

OECD Programme for International Student Assessment (PISA)

Science Competencies
for Tomorrow's World

PISA
OECD Programme for
International Student Assessment

Science competencies for tomorrow's world

Seeing school systems through the prism of PISA

Washington, 4 December 2007

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PISA 2006

Science Competencies for Tomorrow's World

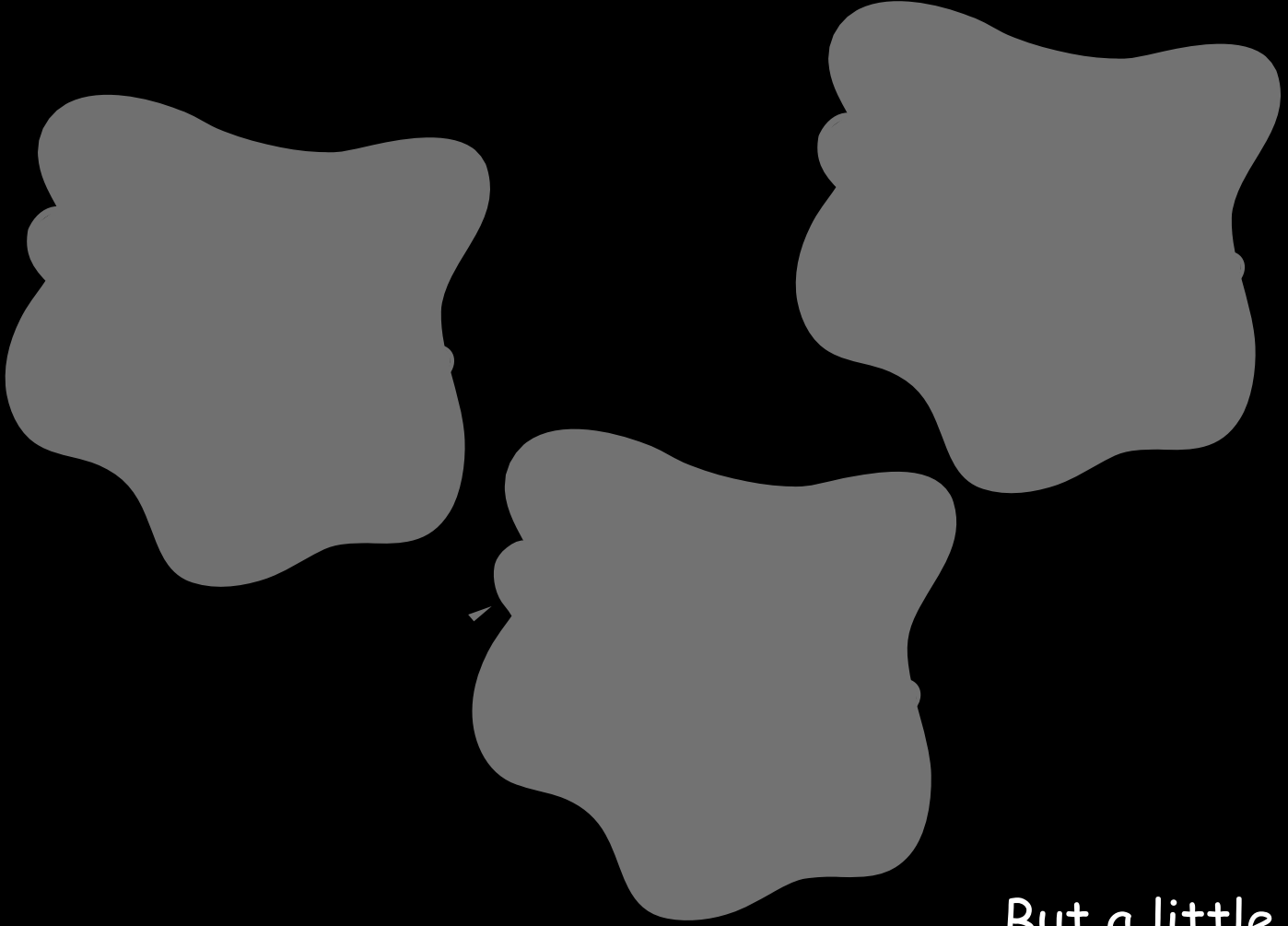
Today

1. **OECD's Programme for International Student Assessment (PISA)**
 - What the world's most comprehensive international assessment measures - and why
 - How PISA works
2. **Where we are - and where we can be**
 - Where the US and other countries stand in terms of quality, equity and efficiency in education
 - What the best performing countries show can be achieved
3. **How we can get there**
 - Some policy levers that emerge from international comparisons

OECD's Programme for International Student Assessment (PISA)

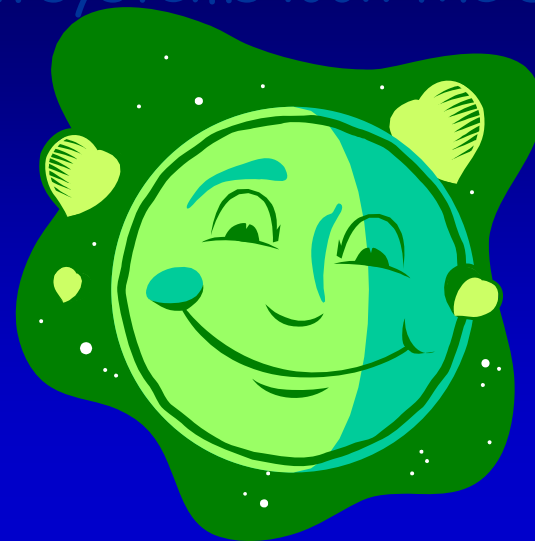
What PISA seeks to accomplish
How PISA works

In the dark...
...all students, schools and education systems look the same...



But a little light....

In the dark...
...all students, schools and education systems look the same...

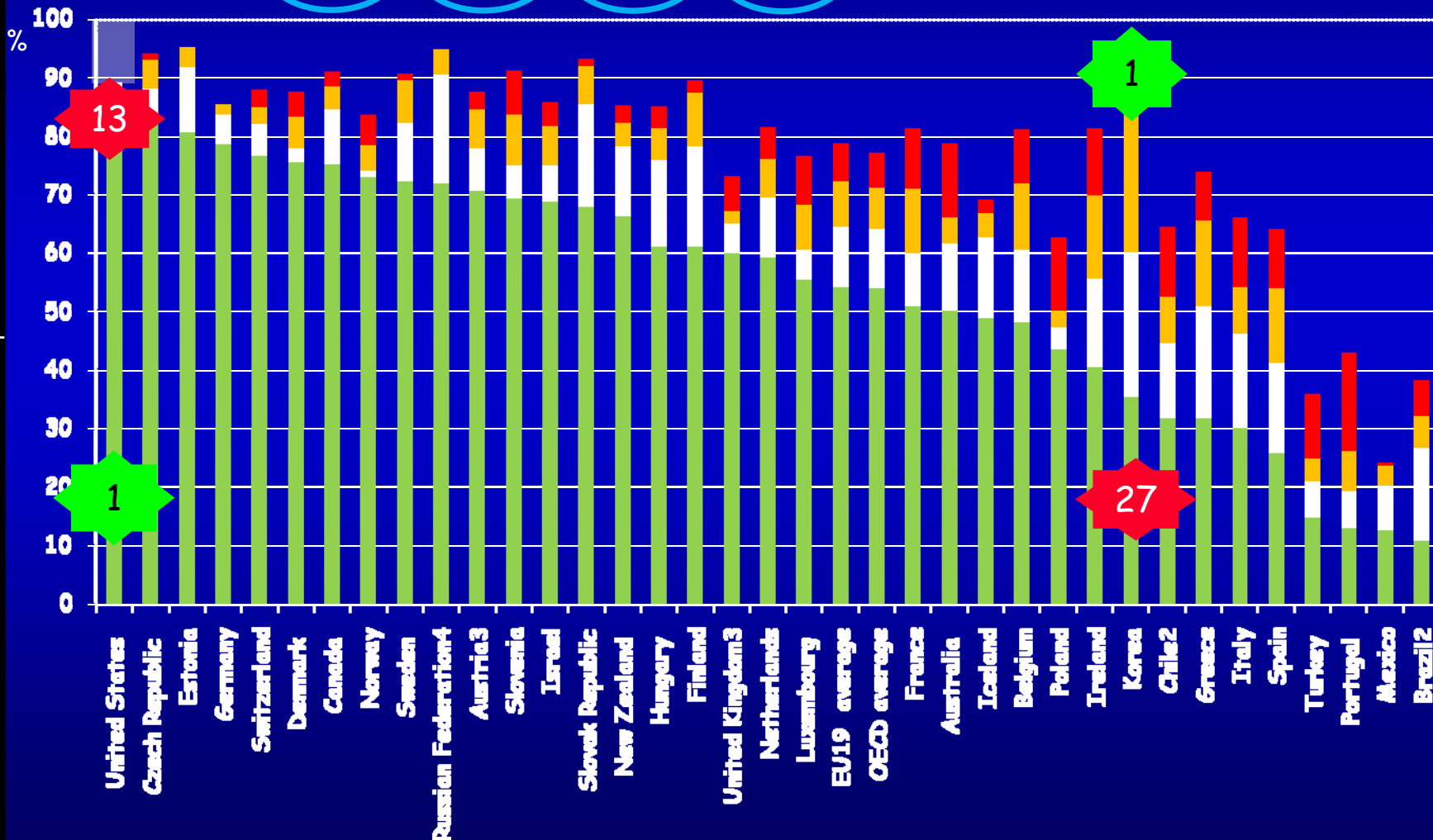


But a little light...
...can show important differences...

School completion

A world of change in the global skill supply

Approximated by percentage of persons with high school or equivalent qualifications in the age groups 55-64, 45-55, 45-44 und 25-34 years

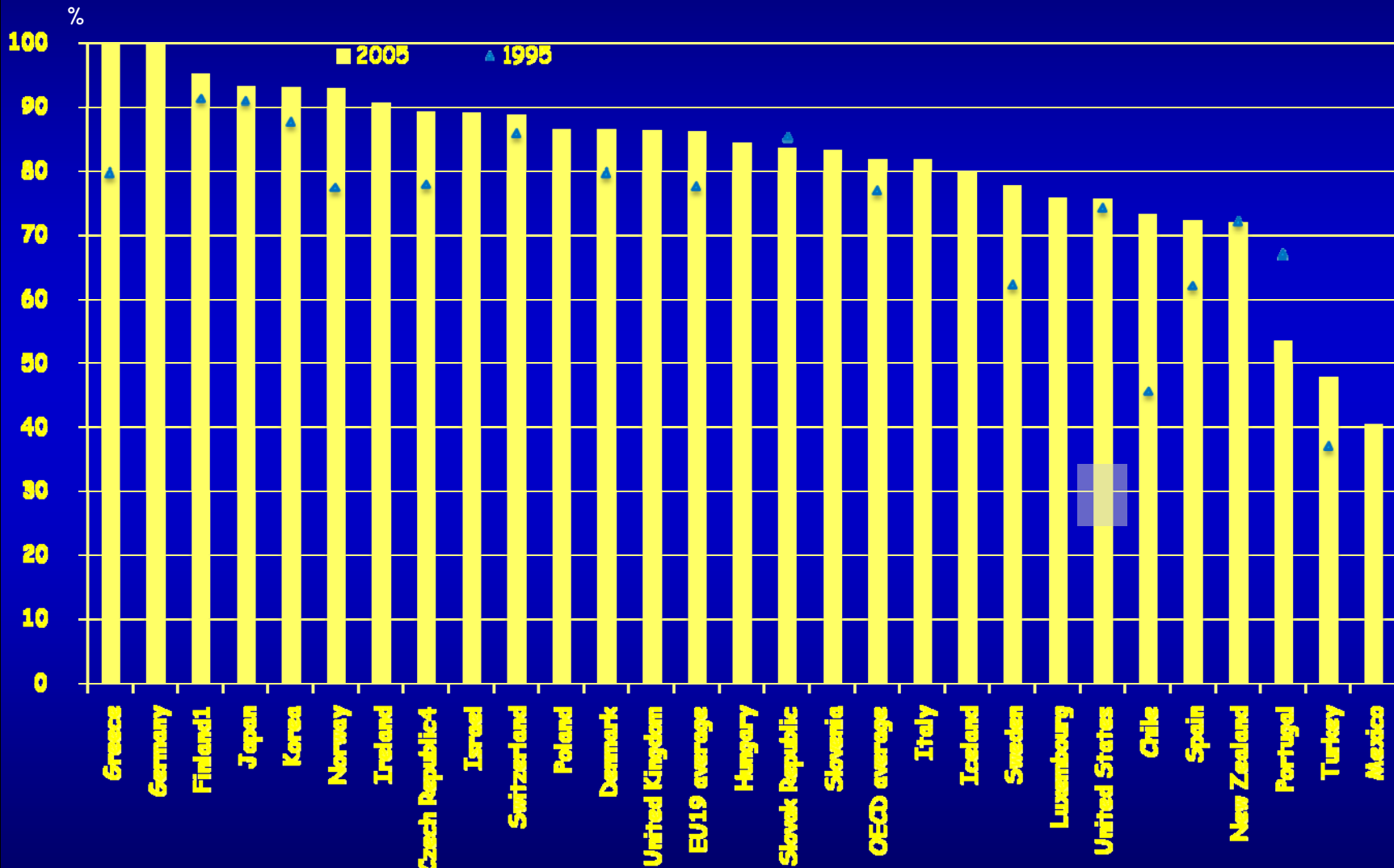


1. Excluding ISCED 3C short programmes
 3. Including some ISCED 3C short programmes

2. Year of reference 2004
 3. Year of reference 2003.

High school completion rates

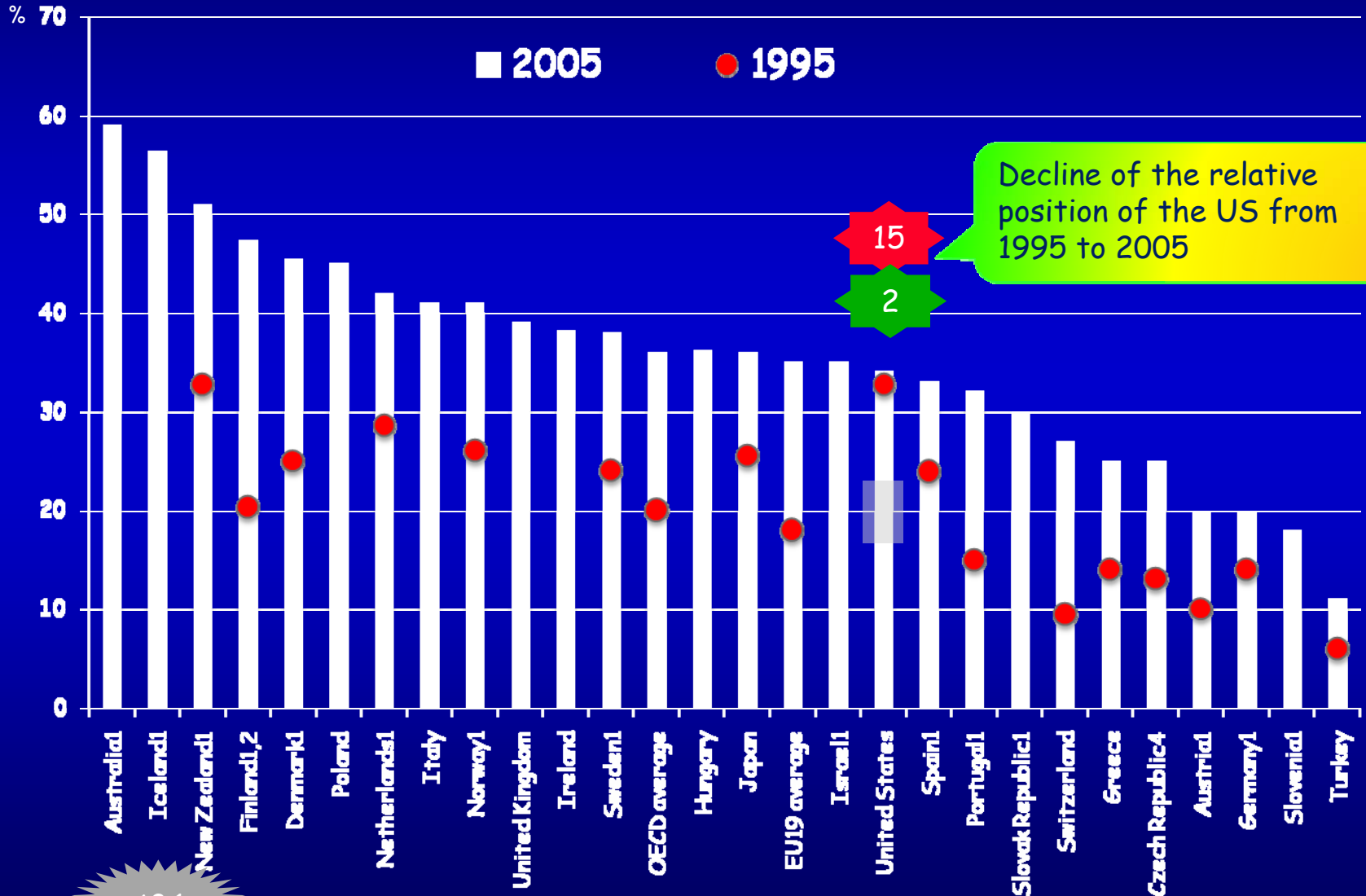
Percentage of graduates to the population at the typical age of graduation



1. Year of reference 2004.

College-level graduation rates

Percentage of tertiary type A graduates to the population at the typical age of graduation



A3.1

1. Net graduation rate is calculated by summing the graduation rates by single year of age in 2005.
2. Year of reference 2004.

A three-yearly global assessment that...

... examines the performance of 15-year-olds in key subject areas as well as a wider range of educational outcomes

- Including students attitudes to learning and their learning behaviour

... collects contextual data from...

... students, parents, schools and systems...

... in order to identify policy levers

Coverage

- Representative samples of between 3,500 and 50,000 15-year-old students drawn in each country
- Most federal countries also draw regional samples
- PISA covers roughly 90% of the world economy .

How PISA works

r A strong international network of expertise among the participating countries...

- From establishing the assessment frameworks...
 - The PISA assessments include tasks from more than 40 countries

... developing the instruments...

- Cross-national and cross-cultural validity

... to analysing and interpreting the results

- National, regional and international analyses and reports
- In-depths country peer reviews

... supported by a consortium of leading research institutions...

