6

Socio-economic status, student performance and students' attitudes towards science

This chapter defines the dimensions of equity in education: inclusiveness and fairness. It first discusses 15-year-olds' access to schooling in PISA-participating countries and economies, and then describes how the socio-economic status of students and schools is related to student performance and students' attitudes towards science.

A note regarding Israel

The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

Equity in education is a central and long-standing focus of PISA and a major preoccupation for countries around the world. Education systems share the goal of equipping students, irrespective of their social background, with the skills necessary to achieve their full potential in social and economic life.

However, PISA shows that in many countries, even those that perform well in PISA, students' backgrounds continue to influence their opportunities to benefit from education and develop their skills. That is why equity in education – ensuring that education outcomes are the result of students' abilities, will and effort, rather than their personal circumstances – lies at the heart of advancing social justice and inclusion. Ensuring that the most talented, rather than the wealthiest, students obtain access to the best education opportunities is also a way to use resources effectively and raise education and social outcomes in general.

This chapter presents the main PISA 2015 indicators of equity in education. Equity is a complex concept, and the chapter concentrates on two related goals: inclusion and fairness. Inclusion refers to the objective of ensuring that all students, particularly those from disadvantaged backgrounds or traditionally marginalised groups, have access to high-quality education and reach a baseline level of skills. Fairness refers to the goal of removing obstacles to the full development of talent that stem from economic and social circumstances over which individual students have no control, such as unequal access to educational resources in their family and school environments.

What the data tell us

- Canada, Denmark, Estonia, Hong Kong (China) and Macao (China) achieve high levels of performance and equity in education outcomes.
- Access to schooling is nearly universal in most OECD countries and more than 80% of 15-year-olds in 33 countries are represented by PISA samples. But a smaller proportion of 15-year-olds are enrolled in school in grade 7 or above in the OECD countries Turkey (70%) and Mexico (62%), and in partner countries and economies such as Beijing-Shanghai-Jiangsu-Guangdong (China) (hereafter "B-S-J-G [China]") (64%), Costa Rica (63%) and Viet Nam (49%).
- On average across OECD countries, students' socio-economic status explains 13% of the variation in student performance in science.
- Socio-economically disadvantaged students across OECD countries are almost three times more likely than more advantaged students not to attain the baseline level of proficiency in science. However, about 29% of disadvantaged students are considered resilient – meaning that they beat the odds and perform among the top quarter of students in all participating countries. In Macao (China) and Viet Nam, students facing the greatest disadvantage on an international scale outperform the most advantaged students in about 20 other PISA-participating countries and economies.
- While between 2006 and 2015 no country or economy improved its performance in science and its equity levels simultaneously, in nine countries where mean achievement remained stable, socio-economic status became a weaker predictor of student performance. Over this period, the United States is the country where the impact of socio-economic status on performance weakened the most and where the percentage of resilient students grew by the largest margin.

While inclusion and fairness can be examined across a wide range of dimensions, this chapter highlights differences in performance and access to resources related to students' socio-economic status. The chapter investigates results in science, reading and mathematics.

HOW PISA EXAMINES INCLUSION AND FAIRNESS IN EDUCATION

PISA defines equity in education as providing all students, regardless of gender, family background or socio-economic status, with high-quality opportunities to benefit from education. Defined in this way, equity implies neither that everyone should achieve the same results, nor that every student should be exposed to identical, "one-size-fits-all" approaches to teaching and learning. Rather, it refers to creating the conditions for minimising any adverse impact of students' socio-economic status or immigrant background on their performance.

This understanding of equity in education enjoys wide support across countries and is aligned with the Sustainable Development Goals (SDG), adopted by the United Nations in September 2015. In particular, Goal 4 encourages countries to ensure "inclusive and equitable quality education and promote lifelong learning opportunities for all". Two important features distinguish this goal from the preceding Millennium Development Goals (MDG). First, it puts the quality of education and learning outcomes front and centre, whereas the MDG agenda remained focused on access and enrolment. Second, the goal has a truly global reach, as no country, rich or poor, can yet claim to have attained it. By providing extensive and internationally comparable information on students' skills and their family and community backgrounds, PISA offers a unique measure to assess progress towards the SDGs and to analyse inclusion and fairness in education from an international perspective.

Figure I.6.1 summarises the conceptual framework underlying the analyses in this chapter.

Figure I.6.1 ▪ **A conceptual framework for examining equity in education in PISA 2015**

Dimensions of equity	**Outcomes**	**Background characteristics**	**Mediating factors**
▪ Inclusion ▪ Fairness	▪ Access to schooling ▪ Average performance ▪ Low performance ▪ Variation in performance ▪ Attitudes	▪ Socio-economic status ▪ Immigrant background ▪ Gender, family structure	▪ Concentration of disadvantage ▪ Access to educational resources ▪ Opportunity to learn ▪ Stratification polices

Defining inclusion and fairness

PISA defines inclusion in education as ensuring that all students attain essential foundation skills. In this light, education systems where a large proportion of 15-year-olds has not learned the basic skills needed to fully participate in society are not considered as sufficiently inclusive.

A second dimension of equity, fairness, is defined in relation to contemporary debates about equality of opportunity in a public policy context (e.g. Kanbur and Wagstaff, 2014; Roemer and Trannoy, 2015). Education systems are fairer if students' achievements are more likely to result from their abilities and factors that students themselves can influence, such as their will or effort, and less fair the more they are conditioned by contextual characteristics or "circumstances" that students cannot influence, including their gender, race or ethnicity, socio-economic status, immigrant background, family structure or place of residence.[1]

In PISA, fairness relates to the distribution of opportunities to acquire a quality education and, more specifically, to the degree to which background circumstances influence students' education outcomes.[2] According to this view, fair education systems provide all students, regardless of their background, with similar opportunities to succeed academically.[3]

Performance outcomes examined

Across these two dimensions, equity in education can be examined by looking at a range of student outcomes. First, access to schooling can be seen as a precondition for children to benefit from education. Access is chiefly reflected in school enrolment rates; more equitable and inclusive systems succeed in minimising the share of school-age youth who are not enrolled or are significantly delayed in their progression through school.

Ensuring universal access to schooling at the current quality of education would yield significant social and economic gains, particularly in lower-income countries. But improving both access to and the quality of schools, so that every student acquires basic skills (the ability to read and understand simple texts, and master basic mathematical and scientific concepts and procedures; defined as performing at or above Level 2 on the PISA scale) would have a much larger impact on social and economic outcomes than extending access to schooling alone.

The estimated gains of achieving full participation in secondary school and ensuring that every student scores at or above the baseline level of proficiency on the PISA scale would average 13 times the current GDP of lower-middle income countries and at least twice the current GDP across most high-income countries (OECD, Hanushek and Woessmann, 2015).

The experience of several countries in PISA also shows that improving basic and higher-order skills can be done simultaneously, thus meeting the need for both types of skills in knowledge-based economies. Using the innovations developed by the most skilled workers requires a workforce that has acquired at least basic skills.

The Survey of Adult Skills, a product of the OECD Programme for the International Assessment of Adult Competencies (PIAAC), shows that poor skills severely limit people's access to better-paying and more-rewarding jobs (OECD, 2016a). It works the same way for nations: the distribution of skills has significant implications for how the benefits of economic growth are shared within societies. Put simply, where large shares of adults have poor skills, it becomes difficult to introduce productivity-enhancing technologies and new ways of working, which can then stall improvements in living standards.

Skills affect more than earnings and employment. In all countries with comparable data from the Survey of Adult Skills, adults with lower skills in literacy are far more likely than those with better skills to report poor health, to perceive themselves as objects rather than actors in political processes, and to have less trust in others. In short, without the right skills, people will languish on the margins of society, technological progress will not translate into economic growth, and countries will not be able to compete in the global economy. It is simply not possible to develop inclusive policies and engage with all citizens if a lack of proficiency in basic skills prevents people from fully participating in society.

The main outcome analysed in this chapter in relation to equity is student performance in the core PISA domains. Students' mean scores on the PISA assessment are key indicators of students' knowledge and skills, including the mastery of processes, conceptual understanding, and the ability to extrapolate and apply knowledge in a variety of situations. For countries, average performance indicates the extent to which students near the end of compulsory education have acquired key knowledge and skills that are essential for full participation in modern societies.[4]

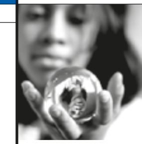
Another outcome of critical relevance for equity in education is basic achievement, which refers to students attaining at least proficiency Level 2 on the PISA assessment.[5] As explained in Chapter 2, proficiency Level 2 is considered a baseline that all students should be expected to reach by the time they leave compulsory education; not attaining this level is likely to lead to considerable disadvantage later in life (OECD, 2010). Level 2 represents the critical benchmark at which students begin to demonstrate the science competencies that will enable them to participate effectively and productively in life situations related to science and technology, and to engage with science-related issues as informed citizens. Students with proficiency at or above Level 2 are, at the very least, able to apply some limited knowledge of science in familiar contexts only and to demonstrate a minimum level of autonomous reasoning and understanding of the basic features of science. For countries around the world, reducing the number of low-performing students is a central avenue towards improving equity in their education systems, given the fact that low-performing students come disproportionately from socio-economically disadvantaged and immigrant backgrounds.

Equity can also be examined by looking at variation in performance within a country or economy. How skills are distributed across the student population complements the information provided by country averages, which can vary as a result of changes at different levels of the performance distribution. Chapter 2 describes trends in science performance between 2006 and 2015 among low- and high-achieving students, looking both at low and top performers (performance below Level 2, and at or above Level 5, respectively) and at differences between students at the 10th and 90th percentiles of the performance distribution within each country and economy. In this chapter, variation in performance is mainly examined as variation between and within schools.

In line with the definition of science literacy in PISA 2015, the equity framework also recognises the affective dimensions of learning science as important student outcomes. These relate to students' attitudes towards and beliefs about science, which can play a significant role in their interest, engagement and response to science-related issues and, in turn, in building strong foundation skills in science. From an equity perspective, the concern is that disparities in science performance related to students' socio-economic and demographic backgrounds might extend to students' attitudes towards science, including their expectations – or lack thereof – of a career in science or their appreciation of scientific approaches to enquiry. Students' attitudes towards science and their self-beliefs about learning science are discussed in greater detail in Chapters 2 and 3.

Socio-economic status and other background characteristics

The chapter examines equity in education by focusing on students' socio-economic status. In PISA, a student's socio-economic background is estimated by the PISA index of economic, social and cultural status (ESCS), which is based on information about the students' home and background (Box I.6.1).



Box I.6.1. **Definition of socio-economic status in PISA**

Socio-economic status is a broad concept that summarises many different aspects of a student, school or school system. In PISA, a student's socio-economic status is estimated by the PISA index of economic, social and cultural status (ESCS), which is derived from several variables related to students' family background: parents' education, parents' occupations, a number of home possessions that can be taken as proxies for material wealth, and the number of books and other educational resources available in the home. The PISA index of economic, social and cultural status is a composite score derived from these indicators via Principal Component Analysis (PCA). It is constructed to be internationally comparable. For the first time, in PISA 2015, the PCA was run across equally weighted countries, including OECD and partner countries/economies. Thus, all countries and economies contribute equally to ESCS scores. However, for the purpose of reporting, the values of the ESCS scale are standardised to have a mean of zero and a standard deviation of one for the population of students in OECD countries, with each country given equal weight. In order to allow for trend analyses, in PISA 2015, the ESCS was computed for the current cycle and also recomputed for the earlier cycles using a similar methodology (see *PISA 2015 Technical Report* [OECD, forthcoming]).

The ESCS index makes it possible to draw comparisons between students and schools with different socio-economic profiles. In this report, students are considered **socio-economically advantaged** if they are among the 25% of students with the highest values on the ESCS index in their country or economy; students are classified as **socio-economically disadvantaged** if their values on the ESCS index are among the bottom 25% within their country or economy. Students whose values on the ESCS index are in the middle 50% within their country or economy are classified as having an average socio-economic status. Following the same logic, schools are classified as socio-economically advantaged, disadvantaged or average within each country or economy based on their students' mean values on the ESCS index.

On average across OECD countries, parents of socio-economically advantaged students are highly educated: a large majority has attained tertiary education (97%) and works in a skilled, white-collar occupation (94%). By contrast, the parents of socio-economically disadvantaged students have much lower educational attainment. Across OECD countries, 55% of parents of disadvantaged students attained some post-secondary non-tertiary education as their highest level of formal schooling, 33% attained lower secondary education or less, and only 12% attained tertiary education. Few disadvantaged students have a parent working in a skilled occupation (8%); many parents of these students work in semi-skilled, white-collar occupations (43%), and the majority (49%) work in elementary occupations or semi-skilled, blue-collar occupations (Table II.6.2b).

One of the home possessions that most clearly distinguishes students of different socio-economic profiles is the quantity of books at home. While 47% of advantaged students reported having more than 200 books at home, on average, this is the case for only 7% of disadvantaged peers. Advantaged students also reported a greater availability of other educational resources, such as educational software. On average across OECD countries, however, more than 80% of students, regardless of their socio-economic status, reported having a quiet place to study at home and a computer that they can use for schoolwork (Table II.6.2b).

At the individual level, analyses in this chapter consider the relationship between each student's socio-economic status and his or her science performance and attitudes towards science as assessed in PISA 2015, with an occasional focus on other domains as well. At the school level, the analyses consider the relationship between the average socio--economic status of 15-year-old students in the school and the scores of the 15-year-olds attending that school. At the country level, the socio-economic status of students, both on average and its distribution within the country, can be related to average performance at the school-system level.

A consistent finding throughout PISA assessments is that socio-economic status is related to performance at the system, school and student levels. These associations partly reflect the advantages in resources that relatively high socio-economic status confers. However, they also result from other characteristics that are associated with socio-economic status but that have not been measured by the ESCS index. For example, at the system level, high socio-economic status is often related to greater wealth and higher spending on education. At the school level, socio-economic status tends to be positively correlated with a range of community characteristics that can boost student performance, such as a safe environment or the availability of public libraries and museums. At the individual level, socio-economic status can be related to parents' attitudes towards education, in general, and to their involvement in their child's education, in particular.

The effects of socio-economic status on student achievement have been widely documented, and research has shed light on specific mechanisms linking economic, social and cultural assets in the family context to students' education outcomes (e.g. Bianchi et al., 2004; Feinstein, Duchworth and Sabates, 2008; Jæger and Breen, 2016). For example, students whose parents have higher levels of education and more prestigious and better-paid jobs typically benefit from a wider range of financial (e.g. private tutoring, computers, books), cultural (e.g. extended vocabulary, time in active parenting) and social (e.g. role models and networks) resources that make it easier for students to succeed in school, compared with peers who come from families with lower levels of education or that are affected by chronic unemployment, low-paid jobs or poverty.

Performance differences between socio-economically advantaged and disadvantaged students are not the only indication of the degree to which an education system is equitable. Other student background characteristics and the environment in which students learn are also related to performance. Chapter 7 examines equity through the lens of differences between students with and without an immigrant background. Other essential factors not covered in this chapter include students' gender and family structure. Differences in science literacy and attitudes towards science between boys and girls are analysed in Chapters 2 and 3. The relationship between family structure and performance in PISA was examined in the volume devoted to equity in PISA 2012.

Mediating factors

The impact of personal background circumstances on student performance is partly mediated by other factors. The equity framework in PISA 2015 focuses on the concentration of disadvantage and its association with students' access to educational resources, on differences in opportunity to learn, and on grade repetition and tracking. This chapter looks at how these mediating factors interact with students' socio-economic status; Chapter 7 examines how they affect students with and without an immigrant background.

How educational resources are distributed among students of different backgrounds can be an important determinant of equity in education opportunities. Education systems that are successful, both in quality and equity, attract the highest-quality resources to where these resources can make the most difference. Chapters in this volume provide a glimpse of how resource allocation is related to students' backgrounds by using information collected from school principals about the quality of school infrastructure and the availability of qualified teachers.

Differences in student performance can also be influenced by inequalities in opportunity to learn, that is, the relative exposure that students of different backgrounds may have to specific content in the classroom. This is mainly reflected in the instructional time school systems and teachers allocate to learning a particular subject or content. Time spent on content and the way in which time is organised are primary factors influencing student achievement (OECD, 2016b). Research using PISA data suggests that up to one third of the relationship between socio-economic status and student performance can be accounted for by measures of opportunity to learn (Schmidt et al., 2015).

Another potential channel for the association between students' socio-economic background and achievement are stratification policies used by schools and education systems to organise instruction for students of varying ability and interests. Two widely used forms of stratification are grade repetition and early tracking. While the decision to retain a student at a given grade or to place a student in a less academically-oriented programme is made primarily on the basis of performance, research suggests that students' background characteristics can also play a role in the likelihood that students are sorted into different grades and programmes (Agasisti and Cordero, forthcoming; van de Werfhorst and Mijs, 2010). Volume II provides a more in-depth examination of the association between student performance and school-level resources, learning environments and stratification policies and practices, and of how they reflect the level of equity in a system.

SUCCESSFUL PERFORMANCE AND EQUITY IN EDUCATION

PISA consistently finds that high performance and greater equity in education opportunities and outcomes are not mutually exclusive. In this light, success in education can be defined as a combination of high levels of achievement and high levels of equity. Looking at performance and equity simultaneously also helps avoid the risk of misinterpreting low variability in student achievement as a synonym of equity. Instead, equity is about success for students from all social backgrounds. Widespread low achievement should never be taken as a desirable outcome.

Indeed, the sources of variability in performance include not only students' background circumstances but also differences in their interests, aspirations and effort. Arguably, an education system where both levels of achievement and variability are high, and where such variation is only weakly related to social background, does better than a system where most students do poorly and variability is low. Equitable education systems are those where inclusion and fairness in education and high levels of performance do not come at the expense of one another.

