

Time Spent at School and Inequality in Students' Learning Outcomes

Giulia Bovini ¹ Marta De Philippis ² Paolo Sestito ²

¹LSE

²Bank of Italy

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Motivation

- ▶ Time spent at school is a costly, but relatively scalable input
- ▶ Relatively understudied compared to other school inputs:
 - ▶ Narrow focus on instruction time
 - ▶ Little evidence on effects on:
 - ▶ distribution and dispersion of achievement
 - ▶ use of time outside school
 - ▶ total time devoted to instruction and leisure

Research question

- ▶ Effect of more time spent at school on:
 - ▶ Level of test scores
 - ▶ Distribution of test scores
 - ▶ Achievement gaps by SES

- ▶ Possible mechanisms:
 - ▶ complementarity/substitutability between time spent at school (homogeneous environment) and time spent at home (role of family resources)
 - ▶ changes in total time devoted to instruction and leisure

Setting: TN and TP

- ▶ We exploit the coexistence in Italian primary schools of *tempo normale* (TN) and *tempo pieno* (TP)
- ▶ *Tempo Normale* (TN):
 - ▶ No less than 24 hours per week spent at school (usually 27)
 - ▶ Lectures distributed across five to six days per week, usually only in the morning
 - ▶ Three main teachers every two classes
- ▶ *Tempo Pieno* (TP):
 - ▶ 40 hours per week spent at school
 - ▶ Typically 5 schooldays per week, from 8.30 to 16.30
 - ▶ Lunch break and supervised study included
 - ▶ Two main teachers per class

Preview

- ▶ Two identification strategies to deal with selection on unobservables:
 - ▶ Within school-grade variation in the share of TP classes over time
 - ▶ Fuzzy RDD based on class size rules (in progress)
- ▶ Main findings about TP schemes:
 - ▶ The effect on reading is virtually null and constant across the distribution
 - ▶ The effect on mathematics is positive, statistically significant and larger at the bottom of the distribution
 - ▶ (Weak) evidence about mitigation of achievement gaps by SES
 - ▶ Effects larger at grade V
 - ▶ Substitution between study at home and study at school close to 1:1

Relevant literature

- ▶ Early literature:
 - ▶ US: Rizzuto and Watchel (1980), Card and Krueger (1992), Grogger (1996), Eide and Showalter (1998)
 - ▶ cross-country: Lee and Barro (2001), Wobmann (2003)
- ▶ Weather-induced natural experiments: Marcotte (2007), Marcotte and Hemelt (2008), Hansen (2011), Goodman (2014)
- ▶ Policy-induced natural/field experiments:
 - ▶ Pischke (2007), Parinduri (2014)
 - ▶ Agüero and Beleche (2013), Aucejo and Romano (2015)
 - ▶ Bellei (2009), Lavy (2010, 2012), Berthelon et al. (2016)
 - ▶ Dobbie and Fryer (2014, 2015)
- ▶ Italian context: Mariani, Recchia, Sestito and Vacca (2012)
- ▶ Explicit analysis on effects across the distribution of achievement: Hubener et al. (2016)

Contributions

- ▶ Variation: sizable ($\geq 33\%$ increase in weekly time at school), lasting and predictable (time to adjust the organization of the school day)
- ▶ Outcomes: beyond average effects, focus on the entire distribution
- ▶ Mechanisms: time spent studying at school and at home, total time dedicated to instruction and leisure

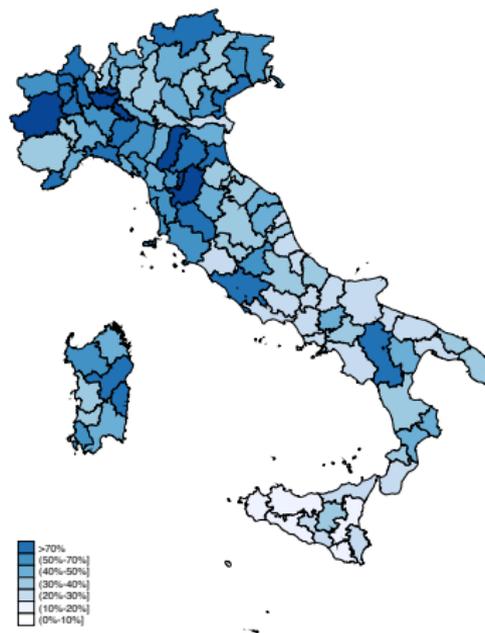
Data

- ▶ INVALSI (a.y.s. 2010/2011 - 2014/2015) (Descriptives)
 - ▶ Achievement: scores from standardized reading and mathematics tests (grades II and V)
 - ▶ School characteristics: enrollment and instruction scheme (TN or TP) of each class
 - ▶ Student characteristics and use of time outside school
- ▶ MIUR (a.y. 2014/2015)
 - ▶ Applications to primary schools: school and schedule (TN or TP) parents apply to (Jan/Feb 2014)
 - ▶ Enrollment in first grade: school and schedule (TN or TP) pupils are actually enrolled in (Sep 2014)
- ▶ ISTAT Time Use Surveys (2008/2009)

