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Student Performance and Inequality in Central and South Eastern Europe

Cross-country Comparison and Case Study on Romani-speaking Students in Slovakia

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About the Roma Education Fund

The Roma Education Fund's (REF) mission and ultimate goal is to close the gap in educational outcomes between Roma and non-Roma. In order to achieve this goal, the organization supports policies and programs which ensure quality education for Roma through scholarships, grant making and advocacy activities.

The objectives of REF include:

- Expanding Romani children's access to quality early childhood education and care
- Improving primary education outcomes for Romani children aged six to fourteen
- Boosting academic performance and graduation rates from secondary education for Romani pupils
- Supporting access to tertiary education, improving graduation levels and strengthening identity of Romani university students
- Expanding employment opportunities for young Romani adults

The Roma Education Fund operates its activities in close links with civil society and institutional partners in 16 countries of Central and South Eastern Europe. For more information about the Fund and its mission to close the gap in educational outcomes between Roma and non-Roma, as well as desegregate education systems, visit: http://www.romaeducationfund.org

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Abstract

The working paper discusses potentials and limitations of measuring educational inequality between Roma and non-Roma based on international student assessment data. First, we give an overview about available data sources that have been used to measure educational inequalities between Roma and non-Roma: national census surveys, international household surveys and international student assessments. Second, we analyze educational inequalities in REF focus countries that participated in the Programme for International Student Assessment (PISA) 2012. Third, we compare the results on student performance, family and schooling characteristics of the Romani-, Slovak- and Hungarian-speaking students in Slovakia based on PISA 2012.

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Introduction

Although all countries in Europe and most countries around the globe have witnessed considerable rates of education expansion (Meyer, Ramirez & Soysal 1992; Schofer & Meyer 2005), educational inequalities remain a structural feature of modern nation-states. Educational inequalities can be observed worldwide, but nation-states differ considerably with regard to the degree of inequality (Shavit & Blossfeld 1993; Hertz et al. 2008; UNESCO 2010). One manifestation of inequality concerns the inequality between majority populations and ethnic, linguistic or national minorities. The persistence and reproduction of severe educational inequalities between majority and minority populations is considered a barrier to promoting fair and just societies.

The Roma Education Fund (REF) aims at closing the gap in educational outcomes between Roma and non-Roma students working in 16 countries in Central, Eastern and South Eastern Europe.[1] The provision of non-discriminatory quality education for Roma children and youth is not only an end itself but is also expected to have a substantial impact in terms of living conditions and upward social mobility. REF also aims at measuring and analyzing educational inequalities between Roma and non-Roma, subsequently addressing these inequalities through various projects, programs and advocacy efforts.

The working paper discusses potentials and limitations of measuring educational inequality between Roma and non-Roma based on international student assessment data. *The first section* considers available data sources that have been used to measure educational inequalities between Roma and non-Roma: national census surveys, international household surveys and international student assessments. The latter are a particularly important tool for measuring educational inequalities as they provide direct measures of educational performance as well as comprehensive background information regarding family and schooling characteristics. *The second section* provides an overview of educational inequalities in REF's country portfolios based on data from the Programme for International Student Assessment (PISA). PISA is currently the only international student assessment that allows analyzing performance, family and schooling characteristics of Roma students and does so only for one country: Slovakia. Therefore, *the third section* presents the results on student performance, family and schooling characteristics of Romani-, Slovak- and Hungarian-speaking students in Slovakia.

Measuring educational inequality between Roma and non-Roma students[2]

A common understanding of educational inequality concerns children and youth's different educational access, participation or performance on the basis of different characteristics such as their parents' level of education, their families' wealth, their gender, their country of origin, their language or their ethnicity. This understanding of educational inequality refers to the concept of

[1] The REF focus countries are: Albania, Bosnia & Herzegovina, Bulgaria, Croatia, Czech Republic, Hungary, Kosovo, Macedonia, Moldova, Montenegro, Romania, Russia, Serbia, Slovakia, Turkey and Ukraine.

[2] This section is based on C. Brüggemann. (2016). "Educational Participation and Success of Roma in Europe." Unpublished Dissertation Thesis. Technical University of Dortmund.

equality of opportunities, which stipulates that everybody, independently from origin or background, should have the same chances to succeed in school. Fundamental to measuring inequality is the availability of data that allows identifying and comparing different groups of individuals. Such data can come from official education statistics, like national census and administrative data on schools, but also household surveys or student assessments.

A main challenge with regard to the analysis and monitoring of educational outcomes of Roma vis-à-vis non-Roma populations is the collection of data disaggregated by ethnicity. Research on ethnic identities has shifted from defining ethnicity as a solid concept defined by birth towards understanding ethnic belonging as changing, dynamic and context-dependent concept (Anderson–Levitt 2012). The fluid nature of ethnicity is especially challenging for the collection of statistics.

Ethnic identification might be assessed in different ways including the identification of origin (parents or grandparents being identified as Roma), self-identification in private settings (e.g., identification towards close friends and family members), self-identification in public settings (e.g., identification in an interview or questionnaire) and hetero-attribution (e.g., identification by an interviewer) (Rughinis 2010, 354–355). Most approaches to ethnic data collection are either based on public self-identification or hetero-attribution. Both self-identification and hetero-attribution are subject to errors and/or omissions. Statistics based on public self-identification are likely to underreport minority belonging, whereas statistics based on external identification face the risk of identifying Roma according to social criteria such as poverty, skin color or family size (Ahmed, Felciano & Emigh 2007; Rughins 2010; Marushiaková & Popov 2001; Ladányi & Szelényi 2001). Identifying as belonging to a national, ethnic or linguistic minority is an individual right, not an obligation.[3] Thus, most scholars agree that surveys aiming at analyzing social inequality and experiences of ethnic minorities should be based on self-identification (Messing 2014, 824).

National census surveys

Census data provides a reliable and detailed account about a wide range of characteristics of a country's population. Countries usually collect census data about once a decade due to high survey costs. If and in which form ethnic belonging is surveyed varies between countries. While surveying "citizenship" is an international standard, "ethnicity," "minority status" or "national identity" is perceived by many states as information that is too sensitive to be surveyed. Some states reject the collection of data disaggregated by ethnicity and collect only data on citizenship and country of birth. In those countries, not surveying ethnicity is widely perceived as a basic ethical principle and a means of minority protection.

In Slovakia – like in many other Central and South Eastern European countries – the census collects data on citizenship but also on national identity and mother tongue: In 2011, two percent of the Slovak population claimed Roma nationality (*národnosť*),[4] whereas 2.3 percent indicated to speak

[3] The Council of Europe Framework Convention for the Protection of National Minorities which came into effect in 1998 and has been signed by 39 out of 47 member states stipulates that: "Every person belonging to a national minority shall have the right freely to choose to be treated or not to be treated as such and no disadvantage shall result from this choice or from the exercise of the rights which are connected to that choice" (Council of Europe, Framework Convention for the Protection of National Minorities, Article 3).

[4] The concept of *národnosť* (lit. nationality) refers to ethnic identity not citizenship. The same applies for Hungary and many other countries in Central and South Eastern Europe.

Romani as mother tongue (Matlovičová et al. 2012). This result raises many questions since the Roma population in Slovakia is acknowledged to be much larger, and therefore the census underestimates the actual share of Roma living in the country (Ibid.). Moreover, it seems a paradox that many individuals indicated speaking Romani as their mother tongue but did not claim Roma nationality. Census data and expert estimations differ due to several reasons: first, Roma are underrepresented in census data because they might refuse to claim Roma national identity because they might have experienced public stigma associated with this identification. Second, the census surveys usually allow for claiming only one national or ethnic identity. For example, a person that speaks Hungarian, self-identifies as *Rom/Romni* in daily life and has Slovak citizenship is compelled to select only one nationality even though he/she probably identifies as Slovak, Hungarian and Rom/Romni all at the same time. Such multiple belongings might, for example, be the case for Romani-speaking populations who live in one of the numerous Hungarian villages in the south of Slovakia.

The first census in Central Europe to acknowledge multiple national identities was the Hungarian national census in 2011. The Hungarian census has been translated into Romani and attempts to survey multiple national/ethnic identities by including two questions: (1) "Which nationality do you feel you belong to?" and (2) "Do you think you belong to another nationality in addition to what you marked above?" (Hungarian Central Statistical Office 2015). As a result, the number of persons who self-identified as Rom/Romni increased by 53 percent compared to 2001 and 60 percent of those who attributed themselves a minority identity claimed two nationalities in 2011 (Messing 2014, 814).

Statistical offices seldom publish census results disaggregated by nationality/ethnicity. Furthermore, the available data is usually limited to school attendance, educational attainment and years of schooling. A recent analysis commissioned by the United Nations Development Programme (UNDP) Albania shows that, despite such limitations, an analysis of census data offers considerable insights into the extent of educational inequality: about 40 percent of children aged 10–14 years who identified as Roma never attended school compared to below one percent of children who identified as Albanians (Simon, Galanxhi & Dhono 2015). Since census data is collected only every ten years and usually contains only few questions that are of use to capture educational inequality, international organizations conducted large-scale household surveys in order to provide comprehensive data on the living conditions of Roma in Europe.

International household surveys

International household surveys collect data on private households. Household surveys are cheaper than national census surveys as they collect data from a sample of a country's population (not from the total population). Household surveys mostly focus on certain topics or issues such for example consumption or living conditions.

World Bank and UNDP carried out large-scale household surveys in the late 1990s and early 2000s to capture international comparative data on Roma households (Ivanov et al. 2002; Revenga, Ringold, & Tracy 2002). In both studies significant differences were found between interviewer identification and self-identification. In order to tackle this issue, UNDP used an "implicit endorsement" method in subsequent surveys. When approaching the household, the interviewers asked the question: "We are conducting a survey among the Roma population. Would you mind to be interviewed?" People who denied belonging to the Roma minority were not approached further (Ivanov & Kagin 2012, 15). As a result, only a few interviews were conducted with persons who were identified as Rom/Romni but who at a later stage did not self-identify as such.