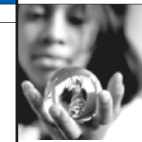


Figure I.6.2 ■ Countries' and economies' performance in science and major indicators of equity in education

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

		Equity in education					
		Inclusion		Fairness			
	Mean performance in science	Coverage of the national 15-year-old population (PISA Coverage index 3)	Percentage of students performing below Level 2 in science	Percentage of variation in science performance explained by students' socio-economic status	Score-point difference in science associated with a one-unit increase in the ESCS[1]	Percentage of resilient students[2]	Percentage of the between-school variation in science performance explained by students' and schools' ESCS
	Mean score	Index	%	%	Score dif.	%	%
OECD average	493	0.89	21	13	38	29	62.9
Singapore	556	0.96	10	17	47	49	64.9
Japan	538	0.95	10	10	42	49	63.0
Estonia	534	0.93	9	8	32	48	48.2
Chinese Taipei	532	0.85	12	14	45	46	72.3
Finland	531	0.97	11	10	40	43	46.1
Macao (China)	529	0.88	8	2	12	65	7.3
Canada	528	0.84	11	9	34	39	53.7
Viet Nam	525	0.49	6	11	23	76	45.8
Hong Kong (China)	523	0.89	9	5	19	62	40.9
B-S-J-G (China)	518	0.64	16	18	40	45	65.0
Korea	516	0.92	14	10	44	40	63.7
New Zealand	513	0.90	17	14	49	30	73.0
Slovenia	513	0.93	15	13	43	35	74.0
Australia	510	0.91	18	12	44	33	63.0
United Kingdom	509	0.84	17	11	37	35	69.2
Germany	509	0.96	17	16	42	34	74.6
Netherlands	509	0.95	19	13	47	31	64.5
Switzerland	506	0.96	18	16	43	29	55.4
Ireland	503	0.96	15	13	38	30	61.5
Belgium	502	0.93	20	19	48	27	78.7
Denmark	502	0.89	16	10	34	28	50.7
Poland	501	0.91	16	13	40	35	63.5
Portugal	501	0.88	17	15	31	38	65.2
Norway	498	0.91	19	8	37	26	34.0
United States	496	0.84	20	11	33	32	54.0
Austria	495	0.83	21	16	45	26	68.8
France	495	0.91	22	20	57	27	w
Sweden	493	0.94	22	12	44	25	65.0
Czech Republic	493	0.94	21	19	52	25	75.4
Spain	493	0.91	18	13	27	39	61.9
Latvia	490	0.89	17	9	26	35	58.7
Russia	487	0.95	18	7	29	26	43.5
Luxembourg	483	0.88	26	21	41	21	90.3
Italy	481	0.80	23	10	30	27	52.5
Hungary	477	0.90	26	21	47	19	80.1
Lithuania	475	0.90	25	12	36	23	59.6
Croatia	475	0.91	25	12	38	24	65.7
CABA (Argentina)	475	1.04	23	26	37	15	83.7
Iceland	473	0.93	25	5	28	17	49.7
Israel	467	0.94	31	11	42	16	59.7
Malta	465	0.98	33	14	47	22	69.2
Slovak Republic	461	0.89	31	16	41	18	70.4
Greece	455	0.91	33	13	34	18	60.1
Chile	447	0.80	35	17	32	15	66.5
Bulgaria	446	0.81	38	16	41	14	74.6
United Arab Emirates	437	0.91	42	5	30	8	34.0
Uruguay	435	0.72	41	16	32	14	68.8
Romania	435	0.93	39	14	34	11	60.4
Cyprus[3]	433	0.95	42	9	31	10	62.2
Moldova	428	0.93	42	12	33	13	55.7
Turkey	425	0.70	44	9	20	22	49.2
Trinidad and Tobago	425	0.76	46	10	31	13	70.1
Thailand	421	0.71	47	9	22	18	55.0
Costa Rica	420	0.63	46	16	24	9	70.0
Qatar	418	0.93	50	4	27	6	34.3
Colombia	416	0.75	49	14	27	11	64.4
Mexico	416	0.62	48	11	19	13	54.5
Montenegro	411	0.90	51	5	23	9	69.8
Georgia	411	0.79	51	11	34	8	53.0
Jordan	409	0.86	50	9	25	8	33.7
Indonesia	403	0.68	56	13	22	11	55.7
Brazil	401	0.71	57	12	27	9	58.0
Peru	397	0.74	58	22	30	3	79.3
Lebanon	386	0.66	63	10	26	6	39.9
Tunisia	386	0.93	66	9	17	5	52.3
FYROM	384	0.95	63	7	25	4	54.5
Kosovo	378	0.71	68	5	18	3	48.3
Algeria	376	0.79	71	1	8	7	30.8
Dominican Republic	332	0.68	86	13	25	0	66.4

1. ESCS refers to the PISA index of economic, social and cultural status.
2. A student is classified as resilient if he or she is in the bottom quarter of the PISA index of economic, social and cultural status (ESCS) in the country/economy of assessment and performs in the top quarter of students among all countries/economies, after accounting for socio-economic status.
3. Note by Turkey: The information in this document with reference to "Cyprus" relates to the southern part of the Island. There is no single authority representing both Turkish and Greek Cypriot people on the Island. Turkey recognises the Turkish Republic of Northern Cyprus (TRNC). Until a lasting and equitable solution is found within the context of the United Nations, Turkey shall preserve its position concerning the "Cyprus issue".
Note by all the European Union Member States of the OECD and the European Union: The Republic of Cyprus is recognised by all members of the United Nations with the exception of Turkey. The information in this document relates to the area under the effective control of the Government of the Republic of Cyprus.
Countries and economies are ranked in descending order of the mean score in science.
Source: OECD, PISA 2015 Database.
StatLink http://dx.doi.org/10.1787/888933432706

Figure I.6.2 presents countries' and economies' mean performance in science in PISA 2015 alongside a selection of indicators that map the dimensions of equity examined in this chapter. While these indicators do not capture all of the inequities that may exist within countries, they provide a reliable indication of levels of inclusion and fairness, particularly from an international perspective.

Two major indicators of inclusion are access to schooling and the percentage of students performing at or above the baseline level of skills. In 22 of the 24 countries/economies that perform above the OECD average in science, PISA samples cover more than 80% of the national population of 15-year-olds, implying that more than 8 in 10 young people in this age group are enrolled in grade 7 or above in school; the only exceptions to this pattern are B-S-J-G (China), where 64% are, and Viet Nam, where only 49% are. In addition, in all high-performing countries but Belgium, the proportion of students performing below proficiency Level 2 in science is below the OECD average. This means that the large majority of high-performing systems also achieve high levels of inclusion: they succeed in ensuring high levels of participation in education among 15-year-olds and in reducing the number of students who perform poorly.

Indicators of fairness in education opportunities confirm that high levels of equity and achievement need not be mutually exclusive. In 10 of the 24 high-performing systems in PISA 2015, the strength of the relationship between performance and socio-economic status is weaker than the OECD average, and in another 9 systems it is not significantly different from the average. Thus, among the most successful countries and economies in mean achievement, socio-economic disadvantage tends to play a relatively minor role in explaining variation in student performance. Similarly, in 15 of these 24 high-performing education systems, the difference in student performance associated with a one-unit increase on the PISA index of economic, social and cultural status is either below or similar to the OECD average. Only in three high-performing systems – Belgium, Singapore and Switzerland – are these two indicators of the relationship between student performance and socio-economic status stronger than average (Figure I.6.2).

Another indication that high equity and high performance can be achieved simultaneously is that, in 17 of these high-performing systems, the proportion of disadvantaged students who manage to perform better than predicted by their socio-economic status and at high international standards is above the OECD average (see the discussion on "resilient" students below).

The degree to which the variation in performance between schools can be attributed to students' and schools' socio-economic status can also be taken as an indicator of fairness. In countries where school performance varies considerably and where a high level of variation is accounted for by the average socio-economic status of the students in the schools, students are more likely to have different resources and opportunities depending on the school they attend, following the broader pattern of socio-economic segregation. In 20 of these 24 high-performing countries and economies, this indicator remains below or around the OECD average (below or within 10 percentage points, respectively).

The education systems that have been able to secure strong and equitable learning outcomes show others what is possible to achieve. Considering collectively the selected indicators presented in Figure I.6.2, Canada, Denmark, Estonia, Hong Kong (China) and Macao (China) stand out by achieving both high performance and high equity in education opportunities.

National income, spending on education and socio-economic heterogeneity

The countries and economies participating in PISA demonstrate that excellence and equity are attainable under a wide variety of conditions.

High national income is neither a prerequisite for nor a guarantee of high performance. As shown in Chapter 2, countries with higher national incomes are at a relative advantage in performance comparisons. However, the relationship between national income and mean performance is not deterministic, and countries and economies of similar wealth show very different mean performance in PISA 2015. Moreover, while there is also a positive relationship between spending per student and mean science performance, yet again, comparable mean science scores in PISA 2015 are achieved by countries and economies with very different levels of expenditure on education (Table I.2.13).

Socio-economic diversity can also coexist with high levels of achievement. In PISA, the level of socio-economic heterogeneity within each country and economy is best captured by the range between the 5th and 95th percentiles of the distribution on the PISA index of economic, social and cultural status.[6] Among the 24 high-performing education systems in the PISA 2015 science assessments, B-S-J-G (China), Portugal and Viet Nam show greater socio-economic diversity than the OECD average. By contrast, in Finland, Japan, Korea and the Netherlands, differences between students at the two extremes of the socio-economic distribution are smaller than the OECD average (Table I.6.2a).

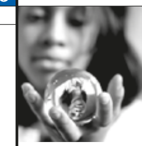


Figure I.6.3 ■ **Socio-economic contextual factors and indicators of equity in education**

System-level correlations

	Equity indicators				
	Coverage of the national 15-year-old population (PISA Coverage index 3)	Percentage of variation in science performance explained by students' socio-economic status	Score-point difference in science associated with a one-unit increase in the ESCS[1]	Percentage of resilient students[2]	Percentage of between-school variation in science performance explained by students' and schools' socio-economic status
OECD					
Per capita GDP	0.30	0.16	0.29	0.01	0.12
Expenditure in education ages 6-15	**0.39**	0.11	0.32	0.13	0.08
Socio-economic heterogeneity	**-0.69**	0.24	**-0.59**	**-0.37**	0.12
Partners					
Per capita GDP	**0.41**	-0.13	0.17	**0.33**	**-0.26**
Expenditure in education ages 6-15	**0.57**	0.10	**0.50**	**0.50**	0.00
Socio-economic heterogeneity	**-0.72**	0.23	**-0.52**	**-0.24**	0.07

1. ESCS refers to the PISA index of economic, social and cultural status.
2. A student is classified as resilient if he or she is in the bottom quarter of the PISA index of economic, social and cultural status (ESCS) in the country/economy of assessment and performs in the top quarter of students among all countries/economies, after accounting for socio-economic status.

Note: Correlation coefficients that are statistically significant at the 5% level are indicated in bold.

Source: OECD, PISA 2015 Database, Tables I.2.11, I.6.1, I.6.2a I.6.3a, I.6.7 and I.6.12a.

StatLink http://dx.doi.org/10.1787/888933432713

Figure I.6.3 shows correlations between these contextual factors and the indicators of equity in education presented above.

As expected, wealthier countries and economies, and those spending more on their education systems, tend to provide better access to schooling – a key indicator of inclusion – as measured by the PISA coverage of the national population of 15-year-olds. Inversely, greater levels of socio-economic heterogeneity appear negatively correlated with the capacity of countries/economies to ensure that all youth have equal opportunities to benefit from education. Still, some countries with socio-economic disparities greater than the OECD average, such as Luxembourg, Portugal and Tunisia, also manage to achieve high levels of coverage.

Socio-economic heterogeneity appears to be positively correlated with the percentage of variation in performance explained by socio-economic status. This means that, in more socio-economically diverse countries/economies, it is somewhat easier to predict students' performance based on their socio-economic status. Inversely, heterogeneity is negatively and more strongly correlated with performance differences between students from different socio-economic groups.[7] These correlations may reflect a certain technical constraint in measuring the impact of socio-economic status: in countries with greater socio-economic diversity, the impact associated with one standard deviation on the ESCS index does not fully capture differences between students at the extremes of the distribution, as they tend to be more than two standard deviations apart.

Overall, moderate correlation coefficients (i.e. with values *r*<.5) indicate that differences between countries' socio-economic conditions play a relatively minor role in explaining levels of equity in education. In other words, countries with similar levels of economic development, investment in education and socio-economic diversity can be home to both more and less equitable school systems.

ACCESS TO EDUCATION AMONG 15-YEAR-OLDS

Access to schooling is a prerequisite for achieving inclusion and equity in education. While having all eligible 15-year-olds enrolled in school does not guarantee that every student will acquire the skills needed to thrive in an increasingly knowledge-intensive economy, it is the first step towards building an inclusive and fair education system. Regardless of its average level of performance, any education system where a large proportion of 15-year-olds does not attend school cannot be considered an equitable system.

Globally, enrolment in secondary education has expanded dramatically over the past decades (Barro and Lee, 2013). Yet in many countries, the goal of universal enrolment in lower and upper secondary education is far from becoming a reality. According to UNESCO,[8] in 2014, 16.0% of the world's youth of lower secondary school age were out of school.

However, this rate varies greatly across world regions. For example, in sub-Saharan Africa, 34.0% of youth in this age group were not enrolled; 19.6% of youth in South and West Asia were not enrolled; nor were 7.6% of youth in Latin America and the Caribbean and 1.6% of adolescents of this age group in developed countries.

Household survey data from low- and middle-income countries consistently show that children from poor households, ethnic minorities or rural areas are significantly less likely to make the transition from primary to lower secondary school and from lower to upper secondary school, and are more likely to be delayed in their progression through the grade levels (UNESCO, 2015). In many regions, therefore, opportunities to participate in education remain unequally distributed, depending on students' socio-economic and immigrant backgrounds.

PISA's population coverage as a measure of inclusion in education

Among PISA-participating countries and economies, the majority of OECD countries achieved near-universal access to schooling at both primary and lower secondary levels well before PISA started measuring students' skills in 2000. Some countries that joined the OECD more recently, and some partner countries and economies, are further from securing universal enrolment for their 15-year-olds but have been gradually advancing towards this goal over the past decades.

Between 2003 and 2015, Mexico added more than 300 000 students and Turkey added more than 375 000 students to the total population of 15-year-olds enrolled in grade 7 or above, an increase of 24% and 52%, respectively. Among partner countries, over the same period, Brazil added more than 493 000 students eligible to participate in PISA, and between 2006 and 2015, Colombia added more than 130 000 students, representing increases in enrolment of 21% and 24%, respectively. In Mexico, the number of enrolled students grew at a faster rate than did the overall population of 15-year-olds, while in Brazil, Colombia and Turkey, enrolment grew in spite of a shrinking population of 15-year-olds (Table I.6.1). This means that, in all of these countries, the increase in enrolment rates resulted from an improved capacity to retain students as they progress through higher grades.

Beyond changes in absolute numbers, enrolment is a major indicator of the degree of inclusion in an education system. While PISA is not designed to estimate enrolment rates per se, it provides a range of indices that measure its coverage of the population of 15-year-olds enrolled in grade 7 or above in each country and economy (also known as the "target population"). PISA relies on an age-based definition of its target population to overcome comparability problems that arise from differences in the structures of national education systems. To be eligible to participate in PISA, students must be between 15 years and 3 months and 16 years and 2 months of age at the beginning of the assessment period, and enrolled in an educational institution in grade 7 or higher.

The best proxy for enrolment available in PISA is Coverage index 3 (CI3), which reflects the proportion of the national population of 15-year-olds (enrolled and not enrolled) who are represented by the PISA sample.[9] Values of CI3 can be taken to reflect the percentage of 15-year-olds excluded/not excluded from the school system. Low values of CI3 can therefore be interpreted as lower levels of access to schooling among 15-year-olds, and less inclusion in an education system.

In PISA 2015, among OECD countries, enrolment, as measured by CI3, was over 90% in 21 countries and between 80% and 90% in another 12 countries, implying that more than 9 in 10 15-year-olds in the first group and more than 8 in 10 in the second group are represented in PISA samples. Lower coverage rates are found only in Mexico (62%) and Turkey (70%). Among partner countries and economies that participated in PISA 2015, coverage differs more widely. Enrolment was above 90% in 14 out of these 37 education systems, between 80% and 90% in another 6 systems, between 70% and 80% in 9 systems, and below 70% in the remaining 8 systems, including a coverage rate of 49% in Viet Nam (Table I.6.1).

Overall, there are 20 countries in PISA 2015 where less than 80% of 15-year-olds are enrolled in school and eligible to participate in PISA. This implies that PISA results for these countries are not fully representative of their populations of 15-year-olds. It also signals that these school systems face serious challenges in becoming more inclusive and equitable.

Looking at the evolution of coverage over time, and taking as a benchmark the UNESCO global out-of-school rate for youth of lower secondary school age in 2014 (16%), average coverage across PISA assessments has been higher than 84% in all OECD countries except Chile (82%), Mexico (58%) and Turkey (56%). A comparison of coverage relative to 2003 (or the earliest year available for countries that joined PISA after 2003) also shows that, in the majority of OECD countries, coverage has remained stable or increased over time, and that changes in the national populations of 15-year-olds enrolled in grade 7 or above have typically mirrored the magnitude of changes in the total population of 15-year-olds (Table I.6.1).

Trends in access to schooling in selected countries with low coverage

Figure I.6.4 describes trends in access to schooling for a number of countries where coverage has consistently remained below the 84% threshold across PISA assessments, and where, therefore, access to schooling arguably remains a major challenge for achieving equity in education. For these countries, Figure I.6.4 also shows trends in the weighted number of students participating in PISA (i.e. the numerator for calculating the coverage index) and in the total population of 15-year-olds (i.e. the denominator for the coverage index). Changes in the former can be seen as indicative of true change in coverage, while changes in the latter reflect demographic changes.[10] The relative magnitude of the changes in these two variables indicates the main source of changes in coverage.

Figure I.6.4 ■ **Change between 2003 and 2015 in the coverage of 15-year-olds in grade 7 and higher**

Selected PISA-participating countries

		Coverage of the national 15-year-old population (PISA coverage index 3)					Change between 2015 and 2003 or earliest available year (PISA 2015 – PISA 2003)				
		PISA 2003	PISA 2006	PISA 2009	PISA 2012	PISA 2015	Coverage index 3	Total population of 15-year-olds		Weighted number of participating students	
		Index	Index	Index	Index	Index	% dif.	Absolute dif.	% dif.	Absolute dif.	% dif.
OECD	Mexico	0.49	0.54	0.61	0.63	0.62	13	64 947	3	321 345	30
	Turkey	0.36	0.47	0.57	0.68	0.70	34	-27 403	-2	444 086	92
Partners	Brazil	0.56	0.54	0.61	0.72	0.71	15	-47 673	-1	473 708	24
	Colombia	m	0.60	0.58	0.63	0.75	15	-136 558	-15	30 586	6
	Costa Rica	m	m	0.53	0.50	0.63	10	1 250	2	8 943	21
	Indonesia	0.46	0.53	0.53	0.63	0.68	22	252 321	6	1121 296	57
	Malaysia	m	m	0.78	0.79	0.76	-2	705	0	-8 924	-2
	Peru	m	m	0.73	0.72	0.74	1	-5 196	-1	4 131	1
	Thailand	0.69	0.72	0.73	0.72	0.71	2	-31 557	-3	-2 281	0
	Uruguay	0.63	0.69	0.63	0.73	0.72	9	-415	-1	4 511	13
	Viet Nam	m	m	m	0.56	0.49	-7	85 556	5	-81 658	-9

Note: Coverage index 3 is the percentage of the national population of 15-year-olds who are represented in the PISA sample (see *PISA 2015 Technical Report* [OECD, forthcoming]).

Source: OECD, PISA 2003, PISA 2006, PISA 2009, PISA 2012 and PISA 2015 Databases, Table I.6.1.

StatLink http://dx.doi.org/10.1787/888933432727

Results indicate that in Brazil, Costa Rica, Indonesia, Mexico, Turkey and Uruguay, coverage expanded greatly, and that changes in the percentage of the population of 15-year-olds enrolled in grade 7 or higher largely outweigh changes in the overall population of this age group. The decomposition of the CI3 trend suggests that, in these countries, changes in CI3 reflect real improvements in coverage. In Colombia, CI3 increased by 15 percentage points over time, but the change appears to be primarily the result of a decline in the total population of 15-year-olds. In Malaysia, Peru and Thailand, CI3 remained stable, suggesting no significant improvements in coverage over time. By contrast, in Viet Nam, coverage shrank by 7 percentage points between 2012 and 2015 as enrolment decreased while the total population of 15-year-olds increased.

