

OECD Economics Department Working Papers No. 708

Equity in Student Achievement Across OECD Countries: An Investigation of the Role of Policies

Orsetta Causa,

Catherine Chapuis

https://dx.doi.org/10.1787/223056645650

OECD

Unclassified **ECO/WKP(2009)49**

Organisation de Coopération et de Développement Économiques
Organisation for Economic Co-operation and Development **07-Jul-2009**

English - Or. English

ECONOMICS DEPARTMENT

ECO/WKP(2009)49
Unclassified

EQUITY IN STUDENT ACHIEVEMENT ACROSS OECD COUNTRIES: AN INVESTIGATION OF THE ROLE OF POLICIES

ECONOMICS DEPARTMENT WORKING PAPERS NO.708

By

Orsetta Causa and Catherine Chapuis

All Economics Department Working Papers are available through OECD's internet web site at www.oecd.org/eco/working_papers

JT03267735

Document complet disponible sur OLIS dans son format d'origine
Complete document available on OLIS in its original format

English - Or. English

ABSTRACT/RESUMÉ

Equity in student achievement across OECD countries: an investigation of the role of policies

This paper focuses on inequalities in learning opportunities for individuals coming from different socio-economic backgrounds as a measure of (in) equality of opportunity in OECD countries and looks at the role played by policies and institutions in shaping countries' relative positions. Based on harmonised 15-year old students' achievement data collected at the individual level, the empirical analysis shows that while Nordic European countries exhibit relatively low levels of inequality, continental Europe is characterised by high levels of inequality - in particular of schooling segregation along socio-economic lines - while Anglo-Saxon countries occupy a somewhat intermediate position. Policies allowing increasing social mix are found to reduce school socio-economic segregation without affecting overall performance. Countries that emphasise childcare and pre-school institutions exhibit lower levels of inequality of opportunity, suggesting the effectiveness of early intervention policies in reducing persistence of education outcomes across generations. There is also a positive association between inequality of opportunities and income inequality. As a consequence, cross-country regressions suggest that redistributive policies can help to reduce inequalities of educational opportunities associated with socio-economic background and, hence, persistence of education outcomes across generations.

JEL classification: I20; I21; I28; I38; H23.
Keywords: education; equality of opportunity; equity in student achievement; school socio-economic segregation; public policies.

****

Équité et compétences scolaires dans les pays de l'OCDE : examen du rôle des politiques publiques

Cet article analyse les inégalités de compétences scolaires pour des individus d'origine sociale différente comme une mesure d'(in)égalité des chances dans les pays de l'OCDE et étudie le rôle joué par les politiques publiques dans ce contexte. Le travail empirique est basé sur l'analyse de données individuelles harmonisées entre pays mesurant les compétences scolaires d'étudiants âgés de 15 ans. Les résultats montrent que les pays d'Europe du Nord sont caractérises par des niveaux relativement faibles d'inégalités, tandis que les pays d'Europe continentale sont caractérises par des niveaux relativement élevés d'inégalités, en particulier en termes de ségrégation socio-économique a l'école; enfin, les pays anglo-saxons occupent a ce titre une position intermédiaire. Les politiques favorables à la mixité sociale à l'école réduisent la ségrégation scolaire sans en affecter la performance générale. Les pays qui mettent l'accent sur les services à la petite enfance et sur les institutions préscolaires sont caractérisés par des niveaux relativement faibles d'inégalités des chances, ce qui suggère l'efficacité potentielle des interventions éducatives précoces dans la promotion de la mobilité intergénérationnelle. L'analyse empirique suggere l'existence d'une association positive entre inégalités de compétences scolaires et inégalités de revenu. Par conséquent, les régressions inter-pays suggerent que les politiques redistributives peuvent aider à réduire les inégalités de compétences scolaires associées a l'origine sociale, et, ce faisant, les phénomènes de persistance éducative entre les générations.

Classification JEL : I20 ; I21 ; I28 ; I38 ; H23.
Mots clés : éducation ; égalité des chances ; équité et compétences scolaires ; ségrégation socio-économique a l'école ; politiques publiques.

Copyright OECD 2009
Application for permission to reproduce or translate all, or part of, this material should be made to: Head of Publications Service, OECD, 2 rue André-Pascal, 75775 Paris CEDEX 16.

TABLE OF CONTENTS

EQUITY IN STUDENT ACHIEVEMENT ACROSS OECD COUNTRIES: AN INVESTIGATION OF THE ROLE OF POLICIES 5

Introduction 5
Motivation and Background 6
Equity in student achievement across OECD countries 7
The PISA dataset 7
Measuring equity in student achievement: definitions and methodology 8
Equity in student achievement across OECD countries: the results 9
The impact of policies on equity in education achievement across OECD countries 19
Equity in student achievement and the role of policies: related literature 20
Empirical approach 22
Results on policies and equity in education achievement 25
Conclusive remarks 30
DATA APPENDIX POLICY VARIABLES: SOURCES AND DEFINITIONS 32
GLOSSARY 34

REFERENCES 36

Tables

1. Estimates of the socio-economic gradient in OECD countries 43
2. Estimates of the socio-economic gradient in OECD countries: the impact of individual characteristics 44
3. Estimates of the socio-economic gradient in OECD countries: school environment and individual background effects 45
4. Estimates of the socio-economic gradient in OECD countries: non-linearities in the impact of socio-economic background 46
5a. Estimates of the socio-economic gradient in OECD countries: urban areas 47
5b. Estimates of the socio-economic gradient in OECD countries: rural areas 48
6. Estimates of the socio-economic gradient in OECD countries: asymmetric contextual effects, by science score 49
7. Estimates of the socio-economic gradient in OECD countries: the impact of heterogeneity in the school environment 52
8a. Individual background and school effects: the impact of education policy/school practices, regression results 53
8b. Individual background and environment effects: the impact of education policy/resources, regression results 54
8c. Individual background and environment effects: the impact of early intervention policies, regression results 55
8d. Individual background environment effect: the impact of social and labour market policies, regression results 56

Figures

1. The influence of parental background on secondary students' achievement 57
2. The influence of parental background on secondary students' achievement: the socio-economic gradient controlling for individual characteristics 58
3. The influence of parental background on secondary students' achievement: the socio-economic gradient and the socio-economic gradient taking cross-country distributional differences into account .. 59
4. Effects of individual background and school socio-economic environment on students' secondary achievement 60
5. The influence of parental background on secondary students' achievement 61
6. The drivers of inequality in student's secondary educational achievement are often concentrated in top or bottom schools 62
7. The influence of school environment on secondary educational achievement: cities versus rural areas 63

Boxes

Box 1: School environment effects: methodological issues and policy implications 13
Box 2. Individual's background and school environment effects in OECD countries 16

EQUITY IN STUDENT ACHIEVEMENT ACROSS OECD COUNTRIES: AN INVESTIGATION OF THE ROLE OF POLICIES

By Orsetta Causa and Catherine Chapuis [1]

Introduction

1. This paper focuses on inequalities in learning opportunities for individuals coming from different socio-economic backgrounds as one of the major drivers of intergenerational social mobility. It analyses cross-country differences in the extent of equality of opportunity (Romer, 1998) – the idea that individual achievement should not reflect circumstances that are beyond an individual's control, such as family socio-economic background – among OECD countries and looks at the role played by policies and institutions in shaping countries' relative positions. While there is little scope for attenuating inequalities arising from the transmission of inheritable factors, inequalities in the distribution of learning opportunities might signal economic inefficiencies that are potentially amenable to policy intervention.

2. The study is based on harmonised 15-year old students' achievement data available for all OECD countries through the Program for International Student Assessment (PISA). Equality in educational achievement is measured with respect to the students' socio-economic background and is used as a proxy for equality of opportunity within OECD countries.

3. The empirical analysis shows that OECD countries are extremely heterogeneous with respect to inequality of educational opportunities associated with family background. In particular, while Nordic European countries exhibit relatively low levels of inequality, continental Europe is characterised by high levels of inequality - in particular of schooling segregation along socio-economic lines - while Anglo-Saxon countries occupy a somewhat intermediate position. By looking at non-linearities and asymmetries arising in the effect of socio-economic background on learning opportunities, the empirical analysis also sheds light on contextual effects and the impact of school socio-economic mix.

4. Empirical results suggest that a number of policies and institutions have the potential to impact upon inequality in learning opportunities. Policies allowing increasing social mix are found to reduce school socio-economic segregation without affecting overall performance, at least in countries where such segregation is relatively high, as in continental Europe. Schooling differentiation and early tracking policies are found, as in earlier studies, to increase socio-economic inequality in learning opportunities. There is mixed evidence on the impact of public education spending on equality of learning opportunities,

[1] Corresponding authors are: Orsetta Causa (Orsetta.Causa@oecd.org) and Catherine Chapuis (Catherine.Chapuis@oecd.org) both at the OECD Economics Department.The authors would like to thank Anna d'Addio, Sven Blondal, Jørgen Elmeskov, Miyako Ikeda, Åsa Johansson, Stephen Machin, Fabrice Murtin, Giuseppe Nicoletti and Jean-Luc Schneider for their valuable comments as well as Irene Sinha for excellent editorial support. The views expressed in this paper are those of the authors and do not necessarily reflect those of the OECD or its member countries.

but empirical results suggest that financial incentives to teachers and effective mechanisms for allocating public resources to schools might help increase equality of opportunities in educational achievement. Countries that emphasise childcare and pre-school institutions exhibit lower levels of inequality of opportunity, suggesting the effectiveness of early intervention policies in reducing persistence of education outcomes across generations. There is also a positive association between inequality of opportunities and income inequality. As a consequence, cross-country regressions suggest that redistributive policies can help to reduce inequalities of educational opportunities associated with socio-economic background and, hence, persistence of education outcomes across generations. Finally, there is some empirical evidence suggesting a role for labour and social policies in shaping cross-country differences in the impact of socio-economic background on student achievement.

5. The document is organised as follows. Section 1 provides the motivation and background underlying the analysis, by illustrating the link between educational equality of opportunity and intergenerational social mobility. Section 2 presents and discusses the estimated impact of parental background on secondary educational achievement on a country-by-country basis, focusing on different dimensions of equality of learning opportunities. Section 3 relates the patterns observed across OECD countries to differences in their institutional settings, by focusing on educational and early intervention policies, as well as welfare, redistribution, and labour market policies. Before presenting the empirical results, the section provides a brief overview of the comparable studies that have focused on the relationship between institutions and equality of opportunity.

Motivation and Background

6. The idea that education is one of the main drivers of intergenerational social mobility has been formally modelled under various assumptions. The theoretical framework is based on models of intergenerational transmission of inequality and allocation of resources within the family, which have led to a close focus on the role of human capital and education policy (Becker and Tomes 1979, 1986). These models were further developed by Solon (2004), who integrated public and private investment in education into a single framework. Restuccia and Urrita (2004) studied intergenerational human capital transmission focusing on innate ability, early education, and college education, and the implications for early and college education policies. In addition, Heckman (2007) has emphasised the importance of human capital investment at the right time in the lifecycle in order to correct for disadvantageous individual conditions inherited from parents.

7. There is ample empirical evidence that education is one of the major drivers of intergenerational social mobility, particularly income mobility. Among others, Machin (2004) and Blanden *et al.* (2004) argue that the recorded fall in intergenerational mobility in the United Kingdom between the cohorts born at the end of the 1950s and those born in the 1970s was, to a large extent, due to the fact that increased educational opportunities in the reference period disproportionately benefited individuals from better-off backgrounds.

8. The estimation of economic returns to education has been the object of numerous empirical contributions.[2] Topical studies (Card, 1999, Ashenfelter *et al.* 1999) have documented substantial earnings returns to quantitative measures of education, such as years of schooling. The earnings returns to qualitative measures of education, like test scores on cognitive achievement, seem to be even higher (Bishop, 1992, Riviera-Batiz, 1992), and, contrary to quantitative measures, increasing with an individual's time on the labour market (Altonji and Pierret, 2001). The results of these studies suggest that qualitative measures of education are relevant for assessing individual future economic success.

2 . Boarini and Strauss (2008) provide recent cross-country estimates for OECD countries.

9. The development of cognitive skills tends to be stronger early on in life. Therefore, intergenerational mobility studies have devoted attention to the relationship between children's cognitive skills and parental background as an important early indicator of (dis)advantage. In this respect, empirical research that relates ability test scores of children to the socio-economic background of parents (see Heckman, 1995) suggests that the link emerges at a young age.[3] Against this background, the present empirical study focuses on the impact of parental background on adolescents' test scores as an indicator of equity in education and, in this respect, a measure of intergenerational social mobility. [4]

10. The OECD has adopted a consistent approach for measuring equality of educational opportunities (OECD, 2001a, 2004, 2007a). It also produced a specific publication on factors related to quality and equity through the use of the 2000 PISA database (OECD, 2005a). PISA results highlight substantial differences across OECD countries. In particular, while Nordic European countries, as well as Canada and Australia, appear to display relatively high levels of educational equity, other countries, notably in continental (Germany, Austria, Belgium, France) and southern Europe (Italy in particular), are characterised by relatively low levels of educational equity.[5] This cross-country picture appears to have been stable over the period covered by PISA surveys, with no deterioration of measured equity in student achievement in OECD countries between 2000 and 2006.

Equity in student achievement across OECD countries

The PISA dataset[6]

11. This study uses cross-country comparable microeconomic data on student achievement, collected consistently across and within OECD countries through the Programme for International Student Assessment (PISA), which assesses the skills of students approaching the end of compulsory education. It targets the 15-year-old student population in each country and independently of how many years of schooling are foreseen for 15-year-olds by the structure of the national school systems. It was conducted in a total of 67 countries, including all OECD countries. The PISA 2006 survey assesses the mathematical, scientific, and reading literacy as well as the problem-solving skills of the student population in each participating country.

12. The PISA sampling procedure ensures that a representative sample of the target population is tested in each country. Most countries employ a two-stage sampling procedure. The first stage draws a random sample of schools in which 15-year-old students are enrolled. In most countries, the probability of each school being selected is proportional to its size, as measured by the estimated numbers of 15-year-old students enrolled in the school. The second stage randomly samples 35 of the 15- year-old students in each of these schools, with each 15-year-old student in a school having equal selection probability. The

3 . For example, in the United States, ability test scores of children as young as five have been found to be closely related to family background (income levels, education of parents, family situation, etc.).

4. Throughout this document, the expressions "equality of opportunity", "equity in learning opportunities", or "educational equity" are used interchangeably.

5. PISA data have also been used extensively outside the OECD both in a cross-country perspective (Esping-Andersen, 2004, Fuchs and Wossmann, 2004, Entorf and Lauk, 2007) and in country-specific studies (among others: for Germany, Fertig, 2003a, 2003b; for Italy, in a cross-regional perspective, Foresti e Pennisi, 2007, and Bratti *et al.* 2007; for Austria, Schneeweis and Winter-Ebner, 2005).

6. For a presentation of PISA, see the latest OECD report (OECD, 2007a) as well as the PISA website (www.pisa.oecd.org). For technical documentation on survey design and data analysis, see OECD (2005b, 2005c).

empirical analysis undertaken in what follows explicitly takes into account the complex survey design of the data, as well as its probabilistic structure.

13. The main focus of the PISA 2006 study is on scientific literacy, with about 70% of the testing time devoted to this item. Given the very high correlation among science, mathematics, and reading scores, the following analysis focuses on science scores. OECD (2007a) points to the robustness of country-specific and cross-country empirical assessments to the use of either score. PISA uses item response theory scaling and calculates five plausible values for proficiency in each of the tested domains for each participating student. The performance in each domain is mapped on a scale with an international mean of 500 and a standard deviation of 100 test-score points across OECD countries.[7] To simplify the empirical analysis, in this paper it was decided to focus on one – specifically, the first - of the five individual's plausible values. This procedure is superior to the *ex ante* averaging of all values (OECD, 2005c). Not surprisingly, results are robust to the use of either of them as a dependent variable.

14. The PISA dataset provides a rich array of background information on each student, as well as on his/her school. In separate background questionnaires, students are asked to provide information on their personal characteristics and family background, and school principals provide information on their schools, resource endowments and institutional settings.

Measuring equity in student achievement: definitions and methodology

15. Equity in student achievement is defined consistently with the concept of equality of opportunity (Roemer, 1998), according to which educational achievement should not reflect circumstances that are beyond a person's control, such as family socio-economic background. The empirical counterpart to the concept is constructed by estimating how strongly educational achievement as measured by PISA test scores depends on the socio-economic background of the students' families in each country. Specifically, the analysis uses the Index of Economic, Social, and Cultural Status (ESCS) provided by PISA as the measure of family background. The size of the achievement difference between students with high and low values of the ESCS index provides a measure of how fair and inclusive each school system is: the smaller the difference, the more equally distributed is education. This methodology is standard in the empirical literature using cross-country educational datasets (OECD PISA reports - 2001a, 2004, 2007a -, Schutz *et al.* 2005, Schutz *et al.* 2007, Woessmann, 2004).

16. The PISA ESCS index is intended to capture a range of aspects of a student's family and home background. It is explicitly created in a comparative perspective by PISA experts with the goal of minimising potential biases arising as a result of cross-country heterogeneity (OECD, 2005b). It is derived from a Principal Component Analysis applied to the following variables: *i)* the international socio-economic index of occupational status of the father or mother, whichever is higher; *ii)* the level of education of the father or mother, whichever is higher, converted into years of schooling; *iii)* the PISA index of home possessions obtained by asking students whether they had at their home a number of items allowing and facilitating learning (*inter alia*, a desk at which to study, a computer, books ...).[8] The student scores on the index are standardised to have an OECD mean of zero and a standard deviation of one.[9]

7 . This mean refers to the OECD aggregate, using appropriate students' weights.

8 . A word of caution is needed here. Indeed, this index contains information on a number of items which can be considered as educational expenditures; those expenditures may vary by country depending on the school system (*e.g.* in some countries students do not have to buy books because they are provided by the school) and not on families' socio-economic status.

9 . This mean refers to the OECD aggregate, using appropriate students' weights.

Equity in student achievement across OECD countries: the results

17. Regression estimates suggest that there are substantial differences among OECD countries in terms of equality of learning opportunities. This section presents the main findings on a country-by-country basis. Part of the results confirm and reflect previous OECD findings (OECD, 2007a). However, previous OECD work is extended with further empirical results on country-specific patterns of equity in the distribution of learning opportunities among students and schools.

Student socio-economic background and student achievement

Empirical approach

18. The baseline empirical model focuses on the estimation of the so-called "socio-economic gradient", β, that is, the influence of parental background on achievement. Hence, the student-level score is regressed upon his/her family socio-economic background:

$$Y_{isc} = \alpha_{1c} + \beta_{1c} \cdot F_{isc} + \varepsilon_{isc} \quad (1)$$

where index i refers to individual, s to school, and c to country. Y_{isc} denotes the student's science test score, F_{isc} denotes family background as measured by the ESCS index, and ε_{isc} is an error term.

19. Baseline estimations can be enriched to control for a number of individual factors, allowing comparison of the "gross" and "net" impact of family background on student performance:

$$Y_{isc} = \alpha_{2c} + \beta_{2c} \cdot F_{isc} + \gamma_c \cdot X_{isc} + \varepsilon_{isc} \quad (2)$$

where X_{isc} denotes student-level individual characteristics (*i.e.* gender, migration, language spoken at home).

