4

Equity in Opportunities to Learn and in Resources

This chapter explores the concept of equity as it relates to the frequency with which students are exposed to certain mathematics problems in class, teacher quality and quantity, the school's disciplinary climate, and students' participation in pre-primary education. It examines the close relationship among these resources, socio-economic status and performance in mathematics.

Previous research has shown a relationship between students' exposure to subject content in school, what is known as "opportunity to learn", and student performance (Schmidt et al., 2001). Building on previous measures of opportunity to learn (Carroll, 1963; Wiley and Harnischfeger, 1974; Sykes, Schneider and Planck, 2009; Schmidt et al., 2001), the PISA 2012 assessment included questions to students about the mathematics theories, concepts and content to which they might have been exposed in school, and the amount of class time they spent studying these various subjects. As reported in Volume I, there are widely different experiences across systems, schools and students. When these differences are related to student or school characteristics, such as the socio-economic status of students or schools, the proportion of immigrant or minority-language students, or the size of the community in which a school is located, inequities can arise.[1]

What the data tell us

- Opportunities to learn formal mathematical problems at school and familiarity with fundamental concepts of algebra and geometry have a stronger impact on performance when the entire student population benefits from them.
- Disparities in exposure to formal mathematics are more marked in school systems that separate students into different schools based on their performance – and, given the strong relationship between performance and socio-economic status, in systems where the unintended result of separation by performance is separation by socio-economic status.
- Across OECD countries, students who reported that they had attended pre-primary school for more than one year score 53 points higher in mathematics – the equivalent of more than one years of schooling – than students who had not attended pre-primary education.
- OECD countries allocate at least an equal, if not a larger, number of teachers to socio-economically disadvantaged schools as to advantaged schools; but disadvantaged schools tend to have great difficulty in attracting qualified teachers.

Volume I of this publication defines and describes a series of indices of exposure and familiarity to formal mathematics based on students' reports. Students were asked about their familiarity with different mathematical concepts. They also reported on how often they had encountered different mathematics problems at school, some focusing on formal mathematics, others on more applied mathematics. These indices provide a measure of the kinds of opportunities to learn mathematics students are exposed to in compulsory education. They reflect what 15-year-old students experience at school but also what they had been exposed to before taking part in PISA. While student self-reports, by definition, give the students' perspective on the types and frequency of mathematics problems to which they are exposed, they may also reflect other student perceptions, such as students' level of comfort with or mastery of these types of problems. Volume I examines how these answers are related to student performance across countries. This section focuses on familiarity with basic concepts of algebra and geometry (such as "quadratic function", linear equation", "polygon" or "cosine") and exposure to formal mathematics problems in school lessons (such as, "Solve: $2x+3=7$" or "Find the volume of a box with sides 3m, 4m and 5m").

Figure II.4.1 shows the main measures of equity in exposure to formal mathematics and how they relate to mean performance, and the main measures of equity in outcomes. It contains the key data and results discussed in this chapter.

Differences across schools in students' exposure to basic concepts of formal mathematics in algebra and geometry are closely related to performance differences between students attending socio-economically advantaged and disadvantaged schools.[2] While differences in exposure do not account for all performance differences between these two groups of students, they do account for much of them. Figure II.4.2 shows the relationship among these disparities.

In countries with high mean scores in mathematics and high levels of equity in education outcomes differences between students in advantaged and disadvantaged schools are smaller, both in terms of mathematics performance and exposure to formal mathematics (Figure II.4.1). For example, Estonia, Finland, and Canada, all in the bottom-left quadrant of Figure II.4.2, show narrow performance gaps between students who attend socio-economically advantaged and disadvantaged schools. Among schools systems with high average mathematics achievement and high equity in education outcomes (as measured by the strength of the relationship between performance and socio-economic status) (Figure II.4.1), only Japan and Korea show large differences in student performance and average disparities in opportunities to learn between advantaged and disadvantaged schools (top-right quadrant of Figure II.4.2).

■ Figure II.4.1 ■

Summary of PISA measures of equity in exposure to formal mathematics

- Higher quality or equity than the OECD average
- Not statistically different from the OECD average
- Lower quality or equity than the OECD average

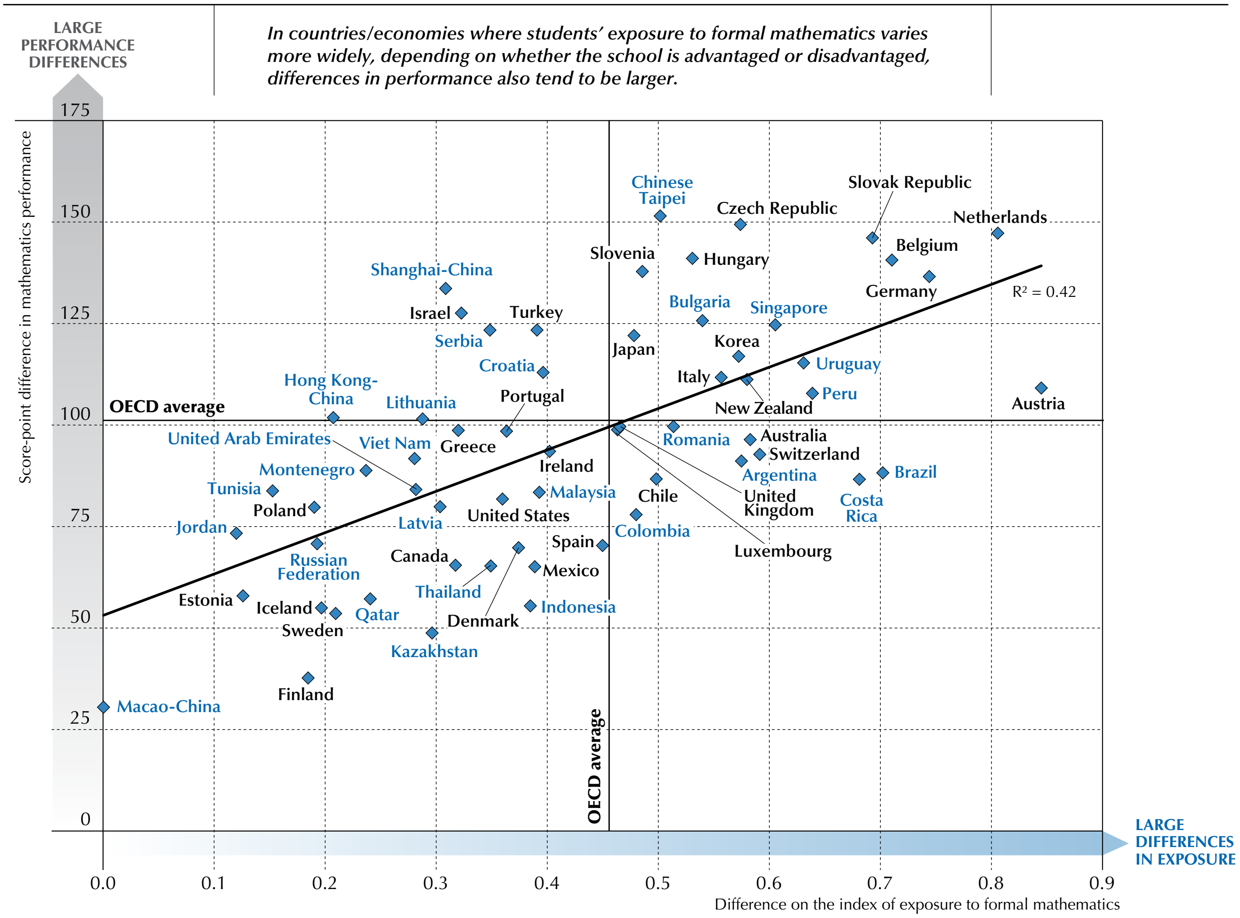
	Average student performance in mathematics	Strength of the relationship between student performance and socio-economic status[1]: Percentage of explained variation in student performance	Performance differences across socio-economic status: Slope of the socio-economic gradient[1]: Score-point difference associated with a one-unit increase in socio-economic status	Mean index of exposure to formal mathematics	Variation of the index of exposure to formal mathematics	Within-school variation of the index of exposure to formal mathematics as a proportion of the sum of the within- and between-school variation	Within-school variation in socio-economic status as a proportion of the sum of the within- and between-school variation	Within-school variation of student performance as a proportion of the sum of the within- and between-school variation
OECD average	494	14.8	39	1.70	0.37	80.4	75.6	64.1
Shanghai-China	613	15.1	41	2.30	0.21	82.8	66.8	53.1
Singapore	573	14.4	44	2.23	0.41	83.5	76.4	63.3
Hong Kong-China	561	7.5	27	1.83	0.40	92.8	67.7	57.6
Chinese Taipei	560	17.9	58	1.98	0.33	81.9	76.7	57.9
Korea	554	10.1	42	2.07	0.27	73.6	78.3	60.4
Macao-China	538	2.6	17	2.20	0.32	86.1	73.7	58.2
Japan	536	9.8	41	2.05	0.22	71.6	77.8	47.0
Liechtenstein	535	7.6	28	1.55	0.57	53.7	85.5	37.5
Switzerland	531	12.8	38	1.41	0.50	59.6	82.7	64.4
Netherlands	523	11.5	40	1.50	0.45	68.2	81.8	34.1
Estonia	521	8.6	29	2.00	0.21	92.0	81.5	82.7
Finland	519	9.4	33	1.72	0.35	87.9	91.1	92.5
Canada	518	9.4	31	1.98	0.37	89.0	82.8	80.2
Poland	518	16.6	41	1.83	0.30	92.5	76.4	79.5
Belgium	515	19.6	49	1.83	0.52	72.1	72.4	48.6
Germany	514	16.9	43	1.66	0.43	66.7	73.6	47.0
Viet Nam	511	14.6	29	1.96	0.22	83.3	58.3	47.9
Austria	506	15.8	43	1.54	0.47	57.3	71.2	51.6
Australia	504	12.3	42	1.69	0.49	80.1	76.5	72.1
Ireland	501	14.6	38	1.47	0.37	90.9	79.7	81.8
Slovenia	501	15.6	42	1.93	0.32	78.7	74.6	41.3
Denmark	500	16.5	39	1.62	0.36	87.7	82.3	83.5
New Zealand	500	18.4	52	1.51	0.51	82.7	77.5	76.2
Czech Republic	499	16.2	51	1.80	0.29	71.2	76.4	48.5
France	495	22.5	57	1.87	0.32	w	w	w
United Kingdom	494	12.5	41	1.63	0.43	82.2	79.4	71.8
Iceland	493	7.7	31	1.14	0.39	95.8	86.4	90.1
Latvia	491	14.7	35	2.03	0.22	88.9	74.7	74.4
Luxembourg	490	18.3	37	1.45	0.51	85.8	73.6	59.0
Norway	489	7.4	32	m	m	m	91.0	87.1
Portugal	487	19.6	35	1.73	0.37	89.5	68.6	70.1
Italy	485	10.1	30	1.83	0.39	68.0	75.9	48.5
Spain	484	15.8	34	1.87	0.44	88.0	75.2	81.2
Russian Federation	482	11.4	38	2.10	0.16	94.7	75.0	73.2
Slovak Republic	482	24.6	54	1.70	0.32	67.2	64.4	50.1
United States	481	14.8	35	2.00	0.41	89.5	73.8	76.3
Lithuania	479	13.8	36	1.65	0.27	91.8	78.7	69.3
Sweden	478	10.6	36	0.77	0.31	92.5	86.9	87.5
Hungary	477	23.1	47	1.96	0.29	72.4	62.6	38.1
Croatia	471	12.0	36	2.07	0.32	87.7	75.9	55.7
Israel	466	17.2	51	1.81	0.41	80.0	74.6	57.6
Greece	453	15.5	34	1.91	0.34	93.1	73.5	67.9
Serbia	449	11.7	34	2.04	0.29	89.1	78.0	54.0
Turkey	448	14.5	32	1.92	0.30	85.1	72.3	38.2
Romania	445	19.3	38	2.02	0.40	78.0	64.4	54.6
Bulgaria	439	22.3	42	1.96	0.45	82.0	59.6	47.2
United Arab Emirates	434	9.8	33	2.13	0.50	80.3	73.9	55.6
Kazakhstan	432	8.0	27	1.97	0.32	90.5	76.8	63.5
Thailand	427	9.9	22	1.70	0.29	85.2	61.6	57.9
Chile	423	23.1	34	1.70	0.34	75.2	47.2	56.6
Malaysia	421	13.4	30	1.59	0.36	88.1	71.5	67.6
Mexico	413	10.4	19	1.78	0.43	82.3	56.5	64.8
Montenegro	410	12.7	33	1.90	0.40	92.8	80.6	63.5
Uruguay	409	22.8	37	1.64	0.47	76.3	60.2	58.0
Costa Rica	407	18.9	24	1.53	0.52	79.4	61.8	57.6
Albania	394	m	m	2.09	0.42	93.1	0.0	95.4
Brazil	391	15.7	26	1.43	0.51	72.4	62.8	56.9
Argentina	388	15.1	26	1.35	0.48	74.7	66.5	55.6
Tunisia	388	12.4	22	1.23	0.36	94.4	67.2	50.7
Jordan	386	8.4	22	2.15	0.57	84.8	79.6	64.0
Colombia	376	15.4	25	1.76	0.51	83.6	63.2	64.9
Qatar	376	5.6	27	1.72	0.67	76.1	75.5	53.8
Indonesia	375	9.6	20	1.60	0.33	81.9	63.1	48.0
Peru	368	23.4	33	1.79	0.51	79.8	54.2	54.4

