Annex A

TECHNICAL BACKGROUND

**All tables in Annex A are available on line
at** *http://dx.doi.org/10.1787/9789264175006-en*

Annex A1: Construction of reading scales and indices from the student, school and parent context questionnaires

Annex A2: Technical notes on preliminary multilevel regression analysis for performance

Annex A3: Standard errors, significance tests and subgroup comparisons

ANNEX A1
CONSTRUCTION OF READING SCALES AND INDICES FROM THE STUDENT, SCHOOL AND PARENT CONTEXT QUESTIONNAIRES

How the PISA 2009 reading assessments were designed, analysed and scaled

The development of the PISA 2009 reading tasks was co-ordinated by an international consortium of educational research institutions contracted by the OECD, under the guidance of a group of reading experts from participating countries. Participating countries contributed stimulus material and questions, which were reviewed, tried out and refined iteratively over the three years leading up to the administration of the assessment in 2009. The development process involved provisions for several rounds of commentary from participating countries, as well as small-scale piloting and a formal field trial in which samples of 15-year-olds from all participating countries took part. The reading expert group recommended the final selection of tasks, which included material submitted by 21 of the participating countries. The selection was made with regard to both their technical quality, assessed on the basis of their performance in the field trial, and their cultural appropriateness and interest level for 15-year-olds, as judged by the participating countries. Another essential criterion for selecting the set of material as a whole was its fit to the framework described in *Volume 1, What Students Know and Can Do* (OECD, 2010), to maintain the balance across various categories of text, aspect and situation. Finally, it was carefully ensured that the set of questions covered a range of difficulty, allowing good measurement and description of the reading literacy of all 15-year-old students, from the least proficient to the highly able.

More than 130 print reading questions were used in PISA 2009, but each student in the sample only saw a fraction of the total pool because different sets of questions were given to different students. The reading questions selected for inclusion in PISA 2009 were organised into half-hour clusters. These, along with clusters of mathematics and science questions, were assembled into booklets containing four clusters each. Each participating student was then given a two-hour assessment. As reading was the focus of the PISA 2009 assessment, every booklet included at least one cluster of reading material. The clusters were rotated so that each cluster appeared in each of the four possible positions in the booklets, and each pair of clusters appeared in at least one of the 13 booklets that were used.

This design, similar to those used in previous PISA assessments, makes it possible to construct a single scale of reading proficiency, in which each question is associated with a particular point on the scale that indicates its difficulty, whereby each student's performance is associated with a particular point on the same scale that indicates his or her estimated proficiency. A description of the modelling technique used to construct this scale can be found in the *PISA 2009 Technical Report* (OECD, 2012).

The relative difficulty of tasks in a test is estimated by considering the proportion of test takers who answer each question correctly. The relative proficiency of students taking a particular test can be estimated by considering the proportion of test questions they answer correctly. A single continuous scale shows the relationship between the difficulty of questions and the proficiency of students. By constructing a scale that shows the difficulty of each question, it is possible to locate the level of reading literacy that the question represents. By showing the proficiency of each student on the same scale, it is possible to describe the level of reading literacy that the student possesses.

The location of student proficiency on this scale is set in relation to the particular group of questions used in the assessment. However, just as the sample of students taking PISA in 2009 is drawn to represent all the 15-year-olds in the participating countries, so the individual questions used in the assessment are designed to represent the definition of reading literacy adequately. Estimates of student proficiency reflect the kinds of tasks they would be expected to perform successfully. This means that students are likely to be able to complete questions successfully at or below the difficulty level associated with their own position on the scale (but they may not always do so). Conversely, they are unlikely to be able to successfully complete questions above the difficulty level associated with their position on the scale (but they may sometimes do so).

The further a student's proficiency is located above a given question, the more likely he or she is to successfully complete the question (and other questions of similar difficulty); the further the student's proficiency is located below a given question, the lower the probability that the student will be able to successfully complete the question, and other questions of similar difficulty.

How reading proficiency levels are defined in PISA 2009

PISA 2009 provides an overall reading literacy scale for the reading texts, drawing on all the questions in the reading assessment, as well as scales for three aspects and two text formats. The metric for the overall reading scale is based on a mean for OECD countries set at 500 in PISA 2000, with a standard deviation of 100. To help interpret what students' scores mean in substantive terms, the scale is divided into levels, based on a set of statistical principles, and then descriptions are generated, based on the tasks that are located within each level, to describe the kinds of skills and knowledge needed to successfully complete those tasks.

For PISA 2009, the range of difficulty of tasks allows for the description of seven levels of reading proficiency: Level 1b is the lowest described level, then Level 1a, Level 2, Level 3 and so on up to Level 6.

Students with a proficiency within the range of Level 1b are likely to be able to successfully complete Level 1b tasks (and others like them), but are unlikely to be able to complete tasks at higher levels. Level 6 reflects tasks that present the greatest challenge in terms of reading skills and knowledge. Students with scores in this range are likely to be able to complete reading tasks located at that level successfully, as well as all the other reading tasks in PISA.

PISA applies a standard methodology for constructing proficiency scales. Based on a student's performance on the tasks in the test, his or her score is generated and located in a specific part of the scale, thus allowing the score to be associated with a defined proficiency level. The level at which the student's score is located is the highest level for which he or she would be expected to answer correctly, most of a random selection of questions within the same level. Thus, for example, in an assessment composed of tasks spread uniformly across Level 3, students with a score located within Level 3 would be expected to complete at least 50% of the tasks successfully. Because a level covers a range of difficulty and proficiency, success rates across the band vary. Students near the bottom of the level would be likely to succeed on just over 50% of the tasks spread uniformly across the level, while students at the top of the level would be likely to succeed on well over 70% of the same tasks.

Figure I.2.12 in Volume I (OECD, 2010) provides details of the nature of reading skills, knowledge and understanding required at each level of the reading scale.

Explanation of indices

This section explains the indices derived from the student and school context questionnaires used in PISA 2009.

Several PISA measures reflect indices that summarise responses from students, their parents or school representatives (typically principals) to a series of related questions. The questions were selected from a larger pool of questions on the basis of theoretical considerations and previous research. Structural equation modelling was used to confirm the theoretically expected behaviour of the indices and to validate their comparability across countries. For this purpose, a model was estimated separately for each country and collectively for all OECD countries.

For a detailed description of other PISA indices and details on the methods, see *PISA 2009 Technical Report* (OECD, 2012).

There are two types of indices: simple indices and scale indices.

Simple indices are the variables that are constructed through the arithmetic transformation or recoding of one or more items, in exactly the same way across assessments. Here, item responses are used to calculate meaningful variables, such as the recoding of the four-digit ISCO-88 codes into "Highest parents' socio-economic index (HISEI)" or, teacher-student ratio based on information from the school questionnaire.