Based on this approach, UNDP conducted two large-scale surveys in Central and South Eastern Europe in 2004 and 2005 and again in 2011 which provide a large amount of data on living conditions of Roma in Europe. The 2011 survey covered about 750 Roma and 350 non-Roma households in Albania, Bosnia and Herzegovina, Bulgaria, Croatia, Czech Republic, Hungary, Macedonia, Moldova, Montenegro, Romania, Serbia and Slovakia. The survey was aligned with a survey conducted by the European Union Agency for Fundamental Rights (FRA) who followed the same survey approach and covered the above-mentioned EU member states in addition to France, Greece, Italy, Poland, Portugal and Spain (FRA & UNDP 2012). The surveys provide an unprecedented amount of household data, including a wide range of questions regarding education. Results have been published in various reports and background papers (Brüggemann 2012; De Laat et al. 2012; FRA 2014, Kamberi 2015).

The amount of data allows for extensive secondary data analysis. However, account should be taken that the above-mentioned household surveys are not representative, because localities with below average Roma populations, as reported in the national census, were not sampled. The UNDP/FRA survey approach does not capture Roma who live in small numbers among majority populations. It is, for example, very likely that Roma who hold university degrees are strongly underrepresented in existing household surveys since they are likely to live in areas that are not covered by the survey. Also, household data does not provide comprehensive information on Roma students' learning outcomes or schooling characteristics. A household survey can provide reliable information about years of schooling, preschool experience, the language used in the family or special school attendance, but it does not capture students' cognitive abilities. Such information is collected by student assessments.

International student assessments[5]

International student assessments measure student achievement in subjects such as reading, mathematics or science and collect an array of background information on the students and schools. Such assessments have been conducted since the 1960s and have received increasing international attention since the late 1990s. The most prominent international student assessments are the Programme for International Student Assessment (PISA) coordinated by the Organisation for Economic Co-operation and Development (OECD), the Trends in International Mathematics and Science Study (TIMSS) and the Progress in International Reading Literacy Study (PIRLS) – both coordinated by the International Association for the Evaluation of Educational Achievement (IEA).

International student assessment studies have been influencing debates about the performance and quality of education systems around the world. In some instances discussions have been merely focusing around performance competition, rankings and league tables (see, for example, Martens & Niemann 2013; Takayama 2008; Steiner-Khamsi 2003; Waldow et al. 2014). Other discussions focused on questions of equity in education. Performance and equity are often discussed in tandem since high equity achievement has been recognized as a key mechanism in order to improve country's overall performance level (Wiseman 2013).

[5] Discussing the potential and limitations of assessing educational inequalities between Roma and non-Roma through national student assessments is beyond of the scope of this paper. See Baucal (2006) for an analysis of educational inequality between Roma and non-Roma based on national student assessment data in Serbia.

PISA measures the reading, mathematics and science achievement of 15-year-olds and is conducted every three years since 2000. TIMSS measures performance in mathematics and science of students in grades four and eight and is conducted every four years since 1995. PIRLS measures reading performance of eighth graders and is conducted every five years since 2001. Whereas PISA intends to measure students' knowledge, skills and problem solving independently of national curricula, PIRLS and TIMSS attempt to measure common aspects of national curricula of the participating countries.

Student assessment studies have various advantages compared to household surveys in terms of providing data about educational inequality. Household surveys rely on descriptive accounts of a household member and inform about a formal status (for example, highest level of education achieved) or a believed ability (e.g., self-evaluation regarding the ability to read a newspaper or write a one-page letter). Student assessments, on the other hand, measure student cognitive performance on a wide range of domains. Standardized student assessments provide a considerable larger and more detailed amount of information about skills and abilities and allow for the comparison of student achievement internationally.

Student assessments do not only collect data about students' knowledge and competencies but also data on students' characteristics, such as students' demographic and family background, attitudes and learning experiences. By means of background questionnaires administered to students and school principals, additional data is collected about the schools' learning environment and governance structures. This allows for the relating of student performance to demographic, social, cultural and educational context factors.

Similar to census surveys, most countries do not assess the belonging to a national, ethnic or linguistic minority in international student assessments. Yet, information on the immigrant background of students is usually being assessed. This allows for an analysis of the educational performance of students with an immigration background compared to students without an immigration background. However, in many countries of Central and Eastern Europe most ethnic minority students do not have an immigration background. Thus, possibilities to analyze educational inequalities between minority and majority students are strongly limited. So far, only PISA offers the possibility to reconstruct minority status by looking at students who speak a language at home that differs from the official language, whereas TIMSS and PIRLS have not been providing data on students' home language until the most recent surveys in 2015 and 2016.[6]

PISA samples students at the age of 15. Thus, PISA allows only for analyzing the performance of those who have not dropped out of school at that age. However, in some countries within the REF portfolio, a considerable share of students leaves school before the age of 15. A further limitation is that student assessments only measure cognitive performance in a number of disciplines that are considered most relevant (mathematics, reading, science and problem solving), but do not measure other skills such as social skills or creativity.

Countries can opt to adjudicate PISA data at a subnational level. This allows comparison of regions within a country. However, only few countries chose this option and none of the countries in which REF works have done so. Observing geographical differences in student performance and educational

[6] Both surveys recently introduced a question asking students what languages they speak at home that differ from the test language. This opens a possibility to identify Romani-speaking students in grades four and eight. The data of the TIMSS 2015 and PIRLS 2016 surveys was not available when this paper was written.

resources is therefore limited to comparing students who attend schools in villages, towns or cities as this is the only geographical variable in the data set.

Educational inequality in Roma Education Fund focus countries

All 16 countries in REF's portfolio of grants and scholarships have participated in at least one international student assessment study and all countries except Bosnia & Herzegovina, Kosovo, Macedonia, Moldova and Ukraine participated in PISA 2012 (see Annex 1).

We focus on two approaches to measure educational participation and success. Following a *threshold approach* assuming that a certain minimum level of skills is needed to participate in modern societies (Allmendinger & Leibfried 2003, 23; Giesinger 2007, 362), we look at the share of students that do not reach a certain proficiency level in PISA. We do not assume that students who fall below a certain proficiency level are automatically excluded from public participation and the labor market, but we recognize that those students face the risk of being limited in their possibilities to participate in modern societies. Following an *equality-of-opportunities approach* assuming that educational outcomes should not be predicted by ascriptive criteria such as gender, socio-economic status or ethnic belonging, we look at performance differences between different groups of students. Considering that Roma students are overrepresented among students with a below average socio-economic status, we focus on performance and characteristics of groups of students who differ according to their socio-economic status.

Average student achievement and share of low-performing students

In order to measure students' performance in mathematics, reading, science literacy and problem solving, international experts involved in PISA developed numerous test items of various degrees of difficulty for each test discipline; each student answers a selection of these items in a computer-based or paper-and-pencil test lasting one hour. In order to facilitate the interpretation of students' performance, reading, mathematics, science and problem-solving performance scales are designed to have an average score of 500 points and a standard deviation of 100 across OECD countries. This means that about two-thirds of students perform between 400 and 600 points. Each PISA cycle focuses on one major test discipline (mathematics, reading, science, problem solving), whereas the other disciplines are tested less extensively. The major test discipline in PISA 2012 was mathematics; consequently, the following analysis is mainly focused on results in mathematics.

The mean performance of most REF focus countries – with the exception of the Czech Republic and Slovakia – is significantly below the OECD average of 500 points in mathematics (see Table 1). The mean mathematics performance is particularly low in Albania with 394 points and in Montenegro with 410 points.

In most REF focus countries, results in reading and science are similar to mathematics. Larger differences between subjects (of 10 points or more) are found in Croatia, Hungary, Montenegro and Turkey, where students perform better in reading and in science than they do in mathematics. In Slovakia, on the contrary, students perform better in mathematics than in reading and science.

Overall, students' achievement levels in REF focus countries are relatively low and significantly below that of high-performing OECD countries, such as Estonia, Japan, Korea, Netherlands, and Switzerland, which all achieve mean scores in mathematics of 520 points or above (OECD 2013a, 15).

In order to render cognitive performance results more accessible to policymakers and educators, performance results are reported in the form of proficiency scales for the assessment domains. Each proficiency level contains a detail description of the knowledge and skills associated with a performance on the respective proficiency level. The basic skills level or the minimum level of competencies a student should achieve is operationalized by proficiency Level 2 in the PISA test. It is considered the "baseline level of mathematical proficiency that is required to participate fully in modern society"[7] (OECD 2014, 68). Results from longitudinal studies from PISA, as conducted in Australia, Canada, Denmark and Switzerland have shown that students who performed below the baseline level at the age of 15 face strong disadvantages with regard to their transition into higher education and the labor market (OECD 2014, 68).

In some REF focus countries the share of students that perform below the baseline level is high compared to the OECD average. Over 50 percent of students in Albania and Montenegro, and over 40 percent in Bulgaria, Romania and Turkey, are performing below Level 2 in mathematics. In Croatia, Czech Republic, Russia and Slovakia the share of students performing below Level 2 is between 20 percent and 30 percent.

In accordance to the higher mean performance in reading and science compared to mathematics in Turkey, the share of students performing below proficiency Level 2 in reading and science are smaller, at 22 percent and 26 percent, respectively. The situation is similar in Croatia, where less than 20 percent of students perform below Level 2 in reading and science.

The relatively high proportion of students performing below the baseline level in mathematics and the other test disciplines indicates that a considerable share of students has not yet acquired basic skills that are important to apply and transfer knowledge to situations outside the narrow scope of the task.