20. The sampling design used for the PISA assessment is a two-stage stratified sample in most countries. This survey design requires a complex structure of the error term, taking into account the two-stage sampling where, in the first stage schools (the primary sampling units or PSUs), and in the second stage, a sample of students within schools are drawn. Hence, the hierarchical structure of the data requires modelling the following error term (see Schutz *et al.* 2007, for more details):

$$\varepsilon_{isc} = \nu_s + \upsilon_i \quad (3)$$

where ν_s is a school-specific component and υ_i is a student-specific component. Furthermore, the standard error estimates recognise the clustering of the survey design by allowing correlation within schools (the PSUs) in the error variance-covariance matrices. The clustering-robust linear regression technique does not require that individual observations are independent within schools but only that they are independent across schools. Since PISA uses a stratified sampling design in each country, sampling probabilities vary for different students. Therefore, estimations are based on a weighted least square approach, using probability sampling.[10]

10. This approach guarantees that the proportional contribution to the parameter estimate of each stratum of the sample is the same as if a complete census had been implemented (see *e.g.* Du Mouchel and Duncan, 1983; Wooldridge, 2001). In addition, the analysis uses a variant of the balance repeated replication (BRR)

21. Parameter β_{1c} in the baseline equation (1) represents the "gross" effect of parental background on student performance (because there are no individual level controls in the regression). Because background characteristics are determined before children attend school, these can be considered exogenous to student performance.[11]Besides, self-selection bias – that is, simply, school enrolment - should not be an important issue in the present context, given that most students at age 15 are enrolled in compulsory schooling in OECD countries.[12]

22. Parameter β_{2c} in equation (2) represents a "net" effect of family background on student performance, where individual control variables include gender, migration background and language spoken at home. Those individual control variables are standard in the education literature. They are also relevant on their own with respect to social mobility, in particular migration background. The relationship between migration and social mobility is, however, not explored in the following analysis: *i)* on the one hand, this is due to the already comprehensive literature on the subject using PISA data (for example, OECD, 2006); *ii)* on the other hand, the subject would deserve an analysis on its own, and, in particular, availability of cross-country data on integration polices in order to investigate the role of institutions. These data are currently not available.

23. The estimated socio-economic gradient combines the joint impact of nature and nurture on students' outcomes. The relative importance of these two effects cannot be distinguished in this dataset. Thus, the estimates of the effect of family background may also include the transmission of inheritable ability. The relative importance of these components in accounting for the influence of parental background on children's educational outcomes is amply debated. The studies that can, at least to some extent, provide some guidance on this issue, are based on samples of twins or adopted individuals, a very stringent data requirement in the present context.[13] However, there is no reason to believe that genetic heritability varies systematically across countries. Therefore, the extent to which heritability can account for the cross-country variation in the influence of family background on student outcomes is limited. Hence, the role of nature *versus* nurture is less of a concern in a cross-country perspective.

Results

24. International patterns in the extent to which parental background impacts upon teenagers' cognitive skills reveal substantial differences among OECD countries. Figure A2.1 presents country estimates of gross socio-economic gradients, β_{1c}, that are in line with OECD (2007a) findings. The corresponding regression results are reported in Table A2.1. On average, across OECD countries, for each

---

method in estimating sampling variances. This method generates several sub-samples, or replicate samples, from the whole, in order to provide an accurate estimate of the sampling variance. A replicate sample is formed through a transformation of the full sample weights according to an algorithm specific to the replication method. In PISA, it was decided to generate 80 replicate samples and, therefore, 80 replicate weights. Finally, Fay's method is used to compute the sampling variance based on the BRR method, with a factor of 0.5 (see PISA manual, OECD, 2005c).

11 . However, it must be acknowledged that some of the sub-components that are used to construct the ESCS index, such as educational items bought by parents (*i.e.* books, computer…), might be endogenous to students' achievement.

12. However, this bias might be a concern for OECD countries such as Mexico and Turkey where enrolment rates of adolescents in compulsory schooling are low in a comparative perspective. This bias should not be disregarded, in particular because of its obvious interference with poverty and social mobility, and because of its implications in terms of individuals' future life chances.

13. See Sacerdote (2002), Plug and Vijverberg (2003).

improvement of one international standard deviation in student socio-economic background, the student performance on the science scale improves by 40 points, with cross-country differences ranging from 25 advantage points (Mexico) to 54 (France); the latter magnitude would represent an average 10% performance improvement (based on an OECD average PISA performance of 500 points). Countries where equality of opportunity is estimated to be relatively low include the United States, New Zealand and the United Kingdom, as well as France, Belgium and Germany. At the opposite end, according to this metric there is a very heterogeneous group of OECD countries in which estimates of the socio-economic gradient are relatively low: *i)* the Nordic European countries appear relatively mobile in this respect, although there are marked differences, *i.e.* Finland, being substantially more mobile than Sweden; *ii)* Southern European countries also belong to this group, with very similar and low effects of parental background; *iii)* finally, Mexico and Turkey also show low levels of parental background influence. A heterogeneous residual group of countries lies in the middle of the gradient distribution, including countries as different as Australia, Ireland, Luxembourg, or Poland.

[Figure A2.1. The influence of parental background on secondary students' achievement in Pisa: the socio-economic gradient]

[Table A2.1. Estimates of the socio-economic gradient in OECD countries]

25. Countries' relative positions are not much affected by the estimation of a net "gradient", accounting for the impact of individual characteristics. Figure A2.2 compares the gross socio-economic gradient, β_{1c} , with the net socio-economic gradient, β_{2c} , where gender, migration status, and language spoken at home are included in the estimated model specification. Results for the corresponding multivariate regressions are reported in Table A2.2. The impact of either migration background or foreign language is statistically significant for almost all OECD countries and also quantitatively important. But the inclusion of these variables in the regression does not appear to substantially alter the magnitude of the socio-economic gradients, except when both of them have a significant impact on PISA scores. Hence, it is the combination of migration background and multiple languages that appears to explain part of the persistence in educational achievement across generations, thereby reducing the estimated socio-economic gradient (notably in Austria, Denmark, Germany, Sweden, Luxembourg, Switzerland and the Netherlands).[14] In sum, despite a number of dissimilarities, the introduction of individual control variables in the estimation of the socio-economic gradient only slightly affects the cross-country pattern concerning the influence of parental background on teenagers' cognitive skills.

[Figure A2.2. The influence of parental background on secondary students' achievement in Pisa: the socio-economic gradient controlling for individual characteristics]

[Table A2.2. Estimates of the socio-economic gradient in OECD countries: the impact of individual characteristics]

26. As recalled by OECD (2007a), cross-country differences in the within-country distribution of socio-economic background imply that in countries with large disparities, even a relatively low impact of parental background can lead to sizeable disparities. Figure A2.3 compares for each country the estimated socio-economic gradient with a "corrected" gradient, that takes cross-country differences in the within-country distribution of family socio-economic status into account. For this purpose, the "corrected" socio-economic gradient is defined as the absolute increase in student performance associated with the move

14. See also OECD (2006a) for a specific assessment of immigrants' achievement in PISA and OECD (2006b) for a focus on Luxembourg.

from the first to the last quartile of the country-specific distribution of student background.[15] The range defined by such an inter-quartile move socio-economic varies widely across OECD countries, from 1.05 units of the (student-level) ESCS index in Japan to 2.06 such units in Mexico. Cross-country positions are sometimes heavily affected by this correction, in particular in Mexico and Turkey, where wide socio-economic disparities imply relatively low levels of equality of opportunity, but also in some Southern European countries (Spain and Portugal). Finally, when distributional differences are taken into account, the United States displays the highest level of inequality in learning opportunities, while France's position is not altered, despite lower levels of socio-economic disparities. The discussion in the remainder of this section is based on these "corrected" estimates, taking distributional differences across countries into account.[16]

[Figure A2.3. The influence of parental background on secondary students' achievement in Pisa: the socio-economic gradient and the socio-economic gradient taking cross-country distributional differences into account]

Socio-economic segregation and equity in student achievement in OECD countries

27. This section analyses how student performance is separately affected by student's own family background and the average socio-economic background of families of other students in the same school, *i.e.* the school socio-economic environment . Separating these two effects allows understanding how learning opportunities are distributed both within and across schools. In turn, this facilitates exploration of how equality of learning opportunities is related to differences in policies and institutions across OECD countries.

Individual background and school environment effects: definition and empirical approach

28. The overall socio-economic gradient can be decomposed in two parts, a "within-school" gradient – or individual background effect - and a "between-school" gradient – or school environment effect. The former can be defined as the relationship between student socio-economic background and student performance within a given school, while the latter can be defined as the relationship between the average socio-economic status of the school and student performance, controlling for his/her background. As explained in OECD, (2004, 2007a), the decomposition of the overall gradient is a function of the between-school gradient, the average within school gradient, and a "segregation" parameter that measures the proportion of variation in socio-economic background that is between schools (OECD, 2007a).[17]

29. The empirical approach for estimating the influence of individual background and school environment on students' test scores is an extension of equation (1):

$$Y_{isc} = \alpha_{1c} + \beta_{wc} \cdot F_{isc} + \beta_{bc} \cdot \overline{F_{sc}} + \varepsilon_{isc} \qquad (4)$$

15 . The figure also reports the value of the country-specific inter-quartile distribution of student socio-economic background. The larger this figure, the larger the correction to the original estimates.

16. Other aspects of the relationship between student achievement and parental background should be accounted for, as reported in OECD (2007a), such as the cross-country differences in the dispersion around the estimated relationship between parental background and student achievement.

17. OECD (2004, 2007a) presents this index as a measure of "segregation by socio-economic background": intuitively, for a given level of overall variation in students' socio-economic background, systems can be either highly segregated, where students within schools come from identical backgrounds, but average socio-economic background varies across schools, or highly desegregated, where each school is identically mixed in terms of socio-economic background, and there are no differences across schools.

where $\overline{F_{sc}}$ is defined as the weighted (by students' sampling weights) average of students' socio-economic background in the school attended by individual *i* (which is computed excluding the student himself).[18] Hence, while β_{wc} refers to the within-school gradient, β_{bc} refers to the between-school gradient. As for equation (2), equation (4) can also be extended to control for student and school-level characteristics.

Interpreting school environment effects

30. Estimation of the school environment effect, or parameter β_{bc}, is a topical question in educational research. Box 1 provides a brief summary of the underlying conceptual framework. Broadly speaking, this parameter captures two interrelated effects: *i)* contextual effects, arising when student achievement depends on the socio-economic composition of his/her reference group (which is exogenous to this group's behaviour); *ii)* peer effects, arising when student achievement depends on that of his/her reference group (*i.e.* on the behaviour of other members of the group).

Box 1: School environment effects: methodological issues and policy implications

The literature on social interactions at school is abundant and its results are controversial.[1] Manski (1995, 2000) provides a framework for a systematic analysis of social interactions. He states three possible reasons why individuals belonging to the same group might tend to behave alike: *i)* endogenous effects, also called peer effects: the probability that an individual behaves in some way is increasing with the presence of this behaviour in the group; that is, student achievement depends positively on the average achievement in the reference group; *ii)* contextual effects: the probability that an individual behaves in some way depends on the distribution of exogenous background characteristics in the group; that is, student achievement depends on the socio-economic composition of the reference group; *iii)* correlated effects: individuals behave in the same way because they have similar background characteristics and face similar environments.

Peer and contextual effects refer to externalities and are driven by social interactions; correlated effects are a non-social phenomenon. Contextual and peer effects cannot be separated empirically due to identification problems, first of all multicollinearity. Moreover, the investigation of peer effects faces a classical simultaneity problem because a student both affects his/her peers and is in turn affected by them. One of the solutions advocated by scholars to overcome this issue is that of estimating contextual effects – that is, the effect of group's socio-economic composition on student achievement. Endogeneity bias is reduced by excluding the student from the average socio-economic background of the group.

Peer and contextual effects are of policy relevance because they can serve as a basis for reallocating students into different schools or environments. The argument is that weak students would benefit if they were in the same class as high-performing students. However, increasing equity in this way potentially threatens overall efficiency in terms of average cognitive achievement at the class, school or even country level. In order to be efficiency-enhancing, in the sense of increasing average cognitive development of students, two conditions have to be met. First, peer effects should be higher for low-skilled students than for high-skilled ones, and second, higher mix in schools should not have detrimental effects on average learning in the group. These topics have been analysed in the educational and economic literature on peer effects, whose main results can be summarised as follows:

- Peer effects are sizeable, both at the primary and secondary levels (Amermuller and Pischke, 2003, Hanushek *et al.* 2003, Vidgor and Nechyba, 2004, Schneeweis and Winter-Ebmer, 2005), as well as at the tertiary level (Sacerdote, 2000, Winston and Zimmerman, 2003)

- Peer effects are asymmetric, and favour weaker students. This result is slightly more controversial, although most studies find that peer effects are stronger – more positive – for low-ability students (Schindler, 2003,

18. The results do not change when this correction is not made. See, for instance, the PISA study which does not exclude the student from the calculation of this average.

Levin, 2001, Sacerdote, 2000, Winston and Zimmerman, 2003, Schneeweis and Winter-Ebmer, 2005)

- Asymmetries in favour of weaker students have to be weighted against the potential negative effects of within-class mix. The literature is controversial in that respect, although a number of studies have found no impact of mix on student performance (Hanushek *et al.* 2003, Schindler, 2003, Vidgor and Nechyba, 2004, Schneeweis and Winter-Ebmer, 2005).

1. See Brock and Durlauf, (2001), Moffitt (2001), Hanushek *et al.* (2003).

31. In this study, the between-school socio-economic gradient estimated in equation (4) can be considered as a proxy for the contextual effect arising in the school. It is not possible to apportion the contribution of peer effects to this estimate. Indeed, as recalled in Box 1, contextual and peer effects are difficult to identify separately. Moreover, a number of caveats apply to this analysis, among which the most important is self-selectivity, whereby wealthier and more skilled students choose a better school and peer group, causing an over-estimation of contextual effects. This bias does not appear to be important in the present context, given that the estimated contextual effects are robust to the introduction of school level controls - such as various measures of school characteristics, resources, and funding,[19] as well as school selection of students on the basis of past achievement. [20][21] Regressions also control for a number of family characteristics that are likely to downplay this effect, first of all, own socio-economic background. Furthermore, the potential upward bias induced by self-selectivity might be somewhat compensated by the potential downward bias arising because of the impossibility of estimating contextual effects at the class level. Indeed, PISA data do not contain information on students' class. The educational literature stresses that contextual and peer effects are higher at the class than at the school level (see Vidgor and Nechyba, 2004), a finding that would suggest a potential under-estimation of social interactions effects in the PISA data.

32. Although properly measuring, quantifying, and characterising peer and contextual effects is beyond the scope of the present study (not least because of data unavailability at the class level), comparing estimates of these effects across countries can provide interesting insights. There need not be *a priori* systematic differences across countries in terms of social interaction effects; and similarly there need not be *a priori* systematic differences across countries in terms of estimation biases. Therefore, the observed *ex post* distribution of estimated school environment effects across OECD countries might, to a large extent, reflect differences in policies and institutions. For instance, higher estimated school environment effects can be interpreted as resulting from policies and institutions that induce higher segregation along socio-economic lines and, therefore, lower levels of social mix. Cross-country studies are rare on this subject. One exception is Entorf and Lauk (2006), who use a comparative approach based on PISA 2000 data, and estimate peer effects for different groups of countries, depending on schooling systems and immigration patterns. They find sizeable differences across groups of countries, and conclude

19 . These are: school location (small town or village, city), school size and school size squared, school resources (index of quality of educational resources, index of teacher shortage, proportion of certified teachers, ratio of computers for instruction to school size), average class size, average student learning time at school, and school type (private independent, private government dependent, public).

20 . School selection policy is measured through the PISA school questionnaire. A school is defined as academically selective if principals report that students' academic records and/or students' recommendation of feeder schools are a prerequisite or a high priority for students' admission.

21. Estimates including these controls are not shown for space concerns, but are available upon request.

that non-comprehensive and ability-differentiated school systems exhibit the highest levels of peer effects.[22]

Individual background and school environment effects in OECD countries: the results

33. Based on the regression results reported in Table A2.3, Figure A2.4 compares the estimated individual background and school environment effects across countries. Box 2 provides details on the methodology used for this comparison and on the differences with the approach used in the 2007 PISA report. The figure illustrates *i)* the estimated between-school effect, or school environment effect, defined as the gap in predicted scores of two students with identical socio-economic backgrounds attending different schools (where the average background of students is separated by an amount equal to the inter-quartile range of the country-specific school socio-economic distribution); *ii)* the estimated within-school effect, or individual background effect, defined as the gap in predicted scores of two students within the same school coming from different family backgrounds (where the family backgrounds are separated by an amount equal the inter-quartile range of the country-specific average within school socio-economic distribution). While the first effect refers to the increase in a student's score obtained from moving the student from a school where the average socio-economic intake is relatively low to one where the average socio-economic intake is relatively high, the second refers to the increase in student's score obtained from moving the student from a relatively low socio-economic status family to a relatively high socio-economic status family, while he/she stays in the same school. The numbers presented in Figure A2.4 should not be taken at face value and are only indicative of the ranking of OECD countries in terms of individual and school environment effects.

[Figure A2.4. Effects of individual background and school environment on students' secondary achievement in science]

[Table A2.3. Estimates of the socio-economic gradient in OECD countries: school environment and individual background effects]

22. Comprehensive school systems refer to school systems that do not systematically separate students according to ability; students follow generally unified *curricula* across secondary schools.

Box 2. Individual's background and school environment effects in OECD countries

The regression results presented in Table A2.3 suggest that, on average across OECD countries, for each improvement of one standard deviation in student socio-economic background within a given school environment, the student performance on the science scale improves by 24 points, with cross-country differences ranging from 9 advantage points (Italy) to 43 (New Zealand). The impact of the school socio-economic background is estimated to be substantially higher: on average across OECD countries, for each improvement of a student-level standard deviation in the average school socio-economic background, the student performance on the science scale improves by 62 points, independent of his/her own socio-economic background, with cross-country differences ranging from 11 advantage points (Finland) to 126 (Japan).[1.]

Based on these raw estimates, the effects of an individual's background and a school's environment can be adjusted for more meaningful cross-country comparisons using the same approach as in the PISA 2007 report (OECD, 2007a), which accounts for the impact of the within-country distribution of students' socio-economic status. However, the approach in this study departs from OECD (2007a) in one respect: cross-country differences in the distribution of students' socio-economic status are taken into account using country-specific within and between distributions in the computations. Hence, the comparison is made both within and across countries. This requires calculating, for each country, the school-level distribution of socio-economic background, as well as the average within-school distribution of socio-economic background, based on student-level data. Such concepts allow measuring consistently the effects associated with relevant moves along both the within and between-school distributions. [2]

1. In Iceland, the estimated negative within effect is not statistically significant (see Table A2.3).

2. Intuitively, the overall distribution of socio-economic status can be decomposed into the between and within school components. Given that each school is mixed in terms of its socio-economic intake, differences in the average of schools' socio-economic backgrounds are naturally smaller than comparable differences between individual students.

34. In all OECD countries, there is a clear advantage in attending a school where students are, on average, from more advantaged socio-economic backgrounds. Some countries exhibit substantial inequalities associated with school attendance: this is, for instance, the case of Germany or France, where moving a student from a low socio-economic environment school to a high socio-economic environment school would produce a 73 and 65 points difference respectively, compared to 14 in Sweden and 15 in Denmark.[23] These cross-country patterns confirm earlier findings, in particular when comparing comprehensive school systems – such as in Nordic European countries - and non-comprehensive systems – such as in Austria and Germany (see in particular OECD PISA reports, but also Fuchs and Wossmann, 2004, Entorf and Lauk, 2006).

35. As shown in Figure A2.5, individual background and school environment effects are negatively correlated. This pattern is consistent with the idea that countries where school environment effects are relatively high (low) are generally characterised by relatively low (high) levels of schools' social mix; in turn, relatively high (low) levels of social mix within schools are associated with relatively weak (strong) individual background effects. Differences across countries are higher in the school environment effect than in the individual background effect. The former effect is particularly high for Continental Europe (Austria, Belgium, France, Germany, Hungary, the Netherlands), and Japan, while it is much lower for Nordic European countries, where it ranges from 5 (Finland) to 16 (Denmark). Southern European countries are heterogeneous in this respect, with Italy displaying the highest level of between-school socio-economic inequalities, and Spain the lowest. The within effect is relatively low in Japan, Italy, and Korea

23. As seen above, this difference does not arise because of distributional differences, given the already high cross-country differences in "uncorrected" gradients.

while it is relatively high in Nordic European countries. Relatively high levels of within-school gradients are found in New Zealand and the United States and, to a lesser extent, the United Kingdom, where such above average within-school effects are associated with average between-school effects.

