HIGHER SALARIES, MORE TEACHING, BETTER PERFORMANCE?

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

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Outline

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5 Concluding remarks
Motivation - Literature findings

Teacher quality is one of the most important determinants of pupils’ outcomes

- Rockoff (2004); Rivkin et al (2005); Aaronson et al (2007); Chetty, Friedman and Rockoff (2013)

There is no consensus on how public school systems could improve teacher quality

How to improve teachers’ quality?

- Offering higher salaries?
  - Gift-exchange theory (Fehr et al, 2009)
  - Adverse selection: Mansky (1987); Delfgaauw and Dur (2007); and Behrman, Tincani, Todd and Wolpin (forthcoming)
  
- Experiment shows that higher salaries attract better applicants (IQ, personality and public service motivation): Dal Bó, Finan and Rossi (2013)
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Motivation - Literature findings (cont)

- Positive effect of salary based on performance on educational outcomes in developing countries: Lavy (2002 and 2009) in Israel; Glewe et al. (2010) in Kenya; Muralidharan (2012) and Muralidharan and Sundararaman (2011) in India; Rau and Contreras (2011) in Chile; and ScorzaFave and Oshiro (2015) in Brazil.

Motivation - Literature findings (cont)

- Effects of unconditional salary increases on proficiency is controversial
  - Loeb and Page (2000): 10% of relative salary raise would reduce high school dropout rates by between 3% and 6% after 10 years
  - 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
  - Pugatch and Schroeder (2014): geographic discontinuity in Gambian salary policy (salary premium of 30-40% to primary school teachers located in remote areas) - increased the proportion of certified teachers in remote schools, but found no effects of the policy on average student performance
  - Ree, Muralidharan, Pradhan and Rogers (2015): no improvement in students learning outcomes after two and three years of a randomized experiment that doubled base teachers’ salary in Indonesia public schools
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- Metzler and Woessmann (2012): one of the few attributes of teachers that is correlated with the performance of students are their academic skills (performance on standardized tests)
- Higher salary attracts better high school students to profession related courses: Leigh (2012)
  - 1% rise in salary boosts the average aptitude of potentially future teachers by 0.6 percentile ranks.
- In Brazil: poor performing students and with poorly socioeconomic background were attracted to the teaching profession (Louzano et al, 2010; INEP, 2009 and 2010; Gatti and Barretto, 2009)
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- **First chapter:**
  - to assess the impact of the introduction of the minimum salary on teachers’ salaries and
  - to assess the impact of teachers’ salaries hikes on teachers move

- **Second chapter:** To assess the impact of higher teachers’ salary on pupils’ performance

- **Third chapter:** Do unconditional higher salaries schemes yield better teachers?
  - Changing teachers’ behavior - devoting more time to teaching
  - Recruiting/Retaining more effective teachers - teacher quality proxied by the score in ENADE
  - Attracting better students into College courses related to teaching profession - student quality proxied by the score in Enem
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Institutional Background

Teacher salary of municipal school systems

- Federal funding scheme (imposition of resource-expenditure linkage and states Fundeb fund)
- Brazilian public education system: decentralized nature with organizational autonomy
- Municipal teachers’ salaries as a decision of the municipality
Institutional Background
Structure of Teacher Salary

- Several different workloads

- Typically, teacher salary consists of two parts:
  - base salary: established according to the teacher’s workload
  - an additional part: based on teacher’s seniority and graduate degrees teacher has
    - Generally these rewards are calculated as a percentage of the base salary
  - *ceteris paribus*, if the base salary grows, all the schedule of teacher salary increases in the same proportion
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National Minimum Salary for Teachers

- Federal Law No.11,738, of July 16th, 2008: institution of a national minimum salary for teachers
- R$ 950 monthly for a 40h per week base-salary (2013: R$1,567/month)
  - January 2009: school systems which were paying less than the minimum must raise salaries, filling at least 2/3 of the gap to the minimum salary
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- Data set was obtained merging different databases

  - Variable of interest
    - Base salaries 2008-2013: Field Research with Brazilian Municipal Departments of Education (representative sample)

  - Dependent variables
    - Test scores in Mathematics and Portuguese of 5th grade pupils
    - Proportion of full time teachers: self reported in *Prova Brasil* questionnaires
    - Teachers move: teachers panel (School Census 2007-2011)
    - Average students scores in Enem 2009 and 2012

  - Covariates
    - Pupils’ socioeconomic and teachers’ characteristics: *Prova Brasil* questionnaire and School Census
    - Characteristics of Municipal Education System and its schools: School Census 2007-2013
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**Figure:** Minimum base salary densities

Note: dashed red lines mark national minimum salary for teachers from 2009 to 2013 respectively.
## Salaries and Economic Indicators, Brazil (2008-2013)