[7] The same applies for other test disciplines.

Table 1.
PISA results in mathematics, reading and science, REF focus countries

	Mathematics				Reading				Science			
	Mean performance		Share of students below proficiency level 2		Mean performance		Share of students below proficiency level 2		Mean performance		Share of students below proficiency level 2	
	Mean score	S.E.	%	S.E.	Mean score	S.E.	%	S.E.	Mean score	S.E.	%	S.E.
Albania	394	(2.0)	60.7	(1.0)	394	(3.2)	52.3	(1.3)	397	(2.4)	53.1	(1.2)
Bulgaria	439	(4.0)	43.8	(1.8)	436	(6.0)	39.4	(2.2)	446	(4.8)	36.9	(2.0)
Croatia	471	(3.5)	29.9	(1.4)	485	(3.3)	18.7	(1.3)	491	(3.1)	17.3	(0.9)
Czech Republic	499	(2.9)	21.0	(1.2)	493	(2.9)	16.9	(1.2)	508	(3.0)	13.8	(1.1)
Hungary	477	(3.2)	28.1	(1.3)	488	(3.2)	19.7	(1.2)	494	(2.9)	18.0	(1.1)
Montenegro	410	(1.1)	56.6	(1.0)	422	(1.2)	43.3	(0.7)	410	(1.1)	50.7	(0.7)
OECD average	494	(0.5)	23.1	(0.2)	496	(0.5)	17.9	(0.2)	501	(0.5)	17.8	(0.2)
Romania	445	(3.8)	40.8	(1.9)	438	(4.0)	37.3	(1.9)	439	(3.3)	37.3	(1.6)
Russian Federation	482	(3.0)	24.0	(1.1)	475	(3.0)	22.3	(1.3)	486	(2.9)	18.8	(1.1)
Serbia	449	(3.4)	38.9	(1.5)	446	(3.4)	33.1	(1.7)	445	(3.4)	35.0	(1.8)
Slovak Republic	482	(3.4)	27.5	(1.3)	463	(4.2)	28.2	(1.8)	471	(3.6)	26.9	(1.6)
Turkey	448	(4.8)	42.0	(1.9)	475	(4.2)	21.6	(1.4)	463	(3.9)	26.4	(1.5)

Source: OECD PISA 2012 Database.

The relation between performance and students' socio-economic status

PISA data allows relating student performance to socio-economic background of students and schools. Analysis shows that in all countries participating in PISA, though to varying degrees, students' socio-economic background predicts student performance. The relationship is particularly strong in many REF focus countries (see Table 2). Different measures of educational inequality with regard to differences in students' socio-economic background are available. The most prominent are discussed next.

Variation in performance attributed to differences in socio-economic status

A key measure of educational inequality is the variance explained in students' performance by students' economic, social and cultural status (ESCS).[8] The indicator reports the proportion of the variation in student performance within a country that is explained by differences in socio-economic status of students. It is also called the strength of the socio-economic gradient "as measured by how much of the variation in student performance can be attributed to variations in socio-economic status" (OECD 2013a, 35). Across OECD countries, about 15 percent of variation observed in mathematics performance can be attributed to differences in students' socio-economic status. In Bulgaria, Hungary and the Slovakia almost one quarter of the variation in performance can be explained by socio-economic status. Educational inequality is particularly large in these countries, especially in Slovakia. In Slovakia, the performance variation explained by students' socio-economic status is 10 percentage points higher than the OECD average (see also World Bank 2015). Performance is less predicted by socio-economic status in Croatia, Montenegro, Russia and Serbia. The variation in reading and science performance that can be explained by students' socio-economic background is similar to the results in mathematics. For Serbia and Romania, the explained performance variation is smaller in reading and science than in mathematics; for Russia, the variation is somewhat larger.

[8] This index is the key indicator of socio-economic status used in the PISA assessments. It is calculated by taking into consideration parents' education and occupations and an array of household possessions. The index is standardized to have a mean of zero and a standard deviation of one across countries in the OECD area. An index of 1.0 means that a student is more advantaged than about one in six students in the average OECD country, having a score of -1.0 means being more advantaged than five-sixths of students.

Performance differences explained by socio-economic status

Another key indicator to measure a country's level of educational inequality is the student's performance associated with his or her socio-economic status: more specifically, the increase in student's performance level that is associated with a one-unit increase on the ESCS. This indicator informs about how much a student would perform better (in points) if he or she had a better socio-economic status (by one standard deviation). The indicator is called the slope of the socio-economic gradient (OECD 2013a, 35).

The results of REF countries for the slope of the gradient are similar to that of variation in performance explained by students' socio-economic status. Again, Slovakia shows the largest inequalities. In Slovakia an increase by one unit of the ESCS is associated with an increase of 54 points on the mathematics scale (56 points in reading and science) – compared to 39 points on OECD average. Large inequalities are also observed in Czech Republic where one-unit increase on the ESCS index is associated with an increase of 51 points on the mathematics scale (46 points in reading and science). In Turkey, however, students' socio-economic background impacts students' mathematics performance to a much lesser extent.

Building on this indicator, the index of curvilinearity provides additional information. The index informs if the impact of socio-economic status on performance becomes stronger or weaker at a higher level of socio-economic status.

According to the OECD (2010, 17):

"A positive value indicates that the socio-economic gradient becomes steeper for more advantaged socio-economic students. In other words, as socio-economic background increases, there is an increase in the extent to which inequalities in socio-economic background translate into performance differences. A negative value indicates the flattening off of the gradient at higher levels of socio-economic background: As socio-economic background becomes more advantaged, there is a decline in the extent to which inequalities in socio-economic background translate into performance differences."

In particular, this means that the poorest students show a large performance difference compared to their more socio-economically advantaged peers, whereas, from a certain level of wealth, the performance difference that is associated with further increases on the ESCS index is associated with a lesser degree of performance improvement. While the gradient line flattens in Slovakia, it becomes steeper in Montenegro, Serbia and Turkey, and especially in Romania. In these countries the wealthiest students particularly stand out and are more likely to perform at higher levels than their less socio-economically advantaged peers.

The slope of the gradient can further be divided into the performance differences that are associated with students' higher economic, social and cultural status for students attending the same school (the within-school association of ESCS and mathematics performance) and schools' higher economic, social and cultural status (the between-school association of ESCS and mathematics performance). The first reflects the performance difference between two students at the same school who differ by one unit on the ESCS, the second reflects performance difference between two schools that differ by one unit on the mean school ESCS.[9] The within-school association of ESCS and mathematics

[9] The mean school ESCS is the average ESCS of students in the school.

performance is relatively low in REF focus countries compared to the OECD average, with the exception of Russia and Slovakia. This means that two students with different economic, social and cultural status have comparably good chances to perform equally if they attend the same school. However, the performance differences between schools of different socio-economic profiles are considerable in all REF focus countries. The between-school association of ESCS and mathematics performance is above the OECD average in all countries with the exception of Romania and Russia. In the Czech Republic, a one-unit increase on the mean school ESCS is associated with a school-level score point increase of 127 points. Thus, inequalities between schools are large and students attending schools that have a student intake of more socio-economically disadvantaged students show a striking lower average student performance.

Results for all indicators presented in 3.2 are shown in Table 2.

Table 2.
Educational success and socio-economic status, REF focus countries

	Strength of the relationship between mathematics performance and ESCS		Slope of the socio-economic gradient for mathematics		Index of curvilinearity		Within-school association of ESCS and mathematics performance		Between-school association of ESCS and mathematics performance	
	Percentage of explained	S.E.	Score-point difference in	S.E.	Score-point difference in	S.E.	Student-level score-point difference	S.E.	School-level score-point difference	S.E.
OECD										
Albania	m	m	m	m	m	m	m	m	m	m
Bulgaria	**22.3**	(2.3)	**42**	(2.7)	2.5	(1.6)	**12**	(1.4)	**73**	(5.7)
Croatia	**12.0**	(1.4)	**36**	(2.6)	2.6	(1.6)	**12**	(1.6)	**90**	(9.2)
Czech Republic	**16.2**	(1.5)	**51**	(2.7)	-5.0	(2.9)	**14**	(1.7)	**127**	(6.5)
Hungary	**23.1**	(2.3)	**47**	(2.8)	-1.4	(1.8)	**6**	(1.4)	**98**	(4.9)
Montenegro	**12.7**	(0.9)	**33**	(1.3)	**2.9**	(1.4)	**12**	(1.8)	**102**	(6.0)
OECD average	**14.8**	(0.2)	**39**	(0.4)	**0.8**	(0.3)	**19**	(0.3)	**72**	(1.1)
Romania	**19.3**	(2.4)	**38**	(2.9)	**6.0**	(1.0)	**17**	(1.6)	**57**	(6.3)
Russian Federation	**11.4**	(1.7)	**38**	(3.2)	1.0	(2.3)	**26**	(2.2)	**47**	(7.0)
Serbia	**11.7**	(1.4)	**34**	(2.4)	**3.7**	(1.6)	**9**	(1.5)	**101**	(7.0)
Slovak Republic	**24.6**	(2.1)	**54**	(2.9)	**-3.9**	(2.0)	**21**	(2.1)	**86**	(6.4)
Turkey	**14.5**	(1.8)	**32**	(2.4)	**3.3**	(1.2)	**6**	(1.0)	**83**	(7.4)

Note: Values that are statistically significant are indicated in bold.
Source: OECD PISA 2012 Database.