How low coverage may affect the interpretation of PISA results

In countries and economies with low values on the coverage index, a significant proportion of eligible 15-year-olds does not sit the PISA assessment. While PISA results are representative of the target population in all adjudicated countries/economies, they cannot be readily generalised to the entire population of 15-year-olds in countries where a large percentage of 15-year-olds are not enrolled in grade 7 or above. A source of concern is that young people not covered by PISA differ from peers who do participate in the test in one or several characteristics that are associated with the outcomes assessed in PISA. The results thus need to be carefully interpreted when considering those countries where many youth are excluded from the target population.

First, caution is needed when making performance comparisons between countries with very different coverage rates. Assuming that students omitted from the PISA samples are likely to perform at lower levels than students represented in the samples, comparisons will likely be biased in favour of countries with lower coverage rates. For example, B-S-J-G (China),

Hong Kong (China), Korea and Viet Nam are all high performers in PISA, with average scores ranging from 515 to 525 points in science; but while coverage rates stand around 90% in both Hong Kong (China) and Korea, they are only 64% in B-S-J-G (China) and 49% in Viet Nam (Table I.6.1).

Moreover, when comparing the performance of education systems over time, it is important to consider that low coverage can also lead to an underestimation of the real improvements achieved by education systems that expanded access to schooling and/or improved performance over time. Typically, as previously omitted student populations gain access to schooling, a larger proportion of low-performing students will be included in PISA samples. In countries or economies that expanded access to education, adjustments for changes in the coverage and composition of target populations can shed light on the real, and potentially larger, magnitude of improvements. Taking into account changes in population coverage over time also serves to assess the extent to which a deterioration in mean performance results from a lower quality of education or from the improved capacity of an education system to include students who, in the past, would not have been enrolled, or who would still have been in lower grades than their 15-year-old peers.

There is a range of analytical strategies to estimate the impact that using proxy results for out-of-school 15-year-olds can have on an education system's mean performance in PISA. The simplest of these strategies is to assume that, if students currently not enrolled in school and/or in eligible grades sat the PISA test, they would all score at a similar level of performance on the PISA scale. Then, these hypothetical results are factored in, weighted by the proportion of out-of-school students in the population of 15-year-olds. Using this strategy, Chapter 2 presents average three-year trends for the median and top quartile of science performance of 15-year-olds, after adjusting for changes in coverage over time.

Low coverage can also have an impact on the analysis of equity outcomes within or between countries and economies. As noted above, at different stages of childhood and adolescence, disadvantaged youth are more often out of school or below the modal grade that corresponds to their age, and as a result they are less likely to meet the criteria for eligibility in the PISA target populations. This means that inequalities related to students' socio-economic and immigrant backgrounds are likely to be underestimated when coverage is low due to a sample selection process that makes disadvantaged students more likely to be excluded from the sample.

The relationship between student performance and socio-economic status can appear similar among countries and economies with large gaps in coverage; but extending coverage in countries with lower levels of inclusion may reveal a different picture. For instance, in Belgium, B-S-J-G (China) and the Czech Republic, students' socio-economic status explains a similar percentage, about 19%, of the variation in student performance, while coverage is about 30 percentage points lower in B-S-J-G (China) than in the Czech Republic and Belgium (Figure I.6.2). If, in B-S-J-G (China), socio-economic status were a stronger predictor of performance among the third of 15-year-olds who are not represented in the PISA sample than among those who are (a hypothesis that cannot be tested with PISA data), then the strength of the socio-economic gradient in B-S-J-G (China) would likely differ from that observed in the other two countries.

Similarly, for Costa Rica, Indonesia, Lebanon, Montenegro, Thailand, Turkey and Viet Nam, the slope of the socio-economic gradient is significantly below the OECD average. In these countries and economies, a one-unit change on the PISA index of economic, social and cultural status is associated with a difference of between 20 and 25 score points in science. Among this group, the coverage rate in Montenegro is at least 20 percentage points higher than in the rest of the countries (Figure I.6.2). Thus, the slope of the socio-economic gradient can be taken as more representative of the influence that socio-economic status has on the skills of the overall population of 15-year-olds in Montenegro. Performance differences between students at the upper and lower ends of the distribution of socio-economic status would also likely increase if coverage were extended in countries with a large share of out-of-school youth.

In order to gain further insight into the impact of non-enrolment or delayed progression on performance and equity, it is important to distinguish among the various reasons why some young people have not been included in PISA samples in their respective countries and economies, and to estimate the relative incidence of these potential causes for omission. Some youth may have never enrolled in formal schooling, whereas others may have dropped out after a period of enrolment; yet others may still be in the school system but have not reached grade 7.[11] As this information cannot be derived from the PISA coverage index, complementary sources of data need to be used. For instance, by combining information from administrative and household survey data, it is often possible to make more fine-grained assumptions about the likely performance and socio-economic profile of youth who are out of school or severely delayed in their progression through school (Box I.6.2). This represents another avenue for estimating countries' average performance in PISA and levels of equity in education.

Box I.6.2. **Combining household surveys and PISA data to better estimate the quality and equity of education systems with low coverage**

There are a variety of strategies to estimate the scores that students who are not covered by PISA would have attained had they sat the PISA test, and to measure education systems' levels of fairness (i.e. equality of opportunity) once access to education (i.e. enrolment) has been taken into account. These strategies vary according to the different assumptions they make about the reasons why students are not enrolled in school or are at a lower grade than expected, and about what their actual but unmeasured level of skills would be.

A common feature of these approaches is their reliance on national government data and household surveys, which can also be part of internationally co-ordinated data collection. These sources cover populations in and out of school, and provide detailed information on non-enrolment, grade progression and dropout in relation to students' socio-economic and demographic characteristics. PISA, which provides a reliable assessment of learning outcomes, cannot, by design, provide this type of information as it takes schools, rather than households, as its sampling unit. Combining data from PISA (or other international assessments of learning outcomes) and national surveys is a way to blend the benefits of both data sources and address issues related to sample coverage. For instance, Ferreira and Gignoux (2014) used household surveys to assess the sensitivity of inequality measures to sample selection in four countries with low coverage rates in PISA 2006: Brazil, Indonesia, Mexico and Turkey. Relying on information about the characteristics of 15-year-olds in these ancillary datasets and sample re-weighting methods, their results suggest that equity indicators in these four countries are robust to selection on three observed variables (gender, mother's education and father's occupation). However, sample selection on unobserved student characteristics would result in large increases in both the variance of student scores and the percentage of variance in performance explained by pre-determined circumstances. In the same vein, Spaull and Taylor (2015) combine household surveys with information on grade completion and surveys providing data on cognitive outcomes for 11 sub-Saharan African countries to construct composite measures of education quantity and quality. These measures, which distinguish between children who never enrol in school or drop out at an early age, and children who complete target grades but remain illiterate and innumerate, suggest that learning deficits outweigh access deficits in all these countries.

As a general rule, the more information that is known about out-of-school adolescents, the fewer the assumptions needed for the predictions of models examining both performance and equity, and the better these assumptions can be grounded empirically. In countries and economies with low access to schooling, combining responses to the following questions about out-of-school students is of particular relevance:

- How many adolescents are out of the school system or enrolled substantially below their expected grade?
- How early did out-of-school adolescents leave the school system?
- What are the characteristics of students outside the school system and/or significantly delayed in their grade progression, and how do they compare with students covered by the PISA assessment?
- Is low performance the main reason why students leave the education system or are delayed in their grade progression?

The more out-of-school adolescents there are, the poorer they are and the earlier they left the school system, the larger the impact that sample omission will likely have on average PISA scores and on estimates of levels of equity in these school systems.

Ultimately, the best solution is to directly measure the knowledge and skills of out-of-school adolescents, particularly in education systems where they represent a large proportion of 15-year-olds. This is the case in the countries that participate in PISA for Development – a PISA assessment tool tailored for emerging and developing economies – where the skills of students in and outside of the school system are evaluated (Box I.6.3).

Box I.6.3. **Assessing the skills of non-enrolled students in PISA for Development**

The PISA for Development (PISA-D) initiative launched by the OECD and its partners aims to make PISA more accessible and relevant to low- and middle-income countries. PISA-D is enabling a wider range of countries to use PISA assessments for monitoring progress towards nationally set targets for improvement, for analysing the factors associated with student learning, particularly among poor and marginalised populations, for building the capacity of national institutions, and for tracking international education targets set out in the Sustainable Development Goals adopted by the United Nations General Assembly in 2015. As of July 2016, eight countries are participating in the PISA-D initiative: Cambodia, Ecuador, Guatemala, Honduras, Panama, Paraguay, Senegal and Zambia.

In particular, PISA-D responds to the needs of low- and middle-income countries where a sizeable proportion of 15-year-olds is not enrolled in school. The project includes three technical strands that enhance the PISA framework. The first focuses the PISA test instruments on the lower levels of performance. The second enhances contextual questionnaires and data-collection instruments to capture the diverse situations of students in low- and middle-income countries. The third strand develops methods and approaches to incorporate out-of-school 15-year-olds in the assessment, because countries are interested in learning about the skills acquired by all children, not just those who attend school.

Including out-of-school youth in the survey makes PISA-D unique in the landscape of large-scale international assessments. The project explores methodologies and data-collection tools for out-of-school youth both to assess their skills, competencies and non-cognitive attributes, and to obtain better actionable data on the characteristics of these children, the reasons why they are not in school, and on the magnitude and forms of exclusion and disparities.

If successful, this third strand of PISA-D will inform strategies, in future rounds of PISA, to measure the competencies of out-of-school 15-year-olds, providing a context for interpreting the in-school results for PISA-participating countries that have sizeable proportions of out-of-school 15-year-olds. With this enhancement, PISA would be able to offer countries an important indicator of human capital in the population as a whole, not just among those who have attained grade 7 and above by the time they are 15 years old. The enhancement would also help monitor progress towards the education Sustainable Development Goal 4, which emphasises ensuring that all children and young people achieve at least minimum levels of proficiency in reading and mathematics.

Source: www.oecd.org/pisa/aboutpisa/pisafordevelopment.htm; Carr-Hill (2015).

DISPARITIES IN PERFORMANCE, BY SOCIO-ECONOMIC STATUS

Home background influences success in education, and schooling can either reinforce or mitigate that influence. Although poor performance in school does not automatically stem from socio-economic disadvantage, the socio-economic status of students and schools can have a powerful influence on learning outcomes. Because advantaged families are better able to enhance the effect of schooling, because students from advantaged families attend higher-quality schools, or because schools are simply better-equipped to nurture and develop young people from advantaged backgrounds, schools may sometimes reproduce existing patterns of socio-economic advantage. However, because schools are also environments that harmonise children's learning experiences, and because they can serve to channel resources towards disadvantaged children, schools can also help create a more equitable distribution of learning opportunities and outcomes (Downey and Condron, 2016). The degree to which reinforcing or compensatory mechanisms prevail depends both on the level of socio-economic inequality in a country/economy and on the characteristics of its school system.

How performance differences relate to socio-economic disparities among students

Examining the strength and slope of the socio-economic gradient

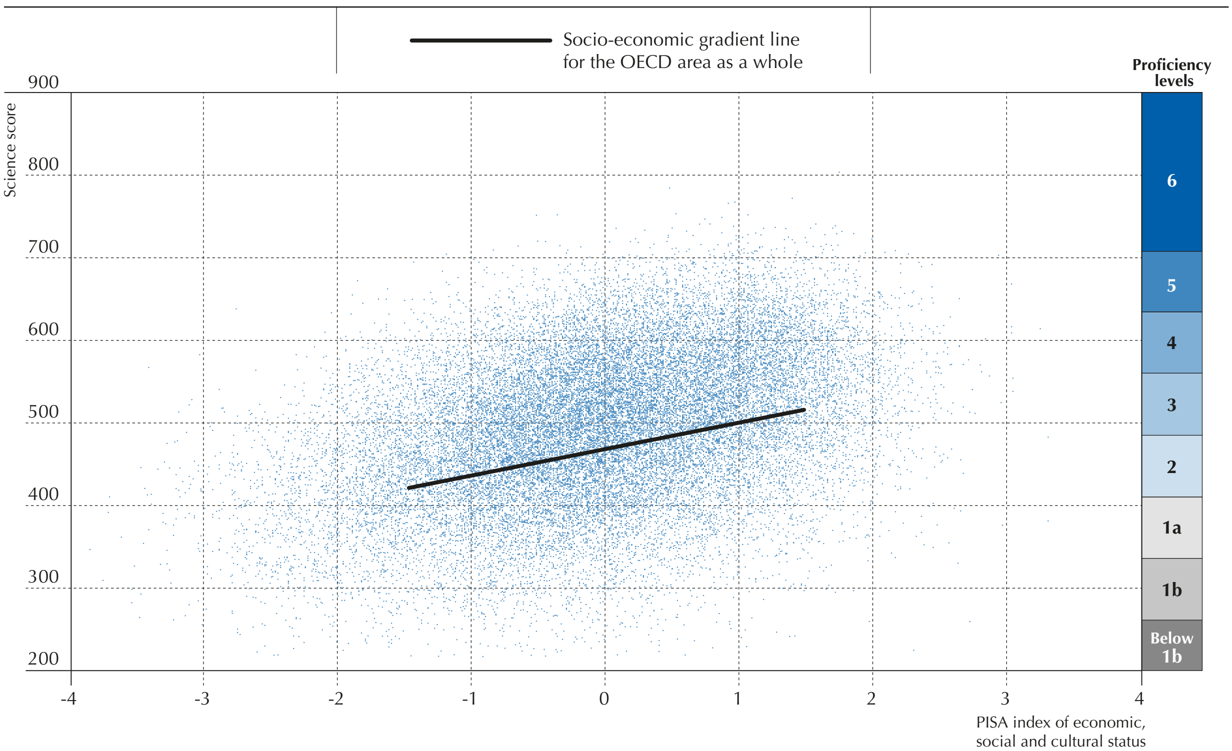
While many disadvantaged students succeed at school, including those who achieve at high levels internationally, socio-economic status is associated with significant differences in performance in most countries and economies that participate in PISA. Advantaged students tend to outscore their disadvantaged peers by large margins; and those differences in performance may also be compounded by other factors.

Figure I.6.5 shows the overall relationship between students' socio-economic status and performance across all countries and economies that participated in PISA 2015, as depicted by the socio-economic gradient. The gradient line describes the typical performance of a student given his or her socio-economic status. The dispersion of dots around the gradient line in Figure I.6.5 indicates that the relationship between student performance and socio-economic status is far from deterministic: many disadvantaged students score well above what is predicted by the gradient line, while a sizeable proportion of students from privileged families perform worse than expected, given their background. In fact, for any group of students with similar backgrounds, the range in performance is considerable.

The socio-economic gradient summarises many of the aspects of equity in education that can be analysed through PISA. Two major aspects of this relationship are the strength and the slope of the socio-economic gradient.

The strength of the socio-economic gradient refers to how well socio-economic status predicts performance. When a student's actual performance is not the same as would be expected given his or her socio-economic status (as when the dots in Figure I.6.5 are far from the dark line), the socio-economic gradient is considered to be weak. When socio-economic status becomes a good predictor of performance (and the dots in the figure are close to the dark line), then the gradient is considered strong.

Figure I.6.5 ■ **Students' socio-economic status and average performance across OECD countries**



Note: Each dot represents an OECD student picked at random out of ten OECD students.
Source: OECD, PISA 2015 Database.
StatLink http://dx.doi.org/10.1787/888933432735

The strength of the gradient provides an indication of the extent to which education policies should target socio-economically disadvantaged students specifically, or low-performing students in general. If the relationship between social background and performance is weak, then other factors are likely to have greater bearing on student achievement, and focusing on students with low socio-economic status might not be so effective. By contrast, when the relationship is strong, then effective policies would be those that eliminate barriers to high-performance linked to socio-economic disadvantage (Box I.6.4). The strength of the socio-economic gradient is measured by the proportion of the variation in performance that is explained by differences in socio-economic status.

On average across OECD countries, students' socio-economic status explains a significant share of the variation in their performance in the core subjects assessed in PISA 2015. For science, 12.9% of the variation in student performance within each country is associated with socio-economic status. In 15 countries and economies, the strength of the socio-economic gradient is above average and students' socio-economic status explains more than 15% of the variation in performance; in Ciudad Autónoma de Buenos Aires (Argentina) (hereafter "CABA [Argentina]"), France, Hungary, Luxembourg and Peru, it accounts for more than 20% of this variability.

By contrast, in 26 countries the strength of the gradient remains below the OECD average; in OECD countries Canada, Estonia, Iceland, Italy, Latvia, Norway and Turkey, students' socio-economic status explains less than 10% of the variation in their performance in science (Table I.6.3a). Similar results are observed for other domains of assessment where, on average across OECD countries, socio-economic status accounts for 11.9% of the variation in reading performance and 13.0% of the variation in mathematics performance (Tables I.6.3b and I.6.3c).

The slope of the socio-economic gradient refers to the impact of socio-economic status on performance, or the average difference in performance between two students whose socio-economic status differs by one unit on the PISA index of economic, social and cultural status. That is, the slope shows the magnitude of the impact on performance that socio-economically targeted policies could potentially have (Box I.6.4). As such, it is a summary measure of the differences in performance observed across socio-economic groups. A flat line in Figure I.6.5, parallel to the horizontal axis, would imply that there are only small differences in performance related to socio-economic status; in other words, advantaged and disadvantaged students would perform equally well. A steep line, however, would signal large performance differences related to socio-economic status.

The upward slope of the line in Figure I.6.5 indicates that advantaged students generally perform better than disadvantaged students. On average across OECD countries, a one-unit increase on the PISA index of economic, social and cultural status is associated with an increase of 38 score points in the science assessment. In the Czech Republic and France, the impact of socio-economic status on performance is largest: a one-unit increase in ESCS is associated with an improvement of more than 50 score points in science; in Austria, Belgium, Hungary, Malta, the Netherlands, New Zealand and Singapore, the increase is associated with an improvement of between 45 and 50 score points.

By contrast, in 13 countries and economies, the associated change in performance is less than 25 score points; this group includes OECD countries Mexico and Turkey (Table I.6.3a). In both reading and mathematics, the average slope across OECD countries is only one score point below that in science, and values of the slope across domains of assessment show very high correlations (*r*=>.94) across countries (Tables I.6.3b and I.6.3c).

Relationship between socio-economic status and performance

Another way to examine the impact of socio-economic status on performance is by looking at differences in performance across students from various socio-economic groups. For instance, on average across OECD countries, advantaged students – those in the top quarter of the distribution on the PISA index of economic, social and cultural status within their countries/economies – score 88 points higher in science than disadvantaged students – those in the bottom quarter of the distribution. In B-S-J-G (China), France, Hungary and Luxembourg, the gap between the two groups of students is largest: 115 score points or more. Among OECD countries, this difference is smallest in Estonia, Iceland, Latvia, Mexico and Turkey, where it ranges between 50 and 70 score points (Table I.6.3a).

In PISA 2015, across countries and economies, the strength and the slope of the socio-economic gradient in science performance show a positive, medium-to-high correlation (*r*=.63). This means that education systems with greater fairness in education outcomes, as measured by the percentage of the variation in student performance explained by socio-economic status, tend to show smaller performance differences between students from different socio-economic groups, as measured by the average change in performance scores associated with a one-unit change on the PISA index of economic, social and cultural status. That is, most countries show either steep, strong socio-economic gradients or flat, weak gradients.