[Figure A2.5. Individual background and school environment effects: cross-country pattern]

School environment effect along the school socio-economic distribution

36. Figure A2.6 shows that the effect of the school socio-economic environment on educational achievement is not always uniform within the school socio-economic distribution. The estimated impact is calculated based on a regression that accounts for possible non-linearities in the effect of school socio-economic background (Table A2.4).[24] In some countries, there are large differences in the between-school gradient for students attending schools at the top and those attending schools at the bottom deciles of the (country-specific) school distribution of socio-economic background. For example, in the United Kingdom it is the very "rich" schools that make a difference, providing a relatively high pay-off to students attending schools where the average student is socially advantaged, independent of their individual background (Figure A2.6, Panel A). Conversely, in France and Germany it is the very "poor" schools that make a difference and provide a relative high penalty to students attending schools where the average student is socially disadvantaged, independent of their own individual background, (Figure A2.6, Panel B).[25]

[Figure A2.6. The drivers of inequality in students' secondary educational achievement are often concentrated in top or bottom schools]

[Table A2.4. Estimates of the socio-economic gradient in OECD countries: non-linearities in the impact of socio-economic background]

24. This regression also controls for student characteristics, student-level socio-economic background, and student-level socio-economic background squared. The latter term is not included in the simulations, because its estimated impact is small and scantly significant, confirming PISA reports (OECD, 2007a).

25. These results on non-linearities in educational opportunities echo some of the findings of intergenerational earnings mobility studies. In particular, both Jannti *et al.* (2006) and Grawe (2004) show that low mobility in the United Kingdom is the result of very high persistence in the upper tails of the distribution, a finding which is confirmed here.

Educational inequality and socio-economic differences in rural and urban areas

37. Taking distributional differences into account, Figure A2.7 compares the effect of school environment on student performance in rural and urban areas. It shows the differences in performance on the PISA science scale associated with the difference between the highest and the lowest quartiles of the country specific distribution of the school average PISA ESCS index. One limitation of this analysis is that due to data limitations, the threshold between urban and rural has been arbitrarily fixed at 100 000 inhabitants for all countries, ignoring possible country specificities in this respect. However, the figure distinguishes groups of countries, based on their proportion of urban population (where the definition of "urban" is country-specific). The values of the interquartile range of the distribution of the school average PISA ESCS index, for rural and urban areas are reported in brackets.

[Figure A2.7. The influence of school environment on students' secondary educational achievement: cities *versus* rural areas]

38. The corresponding regressions, run separately for urban and rural areas, are presented in Tables 5a and 5b.[26] The analysis suggests that in many countries school socio-economic segregation might, to a large extent, be concentrated in cities. However, for most of the countries covered by the analysis, this finding is not the result of (statistically) significant differences in the estimated school environment effects across urban and rural areas, but rather of the substantial differences in the distribution of schools by socio-economic background across urban and rural areas.[27] Indeed, the schools' socio-economic distribution is much wider in cities than in rural areas: it is, for example, around twice as wide in Luxembourg, the Netherlands, Germany and Belgium.[28] These countries also have some of the highest estimated levels of overall school environment effects (adjusted or unadjusted for distributional cross-country differences).

[Table A2.5a. Estimates of the socio-economic gradient in OECD countries: urban areas]

[Table A2.5b. Estimates of the socio-economic gradient in OECD countries: rural areas]

Asymmetries and the impact of social heterogeneity

39. Empirical results indicate that contextual and peer effects are stronger for low-skilled students in a number of OECD countries, pointing to the potential effectiveness of policies aimed at increasing schools' social mix in those countries. Table A2.6 shows rough measures of the so-called "peer effects", *i.e.* the impact of school average science scores (excluding the student for whom the regression is run) on individual science scores.[29] Estimates are run separately for low, average, and high achievers, where the thresholds are defined according to the country-specific distribution of PISA science scores. The

26. The regressions control for individual characteristics. Due to data unavailability at the school level France is not included in these estimations.

27 . The countries for which the estimated school environment effects are statistically different between urban and rural areas are: Iceland and Poland (at 1% confidence level); Spain and Mexico (at 5% confidence level); and Portugal and the Netherlands (at 10% confidence level). For the Netherlands, which in a comparative perspective exhibits one of the highest levels of socio-economic inequality between schools in both rural and urban areas, the estimated effect is slightly stronger in rural areas than in cities; the opposite pattern is observed in other countries.

28 . The Slovak Republic and Ireland also exhibit large differences in school's socio-economic distribution across rural and urban areas. However, the school environment effect is relatively low in those countries.

29. This analysis does not have to be interpreted as a proper estimate of peer effects, given the empirical difficulties of identifying them. Moreover, it has to be kept in mind that the analysis would have to rely on class as opposed to school scores for estimating peer effects. Class level data are not available in PISA.

regressions control for student and school-level characteristics (location, resources, size, status and funding).[30] For almost all OECD countries included in the estimation, projected effects are asymmetric: they are relatively weak around the median score of the achievement distribution and stronger at the extremes, with the strongest impact often found on low ability students (exceptions include Italy, Mexico, Poland, Switzerland and the United States). For example, in Belgium, for each improvement of one international standard deviation in the average school science score, the student performance improves by 39 points at the low end of the skill distribution, while it improves by 12 points around the median, and by 18 points at the high end.[31] Thus, particularly in countries where school socio-economic inequalities are higher, low-skilled /disadvantaged students would benefit more from interacting with high-skilled/socio-economically advantaged students, than the latter would lose from interacting with low-skilled/socio-economically-disadvantaged students. This result has to be taken with care, given the methodological difficulties attached to the estimation of contextual and peer effects, as highlighted above.

[Table A2.6. Estimates of the socio-economic gradient in OECD countries: asymmetric contextual effects, by science score]

40. Social gains from reallocating students across schools and/or classes are realised if there is no adverse effect of social heterogeneity *per se* on educational achievement. Students may be influenced, not only by the mean level of peer quality, but also by the diversity of their peers. Regression results presented in Table A2.7 suggest that in most OECD countries there is no adverse effect of social heterogeneity on student performance. The effect of social heterogeneity on educational achievement is tested by including the standard deviation of the student socio-economic background in each school. The regressions also control for student and school-level characteristics (socio-economic intake, location, resources, size, ownership and funding). The impact of social heterogeneity is statistically insignificant for 26 out of 29 countries, the exceptions being Italy, the Czech Republic, and Finland, where a negative impact is found. These results are only suggestive, given that, due to data limitations, the data used is school-level as opposed to class-level, which would be needed to properly analyse peer effects. Taken at face value, the results reported in Tables A2.6 and A2.7 suggest that in some countries increasing school mix could achieve both equity and efficiency goals, particularly in highly socially-segregated countries.

[Table A2.7. Estimates of the socio-economic gradient in OECD countries: the impact of heterogeneity in the school environment]

The impact of policies on equity in education achievement across OECD countries

41. Institutional features such as early intervention, education, welfare and redistribution policies are likely to have an impact on equity in student achievement in OECD countries. This section gives an overview of the main findings in the comparable empirical literature; it then describes the empirical approach undertaken in trying to identify the effects of policies at the cross-country level, and presents and discusses the relevant results.

30. It is not possible to introduce simultaneously achievement scores and socio-economic variables at the school level because of collinearity issues, as extensively discussed in the literature. Some countries are omitted from the regressions because of missing data on some or all school variables.

31. These tentative calculations are simply obtained by multiplying the corresponding estimated coefficients by 100, which is the international standard deviation of PISA science scores.

Equity in student achievement and the role of policies: related literature

42. Cross-country empirical analysis allows examining to what extent different institutions would moderate or reinforce the relationship between socio-economic background and student performance. Research in this field has generally focused on the role of educational policies and institutions.

43. One robust and common finding is that early differentiation of students' curricula tends to be associated with larger socio-economic inequalities, with no corresponding gains in average performance. Both cross-country and country-specific studies have highlighted the negative impact of ability tracking on educational socio-economic inequalities (for cross-country evidence, see OECD, 2004, 2007a, Schutz *et al.* 2005, Hanushek and Wossmann, 2005, Sutherland and Price, 2007, Duru-Bellat and Suchaut, 2005, Amermuller, 2005; for country-specific evidence, see *e.g.* Bauer and Riphahn, 2006, Pekkarinen *et al.* 2006, Holmlund, 2006, and Bratberg *et al.* 2005).[32]

44. Vocational education can be considered as a tool to reduce inequality of opportunity for disadvantaged individuals. However, given the cross-country differences in the design and organisation of apprenticeship systems, it is not possible to draw any clear-cut policy conclusion from available studies. Some have found positive effects of vocational education on equity; in the French case, Bonnal *et al.* (2002) show that disadvantaged students who tend to opt for apprenticeships gain by being more likely to find a job than those who obtained a mere school-based vocational education. Others have argued that vocational education exacerbates educational and, more generally, economic inequalities. Germany, one of the countries with the most developed apprenticeship systems, has witnessed an increasing gap between supply and demand of apprentices by firms. Given that enrolment rates are higher for disadvantaged students, this mismatch is likely to have reduced equity. Indeed, evidence shows that lower-educated school leavers are selected into apprenticeships with less favourable employment prospects and, over time, they also find it increasingly difficult to transfer successfully from apprenticeship to work (Büchel 2002).

45. Empirical research has highlighted the potential for other policies to influence equality of learning opportunities. Results are, however, more sparse and controversial in this respect. The cross-country available evidence suggests insignificant effects of aggregate spending variables (Schutz *et al.* 2005, for example). Some country studies show that increasing educational spending on disadvantaged students or schools does not help increase equity (for the Netherlands, Leuven and Oosterbeek, 2007; for France, Benabou *et al.* 2004; for the United States, Hanushek, 2007). Other studies suggest that targeted spending can reduce educational inequalities. Using highly disaggregated school data at the territorial level, Bratti *et al.* (2007) suggest that differences in specific resources can explain geographical differences across Italian regions. Piketty and Valdenaire (2006) show that in France class size reductions at the primary and secondary levels would be particularly beneficial to disadvantaged students. A similar result on class size is suggested by Krueger (1999).

46. There is no empirical evidence on the impact of teachers' quality on educational equity. This may be due to the methodological difficulties of measuring teachers' quality (see discussion by Vignoles *et al.* 2000), as well as the endogeneity in the distribution of teachers across schools, in that better teachers may choose to teach in relatively advantaged schools. However, there is some US evidence on the positive relationship between teacher quality, as measured by salaries and experience, and students' outcomes (Hanushek. *et al.* 1998, Dewey *et al.* 2000,Goldhaber, 2002). Recent cross-country evidence has supported this view (Dolton and Marcenaro-Gutierrez, 2009). If teacher quality matters for student performance, it is

32. Checchi and Flabbi (2007) have a slightly different approach, in that they focus on differences *within* tracking systems. The authors compare Germany and Italy and find that Italy, where parents have more latitude to interfere with the schooling careers of their children, exhibits less equality of opportunity than Germany.

arguable that it should matter all the more for that of disadvantaged students. The effect of measures providing financial incentives to teachers is less controversial (Lazear, 2003). Studies on the United Kingdom (Atkinson *et al.* 2004) and Israel (Lavy, 2004) have shown that monetary incentives to teachers can have powerful effects on students' performance. However, in practice, designing and implementing performance-related schemes has not always proved successful, as discussed in OECD (2005d). From an equity perspective, such policies incur a real risk of exacerbating inequalities across schools by giving teachers incentives to move into advantaged schools. To promote equity, financial incentives for teachers can be targeted at disadvantaged schools or students (Lavy, 2002).

47. Research on school autonomy and accountability is voluminous and its results are controversial. In a cross-country empirical work, Schutz *et al.* (2007) argue that school autonomy and accountability are not detrimental to equity in student achievement. The authors suggest that some policies, such as the regular use of teachers' subjective ratings to assess students, influence on staffing decisions and on determining course content, as well as more equal government funding across private and public schools, weaken the relationship between socio-economic background and student performance. In a related paper, Amermuller (2005) finds, on the contrary, that the impact of parental background on students' achievement is higher in countries with a relatively large private sector and greater school autonomy.[33]

48. The impact of school choice on equity in student achievement is also a controversial topic.[34] Cross-country literature is scarce, mostly due to measurement issues.[35] Competition may induce cream-skimming, increase socio-economic segregation, and have adverse effects on disadvantaged students. This is the empirical evidence provided by Burgess *et al.* (2007) for the United Kingdom, and confirmed by Bjorklund *et al.* (2004) for Sweden. However, specific experience suggests that properly designed voucher systems can reduce educational inequalities (see West and Peterson, 2006, on voucher systems in Florida). Hoxby (2003) also suggests similar equity-enhancing effects of voucher and charter school programmes.

49. While there is a consensus on the importance of early intervention for intergenerational social mobility,[36] cross-country quantitative evidence on the relationship between childhood policies and equity in education is scarce. This is due to lack of data on a cross-country comparable basis and, hence, the difficulty of identifying the impact of pre-school institutions. One exception is Schutz *et al.* (2005), who provide empirical cross-country evidence that early enrolment and duration of pre-school are positively related to student achievement.[37] Countries' experience suggests that policy measures to increase equality of learning opportunities through interventions in early childhood have the potential to yield very high returns. Evidence for the United States – mostly based on scientific evaluations of experimental set-ups, such as the Perry pre-school - is abundant (Carneiro and Heckman, 2003; Blau and Currie, 2006; Cunha

33 . He also finds that the time students spend in school tends to limit the effect of social origin upon student performance.

34. School choice broadly refers to the freedom for parents and children to select the school of their choice. In order to reduce inequalities between schools, some countries have put in place policies and institutions that introduce constraints in families' school choice. These policies generally apply to public schools only. For example, according to the "carte scolaire" policy in France, whose rules have recently been relaxed, families could only choose among the restricted sub-set of public schools that belonged to their neighbourhood.

35 . Schutz *et al.* (2007) suggest equity-increasing effects of larger government financing for private schools. This variable is arguably a very indirect and ambiguous proxy for school choice.

36. See, for example OECD (2007b).

37. More precisely, the authors suggest that only after a certain threshold level is reached enrolment in pre-school has a positive impact on equity, which they interpret as an effect of non-random sorting of well-off children into pre-school at low levels of enrolment.

et al. 2006).[38] European evidence is more scattered. Some specific examples of the economic benefits of early education on disadvantaged individuals include Leuven *et al.* (2004) for the Netherlands, as well as Kamerman *et al.* (2003) for France, Sweden, and the United Kingdom.

50. Empirical evidence also suggests the existence of a positive link between cross-sectional income inequality and intergenerational income persistence.[39] As one of the key drivers of income persistence, equality of opportunity could also be influenced by cross-sectional inequality. Yet, the relationship between income inequality and equity in educational achievement has not been studied in the literature. A number of studies have suggested that the countries with the most equal distribution of income at a point in time exhibit the highest earnings mobility across generations. Explanations of this relationship include differences in the returns to education, but also, more broadly, as suggested in D'Addio (2007), the idea that a number of institutional characteristics — redistributive policies, but also labour market institutions — are potentially important for understanding both intergenerational mobility and the level of cross-section inequality.

Empirical approach

The model

51. The baseline empirical approach for analysing the impact of policies on equity in educational achievement in this study is based on two cross-country variants of equation (4):

$$Y_{isc} = \alpha_1 + \beta_w \cdot F_{isc} + \beta_b \cdot \overline{F_{sc}} + \gamma_c \cdot X_{isc} + \chi_c \cdot Z_{sc} + \cdot\psi \cdot W_{c\cdot} + \varepsilon_{isc} \quad (5a)$$

$$Y_{isc} = \alpha_1 + \beta_w \cdot F_{isc} + \beta_b \cdot \overline{F_{sc}} + \gamma_c \cdot X_{isc} + \chi_c \cdot Z_{sc} + \theta \cdot C_{c\cdot} + \varepsilon_{isc} \quad (5b)$$

where X_{isc} denotes student characteristics, Z_{sc} denotes school characteristics, $W_{c\cdot}$ denotes country-level variables, and $C_{c\cdot}$ denotes country fixed effects. In these equations, all school and student-level characteristics display country-specific coefficients. Equations (5a) and (5b) describe country-specific models, in which only the impact of the variables F_{isc} , $\overline{F_{sc}}$ and country-level variables is restricted to be equal across countries. The difference between equations (5a) and (5b) is that equation (5b) allows country-specific intercepts whereas equation (5a) allows estimating the direct impact of country-specific variables. Because of the presence of country fixed effects, equation (5b) is to be considered as less restrictive in terms of cross-country homogeneity assumptions.

52. The choice of the control variables included in models (5a) and (5b) is based on the "education production function" approach (see *e.g.* Hanushek, 1994). The variables included are: individual characteristics (gender, migration status and language spoken at home), school location (small town or village, city), school size and school size squared, school resources (index of quality of educational resources, index of teacher shortage, proportion of certified teachers, ratio of computers for instruction to school size), average class size, average student learning time at school, and school type (private

38 . For the United States, a recent study on the effects of pre-kindergarten on children's school readiness shows larger and longer lasting associations with academic gains for disadvantaged children (Magnuson *et al.* 2007).

39. Bjorklund and Jannti (1997); Gottschalk and Smeeding (1997); Aaberg *et al.* (2002); Andrews and Leigh (2007); Blanden (2008).

independent, private government dependent, public). These variables are allowed to have a heterogeneous impact across countries. Therefore, the findings on the impact of country-level features on equity in student achievement do not depend on the country-level effect of student and schools characteristics on student performance.[40] Baseline estimates of equation (5a) also include GDP per capita as a control variable, as done usually in comparable empirical studies.

How policies and institutions are modelled

53. Policies and institutions are introduced in the model by assuming that the influence of student and school socio-economic background varies across institutional regimes. In this specification, it is no longer required that parameters β_w and β_b are equal across countries. These parameters are made regime-specific, by introducing policy interaction terms:

$$Y_{isc} = \alpha_1 + \beta_w \cdot F_{isc} + \beta_b \cdot \overline{F_{sc}} + \delta_w \cdot P_c \cdot F_{isc} + \delta_b \cdot P_c \cdot \overline{F_{sc}} + \gamma_c \cdot X_{isc} + \chi_c \cdot Z_{sc} + \phi \cdot P_{c\cdot} + \psi \cdot W_{c\cdot} + \varepsilon_{isc} \quad (6a)$$

$$Y_{isc} = \alpha_1 + \beta_w \cdot F_{isc} + \beta_b \cdot \overline{F_{sc}} + \delta_w \cdot P_c \cdot F_{isc} + \delta_b \cdot P_c \cdot \overline{F_{sc}} + \gamma_c \cdot X_{isc} + \chi_c \cdot Z_{sc} + \theta \cdot C_{c\cdot} + \varepsilon_{isc} \quad (6b)$$

where P_c denote policies or system-level features. Specifications (6a) and (6b) identify whether institutional features affect the impact of student and school background on achievement. In specification (6b), which includes country fixed effects, it is not possible to estimate the direct effect of institutional features on student performance, given that those do not vary within countries.

