6 Long-term trends in performance and equity in education

This chapter reviews trends between PISA assessment 2022 and those prior to 2018 in mean performance, performance at the various levels of proficiency measured by PISA, and equity.

For Australia, Canada, Denmark, Hong Kong (China), Ireland, Jamaica, Latvia, the Netherlands, New Zealand, Panama, the United Kingdom and the United States, caution is required when interpreting estimates as not all PISA sampling standards were met (see Reader's Guide, Annexes A2 and A4).

Changes in performance throughout countries' participation in PISA

In education, the most significant changes can often only be seen and understood over the long term. Some of the most important education-policy reforms affect how schools operate and what students learn only very gradually. For example, changes in initial teacher education can take decades before their effects are visible in most classrooms. In addition, investments in pre-school and early-grades education to strengthen the foundations for learning may have significant effects on young people's skills – but only a decade or so later.

This chapter takes a long-term perspective on PISA results and describes the trajectories of countries and economies that have participated in at least three PISA assessments, including PISA 2022.[1]

What the data tell us

- Performance in mathematics dropped sharply in 2022 on average across OECD countries after remaining stable in 2003-2018. In reading and science, however, average trajectories across OECD countries had already turned negative before 2018 after reaching their highest level between PISA 2009 and 2012, well before the COVID-19 disruptions. This decade-long decline, therefore, must have deeper reasons. Over the 2012-2022 period, performance in 29 out of 63 countries/economies deteriorated in at least two (out of three) subjects with only six countries and economies improving in at least two subjects.
- When considering results from all PISA assessments through to 2022, four countries and economies improved in all three subjects: Colombia, Macao (China), Peru and Qatar. Four other countries (Israel, Republic of Moldova, Singapore and Türkiye) improved in two out of three subjects.
- PISA scores declined similarly for both high- and low-achieving students between 2012 and 2022 on average across OECD countries.
- In mathematics, Macao (China) simultaneously boosted its percentage of high-performing students (Level 5 and above) and reduced its share of low-performing students (below Level 2) between 2012 and 2022; the Republic of North Macedonia, Peru and Qatar reduced their percentage of low-performing students, and Sweden and the United Arab Emirates increased their share of high-performing students over the same period.
- Many countries/economies have made significant progress towards the goal of universal secondary education over the past decade, including Cambodia, Colombia, Costa Rica, Indonesia, Morocco, Paraguay and Romania. While in four of these seven countries, average PISA scores appear to decline, they have, in fact, improved or remained consistent once the expansion of secondary education to previously marginalised populations was also considered.
- The socio-economic gap in mathematics performance has remained stable over the last decade in most countries/economies (42 out of 62 with available data). It widened on average across OECD countries (by three score points) and in eight countries/economies, and narrowed in 12 countries/economies.
- The gender gap in mathematics performance has not changed over the last decade in most PISA-participating countries/economies (53 out of the 64 with comparable data). The gender gap has changed over the last decade in another eleven countries/economies. In eight of them the gap has narrowed (Albania, Brazil, Chile, Colombia, Costa Rica, Indonesia, Kosovo, and Spain) and it has widened in three (Latvia*, Macao [China] and Singapore).

PISA 2022 is the eighth round of the international assessment since the programme was launched in 2000. Every PISA test assesses students' knowledge and skills in mathematics, reading and science. The first full assessment of each subject sets the scale and starting point for future comparisons. For reading, trend comparisons are possible starting from 2000. Mathematics was the focal subject for the first time in 2003 and science in 2006. This means that it is possible to measure the change in mathematics performance between PISA 2003 and 2022 but not between

PISA 2000 and 2022. In all subjects, the most reliable way to establish a trend in students' performance over a certain period is to compare results from all the assessments conducted throughout this period.[2]

Every third assessment is an opportunity to revisit what it means to be proficient in the focal subject and the way in which this proficiency is measured. With the 2015 assessment, for example, PISA made it possible for students to take the test on computers; by 2022, all PISA tests were digitalised, allowing, for instance, simulations in the science portion of the assessment and online texts in reading. Because of the changing nature of the test, PISA long-term trends reflect not only whether students have become better at mastering the reading tasks that proficient readers could successfully complete in 2000 or solving the kinds of mathematics and science problems that were assessed in 2003 or 2006, they also show if students' skills are keeping pace with the changing nature of mathematics, reading and science in contemporary societies.[3] For countries that participated in PISA over many years, trends in student performance show if students' skills in mathematics, reading and science have improved, and if so, by how much. But because countries joined PISA in different years, not all can compare their students' performance across every PISA assessment. To better understand a country's/economy's trajectory and include the largest number of countries in the comparisons, this chapter focuses on estimates of the overall direction of trends in student performance and how that direction changed over time.[4]

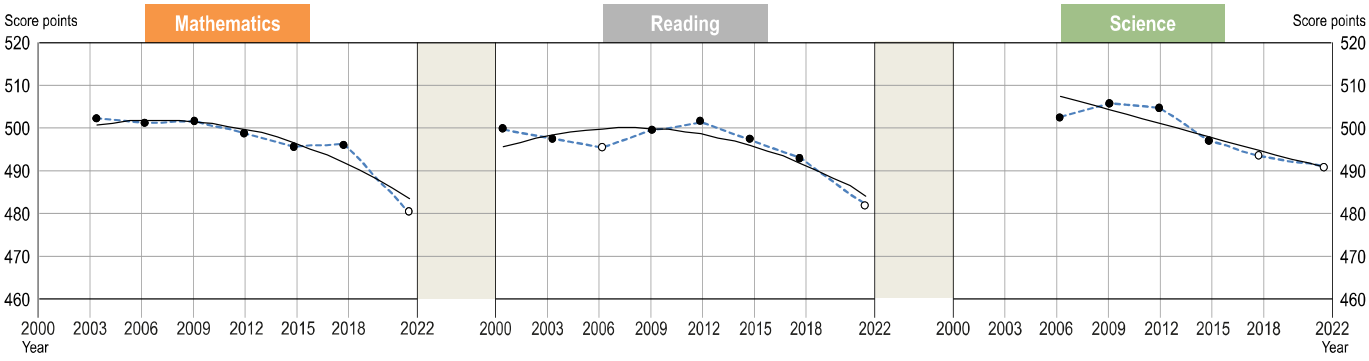
Trends in mean performance

Performance trajectories since the early PISA assessments

The average trend across OECD countries is negative, and, in mathematics and reading, increasingly so over the most recent period (Figure I.5.2; figures similar to Figure I.5.2 are presented in Annex D for each country/economy). Performance in PISA 2022 was the lowest in all subjects, significantly below the mean performance observed in any earlier assessment (except PISA 2018, in science). In mathematics, performance remained close to the 2003 level through all assessments up to 2018, then dropped sharply between 2018 and 2022. In reading and science, the strongest performance was observed in 2012 and 2009, respectively, then the trajectory turned negative: the causes of this decade-long decline have deeper origins that go beyond the COVID-19 shock.

Figure I.6.1. Trends in performance in mathematics, reading and science since the first PISA assessment

OECD average-23



Note: White dots indicate mean-performance estimates that are not statistically significantly above/below PISA 2022 estimates. Black lines indicate the best-fitting trend line.
Source: OECD, PISA 2022 Database, Tables I.B1.5.4, I.B1.5.5 and I.B1.5.6

Figure I.6.2 categorises countries and economies that can compare their PISA results over at least five assessments, i.e. since PISA 2009 or earlier, into nine groups, based on the shape of the trajectory of their mathematics performance (Table I.6.1 and Table I.6.2 provide corresponding information for reading and science).[5] Countries with an average improvement across at least five PISA assessments are in the top row; countries with no significant

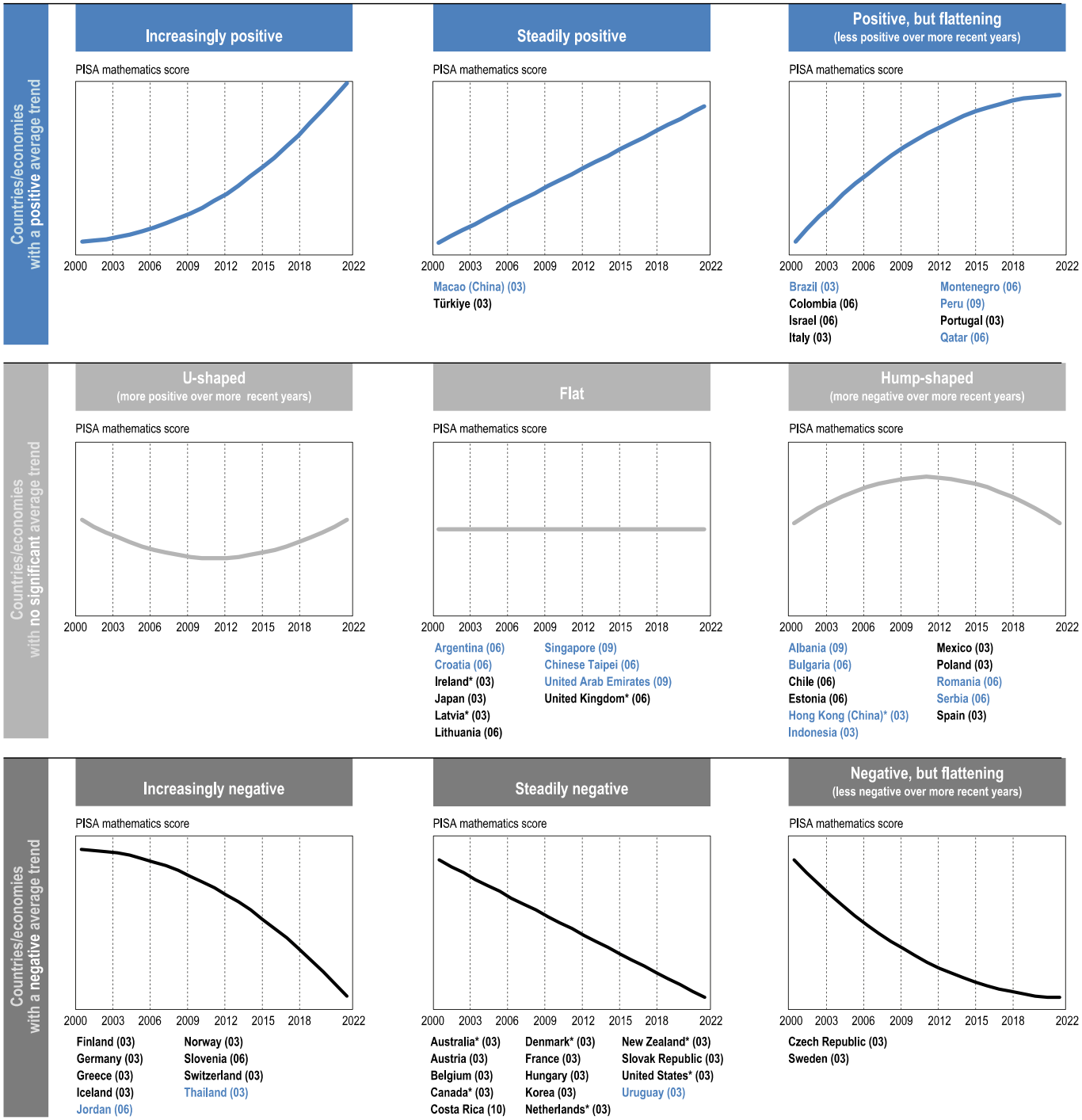
positive or negative trend are in the middle row; and countries with a negative trend are in the bottom row. The column indicates whether the trend observed is a steady trend (middle column) or an accelerating, flattening or reversing trend.