Scale indices are the variables constructed through the scaling of multiple items. Unless otherwise indicated, the index was scaled using a weighted maximum likelihood estimate (WLE), using a one-parameter item response model (a partial credit model was used in the case of items with more than two categories).

The scaling was done in three stages:

- The item parameters were estimated from equal-sized subsamples of students from each OECD country.
- The estimates were computed for all students and all schools by anchoring the item parameters obtained in the preceding step.
- The indices were then standardised so that the mean of the index value for the OECD student population was zero and the standard deviation was one (countries being given equal weight in the standardisation process).

Sequential codes were assigned to the different response categories of the questions in the sequence in which the latter appeared in the student, school or parent questionnaires. Where indicated in this section, these codes were inverted for the purpose of constructing indices or scales. It is important to note that negative values for an index do not necessarily imply that students responded negatively to the underlying questions. A negative value merely indicates that the respondents answered less positively than all respondents did on average across OECD countries. Likewise, a positive value on an index indicates that the respondents answered more favourably, or more positively, than respondents did, on average, in OECD countries. Terms enclosed in brackets < > in the following descriptions were replaced in the national versions of the student, school and parent questionnaires by the appropriate national equivalent. For example, the term <qualification at ISCED level 5A> was translated in the United States into "Bachelor's degree, post-graduate certificate program, Master's degree program or first professional degree program". Similarly the term <classes in the language of assessment> in Luxembourg was translated into "German classes" or "French classes" depending on whether students received the German or French version of the assessment instruments.

In addition to simple and scaled indices described in this annex, there are a number of variables from the questionnaires that correspond to single items not used to construct indices. These non-recoded variables have prefix of "ST" for the questionnaire items in the student questionnaire, "SC" for the items in the school questionnaire, and "PA" for the items in the parent questionnaire. All the context questionnaires as well as the PISA international database, including all variables, are available through *www.pisa.oecd.org*.

Student-level simple indices

Study programme

In PISA 2009, study programmes available to 15-year-old students in each country were collected both through the student tracking form and the student questionnaire (ST02). All study programmes were classified using ISCED (OECD, 1999). In the PISA international database, all national programmes are indicated in a variable (PROGN) where the first three digits are the ISO code for a country, the fourth digit the sub-national category and the last two digits the nationally specific programme code.

The following internationally comparable indices were derived from the data on study programmes:

- Programme level (ISCEDL) indicates whether students are (1) primary education level (ISCED 1); (2) lower-secondary education level; or (3) upper secondary education level.

- Programme designation (ISCEDD) indicates the designation of the study programme: (1) = "A" (general programmes designed to give access to the next programme level); (2) = "B" (programmes designed to give access to vocational studies at the next programme level); (3) = "C" (programmes designed to give direct access to the labour market); or (4) = "M" (modular programmes that combine any or all of these characteristics).

- Programme orientation (ISCEDO) indicates whether the programme's curricular content is (1) general; (2) pre-vocational; (3) vocational; or (4) modular programmes that combine any or all of these characteristics.

Occupational status of parents

Occupational data for both a student's father and a student's mother were obtained by asking open-ended questions in the student questionnaire (ST9a, ST9b, ST12, ST13a, ST13b and ST16). The responses were coded to four-digit ISCO codes (ILO, 1990) and then mapped to Ganzeboom et al.'s SEI index (1992). Higher scores of SEI indicate higher levels of occupational status. The following three indices are obtained:

- Mother's occupational status (BMMJ).
- Father's occupational status (BFMJ).
- The highest occupational level of parents (HISEI) corresponds to the higher SEI score of either parent or to the only available parent's SEI score.

Educational level of parents

The educational level of parents is classified using ISCED (OECD, 1999) based on students' responses in the student questionnaire (ST10, ST11, ST14 and ST15). Please note that the question format for school education in PISA 2009 differs from the one used in PISA 2000, 2003 and 2006 but the method used to compute parental education is the same.

As in PISA 2000, 2003 and 2006, indices were constructed by selecting the highest level for each parent and then assigning them to the following categories: (0) None, (1) ISCED 1 (primary education), (2) ISCED 2 (lower secondary), (3) ISCED Level 3B or 3C (vocational/pre-vocational upper secondary), (4) ISCED 3A (upper secondary) and/or ISCED 4 (non-tertiary post-secondary), (5) ISCED 5B (vocational tertiary), (6) ISCED 5A, 6 (theoretically oriented tertiary and post-graduate). The following three indices with these categories are developed:

- Mother's educational level (MISCED).
- Father's educational level (FISCED).
- Highest educational level of parents (HISCED) corresponds to the higher ISCED level of either parent.

Highest educational level of parents was also converted into the number of years of schooling (PARED). For the conversion of level of education into years of schooling, see Table A1.1.

Immigration and language background

Information on the country of birth of students and their parents (ST17) is collected in a similar manner as in PISA 2000, PISA 2003 and PISA 2006 by using nationally specific ISO coded variables. The ISO codes of the country of birth for students and their parents are available in the PISA international database (COBN_S, COBN_M, and COBN_F).

The index on immigrant background (IMMIG) has the following categories: (1) native students (those students born in the country of assessment, or those with at least one parent born in that country; students who were born abroad with at least one parent born in the country of assessment are also classified as 'native' students), (2) second-generation students (those born in the country of assessment but whose parents were born in another country) and (3) first-generation students (those born outside the country of assessment and whose parents were also born in another country). Students with missing responses for either the student or for both parents, or for all three questions have been given missing values for this variable.

