

DISCUSSION PAPER SERIES

IZA DP No. 16380

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## ABSTRACT

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### **Do Teachers' Labor Contracts Matter?\***

Previous literature on the effect of tenured and tenure-track vs. non-tenure-track professors on students' performance at university finds contrasting results. Our paper is the first to test whether tenured/tenure-track and non-tenure-track teachers differently affect students' performance at school. We use data on standardized test scores of a representative sample of primary and secondary school students in Italy and information on their Italian and mathematics teachers' labor contracts. Controlling for class- and subject-fixed effects, we find that non-tenure-track teachers decrease students' performance by 0.21 standard deviation. This detrimental effect is fully explained because non-tenure-track teachers are less experienced. In line with previous findings on the adverse effects of teachers' absences, non-tenure-track teachers are also associated with 0.1 standard deviation worse student performance when their contracts last less than a year.

**JEL Classification:** J41, H52

**Keywords:** teachers, labor contracts, students' performance, standardized tests

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# 1 Introduction

Good teachers significantly increase students' future incomes. Hanushek [2011] estimates that a teacher one standard deviation above the mean quality generates marginal gains of over 400,000 dollars in the present value of student future earnings. Hence, policies to improve teacher quality have very large payoffs to society. In this context, teachers' hiring practices become a first-order education policy. The type of labor contract offered to teachers also impacts their teaching effort (Jacob [2013]), which in turn affects students' performance (Atkinson, Burgess, Croxson, Gregg, Propper, Slater, and Wilson [2009]). In this paper, we test whether tenured/tenure-track (TT) and non-tenure-track (NTT) teachers differently influence students' performance.

TT and NTT teachers may behave differently. On one hand, NTT teachers may have a higher opportunity cost of exerting effort and devoting time to teach better if they are devoting effort and time to becoming TT teachers. This result is in line with Jacob [2013]'s result that reductions in employment protection reduce teachers' absences. Moreover, NTT teachers do not have incentives to make institution-specific investments if they are working at each institution for a limited amount of time. On the other hand, TT teachers may slack off if there are no promotion opportunities for tenured teachers or if tenure-track teachers' promotion does not depend on the quality of their teaching. Additionally, TT and NTT teachers may behave differently because they *are different*. TT teachers may be high-quality teachers if the selection process identifies the best teachers. In contrast, NTT may be high-quality teachers if they are better prepared because they often belong to the most recent cohorts of graduates.

Previous literature studying the impact of professors' labor contracts on students' performance is circumscribed to universities and finds contrasting results. Ehrenberg and Zhang [2005] show that the growing use of NTT faculty adversely affects undergraduate students enrolled at 4-year colleges and universities by reducing their 5- and 6-year graduation rates. A 10 percentage point increase in the proportion of NTT faculty is as-

sociated with about a 4.4 percentage point reduction in the graduation rate. In contrast, Figlio, Schapiro, and Soter [2015] find that NTT faculty at Northwestern not only induce first-term students to take more classes in a given subject but also leads the students to do better in subsequent course work. The current paper is the first to address the differential impact of TT and NTT faculty *at the school* level.

We use data from National Institute for the Evaluation of Education Systems (Invalsi) on a representative sample of Italian classes for the academic years 2012-2013 to 2021-2022.<sup>1</sup> Invalsi samples classes in the second and fifth year of primary school and third year of secondary school when students are 7, 10, and 13 years old, respectively. Information includes students' performance in Mathematics and Italian and characteristics of their Mathematics and Italian teachers. The key variables in our analysis are average class performance in standardized mathematics and Italian tests given at the end of the academic year and whether the mathematics and Italian teachers are TT or NTT. We also know whether NTT teachers had yearly contracts or contracts lasting less than a year.

We identify the difference in performance induced by TT and NTT teachers by regressing students' performance in standardized tests on indicators for NTT teacher with a yearly contract and NTT teacher with a short contract (lasting less than a year). We add teachers' characteristics (gender, age, education level, years of experience at the school), class and academic year fixed effects, and subject fixed effects. This strategy removes the influence of class innate ability and differences in difficulty between the mathematics and Italian tests.

We find that NTT teachers have a negative impact on students' learning of  $-0.21$  standard deviation that disappears when we control for experience. NTT teachers are also associated with a  $-0.1$  standard deviation lower test score if their contract lasts less than a year. The latter effect is led by the academic years 2012-2013, 2015-2016, and 2021-2022, and is concentrated in the second grade of primary school and third grade of secondary

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<sup>1</sup>Data is not available for the year 2019-2020 due to Covid school closures.

school.

## 1.1 Related Literature

The literature that emphasizes the importance of teacher characteristics on students' performance is vast. Grönqvist and Vlachos [2016] shows that teacher effectiveness depends on the combination of teachers' and students' characteristics. Teachers with high cognitive ability are more effective with best-performing students, and teachers with high socioemotional skills are more effective with low-performing students.

