Chapter 5

School Resources for Teaching Science

e learning environment of the school can be a positive in uence, encouraging a positive attitude toward academic excellence and facilitating classroom instruction. Considerable research has shown that higher levels of school resources are associated with higher achievement. However, the relationship between resources and achievement is complicated. First, a school can have a more socioeconomically advantaged student population, for example, because of its location or because it competes for students. Second, the school system can invest more money into schools for such things as facilities, teachers' salaries, equipment, and materials. It follows that the most successful schools are likely to have more socioeconomically advantaged students and better resources.

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e home backgrounds of students attending a school can be closely related to the learning environment, with the two reinforcing each other and being strongly linked to academic achievement. Students from home backgrounds supporti

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Exhibit 5.4 presents the results for school composition by student economic

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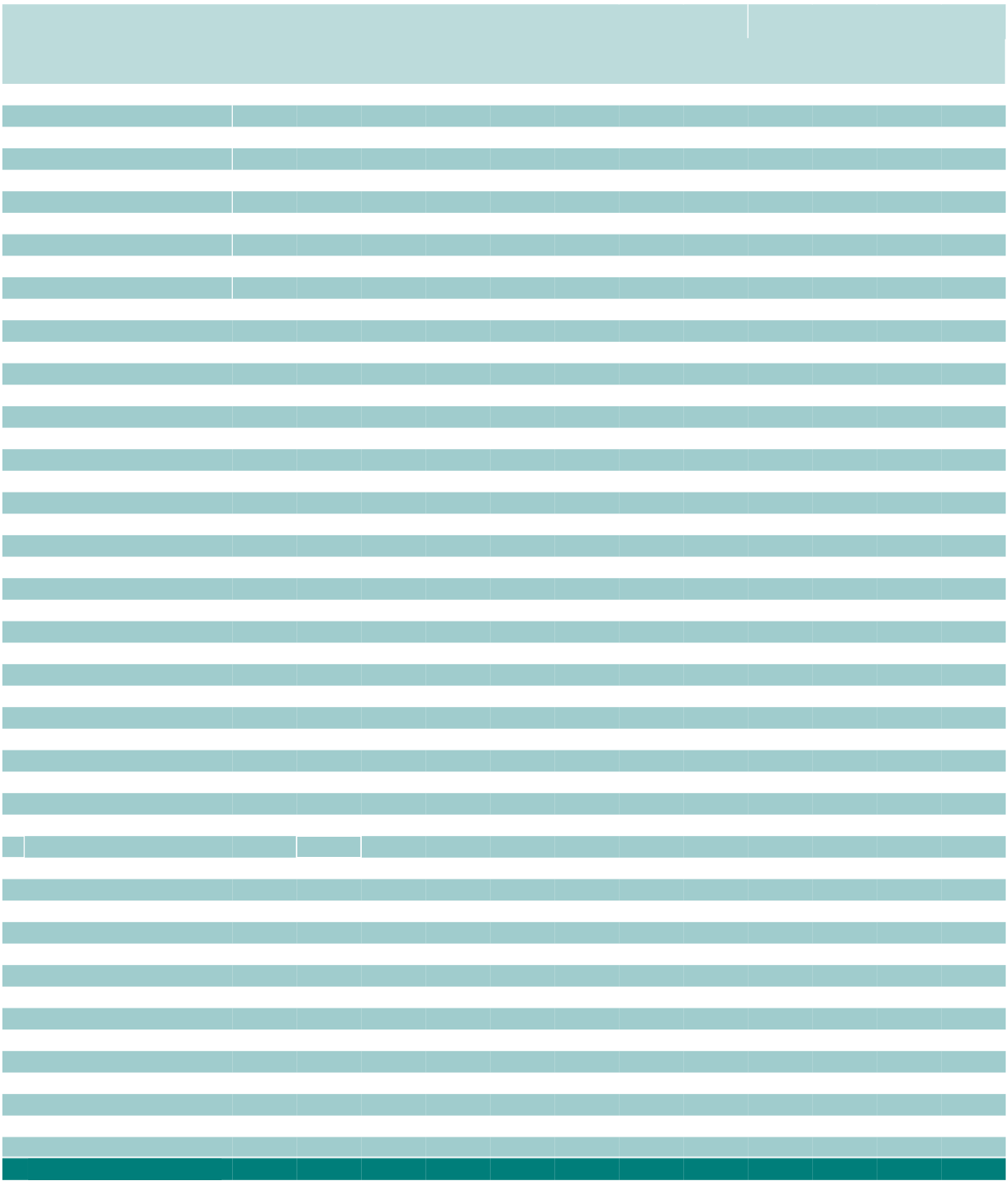
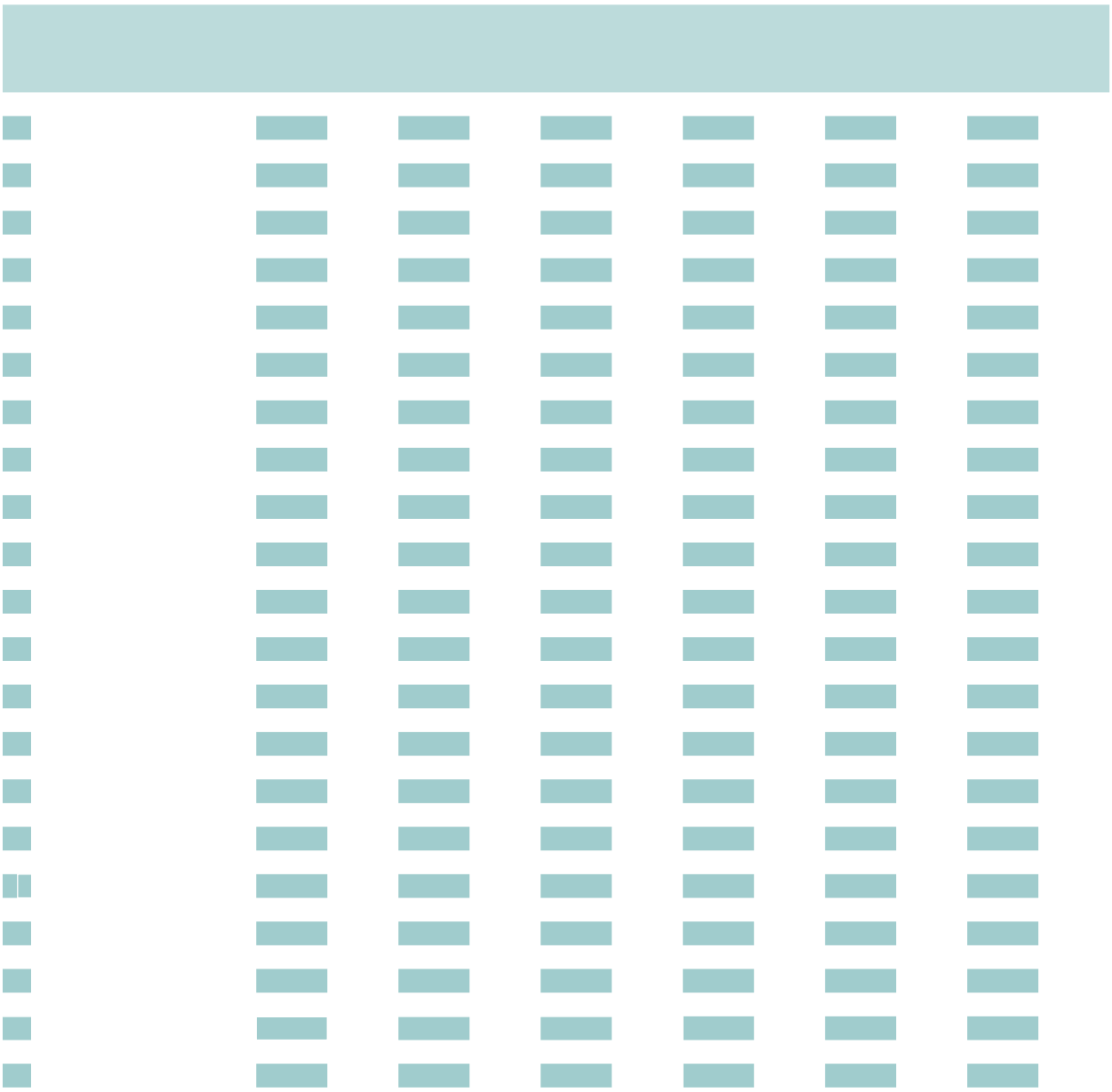
C	More A□uent - Schools Where More than 25% of Students Come from					