Demand for and supply of TP

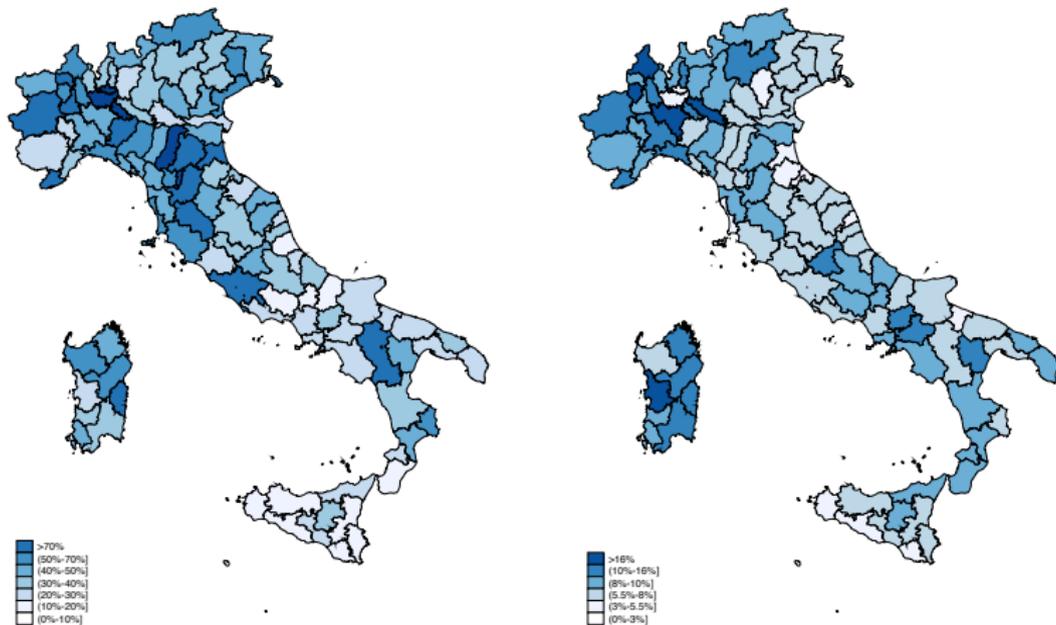
- ▶ Parents express their preference for TN or TP schemes when applying for primary school
- ▶ The supply of TP does not always meet the demand for TP
 - ▶ Lower bounds on class size: if fewer parents apply for TP than what is required to form a class, the TP class is not activated
 - ▶ Upper bounds on class size: availability of financial resources for TP classes may be insufficient to accommodate all applications

TP: Demand (a.y. 14/15)



Note: Authors' elaboration based on MIUR data.

TP: Enrollment and unmet demand (a.y. 14/15)



(a) TP: Enrollment (grade I)

(b) TP: Unmet demand

Note: Authors' elaboration based on MIUR data.

TP vs TN: Descriptive statistics

	TN	TP	Diff: TN - TP
<i>I. Local area characteristics</i>			
Average population	142841	375855	-233014.42
Share in provincial capital	0.25	0.37	-0.11
Average unemp. rate (2011-2014)	0.13	0.10	0.03
Average female non part. rate (2011-2013)	0.29	0.20	0.09
<i>II. School and student characteristics</i>			
Average class size	17.27	19.00	-1.73
Share male *	0.51	0.51	-0.00
Share with Italian citizenship *	0.92	0.85	0.06
Share regular *	0.96	0.97	-0.01
Share attended nursery *	0.28	0.42	-0.14
Share father with HS diploma or more *	0.49	0.53	-0.04
Share mother with HS diploma or more *	0.56	0.62	-0.05
Share mother not working *	0.50	0.34	0.16
Average ESCS *	0.02	0.11	-0.09
<i>III. Test scores</i>			
Average reading test score (NC)	0.02	-0.04	0.06
Average reading test score (C)	-0.02	0.03	-0.05
Average mathematics test score (NC)	0.02	-0.04	0.07
Average mathematics test score (C)	-0.01	0.02	-0.03

Note: * Shares are conditional on non-missing survey response.

Identification and empirical strategy

- ▶ Challenge to identification: selection on unobservables → comparing achievement in TN and TP classes would not uncover the causal effect of longer schedules
- ▶ Two identification strategies:
 - ▶ Exploit variation within school-grade in the share of TP classes over time, across subsequent cohorts of 2th and 5th graders
 - ▶ Exploit class size rules in a fuzzy RDD framework (in progress)

First identification strategy (ID 1): within school-grade variation

$$y_{sgt} = \delta \text{ShareTP}_{sgt} + X'_{sgt} \gamma + \mu_{sg} + \theta_{sg} t + \eta_t + \varepsilon_{sgt}$$

