.0538)	(0.0612)	(0.0628)
Constant	0.0611**	0.0611	0.786***	0.974***	1.036***	0.604***	-0.0841***	-0.0841	0.689***	0.909***	0.984***	0.738***
	(0.0290)	(0.114)	(0.130)	(0.117)	(0.106)	(0.204)	(0.0285)	(0.105)	(0.131)	(0.124)	(0.115)	(0.219)
# Obs	31,587	31,587	31,587	31,587	31,500	31,494	30,335	30,335	30,335	30,335	30,250	30,244
R-squared	0.011	0.011	0.081	0.095	0.097	0.102	0.010	0.010	0.055	0.070	0.072	0.074
Cluster	No	Munic	Munic	Munic	Munic	Munic	No	Munic	Munic	Munic	Munic	Munic
Individual charact.	No	No	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes
Municipal charact.	No	No	No	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes
Market salaries (RAIS)	No	No	No	No	Yes	Yes	No	No	No	No	Yes	Yes
School system charact.	No	No	No	No	No	Yes	No	No	No	No	No	Yes
Complex sample design	Yes	No	No	No	No	No	Yes	No	No	No	No	No

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

In the DDD analysis we compare teachers employed by the municipal school system to teachers employed by other systems within the municipality, and in one particular, actually our preferred, specification, only by private schools. We prefer this last specification because, in several states, the state school system were impinged by the law and underwent treatment too, what could introduce bias in the estimation if state teachers join the control group.

Tables 3.22 and 3.23 present DDD estimates for the impact (ATT) on scores of teachers graduated in all majors, considering major-specific component and general formation component, respectively. Columns (1) to (6) refers to the specification where primary teachers of all other school system are considered as control within treated municipality. Meanwhile, columns (7) to (12) bring results for the specification where just teachers working on private school system are considered as control. Columns (3)-(6) and (9)-(12) bring results for the model of (2)

and (8), respectively, added by groups of covariates. In specifications from (3) to (6) and from (9) to (12) we control for the major teachers have studied.

As in the DID tables, the difference between (1) and (2) or (7) and (8) is that the first model considers the complex sample design of the representative sample and the second presents a clustered standard error in the municipal level. As put earlier, since the contamination of treatment on teachers of state system is likely, it would be expected the null effect when teachers of all other school systems are used as control (columns (1) to (6)). We cannot reject the null hypothesis that the impact (ATT) on teachers quality (scores in *ENADE*) is null, for both exam components (Tables 3.22 and 3.23).

However, when we restrict the control group to teachers from private school system, after controlling for some characteristics of individuals[91] and municipalities[92], and for the municipal average formal market salaries and salaries of alternative professions[93], we find a positive and statistically significant coefficient for the triple interaction (ATT) in major-specific component of *ENADE*. According to these estimates (see Table 3.22), on average, teachers of municipal school system in treated municipalities scored 0.14 standard deviation more in major-specific component of *ENADE* than in the counterfactual situation, i.e., if the minimum salary policy would not have been implemented in treated municipalities. This estimative is statistically significant at 5% level. As the average treated municipal teachers' score was 4.78 points, and its standard deviation was 1.68, the increment corresponds to an increase of 5% in the average score. In the other hand, we could not reject the hypothesis that ATT for general formation is null (Table 3.23).

[91] Individual covariates: age, gender, whether they are freshmen or senior, their course, whether they have diplomas from college and/or post-graduation.
[92] Municipal characteristics: inhabitants, GDP, per capita GDP, and region where is located.
[93] We consider in alternative professions all individuals with college diploma working in other activities but teaching.

Table 3.22 Triple-differences estimates for effects on municipal teachers' quality (measured by *ENADE* Major-specific component score – all majors grouped) – 2008-2014