C	More than 90% of Students		51–90% of Students		50% of Students or Less	
	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement
N G						
Botswana	4 (1.8)	377 (11.1)	1 (0.7)	~ ~	95 (2.0)	404 (3.6)
Honduras	97 (1.8)	370 (4.3)	2 (1.7)	~ ~	1 (0.4)	~ ~
South Africa	7 (1.3)	462 (13.5)	7 (1.4)	446 (17.6)	85 (1.7)	314 (4.5)
B						
Alberta, Canada	51 (4.2)	550 (3.2)	36 (4.2)	546 (4.0)	13 (3.3)	530 (5.4)
Ontario, Canada	51 (3.6)	525 (3.0)	27 (3.1)	520 (5.3)	22 (3.0)	515 (6.4)
Quebec, Canada	66 (3.8)	524 (3.1)	24 (3.2)	523 (7.4)	11 (2.4)	491 (6.7)
Abu Dhabi, UAE	67 (2.6)	444 (4.3)	4 (1.6)	486 (25.9)	30 (2.5)	496 (9.4)
Dubai, UAE	24 (0.3)	442 (3.8)	12 (0.3)	533 (9.5)	64 (0.4)	493 (3.4)
Alabama, US r	84 (6.0)	489 (8.9)	10 (4.9)	486 (12.0)	6 (3.7)	460 (22.0)
California, US r	14 (5.8)	545 (15.3)	47 (6.0)	511 (6.6)	38 (5.7)	466 (8.8)
Colorado, US	45 (5.1)	566 (6.7)	39 (5.5)	532 (8.4)	16 (5.3)	502 (20.9)
Connecticut, US r	73 (4.5)	555 (6.9)	21 (4.3)	488 (15.3)	6 (3.7)	453 (45.9)
Florida, US	43 (6.5)	530 (10.2)	47 (6.6)	537 (11.2)	9 (4.2)	478 (24.6)
Indiana, US r	85 (5.2)	538 (6.4)	15 (5.2)	513 (17.2)	0 (0.0)	~ ~
Massachusetts, US	76 (3.8)	586 (5.2)	10 (3.9)	536 (21.2)	14 (4.5)	484 (16.1)
Minnesota, US	67 (6.5)	559 (5.2)	28 (6.2)	549 (7.2)	5 (3.6)	513 (104.9)
North Carolina, US	69 (6.1)	543 (10.0)	27 (5.6)	506 (7.8)	3 (2.4)	531 (60.1)

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2011

majority of students (51–90%) were native speakers of the TIMSS test language, and 17 percent were in schools where half the students (or less) spoke the language of the test as their native language. For the eighth grade students, on average across countries, the relationship between language composite and

substantial variation across the fourth grade countries—from 0 to 63 percent, with an average of 22 percent of students attending well-resourced schools.