Performance differences and home language

PISA data allows differentiating between students who speak the language of assessment at home and those who speak a minority language at home. This information can be combined with the information on the country of birth of students and parents. Thus, differentiation is possible between students who have a migration background and those who do not have a migration background, and between students who do speak the language of assessment at home and those who do not (see Table 3). The share of non-immigrant students who do not speak the language of assessment at home is considerable in Bulgaria (10 percent), Russia Federation (seven percent), Slovakia (seven percent) and Turkey (six percent). Often minority students are socio-economically disadvantaged compared to their peers. For example, the mean socio-economic background of non-immigrant students whose home language is not the language of assessment differs by more than one unit from their peers in Bulgaria and by almost one unit in Turkey and Slovakia.

In Bulgaria, Czech Republic, Hungary, Romania and Slovakia the performance differences between non-immigrant students who speak the official language at home and those who do not is statistically significant, even after taking into account students' socio-economic background.[10]

Table 3.
Performance differences between students who speak the language of assessment and those who do not, REF focus countries

	Percentage of students								Average socio-economic status								Performance differences after accounting for ESCS					
	Non-immigrant students who speak the language of assessment at home		Non-immigrant students who speak another language at home		Immigrant students who speak the language of assessment at home		Immigrant students who speak another language at home		Non-immigrant students who speak the language of assessment at home		Non-immigrant students who speak another language at home		Immigrant students who speak the language of assessment at home		Immigrant students who speak another language at home		Performance difference across non-immigrant students, by home language		Performance difference across immigrant students, by home language		Performance difference between immigrant students who do not speak the language of assessment at home and non-immigrant students who do	
	%	S.E.	%	S.E.	%	S.E.	%	S.E.	Mean index	S.E.	Mean index	S.E.	Mean index	S.E.	Mean index	S.E.	Score dif.	S.E.	Score dif.	S.E.	Score dif.	S.E.
Albania	0.0	c	0.0	c	0.0	c	0.0	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c
Bulgaria	89.1	(1.2)	10.4	(1.2)	0.3	(0.1)	0.2	(0.1)	-0.14	(0.03)	-1.33	(0.09)	c	c	c	c	**31**	(5.6)	c	c	c	c
Croatia	87.3	(0.8)	0.9	(0.2)	11.5	(0.8)	0.3	(0.1)	-0.30	(0.02)	-0.42	(0.11)	-0.59	(0.04)	c	c	0	(17.8)	c	c	c	c
Czech Republic	96.3	(0.4)	0.8	(0.2)	0.9	(0.2)	2.0	(0.3)	-0.06	(0.02)	0.08	(0.24)	-0.14	(0.15)	-0.15	(0.08)	**50**	(23.2)	-21	(26.6)	9	(16.0)
Hungary	97.7	(0.2)	0.7	(0.1)	1.3	(0.2)	0.3	(0.1)	-0.26	(0.03)	0.08	(0.21)	0.18	(0.12)	c	c	**40**	(18.0)	c	c	c	c
Montenegro	93.3	(0.5)	0.8	(0.1)	5.6	(0.4)	0.2	(0.1)	-0.26	(0.01)	-0.29	(0.20)	-0.10	(0.05)	c	c	20	(14.5)	c	c	c	c
OECD average	85.1	(0.1)	4.4	(0.1)	5.0	(0.1)	5.5	(0.1)	0.08	(0.00)	-0.12	(0.03)	-0.15	(0.02)	-0.39	(0.02)	**26**	(2.2)	3	(1.9)	**23**	(1.5)
Romania	98.2	(0.4)	1.6	(0.4)	0.1	(0.0)	0.1	(0.0)	-0.47	(0.04)	-0.56	(0.19)	c	c	c	c	**27**	(10.5)	c	c	c	c
Russian Federation	82.0	(1.7)	7.1	(1.6)	9.4	(0.8)	1.5	(0.3)	-0.07	(0.02)	-0.31	(0.06)	-0.12	(0.05)	-0.45	(0.12)	6	(7.0)	**34**	(14.2)	**46**	(14.9)
Serbia	88.0	(0.8)	3.5	(0.5)	7.8	(0.7)	0.7	(0.3)	-0.29	(0.02)	-0.49	(0.10)	-0.26	(0.05)	-0.63	(0.23)	1	(7.4)	-30	(20.6)	-40	(21.2)
Slovak Republic	92.3	(0.9)	7.1	(0.8)	0.5	(0.1)	0.2	(0.1)	-0.10	(0.02)	-1.08	(0.10)	c	c	c	c	**50**	(10.2)	c	c	c	c
Turkey	93.0	(0.8)	6.0	(0.8)	0.8	(0.2)	0.2	(0.1)	-1.40	(0.04)	-2.32	(0.08)	-1.05	(0.19)	c	c	24	(13.6)	c	c	c	c

Notes: This table was calculated considering only students with data on the *PISA index of economic, social and cultural status*. Values that are statistically significant are indicated in bold.
Source: OECD PISA 2012 Database.

Educational inequality of Romani-speaking students in Slovakia

Of particular interest is the performance of Roma students. Bulgaria, Hungary, Macedonia, Romania, Slovakia and Serbia have large Roma populations. While in all these countries the share of Roma is estimated to be at or above seven percent (Council of Europe 2012), the number of Roma of school-age is assumed to be significantly higher due to population characteristics (Ivanov et al. 2002, 26).

All these countries, with the exception of Macedonia, participated in PISA 2012 (see Annex 1). Thus, a considerable share of Roma students should have participated in PISA. However, PISA surveys in most countries do not collect students' ethnicity as a unique variable.[11] Identification of ethnic belonging is possible only indirectly via a question about the language spoken at home. Comparisons between Roma and non-Roma students are thus restricted to students that speak Romani at home and those who speak other languages at home.

This section provides analysis results of demographic and schooling characteristics of Romani-speaking students compared to Slovak- or Hungarian-speaking students in Slovakia. Inequalities regarding family background, preschool experience and grade repetition between the different student groups are analyzed. Subsequently, performance gaps are examined and factors that relate to them are investigated.[12] The analysis is restricted to Slovakia, since no other participating country has sufficient data to analyze PISA data for Roma students.

[10] However, it should be kept in mind that the share of non-immigrant students who speak another language at home is very small (> 2%) in Czech Republic, Hungary and Romania.
[11] Neither do TIMSS or PIRLS survey students' ethnicity.
[12] All subsequent analysis is conforming to PISA standard data analysis procedures as described in the PISA *Data Analysis Manual* (2009). Due to the two-stage sampling design applied in PISA, and the use of imputation methods (plausible values) for reporting student performance, specific statistical methodologies are applied. In order to facilitate computation and to apply identical procedures used for the production of the OECD PISA reports, the OECD provides macros which are available on the PISA website (www.pisa.oecd.org).

Romani-speaking students in PISA 2012

Of the almost half million students that were sampled in PISA 2012, only 226 were registered as Romani-speakers, distributed over four countries; 189 Romani-speakers were sampled in Slovakia, 16 in the Czech Republic, 16 in Slovenia and five in Finland. In PISA 2009, out of about 400,000 sampled students, only 83 were Romani-speakers, distributed over the same countries. The share of Romani-speakers in PISA has increased since 2009 but is still very low[13] (see Table 4).

Table 4.
Romani-speaking students in PISA 2009 and PISA 2012, by country

Romani speakers	PISA 2012			PISA 2009		
	Total (unweighted)	Total (weighted)	% (weighted)	Total (unweighted)	Total (weighted)	% (weighted)
Czech Republic	16	380	0.1	16	267	0.2
Finland	5	43	0.1	4	53	0.1
Slovak Republic	189	2200	4.2	53	1004	1.5
Slovenia	16	39	0.2	10	22	0.1
Total	**226**	**2661**	**0**	**83**	**1346**	**0**

Source: OECD PISA 2012 Database.

The largest share of Romani-speaking students can be found in Slovakia. Four percent of students indicated speaking Romani at home, whereas 87 percent of students indicated speaking Slovak at home and eight percent of students indicated to speak Hungarian at home (see Table 5). The extremely small sample sizes in the Czech Republic, Finland and Slovenia make comparisons between Roma and non-Roma impossible. Thus, only the case of Slovakia allows for juxtaposing performance and student and schooling characteristics of Romani-speaking students vis-à-vis other language groups.

Table 5.
Slovak PISA 2012 sample, by language groups and gender

	Total	Girls		Boys	
	%	%	S.E.	%	S.E.
Slovak	86.8	48.2	(1.8)	51.8	(1.8)
Romani	4.2	46.5	(3.1)	53.6	(3.1)
Hungarian	7.9	45.5	(3.6)	54.5	(3.6)
Another language	1.1	41.3	(7.6)	58.7	(7.6)

Source: OECD PISA 2012 Database.

A range of factors contributes to the underrepresentation of Roma students in PISA. Most importantly, PISA does not include a question about the belonging to a national or ethnic minority. Therefore, the only way for Roma students to be identified is via the question "What language do you speak most at home?" However, not all Roma predominantly speak Romani or dialects of Romani at home. In Hungary, for example, only a minority of Roma students speaks the Romani language. Nonetheless, the share of Roma who speak Romani is considerable in several other countries that participated in PISA 2012, for example, in Bulgaria, Romania or Serbia. Yet, in contrast to Slovakia the PISA questionnaires used in these countries did not offer the response category "Romani language."

[13] See Brüggemann & Bloem (2013) for performance, schooling and family characteristics of Romani-speaking students based on PISA 2009 data.