There is consensus in the literature that teacher effectiveness improves over time. Papay and Kraft [2015] find that teachers experience rapid productivity improvement early in their careers. They also find evidence of returns to experience later in their careers, indicating that teachers continue to build human capital beyond these first years. The speed of this improvement heavily depends on the working environment (Kraft and Papay [2014]).

The closest papers to this one study the impact of faculty's tenure track status on university students' educational outcomes. Ehrenberg and Zhang [2005] use institutional level panel data from College Board and other sources and explain graduation rates after five years as a function of the proportions of faculty in part-time or full-time tenure-track positions. Accounting for institution- and year-fixed effects, they find that the increasing use of these contingent contracts has a negative impact on the probability of graduating at four-year colleges and universities. Figlio, Schapiro, and Soter [2015] analyze student final score in the next class of the same subject as a function of whether the first-year class was taught by a contingent faculty member, instructor-class-term-year fixed effects, next class fixed effects, and student fixed effects. They run this model on detailed student-level data from eight cohorts of first-year students at Northwestern University. Their results show that contingent faculty not only induce first-term students to take more classes in a

given subject than do TT professors but also lead the students to do better in subsequent course work than do their TT colleagues.

The current paper also relates to the literature on teachers' absences. This happens because teachers' contracts below one year are often used to substitute absent teachers. Miller, Murnane, and Willett [2008] find that ten teacher's absence days reduce students' mathematics test scores by 3.2% standard deviations. The impact of unplanned absences is greater than that of planned absences. Tingle, Schoeneberger, Schools, Wang, Algozzine, and Kerr [2012] conclude that in schools where teachers' absences are rare, absences are negative and significantly correlated with students' performance. They do not find the same effect in schools where absences are common.

The remainder of this paper is organized as follows. We present the institutional background and data in Section 2. In Section 3, we describe our methodology, and in Section 4, we present our results. We conclude in Section 5.

## 2 Data and Institutional Framework

The Italian government selects teachers through public contests divided by school level (primary and secondary) and subject. These contests happen every two years approximately. The requisites for participating are: (i) holding a MA in a field close to the subject and (ii) having attended a course on teaching techniques.<sup>2</sup> The results of the contest produce a ranking of individuals. Individuals in top positions of the ranking are offered tenured positions.<sup>3</sup> Teachers are assigned to schools following an automatic procedure such that teachers choose their preferred province sequentially, starting from those with higher scores in the public contest. For each province, teachers choose their preferred school sequentially, and, again, priority is given to those with the highest scores in the

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<sup>2</sup>The first requisite was established by Legislative Decree number 59 in 2004. The second requisite was established starting in 2017.

<sup>3</sup>There is a one-year probation period such that teachers are trained during the year and sit an exam at the end, but virtually all teachers get tenure at the end of the probation period.

public contest. The number of individuals offered tenure positions depends on the teaching needs. There are typically a few more TT teachers than the number of free tenure positions. The few extra teachers are temporarily allocated to some slot, and after a few years, they choose their final permanent slot. Formally, they hold a permanent labor contract regardless of whether the slot is temporary or definitive.

Regarding access to NTT positions, candidates can sign up for NTT lists. Candidates' ranking position depends mainly on teaching experience, but they can also improve their ranking position by attending some training courses, gaining a Master's or Ph.D. degree, etc. Candidates with only a BA (no MA) can participate in the selection process. Candidates in those lists are offered combinations of schools and contract duration. They choose sequentially according to their position in the ranking. Preferences over contract duration are heterogeneous. Teachers who want to maximize income and teaching experience may prefer yearly contracts. In contrast, other teachers may prefer short contracts to have free time to study for the next public contest or if the location implies lower commuting costs.

Figure 1 shows the geographical distribution of each type of teacher. NTT teachers with yearly contracts are disproportionately present in Northern regions where there is a higher demand for new teachers<sup>4</sup>. As NTT teachers with contracts below the year are associated with the absences of TT teachers, NTT teachers with short contracts and TT teachers are more equally distributed across Italy. Figure 2 represents the evolution of the number of TT, NTT with yearly contracts, and NTT teachers with short contracts over time. The left axis refers to NTT teachers (with yearly and short contracts) and the right axis to TT teachers. Yearly contracts have experienced a huge increase from 5,600 teachers in 2015-16 to 67,500 teachers in 2021-22. Short contracts have also increased significantly from 94,700 in 2015-16 to 157,500 teachers in 2021-22. In contrast, the number of TT teachers have smoothly decreased from 733,645 in 2015-16 to 698,896 in 2021-22. The

