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Defining and Characterising Student Resilience in PISA

INTRODUCTION

Resilient students come from disadvantaged backgrounds yet exhibit high levels of school success. This chapter answers a question central to this report from a PISA perspective: What does it mean to "beat the odds" and how does this differ across countries?

To address these questions, the chapter presents two different complementary approaches.

First, it discusses resilience from an international perspective. A global perspective is useful to address questions such as to what extent different systems vary in terms of the proportion of students from a disadvantaged socio-economic background that are able to perform at the relatively high levels in PISA. It is possible to tackle this question using an internationally comparable definition of resiliency that takes into account how socio-economic background is related to achievement across countries.

Second, what factors are associated with student resilience within countries? The relationship between resiliency and individual or school level factors is best analysed within the specific context of each educational system. This report presents results from analyses that use a country-specific definition of resilience that is suitable for addressing these issues.

The chapter defines resilient students to be those who, despite being socio-economically disadvantaged compared to other students in their own country, are high achievers in the PISA science assessment. To address the different questions outlined above, the chapter compares these students to students in other countries, for international comparisons, and to other students in their country for drawing insights on policies aimed at fostering high performance among disadvantaged students.

As a comparison group for resilient students, the chapter also identifies disadvantaged low achievers, a group of students that share a similar socio-economic background to resilient students but whose members are among the lowest performers in the PISA science assessment, be it internationally or in their country.

The chapter first presents measures of the share of resilient students across countries that are internationally comparable and then explores potential within-country differences between resilient students and disadvantaged low achievers in terms of three individual student characteristics: gender, immigrant background and language spoken at home.

Although it focuses on resilient students and disadvantaged low achievers defined using information on students' performance in science, the chapter also reports briefly on the findings when resilience is based on mathematics or reading performance. It also considers whether students resilient in relation to science are also resilient in reading and mathematics.

DEFINING RESILIENT AND DISADVANTAGED LOW-ACHIEVING STUDENTS USING PISA

Chapter 1 identified resilient students as those students who "beat the odds". As previously discussed, there is no one commonly-used definition of resilience. The definitions developed and applied in this report were chosen after careful consideration of the many definitions used elsewhere. Within the context of PISA, two distinct and complementary perspectives are possible for identifying resilient students. Each responds best to a particular concern. The report identifies disadvantaged low achievers as the comparison group for resilient students. The definitions of disadvantaged low achievers are therefore always complementary to the resilience definitions.

This chapter develops two operational definitions and empirical approaches to student resilience. From an international perspective, countries are interested in knowing the proportion of internationally successful disadvantaged students different educational systems are able to produce. In this case, success should be

defined in the same way for all countries allowing direct cross-country comparisons. This chapter develops first a definition of resilience that is appropriate for this purpose, namely to compare the share of resilient students across countries. Some systems may be able to produce a larger share of resilient students among their disadvantaged students and their experience may yield insights for other countries. A low proportion of disadvantaged but internationally successful students may point to areas for improvement. These countries may need to carefully analyse policies and resources related to the performance of disadvantaged students, which are analysed in Chapters 3 and 4.

From a within-country perspective, policy makers and stakeholders want to know more about how to foster resilience within their educational system. They are interested in the policy levers that may help increase the performance of socio-economically disadvantaged students. In this case, the performance of disadvantaged students relative to their peers from more advanced socio-economic backgrounds is a more valid indicator of success at school. Looking at relative performance means that successful disadvantaged students in one country may be seen as poor performing in other contexts and therefore relative performance within a system is not useful for comparisons across systems. Although this definition is not used to compare the share of resilient student across countries, it is more helpful when searching for policies and resources related to better performance among disadvantaged students within the context of national educational systems.

Both approaches use two measures: the PISA index of economic, social and cultural status to characterise socio-economic disadvantage and the PISA science scale to characterise academic achievement. Both definitions share the same approach to socio-economic disadvantage: they focus on the context closest to the student and the educational system they experience. The key difference is on performance: the first approach focuses on an international benchmark whereas the second uses a country-specific one.

An international perspective

With this definition, a resilient student is the one who outperforms her or his colleagues sharing the same socio-economic background. In this case, the level of performance above which a student can be called resilient is established as the top third of performers across all countries, after accounting for their socio-economic background. In other words, these are students from all countries who outperformed their peers with the same socio-economic background. The share of resilient students in a country is then calculated as the percentage of high performers among students in a bottom third of socio-economic background in each country (see Annex A5 for details on this definition).

The relation between socio-economic background and performance is established using data from all countries. Therefore, students with the same socio-economic background and the same performance have equal probability of being resilient regardless of the performance of other students in their country. For example, Ana, a student in country A, is resilient if her background is among the bottom third in country A and her performance is on the top third across countries among those students whose background is similar to Ana's, irrespective of their country. In this sense, this definition is mixed because it sets an international benchmark for performance and a national benchmark for socio-economic background. Because it compares equals across countries, using an international benchmark on performance and adjusting for a student background, this definition of resilience yields measures of the extent of resilience at the system level that are comparable across countries.[1]

Within an international perspective, disadvantaged low achievers are students who share the same socio-economic background as resilient students, *i.e.* fall in the bottom third of their country's distribution of socio-economic background, but whose performance is in the bottom third of the student performance after adjusting for socio-economic background.

Comparing the shares of resilient students across countries

Figure 2.1 presents the proportion of resilient and disadvantaged low achievers among disadvantaged low achievers across countries using an internationally comparable definition. One hundred percent in this case represents the bottom third of the student population in each country in terms of socio-economic background.

