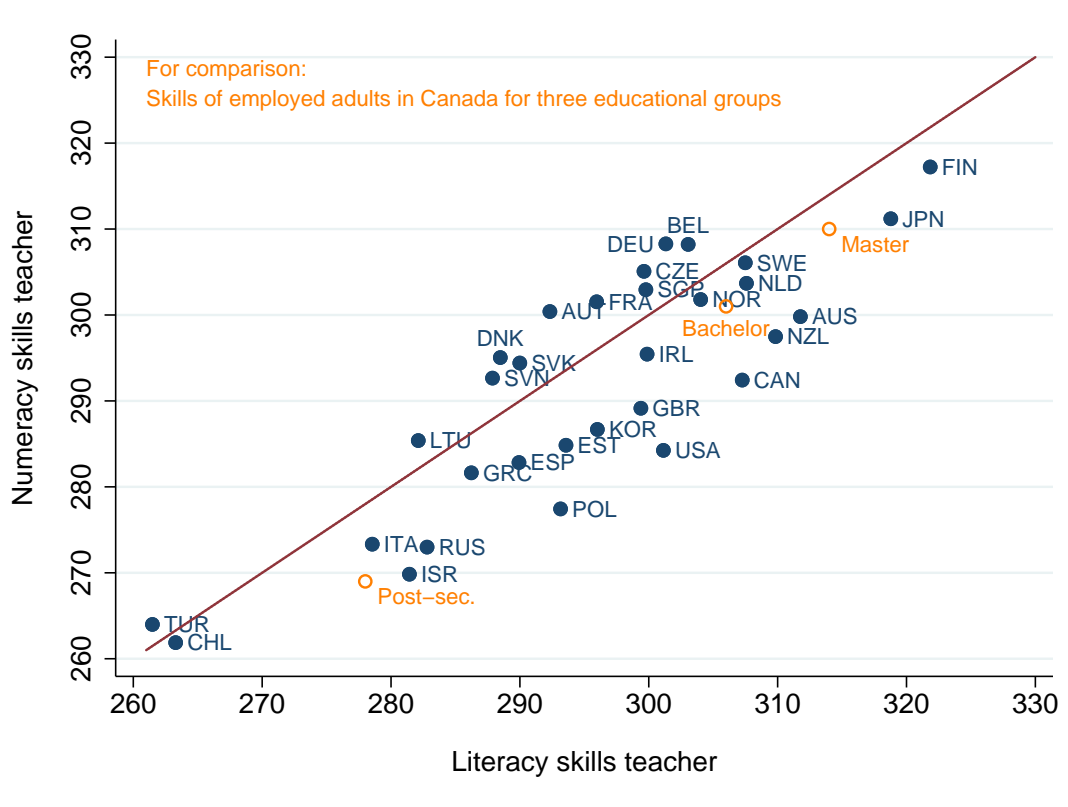


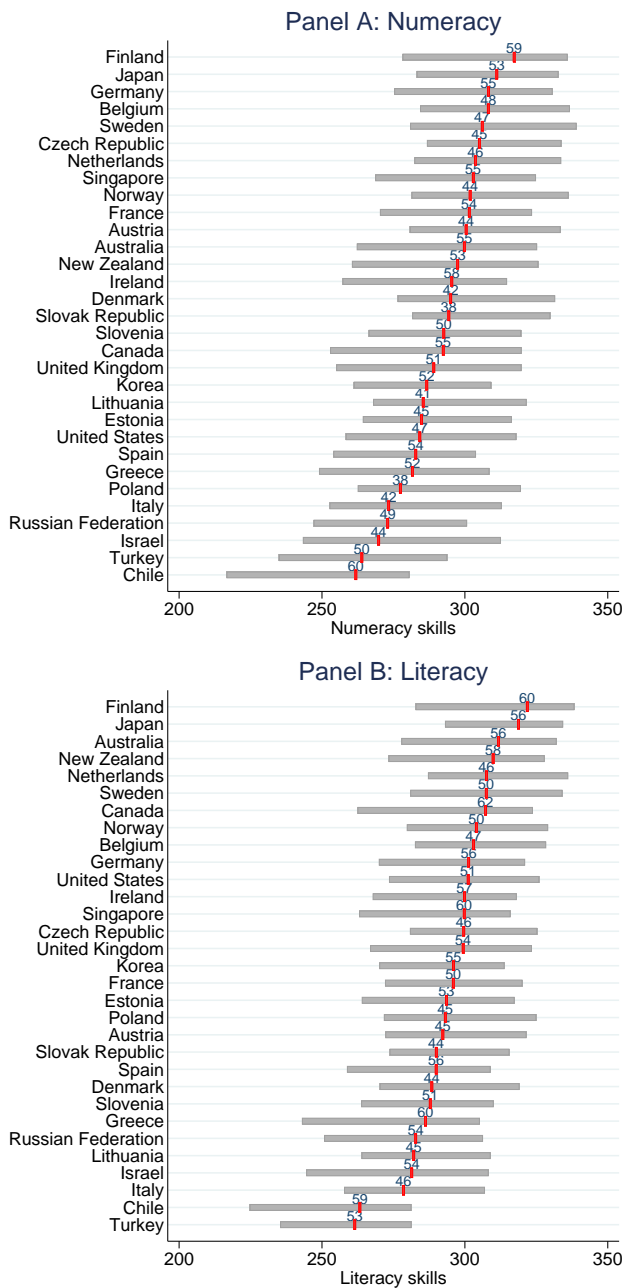
Figures and Tables

Figure 1: Teacher Cognitive Skills Compared to Canadian Workers with Varying Education Levels



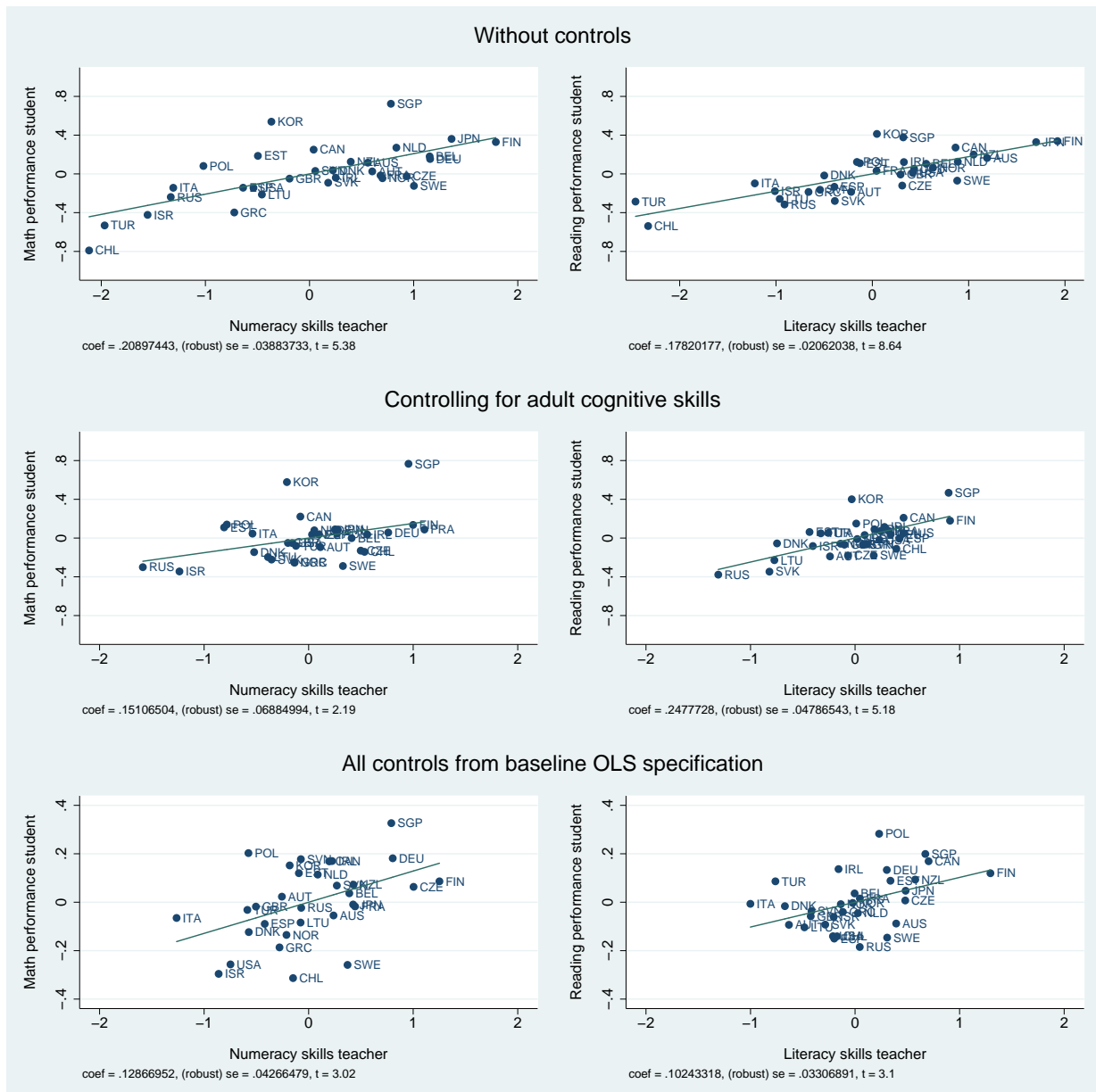
Note: The blue dots indicate country-specific teacher skills in numeracy and literacy (see text for construction of teacher cognitive skills). The orange circles indicate the median cognitive skills for three educational groups of employed adults aged 25–65 years in Canada (the largest national sample in PIAAC). *Post-sec.* includes individuals with vocational education (post-secondary, non-tertiary) as highest degree (2,434 observations); *Bachelor* includes individuals with bachelor degree (3,671 observations); *Master* includes individuals with a master or doctoral degree (1,052 observations). *Data sources:* PIAAC 2011/12 and 2014/15.