Variables	Major-specific component											
	All non-municipal teachers as control						Only private teachers as control					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
ATT (γ)	-0.0993	-0.0993	-0.0679	0.00607	0.0175	0.0320	-0.00476	-0.00476	-0.0160	0.0941	0.117*	0.140**
	(0.0612)	(0.0864)	(0.0759)	(0.0627)	(0.0650)	(0.0653)	(0.0724)	(0.0817)	(0.0781)	(0.0692)	(0.0709)	(0.0706)
Municipal teachers in treated	-0.196***	-0.196	-0.189*	-0.215**	-0.223**	-0.237**	-0.359***	-0.359**	-0.320**	-0.389***	-0.394***	-0.405***
	(0.0528)	(0.125)	(0.106)	(0.101)	(0.0994)	(0.0992)	(0.0626)	(0.145)	(0.129)	(0.125)	(0.124)	(0.123)
Time-FE on teachers	0.156***	0.156**	0.0915*	0.0172	0.0328	0.0214	0.231***	0.231***	0.185***	0.0586	0.0909*	0.0764
	(0.0345)	(0.0625)	(0.0550)	(0.0454)	(0.0470)	(0.0468)	(0.0362)	(0.0622)	(0.0564)	(0.0467)	(0.0487)	(0.0466)
Time-FE on treated	-0.0586	-0.0586	-0.0297	-0.0890	-0.0738	-0.0769	-0.153***	-0.153***	-0.0758	-0.155**	-0.147**	-0.156**
	(0.0428)	(0.0638)	(0.0629)	(0.0566)	(0.0597)	(0.0590)	(0.0577)	(0.0564)	(0.0643)	(0.0653)	(0.0701)	(0.0688)
Municipal teachers	-0.0378	-0.0378	-0.00407	0.0802	0.0797	0.0994	-0.0517	-0.0517	-0.0108	0.129	0.120	0.145
	(0.0308)	(0.110)	(0.0943)	(0.0912)	(0.0904)	(0.0882)	(0.0319)	(0.123)	(0.104)	(0.106)	(0.105)	(0.101)
Treated	0.000124	0.000124	-0.0353	0.190**	0.189**	0.197**	0.163***	0.163*	0.102	0.383***	0.378***	0.386***
	(0.0379)	(0.0847)	(0.0728)	(0.0921)	(0.0895)	(0.0875)	(0.0506)	(0.0830)	(0.0794)	(0.119)	(0.115)	(0.112)
Time	0.194***	0.194***	0.0458	0.0751**	-0.0285	-0.0191	0.119***	0.119***	-0.0537	0.0107	-0.120**	-0.0971*
	(0.0203)	(0.0322)	(0.0467)	(0.0361)	(0.0459)	(0.0431)	(0.0230)	(0.0267)	(0.0507)	(0.0443)	(0.0549)	(0.0517)
Pedagogy			0.232***	0.204***	0.206***	0.205***			0.203***	0.177***	0.185***	0.188***
			(0.0458)	(0.0445)	(0.0443)	(0.0441)			(0.0496)	(0.0493)	(0.0492)	(0.0490)
History			0.0445	0.0647	0.0667	0.0701			-0.0469	-0.00349	0.00588	0.0153
			(0.0511)	(0.0486)	(0.0489)	(0.0484)			(0.0654)	(0.0601)	(0.0607)	(0.0600)
Biology			-0.126**	-0.102*	-0.0963	-0.0932			-0.165*	-0.128*	-0.117	-0.110
			(0.0626)	(0.0583)	(0.0586)	(0.0585)			(0.0851)	(0.0774)	(0.0773)	(0.0769)
Geography			-0.122	-0.0993	-0.0958	-0.0929			-0.215**	-0.170**	-0.161*	-0.155*
			(0.0767)	(0.0715)	(0.0720)	(0.0718)			(0.0868)	(0.0817)	(0.0829)	(0.0832)
Languages			0.105*	0.136**	0.140**	0.142**			0.0387	0.0822	0.0920	0.0988
			(0.0617)	(0.0572)	(0.0577)	(0.0577)			(0.0756)	(0.0703)	(0.0711)	(0.0713)
Math			0.107**	0.123**	0.130**	0.136***			0.0716	0.102	0.114	0.124*
			(0.0527)	(0.0509)	(0.0515)	(0.0521)			(0.0737)	(0.0700)	(0.0707)	(0.0712)
Physical Educ			-0.0684	-0.102*	-0.0979*	-0.0949			-0.106*	-0.134**	-0.125*	-0.117*
			(0.0538)	(0.0577)	(0.0580)	(0.0586)			(0.0603)	(0.0673)	(0.0675)	(0.0682)
Constant	0.0146	0.0146	0.538***	0.572***	0.597***	0.440***	0.0286	0.0286	0.613***	0.630***	0.660***	0.358*
	(0.0185)	(0.0445)	(0.0783)	(0.102)	(0.105)	(0.164)	(0.0202)	(0.0566)	(0.0919)	(0.120)	(0.123)	(0.185)
# Obs	112,780	112,780	112,769	112,769	112,639	112,627	84,883	84,883	84,872	84,872	84,767	84,760
R-squared	0.014	0.014	0.061	0.073	0.074	0.075	0.016	0.016	0.066	0.080	0.082	0.084
Cluster	No	Munic	Munic	Munic	Munic	Munic	No	Munic	Munic	Munic	Munic	Munic
Individual characteristics	No	No	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes
Municipal. character.	No	No	No	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes
Market salaries (RAIS)	No	No	No	No	Yes	Yes	No	No	No	No	Yes	Yes
School system character.	No	No	No	No	No	Yes	No	No	No	No	No	Yes
Complex sample design	Yes	No	No	No	No	No	Yes	No	No	No	No	No

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 3.23 Triple-differences estimates for effects on municipal teachers' quality (measured by *ENADE* General Formation component score – all majors grouped) – 2008-2014

Variables	All majors - General Formation component											
	All non-municipal teachers as control						Only private teachers as control					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
ATT (γ)	-0.146**	-0.146*	-0.109	-0.0619	-0.0513	-0.0411	-0.0521	-0.0521	-0.0364	0.0501	0.0716	0.0883
	(0.0678)	(0.0820)	(0.0759)	(0.0627)	(0.0639)	(0.0642)	(0.0781)	(0.0747)	(0.0775)	(0.0684)	(0.0691)	(0.0688)
Municipal teachers in treated	-0.120**	-0.120	-0.108	-0.106	-0.115	-0.124	-0.259***	-0.259**	-0.228*	-0.274**	-0.282**	-0.292**
	(0.0583)	(0.112)	(0.102)	(0.0950)	(0.0944)	(0.0949)	(0.0669)	(0.130)	(0.123)	(0.116)	(0.115)	(0.115)
Time-FE on teachers	0.144***	0.144**	0.0884	0.0353	0.0466	0.0389	0.208***	0.208***	0.155***	0.0443	0.0670	0.0578
	(0.0362)	(0.0568)	(0.0554)	(0.0466)	(0.0483)	(0.0490)	(0.0380)	(0.0540)	(0.0580)	(0.0454)	(0.0479)	(0.0467)
Time-FE on treated	-0.0203	-0.0203	-0.0223	-0.0429	-0.0273	-0.0295	-0.114*	-0.114*	-0.0864	-0.130*	-0.123*	-0.133*
	(0.0475)	(0.0722)	(0.0692)	(0.0621)	(0.0631)	(0.0613)	(0.0613)	(0.0595)	(0.0684)	(0.0681)	(0.0701)	(0.0690)
Municipal teachers	-0.0980***	-0.0980	-0.0590	0.00176	0.00193	0.0149	-0.102***	-0.102	-0.0527	0.0693	0.0631	0.0800
	(0.0324)	(0.0961)	(0.0841)	(0.0786)	(0.0784)	(0.0778)	(0.0335)	(0.102)	(0.0865)	(0.0845)	(0.0843)	(0.0815)
Treated	-0.0244	-0.0244	-0.0554	0.127	0.127	0.131	0.114**	0.114	0.0744	0.314***	0.313***	0.319***
	(0.0419)	(0.0886)	(0.0782)	(0.0922)	(0.0915)	(0.0911)	(0.0532)	(0.0808)	(0.0819)	(0.115)	(0.114)	(0.111)
Time	0.228***	0.228***	0.124***	0.117***	0.0384	0.0429	0.164***	0.164***	0.0550	0.0880**	-0.00652	0.00571
	(0.0215)	(0.0354)	(0.0458)	(0.0387)	(0.0495)	(0.0471)	(0.0243)	(0.0303)	(0.0525)	(0.0439)	(0.0567)	(0.0542)
Pedagogy			0.0717	0.0407	0.0429	0.0424			0.0500	0.0215	0.0281	0.0307
			(0.0509)	(0.0492)	(0.0493)	(0.0495)			(0.0579)	(0.0568)	(0.0569)	(0.0571)
History			0.0154	0.0356	0.0379	0.0399			-0.0729	-0.0328	-0.0257	-0.0195
			(0.0581)	(0.0546)	(0.0547)	(0.0546)			(0.0807)	(0.0738)	(0.0743)	(0.0741)
Biology			-0.193**	-0.174**	-0.169**	-0.167**			-0.264**	-0.232**	-0.225**	-0.220**
			(0.0810)	(0.0753)	(0.0757)	(0.0754)			(0.108)	(0.0983)	(0.0983)	(0.0979)
Geography			-0.180**	-0.158**	-0.154*	-0.153*			-0.264***	-0.221**	-0.214**	-0.210**
			(0.0858)	(0.0799)	(0.0802)	(0.0800)			(0.102)	(0.0946)	(0.0955)	(0.0955)
Languages			0.0237	0.0493	0.0534	0.0546			-0.0514	-0.0148	-0.00667	-0.00217
			(0.0734)	(0.0686)	(0.0689)	(0.0689)			(0.0917)	(0.0851)	(0.0857)	(0.0858)
Math			0.0388	0.0528	0.0578	0.0610			-0.0270	-5.66e-05	0.00702	0.0134
			(0.0624)	(0.0609)	(0.0611)	(0.0618)			(0.0853)	(0.0814)	(0.0817)	(0.0821)
Physical Educ			0.0952	0.0904	0.0870	0.0916			0.00231	-0.00601	-0.00377	0.00422
			(0.167)	(0.186)	(0.182)	(0.183)			(0.121)	(0.140)	(0.136)	(0.137)
Constant	-0.0224	-0.0224	0.496***	0.606***	0.634***	0.546***	-0.0181	-0.0181	0.585***	0.670***	0.697***	0.522**
	(0.0195)	(0.0359)	(0.0909)	(0.112)	(0.113)	(0.187)	(0.0212)	(0.0417)	(0.116)	(0.139)	(0.141)	(0.216)
# Obs.	111,395	111,395	111,376	111,376	111,247	111,235	83,366	83,366	83,352	83,352	83,249	83,242
R-squared	0.013	0.013	0.040	0.050	0.051	0.051	0.014	0.014	0.044	0.057	0.057	0.058
Cluster	No	Munic	Munic	Munic	Munic	Munic	No	Munic	Munic	Munic	Munic	Munic
Individual charact.	No	No	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes
Municipal.	No	No	No	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes
Market salaries (RAIS)	No	No	No	No	Yes	Yes	No	No	No	No	Yes	Yes
School system charact.	No	No	No	No	No	Yes	No	No	No	No	No	Yes
Complex sample design	Yes	No	No	No	No	No	Yes	No	No	No	No	No

