

1 Appendix

1.1 Sample selection

Table A1: Sample characteristics

	Sample		
	Out	In	Test
N	1,887	5,557	
ESCS	-0.188	-0.020	<0.001
Female	0.456	0.516	0.008
Immigrant background			
Native student	85.4%	92.8%	<0.001
Second-Generation student	7.8%	6.1%	
First-Generation student	6.8%	1.1%	
Sense of belonging	-0.089	-0.052	0.345
Schol truancy	0.686	0.677	0.181
School disciplinary climate	-0.127	-0.063	<0.001
School class size	23.023	24.158	<0.001
School certified teachers	0.697	0.745	<0.001
School extracurriculars	4.269	4.680	<0.001
School average ESCS	-0.110	-0.032	<0.001
Italian: Grade 10	467.419	494.272	<0.001
Maths: Grade 10	455.256	483.812	<0.001

Notes: Weighted estimates. Out sample reflects students who are in the PISA grade 10 sample but that cannot be matched to grade 5 and grade 2 INVALSI results. In sample students are students that were tested in PISA in 2022 in grade 10 with complete information on key characteristics used in the models. *Source:* PISA 2022 and INVALSI data.

1.2 Estimates with inverse probability weighting

Table A2: Predicting resilience in mathematics among low-SES students using models with inverse probability weighting for attrition

	M1	M2	M3	M4	M5	M6
<i>Individual-level variables</i>						
Female	-0.0854*** (-3.64)	-0.0511* (-2.50)	-0.0804*** (-3.56)	-0.0535** (-2.62)	-0.0707*** (-3.53)	-0.0770*** (-3.80)
1st generation	0.137*** (3.45)	0.136*** (3.66)	0.150*** (3.82)	0.142*** (3.76)	0.118** (3.13)	0.0989** (2.68)
2nd generation	0.113 (1.13)	0.136 (1.47)	0.140 (1.50)	0.144 (1.59)	0.113 (1.20)	0.0907 (1.00)
Sense of belonging	-0.00440 (-0.49)	-0.00518 (-0.55)	-0.00333 (-0.38)	-0.00457 (-0.50)	-0.00512 (-0.55)	-0.00265 (-0.30)
ESCS	0.0942** (2.97)	0.0748* (2.44)	0.0838** (2.67)	0.0724* (2.38)	0.0530 (1.73)	0.0205 (0.71)
<i>Gr. 5 quartile grades (ref:bottom)</i>						
2nd quartile		0.0375 (1.64)		0.0253 (1.14)	0.0261 (1.18)	0.0134 (0.59)
3rd quartile		0.185*** (5.25)		0.156*** (4.44)	0.140*** (3.91)	0.123*** (3.52)
Top quartile		0.277*** (4.88)		0.239*** (4.19)	0.220*** (4.08)	0.203*** (3.81)
<i>Gr. 2 quartile grades (ref:bottom)</i>						
2nd quartile			0.0675* (2.57)	0.0223 (0.85)	0.0250 (0.97)	0.0243 (0.98)
3rd quartile			0.163*** (4.49)	0.0865** (2.62)	0.0871** (2.65)	0.0848** (2.62)
Top quartile			0.164*** (4.48)	0.0680* (2.12)	0.0734* (2.37)	0.0802** (2.59)
<i>School-level variables</i>						
Schol truancy					-0.0359* (-2.13)	-0.0294 (-1.87)
School disciplinary climate					0.0256* (2.00)	0.0165 (1.32)
School class size					0.00336 (0.33)	0.00131 (0.13)
School certified teachers					-0.0156 (-1.28)	-0.00862 (-0.73)
School extracurriculars					0.0124 (1.03)	0.00137 (0.12)
School average ESCS						0.0557*** (4.65)
Constant	0.246*** (5.09)	0.114* (2.51)	0.151** (3.23)	0.0920 (1.95)	0.105* (2.19)	0.113* (2.34)
Observations	1138	1138	1138	1138	1138	1138
R-squared	0.0543	0.161	0.106	0.172	0.202	0.226

Notes: Weighted estimates from linear probability models. t statistics in parentheses. * p < 0.05, ** p < 0.01 *** p < 0.001.