1. Single-level bivariate regression of mathematics performance on the *PISA index of economic, social and cultural status* (ESCS); the slope is the regression coefficient for the ESCS, and the strength corresponds to the r-squared*100.
Countries and economies are ranked in descending order of mean mathematics performance.
Source: OECD, PISA 2012 Database, Tables II.2.1, II.2.8a, II.2.13a and II.4.1.
StatLink http://dx.doi.org/10.1787/888932964851

■ Figure II.4.2 ■

Magnitude of performance differences related to students' exposure to formal mathematics, by schools' socio-economic profile

Between students in advantaged schools and those in disadvantaged schools



Note: Depending on the organisation of schooling (comprehensive vs. institutional differentiation according to performance) differences across schools are to be expected for certain aspects of learning opportunities to meet students' needs.
Source: OECD, PISA 2012 Database, Tables II.4.2 and II.4.3.
StatLink http://dx.doi.org/10.1787/888932964851

Figure II.4.2 also shows that, on average across OECD countries, there is a very strong relationship between the differences between advantaged and disadvantaged schools in mathematics performance and in exposure to formal mathematics (the correlation between these two measures is 0.65). On average across OECD countries, the difference in mathematics performance amounts to 104 score points. The difference in exposure to mathematics across school's socio-economic profile is also large (more than 0.45 in the index of exposure of formal mathematics or three quarters of a standard deviation on the index, 0.60). On average, students in advantaged schools reported that they had "often heard of" the more advanced topics of mathematics related to algebra and geometry and had also had "frequent" encounters with problems dealing with formal mathematics, more generally, in class. Students in disadvantaged schools reported that they had heard of these topics somewhere between "once or twice" and "a few times" in class.

DISPARITIES IN EXPOSURE TO FORMAL MATHEMATICS, SOCIO-ECONOMIC STATUS AND PERFORMANCE

Students who are not exposed to mathematics concepts and processes in school cannot be expected to learn (on their own), much less excel at, that material. Allocating more and better resources to education will only go so far; what is taught in the classroom – and how it is taught – ultimately determines whether those resources serve the school system's primary objective: providing high-quality, equitable education to all. Breadth and depth of instructional content and delivery is critical for student learning, particularly in mathematics.

Opportunities to learn may differ across students and schools for many reasons. If the school system tracks students into different schools that distinguish, for example, between academic and vocational pathways, students' exposure to mathematics may vary accordingly, depending on the schools they attend. Exposure to different mathematical concepts and experience with mathematical problems may also differ among students within a particular school, especially when students are grouped by ability and taught different material. Instructional content and delivery may also differ within a school if 15-year-old students are enrolled in different grades within the same school or if students choose different programme strands.

Disparities within countries

On average across OECD countries, 15-year-old students reported that they had heard of mathematical concepts in algebra and geometry "a few times" but had "frequent" encounters with problems involving formal mathematics. While there are significant differences across school systems, there are even larger differences between schools within a country and among students within schools.[3] Most of the differences are observed among students who attend the same school (65%); differences between schools within countries account for 17% of the overall differences and differences across countries and economies account for the remaining 18% of the differences.[4]

School systems that combine high average performance and equity tend to offer all their students frequent exposure to formal mathematics concepts (as measured by higher-than-average means on the *index of exposure to formal mathematics* and lower than average overall and between-school variations in the same index). Of the nine countries with high performance and equity, Liechtenstein is the only where mean exposure to formal mathematics is below average. Of this group, only in Australia, Hong Kong-China and Liechtenstein the variation in exposure to formal mathematics is above average. Liechtenstein is the only system where the variation is large and between school differences are above average. Japan and Korea are the only two countries on this group where differences between schools in exposure to formal mathematics are above average (Figure II.4.1).

Differences in exposure to mathematics and average mathematics performance across school systems

Fewer disparities in exposure to mathematics concepts are associated with higher mean performance, particularly in those school systems where the frequency of exposure to and familiarity with formal mathematical concepts is greater than the OECD average. Exposure to formal mathematics problems at school and familiarity with fundamental concepts of algebra and geometry have a stronger impact on average performance when the entire student population has benefited from them. As Figure II.4.3 shows, the countries that achieve high levels of performance tend to show smaller disparities in exposure to formal mathematics.

Figure II.4.3 also shows that when school systems provide frequent exposure to formal mathematics concepts and practices, there is a strong relationship between differences in exposure to formal mathematics and average performance. Estonia, Japan and Korea, for example, all perform well above the OECD average; in addition, exposure to formal mathematics in these countries is also well above the OECD average and differences in opportunities are below average. These patterns are also seen across partner countries and economies, with Shanghai-China achieving particularly high average performance associated with frequent exposure to formal mathematics problems and familiarity with fundamental mathematics concepts in geometry and algebra, and markedly small variations in those opportunities.