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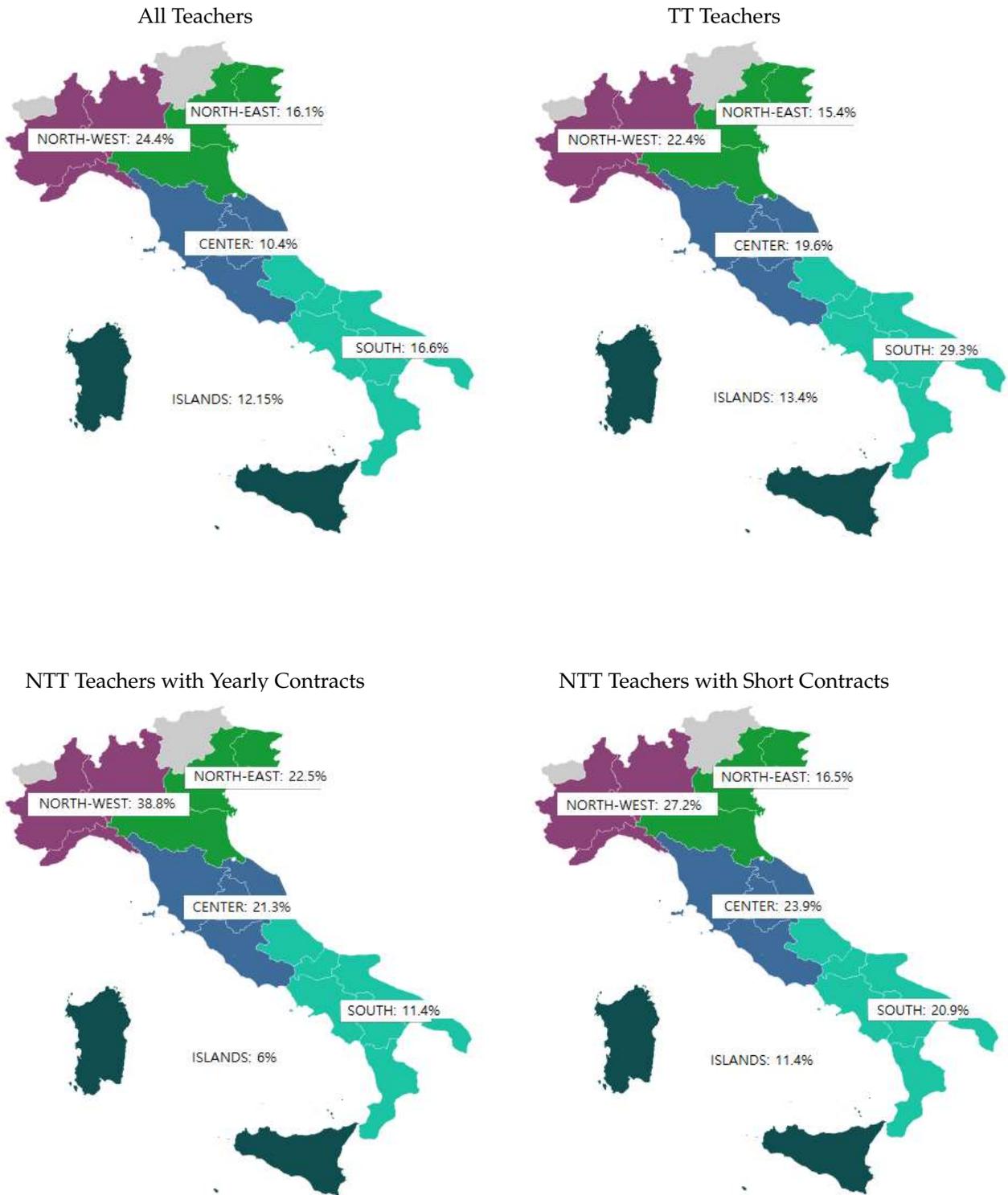
<sup>4</sup>The Italian population is disproportionately located in the North, and the number of inhabitants is decreasing at a lower rate in the North with respect to the Center and especially the South.

growing number of NTT contracts over time in Italy constitutes additional motivation for our study.

For each public contest, we expect candidates who become TT teachers to be more educated, older, and experienced than NTT teachers. In general, we expect new TT teachers to have characteristics that are positively correlated with high teacher quality if the public contest is well-designed. However, long-standing TT teachers are older on average, and given increasing trends in education levels across cohorts, they may be less educated. We next describe the data and explore differences in the composition of the pool of TT and NTT teachers. The variables in the teachers' survey changed from year to year. Table 2 describes the degree of aggregation of the age and experience variables in each wave. Age can be imputed using the year of birth for the period 2012-2017 and is presented in age groups after that. Experience is a continuous variable only in the first two academic years and is then presented in four groups.