54. Variants of models (6a) and (6b) are estimated, depending on the nature of the policy under consideration. While both policy interaction terms may be relevant for education policies, it can be argued that welfare, redistributive and labour market policies are generally targeted towards households or individuals and should, therefore, have no direct impact on school environment effects. Thus, for these policies, only the interactions with the individual background, within-school effect are considered. In this case, the model is further relaxed by assuming that the impact of schools' socio-economic background is country-specific. In terms of the above equations, only parameter δ_w does not vary across countries (but varies across institutional regimes).[41] 55. As already mentioned, specification (6b) is more restrictive in terms of model assumptions than specification (6a) but it provides estimates of the direct impact of policies on students' achievement. Hence, in theory it might allow investigating whether there is a trade-off between efficiency – increasing students' overall performance – and equity – reducing the dependence of performance on socio-economic background. However, caution is needed in this respect. Due to the very

40. Moreover, contrary to expectations, country-level estimates of the "net" within and between schools gradients are not much affected by the introduction of student and school controls. This is the reason why country estimates including school controls are not presented in previous sections, where only estimates accounting for student-level characteristics were discussed.

41 . In theory, it could also be possible to estimate variants of the above model where only interactions between the school socio-economic background and policies are considered, controlling for country-specific effects of own socio-economic background. For example, housing policies might be associated with higher or lower contextual effects across schools. Unfortunately, institutional cross-country data on housing or urban policies are currently not available. Moreover, the difficulty of properly identifying and understanding the nature of contextual and peer effects would make interpretation of the results difficult. Hence, this strategy is not followed in the present approach.

limited degrees of freedom on which the estimation of parameter ϑ is based, it cannot be considered a consistent estimate of the causal impact of system-level features on student performance. As will appear clear below, given the very unrestricted nature of the model in terms of country heterogeneity, the direct impact of policies on performance is weakly identified. Moreover, the main purpose of this analysis is to assess the influence of policies on equity in education, rather than gauging the average impact of institutions on students' and schools' performance, which is extensively discussed in PISA reports (see, for instance, OECD, 2007a). Hence, discussion of regression results will focus on interaction effects, rather than the direct impact of policies.

56. The institutional features are all measured at the country level. While most of them are systemic by definition and, therefore, do not vary within countries, others have a within-country dimension, such as school level policy settings - class sizes, proportion of qualified teachers, school selectivity, or ability grouping.[42] These variables are, however, averaged at the country level (using school weights), and the analysis only uses between-country variation in policies and institutions. Indeed, the extent of within-country variation in school level features is very low and selection bias, whereby students with the same parental background would be found in schools applying certain policies,[43] would make the identification of causal effects difficult. For example, rich families are likely to opt to send their children to schools with high resource levels or highly-qualified teachers. Also, in systems where countries provide disadvantaged areas with additional resources, it is possible to observe an opposite selection bias, whereby disadvantaged students self-select into targeted schools that display specific features – such as lower class sizes. Relying only on between-country variation in policies also makes it easier to interpret results from a policy perspective.[44] However, one drawback of this approach is that the degrees of freedom at the country level are limited, which prevents from investigating potential interactions among policies themselves, and in their relationship with equity in student performance. It is also impossible to introduce various policies simultaneously in the equation, with the associated risk that one policy-specific effect might capture the effect of another, omitted and correlated policy.[45]

57. The cross-country regressions include a maximum of 27 OECD countries. Due to the heterogeneity of Turkey and Mexico in terms of overall socio-economic background, these OECD countries are excluded from the sample. Indeed, the average ESCS level for students in these countries is a full standard deviation below the international mean, suggesting that the comparisons between these countries and the rest of the OECD countries in terms of equity in educational achievement may be misleading. Also, France is excluded from the regressions since school principals did not respond to the PISA school questionnaire.[46]

---

42. These variables are directly available in the PISA dataset through the school questionnaire.

43. Schutz *et al.* (2007) use the same approach for evaluating the impact of school autonomy, accountability and choice on equity in student achievement.

44. An attempt was made to estimate country-by-country regressions on the impact of school policies that display some variation within countries. It revealed the presence of important endogeneity and selection bias issues that made it very difficult to understand the results.

45 . Indeed, a preliminary pairwise correlation analysis reveals very high correlation between policies belonging to the same institutional area. For example, among education policies, the cross-country correlation between number of years since first tracking and system-level number of school types available to 15-year olds is 0.88. Among social and labour market policies, the cross-country correlation between the Gini coefficient on household's disposable income and tax progressivity is 0.90.

46. As discussed above, the estimation controls for the complex survey design of the PISA dataset. Also, student weights are rescaled so that each country receives an equal weight, while maintaining student and school sample representativeness within countries.

Interpretation of the interaction effects

58. As already mentioned, specifications (6a) and (6b) make it is possible to measure how the within and between school socio-economic effects vary across institutional regimes. Indeed, the impact of school and family background varies across systems as follows:

$$\frac{\partial Y_{isc}}{\partial F_{isc}} = \beta_w + \delta_w \cdot P_c \quad \text{and} \quad \frac{\partial Y_{isc}}{\partial \overline{F_{sc}}} = \beta_b + \delta_b \cdot P_c \tag{9}$$

A positive δ means that equity in education achievement decreases ($\beta + \delta > \beta$) while a negative δ means that it increases ($\beta + \delta < \beta$) with the relevant policy.

59. Alternatively, specification (6a) also allows calculating the influence of policies at different levels of the school and/or students' socio-economicsocio-economic background, as follows:

$$\frac{\partial Y_{isc}}{\partial P_c} = \phi + \delta_w \cdot F_{isc} + \delta_b \cdot \overline{F_{sc}} \tag{10}$$

60. In order to ease the interpretation, the policy variables are mean-centered so that coefficient ϕ is to be interpreted as the impact of policy P at the cross-country average of the schools' and students' socio-economic background distribution.[47]

61. Difficulties in identifying proper causal relationships between policies and equity in educational achievement are enormous with the data at hand. As already mentioned, it is not possible to disentangle nature from nurture effects in the (overall or within-school) gradient estimation, nor is it possible to disentangle contextual from endogenous effects in the between-school gradient estimation. Indeed, estimated within- and between-school gradients are descriptive of the distribution in school performance, and should not be interpreted in a causal sense. Yet, cross-country differences in the distribution of within- and between-school gradients are likely to reflect to a large extent differences in policies and institutions. Therefore, cross-country regression results concerning the role of policies should not be influenced by the empirical limitations attached to the interpretation of the estimated gradients. However, in order to properly identify the causal impact of policies, one would need to be in a natural experiment setting, arising when specific reforms are put in place within countries, and implemented differentially across "treated" and "control" groups (such as Pekkarinen *et al.* 2006 study on Finnish education reform in the 1970s). Nonetheless, the cross-country analysis can still identify a number of policies and institutions that are associated with higher levels of equity in educational achievement, and, as such, potentially playing some role in influencing intergenerational social mobility.

Results on policies and equity in education achievement[48]

Education policies

62. Results of cross-country regressions in this section confirm that increasing education spending has an ambiguous link with equity in educational opportunities, but other aspects of the education system,

47. This average is not regression-specific and includes all OECD countries except Turkey and Mexico.

48 . The sources and definitions of policy and institutional variables are provided in the data appendix.

such as differentiation policies and financial incentives embedded in teachers' remuneration, have a significant association with equality of learning opportunities.

Education policies and school practices

63. The empirical results concerning education policies and school practices presented in Table A2.8a share a number of common features: *i)* early differentiation policies are negatively related to equity in education achievement; *ii)* this overall negative relationship is the result of two opposite effects, namely equity-reducing between schools (*e.g.* an increase in the school environment effect), and equity-increasing within schools (*e.g.* a decrease in the individual background effect); *iii)* of these effects, the former dominates the latter. Indeed, consistent with the country-level analysis in the previous section, the within-school effect of socio-economic background is always found to be much lower than the corresponding between-school effect.[49]

64. Regression results confirm earlier findings (for instance OECD, 2007a), according to which educational early tracking increase socio-economic segregation between schools. Interpreting results causally, when educational tracking is brought forward by one year, the impact of a school's environment on student performance would increase by 8.2 PISA science score points. Bringing forward tracking is associated with a much lower decrease in the within-school relationship between students' socio-economic background and science performance, by 2.9 PISA science score points. Implied changes in the school environment effect are quantitatively high, as they would range between 27.7 (PISA score points) in systems with no tracking before age 16 to 77.1 (PISA score points) in systems with early tracking.[50][51] A similar negative link with equity in educational achievement is found for the number of school types programmes available to 15-year olds. This system-level variable indeed captures the existence of early differentiation and, in this setting, polarisation of the schooling system along socio-economic lines. Comparable results emerge also for selection policy and ability grouping within schools.

65. Enrolment in vocational education is also associated with a higher impact of schools' socio-economic background on student performance and a lower impact of an individual's background on student performance (Table A2.8a). Because disadvantaged students are overrepresented in vocational training, it is found to exacerbate school socio-economic inequalities, without increasing overall performance. However, the long-term effects of apprenticeship on individuals' economic outcomes are controversial.[52] Moreover, there are substantial differences across OECD countries in the way vocational education is designed, which could lead to different implications for equity in education achievement. Therefore, it is difficult to draw any clear-cut policy conclusion from cross-country empirical results.

[Table A2.8a. Individual background and school environment effects: the impact of education policy/school practices, regression results]

49 . In estimating models 6a and 6b, Wald tests for the joint significance of parameters δw and δb have been carried out. The tests never reject the joint significance of the parameters under consideration. In order to save space they are not reported here.

50 . This effect refers to the minimum age of first tracking, which is 10 years old across the countries under consideration.

51. These tentative calculations are based on cross-country average estimates and should be interpreted cautiously. The associated effects might be stronger or weaker, depending on countries' specificities.

52. See Machin and Vignoles, 2005, Buchel, 2002.

Education policies and resources

66. The regression results in Table A2.8b confirm that educational spending *per se* is not significantly associated with student performance, even though it is weakly correlated with higher equity in educational achievement within schools (as suggested by the negative sign of the student socio-economic background interaction in the regression with country fixed effects). While the level of spending is not found to be very relevant, the quality of allocation mechanisms, as measured by OECD indicators of "spending decentralisation" and "mechanisms to match resources to needs" appears to be positively related to equity in educational achievement.[53] Indeed, the ability to prioritise and allocate resources efficiently has a very significant negative impact on educational inequalities associated with school's environment, while being associated with a smaller negative impact on equity within schools. Decentralisation between central government and sub-national public authorities can improve efficiency in the allocation of public spending resources to the extent that it allows adapting to differing local circumstances; in the same vein, spending mechanisms aimed at supporting the disadvantaged can reduce educational inequalities associated with school's environment.

67. Regression results suggest that lower class sizes at the secondary and primary levels are associated with lower school environment effects: namely, reducing class size is found to increase disadvantaged schools' performance, relative to that of advantaged schools (Table A2.8b). This result can be interpreted along two main lines. First, it can be argued that reducing class size is a useful tool for increasing performance in poor areas, where relatively more resources might be needed to cope with educational disadvantages. Second, insofar as the impact of school socio-economic background captures the contextual and peer effects arising within classes, one alternative interpretation is that these effects are lower in small classes because there is less scope for pupils' interaction. This idea, which emerges from recent educational studies on contextual effects (Levin, 2001), points to the difficulties associated with the interpretation of contextual effects from a policy perspective. [54] Indeed, if class size reduction is associated with lower impact of school socio-economic background merely because it reduces students' interaction and peer effects, then it might not be the most effective tool for promoting educational equity.

68. Higher ratios of students to teaching staff are found to be negatively related with equity in educational achievement both between and within schools (Table A2.8b). Student-teacher ratios measure the total teaching staff relative to students within schools. Thus, it is not only class size *per se* that matters, but also the number of teachers relative to a school's population. Countries displaying relatively high ratios of teachers per student would, therefore, seem to be able to attenuate the influence of school socio-economic disparities on performance while at the same time coping better with disadvantaged students within schools.[55]

---

53. For details on the definition and computation of these educational institutional indicators, see Sutherland and Price (2007).

54. Also, this interpretation is indeed suggestive since this study makes use of *country-level* average class size (either from the school questionnaire averaged through school weights or from the Education at a Glance database), as opposed to *student-level* class size. As explained above, using the PISA class size variable (defined at the school level, and not at the student level, as required in theory for identifying peer effects) is not possible because of endogeneity bias. Moreover, class size at the school level is one of the (country-specific) control variables included in the regressions.

55. One interpretation of this finding could be that the positive association with equity occurs because in some countries students are exposed to different teachers for different topics, while in others the same teachers cover different topics. In this case, the results would not identify the impact of higher resources devoted to each student, but rather the impact of teachers' variety and diversity on equity. Disadvantaged schools and children could benefit disproportionately from being exposed to a diversity of teachers and teaching methods.

69. Table A2.8b shows that the individual background effect is relatively lower in countries where teachers' wage progression is higher. The variable used in this setting does not cover performance-based pay but rather proxies for cross-country differences in teachers' social status, as measured by their expected earnings growth. Experienced teachers might be more motivated to work with disadvantaged students if appropriately remunerated. Since there is evidence that experience is a key dimension of teachers' qualifications,[56] this might signal that financial incentives for attracting qualified or experienced teachers are an effective tool for promoting equity in educational achievement. Interpreting these results causally, the corresponding quantitative impact would not be negligible. Back of the envelope calculations suggest that the estimated within-school gradient would range from 22.7 at minimum levels of expected growth in teachers' pay to 13.0 at maximum levels. Similar conclusions are reached when estimating the impact of cross-country differences in the proportion of qualified teachers, as measured through the corresponding PISA synthetic indicator. Indeed, a higher proportion of qualified teachers is associated with a lower impact of socio-economic background within schools, suggesting that raising teachers skills might help in promoting educational equity.[57][58]

[Table A2.8b. Individual background and school environment effects: the impact of education policy/resources, regression results]

Early schooling and childcare policies

70. Cross-country regression results presented in Table A2.8c show that higher enrolment in childcare is associated with higher equity in student achievement, consistent with earlier - mostly country-specific - studies. More precisely, relatively high levels of childcare enrolment appear to be associated with relatively low levels of school environment effects, even though they appear to be associated with relatively high levels of individual background effects. However, this equity-decreasing impact within schools is much lower quantitatively than the equity-increasing impact between schools. This result holds both for measures of enrolment in childcare and early education services, as well as enrolment in day-care and pre-school. In terms of quantitative impact, a tentative calculation assuming causality would suggest that increasing enrolment in childcare and early education services from the lowest OECD level (2%), to the highest (62%) would bring the between-school gradient from a level of 61 (PISA score points) to a level of 12. A similar impact would be found for public expenditure on childcare and early education services, as shown in the last column of Table A2.8c**,** delivering comparable results in terms of the magnitude of estimated causal effects.

71. A number of caveats apply to this analysis. First, the childcare variables should be measured at a time when the relevant PISA cohort was in age of childcare. This is not possible, however, because the series are not available for the period before 2003. Thus, the implicit assumption is that countries' relative positions in terms of those policies have remained unchanged over time. Second, one would ideally want to measure if individual achievement depends on past childcare enrolment. This variable is not available at

56. Greenwald *et al.* (1996), Hanushek *et al.* (1998).

57. However, the implied quantitative impact would be lower in this case. Moving from lowest to highest proportion of qualified teachers would imply a reduction in the within-school gradient from 24.3 to 20.3.

58 . These results do not take into account the potential endogenous impact of teachers' quality on the housing market. Indeed, educational policies aimed at raising school quality in disadvantaged areas can be ineffective if they are internalised in housing markets. For instance, research on France found school quality effects on the Paris area housing markets (Fack and Grenet, 2007). Simulations suggest that a standard deviation increase in average school quality would raise prices by about 2%, which would imply that the fraction of housing price differentials across school zones that can be explained by school quality differential amounts to about 7% in Paris.

the individual level in PISA 2006. However, even if it were, endogeneity and selection bias with respect to childcare enrolment would possibly bias its estimated impact. [59]

[Table A2.8c. Individual background and school environment effects: the impact of early intervention policies, regression results]

Social and labour market policies

72. This section focuses on the relationship between equality of learning opportunities and taxation and social policies across OECD countries. It uses both direct *policy indicators* (for example tax policy measures), but also *outcome indicators* (for example, relative poverty rates) that (at least partly) reflect cross-country differences in institutional settings. Indeed, in previous studies, cross-sectional inequality has been shown to be related to low intergenerational inequality. Moreover, welfare policies, by targeting disadvantaged family situations - either due to permanent factors or to temporary loss of income (*e.g.* loss of employment) - reduce cross-sectional inequality, thereby potentially helping to mitigate intergenerational persistence. At the same time, ill-designed taxation and social policies would also perpetuate welfare dependency, with potentially negative effects on social mobility. The net effect of these policies on educational opportunities is, therefore, an important empirical issue, even though causal relationships are particularly difficult to establish in this area

73. Cross-country regression results suggest that countries displaying high levels of child poverty are also characterised by a high level of inequality in educational achievement, as indicated by the positive interaction between child poverty rates and the individual background effect (Table A2.8d). Whichever school environment students face, the penalty associated with coming from a disadvantaged background is stronger in countries where child poverty rates are relatively high.[60] This result, while not interpretable in a causal way, confirms the importance of early child development for educational outcomes. In a social policy context, it points to a strong case in favour of investing in early childhood education as an efficient tool to promote intergenerational equity.[61]

74. Results also suggest that cross-sectional income inequality and educational opportunities are positively correlated. While this has long been a conjecture in the intergenerational social mobility literature (Andrews and Leigh, 2007; Aaronson and Mazunder, 2005; Blanden, 2008), empirical evidence has been much less conclusive. Table A2.8d suggests that income inequality, as measured by the Gini coefficient calculated on disposable household income, is associated with higher educational inequalities, as suggested by the higher impact of individual socio-economic background on student achievement. Similar results are found when using indicators of material deprivation, consistent with findings on the role played by child development in the context of intergenerational social mobility. Results linking inequality and poverty to lack of social mobility may underpin some of the further findings on the impact of welfare and redistributive policies on equity in education. Indeed, regression results suggest that tax progressivity is positively associated with learning opportunities. Interpreting there results in a causal way would suggest that the estimated impact of increasing tax progressivity is relatively important: indeed, the variation in the impact of individual family background on teenagers' cognitive skills from minimum to maximum tax

59 . Another limitation of this analysis is the absence of France, where there are both high levels of childcare enrolment and high estimated school environment effects, potentially contradicting this result. Unfortunately, as mentioned above, French data at the school level are not available in the PISA 2006 survey.

60. This model is highly unrestricted and allows for heterogeneity, given that contextual effects are country-specific.

61. See d'Addio, (2007), for a review of the child development literature in the context of intergenerational social mobility, as well as Duncan *et al.* 1994; Carneiro and Heckman, (2003); and OECD (2001b).

progressivity would range from 25.4 (PISA score points) to 12.4. These calculations are only illustrative, but, nevertheless, point to the potential for redistributive policies to help reduce inequality of learning opportunities.

75. Unemployment benefits might help to alleviate liquidity constraints on the parents of disadvantaged children. At the same time, relatively high levels of such benefits might discourage unemployed parents to take up employment (*e.g.* Bassanini and Duval, 2006). While it is not possible to identify the nature of the indirect mechanisms at work, the empirical results in Table A2.8d show a negative link between the level of short-term net unemployment benefits and the impact of individual socio-economic background on student performance, while the level of long-term net unemployment benefits has an opposite link. This pattern is consistent with the interpretation that while short-term unemployment benefits help to ensure the transition from job-to-job and consequently alleviate transitory liquidity constraints, long-term unemployment benefits, might – if fixed at too high a level – discourage job transition and result in unemployment or welfare-dependency traps. Long-term unemployment benefit dependency may also be associated with social stigma, in turn harming children's cognitive development. This result is consistent with the findings of child development studies relating parents' welfare dependency to children outcomes (Corak and Heisz, 1999; Corak *et al.* 2004).