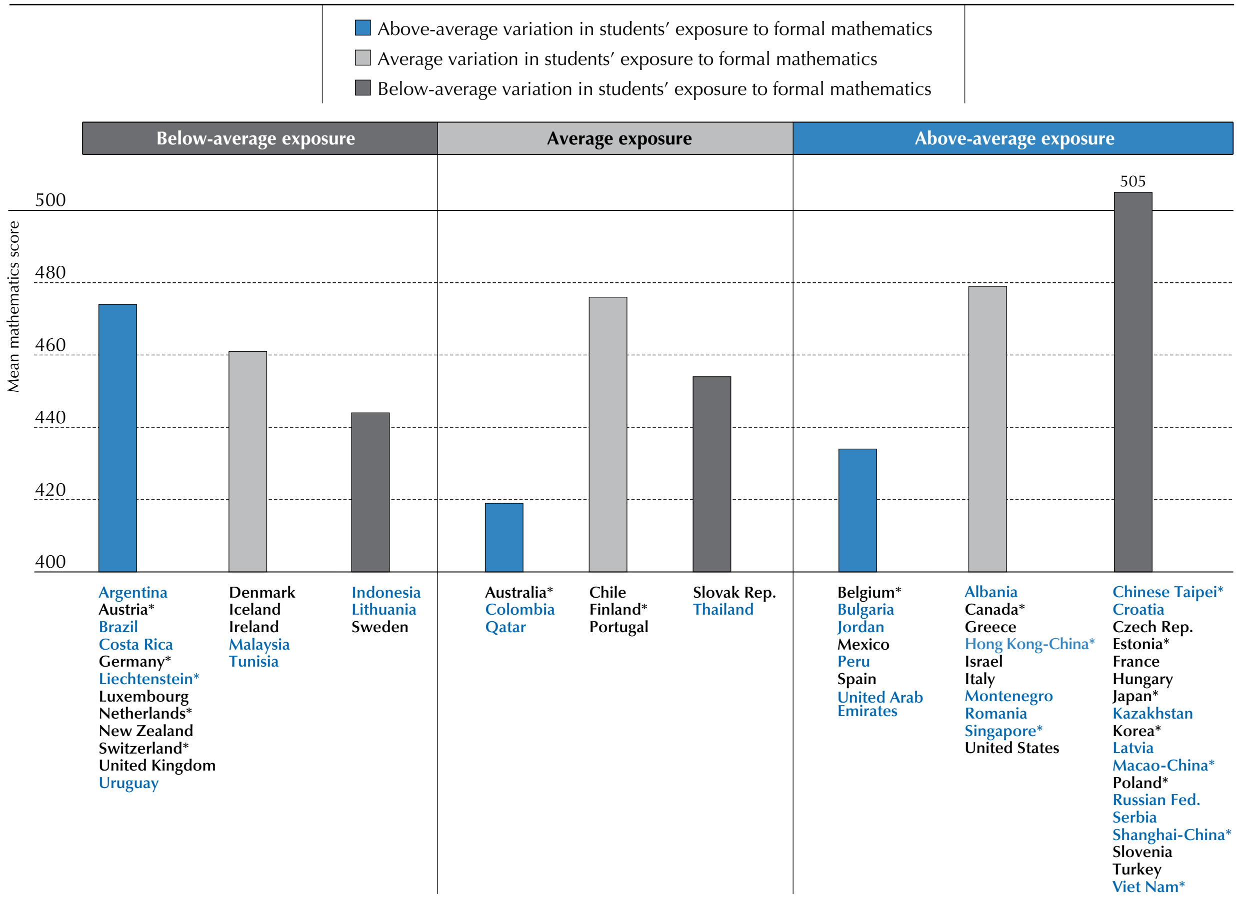
When exposure to formal mathematics is below the OECD average, disparities are not strongly related to mean performance (as represented in the left hand side of Figure II.4.3). There are countries that provide less frequent exposure to formal mathematics, have less variation in those opportunities, and show poorer average performance, such as Costa Rica, Luxembourg, and Uruguay; but there are also countries, such as Austria, Germany, the Netherlands, New Zealand and Switzerland, that provide less frequent exposure to mathematics, show large disparities in exposure and also show above-average performance (Figure II.4.3).

Between-school differences in opportunity to learn, socio-economic status and performance

In most school systems where there is some kind of selection of students, students tend to be selected into schools on the basis of their performance. As explored in Chapter 2, performance tends to be closely related to socio-economic status; so often the unintended result of separating students by performance is the separation of students by socio-economic status as well. Results from PISA 2012 show that disparities in exposure to formal mathematics are more marked in systems that separate students into different schools based on their performance – and, given the relationship between performance and socio-economic status, in systems where the unintended result of separation by performance is separation by socio-economic status. Large between-school differences in opportunities to learn, socio-economic status and performance are associated with systems that show lower levels of equity in education outcomes and, in some cases, lower average performance.

■ Figure II.4.3 ■

Relationship between mathematics performance and variation in students' exposure to formal mathematics



Notes: Depending on the organisation of schooling (comprehensive vs. institutional differentiation according to performance), differences across schools are to be expected for certain learning opportunities to meet students' needs.
Countries with mean mathematics performance above the OECD average are marked with an asterisk.
Source: OECD, PISA 2012 Database, Tables I.2.3a and II.4.1.
StatLink http://dx.doi.org/10.1787/888932964851

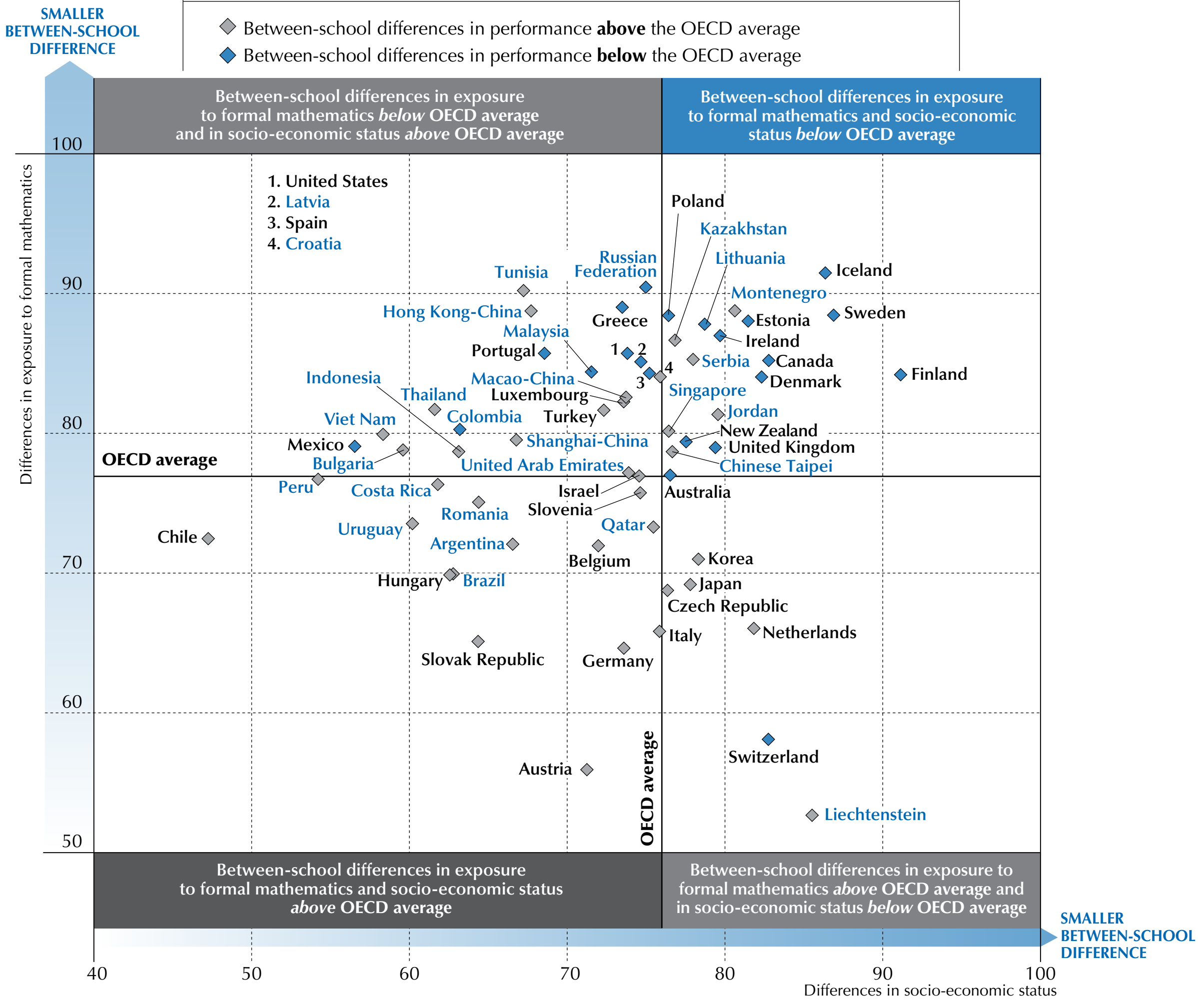
As Figure II.4.1 shows, Canada, Denmark, Estonia, Finland, Iceland and Sweden all show below-average between-school differences in performance, socio-economic status and exposure to formal mathematics. These systems not only succeed in minimising differences between schools across these three indicators, they all show greater-than-average equity in education outcomes, as measured by the strength of the relationship between socio-economic status and performance, except Denmark, where equity is average. Canada, Denmark, Estonia and Finland perform above average, Iceland shows average performance, and only Sweden performs below average.

By contrast, Argentina, Brazil, Chile, Hungary and the Slovak Republic all show large between-school differences in performance, socio-economic status and exposure to formal mathematics. Average performance is below the OECD average in all these school systems. Chile, Hungary and the Slovak Republic also show below-average equity in education outcomes, while equity in Argentina and Brazil is at the OECD average, as measured by the strength of the relationship between socio-economic status and performance.

■ Figure II.4.4 ■

Between-school differences in exposure to formal mathematics, socio-economic status and performance

Less segregation in opportunities to learn and socio-economic status between schools is associated with fewer performance differences between schools.



Note: Depending on the organisation of schooling (comprehensive vs. institutional differentiation according to performance), differences across schools are to be expected for certain learning opportunities to meet students' needs.
Source: OECD, PISA 2012 Database, Tables II.2.8a, II.2.13a and II.4.1.
StatLink http://dx.doi.org/10.1787/888932964851

Between-school differences and the overall variation in exposure to formal mathematics are above average in Austria, Belgium, Germany, Liechtenstein, the Netherlands and Switzerland (with above-average performance) and Argentina, Brazil and Italy (with below-average performance). In all of these countries, except Switzerland, between-school differences in performance are below average. Socio-economic differences between schools are above average in Argentina and Brazil, average in Austria, Belgium, Germany and Italy, and below average in Liechtenstein, the Netherlands and Switzerland. None of these countries, except Italy and Liechtenstein, achieves above-average equity in education outcomes, as measured by the strength of the relationship between socio-economic status and performance.