But there are exceptions to this pattern. Korea is the only country where performance differences related to socio-economic status are relatively large (above the OECD average), but the relationship between performance and socio-economic status is relatively weak (below the OECD average). Inversely, Chile, Peru and Uruguay are the only countries where the relationship between performance and socio-economic status is strong, but performance differences related to socio-economic status are small; thus these countries show flat, strong socio-economic gradients (Figure I.6.2).

Box I.6.4. **A framework for policies to improve performance and equity in education**

Building on the policy framework of previous PISA reports (Willms, 2006; OECD, 2013a), this chapter identifies two main measures of equity in education outcomes: the strength of the relationship between performance and socio-economic status (the strength of the socio-economic gradient) and the size of performance differences across socio-economic groups (the slope of the socio-economic gradient).

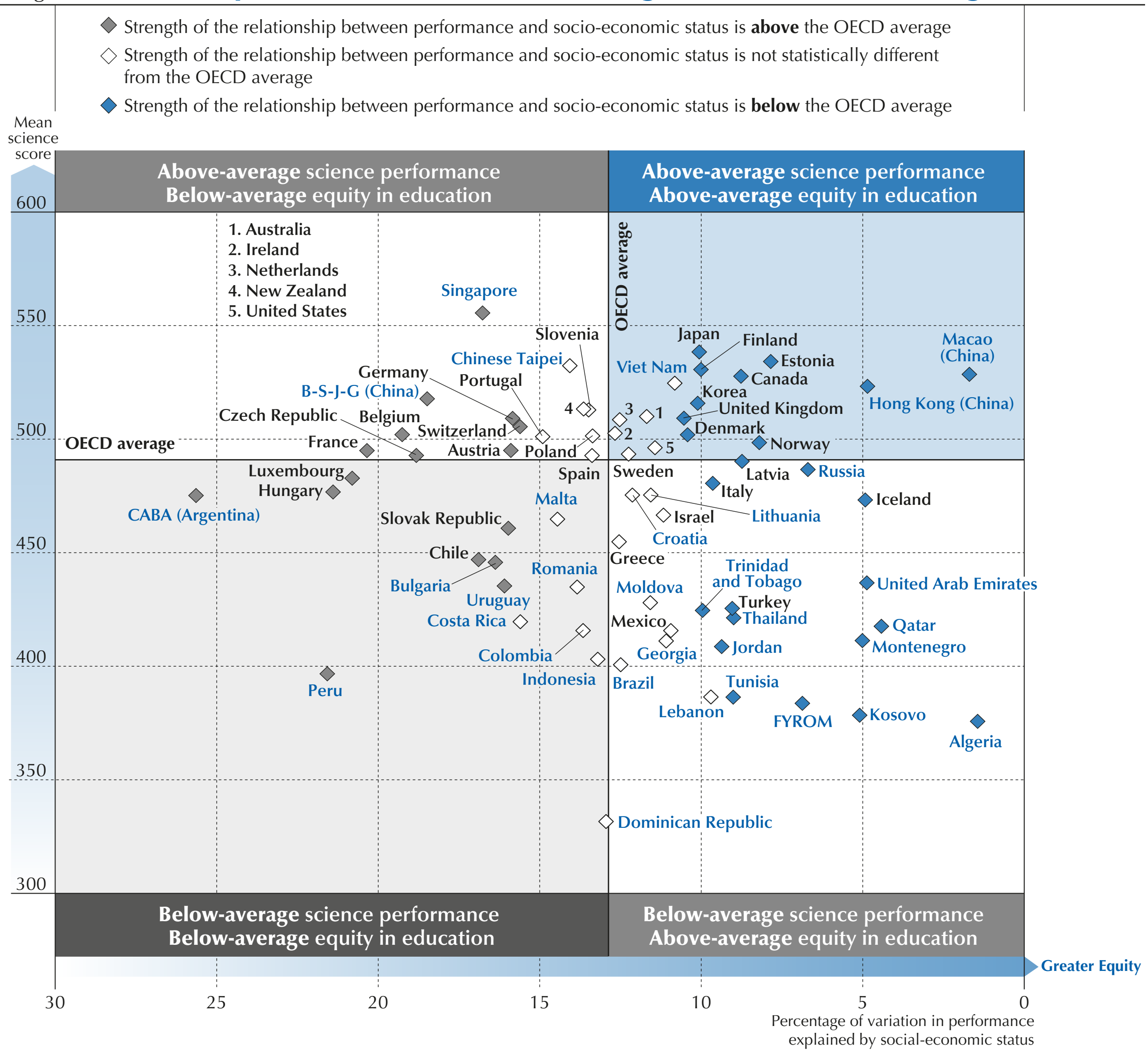
While these two measures are positively correlated, they capture different aspects of the relationship between students' performance and socio-economic status, with potentially different policy implications. Considering these two dimensions of equity in education can help policy makers map a way forward to raise quality and improve equity:

- When performance differences across the socio-economic spectrum are small (i.e. slope is flat) and students often perform better (or worse) than expected given their socio-economic status (i.e. strength is low), a common policy goal is to improve performance across the board. In these cases, universal policies tend to be most effective. These types of policies include changing curricula or instructional systems and/or improving the quality of the teaching staff.
- When performance differences across the socio-economic spectrum are large (i.e. slope is steep) and students often perform better (or worse) than expected given their socio-economic status (i.e. strength is low), improving performance among the lowest performers is typically a major priority, regardless of their socio-economic status. In these cases, targeting disadvantaged students only would provide extra support to some students who are already performing relatively well, while it would leave out some students who are not necessarily disadvantaged but who perform poorly. Policies can be targeted to low-performing students if these students can be easily identified, or to low-performing schools, particularly if low performance is concentrated in particular schools. Examples of such policies involve evaluation, feedback and appraisals for students, teachers and schools, or establishing early-warning mechanisms and providing a modified curriculum or additional instructional support for struggling students.
- When performance differences across the socio-economic spectrum are small (i.e. slope is flat) but students perform as expected given their socio-economic status (i.e. strength is high), policy can focus on dismantling barriers to high performance associated with socio-economic disadvantage. In these cases, effective compensatory policies should target disadvantaged students or schools, providing them with additional support, resources or assistance. Free lunch programmes or free textbooks for disadvantaged families are examples of these policies.
- When performance differences across the socio-economic spectrum are large (i.e. slope is steep) and students perform as would be expected given their socio-economic status (i.e. strength is high), reducing performance differences and improving performance, particularly among disadvantaged students, are combined policy goals. A mix of policies targeting low performance and socio-economic disadvantage can be most effective in these cases, since universal policies may be less effective in improving both equity and performance simultaneously.

While a single measure cannot capture the many complexities of equity in education, the strength of the socio-economic gradient provides a useful benchmark to compare school systems, particularly in relation to their average levels of achievement. As noted above, PISA consistently finds that high performance and greater fairness in education opportunities and outcomes are not mutually exclusive. In 10 of the 24 countries and economies that scored above the OECD average in science in PISA 2015, the strength of the relationship between student performance and socio-economic status is below the OECD average (Figure I.6.6). School systems in Canada, Denmark, Estonia, Finland, Hong Kong (China), Japan, Korea, Macao (China), Norway and the United Kingdom achieve high performance in science, and in Latvia average performance, while the relationship between student performance and socio-economic status is significantly weaker than average. By this measure, school systems in Australia, Ireland, the Netherlands, New Zealand, Poland, Portugal, Slovenia and Chinese Taipei achieve high science performance with a level of fairness similar to the OECD average.[12]

While socio-economic status remains a strong predictor of performance in many countries, another consistent finding from PISA is that poverty is not destiny. Many disadvantaged students succeed in attaining high levels of performance, not only within their own countries and economies, but also when considered globally.

Figure I.6.6 ▪ **Mean performance in science and strength of the socio-economic gradient**



Notes: The correlation between a country's/economy's mean science score and the strength of the socio-economic gradient is 0.17.
Only countries and economies with available data are shown.
Source: OECD, PISA 2015 Database, Table I.6.3a.
StatLink http://dx.doi.org/10.1787/888933432747

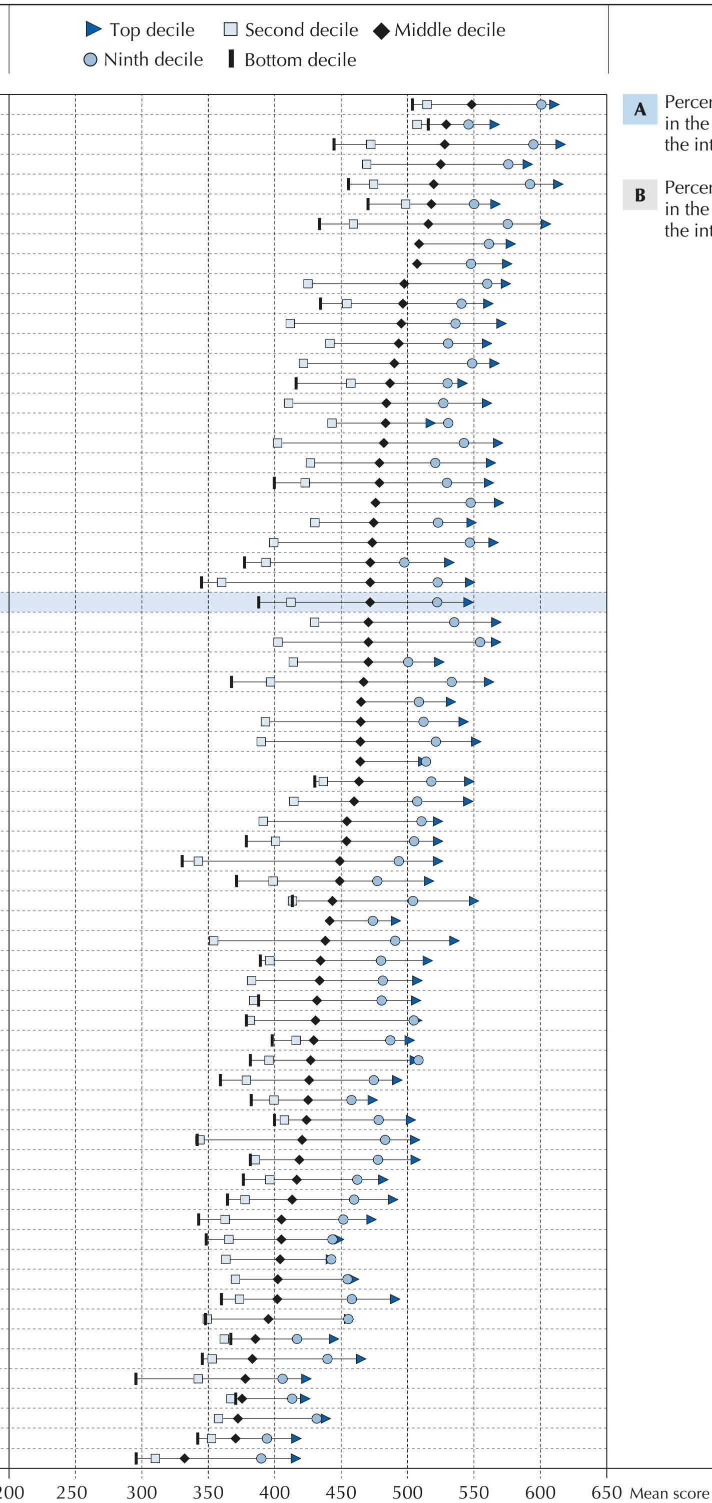
Figure I.6.7 shows performance differences by international deciles of the PISA index of social, economic and cultural status – that is, by placing students on the same scale and allowing a comparison of the performance of student groups from similar socio-economic contexts across countries and economies. This analysis reveals, for instance, that, in Macao (China) and Viet Nam, students facing the greatest disadvantage (i.e. those in the bottom decile of the distribution of the ESCS index internationally) have average scores over 500 points in the science assessment, significantly above the OECD mean score of 493 points, which reflects the performance of students from all socio-economic backgrounds. Such a high level of achievement also means that these disadvantaged students in Macao (China) and Viet Nam outperform the most advantaged students (i.e. those in the top decile of the distribution of the ESCS index internationally) in about 20 other PISA-participating countries and economies.

These results are testimony to how widely the performance of students of similar socio-economic status can vary across school systems. Of course, when comparing countries and economies that differ substantially in their national wealth and socio-economic heterogeneity, the proportion of 15-year-old students at each decile on the international scale will vary considerably. However, large differences in performance can also be observed between countries where similar percentages of students have similar socio-economic status. For instance, in Hong Kong (China), about 26% of students are in the bottom two deciles of the PISA index of economic, social and cultural status internationally, and their average science score is above 485 points.

A corrigendum has been issued for this page. See: http://www.oecd.org/about/publishing/Corrigenda-PISA2015-VolumeI.pdf

Figure I.6.7 ▪ Mean performance in science, by international decile on the PISA index of economic, social and cultural status

	A	B
Viet Nam	2	76
Macao (China)	9	22
B-S-J-G (China)	8	52
Japan	11	8
Singapore	27	11
Hong Kong (China)	12	26
Chinese Taipei	14	12
Estonia	23	5
Finland	33	2
Korea	9	6
Portugal	24	28
Germany	39	7
Canada	48	2
Poland	13	16
Spain	20	31
United Kingdom	35	5
Latvia	11	25
Slovenia	25	5
Switzerland	31	8
Australia	35	4
New Zealand	29	5
Ireland	31	5
Czech Republic	16	9
Denmark	53	3
Hungary	22	16
OECD average	27	12
Netherlands	28	4
France	18	9
Italy	24	15
Belgium	34	7
Norway	45	1
Sweden	39	3
Austria	26	5
Russia	24	5
United States	32	11
Croatia	17	10
Lithuania	24	12
CABA (Argentina)	39	18
Slovak Republic	22	8
Chile	18	27
Luxembourg	34	14
Iceland	57	1
Malta	26	13
Uruguay	13	39
Greece	26	13
Romania	9	20
Israel	29	6
Turkey	4	59
Indonesia	1	74
Moldova	7	28
Mexico	8	53
Thailand	8	55
Bulgaria	28	13
Colombia	8	43
Costa Rica	14	38
Trinidad and Tobago	18	14
Peru	9	50
Jordan	13	21
Montenegro	17	11
United Arab Emirates	42	3
Brazil	14	43
Georgia	12	19
Tunisia	15	39
Lebanon	10	27
FYROM	18	13
Algeria	4	52
Qatar	48	3
Kosovo	19	10
Dominican Republic	7	40



A Percentage of students in the **top** decile of the international ESCS[1] index

B Percentage of students in the **bottom** decile of the international ESCS index

1. ESCS refers to the PISA index of economic, social and cultural status.

Notes: International deciles refer to the distribution of the PISA index of economic, social and cultural status across all countries and economies.

Only countries and economies with available data are shown.

Countries and economies are ranked in descending order of the mean science performance of students in the middle decile of the PISA index of economic, social and cultural status.

Source: OECD, PISA 2015 Database, Table I.6.4a.

StatLink http://dx.doi.org/10.1787/888933432757

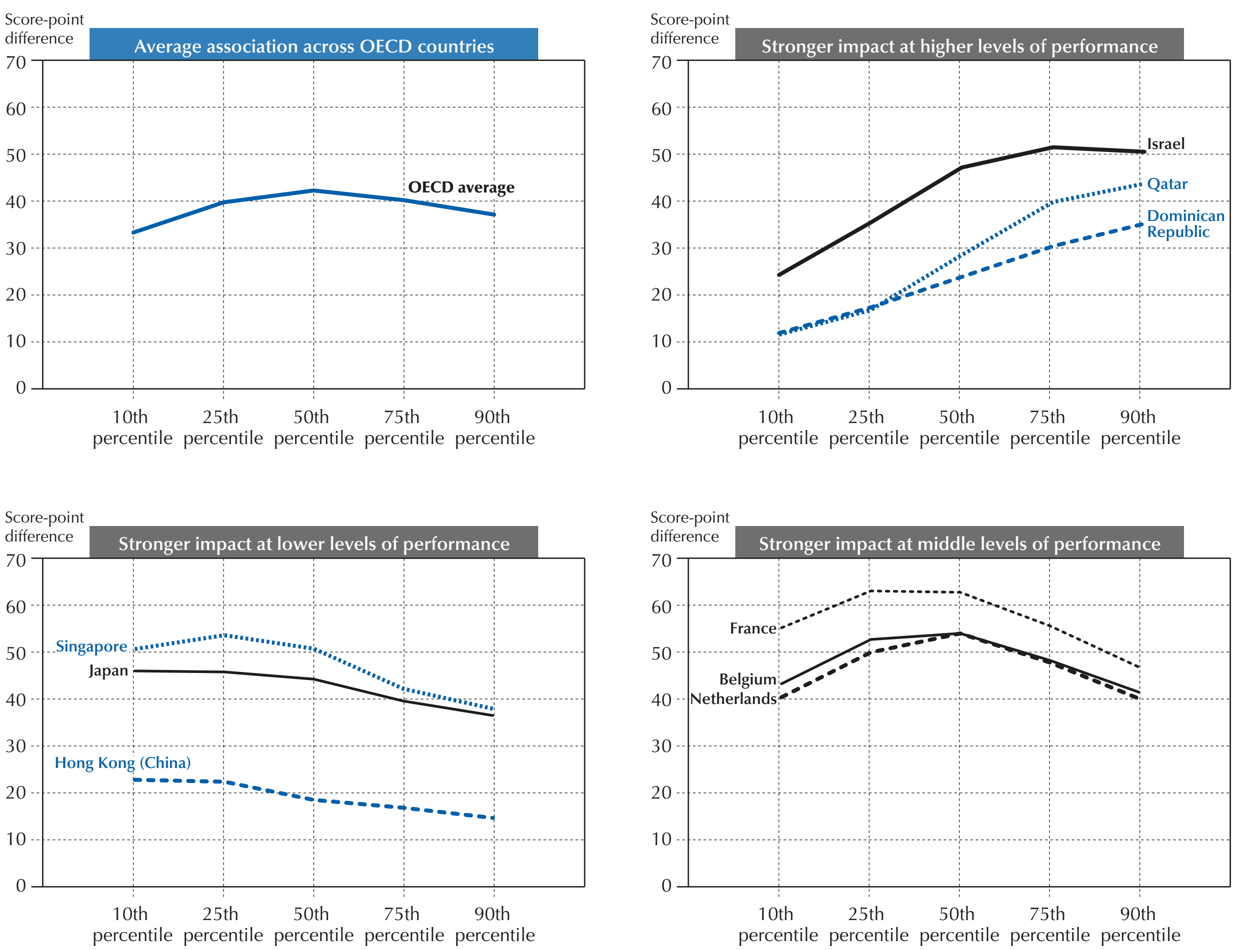
In Chile and Moldova, a similar percentage of students are in this category, while their average scores in science are about 100 score points lower. Likewise, there are large performance differences between countries with comparable percentages of advantaged students. For example, in both Korea and Peru, only 9% of students are in the top two deciles of the ESCS index internationally, but in Korea these students' average performance is above 560 points, whereas in Peru it is around 460 score points.

Socio-economic status as a predictor of low and high performance

When assessing fairness in education systems, it is also informative to examine the influence that socio-economic status has on low- and high-achieving students – that is, whether and how much its impact varies at low and high levels of performance.