Figure 2.1
Shares of resilient and disadvantaged low achievers among disadvantaged students, by country
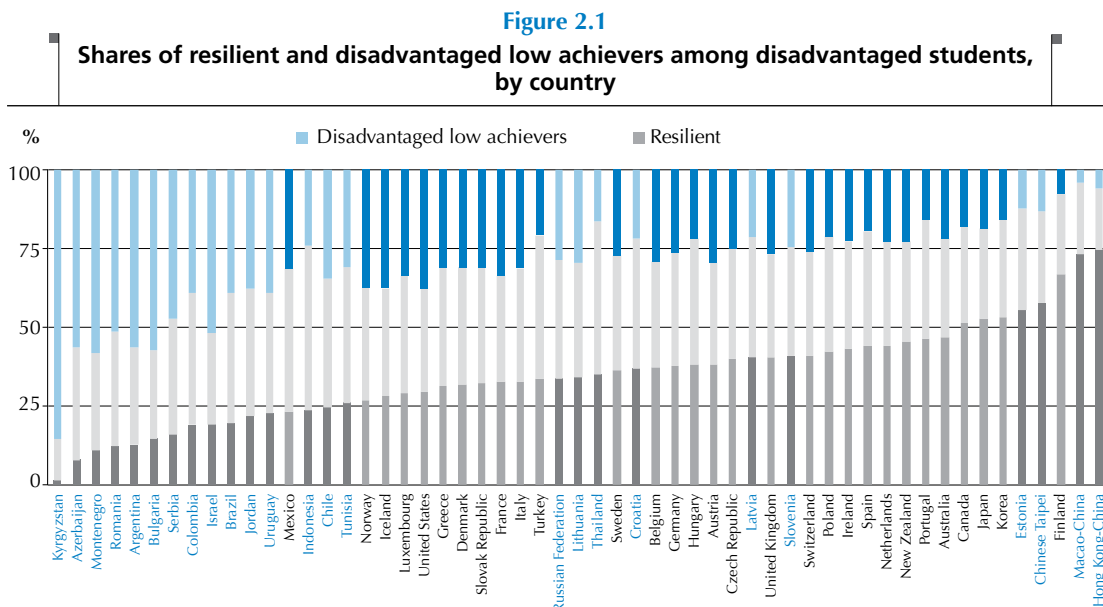
Source: *OECD PISA 2006 Database.*

Some countries have noticeably high shares of resilient students, while others have only few high performing students among disadvantaged ones. Student resilience is more common in OECD countries like Canada, Finland, Japan, and Korea, and among partner countries and economies in Chinese Taipei, Estonia, Hong Kong-China and Macao-China where more than half of disadvantaged students are among top third of performers in all countries after accounting for socio-economic background (Table A1.1). In partner countries and economies the share of resilient students is generally much lower, with only few resilient students in Azerbaijan, Kyrgyzstan, Montenegro and Romania. Students in these countries are rarely outperforming their peers in other countries sharing the same socio-economic background.

Figure 2.1 also shows that there is a close relationship between the shares of resilient and disadvantaged low achievers. The countries with the highest shares of resilient students tend to display also the lowest shares of disadvantaged low achievers. In Canada, Finland, Japan, and Korea, and in the partner countries and economies Chinese Taipei, Estonia, Hong Kong-China and Macao-China, the share of disadvantaged low achievers among disadvantaged students is always below 20%. In Portugal and Spain and partner country Thailand, however, these shares are equally low. The figure also shows examples of countries with relatively low levels of resilient students and low levels of disadvantaged low achievers among disadvantaged students (Table A1.1).

A within-country perspective

For the second perspective, a within-country approach is necessary. With an international perspective in some countries the number of resilient students is extremely small, leaving no room for any analysis of how resilience associates with student or school characteristics. The within-country perspective

defines resilient students as those who fall in both the bottom third of their country's socio-economic background distribution and the top third of their country's performance distribution on the PISA science assessment scale.[2]

This definition allows the examination of factors helping to beat the odds in each country by comparing within-country relationships across countries in order to draw inferences about how to foster resiliency within countries. The data presented in the report enable each country's school leaders to see how student characteristics are associated with resilience within their country's educational context and to look to other countries to see if there are consistent patterns across countries, for example in the relationships of resilience to student approaches to learning as potential levers for increasing the prevalence of resilient students. This requires country-specific cut-points for both socio-economic disadvantage and academic achievement.[3]

Within a country-specific approach disadvantaged low achievers are students who share the same socio-economic background as resilient students but whose scores fall in the bottom third of their country's PISA science assessment score distribution. To the extent that socio-economic background predicts academic performance, disadvantaged low achievers represent how one might expect disadvantaged students to score on the science assessment.

SIMILARITIES AND DIFFERENCES OF RESILIENT STUDENTS ACROSS COUNTRIES

Even within the country-specific perspective, resilient students (and disadvantaged low achievers) share a set of common characteristics across countries, notably in terms of their socio-economic background and performance relative to other students and peers in their country.

In terms of socio-economic background, across OECD countries, resilient students and disadvantaged low achievers share a disadvantaged socio-economic background that is well below the average background within their country. The results presented in Figure 2.2 and Table A1.2 highlight the differences and similarities between resilient students, disadvantaged low achievers and the average student in the country in terms of socio-economic background. The average socio-economic background of resilient students is between three quarters and one full standard deviation below the national average (except in Portugal and Mexico where they are 1.2 standard deviations below). Disadvantaged low achievers are about a standard deviation below the national average in terms of socio-economic background (except in Turkey, Portugal and Mexico where they are more than 1.4 standard deviations below the national average). The same pattern can be observed in partner countries and economies. Figure 2.2 also shows that across all OECD countries, resilient students on average have a somewhat more advantaged socio-economic background than disadvantaged low achievers. In general, however, the relative advantage of resilient students compared to disadvantaged low achievers is less than a fourth of a standard deviation, ranging from a third of a standard deviation in Germany and Luxembourg to a little more than one tenth of a standard deviation in Finland and Japan. The same holds true for partner countries and economies. Additional analysis reveals these differences are driven primarily by group differences in the educational resources, cultural possessions, number of books and parental education components of the index not the wealth and parental occupation components (Table A1.3).