When considering the full period throughout which they participated in PISA, four countries and economies had a positive trend through to 2022 in all three subjects: Colombia, Macao (China), Peru and Qatar (Table I.B1.5.4, Table I.B1.5.5 and Table I. B1.5.6). Four other countries (Israel, Republic of Moldova,[6] Singapore and Türkiye) improved in two out of three subjects.

No single country/economy showed an increasingly positive trend in any subject. In contrast, many countries showed increasingly poor performance in at least one subject (similar to the OECD average trend in mathematics and reading depicted in Figure I.5.2). In addition, several countries (e.g. Germany in reading and Mexico in mathematics and science) reversed gains made in earlier assessments over the most recent period: their trends can be described as "hump-shaped" – improving at first but turning negative in more recent years).

Figure I.6.2. Trajectories of average performance in mathematics across PISA assessments

Direction and trajectory of trends in mean mathematics performance



Notes: Figures are for illustrative purposes only. Countries and economies are grouped according to the overall direction of their trend (the sign and significance of the average decennial trend) and to the rate of change in the direction of their trend (the sign and significance of the curvature in the estimate of quadratic trends) (see Annex A7).
Only countries and economies with data from at least five PISA mathematics assessments are included. Not all countries and economies can compare their students' performance over the same period. For each country/economy, the base year, starting from which mathematics results can be compared, is indicated in parentheses next to the country's/economy's name ("03" = 2003, "06" = 2006, etc.). Both the overall direction and the change in the direction may be affected by the period considered.
Georgia, Malta and Moldova conducted the PISA 2009 assessment in 2010, then participated in PISA 2015, 2018 and 2022. The average trend in mathematics over the full period is not significant in Georgia and Malta, and positive in Moldova. Malaysia conducted the PISA 2009 assessment in 2010, then participated in all subsequent assessments; however, PISA 2015 results were not deemed comparable due to low response rates. The average trend in mathematics over the full period, excluding results from PISA 2015, is not significant. Panama* participated in PISA 2009, 2018 and 2022. The average trend in mathematics over the full period is not significant.
Source: OECD, PISA 2022 Database, Table I.B1.5.4.

Table I.6.1. Trajectories of average performance in reading across PISA assessments

Direction and trajectory of trends in mean reading performance

Countries/economies with a positive average trend	**Increasingly positive**	**Steadily positive**	**Positive, but flattening** (less positive over more recent years)
		Israel (02), Macao (China) (03)	Albania (01), Chile (01), Colombia (06), Estonia (06), Peru (01), Qatar (06), Romania (06), Serbia (06), Singapore (09)
Countries/economies with no significant average trend	**U-shaped** (more positive over more recent years)	**Flat**	**Hump-shaped** (more negative over more recent years)
	Argentina (01)	Austria (00), Brazil (00), Bulgaria (01), the Czech Republic (00), Denmark* (00), Hungary (00), Ireland* (00), Italy (00), Japan (00), Lithuania (06), Mexico (00), Spain (00), Chinese Taipei (06), Türkiye (03), the United Kingdom* (06), the United States* (00), Uruguay (03)	Croatia (06), France (00), Germany (00), Hong Kong (China)* (02), Indonesia (01), Latvia* (00), Montenegro (06), Norway (00), Poland (00), Portugal (00), Slovenia (06), Switzerland (00)
Countries/economies with a negative average trend	**Increasingly negative**	**Steadily negative**	**Negative, but flattening** (less negative over more recent years)
	Belgium (00), Finland (00), Greece (00), Iceland (00), Korea (00), the Netherlands* (03), Thailand (01), the United Arab Emirates (09)	Australia* (00), Canada* (00), Costa Rica (10), New Zealand* (00), the Slovak Republic (03), Sweden (00)	

Notes: Countries and economies are grouped according to the overall direction of their trend (the sign and significance of the average decennial trend) and the rate of change in the direction of their trend (the sign and significance of the curvature in the estimate of quadratic trends) (see Annex A7).
Only countries and economies with data from at least five PISA reading assessments are included. Not all countries and economies can compare their students' performance over the same period. For each country/economy, the base year, starting from which reading results can be compared, is indicated in parentheses next to the country's/economy's name ("00" = 2000, "03" = 2003, etc.). Both the overall direction and the change in the direction may be affected by the period considered.
Trend comparisons for Jordan are not reported in reading (see Annex A4). Georgia, Malta and Moldova conducted the PISA 2009 assessment in 2010, then participated in PISA 2015, 2018 and 2022. The average trend in reading over the full period is not significant in Georgia and Malta, and positive in Moldova. Malaysia conducted the PISA 2009 assessment in 2010, then participated in all subsequent assessments; however, PISA 2015 results were not deemed comparable due to low response rates. The average trend in reading over the full period, excluding results from PISA 2015, is not significant. North Macedonia participated in PISA 2000, 2015, 2018 and 2022. The average trend in reading over the full period is not significant. Panama* participated in PISA 2009, 2018 and 2022. The average trend in reading over the full period is not significant.
Source: OECD, PISA 2022 Database, Table I.B1.5.5.

Table I.6.2. Trajectories of average performance in science across PISA assessments

Direction and trajectory of trends in mean science performance

Countries/economies with a positive average trend	**Increasingly positive**	**Steadily positive**	**Positive, but flattening** (less positive over more recent years)
		Macao (China) (06), Peru (09), Singapore (09), Türkiye (06)	Colombia (06), Qatar (06)
Countries/economies with no significant average trend	**U-shaped** (more positive over more recent years)	**Flat**	**Hump-shaped** (more negative over more recent years)
	Sweden (06), Chinese Taipei (06)	Argentina (06), Chile (06), the Czech Republic (06), Denmark* (06), France (06), Indonesia (06), Ireland* (06), Israel (06), Japan (06), Korea (06), Latvia* (06), Lithuania (06), Montenegro (06), Serbia (06), the United Arab Emirates (09), the United States* (06), Uruguay (06)	Albania (09), Brazil (06), Bulgaria (06), Estonia (06), Italy (06), Mexico (06), Norway (06), Poland (06), Portugal (06), Romania (06), Spain (06), Thailand (06)
Countries/economies with a negative average trend	**Increasingly negative**	**Steadily negative**	**Negative, but flattening** (less negative over more recent years)
	Germany (06), Iceland (06), the Netherlands* (06)	Australia* (06), Austria (06), Belgium (06), Canada* (06), Costa Rica (10), Finland (06), Greece (06), Hong Kong (China)* (06), New Zealand* (06), Slovenia (06), Switzerland (06), the United Kingdom* (06)	Croatia (06), Hungary (06), the Slovak Republic (06)

Notes: Countries and economies are grouped according to the overall direction of their trend (the sign and significance of the average decennial trend) and the rate of change in the direction of their trend (the sign and significance of the curvature in the estimate of quadratic trends) (see Annex A7).
Only countries and economies with data from at least five PISA science assessments are included. Not all countries and economies can compare their students' performance over the same period. For each country/economy, the base year, starting from which science results can be compared, is indicated in parentheses next to the country's/economy's name ("06" = 2006, "09" = 2009). Both the overall direction and the change in the direction may be affected by the period considered.
Trend comparisons for Jordan are not reported in reading and science (see Annex A4). Georgia, Malta and Moldova conducted the PISA 2009 assessment in 2010, then participated in PISA 2015, 2018 and 2022. The average trend in science over the full period is not significant in Georgia, Malta and Moldova. Malaysia conducted the PISA 2009 assessment in 2010, then participated in all subsequent assessments; however, PISA 2015 results were not deemed comparable due to low response rates. The average trend in science over the full period, excluding results from PISA 2015, is not significant. Panama* participated in PISA 2009, 2018 and 2022. The average trend in science over the full period is not significant.
Source: OECD, PISA 2022 Database, Table I.B1.5.6.