Figure I.6.8 describes the relationship between socio-economic status and five different levels of student performance in science.[13] While the results reported above indicate that socio-economic status is strongly and positively associated with changes in average scores, this analysis addresses the question of whether the pattern of association varies depending on students' level of performance. If there were no variation in this relationship for low- and high-performing students, then the lines of the socio-economic gradient depicted in Figure I.6.8 would be flat. By contrast, a changing pattern of association would result in a curved line – implying a greater or lesser impact of socio-economic status, depending on the level of performance.

Figure I.6.8 ▪ **How high and low performance are related to socio-economic status**



Note: Score-point differences are quantile regression estimates of science performance on the PISA index of economic, social and cultural status (ESCS).
Source: OECD, PISA 2015 Database, Table I.6.5.
StatLink http://dx.doi.org/10.1787/888933432762

The upper-left panel of Figure I.6.8 shows that, on average across OECD countries, the impact of socio-economic status on performance is slightly weaker among both low- and high-performing students (a one unit-change in ESCS is associated with a performance difference of 33 score points among students in the 10th percentile of the performance distribution, and with a difference of 37 score points among students in the 90th percentile), and stronger for students who perform around the median (for whom a one-unit change in ESCS is associated with a performance difference of 42 score points).

By comparison, the average slope of the socio-economic gradient, associated with a performance difference of 38 score points, applies to all students, regardless of their level of performance. Although differences are small, they suggest that an increase in socio-economic status may translate into improvements in performance of varying magnitudes across the spectrum of performance. In some countries, for example, higher socio-economic status may be more important for avoiding low performance, whereas in others it may be of greater help for achieving high performance.

Indeed, the average impact masks significant differences in the pattern of association across countries and economies. The upper-right panel of Figure I.6.8 shows how, in the Dominican Republic, Israel and Qatar, the impact of socio-economic status is more pronounced among higher-performing students (those at the 75th and 90th percentiles of the performance distribution) than among lower-performing students (those at the 25th and 10th percentiles). This suggests that, in these countries, coming from an advantaged background is more of a prerequisite for being a high performer.

The bottom-left panel of Figure I.6.8 shows that, in Hong Kong (China), Japan and Singapore, the opposite pattern holds: the impact of socio-economic status is stronger among low performers than among high performers. This indicates that, in these school systems, socio-economic advantage acts more as a protection against low performance than as a springboard to high achievement.

The bottom-right panel shows how, in another group of countries including Belgium, France and the Netherlands, the association between students' performance and socio-economic status mirrors the average pattern in OECD countries but in a more pronounced way. In these countries, socio-economic status matters mostly for students who score around average in science. This may be related to the fact that, in these systems, socio-economic status influences the decisions to sort students who perform at average levels into different tracks, helping to secure better opportunities for middling students with higher status, and potentially interfering to a greater extent with performance-based sorting mechanisms.

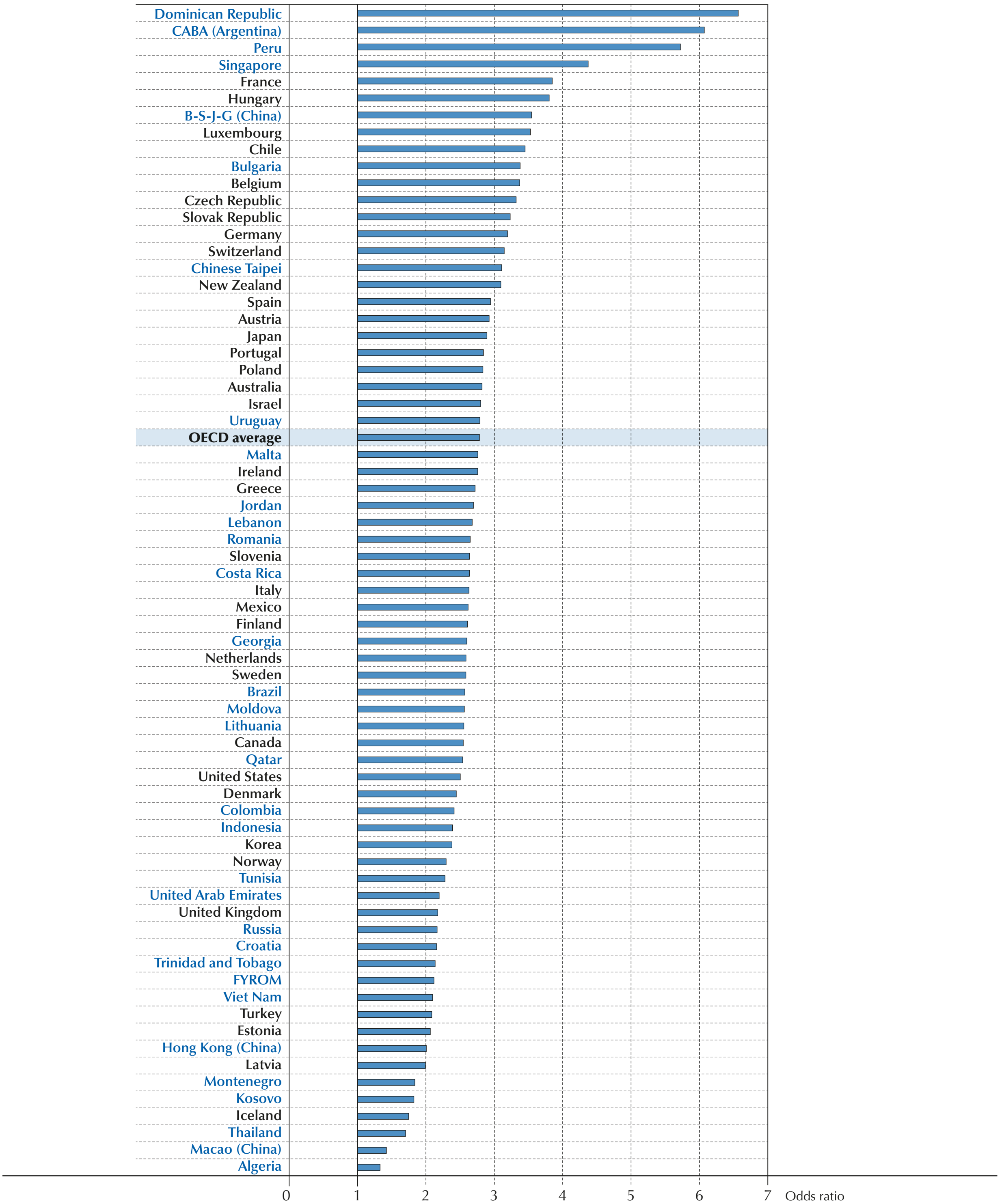
While the examples highlighted in Figure I.6.8 illustrate the largest differences in how socio-economic status is related to performance at various levels, non-linear patterns of association are observed elsewhere too. Indeed, in 53 out of the 72 countries and economies that participated in PISA 2015, there are significant differences between the impact that changes in socio-economic status have for science scores at the 10th and 50th percentiles of the performance distribution. In most cases, the impact is stronger on students whose performance is around the median or not significantly different between the two. In 34 countries and economies, the association between performance and socio-economic status differs between low- and high-performing students, while in 27 countries and economies it differs between top- and average-performing students (Table I.6.5). However, this association can be mediated by other factors; socio-economic status is not the only reason for low or high performance.

When considering inclusion, it is also important to learn more about the relationship between disadvantage and low performance. On average across OECD countries, 21.2% of 15-year-olds score below proficiency Level 2 in science. However, 34.0% of students in the bottom quarter of the PISA index of economic, social and cultural status score at that level, while only 9.3% of students in the top quarter of the index do (Table I.6.6a). Figure I.6.9 shows the likelihood that disadvantaged students within their respective countries/economies score below proficiency Level 2 in science, compared to their peers with average or high socio-economic status.

On average across OECD countries, disadvantaged students are 2.8 times more likely than more advantaged students not to attain the baseline level of proficiency in science. While there is significant variation in the magnitude of this risk, the association between socio-economic disadvantage and low performance is statistically significant in all PISA-participating countries and economies. This shows the pervasiveness of the impact of socio-economic "circumstances" on student achievement, no matter the level at which school systems perform as a whole.

Countries where the likelihood that disadvantaged students perform below proficiency Level 2 in science is greatest, relative to more advantaged students, are remarkably diverse. In CABA (Argentina), the Dominican Republic, Peru and Singapore, these students are between 4 and 7 times more likely to be low performers, while in another 13 countries/economies they are between 3 and 4 times more likely to be low performers. This group of countries/economies where students with low socio-economic status are at greater risk of not attaining the baseline level of skills in science includes high-performing countries such as Belgium, Germany, New Zealand, Singapore, Switzerland and Chinese Taipei, as well as countries/economies with average or low mean performance.

Figure I.6.9 ■ **Likelihood of low performance among disadvantaged students, relative to non-disadvantaged students[1]**



1. A socio-economically disadvantaged student is a student in the bottom quarter of the distribution of the PISA index of economic, social and cultural status (ESCS) within his or her country/economy.

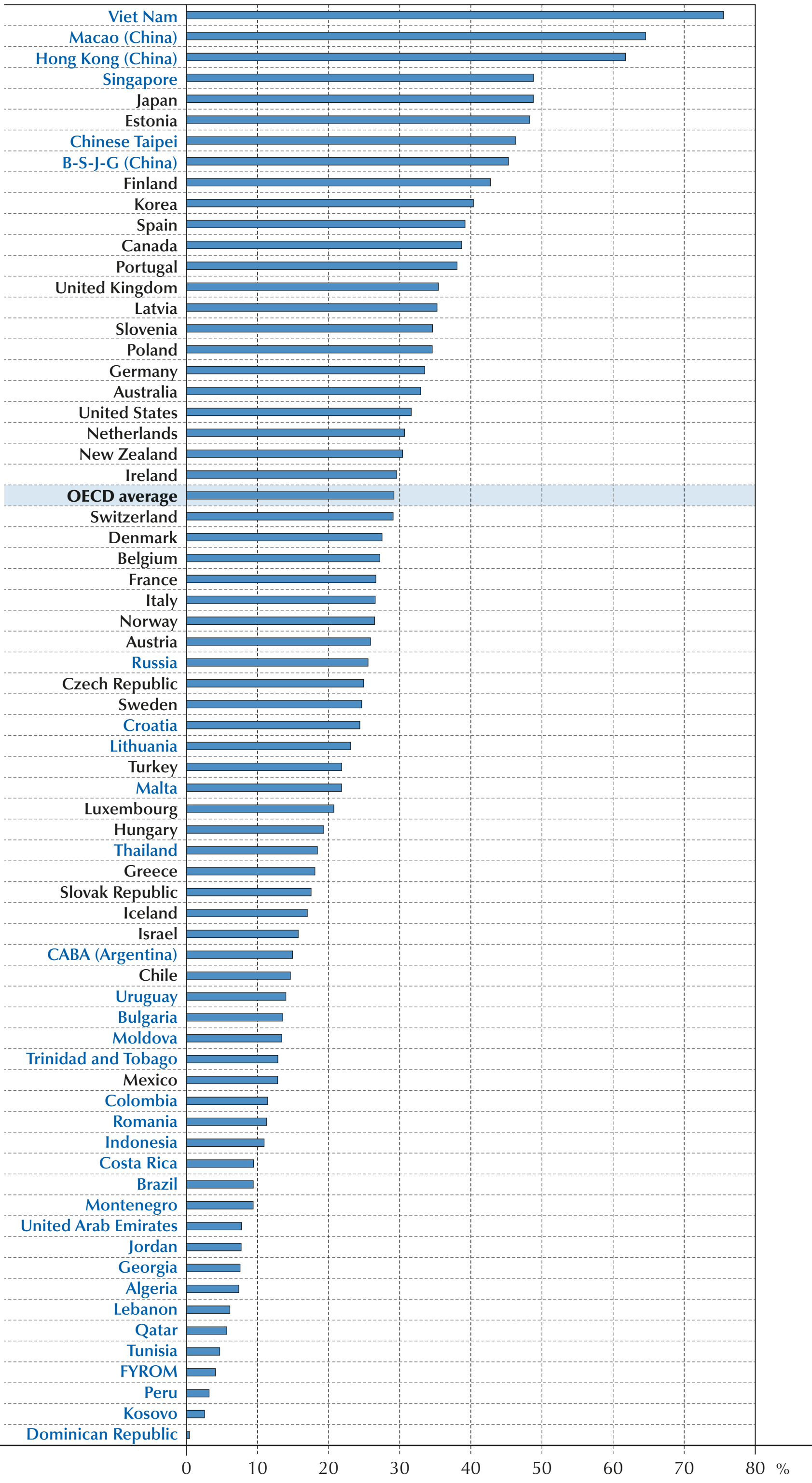
Note: All coefficients are statistically significant (see Annex A3).

Countries and economies are ranked in descending order of the likelihood that students in the bottom quarter of ESCS score below Level 2 in science, relative to non-disadvantaged students.

Source: OECD, PISA 2015 Database, Table I.6.6a.

StatLink http://dx.doi.org/10.1787/888933432777

Figure I.6.10 ■ **Percentage of resilient students[1]**



1. A student is classified as resilient if he or she is in the bottom quarter of the PISA index of economic, social and cultural status (ESCS) in the country/economy of assessment and performs in the top quarter of students among all countries/economies, after accounting for socio-economic status.

Countries and economies are ranked in descending order of the percentage of resilient students.

Source: OECD, PISA 2015 Database, Table I.6.7.

StatLink http://dx.doi.org/10.1787/888933432786

By contrast, in Algeria, Iceland, Kosovo, Macao (China), Montenegro, Qatar and Thailand, socio-economically disadvantaged students are no more than twice as likely as more advantaged students to score below proficiency Level 2 in science. Among these countries/economies, Macao (China) is also a high performer in science.

Results for reading and mathematics are broadly comparable to those observed in science, although the likelihood of low performance among disadvantaged students is slightly lower in reading, when compared to all non-disadvantaged students and to advantaged students in the top quarter of the PISA index of economic, social and cultural status (Tables I.6.6b and I.6.6c).

Resilient students

Further evidence that higher levels of equity and performance need not be at odds with each other comes from the finding that many disadvantaged students, schools and school systems achieve better performance in PISA than predicted by their socio-economic status. As such, they are considered to be "resilient". In PISA, a student is classified as resilient if he or she is in the bottom quarter of the PISA index of economic, social and cultural status in the country/economy of assessment and yet performs in the top quarter of students among all countries, after taking their socio-economic status into account.[14]

Figure I.6.10 shows that, on average across OECD countries, 29.2% of disadvantaged students in PISA 2015 beat the odds against them and score among the top quarter of students in all participating countries, after accounting for socio-economic status. In B-S-J-G (China), Estonia, Finland, Hong Kong (China), Japan, Korea, Macao (China), Singapore, Chinese Taipei and Viet Nam, more than four in ten disadvantaged students are considered to be resilient, although low coverage rates in B-S-J-G (China) and Viet Nam likely mean that the most disadvantaged 15-year-olds in these countries are not represented in these results. By contrast, fewer than one in ten disadvantaged students in Algeria, Brazil, Costa Rica, the Dominican Republic, the Former Yugoslav Republic of Macedonia (hereafter "FYROM"), Georgia, Jordan, Kosovo, Lebanon, Montenegro, Peru, Qatar, Tunisia and the United Arab Emirates is a top performer in science after taking socio-economic status into account (Table I.6.7).

DIFFERENCES IN STUDENTS' SCIENCE-RELATED CAREER EXPECTATIONS AND BELIEFS RELATED TO SOCIO-ECONOMIC BACKGROUND

As discussed in Chapter 3, a shared goal in countries and economies across the world is to promote students' interest in science and technology careers. This has led educators to pay greater attention to the affective dimensions of learning science. Equity in access to these occupations is a related concern, as disadvantaged students are often under-represented in scientific fields of study. This is partly due to their lower average performance relative to students from more privileged backgrounds, but also to differences in their attitudes towards learning science.

PISA 2015 asked students about the occupation they expect to be working in when they are 30 years old. Their responses were grouped into major categories of science-related and non-science-related careers. On average across OECD countries, a smaller percentage of disadvantaged students (18.9%) than of advantaged students (31.5%) expect to work in an occupation that requires further science training beyond compulsory education – a pattern that holds in all countries and economies that participated in PISA 2015. In general, science-related careers prove more popular among students with lower socio-economic status in countries where more advantaged students are also attracted to these occupations (Table I.6.8).

But students' career expectations can, of course, be strongly linked to their academic performance. Indeed, after accounting for students' performance in science, in 25 countries and economies, students from less privileged backgrounds are neither more nor less likely than their advantaged peers to expect to work in a science- or technology-related occupation by age 30. However, in another 46 countries/economies, students from less privileged backgrounds are significantly less likely to expect to work in a science-related career. On average across OECD countries, and after discounting the association with performance, students in the bottom quarter of the PISA index of economic, social and cultural status are 25% less likely than their peers in the top quarter of the index to see themselves pursuing a career in science, and in Finland, Jordan, Moldova, Poland and Romania this likelihood is 50% or less (Table I.6.8). Results in Chapter 3 show that, in a large number of countries, students' expectations of pursuing a career in science are related not only to their performance and socio-economic status, but also to their gender and enjoyment of science (Table I.3.13b).

PISA 2015 also asked students about their views about the nature of scientific knowledge and the validity of scientific methods of enquiry as a source of knowing – their epistemic beliefs. Students whose epistemic beliefs are in agreement with current views about the nature of science can be said to value scientific approaches to enquiry. As reported in Chapter 2, PISA 2015 shows broad support for scientific approaches to enquiry among 15-year-olds and small gender

disparities in these beliefs, on average across OECD countries. When comparing students with different socio-economic status, however, in virtually all PISA-participating countries and economies, advantaged students tend to hold beliefs in greater agreement with scientific approaches to enquiry than disadvantaged students. These differences are largest in Austria, Luxembourg, Sweden and Switzerland (Table I.6.8). Overall, results show that the positive association between socio-economic status and performance is mirrored in students' attitudes towards science, suggesting that differences between students of different backgrounds on these two dimensions might reinforce each other over time.

HOW PERFORMANCE IS RELATED TO SOCIO-ECONOMIC STATUS BETWEEN AND WITHIN SCHOOLS

Ensuring consistently high standards across schools is a formidable challenge for any school system. Some performance differences between schools may be related to the socio-economic composition of the school's student population or other characteristics of the student body. For instance, in some countries and economies, residential segregation, based on income or on cultural or ethnic background, often translates into disparities in the quantity and quality of resources (Reardon and Owens, 2014). Performance differences among schools can also be related to the design of school systems and system-level education policies, such as differences in the degree of autonomy granted to schools, and to policies emphasising greater competition for students among schools and greater school choice (Hsieh and Urquiola, 2006; Söderström and Uusitalo, 2010).

Disadvantaged students have generally been shown to benefit from sharing school and classrooms with more privileged peers, whereas implications for the latter group remain an open debate. Research using PISA data from 2009 has found that a small number of countries host effective, socio-economically integrated schools – those achieving gains for disadvantaged students without lowering the outcomes of advantaged students – and that integration tends to be more effective in larger schools (Montt, 2016).

Systems with small between-school variations in performance tend to be those that are comprehensive, meaning that they do not sort students by programme or school based on ability. Systems trying to meet different needs of students by creating different tracks or pathways through education and inviting students to choose among them at an earlier or later age tend to show larger between-school variations and a greater impact of social background on learning outcomes. Volume II examines how system- and school-level policies vary and are related to performance differences between students and schools.