In terms of performance, resilient students in OECD countries perform between three quarters and one full standard deviation better than the average student in the same country (Figure 2.3). The difference is smallest in Mexico and Turkey, where the average resilient student scores less than 75 points, or two thirds of a standard deviation, above the average student (Table A1.4). It is largest in Austria, New Zealand, the United Kingdom and the United States where the average resilient student scores close to a standard deviation, 100 score points, better than the average student. In general, the average disadvantaged low achiever performs about a standard deviation below the average student.
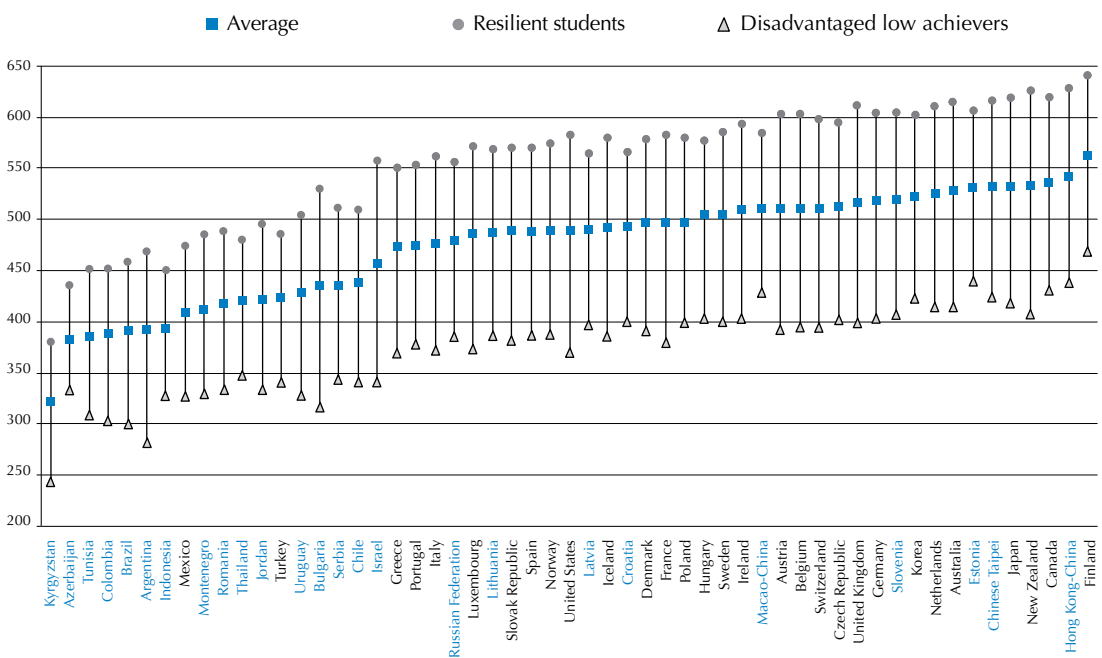
Figure 2.2

PISA index of economic, social and cultural status for system average, resilient and disadvantaged low achievers
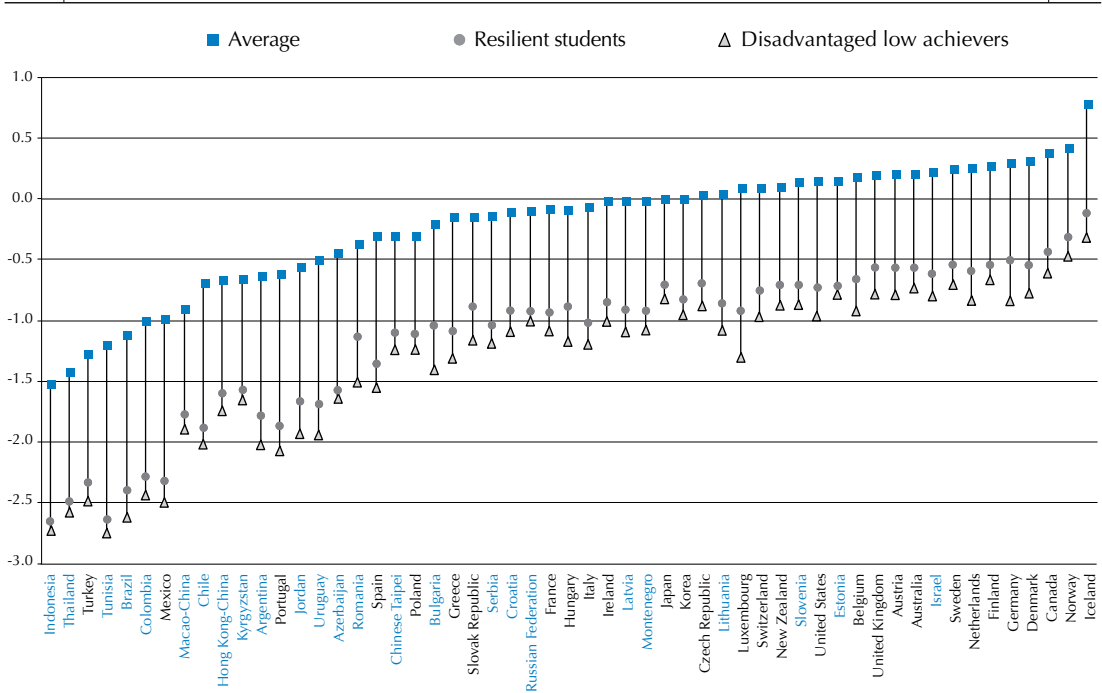
Note: Countries are sorted by system average performance
Source: *OECD PISA 2006 Database.*

Figure 2.3

**Performance in PISA science, system average, resilient and disadvantaged low achievers**

Source: *OECD PISA 2006 Database.*

An alternative measure of performance is provided by proficiency levels. PISA developed six proficiency levels to describe the science competencies students have at different levels of performance. The PISA Science Expert Group identified Level 2 as the baseline level of proficiency, this being the point at which students start to exhibit a level of basic scientific skills that will allow them to effectively participate in real-life situations related to science (see OECD, 2009b for a description of the proficiency levels).