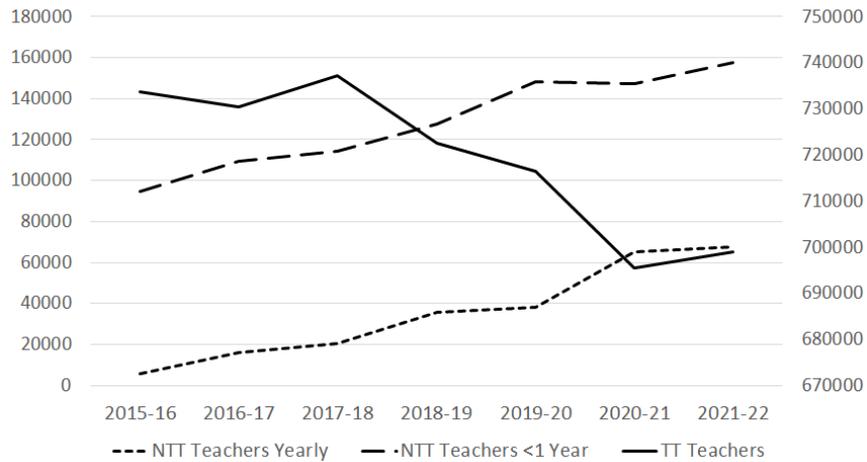
Table 2 describes the sample included in the main estimation. The average test score equals ten times the standard deviation. NTT teachers with yearly contracts represent 2.5% of the sample, while NTT teachers with contracts below one year account for 4.5%. The latter proportion is lower than the actual proportion in the population (between 11% and 17% in the period 2015-2022, according to the Italian Ministry of Education). The reason is that Invalsi interviews teachers at the end of the academic year. Hence, if a position was covered by several NTT teachers throughout the year, there is only information on the last of them. Consistent with Italian gender norms, only 6.5% of teachers are male. The average teacher is 54 years old. The most common education degrees are high-school (47.5%) and the old MA (31.6%), which is a degree that disappeared in 1999 and was equivalent to a BA plus a MA without the possibility of getting a BA degree after three years (students leaving after three years received no official recognition). In terms of accumulated human capital, it is equivalent to an MA degree. The average number of years of experience in the current school is slightly lower than 12. The number of teachers is balanced across subjects, time, and regions (proportional to the population).

Figure 1: The Geographical Distribution of Teachers



Notes: Data comes from the Italian Ministry of Education and is freely available at: <https://dati.istruzione.it/opendata/>.

Figure 2: The Evolution of Teachers' Labor Contracts over Time



Notes: Data comes from the Italian Ministry of Education and is freely available at: <https://dati.istruzione.it/opendata/>. The left axis refers to NTT teachers (with yearly and short contracts) and the right axis to TT teachers.

Table 1: Variables in Teachers' Survey

| Academic Year | Year of Birth | Age (5 groups) | Age (3 groups) | Years in School | Year Started in School | Years in School (4 groups) |
|---------------|---------------|----------------|----------------|-----------------|------------------------|----------------------------|
| 2012-2013     | X             |                |                | X               |                        |                            |
| 2013-2014     | X             |                |                |                 | X                      |                            |
| 2014-2015     | X             |                |                |                 |                        | X                          |
| 2015-2016     | X             |                |                |                 |                        | X                          |
| 2016-2017     | X             |                |                |                 |                        | X                          |
| 2017-2018     |               | X              |                |                 |                        | X                          |
| 2018-2019     |               | X              |                |                 |                        | X                          |
| 2020-2021     |               |                | X              |                 |                        | X                          |
| 2021-2022     |               |                | X              |                 |                        | X                          |

Notes: Data is from Invalsi for the academic years 2012-2013, 2013-2014, 2014-2015, 2015-2016, 2016-2017, 2017-2018, 2018-2019, 2020-2021, and 2021-2022. The three age categories are: below 49, 49-60, and over 60. The five age categories are: below or equal to 45, 46-50, 51-55, 56-60, and over 60. The four experience categories are: one year or less, 2-3, 4-5, and over 5.

Table 3 compares TT teachers, NTT teachers with yearly contracts, and NTT teachers with contracts shorter than a year. The first three columns show descriptive statistics for each of the three subsamples separately. The last two columns display the differences between TT teachers and NTT teachers with yearly contracts and between TT teachers and NTT teachers with contracts shorter than a year. Students of TT teachers score 2.4 points

Table 2: Descriptive Statistics

| <b>Variable</b>            | <b>Mean</b> | <b>Std. Dev.</b> | <b>Min.</b> | <b>Max.</b> | <b>N</b> |
|----------------------------|-------------|------------------|-------------|-------------|----------|
| Scores                     | 198.98      | 19.702           | 15.388      | 340.774     | 49415    |
| Standardized Scores        | 0.001       | 1                | -7.988      | 6.98        | 49415    |
| 1 Year NTT Teacher         | 0.025       | 0.155            | 0           | 1           | 49415    |
| < 1 Year NTT Teacher       | 0.045       | 0.206            | 0           | 1           | 49415    |
| Male                       | 0.065       | 0.246            | 0           | 1           | 49415    |
| Year of Birth              | 1963.823    | 8.491            | 1933        | 1990        | 30259    |
| Age (3 groups)             | 1.781       | 0.675            | 1           | 3           | 6993     |
| Age (5 groups)             | 2.914       | 1.411            | 1           | 5           | 12077    |
| High-School                | 0.475       | 0.499            | 0           | 1           | 49415    |
| BA                         | 0.04        | 0.197            | 0           | 1           | 49415    |
| MA                         | 0.047       | 0.211            | 0           | 1           | 49415    |
| Old MA                     | 0.316       | 0.465            | 0           | 1           | 49415    |
| Master                     | 0.016       | 0.124            | 0           | 1           | 49415    |
| PhD                        | 0.017       | 0.13             | 0           | 1           | 49415    |
| Specialization             | 0.074       | 0.261            | 0           | 1           | 49415    |
| Other Specialization       | 0.016       | 0.126            | 0           | 1           | 49415    |
| Years in School            | 11.671      | 7.873            | 0           | 41          | 4850     |
| Years in School (4 groups) | 3.417       | 1.008            | 1           | 4           | 38505    |
| Year Started in School     | 2000.949    | 9.043            | 1970        | 2014        | 5552     |
| Mathematics                | 0.475       | 0.499            | 0           | 1           | 49415    |
| Region                     | 13.249      | 11.117           | 1           | 54          | 49415    |
| Wave                       | 2016.788    | 2.617            | 2013        | 2022        | 49415    |