Table A1.1 Levels of parental education converted into years of schooling

	Did not go to school	Completed ISCED Level 1 (primary education)	Completed ISCED Level 2 (lower secondary education)	Completed ISCED Levels 3B or 3C (upper secondary education providing direct access to the labor market or to ISCED 5B programmes)	Completed ISCED Level 3A (upper secondary education providing access to ISCED 5A and 5B programmes) and/or ISCED Level 4 (non-tertiary post-secondary)	Completed ISCED Level 5A (university level tertiary education) or ISCED Level 6 (advanced research programmes)	Completed ISCED Level 5B (non-university tertiary education)
Australia	0.0	6.0	10.0	11.0	12.0	15.0	14.0
Austria	0.0	4.0	9.0	12.0	12.5	17.0	15.0
Belgium	0.0	6.0	9.0	12.0	12.0	17.0	14.5
Canada	0.0	6.0	9.0	12.0	12.0	17.0	15.0
Chile	0.0	6.0	8.0	12.0	12.0	17.0	16.0
Czech Republic	0.0	5.0	9.0	11.0	13.0	16.0	16.0
Denmark	0.0	6.0	9.0	12.0	12.0	17.0	15.0
Finland	0.0	6.0	9.0	12.0	12.0	16.5	14.5
France	0.0	5.0	9.0	12.0	12.0	15.0	14.0
Germany	0.0	4.0	10	13.0	13.0	18.0	15.0
Greece	0.0	6.0	9.0	11.5	12.0	17.0	15.0
Hungary	0.0	4.0	8.0	10.5	12.0	16.5	13.5
Iceland	0.0	7.0	10.0	13.0	14.0	18.0	16.0
Ireland	0.0	6.0	9.0	12.0	12.0	16.0	14.0
Italy	0.0	5.0	8.0	12.0	13.0	17.0	16.0
Japan	0.0	6.0	9.0	12.0	12.0	16.0	14.0
Korea	0.0	6.0	9.0	12.0	12.0	16.0	14.0
Luxembourg	0.0	6.0	9.0	12.0	13.0	17.0	16.0
Mexico	0.0	6.0	9.0	12.0	12.0	16.0	14.0
Netherlands	0.0	6.0	10.0	a	12.0	16.0	a
New Zealand	0.0	5.5	10.0	11.0	12.0	15.0	14.0
Norway	0.0	6.0	9.0	12.0	12.0	16.0	14.0
Poland	0.0	a	8.0	11.0	12.0	16.0	15.0
Portugal	0.0	6.0	9.0	12.0	12.0	17.0	15.0
Scotland	0.0	7.0	11.0	13.0	13.0	16.0	16.0
Slovak Republic	0.0	4.5	8.5	12.0	12.0	17.5	13.5
Spain	0.0	5.0	8.0	10.0	12.0	16.5	13.0
Sweden	0.0	6.0	9.0	11.5	12.0	15.5	14.0
Switzerland	0.0	6.0	9.0	12.5	12.5	17.5	14.5
Turkey	0.0	5.0	8.0	11.0	11.0	15.0	13.0
United Kingdom	0.0	6.0	9.0	12.0	13.0	16.0	15.0
United States	0.0	6.0	9.0	a	12.0	16.0	14.0
Albania	0.0	6.0	9.0	12.0	12.0	16.0	16.0
Argentina	0.0	6.0	10.0	12.0	12.0	17.0	14.5
Azerbaijan	0.0	4.0	9.0	11.0	11.0	17.0	14.0
Brazil	0.0	4.0	8.0	11.0	11.0	16.0	14.5
Bulgaria	0.0	4.0	8.0	12.0	12.0	17.5	15.0
Colombia	0.0	5.0	9.0	11.0	11.0	15.5	14.0
Croatia	0.0	4.0	8.0	11.0	12.0	17.0	15.0
Dubai	0.0	5.0	9.0	12.0	12.0	16.0	15.0
Estonia	0.0	4.0	9.0	12.0	12.0	16.0	15.0
Hong Kong- China	0.0	6.0	9.0	11.0	13.0	16.0	14.0
Indonesia	0.0	6.0	9.0	12.0	12.0	15.0	14.0
Israel	0.0	6.0	9.0	12.0	12.0	15.0	15.0
Jordan	0.0	6.0	10.0	12.0	12.0	16.0	14.5
Kazakhstan	0.0	4.0	9.0	11.5	12.5	15.0	14.0
Kyrgyzstan	0.0	4.0	8.0	11.0	10.0	15.0	13.0
Latvia	0.0	3.0	8.0	11.0	11.0	16.0	16.0
Liechtenstein	0.0	5.0	9.0	11.0	13.0	17.0	14.0
Lithuania	0.0	3.0	8.0	11.0	11.0	16.0	15.0
Macao-China	0.0	6.0	9.0	11.0	12.0	16.0	15.0
Montenegro	0.0	4.0	8.0	11.0	12.0	16.0	15.0
Panama	0.0	6.0	9.0	12.0	12.0	16.0	a
Peru	0.0	6.0	9.0	11.0	11.0	17.0	14.0
Qatar	0.0	6.0	9.0	12.0	12.0	16.0	15.0
Romania	0.0	4.0	8.0	11.5	12.5	16.0	14.0
Russian Federation	0.0	4.0	9.0	11.5	12.0	15.0	a
Serbia	0.0	4.0	8.0	11.0	12.0	17.0	14.5
Shanghai-China	0.0	6.0	9.0	12.0	12.0	16.0	15.0
Singapore	0.0	6.0	8.0	10.5	10.5	12.5	12.5
Slovenia	0.0	4.0	8.0	11.0	12.0	16.0	15.0
Chinese Taipei	0.0	6.0	9.0	12.0	12.0	16.0	14.0
Thailand	0.0	6.0	9.0	12.0	12.0	16.0	14.0
Trinidad & Tobago	0.0	5.0	9.0	12.0	12.0	16.0	15.0
Tunisia	0.0	6.0	9.0	12.0	13.0	17.0	16.0
Uruguay	0.0	6.0	9.0	12.0	12.0	17.0	15.0

Source: OECD (2010), *PISA 2009 Results: Learning to Learn – Student Engagement, Strategies and Practices* (Volume III).

Students indicate the language they usually speak at home. The data are captured in nationally-specific language codes, which were recoded into variable ST19Q01 with the following two values: (1) language at home is the same as the language of assessment, and (2) language at home is a different language than the language of assessment.

Student-level scale indices

Family wealth

The *index of family wealth* (WEALTH) is based on the students' responses on whether they had the following at home: a room of their own, a link to the Internet, a dishwasher (treated as a country-specific item), a DVD player, and three other country-specific items (some items in ST20); and their responses on the number of cellular phones, televisions, computers, cars and the rooms with a bath or shower (ST21).

Home educational resources

The *index of home educational resources* (HEDRES) is based on the items measuring the existence of educational resources at home including a desk and a quiet place to study, a computer that students can use for schoolwork, educational software, books to help with students' school work, technical reference books and a dictionary (some items in ST20).

Cultural possessions

The *index of cultural possessions* (CULTPOSS) is based on the students' responses to whether they had the following at home: classic literature, books of poetry and works of art (some items in ST20).

Economic, social and cultural status

The *PISA index of economic, social and cultural status* (ESCS) was derived from the following three indices: highest occupational status of parents (HISEI), highest educational level of parents in years of education according to ISCED (PARED), and home possessions (HOMEPOS). The *index of home possessions* (HOMEPOS) comprises all items on the indices of WEALTH, CULTPOSS and HEDRES, as well as books in the home recoded into a four-level categorical variable (0-10 books, 11-25 or 26-100 books, 101-200 or 201-500 books, more than 500 books).

The *PISA index of economic, social and cultural status* (ESCS) was derived from a principal component analysis of standardised variables (each variable has an OECD mean of zero and a standard deviation of one), taking the factor scores for the first principal component as measures of the index of economic, social and cultural status.