Figure 2: Position of Teacher Cognitive Skills in the Skill Distribution of College Graduates



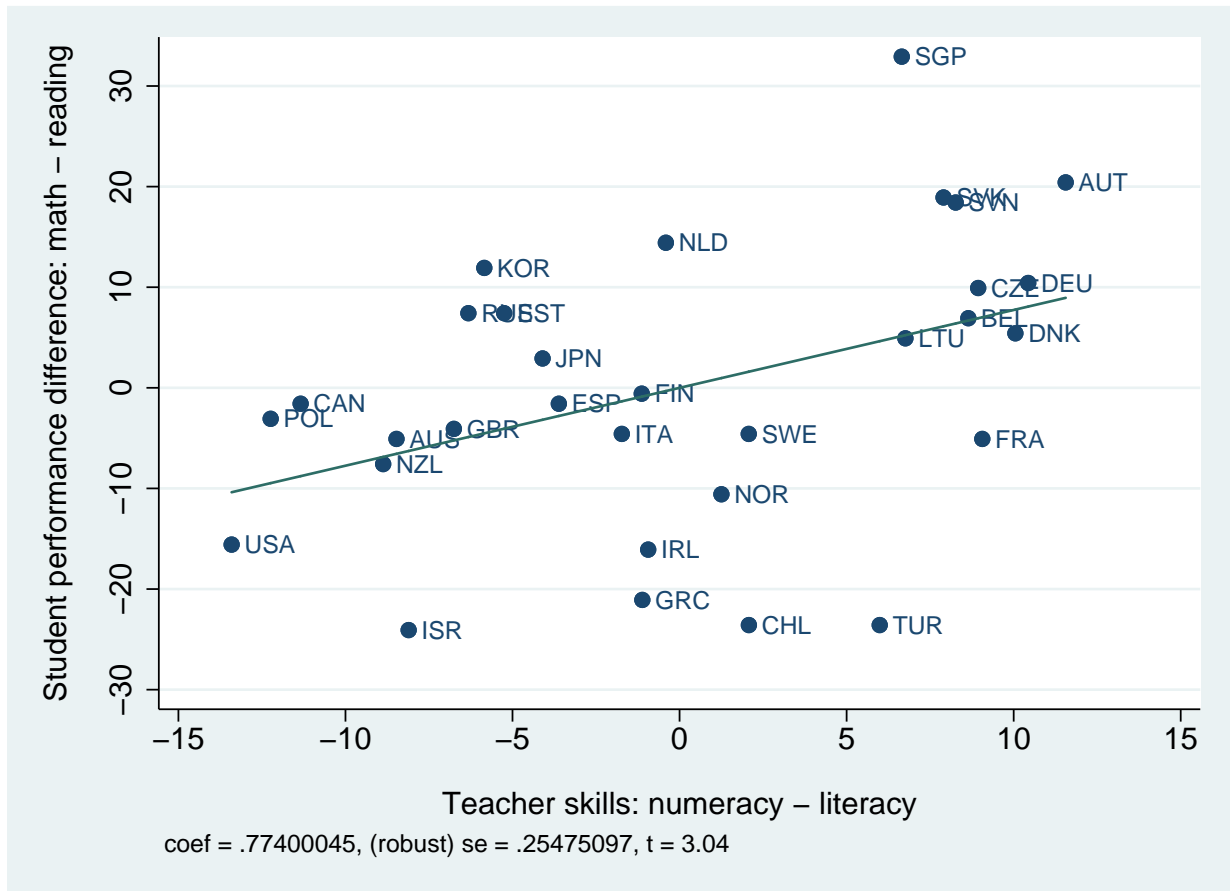
Note: Modified figure from Schleicher (2013). The vertical red bars indicate the median cognitive skills of teachers in a country. Horizontal bars show the interval of cognitive skill levels of all college graduates (including teachers) between the 25th and 75th percentile. Numbers on top of the vertical bars indicate the position of teacher cognitive skills in the cognitive skill distribution of college graduates. Countries are ranked by the median teacher skills in numeracy and literacy, respectively. *Data sources:* PIAAC 2011/12 and 2014/15.

Figure 3: Student Performance and Teacher Cognitive Skills



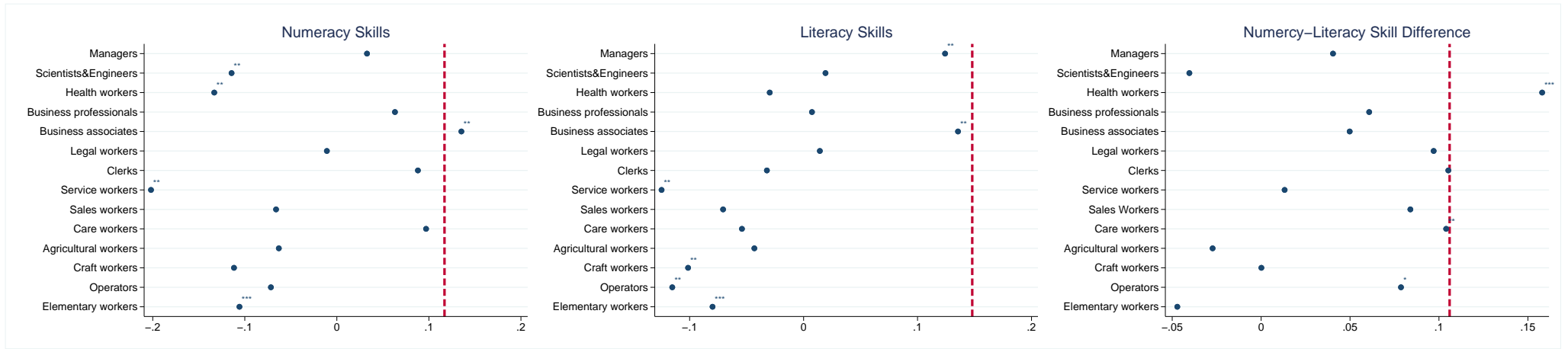
Note: The two graphs in the top panel do not include any controls. The two graphs in the middle panel are added-variable plots that control for country-specific average skills in numeracy and literacy, respectively, of all adults aged 25–65. The two plots in the bottom panel are added-variable plots that control for all variables included in the baseline OLS specification in Columns 3 and 6 of Table 2. *Data sources:* OECD, PIAAC 2011/12 and 2014/15, PISA 2009 and 2012.

Figure 4: Student Performance Difference and Teacher Cognitive Skills Difference



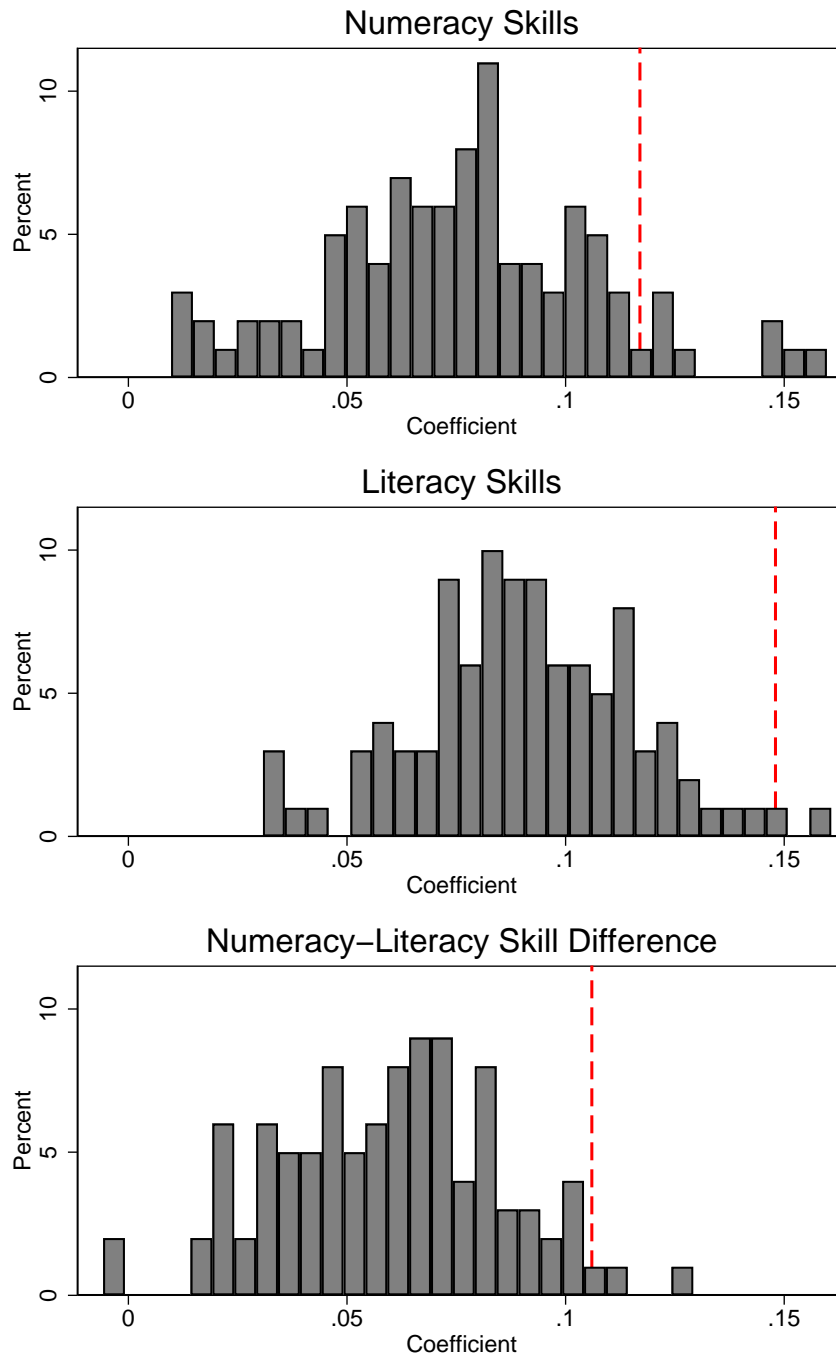
Note: The graph plots the student performance difference between math and reading (at the country level) against the difference in teacher cognitive skills between numeracy and literacy (at the country level). Data sources: PIAAC 2011/12 and 2014/15, PISA 2009 and 2012.

Figure 5: Placebo Tests Using Cognitive Skills in Other Occupations (OLS and Student Fixed Effects)



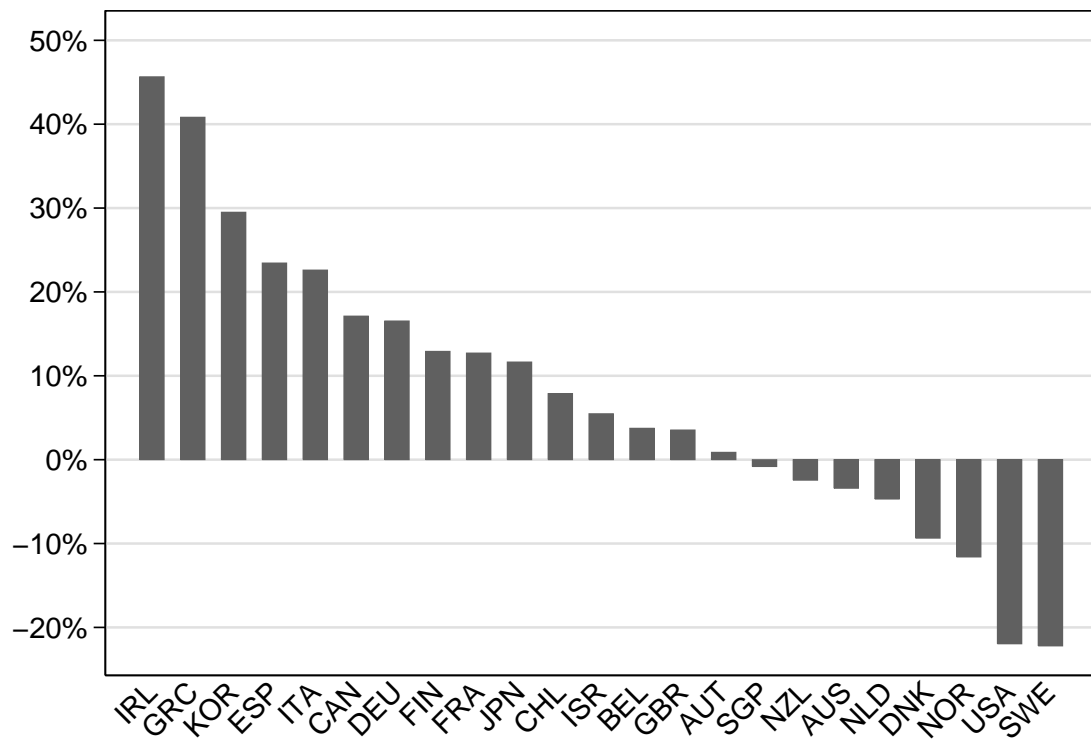
Note: The figure shows the coefficients on cognitive skills for various occupations. Dependent variable is student PISA test score in math (left graph), in reading (middle graph), and difference in standardized student test scores between math and reading (right graph). Skills in occupation refer to numeracy in left figure, to literacy in middle figure, and to the difference between numeracy and literacy in the right figure. Skills in occupation are z-standardized across countries. In the left graph, control variables are the same as in Column 3 of Table 5; in the middle graph, control variables are the same as in Column 6 of Table 5; in the right graph, control variables are the same as in Column 3 of Table 4. Occupations: “Teachers”: teaching professionals; “Managers”: administrative and commercial managers, production and specialised services managers, and hospitality, retail and other services managers; “Scientists&Engineers”: science and engineering professionals and associate professionals; “Health workers”: health professionals and associate professionals; “Business professionals”: business and administration professionals; “Business associates”: business and administration associate professionals; “Legal workers”: legal, social and cultural professionals and associate professionals; “Clerks”: general and keyboard clerks, customer services clerks, and numerical and material recording clerks; “Service workers”: personal service workers; “Sales workers”: sales workers; “Care workers”: personal care workers; “Agricultural workers”: skilled agricultural, forestry and fishery workers; “Craft workers”: craft and related trades workers; “Operators”: plant and machine operators, and assemblers; “Elementary workers”: elementary occupations. Occupations are ranked by ISCO code (teachers placed first). The vertical dashed lines indicate the estimate on teacher cognitive skills. Asterisks next to the coefficient indicate the significance level (robust standard errors, adjusted for clustering at the country level): * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. *Data sources:* PIAAC 2011/12 and 2014/15, PISA 2009 and 2012.