*Notes:* Data is from Invalsi. It includes all available classes with information on teachers' characteristics in compulsory school (grades 2, 5, and 8) for the academic years 2012-2013, 2013-2014, 2014-2015, 2015-2016, 2016-2017, 2017-2018, 2018-2019, 2020-2021, and 2021-2022.

(0.07 standard deviations) and 4.5 points (0.18 standard deviations) higher than students of NTT teachers with yearly contracts and short contracts, respectively. TT teachers are less likely to be male, which can be explained because traditional role models are more prevalent in older generations. TT teachers are older than NTT teachers with yearly contracts (12 years older) and NTT teachers with short contracts (13 years older). TT teachers are less educated than NTT teachers. This is because TT teachers belong to older generations who are less educated in general. This happens even if Law 249, from September 10th, 2010, requested the new TT teachers to hold a MA degree. Regarding experience, TT teachers are six and a half years longer in the current school than NTT teachers with yearly contracts and eight and a half years longer than NTT teachers with short contracts. NTT teachers with yearly contracts are more likely to teach mathematics.

### 3 Methodology

We estimate the impact of yearly-contract NTT and short-contract NTT teachers on test scores using TT teachers as the reference category. We control for class-fixed effects, subject-fixed effects, and teachers' characteristics as follows:

$$TS_{cst} = \beta_0 + \beta_1 Yearly_{cst} + \beta_2 Short_{cst} + \beta_3 Class_c + \beta_4 Maths_s + \beta_5 X_{cst} + \varepsilon_{cst} \quad (1)$$

Where  $TS$  stands for average test scores of class  $c$  in subject  $s$  in academic year  $t$ , the dummies  $Yearly$  and  $Short$  equal one if the teacher of class  $c$ , subject  $s$  in academic year  $t$  holds a yearly or a short non-tenure-track contract, respectively.  $Class$  is a vector of class fixed effects,  $Maths$  is a dummy equal to one for mathematics and zero for Italian, and  $X$  is a vector of teacher's characteristics. Teachers' characteristics include gender, education fixed effects, age fixed effects, and experience fixed effects. Finally,  $\varepsilon$  is the error term, which we cluster at the class level.