<table>
<thead>
<tr>
<th>Year</th>
<th>Economy minimum salary</th>
<th>National minimum base salary for teachers</th>
<th>Municipal teachers' base salary</th>
<th>Total Salaries (RAIS)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>R$</td>
<td>Var</td>
<td>R$</td>
<td>Var</td>
</tr>
<tr>
<td>2008</td>
<td>415.00</td>
<td>12.0%</td>
<td>950.00</td>
<td></td>
</tr>
<tr>
<td>2009</td>
<td>465.00</td>
<td>9.7%</td>
<td>1,024.67</td>
<td>7.9%</td>
</tr>
<tr>
<td>2010</td>
<td>510.00</td>
<td>6.9%</td>
<td>1,187.14</td>
<td>15.9%</td>
</tr>
<tr>
<td>2011</td>
<td>545.00</td>
<td>14.1%</td>
<td>1,450.75</td>
<td>22.2%</td>
</tr>
<tr>
<td>2012</td>
<td>622.00</td>
<td>9.0%</td>
<td>1,557.00</td>
<td>8.0%</td>
</tr>
<tr>
<td>2013</td>
<td>678.00</td>
<td>63.4%</td>
<td>1,822.82</td>
<td>1,829.87</td>
</tr>
<tr>
<td>Variation (2008-2013)</td>
<td></td>
<td></td>
<td>64.9%</td>
<td>75.7%</td>
</tr>
<tr>
<td>Annual variation</td>
<td></td>
<td></td>
<td>10.3%</td>
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### Average inflation rate per year

5.7%
Salary Increases 2008-2009

Figure: Salary Increases 2008-2009

Figure 6a: Salary hikes 2008–2009

[Graph showing salary increases with labels for different groups: treated, treated local pol., 95% CI treated polin., non-compliers, non-compl. local pol., non-impinged, 95% CI non-imp. polin., non-imp. local pol.]
Salary Increases 2008-2011

Figure: Salary Increases 2008-2011

Figure 6b: Salary hikes 2008–2011

- treated
- non-impinged
- non-compliers
- treated local polynom
- non-compliers local polynom
- non-impinged local polynom
Figure: Characterizing Treatment

(a) 2008-2009

(b) 2008-2013
Characterizing Treatment
First year of the policy (2009)

- **Treatment**: increase salaries in order to comply with the law

- **Treated**
  - municipalities which comply with the law in 2009
  - average base-salary variation: R$ 861.35 → R$ 1,044.76 (23.8%)

- **Control**
  - not impinged by the law
  - average base-salary variation: R$ 1,344.68 → R$ 1,438.02 (7.1%)

- **Average salary increase**:
  - 16.7 p.p. (or R$ 90.07) higher in treated units
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Characterizing Treatment
After three years (2011)

Treated
- municipalities which comply with the law at least one year during 2009-2011 period
- average base-salary variation: R$ 905.32 → R$ 1,417.08 (61.0%)

Control
- never impinged until 2011
- average base-salary variation: R$ 1,419.43 → R$ 1,781.18 (27.0%)

Average salary increase:
- on average 34 p.p. (or R$ 149.91) more among treated than untreated
Characterizing Treatment
After three years (2011)

- **Treated**
  - municipalities which comply with the law at least one year during 2009-2011 period
  - average base-salary variation: R$ 905.32 → R$ 1,417.08 (61.0%)

- **Control**
  - never impinged until 2011
  - average base-salary variation: R$ 1,419.43 → R$ 1,781.18 (27.0%)

- **Average salary increase:**
  - on average 34 p.p. (or R$ 149.91) more among treated than untreated
Characterizing Treatment
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After five years (2013)

- **Treated**
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  - average base-salary variation: R$ 905.32 → R$ 1,831.15 (108.4%)
  - average total salary variation: R$ 1,146.47 → R$ 2,395.15 (108.9%)
  - private teachers salary var.: R$ 1,106.38 → R$ 1,859.37 (68.1%)

- **Control**
  - never impinged until 2013
  - average base-salary variation: R$ 1,419.43 → R$ 2,108.30 (51.2%)
  - average total salary variation: R$ 1,989.80 → R$ 3,126.35 (57.1%)
  - private teachers salary var.: R$ 1,940.28 → R$ 2,946.40 (51.9%)

- **Average salary increase:**
  - base salary: on average 57.2 p.p. (or R$ 236.96) more among treated than untreated
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Characterizing Treatment

**Figure:** Groups of Treatment and Control

<table>
<thead>
<tr>
<th></th>
<th>Treated</th>
<th></th>
<th>Untreated</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>main</td>
<td>alternative</td>
<td></td>
</tr>
<tr>
<td>1st year of the policy</td>
<td>compliers in 2009</td>
<td>compliers in 2009 or in 2010</td>
<td>not impinged by the law in 2008</td>
</tr>
<tr>
<td>(2007-2009)</td>
<td>n = 276 units</td>
<td>n = 371 units</td>
<td>n = 395 units</td>
</tr>
<tr>
<td>3rd year of the policy</td>
<td>compliers since 2009, 2010 or 2011</td>
<td></td>
<td>not impinged by the law in 2008, 2009 and 2010</td>
</tr>
<tr>
<td>(2007-2011)</td>
<td>n = 221 units</td>
<td></td>
<td>n = 294 units</td>
</tr>
<tr>
<td>(2007-2013)</td>
<td>n = 221 units</td>
<td></td>
<td>n = 202 units</td>
</tr>
</tbody>
</table>
The instrument is the distance from the 2009 national minimum salary to 2008 municipal base salary.