- ▶ s indexes the school, g indexes the grade, t indexes time):
- ▶ Identification comes from within school-grade variation in the share of TP classes over time
- ▶ Identifying assumption:
 - ▶ the leveraged variation is not systematically correlated with unobserved changes in the characteristics of pupils (and teachers) enrolled in a given school-grade
 - ▶ it reflects variations in the supply of TP, driven by fluctuations in financial resources and marginal changes in applications to TP around lower bounds for class size formation
- ▶ Drawback: most of the variation in TP diffusion is cross-sectional rather than longitudinal

Second identification strategy (ID 2): fuzzy RDD

- ▶ Class size rules:
 - ▶ Lower bound on class size: 15 for *comuni non montani* (CNM), 10 for *comuni montani* (CM)
 - ▶ A 10% tolerance buffer applies
- ▶ Fuzzy RDD approach:
 - ▶ comparison between schools that barely activate TP classes and schools that barely do not
 - ▶ Regression specification (reduced form):

$$y_s = \beta \mathbb{1}(D_s^{TP} \geq \bar{D}_s) + f(D_s^{TP}) + \varepsilon_s$$

where D_s^{TP} is the n. of applications to TP and \bar{D}_s is the lower bound to class size

- ▶ So far we can only show the first stage

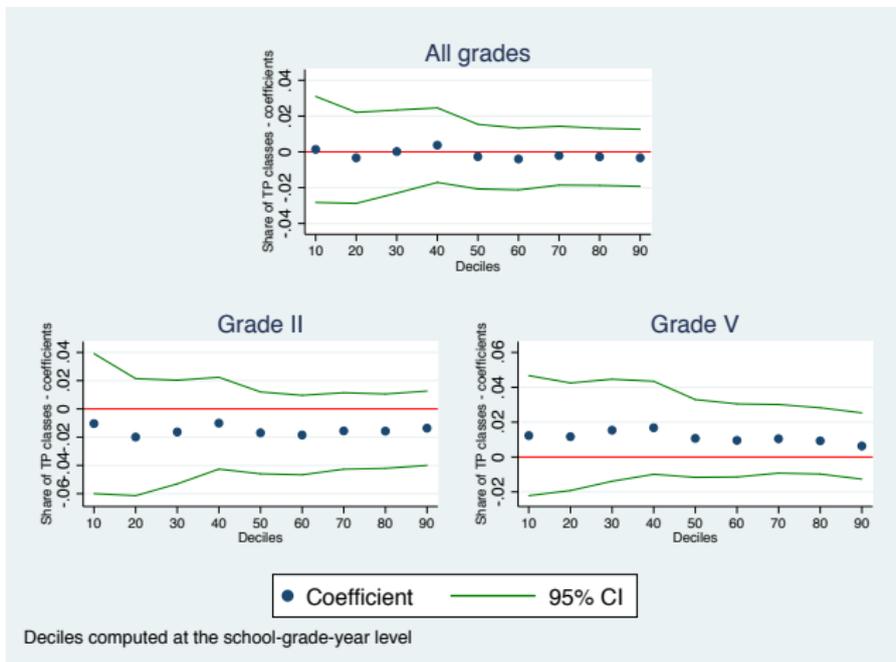
ID 1: Balancing tests

	[1]	[2]	[3]	[4]	[5]	[6]
	Enrolment			Share males		
Share TP	5.905***	-0.728***	-1.000***	0.002***	0.004	0.002
	(0.315)	(0.226)	(0.289)	(0.001)	(0.002)	(0.004)
Obs.	118662	118662	118662	118662	118662	118662
Y mean		39.86			0.51	
	Share natives			Share regulars		
Share TP	-0.054***	-0.006***	-0.003	0.005***	0.003***	-0.002
	(0.002)	(0.002)	(0.003)	(0.001)	(0.001)	(0.002)
Obs.	118633	118633	118633	118641	118641	118641
Y mean		0.90			0.96	
	Share moth. HS dip. or more			Share fath. HS dip. or more		
Share TP	0.043***	0.018***	-0.002	0.037***	0.014***	-0.002
	(0.002)	(0.003)	(0.004)	(0.003)	(0.003)	(0.005)
Obs.	106403	106403	106403	106149	106149	106149
Y mean		0.58			0.49	
μ_{sg}	No	Yes	Yes	No	Yes	Yes
$\theta_{sg} t$	No	No	Yes	No	No	Yes

Note: The unit of observation is the school-grade-year. Standard errors are clustered at the school level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