EQUITY IN EDUCATIONAL RESOURCES

A potential source of inequity in learning outcomes and opportunities lies in the distribution of resources across students and schools. A positive relationship between the socio-economic profile of schools and the quantity or quality of resources means that advantaged schools benefit from more or better resources; a negative relationship implies that more or better resources are devoted to disadvantaged schools. No relationship between the two implies that schools attended by disadvantaged students are as likely to have access to better or more resources as schools attended by advantaged students.

■ Figure II.4.5 ■

Summary of PISA measures of equity in educational resources

Disadvantaged schools are more likely to have more or better resources; correlation is stronger than 0.25
Advantaged schools are more likely to have more or better resources; correlation is stronger than 0.25

		Simple correlation between the school mean socio-economic profile and:						
		Student-teacher ratio[1]	Composition and qualifications of mathematics teaching staff (proportion of teachers with university-level qualifications)	Student-related factors affecting school climate	Proportion of students who leave school without a certificate	Parental pressure to achieve	Attendance at after-school lessons	Hours spent on homework or other study set by teachers
	OECD average	0.16	0.14	0.30	-0.28	0.31	0.10	0.18
OECD	Australia	**-0.05**	**0.02**	**0.52**	-0.31	0.36	**0.14**	0.25
	Austria	**-0.11**	**0.60**	0.23	-0.22	0.25	0.12	**0.23**
	Belgium	**0.59**	**0.61**	**0.56**	-0.36	0.30	**0.17**	0.31
	Canada	0.20	**0.02**	0.36	-0.31	**0.41**	0.10	**0.18**
	Chile	**-0.03**	0.19	**0.45**	-0.34	**0.44**	0.08	0.16
	Czech Republic	0.05	**0.28**	0.31	-0.18	0.28	**0.02**	0.14
	Denmark	0.20	0.09	0.35	-0.30	0.35	**0.00**	0.05
	Estonia	**0.45**	0.00	**0.09**	**-0.12**	**0.13**	**0.02**	**0.04**
	Finland	**0.36**	0.01	**0.01**	**0.02**	**0.14**	**0.05**	**0.05**
	France	w	w	w	w	w	w	w
	Germany	0.19	0.00	0.29	**-0.18**	**0.13**	0.08	**0.14**
	Greece	0.18	0.19	**0.14**	**-0.37**	0.35	**0.21**	0.20
	Hungary	**-0.04**	0.16	**0.47**	**-0.43**	**0.49**	**0.20**	0.32
	Iceland	**0.42**	**0.18**	**-0.01**	**-0.07**	**0.24**	**0.05**	**0.11**
	Ireland	**0.32**	-0.08	**0.42**	-0.33	**0.56**	0.10	**0.15**
	Israel	**-0.03**	0.21	**0.14**	-0.20	0.37	**-0.06**	0.07
	Italy	**0.40**	**0.30**	**0.41**	**-0.35**	0.30	**0.24**	**0.38**
	Japan	**0.30**	0.18	0.34	-0.39	**0.44**	**0.31**	**0.33**
	Korea	0.27	**0.02**	0.25	-0.24	0.42	**0.36**	**0.28**
	Luxembourg	0.17	**0.46**	**0.47**	**-0.38**	**-0.06**	**0.06**	**0.16**
	Mexico	**0.02**	**0.01**	**0.12**	**-0.02**	**0.10**	0.09	0.16
	Netherlands	**0.43**	**0.51**	0.21	-0.34	0.39	0.12	0.22
	New Zealand	0.15	0.21	**0.53**	**-0.80**	**0.44**	0.14	0.24
	Norway	0.27	0.00	0.28	c	**0.47**	0.09	**0.12**
	Poland	0.07	**-0.07**	**0.04**	**-0.05**	**0.07**	**0.01**	**0.03**
	Portugal	**0.41**	**-0.15**	0.17	**0.08**	0.38	0.12	**0.17**
	Slovak Republic	0.04	**-0.15**	0.25	-0.28	0.30	**-0.01**	0.16
	Slovenia	**0.25**	**0.43**	**0.27**	**-0.23**	0.27	**0.04**	0.16
	Spain	0.17	**-0.04**	**0.45**	-0.31	0.27	**0.04**	0.08
	Sweden	0.26	0.12	**0.43**	**-0.49**	0.40	0.11	**0.17**
	Switzerland	**-0.07**	0.18	**0.08**	c	**-0.10**	0.06	0.12
	Turkey	**-0.37**	0.04	0.31	-0.19	0.21	**0.05**	**0.04**
	United Kingdom	**-0.18**	**0.00**	0.35	-0.29	**0.48**	0.16	**0.31**
	United States	**0.02**	-0.02	**0.42**	-0.31	**0.47**	0.14	**0.25**
Partners	Albania	m	m	m	m	m	m	m
	Argentina	**0.05**	0.17	0.33	-0.24	0.15	**0.04**	0.10
	Brazil	**-0.21**	**-0.01**	0.38	-0.21	0.31	**0.05**	**0.13**
	Bulgaria	**-0.02**	0.00	0.23	**-0.39**	0.40	**0.17**	**0.33**
	Chinese Taipei	**-0.01**	0.02	0.36	-0.20	0.29	**0.29**	**0.36**
	Colombia	**-0.07**	-0.04	0.25	**-0.06**	**0.07**	0.12	**0.18**
	Costa Rica	0.18	0.15	**0.43**	**-0.41**	0.22	0.13	0.22
	Croatia	0.22	**0.42**	0.20	-0.22	0.19	0.10	0.24
	Hong Kong-China	0.04	0.04	0.21	**0.02**	**-0.07**	**0.20**	**0.14**
	Indonesia	**-0.11**	0.20	0.17	-0.19	**-0.06**	**0.14**	0.16
	Jordan	**-0.07**	**-0.01**	**0.06**	-0.18	0.19	**-0.03**	0.04
	Kazakhstan	0.22	0.21	**-0.04**	**-0.04**	0.20	0.08	**0.13**
	Latvia	**0.37**	0.16	**0.01**	-0.14	**0.13**	0.11	0.17
	Liechtenstein	**0.50**	**0.46**	**0.45**	c	**-0.56**	0.01	0.12
	Lithuania	0.05	0.05	0.24	-0.17	**0.15**	**0.04**	0.16
	Macao-China	**-0.05**	**-0.09**	**0.26**	**-0.23**	**0.16**	**0.15**	0.16
	Malaysia	0.08	**-0.10**	0.41	-0.23	0.30	0.11	0.18
	Montenegro	**0.40**	**0.27**	**0.20**	**-0.25**	**-0.07**	**0.05**	0.16
	Peru	0.20	-0.05	0.29	**-0.14**	0.18	0.08	0.13
	Qatar	**0.07**	**-0.09**	**-0.02**	**-0.06**	**0.19**	**-0.03**	**0.13**
	Romania	**-0.19**	**0.24**	0.27	-0.24	**0.06**	0.16	**0.25**
	Russian Federation	**0.35**	**0.27**	0.21	**-0.07**	0.26	0.06	**0.09**
	Serbia	0.29	0.07	0.24	-0.21	0.31	**0.03**	**0.10**
	Shanghai-China	**-0.26**	0.26	0.17	-0.35	0.19	**0.24**	**0.35**
	Singapore	0.11	**0.36**	**0.47**	-0.17	**0.38**	0.13	**0.18**
	Thailand	0.11	**0.03**	**0.12**	-0.28	0.30	**0.22**	0.24
	Tunisia	**0.05**	0.03	**-0.08**	-0.19	0.23	**0.03**	**0.07**
	United Arab Emirates	**-0.05**	**-0.05**	**0.11**	-0.22	0.26	**-0.03**	**0.11**
	Uruguay	**-0.08**	0.23	**0.54**	-0.35	0.25	0.09	**0.10**
	Viet Nam	0.12	0.10	0.20	-0.26	0.24	**0.21**	**0.20**

Note: The data are indicated in bold if within-country/economy correlation is significantly different from the OECD average.
1. Negative correlations indicate more favourable characteristics for advantaged students.
Source: OECD, PISA 2012 Database, Table II.4.6.
StatLink http://dx.doi.org/10.1787/888932964851

Figure II.4.5 shows the relationship between the socio-economic profile of schools – the average *PISA index of economic, social and cultural status* of the students in the school – and various school characteristics, such as the student-teacher ratio, the proportion of full-time teachers, the *index of teacher shortage,* and the *index of quality of educational resources* (see Volume IV for more analysis and details about these indices). Relationships involving disadvantaged schools whose principal reported more and/or better-quality resources are coloured light blue; relationships involving disadvantaged schools whose principals reported less and/or lower-quality resources are coloured medium blue. If the relationship in a school system, overall, is stronger than the OECD average, the correlation appears in bold; for those school systems where there is no apparent relationship, the cell in the table is coloured blue.

More is not always better

For students attending disadvantaged schools, quantity of resources does not necessarily translate into quality of resources. In general, more disadvantaged students attend schools with lower student-teacher ratios, but more advantaged students attend schools that have a higher proportion of teachers who have a university degree.

Findings from PISA suggest that many students face the double liability of coming from a disadvantaged background and attending a school with lower-quality teaching resources. Taking into account the size of the student population in schools, OECD countries allocate at least an equal, if not a larger, number of mathematics teachers to disadvantaged schools as to advantaged schools. As Figure II.4.6 shows, however, disadvantaged schools tend to have great difficulty in attracting qualified teachers. For example, in the Netherlands the proportion of qualified teachers in socio-economically advantaged schools is three times higher than the proportion of qualified teachers in disadvantaged schools (52% versus 14%), while the student-teacher ratio is 28% higher in socio-economically advantaged than in disadvantaged schools (18 versus 14 students per teacher, respectively). A similar situation is observed in Belgium, Croatia, Greece, Iceland, Italy, Kazakhstan, Luxembourg, Montenegro, the Russian Federation and Slovenia. In Austria, the student-teacher ratio in socio-economically advantaged schools is smaller and the proportion of university-educated teachers is higher than in disadvantaged schools. That is, disadvantaged schools have fewer teachers per student and those teachers tend to have had less education. A similar situation is observed in Romania, Shanghai-China and Uruguay.