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.
Salary Variation 2008-2013

Figure: Salary Variation 2008-2013 x Instrument

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distance</td>
<td>0,0009186 ***</td>
<td>0,0009138 ***</td>
<td>0,0013221 ***</td>
<td>0,0004326 ***</td>
</tr>
<tr>
<td>Squared distance</td>
<td>0,0000008 ***</td>
<td>0,0000008 ***</td>
<td>0,0000039 ***</td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>0,8654723 ***</td>
<td>1,036025 ***</td>
<td>0,7707572 ***</td>
<td>0,7103264 ***</td>
</tr>
<tr>
<td>Municipality characteristics and fiscal covariates</td>
<td></td>
<td>Yes</td>
<td></td>
<td></td>
</tr>
<tr>
<td># Obs</td>
<td>906</td>
<td>904</td>
<td>906</td>
<td>906</td>
</tr>
<tr>
<td>$R^2$</td>
<td>0,3448</td>
<td>0,423</td>
<td>0,4672</td>
<td>0,5089</td>
</tr>
<tr>
<td>$F$</td>
<td>(1, 904) = 188.28 (34, 869) = 13.65</td>
<td>(2, 903) = 157.67 (2, 903) = 256.28</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prob &gt; $F$</td>
<td>0,0000</td>
<td>0,0000</td>
<td>0,0000</td>
<td>0,0000</td>
</tr>
</tbody>
</table>

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- 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
**Figure:** Aggregate municipal teachers proportion

Table 1: Aggregate municipal teachers' proportions according to their status as stayers, droppers, entrants, fresh, former private teacher and College graduated

<table>
<thead>
<tr>
<th>Teachers proportions</th>
<th>Year</th>
<th>Treated mean</th>
<th>95% Conf. Interval</th>
<th>Untreated mean</th>
<th>95% Conf. Interval</th>
<th>Dif-in-mean</th>
<th>Dif (p.p.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stayers</td>
<td>2011</td>
<td>83.0%</td>
<td>81.5% - 84.4%</td>
<td>82.4%</td>
<td>81.2% - 83.7%</td>
<td></td>
<td>3.3</td>
</tr>
<tr>
<td></td>
<td>2008</td>
<td>79.7%</td>
<td>77.8% - 81.5%</td>
<td>78.3%</td>
<td>76.5% - 80.2%</td>
<td></td>
<td>-4.1</td>
</tr>
<tr>
<td></td>
<td>Diff (p.p.)</td>
<td>-0.8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Droppers</td>
<td>2011</td>
<td>15.5%</td>
<td>14.2% - 16.7%</td>
<td>16.8%</td>
<td>15.4% - 18.2%</td>
<td></td>
<td>-1.3</td>
</tr>
<tr>
<td></td>
<td>2008</td>
<td>16.7%</td>
<td>15.3% - 18.1%</td>
<td>17.0%</td>
<td>15.3% - 18.7%</td>
<td></td>
<td>-0.2</td>
</tr>
<tr>
<td></td>
<td>Diff (p.p.)</td>
<td>-1.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Entrants</td>
<td>2011</td>
<td>17.0%</td>
<td>15.6% - 18.5%</td>
<td>17.6%</td>
<td>16.3% - 18.8%</td>
<td></td>
<td>-3.3</td>
</tr>
<tr>
<td></td>
<td>2008</td>
<td>20.3%</td>
<td>18.5% - 22.2%</td>
<td>21.7%</td>
<td>19.8% - 23.5%</td>
<td></td>
<td>-4.1</td>
</tr>
<tr>
<td></td>
<td>Diff (p.p.)</td>
<td>0.8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fresh</td>
<td>2011</td>
<td>5.6%</td>
<td>4.9% - 6.3%</td>
<td>5.8%</td>
<td>5.0% - 6.6%</td>
<td></td>
<td>-14.6</td>
</tr>
<tr>
<td></td>
<td>2008</td>
<td>20.2%</td>
<td>18.2% - 22.1%</td>
<td>21.6%</td>
<td>19.8% - 23.5%</td>
<td></td>
<td>-15.8</td>
</tr>
<tr>
<td></td>
<td>Diff (p.p.)</td>
<td>1.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Former private</td>
<td>2011</td>
<td>0.9%</td>
<td>0.6% - 1.2%</td>
<td>1.1%</td>
<td>0.8% - 1.3%</td>
<td></td>
<td>-0.1</td>
</tr>
<tr>
<td></td>
<td>2008</td>
<td>0.8%</td>
<td>0.6% - 1.0%</td>
<td>1.5%</td>
<td>1.2% - 1.8%</td>
<td></td>
<td>-0.7</td>
</tr>
<tr>
<td></td>
<td>Diff (p.p.)</td>
<td>0.6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>College graduated</td>
<td>2011</td>
<td>64.9%</td>
<td>61.8% - 68.0%</td>
<td>76.7%</td>
<td>73.4% - 80.0%</td>
<td></td>
<td>13.4</td>
</tr>
<tr>
<td></td>
<td>2008</td>
<td>51.6%</td>
<td>48.5% - 54.6%</td>
<td>65.7%</td>
<td>61.4% - 69.9%</td>
<td></td>
<td>11.1</td>
</tr>
<tr>
<td></td>
<td>Diff (p.p.)</td>
<td>2.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
DID+selection on observables+complex survey design

Potential outcomes determined by the following model:

\[ Y_{it} = \alpha + \beta d_i + \delta I\{t = T_1\} + \tau I\{t = T_1\}d_i + \rho' X_{it} + \varepsilon_{it} \]  