Table 3: Descriptive Statistics by Teachers' Contract Type

|                          | TT                  | NTT<br>yearly       | NTT<br>short        | TT-NTT<br>yearly      | TT-NTT<br>short       |
|--------------------------|---------------------|---------------------|---------------------|-----------------------|-----------------------|
| Scores                   | 199.206<br>(19.777) | 196.768<br>(18.029) | 194.489<br>(19.005) | 2.437***<br>(0.414)   | 4.535***<br>(0.537)   |
| Standardized Scores      | 0.009<br>(1.003)    | -0.065<br>(0.933)   | -0.189<br>(0.978)   | 0.072***<br>(0.021)   | 0.178***<br>(0.027)   |
| Male                     | 0.06<br>(0.237)     | 0.142<br>(0.349)    | 0.124<br>(0.33)     | -0.086***<br>(0.005)  | -0.070***<br>(0.007)  |
| Year of Birth            | 1963.041<br>(7.92)  | 1974.78<br>(8.524)  | 1975.802<br>(8.136) | -11.604***<br>(0.227) | -12.723***<br>(0.277) |
| Age (3 groups)           | 1.845<br>(0.665)    | 1.156<br>(0.386)    | 1.227<br>(0.488)    | 0.689***<br>(0.031)   | 0.618***<br>(0.048)   |
| Age (5 groups)           | 3.016<br>(1.385)    | 1.481<br>(0.940)    | 1.548<br>(0.944)    | 1.533***<br>(0.056)   | 1.237***<br>(0.072)   |
| High-School              | 0.489<br>(0.5)      | 0.241<br>(0.428)    | 0.338<br>(0.473)    | 0.242***<br>(0.010)   | 0.169***<br>(0.135)   |
| BA                       | 0.039<br>(0.193)    | 0.04<br>(0.196)     | 0.101<br>(0.301)    | -0.001<br>(0.860)     | -0.053***<br>(0.005)  |
| MA                       | 0.035<br>(0.184)    | 0.211<br>(0.408)    | 0.2<br>(0.401)      | -0.163***<br>(0.004)  | -0.143***<br>(0.005)  |
| Old MA                   | 0.321<br>(0.467)    | 0.25<br>(0.433)     | 0.226<br>(0.418)    | 0.071***<br>(0.010)   | 0.104***<br>(0.012)   |
| Master                   | 0.015<br>(0.12)     | 0.031<br>(0.174)    | 0.024<br>(0.152)    | -0.015***<br>(0.003)  | -0.007**<br>(0.003)   |
| PhD                      | 0.014<br>(0.116)    | 0.073<br>(0.26)     | 0.047<br>(0.213)    | -0.055***<br>(0.003)  | -0.029***<br>(0.003)  |
| Post-Graduate Studies    | 0.072<br>(0.259)    | 0.124<br>(0.33)     | 0.045<br>(0.207)    | -0.047***<br>(0.005)  | 0.029***<br>(0.007)   |
| Other Post-Graduate      | 0.015<br>(0.123)    | 0.031<br>(0.173)    | 0.019<br>(0.136)    | -0.014***<br>(0.003)  | -0.002<br>(0.003)     |
| Years in School          | 11.94<br>(7.849)    | 5.836<br>(4.022)    | 3.296<br>(3.47)     | 6.594***<br>(0.863)   | 8.582***<br>(0.634)   |
| Years in Sch. (4 groups) | 3.556<br>(0.875)    | 1.828<br>(0.958)    | 1.235<br>(0.602)    | 1.728***<br>(0.021)   | 2.323***<br>(0.029)   |
| Year Started in School   | 2000.291<br>(8.864) | 2010.335<br>(4.504) | 2011.055<br>(6.748) | -10.042***<br>(0.487) | -10.835***<br>(0.682) |
| Mathematics              | 0.469<br>(0.499)    | 0.579<br>(0.494)    | 0.479<br>(0.5)      | -0.110***<br>(0.011)  | -0.009<br>(0.014)     |
| Region                   | 13.179<br>(10.746)  | 15.015<br>(16.718)  | 12.682<br>(11.921)  | -1.836***<br>(0.242)  | 0.497<br>(0.312)      |
| Wave                     | 2016.761<br>(2.605) | 2017.485<br>(2.649) | 2016.574<br>(2.821) | -0.725***<br>(0.057)  | 0.187**<br>(0.076)    |
| N. observations          | 45990               | 2203                | 1222                |                       |                       |

Notes: Data is from Invalsi. It includes all available classes with information on teachers' characteristics in compulsory school grades (grades 2, 5, and 8) for the academic years 2012-2013, 2013-2014, 2014-2015, 2015-2016, 2016-2017, 2017-2018, 2018-2019, 2020-2021, and 2021-2022.

## 4 Results

In this section, we present the result of estimating the effect of teachers' labor contracts on students' performance as in Equation 1. We first show the regression that includes only the dummies for the type of teacher contract, class fixed effects, and subject fixed, omitting all teachers' observed characteristics. We then add gender, education, age, and experience sequentially. The coefficients of the type of labor contract (first two rows) remain stable when including gender and education controls. They drop slightly when we control for age, which implicitly controls also for potential experience. Finally, they experience a sharp reduction when we control for school experience such that the effect of NTT teachers with yearly contracts disappears, and the effect of NTT teachers with shorter contracts becomes half of its original magnitude.

The absence of effect of NTT teachers with yearly contracts after we control for experience leads us to conclude that the initial gap of  $-0.094$  standard deviations in students' test scores induced by NTT teachers with yearly contracts is fully explained by their shorter experience. Moreover, the halving of the coefficient associated with NTT teachers with short contracts after accounting for experience confirms the crucial role of experience in explaining differences in students' performance according to teachers' contracts. However, the coefficient associated with NTT teachers with short contracts remains sizeable and significant even after controlling for experience, which is consistent with the literature on the negative impact of teachers' absences on students' performance.

Are these results stable throughout all academic years and all grades? We perform the regression in Equation 1 on each academic year and on each grade (second, fifth year of primary school, and third year of secondary school) separately. We show the results by academic year in Table 5 and by grade in Table 6. We find that the negative effect of NTT teachers with yearly contracts is only significantly estimated in 2020-21. Instead, the effect of NTT teachers with short contracts is significantly estimated in 2012-13, 2020-21, and 2021-22. Interestingly, those are years immediately after public contests and hence