Students in schools where instruction was **A** **A** had principals who reported that shortages a ected instruction "a lot" for six of the twelve resources and "some" for the other six, on average. All other students attended schools where instruction was **A** by resource shortages. Countries are ordered according to the percentage of students (from highest to lowest) in schools **A** by resource shortages. Only two countries (Korea and Slovenia) had more than 50 percent of their students in schools **A** by resource shortages; a large majority of countries and benchmarking participants had more than 50 percent of their students in schools that were **A** by resource shortages. Only eight of the 50 fourth grade countries and one benchmarking participant had more than 15 percent of their

Teacher Working Conditions

ere is evidence that, in some countries, teacher shortages may exist partly

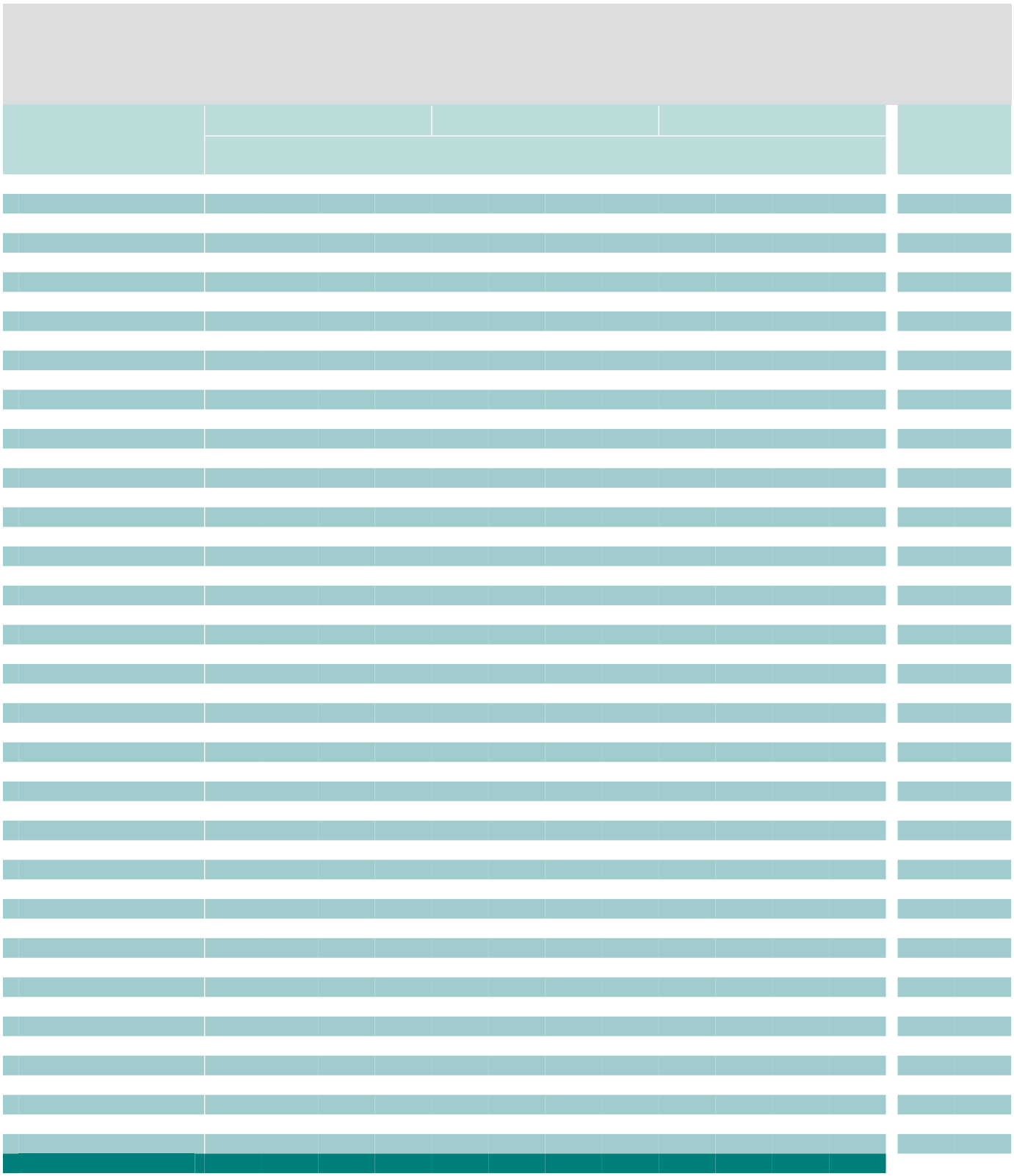
the results for the sixth grade and benchmarking participants followed a similar pattern. However, substantial percentages of students (ranging from 45–56%) in the sixth grade countries had teachers reporting moderate problems with school conditions.