- ACER, CITO, ETS, NIER, WESTAT

... co-ordinated through the OECD in collaboration with other international organisations .

Key findings from PISA 2006

Where we are - how students perform across countries

Where we can be - the top performers

How we can get there - some school and system factors

PISA 2006

- r The latest PISA assessment emphasizes science competencies, defined in terms of an individual's:
 - Scientific knowledge and *use* of that knowledge to...
 - ... identify scientific issues,
 - ... explain scientific phenomena, and
 - ... draw evidence-based conclusions about science-related issues
 - Understanding of the characteristic features of science as a form of human knowledge and enquiry
 - Awareness of how science and technology shape our material, intellectual and cultural environments
 - Willingness to engage with science-related issues
- r A large proportion of complex open-ended tasks .

Deciding what to assess...

looking back at what students were
expected to have learned

...or...

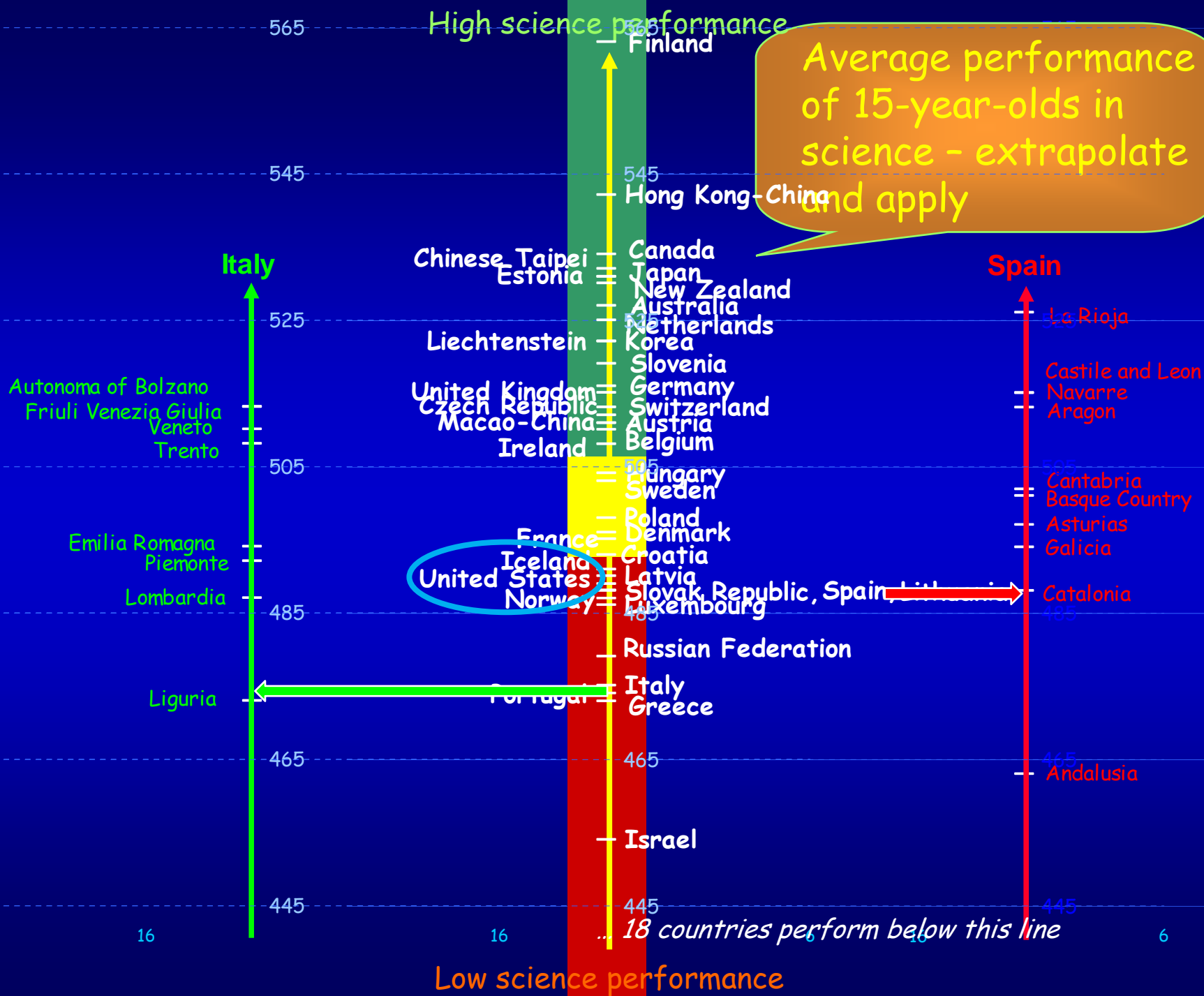
looking ahead to how well they can
extrapolate from what they have learned
and apply their knowledge and skills in
novel settings.

For PISA, the OECD countries chose the latter.

Quality in learning outcomes

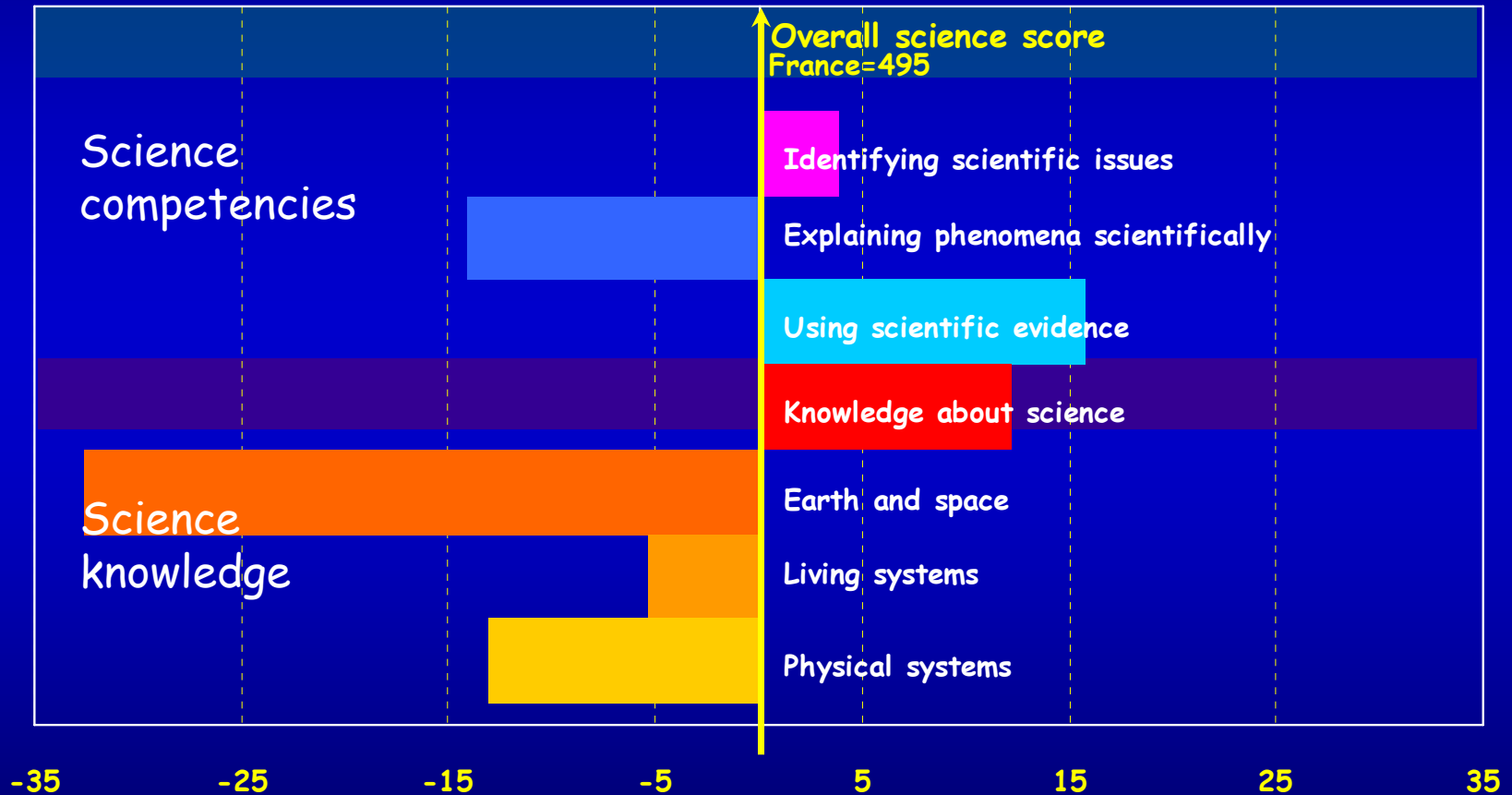
Science performance

Average performance of 15-year-olds in science - extrapolate and apply



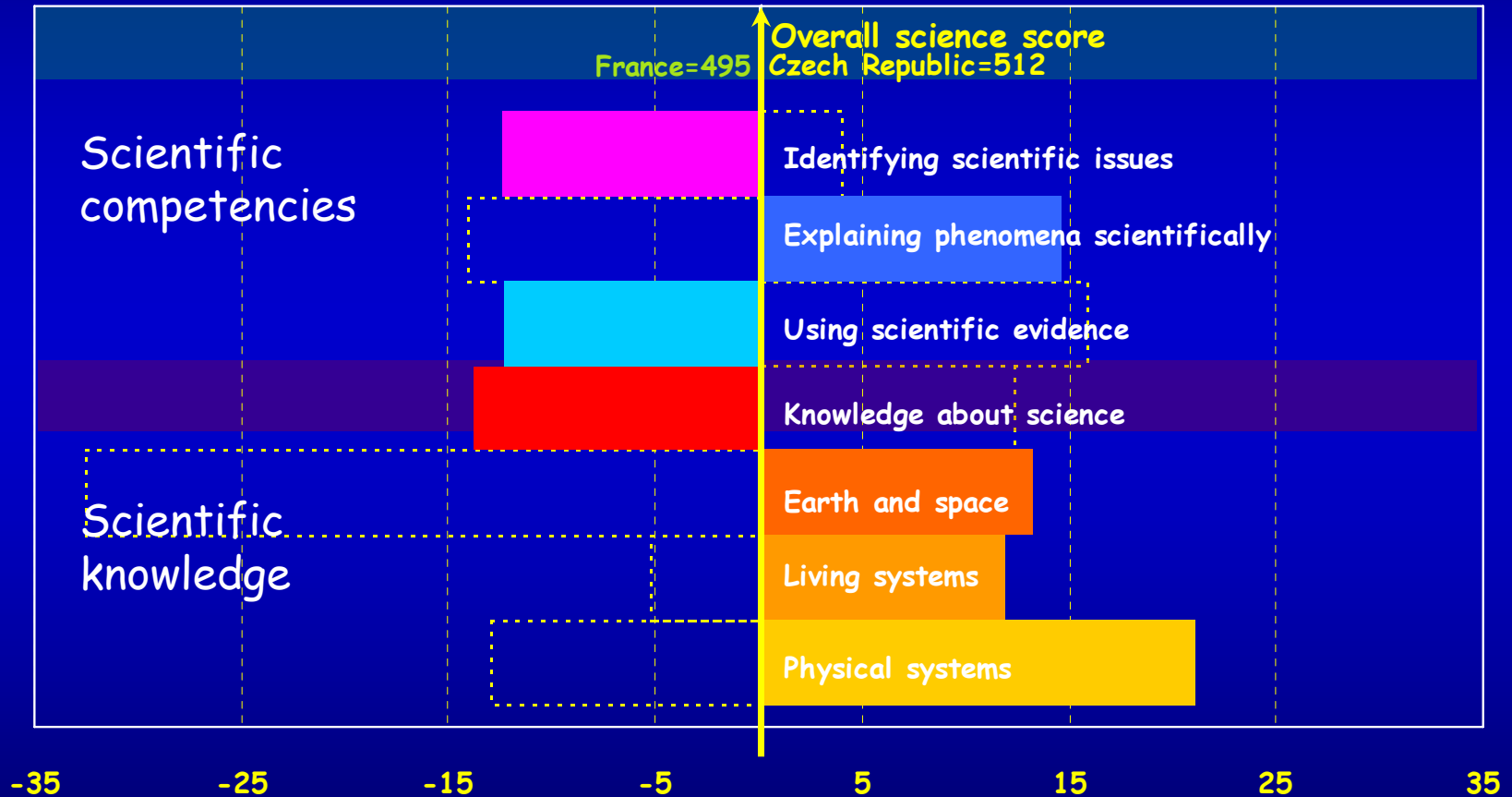
Strengths and weaknesses of countries in science relative to their overall performance

France



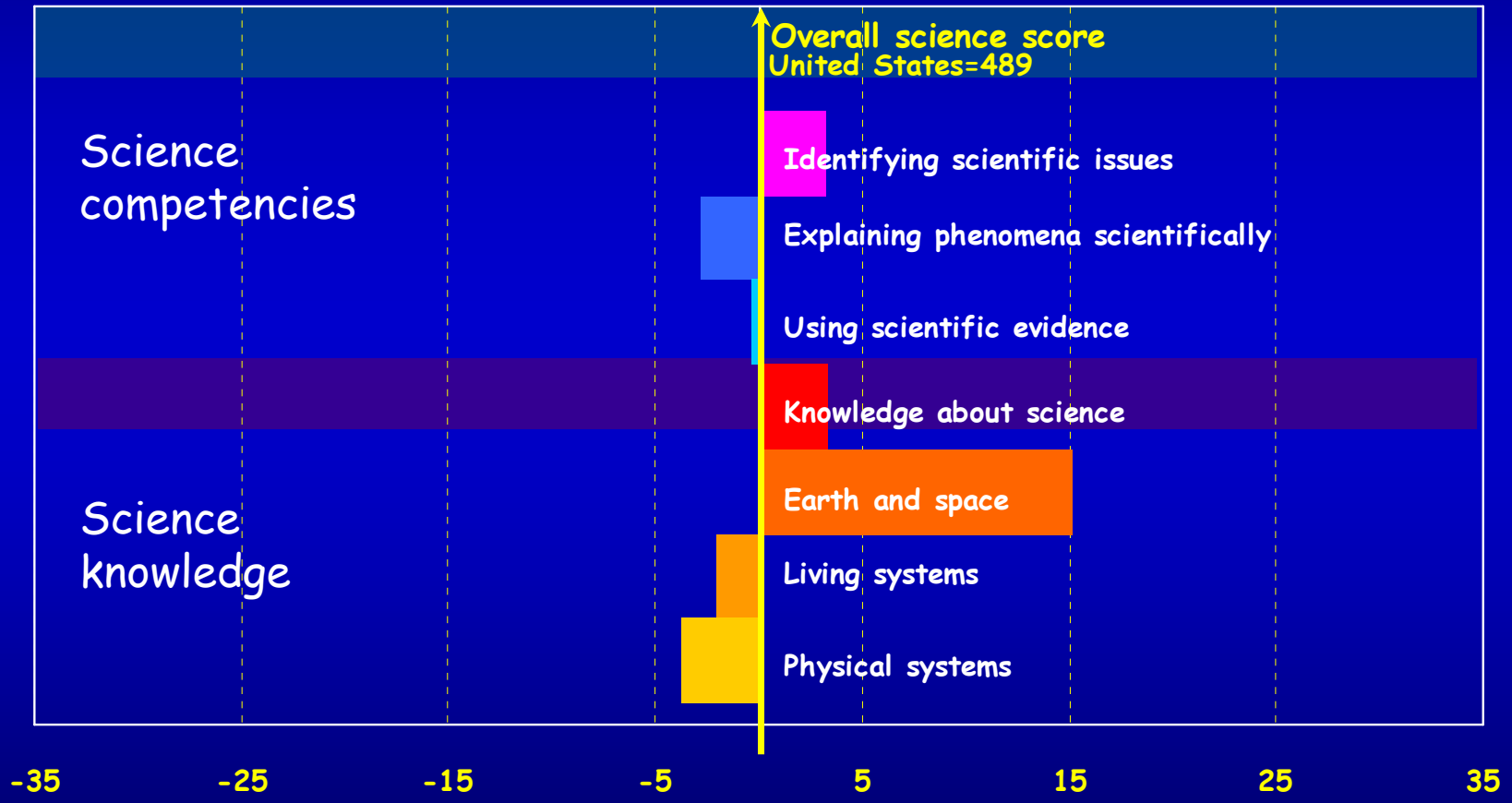
Strengths and weaknesses of countries in science relative to their overall performance

Czech Republic

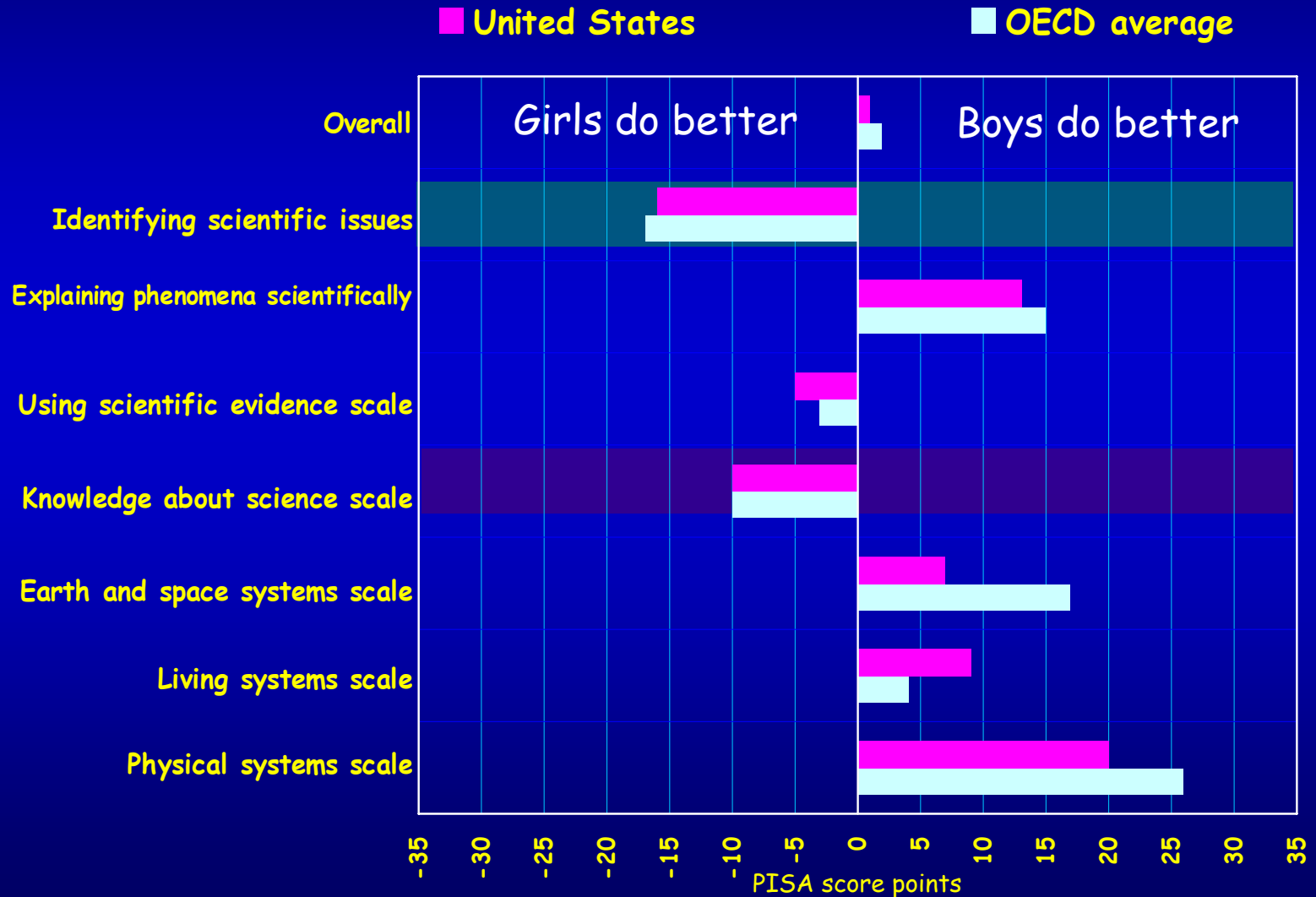


Strengths and weaknesses of countries in science relative to their overall performance