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Tables 3.24 and 3.25 present DDD estimates for ATT on scores of teachers when they were graduating in Pedagogy, for the major-specific component and the general formation component, respectively. As previously, columns (1) to (6) refers to the specification where primary teachers of all other school system are considered as control within treated municipality. Meanwhile, columns (7) to (12) bring results for the specification where just teachers working on private school system are considered as control.

For the general formation component of teachers' *ENADE* (Table 3.25), the results are the same as in the case of the regressions considering all majors together, i.e., we do not reject the null hypothesis that ATT is zero. For the major-specific component score in the specification that considers as control group all other school systems teachers we find null ATT on teachers' scores too. However, considering just private teachers as control group in the case of major-specific component, we reject the null hypothesis that ATT on teachers' scores in *ENADE* is null in the full model at 5% of significance level (see columns 11 and 12). According to the estimates, on average, municipal teachers in treated municipalities had scored 0.221 standard deviation more than what they would have scored in the counterfactual scenario, with the absence of salary hikes in treated municipalities. Therefore, according to the results, individuals teaching in the municipal schools in 2014 scored on the Pedagogy specific component of *ENADE* 7.5% (or 0.38 point in a 0-10 scale) more than those who were teaching in 2008, before the salary hike.

For the general formation component, the full model shows a statistically significant effect of teacher salary hike on teachers score only at 10% level of statistical significance (see columns (11) and (12) on Table 3.25). The result indicates that individuals teaching in the municipal schools in 2014 scored on the general formation component of *ENADE* 10.4% more than those who were teaching in 2008, before the salary hike.

Table 3.24 Triple-differences estimates for effects on municipal teachers' quality (measured by *ENADE* Major-specific component scores, Pedagogy) – 2008-2014