Source: PISA 2022 and INVALSI data.

Table A3: Predicting top achievement in mathematics among all students using models with inverse probability weighting for attrition

	M1	M2	M3	M4	M5
<i>Individual-level variables</i>					
Female	-0.136*** (-8.66)	-0.102*** (-7.11)	-0.0998*** (-7.11)	-0.101*** (-7.04)	-0.0996*** (-7.03)
1st generation	0.00628 (0.19)	0.0289 (0.89)	0.0361 (1.11)	0.0354 (1.09)	0.0344 (1.05)
2nd generation	0.0201 (0.26)	0.0445 (0.61)	0.0541 (0.74)	0.0465 (0.63)	0.0445 (0.60)
Sense of belonging	-0.00394 (-0.50)	-0.00367 (-0.47)	-0.00342 (-0.44)	-0.00405 (-0.51)	-0.00346 (-0.44)
<i>School-level variables</i>					
Schol truancy	-0.0878*** (-7.51)	-0.0805*** (-7.14)	-0.0823*** (-7.17)	-0.0816*** (-7.11)	-0.0820*** (-7.14)
School disciplinary climate	0.0285* (2.14)	0.0199 (1.63)	0.0172 (1.39)	0.0166 (1.36)	0.0162 (1.32)
School class size	0.0142 (1.49)	0.0137 (1.41)	0.0130 (1.28)	0.0136 (1.33)	0.0142 (1.39)
School certified teachers	-0.000792 (-0.09)	-0.000933 (-0.10)	-0.000908 (-0.10)	-0.00138 (-0.15)	-0.00182 (-0.19)
School extracurriculars	0.0399*** (3.61)	0.0281** (2.73)	0.0264* (2.45)	0.0268* (2.51)	0.0271* (2.54)
<i>ESCS quartile (ref:bottom)</i>					
2nd	0.0563** (3.09)	0.0362 (1.93)	0.0360 (1.89)	0.0421* (2.18)	0.0423* (2.19)
3rd	0.0901*** (4.55)	0.0609** (3.16)	0.0597** (3.07)	0.0608** (3.14)	0.0615** (3.20)
Top	0.196*** (7.43)	0.149*** (5.80)	0.146*** (5.70)	0.136*** (5.61)	0.132*** (5.44)
<i>Gr5 performance</i>					
		0.130*** (14.52)	0.109*** (11.88)	0.0739*** (4.30)	0.0795*** (4.40)
<i>Gr2 performance</i>					
			0.0433*** (4.82)	0.0423*** (4.77)	0.0296* (2.45)
<i>ESCS quartile * gr5 performance</i>					
2nd * Gr5 performance				0.0173 (0.91)	0.00829 (0.37)
3rd * Gr5 performance				0.0590* (2.41)	0.0662* (2.18)
Top * Gr5 performance				0.0775** (2.95)	0.0575* (2.16)
<i>ESCS quartile * gr2 performance</i>					
2nd * Gr2 performance					0.0192 (0.97)
3rd * Gr2 performance					-0.00976 (-0.37)
Top * Gr2 performance					0.0427* (2.17)
Constant	0.221*** (12.55)	0.210*** (11.98)	0.208*** (11.94)	0.204*** (11.46)	0.203*** (11.43)
Observations	4890	4890	4890	4890	4890
R-squared	0.156	0.233	0.240	0.244	0.246

Notes: Weighted estimates from linear probability models. t statistics in parentheses. * p < 0.05, ** p < 0.01 *** p < 0.001.

Source: PISA 2022 and INVALSI data.