[Table A2.8d. Individual background effect: the impact of social and labour market policies, regression results]

Conclusive remarks

76. This work has provided measures of equality of educational opportunities across OECD countries. It suggests that the majority of OECD countries exhibit ample scope for increasing educational opportunities for disadvantaged individuals, allowing for coping with both equity as well as efficiency concerns. However, the empirical analysis shows that OECD countries are extremely heterogeneous with respect to educational socio-economic inequalities. In particular, while Nordic countries exhibit relatively low levels of inequality, continental Europe is characterised by relatively high levels of inequality in educational achievement - in particular related to schooling segregation along socio-economic lines - while Anglo-Saxon countries occupy a somewhat intermediate position. The analysis also uncovers non-linearities and asymmetries in the impact of school environment on student performance – or the so-called contextual effects: since contextual effects appear to favour disproportionately weak students in a number of OECD countries, increasing schools' social mix is likely to increase equality in educational opportunities without being detrimental to average performance.

77. A number of relevant findings concern the association between equality of educational opportunities and public policies in OECD countries. First, this work confirms earlier findings on the negative impact of early differentiation and tracking policies on educational equality of opportunity. Second, it confirms also the relative weakness and ambiguity attached to the empirical identification of the relationship between educational spending and educational equity. However, the empirical results suggest that an equity-increasing use of educational resources may be obtained through policies that provide the relevant signals to schools and teachers: for instance, providing financial incentives to qualified teachers may prove to be an effective tool for targeting disadvantaged students or areas. Thirdly, this work fills a gap in empirical research by providing cross-country (as opposed to country-specific) evidence on the importance of early intervention policy for attenuating intergenerational socio-economic inequalities in educational opportunities. It suggests that childcare and early intervention policies could be effective to reach this objective. Finally, the cross-country analysis attempts to uncover the role played by social and labour market policies in influencing equality of educational opportunities, given the positive relationship between intergenerational and cross-sectional (income) inequality. Empirical results suggest that some

redistributive and income support policies are associated with lower inequality of educational opportunities.

78. However, given the empirical limitations of the analysis, results on policies and educational outcomes of teenagers do not imply causality. More needs to be done in order to provide empirical estimates of the causal impact of policies on equality of educational opportunities, either through specific case studies looking at the effects of policy changes, or through the development of more refined cross-country time series data on individuals and the policies that affected their cognitive skills.

DATA APPENDIX

POLICY VARIABLES: SOURCES AND DEFINITIONS

79. This section provides data definitions and sources on policy variables used in the cross-country regressions. The PISA dataset is presented in the main text. Policy variables from the PISA Database refer to 2006.

80. Early intervention and childcare policies: *i)* Enrolment rates of children under the age of six in childcare and early education services (2003 or 2004); and *ii)* enrolment in day-care for children under the age of three and pre-school from three to six years old (2003 or 2004): the sources of these variables are the OECD Family database and the OECD Education at a glance database. *iii)* Public expenditure on childcare and early education services as a percentage of GDP (2003): the source of this variable is the OECD Social Expenditure database.

81. Education spending is defined as annual expenditure on educational institutions per student for all services (all secondary) in 2004. The source is OECD Education at a Glance database.

82. Indicators of spending efficiency ("decentralisation", "matching resources to specific needs") are from Sutherland and Price (2007).

83. Variables measuring class size and student teacher ratio come from two sources: *i)* the PISA questionnaire, in which case they are averaged at the country level using school weights; *ii)* OECD Education at a Glance database, where this study makes use of average class size in lower secondary and primary education for public and private institutions and the ratio of students to teaching staff in lower secondary education (2005 data).

84. The variable measuring the ratio of the teachers' salary at top of scale as a proportion of teachers' salary at the minimum training in lower secondary education is drawn from OECD's Education at a Glance database (2005 data). The index of proportion of qualified teachers is computed in the PISA project. It is based on the school questionnaire and averaged at the country level using school weights.

85. The variable measuring ability tracking within schools is based on the PISA school questionnaire and is constructed as follows. First, a school-level binary variable is created, where a value of one is given when principals report that schools regroup students according to ability in all subjects. Aggregated at the country level, this variable measures the proportion of schools that are estimated to regroup students according to ability. The variable on school selection policy is constructed in a similar way, following the school questionnaire; a school is defined as academically selective if principals report that students' academic records, students' recommendation of feeder schools are a prerequisite, or a high priority for students' admission. Aggregated at the country level, this variable measures the proportion of academically selective schools.

86. System-level educational variables on tracking and vocational education are available in the PISA database: *i)* age of first tracking, on the basis of which this work constructs the variable "number of years since first tracking", measured as fifteen minus the age of first tracking; *ii)* the number of school types of programmes available to 15-year olds; *iii)* the percentage of 15-year olds enrolled in vocational education. The latter variable is computed from the student-level PISA dataset.

87. Relative child poverty rate is defined after taxes and transfers and refers to the 1990s; it is taken from OECD (2001b). The Gini coefficient on income inequality is based on OECD (2008) and refers to the mid-2000s. Data refer to the distribution of household disposable income in cash across people, with each person being attributed the income of the household where they live adjusted for household size. Material

deprivation is measured through household data and defined as the share of household reporting material deprivation in terms of six dimensions (this work uses the synthetic indicator defined as the average of the six dimensions). The data refer to the beginning or mid–2000s and come from Boarini and Mira d'Ercole (2006). The measure of tax progressivity is the difference between the marginal and average personal income tax rate, divided by one minus the average personal income tax rate, for an average single production worker. The data are averaged across the years 1995-2004. The source is the OECD Taxing Wages database. Short- and long-term net unemployment benefits refer to the year 2002 and are drawn from the OECD Going for Growth database.

GLOSSARY

- **Equality of opportunity**: the concept of equality of opportunity was originally introduced by Roemer (1998) and states that individual achievement should not reflect circumstances that are beyond an individual's control, such as family background.

  – Throughout this work, the expressions *equality of opportunity, equity in learning opportunities, educational equity, inequalities associated with socio-economic background, or socio-economic inequalities,* are used interchangeably to cover the differences in achievement between students coming from socio-economically advantaged and disadvantaged family backgrounds, or between students attending socio-economically advantaged and disadvantaged schools (identified by the average socio-economic status of the students enrolled in their school).

- **PISA 2006 science score**: This study uses cross-country comparable microeconomic data on student achievement, collected consistently across and within OECD countries through the Programme for International Student Assessment (PISA). PISA aims to assess the skills of students approaching the end of compulsory education. The main focus of the PISA 2006 study is on science literacy, with about 70% of the testing time devoted to this item. Given the very high correlation among science, mathematics, and reading scores, the following analysis focuses on science scores. *The performance in science is mapped on a scale with an international mean of 500 and a standard deviation of 100 test-score points across OECD countries* (aggregate OECD mean, using appropriate students' weights).

- **PISA index of economic, social, and cultural status (ESCS):** the PISA ESCS index is intended to capture a range of aspects of a student's family and home background. It is explicitly created by PISA experts in a comparative perspective and hence with the goal of minimizing potential biases arising as a result of cross-country heterogeneity. It is derived from the following variables: *i)* the international socio-economic index of occupational status of the father or mother whichever is higher; *ii)* the level of education of the father or mother, whichever is higher, converted into years of schooling; *iii)* the index of home possessions obtained by asking students whether they had at their home: a desk at which to study, a room of their own, a quiet place to study, an educational software, a link to the Internet, their own calculator, classic literature, books of poetry, works of art (*e.g.* paintings), books to help with their school work, a dictionary, a dishwasher, a DVD player or VCR, three other country-specific items, as well as the number of cellular phones, televisions, computers, cars and books at home. *The student scores on the index are factor scores derived from a Principal Component Analysis which are standardised to have an OECD mean of zero and a standard deviation of one* (aggregate OECD mean, using appropriate students' weights).

- **(Socio-economic) gradient**: the (socio-economic) gradient measures the relationship between student performance, as measured by PISA 2006 science scores, and student socio-economic background, as measured by the PISA ESCS index.

  – The (socio-economic) gradient is called "(socio-economic) gradient taking cross-country distribution differences into account" when the estimated gradient is used to predict country-specific differences in student performance associated with the difference between the highest and the lowest quartiles of the country-specific distribution of the PISA ESCS index.

  - The (socio-economic) gradient can be called "gross (socio-economic) gradient" when the estimated relationship between student performance and student socio-economic background does not include control variables.

  - The (socio-economic) gradient can be called "net (socio-economic) gradient" when the estimated relationship between student performance and student socio-economic background includes control variables (individual control variables: gender, migration status, language spoken at home)

- **The individual background effect, or within-school effect**: the individual background effect or within-school effect measures the relationship between student performance, as measured by PISA 2006 science scores, and student socio-economic background, as measured by the student-level PISA ESCS index, controlling for school socio-economic background, as measured by the average ESCS level across students within the school.

  - The individual background effect can be used to predict country-specific differences in student performance associated with the difference between the highest and the lowest quartiles of the country-specific within-school average distribution of the PISA ESCS index, calculated at the student level.

- **The school environment effect, or between-school effect**: the school environment effect or between-school effect measures the relationship between student performance, as measured by PISA 2006 science scores, and school socio-economic background, as measured by the average ESCS index, across students within the school, controlling for student socio-economic background as measured by the student-level PISA ESCS index.

  - The school environment effect can be used to predict country-specific differences in student performance associated with the difference between the highest and the lowest quartiles of the country-specific school-level average distribution of the PISA ESCS, calculated at the student-level.

- **Contextual effects**: contextual effects arise when the probability that an individual behaves in some way depends on the distribution of exogenous background characteristics in the group: in the present work, student achievement depends on the socio-economic composition of the reference group, measured at the school level.

- **Peer effects**: peer effects arise when the probability that an individual behaves in some way is increasing with the presence of this behaviour in the group: in the present work, student achievement depends positively on the average achievement in the reference group, measured at the school level. Peer effects are also referred to as endogenous effects.

REFERENCES

Aaberg, R., A. Björklund, M. Jäntti, M. Palme, P.J. Pedersen, N. Smith and T. Wennemo (2002), "Income Inequality and Income Mobility in the Scandinavian Countries Compared to the United States", *Review of Income and Wealth*, Series 48, No. 4.

Aaronson, D. and B. Mazumder (2005), "Intergenerational Economic Mobility in the United States: 1940–2000", *Federal Reserve Bank of Chicago Working Paper 2005-12*.

Altonji, J.G. and C. R. Pierret (2001), "Employer Learning and Statistical Discrimination", *Quarterly Journal of Economics* 116 (1), pp. 313-350.

Amermuller, A. (2005), "Educational Opportunities and the Role of Institutions", ROA-RM-2005E, Research Centre for Education and the Labour Market, Maastricht University.

Amermuller, A., and J. F. Pischke (2006), "Peer effects in European Primary schools: Evidence from PIRLS", Canter for the Economics of Education, London School of Economics.

Andrews, D. and A. Leigh (2007), "More Inequality, Less Social Mobility", unpublished document.

Ashenfelter, O., C. Harmon, and H. Oosterbeek (1999), "A Review of Estimates of the Schooling/Earnings Relationship, with Tests for Publication Bias", *Labour Economics*, Vol. 6(4), pp. 453-470.

Atkinson, A., S. Burgess, B. Croxson, P. Gregg, C. Propper, H. Slater and D. Wilson (2004), "Evaluating the Impact of Performance-Related Pay for Teachers in England", *CMPO Working Paper 04/113*, Bristol: Centre for Market and Public Organisation.

Bassanini, A. and R. Duval (2006), "Employment Patterns in OECD Countries: Reassessing the Role of Policies and Institutions", *Economics Department Working Papers* No. 486, Paris.

Bauer, P. and R. Riphahn (2006), "Timing of School Tracking as a Determinant of Intergenerational Transmission of Education", *Economics Letters*, 91(1), pp. 90-97.

Becker, G.S. and N. Tomes (1979), "An Equilibrium Theory of the Distribution of Income and Intergenerational Mobility", *Journal of Political Economy*, Vol. 87, pp. 1153-89.

Becker, G.S. and N. Tomes (1986), "Human Capital and the Rise and Fall of Families", *Journal of Labour Economics*, Vol. 4, pp. S1-S39.

Bénabou, R., F. Kramarz and C. Prost (2004), "Zones d'éducation prioritaire: quels moyens pour quels résultats? Une évaluation sur la période 1982–1992", *Économie et Statistique*, Vol. 380, pp. 3–29.

Bishop, J.H. (1992), "The Impact of Academic Competencies on Wages, Unemployment, and Job Performance", *Carnegie-Rochester Conference Series on Public Policy* , Vol. 37, pp. 127-194.

Blanden, J., A. Goodman, P. Gregg and S. Machin (2004), "Changes in Intergenerational Mobility in Britain", Chapter 6 in M. Corak, ed., *Generational Income Mobility in North America and Europe*, Cambridge University Press, pp. 123-145.

Blanden, J. (2008), "How Much Can We Learn from International Comparisons of Social Mobility?" *mimeo*.

Boarini, R. and M. Mira d'Ercole (2006), "Measures of Material Deprivation in OECD Countries", *OECD Social, Employment and Migration Working Papers* No. 37.

Björklund, A. and M. Jäntti (1997), "Intergenerational Income Mobility in Sweden Compared to the United States", *American Economic Review*, 87(5), pp. 1009-1018.

Björklund, A., P.A. Edin, P. Freriksson and A. Krueger (2004), "Education, Equality and Efficiency: An Analysis of Swedish School Reforms During the 1990s", IFAU Report 2004:1, Uppsala: Institute for Labour Market Policy Evaluation.

Blau, D., and J. Currie (2006), "Who's Minding the Kids? Preschool, Day Care, and Afterschool Care", in *Handbook of the Economics of Education*, New York: North Holland.

Boarini, R. and H. Strauss (2007), "The Private Internal Rates of Return to Tertiary Education: New Estimates for 21 OECD Countries", *OECD Economics Department Working Papers* No.591.

Bonnal, L., S. Mendes, and C. Sofer (2002), "School-to-Work Transition: Apprenticeship Versus Vocational School in France", *International Journal of Manpower*, vol. 23(5), pp. 426–442.

Bratberg, E., Ø.A. Nilsen, and K. Vaage (2005), "Intergenerational Earnings Mobility in Norway: Levels and Trends", *The Scandinavian Journal of Economics*, Vol. 107(3), pp. 419-435.

Bratti, M. , D. Checchi, and A. Filippin (2007), "Geographical Differences in Italian Students' Mathematical Competencies: Evidence from PISA 2003", *Giornale degli Economisti e Annali di Economia*, Vol. 66, No. 3, pp. 299-335.

Brock, W. and S. Durlauf (2001), "Discrete Choice with Social Interactions", *Review of Economic Studies*, Vol. 68, No. 2, pp. 235-260.

Büchel, F. (2002), "Successful Apprenticeship-to-Work Transitions: On the Long-Term Change in Significance of the German School-Leaving Certificate", *International Journal of Manpower*, *23*(5), 394–410.

Burgess, S., B. McConnell, C. Propper, and D. Wilson (2007),"The Impact of School Choice on Sorting by Ability and Socio-Economic Factors in English Secondary Education", in L. Wößmann, and P.E. Peterson (Eds.), *Schools and the Equal OpportunityProblem*, pp. 273–291, Cambridge: MIT Press.

Card, D. (1999), "The Causal Effect of Education on Earnings", In: Orley Ashenfelter, David Card (eds.), *Handbook of Labor Economic*s, Vol. 3A: 1801–1863. Amsterdam: Elsevier.

Carneiro, P. and J. Heckman (2003), "Human Capital Policy", *NBER Discussion Paper*, No. 9495.

Checchi, D. and L. Flabbi (2007), "Intergenerational Mobility and Schooling Decisions in Germany and Italy: the Impact of Secondary School Tracks", *IZA Discussion Paper*, No. 2876.

Corak, M. and A., Heisz (1999), "The Intergenerational Earnings and Income Mobility of Canadian Men: Evidence from Longitudinal Income Tax Data", *Journal of Human Resources*. Vol. 34, pp. 504-33.

Corak, M., B., Gustafsson and T., Österberg (2004), "Intergenerational Influences on the Receipt of Unemployment Insurance in Canada and Sweden", Chapter 11 in M. Corak, ed., *Generational Income Mobility in North America and Europe*, Cambridge University Press.

Cunha, F., J.J. Heckman, L.J. Lochner, and D.V. Masterov (2006), " Interpreting the Evidence on Life Cycle Skill Formation", in E.A. Hanushek and F. Welch (Eds.), Handbook of the Economics of Education. Amsterdam: North-Holland.

D'Addio, A. (2007), "Intergenerational Transmission of Disadvantage: Mobility or Immobility Across Generations? A Review of the Evidence for OECD Countries", *OECD Social, Employment and Migration Working Paper*, No. 52.

Dewey, J., T.A. Husted and L.W. Kenny (2000), "The Ineffectiveness of School Inputs: A Product of Misspecification?", *Economics of Education Review*, Vol. 19(1), pp. 27-45.

Dolton, P. and O. Marcenaro-Gutierrez (2009), "If You Pay Peanuts Do You Get Monkeys? A Cross-Country Comparison of Teacher Pay and Pupil Performance", Paper presented at the Conference on "Economic of Education and Education Policy in Europe", Hosted by the Centre for Economic Performance, LSE.

DuMouchel, W. H., and G. Duncan (1983), "Using Sample Survey Weights in Multiple Regression Analyses of Stratified Samples." *Journal of the American Statistical Association*, Vol. 78(383), pp. 535-542.

Duncan, J. G., J. Brooks-Gunn, and P. K. Klebanov (1994), " Economic Deprivation and Early Childhood Development ", *Child Development*, Vol. 65 (no. 2), pp. 296-318.

Duru-Bellat, M., and B. Suchaut (2005), "Organisation and Context, Efficiency and Equity of Educational Systems: What PISA Tells Us", *European Educational Research Journal*, Vol. 4, pp. 181-194.

Entorf, H. and M. Lauk (2006), "Peer Effects, Social Multipliers and Migrants at School: An International Comparison," *IZA Discussion Papers 2182*, Institute for the Study of Labor (IZA).

Esping-Andersen, G. (2004), "Unequal Opportunities and Social Inheritance", Chapter 12 in M. Corak (ed.), *Generational Income Mobility in North America and Europe*, Cambridge University Press.

Fack, G. and J. Grenet (2007), "Do Better Schools Raise Housing Prices? Evidence from Paris School Zoning", *mimeo*.

Fertig, M. (2003a), "Who's to Blame? The Determinants of German Students' Achievement in the PISA 2000 Study", *IZA Discussion Papers 739*, Institute for the Study of Labor (IZA).

Fertig, M. (2003b), "Educational Production, Endogenous Peer Group Formation and Class Composition. Evidence from the PISA 2000 Study", *IZA Discussion Paper* No. 714.

Foresti, M. and A. Pennisi (2007), "Fare i conti con la scuola nel mezzogiorno. Analisi dei divari tra le competenze dei quindicenni in Italia", *Analisi e Studi dei materiali UVAL, n. 13.*

Fuchs, T. and L. Woessmann, L. (2004), "What Accounts for International Differences in Student Performance? A Re-examination using PISA data", *mimeo*.

Goldhaber, D. (2002), "The Mystery of Good Teaching", *Education Next*, Vol. 2 (1), Hoover Institute.

Gottschalk, P. and T. Smeeding (1997), "Cross-National Comparisons of Earnings and Income Inequality", *Journal of Economic Literature*, 35, pp. 633-686.

Grawe, N.D. (2004), "Intergenerational Mobility for Whom? The Experience of High and Low-Earnings Sons in International Perspective", Chapter 4 in M. Corak (ed.), *Generational Income Mobility in North America and Europe*, Cambridge University Press, pp. 58-89.

Greenwald, R., L. Hedges, and R. Laine (1996), "The Effect of School Resources on Student Achievement", *Review of Educational Research*, Vol. 66 (No. 3), pp. 361-396.

Heckman, J. (1995), "Lessons from the Bell Curve", *Journal of Political Economy*, Vol. 103, pp. 1091-2020.