Figure 6: Placebo Tests Using Cognitive Skills of Matched Teacher Twins (OLS and Student Fixed Effects)



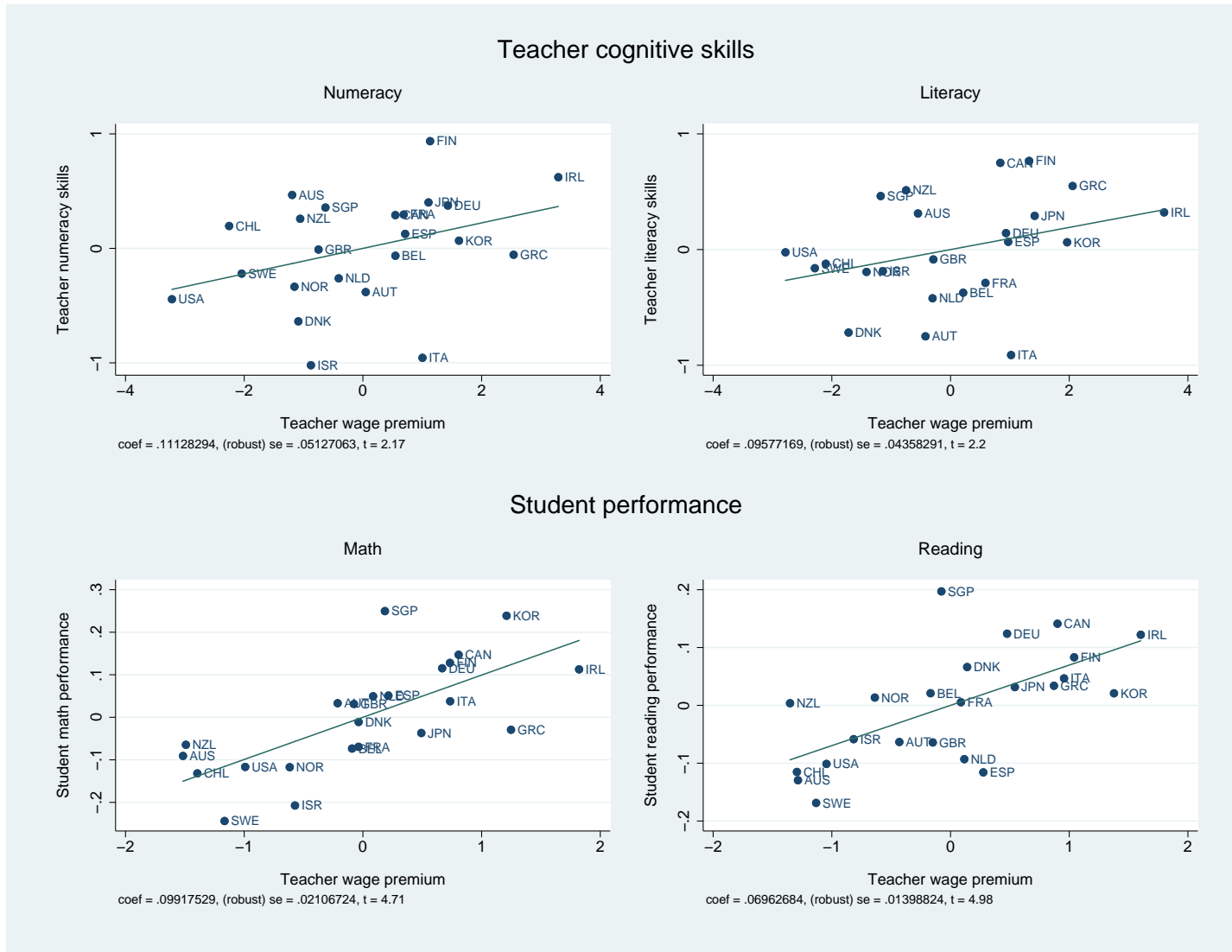
Note: The figure shows histograms of the coefficients on cognitive skills for 100 random samples of adults with the same sample size and age, gender, and education distribution as the teacher sample in the country. Dependent variable is student PISA test score in math (top graph), in reading (middle graph), and difference in standardized student test scores between math and reading (bottom graph). Skills refer to numeracy in top figure, to literacy in middle figure, and to the difference between numeracy and literacy in the bottom figure. Skills are z-standardized across countries. In the top graph, control variables are the same as in Column 3 of Table 5; in the middle graph, control variables are the same as in Column 6 of Table 5; in the bottom graph, control variables are the same as in Column 3 of Table 4. The vertical dashed lines indicate the estimate on teacher cognitive skills. *Data sources:* PIAAC 2011/12 and 2014/15, PISA 2009 and 2012.

Figure 7: Teacher Wage Premiums around the World



Notes: Bars indicate the percentage difference in gross hourly earnings of teachers with a college degree relative to all nonteacher college graduates in a country. Estimates condition on gender, a quadratic polynomial in potential work experience ($\text{age} - \text{years of schooling} - 6$), and numeracy and literacy skills. Post-communist countries and Turkey are excluded (explanations see text). *Data sources:* PIAAC 2011/12 and 2014/15.

Figure 8: Teacher Wage Premiums and Teacher Cognitive Skills/Student Performance



Note: Dependent variable is standardized teacher cognitive skills (upper panel) and standardized student PISA test scores (lower panel), respectively. Upper panel shows added-variable plots that control for country-specific numeracy skills (left graph) and literacy skills (right graph) of all college graduates (without teachers); lower panel additionally controls for all variables included in the baseline specification in Table 2 (left graph: Column 3 of Table 2; right graph: Column 6 of Table 2). Teacher wage premiums are the percentage difference in gross hourly earnings of teachers with a college degree relative to all nonteacher college graduates in a country, conditional on gender, quadratic polynomial in potential work experience, and numeracy and literacy skills; divided by 10 (see also Figure 7 and Table EA-11). Post-communist countries and Turkey are excluded (explanations see text). *Data sources:* OECD, PIAAC 2011/12 and 2014/15, PISA 2009 and 2012.

Table 1: Teacher Cognitive Skills by Country

	Pooled	Australia	Austria	Belgium	Canada	Chile	Czech R.	Denmark	Estonia	Finland	France
Numeracy	292	300	300	308	292	262	305	295	285	317	302
Literacy	295	312	292	303	307	263	300	288	294	322	296
Domain difference	-3	-12	8	5	-15	-1	5	7	-9	-5	6
Numeracy percentile	68	71	69	68	67	81	73	56	60	73	80
Literacy percentile	71	75	70	71	72	79	77	60	69	74	77
Observations	6,402	248	188	215	834	106	141	413	188	221	163
	Germany	Greece	Ireland	Israel	Italy	Japan	Korea	Lithuania	Netherl.	New Zealand	Norway
Numeracy	308	282	295	270	273	311	287	285	304	297	302
Literacy	301	286	300	281	279	319	296	282	308	310	304
Domain difference	7	-5	-4	-12	-5	-8	-9	3	-4	-12	-2
Numeracy percentile	72	74	75	57	67	70	72	66	63	64	65
Literacy percentile	74	75	74	62	73	67	74	64	67	71	68
Observations	127	150	180	250	124	147	217	133	197	198	279
	Poland	Russia	Singapore	Slovak R.	Slovenia	Spain	Sweden	Turkey	U.K.	U.S.	
Numeracy		277	273	303	294	293	283	306	264	289	284
Literacy		293	283	300	290	288	290	307	261	299	301
Domain difference		-16	-10	3	4	5	-7	-1	3	-10	-17
Numeracy percentile		64	53	72	66	70	75	62	80	65	70
Literacy percentile		73	54	76	60	69	80	65	78	67	71
Observations		199	137	193	133	121	183	147	128	310	132

Notes: Teacher cognitive skills are country-specific median cognitive skills of primary school teachers, secondary school teachers, and “other” teachers (including, e.g., special education teachers and language teachers). Because occupation in Australia and Finland is reported only at the two-digit level, teachers in these countries include all "teaching professionals" (ISCO-08 code 23), i.e., additionally include pre-kindergarten teachers and university professors. All skill measures are rounded to the nearest integer. Percentile refers to the position of median cognitive skills of teachers in the cognitive skill distribution of all adults aged 25–65 excluding teachers. Individuals are weighted with PIAAC final sample weights. Observations refer to the number of teachers used to construct country-specific teacher skills. *Data sources:* PIAAC 2011/12 and 2014/15.

Table 2: Student Performance and Teacher Cognitive Skills (OLS)

	Student Math Performance			Student Reading Performance		
	(1)	(2)	(3)	(4)	(5)	(6)
Teacher cognitive skills	0.209*** (0.038)	0.173*** (0.031)	0.145*** (0.032)	0.178*** (0.020)	0.102*** (0.020)	0.092*** (0.022)
Parent cognitive skills			0.044** (0.017)			0.015 (0.016)
Student characteristics		X	X		X	X
Parent characteristics		X	X		X	X
School characteristics		X	X		X	X
Country characteristics		X	X		X	X
Students	490,818	490,818	490,818	490,818	490,818	490,818
Countries	31	31	31	31	31	31
Adj. R2	0.04	0.29	0.29	0.03	0.30	0.30

Notes: Least squares regressions weighted by students' inverse sampling probability, giving each country the same weight. Dependent variable: student PISA test score in math (Columns 1–3) and in reading (Columns 4–6), respectively. Student test scores are z-standardized at the individual level across countries. Country-level teacher cognitive skills refer to numeracy in Columns 1–3 and to literacy in Columns 4–6. Teacher skills are z-standardized across countries. Parent cognitive skills are computed as the maximum of mother's and father's skills in numeracy (Columns 1–3) or literacy (Columns 4–6). Parent cognitive skills are standardized using teacher cognitive skills as "numeraire" scale. Student characteristics are age, gender, migrant status (first-generation or second-generation), and language spoken at home. Parent characteristics include parents' educational degree, number of books at home, and occupation. School characteristics include school location, number of students per school, three autonomy measures, as well as shortage of qualified teachers and weekly instructional time in math classes (Columns 1–3) or language classes (Columns 4–6). Country characteristics are expenditures per student and school starting age (Table EA-6 reports results for all control variables). All regressions include controls for respective imputation dummies and a dummy indicating the PISA wave. Robust standard errors, adjusted for clustering at the country level, in parentheses. Significance levels: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. *Data sources:* OECD, PIAAC 2011/12 and 2014/15, PISA 2009 and 2012.