Principal component analysis was also performed for each participating country to determine to what extent the components of the index operate in similar ways across countries. The analysis revealed that patterns of factor loading were very similar across countries, with all three components contributing to a similar extent to the index. For the occupational component, the average factor loading was 0.80, ranging from 0.66 to 0.87 across countries. For the educational component, the average factor loading was 0.79, ranging from 0.69 to 0.87 across countries. For the home possession component, the average factor loading was 0.73, ranging from 0.60 to 0.84 across countries. The reliability of the index ranged from 0.41 to 0.81. These results support the cross-national validity of the *PISA index of economic, social and cultural status*.

The imputation of components for students missing data on one component was done on the basis of a regression on the other two variables, with an additional random error component. The final values on the *PISA index of economic, social and cultural status* (ESCS) have an OECD mean of 0 and a standard deviation of one.

Disciplinary climate

The *index of disciplinary climate* (DISCLIMA) was derived from students' reports on how often the followings happened in their lessons of the language of instruction (ST36): *i)* students don't listen to what the teacher says; *ii)* there is noise and disorder; *iii)* the teacher has to wait a long time for the students to <quieten down>; *iv)* students cannot work well; and *v)* students don't start working for a long time after the lesson begins. As all items are inverted for scaling, higher values on this index indicate a better disciplinary climate.

School-level simple indices

School size

The *index of school size* (SCHSIZE) was derived by summing up the number of girls and boys at a school (SC06).

School-level scale indices

School responsibility for resource allocation

School principals were asked to report whether "principals", "teachers", "school governing board", "regional or local education authority" or "national education authority" has a considerable responsibility for the following tasks (SC24): *i)* selecting teachers for hire;

ii) dismissing teachers; *iii)* establishing teachers' starting salaries; *iv)* determining teachers' salaries increases; *v)* formulating the school budget; and *vi)* deciding on budget allocations within the school. *The index of school responsibility for resource allocation* (RESPRES) was derived from these six items. The ratio of the number of responsibility that "principals" and/or "teachers" have for these six items to the number of responsibility that "regional or local education authority" and/or "national education authority" have for these six items was computed. Positive values on this index indicate relatively more responsibility for schools than local, regional or national education authority. This index has an OECD mean of 0 and a standard deviation of 1.

School responsibility for curriculum and assessment

School principals were asked to report whether "principals", "teachers", "school governing board", "regional or local education authority", or "national education authority" has a considerable responsibility for the following tasks (SC24): *i)* establishing student assessment policies; *ii)* choosing which textbooks are used; *iii)* determining course content; and *iv)* deciding which courses are offered. The *index of school responsibility for curriculum and assessment* (RESPCURR) was derived from these four items. The ratio of the number of responsibility that "principals" and/or "teachers" have for these four items to the number of responsibility that "regional or local education authority" and/or "national education authority" have for these four items was computed. Positive values on this index indicate relatively more responsibility for schools than local, regional or national education authority. This index has an OECD mean of 0 and a standard deviation of 1.

Teacher shortage

The *index of teacher shortage* (TCSHORT) was derived from four items measuring school principals' perceptions of potential factors hindering instruction at their school (SC11). These factors are a lack of: *i)* qualified science teachers; *ii)* a lack of qualified mathematics teachers; *iii)* qualified <test language> teachers; and *iv)* qualified teachers of other subjects. Higher values on this index indicate school principals' reports of higher teacher shortage at a school.

School's educational resources

The *index on the school's educational resources* (SCMATEDU) was derived from seven items measuring school principals' perceptions of potential factors hindering instruction at their school (SC11). These factors are: *i)* shortage or inadequacy of science laboratory equipment; *ii)* shortage or inadequacy of instructional materials; *iii)* shortage or inadequacy of computers for instruction; *iv)* lack or inadequacy of Internet connectivity; *v)* shortage or inadequacy of computer software for instruction; *vi)* shortage or inadequacy of library materials; and *vii)* shortage or inadequacy of audio-visual resources. As all items were inverted for scaling, higher values on this index indicate better quality of educational resources.

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ANNEX A2
TECHNICAL NOTES ON PRELIMINARY MULTILEVEL REGRESSION ANALYSIS FOR PERFORMANCE

The relationship between public and private involvement in schools and countries' performance in reading is examined based on a multilevel analysis. A three-level regression analysis is conducted using HLM 6.08, with students serving as level 1, schools as level 2 and countries as level 3. The model coefficients and statistics are estimated using Maximum Likelihood method procedure. Normalised student final weights are used, so that the sum of the weights was equal to the number of students in the dataset, and each country contributed equally to the analysis. Five plausible values for performance in reading (PV1READ to PV5READ) are used.

This preliminary analysis does not show clear patterns in the relationship between public management and countries' performance in reading, while the level of public funding seems to be related negatively to performance only after accounting for background and institutional characteristics of schools (see Table A2.2). However, before developing any policy recommendations, further study is required to better understand the inter-relationship between public and private involvement in schools, background and institutional variables and countries' performance in reading. The reminder of this annex provides details of how the preliminary analysis is conducted.

Data

The data file used for the multilevel analysis includes 287 566 students from 10 591 schools in 32 OECD countries. Austria and France are excluded as data for public funding or management were not available. All indicators used at the student and school levels were from PISA 2009 student and school questionnaires. Country-level indicators are either from *Education at a Glance 2010: OECD Indicators* (OECD, 2010a) or were extracted from the PISA system-level data collection 2010. All of these country-level indicators are presented in *PISA 2009 Results, What Makes a School Successful? Policies, Practices and Resources* (Volume IV) (OECD, 2010b).

Selecting and recording variables

Two country-level variables – public funding and public management – are used to examine the relationships between these variables and student performance. These variables were collected at the school level through the PISA 2009 School Questionnaire, but were aggregated at the country level for this analysis.

Demographic and socio-economic background variables as well as institutional variables are also selected based on previous studies (Woessmann, 2006; Woessmann, 2009; OECD, 2010b). Five institutional variables at the country level are those shown to be related to performance, even after accounting for GDP per capita (OECD, 2010b). These variables are included in the net models – i.e. models accounting for background variables – in order to examine the net effects of public management and funding. The variables used in the models are:

- Student level
  - *PISA index of economic, social and cultural status* (ESCS);
  - gender;
  - language spoken at home;
  - immigrant status;
  - dummy variables for grade levels;
  - age; and
  - learning time in test language.

- School level
  - school average *PISA index of economic, social and cultural status* (ESCS);
  - school size and its squared value;
  - school location;
  - standardised test;
  - school autonomy for curriculum and assessment;
  - school autonomy for resource allocation;
  - availability of computers;
  - school's educational resources; and
  - proportion of qualified teachers.

- Country level
  - GDP per capita;
  - percentage of students who repeated one or more grades;
  - percentage of students in schools that group students by ability in all subjects;
  - percentage of students in schools that transfer students to other schools due to low achievement, behavioural problems or special learning needs;
  - average index of school responsibility for curriculum and assessment; and
  - teachers' salaries to GDP per capita (weighted average of upper and lower secondary school teachers).