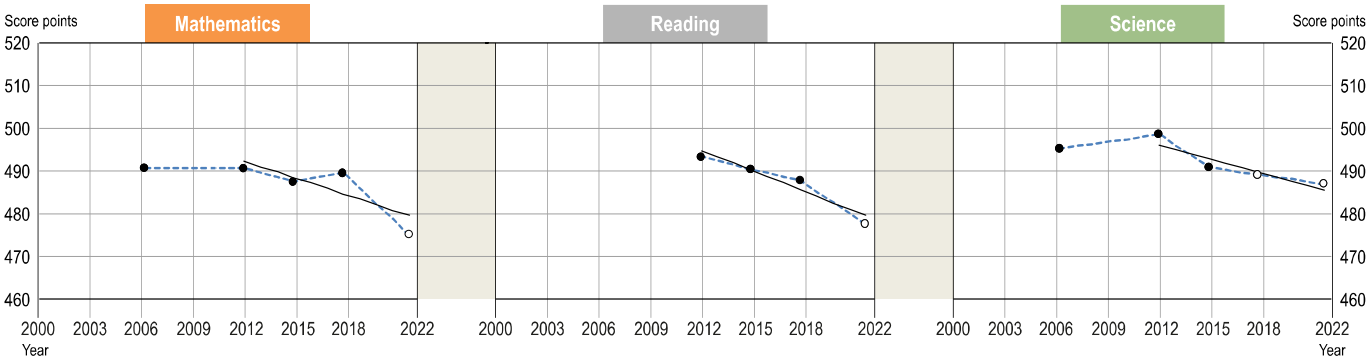
Trends over the 2012-2022 period

Over the most recent decade (2012-2022), the trend has been negative in all three subjects (Figure I.6.3) on average across OECD countries. Between 2012 and 2022, just under half of the countries/economies whose trends are reported (29 out of 63, including those whose trends can only be reported going back to 2015) performed increasingly poorly in at least two subjects (Table I.6.3) (Jordan, whose trends are only reported in mathematics, also has a negative trend). In contrast, only six countries and economies improved performances in at least two out of three subjects.

While OECD member countries have performed increasingly poorly on average, students in Peru and Qatar have improved their mean performance in mathematics, reading and science since 2012 (Table I.6.3).

Figure I.6.3. Trends in performance in mathematics, reading and science since 2012

OECD average-35



Note: White dots indicate mean-performance estimates that are not statistically significantly above/below PISA 2022 estimates. Black lines indicate the best-fitting trend lines.
Source: OECD, PISA 2022 Database, Tables I.B1.5.4, I.B1.5.5 and I.B1.5.6

Table I.6.3. Trends in mean performance in mathematics, reading and science since 2012

Based on average decennial trend

		Improving trend in **mathematics**	Non-significant trend in **mathematics**	Declining trend in **mathematics**
Improving trend in **reading**	Improving trend in **science**	Peru, Qatar	Uruguay	
	Non-significant trend in **science**			
	Declining trend in **science**			
Non-significant trend in **reading**	Improving trend in **science**	The Dominican Republic (15), Macao (China), Türkiye		
	Non-significant trend in **science**		Brazil, Colombia, Croatia, the Czech Republic, Hungary, Israel, Kazakhstan, Lithuania, Malaysia, Serbia, Singapore, Sweden	Argentina, Chile, Denmark*, Malta (15), Mexico, Portugal, Romania, the Slovak Republic, Chinese Taipei, the United States*
	Declining trend in **science**	North Macedonia (15)	Moldova (15), the United Kingdom*	Australia*, Austria, Estonia, Ireland*, Italy, Kosovo (15), New Zealand*
Declining trend in **reading**	Improving trend in **science**			
	Non-significant trend in **science**		Japan, Latvia*, Montenegro	France, Indonesia, Korea
	Declining trend in **science**		The United Arab Emirates	Albania, Belgium, Bulgaria, Canada*, Costa Rica, Finland, Georgia (15), Germany, Greece, Hong Kong (China)*, Iceland, the Netherlands*, Norway, Poland, Slovenia, Spain, Switzerland, Thailand

Notes: Only countries and economies that participated PISA 2022 and in either PISA 2012 or PISA 2015 are included.
Cells with the darkest background indicate positive (blue) or negative (grey) significant changes in all three subjects; cells with lighter background indicate one or two significant changes, all in the same direction (see Annex A3).
A number 15, in parentheses, signals countries and economies for which a shorter reference period (2015-2022) was used to compute the trends.
Jordan is not included in this table because earlier PISA results are only comparable to PISA 2022 results in mathematics (see Annex A4). The trend in mathematics in Jordan is declining.
Source: OECD, PISA 2022 Database, Tables I.B1.5.4, I.B1.5.5 and I.B1.5.6

Trends among high- and low-achieving students

Changes in a country's/economy's average performance can result from improvements or declines in performance by low-, medium- and high-achieving students. In some countries/economies, performance declines are observed along the entire distribution of performance, resulting in more students who perform at the lowest levels of proficiency and fewer students who attain the highest levels of proficiency. In other contexts, average performance declines can be mostly attributed to large declines among low-achieving students and little or no change among high-achieving students. This may result in a larger proportion of low-achieving students but no change in the share of top performers.

Figure I.6.4 shows the linear trend in median performance since PISA 2012 alongside trends observed in the performance of students in the 90th and 10th percentiles (i.e. near the top and bottom of the performance distribution; the median performance corresponds to that of students in the 50th percentile, i.e. at the mid-point of the performance distribution). Trends at the 10th percentile indicate whether the lowest-achieving 10% of students in a country/economy moved up the PISA scale over time. Similarly, trends at the 90th percentile indicate improvements among a country's/economy's high-achieving students (the 90th percentile is the point on the PISA scale below which exactly 90% of students can be found).

Among countries and economies whose mean mathematics performance worsened since 2012, there have been both widening and shrinking performance gaps in about equal proportion:

- Australia*, Canada*, Estonia, Finland, Hong Kong (China)*, the Netherlands*, Norway and Romania saw more rapid declines among low-performing students. As a result, the achievement gap in mathematics (measured by distance between the 10th and 90th percentiles) widened between 2012 and 2022.
- In contrast, Albania, Belgium, France, Georgia, Greece, Indonesia, Ireland*, Jordan, Kosovo, Malta, Mexico and Portugal saw more rapid declines among high-performing students. As a result, the achievement gap in mathematics shrank between 2012 and 2022 (Table I.B1.5.10).

In many countries, performance declines were relatively uniform along the distribution of performance; there are similar declines at the 10th and 90th percentiles, for example, for the OECD average.

Among countries and economies where mathematics performance improved over the 2012-2022 period, the Dominican Republic, North Macedonia and Qatar saw a significant change in the achievement gap, with low-achieving students improving more rapidly than (and catching up to) high-achieving students.

Finally, among countries and economies with no significant change in mean mathematics performance over the 2012-2022 period, Kazakhstan, Sweden and the United Arab Emirates nevertheless widened their performance gap. In contrast, the performance gap shrank in the Republic of Moldova (where low-achievers improved and high-achievers declined) and in Malaysia (where low-achievers' performance remained stable, and high-achievers' performance declined).

On average across the 23 OECD countries that can compare PISA results across all assessments, performance differences widened in reading and science because low-achieving students performed worse while high-achieving students remained stable; in contrast, performance differences narrowed in mathematics because almost all students performed worse but high-achieving students declined by more than low-achieving students did. Table I.6.4 considers all subjects and, for each country, the longest possible period over which comparisons are possible (excluding countries that can only compare results between PISA 2018 and 2022: their results were already reported in Chapter 5). It lists countries and economies according to whether their performance distributions in reading, mathematics and science narrowed, widened or did not change significantly (as measured by the inter-decile range) over the course of their participation in PISA. When this can be ascertained with confidence,[7] the table also shows whether the change or lack thereof is primarily due to changes among low-achieving students, high-achieving students or both.

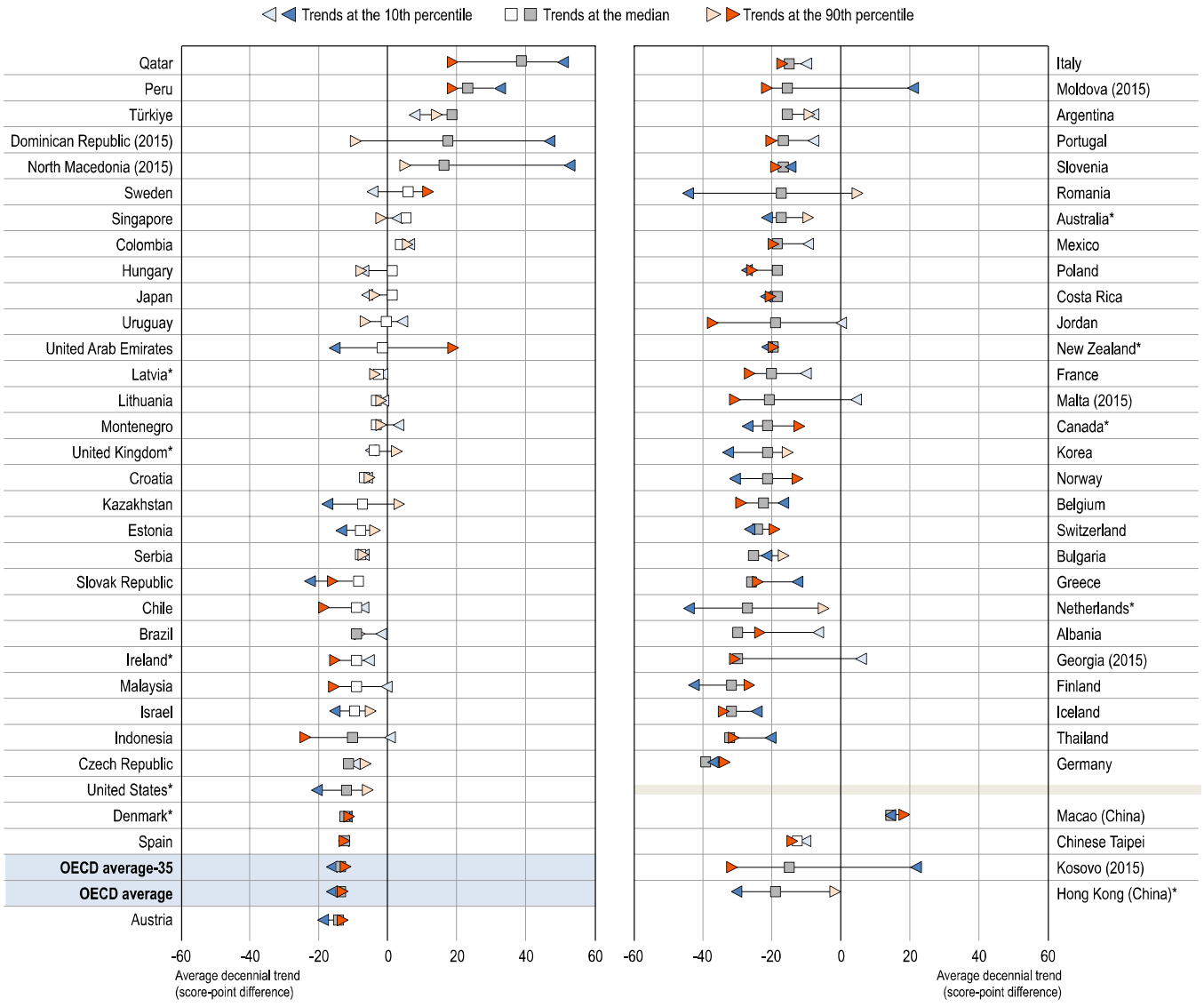
Table I.6.4. Change in performance distribution in mathematics, reading and science since the first PISA assessment