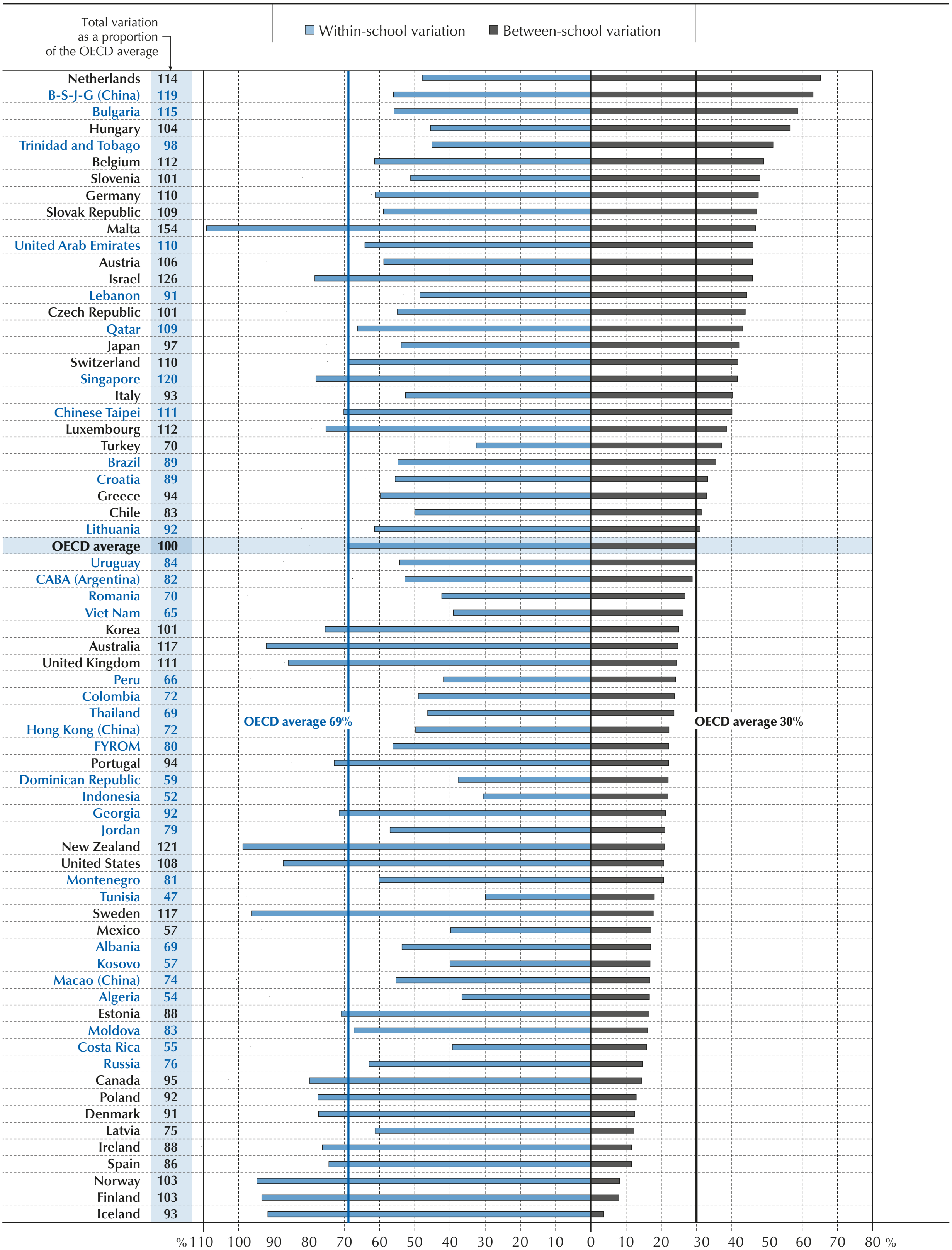
Figure I.6.11 shows the variation in student performance in science between and within schools in countries and economies participating in PISA 2015. The overall length of the bar represents the total variation in that country as a proportion of the OECD average level of variation in performance. The dark part of the bar represents the proportion of those differences that is observed between schools, and the light part of the bar represents the proportion observed within schools.

Across OECD countries, 30.1% of performance differences are observed between schools and the remaining part is observed within schools.[15,16] The extent of between-school differences in performance varies widely across school systems. For example, in Finland, Iceland and Norway, between-school differences account for less than 10% of total variation in performance, and in Canada, Denmark, Ireland, Latvia, Poland and Spain, they account for between 10% and 15% of the variance. In these countries, overall variation in performance also tends to be low; but in Finland and Norway, relatively small differences across students in different schools coexist with an overall level of variation slightly above the OECD average (Table I.6.9). Because Canada, Denmark, Finland, Ireland, Norway and Poland also manage to achieve higher-than-average mean performance in science, in these countries families can expect that, no matter which school their children attend, they are likely to achieve at high levels.

By contrast, in B-S-J-G (China), Bulgaria, Hungary, the Netherlands, and Trinidad and Tobago, differences between schools account for more than 50% of the total variation in the country's/economy's performance. In these countries the overall level of variation is similar or higher than the OECD average (Table I.6.9).

How the variation in performance is distributed between and within schools is often related to the degree of socio-economic diversity across schools. On average across OECD countries, 76.5% of variation in the PISA index of economic, social and cultural status observed within schools, as indicated by the value of the index of social inclusion, while the remaining 23.5% of the variation in students' socio-economic status is found between schools. This implies that, on average, there tends to be more socio-economic diversity among students attending the same schools than between students attending different schools. In B-S-J-G (China), CABA (Argentina), Chile, Colombia, Indonesia and Peru, more than 40% of the variation in students' socio-economic status lies between schools, whereas in Albania, Finland, Iceland, Kosovo, Montenegro, Norway and Sweden, less than 15% of the variation lies between schools (Table I.6.10).

Figure I.6.11 ▪ **Variation in science performance between and within schools**



Countries and economies are ranked in descending order of the between-school variation in science performance, as a percentage of the total variation in performance across OECD countries.

Source: OECD, PISA 2015 Database, Table I.6.9.

StatLink http://dx.doi.org/10.1787/888933432794

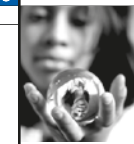


Figure I.6.12 shows the mean performance of students attending schools with varying socio-economic profiles across countries. Socio-economically disadvantaged schools are defined as schools in the bottom quarter of the distribution of the school-level PISA index of economic, social and cultural status within each country/economy; advantaged schools are defined as those in the top quarter of the distribution of the index. On average across OECD countries, students attending advantaged schools have a mean performance of 546 points in science, while students in disadvantaged schools have a mean performance of 442 points. This implies an average difference across OECD countries of 104 score points in science between students attending the two types of school. This difference is larger than 160 score points in Bulgaria, Hungary and the Netherlands, and ranges between 140 and 160 score points in Belgium, B-S-J-G (China), Germany, Malta, the Slovak Republic, Slovenia, and Trinidad and Tobago. In all of these countries/economies, students attending advantaged schools score well above the OECD average in science, but the mean performance of 15-years-olds attending disadvantaged schools is at least 50 points lower than the OECD average (Table I.6.11).

By contrast, in 18 countries and economies, less than 70 score points separate the mean performance of students attending advantaged and disadvantaged schools. And in some of these countries and economies, students in disadvantaged schools score high by international standards. For instance, in Macao (China), these students score 512 points in science, on average, while their peers in advantaged schools score 25 points higher. In Finland, students in disadvantaged schools score 511 points in science, on average, while their peers in advantaged schools score 45 points higher; in Estonia, disadvantaged students score 509 points in science, 64 points below their peers in advantaged schools (Table I.6.11). This shows that some high-performing schools systems also achieve a high level of fairness as measured by a weak relationship between the concentration of socio-economic disadvantage in schools and poor performance.

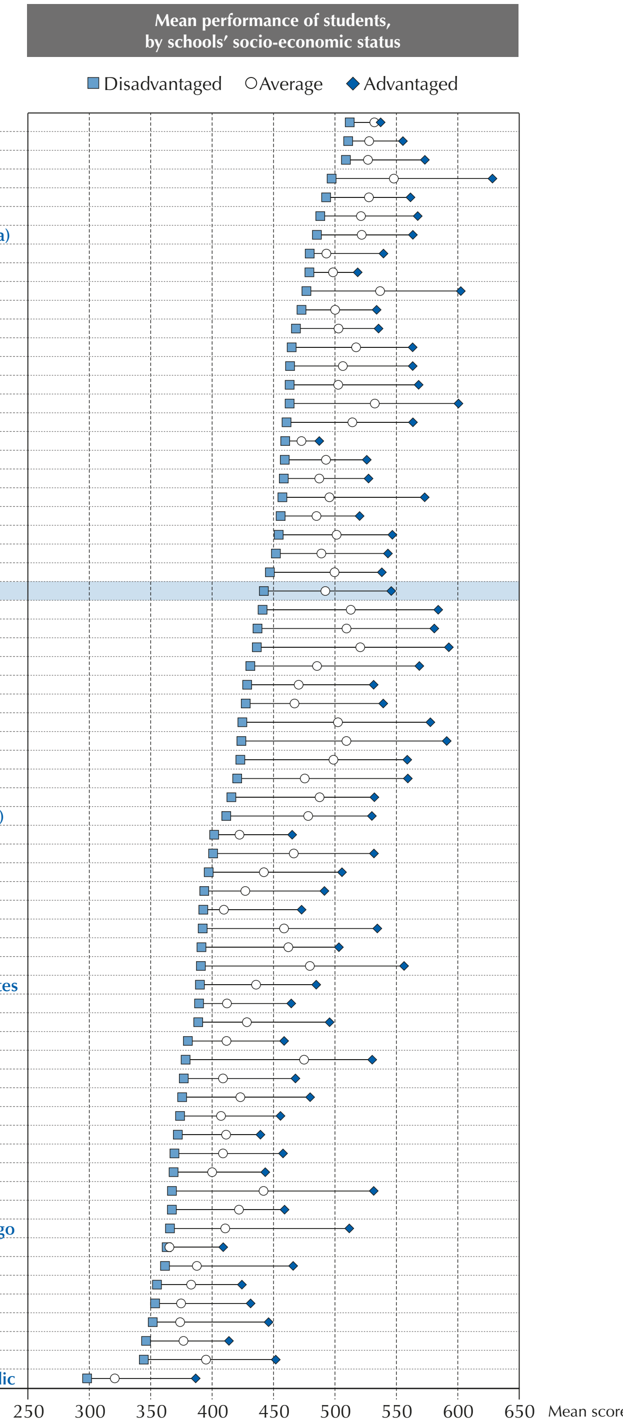
That some school systems are better than others at weakening the relationship between disparities in performance and the socio-economic composition of schools is also illustrated by Figure I.6.13, which shows the overall levels of variation in performance found between and within schools and the proportion of these differences that is explained by students' and schools' socio-economic profile. On average across OECD countries, 62.6% of the performance differences observed across students in different schools can be accounted for by the socio-economic status of students and schools, whereas only 3.8% of the performance differences among students attending the same school is associated with their socio-economic status (Table I.6.12a). In reading and mathematics, the socio-economic profile of students and schools explains a similar share of the differences in performance found between and within schools (Tables I.6.12b and I.6.12c). While socio-economic status explains a larger share of the performance differences between schools, it is important to note that these differences represent, on average, slightly less than a third (30.1%) of the overall level of variation in performance in science across OECD countries (Table I.6.9).

Socio-economic equity between schools is greater in countries with greater equity in outcomes, in general, as measured by the strength of the relationship between performance and socio-economic status and the proportion of variation in performance observed between rather than within schools. This is the case of school systems with high average science performance, such as Estonia, Finland, Macao (China), Norway and Viet Nam. In all of these countries/economies, less than 50% of between-school differences in performance – which in turn are below the OECD average as a share of the overall level of variation – is explained by socio-economic disparities among students and schools. By contrast, socio-economic disparities are closely associated with performance differences in CABA (Argentina), Belgium, the Czech Republic, Hungary, Luxembourg and Peru, where more than 75% of the between-school variation in performance – which in turn is above the OECD average as a share of the overall level of variation, except in Peru – is explained by the socio-economic profile of students and schools.

Generally, the higher the level of variation in performance, either between or within schools, the higher the percentage of that variation that is accounted for by socio-economic status. However, countries and economies with similar levels of variation in performance between schools can differ notably in this respect. For instance, in both Italy and Chinese Taipei, between-school variation in performance is about 10 percentage points higher than the OECD average, but the share of that variation that is explained by socio-economic status is 20 percentage points lower in Italy than in Chinese Taipei. Similarly, socio-economic status is a weaker predictor of between-school performance differences in the United States than in New Zealand, two countries with a between-school level of variation that is about 10 percentage points lower than the OECD average (Tables I.6.9 and I.6.12a). From an equity point of view, both the overall level of variation in performance and the proportion of variance explained by socio-economic status are important. These indicators can provide guidance to policy makers about whether to focus efforts on reducing overall variation or weakening the impact of socio-economic disparities.

Figure I.6.12 ▪ **Science performance of students in socio-economically advantaged, average and disadvantaged schools**

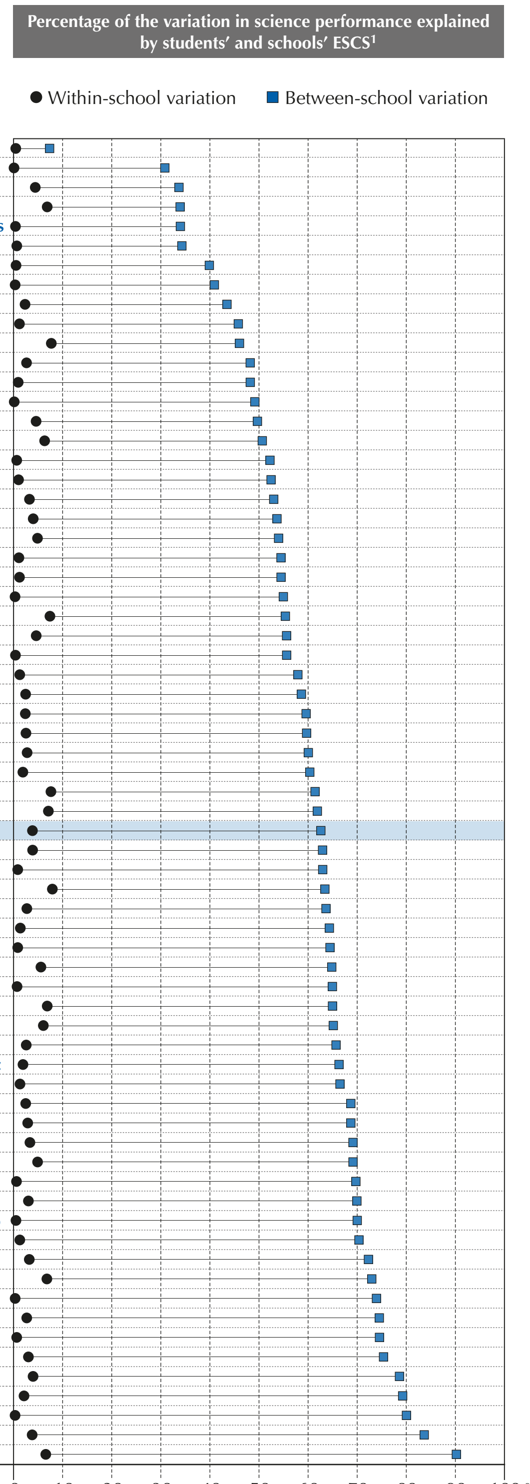
Average socio-economic status of students attending a…			
Disadvantaged school[1]	Average school[2]	Advantaged school[3]	
-1.06	-0.65	0.18	Macao (China)
-0.11	0.23	0.66	Finland
-0.44	0.04	0.56	Estonia
-0.51	-0.04	0.72	Singapore
0.05	0.54	0.99	Canada
-2.63	-1.95	-0.94	Viet Nam
-1.05	-0.63	0.16	Hong Kong (China)
-0.85	-0.41	0.11	Poland
0.14	0.48	0.83	Norway
-0.63	-0.19	0.27	Japan
0.09	0.60	1.08	Denmark
-0.29	0.13	0.66	Ireland
-0.59	-0.22	0.25	Korea
-0.30	0.28	0.80	Australia
-0.31	0.18	0.77	United Kingdom
-0.72	-0.23	0.33	Chinese Taipei
-0.28	0.15	0.62	New Zealand
0.35	0.75	1.07	Iceland
-1.32	-0.60	0.47	Spain
-1.04	-0.45	0.20	Latvia
-0.36	0.09	0.75	Switzerland
-0.48	0.08	0.49	Russia
-1.15	-0.43	0.44	Portugal
-0.09	0.31	0.78	Sweden
-0.61	0.12	0.77	United States
-0.62	-0.05	0.57	**OECD average**
-0.52	0.00	0.64	Slovenia
-0.52	0.08	0.75	Germany
-1.89	-1.19	-0.04	B-S-J-G (China)
-0.73	-0.26	0.41	Czech Republic
-0.67	-0.05	0.52	Lithuania
-0.70	-0.30	0.32	Croatia
-0.49	0.18	0.79	Belgium
-0.31	0.15	0.64	Netherlands
-0.48	0.07	0.71	Austria
-0.58	0.00	0.92	Luxembourg
-0.69	-0.08	0.58	Italy
-1.17	0.09	1.01	CABA (Argentina)
-1.29	-0.72	-0.03	Moldova
-0.38	0.18	0.66	Israel
-1.36	-0.55	0.51	Chile
-1.17	-0.64	0.13	Romania
-1.99	-1.33	-0.25	Thailand
-0.82	-0.08	0.55	Slovak Republic
-0.72	-0.07	0.56	Greece
-1.03	-0.23	0.58	Hungary
0.03	0.50	0.96	United Arab Emirates
-1.62	-0.90	0.22	Costa Rica
-1.46	-0.92	0.19	Uruguay
-2.22	-1.24	-0.18	Mexico
-0.61	-0.10	0.61	Malta
-1.82	-1.08	0.04	Colombia
-2.23	-1.44	-0.61	Turkey
-0.96	-0.35	0.33	Georgia
-1.06	-0.45	0.26	Jordan
-0.61	-0.19	0.30	Montenegro
-2.72	-1.97	-0.80	Indonesia
-0.86	-0.07	0.65	Bulgaria
0.09	0.63	1.00	Qatar
-0.73	-0.28	0.34	Trinidad and Tobago
-1.81	-1.35	-0.61	Algeria
-1.76	-1.04	-0.01	Brazil
-1.63	-0.88	0.06	Tunisia
-0.71	-0.26	0.30	FYROM
-1.48	-0.60	0.27	Lebanon
-0.60	-0.15	0.32	Kosovo
-2.19	-1.10	0.07	Peru
-1.57	-1.00	-0.06	Dominican Republic



1. A socio-economically disadvantaged school is a school in the bottom quarter of the distribution of the school-level PISA index of economic, social and cultural status (ESCS) within each country/economy.
2. A socio-economically average school is a school in the second and third quarters of the distribution of the school-level PISA ESCS index within each country/economy.
3. A socio-economically advantaged school is a school in the top quarter of the distribution of the school-level PISA ESCS index within each country/economy.
Note: Only countries with available data are shown.
Countries and economies are ranked in descending order of the mean performance in science of students attending disadvantaged schools.
Source: OECD, PISA 2015 Database, Table I.6.11.
StatLink http://dx.doi.org/10.1787/888933432803

Figure I.6.13 ■ Performance differences between and within schools explained by students' and schools' socio-economic profile

Within-school variation as a percentage of the average total variation in science performance across OECD countries	Between-school variation as a percentage of the average total variation in science performance across OECD countries	
55	17	Macao (China)
37	17	Algeria
57	21	Jordan
95	8	Norway
64	46	United Arab Emirates
66	43	Qatar
49	44	Lebanon
50	22	Hong Kong (China)
63	15	Russia
39	26	Viet Nam
93	8	Finland
71	17	Estonia
40	17	Kosovo
33	37	Turkey
92	4	Iceland
77	12	Denmark
30	18	Tunisia
53	40	Italy
71	21	Georgia
80	14	Canada
87	21	United States
56	22	FYROM
40	17	Mexico
46	24	Thailand
69	42	Switzerland
67	16	Moldova
31	22	Indonesia
55	36	Brazil
61	12	Latvia
61	31	Lithuania
78	46	Israel
60	33	Greece
42	27	Romania
76	12	Ireland
74	12	Spain
69	**30**	**OECD average**
92	25	Australia
54	42	Japan
77	13	Poland
75	25	Korea
49	24	Colombia
48	65	Netherlands
78	42	Singapore
56	63	B-S-J-G (China)
96	18	Sweden
73	22	Portugal
56	33	Croatia
38	22	Dominican Republic
50	31	Chile
59	46	Austria
54	30	Uruguay
86	24	United Kingdom
109	47	Malta
60	21	Montenegro
39	16	Costa Rica
45	52	Trinidad and Tobago
59	47	Slovak Republic
70	40	Chinese Taipei
99	21	New Zealand
51	48	Slovenia
61	48	Germany
56	59	Bulgaria
55	44	Czech Republic
61	49	Belgium
42	24	Peru
46	57	Hungary
53	29	CABA (Argentina)
75	39	Luxembourg



1. ESCS refers to the PISA index of economic, social and cultural status.

Countries are ranked in ascending order of the percentage of between-school variation in science performance explained by the PISA index of economic, social and cultural status.