Another factor that potentially contributes to the underrepresentation of Roma students in PISA is dropping out of school. PISA does not sample students that dropout of school before the age of 15. Household surveys suggest that a considerable share of Roma students leaves school before the end of compulsory schooling in Bulgaria, Romania or Serbia, whereas in Czech Republic and Hungary dropping out of school takes place at a later stage and thus does not prevent the assessment of Roma students (Brüggemann 2012, 41–44). Assessment studies might further underrepresent Roma students if students are reluctant to identify as Romani speakers, for example, trying to avoid stigmatization and discrimination. Finally, countries are allowed to exclude up to five percent of the student body on the basis of special needs. Romani students might be overrepresented among those students excluded from PISA. It is possible that the increase of Romani-speaking students sampled in Slovakia in PISA 2012 compared to PISA 2009 is related to the fact that fewer students have been excluded from the sampling (the exclusion rate was 4.6 percent in PISA 2009 and 2.9 percent in PISA 2012).

Even though a considerable share of Romani-speaking students has been sampled in Slovakia, the share of the Romani-speaking student population is still likely to be underrepresented. Recent estimates assume the share of Roma living in Slovakia to be between six percent and seven percent of the total population (Matlovičová 2012) and over two-thirds of Roma in Slovakia are estimated to speak Romani at home (Baker & Rooker 2001, 10; Brüggemann 2012, 54). In addition, the share of Roma in younger age cohorts is significantly higher than the share of Roma in older age cohorts due to different population dynamics (Statistical Office of the Slovak Republic 2015, 81). The share of Roma at the age of compulsory schooling is thus significantly higher than the overall share of Roma living in Slovakia. Therefore, the share of students that speak Romani at home is likely to be far above four percent. Results presented in this paper should be understood against this background: the data represents Romani-speaking students sampled in PISA but does not allow for a general conclusion about the total Roma student population in Slovakia.

The underrepresentation of Romani-speakers leads to a small sample size, which limits the possibilities to disaggregate PISA data according to linguistic categories. Therefore, the results presented below should be treated with caution. Standard errors, which are reported for all results, are usually much larger for small sample sizes. They increase the range within the real value is located so that the presented results should not be taken in the strict sense.[14] Yet, due to very large differences between Romani-speakers and Slovak- and Hungarian-speaking students, certain results are statistically significant despite relatively large standard errors. It is not possible to analyze changes over time from 2009 to 2012 due to small sample sizes in both assessment cycles.

Romani-speaking students in Slovakia: Performance

Romani-speaking students achieve much lower mean scores in all test disciplines than their Slovak- and Hungarian-speaking peers (see Table 6). The performance gap between Romani-speaking students and Slovak- and Hungarian-speaking students equals a deficit of three to four years of schooling in all test disciplines.[15] The performance of Romani-speaking students is lowest in reading

[14] For some analysis the minimum number of observations (i.e. there are fewer than 30 students or fewer than 5 schools with valid data) is not fulfilled to provide reliable estimates. These results are not presented numerically.
[15] Around 40 points roughly equals one school year (OECD, 2014).

with a mean score below 300 points. Also for their Slovak- and Hungarian-speaking peers, reading is the discipline with the lowest mean performance (476 points and 441 points, respectively).

The performance of Romani-speaking students is highest in problem solving, with 350 points. Accordingly, the performance difference of Romani-speaking students compared to their Slovak- and Hungarian-speaking peers is highest in reading (a difference of 186 points and 151 points, respectively) and lowest for problem solving (a difference of 145 points and 95 points, respectively). There is no statistically significant performance difference between Romani-speaking boys and girls in either discipline.

Table 6.
Mean scores in mathematics, reading, science and problem solving, by language groups, Slovakia

	Romani		Slovak		Hungarian	
	Mean	S.E.	Mean	S.E.	Mean	S.E.
Mathematics	***340***	(11.6)	493	(3.6)	462	(21.1)
Reading	***290***	(11.1)	476	(4.2)	441	(25.5)
Science	***308***	(10.4)	483	(3.7)	458	(23.2)
Problem solving	***350***	(13.4)	495	(3.5)	445	(19.3)

Note: Differences between Romani-speaking and Slovak-speaking students that are statistically significant are indicated in bold. Differences between Romani-speaking and Hungarian-speaking students that are statistically significant are indicated in italic.

Source: OECD PISA 2012 Database.

The share of Romani-speaking students that achieve basic skill levels is equally low. The share of Romani-speaking students who does not achieve proficiency Level 2, which is considered the baseline level of proficiency, exceeds 90 percent in reading and science, is at 87 percent in mathematics and at 81 percent in problem solving (see Table 7). It can be concluded that between 80 percent and 95 percent of Romani-speaking students sampled in PISA have not acquired basic cognitive skills and competencies and have thus limited possibilities to find qualified employment and cope with the complex demands of today's societies. Among Hungarian-speaking students this share is slightly above 35 percent in mathematics and science and slightly above 40 percent in reading and problem solving. Among Slovak-speaking students this share is slightly above 20 percent in all disciplines.

Table 7.
Distribution of students at the proficiency levels in mathematics, reading, science and problem solving by language groups, Slovakia

	Romani		Slovak		Hungarian	
	%	S.E.	%	S.E.	%	S.E.
Mathematics						
below Level 2	86.6	(5.4)	22.9	(1.2)	36.8	(7.9)
Level 2 or 3	13.4	(5.4)	47.5	(1.4)	37.4	(4.7)
Level 4, 5 or 6	0	c	29.6	(1.7)	25.8	(7.6)
Reading						
below Level 2	95.1	(3.1)	23.0	(1.8)	40.3	(8.5)
Level 2 or 3	4.9	(3.1)	55.8	(1.7)	36.3	(4.7)
Level 4, 5 or 6	0	c	21.2	(1.5)	23.4	(7.6)
Science						
below Level 2	94.1	(3.4)	21.9	(1.6)	35.3	(8.1)
Level 2 or 3	5.7	(3.4)	56.8	(1.6)	41.9	(5.1)
Level 4, 5 or 6	0.2	(0.6)	21.3	(1.6)	22.8	(7.8)
Problem solving						
below Level 2	80.5	(6.1)	21.2	(1.4)	41.8	(8.4)
Level 2 or 3	19.2	(5.9)	52.4	(1.5)	40.6	(5.2)
Level 4, 5 or 6	c	c	26.5	(1.6)	17.6	(4.9)

Source: OECD PISA 2012 Database.

Romani-speaking students in Slovakia: Family background

Unsurprisingly, Romani-speaking students come from disadvantaged socio-economic backgrounds (see Table 8). The gap on the PISA index of economic, social and cultural status between Romani-speaking students and their peers is more than one and a half standard deviations. It is at -1.7, compared to -0.1 and -0.3, respectively, for Slovak- and Hungarian-speaking students (see Table 8). The socio-economic status of Slovak-speaking students is at the OECD average, which means a typical Slovak-speaking student in Slovakia comes from a socio-economic background that is similar to that of a typical student in other OECD countries. In an international perspective, an ESCS below -1 is considered a socio-economically disadvantaged student (OECD 2013a). Romani-speaking students in Slovakia are situated well below this internationally defined level of socio-economic disadvantage.

With regard to educational success, the possession of educational resources at home, such as a desk, a quiet place to study, a computer that can be used for schoolwork, educational software, books to help with students' school work, technical reference books and a dictionary support effective learning (see Annex 2 for a list of items that define corresponding PISA indices). Romani-speaking students reported to possess significantly less educational resources at home compared to their peers.

The level of education of parents of Romani-speaking students is also lower than that of parents from students that speak Slovak or Hungarian. While students who speak Slovak and Hungarian at home reported an average of about 14 years of parents' schooling, students who speak Romani at home reported an average of about 11 years. Similarly, Romani-speaking students have a greater than one standard deviation lower index of parents' highest educational level than their Slovak- and Hungarian-speaking peers. The occupational status of parents of Romani-speaking students is also

significantly lower than that of parents from their Slovak- and Hungarian-speaking peers (23 compared to 44 and 41, respectively).

Compared to their peers, Romani-speaking students are less often to be found in town and city schools (11 percent) but more frequently in village schools (43 percent) and small town schools (46 percent). In comparison, among Slovak-speaking students two-thirds attend schools in towns or cities and among Hungarian-speaking students still nearly four out of ten do so. Often socio-economic disadvantage and living in rural areas fall together, as is the case in Slovakia, where more than half of all students in rural schools[16] attend socio-economically disadvantaged schools (OECD 2013a, Table II.4.2).

Table 8.
Family characteristics of students in Slovakia, by language group

	Romani		Slovak		Hungarian	
	Mean	S.E.	Mean	S.E.	Mean	S.E.
PISA index of economic, social and cultural status (ESCS)	***-1.66***	(0.09)	-0.10	(0.03)	-0.26	(0.13)
PISA index of home educational resources	***-2.19***	(0.16)	0.19	(0.03)	-0.15	(0.08)
Parents' education converted in years of schooling	***11.3***	(0.30)	14.2	(0.10)	13.8	(0.30)
PISA index of parents' highest educational status	***2.97***	(0.14)	4.40	(0.31)	4.23	(0.13)
PISA index of parents' highest occupational status	***22.8***	(1.61)	43.9	(0.63)	41.1	(2.87)
Percentage of students attending schools in …						
…villages	43.1	(10.9)	11.8	(2.0)	18.8	(5.2)
…small towns	45.6	(10.2)	20.8	(2.9)	42.8	(10.7)
…towns	10.7	(3.1)	53.0	(3.6)	29.1	(7.7)
…city	0.6	(0.6)	14.4	(1.9)	9.3	(5.5)

Notes:
Differences between Romani-speaking and Slovak-speaking students that are statistically significant are indicated in bold. Differences between Romani-speaking and Hungarian-speaking students that are statistically significant are indicated in italic.
The educational level of parents is classified using ISCED (OECD, 1999) based on students' responses in the student questionnaire

Occupational data for both a student's parents were obtained by asking open-ended questions in the student questionnaire. The responses were coded to four-digit ISCO codes and then mapped to the SEI index. Higher scores of SEI indicate higher levels of occupational status.

Source: OECD PISA 2012 Database.