(1)

where:
- \( t = 2007, 2009(2011/2013) \)
- \( Y_{it} \), the mean of the 5th graders’ test score of municipality \( i \);
- \( \beta \), that captures difference between groups that is fixed in time;
- \( \delta \), the common effect of the passage of time;
- the parameter of interest, \( \tau \), that captures the average effect of the treatment on the treated;
- \( X_i \): characteristics of the municipality/its school system/pupils/teachers

**selection on observables**: propensity score weights (IPTW) and survey weights are multiplied to form a new weight for the regression

\[ \text{weight}_{i} = \text{iptw}_{i} \cdot \text{sampleweight}_{i}; \text{where } \text{iptw}_{i} = d_{i} + \left[ \frac{(1-d_{i})\hat{p}_{i}}{1-\hat{p}_{i}} \right] \]
DID + selection on observables + complex survey design

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Instrumental Variable in a model of first differences

\[
\begin{align*}
Y_{it} &= \alpha + \beta X_{it} + \gamma D_{it} + \varepsilon_{it} \\
D_{it} &= (\overline{D} - D_{i,2008}) + \beta X_{it} + \eta_{it}
\end{align*}
\]

- \(D_i\) is the variation of teachers’ beginning salary of municipality \(i\), instrumentalized by \(Z_i = (\overline{D} - D_{i,2008})\), the distance between national minimum salary and municipality salary.
- \(X_{it}\) is the vector of socioeconomic characteristics of pupils, teachers observed characteristics, and characteristics of the municipality \(i\) in period \(t\).
- \(\gamma\) captures the average effect of teachers’ salary variation on pupils proficiency variation.
Triple Differences

\[ \hat{\gamma}_{DDD} = \left[ (\bar{y}_{m_T,G_T,1} - \bar{y}_{m_T,G_T,0}) - (\bar{y}_{m_U,G_T,1} - \bar{y}_{m_U,G_T,0}) \right] - \left[ (\bar{y}_{m_T,G_U,1} - \bar{y}_{m_T,G_U,0}) - (\bar{y}_{m_U,G_U,1} - \bar{y}_{m_U,G_U,0}) \right] \] (3)

- With this procedure we control for two kinds of potentially confounding trends:
  1. (i) changes in the performance of (potential future) teachers across municipalities unrelated to the policy and
  2. (ii) changes in performance of all teachers (students) living in the policy-change municipality, possibly due to other municipal policies or to the conditions of the offer of job positions (higher education vacancies) that affect every teacher’s (student’s) performance in Enade (Enem), or municipality-specific changes in the education or economy that affect every teacher’s (student’s) performance.
Results - Chapter 1

- impact of the introduction of the minimum salary on teachers’ salaries
- impact of teachers’ salaries hikes on teachers move
Explaining teacher salary variability across municipalities

- What do explain the variability of municipal teacher salary
  - The state where the municipal school system is located (36.6%)
  - School infrastructure and facilities (21.1%)
  - Socioeconomic characteristics (16.7%)
  - Budgetary variables (15.9%)
  - observables explain 54.7% of variability in 2008

- After the introduction of minimum salary, the explained part falls considerably (35.2%)
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Explaining compliance with the law

- **Linear probability model:**
  - All covariates explained only 44.1% of the probability of compliance in 2009 and 47.1% of the probability of compliance in 2009 or 2010.
  - Institutional characteristics of the school system explain: 15.3%
  - Socioeconomic characteristics: 14.9%
  - Covariates reflecting the fiscal situation: only 3.8%
  - All covariates explain only 44.1% of the probability of compliance.
Explaining compliance with the law

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  - Covariates reflecting the fiscal situation: only 3.8%
  - All covariates explain only 44.1% of the probability of compliance
Explaining compliance with the law

- Linear probability model:
  - All covariates explained only 44.1% of the probability of compliance in 2009 and
  - 47.1% of the probability of compliance in 2009 or 2010

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Impact of salary increase on teachers’ move

**Figure**: Aggregate municipal teachers move 2010

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### Impact of salary increase on teachers’ move

**Figure:** Aggregate municipal teachers move 2011

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Results - Chapter 2

- impact of higher teachers’ salary on pupils’ performance
Impact of salary increase on pupils’ proficiency

Figure: ATT and ITT for pupils’ test scores 2009

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Robust standard errors in parentheses.

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Matching Balance

- treated
- untreated before matching
- untreated after matching
## Impact of salary increase on pupils’ proficiency

Figure: ATT for pupils’ test scores 2011 and 2013

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<tr>
<td></td>
<td>(1.572)</td>
<td>(1.446)</td>
</tr>
<tr>
<td>Constant</td>
<td>180.0***</td>
<td>112.3***</td>
</tr>
<tr>
<td></td>
<td>(1.033)</td>
<td>(18.60)</td>
</tr>
</tbody>
</table>

Observations: 854, 775, 538, 850, 764, 540, 846, 766, 534, 850, 764, 540
R-squared: 0.308, 0.788, 0.855, 0.297, 0.861, 0.923, 0.284, 0.759, 0.798, 0.247, 0.815, 0.897
Sample weights: Yes, IPTW, Yes, Yes, IPTW Kernel