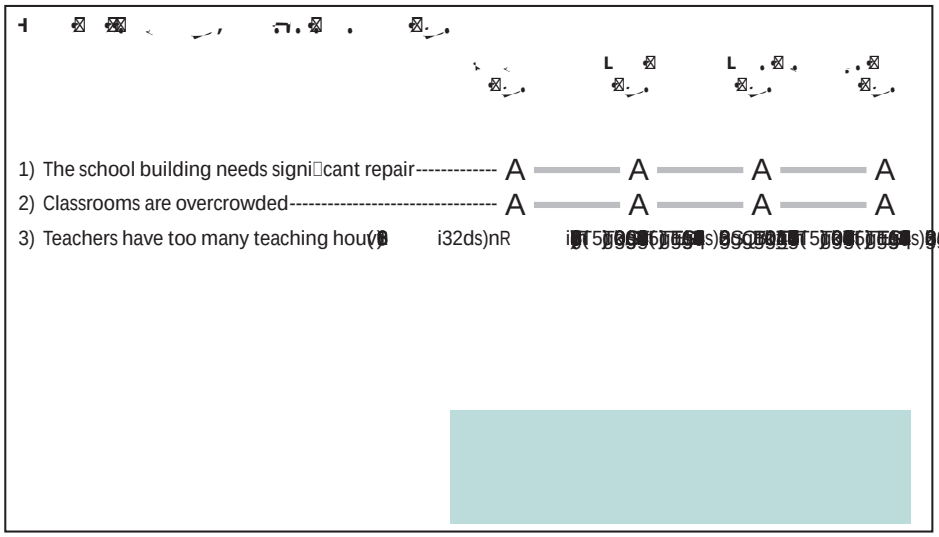
Exhibit 5.10 presents the results for the Teacher Working Conditions scale for the TIMSS 2011 eighth grade assessment. e eighth grade scale was based on responses by the students' science teachers to statements about the same ve problem areas as the fourth grade. Eighth grade science teachers expressed about the same level of satisfaction with working conditions as fourth grade teachers, with 20 percent of students in schools whose teachers reported **A** and 32 percent in schools with . On average across countries, the science achievement di erence between these two groups of students was 16 points (489 vs. 473).

Di culties Filling Vacancies for Science Teachers

Recent research suggests that teachers are in relatively short supply in some countries, and that the impending retirement of aging teachers will further contribute to this shortage (Ingersoll & Perda, 2010). TIMSS Advanced 2008 noted that, in several countries, not only were teachers of physics nearing retirement age, but relatively few students were considering physics as a career option, suggesting that there also may be a shortage of students entering science education careers (Mullis, Martin, Robitaille, & Foy, 2009).

Exhibit 5.11 summarizes school principals' reports from the TIMSS 2011




1) The school building needs signi□cant repair---------- A A A A
2) Classrooms are overcrowded---------- A A A A
3) Teachers have too many teaching hou