Ensuring an equitable distribution of resources is still a major challenge for many countries, if not in terms of the quantity of resources, then in terms of their quality. As Figure II.4.7 shows, student socio-economic status and school socio-economic profile explain a significant proportion of the variation in teacher quality across schools. Between 17% and 27% of the variation in teacher quality across schools in Croatia, Liechtenstein, Luxembourg, the Netherlands and Slovenia is so explained, as is more than 35% of that variation in Austria and Belgium. Volume IV takes this analysis further by examining the inter-relationship between socio-economic status and resources, policies and practices in greater detail.

Challenging school environments

Disadvantaged schools often have poor disciplinary climates. As Figure II.4.8 shows, the differences in disciplinary climate between advantaged and disadvantaged schools are particularly marked in Croatia, Hungary, Shanghai-China and Slovenia, with a difference of more than half a unit on the *index of disciplinary climate,* while in Estonia, Jordan, Latvia, Norway, Peru and Thailand there are no apparent differences in disciplinary climate across schools related to the schools' socio-economic profile. As Figure II.4.9 shows, in some systems socio-economic status is strongly related to disciplinary climate while in others the relationship is much weaker. The variation across school systems in the strength of this relationship suggests that system- and school-level policies play a role in increasing or mitigating these differences.

While all these factors may be more or less related to student performance, it is clear that they do not constitute the kind of supportive learning environments that disadvantaged students need. If schools are to compensate for resources and support that students are lacking at home, it is hard to imagine how these environments can enable disadvantaged students to reach their potential.

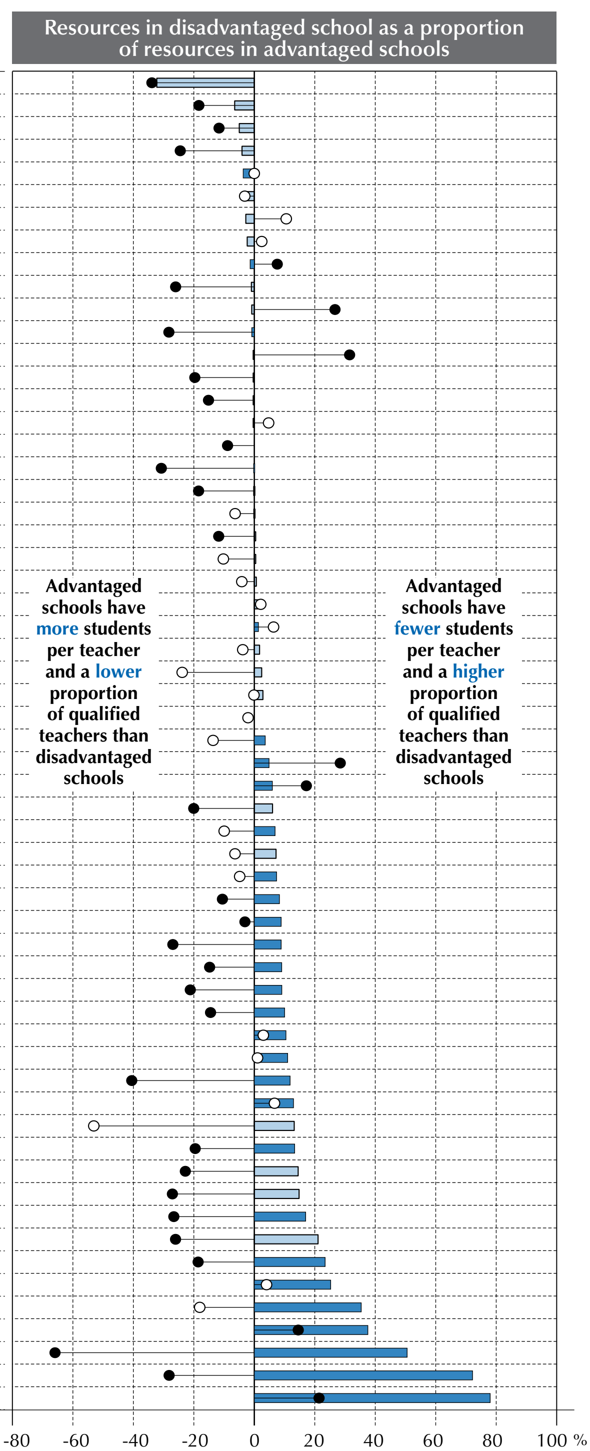
Learning opportunities outside school and parents' expectations of schools

Parents play a key role in their children's education in various ways, including by providing additional learning opportunities through after-school programmes or private tutoring to enhance or support learning at school, setting high expectations for their children and the school they attend, demanding that those expectations are met, and putting pressure on schools to achieve higher academic standards. In all of these areas, socio-economic status and resources at home are closely related.

■ Figure II.4.6 ■

Teacher quantity and quality, by schools' socio-economic profile

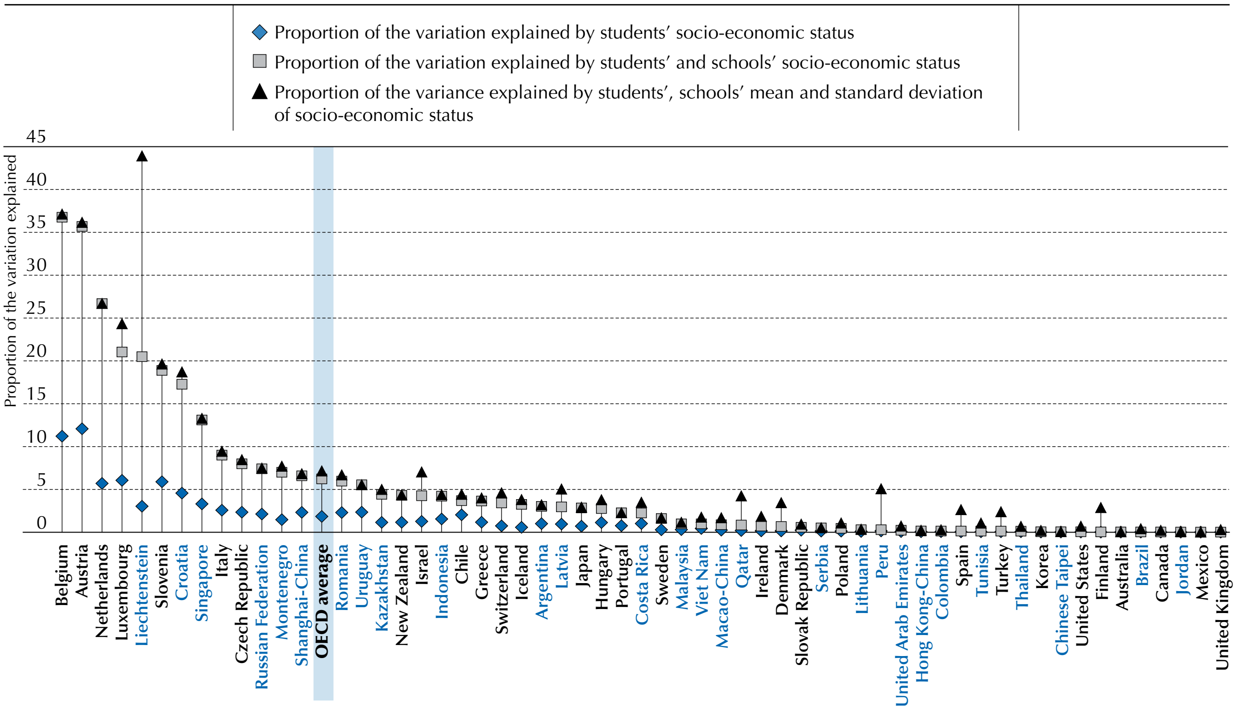
Proportion of teachers with university degrees		Student/teacher ratio		
Advantaged schools	Disadvantaged schools	Advantaged schools	Disadvantaged schools	
53.0	70.1	10.4	7.8	Portugal
78.1	83.1	20.1	17.0	Peru
91.1	95.7	9.7	8.7	Poland
87.4	90.9	11.4	9.2	Finland
89.3	92.6	12.0	12.0	United Arab Emirates
87.5	90.4	13.7	13.3	Malaysia
82.1	84.4	15.0	16.7	Jordan
90.1	92.2	25.4	26.0	Colombia
92.0	93.3	15.2	16.4	Macao-China
94.4	95.3	14.7	11.6	Spain
87.1	87.9	22.9	31.3	Brazil
97.0	97.8	16.0	12.5	Qatar
92.1	92.3	14.2	20.7	Turkey
99.2	99.4	15.0	12.6	Ireland
96.3	96.5	16.9	14.7	Canada
96.5	96.6	13.8	14.5	United Kingdom
100.0	100.0	11.6	10.7	Norway
100.0	99.8	13.0	10.0	Japan
100.0	99.8	16.6	14.0	Korea
99.6	99.4	21.1	19.8	Thailand
87.9	87.5	30.5	27.3	Mexico
98.8	98.3	18.5	16.8	United States
98.1	97.5	15.1	14.5	Hong Kong-China
97.2	95.9	12.4	12.7	Australia
99.9	98.5	12.6	13.4	Hungary
91.7	90.1	11.6	11.2	Lithuania
92.0	89.8	14.1	11.4	Tunisia
91.8	89.1	18.0	18.0	Chinese Taipei
92.4	89.2	13.1	12.8	Slovak Republic
97.0	93.5	15.9	14.0	Singapore
96.6	91.9	10.5	14.7	Shanghai-China
98.3	92.5	15.0	18.1	Romania
94.3	88.6	13.4	11.1	Denmark
95.9	89.3	15.5	14.1	New Zealand
90.1	83.6	19.2	18.0	Viet Nam
95.0	88.0	22.4	21.4	Chile
88.8	81.4	13.8	12.5	**OECD average**
97.3	88.6	9.3	9.0	Luxembourg
93.4	85.1	15.5	12.2	Russian Federation
94.8	86.2	16.8	14.6	Montenegro
93.9	85.3	9.3	7.7	Greece
99.2	89.2	14.0	12.2	Croatia
91.3	81.8	10.8	11.1	Israel
95.3	84.8	12.5	12.6	Czech Republic
95.7	84.3	12.3	8.7	Italy
89.3	77.7	16.7	17.9	Indonesia
83.3	72.3	25.3	16.5	Costa Rica
91.1	79.0	11.0	9.2	Kazakhstan
87.6	74.9	14.0	11.4	Sweden
55.8	47.5	10.4	8.1	Latvia
96.8	80.4	12.0	9.5	Slovenia
6.2	4.9	13.3	10.5	Serbia
89.9	68.9	11.7	9.8	Iceland
77.8	58.2	11.6	12.1	Switzerland
23.8	15.4	11.3	9.6	Argentina
12.0	7.5	13.2	15.5	Uruguay
51.2	25.3	11.5	6.9	Belgium
51.6	14.3	18.1	14.1	Netherlands
83.3	18.3	10.0	12.8	Austria