Variables	Pedagogy - Major-specific component											
	All non-municipal teachers as control						Only private teachers as control					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
ATT (γ)	-0.0601	-0.0601	-0.0786	-0.00174	0.0243	0.0396	0.0781	0.0781	0.0437	0.151	0.198*	0.221**
	(0.0866)	(0.112)	(0.0965)	(0.0910)	(0.0918)	(0.0908)	(0.0960)	(0.120)	(0.103)	(0.0999)	(0.102)	(0.101)
Municipal teachers in treated	-0.214***	-0.214	-0.165	-0.210	-0.230	-0.251*	-0.376***	-0.376**	-0.312*	-0.392**	-0.408**	-0.425***
	(0.0726)	(0.172)	(0.147)	(0.143)	(0.141)	(0.140)	(0.0823)	(0.182)	(0.164)	(0.163)	(0.161)	(0.160)
Time-FE on teachers	0.197***	0.197**	0.153**	0.0705	0.0821	0.0722	0.255***	0.255***	0.221***	0.104	0.124*	0.112*
	(0.0418)	(0.0841)	(0.0653)	(0.0611)	(0.0613)	(0.0597)	(0.0425)	(0.0860)	(0.0653)	(0.0630)	(0.0634)	(0.0602)
Time-FE on treated	-0.0685	-0.0685	0.00395	-0.0295	-0.0121	-0.0184	-0.207***	-0.207**	-0.114	-0.169*	-0.173*	-0.184*
	(0.0662)	(0.0632)	(0.0667)	(0.0688)	(0.0745)	(0.0751)	(0.0777)	(0.0862)	(0.0868)	(0.0884)	(0.0965)	(0.0949)
Municipal teachers	0.0432	0.0432	0.0677	0.146	0.157	0.181*	0.0472	0.0472	0.0791	0.201	0.206	0.233*
	(0.0367)	(0.141)	(0.113)	(0.115)	(0.113)	(0.109)	(0.0371)	(0.148)	(0.122)	(0.128)	(0.126)	(0.121)
Treated	0.127**	0.127	0.0435	0.150	0.143	0.153	0.289***	0.289***	0.192*	0.339**	0.324**	0.332**
	(0.0557)	(0.0849)	(0.0821)	(0.107)	(0.105)	(0.104)	(0.0676)	(0.108)	(0.111)	(0.136)	(0.134)	(0.133)
Time	0.100***	0.100***	-0.0528	-0.0269	-0.186***	-0.181***	0.0431*	0.0431	-0.120**	-0.0716	-0.246***	-0.227***
	(0.0249)	(0.0330)	(0.0512)	(0.0432)	(0.0529)	(0.0552)	(0.0261)	(0.0315)	(0.0554)	(0.0516)	(0.0624)	(0.0635)
Constant	0.0179	0.0179	0.735***	0.800***	0.855***	0.675***	0.0139	0.0139	0.718***	0.762***	0.817***	0.503**
	(0.0218)	(0.0594)	(0.0999)	(0.129)	(0.131)	(0.199)	(0.0224)	(0.0682)	(0.113)	(0.144)	(0.146)	(0.218)
# Obs	65,250	65,250	65,250	65,250	65,144	65,136	57,542	57,542	57,542	57,542	57,454	57,448
R-squared	0.009	0.009	0.068	0.076	0.078	0.080	0.011	0.011	0.070	0.078	0.081	0.083
Cluster	No	Munic	Munic	Munic	Munic	Munic	No	Munic	Munic	Munic	Munic	Munic
Individual charact.	No	No	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes
Market salaries (RAIS)	No	No	No	No	Yes	Yes	No	No	No	No	Yes	Yes
Municipal charact.	No	No	No	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes
School system charact.	No	No	No	No	No	Yes	No	No	No	No	No	Yes
Complex sample design	Yes	No	No	No	No	No	Yes	No	No	No	No	No

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 3.25 Triple-differences estimates for effects on municipal teachers' quality (measured by *ENADE* General Formation component scores, Pedagogy) – 2008-2014

Variables	Pedagogy - General Formation component											
	All non-municipal teachers as control						Only private teachers as control					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
ATT (γ)	-0.200	-0.200	-0.194	-0.0724	-0.0431	-0.0242	0.0241	0.0241	0.0173	0.194	0.262*	0.292*
	(0.152)	(0.159)	(0.142)	(0.129)	(0.129)	(0.128)	(0.168)	(0.173)	(0.157)	(0.147)	(0.150)	(0.149)
Municipal teachers in treated	-0.128	-0.128	-0.0793	-0.136	-0.160	-0.185	-0.369***	-0.369	-0.312	-0.428*	-0.457**	-0.481**
	(0.127)	(0.245)	(0.216)	(0.205)	(0.202)	(0.201)	(0.142)	(0.259)	(0.237)	(0.233)	(0.231)	(0.230)
Time-FE on teachers	0.344***	0.344***	0.267***	0.135*	0.149*	0.138*	0.398***	0.398***	0.329***	0.140*	0.166**	0.151**
	(0.0691)	(0.113)	(0.0944)	(0.0791)	(0.0772)	(0.0760)	(0.0711)	(0.114)	(0.0964)	(0.0792)	(0.0784)	(0.0752)
Time-FE on treated	-0.0867	-0.0867	-0.0183	-0.0233	0.0109	0.000533	-0.311**	-0.311**	-0.224	-0.273*	-0.276*	-0.294**
	(0.116)	(0.104)	(0.109)	(0.113)	(0.115)	(0.116)	(0.136)	(0.139)	(0.145)	(0.146)	(0.151)	(0.149)
Municipal teachers	-0.0708	-0.0708	-0.0217	0.0985	0.114	0.142	-0.0781	-0.0781	-0.00974	0.183	0.191	0.224
	(0.0602)	(0.186)	(0.150)	(0.149)	(0.146)	(0.141)	(0.0616)	(0.195)	(0.157)	(0.164)	(0.160)	(0.154)
Treated	0.139	0.139	0.0583	0.133	0.119	0.131	0.381***	0.381**	0.291*	0.419**	0.404**	0.416**
	(0.0971)	(0.128)	(0.129)	(0.159)	(0.159)	(0.158)	(0.116)	(0.161)	(0.169)	(0.202)	(0.202)	(0.201)
Time	0.215***	0.215***	0.0415	0.0301	-0.189**	-0.193**	0.160***	0.160***	-0.00945	0.0212	-0.219**	-0.208**
	(0.0410)	(0.0616)	(0.0860)	(0.0734)	(0.0887)	(0.0948)	(0.0444)	(0.0541)	(0.0922)	(0.0798)	(0.101)	(0.105)
Constant	4.931***	4.931***	6.126***	6.322***	6.426***	6.310***	4.938***	4.938***	6.162***	6.315***	6.425***	6.160***
	(0.0353)	(0.0812)	(0.152)	(0.199)	(0.201)	(0.325)	(0.0376)	(0.0870)	(0.183)	(0.229)	(0.231)	(0.358)
# Obs	62,915	62,915	62,915	62,915	62,811	62,803	55,415	55,415	55,415	55,415	55,329	55,323
R-squared	0.007	0.007	0.045	0.054	0.055	0.056	0.008	0.008	0.045	0.055	0.056	0.057
Cluster	No	Munic	Munic	Munic	Munic	Munic	No	Munic	Munic	Munic	Munic	Munic
Individual charact.	No	No	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes
Market salaries (RAIS)	No	No	No	No	Yes	Yes	No	No	No	No	Yes	Yes
Municipal charact.	No	No	No	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes
School system charact.	No	No	No	No	No	Yes	No	No	No	No	No	Yes
Complex sample design	Yes	No	No	No	No	No	Yes	No	No	No	No	No

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

It is important to notice that until here we were not able to disentangle the effect of newly recruited teachers from the others. Thus the effect estimated above, whether it exists, may be a mixture of better recruitment and retention of teachers with higher performance in *ENADE*.