1.3 Reading results

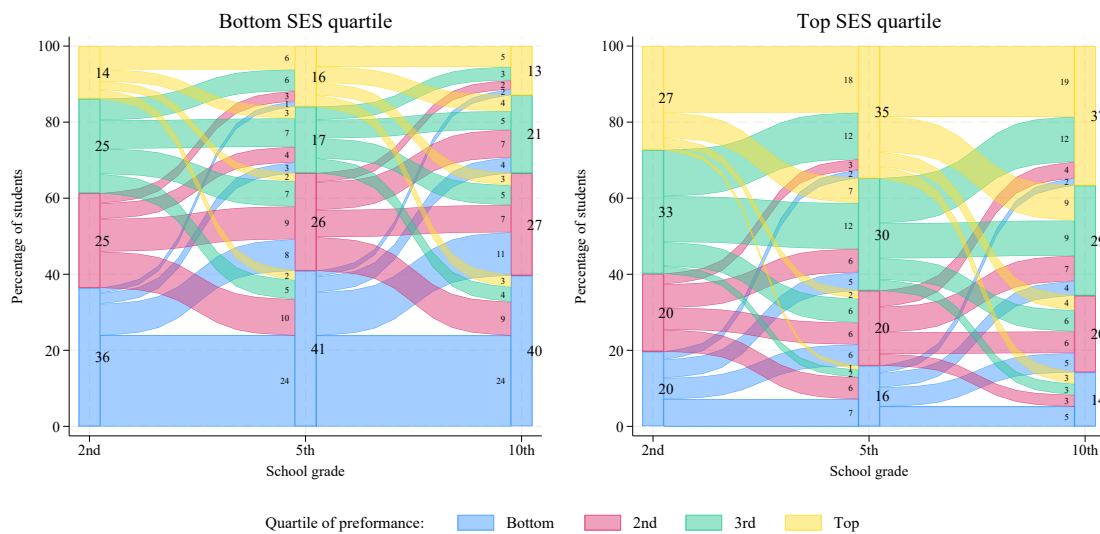
Table A4: Descriptive table for reading results

	ESCS quartiles				Test
	Bottom	Second	Third	Top	
N	1,138	1,260	1,317	1,175	
Grade 10 performance					
Bottom quartile	29.4%	17.5%	13.7%	7.2%	<0.001
2nd quartile	26.2%	23.4%	21.2%	15.7%	
3rd quartile	25.8%	28.3%	27.0%	26.4%	
4th quartile	18.6%	30.8%	38.1%	50.7%	
Standardized performance	-0.404	-0.067	0.104	0.367	<0.001
Grade 5 performance					
Bottom quartile	40.9%	29.1%	20.9%	16.0%	<0.001
2nd quartile	25.7%	24.1%	23.8%	19.7%	
3rd quartile	17.5%	24.9%	28.1%	29.6%	
4th quartile	15.9%	21.9%	27.2%	34.7%	
Standardized performance	-0.353	-0.090	0.124	0.319	<0.001
Grade 2 performance					
Bottom quartile	36.4%	27.4%	24.8%	19.7%	<0.001
2nd quartile	24.9%	24.1%	22.3%	20.5%	
3rd quartile	24.8%	29.5%	33.1%	32.5%	
4th quartile	13.8%	18.9%	19.9%	27.3%	
Standardized performance	-0.217	-0.031	0.034	0.214	<0.001
Female	0.521	0.541	0.534	0.463	0.004
Immigrant background					
Native student	83.1%	92.9%	97.3%	97.6%	<0.001
Second-Generation student	14.7%	5.8%	2.2%	2.0%	
First-Generation student	2.2%	1.3%	0.5%	0.4%	
Sense of belonging	-0.067	0.001	-0.001	0.067	0.069
School truancy	0.216	0.041	-0.032	-0.226	<0.001
School disciplinary climate	-0.219	-0.053	0.011	0.261	<0.001
School class size	-0.002	-0.009	-0.027	0.039	0.463
School certified teachers	0.022	-0.059	-0.034	0.071	0.028
School extracurriculars	-0.278	-0.061	0.049	0.291	<0.001
School average ESCS	-0.645	-0.141	0.173	0.613	<0.001
School track					
Academic	40.4%	54.1%	65.5%	81.1%	<0.001
Technical	41.9%	35.2%	28.0%	16.8%	
Professional	17.7%	10.7%	6.5%	2.1%	

Notes: Weighted estimates.