Because performance varies across countries and because students are defined as resilient if they perform among the top third of students in their country, in some countries being resilient implies being able to tackle the most difficult questions in the PISA assessment while in other countries resilient students are not able to successfully complete even some of the simplest tasks.

In general, however, the vast majority of resilient students achieve Level 2 or above whereas more than 25% of disadvantaged low achievers perform below Level 2 in all countries except Finland, Estonia, Hong Kong-China and Macao China. In most OECD countries the majority of resilient students in fact achieve proficiency Level 4 (Figure 2.4 and Table A1.5). In partner countries and economies, the majority of resilient students achieve at least Level 2. This indicates that in many countries a large fraction of disadvantaged students do not have even basic science literacy skills.

Figure 2.4

Percentage of resilient and disadvantaged low achievers above and below the basic level of proficiency
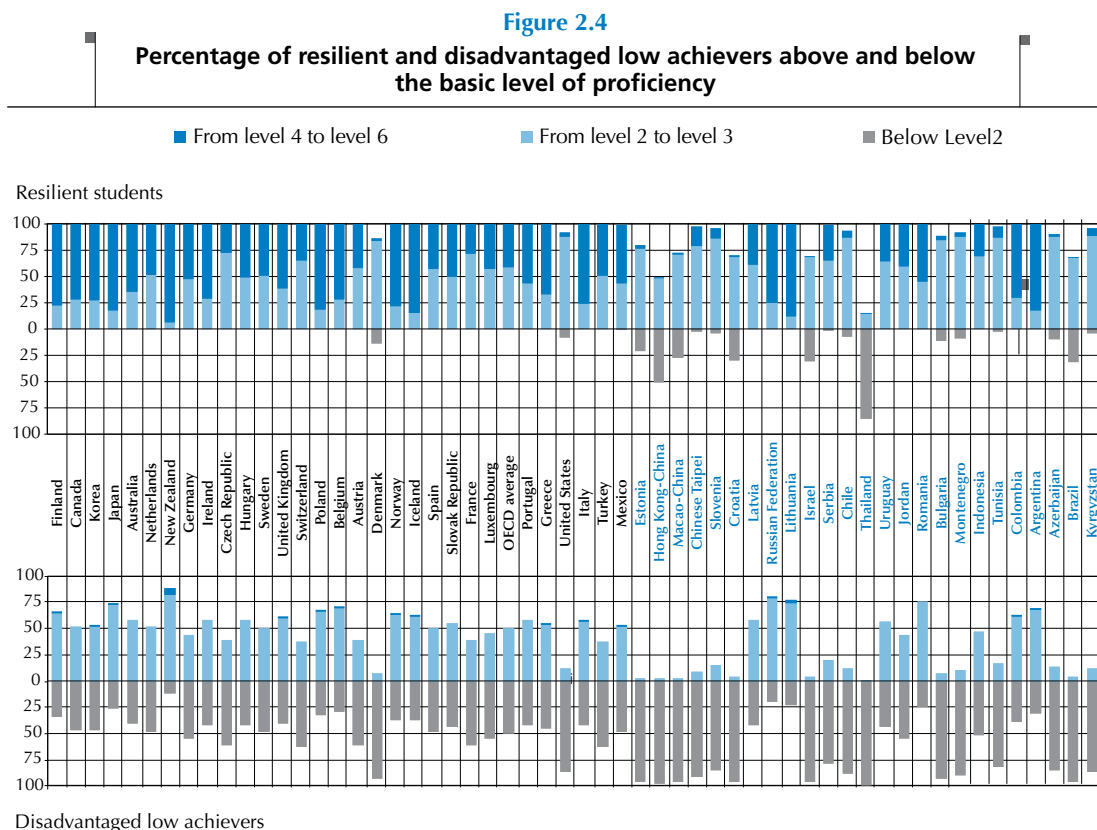
Source: *OECD PISA 2006 Database.*

This section and most of the report draws country-specific conclusions on resilience but it does not compare the proportions of resilient students across countries. Because of the country-specific nature of these analyses, it is possible to compare country experiences of factors that are associated with resilience while it could be misleading to draw conclusions on the prevalence of resilience across countries.[4]

The rest of this chapter and Chapter 3 compare the characteristics of different groups of disadvantaged students within countries. Analysing how these within-country comparisons vary across countries can lead to new insights into what factors may help some disadvantaged students to overcome social and economic barriers and succeed at school.

STUDENT RESILIENCE ACROSS SCIENCE, READING AND MATHEMATICS

PISA 2006 focused on science. This report uses the PISA 2006 science assessment to identify resilient students. However, PISA also tests students in reading and mathematics. It is possible, therefore, to define resilience in terms of reading and mathematics. The sections that follow report results first in terms of science resilience and then comment on the results for each of mathematics and reading resilience.

Do students who exhibit resilience in one domain – science – also exhibit resilience in the other domains? Figure 2.5 shows the proportion of students resilient in science who are also resilient in mathematics and reading. Among OECD countries, between 44 and 59% of those students resilient in science are also resilient in mathematics and reading. The percentages are somewhat lower in partner countries and economies, ranging from 27% to 56% (Table A1.5).