Municipality characteristics: Yes, Yes, Yes, Yes, Yes, Yes, Yes, Yes, Yes
Fiscal covariates: Yes, Yes, Yes, Yes, Yes, Yes, Yes, Yes, Yes
Pupils' characteristics: Yes, Yes, Yes, Yes, Yes, Yes, Yes, Yes, Yes
School Infrastructure: Yes, Yes, Yes, Yes, Yes, Yes, Yes, Yes, Yes
School system characteristics: Yes, Yes, Yes, Yes, Yes, Yes, Yes, Yes, Yes

Robust standard errors in parentheses.
Do unconditional higher salaries schemes yield better teachers?
Data - Teacher Quality

  - about 3% of all the school system-teacher matches in 2008 and about 4% in 2014 are composed by teachers found in ENADE database
  - Scores in ENADE normalized in each year (2005, 2008, 2011)
## Impact of teachers salary increase on teacher quality

![Figure: ENADE](image)

<table>
<thead>
<tr>
<th>Group</th>
<th>Year</th>
<th>Average Score</th>
<th>Std. Dev.</th>
<th>Linearized Std. Err.</th>
<th>[95% Conf. Interval]</th>
<th>Average Score</th>
<th>Std. Dev.</th>
<th>Linearized Std. Err.</th>
<th>[95% Conf. Interval]</th>
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<tr>
<td>Municipal teachers</td>
<td>2014</td>
<td>4.954</td>
<td>1.575</td>
<td>0.032</td>
<td>4.891 5.017</td>
<td>4.902</td>
<td>1.688</td>
<td>0.037</td>
<td>4.829 4.974</td>
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<tr>
<td>in treated</td>
<td>2008</td>
<td>4.634</td>
<td>1.448</td>
<td>0.044</td>
<td>4.548 4.721</td>
<td>4.558</td>
<td>1.593</td>
<td>0.050</td>
<td>4.459 4.657</td>
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<tr>
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<td>2.379</td>
<td>0.020</td>
<td>5.505 5.585</td>
<td>5.420</td>
<td>2.419</td>
<td>0.021</td>
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<tr>
<td>in untreated</td>
<td>2008</td>
<td>4.961</td>
<td>2.457</td>
<td>0.039</td>
<td>4.885 5.038</td>
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<td>-0.277</td>
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<tr>
<td>Private teachers</td>
<td>2014</td>
<td>5.262</td>
<td>2.005</td>
<td>0.042</td>
<td>5.179 5.344</td>
<td>5.244</td>
<td>2.145</td>
<td>0.046</td>
<td>5.153 5.335</td>
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<tr>
<td>in treated</td>
<td>2008</td>
<td>5.319</td>
<td>2.398</td>
<td>0.077</td>
<td>5.168 5.471</td>
<td>5.160</td>
<td>2.418</td>
<td>0.081</td>
<td>5.001 5.319</td>
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<tr>
<td>Diff (2014-2008)</td>
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<td>Private teachers</td>
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<td>5.245</td>
<td>2.581</td>
<td>0.018</td>
<td>5.210 5.281</td>
<td>5.244</td>
<td>2.730</td>
<td>0.019</td>
<td>5.206 5.282</td>
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<td>in untreated</td>
<td>2008</td>
<td>5.048</td>
<td>2.957</td>
<td>0.034</td>
<td>4.982 5.113</td>
<td>4.970</td>
<td>3.011</td>
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<tr>
<td>Diff (2014-2008)</td>
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<tr>
<td>Diff-in-Diff</td>
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<td>-0.190</td>
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<tr>
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</table>

Note: all statistics considered complex survey design.
Impact of teachers salary increase on teacher quality

Figure: ENADE Pedagogy-Specific Component - Triple difference

<table>
<thead>
<tr>
<th>Variables</th>
<th>Pedagogy - Major-specific component</th>
<th>All non-municipal teachers as control</th>
<th>Only private teachers as control</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
</tr>
<tr>
<td>ATT (y)</td>
<td>-0.0601</td>
<td>-0.0601</td>
<td>-0.0786</td>
</tr>
<tr>
<td></td>
<td>(0.0666)</td>
<td>(0.112)</td>
<td>(0.0965)</td>
</tr>
<tr>
<td>Municipal teachers in treated</td>
<td>-0.214***</td>
<td>-0.214</td>
<td>-0.165</td>
</tr>
<tr>
<td></td>
<td>(0.0726)</td>
<td>(0.172)</td>
<td>(0.147)</td>
</tr>
<tr>
<td>Time-FE on teachers</td>
<td>0.197**</td>
<td>0.197</td>
<td>0.153**</td>
</tr>
<tr>
<td></td>
<td>(0.0418)</td>
<td>(0.0841)</td>
<td>(0.0633)</td>
</tr>
<tr>
<td>Time-FE on treated</td>
<td>0.0685**</td>
<td>0.0685</td>
<td>0.0395</td>
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<tr>
<td></td>
<td>(0.0662)</td>
<td>(0.0632)</td>
<td>(0.0667)</td>
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<tr>
<td>Municipal teachers</td>
<td>0.0432</td>
<td>0.0432</td>
<td>0.0677</td>
</tr>
<tr>
<td></td>
<td>(0.0575)</td>
<td>(0.0549)</td>
<td>(0.0821)</td>
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<tr>
<td>Treated</td>
<td>0.12**</td>
<td>0.127</td>
<td>0.0443</td>
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<tr>
<td></td>
<td>(0.0367)</td>
<td>(0.141)</td>
<td>(0.112)</td>
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<tr>
<td>Time</td>
<td>0.160***</td>
<td>0.160</td>
<td>0.0528</td>
</tr>
<tr>
<td></td>
<td>(0.0249)</td>
<td>(0.0330)</td>
<td>(0.0412)</td>
</tr>
<tr>
<td>Constant</td>
<td>0.0179</td>
<td>0.0179</td>
<td>0.173**</td>
</tr>
<tr>
<td></td>
<td>(0.0218)</td>
<td>(0.0594)</td>
<td>(0.0999)</td>
</tr>
</tbody>
</table>