The descriptive statistics for all variables are listed in Table A2.1. The variables with "M" in the first are missing dummies, which is explained in detail in the following section.

[Part 1/1]

Table A2.1 Descriptive statistics of explanatory and background variables

Variable description	Variable name	Mean	S.D.	Min.	Max.	Missing
SYSTEM LEVEL						
Percentage of students who attend publicly managed school (1 unit = 10 percentage-point increase)	YPUB10	8.19	2.05	3.05	9.92	no
Percentage of total funding for school for a typical school year that comes from government (1 unit = 10 percentage-point increase)	GFUND10	8.55	1.48	4.39	9.98	no
GDP per capita (1 000 USD converted using PPPs)	GDP	32.07	13.28	13.36	82.46	no
Teachers' salaries to GDP per capita (weighted average of upper and lower secondary school teachers) (ratio - 1)	ZSALARY	0.62	0.38	0.16	1.78	2 countries
Average index of school responsibility for curriculum and assessment (1 unit = one standard deviation across OECD countries)	YRESPC	-0.05	0.61	-1.25	1.06	no
Percentage of students in schools that group students by ability in all subjects (1 unit = 100 percentage-point increase)	YABG	0.13	0.12	0.00	0.49	no
Percentage of students in schools that transfer students to other schools due to low achievement, behavioural problems or special learning needs (1 unit = 100 percentage-point increase)	YTRANS	0.15	0.14	0.00	0.63	no
Percentage of students who repeated one or more grades (1 unit = 100 percentage-point increase)	YREPEA	0.12	0.11	0.00	0.37	no

	Variable name	Mean	S.D.	Min.	Max.	% missing
SCHOOL LEVEL						
School average *PISA index of economic, social and cultural status* (ESCS) (1 unit = one index point)	XESCS; MXESCS	0.00	0.65	-3.87	2.13	0.03
School size (100 students)	SCHSIZE; MSCHSIZE	7.50	5.82	0.02	112.68	3.71
School located in a city (with over 100 000)	CITY; MCITY	0.35	0.48	0.00	1.00	1.98
School located in a small town or village (fewer than 15 000)	RURAL	0.31	0.46	0.00	1.00	1.98
School-level index of quality of school educational resources (1 unit = one index point)	SCMATEDU; MSCHMATEDU	0.04	0.98	-3.39	1.93	2.25
School average number of computers available for students	IRATCOMP; MIRATCOMP	0.55	0.41	0.00	2.50	6.94
Proportion of teachers who have an ISCED 5A qualification	PROPQUAL; MPROPQUAL	0.74	0.37	0.00	1.00	12.32
School autonomy for curriculum and assessment (1 unit = 1 index point)	RESPCURR; MRESPCURR	-0.05	0.99	-1.37	1.36	1.90
School autonomy for resource allocation (1 unit = 1 index point)	RESPRES	-0.04	0.95	-0.84	2.45	1.90
Students are assessed using standardised test at least more than 1 time a year	XSTD_TEST; MXSTD_TEST	0.77	0.42	0.00	1.00	3.80
STUDENT LEVEL						
Student is female	GENDER; MGENDER	0.49	0.50	0.00	1.00	0.00
Student's *PISA index of economic, social and cultural status* (ESCS) (1 unit = one index point)	ESCS; MESCS	0.00	1.01	-6.04	3.53	1.36
Student has no immigration background	NATIVE; MNATIVE	0.90	0.30	0.00	1.00	2.09
Student speaks the test language or other national langue most of the time or always at home	SLANG; MSLANG	0.91	0.29	0.00	1.00	3.76
Student's age	AGE	15.76	0.29	15.17	16.33	0.00
Student's grade (4 = modal grade in country; 1 unit = one grade)	GRADE1; MGRADE	3.91	0.57	1.00	7.00	0.42
Learning time in test language per week (mins)	LMINS; MLMINS	217.54	84.74	0.00	1 000	7.03

1. Since the variable GRADE varies from 1 to 7, six dummy variables (i.e. GRADE-3, GRADE-2, GRADE-1, GRADE1, GRADE2 and GRADE3) are created. The reference group is the students in the modal grade in each country.
Source: OECD, *PISA 2009 Database*.

Treatment of missing data

The proportion of missing values for the variables considered in the analysis is presented in Table A2.1. Even though the missing rate is less than 5% for most of the variables, a list-wise deletion of observations that have a missing value of at least one variable would have reduced the sample size by 26.9%, since around 20 variables are included in the models. Therefore, missing values are imputed in order to include the maximum number of cases in the analysis.

Since the missing rates are not high for most of the variables, a simple imputation approach was used to circumvent the problem of missing data: predictors at the individual and school levels were imputed using a dummy variable adjustment (Cohen and Cohen, 1985).

It is known that this imputation method generally produces biased estimates of coefficients (Jones, 1996), and that standard errors of those variables that contain missing values are underestimated since they do not account for the uncertainty introduced through imputation. However, given that more than 5% of the data are missing on only three variables (Table A2.1), this bias is considered negligible.

As a first step of the imputation, a so-called "missing dummy" variable is created for all variables with missing values, regardless of whether a variable was continuous, categorical or dichotomous. A missing dummy variable is set to 1 if the data were missing on that variable; it was set to 0 if the data are not missing. The first letter "M" in the variable names in Table A2.1 signifies a missing dummy.

As a second step, missing values are imputed for continuous variables. Missing values are replaced by the weighted school average of the variable. If all data on the respective variable are missing in one school, such that the weighted school mean could not be computed, the weighted country mean is imputed. If all data on the respective variable are missing in a country, the weighted international mean is imputed. When a missing value is replaced by the country or school mean, the weights are proportional to the sampling probability (weighting factor W_FSTUWT from the PISA 2009 dataset). When a missing value is replaced by the international mean, equal country weights are used, i.e. each country is given an equal weight of 1 000 cases.

All 32 countries have data for all country-level variables except one variable, teachers' salaries to GDP per capita. As these data are missing in Canada and New Zealand, these missing values are replaced by the international mean without including a missing dummy.

Student weights

For the multilevel analysis, data files are weighted at the student level with "normalised student final weights", which are computed based on the student final weights (W_FSTUWT) in the PISA 2009 dataset.

The student final weights (W_FSTUWT) are normalised at the international level, including 32 of the 34 OECD countries, to *i)* make the sum of the weights across the 32 countries equal to the number of students across the 32 countries in the dataset; *ii)* maintain the same proportion of weights as in the student final weights (W_FSTUWT) within each country; and *iii)* ensure that each individual country's contribution to the analysis is equal by introducing a country factor (i.e. the sum of the weights within each country is the same for all 32 countries).