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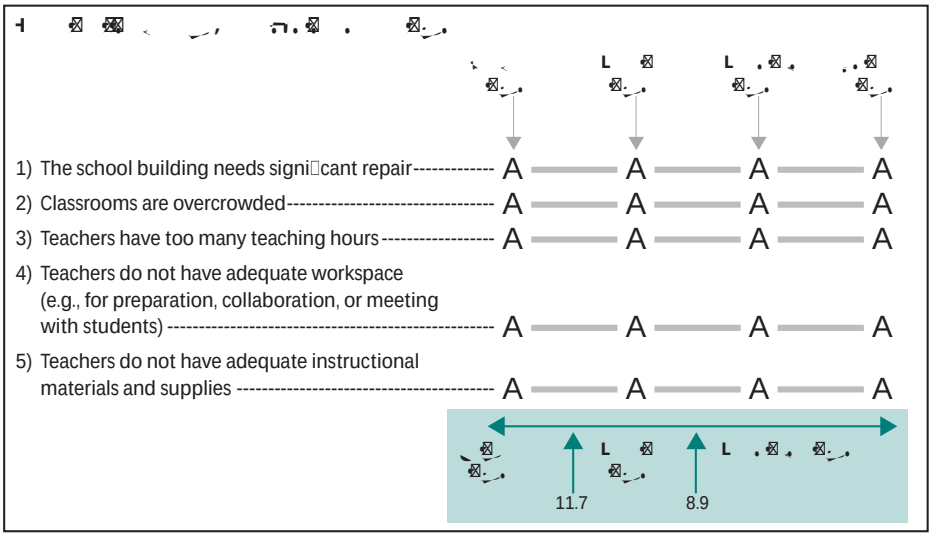
C		Hardly Any Problems		Minor Problems		Moderate Problems		Average Scale Score
		Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement	
N G								
Honduras		13 (3.0)	397 (10.3)	39 (4.0)	372 (6.6)	48 (3.9)	359 (5.6)	9.4 (0.16)
South Africa		5 (0.9)	505 (13.2)	30 (3.3)	349 (9.4)	64 (3.3)	306 (4.6)	8.4 (0.12)
Botswana		2 (1.0)	~ ~	26 (3.6)	403 (8.4)	72 (3.6)	401 (4.0)	7.8 (0.16)
B								
Indiana, US	r	52 (6.6)	539 (6.8)	40 (6.2)	532 (7.3)	8 (3.7)	525 (15.5)	11.7 (0.32)
Ontario, Canada		50 (4.2)	521 (3.8)	37 (3.9)	521 (4.4)	13 (3.0)	525 (8.8)	11.4 (0.20)
Dubai, UAE	r	45 (3.0)	501 (4.0)	43 (3.5)	464 (6.1)	12 (1.8)	450 (11.9)	11.2 (0.12)
Massachusetts, US	r	41 (7.0)	575 (11.1)	53 (6.6)	560 (10.5)	6 (3.3)	514 (26.9)	11.1 (0.26)
North Carolina, US	s	38 (6.4)	531 (8.2)	47 (6.8)	532 (16.6)	14 (5.1)	493 (18.8)	10.8 (0.27)
Minnesota, US	r	36 (6.9)	563 (7.2)	48 (6.5)	543 (9.3)	16 (4.3)	564 (14.9)	10.9 (0.30)
Alabama, US	r	36 (6.6)	501 (8.5)	46 (6.0)	476 (10.1)	18 (4.4)	465 (11.9)	10.7 (0.34)
Colorado, US		35 (6.9)	550 (9.1)	57 (6.6)	538 (8.7)	7 (2.8)	524 (13.1)	11.2 (0.30)
California, US	s	33 (5.1)	504 (8.9)	52 (5.0)	496 (7.3)	14 (3.8)	504 (19.1)	10.8 (0.18)
Quebec, Canada		33 (4.1)	529 (4.9)	57 (4.4)	519 (4.4)	10 (2.2)	500 (7.7)	10.7 (0.12)
Connecticut, US	r	33 (6.0)	574 (9.5)	48 (6.8)	524 (11.9)	20 (5.6)	486 (16.3)	10.7 (0.26)
Alberta, Canada		32 (3.6)	548 (4.5)	50 (3.9)	548 (3.3)	19 (3.1)	537 (3.5)	10.8 (0.15)
Abu Dhabi, UAE		29 (4.0)	463 (6.6)	52 (3.8)	456 (6.4)	19 (3.3)	467 (8.9)	10.6 (0.19)
Florida, US		x x	x x	x x	x x	x x	x x	x x



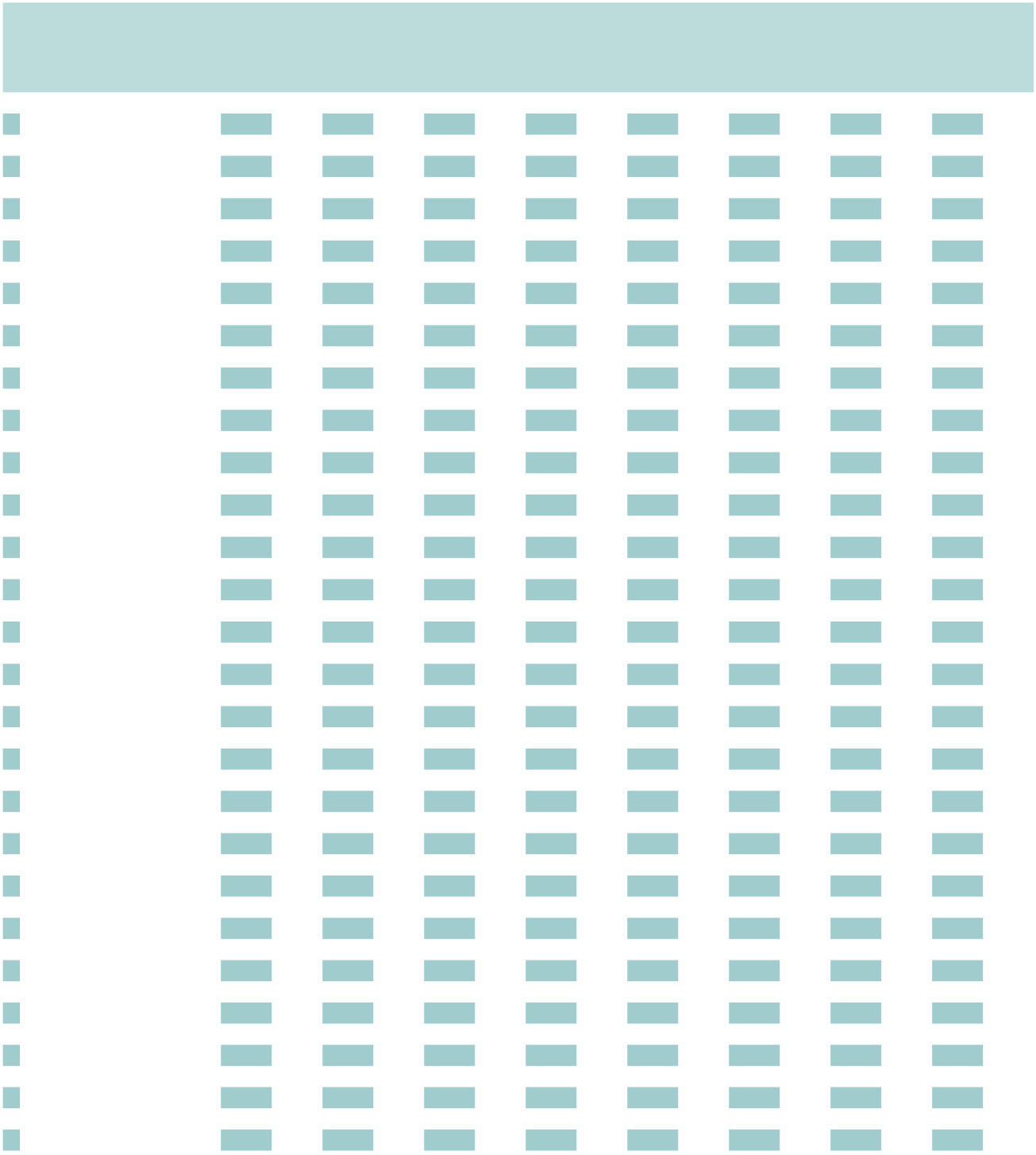
SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2011