| # Obs                          | 65,250                             | 65,250                                | 65,250                           |
| R-squared                      | 0.009                              | 0.009                                 | 0.006                            |
| Cluster                       | No                                  | No                                    | No                               |
| Individual character          | No                                 | Yes                                   | Yes                              |
| Market salaries               | No                                 | No                                    | No                               |
| (PAIS)                        | No                                 | No                                    | No                               |
| Municipal character           | No                                 | No                                    | No                               |
| School system character       | No                                 | No                                    | No                               |
| Complex sample design         | Yes                                | No                                    | No                               |

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1
### Impact of teachers salary increase on teacher quality

**Figure:** ENADE General Formation Component (Pedagogy) - Triple difference

![Table](image-url)

<table>
<thead>
<tr>
<th>Variables</th>
<th>All non-municipal teachers as control</th>
<th>Pedagogy - General Formation component</th>
<th>Only private teachers as control</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>(1) (2) (3) (4) (5) (6)</td>
<td>(7) (8) (9) (10) (11) (12)</td>
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</tr>
<tr>
<td>ATT (y)</td>
<td>-0.200 (0.152) -0.200 (0.159) -0.194 (0.142) -0.0724 (0.125) -0.0421 (0.120) -0.0242 (0.120)</td>
<td>0.0241 (0.160) 0.0241 (0.173) 0.0173 (0.157) 0.194 (0.147) 0.262* (0.150) 0.292* (0.149)</td>
<td></td>
</tr>
<tr>
<td>Municipal teachers in</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>treated</td>
<td>(0.127) (0.245) (0.216) (0.205) (0.202) (0.201)</td>
<td>(0.142) (0.259) (0.237) (0.233) (0.231) (0.230)</td>
<td></td>
</tr>
<tr>
<td>Time-FE on teachers</td>
<td>0.344*** (0.069) 0.344*** (0.113) 0.267*** (0.0944) 0.135* (0.0791) 0.149* (0.0772) 0.138* (0.0760)</td>
<td>0.398*** (0.0712) 0.398*** (0.114) 0.329*** (0.0964) 0.146* (0.0792) 0.166* (0.0764) 0.151*** (0.0752)</td>
<td></td>
</tr>
<tr>
<td>Time-FE on treated</td>
<td>-0.0867 (0.116) -0.0867 (0.104) -0.083 (0.109) -0.0233 (0.113) -0.0109 (0.115) -0.000533 (0.116)</td>
<td>-0.311*** (0.130) -0.311*** (0.139) -0.224 (0.145) -0.273* (0.146) -0.276* (0.146) -0.294*** (0.149)</td>
<td></td>
</tr>
<tr>
<td>Municipal teachers</td>
<td>-0.0708 (0.0602) -0.0708 (0.186) -0.0217 (0.150) -0.0985 (0.149) 0.114 (0.146) 0.142 (0.141)</td>
<td>-0.0781 (0.0616) -0.0781 (0.195) -0.00974 (0.157) 0.183 (0.164) 0.191 (0.160) 0.224 (0.154)</td>
<td></td>
</tr>
<tr>
<td>treated</td>
<td>(0.116) (0.104) (0.092) (0.113) (0.115) (0.116)</td>
<td>(0.130) (0.139) (0.145) (0.146) (0.151) (0.149)</td>
<td></td>
</tr>
<tr>
<td>Time</td>
<td>0.139 (0.0971) 0.139 (0.128) 0.0583 (0.129) 0.133 (0.159) 0.119 (0.159) 0.131 (0.158)</td>
<td>0.381*** (0.016) 0.381*** (0.161) 0.291* (0.169) 0.419*** (0.202) 0.404* (0.202) 0.415*** (0.201)</td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>4.931*** (0.0352) 4.931*** (0.0812) 6.126*** (0.152) 6.322*** (0.159) 6.425*** (0.201) 6.310*** (0.325)</td>
<td>4.938*** (0.0376) 4.928*** (0.0870) 6.162*** (0.183) 6.315*** (0.229) 6.425*** (0.231) 6.160*** (0.339)</td>
<td></td>
</tr>
<tr>
<td># Qqs</td>
<td>62.915 (0.007) 62.915 (0.007) 62.915 (0.045) 62.815 (0.054) 62.803 (0.055)</td>
<td>55.415 (0.008) 55.415 (0.008) 55.415 (0.045) 55.415 (0.035) 55.329 (0.036) 55.323 (0.037)</td>
<td></td>
</tr>
<tr>
<td>R-squared</td>
<td>0.007 (0.007) 0.007 (0.007) 0.045 (0.054) 0.055 (0.055) 0.056 (0.056)</td>
<td>0.008 (0.007) 0.008 (0.007) 0.045 (0.035) 0.036 (0.035) 0.037 (0.036)</td>
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</tr>
<tr>
<td>Cluster</td>
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<tr>
<td>Individual charact.</td>
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<tr>
<td>Market salaries (RAIS)</td>
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<td>No No No No No No No No No No No No No</td>
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<td>Municipal charact.</td>
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<td>School system charact.</td>
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<tr>
<td>Complex sample design</td>
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<td>No No No No No No No No No No No No No</td>
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</table>