Figure 2.5
Overlap of resilience in different subject domains

Legend:
- ■ Resilient in science
- ■ Resilient in science and reading
- ■ Resilient in science and mathematics
- ■ Resilient in science, mathematics and reading
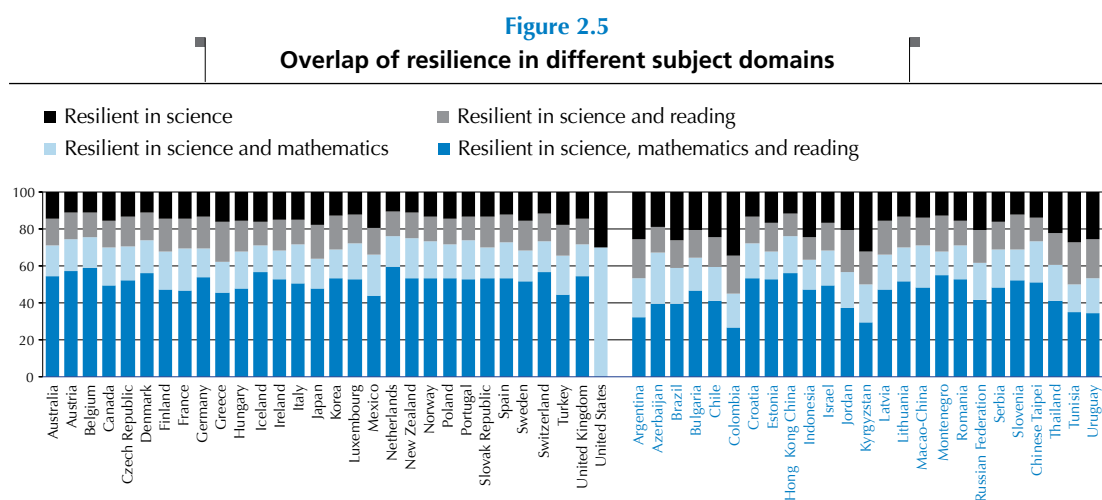
Source: *OECD PISA 2006 Database.*

The proportion of students resilient in both science and one of the other assessment domains (either reading or mathematics) is also shown in Table A1.6. This evidence indicates that the vast majority of students who are resilient with respect to science are also resilient in at least one if not both of the other domains. Among OECD countries, the proportion of students who are resilient in science only ranges from 11% in Austria, Belgium, Denmark, the Netherlands and New Zealand to 19% in Mexico.[5] The percentages are somewhat higher in partner countries and economies, ranging from less than 12% in Hong Kong-China to almost 35% in Colombia (Table A1.6). These results suggest that resilience in science is not a domain-specific characteristic but rather there is something about these students or the schools they attend that lead them to overcome their social disadvantage and excel at school in multiple subject domains.[6]

STUDENT RESILIENCE AMONG SPECIFIC DEMOGRAPHIC GROUPS WITHIN COUNTRIES

Previous sections of this chapter developed a working definition of resilience among school age students and presented an empirical approach to identify two particular groups of disadvantaged students: resilient students and disadvantaged low achievers. This section describes some key demographic characteristics of resilient students and disadvantaged low achievers within each country: gender, immigrant background and language spoken at home.

Gender

Overall, male students are not over-represented among resilient students in science, nor among low achievers or disadvantaged students in general (Figure 2.6). This finding is in line with previous research indicating no gender differences in the prevalence of academic resilience (examples include Catterall, 1998 and Martin and Marsh, 2006). But some exceptions exist, Chile among other countries – where males are over-represented among resilient students and under-represented among disadvantaged low achievers – and Turkey and Jordan – where males are under-represented among resilient students and over-represented among disadvantaged students.

Figure 2.6
Percentage of male students among disadvantaged students and resilient students
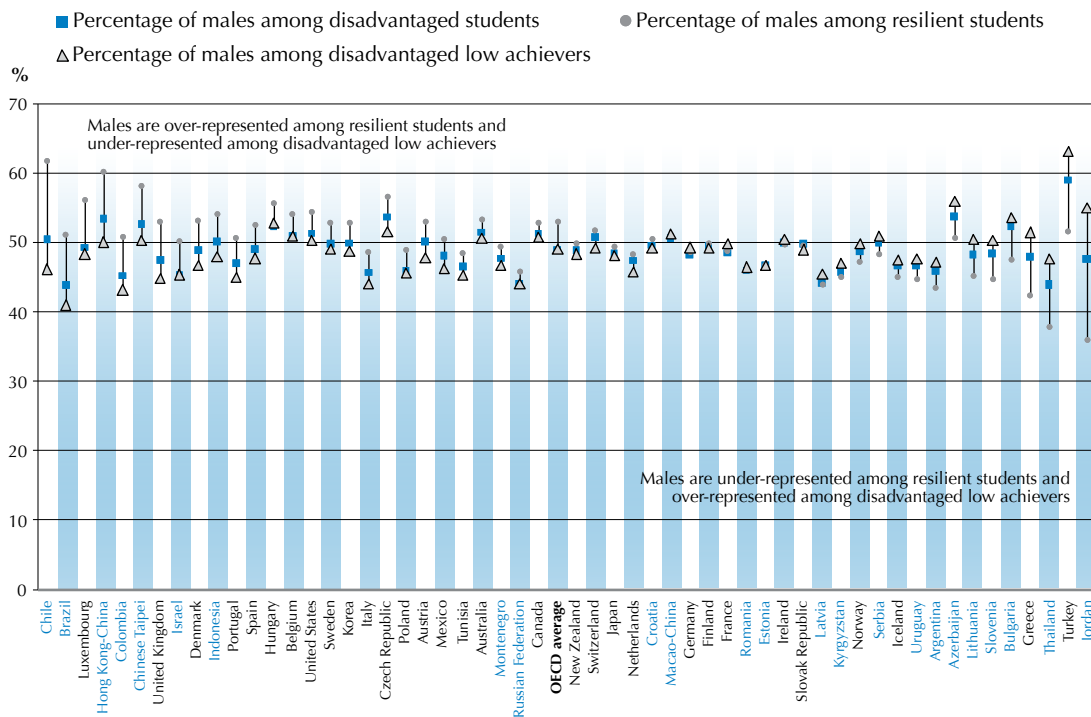
Source: *OECD PISA 2006 Database.*