Note: Differences in resources between students in advantaged and disadvantaged schools that are statistically significant are marked in a darker tone.
Countries and economies are ranked in ascending order of the proportion of qualified teachers in advantaged schools relative to the proportion of qualified teachers in disadvantaged schools.
Source: OECD, PISA 2012 Database, Tables II.4.8 and II.4.9.
StatLink http://dx.doi.org/10.1787/888932964851

■ Figure II.4.7 ■

Differences in teacher quality explained by students' and schools' socio-economic profile



Countries and economies are ranked in descending order of the variation in the percentage of university-trained teachers explained by students' and schools' socio-economic status.

Source: OECD, PISA 2012 Database, Table II.4.9.

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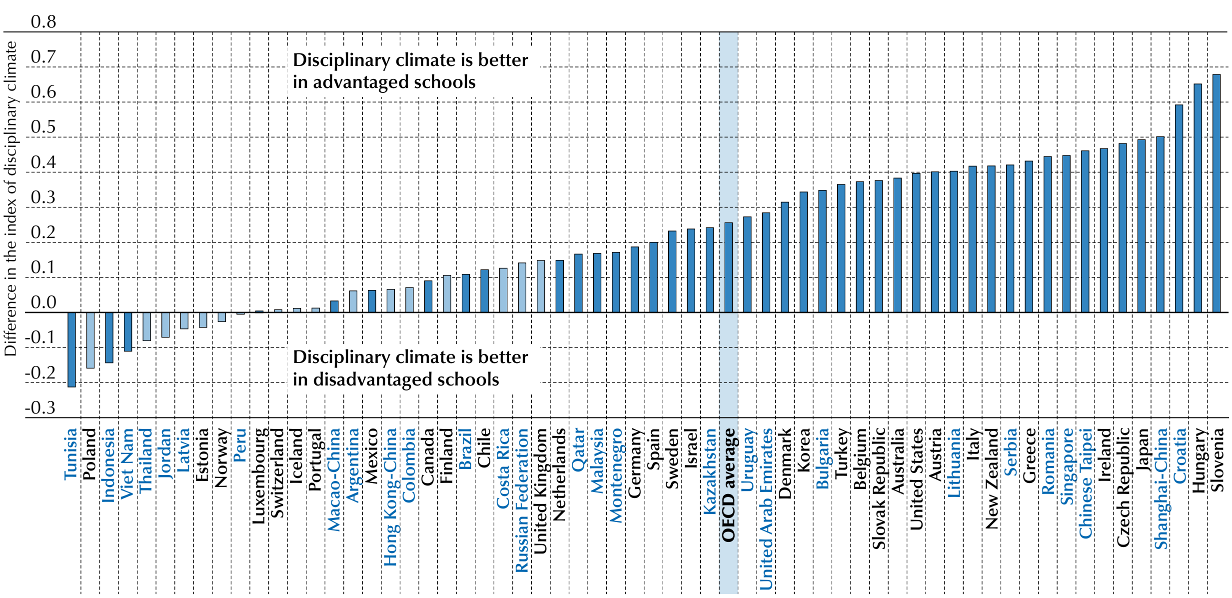
■ Figure II.4.8 ■

Differences in disciplinary climate, by schools' socio-economic profile



Note: Differences in the *index of disciplinary climate* between students in disadvantaged and advantaged schools that are statistically significant are marked in a darker tone.

Countries and economies are ranked in ascending order of the difference between disadvantaged and advantaged schools.

Source: OECD, PISA 2012 Database, Table II.4.10.

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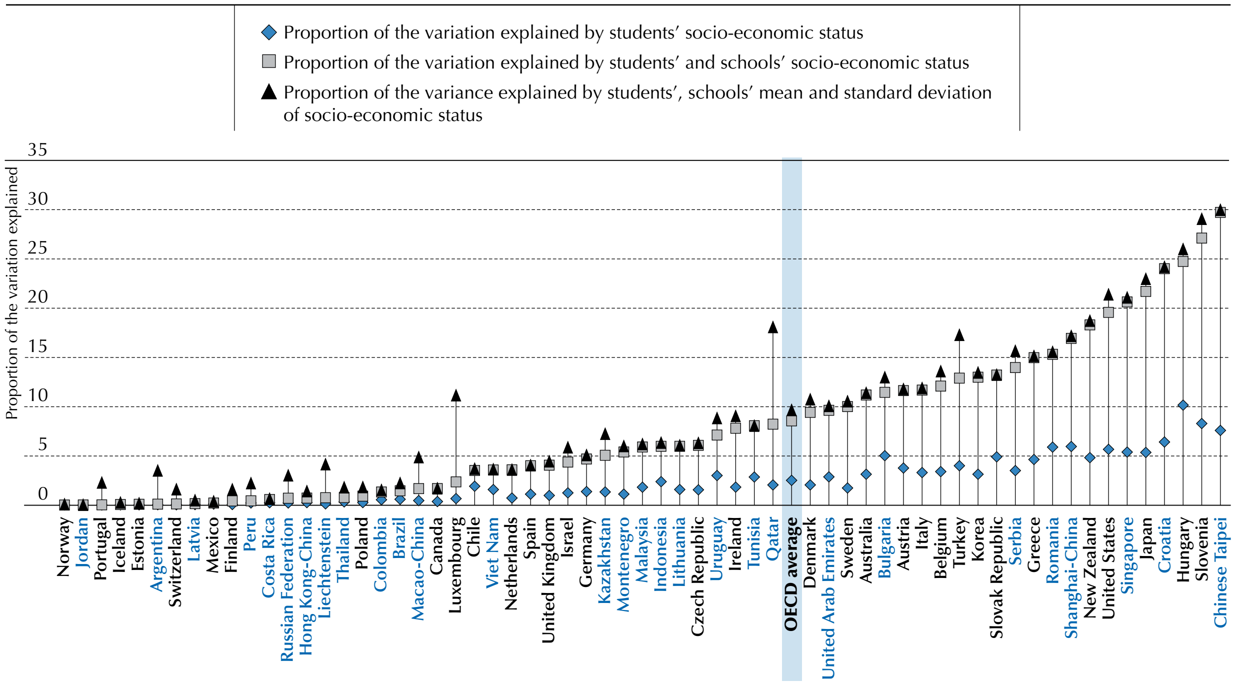
■ Figure II.4.9 ■

Differences in disciplinary climate explained by students' and schools' socio-economic profile



Countries and economies are ranked in descending order of the variation in the index of disciplinary climate *explained by students' and schools' socio-economic status.*

Source: OECD, PISA 2012 Database, Table II.4.10.

StatLink http://dx.doi.org/10.1787/888932964851

In all countries/economies that participated in PISA 2012, socio-economically advantaged students tend to spend more hours after school doing homework or other study required by their teachers. The relationship between a student's socio-economic status and the time spent on homework (on all subjects) is relatively strong (a correlation above 0.3) in Belgium, Bulgaria, Hungary, Italy, Japan, Shanghai-China, Chinese Taipei and the United Kingdom. Socio-economically advantaged students tend to spend more time than disadvantaged students attending after-school classes organised by a commercial company and paid for by their parents and the relationship is particularly strong (with a correlation above 0.3) in Japan and Korea (Figure II.4.5).