	Mathematics	Reading	Science
Widening of the distribution	**12 countries/economies**	**27 countries/economies**	**21 countries/economies**
Low-achievers performed worse; high-achievers performed better		The United Arab Emirates (09)	The United Arab Emirates (09)
Low-achievers performed worse, while performance did not change significantly among high-achievers	The United Kingdom* (06)	**OECD average-23 (00)**, Canada* (00), France (00), Hong Kong (China)* (00), Hungary (00), Korea (00), Norway (00), the Slovak Republic (03), Slovenia (06), Sweden (00)	**OECD average-23 (06)**, Canada* (06), Croatia (06), Hungary (06), Korea (06), Norway (06), Poland (06), Sweden (06)
High-achievers performed better, while performance did not change significantly among low-achievers	Romania (06), the United Arab Emirates (09)	Brazil (00), Estonia (06), Israel (00), Macao (China) (03), Romania (06), Singapore (09), Chinese Taipei (06)	Romania (06), Serbia (06), Chinese Taipei (06)
Almost all students performed worse, but low-achievers declined by more than high-achievers did	Australia* (03), Canada* (03), Finland (03), Korea (03), the Netherlands* (03), the Slovak Republic (03)	Australia* (00), Costa Rica (09), Finland (00), Iceland (00), the Netherlands* (03)	Australia* (06), Costa Rica (09), Finland (06), Germany (06), the Netherlands* (06), the Slovak Republic (06)
Almost all students performed better, but high-achievers improved by more than low-achievers did		Malaysia (09)	Macao (China) (06), Qatar (06)
Overall widening of the dispersion (none of the above patterns)	Croatia (06), Estonia (06), Chinese Taipei (06)	Austria (00), the Czech Republic (00), Japan (00), Spain (00)	Estonia (06), Montenegro (06)
No change in the dispersion of the distribution	**30 countries/economies**	**28 countries/economies**	**33 countries/economies**
Performance dropped to a similar extent for both high- and low-achievers	Austria (03), the Czech Republic (03), France (03), Hungary (03), Iceland (03), New Zealand* (03), Norway (03), Slovenia (06), Sweden (03), Switzerland (03), the United States* (03)	Belgium (00), Greece (00), New Zealand* (00), Thailand (00)	Austria (06), Belgium (06), Greece (06), Hong Kong (China)* (06), Iceland (06), New Zealand* (06), Slovenia (06), Switzerland (06), Thailand (06), the United Kingdom* (06)
Performance improved to a similar extent for both high- and low-achievers	Georgia (09), Israel (06), Italy (03), Kazakhstan (09), Macao (China) (03), Malaysia (09), Malta (09), Montenegro (06), Portugal (03), Qatar (06), Singapore (09), Türkiye (03)	Chile (00), the Dominican Republic (15), Malta (09), Moldova (09), Panama* (09), Peru (00), Qatar (06), Serbia (06)	Colombia (06), the Dominican Republic (15), Malaysia (09), Moldova (09), North Macedonia (15), Panama* (09), Peru (09), Türkiye (06)
Performance remained close to prior levels for both high- and low-achievers	Bulgaria (06), Hong Kong (China)* (03), Japan (03), Lithuania (06), Poland (03), Serbia (06), Spain (03)	Bulgaria (00), Croatia (06), Denmark* (00), Germany (00), Indonesia (00), Ireland* (00), Italy (00), Lithuania (06), Mexico (00), Montenegro (06), Poland (00), Portugal (00), Switzerland (00), Türkiye (03), the United Kingdom* (06), the United States* (00)	Brazil (06), Chile (06), the Czech Republic (06), Denmark* (06), France (06), Indonesia (06), Ireland* (06), Israel (06), Italy (06), Latvia* (06), Lithuania (06), Portugal (06), Spain (06), the United States* (06), Uruguay (06)
Narrowing of the distribution	**23 countries/economies**	**9 countries/economies**	**10 countries/economies**
Low-achievers performed better; high-achievers performed worse	Argentina (06)	Uruguay (03)	Albania (09)
High-achievers performed worse, while performance did not change significantly among low-achievers	Ireland* (03), Jordan (06), Uruguay (03)		Bulgaria (06)
Low-achievers performed better, while performance did not change significantly among high-achievers	Albania (09), Brazil (03), Colombia (06), Indonesia (03), Mexico (03)	Albania (00), Argentina (00), Colombia (06)	Argentina (06), Singapore (09)
Almost all students performed worse, but high-achievers declined by more than low-achievers did	**OECD average-23 (03)**, Belgium (03), Costa Rica (09), Denmark* (03), Germany (03), Greece (03), Thailand (03)		
Almost all students performed better, but low-achievers improved by more than high-achievers did	The Dominican Republic (15), Kosovo (15), Moldova (09), North Macedonia (15), Panama* (09), Peru (09)	Georgia (09), Kazakhstan (09), Kosovo (15), North Macedonia (00)	Georgia (09), Kazakhstan (09), Kosovo (15), Malta (09)
Overall narrowing of the dispersion (none of the above patterns)	Chile (06), Latvia* (03)	Latvia* (00)	Japan (06), Mexico (06)

Notes: For each country/economy, the base assessment, starting from which results can be compared, is indicated in parentheses next to the country's/economy's name ("00" = 2000, "03" = 2003, etc.) Changes in the dispersion of the distribution – widening, narrowing or no change – are measured by the inter-decile range, i.e. the difference in score points between the 90th percentile and the 10th percentile of the student-performance distribution. Trends in percentiles are estimated with less precision than trends in mean performance. For some countries/economies, a significant trend in mean performance was observed during the period even though changes in points along the distribution could not be deemed significant. Trends among low-achievers refer to situations in which student performance at either the 10th or 25th percentile improved or declined and the other percentile moved in the same direction or did not change significantly. Likewise, trends among high-achievers refer to situations in which student performance at either the 75th or 90th percentile improved or declined and the other percentile moved in the same direction or did not change significantly. In order to classify a country/economy as one where almost all students became weaker or stronger, when the distribution either widened or narrowed, at least four of the percentiles examined (the 10th, 25th, 50th, 75th and 90th percentiles) must have declined or improved. In order to classify a country/economy as one where most students became weaker or stronger, when there was no change in the dispersion of the distribution, at least three of the percentiles examined (the 10th, 25th, 50th, 75th and 90th percentiles) must have declined or improved.
Trend comparisons for Jordan are not reported in reading and science (see Annex A4).
OECD average-23 refers to the average across OECD countries that can compare performance across all assessments, from PISA 2000 through to PISA 2022.
Source: Tables I.B1.5.7, I.B1.5.8, I.B1.5.9, I.B1.5.10, I.B1.5.11 and I.B1.5.12

Changes in enrolment rates (i.e. more disadvantaged 15-year-olds are now enrolled in secondary school than were in previous generations) may, in some cases, have contributed to widening disparities in performance. To determine how this may have shifted performance trends, "adjusted trends" that neutralise the contribution of enrolment trends on performance trends are computed (see section "Average 10-year trend in performance, taking into account changes in enrolment rates" and Figure I.6.7 below). Demographic shifts such as increases in the immigrant population may also have contributed to the observed trends; the magnitude of international migration trends and their effect on education systems' performance is discussed in Chapter 7.