United States

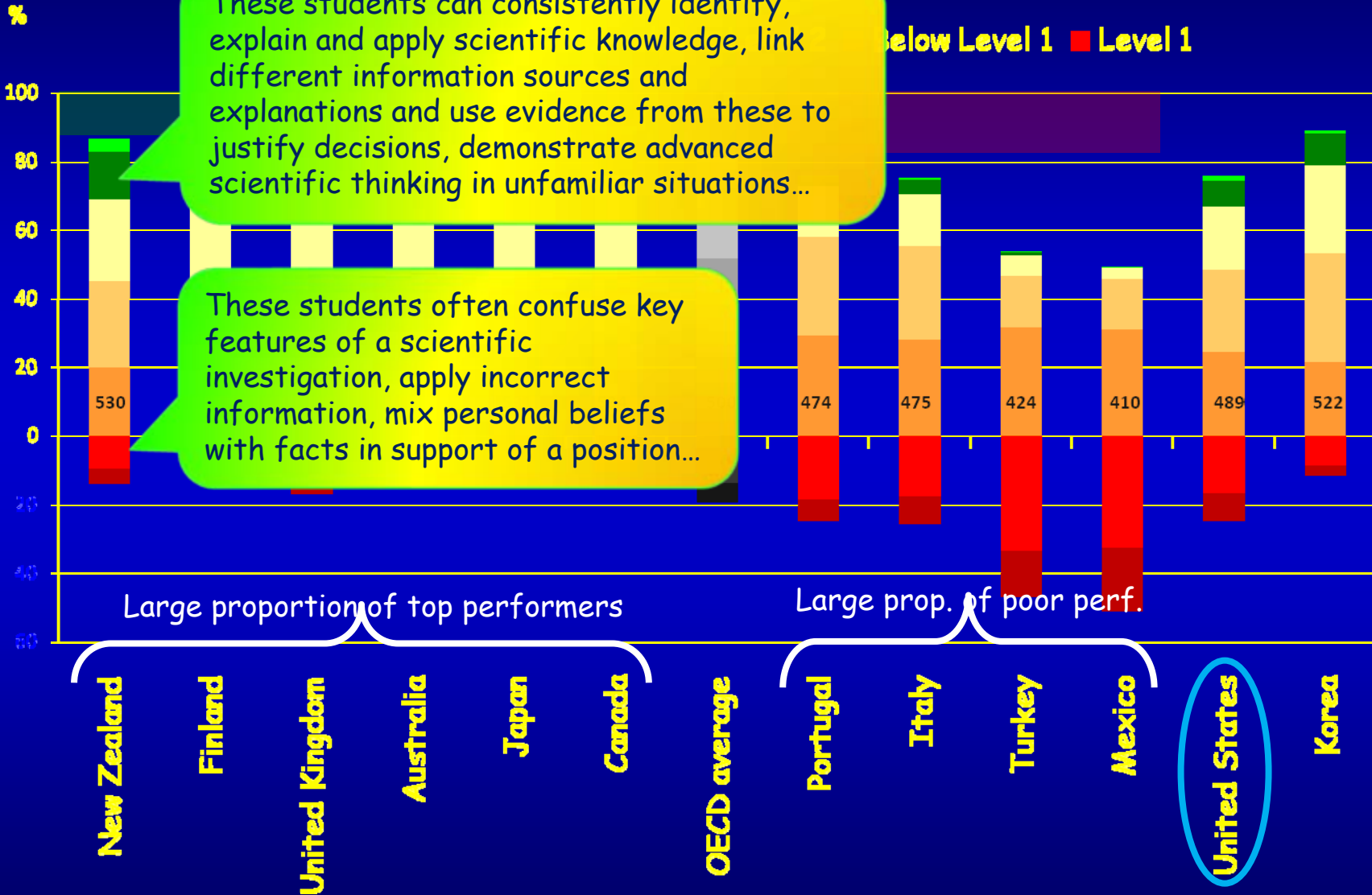


Gender differences in science performance



Distribution of student performance

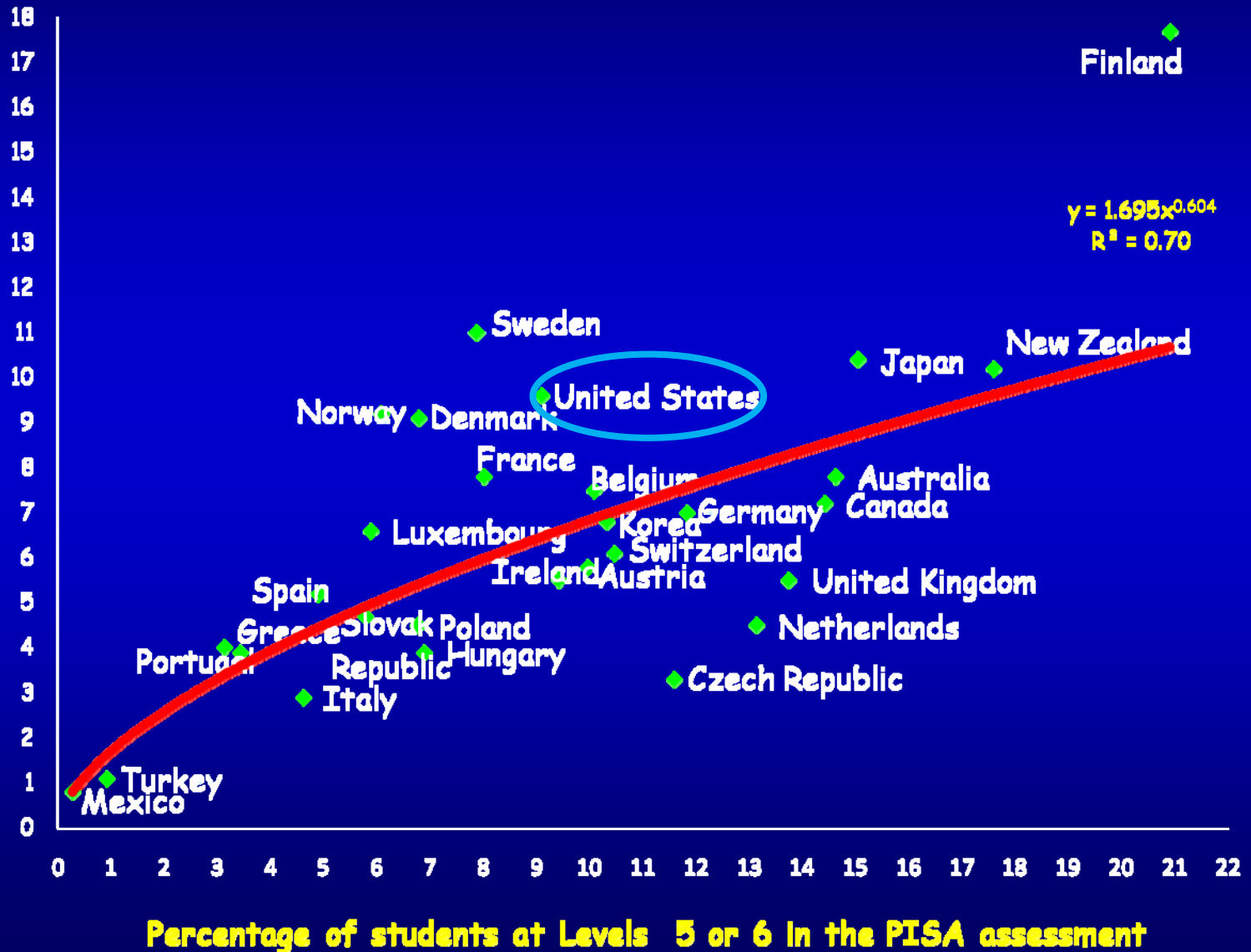
Top and bottom performers in science



Top performers matter

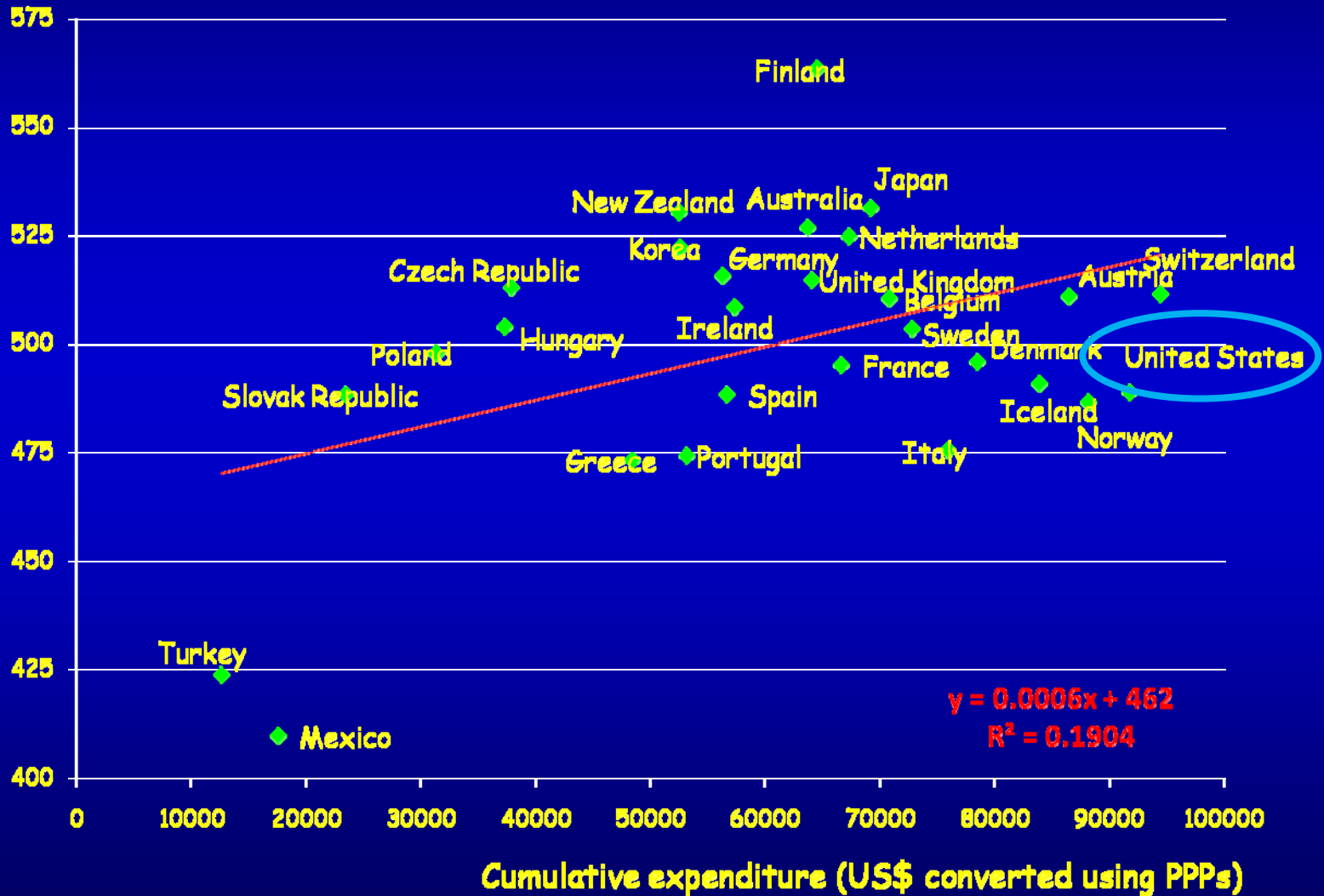
Excellence in education and countries' research intensity

Number of researchers per thousand employed,
full-time equivalent



Money matters - but other things do too

Science performance

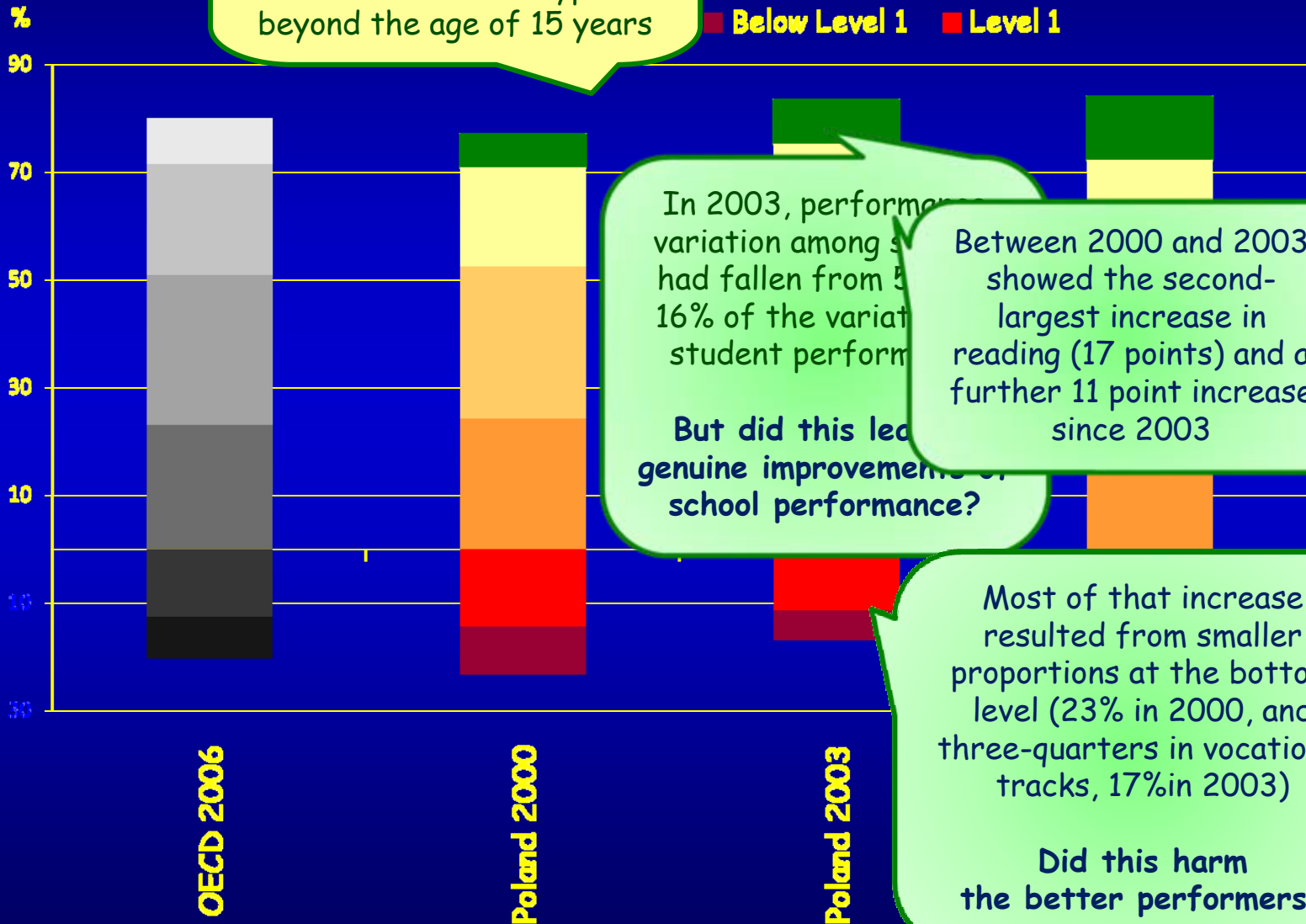


Investments and outcomes

- r Since 2000, expenditure per primary and secondary student increased across OECD countries by 39% (in real terms) ...
- ... while PISA outcomes generally remained flat...
- ... but there are notable exceptions...

Poland raised its average performance by 28 PISA points, year - What happened?

Between PISA 2000 and 2003 Poland delayed the separation of students into different school types beyond the age of 15 years



In 2003, performance variation among schools had fallen from 5% to 3%. 16% of the variation in student performance was due to school performance.

But did this lead to genuine improvements in school performance?