Table 4: The Impact of NTT Teachers on Students' Performance

|                      | (1)                 | (2)                 | (3)                 | (4)                 | (5)                 |
|----------------------|---------------------|---------------------|---------------------|---------------------|---------------------|
| 1 year NTT Teacher   | -.094<br>(0.027)*** | -.093<br>(0.027)*** | -.099<br>(0.026)*** | -.080<br>(0.025)*** | -.023<br>(0.027)    |
| < 1 Year NTT Teacher | -.205<br>(0.03)***  | -.200<br>(0.03)***  | -.209<br>(0.031)*** | -.191<br>(0.033)*** | -.100<br>(0.035)*** |
| Gender               | No                  | Yes                 | Yes                 | Yes                 | Yes                 |
| Education            | No                  | No                  | Yes                 | Yes                 | Yes                 |
| Age                  | No                  | No                  | No                  | Yes                 | Yes                 |
| Experience           | No                  | No                  | No                  | No                  | Yes                 |
| Obs.                 | 49415               | 49415               | 49415               | 49415               | 49415               |
| R <sup>2</sup>       | 0.002               | 0.003               | 0.004               | 0.007               | 0.012               |

Notes: Data is from Invalsi. It includes all available compulsory school grades (grades 2, 5, and 8) for the academic years 2012-2013, 2013-2014, 2014-2015, 2015-2016, 2016-2017, 2017-2018, 2018-2019, 2020-2021, and 2021-2022. The sample is composed of all classes with information on teachers. Standard errors are clustered at the class level. \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ .

years in which new TT teachers started their jobs.<sup>5</sup> Hence, composition effects may be behind these estimates. We also find that although the effect of NTT teachers with yearly contracts is null after controlling for experience in all grades, there are significant negative effects of NTT teachers with short contracts in third grade of primary and third grade of secondary school.

Table 5: The Impact of NTT Teachers on Students' Performance: By Wave

|                      | 12-13            | 13-14            | 14-15            | 15-16            | 16-17            | 17-18            | 18-19            | 20-21             | 21-22              |
|----------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|-------------------|--------------------|
|                      | (1)              | (2)              | (3)              | (4)              | (5)              | (6)              | (7)              | (8)               | (9)                |
| 1 Year NTT Teacher   | 0.094<br>(0.14)  | 0.04<br>(0.098)  | -.032<br>(0.056) | -.070<br>(0.066) | -.044<br>(0.073) | -.033<br>(0.053) | -.005<br>(0.049) | -.110<br>(0.065)* | -.021<br>(0.057)   |
| < 1 Year NTT Teacher | -.207<br>(0.11)* | 0.026<br>(0.103) | -.050<br>(0.081) | -.170<br>(0.11)  | -.115<br>(0.086) | -.033<br>(0.072) | -.026<br>(0.086) | -.165<br>(0.099)* | -.195<br>(0.093)** |
| Obs.                 | 5358             | 5552             | 6507             | 7255             | 6699             | 5841             | 5210             | 3329              | 3664               |
| R <sup>2</sup>       | 0.068            | 0.065            | 0.022            | 0.016            | 0.023            | 0.011            | 0.004            | 0.014             | 0.013              |

Notes: Data is from Invalsi. It includes all available compulsory school grades (grades 2, 5, and 8) for the academic years 2012-2013, 2013-2014, 2014-2015, 2015-2016, 2016-2017, 2017-2018, 2018-2019, 2020-2021, and 2021-2022. Each column refers to one of these academic years, separately. The sample is composed of all classes with information on teachers. Controls include teachers' gender, age, highest education degree, and experience. Standard errors are clustered at the class level. \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ .

<sup>5</sup>During our sample period, public contests happened in 2012, 2016, 2018, 2020, and 2021.

Table 6: The Impact of Short and Long NTT Teachers on Students' Performance: By Grade

|                      | SecondGrade        | FifthGrade       | EighthGrade        |
|----------------------|--------------------|------------------|--------------------|
|                      | (1)                | (2)              | (3)                |
| 1 Year NTT Teacher   | -.022<br>(0.058)   | 0.011<br>(0.054) | -.038<br>(0.034)   |
| < 1 Year NTT Teacher | -.127<br>(0.062)** | -.053<br>(0.065) | -.113<br>(0.056)** |
| Obs.                 | 17173              | 17128            | 15114              |
| R <sup>2</sup>       | 0.021              | 0.02             | 0.023              |

*Notes:* Data is from Invalsi. It includes the academic years 2012-2013, 2013-2014, 2014-2015, 2015-2016, 2016-2017, 2017-2018, 2018-2019, 2020-2021, and 2021-2022 and all available compulsory school grades (grades 2, 5, and 8). Each column includes one of these grades, separately. The sample is composed of all classes with information on teachers. Controls include teachers' gender, age, highest education degree, and experience. Standard errors are clustered at the class level. \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ .

## 4.1 Heterogeneity

Our main results in Table 4 reveal that the effect of teachers' labor contracts on students' performance crucially depends on teachers' characteristics. We explore the heterogeneity of the teachers' labor contracts effect by teachers' characteristics by adding the interactions of the labor contract dummies and teachers' characteristics as additional regressors in Equation 1. In the first column of Table 7, we explore whether the estimated coefficients vary across subjects. The negative effect of NTT teachers with short contracts is exacerbated for mathematics. According to column 2, the effect is present only for females, while the sign of the effect reverses for males. Finally, there is a negative effect of NTT teachers with yearly contracts among the subsample of teachers with old MA degrees. This may be due to the fact that teachers with old MA degrees and hence, who belong to the older cohorts, and did not manage to achieve a TT position at any point in their careers, may be of particularly low quality.