### Table Notes:
- **ATT (y):** ATT (y) is the effect of a one-unit increase in teacher salary on teacher quality.
- **Municipal teachers in treated:** Denotes the number of municipal teachers in the treatment group.
- **Time-FE on teachers:** Time-Fixed Effects on teachers' performance.
- **Time-FE on treated:** Time-Fixed Effects on treated teachers.
- **Constant:** Represents the constant term in the regression model.
- **# Qqs:** The number of questions in the survey.
- **R-squared:** The coefficient of determination indicating the proportion of variance explained by the model.
- **Cluster:** Indicates whether clustering was applied in the analysis.
- **Individual charact.:** Individual characteristics included in the analysis.
- **Market salaries (RAIS):** Market salaries considering RAIS adjustments.
- **Municipal charact.:** Municipal characteristics included in the analysis.
- **School system charact.:** School system characteristics included in the analysis.
- **Complex sample design:** Indicates whether a complex sample design was considered in the analysis.
Entrance into higher education: competitive process, there are not enough vacancies to all

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.

We infer the effect of salary increase on attractiveness of the docent career using entrance exam scores of students in teaching related courses and its relation to other courses
Data - Attractiveness of Teaching Career

- College freshmen in 2010 and 2013 found in ENEM database (2009, 2012)
  - about 55% of 2010 entrants took Enem in 2009 and 64% of 2013 entrants took Enem in 2012
  - Scores in IRT, allowing comparison between years
Achievement distribution of college attenders by ability

**Figure**: Achievement distribution of attenders of courses related to teaching by ability (Enem scores) - treated and untreated

<table>
<thead>
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<tbody>
<tr>
<td></td>
<td>mínimo</td>
<td>máxima</td>
<td>%</td>
<td>quantidade</td>
<td>mínimo</td>
<td>máxima</td>
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<td>1º quartil</td>
<td>317.3</td>
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<tr>
<td>2º quartil</td>
<td>450.4</td>
<td>497.7</td>
<td>32.3%</td>
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<td>441.1</td>
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<td>Controles</td>
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<tr>
<td>3º quartil</td>
<td>497.7</td>
<td>545.1</td>
<td>18.5%</td>
<td>6,893</td>
<td>485.6</td>
<td>530.3</td>
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<td>Controles</td>
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<tr>
<td>4º quartil</td>
<td>545.1</td>
<td>802.4</td>
<td>3.9%</td>
<td>1,434</td>
<td>530.3</td>
<td>744.8</td>
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<tr>
<td>10º decil</td>
<td>584.0</td>
<td>802.4</td>
<td>0.4%</td>
<td>153</td>
<td>565.4</td>
<td>744.8</td>
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<td></td>
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<td></td>
<td></td>
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</tbody>
</table>
Impact of teachers salary increase on the attractiveness of teaching profession