Exhibit 5.13 shows principals' reports about the availability of computers for instruction for participants in the TIMSS fourth grade assessment. Internationally, 38 percent of the fourth grade students, on average, were in schools that had 1 computer for every 1–2 fourth grade students, 30 percent were in schools with 1 computer for every 3–5 fourth grade students, and 24 percent were in schools with 1 computer for 6 or more students. ere was considerable variation from countiy oi wbe. iy i

1) Yes
2) No

If Yes,

1) 250 or fewer
2) 251–500
3) 501–2,000
4) 2,001–5,000
5) 5,001–10,000
6) More than 10,000

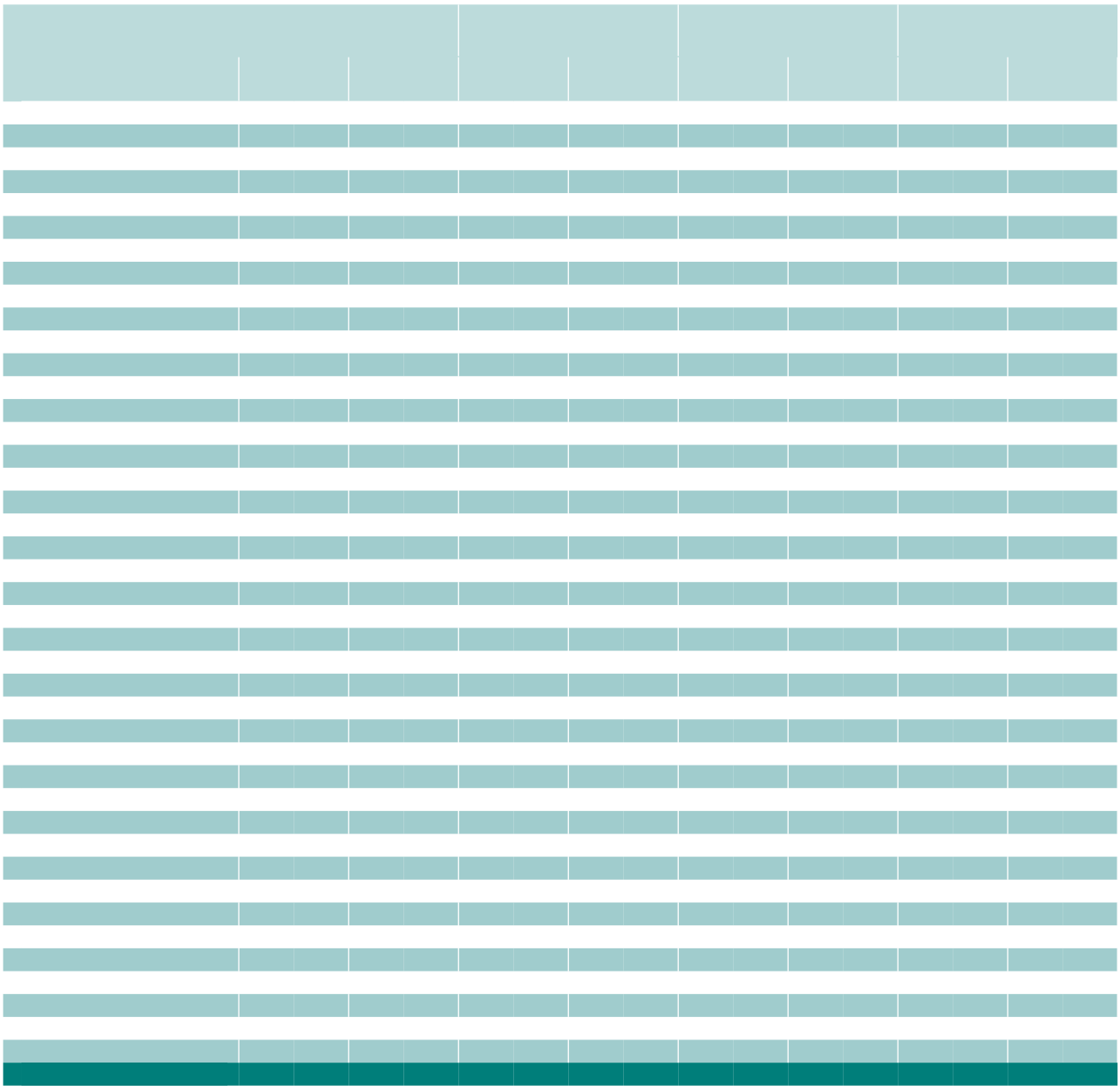


C	1 Computer for 1–2 Students		1 Computer for 3–5 Students					

The number of students per computer was calculated by dividing the number of students by the number of computers.