Between 2000 and 2003 Poland showed the second-largest increase in reading (17 points) and a further 11 point increase since 2003

Most of that increase resulted from smaller proportions at the bottom level (23% in 2000, and three-quarters in vocational tracks, 17% in 2003)

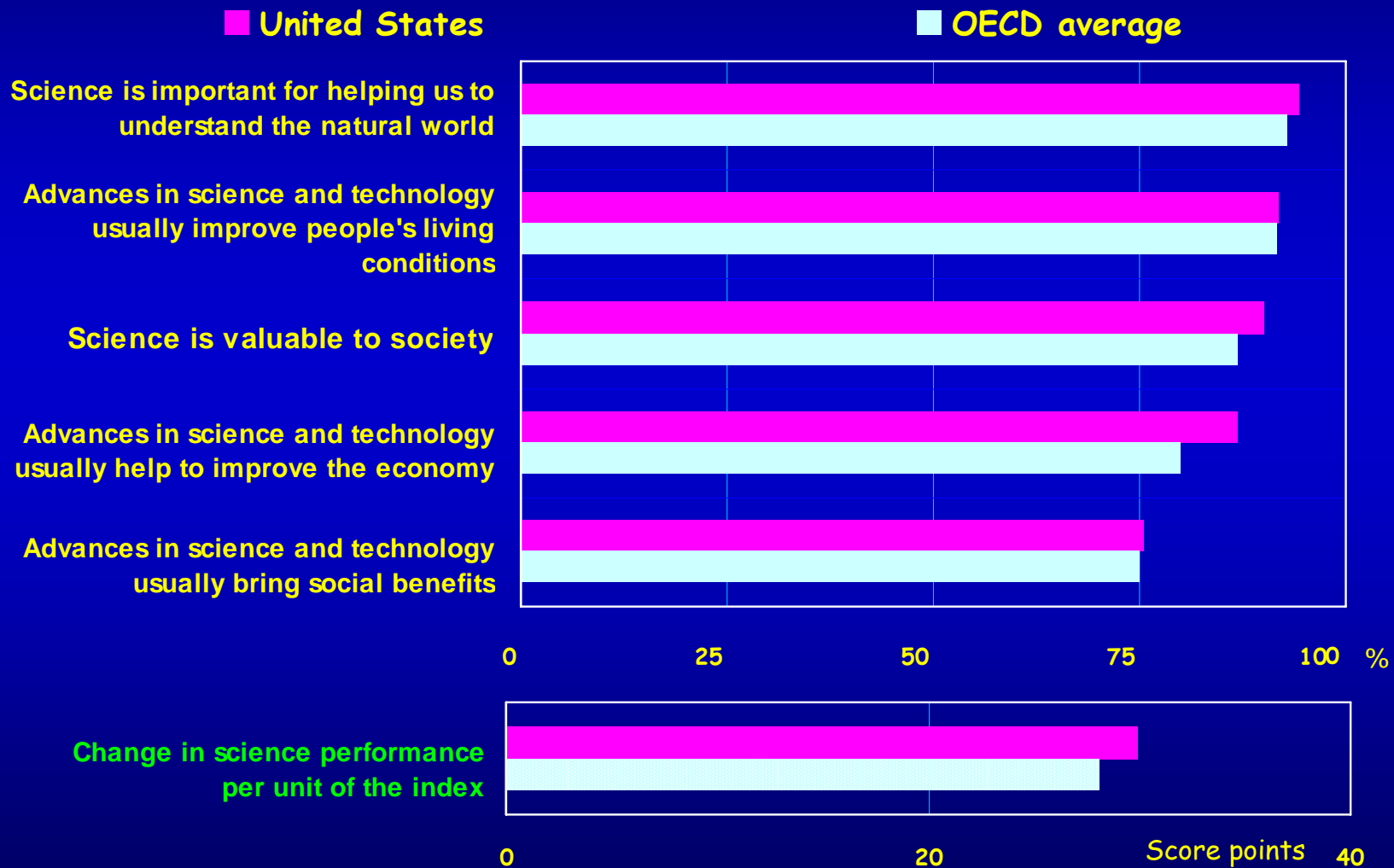
Did this harm the better performers?



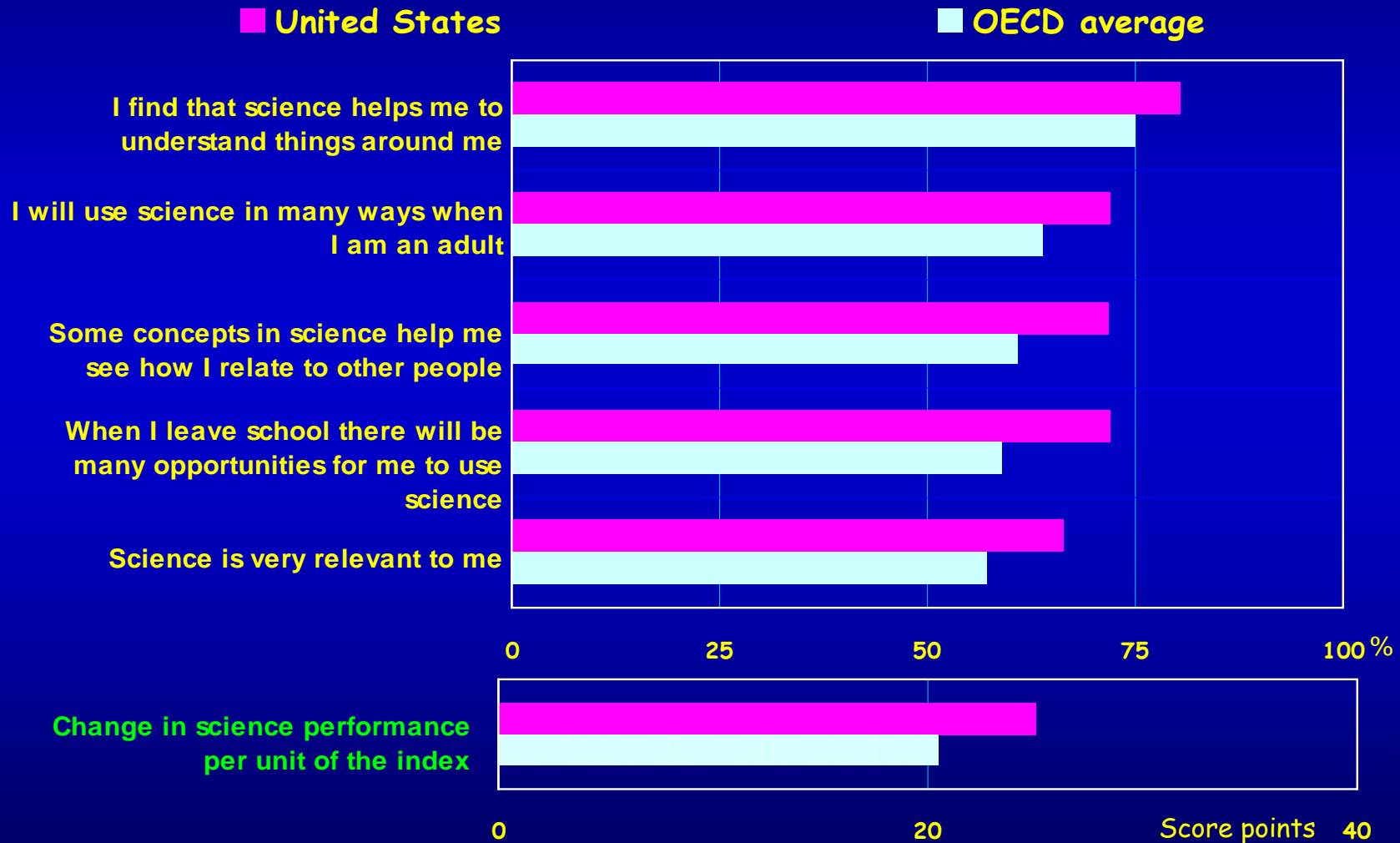
Students attitudes to science and
their awareness of the life
opportunities science may open

Students generally value science...

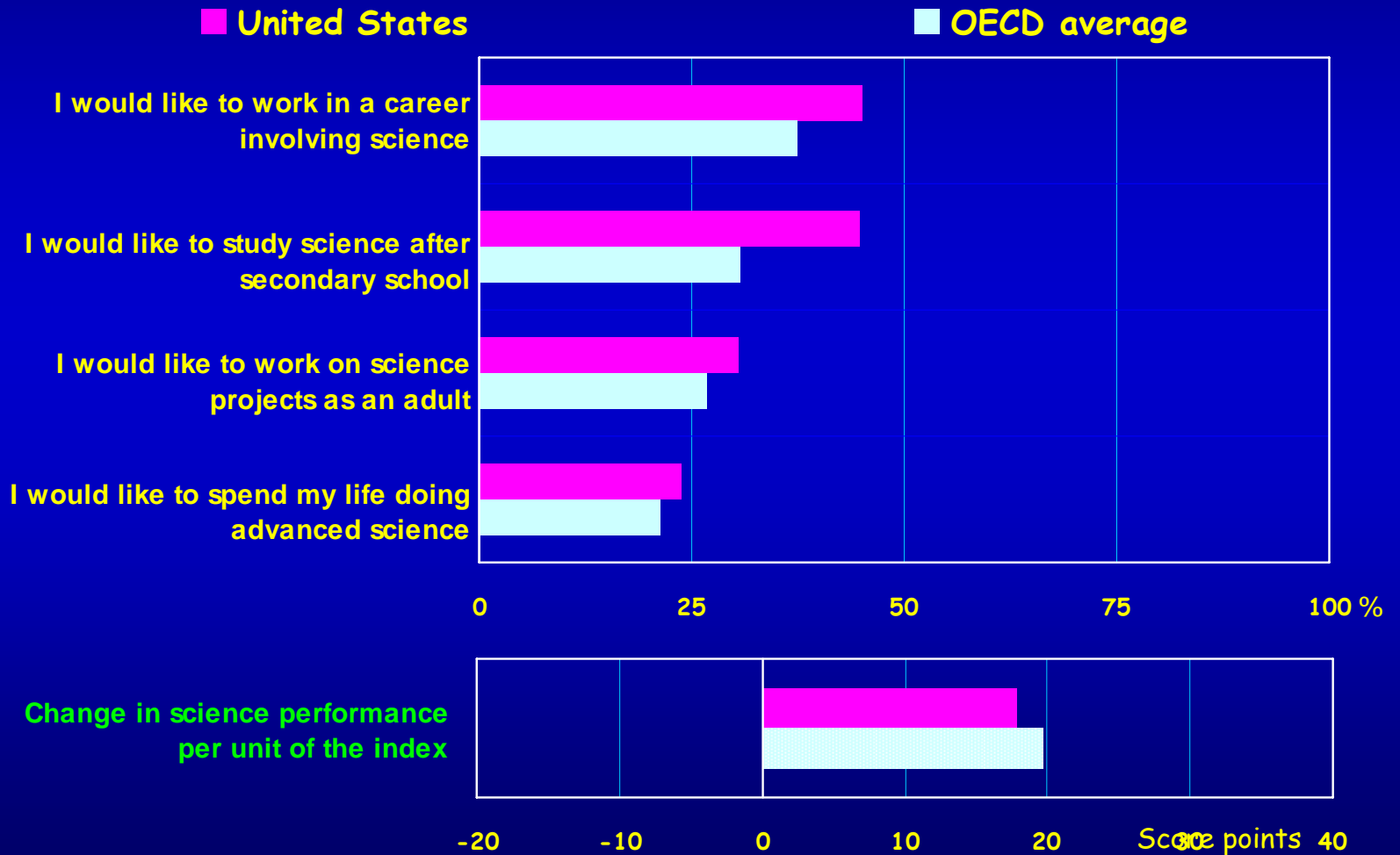
but report stronger belief in the technological potential of science than in its capacity to make social improvements



...but somewhat less so when it concerns themselves...

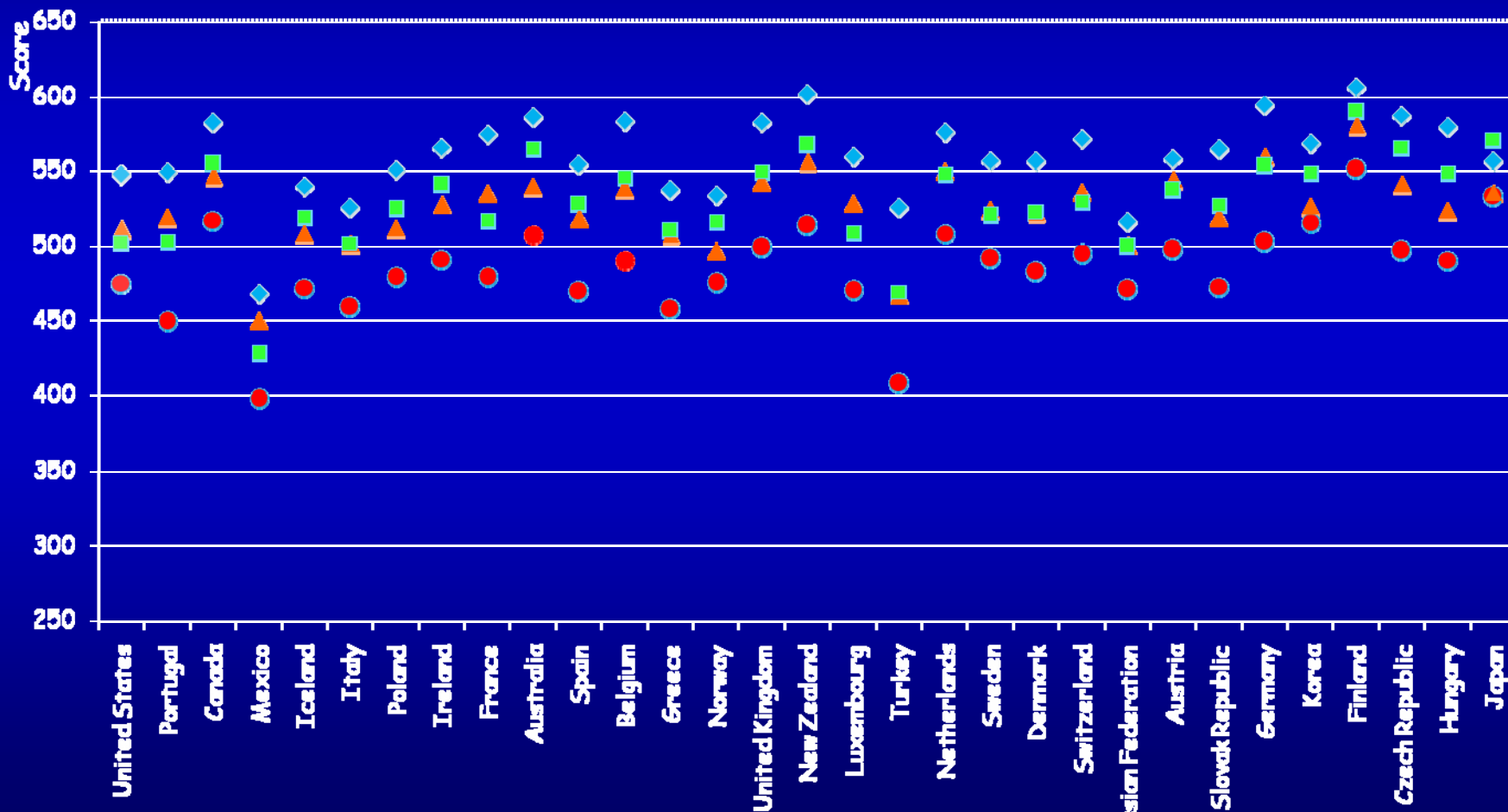


...and only a minority report interest in a scientific career



Students expecting a science-related career and their performance in science

- Students not expecting a science career without a parent in a science-related occupation
- ▲ Students not expecting a science career with at least one parent in a science-related occupation
- Students expecting a science career without a parent in a science-related occupation
- ◆ Students expecting a science career with at least one parent in a science-related occupation



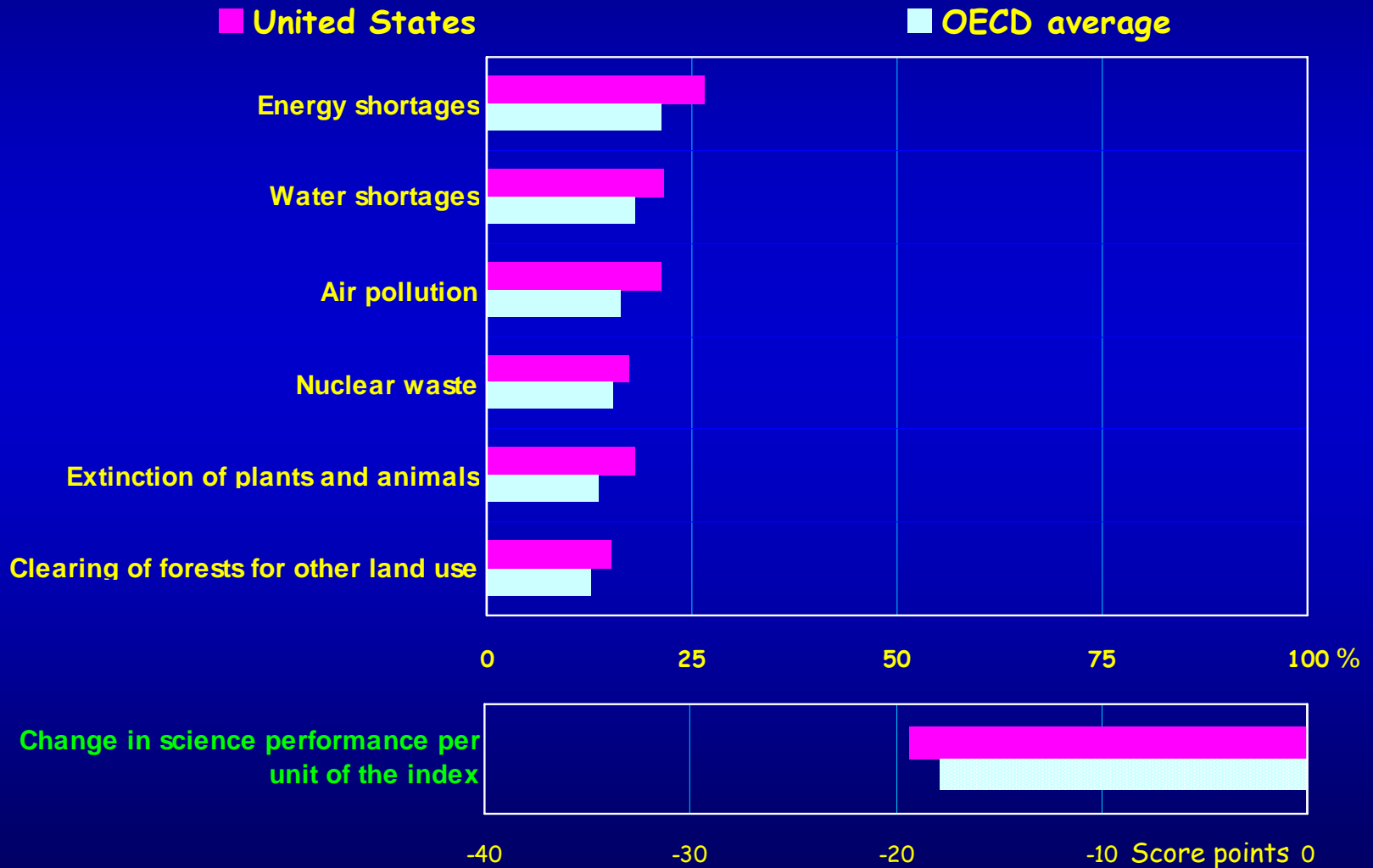
Note: Science performance scores are only shown for groups where there are at least 3% of students.