Source: OECD, PISA 2015 Database, Tables I.6.9 and I.6.12a.

StatLink http://dx.doi.org/10.1787/888933432819

Differences in access to educational resources, grade repetition and enrolment in vocational tracks related to socio-economic status

A potential source of inequity in learning opportunities and outcomes 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.

PISA 2015 provides two summary measures of the availability of educational resources at the school level: the index of shortage of educational material and the index of shortage of educational staff. Both indices combine school principals' responses to questions about whether their school's capacity to provide instruction is hindered by a shortage or inadequacy of either material resources (e.g. textbooks, IT equipment, laboratory material or physical infrastructure) or human resources (including both teaching and assisting staff).[17]

Figure I.6.14 shows differences in the mean values of the indices of shortage of educational material and educational staff between socio-economically advantaged and disadvantaged schools across countries and economies participating in PISA 2015. Negative differences imply that principals in disadvantaged schools perceive the amount and/or quality of resources in their schools as an obstacle to providing instruction to a greater extent than principals in advantaged schools; positive differences mean that the perception of having inadequate resources is more common among principals of schools with a more privileged socio-economic intake.

Results suggest that, in a large number of countries, access to educational resources at the school level is unequally distributed between students with the highest and lowest socio-economic status within each country and economy. According to school principals' reports, in 31 countries/economies, students in advantaged schools have access to better educational material resources than their peers in disadvantaged schools; in 36 countries and economies, students in advantaged schools have greater access to education staff than do disadvantaged students. The largest disparities in the perceived quality of material resources between schools with different socio-economic profiles are observed in CABA (Argentina), Lebanon, Macao (China), Mexico, Peru and the United Arab Emirates. By contrast, in FYROM, Iceland and Latvia, 15-year-olds attending disadvantaged schools enjoy greater access to educational resources than their peers in advantaged schools. And in about half of the countries and economies that participated in PISA 2015, students in disadvantaged schools appear no more likely than students in advantaged schools to have access to better or more resources (Table I.6.13). The relationship between access to educational resources and student performance is analysed in Chapter 6 of Volume II.

Equity in education opportunities for students of different socio-economic backgrounds can also be related to the policies adopted by school systems to sort and select students. One of these policies is grade repetition, the practice of requiring students to remain in the same grade for an additional school year, generally with the objective to give struggling students more time to master grade-appropriate content before they move on to more advanced coursework. However, research consistently finds that grade repetition is ineffective in equalising student performance because students who are retained tend to experience achievement losses relative to those not being retained (Jimerson, 2001; Choi et al., 2016; Fruehwirth, Navarro and Takahashi, 2016). While students are mainly retained in their grade progression on the basis of performance, students' backgrounds can also be related to the likelihood of repeating a grade.

Indeed, based on students' self-reports about grade repetition, Figure I.6.15 shows that, across OECD countries, disadvantaged students are about 80% more likely to have repeated a grade either in primary or secondary school than advantaged students, even after accounting for their performance in two assessment domains.

The increased likelihood of grade repetition among disadvantaged students compared with their advantaged peers, and after taking performance into account, is observed in 33 out of the 72 countries and economies that participated in PISA 2015. Differences in this likelihood are largest in CABA (Argentina), Portugal, the Slovak Republic, Spain, Uruguay and Viet Nam – where 15-year-olds in the bottom quarter of the PISA index of economic, social and cultural status are at least three-and-a-half times more likely than 15-year-olds in the top quarter of the index to have repeated a grade. The opposite pattern, a higher likelihood of grade repetition among advantaged students, is observed in only three countries: Korea, Malta and Singapore. Overall, the relative likelihood of having repeated a grade based on socio-economic status is only weakly correlated (r=.29) with the overall incidence of grade repetition in each school system (Table I.6.14).

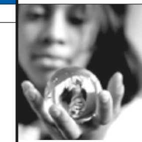
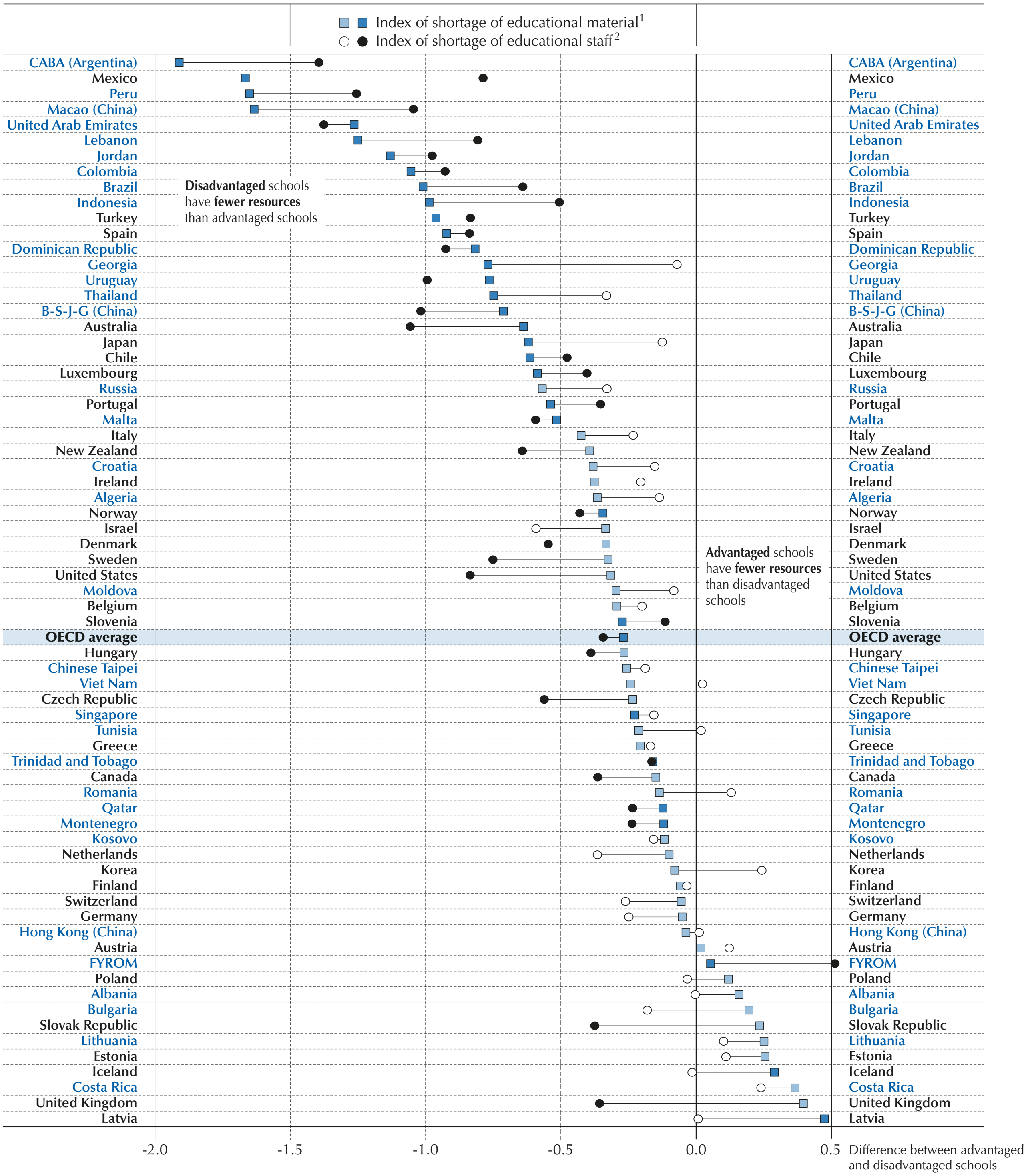


Figure I.6.14 ▪ **Differences in educational resources between advantaged and disadvantaged schools**



1. The index of shortage of educational material is measured by an index summarising school principals' agreement with four statements about whether the school's capacity to provide instruction is hindered by a lack of and/or inadequate educational materials, including physical infrastructure.

2. The index of shortage of educational staff is measured by an index summarising school principals' agreement with four statements about whether the school's capacity to provide instruction is hindered by a lack and/or inadequate qualifications of the school staff.

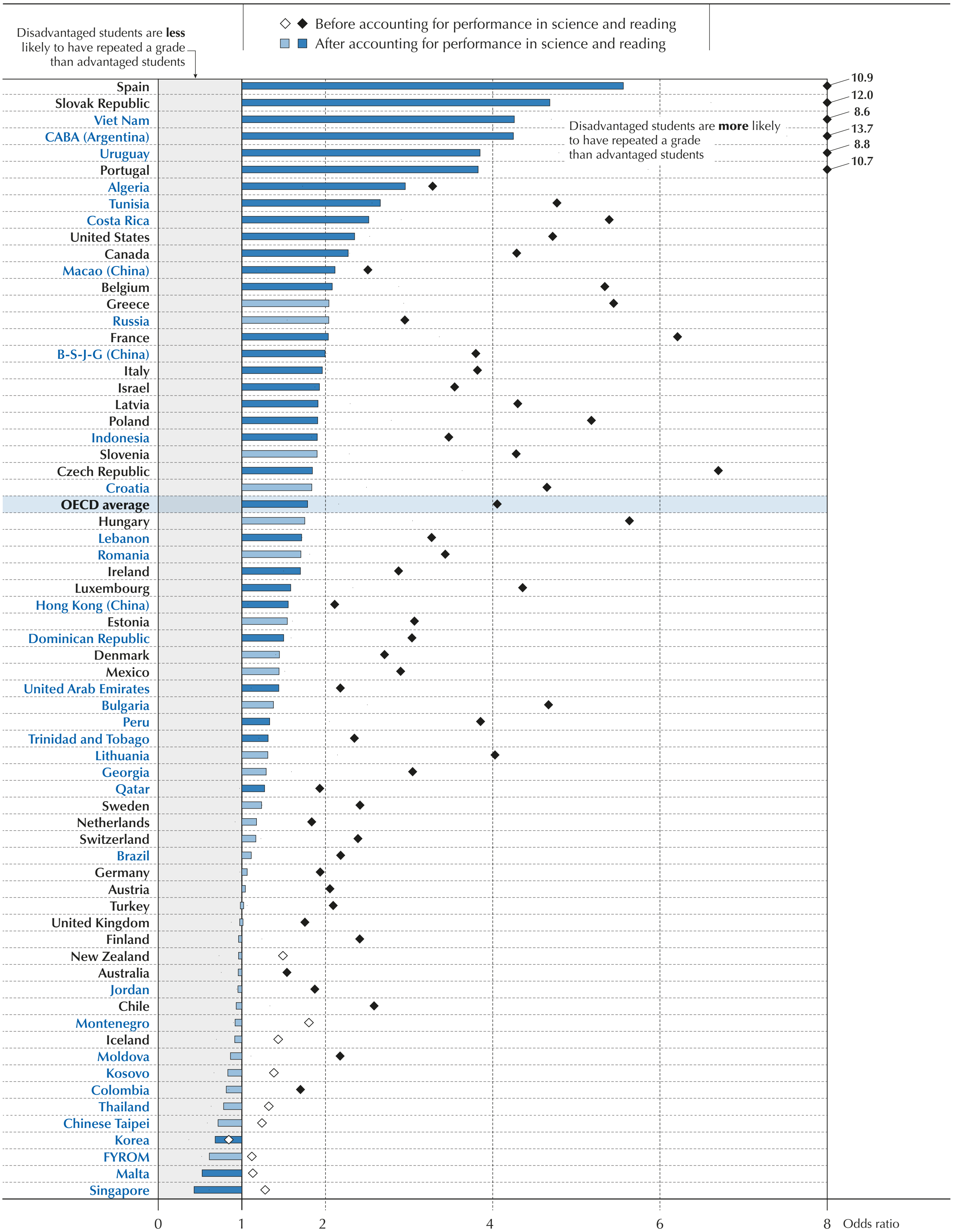
Note: Statistically significant differences between advantaged and disadvantaged schools are marked in a darker tone (see Annex A3).

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

Source: OECD, PISA 2015 Database, Table I.6.13.

StatLink http://dx.doi.org/10.1787/888933432823

Figure I.6.15 ■ **Increased likelihood of grade repetition, by students' socio-economic status**



Note: Statistically significant values are marked in a darker tone (see Annex A3).

Countries and economies are ranked in descending order of the likelihood for disadvantaged students to have repeated a grade, relative to advantaged students, after accounting for socio-economic status.

Source: OECD, PISA 2015 Database, Table I.6.14.

StatLink http://dx.doi.org/10.1787/888933432839

Differences in student performance in science related to socio-economic status can also be rooted in disparities in the amount of time devoted to learning science in school, as learning time is a major component of opportunity to learn (OECD, 2016b). PISA 2015 asked students how many regular science lessons they are required to attend per week and how much time they spend in science lessons per week. On average across OECD countries, the percentage of advantaged students who attend at least one science lesson per week is 3.4 percentage points higher than that among disadvantaged students, even if more than nine in ten students in both groups take science courses every week. However, in Austria, Belgium, Croatia and FYROM, the difference ranges between 10 and 20 percentage points, and in another 15 countries and economies, it ranges between 5 and 10 percentage points (Table I.6.15). In addition, advantaged students tend to spend about 35 more minutes every week in regular school science lessons, on average across OECD countries (Table I.6.15). Given an average school year of 37 weeks across OECD countries (OECD, 2016c, Table D1.2), the average cumulative additional exposure to science lessons for advantaged students, compared to disadvantaged students, would amount to more than 20 hours per school year.

Arguably, differences in instruction time in science can translate into significant differences in performance on the PISA science assessment and in science-related attitudes. As shown in Chapter 2 of Volume II, students who are not required to attend science lessons score 25 points lower in science than students who are required to attend at least one science lesson per week, on average across OECD countries, and after accounting for the socio-economic status of students and schools. Likewise, the likelihood of expecting to work in a science-related occupation by age 30 is almost two-and-a-half times higher for students who are required to attend at least one science course per week than for those who are not, also after accounting for their socio-economic status (Table II.2.3). These results suggest that differences in opportunity to learn contribute to the performance differences between students from different socio-economic backgrounds.

Socio-economic differences in students' opportunity to learn can be related to stratification policies. A case in point is tracking, the practice of sorting students into academic or vocational study programmes. While tracking allows for a better match between students' interests and abilities, and the subjects they study, it can also widen differences in students' exposure to subject-specific content, as subjects might be excluded from or covered in less depth in certain tracks, and receive greater attention in others.

On average across OECD countries, 14.3% of 15-year-old students are enrolled in a vocational track. Among them, 72.5% participate in at least one science lesson per week at school, compared to 95.8% of students enrolled in academic tracks. This means that 15-year-olds enrolled in vocational programmes receive, on average, around 80 minutes less per week of regular science instruction than their peers in academic tracks (Tables I.6.15 and I.6.16). The overall potential impact of these differences in exposure to science courses is limited because of the small proportion of students who are enrolled in vocational tracks, on average across OECD countries. But disadvantaged students are more likely than advantaged students to be affected by this policy. PISA 2015 results find that the likelihood that disadvantaged students are enrolled in a vocational programme, after taking students' science performance into account, is almost three times higher than the likelihood for advantaged students, on average across OECD countries where different study programmes are offered to 15-year-olds (Table I.6.16). Chapter 6 of Volume II examines in greater detail the associations between stratification policies and student performance.

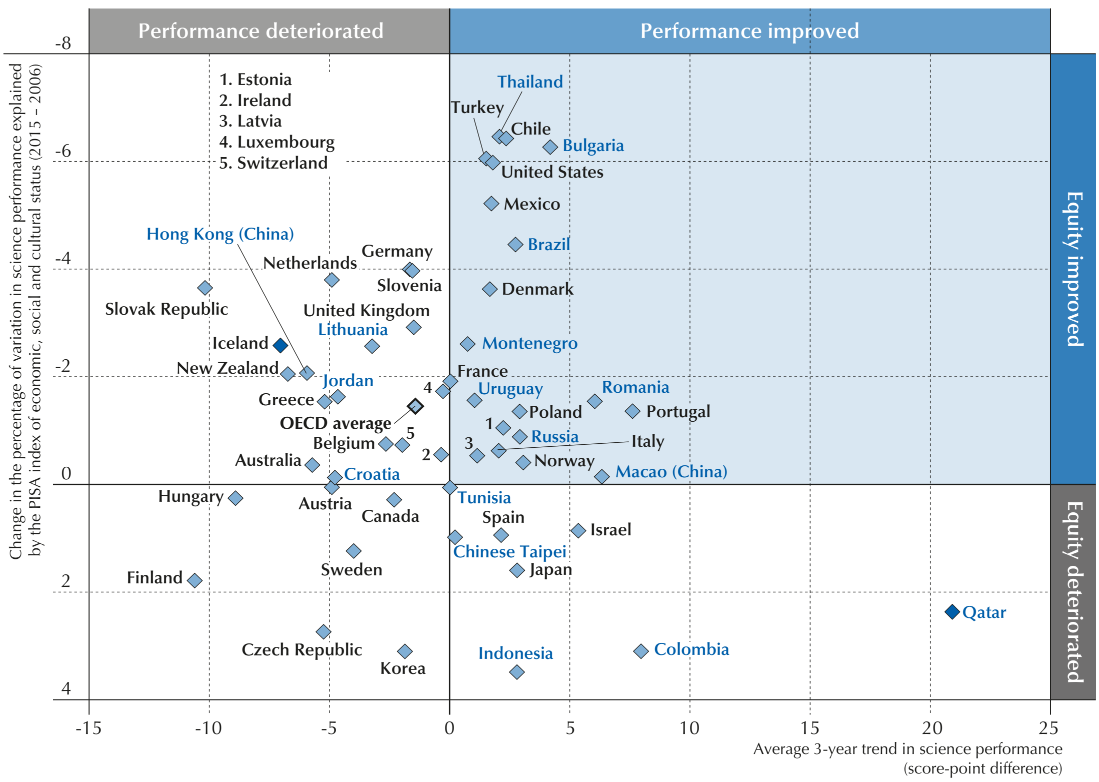
TRENDS IN EQUITY IN EDUCATION

By analysing data across different PISA assessments, it is possible to identify those school systems that have become more or less equitable over time, and whether trends in equity are commensurate with trends in performance. In this chapter, trends in equity are analysed by comparing the evolution of some key equity indicators between PISA 2006 and PISA 2015, two rounds of PISA when science was the major domain of assessment.