Table 3.26 DID estimates for effects on average municipal teachers' quality (measured by *ENADE* component scores, All majors) – 2008-2014

Variables	Major-specific component				General Formation component			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ATT	-0.0422	0.0356	-0.0422	0.0356	-0.0442	-0.00533	-0.0442	-0.00533
	(0.0712)	(0.0733)	(0.112)	(0.102)	(0.0782)	(0.0829)	(0.122)	(0.109)
Treated	-0.253***	-0.186***	-0.253*	-0.186	-0.207***	-0.138*	-0.207	-0.138
	(0.0646)	(0.0672)	(0.141)	(0.115)	(0.0706)	(0.0759)	(0.156)	(0.132)
Time	0.415***	0.0229	0.415***	0.0229	0.434***	0.140**	0.434***	0.140
	(0.0472)	(0.0571)	(0.0880)	(0.0866)	(0.0500)	(0.0640)	(0.0843)	(0.0858)
Pedagogy		0.346***		0.346***		0.0558		0.0558
		(0.0543)		(0.0653)		(0.0712)		(0.0782)
History		-0.000863		-0.000863		-0.147*		-0.147
		(0.0681)		(0.0989)		(0.0872)		(0.116)
Biology		-0.0282		-0.0282		-0.301***		-0.301**
		(0.0786)		(0.112)		(0.0997)		(0.135)
Geography		-0.125		-0.125		-0.263***		-0.263*
		(0.0781)		(0.123)		(0.0998)		(0.139)
Languages		0.271***		0.271***		0.0828		0.0828
		(0.0617)		(0.0920)		(0.0797)		(0.102)
Math		0.219***		0.219**		0.0882		0.0882
		(0.0712)		(0.0896)		(0.0920)		(0.109)
Physical Educ		0.0675		0.0675		-0.0160		-0.0160
		(0.0758)		(0.0825)		(0.0913)		(0.148)
Constant	-0.0196	-0.148	-0.0196	-0.148	-0.100**	-0.0365	-0.100	-0.0365
	(0.0450)	(0.117)	(0.100)	(0.199)	(0.0478)	(0.139)	(0.0916)	(0.236)
Observations	28,437	28,396	28,437	28,396	27,814	27,775	27,814	27,775
R-squared	0.023	0.084	0.023	0.084	0.019	0.054	0.019	0.054
Municipal FE	No	No	Yes	Yes	No	No	Yes	Yes
Cluster	No	No	Munic	Munic	No	No	Munic	Munic
Individual charact.	No	Yes	No	Yes	No	Yes	No	Yes
Municipal charact.	No	Yes	No	Yes	No	Yes	No	Yes
Market salaries (RAIS)	No	Yes	No	Yes	No	Yes	No	Yes
School system charact.	No	Yes	No	Yes	No	Yes	No	Yes
Complex survey design	Yes	Yes	No	No	Yes	Yes	No	No

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Note: Estimation proceeded with matches destroyed as base-line and new matches in period after the law.

Now we will try to disentangle these two phenomena, better recruitment or teachers and retention of teachers with higher performance in tests. To identify the effect of salary hikes on better recruitment, we implement the following exercise. We estimate the effect through DID, considering as baseline only matches that were destroyed after the law and as after treatment only matches formed after the law enactment. Thus, we had expunged from the previous analysis all individuals that were working as teachers in 2008 and 2014, regressing *ENADE* scores just of teachers that were working only in 2008 or in 2014. Table 3.26 and Table 3.27

present the results for all majors together and for just Pedagogy, respectively. We do not find any significant and robust result.

Table 3.27 DID estimates for effects on average municipal teachers' quality (measured by *ENADE* component scores, Pedagogy) – 2008-2014

Variables	Major-specific component				General Formation component			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ATT	-0.131	-0.0483	-0.131	-0.0483	-0.167*	-0.110	-0.167	-0.110
	(0.0893)	(0.0925)	(0.144)	(0.135)	(0.0932)	(0.0992)	(0.147)	(0.142)
Treated	-0.0424	-0.0197	-0.0424	-0.0197	0.0309	0.0645	0.0309	0.0645
	(0.0799)	(0.0837)	(0.163)	(0.141)	(0.0835)	(0.0899)	(0.159)	(0.147)
Time	0.373***	-0.0439	0.373***	-0.0439	0.413***	0.0999	0.413***	0.0999
	(0.0547)	(0.0679)	(0.110)	(0.103)	(0.0557)	(0.0731)	(0.100)	(0.0997)
Constant	0.0320	0.291**	0.0320	0.291	-0.0987*	0.237	-0.0987	0.237
	(0.0519)	(0.145)	(0.121)	(0.213)	(0.0529)	(0.157)	(0.109)	(0.209)
Observations	20,321	20,288	20,321	20,288	19,476	19,445	19,476	19,445
R-squared	0.009	0.072	0.009	0.072	0.009	0.045	0.009	0.045
Municipal FE	No	No	Yes	Yes	No	No	Yes	Yes
Cluster	No	No	Munic	Munic	No	No	Munic	Munic
Individual charact.	No	Yes	No	Yes	No	Yes	No	Yes
Municipal charact.	No	Yes	No	Yes	No	Yes	No	Yes
Market salaries (RAIS)	No	Yes	No	Yes	No	Yes	No	Yes
School system charact.	No	Yes	No	Yes	No	Yes	No	Yes
Complex survey design	Yes	Yes	No	No	Yes	Yes	No	No

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

3.4.3 Effect on the attractiveness of Pedagogy and Teaching courses

To enhance the academic quality of college undergraduate students is perhaps the first step in the way to accomplish the main objective of the policy, getting better teachers into public school classrooms. This last subsection of the Results section is devoted to the presentation of the estimation of the impact of teacher salary hike on the attractiveness of College courses related to teaching profession.

Again, the estimates were obtained through a Difference-in-Differences and Triple-Differences models, getting an Average Treatment Effect on the Treated (ATT). The regressions were run only in the individual level and weighted by municipal weights calculated to restore country representativeness of the base salary sample. Table 3.28 presents results for the estimated ATT, using DID estimator, on

Enem scores of freshmen in Pedagogy courses. The simplest model shows a positive and statistically significant ATT for the scores on objective tests. However, the coefficient loses its statistical significance after the introduction of municipal characteristics into the regression (column (4)). For the writing exam, we find no effect (columns (6) to (10)), and the point estimates become negative when municipalities covariates are introduced into the model.