Romani-speaking students in Slovakia: School characteristics

The majority of students in Slovakia reported that they started school at the age of six. There are no differences between the three language groups. Pre-primary education for two years or more is almost universal in Slovakia (OECD 2013a, Table II.4.12). This, however, does not hold true for Romani-speaking students: Only 33 percent attended pre-primary education for more than one year, 21 percent did so for one year or less and 45 percent did not attend pre-primary education at all (see Table 9).

Romani-speaking students show higher class repetition rates than their peers. About two percent of Slovak-speaking students and about seven percent of Hungarian-speaking students repeated one year or more in primary school, compared to more than 50 percent of Romani-speaking students. The same holds true for lower secondary education, where again Romani-speaking students show much higher repetition rates than their peers. In light of these findings, it is not surprising that Romani-speaking students are in lower grades than their peers: About 60 percent are two years or more behind the modal grade. Among Slovak- and Hungarian-speaking students more than half attend the modal grade and less than five percent are two years or more behind the modal grade.

[16] Rural schools are defined as schools located in a village or in a rural area with fewer than 3,000 people.

The tracking of students to academic or vocational schools usually takes place after grade nine at an age of about 14. The share of Romani-speaking students that is still in basic schools (*Základná škola*, grades one to nine) is almost twice as high compared to their Slovak- and Hungarian speaking peers (80 percent, 40 percent and 43 percent, respectively). A relatively large share of Roma students in Slovakia attends special schools or classes. In areas with above average Roma populations the share of Roma who attend special schools or classes is about 20 percent according to household survey data (Brüggemann & Skobla 2012). No student sampled in PISA attended a special school. However, it is unknown how many students attended classes for students with special needs.

Table 9.
Schooling characteristics of students in Slovakia, by language groups

	Romani		Slovak		Hungarian	
	Mean	S.E.	Mean	S.E.	Mean	S.E.
Percentage of students that started school						
at age 6	64.5	(4.3)	65.8	(1.2)	64.9	(5.8)
at age 7	32.2	(4.0)	31.8	(1.2)	32.7	(5.5)
Percentage of students that attended pre-primary education						
never	45.7	(5.4)	4.7	(0.5)	c	c
for one year or less	21.4	(4.1)	13.2	(0.9)	c	c
for more than one year	32.9	(6.0)	82.2	(1.0)	85.6	(2.5)
Percentage of students that repeated a grade in primary education						
…never	48.9	(4.7)	97.8	(0.3)	92.6	(2.1)
…once	37.6	(4.9)	1.6	(0.3)	5.8	(2.2)
…twice or more	13.5	(3.0)	0.7	(0.2)	1.6	(1.0)
Percentage of students that repeated a grade in lower secondary education						
…never	69.5	(5.3)	97.4	(0.4)	95.4	(2.6)
…once	24.9	(4.5)	2.3	(0.4)	3.8	(1.9)
…twice or more	5.6	(2.8)	0.3	(0.1)	0.8	(0.9)
Percentage of students that attend a grade level compared to modal grade						
3 years behind the modal grade	15.4	(3.6)	1.0	(0.2)	0.9	(0.9)
2 years behind the modal grade	44.2	(6.7)	2.5	(0.3)	2.3	(1.4)
1 year behind the modal grade	33.5	(6.0)	40.0	(1.6)	43.4	(7.1)
modal grade	6.9	(2.7)	54.8	(1.6)	52.3	(7.5)
1 year ahead the modal grade	c	c	1.7	(0.5)	1.1	(0.5)
Percentage of students that attend a school with ISCED destination						
1A	92.6	(1.4)	80.9	(7.8)	81.0	(6.4)
2B	0.5	(0.3)	12.9	(7.3)	0.9	(0.7)
3C	6.8	(1.4)	6.3	(2.4)	18.2	(6.3)
Percentage of students in the different programmes						
Basic school (ISCED 1+2)	80.2	(7.9)	40.0	(1.7)	43.4	(8.9)
Special school (ISCED 1+2)	c	c	c	c	c	c
8-years Gymnasium (ISCED 2+3)	c	c	7.2	(1.2)	c	c
Gymnasium (ISCED 3)	c	c	26.7	(1.2)	22.6	(6.8)
Vocational school or class with matura option	c	c	28.8	(1.6)	9.5	(3.7)
Vocational school or class without matura option	c	c	6.8	(1.4)	18.2	(6.3)

Source: OECD PISA 2012 Database.

Romani-speaking students attend schools with a comparatively low level of disciplinary climate, for example, where interruption of class occurs frequently (see Table 10). Based on reports from school principals, Romani-speaking students are more likely to be found in schools where learning is hindered by different factors related to student behavior, such as tardiness or disruption of classes. Yet, Romani-speaking students reported better student-teacher relations than their Hungarian- and, in particular, Slovak-speaking peers. This means that Romani-speaking students more often than Slovak-speaking students agreed with statements such as whether they get along well with most of their teachers or whether teachers listen to what they have to say. The quality of school educational resources and the quality of physical infrastructure of schools attended by Romani-speaking students is not statistically significantly different from schools attended by Slovak- and Hungarian-speaking students. But teacher shortages are a problem that more often happens in schools that are attended by Romani-speaking students.

Table 10.
Disciplinary climate and school characteristics, by language groups, Slovakia

	Romani		Slovak		Hungarian	
	Mean	S.E.	Mean	S.E.	Mean	S.E.
PISA index of disciplinary climate at school	***-0.56***	(0.08)	-0.11	(0.03)	0.00	(0.11)
PISA index of teacher morale	-0.15	(0.20)	-0.28	(0.07)	-0.22	(0.13)
PISA index of teacher-related factors affecting school climate	0.06	(0.15)	0.05	(0.06)	-0.10	(0.12)
PISA index of student-related factors affecting school climate	***-0.64***	(0.13)	-0.19	(0.07)	-0.13	(0.22)
PISA index of teacher-student relations	***0.34***	(0.10)	-0.22	(0.02)	0.04	(0.09)
PISA index of quality of school educational resources	-0.65	(0.15)	-0.53	(0.04)	-0.74	(0.15)
PISA index of quality of physical infrastructure	-0.36	(0.24)	-0.12	(0.07)	-0.21	(0.16)
PISA index of teacher shortage	**0.24**	(0.17)	-0.4	(0.05)	-0.04	(0.08)

Note: Differences between Romani-speaking and Slovak-speaking students that are statistically significant are indicated in bold. Differences between Romani-speaking and Hungarian-speaking students that are statistically significant are indicated in italic.

Source: OECD PISA 2012 Database.

Mathematics performance is influenced by different factors that have to do with students' opinion about themselves as mathematics learners and their learning strategies (OECD, 2013b). PISA data shows that Romani-speaking students score worse on various indices related to attitudes towards mathematics and learning strategies (see Table 11). In particular, they are more afraid of mathematics, and are less efficient mathematics learners. This is not surprising since mathematics performance is highly associated with mathematics anxiety and self-efficiency in almost all participating countries (OECD 2013b, Tables III.4.1d and III.4.2d). While the direction of this relationship cannot be determined with PISA data, i.e., if a high level of anxiety leads to low performance or if low performance increases mathematics anxiety, research on this issue suggests that a high level of anxiety hinders learning and problem solving as the student cannot or to a lesser extent concentrate on the task (OECD, 2013b, 98).

In contrast, Romani-speaking students did report statistically significant higher levels of mathematics work ethics than their Slovak speaking peers and higher instrumental motivation to learn mathematics. They are thus motivated mathematics learners who perceive mathematics as useful to them and to their future studies and careers (OECD 2013b). There are no statistically significant differences between the language groups concerning their perseverance – for example, their willingness to work on problems that are difficult even when they encounter problems. No statistically significant differences concerning attitudes towards school, and the sense of belonging at school are observed between Romani-speaking students and their peers. Thus, Slovak-, Hungarian- and Romani-speaking students all reported similar levels of agreement and disagreement for what

concerns their views on whether or not school has been useful for them for later life and will bring positive future outcomes, as well as their view on whether or not they feel that they belong to the school and class community. This means that Romani-speaking students and Slovak-speaking students do not differ with regard to questions such as whether they feel lonely or happy at school or questions such as whether trying hard at school will help them to get good grades or a good job.

Table 11.
Students' attitudes towards mathematics and schooling, by language group, Slovakia

	Romani		Slovak		Hungarian	
	Mean	S.E.	Mean	S.E.	Mean	S.E.
PISA index of mathematics anxiety	***0.48***	(0.09)	-0.02	(0.03)	0.07	(0.10)
PISA index of mathematics efficiency	***-0.50***	(0.10)	0.12	(0.03)	0.00	(0.12)
PISA index of mathematics work ethics	**-0.15**	(0.11)	-0.45	(0.02)	-0.31	(0.07)
PISA index of mathematics self-concept	**0.01**	(0.08)	-0.18	(0.02)	-0.08	(0.08)
PISA index of perseverance	-0.41	(0.09)	-0.52	(0.02)	-0.18	(0.09)
PISA index of instrumental motivation to learn mathematics	**0.07**	(0.12)	-0.36	(0.02)	-0.16	(0.07)
PISA index of sense of belonging	*-0.46*	(0.10)	-0.31	(0.02)	-0.21	(0.06)
PISA index of familiarity with mathematics concepts	***-0.71***	(0.08)	-0.01	(0.03)	0.09	(0.19)
PISA index of attitudes towards schools (learning outcomes)	*-0.43*	(0.11)	-0.26	(0.02)	-0.06	(0.08)
PISA index of attitudes towards schools (learning activities)	-0.21	(0.12)	-0.43	(0.02)	-0.25	(0.06)

Differences between Romani-speaking and Slovak-speaking students that are statistically significant are indicated in bold.
Differences between Romani-speaking and Hungarian-speaking students that are statistically significant are indicated in italic.