Source: PISA 2022 and INVALSI data.

Figure A1: Sankey plot of reading performance for bottom and top SES quartiles



Notes: Weighted estimates.

Source: PISA 2022 and INVALSI data.

Table A5: Predicting resilience in reading among low-SES students

	M1	M2	M3	M4	M5	M6
<i>Individual-level variables</i>						
Female	0.0387 (1.39)	0.0354 (1.37)	0.0368 (1.40)	0.0353 (1.41)	0.0202 (0.77)	0.0211 (0.81)
1st generation	0.0689 (1.39)	0.0915 (1.91)	0.0811 (1.67)	0.0929 (1.94)	0.0648 (1.30)	0.0491 (0.93)
2nd generation	0.0986 (0.88)	0.119 (1.27)	0.134 (1.29)	0.133 (1.44)	0.0995 (1.07)	0.0888 (0.93)
Sense of belonging	-0.00983 (-0.91)	-0.00755 (-0.68)	-0.0147 (-1.42)	-0.00997 (-0.93)	-0.00948 (-0.86)	-0.00997 (-0.92)
ESCS	0.103** (3.18)	0.0716* (2.38)	0.0881** (2.82)	0.0703* (2.39)	0.0473 (1.55)	0.0279 (0.88)
<i>Gr. 5 quartile grades (ref:bottom)</i>						
2nd quartile		0.0658* (2.31)		0.0548* (1.97)	0.0383 (1.38)	0.0316 (1.14)
3rd quartile		0.180*** (4.60)		0.148*** (3.49)	0.117** (2.74)	0.111** (2.60)
Top quartile		0.298*** (6.41)		0.248*** (5.12)	0.217*** (4.56)	0.208*** (4.36)
<i>Gr. 2 quartile grades (ref:bottom)</i>						
2nd quartile			0.0321 (1.06)	-0.00332 (-0.11)	-0.000766 (-0.03)	-0.00508 (-0.17)
3rd quartile			0.147*** (4.17)	0.0660 (1.96)	0.0728* (2.13)	0.0735* (2.14)
Top quartile			0.221*** (4.08)	0.104 (1.78)	0.104 (1.77)	0.106 (1.83)
<i>School-level variables</i>						
Schol truancy					-0.0387** (-2.75)	-0.0338* (-2.50)
School disciplinary climate					0.0176 (1.16)	0.0169 (1.11)
School class size					0.00148 (0.13)	0.000444 (0.04)
School certified teachers					-0.0195 (-1.52)	-0.0151 (-1.20)
School extracurriculars					0.00872 (0.57)	0.00897 (0.63)
Track: technical					-0.0218 (-0.64)	0.0189 (0.52)
Track: professional					-0.0487 (-1.26)	0.0185 (0.41)
School average ESCS						0.0427* (2.20)
Constant	0.219*** (5.24)	0.0849* (2.22)	0.125*** (3.31)	0.0690 (1.86)	0.0999* (2.30)	0.0811 (1.88)
Observations	1138	1138	1138	1138	1138	1138
R-squared	0.0301	0.132	0.0899	0.145	0.174	0.183

Notes: Weighted estimates from linear probability models

Source: PISA 2022 and INVALSI data.