Heckman, J. (2007), "The Economics, Technology and Neuroscience of Human Capital Formation", *NBER Working Paper*, No. 13195.

Hanushek, E. A. (1994), "Education Production Functions," in Torsten Husén and T. Neville Postlethwaite (ed.), *International Encyclopedia of Education*, 2nd Edition, Vol. 3 (Oxford: Pergamon, 1994), pp. 1756-1762. [reprinted in Martin Carnoy (ed.), International Encyclopedia of Economics of Education, 2nd Edition (Oxford: Pergamon, 1995), pp. 277-282].

Hanushek, E.A., J.F. Kain and S.G. Rivkin (1998), "Teachers, Schools, and Academic Achievement", *NBER Working Paper* No. 6691.

Hanushek, E. A., J.F Kain, J. M. Markman, and S. G. Rivkin (2003), "Does Peer Ability Affect Student Achievement?" *Journal of Applied Econometrics*, Vol. 18/5, pp. 527-544.

Hanushek, E.A. and L. Woessmann (2005), "Does Educational Tracking Affect Performance and Inequality? Differences-in-Differences Evidence across Countries", *NBER Working Paper*, No. 11124.

Hanushek, E. A. (2007), "Some U.S. Evidence on How the Distribution of Educational Outcomes Can be Changed", in Wößmann, L. and P. E. Peterson (Eds.), *Schools and the Equal Opportunity Problem* , pp. 159–190. Cambridge, MIT Press.

Holmlund, H. (2006), "Intergenerational Mobility and Assortative Mating Effects of an Educational Reform", *Swedish Institute for Social Research Working Paper*, No. 4/2006, Stockholm University.

Hoxby, C. M. (2003), "School Choice and School Competition: Evidence from the United States", *Swedish Economic Policy Review*, Vol. 10(3), pp. 9–65.

Jäntti, M., B. Bratsberg, K. Roed, O. Raaum, R. Naylor, E. Österbacka, A. Björklund and T. Eriksson (2006), "American Exceptionalism in a New Light: A Comparison of Intergenerational Earnings Mobility in the Nordic Countries, the United Kingdom and the United States", *IZA Discussion Papers*, No 938, IZA-Bonn.

Kamerman, S. B., M. Neuman, J. Waldfogel and J. Brooks-Gunn (2003), "Social Policies, Family Types and Child Outcomes in Selected OECD Countries", *OECD Social, Employment and Migration Working Paper* No. 6, OECD.

Krueger, A.B. (1999), "Experimental Estimates of Education Production Functions", *Quarterly Journal of Economics*, Vol. 114(2), pp. 497-532.

Lavy, V. (2002),"Evaluating the Effect of Teachers' Group Performance Incentives on Pupil Achievement", *Journal of Political Economy*, Vol. *110*(6), pp. 1286–1317.

Lavy, V. (2004), "Performance Pay and Teachers' Effort, Productivity and Grading Ethics", *NBER Working Paper* 10622, National Bureau of Economic Research.

Lazear, E. P. (2003), "Teacher Incentives", *Swedish Economic Policy Review*, Vol. 10(3), pp. 179–214.

Leuven, E., M. Lindahl, H. Oosterbeek, and D. Webbink (2004), "New Evidence on the Effect of Time in School on Early Achievement", *Scholar Working Paper* 47/04, Amsterdam: Research Institute Scholar.

Leuven, E. and H. Oosterbeek (2007), "The Effectiveness of Human-Capital Policies for Disadvantaged Groups in the Netherlands", in L. Wößmann & P. E. Peterson (Eds.), *Schools and the Equal Opportunity Problem*, pp. 191–208. Cambridge: MIT Press.

Levin, J. (2001), "For Whom the Reductions Count? A Quantile Regression Analysis of Class Size and Peer Effects on Scholastic Achievement", *Empirical Economics*, Vol. 26, pp. 221-246.

Machin, S. (2004), "Educational Systems and Intergenerational Mobility", Draft paper prepared for CESifo/PEPG Conference, Munich, September.

Machin, S. J., and A. Vignoles (Eds.), (2005), *What's the Good of Education? The Economics of Education in the UK,* Princeton: Princeton University Press.

Magnuson, K. A., C. Ruhm, and J. Waldfogel (2007), "Does Prekindergarten Improve School Preparation and Performance?", *Economics of Education Review,* Vol. 26, Issue 1, pp.35-51.

Manski, C. F. (1995), *Identification Problems in the Social Sciences*. Harvard University Press, Massachusetts.

Manski, C. F. (2000), "Economic Analysis of Social Interactions." *Journal of Economic Perspectives* vol. 14, No. 3, pp. 115-136.

Moffitt, R. (2001), "Policy Interventions, Low-Level Equilibria, and Social Interactions", in *Social Dynamics*, S. Durlauf and H. P. Young, eds., Cambridge Mass. MIT Press, pp. 45-82.

OECD (2001a), *Knowledge and Skills for Life – First Results from PISA*, Paris.

OECD (2001b), *Starting Strong: Early Childhood Education and Care*, Paris.

OECD (2004*), Learning for Tomorrow's World: First Results from PISA 2003*, Paris.

OECD (2005a*), School Factors Related to Quality and Equity: Results from PISA 2000*, Paris.

OECD (2005b*), PISA 2003 Technical Report*, Paris.

OECD (2005c*), PISA 2003 Data Analysis Manual*, Paris.

OECD (2005d*),Teachers Matter: Attracting, Developing and Retaining Effective Teachers*, Paris.

OECD (2006a), *Where Immigrants Succeed. A Comparative Review of Performance and Engagement in PISA 2003*, Paris.

OECD (2006b), OECD Economic Surveys: Luxembourg 2006, Paris.

OECD (2007a), *PISA 2006 Science Competencies for Tomorrow's World*, Paris.

OECD (2007b), *Babies and Bosses -- Reconciling Work and Family Life: A Synthesis of Findings for OECD Countries*, Paris.

OECD (2008), *Growing Unequal?*, Paris.

Pekkarinen, T., R. Uusitalo and S. Pekkala (2006), "Education Policy and Intergenerational Income Mobility: Evidence from the Finnish Comprehensive School Reform", *IZA Discussion Paper*, No. 2204.

Piketty, T. and M. Valdenaire (2006), "L'impact de la taille des classes sur la réussite scolaire dans les écoles, collèges et lycées français, *Les dossiers Enseignement Scolaire*, Vol. 173, Ministère de l'Éducation nationale enseignement supérieur recherche.

Plug, E. and W. Vijverberg (2003), "Schooling, Family Background, and Adoption: Is it Nature or is it Nurture?", *Journal of Political Economy*, Vol. 111(3), pp. 611-641.

Restuccia, D. and C. Urritia (2004), "Intergenerational Persistence of Earnings: The Role of Early and College Education", *American Economic Review*, Vol. 94, No. 5, pp. 1354-1378.

Rivera-Batiz, F. L. (1992), "Quantitative Literacy and the Likelihood of Employment Among Young Adults in the United States", *Journal of Human Resources*, Vol. 27 (2), pp. 313-328.

Romer, J. E. (1998), *Equality of Opportunity*, Cambridge, MA: Harvard University Press.

Sacerdote, B. (2000), "Peer Effects with Random Assignment: Results for Dartmouth Roommates". *NBER Working Paper* No. 7469.

Sacerdote, B. (2002), "The Nature and Nurture of Economic Outcomes", *American Economic Review*, American Economic Association, Vol. 92(2), pp. 344-348.

Schindler- Rangvid, B. (2003), "Educational Peer Effects, Quantile Regression Evidence from Denmark with PISA 2000 Data", Chapter 3 in *Do Schools Matter*? Phd thesis: Aarhus School of Business, Denmark.

Schneeweis, N. and R. Winter-Ebner (2005), "Peer Effects in Austrian Schools", Economics Working Papers 2005-02, Department of Economics, Johannes Kepler University Linz, Austria.

Schütz, G., H.W. Ursprung and L. Woessmann (2005), "Education Policy and Equality of Opportunity", *IZA Discussion Paper, No. 1906*, Institute for the Study of Labour, Bonn.

Schütz, G., M. R. West and L. Wöbmann (2007), "School Accountability, Autonomy, Choice, and the Equity of Student Achievement: International Evidence from PISA2003", *OECD Education Working Papers*, No. 14, OECD.

Solon, G., (2004), "A Model of Intergenerational Mobility Variation over Time and Place", Chapter 2 in M. Corak, ed., *Generational Income Mobility in North America and Europe*, Cambridge University Press, pp. 38-47.

Sutherland, D. and R. Price (2007), "Linkages between Performance and Institutions in the Primary and Secondary Education Sector, Performance Indicators", *OECD Economics Department Working Papers*, No. 558, *Paris.*

Vigdor, J., and T. Nechyba (2004), "Peer Effects in North Carolina Public Schools", Duke University Durham USA, Working Paper.

Vignoles, A., R. Levacic, J. Walker, S. Machin and D. Reynolds (2000), "The Relationship Between Resource Allocation and Pupil Attainment: A Review", Centre for the Economics of Education, London School of Economics and Political Science.

West, M. R., and P. E. Peterson (2006), "The Efficacy of Choice Threats Within School Accountability Systems: Results from Legislatively-Induced Experiments*"*, *Economic Journal*, Vol. 116(510), C46–C62.

Winston, G C., and D. J. Zimmerman (2003),"Peer Effects in Higher Education", NBER *WP* No. 9501.

Woessmann, L. (2004), "How Equal Are Educational Opportunities? Family Background and Student Achievement in Europe and the United States", *IZA Discussion Papers*, No. 1284.

Wooldrige, J.M (2001), *Econometric Analysis of Cross-Section and Panel Data*, MIT Press.

Table 1. **Estimates of the socio-economic gradient in OECD countries**

Impact of parental background on PISA science scores of teenagers

	Australia	Austria	Belgium	Canada	Czech Republic	Denmark	Finland	France	Germany	Greece	Hungary	Iceland	Ireland	Italy	Japan
Parental background	42.882***	46.357***	47.317***	33.460***	50.518***	38.502***	31.443***	54.263***	46.577***	37.266***	44.297***	27.761***	39.416***	28.835***	38.455***
	[1.491]	[3.047]	[1.750]	[1.361]	[2.452]	[1.845]	[1.541]	[2.358]	[1.940]	[2.266]	[1.787]	[1.740]	[2.073]	[1.460]	[2.567]
Constant	518.880***	502.083***	503.292***	524.224***	512.109***	485.292***	556.105***	502.100***	504.503***	479.476***	508.300***	470.443***	510.012***	531.348***	533.510***
	[1.665]	[3.711]	[2.207]	[1.796]	[3.111]	[2.334]	[1.738]	[2.661]	[3.020]	[2.482]	[2.130]	[1.891]	[2.344]	[3.214]	[3.193]
Number of observations	13995	4914	8777	22136	5903	4496	4697	4606	4686	4862	4474	3745	4501	21683	5862
R-squared	0.113	0.158	0.193	0.084	0.154	0.139	0.084	0.215	0.191	0.153	0.215	0.064	0.127	0.190	0.074

	Korea	Luxembourg	Mexico	Netherlands	New Zealand	Norway	Poland	Portugal	Slovak Republic	Spain	Sweden	Switzerland	Turkey	United Kingdom	United States
Parental background	31.831***	41.325***	24.990***	43.659***	52.220***	34.502***	39.843***	28.162***	44.673***	31.106***	38.190***	44.150***	31.025***	48.347***	48.878***
	[3.164]	[0.940]	[1.232]	[2.189]	[1.720]	[2.267]	[1.743]	[1.402]	[2.472]	[1.215]	[1.880]	[1.741]	[3.227]	[1.904]	[2.516]
Constant	522.320***	483.404***	434.546***	514.237***	527.292***	474.185***	509.795***	491.494***	495.121***	498.483***	496.045***	507.546***	463.751***	508.311***	482.840***
	[2.951]	[1.187]	[2.218]	[2.308]	[2.240]	[2.838]	[2.106]	[2.134]	[2.157]	[1.868]	[2.013]	[2.469]	[6.377]	[1.715]	[3.034]
Number of observations	5168	4488	30877	4838	4727	4602	5520	5091	4723	19499	4392	12136	4934	12806	5568
R-squared	0.082	0.220	0.166	0.168	0.166	0.076	0.147	0.166	0.189	0.136	0.106	0.158	0.166	0.139	0.176

Regression of students' science performance on student PISA index of economic, social and cultural status (ESCS). Country-by-country least-squares regressions weighted by students' sampling probability. Regressions for Italy include regional fixed effects. Robust standard errors adjusted for clustering at the school level.

Example: In Australia, for each improvement of one international standard deviation in the parental socio-economic background, the student performance on the OECD PISA science scale improves by 43 points.

Balanced repeated replicate variance estimation, standard errors clustered by school in brackets, *** p<0.01, ** p<0.05, * p<0.1.

Source: OECD calculations based on the 2006 OECD PISA Database.

Table 2. **Estimates of the socio-economic gradient in OECD countries: The impact of individual characteristics**

Impact of parental background on PISA science scores of teenagers

	Australia	Austria	Belgium	Canada	Czech Republic	Denmark	Finland	France	Germany	Greece	Hungary	Iceland	Ireland	Italy	Japan
Parental background	42.214***	39.221***	41.894***	33.165***	49.378***	33.827***	29.957***	53.073***	40.561***	36.841***	43.834***	26.769***	39.564***	26.771***	37.774***
	[1.533]	[2.275]	[1.771]	[1.359]	[2.484]	[1.787]	[1.582]	[2.412]	[1.771]	[2.073]	[1.822]	[1.829]	[1.977]	[1.486]	[2.622]
Female student	-1.314	-7.128*	-0.324	-7.175***	-3.740	-7.106**	1.014	-1.267	-4.243	13.651***	-5.287	5.870*	-0.187	-4.909	-4.781
	[2.760]	[3.793]	[3.025]	[1.893]	[4.708]	[2.897]	[2.780]	[3.494]	[2.768]	[4.198]	[3.205]	[3.148]	[3.247]	[2.952]	[6.551]
Migration background: first generation	4.779	-34.177***	-32.514***	-5.853	-72.142***	-33.386***	-56.636**	-12.178	-25.023***	-15.981	-34.358	-20.125	-9.685	-46.928**	38.340
	[4.096]	[8.222]	[6.072]	[4.534]	[20.423]	[10.982]	[27.273]	[9.320]	[7.399]	[14.241]	[20.804]	[22.781]	[13.648]	[19.872]	[46.428]
Migration background: second generation	2.847	-30.056***	-59.571***	-17.750***	-12.195	-28.611***	-71.703***	-41.148***	-21.898***	-9.406	7.847	-35.517*	15.516	-63.542***	55.584*
	[4.394]	[8.745]	[7.883]	[5.632]	[14.125]	[9.874]	[16.266]	[8.992]	[7.907]	[11.174]	[13.259]	[20.271]	[9.758]	[12.789]	[33.102]
Foreign language spoken at home	-12.754**	-38.117***	-29.454***	-3.353	-10.642	-33.197***	-12.487	7.407	-44.763***	-50.857***	-44.286***	-36.777**	-78.431***	-4.139	-144.081***
	[5.653]	[10.779]	[5.971]	[5.497]	[16.848]	[9.279]	[13.956]	[8.318]	[6.909]	[13.025]	[14.971]	[15.197]	[15.949]	[13.206]	[21.115]
Constant	521.981***	517.067***	516.583***	532.823***	516.541***	495.682***	558.178***	506.717***	521.164***	475.950***	511.592***	471.350***	511.949***	541.368***	537.785***
	[2.177]	[3.994]	[2.882]	[1.934]	[3.907]	[2.932]	[2.287]	[3.895]	[3.162]	[3.734]	[2.537]	[2.592]	[3.090]	[3.289]	[4.500]
Number of observations	13573	4765	8026	21289	5788	4268	4624	4453	4187	4582	4420	3670	4404	18643	5638
R-squared	0.113	0.201	0.232	0.090	0.155	0.153	0.095	0.222	0.226	0.179	0.218	0.071	0.138	0.204	0.078

	Korea	Luxembourg	Mexico	Netherlands	New Zealand	Norway	Poland	Portugal	Slovak Republic	Spain	Sweden	Switzerland	Turkey	United Kingdom	United States
Parental background	31.487***	31.997***	23.811***	38.346***	51.223***	32.258***	39.879***	28.338***	44.163***	30.371***	34.915***	37.148***	31.122***	47.339***	45.456***
	[3.161]	[1.372]	[1.191]	[1.751]	[1.802]	[2.263]	[1.754]	[1.358]	[2.297]	[1.147]	[1.766]	[1.793]	[3.254]	[1.906]	[2.762]
Female student	1.958	-5.931**	-6.184***	-5.483*	1.171	3.432	-0.432	-0.857	-3.626	-4.710**	0.792	-6.639***	8.751**	-9.750***	-3.035
	[4.705]	[2.538]	[1.848]	[2.954]	[3.948]	[3.258]	[2.303]	[2.379]	[3.926]	[1.929]	[2.803]	[2.071]	[3.451]	[2.583]	[3.099]
Migration background: first generation	29.496***	-11.971***	-43.702***	-37.569***	-5.738	-30.409**	41.277	-50.176***	-29.459	-2.050	-16.598**	-32.760***	-17.761	-3.313	-2.566
	[3.254]	[4.359]	[10.686]	[9.232]	[6.188]	[11.847]	[57.038]	[10.525]	[21.241]	[12.885]	[6.883]	[4.374]	[18.366]	[7.447]	[5.976]
Migration background: second generation	0.000	-9.591**	-90.935***	-32.118***	-5.424	-18.575	-95.575**	-58.477***	-44.303	-50.660***	-34.531***	-45.221***	14.673	-13.288	-5.593
	[0.000]	[4.440]	[6.956]	[9.921]	[5.789]	[14.044]	[47.464]	[9.534]	[38.198]	[6.310]	[10.038]	[6.732]	[16.762]	[9.292]	[8.443]
Foreign language spoken at home	-38.809	-34.086***	25.714	-19.711**	-27.977***	-17.224	-0.016	-2.912	-10.771	-2.470	-28.626***	-31.550***	-4.838	-16.853	-21.602***
	[30.929]	[4.388]	[26.435]	[8.992]	[6.522]	[10.584]	[15.986]	[8.578]	[21.772]	[12.468]	[7.690]	[5.291]	[9.260]	[10.478]	[6.014]
Constant	522.655***	506.659***	440.926***	524.602***	533.571***	477.298***	511.208***	497.546***	498.221***	505.370***	503.089***	528.741***	461.178***	516.716***	490.402***
	[4.201]	[2.215]	[2.765]	[2.934]	[2.992]	[3.374]	[2.355]	[2.382]	[3.408]	[1.864]	[2.359]	[2.276]	[6.937]	[2.113]	[4.255]
Number of observations	5059	3981	29723	4690	4524	4489	5372	4880	4621	18861	4262	11347	4784	12430	5311
R-squared	0.082	0.249	0.191	0.184	0.173	0.081	0.150	0.192	0.188	0.158	0.128	0.226	0.174	0.143	0.176

Regression of students' science performance on student PISA index of economic, social and cultural status (ESCS), plus individual control variables (gender, migration status and language spoken at home). Regressions for Italy include regional fixed effects. Country-by-country least-squares regressions weighted by students' sampling probability. Robust standard errors adjusted for clustering at the school level.

Balanced repeated replicate variance estimation, standard errors clustered by school in brackets, *** p<0.01, ** p<0.05, * p<0.1.
Source: OECD calculations based on the 2006 OECD PISA Database.