ID 1: TP and the distribution of test scores NC

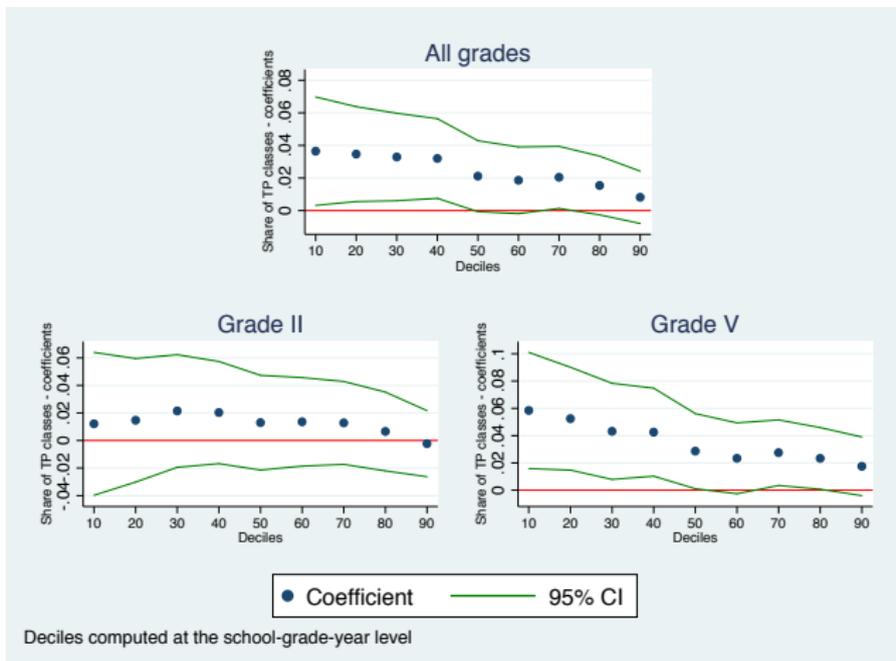
Reading test scores (C)



Note: The unit of observation is the school-grade-year. Standard errors are clustered at the school-grade level.

ID 1: TP and the distribution of test scores NC

Mathematics test scores (C)



Note: The unit of observation is the school-grade-year. Standard errors are clustered at the school-grade level.

ID 1: TP and measures of central tendency NC

	Reading			Mathematics		
	All grades	Grade II	Grade V	All grades	Grade II	Grade V
	<i>Mean score</i>					
Share TP	-0.002 (0.009)	-0.013 (0.014)	0.009 (0.011)	0.022** (0.010)	0.011 (0.015)	0.032** (0.013)
	<i>Median score</i>					
Share TP	-0.004 (0.009)	-0.016 (0.015)	0.008 (0.012)	0.021* (0.011)	0.013 (0.018)	0.029** (0.014)
Stud. contr.	Yes	Yes	Yes	Yes	Yes	Yes
School contr.	Yes	Yes	Yes	Yes	Yes	Yes
μ_{sg}	Yes	Yes	Yes	Yes	Yes	Yes
$\theta_{sg} t$	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	81696	38442	43254	81698	38442	43256

Note: The unit of observation is the school-grade-year. The independent variable of interest is the share of TP classes. The dependent variables are the (log) mean and the median test scores (corrected for cheating). Standard errors are clustered at the school-grade level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

ID 1: TP and measures of dispersion NC

	Reading			Mathematics		
	All grades	Grade II	Grade V	All grades	Grade II	Grade V
	<i>Std. Dev.</i>					
Share TP	-0.019 (0.018)	-0.013 (0.026)	-0.023 (0.024)	-0.015 (0.015)	-0.004 (0.020)	-0.025 (0.021)
	<i>Ratio 75/25</i>					
Share TP	0.001 (0.009)	0.007 (0.014)	-0.005 (0.012)	-0.016 (0.010)	-0.008 (0.015)	-0.023* (0.013)
	<i>Ratio 90/10</i>					
Share TP	-0.003 (0.014)	-0.001 (0.024)	-0.006 (0.015)	-0.028* (0.014)	-0.014 (0.023)	-0.041** (0.019)
Stud. contr.	Yes	Yes	Yes	Yes	Yes	Yes
School contr.	Yes	Yes	Yes	Yes	Yes	Yes
μ_{sg}	Yes	Yes	Yes	Yes	Yes	Yes
$\theta_{sg} t$	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	81545	38353	43192	81611	38396	43215

Note: The unit of observation is the school-grade-year. The independent variable of interest is the share of TP classes. The dependent variables are the (log) standard deviation, the 75/25 ratio and the 90/10 ratio of test scores (corrected for cheating). Standard errors are clustered at the school-grade level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

ID1: Achievement Gaps by SES NC

	Reading			Mathematics		
	Father education	Cit.	Lang. at home	Father education	Cit.	Lang. at home
	<i>All grades</i>					
Share TP	-0.008 (0.007)	-0.003 (0.014)	-0.014 (0.020)	-0.006 (0.008)	-0.006 (0.015)	-0.020 (0.023)
Obs.	77144	49782	25066	77198	50004	25471
	<i>Grade II</i>					
Share TP	0.001 (0.011)	-0.001 (0.023)		0.009 (0.012)	0.006 (0.024)	
Obs.	36384	24039		36408	24145	
	<i>Grade V</i>					
Share TP	-0.016* (0.008)	-0.002 (0.017)	-0.014 (0.020)	-0.019* (0.010)	-0.017 (0.020)	-0.020 (0.023)
Obs.	40760	25743	25066	40790	25859	25471
Stud. contr.	Yes	Yes	Yes	Yes	Yes	Yes
School contr.	Yes	Yes	Yes	Yes	Yes	Yes
μ_{sg}	Yes	Yes	Yes	Yes	Yes	Yes
$\theta_{sg}t$	Yes	Yes	Yes	Yes	Yes	Yes