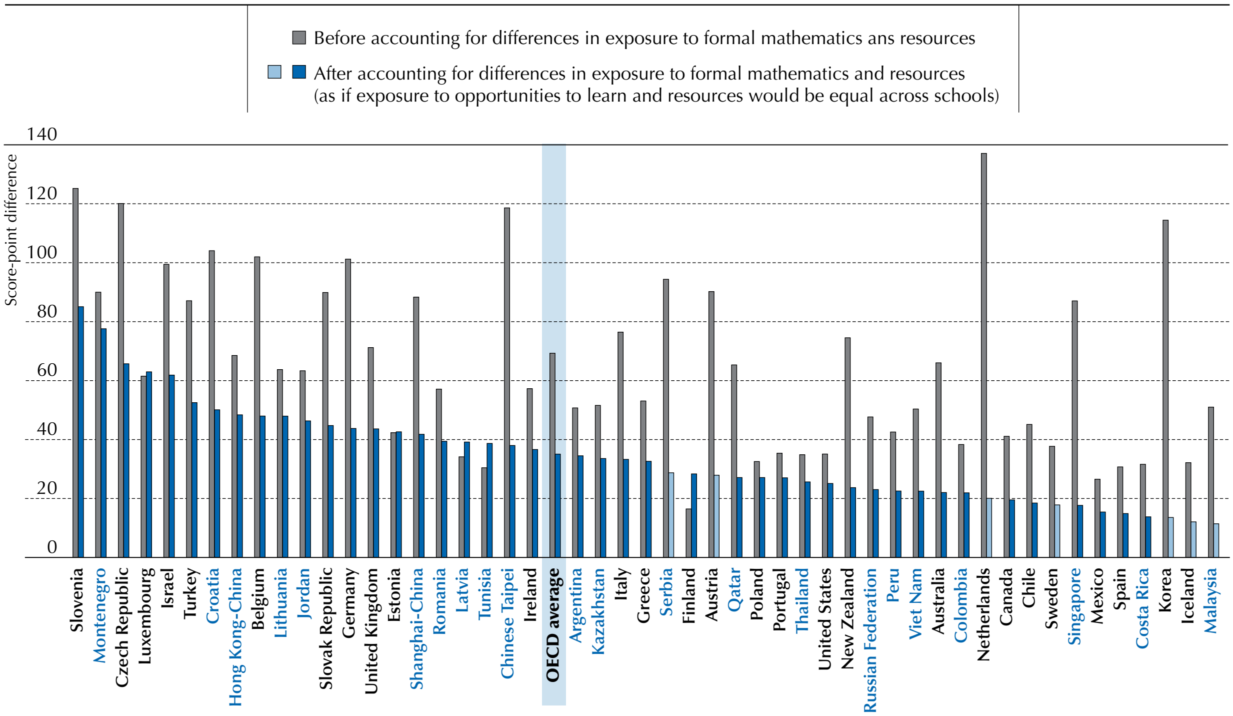
Parents' aspirations for their child's education are also strongly related to socio-economic status. The parents of advantaged students have higher aspirations for their child's education than parents of disadvantaged students do. Advantaged parents also put greater pressure on schools to meet high academic standards. In all countries and economies (except Hong Kong-China, Indonesia, Liechtenstein, Luxembourg, Montenegro and Switzerland), more advantaged students attend schools whose principals reported that "there is constant pressure from many parents who expect our school to set very high academic standards and to have our students achieve them" (Figure II.4.5).

OPPORTUNITIES, RESOURCES, PERFORMANCE AND SOCIO-ECONOMIC STATUS

Student performance is related to socio-economic status, at both the school and the student levels, and to the resources and opportunities available to students and schools. Across OECD countries, 49% of the performance differences among students who attend different schools is accounted for by differences in access to opportunities and resources. The average difference in mathematics performance between more advantaged and less advantaged schools drops from 69 score points to 35 score points after taking these differences into account. Differences in opportunities and resources also account for 39% of the performance differences observed among students who attend the same school. Differences in disciplinary climate account for 17% of performance differences, and the quality of teachers accounts for 8% of performance differences (Table II.4.9). Figure II.4.10 shows the between-school difference in performance, before and after accounting for differences in opportunities to learn and educational resources across both students and schools for those countries with available data.[5]

■ Figure II.4.10 ■

Performance differences related to differences in exposure to formal mathematics to learn and resources[1]



Note: Score-point differences that are statistically significant are marked in a darker tone.
1. Score-point differences between schools that differ by one unit on the *PISA index of economic, social and cultural status.*
Countries and economies are ranked in descending order of the score-point difference between two students attending schools that differ by one unit on the PISA index of economic, social and cultural status *after accounting for differences in opportunity to learn and resources.*
Source: OECD, PISA 2012 Database, Table II.4.11.
StatLink http://dx.doi.org/10.1787/888932964851

PARTICIPATION IN PRE-PRIMARY EDUCATION

Many of the inequities that exist within school systems are already present when students enter formal schooling and persist as students progress through school (Alexander, Entwisle and Olson, 1997; Downey, von Hippel and Broh, 2004). Because these inequities tend to grow when school is out of session, earlier entrance into the school system may help to reduce them. With earlier entrance into pre-primary education, students are better prepared to enter and succeed in formal schooling.

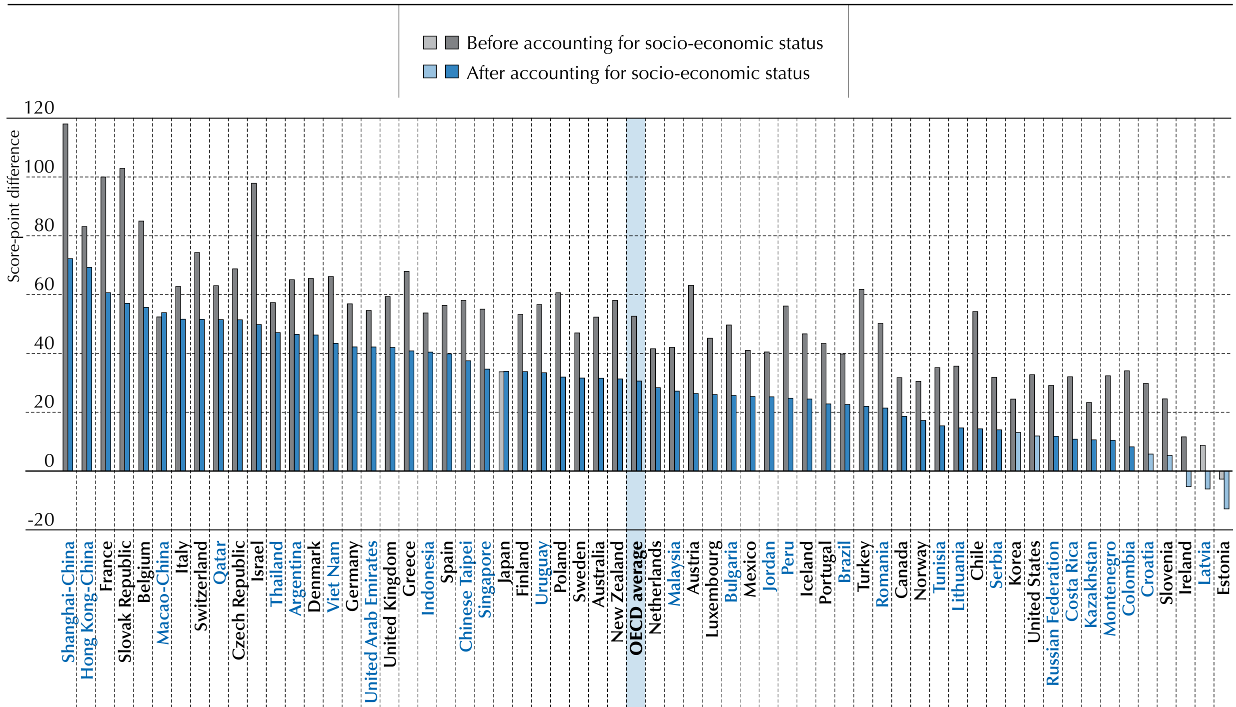
Figure II.4.11 shows the advantage in mathematics performance among students who reported having attended pre-primary education for more than one year over those who reported that they had not, both before and after accounting for students' socio-economic status. In all countries with available data, except Estonia and Latvia, students who had attended pre-primary education for more than one year outperformed students who had not. This finding remains unchanged after socio-economic status is accounted for in all countries with available data (except Estonia and Latvia). On average across OECD countries, the advantage amounts to more than 53 score points before accounting for socio-economic status, and to 31 points after accounting for socio-economic status. The difference between the two suggests that attendance in pre-primary education for more than one year is somewhat related to socio-economic status; still, there is a strong, independent relationship between having attended pre-primary school and performance at age 15. Those who did not participate in pre-primary education are 1.84 times more likely to score at the bottom of the performance distribution.

In France and the Slovak Republic, students who reported having attended pre-primary school for more than one year score at least 100 points higher in mathematics than students who had not attended pre-primary education. In France, only 2% of students had not participated in any pre-primary education, while 92% had attended for more than one year.

■ Figure II.4.11 ■

Differences in mathematics performance, by attendance at pre-primary school

Between students who attended pre-primary school for more than one year and those who had not attended



Note: Score-point differences that are statistically significant are marked in a darker tone.
Countries and economies are ranked in descending order of the score-point difference in mathematics performance between students who reported that they had attended pre-primary school (ISCED 0) for more than one year and those who had not attended pre-primary school, after accounting for socio-economic status.
Source: OECD, PISA 2012 Database, Table II.4.12.
StatLink http://dx.doi.org/10.1787/888932964851

Those who had not participated are largely those from disadvantaged families. However, even after students' socio-economic status is accounted for, the strong relationship between attendance in pre-primary school and performance persists, although differences in performance are halved. The situation is similar in Shanghai-China, where the performance difference before accounting for socio-economic status is 118 score points but 72 points after taking socio-economic status into account. After accounting for socio-economic status, the score differences between students who had not attended pre-primary education and those who had attended for more than one year are largest (i.e. at least 50 score points) in Belgium, the Czech Republic, France, Hong Kong-China, Italy, Macao-China, Qatar, Shanghai-China, the Slovak Republic and Switzerland. However, among this group of countries, the population relevance is less than 5% (the OECD average population relevance) in all countries except Shanghai-China (7%), the Slovak Republic (11%) and Qatar (17%) (Table II.4.12).