Figure I.6.4. Average decennial trend in mathematics for high- and low-achieving students (2012-2022)



Notes: Only countries/economies that participated in the 2022 and either the 2012 or 2015 PISA assessments are shown.
When the base year is 2015, this is indicated next to the country/economy name.
Values that are statistically significantly different from 0 are marked in a darker tone (see Annex A3).
OECD average-35 refers to the average across OECD countries, excluding Costa Rica, Luxembourg and Spain.
Countries and economies are ranked in descending order of the average decennial trend in median performance in mathematics.
Source: OECD, PISA 2022 Database, Table I.B1.5.7

Changes in the proportion of 15-year-old students at different levels of proficiency

PISA scores in mathematics, reading and science skills are more than a tool to rank students and countries. Together with proficiency-level descriptions, scores give information on what level of skills students have. In each subject, these range from the basic skills required for further learning, and full participation in non-manual work and most of today's institutions to the complex skills that only a few students in most countries have mastered. These include being able to understand and communicate complex information, and model complex situations mathematically. Trends in the proportion of low- and top-performing students indicate how their mastery of specific skills (as established in the described proficiency scale) has changed over time.[8]

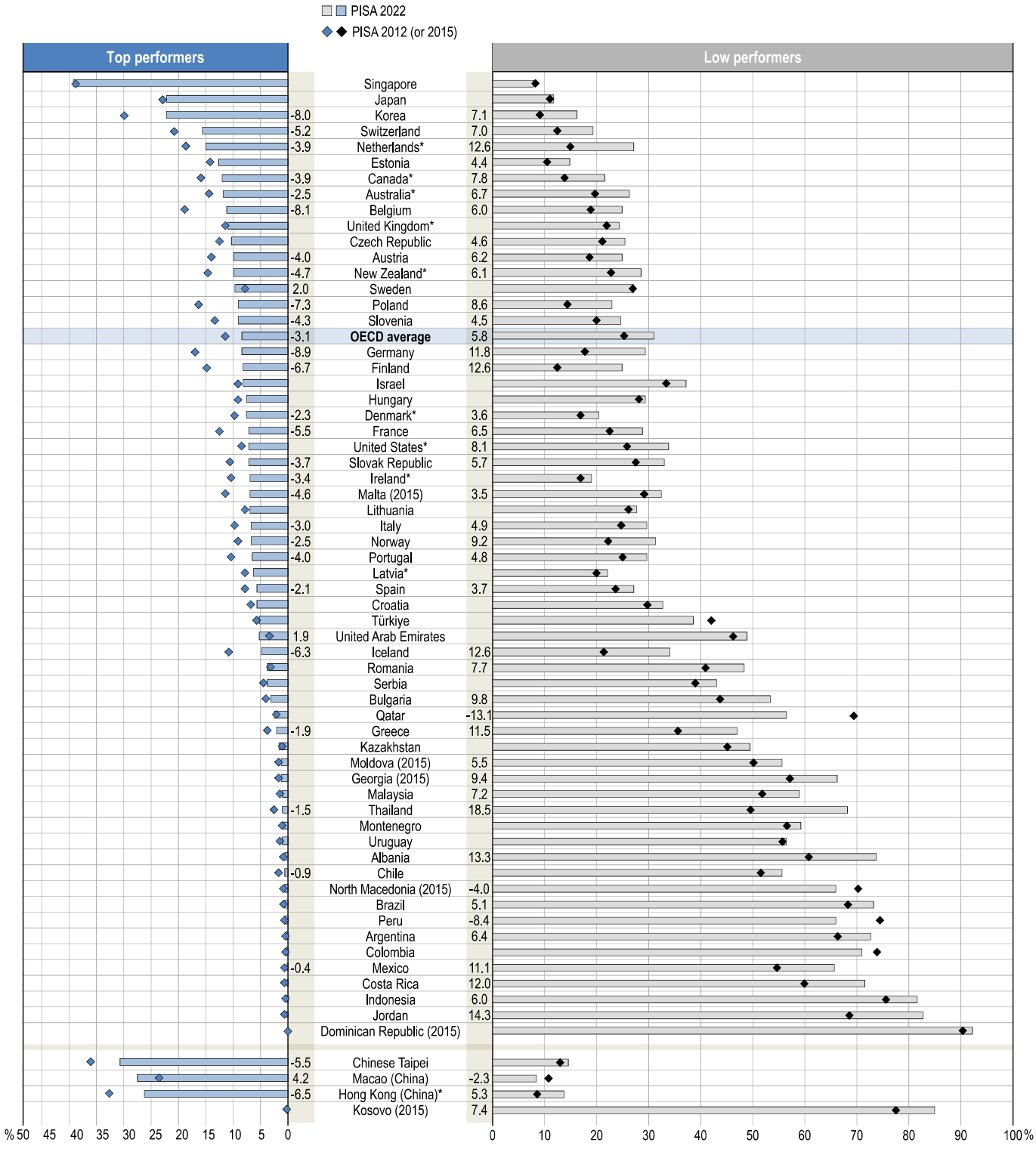
The proportion of students who do not reach Level 2 on the PISA scales (low-performing students) and the proportion of students who are able to score at Level 5 or 6 (top-performing students) indicate the quality of a country's/economy's talent pool. Trends in the share of low-performing students indicate the extent to which school systems are advancing (or not) towards providing all students with basic literacy and numeracy skills. Trends in the share of top-performing students indicate whether education systems are making progress in ensuring that young people can successfully use their mathematics, reading and science skills to navigate a volatile, uncertain, complex and ambiguous environment.

On average across OECD countries, the proportion of students scoring below Level 2 in mathematics increased by 5.8 percentage points between 2012 and 2022 whereas the proportion of students scoring at or above Level 5 decreased by 3.1 percentage points (Figure I.6.5). Over the decade prior to 2022, 25 countries and economies had a similar pattern of increasing shares of low-performing students and decreasing shares of high-performing students in mathematics.

In mathematics, only one economy, Macao (China), was able to simultaneously reduce its share of low-performing students and increase its share of high-performing students over the past decade. Three countries/economies decreased their share of low-performing students: North Macedonia, Peru and Qatar (North Macedonia can only compare PISA 2022 with 2015 results). In addition, Sweden and the United Arab Emirates increased their share of students at Level 5 and above.

Table I.6.5 summarises the information in Figure I.6.5 by grouping countries/economies according to the significance and direction of trends in the share of top-performing and low-performing students since PISA 2012. It presents similar information for reading and science.

Figure I.6.5. Percentage of low- and top performers in mathematics in 2012 and 2022



Notes: Only countries/economies that participated in the 2022 and either the 2012 or 2015 PISA assessments are shown.
When the base year is 2015, this is indicated next to the country/economy name.
The numbers at the bottom indicate statistically significant changes between the base year and 2022 in the share of students performing below Level 2 in mathematics; the numbers to the top indicate statistically significant changes in the share of students performing at or above Level 5.
Countries and economies are ranked in descending order of the percentage of students who scored at or above Level 5 in 2022.
Source: OECD, PISA 2022 Database, Table I.B1.5.1.

Table I.6.5. Change in the percentage of low- and top performers in mathematics, reading and science since PISA 2012

Countries/economies where the ...

... share of low-performing students (students scoring below Level 2) ...	...and the share of top-performing students (students scoring at Level 5 or 6)...	Mathematics	Reading	Science
... decreased ...	... increased	Macao (China)	Qatar, Uruguay	Peru, Qatar
	... did not change significantly	North Macedonia (15), Peru, Qatar	Peru	The Dominican Republic (15), Uruguay
	... decreased			
... did not change significantly ...	... increased	Sweden, the United Arab Emirates	Brazil, Chile, Colombia, the United States*	Brazil, Chile, Colombia, Kazakhstan, Macao (China), Sweden, Chinese Taipei, Türkiye, the United States*
	... did not change significantly	Colombia, Croatia, the Dominican Republic (15), Hungary, Israel, Japan, Kazakhstan, Latvia*, Lithuania, Montenegro, Serbia, Singapore, Türkiye, the United Kingdom*, Uruguay	Argentina, Croatia, the Czech Republic, the Dominican Republic (15), Ireland*, Italy, Lithuania, Macao (China), Malaysia, Malta (15), North Macedonia (15), Portugal, Romania, Serbia, Singapore, Sweden, the United Kingdom*	Argentina, Denmark*, Indonesia, Israel, Japan, Malaysia, Mexico, Montenegro, Portugal, Serbia, Singapore, the Slovak Republic
	... decreased	Chile, Ireland*, Chinese Taipei	Moldova (15)	Malta (15)
... increased ...	... increased		Kazakhstan, the United Arab Emirates	Korea, the United Arab Emirates
	... did not change significantly	Albania, Argentina, Brazil, Bulgaria, Costa Rica, the Czech Republic, Estonia, Georgia (15), Indonesia, Jordan, Kosovo (15), Malaysia, Moldova (15), Romania, the United States*	**OECD average**, Australia*, Austria, Canada*, Costa Rica, Denmark*, Estonia, Germany, Hungary, Indonesia, Israel, Korea, Kosovo (15), Latvia*, Mexico, Montenegro, New Zealand*, Norway, Poland, the Slovak Republic, Slovenia, Spain, Switzerland, Chinese Taipei	**OECD average**, Albania, Australia*, Austria, Belgium, Canada*, Costa Rica, Croatia, the Czech Republic, Estonia, France, Germany, Greece, Hungary, Kosovo (15), Latvia*, Lithuania, Moldova (15), the Netherlands*, New Zealand*, North Macedonia (15), Norway, Romania, Slovenia, Spain, Switzerland, Thailand, the United Kingdom*
	... decreased	**OECD average**, Australia*, Austria, Belgium, Canada*, Denmark*, Finland, France, Germany, Greece, Hong Kong (China)*, Iceland, Italy, Korea, Malta (15), Mexico, the Netherlands*, New Zealand*, Norway, Poland, Portugal, the Slovak Republic, Slovenia, Spain, Switzerland, Thailand	Albania, Belgium, Bulgaria, Finland, France, Georgia (15), Greece, Hong Kong (China)*, Iceland, Japan, the Netherlands*, Thailand, Türkiye	Bulgaria, Finland, Georgia (15), Hong Kong (China)*, Iceland, Ireland*, Italy, Poland

Notes: Only countries/economies that participated in the 2022 and either the 2012 or 2015 PISA assessments are shown.
Trend comparisons for Jordan are not reported in reading and science (see Annex A4).
When the base year is 2015, this is indicated next to the country/economy name.
Source: OECD, PISA 2022 Database, Tables I.B1.5.1, I.B1.5.2 and I.B1.5.3.