Source: OECD PISA 2012 Database.

How family background and schooling characteristics influence performance

One possibility to measure the extent to which contextual factors affect the performance of students is to adjust performance outcomes for socio-economic background, assuming that Roma students have the same socio-economic background of their Slovak-speaking peers. Such an adjustment is obviously entirely hypothetical: students act in an environment where actual, rather than adjusted, performance in cognitive skills and abilities — and non-cognitive skills beyond PISA's measure — is what matters.

Results from simple linear regression analysis show that Roma students' disadvantaged family background explains to some extent their huge performance gap (a difference of 153 points in mathematics performance) when compared to their peers (see Table 12). After controlling for socio-economic background, the performance gap in mathematics between Slovak and Roma students decreases to 77 points. Thus, family background accounts for roughly half of the performance gap between these two groups.

As pointed out above, Romani-speaking students repeat grades more frequently and are overrepresented in lower grades. As lower test scores may be due to the attendance of lower grades, we also repeat simple regression analysis, taking grade repetition and grade attendance into account. The grade attended when sitting the PISA test explains again 54 points of the performance gap between Slovak- and Romani-speaking students. Roma students' more frequent grade repetition compared to their peers explains 78 points of the performance gap with Slovak-speaking students. If controlling for both grade attendance and repetition, as these factors relate to each other, the

performance gap decreases by further 20 points compared to grade repetition alone and remains at 73 points difference between the two groups.

Table 12.
Simple regression analysis to explain performance differences between Romani- and Slovak-speaking students in Slovakia

	Romani-speaking student compared to Slovak-speaking students			
	Score difference	S.E.	R-Square	S.E.
Null-Model	-153	(12.2)	0.10	(0.02)
Model 1: ESCS	**-77**	(15.1)	0.27	(0.03)
Model 2: Grade level	**-99**	(11.3)	0.17	(0.03)
Model 3: Grade repetition	**-75**	(14.0)	0.17	(0.02)
Model 4: Grade level and grade repetition	**-73**	(12.5)	0.20	(0.03)
Model 5: Pre-primary education	-125	(13.6)	0.12	(0.22)
Model 6: National programme	-147	(11.8)	0.10	(0.02)

Differences between Romani-speaking and Slovak-speaking students that are statistically significant are indicated in bold.
Source: OECD PISA 2012 Database.

Conclusion

The Roma Education Fund aims at closing the gap in educational outcomes between Roma and non-Roma students working in 16 countries in Central, Eastern and South Eastern Europe. REF therefore also aims at measuring and analyzing educational inequalities between Roma and non-Roma across countries. This working paper contributes to the understanding of educational inequalities by looking at the potential of international student assessment data to (a) compare performance inequalities across REF focus countries and (b) measure performance inequalities between Romani-speaking students and Slovak- and Hungarian-speaking students in Slovakia, the only country where such comparison is possible at the moment.

Collecting ethnic data is highly sensitive since ethnic identification is subjective and data protection is a fundamental right. In addition, ethnic identification is a multifaceted and context dependent. Who is counted as belonging to a national or ethnic minority is strongly determined by factors such as: *Who counts, how and when and why?* (Ladányi & Szelényi 2001; Messing 2014; Rughiniş 2011). Given the existing limitations of census surveys, household surveys and international student assessments, researchers and policymakers should always take into account various sources and comprehensive context information. In order to receive an adequate picture about access, participation and performance of Roma students in education, various quantitative sources should be taken into account. Qualitative studies along with professional knowledge and experiences are equally relevant and crucial in order to contextualize survey data.

Since international surveys do not collect data based on ethnic belonging, specialized and cost-intensive household surveys are the standard approach of measuring educational inequalities between Roma and non-Roma students. Such surveys have produced a great wealth of data mainly with regard to educational participation and attainment, educational segregation and self-perceived literacy. Inequalities captured by these indicators are well documented. However, very little is known

about inequalities regarding actual skills and competencies as well as cognitive performance in areas such as reading, mathematics, science and problem solving.

Almost all Roma Education Fund focus countries have participated in international student assessments such as PISA, TIMSS and PIRLS. International student assessments therefore have a considerable potential to inform about educational inequalities in REF focus countries, for example, by looking at the share of students who do not reach a certain threshold or by analyzing how a student's socio-economic status predicts his or her performance. PISA 2012 results show that educational inequality is large in many REF focus countries, especially in Slovakia, but also in Bulgaria, Czech Republic and Hungary where socio-economic disparities explain a significant share of observed differences in students' performance.

International student assessments offer limited possibilities to measure the performance of minority students. PISA, TIMSS and PIRLS do not assess the belonging to a national or ethnic minority. PISA These assessments collect information on the language a student speaks at home which allows disaggregating data for linguistic minorities.

Even though Roma are considered to be the most numerous minority in Europe, only a very small number of Romani-speaking students can be identified in PISA data. Most students identified live in the Slovakia: the Slovak PISA 2012 sample included 189 students (four percent of the student population) who indicated speaking predominantly Romani at home. The number of Roma students sampled in PISA 2012 is likely to be underestimated since not all Roma students predominantly speak Romani at home. Also, Roma students might not want to identify as Romani-speaking in order to avoid being stigmatized. Furthermore, Roma students might be overrepresented among those students excluded from PISA assessments. In consequence, the results presented in this paper are not representative for all Roma students in Slovakia. However, results presented here provide an indication on the extent to which 15-year-old Romani-speaking students attending regular schools in Slovakia are disadvantaged compared to Slovak- and Hungarian-speaking students.

We found considerable performance differences: Romani-speakers perform significantly lower than Slovak-speaking and Hungarian-speaking students in all subjects. Romani-speaking students are between three and four years behind in reading, mathematics and science and perform best, but still significantly lower than Slovak- and Hungarian-speaking students, in problem solving. Over 80 percent of Romani-speaking students do not reach proficiency Level 2 in PISA, a baseline to cope with the complex requirements of modern societies, whereas about 35–40 percent of Hungarian-speaking students and about 20 percent of Slovak-speaking students do not reach proficiency Level 2. This suggests that the educational disadvantages of Romani-speaking students do not only concern limited access to early childhood education, streaming into special schools and dropping out of school at a young age, but also the actual skills and abilities of Romani-speaking students who attend regular schools at the age of 15. Also, Romani-speaking students live in families with a considerably lower socio-economic status, and live more frequently in villages and small towns instead of towns or cities compared to Slovak- and Hungarian-speaking students.

We did not find differences with regard to the age of school entry but high repetition rates among Romani-speaking students, who in turn attend lower grades than their Slovak- and Hungarian-speaking peers: less than 10 percent of Romani-speaking students attended the modal grade. Schools attended by Romani-speaking students did not report possessing, on average, less educational resources or having a worse physical infrastructure, but school principals of such schools reported significantly higher rates of teacher shortages (lower rates of qualified teachers).

Controlling for the socio-economic background and grade repetition strongly reduced the performance gap in mathematics between Romani-speaking students and their peers but significant differences remain.

Most interestingly, Romani-speaking students reported better student-teacher relations than their Hungarian-speaking and, in particular, Slovak-speaking peers. Furthermore, we did not find statistically significant differences with regard to attitudes towards school or the sense of belonging at school. Thus, assumptions such as mainstream education "lacks relevance and value" for Roma students (Smith 1997, 249) or that for Roma "going to school is wasted time" (Lee and Warren 1991, 315) seem not to apply to Romani-speaking students at the age of 15 in Slovakia.

In countries where a significant amount of Roma students leaves school before the age of 15, PIRLS and TIMSS – which measure the achievement of students attending fourth grade – might have a higher potential to evaluate performance and schooling characteristics of Roma students than PISA does, since dropout rates are lower in primary than in secondary education. TIMSS and PIRLS do not capture ethnic belonging but have recently introduced questions on the languages spoken at home only in the 2015 and 2016 surveys.

Several steps could be taken in order to capture Romani students in international student assessments :

- *First*, countries with a relatively high share of Roma minority students could offer an additional variable covering the belonging to a national or ethnic minority, possibly providing the option to identify with more than one national or ethnic group.
- *Second*, countries with a relatively high share of Roma minority students could offer the category "Romani" as an answer characteristic concerning the question what languages students speak at home. This might possibly increase the share of Roma students in the PISA sample, at least in those countries where a high share of Roma speak Romani.
- *Third*, countries with relatively small Roma minorities, however, would need to provide additional oversamples targeting exclusively Roma students.

A better coverage of Roma students in PISA (and/or other international student assessments) would allow for analyzing and comparing learning outcomes of Roma students within the country but also across countries. This may give relevant insights with regard to the differences between Roma students and their peers and how such differences are related to background characteristics and differences in terms of the organization and governance of the education systems. There is a hidden potential of international student surveys to evaluate inequalities between majority and minority students. Nevertheless, a certain risk remains that disaggregated data might be used to the disadvantage of minority students. Results may be misused to argue for the apparently lower aptitudes and abilities of minority students while ignoring students' different family and school characteristics and/or foregoing factors of inequity between student groups. Disaggregated data may also contribute to reconstructing differences by differentiating groups of students. This could amplify hostility and stigmatization. Therefore, it is essential to carefully present and contextualize the results of disaggregated data analysis.