Table A6: Predicting top achievement in reading among all students

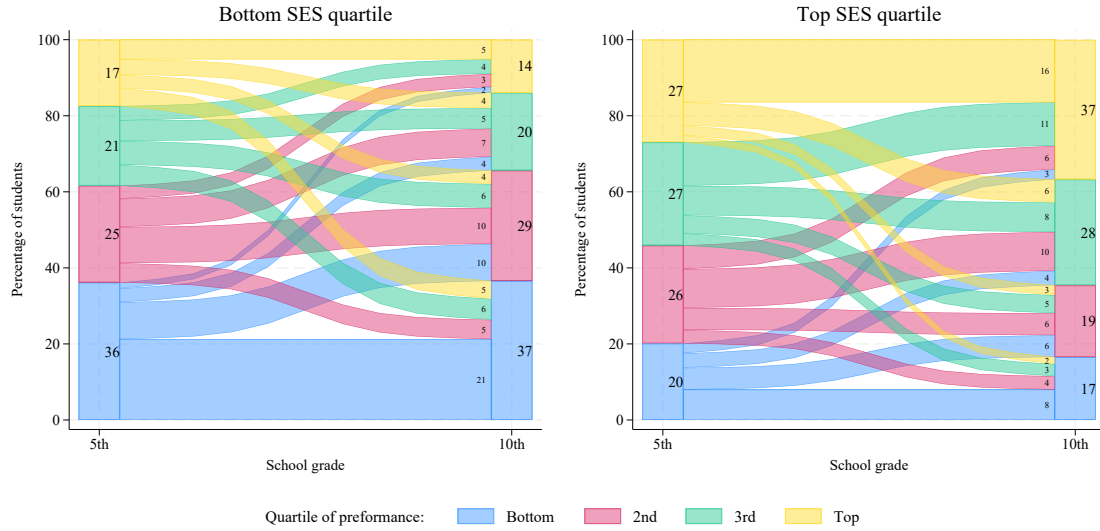
	M1	M2	M3	M4	M5
<i>Individual-level variables</i>					
Female	0.0135 (0.76)	0.0237 (1.39)	0.0265 (1.58)	0.0280 (1.65)	0.0279 (1.65)
1st generation	-0.00218 (-0.05)	0.0250 (0.60)	0.0294 (0.70)	0.0281 (0.68)	0.0283 (0.68)
2nd generation	0.0274 (0.34)	0.0582 (0.80)	0.0720 (1.00)	0.0684 (0.92)	0.0656 (0.88)
Sense of belonging	-0.0104 (-1.30)	-0.00977 (-1.25)	-0.0108 (-1.38)	-0.0109 (-1.38)	-0.0110 (-1.39)
<i>School-level variables</i>					
Schol truancy	-0.0650*** (-5.84)	-0.0607*** (-5.89)	-0.0621*** (-6.03)	-0.0624*** (-6.07)	-0.0625*** (-6.07)
School disciplinary climate	0.0267* (2.17)	0.0202 (1.70)	0.0194 (1.62)	0.0190 (1.59)	0.0188 (1.57)
School class size	0.00973 (0.92)	0.00893 (0.86)	0.00863 (0.83)	0.00922 (0.89)	0.00924 (0.89)
School certified teachers	-0.00837 (-0.84)	-0.00565 (-0.55)	-0.00569 (-0.55)	-0.00620 (-0.59)	-0.00608 (-0.58)
School extracurriculars	0.0119 (1.13)	0.00608 (0.63)	0.00556 (0.57)	0.00500 (0.51)	0.00527 (0.54)
Track: technical	-0.0741** (-2.77)	-0.0357 (-1.44)	-0.0330 (-1.33)	-0.0336 (-1.34)	-0.0336 (-1.35)
Track: professional	-0.159*** (-4.84)	-0.0733* (-2.36)	-0.0667* (-2.10)	-0.0753* (-2.37)	-0.0766* (-2.40)
<i>ESCS quartile (ref:bottom)</i>					
2nd	0.0607** (3.03)	0.0428* (2.12)	0.0422* (2.08)	0.0476* (2.35)	0.0487* (2.40)
3rd	0.0884*** (3.87)	0.0533* (2.38)	0.0547* (2.41)	0.0558* (2.42)	0.0555* (2.40)
Top	0.149*** (5.10)	0.102*** (3.56)	0.102*** (3.54)	0.0911** (3.08)	0.0900** (3.04)
<i>Gr5 performance</i>					
		0.131*** (13.82)	0.115*** (10.76)	0.0864*** (5.89)	0.0844*** (5.30)
<i>Gr2 performance</i>					
			0.0322** (2.89)	0.0321** (2.88)	0.0360* (2.08)
<i>ESCS quartile * gr5 performance</i>					
2nd * Gr5 performance				0.0157 (0.90)	0.0276 (1.35)
3rd * Gr5 performance				0.0404 (1.75)	0.0394 (1.37)
Top * Gr5 performance				0.0629** (2.61)	0.0602* (2.20)
<i>ESCS quartile * gr2 performance</i>					
2nd * Gr2 performance					-0.0226 (-0.95)
3rd * Gr2 performance					0.00214 (0.08)
Top * Gr2 performance					0.00534 (0.23)
Constant	0.206*** (9.51)	0.184*** (9.00)	0.179*** (8.72)	0.175*** (8.33)	0.175*** (8.34)
Observations	4890	4890	4890	4890	4890
R-squared	0.104	0.173	0.177	0.179	0.180