Average 10-year trend in performance, taking into account changes in enrolment rates

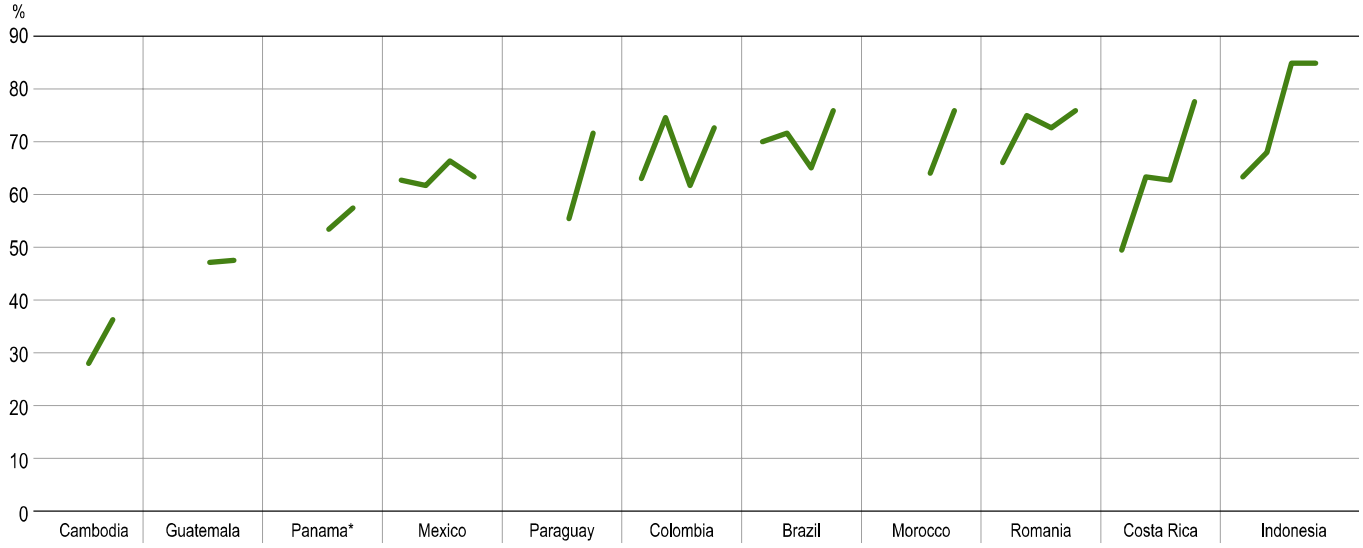
In most countries, all boys and girls who were born in 2006 were of the correct age to sit the PISA 2022 test (in countries that tested students in the second part of 2022, a 12-month period spanning the years 2006 and 2007 defined the eligible birthdates). However, age was not the only criterion for eligibility: 15-year-olds also had to be enrolled in seventh grade or higher at the time of testing.

This additional condition might seem redundant in high-income countries that had established universal, free, and, sometimes, compulsory primary and lower-secondary schooling many decades ago,[9] but because eligibility in PISA is determined by more than just a student's age, the PISA sample excludes 15-year-olds who do not go to school or are severely delayed in their school-grade progression. PISA results thus reflect a combination of 15-year-olds' access to education and the quality of the education they have received over the course of their lives.

Globally, enrolment in secondary education has continued to expand over the past decade in many countries. This expansion is also reflected in PISA data: in most of the 11 countries where fewer than two in three 15-year-olds were eligible to participate in past PISA assessments, there is now a marked increase in the number of 15-year-olds eligible for the test relative to all the 15-year-olds in the country. Between 2012 and 2022, Indonesia added more than 1.1 million students to the total population of 15-year-olds that could take the PISA test (the total population of 15-year-olds increased only by about 300 000 over the same period). Cambodia, Colombia, Costa Rica, Morocco, Paraguay and Romania also increased the number of 15-year-olds eligible to sit the PISA test despite stable or, in some cases, shrinking populations of 15-year-olds. As a result, PISA coverage – the proportion obtained by dividing the number of PISA-eligible students by the total number of 15-year-olds in a country – increased by about 10 percentage points in Cambodia, Colombia, Morocco and Romania; 16 percentage points in Paraguay; and more than 20 percentage points in Costa Rica and Indonesia.

Figure I.6.6. Change between 2012 and 2022 in the percentage of 15-year-olds covered by PISA

Selected countries; 2012, 2015 or 2018 to 2022.



Note: Only countries whose Coverage Index 3 (CI3) was below 66.6% in 2012, 2015 or 2018 are included in the figure.
Countries are ranked in ascending order of the percentage of 15-year-olds covered by the PISA sample (CI3) in 2022.
Source: OECD, PISA 2022 Database, Table I.B1.4.1.

There are many reasons why the social, economic and institutional barriers that kept many 15-year-olds out of school have come down. These include compulsory-schooling laws, income-support policies (such as conditional cash transfers), and wider changes in society and the economy, such as urbanisation. This welcome expansion in education opportunities makes it, however, more difficult to interpret how mean scores in PISA have changed over time. Increases in the share of PISA-eligible students relative to all 15-year-olds can lead to an underestimation of the real improvements education systems have achieved. Household surveys often show that children from poor households, rural areas, or ethnic minorities have a greater chance of not attending or completing lower secondary education (UNESCO, 2015[1]). Typically, as populations that had previously been excluded gain access to higher

levels of schooling, a larger proportion of low-performing students would be included in PISA samples (Avvisati, 2017[2]).

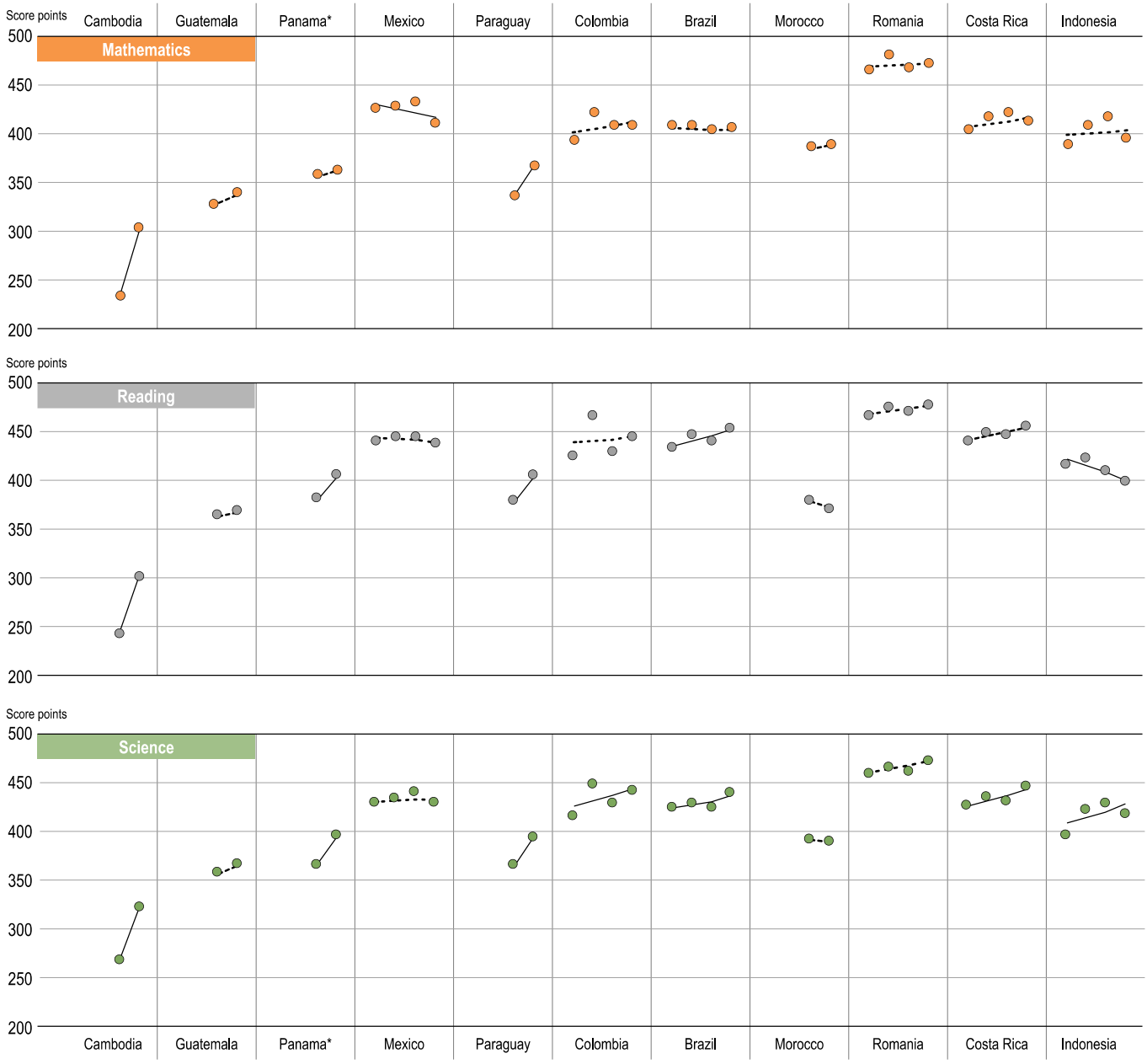
Just like the majority of countries and economies discussed in this chapter, many of these countries saw a declining trend over the past decade in two and, sometimes, all three subjects. Of the countries in which PISA coverage increased markedly, only Cambodia and Paraguay (whose first participation was as participants in the PISA for Development initiative in 2017) saw improvements in performance in at least one subject by 2022. Among those with a longer record of participation, only in Colombia did mean performance remain stable in all three subjects over the period – all other countries experienced falling mean scores in one subject at least.