Table 3.28 Estimated effects of teacher salary hikes on scores of Pedagogy freshmen - *Enem* 2009-2012

VARIABLES	Objective tests					Writing				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
ATT	10.60**	9.617**	10.13*	2.701	3.027	6.023	2.122	-0.0482	-5.586	-5.537
	(4.581)	(4.646)	(5.468)	(3.898)	(3.501)	(9.038)	(9.284)	(10.46)	(9.311)	(9.167)
Treated	-19.50***	-21.09***	-15.37***	-3.839	-4.964	-10.91	-10.16	1.294	3.726	2.346
	(4.579)	(4.944)	(5.253)	(4.307)	(3.970)	(7.895)	(8.409)	(9.776)	(9.895)	(9.565)
Time	-15.77***	-14.95***	-24.43***	-12.28***	-12.78***	-113.5***	-106.4***	-124.1***	-112.7***	-115.9***
	(2.949)	(3.065)	(6.315)	(3.645)	(4.294)	(4.680)	(5.840)	(10.92)	(8.475)	(9.995)
Constant	506.1***	542.3***	532.4***	540.6***	553.6***	621.3***	641.7***	628.0***	635.8***	667.5***
	(2.874)	(4.130)	(6.553)	(5.567)	(10.62)	(3.958)	(6.271)	(10.46)	(11.48)	(22.41)
# Observations	39,358	29,880	24,619	24,619	24,610	39,358	29,880	24,619	24,619	24,610
R-squared	0.023	0.058	0.069	0.110	0.113	0.119	0.122	0.130	0.139	0.140
Cluster	Munic	Munic	Munic	Munic	Munic	Munic	Munic	Munic	Munic	Munic
# Municipalities	473	450	350	350	349	473	450	350	350	349
Individual characteristics	No	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes
Market salaries (RAIS)	No	No	Yes	Yes	Yes	No	No	Yes	Yes	Yes
Municipality characteristics	No	No	No	Yes	Yes	No	No	No	Yes	Yes
School system characteristics	No	No	No	No	Yes	No	No	No	No	Yes

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 3.29 presents results for the estimated ATT, using DID estimator, on *Enem* scores of freshmen in Teaching courses (*licenciaturas*). The simplest model shows a positive and statistically significant ATT for the objective tests (columns (1) to (5)). However, again, the ATT coefficient loses its statistical significance after the introduction of municipal characteristics into the regression (column (4)). The full model that includes school system characteristics restores statistical significance to the ATT coefficient, but only at 10% of significance level (see column (5)).

Table 3.29 Estimated effects of teacher salary hikes on scores of Teaching courses freshmen - *Enem* 2009-2012

VARIABLES	Objective tests					Writing				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
ATT	20.10***	18.36***	21.14***	6.095	7.216*	11.71	9.750	11.82	-0.311	0.367
	(6.766)	(6.248)	(6.173)	(4.525)	(3.956)	(10.15)	(10.12)	(10.13)	(8.233)	(8.125)
Treated	-26.18***	-28.23***	-22.69***	-6.386	-7.550*	-10.77	-10.04	-2.262	-1.289	-3.389
	(6.335)	(5.807)	(6.543)	(5.036)	(4.201)	(6.802)	(6.995)	(8.801)	(9.691)	(8.924)
Time	-21.36***	-23.77***	-40.07***	-21.20***	-21.45***	-97.14***	-91.71***	-112.2***	-100.1***	-103.4***
	(5.044)	(4.699)	(7.777)	(5.464)	(4.944)	(5.182)	(5.154)	(9.583)	(9.162)	(9.001)
Constant	539.5***	563.4***	549.3***	548.7***	561.7***	634.4***	641.1***	626.6***	627.1***	663.7***
	(4.932)	(3.921)	(7.022)	(7.504)	(10.57)	(3.743)	(4.462)	(8.946)	(11.66)	(19.21)
# Observations	124,123	93,045	76,837	76,837	76,816	124,123	93,045	76,837	76,837	76,816
R-squared	0.024	0.095	0.118	0.151	0.157	0.083	0.084	0.089	0.095	0.097
Cluster	Munic	Munic	Munic	Munic	Munic	Munic	Munic	Munic	Munic	Munic
# Municipalities	509	500	396	396	395	509	500	396	396	395
Individual characteristics	No	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes
Market salaries - RAIS	No	No	Yes	Yes	Yes	No	No	Yes	Yes	Yes
Municipality characteristics	No	No	No	Yes	Yes	No	No	No	Yes	Yes
School system characteristics	No	No	No	No	Yes	No	No	No	No	Yes

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

DID analysis do not account for differences in trends between treated and untreated municipalities. It would be possible that, somehow, in the counterfactual scenario, *i.e.*, without the minimum salary for teachers, entrants into College courses related to teaching profession were getting worse grades when compared to other entrant students' grades.

A more robust analysis than of the DID analysis presented above can be obtained by triple-difference, using both a different municipality and a group within the treatment municipality as control. The intention is that this procedure controls also for changes in performance of all students living in the policy-change municipality. Possibly due to other municipal policies or to the conditions of the offer of higher education vacancies that can affect every student's performance in *Enem*, or municipality-specific changes in the education or economy that can affect every student's performance.

Table 3.30 Estimated effects of teacher salary hikes on scores of Pedagogy and Teaching courses freshmen by triple differences - *Enem* 2009-2012