Table 3. **Estimates of the socio-economic gradient in OECD countries: School environment and individual background effects**

Impact of parental background on PISA science scores of teenagers

	Australia	Austria	Belgium	Canada	Czech Republic	Denmark	Finland	France	Germany	Greece	Hungary	Iceland	Ireland	Italy	Japan
Individual background	30.424***	16.279***	20.645***	25.679***	24.097***	33.675***	30.330***	23.415***	19.535***	19.268***	11.205***	28.341***	30.177***	10.885***	8.987***
	[1.405]	[1.661]	[1.032]	[1.297]	[1.570]	[1.523]	[1.498]	[1.774]	[1.179]	[1.471]	[1.434]	[1.857]	[1.722]	[1.012]	[1.965]
School environment	53.140***	103.910***	101.220***	39.427***	110.141***	36.766***	11.972**	98.903***	107.591***	59.354***	82.570***	-6.836	43.813***	75.631***	125.737***
	[4.244]	[6.053]	[5.052]	[4.464]	[6.855]	[6.943]	[5.716]	[4.683]	[5.297]	[4.981]	[4.884]	[4.142]	[5.253]	[5.158]	[8.698]
Constant	510.484***	487.508***	490.381***	512.577***	509.669***	475.406***	553.324***	508.298***	480.865***	485.832***	512.492***	474.953***	510.543***	526.669***	534.546***
	[1.512]	[3.285]	[2.594]	[2.427]	[3.335]	[3.110]	[1.946]	[3.164]	[2.887]	[2.528]	[2.660]	[3.451]	[2.114]	[4.650]	[3.090]
Number of observations	13995	4908	8777	22132	5902	4496	4697	4606	4686	4861	4462	3733	4501	21678	5862
R-squared	0.147	0.348	0.387	0.107	0.314	0.160	0.085	0.388	0.421	0.249	0.410	0.063	0.158	0.316	0.236

	Korea	Luxembourg	Mexico	Netherlands	New Zealand	Norway	Poland	Portugal	Slovak Republic	Spain	Sweden	Switzerland	Turkey	United Kingdom	United States
Individual background	11.492***	24.889***	7.947***	14.972***	42.907***	30.925***	36.362***	18.534***	23.251***	24.636***	34.299***	29.721***	10.755***	34.645***	35.111***
	[1.694]	[1.089]	[0.749]	[1.175]	[1.768]	[1.798]	[1.483]	[1.187]	[1.689]	[1.187]	[2.335]	[1.401]	[1.121]	[1.983]	[1.726]
School environment	80.049***	70.134***	35.939***	120.000***	50.897***	29.559***	15.842***	30.693***	64.124***	21.949***	33.414***	75.539***	65.692***	65.766***	51.149***
	[7.950]	[2.281]	[2.183]	[5.317]	[5.452]	[8.123]	[5.289]	[3.233]	[7.216]	[2.638]	[7.546]	[5.971]	[4.937]	[4.704]	[7.092]
Constant	522.712***	478.659***	453.385***	491.176***	522.973***	463.253***	513.414***	504.485***	501.467***	503.282***	489.080***	502.251***	521.766***	498.342***	477.770***
	[2.573]	[1.126]	[2.207]	[2.819]	[2.311]	[4.967]	[2.473]	[2.292]	[2.172]	[1.862]	[2.858]	[2.022]	[7.599]	[2.028]	[3.102]
Number of observations	5168	4488	30869	4838	4727	4601	5502	5091	4723	19499	4386	12136	4934	12806	5568
R-squared	0.193	0.336	0.262	0.439	0.194	0.084	0.151	0.214	0.288	0.152	0.119	0.249	0.344	0.189	0.218

Regression of students' science performance on student PISA index of economic, social and cultural status (ESCS), and school-level ESCS (average across students in the same school, excluding the individual student for whom the regression is run). Regressions for Italy include regional fixed effects. Country-by-country least-squares regressions weighted by students' sampling probability. Robust standard errors adjusted for clustering at the school level.

Example: In Australia, for each improvement of one international standard deviation in the individual socio-economic background, the student performance on the OECD PISA science scale improves by 30 points, within a given school socio-economic environment. In Australia, for each improvement of one international standard deviation in the school socio-economic environment, the student performance on the OECD PISA science scale improves by 53 points, for a given level of individual socio-economic background.

Balanced repeated replicate variance estimation, standard errors clustered by school in brackets, *** p<0.01, ** p<0.05, * p<0.1. All regressions include a constant.

Source: OECD calculations based on the 2006 OECD PISA Database.

Table 4. **Estimates of the socio-economic gradient in OECD countries: Non-linearities in the impact of socio-economic background**

Impact of parental background on PISA science scores of teen-agers

	Australia	Austria	Belgium	Canada	Czech Republic	Denmark	Finland	France	Germany	Greece	Hungary	Iceland	Ireland	Italy	Japan
Individual background	30.455***	12.712***	18.767***	26.892***	23.687***	28.609***	27.516***	23.148***	16.501***	19.756***	9.764***	28.717***	30.740***	9.681***	8.866***
	[1.429]	[2.002]	[1.075]	[1.556]	[1.559]	[1.694]	[1.552]	[1.852]	[1.632]	[1.518]	[1.471]	[3.088]	[1.658]	[1.151]	[2.078]
Individual background squared	-3.324***	-3.497***	-0.139	-3.091**	-4.097***	1.472	2.002	2.023	-0.850	-3.055**	-2.023**	-1.180	0.059	-2.492***	-5.991***
	[1.218]	[1.243]	[0.753]	[1.189]	[1.547]	[1.164]	[1.396]	[1.503]	[0.990]	[1.191]	[0.945]	[1.555]	[1.280]	[0.750]	[1.974]
School environment	48.585***	108.204***	95.736***	45.289***	108.844***	39.820***	-2.942	93.726***	111.147***	53.877***	84.888***	-18.107	46.470***	73.651***	123.128***
	[6.288]	[9.085]	[5.827]	[8.242]	[7.528]	[8.039]	[9.541]	[4.798]	[6.999]	[4.234]	[5.479]	[12.146]	[4.477]	[5.222]	[8.995]
School environment squared	7.383	-15.011	-8.552	-6.842	8.375	-5.234	29.462**	-27.038***	-16.974**	-19.242***	-6.401	9.468	-24.051***	-13.090**	-18.216
	[8.373]	[11.481]	[8.107]	[7.657]	[10.087]	[11.369]	[11.966]	[8.579]	[8.102]	[4.312]	[6.384]	[9.030]	[6.620]	[6.126]	[20.363]
Female student	-1.403	-14.573***	-6.368**	-7.409***	-11.935**	-7.462**	0.694	-7.634**	-10.913***	7.614**	-19.596***	5.438*	-1.121	-11.888***	-5.050
	[2.351]	[4.101]	[2.670]	[1.831]	[4.654]	[2.851]	[2.819]	[3.042]	[2.303]	[3.795]	[3.029]	[3.113]	[3.035]	[2.704]	[5.162]
Migration background: first generation	1.950	-28.747***	-14.402***	-9.271**	-54.888***	-30.276***	-60.102**	-17.741**	-26.164***	-16.677	-45.038***	-19.355	-11.445	-47.480***	3.550
	[3.819]	[8.642]	[5.270]	[4.299]	[17.018]	[11.049]	[26.607]	[7.884]	[7.168]	[12.852]	[14.137]	[22.670]	[13.954]	[16.834]	[36.562]
Migration background: second generation	-1.199	-32.774***	-39.543***	-22.227***	-26.632**	-23.683**	-72.923***	-35.993***	-19.135***	-4.006	-3.561	-35.513*	20.781**	-55.573***	38.963
	[4.020]	[7.256]	[7.709]	[5.107]	[12.490]	[9.957]	[16.538]	[9.665]	[6.109]	[8.780]	[9.748]	[20.424]	[9.298]	[10.123]	[30.478]
Foreign language spoken at home	-13.967**	-25.553***	-22.782***	-1.995	-4.881	-37.087***	-16.383	4.734	-29.044***	-25.012**	-25.799**	-36.258**	-74.552***	-5.563	-119.733***
	[5.629]	[7.868]	[5.122]	[5.311]	[14.679]	[9.219]	[13.905]	[7.717]	[5.380]	[9.667]	[11.551]	[15.142]	[13.177]	[11.257]	[20.796]
Number of observations	13573	4760	8026	21285	5787	4268	4624	4453	4187	4581	4408	3658	4404	18640	5638
R-squared	0.148	0.385	0.395	0.115	0.316	0.173	0.099	0.397	0.439	0.276	0.423	0.071	0.173	0.328	0.239

	Korea	Luxembourg	Mexico	Netherlands	New Zealand	Norway	Poland	Portugal	Slovak Republic	Spain	Sweden	Switzerland	Turkey	United Kingdom	United States
Individual background	11.485***	16.703***	10.479***	11.656***	41.821***	30.286***	36.394***	19.184***	23.129***	22.520***	31.233***	22.038***	17.258***	34.560***	33.355***
	[1.725]	[1.496]	[0.913]	[1.213]	[2.015]	[2.177]	[1.492]	[1.295]	[1.561]	[1.106]	[1.949]	[1.457]	[2.665]	[2.009]	[1.765]
Individual background squared	1.684	-0.656	1.519***	0.818	2.731	-2.964**	-0.042	0.666	-5.143***	-3.403***	-0.106	0.926	3.069***	-2.397*	2.909**
	[1.379]	[0.770]	[0.390]	[1.200]	[1.663]	[1.402]	[1.040]	[0.679]	[1.472]	[0.870]	[1.443]	[0.897]	[0.952]	[1.347]	[1.219]
School environment	80.094***	65.910***	37.046***	121.846***	51.600***	10.323	26.150***	25.056***	73.009***	22.855***	41.060***	75.236***	85.129***	48.701***	47.129***
	[8.433]	[2.899]	[3.180]	[7.444]	[6.130]	[19.271]	[5.679]	[2.417]	[4.910]	[2.508]	[12.527]	[5.663]	[9.625]	[5.900]	[9.080]
School environment squared	-10.571	2.296	1.672	-8.365	-2.840	23.063	27.676***	-6.928***	19.106***	3.330	-17.003	-0.674	8.794**	30.976***	-3.018
	[13.341]	[4.205]	[1.300]	[10.049]	[9.326]	[15.964]	[6.700]	[2.349]	[5.821]	[3.638]	[17.573]	[8.467]	[3.689]	[9.907]	[10.742]
Female student	2.761	-6.505**	-10.398***	-11.217***	-0.011	2.649	-1.000	-2.871	-9.096**	-5.218***	-0.393	-11.244***	4.097	-8.739***	-2.929
	[4.033]	[2.583]	[1.772]	[2.584]	[3.602]	[3.281]	[2.323]	[2.368]	[3.477]	[1.889]	[2.760]	[1.959]	[3.540]	[2.212]	[2.865]
Migration background: first generation	38.128***	-21.944***	-35.831***	-21.920***	-9.063	-29.104**	37.656	-52.736***	-30.009	-2.889	-15.634*	-39.658***	-19.343	-3.700	1.303
	[3.367]	[4.272]	[8.825]	[7.793]	[5.537]	[11.708]	[62.558]	[9.919]	[19.767]	[11.371]	[8.437]	[3.974]	[16.232]	[6.308]	[7.148]
Migration background: second generation	0.000	-21.579***	-74.390***	-25.141***	-8.761	-19.686	-99.875**	-61.677***	-29.207	-49.289***	-33.838***	-54.872***	11.176	-13.699	-3.287
	[0.000]	[4.783]	[6.485]	[8.795]	[5.451]	[13.661]	[49.676]	[8.341]	[33.640]	[6.354]	[9.835]	[5.582]	[11.586]	[9.258]	[8.698]
Foreign language spoken at home	-14.001	-22.048***	25.977	-14.347**	-31.190***	-16.938	-0.254	-0.246	-16.937	-2.035	-26.548***	-25.287***	5.085	-11.795	-19.874***
	[25.738]	[4.379]	[23.447]	[6.695]	[6.196]	[10.569]	[16.061]	[8.358]	[22.092]	[12.300]	[6.775]	[4.757]	[10.543]	[9.210]	[5.985]
Number of observations	5059	3981	29715	4690	4524	4488	5354	4880	4621	18861	4256	11347	4784	12430	5311
R-squared	0.195	0.356	0.280	0.446	0.203	0.092	0.160	0.243	0.303	0.175	0.142	0.320	0.364	0.194	0.212

Regression of students' science performance on student ESCS, student ESCS squared, individual control variables (gender, migration status and language spoken at home), school-level ESCS (average across students in the same school, excluding the individual student for whom the regression is run), and school-level ESCS squared. Regressions for Italy include regional fixed effects. Country-by-country least-squares regressions weighted by students' sampling probability. Robust standard errors adjusted for clustering at the school level.

Balanced repeated replicate variance estimation, standard errors clustered by school in brackets, *** p<0.01, ** p<0.05, * p<0.1.
Source: OECD calculations based on the 2006 OECD PISA Database.

Table 5a. **Estimates of the socio-economic gradient in OECD countries: Urban areas**

Impact of parental background on PISA science scores of teen-agers

	Australia	Austria	Belgium	Canada	Czech Republic	Denmark	Finland	Germany	Greece	Hungary	Iceland	Ireland	Italy	Japan	Korea
Individual background	28.441***	12.119***	17.042***	24.228***	21.754***	23.131***	32.360***	17.561***	20.025***	8.833***	31.558***	28.670***	9.551***	7.066***	11.088***
	[1.665]	[2.890]	[2.782]	[2.097]	[2.908]	[6.764]	[2.999]	[2.561]	[2.958]	[2.595]	[3.649]	[2.954]	[2.109]	[1.933]	[1.862]
School environment	57.521***	93.391***	90.512***	46.451***	111.080***	15.184	29.522***	100.900***	50.122***	88.498***	53.964***	47.397***	71.247***	127.281***	85.654***
	[5.513]	[8.592]	[7.160]	[5.012]	[12.968]	[22.473]	[10.161]	[10.731]	[8.884]	[8.726]	[13.291]	[6.480]	[6.153]	[12.284]	[9.600]
Female student	-4.422	-7.431	-2.872	-8.017***	-11.948	-9.567	6.319	-6.036	-3.238	-23.717***	2.564	9.343	-12.637***	-1.791	-0.672
	[3.038]	[5.959]	[7.081]	[2.960]	[9.216]	[12.750]	[6.838]	[3.767]	[5.530]	[5.374]	[4.805]	[6.936]	[3.972]	[6.040]	[4.146]
Migration background: first generation	8.063*	-31.385**	4.480	-7.576	-67.319***	-35.577	-48.477	-26.629*	-0.893	-54.978**	-9.393	-27.092	-50.736*	4.801	0.000
	[4.656]	[12.872]	[8.366]	[5.008]	[14.176]	[28.966]	[42.498]	[13.466]	[20.325]	[22.524]	[32.137]	[27.403]	[27.476]	[45.441]	[0.000]
Migration background: second generation	4.144	-38.678***	-41.512***	-25.362***	-32.462	-32.039	-72.964***	-29.951**	-3.442	0.727	9.486	-30.771	-52.812***	54.809*	0.000
	[4.700]	[9.704]	[13.079]	[6.659]	[20.207]	[27.231]	[22.357]	[13.895]	[14.014]	[13.022]	[28.804]	[19.939]	[14.541]	[29.176]	[0.000]
Foreign language spoken at home	-11.106*	-23.846**	-21.288***	7.541	24.251	-79.925***	-16.873	-33.014***	-23.816	-5.845	-43.532**	-13.641	10.946	-112.741***	-9.640
	[6.274]	[11.105]	[5.996]	[6.217]	[35.777]	[27.649]	[19.478]	[9.947]	[16.693]	[19.851]	[21.387]	[20.994]	[16.096]	[20.683]	[24.887]
Number of observations	8156	1503	1360	6769	914	435	928	937	1585	1846	1168	1187	4673	3701	4259
R-squared	0.162	0.495	0.488	0.136	0.368	0.250	0.169	0.526	0.256	0.414	0.110	0.241	0.328	0.238	0.193

	Luxembourg	Mexico	Netherlands	New Zealand	Norway	Poland	Portugal	Slovak Republic	Spain	Sweden	Switzerland	Turkey	United Kingdom	United States
Individual background	20.580***	8.533***	10.211***	45.132***	30.172***	37.851***	17.788***	18.863***	21.354***	34.396***	19.609***	11.682***	31.581***	37.688***
	[4.958]	[0.849]	[2.468]	[3.079]	[4.848]	[3.476]	[2.389]	[3.651]	[1.259]	[3.618]	[3.830]	[1.745]	[3.777]	[3.087]
School environment	58.561***	37.590***	108.987***	58.494***	51.235***	49.583***	45.401***	78.862***	27.604***	30.507**	92.375***	72.617***	67.677***	48.251***
	[8.870]	[3.244]	[6.455]	[6.948]	[15.894]	[13.226]	[6.035]	[8.418]	[4.412]	[11.800]	[15.916]	[6.564]	[6.938]	[13.272]
Female student	-2.236	-12.206***	-15.427***	-4.719	7.010	-4.951	-9.372*	-20.595*	-7.107**	-7.902	-8.217	-0.944	-7.070	4.030
	[8.778]	[2.609]	[5.170]	[3.797]	[10.912]	[3.015]	[5.491]	[11.245]	[3.338]	[5.735]	[5.692]	[4.756]	[5.722]	[6.156]
Migration background: first generation	-13.619	-20.133**	-21.527**	-9.797	-17.844	-114.272***	-9.599	-65.725	-17.058*	-0.109	-29.622***	-22.729	-0.571	7.202
	[13.969]	[9.425]	[9.597]	[5.906]	[24.091]	[9.303]	[17.172]	[50.238]	[9.724]	[11.014]	[10.274]	[22.513]	[9.059]	[10.345]
Migration background: second generation	-19.334	-73.430***	-18.627	-13.340**	-5.182	-145.079***	-39.669***	0.000	-53.655***	-44.184**	-46.983***	14.042	-12.270	11.499
	[17.582]	[13.136]	[12.715]	[6.490]	[26.710]	[16.722]	[8.114]	[0.000]	[9.255]	[17.405]	[9.674]	[16.002]	[13.038]	[10.818]
Foreign language spoken at home	-14.699	12.701	-0.322	-24.824***	-14.878	3.771	5.791	-20.471	8.350	-30.721***	-14.443	15.384	-17.339	-13.227
	[14.171]	[31.443]	[13.477]	[7.405]	[19.232]	[18.617]	[9.854]	[22.763]	[21.591]	[11.028]	[10.007]	[16.323]	[13.551]	[8.033]
Number of observations	374	14739	1096	2588	533	1335	1021	628	7563	888	943	2588	3165	1733
R-squared	0.437	0.208	0.566	0.244	0.164	0.240	0.363	0.377	0.205	0.214	0.434	0.386	0.230	0.252

Regression of students' science performance on student PISA index of economic, social and cultural status (ESCS), individual control variables (migration status and language spoken at home), and school-level ESCS (average across students in the same school, excluding the individual student for whom the regression is run). Country-by-country least-squares regressions weighted by students' sampling probability. Robust standard errors adjusted for clustering at the school level. Regressions for Italy include regional fixed effects. Regressions run over rural and urban areas separately where urban areas are defined as communities with more than 100 000 inhabitants.

Balanced repeated replicate variance estimation, standard errors clustered by school in brackets, *** p<0.01, ** p<0.05, * p<0.1.
Source: OECD calculations based on the 2006 OECD PISA Database.