1)

2)



C	1 Computer for 1–2 Students		1 Computer for 3–5 Students		1 Computer for 6 or More Students		No Computers Available	
	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement
N G								

The number of students per computer was calculated by dividing the number of students by the number of computers.

1)

2)

Schools with Science Laboratories

Undertaking "hands-on" science investigations is an important component of science curricula in many countries. TIMSS 2011 collected information on the availability of science laboratories at the fourth and eighth grades,

Exhibit 5.16 presents results for principals' reports of the availability of science laboratories and of assistance for teachers when students are conducting science experiments for participants in the eighth grade assessment. Across the eighth grade countries, a much higher percentage of students attended schools with science laboratories (80%) than at the fourth grade. In 29 of the 42 countries, more than 80 percent of students attended schools that had a science laboratory, and in only two countries (Lithuania and Ghana) was the percentage of students in schools with a laboratory less than 35 percent (13% and 2%, respectively). On average across countries, student science achievement in schools with laboratories was higher (485) than that of students at schools with no laboratories (451); this achievement di erence also occurred within many countries. Across the eighth grade countries, 57 percent of students attended schools in which teachers had assistance when students were conducting science experiments, but among countries this percentage ranged from 9 percent (Chile and Italy) to 99 percent (Hong Kong SAR). On average across countries, the eighth grade students attending schools in which teachers had assistance had higher achievement (480) than students attending schools in which teachers did not have assistance (472).

Reported by Principals

C	Yes		No	
	Percent of Students	Average Achievement	Percent of Students	Average Achievement
Korea, Rep. of	100 (0.0)	587 (2.0)	0 (0.0)	~ ~
Kuwait	100 (0.0)	348 (4.7)	0 (0.0)	~ ~
Singapore	100 (0.0)	583 (3.4)	0 (0.0)	~ ~
Japan	99 (0.6)	559 (1.9)	1 (0.6)	~ ~
Chinese Taipei	89 (2.3)	551 (2.4)	11 (2.3)	562 (4.6)
Qatar	88 (2.1)	388 (4.8)	12 (2.1)	441 (13.1)
Bahrain	87 (3.0)	449 (3.9)	13 (3.0)	450 (10.6)
United Arab Emirates	84 (1.3)	417 (2.6)	16 (1.3)	469 (7.7)
Saudi Arabia	68 (4.0)	436 (7.1)	32 (4.0)	415 (10.1)
Turkey	66 (2.6)	478 (4.3)	34 (2.6)	432 (9.5)
Thailand	64 (3.8)	486 (6.1)	36 (3.8)	446 (10.1)
Armenia	60 (4.5)	415 (5.3)	40 (4.5)	418 (6.2)
Denmark r	56 (3.6)	527 (3.9)	44 (3.6)	534 (4.3)
Iran, Islamic Rep. of	48 (3.7)	477 (6.1)	52 (3.7)	430 (5.3)
Romania	45 (4.1)	520 (9.0)	55 (4.1)	492 (8.5)
Chile	45 (3.5)	502 (4.3)	55 (3.5)	467 (4.3)
Italy	43 (3.4)	517 (4.5)	57 (3.4)	528 (3.9)
Kazakhstan	43 (4.4)	481 (8.7)	57 (4.4)	505 (6.6)
Hong Kong SAR	37 (4.0)	540 (5.6)	63 (4.0)	532 (5.8)
Czech Republic	36 (3.6)	537 (4.4)	64 (3.6)	536 (2.9)
Spain	34 (3.4)	510 (4.3)	66 (3.4)	504 (3.9)
Georgia	34 (3.9)	452 (6.6)	66 (3.9)	456 (5.0)
Oman	26 (2.1)	361 (6.3)	74 (2.1)	375 (5.8)
United States	25 (2.7)	549 (5.4)	75 (2.7)	545 (2.5)
Yemen	25 (3.6)	242 (11.8)	75 (3.6)	199 (8.4)
Sweden	24 (3.7)	527 (6.1)	76 (3.7)	534 (3.4)
Russian Federation	23 (2.9)	547 (7.2)	77 (2.9)	554 (3.4)
Slovak Republic	21 (3.1)	532 (6.9)	79 (3.1)	531 (4.3)
Slovenia	19 (2.7)	522 (4.7)	81 (2.7)	520 (3.2)
Portugal	18 (4.7)	519 (15.1)	82 (4.7)	522 (3.9)
Malta	18 (0.1)	477 (4.0)	82 (0.1)	440 (2.0)
Azerbaijan	17 (3.2)	443 (11.0)	83 (3.2)	437 (6.4)
Norway	17 (3.4)	496 (5.6)	83 (3.4)	493 (2.7)
Finland	16 (3.4)	566 (5.1)	84 (3.4)	571 (2.8)
Australia	13 (2.4)	535 (7.4)	87 (2.4)	514 (2.9)
Serbia	13 (2.9)	509 (11.1)	87 (2.9)	516 (3.4)
Hungary	13 (2.8)	551 (7.7)	87 (2.8)	533 (4.1)
Germany	13 (2.4)	519 (9.6)	87 (2.4)	531 (2.8)
Croatia	12 (2.9)	516 (5.7)	88 (2.9)	516 (2.4)
England	9 (2.1)	559 (10.6)	91 (2.1)	524 (3.5)
Poland	9 (2.4)	503 (11.2)	91 (2.4)	506 (2.7)
Austria	8 (2.5)	534 (9.6)	92 (2.5)	531 (2.9)
New Zealand	5 (1.9)	530 (13.9)	95 (1.9)	496 (2.6)
Tunisia	4 (1.4)	335 (14.9)	96 (1.4)	346 (5.3)
Morocco	3 (0.9)	324 (24.3)	97 (0.9)	261 (5.1)
Netherlands r	3 (1.8)	535 (3.6)	97 (1.8)	532 (2.5)
Belgium (Flemish)	1 (0.0)	~ ~	99 (0.7)	510 (2.0)
Ireland	0 (0.0)	~ ~	100 (0.0)	517 (3.4)
Lithuania	0 (0.0)	~ ~	100 (0.0)	515 (2.5)
Northern Ireland	0 (0.0)	~ ~	100 (0.0)	517 (3.0)
International Avg.	36 (0.4)	489 (1.2)	64 (0.4)	483 (0.8)