Modelling student performance

In order to examine how the country-level public management and public funding variables are related to students' performance in reading before and after accounting for background characteristics of students, schools and countries, ten models are developed. Model 1 in Table A2.2 is the simplest model that contains aggregated variables for public funding and management at the country level, without any background variables. In Model 2, an interaction effect between public management and public funding is added to Model 1. Models 1 and 2 are gross models that do not account for any background variables listed in Table A2.1. Models 3 to 8 are net models. Model 3 accounts for student-level background variables. Model 4 accounts for school-level background variables. Model 5 accounts for country-level background variables. Models 6 to 8 account for different combinations of background variables at the student, school and country levels. Model 9 accounts for background variables at student, school and country levels altogether. In Model 10, an interaction effect between public management and public funding is added to Model 9.

In all models, all the slopes are fixed and only the intercepts are randomised at all three levels. Public management and public funding variables are centred on the international mean and the interaction is computed. Six other country-level variables are also centred on the international mean. Student- and school-level variables are not centred.

As an example, the detailed specification of Model 2 is presented below.

Detailed specification of Model 2

Level 1: $Reading = P0 + E$

Level 2: $P0 = B00 + R0$

Level 3: $B00 = G000 + G001(GFUND10) + G002(YPUB10) + G003(I\_FPUB) + U00$

In Model 1, both the prevalence of publicly managed schools and the level of public funding for schools are not significantly related to performance. Even after including the interaction between these two variables in Model 2, no clear pattern is observed in the relationship between public and private involvement in schools and countries' performance in reading. Similarly, in Model 3, after accounting for the student-level background variables, and in Model 5, after accounting for the country-level background variables, public involvement in managing and funding schools are not related to performance. Only after accounting for school-level background variables in Models 4, 6 and 8, do countries that provide higher levels of public funding for schools tend to have lower scores than countries that provide lower levels of public funding. The prevalence of publicly managed schools is not related to performance. Similar results can be obtained from Models 9 and 10, which account for background variables at the student, school and country levels altogether. The interaction between public funding and public management in Model 10 is not significantly related to performance.

[Part 1/3]
Table A2.2 Relationship between public and private involvement in schools and performance in reading

	Variable	Model 1			Model 2			Model 3		
		Coef.	S.E.	p-value	Coef.	S.E.	p-value	Coef.	S.E.	p-value
Percentage of students who attend publicly managed school (1 unit = 10 percentage-point increase)	YPUB10	-0.83	(2.21)	(0.71)	-1.12	(2.80)	(0.69)	-1.48	(2.09)	(0.48)
Percentage of total funding for school for a typical school year that comes from government (1 unit = 10 percentage-point increase)	GFUND10	2.77	(5.41)	(0.61)	3.25	(4.06)	(0.43)	-2.49	(3.03)	(0.42)
Interaction between public funding and public management	I_FPUB				2.33	(2.92)	(0.43)			
Intercept	INTRCPT1	**487.89**	(5.24)	(0.00)	**486.10**	(4.36)	(0.00)	**555.97**	(34.19)	(0.00)
Country-level variables										
GDP per capita (1 000 USD converted using PPPs)	GDP									
Teachers' salaries to GDP per capita (weighted average of upper and lower secondary school teachers)	ZSALARY									
Average index of school responsibility for curriculum and assessment (1 unit = 1 standard deviation across OECD countries)	YRESPC									
Percentage of students in schools that group students by ability in all subjects (1 unit = 100 percentage-point increase)	YABG									
Percentage of students in schools that transfer students to other schools due to low achievement, behavioural problems or special learning needs (1 unit = 100 percentage-point increase)	YTRANS									
Percentage of students who repeated one or more grades (1 unit = 100 percentage-point increase)	YREPEA									
School level variables										
School average *PISA index of economic, social and cultural status* (ESCS) (1 unit = 1 index point)	XESCS									
School size (100 students)	SCHSIZE									
School size squared	SCHSIZE2									
School located in a city (with over 100 000 people)	CITY									
School located in a small town or village (fewer than 15 000 people)	RURAL									
School-level index of quality of school educational resources (1 unit = 1 index point)	SCMATEDU									
Proportion of teachers who have an ISCED 5A qualification	PROPQUAL									
Average number of computers available for students in the school	IRATCOMP									
School autonomy for curriculum and assessment (1 unit = 1 index point)	RESPCURR									
School autonomy for resource allocation (1 unit = 1 index point)	RESPRES									
Students are assessed using standardised tests more than once a year	XSTDT									
Student-level variables										
Student is female	GENDER							**30.74**	(1.87)	(0.00)
Student's *PISA index of economic, social and cultural status* (ESCS) (1 unit = 1 index point)	ESCS							**17.48**	(1.46)	(0.00)
Student has no immigration background	NATIVE							**10.25**	(2.81)	(0.00)
Student speaks the test language or other national language most of the time or always at home	SLANG							**13.57**	(3.29)	(0.00)
Student's age	AGE							**-5.79**	(2.14)	(0.01)
Student's grade	GRADE-3							**-113.62**	(7.04)	(0.00)
	GRADE-2							**-94.12**	(4.90)	(0.00)
	GRADE-1							**-45.36**	(2.66)	(0.00)
	GRADE1							**33.73**	(2.58)	(0.00)
	GRADE2							**29.19**	(7.88)	(0.00)
	GRADE3							**91.09**	(33.13)	(0.02)
Learning time in test language per week (mins)	LMINS							0.00	(0.01)	(0.94)

Note: Values that are statistically significant are indicated in bold at the 5% level (p<0.05); at the 10% level (p>0.10) they are indicated in italic.
Source: OECD, *PISA 2009 Database.*

[Part 2/3]
Table A2.2 Relationship between public and private involvement in schools and performance in reading

	Variable	Model 4			Model 5			Model 6		
		Coef.	S.E.	p-value	Coef.	S.E.	p-value	Coef.	S.E.	p-value
Percentage of students who attend publicly managed school (1 unit = 10 percentage-point increase)	YPUB10	1.04	(1.46)	(0.48)	1.39	(2.27)	(0.55)	-0.39	(1.66)	(0.82)
Percentage of total funding for school for a typical school year that comes from government (1 unit = 10 percentage-point increase)	GFUND10	**-9.23**	(3.25)	(0.01)	-1.66	(2.97)	(0.58)	**-8.30**	(2.57)	(0.00)
Interaction between public funding and public management	I_FPUB									
Intercept	INTRCPT1	**464.90**	(8.98)	(0.00)	**488.22**	(2.71)	(0.00)	**529.87**	(9.23)	(0.00)