Note: The unit of observation is the school-grade-year. The independent variable of interest is the share of TP classes. The dependent variables are the (log) achievement gaps, expressed as ratios, by father education (diploma/not diploma), student citizenship (Italian/foreign) and language prevalently spoken at home (Italian or regional dialect/foreign language). Standard errors are clustered at the school-grade level.
 * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Use of time at and outside school (INVALSI)

	TN	TP	Diff: TN - TP
Share never do homework *	0.02	0.03	-0.01
Share do homework 1-2 times a week *	0.12	0.37	-0.25
Share do homework 3-4 times a week *	0.22	0.36	-0.13
Share do homework more than 5 times a week *	0.64	0.24	0.40
Share watch TV more than 1 hr a day *	0.52	0.53	-0.01
Share play with PC/videogames more than 1 hr a day *	0.47	0.46	0.01
Share play with friends more than 1 hr a day *	0.81	0.81	-0.00
Share help with housework more than 1 hr a day *	0.42	0.40	0.02
Share read books/comics more than 1 hr a day *	0.31	0.31	0.01
Share play sport more than 3 times a week *	0.38	0.36	0.02
Share do other recr. act. more than 3 times a week *	0.08	0.06	0.02

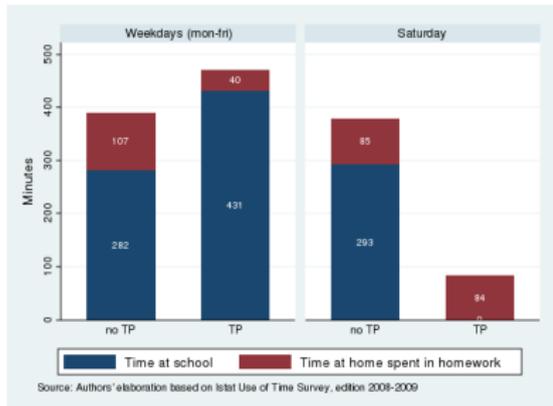
Note: * Shares are conditional on non-missing survey response.

Use of time at and outside school (INVALSI)

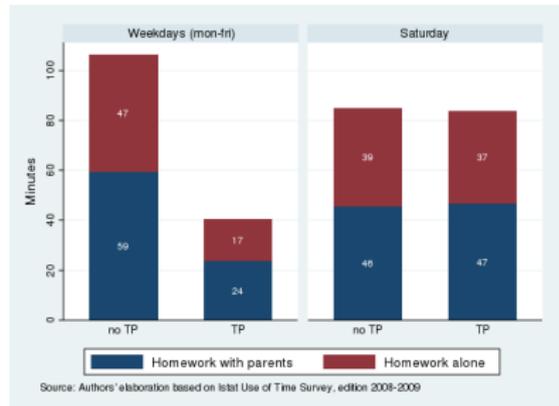
	Coeff.	Obs.
Never homework	0.011*** (0.004)	35616
Homework < 2 times/week	0.058*** (0.016)	35616
Homework > 5 times/week	-0.073*** (0.017)	35616
Watch TV > 1 hr/day	-0.017 (0.014)	35618
Play w/PC > 1 hr/day	-0.020 (0.014)	35617
Play w/ friends > 1 hr/day	-0.009 (0.010)	35617
Housework > 1 hr/day	0.011 (0.012)	35617
Read books > 1 hr/day	0.015 (0.012)	35617
Play sport > 3 times/week	0.000 (0.012)	35617
Other recreational activities > 3 times/week	0.002 (0.007)	35615
Student controls	Yes	
School controls	Yes	
<i>School</i> × <i>grade</i> FE	Yes	
<i>School</i> × <i>grade</i> trends	Yes	

Note: The unit of observation is the school-grade-year. The independent variable of interest is the share of TP classes. Standard errors are clustered at the school-grade level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Use of time at and outside school (ISTAT UTS)



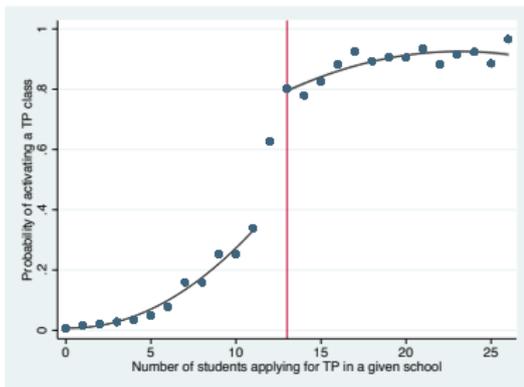
(c) Total time - instruction



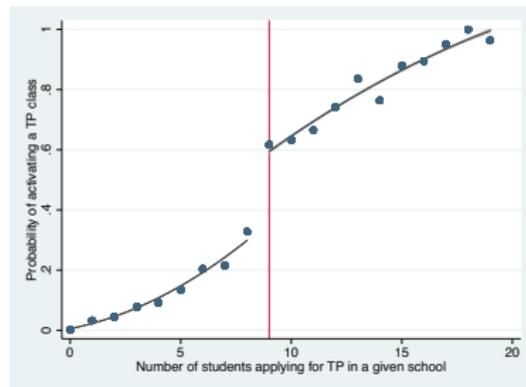
(d) Total time - homework

Note: Authors' elaboration based on ISTAT Time Use Survey data.