Science and the environment

- r 53% of US 15-year-olds report familiarity and knowledge of the increase of greenhouse gases in the atmosphere, 73% with consequences of clearing forests for other land use, 54% with issues around pollution and acid rain (large variation across countries)...
 - Awareness of environmental issues is closely linked with students' science performance...
... and with their social background
- r US students also express concern for environmental issues but a below-average sense of personal responsibility for sustainable development
- r Only a minority are optimistic that the issues will be successfully addressed...
 - ... and the more students know and the better they perform in science, the less optimistic they are...

Some degree of pessimism among students about the future of the natural environment

problems associated with the areas below will improve over the next 20 years



Equity in educational opportunities

High science performance

High average performance

High average performance

Large socio-economic disparities

High social equity

Strong socio-economic impact on student performance

Socially equitable distribution of learning opportunities

United States



Low average performance

Low average performance

Large socio-economic disparities

High social equity

Low science performance

High science performance

High average performance

Large socio-economic disparities

High average performance

High social equity

Hong Kong-China

Finland

560

540

Chinese Taipei
New Zealand

Estonia
Australia
Canada
Japan

Liechtenstein

Netherlands
Slovenia

Korea

520

Germany
United Kingdom
Belgium
Czech Republic
Switzerland
Austria
Ireland

Macao-China

Strong socio-economic impact on student performance

Socially equitable distribution of learning opportunities

Hungary

Sweden

Poland
Denmark

500

France

Croatia
Latvia
Iceland
Norway

United States

Luxembourg
Slovak Republic
Lithuania

Spain

Russian Federation
Italy

480

Portugal
Greece

460

Low average performance

Large socio-economic disparities

Low average performance

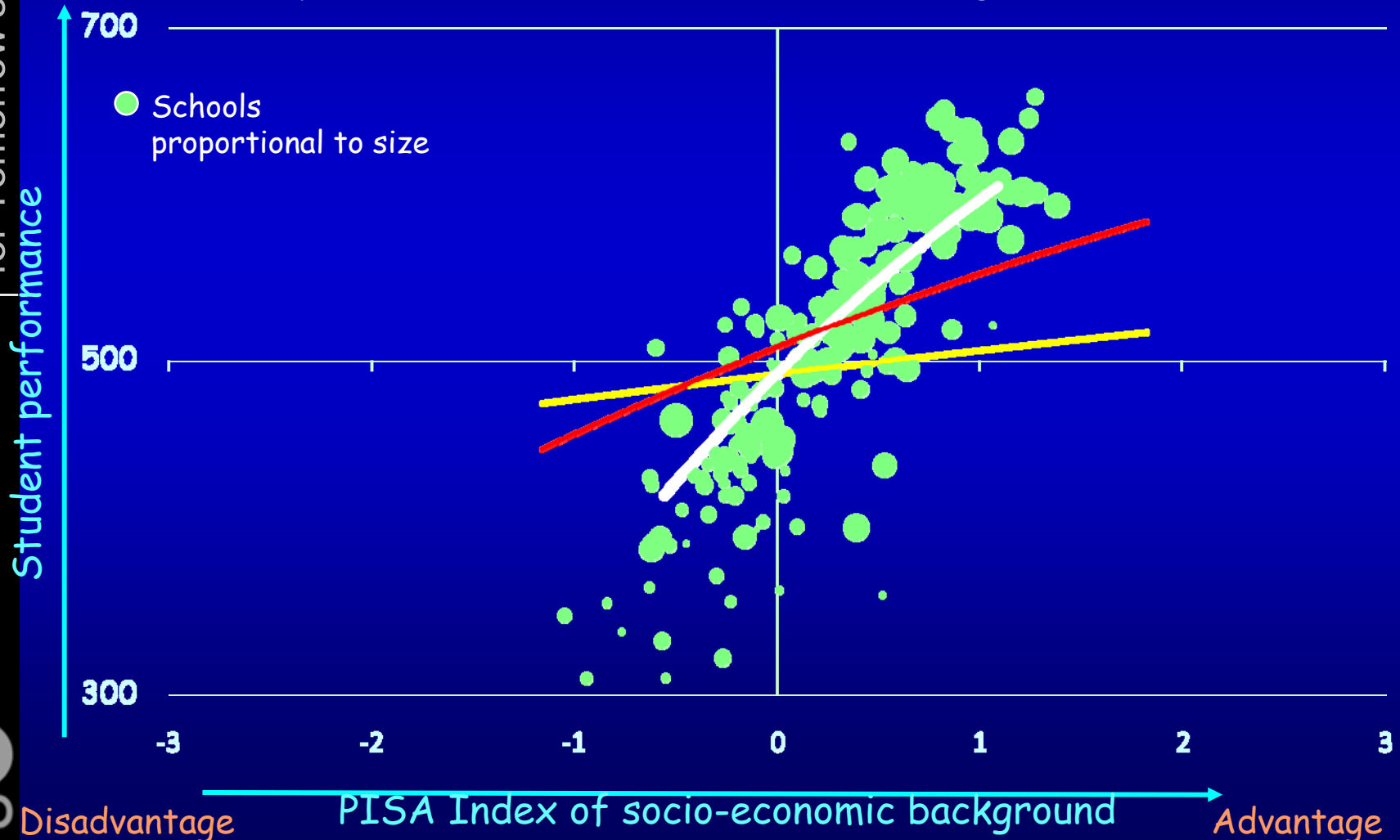
High social equity

440

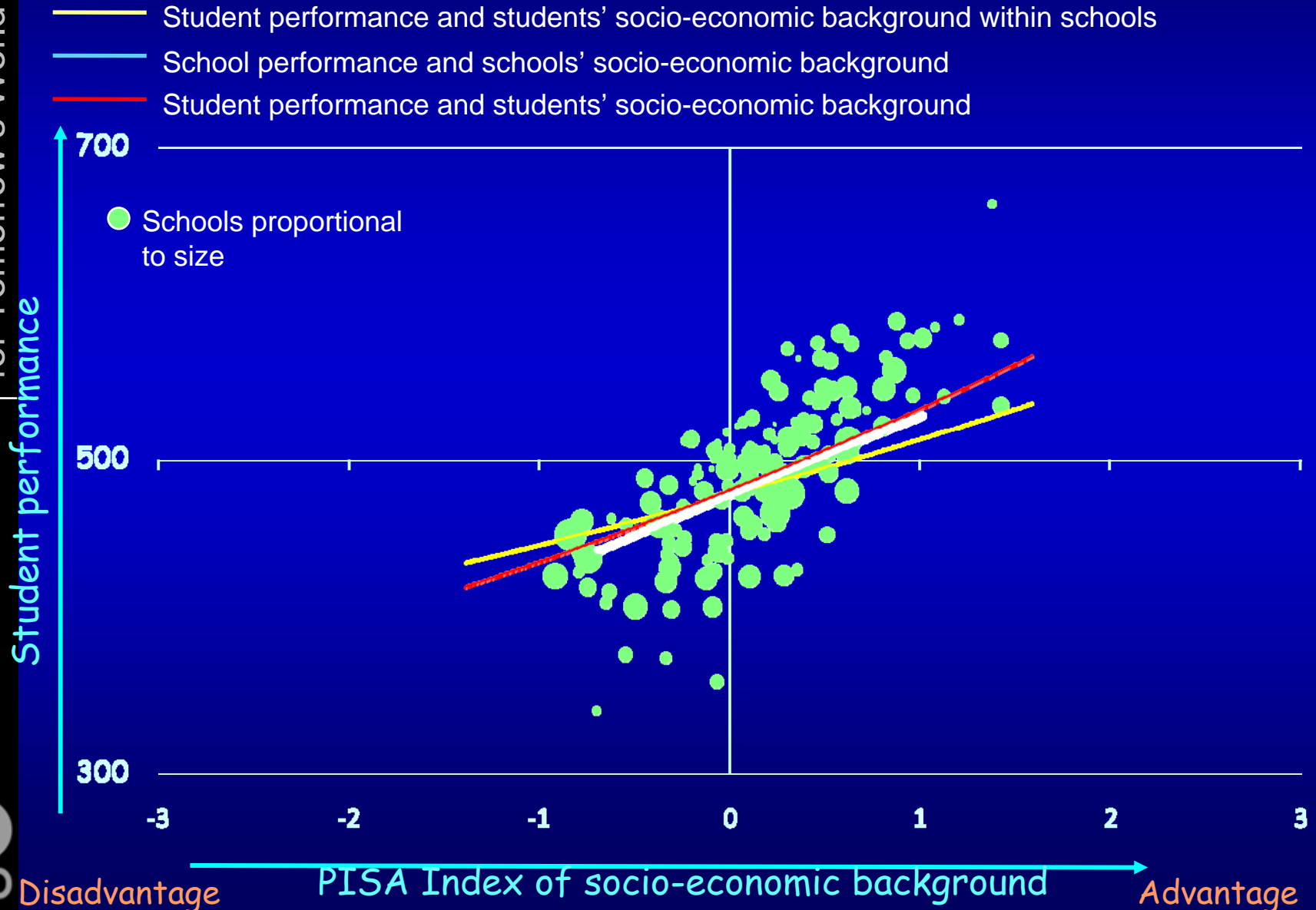
Low science performance

School performance and socio-economic background Germany

- Student performance and students' socio-economic background within schools
- School performance and schools' socio-economic background
- Student performance and students' socio-economic background

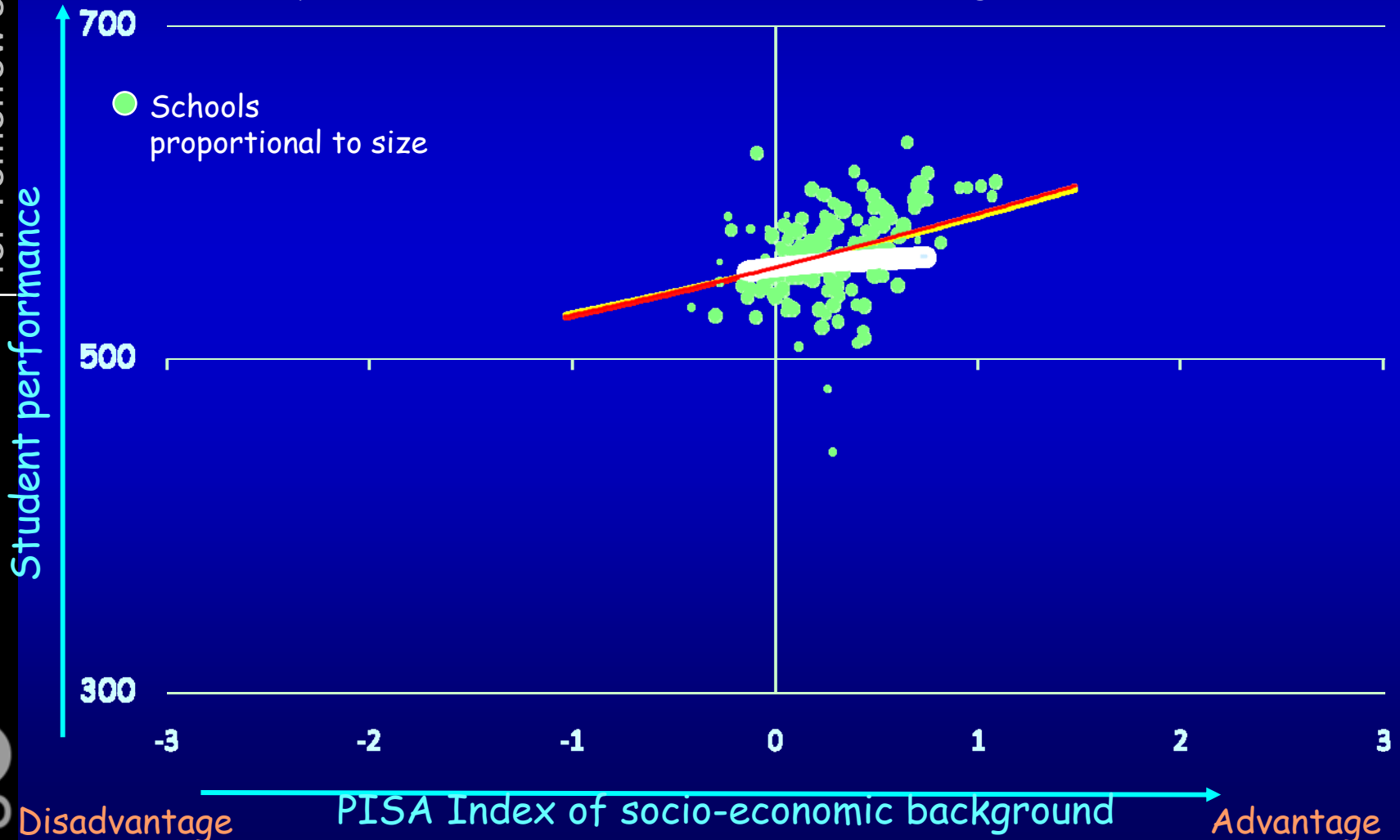


School performance and socio-economic background United States



School performance and socio-economic background Finland

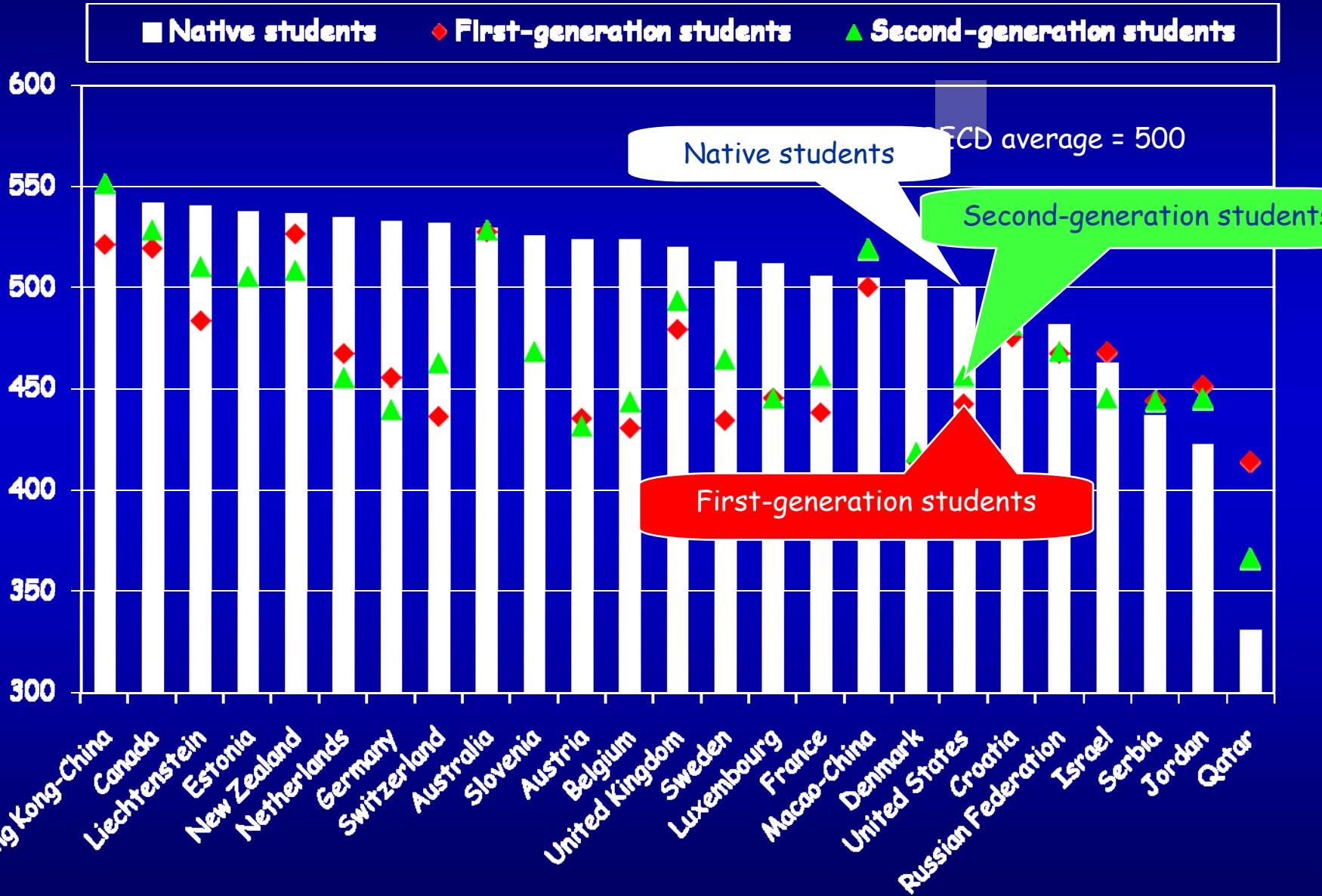
- Student performance and students' socio-economic background within schools
- School performance and schools' socio-economic background
- Student performance and students' socio-economic background



Immigrants and science performance

- r Among 15-year-olds, the proportion of students with an immigrant background...
 - ... is 36% in Luxemburg and between 21 and 23% in Switzerland, Australia, New Zealand and Canada
 - ... is 15% in the United States
 - ... still exceeds 10% in Germany, Belgium, Austria, France, the Netherlands and Sweden
- r Immigrant students tend perform less well...
 - ... but in OECD countries other than Luxembourg that have a greater immigrant share, students perform better than in the US
- r US second-generation immigrant students do not perform better than first-generation students
- r Immigrant students tend to face the double disadvantage of being in schools with a more disadvantaged socio-economic intake
- r Immigrant students tend to report stronger attitudes towards science .