Country-level variables										
GDP per capita (1 000 USD converted using PPPs)	GDP				**1.00**	(0.24)	(0.00)			
Teachers' salaries to GDP per capita (weighted average of upper and lower secondary school teachers)	ZSALARY				7.28	(10.47)	(0.49)			
Average index of school responsibility for curriculum and assessment (1 unit = 1 standard deviation across OECD countries)	YRESPC				*13.23*	*(7.21)*	*(0.08)*			
Percentage of students in schools that group students by ability in all subjects (1 unit = 100 percentage-point increase)	YABG				-44.54	(38.75)	(0.26)			
Percentage of students in schools that transfer students to other schools due to low achievement, behavioural problems or special learning needs (1 unit = 100 percentage-point increase)	YTRANS				**-72.94**	(27.89)	(0.02)			
Percentage of students who repeated one or more grades (1 unit = 100 percentage-point increase)	YREPEA				7.92	(30.75)	(0.80)			

School level variables										
School average *PISA index of economic, social and cultural status* (ESCS) (1 unit = 1 index point)	XESCS	**76.07**	(5.76)	(0.00)				**43.70**	(0.85)	(0.00)
School size (100 students)	SCHSIZE	**1.94**	(0.44)	(0.00)				**1.33**	(0.12)	(0.00)
School size squared	SCHSIZE2	**-0.02**	(0.01)	(0.01)				**-0.01**	(0.00)	(0.00)
School located in a city (with over 100 000 people)	CITY	**-5.43**	(1.89)	(0.01)				-0.71	(1.00)	(0.48)
School located in a small town or village (fewer than 15 000 people)	RURAL	**5.40**	(2.22)	(0.02)				**6.94**	(0.97)	(0.00)
School-level index of quality of school educational resources (1 unit = 1 index point)	SCMATEDU	0.92	(0.91)	(0.31)				0.58	(0.42)	(0.16)
Proportion of teachers who have an ISCED 5A qualification	PROPQUAL	**27.21**	(7.96)	(0.00)				**18.33**	(1.85)	(0.00)
Average number of computers available for students in the school	IRATCOMP	-1.90	(2.52)	(0.45)				-1.09	(1.06)	(0.30)
School autonomy for curriculum and assessment (1 unit = 1 index point)	RESPCURR	0.51	(1.22)	(0.67)				0.42	(0.49)	(0.38)
School autonomy for resource allocation (1 unit = 1 index point)	RESPRES	-0.87	(0.95)	(0.36)				*-1.00*	*(0.51)*	*(0.05)*
Students are assessed using standardised tests more than once a year	XSTDT	-2.77	(1.74)	(0.11)				1.07	(0.98)	(0.27)

Student-level variables										
Student is female	GENDER							**30.65**	(0.28)	(0.00)
Student's *PISA index of economic, social and cultural status* (ESCS) (1 unit = 1 index point)	ESCS							**15.76**	(0.19)	(0.00)
Student has no immigration background	NATIVE							**10.45**	(0.73)	(0.00)
Student speaks the test language or other national language most of the time or always at home	SLANG							**13.11**	(0.70)	(0.00)
Student's age	AGE							**-5.56**	(0.53)	(0.00)
Student's grade	GRADE-3							**-102.95**	(3.01)	(0.00)
	GRADE-2							**-87.09**	(1.30)	(0.00)
	GRADE-1							**-43.29**	(0.54)	(0.00)
	GRADE1							**33.02**	(0.67)	(0.00)
	GRADE2							**28.88**	(2.80)	(0.00)
	GRADE3							**88.59**	(38.29)	(0.03)
Learning time in test language per week (mins)	LMINS							0.00	(0.00)	(0.79)

Note: Values that are statistically significant are indicated in bold at the 5% level (p<0.05); at the 10% level (p>0.10) they are indicated in italic.
Source: OECD, *PISA 2009 Database.*

[Part 3/3]

Table A2.2 Relationship between public and private involvement in schools and performance in reading