VARIABLES	Objective tests					Writing				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
ATT	10.87***	9.956***	10.94***	9.420**	8.832**	15.40***	17.71***	21.47***	22.61***	21.97***
	(2.967)	(2.706)	(3.467)	(3.899)	(3.771)	(5.287)	(5.720)	(6.141)	(6.776)	(6.699)
Teaching in treated	-7.105**	-7.272**	-5.378	-5.729*	-5.306*	-15.19***	-14.68***	-14.69***	-17.05***	-16.52***
	(2.791)	(2.974)	(3.342)	(3.170)	(3.173)	(4.275)	(4.869)	(5.259)	(5.143)	(5.058)
Time-FE on treated	9.225	8.634*	11.52**	-1.785	-0.332	-3.686	-7.659	-8.097	-18.98***	-17.98***
	(6.166)	(5.090)	(5.257)	(4.214)	(3.252)	(9.422)	(8.635)	(8.183)	(7.046)	(6.493)
Time-FE on Teaching students	-4.591***	-5.696***	-3.201*	-2.009	-2.048	-26.35***	-24.96***	-23.87***	-23.00***	-22.72***
	(1.495)	(1.495)	(1.700)	(1.532)	(1.541)	(2.842)	(3.054)	(3.286)	(3.300)	(3.269)
Treated	-19.08***	-21.18***	-18.26***	-0.304	-1.202	4.424	4.982	10.95	13.76*	11.98*
	(6.565)	(5.340)	(5.986)	(4.163)	(3.449)	(5.764)	(5.470)	(6.711)	(7.160)	(6.381)
Teaching major	-22.02***	-14.89***	-14.46***	-12.02***	-11.81***	2.596	0.891	2.496	3.592*	3.752*
	(1.455)	(1.422)	(1.652)	(1.549)	(1.678)	(1.746)	(2.162)	(2.320)	(2.175)	(2.159)
Time	-16.77***	-22.20***	-42.77***	-26.24***	-25.26***	-70.78***	-71.80***	-91.86***	-82.01***	-84.64***
	(5.297)	(4.055)	(7.081)	(3.828)	(3.339)	(5.002)	(4.301)	(7.697)	(6.247)	(6.318)
Constant	561.5***	567.4***	556.6***	554.8***	560.8***	631.8***	627.6***	618.1***	621.6***	651.4***
	(5.307)	(3.600)	(5.989)	(4.621)	(9.072)	(3.596)	(3.716)	(6.251)	(7.167)	(12.92)
# Obs	877,838	593,080	485,867	485,867	485,794	877,838	593,080	485,867	485,867	485,794
R-squared	0.028	0.073	0.087	0.114	0.117	0.051	0.056	0.056	0.062	0.063
Cluster	Munic	Munic	Munic	Munic	Munic	Munic	Munic	Munic	Munic	Munic
# Municipalities	515	515	410	410	409	515	515	410	410	409
Individual charact.	No	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes
Market salaries (RAIS)	No	No	Yes	Yes	Yes	No	No	Yes	Yes	Yes
Municipality charact.	No	No	No	Yes	Yes	No	No	No	Yes	Yes
School system characteristics	No	No	No	No	Yes	No	No	No	No	Yes

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

In DDD the group of freshmen in Pedagogy and in Teaching courses are compared to freshmen of all other courses. Table 3.30 presents the results obtained from DDD regression. In this case, for the objective component of Enem, although the triple-interaction coefficient diminishes from the basic model specification to the full model specification, it remains significant at 5% of significance level (see column (5)). With the addition of individual covariates in the basic model, the coefficient decreases (column (2)), but increases a lot when we control for formal market salaries (column (3)), and do not lose its significance after the addition of municipalities and school systems characteristics (column (4) and (5)).

For the writing exam, the results are similar. The simplest specification shows a coefficient of 15.4 points, with statistical significance at 1% level. When covariates are introduced in the model, the estimative becomes larger except when are introduced some school system characteristics. The full model shows an ATT coefficient of 21.97 points.

According to this last estimation, freshmen of Pedagogy and Teaching courses show better performance than the freshmen of other courses in treated municipalities, associated to 8.8 points in Enem objective tests, as a result of teachers' salary hikes. Then, we can conclude that salary hikes seem to have an effect on the attractiveness of teachers' career related courses. However this effect has very little economic significance since it corresponds to about 0.15 standard deviation[94]. The impact of teachers' salary hikes on freshmen writing scores is stronger in points, 21.97 points, but very similar in terms of standard deviation, about 0.18[95].

3.5 Concluding Remarks

This chapter showed that at least in its first five years the minimum salary policy for public teachers was not effective in inducing a significant change on teachers' behavior. As a response to salary hikes, teachers have not made more effort correcting pupils' homework and have not interrupted their participation in other concurrent working activities. Since no effect on pupils' proficiency on Math and Language was revealed in the previous chapter, these null effects on teachers' behavior were not surprising. Results contradict gift-exchange and efficiency wage models of employee behavior, as the conclusion already reported in Ree et al (2015).

Although impacts on pupils' learning and on teachers' behavior have not been detected, it seems that some other transmission mechanisms from salary increase to better education outcomes have been activated. There are promising signs of teacher quality enhancement. We find a mild impact of salary hikes on a proxy for

[94] The standard deviation of the average score on objective tests of Enem in 2009 obtained by freshmen of teacher career related courses in treated municipalities was 58.72 points. So, 8.8 points corresponds to 15% of a standard deviation.

[95] The standard deviation of the average score on writing exam of Enem in 2009 obtained by freshmen of teacher career related courses in treated municipalities was 124.57 points. So, 22 points corresponds to 17.6% of a standard deviation.

teachers' quality, namely, their scores on *ENADE*. Based on our estimates, treated municipal school systems witnessed a mild improvement of the quality of their teachers from 2008 to 2014. According to the estimates, on average, teachers of municipal school system in treated municipalities scored 0.14 standard deviations more in major-specific component of *ENADE* than in the counterfactual situation, i.e., if the minimum salary policy would not have been implemented in treated municipalities. Teachers whose major was in Pedagogy were more affected by the salary increase, they scored 0.22 standard deviations more in major-specific exam than what they would have scored in the counterfactual scenario, with the absence of salary hikes.

In this last chapter we apply a Triple-Differences model, which allow us to control for two types of potentially confounding trends: (i) changes in the performance of teachers (potential future teachers) across municipalities unrelated to the policy; and (ii) changes in performance of all teachers (students) living in municipalities affected by the new policy.

Moreover, salary hikes seem to have prompted an increase on the attractiveness of courses related to teaching career from 2009 to 2012, what may reinforce improvements in teacher quality in the long-run. Course attractiveness was measured by relative *Enem* scores obtained by entrants into College. However this effect, at least until 2012, has little economic significance, corresponding to about 0.15 standard deviations in the objective tests and about 0.18 standard deviations in the writing exam.