Immigrants and science performance

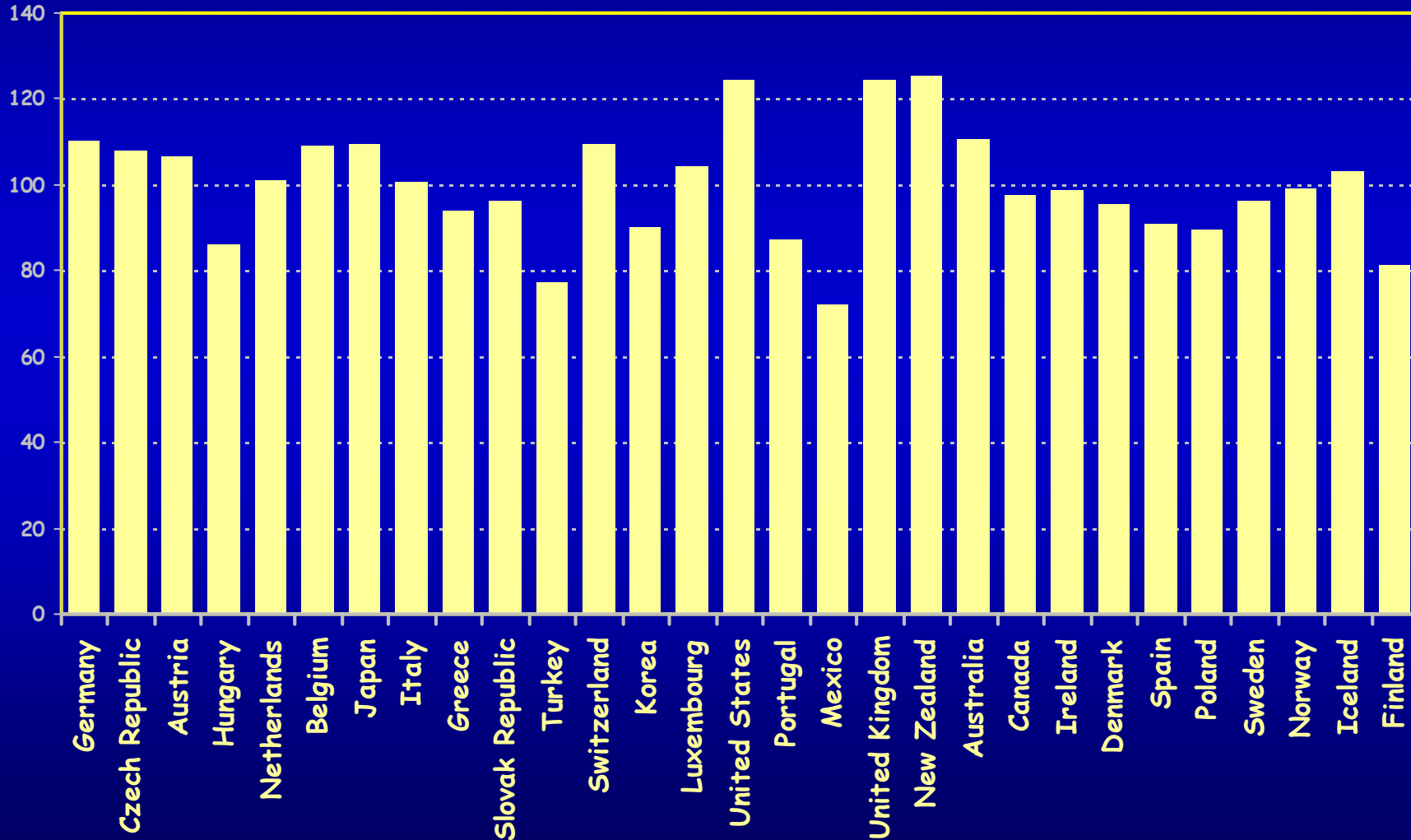


PISA 2006: Science Competencies for Tomorrow's World, Figure 4.2a.



Coherence of educational standards across schools

Variation in student performance

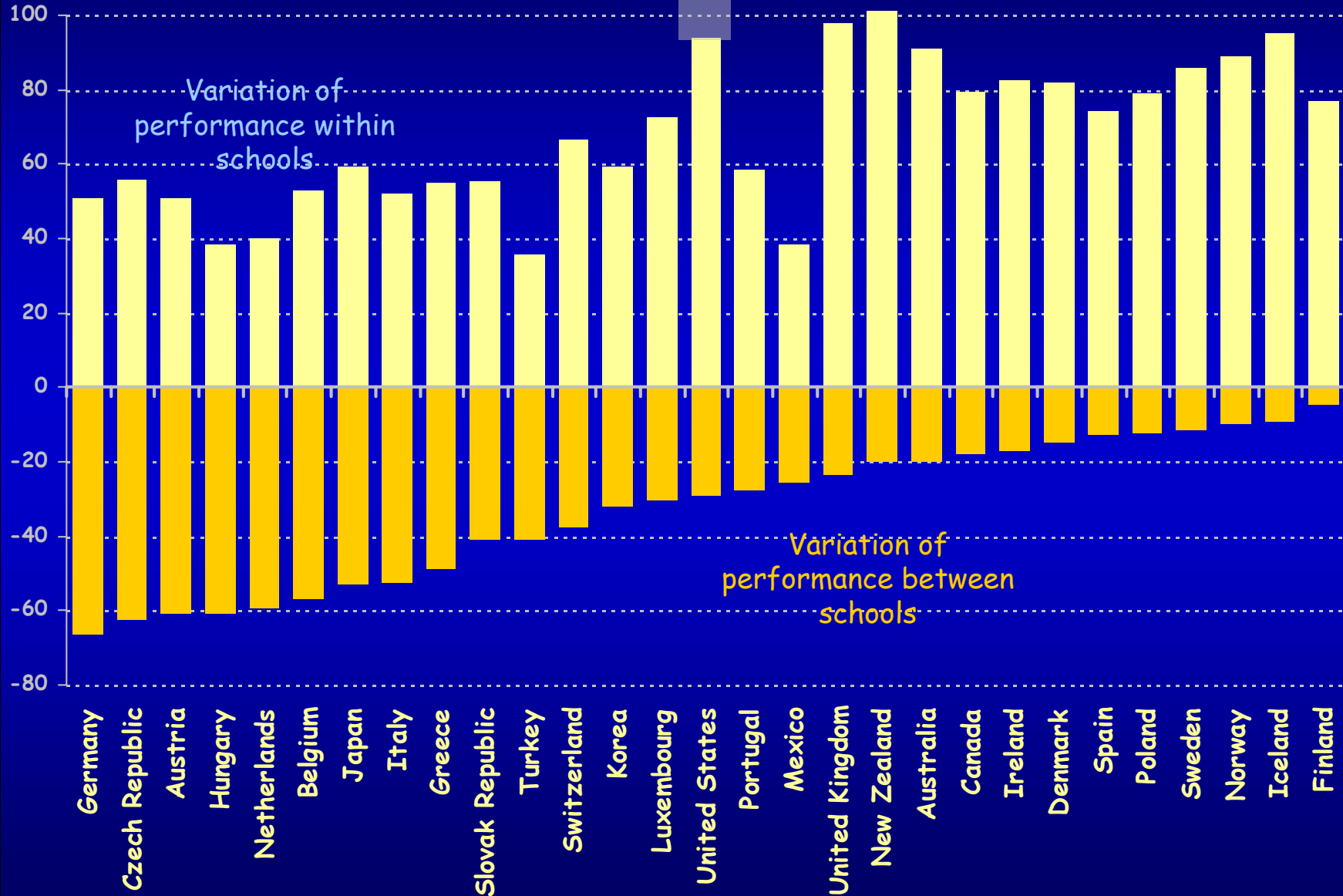


Variation in student performance

Science Competencies
for Tomorrow's World

PISA

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International Student Assessment



Some levers for policy that emerge from OECD's comparisons

Some myths

- r US coverage of the sampled population is more comprehensive than in other countries
 - US covered 96% of 15-year-olds enrolled (OECD 97%)
 - US covered 86% of all 15-year-olds (OECD 89%)
 - No impact on mean performance
- r No relationship between size of countries and average performance
- r No relationship between proportion of immigrants and average performance
- r Few difference in students' reported test motivation
- r Limited impact of national item preferences .



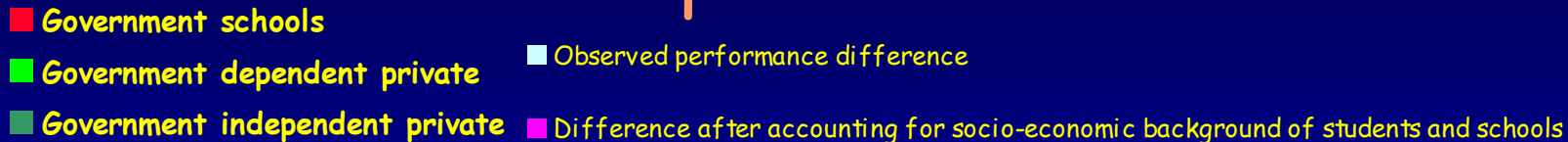
High ambitions
and universal standards

Access to best practice
and quality professional
development

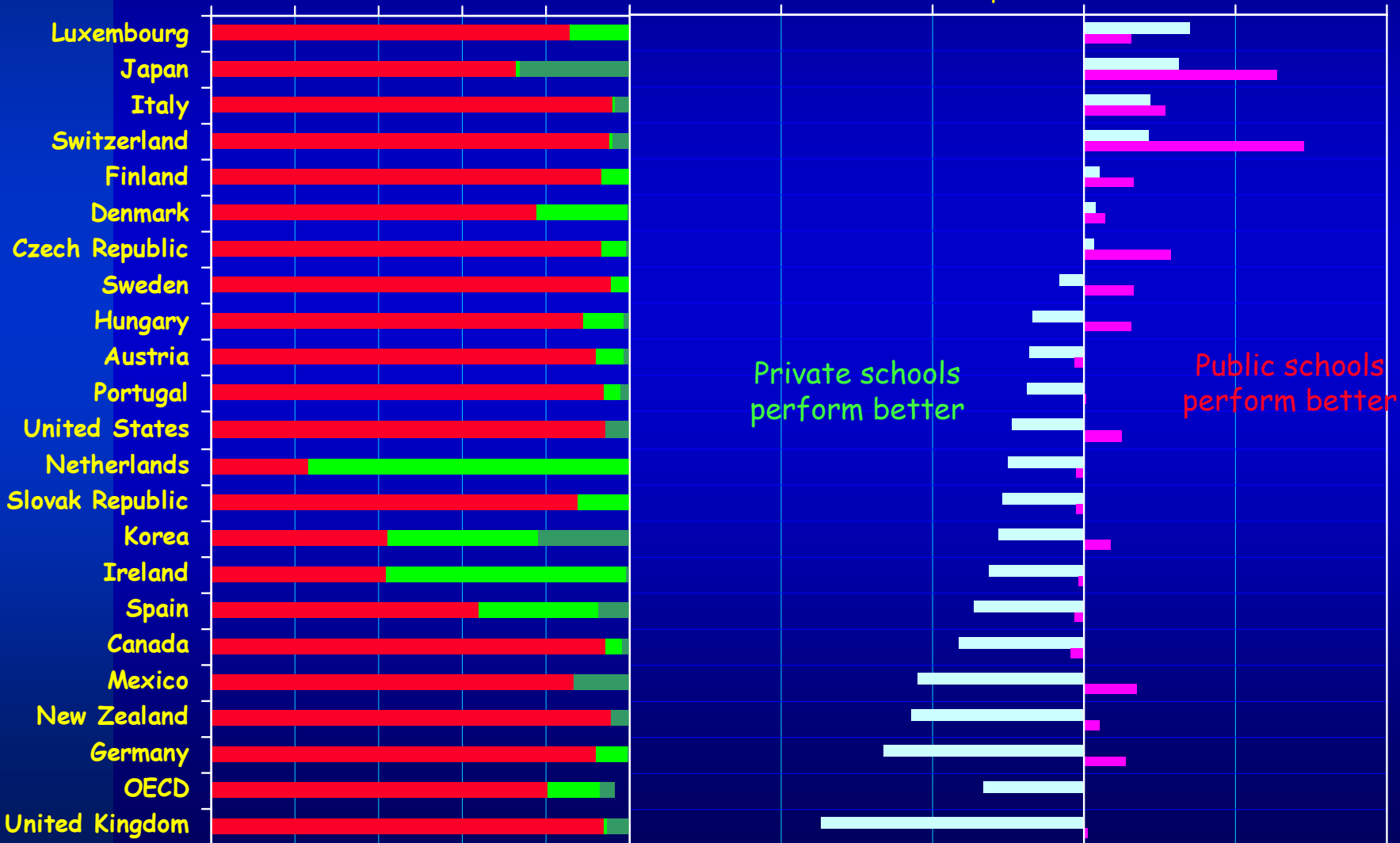
High ambi



Public and private schools



% 0 20 40 60 80 100 -100 -50 0 50 100
Score point difference



Private schools perform better

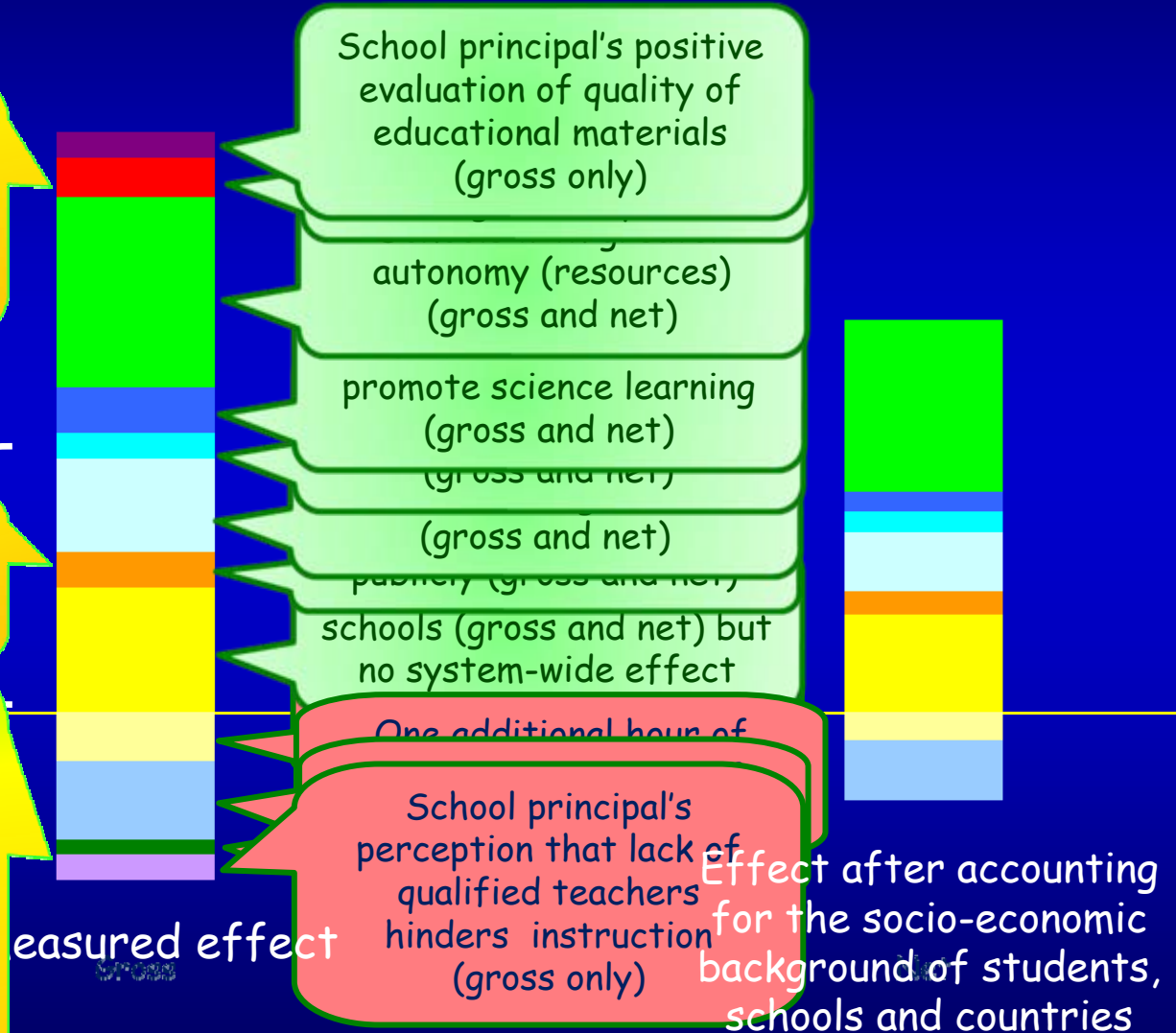
Public schools perform better

Pooled international dataset, effects of selected school/system factors on science performance after accounting for all other factors in the model

64% of US students in schools that compete with more than 2 schools in same area, 11% with one school, 26% with no school

91% of US students in schools posting achievement data publicly (OECD 38%)