## 5 Discussion

The type of labor contract held by workers affects their productivity (Dolado, Ortigueira, and Stucchi [2016]). Previous literature show that this is the case also in the education sector, among university instructors (Ehrenberg and Zhang [2005] and Figlio, Schapiro, and Soter [2015]). Unfortunately, previous literature on university faculty finds contrast-

Table 7: The Heterogeneous Impact of NTT Teachers on Students' Performance

|   | Subject<br>(1)       | Gender<br>(2)        | Degree<br>(3)       |
|---|----------------------|----------------------|---------------------|
| 1 Year NTT Teacher                        | -0.029<br>(0.034)    | -0.024<br>(0.028)    | 0.059<br>(0.062)    |
| < 1 Year NTT Teacher                      | -0.146<br>(0.041)*** | -0.124<br>(0.039)*** | -0.077<br>(0.062)   |
| 1 Year NTT Teacher*Maths                  | 0.010<br>(0.032)     |                      |                     |
| < 1 Year NTT Teacher*Maths                | -0.100<br>(0.048)**  |                      |                     |
| 1 Year NTT Teacher*Male                   |                      | 0.012<br>(0.06)      |                     |
| < 1 Year NTT Teacher*Male                 |                      | 0.176<br>(0.092)*    |                     |
| 1 Year NTT Teacher*BA                     |                      |                      | -0.013<br>(0.113)   |
| < 1 Year NTT Teacher*BA                   |                      |                      | -0.087<br>(0.095)   |
| 1 Year NTT Teacher*MA                     |                      |                      | -0.122<br>(0.077)   |
| < 1 Year NTT Teacher*MA                   |                      |                      | 0.012<br>(0.082)    |
| 1 Year NTT Teacher*Old MA                 |                      |                      | -0.155<br>(0.071)** |
| < 1 Year NTT Teacher*Old MA               |                      |                      | -0.070<br>(0.082)   |
| 1 Year NTT Teacher*Master                 |                      |                      | -0.154<br>(0.119)   |
| < 1 Year NTT Teacher*Master               |                      |                      | -0.311<br>(0.193)   |
| 1 Year NTT Teacher*PhD                    |                      |                      | -0.124<br>(0.112)   |
| < 1 Year NTT Teacher*PhD                  |                      |                      | 0.168<br>(0.158)    |
| 1 Year NTT Teacher*Specialization         |                      |                      | -0.043<br>(0.085)   |
| < 1 Year NTT Teacher*Specialization       |                      |                      | 0.012<br>(0.176)    |
| 1 Year NTT Teacher*Other Specialization   |                      |                      | 0.016<br>(0.125)    |
| < 1 Year NTT Teacher*Other Specialization |                      |                      | -0.324<br>(0.262)   |
| Obs.                                      | 49415                | 49415                | 49415               |
| R <sup>2</sup>                            | 0.012                | 0.012                | 0.013               |

Notes: Data is from Invalsi. It includes all available compulsory school grades (grades 2, 5, and 8) for the academic years 2012-2013, 2013-2014, 2014-2015, 2015-2016, 2016-2017, 2017-2018, 2018-2019, 2020-2021, and 2021-2022. The sample is composed of all classes with information on teachers. Standard errors are clustered at the class level. \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ .

ing results, and even if their results were alligned, they do not necessarily apply to school teachers. The current paper analyzes the role of tenured/tenure track teachers vs non-tenure-track teachers in explaining students' performance in standardized tests during compulsory education. We use Italian data on a large and representative sample of primary and secondary school teachers and their students for the period 2012-13 to 2021-22. Results show that there is a penalty for students of non-tenure-track teachers. However, this penalty is fully explained by the lower experience of non-tenure-track teachers. The penalty still applies to students of non-tenure-track teachers when teachers are in their roles for less than a year, which directly speaks to the literature on the negative effect of teachers' absences on students' performance (Miller, Murnane, and Willett [2008] and Tingle, Schoeneberger, Schools, Wang, Algozzine, and Kerr [2012]).

We acknowledge that by using students' test scores as outcomes, we miss the potential influence of teachers on other aspects like absences, suspensions, course grades, and grade repetition. These outcomes are influenced by teachers' quality (Jackson [2018]), and hence, they are potentially affected by teachers' labor contracts. Unfortunately, our data do not allow us to explore those dimensions of students' performance.

Our effects are identified out of classes where one of the teachers is NTT and the other is TT, we need to consider the role of peer effects between teachers of the same class. Teachers' peer effects are documented to be positive and sizeable (according to Jackson and Bruegmann [2009], historical peer quality explains away about 20 percent of the own-teacher effect). Hence, our results that NTT teachers with one-year contracts do not damage students' performance could be explained by the positive influence of TT teachers.

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