Table 3: Simulation Analysis: Raising Teacher Cognitive Skills to Finnish Level

	Teacher Numeracy Skills		Teacher Literacy Skills	
	Difference from Finnish teachers (in PIAAC points)	Student perf. increase (in % of internat. SD)	Difference from Finnish teachers (in PIAAC points)	Student perf. increase (in % of internat. SD)
	(1)	(2)	(3)	(4)
Australia	17	17.8	10	6.7
Austria	17	17.2	30	19.6
Belgium	9	9.2	19	12.5
Canada	25	25.3	15	9.7
Chile	55	56.6	59	38.9
Czech Republic	12	12.4	22	14.8
Denmark	22	22.7	33	22.2
Estonia	32	33.1	28	18.8
France	16	16.0	26	17.2
Germany	9	9.1	21	13.6
Greece	36	36.4	36	23.7
Ireland	22	22.3	22	14.6
Israel	47	48.4	40	26.9
Italy	44	44.8	43	28.8
Japan	6	6.2	3	2.0
Korea	31	31.2	26	17.2
Lithuania	32	32.5	40	26.4
Netherlands	14	13.8	14	9.5
New Zealand	20	20.2	12	8.0
Norway	15	15.8	18	11.8
Poland	40	40.7	29	19.1
Russia	44	45.2	39	26.0
Singapore	14	14.6	22	14.7
Slovak Republic	23	23.3	32	21.2
Slovenia	25	25.1	34	22.6
Spain	34	35.1	32	21.2
Sweden	11	11.4	14	9.5
Turkey	53	54.4	60	40.1
U.K.	28	28.7	22	14.9
U.S.	33	33.7	21	13.8

Notes: This table shows by how much student performance would increase if teacher skills in numeracy and literacy, respectively, were at the levels in Finland (i.e., the country with highest teacher skills in both numeracy and literacy). Estimations are based on Columns 3 and 6 of Table 2. Columns 1 and 3 show difference in teacher skills to Finland. *Data sources:* PIAAC 2011/12 and 2014/15, PISA 2009 and 2012.

**Table 4: Student Performance and Teacher Cognitive Skills
(Student Fixed Effects)**

Dependent Variable: Student Performance Difference: Math – Reading			
	(1)	(2)	(3)
Teacher skills: numeracy – literacy	0.105*** (0.037)	0.117*** (0.035)	0.106** (0.049)
Parent skills: numeracy – literacy			0.016 (0.035)
Instruction time: math – reading		0.058** (0.026)	0.058** (0.026)
Shortage teachers: math – reading		-0.012 (0.012)	-0.012 (0.012)
Students	490,818	490,818	490,818
Countries	31	31	31
Adj. R2	0.01	0.02	0.02

Notes: Dependent variable: difference in standardized student test scores between math and reading. All regressions include controls for respective imputation dummies and for the PISA wave. Specifications give equal weight to each country. Robust standard errors, adjusted for clustering at country level, in parentheses. Significance levels: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. *Data sources:* PIAAC 2011/12 and 2014/15, PISA 2009 and 2012.

Table 5: Impact of Country-Level Adult Cognitive Skills on Student Performance (OLS)

	Student Math Performance			Student Reading Performance		
	(1)	(2)	(3)	(4)	(5)	(6)
Teacher cognitive skills	0.145*** (0.032)	0.134*** (0.048)	0.117** (0.051)	0.092*** (0.022)	0.144*** (0.039)	0.148*** (0.044)
Parent cognitive skills	0.044** (0.017)	0.039*** (0.012)	0.033** (0.012)	0.015 (0.016)	0.038** (0.015)	0.035** (0.015)
Parent cognitive skills (country level)		0.014 (0.035)			-0.061* (0.035)	
Adult cognitive skills (country level)			0.036 (0.040)			-0.064 (0.041)
Student characteristics	X	X	X	X	X	X
Parent characteristics	X	X	X	X	X	X
School characteristics	X	X	X	X	X	X
Country characteristics	X	X	X	X	X	X
Students	490,818	490,818	490,818	490,818	490,818	490,818
Countries	31	31	31	31	31	31
Adj. R2	0.29	0.29	0.29	0.30	0.30	0.30

Notes: Dependent variable: standardized student PISA test score in math (Columns 1–3) and reading (Columns 4–6), respectively. All cognitive skill measures in Columns 1–3 (4–6) refer to numeracy (literacy) unless noted otherwise. Columns 1 and 4 report the baseline specification (see Columns 3 and 6 of Table 2). In Columns 2 and 5, we add the country-specific median cognitive skill level of PIAAC respondents aged 35–59 with children. In Columns 3 and 6, we add the median cognitive skill level of all PIAAC respondents aged 25–65. Student, parent, school, and country characteristics are the same as in the baseline least squares models (see Table 2). All regressions include controls for imputation dummies and the PISA wave. Specifications give equal weight to each country. Robust standard errors, adjusted for clustering at the country level, in parentheses. Significance levels: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. *Data sources:* OECD, PIAAC 2011/12 and 2014/15, PISA 2009 and 2012.

Table 6: Impact of Female Share in High-Skilled Occupations on Teacher Cognitive Skills

Dependent Variable: Teacher Cognitive Skills				
	Numeracy		Literacy	
	(1)	(2)	(3)	(4)
Share: female teachers/females in high-skilled occ. ($\times 10$)	0.371*** (0.120)	0.361*** (0.123)	0.243** (0.124)	0.238* (0.126)
Numeracy skills of college graduates (w/o teachers)		0.271 (0.253)		
Literacy skills of college graduates (w/o teachers)				0.405* (0.224)
Country fixed effects	X	X	X	X
Cohort fixed effects	X	X	X	X
Observations	69	69	69	69
Countries	23	23	23	23

Notes: Dependent variable: teacher skills in numeracy (Columns 1–2) and literacy (Columns 3–4). Teacher cognitive skills are standardized using the standard deviation from the full sample (31 countries) as “numeraire” scale, such that magnitudes are comparable to the main analysis; cognitive skills of college graduates are standardized similarly. *Share: female teachers/females in high-skilled occ.* is the share of female teachers in a country-cohort cell over all females working in high-skilled occupations. Each cohort covers 15 adjacent birth years. Occupations are classified as high-skilled applying the following procedure in PIAAC: First, for each two-digit occupation in each country, we calculate average years of schooling of persons currently working in these occupations. Second, ranking occupations by average schooling level and starting from the occupation with the highest level, we define occupations as high-skilled until males working in these occupations comprise 25 percent of all males currently working in that country. Robust standard errors, adjusted for clustering at the country level, in parentheses. Significance levels: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Post-communist countries and Turkey are excluded (explanations see text). *Data sources:* PIAAC 2011/12 and 2014/15.

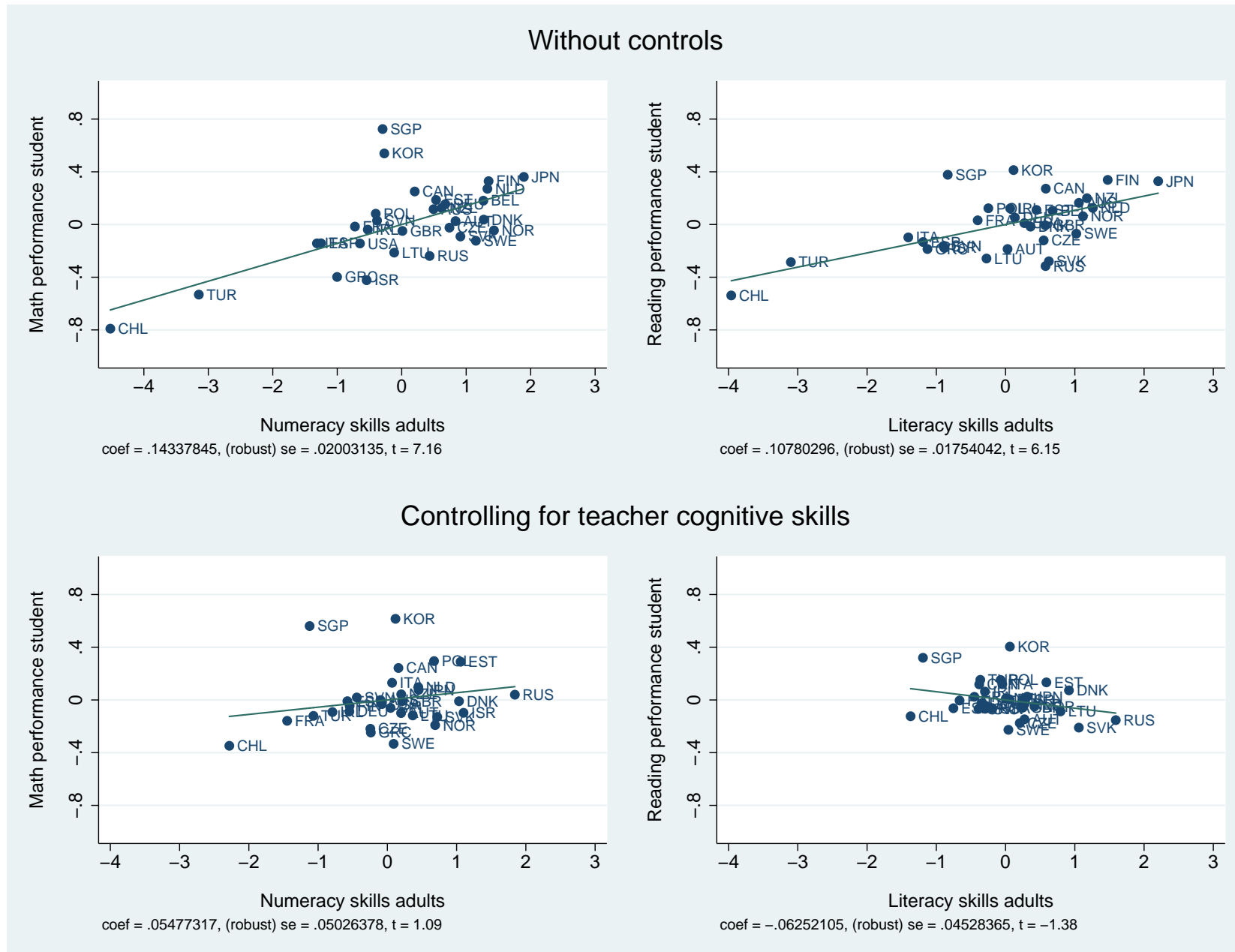
Table 7: Relationship of Teacher Wage Premiums to Teacher Cognitive Skills

Dependent Variable: Teacher Cognitive Skills	Numeracy	Literacy
	(1)	(2)
Teacher wage premium (/10)	0.113** (0.052)	0.097** (0.044)
Numeracy skills of college graduates (w/o teachers)	0.943*** (0.112)	
Literacy skills of college graduates (w/o teachers)		0.918*** (0.070)
Countries	23	23
Adj. R2	0.77	0.78

Notes: Dependent variable: teacher skills in numeracy (Column 1) and literacy (Column 2). *Teacher wage premium (/10)* is the percentage difference in gross hourly earnings of teachers with a college degree relative to all college graduates in a country, conditional on gender, quadratic polynomial in potential work experience, and numeracy and literacy skills; divided by 10. Robust standard errors in parentheses. Significance levels: * p<0.10, ** p<0.05, *** p<0.01. Post-communist countries and Turkey are excluded (explanations see text). *Data sources:* PIAAC 2011/12 and 2014/15.