ID 2: First stage Reg.



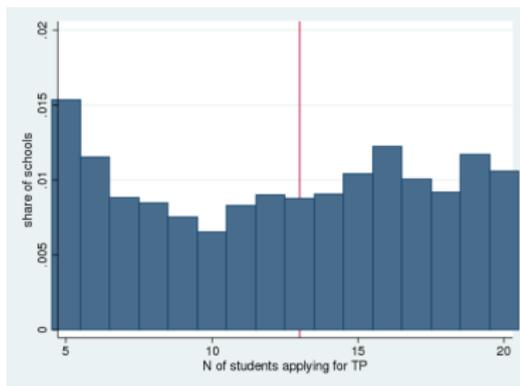
(e) Comuni non montani



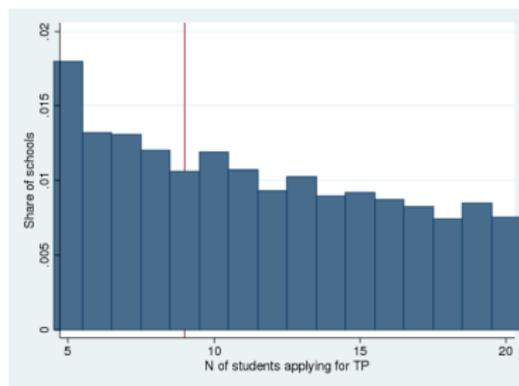
(f) Comuni montani

Note: Authors' elaboration based on MIUR data.

ID 2: Running variable distribution



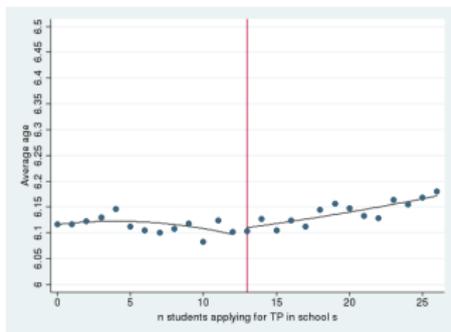
(g) Comuni non montani



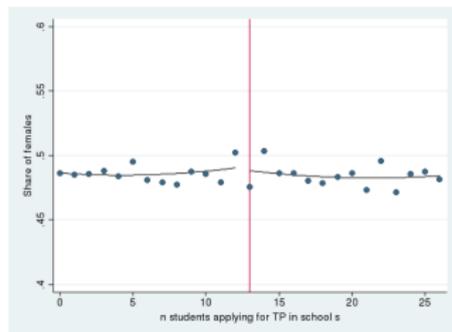
(h) Comuni montani

Note: Authors' elaboration based on MIUR data.

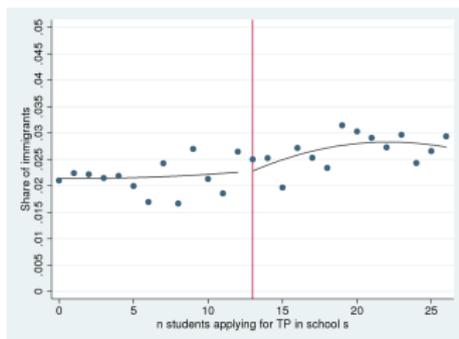
ID 2: Running variable and pre-determined characteristics



(i) Age



(j) Female = 1



(k) Immigrant = 1

Note: Authors' elaboration based on MIUR data.

Conclusion

- ▶ We exploit the co-existence of TN and TP schedules in Italian primary schools to study how time spent at school affects the distribution of achievement
- ▶ The effect on reading is virtually null and constant across the distribution
- ▶ The effect on mathematics is positive, statistically significant and larger at the bottom of the distribution
- ▶ (Weak) evidence about mitigation of achievement gaps by SES
- ▶ Effects larger at grade V
- ▶ Substitution between study at home and study at school close to 1:1