( ) Standard errors appear in parentheses. Because of rounding some results may appear inconsistent.
A tilde (~) indicates insu□cient data to report achievement.
An "r" indicates data are available for at least 70% but less than 85% of the students.

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2011

Reported by Principals

C	Schools Have a Science Laboratory				Teachers Have Assistance Available When Students are Conducting Experiments			
	Yes		No		Yes		No	
	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement
Bahrain	100 (0.0)	452 (2.0)	0 (0.0)	~ ~	93 (0.1)	452 (2.1)	7 (0.1)	465 (4.8)
England	100 (0.0)	534 (5.2)	0 (0.0)	~ ~	75 (4.6)	532 (5.9)	25 (4.6)	546 (12.3)
Japan	100 (0.0)	558 (2.4)	0 (0.0)	~ ~	34 (4.1)	559 (4.1)	66 (4.1)	557 (3.3)
Korea, Rep. of	100 (0.0)	560 (2.0)	0 (0.0)	~ ~	63 (3.2)	562 (2.7)	37 (3.2)	557 (3.2)
Singapore	100 (0.0)	590 (4.4)	0 (0.0)	~ ~	89 (0.0)	590 (4.7)	11 (0.0)	591 (13.8)
New Zealand	100 (0.0)	514 (4.7)	0 (0.0)	~ ~	37 (4.8)	517 (7.4)	63 (4.8)	512 (6.6)
Australia	100 (0.1)	521 (5.0)	0 (0.1)	~ ~	66 (3.6)	525 (6.4)	34 (3.6)	514 (7.1)
Hong Kong SAR	99 (0.8)	533 (3.7)	1 (0.0)	~ ~	99 (1.0)	534 (3.7)	1 (1.0)	~ ~
Sweden	r 99 (0.8)	510 (3.0)	1 (0.8)	~ ~	r 11 (3.1)	505 (7.8)	89 (3.1)	511 (3.3)
Malaysia	99 (0.8)	426 (6.4)	1 (0.8)	~ ~	93 (2.0)	424 (6.5)	7 (2.0)	457 (21.5)
Qatar	99 (0.0)	416 (3.5)	1 (0.0)	~ ~	93 (0.4)	416 (3.7)	7 (0.4)	441 (11.1)
Chinese Taipei	99 (1.0)	564 (2.3)	1 (1.0)	~ ~	88 (2.7)	567 (2.5)	12 (2.7)	540 (10.2)
Oman	98 (1.0)	421 (3.2)	2 (1.0)	~ ~	93 (1.8)	423 (3.3)	7 (1.8)	377 (13.2)
United Arab Emirates	96 (1.2)	462 (2.3)	4 (1.2)	508 (16.5)	95 (0.8)	461 (2.3)	5 (0.8)	491 (8.2)
Thailand	94 (1.5)	451 (4.1)	6 (1.5)	455 (25.8)	23 (3.1)	444 (9.1)	77 (3.1)	453 (4.8)
Finland	91 (2.2)	552 (2.5)	9 (2.2)	555 (8.2)	10 (2.9)	550 (5.2)	90 (2.9)	552 (2.6)
Jordan	91 (2.5)	453 (4.4)	9 (2.5)	409 (16.7)	94 (1.4)	449 (4.2)	6 (1.4)	448 (13.4)
Norway	90 (2.9)	496 (3.0)	10 (2.9)	484 (6.4)	24 (4.1)	486 (5.6)	76 (4.1)	497 (3.0)
Ukraine	89 (2.8)	503 (3.5)	11 (2.8)	490 (8.5)	74 (3.5)	505 (3.4)	26 (3.5)	490 (8.4)
Saudi Arabia	89 (2.8)	438 (4.0)	11 (2.8)	425 (12.4)	93 (2.1)	438 (4.1)	7 (2.1)	415 (15.0)
Russian Federation	86 (2.7)	545 (3.9)	14 (2.7)	527 (8.6)	66 (3.2)	544 (3.7)	34 (3.2)	540 (6.7)
Israel