Appendix

Figure A-1: Student Performance and Adult Cognitive Skills



Note: The two graphs in the top panel do not include any controls. The two graphs in the bottom panel are added-variable plots that control for country-level teacher skills in numeracy and literacy, respectively. Data sources: PIAAC 2011/12 and 2014/15, PISA 2009 and 2012.

Table A-1: Where Teachers Need to Be Drawn From to Get to the Skill Level of Finnish Teachers?

	Numeracy			Literacy		
	Current position	Position to reach	Difference	Current position	Position to reach	Difference
	teachers	Finnish teachers		teachers	Finnish teachers	
(1)	(2)	(3)	(4)	(5)	(6)	
Australia	55	69	14	56	66	10
Austria	44	59	15	45	76	31
Belgium	48	56	8	47	68	21
Canada	55	73	18	62	74	12
Chile	60	92	32	59	93	34
Czech R.	45	55	10	46	72	26
Denmark	42	61	19	44	78	34
Estonia	45	75	30	53	79	26
Finland	59	59	0	60	60	0
France	54	69	15	50	77	27
Germany	55	61	6	56	76	20
Greece	52	80	28	60	87	27
Ireland	58	77	19	57	78	21
Israel	44	77	33	54	85	31
Italy	42	79	37	46	84	38
Japan	53	60	7	56	58	2
Korea	52	82	30	55	83	28
Lithuania	41	70	29	45	85	40
Netherlands	46	58	12	46	61	15
New Zealand	53	69	16	58	70	12
Norway	44	58	14	50	68	18
Poland	38	74	36	45	72	27
Russia	49	87	38	54	85	31
Singapore	55	69	14	60	81	21
Slovak R.	38	61	23	44	80	36
Slovenia	50	72	22	51	84	33
Spain	54	85	31	56	85	29
Sweden	47	55	8	50	63	13
Turkey	50	89	39	53	97	44
U.K.	51	73	22	54	74	20
U.S.	47	74	27	51	71	20

Notes: Position refers to percentile in cognitive skill distribution of college educated. *Data source:* PIAAC 2011/12 and 2014/15.

**Table A-2: Student Performance and Teacher Cognitive Skills (OLS):
Same-Subject and Cross-Subject Effects**

Panel A: Teacher Numeracy Skills				
	Student Math Performance		Student Reading Performance	
	(1)	(2)	(3)	(4)
Teacher numeracy skills	0.145*** (0.032)	0.117** (0.051)	0.067** (0.028)	0.069* (0.038)
Parent cognitive skills	0.044** (0.017)	0.033** (0.012)	0.032 (0.022)	0.034* (0.017)
Cognitive skills of adults		0.036 (0.040)		-0.004 (0.031)
Adj. R2	0.29	0.29	0.30	0.30
Panel B: Teacher Literacy Skills				
	Student Math Performance		Student Reading Performance	
	(1)	(2)	(3)	(4)
Teacher literacy skills	0.116*** (0.029)	0.073* (0.042)	0.092*** (0.022)	0.148*** (0.044)
Parent cognitive skills	0.061*** (0.015)	0.045*** (0.015)	0.015 (0.016)	0.035** (0.015)
Cognitive skills of adults		0.051 (0.036)		-0.064 (0.041)
Adj. R2	0.29	0.29	0.30	0.30
Panel C: Teacher Numeracy and Literacy Skills				
	Student Math Performance		Student Reading Performance	
	(1)	(2)	(3)	(4)
Teacher numeracy skills	0.127* (0.069)	0.117 (0.073)	0.013 (0.052)	0.011 (0.049)
Teacher literacy skills	0.023 (0.065)	-0.000 (0.065)	0.082 (0.050)	0.139** (0.064)
Parent cognitive skills	0.043** (0.017)	0.033** (0.013)	0.015 (0.016)	0.034** (0.015)
Adult cognitive skills (country level)		0.037 (0.039)		-0.064 (0.041)
Adj. R2	0.29	0.29	0.30	0.30
Additional controls in Panels A–C				
Student characteristics	X	X	X	X
Parent characteristics	X	X	X	X
School characteristics	X	X	X	X
Country characteristics	X	X	X	X
Students	490,818	490,818	490,818	490,818
Countries	31	31	31	31

Notes: Least squares regressions weighted by students' inverse sampling probability, giving each country the same weight. Dependent variable: student PISA test score in math (Columns 1–2) and in reading (Columns 3–4), respectively. Student test scores are z-standardized at the individual level across countries. Teacher skills are z-standardized across countries. Parent skills and country-level adult skills refer to numeracy in Columns 1–2 and to literacy in Columns 3–4. Parent skills and country-level adult skills use teacher skills as “numeraire” scale. Control variables are the same as in the baseline least squares models (see Table 2). Robust standard errors, adjusted for clustering at the country level, in parentheses. Significance levels: * p<0.10, ** p<0.05, *** p<0.01. *Data sources:* OECD, PIAAC 2011/12 and 2014/15, PISA 2009 and 2012.

Table A-3: Falsification Check Using Teacher ICT Skills (OLS)

	Student Math Performance			Student Reading Performance		
	(1)	(2)	(3)	(4)	(5)	(6)
Teacher ICT skills	0.081*	0.057	0.053	0.040	0.041	0.037
	(0.045)	(0.048)	(0.047)	(0.033)	(0.032)	(0.033)
Parent cognitive skills	0.076***		0.041**	0.041*		0.034*
	(0.018)		(0.015)	(0.021)		(0.019)
Adult cognitive skills (country level)		0.099***	0.077**		0.032	0.012
		(0.027)	(0.029)		(0.027)	(0.028)
Student characteristics	X	X	X	X	X	X
Parent characteristics	X	X	X	X	X	X
School characteristics	X	X	X	X	X	X
Country characteristics	X	X	X	X	X	X
Students	368,729	368,729	368,729	368,729	368,729	368,729
Countries	28	28	28	28	28	28
Adj. R2	0.28	0.28	0.29	0.30	0.30	0.30

Notes: Dependent variable: student PISA test score in math (Columns 1–3) and in reading (Columns 4–6), respectively. Student test scores are z-standardized at the individual level across countries. ICT skills were not tested in France, Italy, and Spain. Parent cognitive skills are computed as the maximum of mother’s and father’s skills in numeracy (Columns 1–3) or literacy (Columns 4–6). Country-level adult skills refer to numeracy in Columns 2–3 and to literacy in Columns 5–6. Parent skills and country-level adult skills use teacher skills (either in numeracy or in literacy) as “numeraire” scale. Control variables are the same as in the baseline least squares models (see Table 2). Robust standard errors, adjusted for clustering at the country level, in parentheses. Significance levels: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. *Data sources:* OECD, PIAAC 2011/12 and 2014/15, PISA 2009 and 2012.

Electronic Appendix—Not for Publication

Table EA-1: Summary Statistics for Parent Cognitive Skills

	Pooled	Australia	Austria	Belgium	Canada	Chile	Czech R.	Denmark	Estonia	Finland	France
Numeracy											
Mean	278	287	291	301	282	223	276	293	276	299	275
Std. Dev.	29	21	22	22	20	30	27	21	16	18	26
Max – Min	115	128	140	108	120	139	109	141	87	102	132
Literacy											
Mean	275	293	279	289	284	226	270	278	272	297	272
Std. Dev.	26	19	20	20	18	23	24	20	16	17	21
Max – Min	101	113	111	96	116	105	98	148	95	101	106
Observations	83,492	3,137	2,231	2,251	11,933	2,165	2,105	3,352	3,463	2,252	3,086
	Germany	Greece	Ireland	Israel	Italy	Japan	Korea	Lithuania	Netherl.	New Zealand	Norway
Numeracy											
Mean	289	273	275	267	267	308	276	277	295	284	297
Std. Dev.	21	19	22	25	19	14	17	20	22	22	23
Max – Min	126	77	96	132	104	50	85	65	120	134	192
Literacy											
Mean	279	268	280	260	264	307	281	271	293	288	290
Std. Dev.	19	16	18	23	16	12	15	13	21	19	19
Max – Min	109	75	86	117	86	44	76	46	109	109	162
Observations	2,293	2,128	2,371	1,882	1,789	2,103	3,361	2,364	2,276	2,504	2,228
	Poland	Russia	Singapore	Slovak R.	Slovenia	Spain	Sweden	Turkey	U.K.	U.S.	
Numeracy											
Mean		264	271	261	281	268	265	295	240	281	267
Std. Dev.		19	8	39	23	24	22	25	27	20	32
Max – Min		103	32	149	139	149	94	174	100	109	135
Literacy											
Mean		267	277	253	275	261	266	290	237	285	277
Std. Dev.		19	9	31	17	22	21	23	19	18	27
Max – Min		92	35	116	129	120	87	156	69	95	122
Observations		1,793	1,074	2,119	2,442	2,435	2,614	1,864	2,319	3,578	1,980

Notes: Summary statistics of parents' cognitive skills (average skill of mother and father) based on actual parents of PISA students. See text for computation of parent cognitive skills. *Max-Min* indicates the difference between the maximum and minimum parent cognitive skills within a country. *Observations* refer to the number of adults in the PIAAC samples used for computing parents' skills. *Data sources:* PIAAC 2011/12 and 2014/15, PISA 2009 and 2012.

Table EA-2: Summary Statistics for Student Performance and Student Characteristics

	Pooled	Australia	Austria	Belgium	Canada	Chile	Czech R.	Denmark	Estonia	Finland	France
Math performance	498 (97)	509 (95)	500 (94)	515 (103)	522 (88)	422 (80)	496 (94)	502 (84)	516 (81)	530 (85)	496 (100)
Reading performance	497 (97)	513 (98)	480 (96)	508 (102)	524 (91)	445 (81)	486 (91)	496 (84)	508 (82)	530 (91)	501 (108)
Age (in years)	15.8	15.8	15.8	15.8	15.8	15.8	15.8	15.7	15.8	15.7	15.9
Female	0.49	0.50	0.51	0.49	0.50	0.50	0.48	0.50	0.49	0.49	0.51
First-gen. migrant	0.06	0.12	0.06	0.09	0.13	0.01	0.02	0.04	0.01	0.02	0.05
Second-gen. migrant	0.05	0.12	0.11	0.08	0.15	0.00	0.01	0.06	0.07	0.01	0.10
Other language	0.09	0.09	0.11	0.22	0.16	0.01	0.02	0.05	0.04	0.04	0.08
Observations	490,818	28,732	11,345	17,098	44,751	12,525	11,391	13,405	9,506	14,639	8,911
	Germany	Greece	Ireland	Israel	Italy	Japan	Korea	Lithuania	Netherl.	New Zealand	Norway
Math performance	513 (97)	459 (89)	494 (86)	457 (105)	484 (93)	533 (94)	550 (94)	477 (88)	524 (90)	510 (99)	494 (88)
Reading performance	503 (93)	479 (97)	509 (92)	480 (113)	488 (96)	529 (100)	537 (83)	473 (87)	510 (91)	517 (104)	503 (96)
Age (in years)	15.8	15.7	15.7	15.7	15.7	15.8	15.7	15.8	15.7	15.8	15.8
Female	0.49	0.51	0.49	0.51	0.48	0.48	0.47	0.49	0.50	0.49	0.49
First-gen. migrant	0.05	0.07	0.12	0.07	0.06	0.00	0.00	0.01	0.04	0.19	0.05
Second-gen. migrant	0.11	0.04	0.02	0.12	0.02	0.00	0.00	0.01	0.08	0.09	0.04
Other language	0.09	0.05	0.05	0.11	0.14	0.00	0.00	0.04	0.06	0.15	0.07
Observations	9,980	10,094	8,953	10,816	61,978	12,439	10,022	9,146	9,220	8,934	9,346
		Poland	Russia	Singapore	Slovak R.	Slovenia	Spain	Sweden	Turkey	U.K.	U.S.
Math performance		506 (90)	475 (86)	568 (105)	489 (99)	501 (93)	484 (89)	486 (93)	447 (92)	493 (91)	484 (90)
Reading performance		509 (89)	467 (90)	534 (100)	470 (98)	482 (91)	485 (90)	491 (103)	470 (84)	497 (96)	498 (94)
Age (in years)		15.7	15.8	15.8	15.8	15.7	15.9	15.7	15.8	15.7	15.8
Female		0.51	0.50	0.49	0.49	0.49	0.49	0.49	0.49	0.51	0.49
First-gen. migrant		0.00	0.05	0.12	0.01	0.03	0.10	0.06	0.00	0.07	0.07
Second-gen. migrant		0.00	0.07	0.05	0.00	0.06	0.01	0.08	0.01	0.05	0.13
Other language		0.01	0.09	0.57	0.06	0.06	0.18	0.09	0.05	0.07	0.14
Observations		9,524	10,539	10,829	9,233	12,066	51,200	9,303	9,844	24,838	10,211