Notes: Weighted estimates from linear probability models

Source: PISA 2022 and INVALSI data.

1.4 PISA 2018 results

Figure A2: Sankey plot of math performance for bottom and top SES quartiles (PISA 2018)



Notes: Weighted estimates.

Source: PISA 2018 and INVALSI data.

Table A7: Descriptive table (PISA 2018)

	ESCS quartiles				Test
	Bottom	Second	Third	Top	
N	1,226	1,269	1,195	1,209	
Grade 10 performance					
Bottom quartile	36.6%	24.5%	22.6%	16.5%	<0.001
2nd quartile	29.0%	26.6%	25.3%	18.9%	
3rd quartile	20.5%	26.6%	25.0%	27.9%	
4th quartile	13.9%	22.3%	27.1%	36.7%	
Standardized performance	-0.368	-0.024	0.059	0.333	<0.001
Grade 5 performance					
Bottom quartile	36.1%	24.4%	25.3%	20.1%	<0.001
2nd quartile	25.5%	28.9%	28.1%	25.8%	
3rd quartile	20.9%	25.1%	25.6%	27.2%	
4th quartile	17.5%	21.7%	21.0%	27.0%	
Standardized performance	-0.196	0.004	0.008	0.184	<0.001
Female	0.515	0.513	0.500	0.470	0.306
Immigrant background					
Native	87.5%	91.2%	95.8%	98.3%	<0.001
Second-Generation	9.3%	5.6%	2.3%	1.2%	
First-Generation	3.2%	3.2%	1.9%	0.5%	
Sense of belonging	-0.058	-0.013	0.024	0.047	0.246
School truancy	0.221	0.061	-0.081	-0.202	<0.001
School disciplinary climate	-0.193	-0.079	0.037	0.236	<0.001
School class size	-0.112	-0.086	0.039	0.160	<0.001
School certified teachers	0.110	0.087	-0.065	-0.131	<0.001
School extracurriculars	-0.014	-0.008	0.007	0.015	0.945
School average ESCS	-0.647	-0.158	0.195	0.611	<0.001
School track					
Academic	34.3%	48.8%	59.5%	74.8%	<0.001
Technical	39.6%	34.8%	29.5%	22.6%	
Professional	26.1%	16.4%	11.1%	2.6%	

Notes: Weighted estimates.

Source: PISA 2018 and INVALSI data.