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APPENDIX

Table A1 Scores of freshmen in Enem in the previous year according to different majors (2009 and 2012)

Major	Stats	Nature		Humanities		Portuguese		Math		Average - objective tests			Writing		
		2009	2012	2009	2012	2009	2012	2009	2012	2009	2012	var (%)	2009	2012	var (%)
Pedagogy	mean	494.0	456.6	510.0	517.8	515.0	494.0	475.7	478.2	498.7	486.7	-2.4%	619.7	513.3	-17.2%
	sd	76.4	60.8	87.7	71.9	85.4	64.6	75.5	95.4	81.3	73.2	-10.0%	154.3	154.4	0.0%
	min	263.3	319.3	300.0	302.6	224.3	295.4	345.9	277.2	283.4	298.6	5.4%	0.0	0.0	
	max	816.2	745.7	856.3	800.6	813.7	742.6	865.4	894.9	837.9	796.0	-5.0%	1000	1000	0.0%
	p25	441.9	410.4	443.0	469.9	457.2	452.1	421.0	402.6	440.8	433.8	-1.6%	525.0	420.0	-20.0%
	p50	497.0	455.4	509.9	522.5	519.2	498.6	469.5	477.9	498.9	488.6	-2.1%	625.0	520.0	-16.8%
	p75	548.7	499.7	574.8	567.7	575.8	539.3	523.9	549.5	555.8	539.1	-3.0%	725.0	620.0	-14.5%
Teaching courses	mean	527.9	481.9	543.3	542.9	539.9	510.7	505.0	516.8	529.0	513.0	-3.0%	634.5	544.6	-14.2%
	sd	85.5	70.8	95.6	76.5	90.4	66.9	92.8	109.2	91.1	80.8	-11.2%	156.4	153.8	-1.7%
	min	263.3	319.3	300.0	302.6	224.3	295.4	345.9	277.2	283.4	298.6	5.4%	0.0	0	
	max	860.2	787.1	864.9	823.9	835.6	798.4	960.8	955.2	880.4	841.2	-4.5%	1000	1000	0.0%
	p25	469.9	429.1	471.8	493.8	480.4	469.0	436.8	433.4	464.7	456.3	-1.8%	550.0	440	-20.0%
	p50	530.6	480.4	547.3	547.1	546.3	514.9	494.1	518.9	529.6	515.3	-2.7%	650.0	540	-16.9%
	p75	587.5	531.6	614.3	595.6	604.5	556.7	560.4	594.9	591.7	569.7	-3.7%	725.0	640	-11.7%
All other courses	mean	562.6	508.5	567.4	560.5	559.8	526.1	550.2	565.3	560.0	540.1	-3.6%	637.1	565.6	-11.2%
	sd	98.7	85.7	104.2	83.4	95.6	70.2	115.4	125.3	103.5	91.1	-11.9%	170.2	162.8	-4.3%
	min	263.3	319.3	300.0	302.6	224.3	295.4	343.0	277.2	282.7	298.6	5.7%	0.0	0.0	
	max	903.2	864.9	887.0	874.9	835.6	817.9	985.1	955.2	902.7	878.2	-2.7%	1000	1000	0.0%
	p25	495.4	444.3	490.1	505.8	497.1	482.0	463.2	474.7	486.5	476.7	-2.0%	550.0	460.0	-16.4%
	p50	563.8	504.9	573.0	562.6	566.5	528.4	533.0	568.6	559.1	541.1	-3.2%	650.0	560.0	-13.8%
	p75	629.1	567.1	645.5	617.4	628.5	573.8	627.6	651.3	632.7	602.4	-4.8%	750.0	660.0	-12.0%

FINAL CONSIDERATIONS

This dissertation contributes to the debate of an important policy issue, mainly for developing countries, bringing more empirical evidence about different schemes of teacher remuneration, a crucial issue in the field of Public Economics, and particularly of Economics of Education. How countries can increase the quality of teachers and improve public education? One way that teacher quality might be improved is by enhancing pay structure within the teaching profession. In order to enhance teacher quality, to increase teaching career attractiveness and consequently, improve public education quality, Brazilian federal government introduced a minimum base-salary for teachers since January, 2009.

Due to the lack of secondary data on municipal base teacher salary, we carried out a survey on teacher career and remuneration with a representative sample of Brazilian municipal school systems. Our survey contributes to a better understanding about which municipal school systems were impinged by the law; about the compliance of municipal school system with the national minimum salary for teachers; and about the effects of the law on teacher salary. The majority of Brazilian municipal school systems (61.4%) were impinged by the introduction of the national minimum salary and, in 2013, there were a high proportion of municipalities that do not comply with the law, 32.8%. The main factors that explain the probability of compliance are institutional characteristics of the school system followed by socioeconomic characteristics and the state of location of municipalities.

The estimates obtained through our survey reveals that the institution of the minimum salary moved significantly base teacher salaries and, consequently, total teachers' salaries. Municipal school systems that complied with the law at least since 2011 present an annual real growth rate of teachers' salaries of 10.2% in the period from 2008 to 2013, significantly above the growth rate verified in the others municipal school systems (2.9%).

Do unconditionally higher teachers' salaries impact students learning? Our results, shown in Chapter two, corroborate the main finding of the empirical literature on the issue, that unconditional salary increase does not trigger better performance of students in the short run (five years). Moreover, a result shown in the third chapter, that teachers have not made more effort correcting pupils' homework and have not interrupted their participation in other concurrent working activities contradicts gift-exchange and efficiency wage models of employee behavior.

However, can changes in teacher pay prompt teacher quality and consequently the quality of the education provided by the public sector? In 2008, average municipal teachers' salary was a little bit lower than private teachers' salary according to *RAIS* database, representing 0.93 of the average private primary teachers' remuneration. But after the introduction of the minimum salary for public teachers this relation jumped to 1.11 in 2013, with an eloquent relation of 1.27:1 in municipalities where municipal school systems comply with the law at least one year, departing from 1:1 in 2008. Meanwhile in municipalities that already paid more than the minimum this relation evolved from 1.03:1 to 1.06:1. Perhaps this sharp increase in relative municipal teachers' salaries explains the impact of the policy on a proxy of teachers' quality found in Chapter three.

Although teachers' salaries have increased sharply, in Brazil, teacher salaries are still lower than salaries in alternative occupations, and there is evidence that poor performing students were attracted to the teaching profession. However, salary hikes seem to have prompted an increase on the attractiveness of College courses related to the teaching profession from 2009 to 2012. The attraction of higher ability students to the teaching career may reinforce improvements in teacher quality in the long-run.

In fact it seems that salary hikes actually avoid the deterioration of teacher quality and the quality of students of College courses related to the teaching profession, more than improve them. As a next step we intend to test the robustness of the impact found on teachers' quality and on the attraction of College courses for other years and to investigate the existence of other confounding factors in order to properly control for them.