Notes: Means and standard deviations (in parentheses) reported. *Other language* indicates a student who speaks a foreign language at home. *Observations* refer to the number of students in both PISA cycles. Statistics are based on student-level observations weighted with inverse sampling probabilities, giving each PISA cycle the same total weight. *Data sources:* PISA 2009 and 2012.

Table EA-3: Summary Statistics for Parent Characteristics

	Pooled	Australia	Austria	Belgium	Canada	Chile	Czech R.	Denmark	Estonia	Finland	France
Number of books at home											
0-10 books	0.13	0.09	0.13	0.16	0.10	0.23	0.10	0.13	0.07	0.07	0.16
11-25 books	0.16	0.12	0.16	0.17	0.14	0.29	0.14	0.16	0.14	0.12	0.17
26-100 books	0.32	0.30	0.31	0.29	0.31	0.31	0.35	0.32	0.31	0.34	0.29
101-200 books	0.18	0.21	0.17	0.17	0.21	0.10	0.19	0.18	0.21	0.22	0.17
201-500 books	0.14	0.18	0.14	0.13	0.16	0.05	0.15	0.14	0.17	0.18	0.13
More than 500 books	0.08	0.10	0.09	0.08	0.08	0.02	0.07	0.07	0.09	0.06	0.07
Highest educational degree											
ISCED 0	0.01	0.00	0.00	0.01	0.00	0.02	0.00	0.00	0.00	0.00	0.01
ISCED 1	0.02	0.01	0.01	0.02	0.01	0.03	0.00	0.01	0.00	0.01	0.01
ISCED 2	0.06	0.05	0.04	0.03	0.02	0.18	0.01	0.05	0.03	0.02	0.09
ISCED 3B,C	0.09	0.07	0.29	0.05	0.00	0.00	0.18	0.13	0.02	0.08	0.19
ISCED 3A,4	0.29	0.32	0.18	0.28	0.25	0.43	0.49	0.15	0.38	0.09	0.19
ISCED 5B	0.19	0.13	0.28	0.22	0.24	0.12	0.09	0.41	0.22	0.27	0.22
ISCED 5A,6	0.34	0.42	0.20	0.40	0.48	0.22	0.23	0.24	0.35	0.53	0.30
Highest occupational status											
Blue collar-low skilled	0.07	0.05	0.05	0.09	0.06	0.16	0.07	0.05	0.06	0.03	0.07
Blue collar-high skilled	0.11	0.08	0.14	0.10	0.07	0.17	0.13	0.07	0.14	0.07	0.11
White collar-low skilled	0.24	0.17	0.26	0.23	0.21	0.28	0.27	0.25	0.23	0.20	0.26
White collar-high skilled	0.56	0.68	0.53	0.56	0.64	0.34	0.52	0.62	0.55	0.69	0.54

Table EA-3: Summary Statistics for Parent Characteristics (continued)

	Germany	Greece	Ireland	Israel	Italy	Japan	Korea	Lithuania	Netherl.	New Zealand	Norway
Number of books at home											
0-10 books	0.11	0.11	0.14	0.12	0.12	0.09	0.05	0.16	0.16	0.10	0.08
11-25 books	0.13	0.20	0.15	0.17	0.19	0.13	0.09	0.20	0.18	0.13	0.11
26-100 books	0.10	0.08	0.07	0.12	0.08	0.09	0.10	0.05	0.07	0.09	0.11
101-200 books	0.29	0.32	0.30	0.30	0.30	0.35	0.29	0.33	0.30	0.31	0.30
201-500 books	0.20	0.17	0.19	0.17	0.18	0.19	0.23	0.15	0.15	0.21	0.22
More than 500 books	0.17	0.12	0.15	0.13	0.13	0.15	0.24	0.10	0.13	0.17	0.19
Highest educational degree											
ISCED 0	0.02	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.01	0.00	0.00
ISCED 1	0.00	0.03	0.02	0.01	0.01	0.00	0.01	0.00	0.02	0.01	0.00
ISCED 2	0.15	0.09	0.07	0.03	0.21	0.02	0.04	0.01	0.04	0.06	0.02
ISCED 3B,C	0.12	0.02	0.02	0.09	0.06	0.06	0.07	0.01	0.00	0.16	0.03
ISCED 3A,4	0.23	0.34	0.35	0.26	0.37	0.30	0.34	0.37	0.32	0.25	0.25
ISCED 5B	0.18	0.14	0.18	0.16	0.07	0.15	0.06	0.19	0.39	0.15	0.39
ISCED 5A,6	0.30	0.37	0.35	0.44	0.28	0.47	0.48	0.41	0.21	0.37	0.30
Highest occupational status											
Blue collar-low skilled	0.06	0.08	0.05	0.07	0.07	0.07	0.04	0.08	0.04	0.07	0.03
Blue collar-high skilled	0.10	0.14	0.09	0.06	0.17	0.08	0.06	0.18	0.06	0.07	0.04
White collar-low skilled	0.29	0.24	0.26	0.15	0.28	0.36	0.29	0.22	0.20	0.18	0.16
White collar-high skilled	0.53	0.51	0.58	0.68	0.45	0.48	0.59	0.49	0.68	0.66	0.75

Table EA-3: Summary Statistics for Parent Characteristics (continued)

	Poland	Russia	Singapore	Slovak R.	Slovenia	Spain	Sweden	Turkey	U.K.	U.S.
Number of books at home										
0-10 books	0.11	0.09	0.11	0.15	0.14	0.09	0.09	0.26	0.14	0.21
11-25 books	0.20	0.19	0.19	0.17	0.20	0.15	0.11	0.26	0.16	0.18
26-100 books	0.07	0.08	0.05	0.05	0.06	0.09	0.11	0.03	0.08	0.05
101-300 books	0.34	0.34	0.36	0.37	0.35	0.32	0.30	0.28	0.29	0.29
301-500 books	0.17	0.17	0.17	0.17	0.15	0.21	0.20	0.11	0.18	0.15
More than 500 books	0.11	0.13	0.12	0.10	0.10	0.15	0.19	0.06	0.15	0.11
Highest educational degree										
ISCED 0	0.00	0.00	0.01	0.00	0.00	0.02	0.01	0.04	0.00	0.01
ISCED 1	0.00	0.00	0.05	0.00	0.00	0.07	0.01	0.32	0.00	0.02
ISCED 2	0.01	0.05	0.02	0.04	0.18	0.04	0.24	0.03	0.05	
ISCED 3B,C	0.39	0.01	0.00	0.14	0.35	0.02	0.07	0.02	0.20	0.00
ISCED 3A,4	0.33	0.08	0.44	0.54	0.19	0.25	0.18	0.17	0.18	0.34
ISCED 5B	0.00	0.44	0.19	0.06	0.16	0.14	0.21	0.08	0.23	0.15
ISCED 5A,6	0.24	0.46	0.27	0.23	0.25	0.33	0.48	0.14	0.36	0.43
Highest occupational status										
Blue collar-low skilled	0.07	0.06	0.06	0.11	0.07	0.09	0.05	0.14	0.05	0.07
Blue collar-high skilled	0.27	0.11	0.04	0.16	0.14	0.18	0.05	0.25	0.05	0.06
White collar-low skilled	0.23	0.26	0.21	0.31	0.24	0.29	0.24	0.25	0.26	0.21
White collar-high skilled	0.43	0.54	0.67	0.40	0.53	0.43	0.65	0.28	0.62	0.64

Notes: Shares reported. Statistics are based on student-level observations weighted with inverse sampling probabilities, giving each PISA cycle the same total weight. *Highest educational degree* includes the following categories: *ISCED 0*: no educational degree; *ISCED 1*: primary education; *ISCED 2*: lower secondary; *ISCED 3B,C*: vocational/pre-vocational upper secondary; *ISCED 3A,4*: upper secondary or non-tertiary post-secondary; *ISCED 5B*: vocational tertiary; and *ISCED 5A,6*: theoretically oriented tertiary and post-graduate. *Data sources:* PISA 2009 and 2012.

Table EA-4: Summary Statistics for School Characteristics

	Pooled	Australia	Austria	Belgium	Canada	Chile	Czech R.	Denmark	Estonia	Finland	France
Instructional time math	3.6	4.0	2.6	3.5	5.3	5.8	3.1	3.7	3.7	2.9	3.5
Instructional time reading	3.6	3.9	2.4	3.6	5.4	5.7	3.0	5.2	3.3	2.5	3.7
Shortage math teachers	1.52	1.89	1.33	1.92	1.44	2.05	1.25	1.23	1.45	1.16	1.35
Shortage language teachers	1.42	1.53	1.36	1.54	1.26	1.82	1.12	1.17	1.30	1.10	1.36
Private school	0.19	0.41	0.11	0.69	0.08	0.61	0.06	0.24	0.04	0.04	0.20
Students per school	735	981	559	718	1032	1013	450	480	557	429	821
Content autonomy	0.64	0.71	0.58	0.56	0.37	0.67	0.88	0.68	0.77	0.64	0.64
Personnel autonomy	0.42	0.39	0.08	0.38	0.30	0.63	0.88	0.58	0.54	0.24	0.06
Budget autonomy	0.82	0.93	0.86	0.69	0.75	0.78	0.79	0.96	0.84	0.92	0.97
	Germany	Greece	Ireland	Israel	Italy	Japan	Korea	Lithuania	Netherl.	New Zealand	Norway
Instructional time math	3.3	3.4	3.1	4.3	3.8	3.9	3.6	2.9	2.8	4.0	3.2
Instructional time reading	3.1	3.0	3.0	3.4	4.7	3.5	3.5	3.4	2.8	4.1	3.8
Shortage math teachers	1.78	1.13	1.40	1.90	1.69	1.27	1.57	1.14	2.10	1.72	1.73
Shortage language teachers	1.46	1.20	1.16	1.96	1.64	1.21	1.57	1.14	1.74	1.40	1.70
Private school	0.06	0.06	0.60	0.09	0.06	0.30	0.42	0.01	0.67	0.06	0.02
Students per school	702	283	593	770	752	750	1116	593	1023	1178	340
Content autonomy	0.63	0.04	0.69	0.53	0.72	0.92	0.89	0.80	0.93	0.88	0.49
Personnel autonomy	0.15	0.03	0.34	0.39	0.05	0.32	0.23	0.65	0.89	0.55	0.42
Budget autonomy	0.88	0.84	0.87	0.69	0.84	0.90	0.85	0.59	0.99	0.99	0.88
	Poland	Russia	Slovak R.	Slovenia	Spain	Sweden	Turkey	U.K.	U.S.		
Instructional time math	3.4	3.6	3.0	2.7	3.5	3.1	2.9	3.7	4.3		
Instructional time reading	3.7	3.1	3.0	2.9	3.4	3.0	3.6	3.8	4.4		
Shortage math teachers	1.03	1.71	1.13	1.12	1.09	1.35	1.08	1.35	2.73	1.64	1.37
Shortage language teachers	1.01	1.63	1.10	1.06	1.08	1.19	1.08	1.19	2.64	1.38	1.20
Private school	0.03	0.00	0.09	0.03	0.33	0.12	0.01	0.12	0.01	0.26	0.08
Students per school	324	566	480	462	701	420	890	420	890	1062	1381
Content autonomy	0.75	0.59	0.59	0.45	0.53	0.63	0.20	0.63	0.20	0.89	0.48
Personnel autonomy	0.46	0.65	0.70	0.51	0.18	0.72	0.02	0.72	0.02	0.75	0.66
Budget autonomy	0.26	0.58	0.72	0.79	0.94	0.93	0.77	0.93	0.77	0.96	0.76