Across OECD countries, the difference in the proportion of males among resilient, and low achievers or disadvantaged students is very small, on average less than 2 percentage points. Exceptions include Greece and Turkey, where male students are relatively under-represented among resilient students by more than 5 percentage points and Luxembourg and the United Kingdom where male students are over-represented by more than 5 percentage points. The differences between low achievers and disadvantaged students in general are even smaller, less than one percentage point on average. The pattern is similar among partner countries and economies, except in Chile, where males are over-represented by more than 10 percentage points and Jordan where males are under-represented among resilient students by more than 10 percentage points. Among partner countries and economies differences are also smaller between low achievers and disadvantaged students in general than between resilient students and disadvantaged students (Table A1.7).

While there are no overall gender differences in science, weak gender differences can be found in mathematics. When mathematics is used to define resilient students, male students are over-represented among resilient students and under-represented among disadvantaged low achievers (except in the

OECD countries of France, Greece and Iceland and in the partner countries of Jordan, Lithuania and Thailand where the pattern is reversed). The differences in the proportions of male students among resilient and all disadvantaged students exceed 5 percentage points in 14 OECD countries and 11 partner countries and economies. The differences in the proportions of male students among disadvantaged low-achieving and all disadvantaged students are smaller and exceed 5 percentage points only in Jordan (Table A1.7).

Gender differences are starkest when reading assessment scores are used to define resilience. In this case male students are under-represented among resilient students and over-represented among disadvantaged low achievers in all countries. The difference in the proportions of male students among resilient and all disadvantaged students exceeds 10 percentage points in 21 OECD countries and 18 partner countries and economies. Again for disadvantaged low achievers the gap is smaller; the difference in the proportions of male students between disadvantaged low achievers and all disadvantaged students exceeds 10 percentage points in 2 OECD countries and 3 partner countries and economies (Table A1.7).
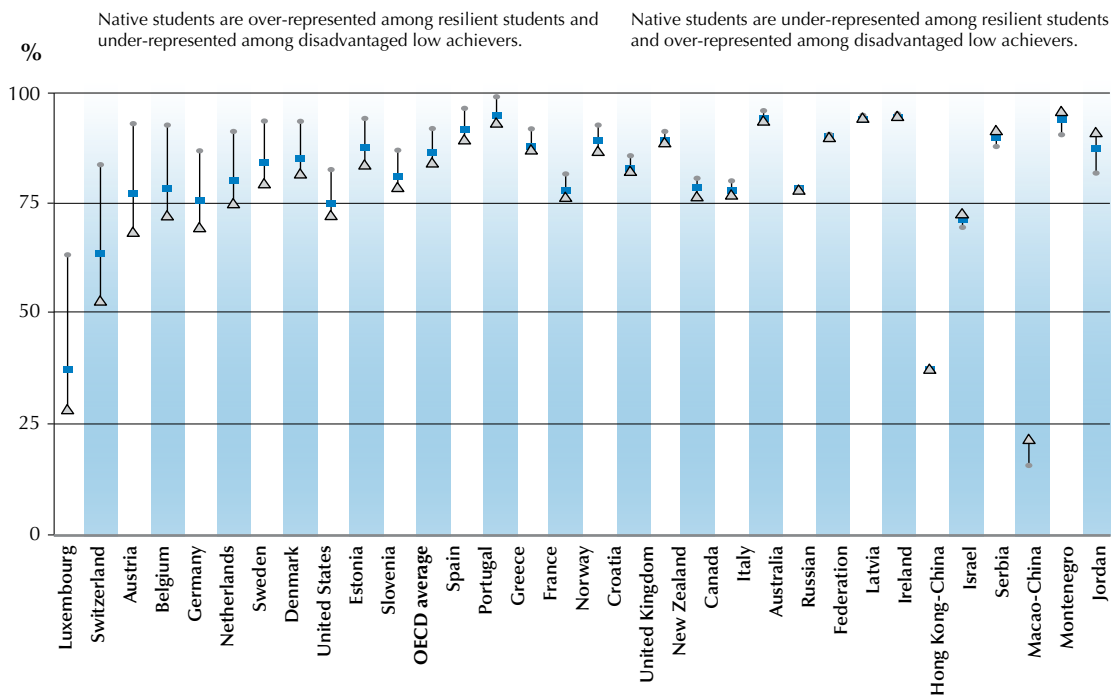
Immigrant background

Many OECD and partner countries and economies are experiencing record levels of immigration. For countries that have a substantial number of immigrant students (see OECD, 2007a for minimum standards for inclusion), this section examines the prevalence of immigrant and native students among all disadvantaged students as well as among resilient and disadvantaged low-achieving students. Students with an immigrant background are defined as those students who were themselves born outside the country (first-generation immigrants) or whose parents were born outside the country (second-generation immigrants).