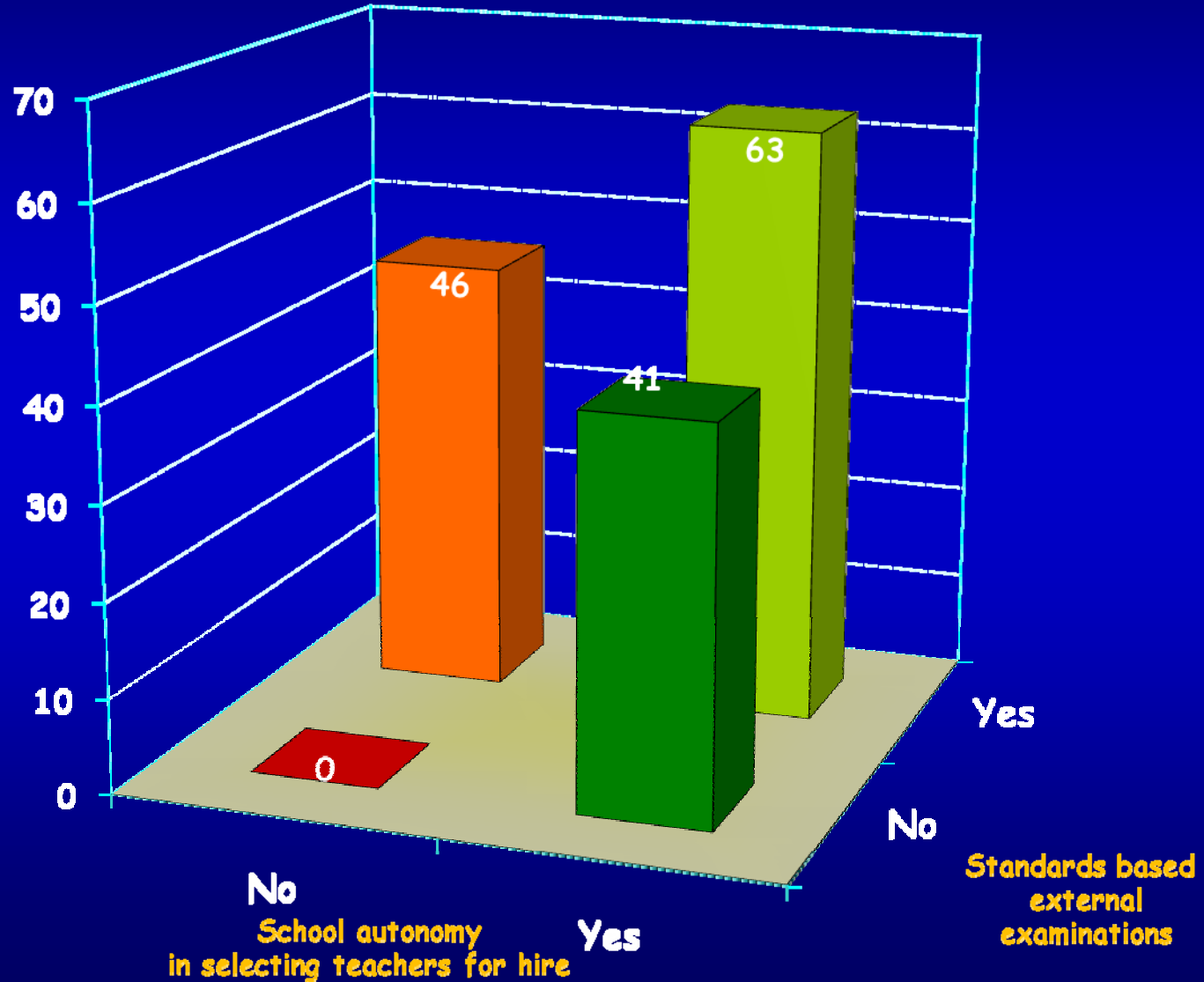
26% of US students in schools with no vacant science teaching positions (OECD 38%), 71% where all vacant positions had been filled (OECD 59%), BUT 20% where principals report that instruction is hindered by a lack of qualified science teachers



School autonomy, standards-based examinations and science performance

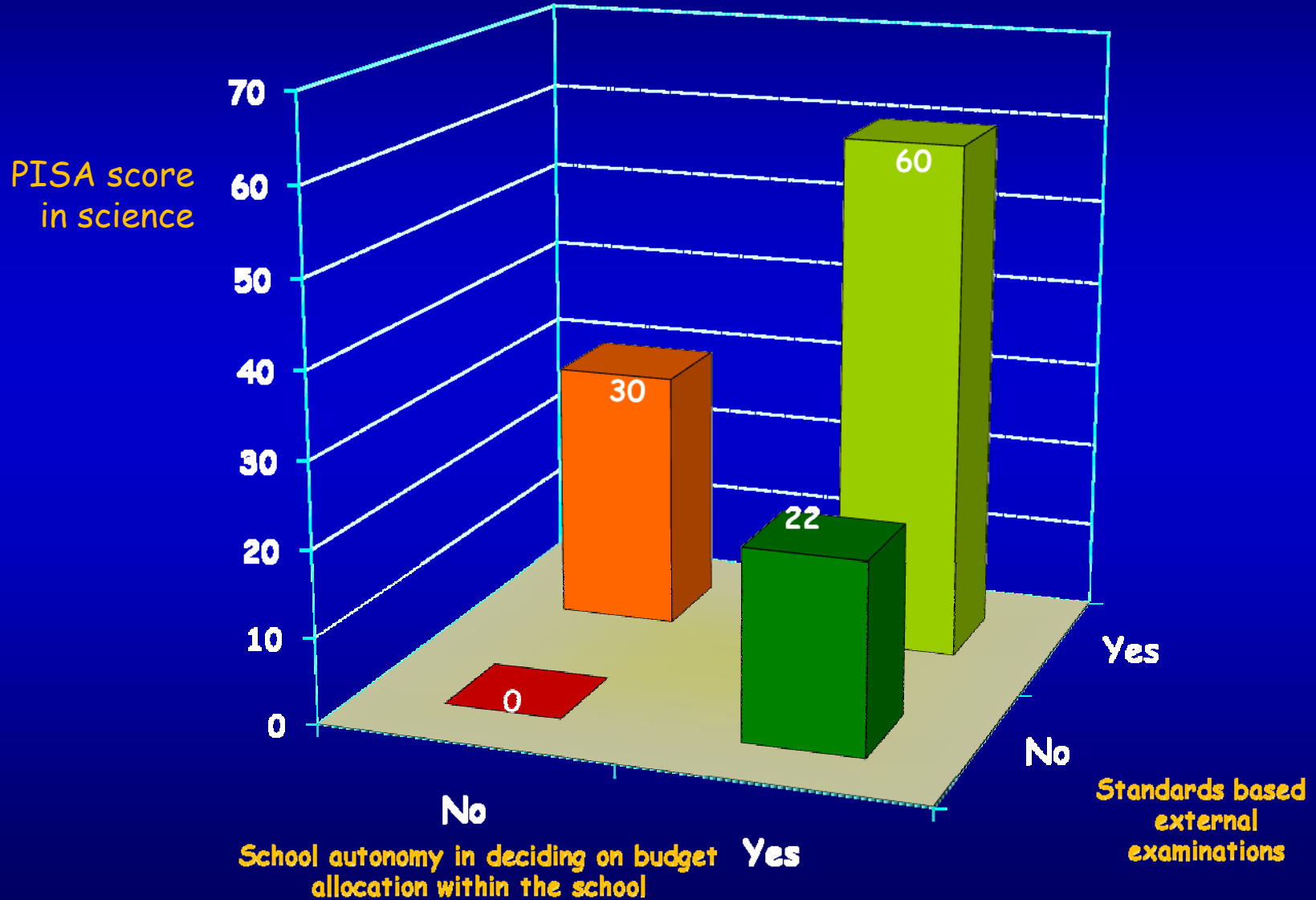
School autonomy in selecting teachers for hire

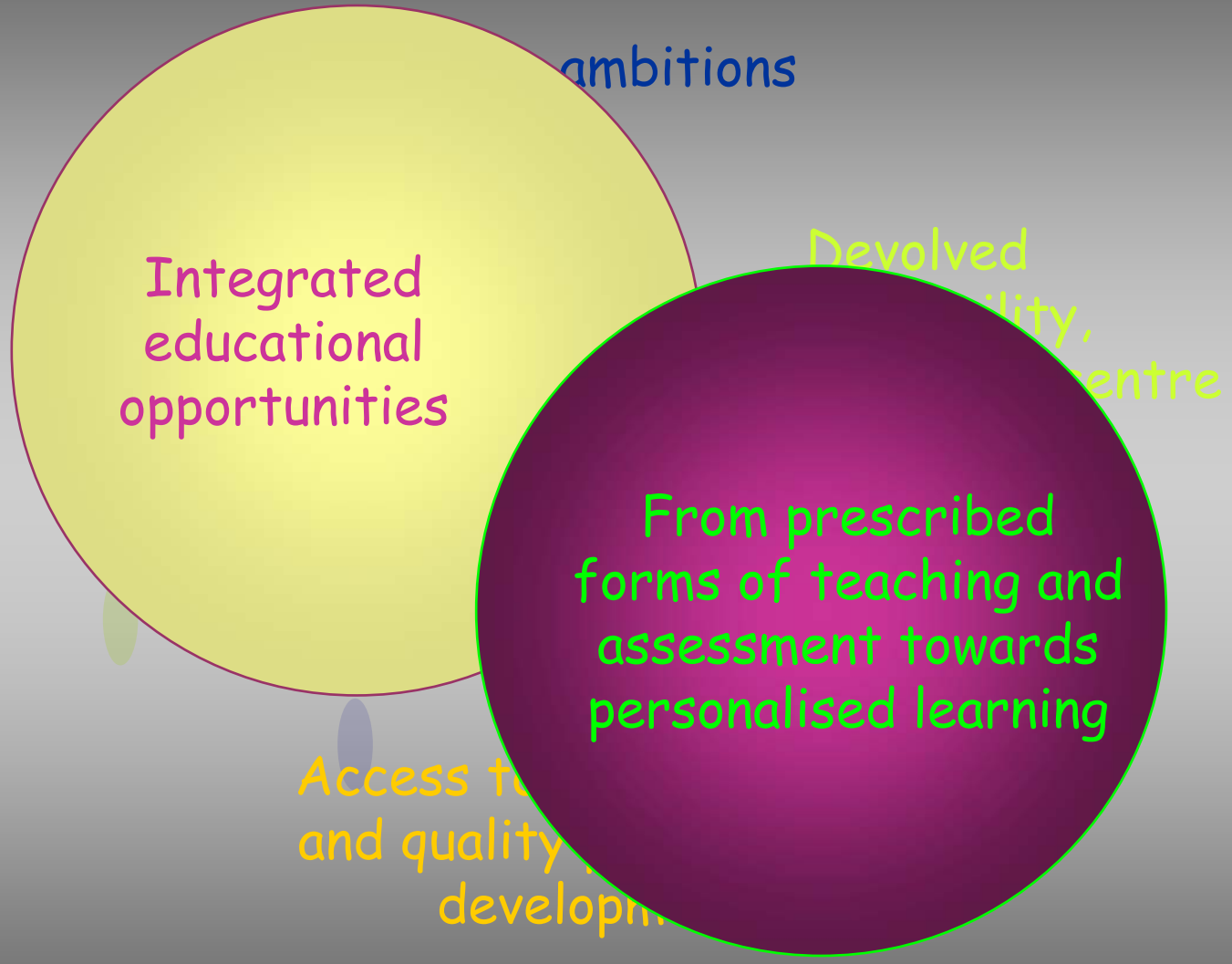
PISA score
in science

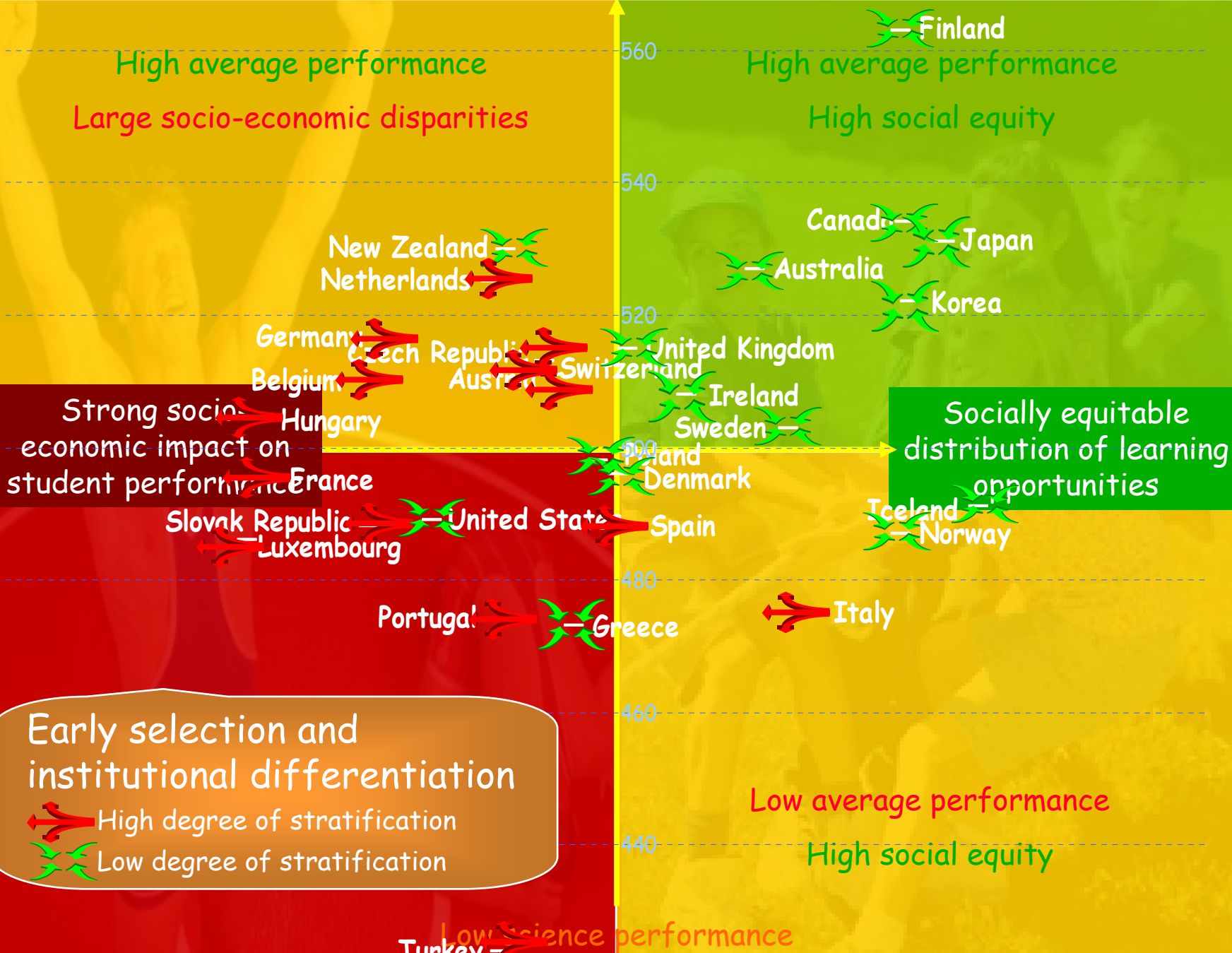


School autonomy, standards-based examinations and science performance

School autonomy in deciding on budget allocation within the school







High ambitions

Integrated
educational
opportunities

Devolved
responsibility,
the school as the centre
of action

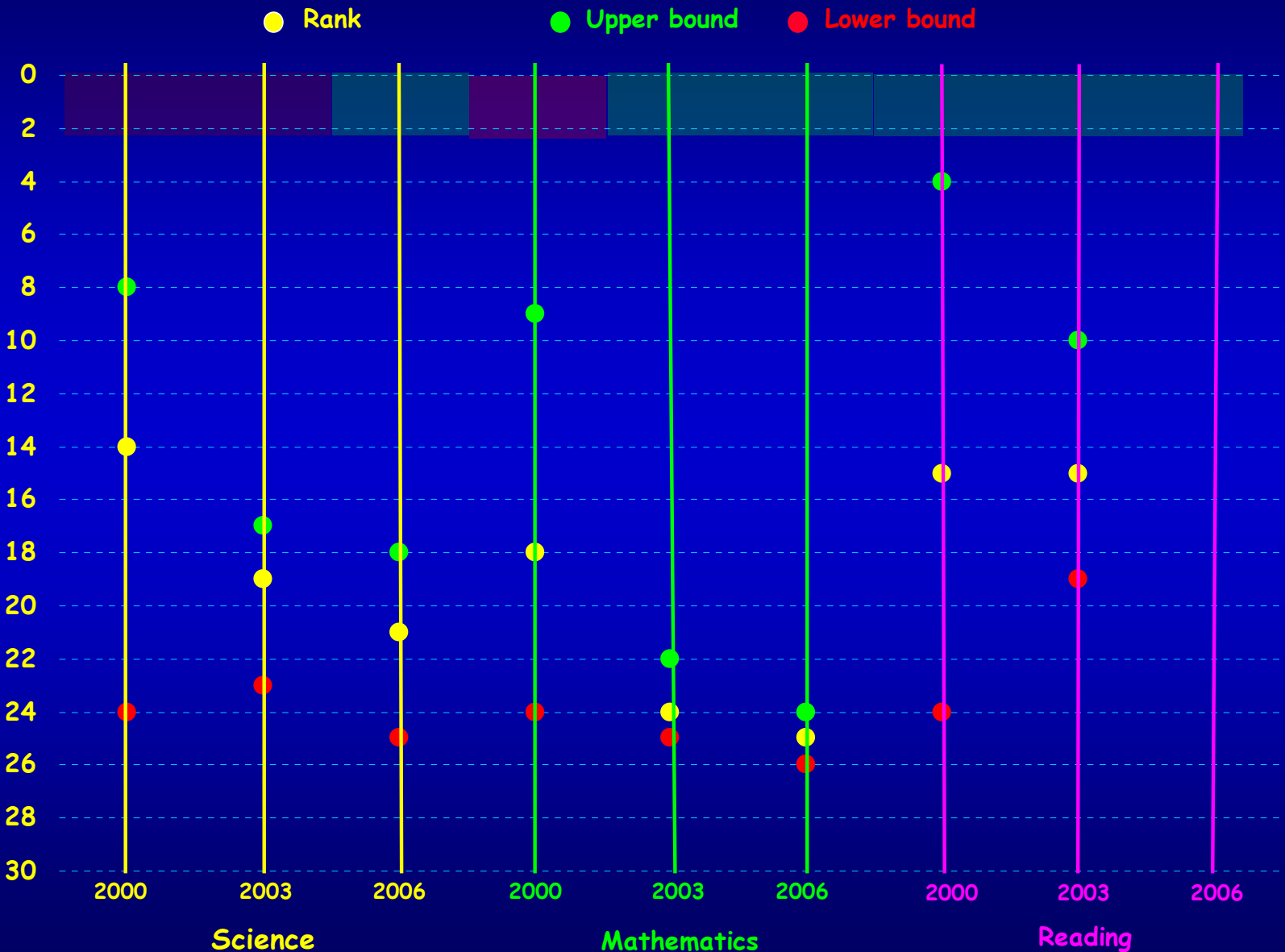
Accountability
and intervention in
inverse proportion to
success

Personalized
learning

Access to best practice
and quality professional
development

Relative standing of the US in PISA

(2000: 27 OECD countries, 2003: 29 OECD countries, 2006: 30 OECD countries)