Appendix

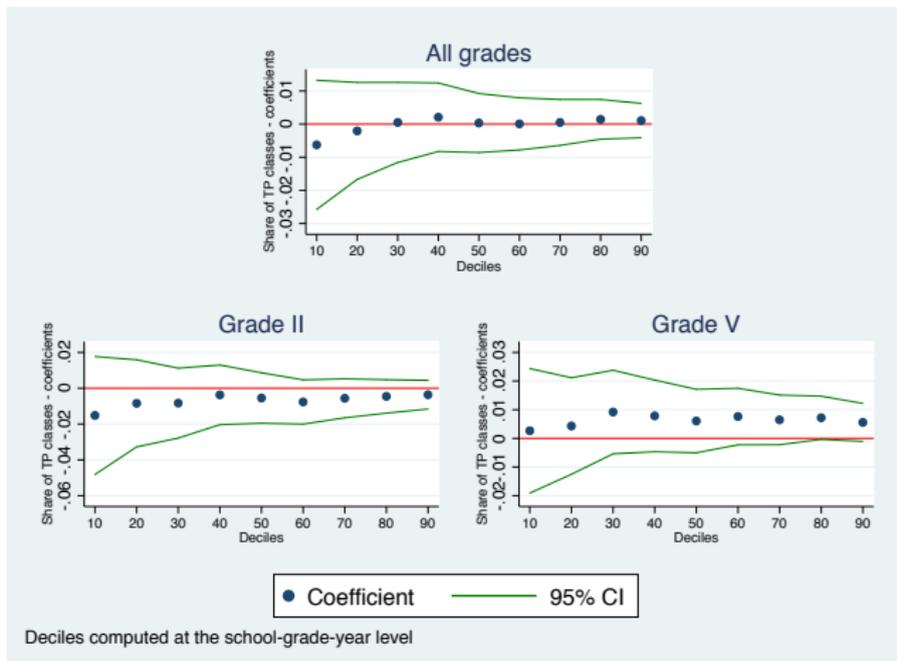
Sample: descriptive statistics [Back](#)

	Grade II		Grade V	
	Mean	SD	Mean	SD
<i>I. School characteristics</i>				
Average enrolment (by grade)	33.76	25.97	33.60	25.83
Average class size	17.81	5.86	17.66	5.78
N. of classes	1.77	1.08	1.78	2.08
Share of TP classes	0.33	0.41	0.29	0.41
<i>II. Students characteristics</i>				
Share male *	0.51	0.50	0.51	0.50
Share native *	0.90	0.31	0.90	0.30
Share regular *	0.97	0.18	0.95	0.21
Share speak prevalently Italian at home *	.	.	0.92	0.27
Share attended nursery *	0.35	0.48	0.30	0.46
Share father with HS diploma or more *	0.51	0.50	0.48	0.50
Share mother with HS diploma or more *	0.60	0.49	0.56	0.50
Share mother not working *	0.45	0.50	0.46	0.50
Average ESCS *	.	.	0.04	1.03

Note: * Shares are conditional on non-missing survey response.

ID 1: TP and the distribution of test scores

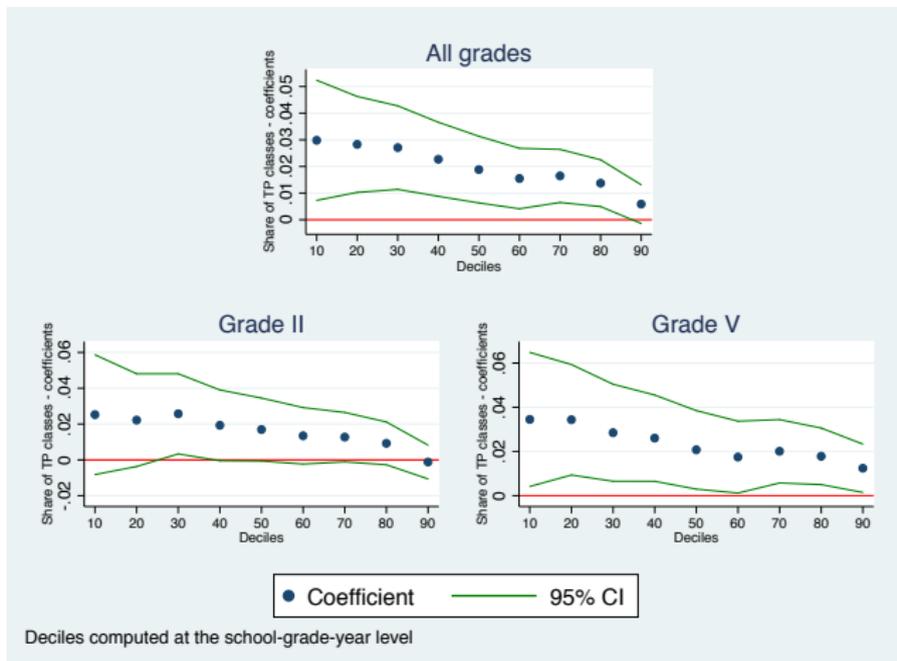
Reading test scores (NC)



Note: The unit of observation is the school-grade-year. Standard errors are clustered at the school-grade level.

ID 1: TP and the distribution of test scores

Mathematics test scores (NC)



Note: The unit of observation is the school-grade-year. Standard errors are clustered at the school-grade level.