Figure 2.7
Percentage of native students among disadvantaged students and resilient students

■ Percentage of native students among disadvantaged students   ● Percentage of native students among resilient students
△ Percentage of native students among disadvantaged low achievers

Source: *OECD PISA 2006 Database.*

When looking at students with an immigrant background across countries it is important to recognise that these students come from a wide range of countries and might differ along several dimensions. For example, in Australia the largest three immigrant groups are from the United Kingdom, New Zealand and China; in Belgium the most common origin countries are France, Turkey and the Netherlands; and in the United States the largest group of immigrants is from Mexico – outnumbering the next largest group by seven to one (OECD, 2006). In Australia, native students and students with an immigrant background exhibit similar levels of achievement while in many other countries there are large and significant differences in achievement between these students (Christensen and Segeritz, 2008).

As a general rule, native students tend to be over-represented among resilient students than students with an immigrant background. The gap is not very large but native students tend to be over-represented among resilient students, particularly so in Austria, Belgium, Germany, Luxembourg, the Netherlands and Switzerland where the difference in the proportions of native students among resilient students and among all disadvantaged students is over 10% percentage points (Table A1.8). In no OECD country are native students over-represented among disadvantaged low achievers. Among partner countries and economies the pattern is generally similar but weaker in that the differences are smaller. While studies have shown that students with an immigrant background tend to possess higher levels of motivation than native students (see OECD, 2006 or Christensen and Segeritz, 2008 for an overview), it appears that in many countries only a small fraction of students with an immigrant background beat the odds. These findings highlight one of the challenges facing many of the countries participating in PISA.

The pattern is generally similar when performance on the mathematics or reading assessments is used to define resilience. Native students continue to be over-represented among resilient students in OECD countries (except in Australia for both reading and mathematics). Differences in the proportions of native students among resilient and all disadvantaged students exceed 10 percentage points in four countries on the basis of reading (Austria, Belgium, Luxembourg and Switzerland) and in five countries in the case of mathematics (the same four countries plus Germany). Differences in the proportions of native students among disadvantaged low achievers and all disadvantaged students are smaller than for science, with the largest differences in the same set of countries identified with respect to resilient students. No clear patterns are found among the partner countries and economies (Table A1.8).

Language spoken at home

Frequently as a result of immigration (and in some cases history), a growing numbers of students speak a language at home other than the test language. This presents challenges as many schools and school systems struggle to provide for the needs of this group of students.

Speaking the language of the test (*i.e.* the language of instruction) at home provides a small advantage to students in terms of resilience. As shown in Figure 2.8, in no OECD country, students who speak the language of the test are significantly under-represented among resilient students in those countries where there is sufficient data available to do the analysis. There are only three countries (Austria, Germany and Switzerland) where the proportion of students who speak the test language at home among resilient students in science is more than 10 percentage points higher than the proportion for disadvantaged students generally (Table A1.9). The pattern is very similar in partner countries and economies but the differences are somewhat smaller. In most countries, there is a relative under-representation of students that speak the language at home among low achievers, but again the size of the difference is rather small and it only exceeds 10 percentage points in Switzerland. Similar patterns are identified using either reading or mathematics assessment scores. The differences tend to be slightly smaller on average than those found using science scores (Table A1.9).

Percentage of students who speak the test language at home among disadvantaged students and resilient students

- ■ Percentage of students who speak the test language at home among disadvantaged students
- ● Percentage of students who speak the test language at home among resilient students
- △ Percentage of students who speak the test language at home among diadvantaged low achievers

Students who speak the test language at home are over-represented among resilient students and under-represented among disadvantaged low achievers

Students who speak the test language at home are under-represented among resilient students and under-presented among disadvantaged low achievers
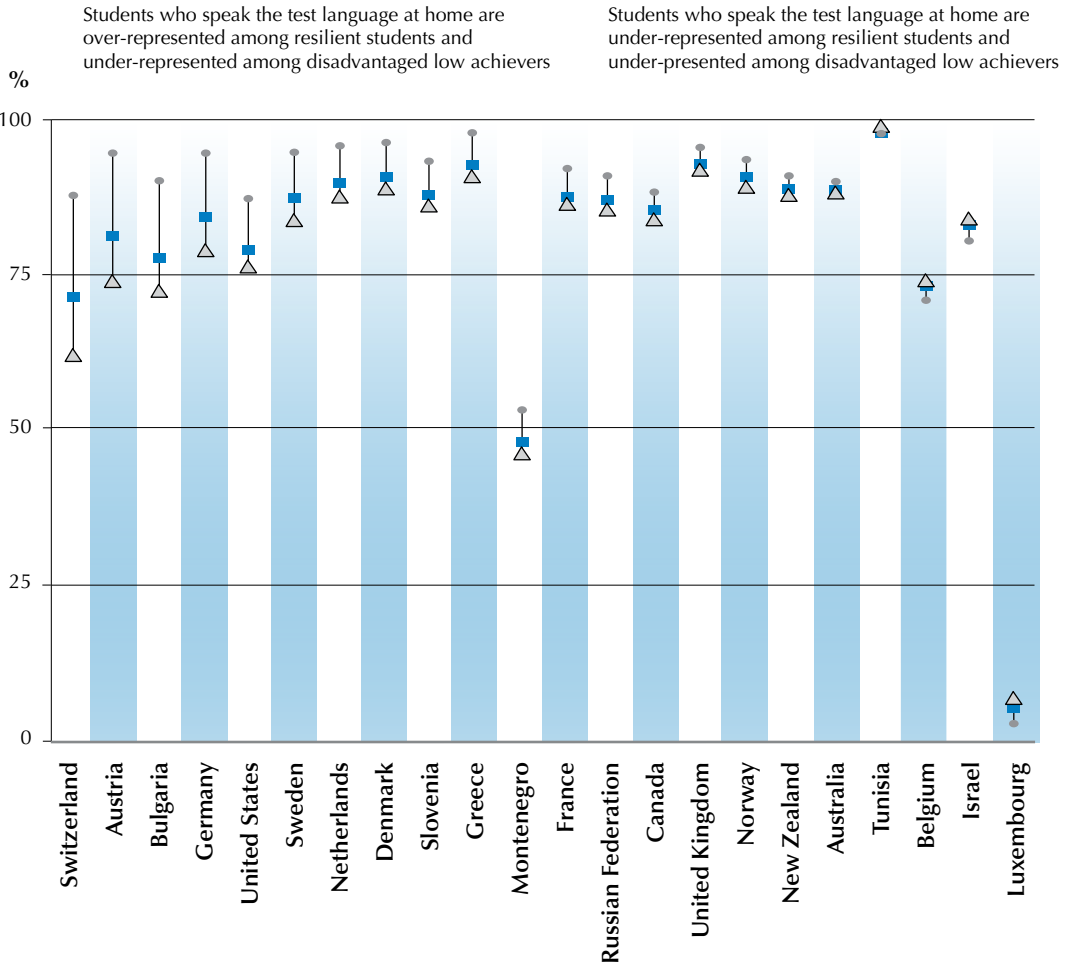
Source: *OECD PISA 2006 Database.*