Table A8: Predicting resilience in math among low-SES students (PISA 2018)

	M1	M2	M3	M4
<i>Individual-level variables</i>				
Female	-0.121*** (-3.87)	-0.0978** (-3.10)	-0.118*** (-3.43)	-0.105** (-3.11)
1st generation	-0.0111 (-0.19)	0.00378 (0.07)	0.00879 (0.15)	-0.0130 (-0.22)
2nd generation	0.0725 (0.71)	0.0796 (0.79)	0.0629 (0.61)	0.0426 (0.40)
Sense of belonging	0.0103 (0.67)	0.0108 (0.75)	0.00819 (0.59)	0.0110 (0.82)
ESCS	0.0888* (2.37)	0.0601 (1.63)	0.0183 (0.49)	-0.00148 (-0.04)
<i>Gr. 5 quartile grades (ref:bottom)</i>				
2nd quartile		0.0909* (2.53)	0.0513 (1.48)	0.0457 (1.34)
3rd quartile		0.137*** (3.39)	0.0945* (2.43)	0.0855* (2.19)
Top quartile		0.237*** (4.80)	0.200*** (4.17)	0.196*** (4.15)
<i>School-level variables</i>				
Schol truancy			-0.0565*** (-3.39)	-0.0398* (-2.28)
School disciplinary climate			0.00932 (0.45)	0.0214 (1.09)
School class size			0.0130 (0.70)	0.00914 (0.54)
School certified teachers			-0.00506 (-0.26)	0.00338 (0.17)
School extracurriculars			-0.0138 (-0.84)	-0.0127 (-0.77)
Track: technical			-0.0488 (-1.17)	0.00948 (0.22)
Track: professional			-0.0985* (-2.07)	0.0129 (0.21)
School average ESCS				0.0705* (2.45)
Constant	0.317*** (6.07)	0.174** (3.10)	0.219*** (3.34)	0.186** (2.92)
Observations	1226	1226	1226	1226
R-squared	0.0400	0.0971	0.154	0.170

Notes: Weighted estimates from linear probability models.

Source: PISA 2018 and INVALSI data.

Table A9: Predicting top achievement in math among all students (PISA 2018)

	M1	M2	M3
<i>Individual-level variables</i>			
Female	-0.148*** (-7.52)	-0.114*** (-5.75)	-0.116*** (-5.81)
1st generation	-0.0164 (-0.42)	0.00620 (0.16)	0.00229 (0.06)
2nd generation	-0.0183 (-0.34)	0.0150 (0.28)	0.0113 (0.21)
Sense of belonging	-0.0117 (-1.17)	-0.00998 (-1.00)	-0.0107 (-1.07)
<i>School-level variables</i>			
Schol truancy	-0.0649*** (-4.43)	-0.0574*** (-4.29)	-0.0581*** (-4.38)
School disciplinary climate	0.0238 (1.50)	0.0129 (0.84)	0.0131 (0.86)
School class size	0.0174 (1.13)	0.0148 (1.05)	0.0164 (1.19)
School certified teachers	0.00832 (0.49)	0.0103 (0.62)	0.0113 (0.67)
School extracurriculars	-0.00693 (-0.46)	-0.00641 (-0.44)	-0.00658 (-0.46)
Track: technical	-0.0954** (-2.80)	-0.0741* (-2.33)	-0.0704* (-2.21)
Track: professional	-0.175*** (-4.79)	-0.111** (-3.13)	-0.115** (-3.26)
<i>ESCS quartile (ref:bottom)</i>			
2nd	0.0400 (1.93)	0.0260 (1.24)	0.0290 (1.38)
3rd	0.0593* (2.29)	0.0541* (2.22)	0.0535* (2.22)
Top	0.117*** (3.84)	0.102*** (3.51)	0.0906** (3.11)
<i>Gr5 performance</i>			
		0.130*** (10.43)	0.0753*** (4.39)
<i>ESCS quartile * gr5 performance</i>			
2nd * Gr5 performance			0.0479* (2.01)
3rd * Gr5 performance			0.0708** (2.81)
Top * Gr5 performance			0.0952*** (3.62)
Constant	0.326*** (10.17)	0.282*** (9.55)	0.280*** (9.43)
Observations	4899	4899	4899
R-squared	0.125	0.198	0.205

Notes: Weighted estimates from linear probability models.

Source: PISA 2018 and INVALSI data.