Do these declines mean that the quality of education has gone down for all students in the past decade? Or, do they reflect the expansion of education to more marginalised populations? By considering a population equal in size to 25% of an age group made up of only the best-performing students in a country, it is possible to monitor the rate of change in PISA performance for a sample of 15-year-olds that was only indirectly affected by changes in coverage rates over a given period but whose composition remained unchanged. Most likely, all members of this group would have been eligible to participate in PISA even in the counterfactual situation of no educational expansion.[10] This analysis, reported in Figure I.6.7, offers a different reading of many of these countries' results. Minimum scores for 25% of top-performing 15-year-olds increased over this period in all three subjects in Cambodia and Paraguay. They improved in reading and science in Brazil and Panama*, and improved in science only in Colombia and Costa Rica. Minimum scores remained stable in all three subjects in Morocco and Romania. In Indonesia, science scores at the 75th percentile of young people improved, reading results deteriorated, and mathematics results remained stable over this period.

Summing up, among the seven countries that increased participation in secondary education over the 2012-2022 period, mean scores remained stable in Colombia; improved in one subject at least in Cambodia and Paraguay; and dropped in one subject at least in the remaining four (Costa Rica, Indonesia, Morocco and Romania). In all these cases, the decline in mean scores is linked to the integration of more 15-year-olds from marginalised populations into schooling. PISA results show that these education systems did not deteriorate and that expanding secondary education to more marginalised students did not compromise the quality of education for their more-advantaged peers.

Figure I.6.7. Linear trend in the minimum score attained by at least 25% of 15-year-olds since 2012

Selected countries; 2012, 2015 or 2018 to 2022



Note: Only countries whose Coverage Index 3 (CI3) was below 66.6% in 2012, 2015 or 2018 are included in the figure.
Dotted trend-lines indicate non-significant trends over the period considered.
Countries are ranked in ascending order of the percentage of 15-year-olds covered by the PISA sample (CI3) in 2022.
Source: OECD, PISA 2022 Database, Tables I.B1.4.1, I.B1.5.16, I.B1.5.17 and I.B1.5.18.

Changes in equity in education over the last decade

Long-term changes in socio-economic disparities

Table I.6.6 shows how the socio-economic gap in mathematics performance has evolved over time as well as how mathematics performance has evolved for advantaged and disadvantaged students. For each country/economy, a "10-year average trend" is computed based on every PISA assessment available since PISA 2012.

In most countries and economies (42 out of 62 with available data), the socio-economic gap has remained stable over the last decade. This includes, most importantly, 15 countries/economies where advantaged and disadvantaged students saw a decline in their performance; 13 countries/economies where the performance of advantaged and disadvantaged students did not change over time; and three countries/economies where advantaged and disadvantaged students improved their performance (North Macedonia, Qatar and Türkiye).

The socio-economic gap narrowed over the last decade in 12 countries/economies. In 11 of them, advantaged students saw a decline in their performance (the exception is Peru, where advantaged students' performance improved). Disadvantaged students' performance did not change in eight out of the 12 countries/economies where the socio-economic gap narrowed. It improved in one (Peru) and declined in another three (Denmark*, Greece and New Zealand*).

The socio-economic gap has widened over the last decade on average across OECD countries (by three score points) and in eight countries/economies. Except for Macao (China), all other countries where socio-economic disparities have increased on average over the last decade are European, which explains why the OECD average doesn't reflect the more widespread international trend of stable (not growing) socio-economic disparities in performance. Among countries/economies where the socio-economic gap in student performance has widened, the driving factor has been the decline in disadvantaged students' performance (six out of eight countries/economies), more than the improvement of advantaged students' performance (two out of eight countries/economies).

Table I.6.6. Change in the socio-economic gap in mathematics performance since 2012

Average decennial trend in mathematics performance across PISA assessments since 2012, by quarter of socio-economic status

	Advantaged students' performance **declined** and …	**Advantaged students'** performance **did not change** and …	**Advantaged students'** performance **improved** and …
…**disadvantaged students'** performance **declined**	The socio-economic gap ***narrowed***:		
	Denmark*, Greece, New Zealand*		
	The socio-economic gap ***did not change***:		
	Argentina, Australia*, Belgium, Bulgaria, Canada*, France, Germany, Hong Kong (China)*, Iceland, Korea, Mexico, Poland, Slovenia, Spain, Thailand	Austria, Croatia, the Czech Republic, Italy, Malaysia, Serbia, the Slovak Republic, the United States*	
	The socio-economic gap ***widened***:		
	OECD average-35, Finland, Norway	Estonia, the Netherlands*, Romania, Switzerland	
…**disadvantaged students'** performance **did not change**	The socio-economic gap ***narrowed***:		
	Chile, Georgia, Indonesia, Ireland*, Jordan, Malta, the United Arab Emirates, Uruguay		
	The socio-economic gap ***did not change***:		
	Portugal, Chinese Taipei	Brazil, Colombia, Hungary, Israel, Japan, Kazakhstan, Kosovo, Latvia*, Lithuania, Moldova, Montenegro, Singapore, the United Kingdom*	
	The socio-economic gap ***widened***:		
			Macao (China), Sweden
…**disadvantaged students'** performance **improved**	The socio-economic gap ***narrowed***:		
			Peru
	The socio-economic gap ***did not change***:		
		The Dominican Republic	North Macedonia, Qatar, Türkiye
	The socio-economic gap ***widened***:		

Notes: Only countries/economies that participated in the 2022 and either the 2012 or 2015 PISA assessments are shown.
OECD average-35 refers to the average across OECD countries, excluding Costa Rica, Luxembourg and Spain.
Source: OECD, PISA 2022 Database, Table I.B1.5.19.

Long-term changes in gender disparities

Table I.6.7 shows trends in the gender gap in mathematics performance as well as trends in girls' and boys' mathematics performance since 2012. The gender gap is measured here by the score difference in mathematics between boys and girls (boys – girls); thus, positive values for this difference indicate a gap in favour of boys and negative values indicate a gap in favour of girls. In addition, notice that when the gender gap narrows it means that the gap becomes more favourable to girls, and when it widens it means that the gap becomes more favourable to boys. Regardless of the trend in the gap, the gender gap can favour girls or boys or not be significant in PISA 2022.

The gender gap in mathematics performance has not changed over the last decade in most PISA-participating countries/economies (53 out of the 64 with comparable data). This includes 26 countries/economies where girls and boys have seen a decline in their performance; 16 countries/economies where the performance of boys and girls has not changed over time; and five countries/economies where boys and girls have improved their performance (the Dominican Republic, North Macedonia, Peru, Qatar and Türkiye). In half of the 53 countries/economies where the gender gap has not changed since 2012, boys outperformed girls in PISA 2022 whereas in seven of them girls outperformed boys (Dominican Republic, Finland, Jordan, Malaysia, North Macedonia, Qatar and the United Arab Emirates).

The gender gap has changed over the last decade in another eleven countries/economies. In eight of them the gap has narrowed (Albania, Brazil, Chile, Colombia, Costa Rica, Indonesia, Kosovo and Spain) and it has widened in three (Latvia*, Macao [China] and Singapore).

On average across OECD countries, the gender gap has narrowed over the last decade by 3 score points. The gender gap has narrowed by 15 score points in Albania (the most) and 7 points (the least) in Costa Rica and Spain on average since 2012. In countries/economies where the gender gap has narrowed, this is due to declines in boys' performance more than to improvements in girls' performance. Girls' performance has not improved over the last decade in any of the eight countries/economies where the gender gap narrowed; in five of them (Brazil, Chile, Colombia, Indonesia and Kosovo) girls' performance has not changed and in three (Albania, Costa Rica and Spain) it has declined. Out of the eight countries/economies where the gender gap has narrowed over the last decade, girls outperformed boys in PISA 2022 in two (Albania and Indonesia), and boys outperformed girls in five (Brazil, Chile, Colombia, Costa Rica and Spain).

The gender gap in performance has widened in Singapore (by 15 points on average since 2012) because boys' performance has improved while girls' performance has remained stable over time. In Macao (China), the gap has widened because boys' performance has improved more than girls' performance (which has also improved). In Latvia*, the gender gap has widened because girls' performance has declined while boys' performance has remained stable. In the three countries/economies where the gender gap has widened over the last decade, boys outperformed girls in PISA 2022.

Table I.6.7. Change since 2012 in mean performance in mathematics, by gender

Average decennial trend in mathematics performance across PISA assessments since 2012, by gender

	Boys' performance **declined** and …	**Boys'** performance **did not change** and …	**Boys'** performance **improved** and …
…**Girls'** performance **declined**	The gender gap ***narrowed***:		
	OECD average (b), Albania (g), Costa Rica (b), Spain (b)		
	The gender gap ***did not change***:		
	Australia* (b), Austria (b), Belgium, Bulgaria, Canada* (b), Denmark* (b), Finland (g), France (b), Germany (b), Greece, Hong Kong (China)* (b), Iceland, Italy (b), Jordan (g), Korea, Malta, Mexico (b), the Netherlands* (b), New Zealand* (b), Norway, Poland, Portugal (b), Romania, Slovenia, Switzerland (b), Thailand	Estonia (b), Georgia, the United States* (b)	
	The gender gap ***widened***:		
		Latvia* (b)	
…**Girls'** performance **did not change**	The gender gap ***narrowed***:		
	Brazil (b), Chile (b), Indonesia (g), Kosovo	Colombia (b)	
	The gender gap ***did not change***:		
	Argentina (b), Ireland* (b), the Slovak Republic	Croatia, the Czech Republic (b), Hungary (b), Israel (b), Japan (b), Kazakhstan, Lithuania (b), Malaysia (g), Moldova, Montenegro, Serbia (b), Sweden, Chinese Taipei, the United Arab Emirates (g), the United Kingdom* (b), Uruguay (b)	
	The gender gap ***widened***:		
			Singapore (b)
…**Girls'** performance **improved**	The gender gap ***narrowed***:		
	The gender gap ***did not change***:		
			The Dominican Republic (g), North Macedonia (g), Peru (b), Qatar (g), Türkiye
	The gender gap ***widened***:		
			Macao (China) (b)

Notes: Only countries/economies that participated in the 2022 and either the 2012 or 2015 PISA assessments are shown.
The gender gap is measured in this table by the score difference in mathematics between boys and girls (boys – girls). This means that, in any particular PISA cycle, positive values for this difference indicate a gap in favour of boys and negative values indicate a gap in favour of girls. Thus, when interpreting trends in the gender gap between PISA cycles, notice that when the gender gap narrows it means that the gap becomes more favourable to girls, and when it widens it means that the gap becomes more favourable to boys. Regardless of the trend in the gap, the gender gap can favour girls or boys or not be significant in PISA 2022.
The letter "g" in parenthesis next to the country name means that girls' performance in mathematics is higher than boys' performance in PISA 2022. The letter "b" means that boys perform higher than girls. No letter next to the country name means that the difference in mathematics performance between boys and girls in PISA 2022 is not statistically significant (see Annex A3).
Source: OECD, PISA 2022 Database, Tables I.B1.5.38, I.B1.5.39 and I.B1.5.40.