CONCLUSION

This chapter defined and empirically characterised resilience among socio-economically disadvantaged students. It is possible to characterise relatively disadvantaged students who beat the odds and achieve academic excellence relative to their peers. These findings show that resilient and disadvantaged low achievers share some common characteristics. While comparing the prevalence of resilient students across countries is problematic with this definition, it is possible and useful to draw conclusions across countries from within-country group comparisons. Several key findings emerge from the analyses presented in the chapter.
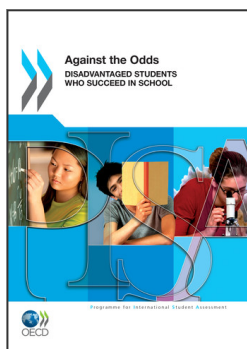
- In all participating countries, it is possible to identify a group of students that does well despite their relatively disadvantaged socio-economic background. The report categorises these students as resilient. By comparison, disadvantaged low achievers share a similar background but perform poorly. Practically all resilient students exhibit a proficiency level in science that is above the baseline level of competency in PISA 2006.

- In most countries the vast majority of students who are resilient in science would be categorised as resilient if their performance in mathematics and/or in reading had been considered instead. Resilience does not appear to be a domain-specific characteristic but rather a general feature of some disadvantaged students, their communities or the schools they attend that help them overcome their social disadvantage and become high performers.

- In general, there is no gender gap in resilience for science (there is a gap for reading but it is small). In almost all countries, male and female students are equally represented among resilient students, disadvantaged low achievers and disadvantaged students more generally. Notable exceptions include the partner country Chile, where males are over-represented among resilient students (and under-represented among disadvantaged low achievers) and Turkey, where males are under-represented among resilient students (and over-represented among disadvantaged students).

- Language and immigrant background appear to be associated with resilience only marginally and only in few countries. Results suggest that native students and students who speak the language of the test at home are over-represented to a marked degree among resilient students (and under-represented among disadvantaged low achievers) most notably in Austria, Germany and Switzerland.

Findings presented in this chapter show that some students from disadvantaged backgrounds are beating the odds and are thriving in school. Understanding more about these students and the approaches to learning and school characteristics that are associated with resilience could help policymakers and school leaders foster resilience among a greater number of students. The next chapters of this report focus on these issues.

Notes

1. An international cut-point for socio-economic disadvantage would identify almost all students in some countries as disadvantaged students and all students in other countries as advantaged. No country would describe their student population in such terms. Similarly a single international cut-point for academic achievement may leave some countries and economies with no resilient students and therefore no analytical power to study what makes these students different.

2. The decision to divide the socio-economic background and science score distributions into thirds was driven partly by theoretical considerations and partly by statistical requirements. The variables which comprise the background index and the test items that comprise the assessment score were chosen for their theoretical ability to discriminate among differing levels of socio-economic background and academic performance. Other cut-points could have been applied to these indices such as choosing different cut-points (*e.g.*, the 25th and 75th percentiles) or choosing specific proficiency levels to indicate high achievement. However, if proficiency levels or if the 25th and 75th percentiles are used rather than the 33rd and 67th percentiles as cut-points the resultant groups of disadvantaged students would have been too small in some countries to allow the precise measurement of mean differences. Dividing the distributions into thirds to distinguish groups of students with different levels of socio-economic background and different levels of performance balanced the theoretical need for distinction with the statistical need for large enough sample sizes.

3. Because each of the groups identified is country-specific, it is not possible to compare across countries the shares of resilient students calculated using this definition. Disadvantaged students in one country, for example, would not necessarily be defined as disadvantaged in another. The proportion of resilient students within each country change when different cut-off points are used but the ranking of countries of countries does not change substantially. Obviously, less stringent requirements, such as lower performance or higher socio-economic background limits, result in higher proportions of resilient students. This fact highlights that cross-country comparisons of the proportion of resilient students may be misleading and that the interpretation of these proportions as representing the prevalence of resilience in each country may be misleading. For information and to clarify the size of the sample on which the analysis in this report is carried out and the proportions of resilient students and disadvantaged low achievers, see Table A5.11.

4. Table A5.11 in Annex A5 includes a description of the relative sample sizes for each of these groups. For reference, the proportion of resilient, average achievers and low achievers among disadvantaged students are presented for each country. However, given the country-specific definition used in this report, they are a potentially misleading indication of the prevalence of resilience across countries.

5. Please note data for the United States are only available in science and mathematics making the comparison across the three domains impossible and that is why it was not included in this discussion.

6. The results are similar but less marked if one looks at resilience defined using mathematics or reading, but this evidence is not reported on this report.