**Figure:** Enem objective tests and writing

<table>
<thead>
<tr>
<th>Group</th>
<th>Year</th>
<th>Average score</th>
<th>Std. Dev.</th>
<th>Linearized Std. Err.</th>
<th>[95% Conf. Interval]</th>
<th>Average score</th>
<th>Std. Dev.</th>
<th>Linearized Std. Err.</th>
<th>[95% Conf. Interval]</th>
</tr>
</thead>
<tbody>
<tr>
<td>teaching</td>
<td>2012</td>
<td>512.02</td>
<td>53.51</td>
<td>0.56</td>
<td>510.93 - 513.11</td>
<td>538.20</td>
<td>121.31</td>
<td>1.29</td>
<td>535.68 - 540.72</td>
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<tr>
<td>careers</td>
<td>2009</td>
<td>513.29</td>
<td>54.95</td>
<td>0.77</td>
<td>511.78 - 514.80</td>
<td>623.63</td>
<td>116.58</td>
<td>1.65</td>
<td>620.39 - 626.87</td>
</tr>
<tr>
<td>Diff (2012-2009)</td>
<td>-1.27</td>
<td></td>
<td></td>
<td></td>
<td>511.78 - 514.80</td>
<td>623.63</td>
<td>116.58</td>
<td>1.65</td>
<td>620.39 - 626.87</td>
</tr>
<tr>
<td>teaching</td>
<td>2012</td>
<td>518.11</td>
<td>71.60</td>
<td>0.50</td>
<td>517.13 - 519.08</td>
<td>537.26</td>
<td>154.38</td>
<td>1.12</td>
<td>535.06 - 539.46</td>
</tr>
<tr>
<td>careers</td>
<td>2009</td>
<td>539.47</td>
<td>79.14</td>
<td>0.51</td>
<td>538.48 - 540.46</td>
<td>634.40</td>
<td>159.70</td>
<td>1.07</td>
<td>632.31 - 636.49</td>
</tr>
<tr>
<td>Diff (2012-2009)</td>
<td>-21.36</td>
<td></td>
<td></td>
<td></td>
<td>538.48 - 540.46</td>
<td>634.40</td>
<td>159.70</td>
<td>1.07</td>
<td>632.31 - 636.49</td>
</tr>
<tr>
<td>Diff-in-Diff</td>
<td>20.10</td>
<td>70.56</td>
<td>0.29</td>
<td></td>
<td>534.30 - 535.45</td>
<td>561.76</td>
<td>146.32</td>
<td>0.63</td>
<td>560.52 - 562.99</td>
</tr>
<tr>
<td>other</td>
<td>2012</td>
<td>534.87</td>
<td>70.56</td>
<td>0.29</td>
<td>534.30 - 535.45</td>
<td>561.76</td>
<td>146.32</td>
<td>0.63</td>
<td>560.52 - 562.99</td>
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<tr>
<td>careers</td>
<td>2009</td>
<td>542.42</td>
<td>73.32</td>
<td>0.48</td>
<td>541.48 - 543.35</td>
<td>636.22</td>
<td>140.65</td>
<td>0.95</td>
<td>634.37 - 638.08</td>
</tr>
<tr>
<td>Diff (2012-2009)</td>
<td>-7.55</td>
<td></td>
<td></td>
<td></td>
<td>541.48 - 543.35</td>
<td>636.22</td>
<td>140.65</td>
<td>0.95</td>
<td>634.37 - 638.08</td>
</tr>
<tr>
<td>other</td>
<td>2012</td>
<td>544.72</td>
<td>86.44</td>
<td>0.19</td>
<td>544.35 - 545.09</td>
<td>561.02</td>
<td>170.93</td>
<td>0.39</td>
<td>560.26 - 561.77</td>
</tr>
<tr>
<td>careers</td>
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<td>95.30</td>
<td>0.23</td>
<td>561.03 - 561.95</td>
<td>631.80</td>
<td>176.78</td>
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<td>630.93 - 632.67</td>
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<tr>
<td>Diff (2012-2009)</td>
<td>-16.77</td>
<td></td>
<td></td>
<td></td>
<td>561.03 - 561.95</td>
<td>631.80</td>
<td>176.78</td>
<td>0.44</td>
<td>630.93 - 632.67</td>
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<tr>
<td>Diff-in-Diff</td>
<td>9.23</td>
<td>10.87</td>
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<td></td>
<td>15.40</td>
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</tbody>
</table>

Note: all statistics considered complex survey design. Inep adopts IRT for Enem sci
Source: Author’s estimates based on Enem database.
**Impact of teachers salary increase on the attractiveness of teaching profession**

Figure: Enem objective tests and writing - Triple difference

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>Objective tests</th>
<th>Writing</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
</tr>
<tr>
<td></td>
<td>(2.791)</td>
<td>(2.574)</td>
</tr>
<tr>
<td>Time-FE on treated</td>
<td>9.223</td>
<td>8.634**</td>
</tr>
<tr>
<td></td>
<td>(1.495)</td>
<td>(1.492)</td>
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<tr>
<td>Treated</td>
<td>-19.08***</td>
<td>-21.18***</td>
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<td>Teaching major</td>
<td>-22.02***</td>
<td>-14.89***</td>
</tr>
<tr>
<td></td>
<td>(1.453)</td>
<td>(1.422)</td>
</tr>
<tr>
<td>Time</td>
<td>-15.77***</td>
<td>-22.20***</td>
</tr>
<tr>
<td>Constant</td>
<td>361.5***</td>
<td>567.4***</td>
</tr>
</tbody>
</table>

# Obs: 877,808  
R-squared: 0.025  
Cluster: Music  
# Municipalities: 315  
Individual character: No  
Market salaries (RAIS): No  
Municipality character: No  
School system characteristics: No

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1
Our survey brings unique information about Brazilian municipal base teachers’ salaries and other information about municipal teacher career structure in the period 2008-2013.

Our survey indicates that about 60% of Brazilian municipal school systems were impinged by the introduction of the minimum salary for teachers.

About 1/3 still remained on the margin of the law in 2013.

Treated municipal school systems increased the absolute and relative teachers’ salaries considerably more than untreated ones.

Our results corroborate the main finding of the empirical literature that unconditional salary increase does not trigger better performance of students in the short run (five years).
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- Treated municipal school systems increased the absolute and relative teachers’ salaries considerably more than untreated ones.
- Our results corroborate the main finding of the empirical literature that unconditional salary increase does not trigger better performance of students in the short run (five years).
Teachers have not made more effort correcting pupils’ homework and have not interrupted their participation in other concurrent working activities, what contradicts gift-exchange models of employee behavior.

Although teachers’ salaries have increased sharply, teacher salaries are still lower than in alternative occupations.

There are promising signs of teacher quality enhancement:

- We found mild positive statistically significant effects of municipal teachers salary increase on teachers quality (Enade scores) and on the attractiveness of college courses related to teaching profession
- 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
Concluding remarks (cont)

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