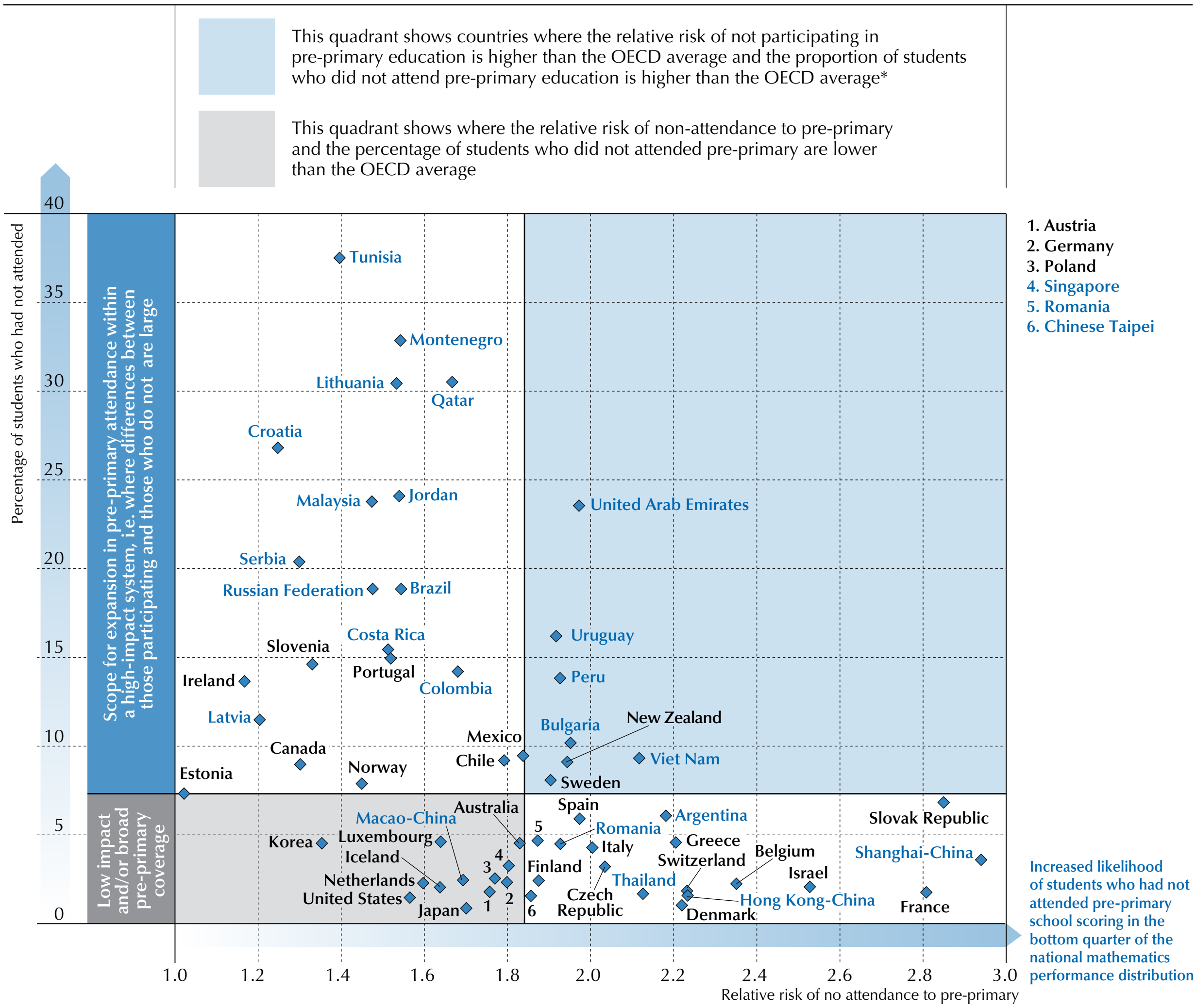
Figure II.4.12 highlights those countries where the participation rates are relatively low (the proportion of students who did not attend pre-primary school is high) and the relative risk of low performance for those who did not attend is particularly high. Indonesia and Turkey show high relative risk and very low participation rates. Croatia, Lithuania, Montenegro, Qatar and Tunisia also show low participation rates and relative risks that are relevant even if they are below the OECD average. In contrast, in France, Israel, Shanghai-China and the Slovak Republic, the relative risk is very high but few students are vulnerable to this type of risk.

In practically all countries, there is no significant difference in performance observed between advantaged and disadvantaged students when considering the relationship between pre-primary attendance and mathematics performance at age 15 (Table II.4.13). In 32 OECD countries and 22 partner countries and economies, disadvantaged and advantaged students benefit equally from pre-primary attendance. Across OECD countries, immigrant students who had attended pre-primary school score as well as immigrant students who had not attended, except in Canada and Estonia (Table II.4.14).

Many other factors, apart from participation in pre-primary education, have an impact on 15-year-olds' performance in school, and the estimates provided here are limited because they do not take many of these other factors into account. Volume IV of this report explores these issues further and examines how they have evolved since PISA 2003. The trends show that equity issues related to pre-primary education are on the rise in many countries, and that disadvantaged students, those who would benefit most from pre-primary education, are still under-represented in pre-primary enrolments.

■ Figure II.4.12 ■

Pre-primary school, mathematics performance and students' socio-economic status



*Turkey and Indonesia have a large percentage of students who did not attend pre-primary (70% and 46%, respectively) and high relative risk, and Kazakhstan also has a high non-attendance rate (65%) but a lower-than-average relative risk. They are not included in this figure to make differences among other countries more visible.

Source: OECD, PISA 2012 Database, Tables II.4.12.

StatLink http://dx.doi.org/10.1787/888932964851

Notes

1. For a more in-depth analysis of opportunity to learn in PISA 2012, see Schmidt et al. (2013).

2. Advantaged (disadvantaged) schools are those where the typical student in the school, or the socio-economic profile of the school, is above (below) the socio-economic status of the typical student in the country, the country mean socio-economic status. In each school, a random sample of 35 students are to take part in PISA (for more details see the *PISA 2012 Technical Report* [OECD, forthcoming]). The socio-economic profile of the school is calculated using the information provided by these students. Therefore, the precision of the estimate depends on the number of students that actually take the test in the school and the diversity of their answers. This precision was taken into account when classifying schools as advantaged, disadvantaged or average. If the difference between the school socio-economic profile and the socio-economic status of the typical student in the country (the mean socio-economic status at the country level) was not statistically significant, the school was classified as a school with an average socio-economic profile. If the school profile was statistically significantly above the country mean, the school is classified as a socio-economically advantaged school. If the profile was below the country mean, the school is classified as a socio-economically disadvantaged school.

3. These results also depend on how schools are defined and organised within countries, and by the units that were chosen for sampling purposes. For example, in some countries, some of the schools in the PISA sample were defined as administrative units (even if they spanned several geographically separate institutions, as in Italy); in others, they were defined as those parts of larger educational institutions that serve 15-year-olds; in others they were defined as physical school buildings; and in yet others they were defined from a management perspective (e.g., entities having a principal). The *PISA 2012 Technical Report* (OECD, forthcoming) provides an overview of how schools were defined. Because of the manner in which students were sampled, the within-school variation includes variation between classes as well as between students. In Slovenia, the primary sampling unit is defined as a group of students who follow the same study programme within a school (an educational track within a school). So in this particular case, the between-school variation is actually the difference between tracks within a school.

4. These are the results of a simple decomposition of the variation on a three-level model, with students nested within schools, and schools nested within countries. The results are based on the pooled sample of all the countries and economies that participated in PISA 2012.

5. All the models presented in Table II.4.9 include student and school level socio-economic status, then individual characteristics (gender, immigrant background and language at home) and school location are included. All of these variables are kept for every single model. School and student level variables measuring availability and quality of resources are introduced one group at a time. At the end, all variables are combined in a single model: the "combined model". Some students, schools and countries do not have data for some of these variables, therefore they are not included on the combined model. Then a baseline model, only with student and school level socio-economic status is presented, where all students, schools and countries without data have been omitted, which allows a more direct comparison with the estimates in the combined model. Figure II.4.10 presents the results of these last two models, the combined model and the basic model with all missing observations deleted.

References

Alexander, K.L., D.R. Entwisle and **L.S. Olson** (2007), "Lasting Consequences of the Summer Learning Gap", *American Sociological Review*, Vol. 72, pp. 167-80.

Carroll, J.B. (1963), "A model of School Learning", *Teachers College Record*, Vol. 64, No. 8, pp. 723-733.

Downey D. B., P.T. von Hippel and **B.A. Broh** (2004), "Are Schools the Great Equalizer? Cognitive Inequality during the Summer Months and the School Year", *American Sociological Review*, October 2004 Vol. 69, No. 5, pp. 613-35.

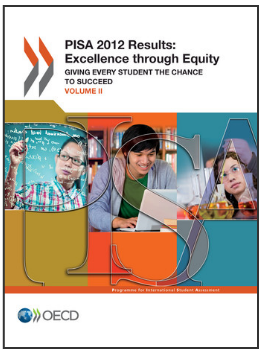
OECD (forthcoming), *PISA 2012 Technical Report*, PISA, OECD Publishing.

Schmidt, W.H., L.S. Cogan and **P. Zoido** (2013), "Schooling Matters: Opportunity to Learn in PISA 2012", *OECD Education Working Papers,* No. 95, OECD Publishing.
http://dx.doi.org/10.1787/5k3v0hldmchl-en

Schmidt, W.H., et al. (2001), *Why Schools Matter: A Cross-National Comparison of Curriculum and Learning,* Jossey-Bass, San Francisco.

Sykes, G., B. Schneider and **D.N. Plank** (2009), *Handbook of Education Policy Research,* Routledge, New York.

Wiley, D.E. and **A. Harnischfeger** (1974), "Explosion of a Myth: Quantity of Schooling and Exposure to Instruction, Major Educational Vehicles", *Educational Researcher*, Vol. 3, No. 4, pp. 7-12.



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