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Annex 1
Roma Education Fund focus countries according to their participation in international student assessments

	PISA	PIRLS	TIMSS
Albania	Since 2000 (not 2003 and 2006)	-	-
Bosnia & Herzegovina	-	-	2007
Bulgaria	Since 2000 (not 2003)	Since 2001	Since 1995
Croatia	Since 2006	2011	2011, 2015
Czech Republic	Since 2000	2001, 2011	Since 1995 (not 2003)
Hungary	Since 2000	Since 2001	Since 1995
Macedonia	2000, 2015	2001, 2006	1999, 2003, 2011
Moldova	2009, 2015	2001, 2006	1999, 2003
Montenegro	Since 2003	-	-
Kosovo	2015	-	-
Romania	Since 2006	Since 2001	Since 1995, not 2015
Russian Federation	Since 2000	Since 2001	Since 1995
Serbia	Since 2003 (not 2015)	-	2003, 2007, 2011
Slovak Republic	Since 2003	Since 2001	Since 1995
Turkey	Since 2000	2001	1999, since 2007
Ukraine	-	-	2007, 2011

PISA circles: 2000, 2003, 2006, 2009, 2012, 2015; PIRLS circles: 2001, 2006, 2011; TIMSS circles: 1995, 1999, 2003, 2007, 2011, 2015.

Sources: http://www.oecd.org/pisa/aboutpisa/pisaparticipants.htm (for PISA), https://nces.ed.gov/surveys/pirls/countries.asp (for PIRLS), https://nces.ed.gov/timss/countries.asp (for TIMSS)

Annex 2
Description of the PISA indices

PISA index of economic, social and cultural status (ESCS)	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 family wealth possessions (WEALTH), cultural possessions (CULTPOSS) and home educational resources (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).
PISA index of home educational resources	The index of home educational resources 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.
PISA index of parents' highest educational status	The educational level of parents is classified using ISCED (OECD, 1999) based on students' responses in the student questionnaire.
PISA index of parents' highest occupational status	Occupational data for both a student's parents were obtained by asking open-ended questions in the student questionnaire. The responses were coded to four-digit ISCO codes and then mapped to the Socioeconomic Index (SEI). Higher scores of SEI indicate higher levels of occupational status.
PISA index of disciplinary climate at school	The index of disciplinary climate was derived from students' reports on how often the followings happened in their lessons of the language of instruction: students don't listen to what the teacher says; there is noise and disorder; the teacher has to wait a long time for the students to <quieten down>; students cannot work well; students don't start working for a long time after the lesson begins. In this index higher values indicate a better disciplinary climate.
PISA index of teacher morale	The index of teacher morale was derived from school principals' reports on the extent to which they agree with the following statements considering teachers in their schools: the morale of teachers in this school is high; teachers work with enthusiasm; teachers take pride in this school; and teachers value academic achievement. As all items were inverted for scaling, higher values on this index indicate more positive teacher morale.

PISA index of teacher-related factors affecting school climate	The index on teacher-related factors affecting school climate was derived from school principals' reports on the extent to which the learning of students was hindered by the following factors in their schools: students not being encouraged to achieve their full potential; poor student-teacher relations; iii) teachers having to teach students of heterogeneous ability levels within the same class; teachers having to teach students of diverse ethnic backgrounds (i.e. language, culture) within the same class; teachers' low expectations of students; teachers not meeting individual students' needs; teacher absenteeism; staff resisting change; teachers being too strict with students; teachers being late for classes; teachers not being well prepared for classes. As all items were inverted for scaling, higher values on this index indicate a positive teacher behavior.
PISA index of student-related factors affecting school climate	The index of student-related factors affecting school climate was derived from school principals' reports on the extent to which the learning of students was hindered by the following factors in their schools: student truancy; students skipping classes; students arriving late for school; students not attending compulsory school events (e.g., sports day) or excursions; students lacking respect for teachers; disruption of classes by students; student use of alcohol or illegal drugs; students intimidating or bullying other students. As all items were inverted for scaling, higher values on this index indicate a positive student behavior.
PISA index of teacher-student relations	The index of teacher-student relations was derived from students' level of agreement with the following statements. The question asked stated "Thinking about the teachers at your school: to what extent do you agree with the following statements": Students get along well with most of my teachers; Most teachers are interested in students' well-being; Most of my teachers really listen to what I have to say; If I need extra help, I will receive it from my teachers; Most of my teachers treat me fairly. Higher values on this index indicate positive teacher-student relations.
PISA index of quality of school educational resources	The index of quality of school educational resources was derived from six items measuring school principals' perceptions of potential factors hindering instruction at their school. These factors are: shortage or inadequacy of science laboratory equipment; shortage or inadequacy of instructional materials; shortage or inadequacy of computers for instruction; lack or inadequacy of Internet connectivity; shortage or inadequacy of computer software for instruction; shortage or inadequacy of library materials. As all items were inverted for scaling, higher values on this index indicate better quality of educational resources.

PISA index of quality of physical infrastructure	The index of quality of physicals' infrastructure was derived from three items measuring school principals' perceptions of potential factors hindering instruction at their school. These factors are: shortage or inadequacy of school buildings and grounds; shortage or inadequacy of heating/cooling and lighting systems; shortage or inadequacy of instructional space (e.g., classrooms). As all items were inverted for scaling, higher values on this index indicate better quality of physical infrastructure.
PISA index of teacher shortage	The index of teacher shortage was derived from four items measuring school principals' perceptions of potential factors hindering instruction at their school. These factors are a lack of: qualified science teachers; qualified mathematics teachers; qualified teachers; qualified teachers of other subjects. Higher values on this index indicate school principals' reports of higher teacher shortage at a school.
PISA index of mathematics anxiety	The index of mathematics anxiety was constructed using student responses to the question over the extent they strongly agreed, agreed, disagreed or strongly disagreed with the following statements when asked to think about studying mathematics: I often worry that it will be difficult for me in mathematics classes; I get very tense when I have to do mathematics homework; I get very nervous doing mathematics problems; I feel helpless when doing a mathematics problem; I worry that I will get poor in mathematics.
PISA index of mathematics self-efficacy	The index of mathematics self-efficacy was constructed using student responses over the extent they reported feeling very confident, confident, not very confident, not at confident about having to do a number of tasks. The question asked about the following mathematics tasks: Using a to work out how long it would take to get from one place to another; calculating how much cheaper a TV would be after a 30 percent discount; calculating how many square meters of tiles you need to cover a floor; understanding graphs presented in newspapers; solving an equation like 3x+5=17; finding the actual distance between two places on a map with a 1:10,000 scale; solving an equation like 2(x+3)=(x+3)(x-3); calculating the petrol consumption rate of a car.

PISA index of mathematics work ethics	The index of mathematics work ethics was constructed using student responses over the extent they strongly agreed, agreed, disagreed or strongly disagreed with the following statements: I finish my homework in time for mathematics class; I work hard on my mathematics homework; I'm prepared for my mathematics exams; I study hard for mathematics quizzes; I keep studying until I understand mathematics material; I listen in mathematics class; I pay attention in mathematics class; I avoid distractions when I am studying mathematics; I keep my mathematics work well organized.
PISA index of mathematics self-concept	The index of mathematics self-concept was constructed using student responses to the question over the extent they strongly agreed, agreed, disagreed or strongly disagreed with the following statements when asked to think about studying mathematics: I am just not good at mathematics; I get good in mathematics; I learn mathematics quickly; I have always believed that mathematics is one of my best subjects; in my mathematics class, I understand even the most difficult work.
PISA index of perseverance	The index of perseverance was constructed using student responses over whether they report that the following statements describe them very much, mostly, somewhat, not much, not at all: When confronted with a problem, I give up easily; I put off difficult problems; I remain interested in the tasks that I start; I continue working on tasks until everything is perfect; when confronted with a problem, I do more than what is expected of me.
PISA index of instrumental motivation to learn mathematics	The index of instrumental motivation to learn mathematics was constructed using student responses over the extent they strongly agreed, agreed, disagreed or strongly disagreed to a series of statements in the question when asked to think about their views on mathematics: Making an effort in mathematics is worth because it will help me in the work that I want to do later on; learning mathematics is worthwhile for me because it will improve my career; Mathematics is an important subject for me because I need it for what I want to study later on; I will learn many things in mathematics that will help me get a job.
PISA index of sense of belonging	The index of sense of belonging was constructed using student responses over the extent they strongly agreed, agreed, disagreed or strongly disagreed to the following statements: I feel like an outsider (or left out of things) at school; I make friends easily at school; I feel like I belong at school; I feel awkward or out of place in my school; other students seem to like me; I feel lonely at school; I feel happy at school; things are ideal in my school; I am satisfied with my school.

PISA index of familiarity with mathematics concepts	Thirteen items measuring students' perceived familiarity with mathematics concepts (*FAMCON*) were used in the Main Survey of PISA 2012 (ST62). Foils represented non-existing pseudo-concepts and formed the auxiliary scale FOIL. Response categories for students indicating their familiarity with real concepts and with foils were "Never heard of it", "Heard of it once or twice", "Heard of it a few times", "Heard of it often" and "Know it well, understand the concept". If students indicated that they had heard of these pseudo-concepts or even know them well, this would indicate overclaiming. In other words, higher values on *FOIL* were indicative of greater signal detection in terms of students making unsubstantiated claims.
PISA index of attitudes towards schools (learning outcomes)	The index of attitudes towards school (learning outcomes) was constructed using student responses over the extent they strongly agreed, agreed, disagreed or strongly disagreed to the following statements when asked about what they have learned in school: School has done little to prepare me for adult life when I leave school; school has been a waste of time; school has helped give me confidence to make decisions; school has taught me things which could be useful in a job.
PISA index of attitudes towards schools (learning activities)	The index of attitudes towards school (learning activities) was constructed using student responses over the extent they strongly agreed, agreed, disagreed or strongly disagreed to the following statements when asked to think about their school: Trying hard at school will help me get a good job; trying hard at school will help me get into a good <college>; I enjoy receiving good <grades>; trying hard at school is important.

Source: OECD 2013a, 2013b, 2013c, 2014aAnnexes A1. OECD 2014b, p. 329.