Notes: Country means reported. Student-level information on *instructional time* (hours per week) is aggregated to the school level for both math and reading (see also Lavy (2015)). *Shortage math/language teachers* is based on the following school principal question: "Is your school's capacity to provide instruction hindered by any of the following issues? A lack of qualified mathematics/test language teachers" Possible answer categories are: not at all (1), very little (2), to some extent (3), a lot (4). School autonomy measures are binary. *Data sources:* PISA 2009 and 2012.

Table EA-5: Summary Statistics for Country Characteristics

	Pooled	Australia	Austria	Belgium	Canada	Chile	Czech R.	Denmark	Estonia	Finland	France
Expenditure per student	70.79	85.21	107.20	88.64	80.42	27.92	49.64	98.69	49.28	78.81	79.12
School starting age	6.12	5	6	6	5	6	6	7	7	7	6
Instruction practice math	0.61	0.66	0.57	0.56	0.70	0.67	0.62	0.64	0.59	0.58	0.59
Instruction practice reading	0.50	0.53	0.41	0.43	0.56	0.53	0.44	0.57	0.50	0.37	0.52
GDP per capita	35.34	41.43	43.24	39.78	40.45	18.80	27.87	41.93	23.06	38.99	36.13
Teacher gross hourly wage	18.9	21.4	19.6	23.6	26.6	14.2	9.4	22.9	9.1	22.6	21.1
Teacher performance pay	0.59	0	1	0	0	1	1	1	1	1	0
Central exit exams	0.70	1.0	0.0	0.0	0.7	0.0	0.5	1.0	1.0	1.0	1.0
	Germany	Greece	Ireland	Israel	Italy	Japan	Korea	Lithuania	Netherl.	New Zealand	Norway
Expenditure per student	72.05	53.29	84.52	55.17	80.86	83.70	65.07	41.20	87.71	59.64	112.43
School starting age	6	6	4	6	6	6	6	7	6	5	6
Instruction practice math	0.64	0.62	0.69	0.69	0.59	0.46	0.38	0.63	0.57	0.66	0.52
Instruction practice reading	0.44	0.49	0.51	0.40	0.49	0.44	0.34	0.58	0.37	0.53	0.37
GDP per capita	40.36	28.32	43.96	29.78	35.02	33.80	30.31	21.38	45.42	31.89	60.78
Teacher gross hourly wage	26.7	18.8	35.7	14.7	23.0	18.4	25.0	11.0	22.3	19.8	23.6
Teacher performance pay	0	0	0	0	0	0	0	.	1	1	1
Central exit exams	0.9	0.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	Poland	Russia	Singapore	Slovak R.	Slovenia	Spain	Sweden	Turkey	U.K.	U.S.	
Expenditure per student	48.80	13.29	78.15	42.68	84.84	78.15	89.29	16.26	91.46	110.86	
School starting age	7	7	7	6	6	6	7	7	5	6	
Instruction practice math	0.60	0.69	0.70	0.54	0.56	0.64	0.51	0.59	0.73	0.72	
Instruction practice reading	0.59	0.80	0.47	0.47	0.56	0.44	0.42	0.64	0.54	0.61	
GDP per capita	21.37	22.35	69.37	24.63	27.99	32.52	42.05	16.55	36.97	49.22	
Teacher gross hourly wage	12.8	4.7	22.4	8.6	11.7	19.8	16.4	19.7	21.2	20.0	
Teacher performance pay	1	1	.	1	1	0	1	1	1	1	
Central exit exams	1.0	.	.	1.0	1.0	0.0	0.0	0.0	1.0	0.1	

Notes: Expenditure per student and GDP per capita are expressed in 1,000 PPP-US-\$. The *instruction practice* indicators are based on student information provided in PISA; in 2009 for language teachers and in 2012 for math teachers. See text for details on the construction of the instruction practice indicators. *Teacher performance pay* is a binary variable, taking the value 1 if salary adjustments are awarded to teachers with outstanding performance in teaching in a country; not available for Lithuania and Singapore. *Central exit exams* equals 1 if central exam examinations exist on the upper secondary level (ISCED 3) in a country, 0 otherwise; data are taken from Leschnig, Schwerdt, and Zigova (2016). Information on central exit exams is not available for the Russian Federation and Singapore. The remaining country characteristics come from OECD statistics. *Data sources:* Leschnig, Schwerdt, and Zigova (2016), OECD, PISA 2009 and 2012.

**Table EA-6: Student Performance and Teacher Cognitive Skills from OLS
Estimation: Results on Covariates not Reported in Table 2**

Dependent variable: student performance	Math	Reading
Student characteristics		
Age	0.137*** (0.018)	0.137*** (0.012)
Female	-0.145*** (0.011)	0.358*** (0.015)
First-generation migrant	-0.107*** (0.038)	-0.103** (0.038)
Second-generation migrant	-0.086** (0.035)	-0.021 (0.034)
Other language at home	-0.056* (0.029)	-0.179*** (0.031)
Family background		
Books at home		
11-25 books	0.186*** (0.021)	0.226*** (0.021)
26-100 books	0.420*** (0.033)	0.467*** (0.034)
101-200 books	0.588*** (0.043)	0.647*** (0.044)
201-500 books	0.776*** (0.049)	0.822*** (0.053)
More than 500 books	0.775*** (0.053)	0.801*** (0.059)
Parental education		
ISCED 1	0.175*** (0.042)	0.219*** (0.042)
ISCED 2	0.090 (0.065)	0.137** (0.054)
ISCED 3B,C	0.254*** (0.069)	0.242*** (0.060)
ISCED 3A, 4	0.249*** (0.062)	0.270*** (0.055)
ISCED 5B	0.169* (0.089)	0.244*** (0.074)
ISCED 5A, 6	0.261*** (0.085)	0.330*** (0.067)
Parental occupation		
Blue collar-high skilled	0.119*** (0.015)	0.097*** (0.018)
White collar-low skilled	0.190*** (0.016)	0.184*** (0.019)
White collar-high skilled	0.403*** (0.018)	0.405*** (0.020)

(continued on next page)

Table EA-6 (continued)

Dependent variable: student performance	Math	Reading
School characteristics		
School location		
Small Town	-0.008 (0.032)	0.019 (0.028)
Town	0.014 (0.042)	0.057 (0.035)
City	0.014 (0.040)	0.079** (0.034)
Large City	0.080* (0.045)	0.129*** (0.043)
Private school	0.140*** (0.038)	0.159*** (0.031)
No. students per school (in 1000)	0.281*** (0.062)	0.255*** (0.052)
School autonomy		
Content autonomy	0.069 (0.051)	0.002 (0.032)
Personnel autonomy	-0.148*** (0.048)	-0.167*** (0.031)
Budget autonomy	0.020 (0.039)	0.048 (0.036)
Shortage math teacher	-0.048*** (0.012)	
Shortage language teacher		-0.032** (0.013)
Weekly hours math classes	0.057** (0.027)	
Weekly hours language classes		-0.001 (0.018)
Country-level measures		
Educational expenditure per student	-0.000 (0.001)	0.000 (0.001)
School starting age	0.139*** (0.049)	0.080* (0.041)
Students	490,818	490,818
Countries	31	31
Adj. R2	0.29	0.30

Notes: The table reports results on all further covariates of the ordinary least squares estimations with the full set of control variables, corresponding to Column 3 (math) and Column 6 (reading) in Table 2. Omitted categories of family background and school characteristics: *0-10 books*; *parents have no educational degree*; *blue collar-low skilled*; and *village*. Significance levels: * p<0.10, ** p<0.05, *** p<0.01. *Data sources:* OECD, PIAAC 2011/12 and 2014/15, PISA 2009 and 2012.

Table EA-7: Student Performance and Teacher Cognitive Skills (Heterogeneity)

Panel A: Student Math Performance						
	Gender		Parental background		Migration background	
	Boys	Girls	High SES	Low SES	Natives	Migrants
Teacher cognitive skills	0.135*** (0.032)	0.155*** (0.032)	0.137*** (0.032)	0.144*** (0.033)	0.140*** (0.034)	0.107** (0.045)
Parent cognitive skills	0.046*** (0.016)	0.040** (0.019)	0.079*** (0.020)	0.025 (0.019)	0.049** (0.018)	0.061** (0.026)
Panel B: Student Reading Performance						
Teacher cognitive skills	0.081*** (0.021)	0.103*** (0.025)	0.068*** (0.024)	0.112*** (0.024)	0.082*** (0.023)	0.070* (0.038)
Parent cognitive skills	0.016 (0.015)	0.013 (0.018)	0.052** (0.025)	0.004 (0.015)	0.022 (0.018)	0.017 (0.023)
Students	246,649	244,169	250,954	239,864	424,419	24,232
Countries	31	31	31	31	31	30
Additional controls in Panels A + B						
Student characteristics	X	X	X	X	X	X
Parent characteristics	X	X	X	X	X	X
School characteristics	X	X	X	X	X	X
Country characteristics	X	X	X	X	X	X

Notes: Dependent variable: standardized student PISA test score in math (Panel A) and reading (Panel B), respectively. Parental background is measured by the PISA index of economic, social and cultural status (ESCS). This index captures a range of aspects of a student's family and home background that combines information on parents' education, occupations, and home possessions. Migrants refer to second-generation migrants. To account for the unequal distribution of migrants across countries, we re-weight regressions based on the sample of natives and migrants, respectively, giving equal weight to each country within each subsample. Korea has no second-generation migrants in the PISA sample and is therefore excluded. All cognitive skill measures in Panel A (Panel B) refer to numeracy (literacy). Student, parent, school, and country characteristics are the same as in the least squares models (see Table 2). All regressions include controls for respective imputation dummies and a dummy indicating the PISA wave. Specifications give equal weight to each country. Robust standard errors, adjusted for clustering at the country level, in parentheses. Significance levels: * p<0.10, ** p<0.05, *** p<0.01. *Data sources:* OECD, PIAAC 2011/12 and 2014/15, PISA 2009 and 2012.