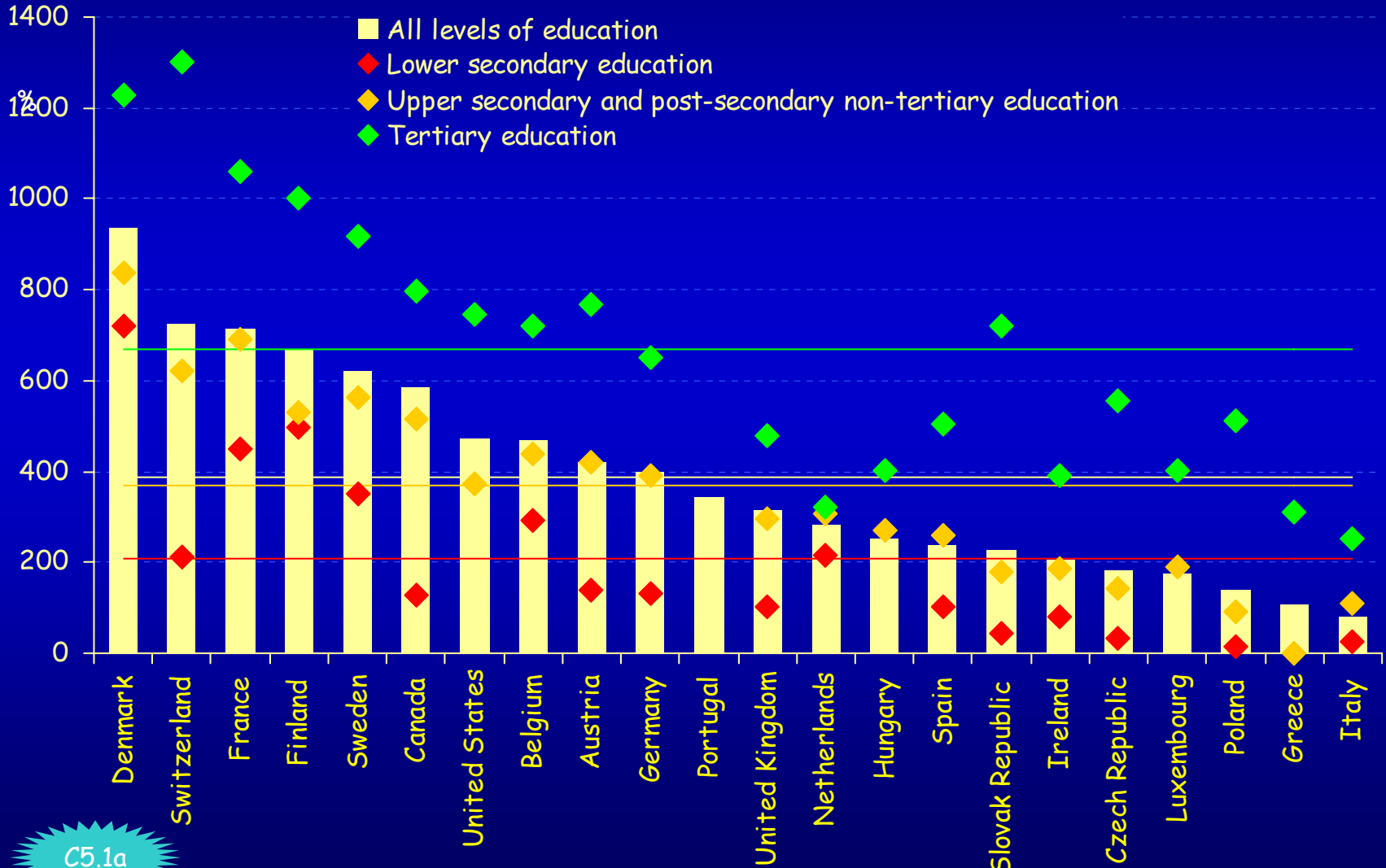


OECD (2007), *PISA 2006 - Science Competencies for Tomorrow's World*, Figures 2.11c, 2.14e, 6.8b, 6.20b

A second chance?

Expected hours in non-formal job-related training (2003)

This chart shows the expected number of hours in non-formal job-related education and training, over a forty year period, for 25-to-64 year olds.



C5.1a

Why care?

r Progress

- Concerns about skill barriers to economic growth, productivity growth and rates of technological innovation
 - One additional year of education equals to between 3 and 6% of GDP
 - Rising college-level qualifications seem generally not to have led to an "inflation" of the labour-market value of qualifications (in all but three of the 20 countries with available data, the earnings benefit increased between 1997 and 2003, in Germany, Italy and Hungary by between 20% and 40%)

r Fairness

- Concerns about the role of skills in creating social inequity in economic outcomes
 - Both average and distribution of skill matter to long-term growth

r Value for money

- Concerns about the demand for, and efficiency and effectiveness of, investments in public goods

- www.oecd.org; www.pisa.oecd.org
 - All national and international publications
 - The complete micro-level database
- email: pisa@oecd.org

- Andreas.Schleicher@OECD.org

Thank you !

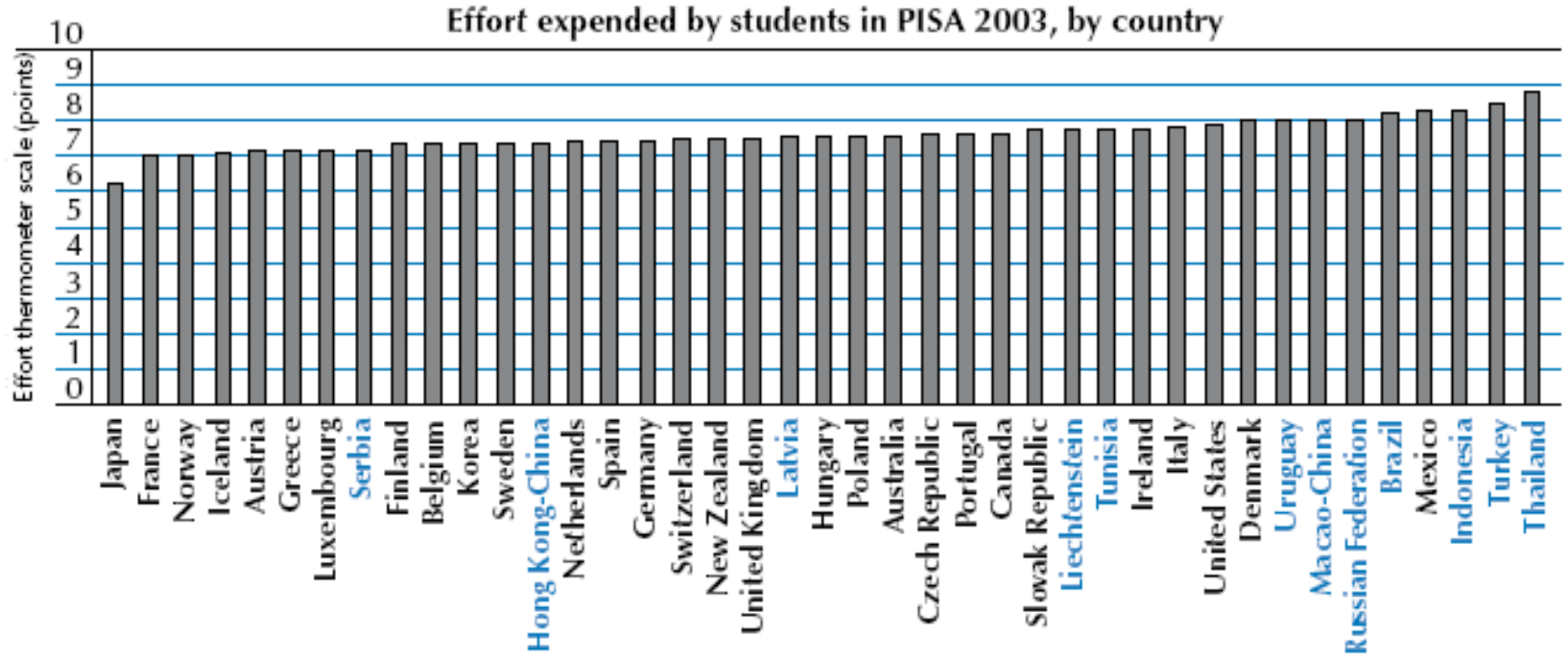
... and remember:

Without data, you are just another person with an opinion

Backup slides

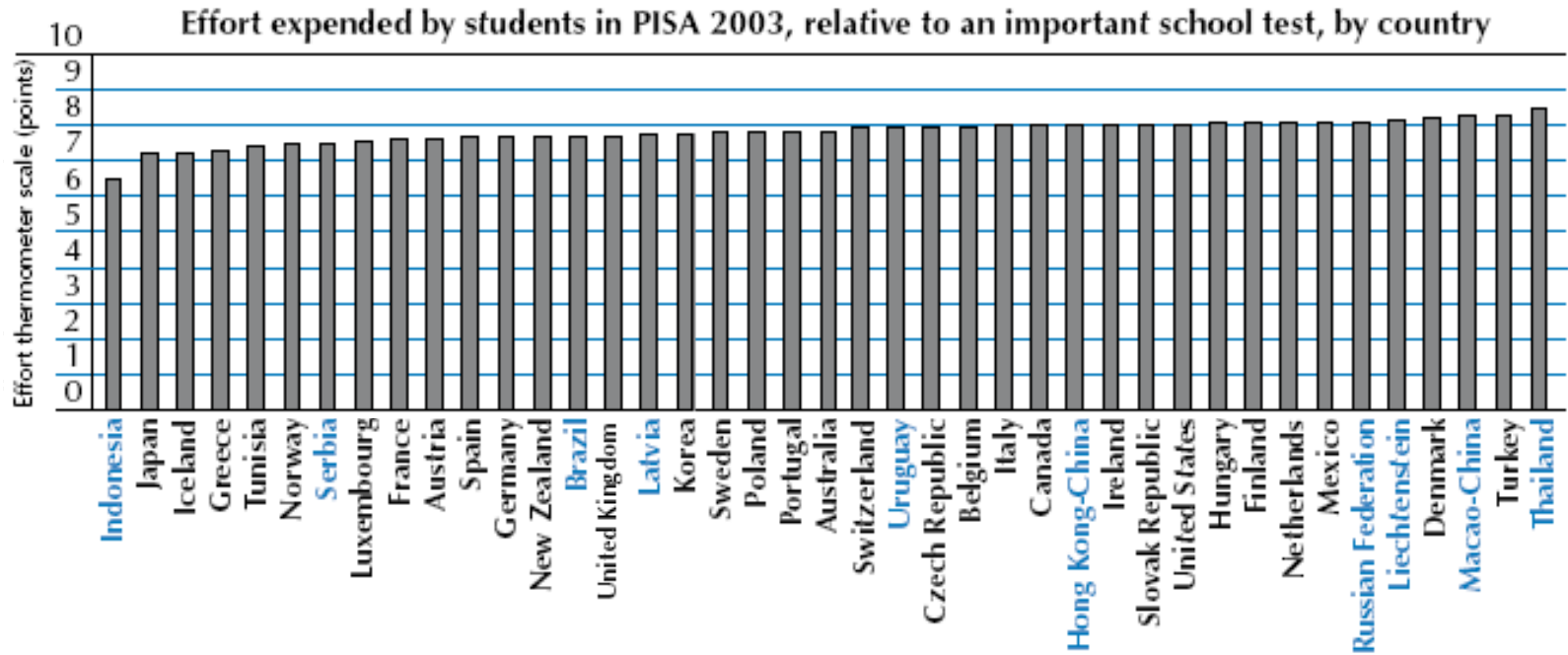


Effort expended by students in PISA 2003



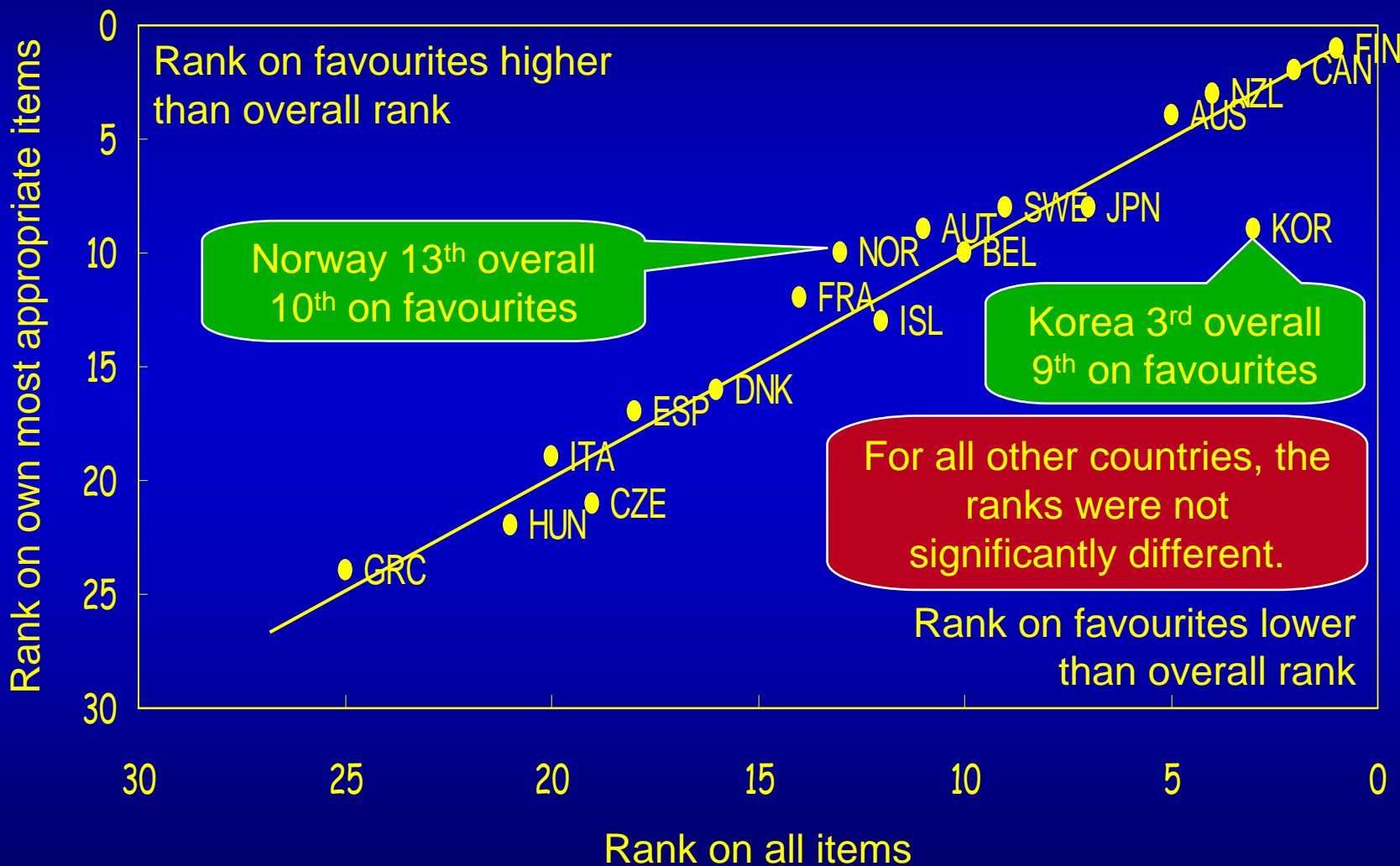
(Butler and Adams, 2007)

Effort expended by students in PISA 2003, relative to an important school test



(Butler and Adams, 2007)

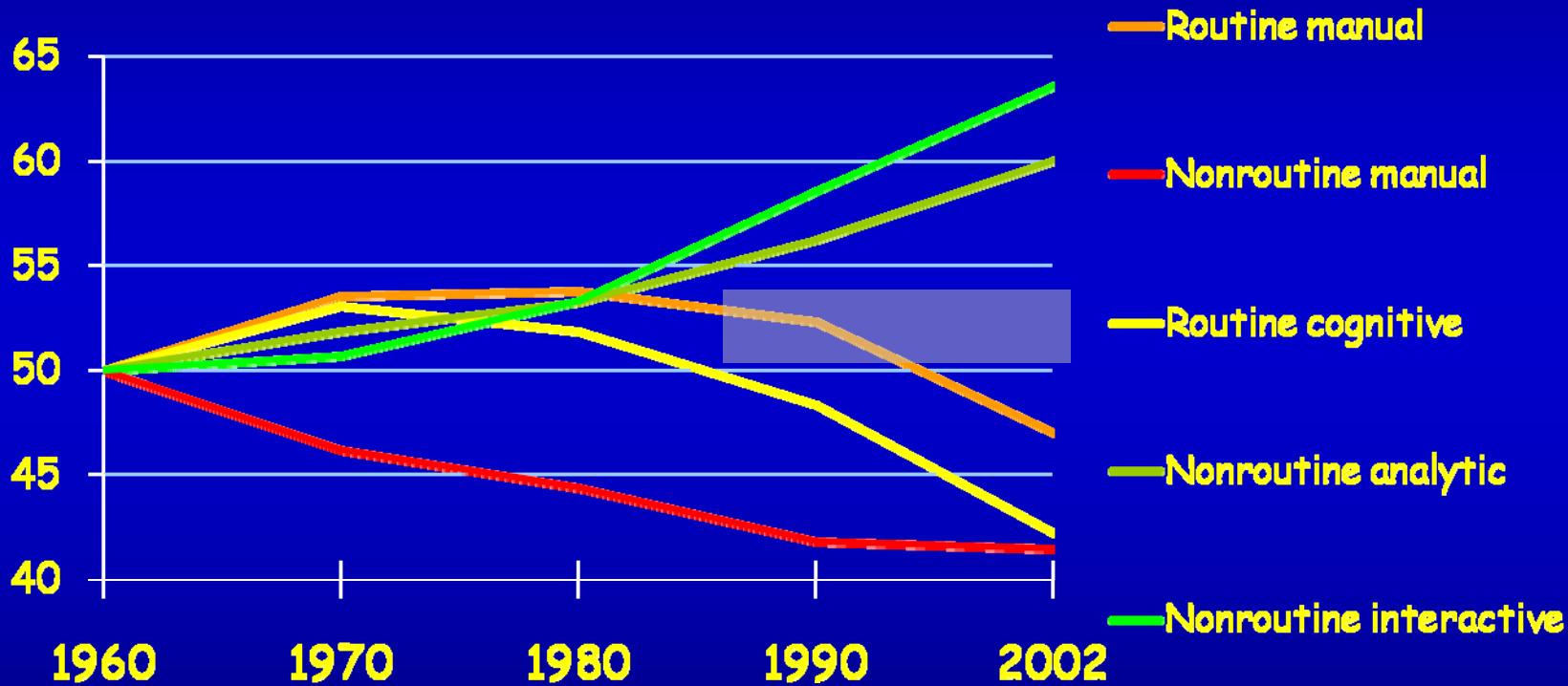
Ranks comparisons: Overall vs favourites



How the demand for skills has changed

Economy-wide measures of routine and non-routine task input (US)

Mean task input as percentiles of the 1960 task distribution



(Levy and Murnane)

Increased likelihood of postsec. particip. at age 19 associated with reading proficiency at age 15 (Canada) after accounting for school engagement, gender, mother tongue, place of residence, parental, education and family income (reference group Level 1)