Table I.6.8. Long-term trends in performance and equity in education Chapter 6 figures and tables

Figure I.6.1	Trends in performance in mathematics, reading and science since the first PISA assessment
Figure I.6.2	Trajectories of average performance in mathematics across PISA assessments
Table I.6.1	Trajectories of average performance in reading across PISA assessments
Table I.6.2	Trajectories of average performance in science across PISA assessments
Figure I.6.3	Trends in performance in mathematics, reading and science since 2012
Table I.6.3	Trends in mean performance in mathematics, reading and science since 2012
Table I.6.4	Change in performance distribution in mathematics, reading and science since the first PISA assessment
Figure I.6.4	Average decennial trend in mathematics for high- and low-achieving students (2012-2022)
Figure I.6.5	Percentage of low- and top performers in mathematics in 2012 and 2022
Table I.6.5	Change in the percentage of low- and top performers in mathematics, reading and science since PISA 2012
Figure I.6.6	Change between 2012 and 2022 in the percentage of 15-year-olds covered by PISA
Figure I.6.7	Linear trend in the minimum score attained by at least 25% of 15-year-olds since 2012
Table I.6.6	Change in the socio-economic gap in mathematics performance since 2012
Table I.6.7	Change since 2012 in mean performance in mathematics, by gender

StatLink https://stat.link/lsncy9

Notes

[1] Out of all countries and economies that participated in PISA 2022, 64 can compare their results in mathematics, reading and science performance to at least one assessment *prior to* PISA 2018 (i.e. with PISA 2015 or earlier assessments and over a period of seven years or more). Jordan can compare its results only in mathematics; results in reading and science from prior assessments were not deemed fully comparable to those in 2022 (see Annex A4). The methodology underpinning the analysis of trends in performance in this chapter is detailed in Annex A7.

[2] In order to allow for fair comparisons across subjects and countries, this chapter emphasises, next to the "longest possible trends", trends between 2012 and 2022 (i.e. over a decade including up to four PISA assessments). When the emphasis is on comparisons across countries and subjects, such trends allow to control for differences in the reference period. In some cases, even this shorter reference period had to be adjusted for some countries/economies and subjects due to the unavailability of data; this is explicitly signalled in figures throughout this chapter.

[3] In 2022, four countries continued to assess students using pen-and-pencil tests. Three of these (Cambodia, Guatemala and Paraguay) participated for the first time in PISA in 2017 as part of the PISA for Development initiative; trends between their first participation in PISA and 2022 are discussed in the previous chapter. Changes in enrolment and PISA coverage, and their effects on PISA performance are discussed in this chapter for all countries to provide a wider comparative perspective. Viet Nam participated in all PISA assessments since 2012, using the same paper-based test in each cycle; however, because response patterns in 2022 in all subjects deviated significantly from those observed in Viet Nam in earlier assessments, no reliable trend could be established for Viet Nam and comparisons of scale scores to those reported in past assessments are not discussed in this chapter.

[4] The overall direction of a trend is estimated by the linear trend. This represents the average change in student performance per unit of time (a 10-year interval is chosen in this chapter) observed over the entire period for which data are available. The exact period may vary depending on the country and the subject assessed. Because the rate of change is reported over intervals of 10 years, the linear trend is referred to as the "decennial or 10-year trend" in this chapter. For countries and economies that have participated in all PISA assessments, the average decennial trend computed over the longest period takes into account up to eight points in time (for reading); for those countries

that have data that were deemed comparable for fewer assessments, the average decennial trend takes into account only the comparable and available information.

[5] Non-linear trend trajectories are estimated using a regression model by fitting a quadratic function to the five, six or seven mean estimates available and taking into account the statistical uncertainty associated with each estimate as well as with comparisons over time (see Annex A7). Trajectories are classified as steadily positive (negative) or flat if the curvature (the quadratic coefficient) is not significant. This regression-based measure is a more robust measure of a country's/economy's trajectory in performance than the successive comparison of mean scores across consecutive assessments because it is less sensitive to one-time statistical fluctuations that may alter a country's/economy's mean performance estimate.

[6] Moldova only participated in four assessments up to 2022 (in 2010, 2015, 2018 and 2022), and is therefore not included in the figures and tables which examine curvilinear trajectories.

[7] This discussion only considers changes that were statistically significant. In most cases, estimates of percentiles are subject to greater uncertainty than estimates of means. Just like changes in mean performance, changes in percentiles over time are also subject to link errors; in contrast, link errors can be ignored in the estimation of changes in the inter-decile range (i.e. when determining whether the distribution narrowed or widened). For this reason, it is sometimes possible to conclude that the performance distribution widened even if neither the 10th nor the 90th percentile exhibit significant changes.

[8] In this section, the proportions of students at Level 5 and above, and below Level 2, are compared across countries over the same period (2012 to 2022). Due to updates to the assessment framework, the specific abilities that define top-performing and low-achieving students differ slightly between the reference year and 2022 but the same cut-off scores on the equated scales were used to define and compare proficiency levels.

[9] The *International Covenant on Economic, Social and Cultural Rights* adopted by the United Nations General Assembly on 16 December 1966 recognises the right of everyone to free primary education and commits its parties to work towards introducing free education at secondary and higher levels (UN General Assembly, 16 December 1966[3])

[10] The interpretation of these trends requires the additional hypothesis that all 15-year-olds who were excluded from participation in PISA in past cycles (mostly because they were not in secondary school at age 15) would not have scored above the "adjusted 75th percentile" if they had sat the test. In other words, this analysis relies on the hypothesis that, while the skills and ability of the 15-year-olds who were not eligible to participate in PISA may vary, this variation is bounded below the 75th percentile of the distribution of 15-year-olds' performance in the subjects assessed by PISA. In particular, 15-year-olds who were not in school or were below Grade 7 at the time of the PISA test would not have scored among the country's top quarter had they sat the PISA test. No assumption is made about how well these 15-year-olds would have scored if they had received the additional schooling that would have made them eligible to sit the PISA test. If some non-eligible 15-year-olds had had greater skills than assumed in this analysis, the 75th percentile estimates on which this analysis is based are, in reality, lower bounds on the *true* 75th percentiles. As the selectivity of PISA samples is attenuated (i.e. Coverage Index 3 increases), the lower bounds can be expected to move closer to the true value. In that context, the reported changes and trends may overestimate the *true* changes and trends. For a discussion of non-parametric methods for partial identification of trends in the presence of selection, see Blundell et al. (2007[4]).

It is impossible to know for certain what the PISA score of 15-year-olds who were not enrolled in school or who were still in Grades 1 through 6 would have been, had they been tested. Without attributing an exact score to these students, it is nevertheless possible to assume with some confidence that they would have scored in the bottom part

of a country's performance distribution (Hanushek and Woessmann, 2008[7]; Spaull and Taylor, 2015[5]; Taylor and Spaull, 2015[6])

References

Avvisati, F. (2017), "Does the quality of learning outcomes fall when education expands to include more disadvantaged students?", *PISA in Focus*, No. 75, OECD Publishing, Paris, https://doi.org/10.1787/06c8a756-en. [2]

Blundell, R. et al. (2007), "Changes in the Distribution of Male and Female Wages Accounting for Employment Composition Using Bounds", *Econometrica*, Vol. 75/2, pp. 323-363, https://doi.org/10.1111/j.1468-0262.2006.00750.x. [4]

Hanushek, E. and L. Woessmann (2008), "The Role of Cognitive Skills in Economic Development", *Journal of Economic Literature*, Vol. 46/3, pp. 607-668, https://doi.org/10.1257/jel.46.3.607. [7]

Spaull, N. and S. Taylor (2015), "Access to What? Creating a Composite Measure of Educational Quantity and Educational Quality for 11 African Countries", *Comparative Education Review*, Vol. 59/1, pp. 133-165, https://doi.org/10.1086/679295. [5]

Taylor, S. and N. Spaull (2015), "Measuring access to learning over a period of increased access to schooling: The case of Southern and Eastern Africa since 2000", *International Journal of Educational Development*, Vol. 41, pp. 47-59, https://doi.org/10.1016/j.ijedudev.2014.12.001. [6]

UN General Assembly (16 December 1966), *International Covenant on Economic, Social and Cultural Rights*, United Nations, https://www.refworld.org/docid/3ae6b36c0.html (accessed on 26 July 2023). [3]

UNESCO (2015), *Education for All 2000-2015: Achievements and Challenges. EFA Global Monitoring Report*, UNESCO, https://unesdoc.unesco.org/ark:/48223/pf0000232205 (accessed on 4 September 2019). [1]