Table EA-8: Student Performance and Position of Teachers in Adult Cognitive Skill Distribution (OLS)

	Student Math Performance			Student Reading Performance		
	(1)	(2)	(3)	(4)	(5)	(6)
Position of teacher skills	0.015*** (0.005)	0.014*** (0.005)	0.013*** (0.005)	0.020*** (0.005)	0.014*** (0.004)	0.013*** (0.004)
Parent cognitive skills			0.029** (0.012)			0.026* (0.014)
Adult cognitive skills (country level)	0.184*** (0.022)	0.159*** (0.025)	0.140*** (0.026)	0.149*** (0.017)	0.083*** (0.020)	0.067*** (0.021)
Student characteristics		X	X		X	X
Parent characteristics		X	X		X	X
School characteristics		X	X		X	X
Country characteristics		X	X		X	X
Students	490,818	490,818	490,818	490,818	490,818	490,818
Countries	31	31	31	31	31	31
Adj. R2	0.04	0.29	0.29	0.03	0.30	0.30

Notes: Least squares regressions weighted by students' inverse sampling probability, giving each country the same weight. Dependent variable: student PISA test score in math (Columns 1–3) and in reading (Columns 4–6), respectively. Student test scores are z-standardized at the individual level across countries. *Position of teacher skills* is the country-specific percentile rank of teacher cognitive skills in the cognitive skill distribution all adults aged 25–65 years. Position of teacher skills, parent skills, and country-level adult skills refer to numeracy in Columns 1–3 and to literacy in Columns 4–6. Parent skills and country-level adult skills use teacher skills as “numeraire” scale. Control variables are the same as in the baseline least squares models (see Table 2). Robust standard errors, adjusted for clustering at the country level, in parentheses. Significance levels: * p<0.10, ** p<0.05, *** p<0.01. *Data sources:* OECD, PIAAC 2011/12 and 2014/15, PISA 2009 and 2012.

Table EA-9: Student Performance and Teacher Cognitive Skills: Including Additional Country Controls

	Student Math Performance					Student Reading Performance				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Teacher cognitive skills	0.145*** (0.032)	0.147*** (0.033)	0.134*** (0.030)	0.108*** (0.029)	0.123*** (0.028)	0.092*** (0.022)	0.101*** (0.023)	0.080*** (0.024)	0.070*** (0.021)	0.084*** (0.022)
Parent cognitive skills	0.044** (0.017)	0.045** (0.017)	0.047** (0.017)	0.052*** (0.014)	0.053*** (0.014)	0.015 (0.016)	0.012 (0.014)	0.022 (0.015)	0.032* (0.017)	0.026* (0.014)
Instructional practices		0.191 (0.191)			0.104 (0.164)		0.291 (0.211)			0.593*** (0.156)
GDP per capita (1,000 PPP-\$)			0.003 (0.004)		-0.008** (0.003)			0.003 (0.003)		0.004* (0.002)
Central exit exams				0.167*** (0.056)	0.166*** (0.051)				0.095** (0.036)	0.095*** (0.034)
Student characteristics	X	X	X	X	X	X	X	X	X	X
Parent characteristics	X	X	X	X	X	X	X	X	X	X
School characteristics	X	X	X	X	X	X	X	X	X	X
Country characteristics	X	X	X	X	X	X	X	X	X	X
Students	490,818	490,818	490,818	469,450	469,450	490,818	490,818	490,818	469,450	469,450
Countries	31	31	31	29	29	31	31	31	29	29
Adj. R2	0.29	0.29	0.29	0.29	0.29	0.30	0.30	0.30	0.30	0.31

Notes: Dependent variable: standardized student PISA test score in math (Columns 1–5) and reading (Columns 6–10), respectively. Teacher and parent cognitive skills in Columns 1–5 (6–10) refer to numeracy (literacy). Columns 1 and 6 replicate the baseline models from Columns 3 and 6 in Table 2. Indicator for teacher instructional practices is based on the PISA data. See text for details on the construction of the instructional practices indicator. *Central exit exams* takes the value 1 if central exam examinations exist on the upper secondary level (ISCED 3) in a country; data are taken from Leschnig, Schwerdt, and Zigova (2016). Information on central exit exams is not available for the Russian Federation and Singapore. Student, parent, school, and country characteristics are the same as in the baseline least squares models (see Table 2). All regressions include controls for imputation dummies and the PISA wave. Specifications give equal weight to each country. Robust standard errors, adjusted for clustering at the country level, in parentheses. Significance levels: * p<0.10, ** p<0.05, *** p<0.01. *Data sources:* OECD, Leschnig, Schwerdt, and Zigova (2016), PIAAC 2011/12 and 2014/15, PISA 2009 and 2012.

Table EA-10: Student Performance and Teacher Cognitive Skills with Continental Fixed Effects and in Country Subsamples (OLS)

Panel A: Student Math Performance					
	Baseline	Continent		w/o ex-communist	Large
		Fixed effects	Europe only	& Turkey	teacher sample
	(1)	(2)	(3)	(4)	(5)
Teacher cognitive skills	0.145*** (0.032)	0.127*** (0.030)	0.104*** (0.030)	0.178*** (0.032)	0.171*** (0.045)
Parent cognitive skills	0.044** (0.017)	0.024** (0.012)	0.038** (0.014)	0.034** (0.014)	0.004 (0.010)
Panel B: Student Reading Performance					
Teacher cognitive skills	0.092*** (0.022)	0.088*** (0.025)	0.072** (0.029)	0.102*** (0.028)	0.118*** (0.020)
Parent cognitive skills	0.015 (0.016)	0.003 (0.012)	0.016 (0.015)	0.003 (0.018)	-0.019 (0.018)
Students	490,818	490,818	352,375	409,569	312,163
Countries	31	31	23	23	19
Additional controls in Panels A + B					
Student characteristics	X	X	X	X	X
Parent characteristics	X	X	X	X	X
School characteristics	X	X	X	X	X
Country characteristics	X	X	X	X	X

Notes: Dependent variable: standardized student PISA test score in math (Panel A) and reading (Panel B). All skill measures in Panel A (Panel B) refer to numeracy (literacy). Column 1 replicates the baseline least squares models from Columns 3 and 6 in Table 2. In Column 2, we add continental fixed effects and in Column 3, the sample is restricted to only European countries. In Column 4, we exclude countries with a communist heritage and Turkey, while we keep only countries with at least 150 teacher observations in PIAAC in Column 5. Student, parent, school, and country characteristics are the same as in the baseline least squares models (see Table 2). All regressions include controls for imputation dummies and the PISA wave. Specifications give equal weight to each country. Robust standard errors, adjusted for clustering at the country level, in parentheses. Significance levels: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. *Data sources:* OECD, PIAAC 2011/12 and 2014/15, PISA 2009 and 2012.

Table EA-11: Teacher Wage Premiums around the World: Regression Output

	Australia	Austria	Belgium	Canada	Chile	Denmark	Finland	France	Germany	Greece	Ireland	Israel
Teacher	-0.034 (0.027)	0.009 (0.034)	0.037 (0.025)	0.171*** (0.025)	0.079 (0.091)	-0.094*** (0.016)	0.129*** (0.021)	0.127*** (0.032)	0.165*** (0.042)	0.408*** (0.064)	0.457*** (0.040)	0.055 (0.052)
Numeracy	0.124*** (0.019)	0.015 (0.027)	0.058*** (0.017)	0.082*** (0.013)	0.174*** (0.049)	0.046*** (0.014)	0.103*** (0.014)	0.076*** (0.017)	0.062** (0.026)	0.027 (0.042)	0.095*** (0.025)	0.133*** (0.022)
Literacy	-0.013 (0.020)	0.105*** (0.026)	0.016 (0.017)	0.073*** (0.013)	-0.007 (0.054)	0.040*** (0.014)	-0.009 (0.015)	0.013 (0.018)	0.073 *** (0.026)	0.014 (0.037)	0.037 (0.026)	0.050** (0.023)
Female	-0.120*** (0.021)	-0.113*** (0.030)	-0.036* (0.019)	-0.113*** (0.016)	-0.210*** (0.060)	-0.116*** (0.016)	-0.162*** (0.017)	-0.061*** (0.020)	-0.168*** (0.029)	-0.071 (0.048)	0.004 (0.029)	-0.102*** (0.035)
Pot. experience	0.036*** (0.003)	0.026*** (0.005)	0.026*** (0.003)	0.039*** (0.003)	0.035*** (0.009)	0.026*** (0.003)	0.024*** (0.003)	0.031*** (0.003)	0.046*** (0.006)	0.042*** (0.009)	0.052*** (0.005)	0.051*** (0.006)
Pot. experience ²	-0.001*** (0.000)	-0.000** (0.000)	-0.000*** (0.000)	-0.001*** (0.000)	-0.001*** (0.000)	-0.000*** (0.000)	-0.000*** (0.000)	-0.000*** (0.000)	-0.001*** (0.000)	-0.000* (0.000)	-0.001*** (0.000)	-0.001*** (0.000)
	Italy	Japan	Korea	Netherl.	New Zeal.	Norway	Singapore	Spain	Sweden	U.K.	U.S.	
Teacher	0.226*** (0.055)	0.116** (0.049)	0.295*** (0.052)	-0.047 (0.030)	-0.025 (0.033)	-0.116*** (0.016)	-0.008 (0.043)	0.234*** (0.035)	-0.222*** (0.021)	0.035 (0.039)	-0.220*** (0.039)	
Numeracy	0.106*** (0.035)	0.245*** (0.025)	0.099*** (0.036)	0.025 (0.022)	0.096*** (0.018)	0.055*** (0.015)	0.224*** (0.023)	0.094*** (0.031)	0.028* (0.016)	0.134*** (0.025)	0.112*** (0.030)	
Literacy	-0.017 (0.034)	-0.091*** (0.027)	0.056 (0.036)	0.081*** (0.021)	0.047** (0.020)	0.021 (0.016)	-0.016 (0.023)	0.035 (0.026)	0.034** (0.015)	0.043 (0.026)	0.061** (0.031)	
Female	-0.133*** (0.045)	-0.334*** (0.025)	-0.203*** (0.035)	-0.078*** (0.022)	-0.092*** (0.022)	-0.117*** (0.015)	-0.048* (0.025)	-0.111*** (0.029)	-0.110*** (0.017)	-0.131*** (0.028)	-0.108*** (0.033)	
Pot. experience	0.041*** (0.007)	0.037*** (0.004)	0.024*** (0.006)	0.042*** (0.003)	0.035*** (0.003)	0.030*** (0.002)	0.076*** (0.004)	0.036*** (0.006)	0.024*** (0.003)	0.042*** (0.004)	0.046*** (0.005)	
Pot. experience ²	-0.000** (0.000)	-0.001*** (0.000)	-0.000 (0.000)	-0.001*** (0.000)	-0.001*** (0.000)	-0.001*** (0.000)	-0.001*** (0.000)	-0.001*** (0.000)	-0.000*** (0.000)	-0.001*** (0.000)	-0.001*** (0.000)	

Notes: Least squares regressions (weighted by sampling weights). Dependent variable: log gross hourly wage. All country samples include workers with a college degree. Numeracy and literacy scores are standardized with standard deviation 1 across countries. *Pot. experience* is age – years of schooling – 6. Robust standard errors in parentheses. Significance levels: * p<0.10, ** p<0.05, *** p<0.01. *Data sources:* PIAAC 2011/12 and 2014/15.