	Variable	Model 7 Coef.	S.E.	p-value	Model 8 Coef.	S.E.	p-value	Model 9 Coef.	S.E.	p-value	Model 10 Coef.	S.E.	p-value
Percentage of students who attend publicly managed school (1 unit = 10 percentage-point increase)	YPUB10	0.70	(2.58)	(0.79)	0.97	(1.72)	(0.58)	0.52	(1.83)	(0.78)	0.70	(1.78)	(0.70)
Percentage of total funding for school for a typical school year that comes from government (1 unit = 10 percentage-point increase)	GFUND10	-4.48	(2.66)	(0.11)	*-7.80*	*(3.88)*	*(0.06)*	**-7.41**	**(2.99)**	**(0.02)**	**-6.99**	**(2.91)**	**(0.03)**
Interaction between public funding and public management	I_FPUB										-1.85	(1.29)	(0.17)
Intercept	INTRCPT1	**556.86**	**(34.29)**	**(0.00)**	**465.20**	**(8.35)**	**(0.00)**	**530.95**	**(9.05)**	**(0.00)**	**532.13**	**(9.06)**	**(0.00)**
Country-level variables													
GDP per capita (1 000 USD converted using PPPs)	GDP	0.14	(0.23)	(0.54)	-0.56	(0.31)	(0.09)	**-0.67**	**(0.23)**	**(0.01)**	**-0.64**	**(0.23)**	**(0.01)**
Teachers' salaries to GDP per capita (weighted average of upper and lower secondary school teachers)	ZSALARY	0.62	(9.23)	(0.95)	-0.02	(15.18)	(1.00)	-4.52	(10.82)	(0.68)	1.32	(11.24)	(0.91)
Average index of school responsibility for curriculum and assessment (1 unit = 1 standard deviation across OECD countries)	YRESPC	7.58	(8.40)	(0.38)	0.23	(5.78)	(0.97)	1.31	(6.74)	(0.85)	0.76	(6.54)	(0.91)
Percentage of students in schools that group students by ability in all subjects (1 unit = 100 percentage-point increase)	YABG	-19.89	(38.85)	(0.61)	-4.44	(42.09)	(0.92)	*0.10*	*(35.17)*	*(1.00)*	-7.56	(34.51)	(0.83)
Percentage of students in schools that transfer students to other schools due to low achievement, behavioural problems or special learning needs (1 unit = 100 percentage-point increase)	YTRANS	-50.36	(30.99)	(0.12)	*-43.75*	*(21.25)*	*(0.05)*	-33.70	(25.80)	(0.21)	-35.12	(25.02)	(0.17)
Percentage of students who repeated one or more grades (1 unit = 100 percentage-point increase)	YREPEA	**71.98**	**(31.40)**	**(0.03)**	33.82	(38.16)	(0.39)	*84.49*	*(41.92)*	*(0.06)*	*75.20*	*(41.12)*	*(0.08)*
School level variables													
School average *PISA index of economic, social and cultural status* (ESCS) (1 unit = 1 index point)	XESCS				**76.11**	**(5.78)**	**(0.00)**	**43.80**	**(0.85)**	**(0.00)**	**43.81**	**(0.85)**	**(0.00)**
School size (100 students)	SCHSIZE				**1.95**	**(0.44)**	**(0.00)**	**1.33**	**(0.12)**	**(0.00)**	**1.33**	**(0.12)**	**(0.00)**
School size squared	SCHSIZE2				**-0.02**	**(0.01)**	**(0.01)**	**-0.01**	**(0.00)**	**(0.00)**	**-0.01**	**(0.00)**	**(0.00)**
School located in a city (with over 100 000 people)	CITY				**-5.48**	**(1.90)**	**(0.00)**	-0.73	(1.00)	(0.47)	-0.72	(1.00)	(0.47)
School located in a small town or village (fewer than 15 000 people)	RURAL				**5.38**	**(2.21)**	**(0.02)**	**6.95**	**(0.97)**	**(0.00)**	**6.95**	**(0.97)**	**(0.00)**
School-level index of quality of school educational resources (1 unit = 1 index point)	SCMATEDU				0.92	(0.91)	(0.31)	0.59	(0.42)	(0.16)	0.59	(0.42)	(0.16)
Proportion of teachers who have an ISCED 5A qualification	PROPQUAL				**27.00**	**(7.92)**	**(0.00)**	**18.12**	**(1.84)**	**(0.00)**	**18.07**	**(1.84)**	**(0.00)**
Average number of computers available for students in the school	IRATCOMP				-1.88	(2.55)	(0.46)	-1.06	(1.06)	(0.32)	-1.06	(1.06)	(0.32)
School autonomy for curriculum and assessment (1 unit = 1 index point)	RESPCURR				0.47	(1.23)	(0.70)	0.42	(0.49)	(0.39)	0.42	(0.49)	(0.39)
School autonomy for resource allocation (1 unit = 1 index point)	RESPRES				-0.90	(0.95)	(0.35)	**-1.04**	**(0.51)**	**(0.04)**	**-1.04**	**(0.51)**	**(0.04)**
Students are assessed using standardised tests more than once a year	XSTDT				-2.75	(1.74)	(0.11)	1.11	(0.98)	(0.26)	1.12	(0.98)	(0.25)
Student-level variables													
Student is female	GENDER	**30.74**	**(1.87)**	**(0.00)**				**30.65**	**(0.28)**	**(0.00)**	**30.65**	**(0.28)**	**(0.00)**
Student's *PISA index of economic, social and cultural status* (ESCS) (1 unit = 1 index point)	ESCS	**17.48**	**(1.46)**	**(0.00)**				**15.76**	**(0.19)**	**(0.00)**	**15.76**	**(0.19)**	**(0.00)**
Student has no immigration background	NATIVE	**10.25**	**(2.80)**	**(0.00)**				**10.45**	**(0.73)**	**(0.00)**	**10.45**	**(0.73)**	**(0.00)**
Student speaks the test language or other national language most of the time or always at home	SLANG	**13.56**	**(3.30)**	**(0.00)**				**13.09**	**(0.70)**	**(0.00)**	**13.08**	**(0.70)**	**(0.00)**
Student's age	AGE	**-5.78**	**(2.14)**	**(0.01)**				**-5.56**	**(0.53)**	**(0.00)**	**-5.55**	**(0.53)**	**(0.00)**
Student's grade	GRADE-3	**-113.60**	**(7.06)**	**(0.00)**				**-102.97**	**(3.01)**	**(0.00)**	**-102.96**	**(3.01)**	**(0.00)**
	GRADE-2	**-94.10**	**(4.90)**	**(0.00)**				**-87.11**	**(1.30)**	**(0.00)**	**-87.10**	**(1.30)**	**(0.00)**
	GRADE-1	**-45.35**	**(2.66)**	**(0.00)**				**-43.30**	**(0.54)**	**(0.00)**	**-43.30**	**(0.54)**	**(0.00)**
	GRADE1	**33.72**	**(2.59)**	**(0.00)**				**33.01**	**(0.67)**	**(0.00)**	**33.01**	**(0.67)**	**(0.00)**
	GRADE2	**29.17**	**(7.87)**	**(0.00)**				**28.88**	**(2.80)**	**(0.00)**	**28.87**	**(2.80)**	**(0.00)**
	GRADE3	**91.07**	**(33.13)**	**(0.02)**				**88.58**	**(38.29)**	**(0.03)**	**88.57**	**(38.29)**	**(0.03)**
Learning time in test language per week (mins)	LMINS	0.00	(0.01)	(0.93)				0.00	(0.00)	(0.77)	0.00	(0.00)	(0.78)

Note: Values that are statistically significant are indicated in bold at the 5% level (p<0.05); at the 10% level (p>0.10) they are indicated in italic.
Source: OECD, *PISA 2009 Database*.

References

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ANNEX A3
STANDARD ERRORS, SIGNIFICANCE TESTS AND SUBGROUP COMPARISONS

The statistics in this report represent estimates of national performance based on samples of students, rather than values that could be calculated if every student in every country had answered every question. Consequently, it is important to measure the degree of uncertainty of the estimates. In PISA, each estimate has an associated degree of uncertainty, which is expressed through a standard error. The use of confidence intervals provides a way to make inferences about the population means and proportions in a manner that reflects the uncertainty associated with the sample estimates. From an observed sample statistic and assuming a normal distribution, it can be inferred that the corresponding population result would lie within the confidence interval in 95 out of 100 replications of the measurement on different samples drawn from the same population.

In many cases, readers are primarily interested in whether a given value in a particular country is different from a second value in the same or another country, e.g. whether females in a country perform better than males in the same country. In the tables and charts used in this report, differences are labelled as statistically significant when a difference of that size, smaller or larger, would be observed less than 5% of the time, if there were actually no difference in corresponding population values. Similarly, the risk of reporting a correlation as significant if there is, in fact, no correlation between two measures, is contained at 5%.

Throughout the report, significance tests were undertaken to assess the statistical significance of the comparisons made.

Change in the *PISA index of economic, social and cultural status* performance per unit of the independent variable

For many tables, the difference in *PISA index of economic, social and cultural status* per unit of the independent variable shown was calculated. Figures in bold indicate that the differences are statistically significantly different from zero at the 95% confidence level.

Difference in various characteristics between publicly and privately managed schools

Differences in various characteristics (e.g. *PISA index of economic, social and cultural status* and reading performance) between publicly and privately schools were tested for statistical significance. For this purpose, government-dependent and government-independent private schools were jointly considered as privately managed schools. Positive differences represent higher scores for private schools while negative differences represent higher scores for public schools. Figures in bold in data tables presented in Annex B of this report indicate statistically significant different scores at the 95% confidence level.
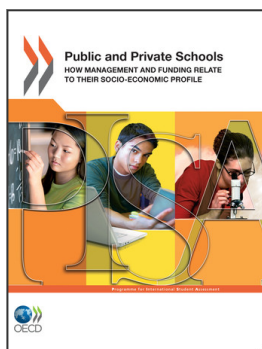
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