ID 1: TP and measures of central tendency

	All grades	Reading Grade II	Grade V	All grades	Mathematics Grade II	Grade V
	<i>Mean score</i>					
Share TP	-0.000 (0.004)	-0.006 (0.007)	0.005 (0.005)	0.018*** (0.006)	0.013* (0.008)	0.022*** (0.008)
	<i>Median score</i>					
Share TP	-0.001 (0.005)	-0.006 (0.007)	0.005 (0.006)	0.019*** (0.006)	0.017* (0.009)	0.021** (0.009)
Stud. contr.	Yes	Yes	Yes	Yes	Yes	Yes
School contr.	Yes	Yes	Yes	Yes	Yes	Yes
μ_{sg}	Yes	Yes	Yes	Yes	Yes	Yes
$\theta_{sg} t$	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	105772	49154	56618	105764	49154	56610

Note: The unit of observation is the school-grade-year. The independent variable of interest is the share of TP classes. The dependent variables are the (log) mean and the median test scores (corrected for cheating). Standard errors are clustered at the school-grade level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

ID 1: TP and measures of dispersion

	Reading			Mathematics		
	All grades	Grade II	Grade V	All grades	Grade II	Grade V
	<i>Std. Dev.</i>					
Share TP	0.002 (0.010)	0.003 (0.015)	-0.000 (0.015)	-0.007 (0.009)	-0.011 (0.013)	-0.003 (0.013)
	<i>Ratio 75/25</i>					
Share TP	0.002 (0.005)	0.006 (0.008)	-0.002 (0.006)	-0.014** (0.006)	-0.013 (0.009)	-0.015* (0.008)
	<i>Ratio 90/10</i>					
Share TP	0.008 (0.009)	0.012 (0.016)	0.003 (0.010)	-0.024** (0.010)	-0.027* (0.015)	-0.023* (0.013)
Stud. contr.	Yes	Yes	Yes	Yes	Yes	Yes
School contr.	Yes	Yes	Yes	Yes	Yes	Yes
μ_{sg}	Yes	Yes	Yes	Yes	Yes	Yes
$\theta_{sg} t$	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	105595	49068	56527	105634	49091	56543

Note: The unit of observation is the school-grade-year. The independent variable of interest is the share of TP classes. The dependent variables are the (log) standard deviation, the 75/25 ratio and the 90/10 ratio of test scores (corrected for cheating). Standard errors are clustered at the school-grade level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

ID1: Achievement Gaps by SES

	Reading			Mathematics		
	Father education	Cit.	Lang. at home	Father education	Cit.	Lang. at home
	<i>All grades</i>					
Share TP	-0.004 (0.005)	-0.005 (0.010)	-0.014 (0.015)	-0.007 (0.006)	-0.004 (0.012)	-0.021 (0.018)
Obs.	100454	65669	33227	100493	65870	33697
	<i>Grade II</i>					
Share TP	-0.003 (0.008)	-0.005 (0.016)		-0.006 (0.009)	0.003 (0.018)	
Obs.	46808	31319		46828	31416	
	<i>Grade V</i>					
Share TP	-0.004 (0.006)	-0.004 (0.012)	-0.014 (0.015)	-0.008 (0.008)	-0.010 (0.016)	-0.021 (0.018)
Obs.	53646	34350	33227	53665	34454	33697
Stud. contr.	Yes	Yes	Yes	Yes	Yes	Yes
School contr.	Yes	Yes	Yes	Yes	Yes	Yes
μ_{sg}	Yes	Yes	Yes	Yes	Yes	Yes
$\theta_{sg}t$	Yes	Yes	Yes	Yes	Yes	Yes

Note: The unit of observation is the school-grade-year. The independent variable of interest is the share of TP classes. The dependent variables are the (log) achievement gaps, expressed as ratios, by father education (diploma/not diploma), student citizenship (Italian/foreign) and language prevalently spoken at home (Italian or regional dialect/foreign language). Standard errors are clustered at the school-grade level.

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

ID 2: First stage and balancing tests Charts

	Activate TP class	1= female	1= immigrant	Age
<i>Entire sample, 3 degree polynomial</i>				
TP applicants > min size	0.135*** (0.016)	0.003 (0.004)	-0.002 (0.002)	-0.012 (0.010)
TP applicants	0.024*** (0.001)	-0.000 (0.000)	0.000*** (0.000)	0.002*** (0.001)
TP applicants ²	-0.000*** (0.000)	0.000 (0.000)	-0.000* (0.000)	-0.000 (0.000)
TP applicants ³	0.000*** (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)
Obs.	525280	525280	525280	525280
<i>Around the threshold, 2 degree polynomial</i>				
TP applicants > min size	0.091*** (0.018)	0.004 (0.005)	-0.001 (0.002)	-0.014 (0.014)
TP applicants	0.025*** (0.001)	-0.000 (0.001)	0.000 (0.000)	0.000 (0.002)
TP applicants ²	-0.000** (0.000)	0.000 (0.000)	0.000* (0.000)	0.000 (0.000)
Obs.	346636	346636	346636	346636

Note: The unit of observation is the student. The independent variable of interest is whether the number of applicants in school s is above the minimum class size threshold. Standard errors are clustered at the school level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.