In 2006, on average across OECD countries, 14.4% of the variation in students' science performance could be explained by students' socio-economic status (the strength of the socio-economic gradient). A one-unit change in the PISA index of economic, social and cultural status – which corresponds to the difference between students with average socio-economic status and disadvantaged students – was associated with a difference in science performance of 39 score points (the slope of the socio-economic gradient). By 2015, the degree to which students' socio-economic status predicted performance in science decreased to 12.9% – a drop of 1.4 percentage points – while the difference in performance between students who were one unit apart on the ESCS index decreased to 38 score points – a minimal drop of 1 point (Table I.6.16).

Figure I.6.16 presents changes in the strength of the socio-economic gradient against average three-year trends in science performance between 2006 and 2015. Over this period, the strength of the gradient decreased by more than three percentage points in eight countries that also managed to maintain their average performance: Brazil, Bulgaria, Chile, Denmark, Germany, Slovenia, Thailand and the United States. In these countries, students' socio-economic status became a less reliable predictor of achievement as there was no significant change in performance.

Figure I.6.16 ▪ **Change between 2006 and 2015 in the strength of the socio-economic gradient and average 3-year trend in science performance**



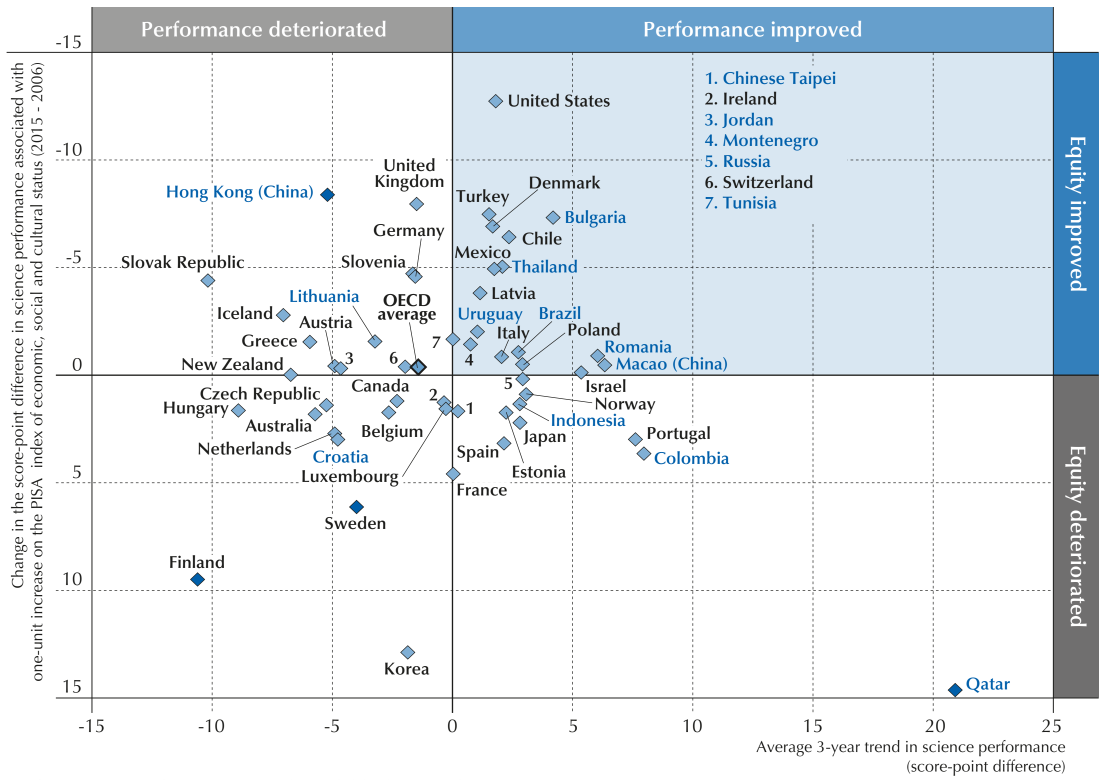
Notes: Only countries and economies with available data are shown.
Changes in both equity and performance between 2006 and 2015 that are statistically significant are indicated in a darker tone (see Annex A3).
The average three-year trend is the average rate of change, per three-year period, between the earliest available measurement in PISA and PISA 2015. For countries and economies with more than one available measurement, the average three-year trend is calculated with a linear regression model. This model takes into account that Costa Rica, Georgia, Malta and Moldova conducted the PISA 2009 assessment in 2010 as part of PISA 2009+.
Source: OECD, PISA 2015 Database, Table I.6.17.
StatLink http://dx.doi.org/10.1787/888933432843

Figure I.6.17 shows changes in the slope of the socio-economic gradient alongside average three-year trends in science performance. Between PISA 2006 and PISA 2015, in Chile, Denmark, Mexico, Slovenia, Turkey, the United Kingdom and the United States, the average impact of students' socio-economic status on performance weakened by more than four score points while mean science achievement did not decline. In these countries, average differences in performance between students with different socio-economic status shrank even as overall performance remained stable.

Chile, Denmark, Mexico, Slovenia and the United States appear in the upper-right quadrants of both figures; these are countries that achieved improvements in equity between 2006 and 2015, as measured by both the strength and the slope of the socio-economic gradient, without compromising their average performance in science.

The largest reduction in the average impact of socio-economic status on science performance – by 13 score points – is observed in the United States, where the percentage of variation explained by students' socio-economic status also decreased by 6 percentage points. In addition, between 2006 and 2015, the percentage of resilient students grew from 25.0% to 31.6%. Trends in science literacy and equity in the United States are examined in greater detail in a special report that draws comparisons with other countries/economies with above-average performance and equity in PISA 2015 (OECD, 2016d).

Figure I.6.17 ▪ **Change between 2006 and 2015 in the slope of the socio-economic gradient and average 3-year trend in science performance**



Notes: Only countries and economies with available data are shown.
Changes in both equity and performance between 2006 and 2015 that are statistically significant are indicated in a darker tone (see Annex A3).
The average three-year trend is the average rate of change, per three-year period, between the earliest available measurement in PISA and PISA 2015. For countries and economies with more than one available measurement, the average three-year trend is calculated with a linear regression model. This model takes into account that Costa Rica, Georgia, Malta and Moldova conducted the PISA 2009 assessment in 2010 as part of PISA 2009+.
Source: OECD, PISA 2015 Database, Table I.6.17.

StatLink http://dx.doi.org/10.1787/888933432855

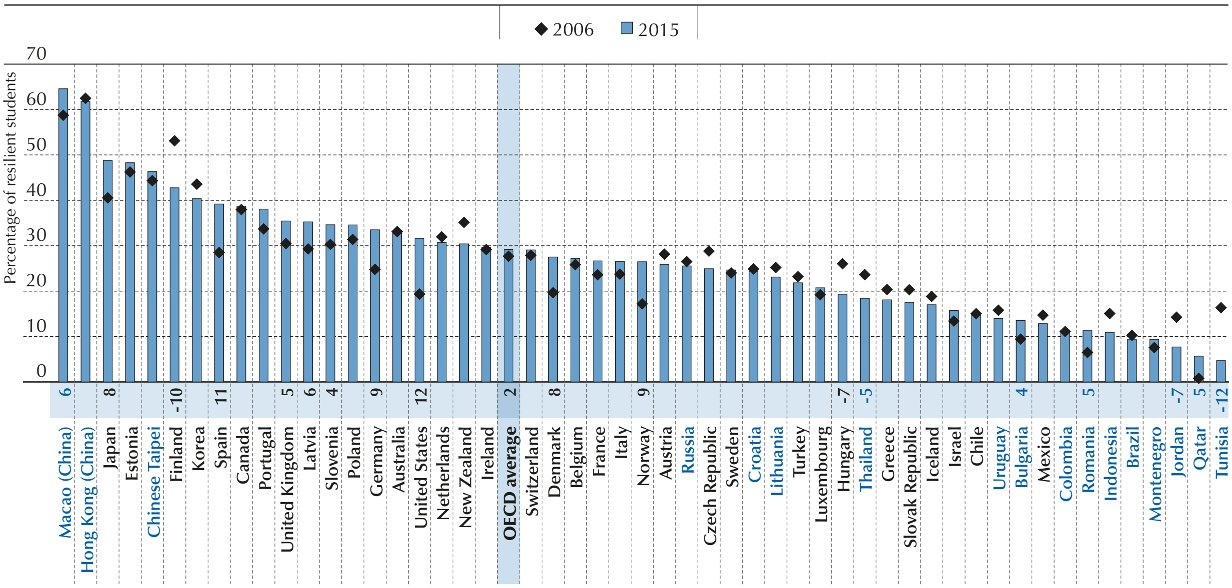
Colombia, Israel, Macao (China), Portugal and Romania managed to improve their average science performance while maintaining equity levels.

Overall, trend analyses looking at the evolution of science performance and the socio-economic gradient in PISA-participating countries and economies show that school systems succeeded in improving performance while maintaining equity levels, or vice versa. However, between PISA 2006 and PISA 2015, no country or economy improved its performance in science while simultaneously weakening the socio-economic gradient.

A different indicator of whether countries and economies are moving towards more equitable school systems are trends in student resiliency. Resilient students are disadvantaged students within their countries and economies who beat the socio-economic odds against them and perform in the top quarter of students across all participating countries and economies after taking socio-economic status into account. Countries and economies in which the proportion of students who are resilient is growing are those that are improving the chances for disadvantaged students to become high achievers.

Figure I.6.18 shows that, on average across OECD countries, the percentage of resilient students increased from 27.7% in 2006 to 29.0% in 2015 (Table I.6.7). A negative trend in student resiliency is observed in 5 of the 53 countries and economies for which data are available, with reductions of more than 10 percentage points in Finland and Tunisia, and between 5 and 10 percentage points in Hungary, Jordan and Thailand. Over this period, some of these countries also saw increases in the percentage of low performers, negative or stable trends in the strength and slope of the socio-economic gradient, and a decline in mean science performance (Table I.6.16).

Figure I.6.18 ▪ **Change between 2006 and 2015 in student resiliency[1]**



1. A student is classified as resilient if he or she is in the bottom quarter of the PISA index of economic, social and cultural status (ESCS) in the country/economy of assessment and performs in the top quarter of students among all countries/economies, after accounting for socio-economic status.

Notes: Only countries/economies with available data are shown. The percentage-point difference between 2006 and 2015 in the share of resilient students is shown next to the country/economy name. Only statistically significant differences are shown (see Annex A3).

Countries and economies are ranked in descending order of the percentage of resilient students in 2015.

Source: OECD, PISA 2015 Database, Table I.6.7.

StatLink http://dx.doi.org/10.1787/888933432860

By contrast, some countries with large improvements in student resiliency – Macao (China), Qatar and Romania – also managed to reduce the percentage of students performing below Level 2 and maintain or improve their average performance. Trends in resiliency are correlated with trends in the proportion of low performers – who, as discussed in previous sections, tend to come from disadvantaged backgrounds. This suggests that policies aimed at helping disadvantaged students thrive academically need not be at odds with policies that target low performance, regardless of students' socio-economic status.

Notes

1. Applications of equality of opportunity or fairness that rely on the distinction between "circumstances" and "effort" assume that the influence of these two sets of factors can be disentangled. However, the approach adopted here acknowledges that societies and cultures differ in where they draw the line between effort and circumstances, and that such a distinction is a social and cultural decision, rather than an ontological one. Views of equality of opportunity typically differ with respect to the point after which they hold individuals accountable for their economic and social achievements. A pragmatic view of equality of opportunity accepts that each society may determine the precise indicators that reflect circumstances and effort in its own way.

2. Defined in this way, fairness differs from equality of opportunity understood as equal treatment or lack of discrimination in the competition for valued resources or positions (e.g. admission to university, jobs) among people with the same relevant skills/abilities. While the latter remains a basis for non-discriminatory policies, it does not account for the fact that the process of skill development and the distribution of skills across the population (e.g. at age 15) can be themselves socially conditioned and subject to the influence of "circumstances". Therefore, considerations of fairness do not only concern situations where individuals have similar skills, but also, and in the first place, differential opportunities for acquiring skills.

3. This may involve compensatory mechanisms in the allocation of resources, so that education systems reduce pre-existing inequalities among students from different backgrounds in their chances to succeed academically. It also follows that inequalities in outcomes (e.g. performance) among students of different backgrounds can only be seen as acceptable or fair if they are driven by factors under students' control, such as effort.

4. Science was the major domain of PISA 2015. As explained in Chapter 2, the definition of science literacy in PISA 2015 reflects its intention to assess not only what students know in science, but also what they can do with what they know, and how they can creatively apply scientific knowledge to real-life situations. PISA 2015 provides an overall science scale, which draws on all of the science questions in the assessment, as well as scales for three science competencies, three content areas and three knowledge categories. The metric for the overall science scale is based on a mean for OECD countries of 500 points and a standard deviation of 100 points that were set in PISA 2006 when the science scale was first developed.

5. The PISA performance scale is divided into proficiency levels to help users interpret what student scores mean in substantive terms. For PISA 2015, the range of difficulty of the tasks is represented by seven levels of science proficiency. At Level 2, which corresponds with performance between 410 and 483.9 score points in science, students are able to draw on everyday content knowledge and basic procedural knowledge to identify an appropriate scientific explanation, interpret data, and identify the question being addressed in a simple experimental design. They can use basic or everyday scientific knowledge to identify a valid conclusion from a simple data set. Students at Level 2 also demonstrate basic epistemic knowledge by being able to identify questions that could be investigated scientifically. Proficiency above Level 2 implies a greater mastery of these competencies and types of knowledge.

6. However, this measure does not capture differences between countries in the average socio-economic status of 15-year-olds. As such, it does not reflect how students from different countries and economies differ from each other in terms of their average socio-economic backgrounds.

7. This corresponds to the slope of the socio-economic gradient, which, for science in PISA 2015, varies from 8 to 15 score points. The negative relationship does not mean that more socio-economically diverse countries and economies have a negative slope.

8. See UNESCO Institute of Statistics database at http://data.uis.unesco.org/ (accessed 3 October 2016).

9. Coverage index 3 (CI3) is one of the indices intended to measure PISA population coverage (alongside Coverage index 1 and Coverage index 2). Specifically, CI3 represents the coverage of the national 15-year-old population. It is calculated by P/ST7a_1, where the value ST7a_1 is the entire population of 15-year-olds in each country (enrolled and not enrolled), based on national statistics; and where the value P is the weighted estimate of PISA-eligible non-excluded 15-year-old students from the student sample. Thus P/ST7a_1 indicates the proportion of the national population of 15-year-olds covered by the non-excluded portion of the student sample (see *PISA 2015 Technical Report,* OECD [forthcoming]). Low values of CI3 tend to be mirrored by low values of Coverage index 4 (CI4), which indicates the coverage of the estimated school population, and which takes into account a weighted estimate of PISA-eligible 15-year-old students excluded within schools in each country, and an estimate of the number of 15-year-old students enrolled in each school in the sample, prior to contacting the school to conduct the assessment. Values of CI4 are presented in the *PISA 2015 Technical Report* (OECD, forthcoming).

10. There is a degree of uncertainty surrounding point estimates for CI3. This arises mainly from the fact that its denominator (i.e. the total number of 15-year-olds in the country or economy) is a population estimate typically derived from administrative data sources, therefore subject to non-sampling error and sometimes also to changes in methodology and sources over time. By contrast, the numerator in the calculation of CI3 is a weighted estimate from the PISA sample, subject to sampling error and for which confidence intervals can be computed. For these reasons, it can be difficult to assess whether changes in CI3 over time are statistically significant.

11. The PISA sampling frame allows an overall exclusion rate within a country (i.e. school-level and within-school exclusions combined) of up to 5% below the PISA desired target population (see *PISA 2015 Technical Report,* OECD [forthcoming]).

12. Viet Nam has similar achievements but cannot be characterised as an equitable school system since only 49% of its national population of 15-year-olds is represented by the PISA sample.

13. These results are obtained through quantile regressions of the 10th, 25th, 50th, 75th and 90th percentiles of the distribution of student performance in science on students' socio-economic status; on the method, see Koenker and Hallock (2001).

14. A student is classified as resilient if he or she is in the bottom quarter of the PISA index of economic, social and cultural status (ESCS) in the country/economy of assessment and performs in the top quarter of residual scores among students from all countries/economies, after accounting for socio-economic status. The procedure for identifying resilient students is as follows: in a first step, a measure of performance adjusted for differences in ESCS across countries is computed through a linear regression of performance on ESCS and a squared transformation of ESCS. International top performers are then defined as those students who are in the top quarter of this adjusted measure among students in all PISA participating countries and economies. In a second step, the disadvantaged students in each country/economy are defined as those students whose ESCS is in the bottom quarter among students in their country/economy. Resilient students are those students who are socio-economically disadvantaged (their socio-economic status is low relative to other students in their own country) and international top performers (their performance is high with respect to all other students in PISA, after accounting for differences in socio-economic status across countries). Therefore, one characteristic of resilient students is that they achieve better performance in PISA than predicted by their socio-economic status.

15. Note that these results also depend on how schools are defined and organised within countries and on the units 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 others they were defined from a management perspective). The *PISA 2015 Technical Report* (OECD, forthcoming) provides an overview of how schools were defined in each country and economy. Note also that, because of the manner in which students were sampled, the within-school variation includes variation in performance between classes and grade levels as well as between students in similar classes and grades.

16. In the multilevel analyses carried out to estimate the overall level of variation in performance and its decomposition between and within schools, student final weights were used for Level 1 and school weights were used for Level 2.

17. The indices are constructed to have a mean of zero and a standard deviation of one across OECD countries. Positive values on the indices mean that principals view the amount and/or quality of resources in their schools as an obstacle to provide instruction for their students to a greater extent than the OECD average; inversely, negative values reflect that school principals perceive the lack or inadequacy of resources as an obstacle to instruction to a lesser extent than the OECD average (for more details, see Chapter 6 in Volume II).

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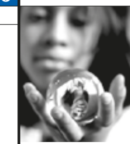

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