Table 5b. **Estimates of the socio-economic gradient in OECD countries: Rural areas**

Impact of parental background on PISA science scores of teen-agers

	Australia	Austria	Belgium	Canada	Czech Republic	Denmark	Finland	Germany	Greece	Hungary	Iceland	Ireland	Italy	Japan	Korea
Individual background	32.228***	9.096***	19.320***	26.070***	24.448***	30.112***	27.359***	16.192***	20.957***	10.624***	25.164***	31.011***	8.904***	12.326***	13.566***
	[2.430]	[2.464]	[1.034]	[2.043]	[1.671]	[1.606]	[1.735]	[1.456]	[1.540]	[2.102]	[2.489]	[1.980]	[1.270]	[4.127]	[4.728]
School environment	43.009***	106.672***	95.346***	33.488***	116.818***	37.221***	9.645	106.580***	59.190***	94.587***	-14.563***	42.903***	81.195***	139.349***	88.648***
	[8.897]	[6.815]	[6.431]	[6.644]	[9.575]	[7.143]	[6.624]	[6.192]	[7.376]	[5.204]	[5.008]	[7.834]	[7.190]	[13.428]	[19.535]
Female student	3.171	-19.668***	-8.102***	-6.695***	-12.223**	-8.547**	-0.513	-12.689***	13.831**	-18.975***	7.904**	-4.259	-12.281***	-14.330*	21.979*
	[3.634]	[4.885]	[2.902]	[2.361]	[5.509]	[3.400]	[2.897]	[2.859]	[5.473]	[3.208]	[3.712]	[3.478]	[3.343]	[7.793]	[11.861]
Migration background: first generation	-16.482**	-46.643***	-21.844***	-11.262	-54.771***	-22.917**	-73.639***	-30.441***	-29.902	-28.299***	-33.470	-4.276	-45.048***	-2.094	15.552*
	[7.013]	[8.248]	[6.459]	[7.475]	[18.278]	[11.106]	[20.176]	[6.166]	[19.391]	[7.208]	[33.879]	[15.605]	[16.845]	[7.562]	[8.708]
Migration background: second generation	-16.785**	-28.359**	-37.933***	-4.679	-25.038	-22.662*	-66.530***	-12.078*	-10.959	3.349	-68.078**	27.743***	-53.381***	-162.198	0.000
	[7.975]	[11.262]	[9.040]	[8.726]	[16.526]	[12.850]	[23.265]	[6.969]	[10.116]	[15.625]	[27.604]	[9.012]	[13.980]	[102.923]	[0.000]
Foreign language spoken at home	-40.405***	-41.874***	-18.488**	-39.314***	-14.180	-32.490***	-5.839	-29.441***	-34.202***	-39.685**	-22.584	-101.134***	-18.997	0.000	0.000
	[12.747]	[10.161]	[7.378]	[8.217]	[17.096]	[12.186]	[22.414]	[6.821]	[11.958]	[15.174]	[23.088]	[17.390]	[14.279]	[0.000]	[0.000]
Number of observations	5417	3257	6571	13666	4656	3128	3696	3081	2929	2469	2367	3165	13583	1937	800
R-squared	0.103	0.313	0.369	0.094	0.290	0.157	0.075	0.423	0.253	0.441	0.066	0.140	0.318	0.253	0.139

	Luxembourg	Mexico	Netherlands	New Zealand	Norway	Poland	Portugal	Slovak Republic	Spain	Sweden	Switzerland	Turkey	United Kingdom	United States
Individual background	16.332***	7.306***	12.360***	37.810***	27.867***	36.056***	18.883***	22.942***	25.441***	29.865***	22.391***	10.175***	36.276***	32.018***
	[1.533]	[0.990]	[1.458]	[2.885]	[2.166]	[1.586]	[1.299]	[1.882]	[1.502]	[2.434]	[1.456]	[1.558]	[2.207]	[2.522]
School environment	68.880***	29.156***	127.463***	46.447***	25.702**	1.458	32.005***	66.365***	15.134***	30.507***	71.781***	64.630***	61.676***	45.915***
	[2.795]	[2.802]	[7.822]	[7.761]	[9.979]	[6.918]	[4.200]	[9.098]	[4.024]	[7.921]	[5.437]	[8.571]	[6.958]	[6.219]
Female student	-7.001***	-8.933***	-9.692***	5.761	2.864	0.039	0.010	-7.922**	-4.197**	1.583	-11.439***	5.742	-11.144***	-6.612**
	[2.585]	[2.453]	[2.950]	[5.876]	[3.539]	[2.868]	[2.765]	[3.884]	[2.093]	[3.213]	[2.162]	[4.986]	[3.110]	[2.816]
Migration background: first generation	-23.511***	-57.839***	-26.399***	15.140	-28.409**	90.148*	-61.763***	-11.668	4.020	-27.282**	-40.938***	-15.746	-8.356	8.087
	[4.282]	[11.854]	[9.296]	[12.853]	[14.178]	[51.542]	[9.873]	[14.506]	[16.691]	[11.407]	[4.619]	[27.432]	[10.559]	[9.033]
Migration background: second generation	-22.284***	-76.097***	-32.887***	13.660	-30.344*	76.407***	-63.028***	-30.632	-45.145***	-27.516**	-55.086***	-0.117	-8.052	-10.422
	[4.646]	[7.342]	[8.402]	[11.657]	[15.321]	[2.814]	[12.632]	[32.575]	[9.768]	[12.503]	[6.818]	[12.396]	[13.873]	[13.660]
Foreign language spoken at home	-22.924***	69.331**	-22.114***	-49.295***	-15.870	-0.944	-2.498	-16.796	-8.495	-26.382**	-27.225***	4.995	-1.071	-18.519**
	[4.479]	[30.838]	[7.573]	[17.980]	[12.045]	[17.463]	[10.542]	[26.585]	[15.733]	[10.050]	[5.973]	[12.413]	[13.130]	[8.173]
Number of observations	3607	14447	3582	1936	3868	4019	3827	3979	11276	3292	10312	2196	8384	3428
R-squared	0.346	0.184	0.400	0.149	0.076	0.117	0.202	0.271	0.141	0.118	0.295	0.288	0.179	0.182

Regression of students' science performance on student PISA index of economic, social and cultural status (ESCS), individual control variables (migration status and language spoken at home), and school-level ESCS (average across students in the same school, excluding the individual student for whom the regression is run). Country-by-country least-squares regressions weighted by students' sampling probability. Robust standard errors adjusted for clustering at the school level. Regressions for Italy include regional fixed effects. Regressions run over rural and urban areas separately where urban areas are defined as communities with more than 100 000 inhabitants.

Balanced repeated replicate variance estimation, standard errors clustered by school in brackets, *** p<0.01, ** p<0.05, * p<0.1.

Source: OECD calculations based on the 2006 OECD PISA Database.

Table 6. **Estimates of the socio-economic gradient in OECD countries: Asymmetric contextual effects, by science score**

	Austria			Belgium			Canada			Czech Republic			Finland		
Achievement level	Low	Average	High	Low	Average	High	Low	Average	High	Low	Average	High	Low	Average	High
Parental background	6.797***	0.303	0.233	6.462***	1.381	5.143***	6.496***	2.449***	5.262***	4.376*	3.106***	7.889***	7.316***	2.277***	7.159***
	[1.686]	[1.040]	[1.442]	[1.404]	[0.938]	[0.981]	[1.757]	[0.709]	[1.242]	[2.306]	[0.998]	[1.555]	[1.835]	[0.645]	[1.896]
School science score	0.347***	0.114***	0.244***	0.393***	0.120***	0.183***	0.201***	0.066***	0.127***	0.233***	0.128***	0.284***	0.180***	0.014	0.097
	[0.028]	[0.019]	[0.034]	[0.053]	[0.016]	[0.031]	[0.030]	[0.020]	[0.035]	[0.036]	[0.014]	[0.024]	[0.052]	[0.022]	[0.059]
Index of quality of educational resources	0.334	-1.275	0.068	-1.664	1.175**	-0.215	0.744	0.187	0.765	-3.113*	0.867	2.463	-3.887*	0.215	-3.241*
	[1.480]	[0.909]	[1.617]	[1.785]	[0.574]	[1.066]	[1.160]	[0.512]	[1.182]	[1.832]	[0.881]	[1.581]	[1.962]	[0.955]	[1.857]
Private government dependent school	-6.700	8.685*	17.673	19.323***	-6.893**	5.038	-4.124	0.480	-1.081	3.384	-26.246***	-6.315	-10.909	0.000	13.892
	[11.183]	[4.518]	[11.419]	[5.422]	[2.623]	[4.494]	[10.446]	[3.282]	[4.538]	[25.743]	[4.023]	[8.091]	[12.391]	[4.301]	[13.261]
Public school	-10.446	11.191***	11.688	18.909***	-8.631***	5.647	-10.391	2.382	-3.153	7.670	-26.656***	0.000	0.000	3.574	0.000
	[10.400]	[4.173]	[11.227]	[6.603]	[2.490]	[4.407]	[9.860]	[2.853]	[3.819]	[22.975]	[3.871]	[6.769]	[11.815]	[3.459]	[13.339]
Proportion of certified teachers	-8.199	-1.947	-3.534	-5.183	3.733**	-1.531	-0.894	-6.334*	-0.879	-6.837	-16.684***	-5.268	-0.626	3.282	-2.548
	[5.672]	[4.668]	[4.896]	[4.995]	[1.854]	[4.111]	[3.142]	[3.689]	[7.543]	[6.201]	[4.940]	[6.225]	[6.350]	[3.152]	[3.965]
Ratio of computers for instruction to school size	-0.393	-7.395	5.126	16.211	-2.630	-6.873	-5.233	-1.210	7.708	32.920	-2.359	-16.913**	38.582*	-1.394	27.621
	[8.746]	[6.844]	[12.859]	[13.212]	[4.006]	[8.000]	[6.973]	[4.066]	[9.137]	[20.814]	[3.715]	[8.165]	[20.230]	[11.089]	[20.965]
Average student learning time at school	0.144	-0.531	1.489**	-0.914	0.314	0.912	1.318**	-0.129	0.644	0.969	0.519	1.594*	-0.217	0.095	0.021
	[0.884]	[0.557]	[0.744]	[1.012]	[0.310]	[0.666]	[0.541]	[0.269]	[0.470]	[0.754]	[0.445]	[0.824]	[0.840]	[0.477]	[0.988]
Average class size	0.467*	0.126	-0.640***	0.106	-0.024	-0.067	0.259	-0.051	0.232	0.938***	-0.070	-0.402	0.368**	-0.096	-0.060
	[0.272]	[0.162]	[0.221]	[0.245]	[0.156]	[0.265]	[0.251]	[0.127]	[0.196]	[0.289]	[0.142]	[0.261]	[0.157]	[0.089]	[0.191]
Teacher shortage	-0.659	-0.186	3.717**	-3.673**	1.026**	0.770	1.663	-0.075	1.365	-2.971	-0.764	-2.612	2.482	3.548***	-1.381
	[2.020]	[0.980]	[1.736]	[1.594]	[0.497]	[1.155]	[1.323]	[0.579]	[1.007]	[2.133]	[0.943]	[1.702]	[1.856]	[0.979]	[1.977]
Female student	-7.003***	0.519	-7.857***	0.564	-1.944	-9.934***	4.054*	-1.625	-6.785***	-7.140**	-0.069	-8.681***	8.771***	0.288	-6.442***
	[2.640]	[1.356]	[2.228]	[2.904]	[1.174]	[2.014]	[2.363]	[1.084]	[2.275]	[2.877]	[1.553]	[2.170]	[2.325]	[1.032]	[2.327]
Migration background: first generation	-23.737***	-6.844	4.445	6.338	-0.680	-9.145	-5.671	-1.528	-0.873	-21.885*	13.954**	5.128	-22.531	-4.123	-14.426***
	[8.498]	[5.295]	[8.338]	[5.226]	[3.138]	[5.522]	[4.310]	[2.012]	[4.225]	[13.016]	[5.414]	[11.233]	[18.339]	[9.024]	[3.418]
Migration background: second generation	-32.753***	-2.817	-9.855	-11.128**	-1.403	2.657	-11.820**	2.210	-3.463	-14.196	-13.683	-30.691***	-24.372	-4.900	28.322
	[6.786]	[4.382]	[6.068]	[5.557]	[3.125]	[5.983]	[5.190]	[2.773]	[8.059]	[15.929]	[9.069]	[8.473]	[14.999]	[10.672]	[20.204]
Foreign language spoken at home	-2.558	-4.951	-15.219*	-22.243***	-2.862	-12.800**	-2.576	-0.429	7.446	-15.441	10.564	14.657	-13.015	5.047	-25.878**
	[6.456]	[4.126]	[8.131]	[5.360]	[3.110]	[6.374]	[4.584]	[2.766]	[6.218]	[17.577]	[7.553]	[8.938]	[17.492]	[11.022]	[9.895]
Number of observations	1237	1466	1479	1792	2158	2296	5291	4807	4440	1357	1492	2263	1413	1439	1432
R-squared	0.356	0.095	0.096	0.269	0.098	0.101	0.076	0.024	0.036	0.182	0.085	0.208	0.079	0.017	0.038

	Germany			Greece			Hungary			Iceland			Ireland		
Achievement level	Low	Average	High	Low	Average	High	Low	Average	High	Low	Average	High	Low	Average	High
Parental background	4.060*	2.846***	6.756***	5.711***	1.810*	7.886***	3.657**	-0.740	2.042	4.612***	1.267	6.600***	8.661***	1.457	7.802***
	[2.110]	[0.886]	[1.597]	[2.056]	[0.952]	[1.327]	[1.633]	[0.733]	[1.579]	[1.567]	[0.873]	[1.590]	[2.149]	[0.994]	[1.573]
School science score	0.332***	0.080***	0.270***	0.375***	0.084***	0.255***	0.346***	0.100***	0.287***	0.162***	0.038	0.093*	0.172***	0.062**	0.023
	[0.040]	[0.018]	[0.029]	[0.056]	[0.024]	[0.042]	[0.034]	[0.021]	[0.039]	[0.061]	[0.030]	[0.053]	[0.050]	[0.029]	[0.047]
Index of quality of educational resources	1.459	0.996	-1.998	-4.048	-0.621	-1.696	1.652	-0.852	2.566*	1.134	-2.395**	0.489	1.478	1.291*	1.688
	[1.948]	[0.888]	[1.299]	[2.525]	[0.971]	[1.423]	[1.657]	[1.087]	[1.500]	[1.949]	[1.124]	[1.850]	[2.155]	[0.719]	[1.629]
Private government dependent school	-13.448	8.956**	6.318	0.000	0.000	0.000	-9.879	0.285	14.741**	1.755	0.000	-14.044	8.061	1.222	-6.869
	[9.932]	[4.390]	[11.276]	[0.000]	[0.000]	[0.000]	[13.221]	[5.318]	[5.740]	[53.114]	[14.984]	[19.826]	[11.874]	[4.499]	[15.328]
Public school	-12.035*	0.118	1.193	11.128	5.078	6.214	-11.906	0.915	10.943*	10.444	13.174	0.000	4.564	-2.758	-12.407
	[6.846]	[3.299]	[7.693]	[8.609]	[3.169]	[5.002]	[13.517]	[5.335]	[6.292]	[49.170]	[13.142]	[12.954]	[12.193]	[4.451]	[15.890]
Proportion of certified teachers	2.580	-1.858	-5.069	-8.726	-10.898	-8.497	4.375	-3.311	11.302	-7.620	-8.957	-5.706	-8.941	5.689	1.874
	[6.615]	[3.177]	[6.751]	[15.819]	[7.059]	[5.253]	[6.325]	[6.842]	[7.821]	[15.636]	[9.072]	[21.884]	[7.057]	[4.911]	[25.664]
Ratio of computers for instruction to school size	-13.319	6.038	31.747	9.798	5.233	53.709*	-2.691	-3.421	-25.971***	-36.024	-7.117	11.212	-30.468	7.570	9.564
	[25.500]	[12.255]	[27.528]	[22.932]	[14.106]	[27.214]	[8.332]	[6.144]	[6.538]	[29.603]	[12.768]	[21.409]	[26.246]	[12.366]	[26.778]
Average student learning time at school	1.165	0.686	1.619*	0.351	0.084	0.890	0.937	1.503**	0.526	3.945***	-0.107	0.346	-0.070	-1.451**	-0.556
	[0.807]	[0.446]	[0.968]	[1.363]	[0.611]	[1.304]	[0.906]	[0.678]	[0.995]	[1.251]	[0.728]	[1.419]	[1.350]	[0.556]	[1.066]
Average class size	0.735*	0.049	-0.388	0.019	-0.038	0.003	0.587**	-0.109	0.069	-0.396*	0.037	-0.121	0.233	0.305	0.026
	[0.442]	[0.195]	[0.424]	[0.106]	[0.055]	[0.083]	[0.225]	[0.098]	[0.157]	[0.226]	[0.105]	[0.170]	[0.467]	[0.218]	[0.378]
Teacher shortage	-0.144	0.855	-0.659	-3.848**	-1.715**	1.511	4.738**	-0.782	-6.013***	-1.910	-1.767*	3.251*	-1.871	0.734	-1.494
	[1.937]	[0.807]	[1.301]	[1.864]	[0.684]	[1.070]	[1.965]	[1.212]	[2.105]	[2.052]	[1.001]	[1.756]	[2.293]	[0.831]	[1.720]
Female student	-4.596*	-0.439	-8.452***	-0.383	1.264	-9.159***	-6.570**	-2.470**	-13.472***	9.083***	0.888	-5.359**	3.538	-2.102	-5.831**
	[2.330]	[1.438]	[2.143]	[3.260]	[1.405]	[3.063]	[2.741]	[1.158]	[2.272]	[3.354]	[1.377]	[2.562]	[2.475]	[1.425]	[2.534]
Migration background: first generation	-4.493	-8.156*	-13.854	-4.276	-7.627	15.794	-9.637	-19.484***	-39.364***	-29.433	9.875	-21.106*	-11.081	-11.808**	-7.753
	[5.582]	[4.849]	[8.787]	[13.601]	[7.883]	[15.170]	[24.192]	[4.055]	[7.322]	[23.877]	[10.517]	[11.593]	[10.604]	[5.391]	[9.064]
Migration background: second generation	-10.926	-5.480	-2.836	5.628	0.689	17.374*	-11.635	2.596	3.252	-0.278	-11.261	14.218	4.383	6.789*	7.903
	[7.137]	[3.512]	[9.684]	[7.766]	[3.139]	[9.126]	[19.652]	[6.144]	[10.884]	[16.809]	[8.458]	[33.367]	[7.316]	[3.990]	[7.667]
Foreign language spoken at home	-8.660*	0.320	-3.685	-16.836	0.964	-9.456	-12.780	9.865	19.475	-25.645*	-5.727	-8.959	-41.472***	-11.683*	-29.448**
	[5.195]	[2.884]	[7.758]	[10.652]	[5.755]	[10.886]	[12.634]	[8.208]	[12.575]	[13.655]	[7.102]	[16.114]	[12.250]	[6.866]	[11.187]
Number of observations	933	1131	1206	1142	1131	1194	1169	1390	1455	1045	1119	1130	1122	1183	1187
R-squared	0.313	0.101	0.132	0.283	0.040	0.108	0.246	0.084	0.205	0.072	0.020	0.029	0.097	0.036	0.040

Regression of students' science performance on student PISA index of economic, social and cultural status (ESCS), school-level (weighted) average performance (average across students in the same school, excluding the individual student for whom the regression is run), plus individual control variables (gender, migration status and language spoken at home) and school-level control variables (school location, school size and school size squared, index of quality of educational resources, index of teacher shortage, proportion of certified teachers, ratio of computers for instruction to school size, average class size, average student learning time at school, school type: private independent, private government dependent or public). Regressions are run separately for each tertile of the student science score distribution, where the distribution is country specific. Tertiles are ordered as low, average and high where low refers to the first tertile and high to the last. Regressions for Italy include regional fixed effects.

Country-by-country least-squares regressions weighted by students' sampling probability. Robust standard errors adjusted for clustering at the school level. All regressions include a constant.

Balanced repeated replicate variance estimation, standard errors clustered by school in brackets, *** p<0.01, ** p<0.05, * p<0.1.
Source: OECD calculations based on the 2006 OECD PISA Database.

Table 6. **Estimates of the socio-economic gradient in OECD countries: Asymmetric contextual effects, by science score** (continued)

	Italy			Japan			Korea			Luxembourg			Mexico		
Achievement level	Low	Average	High	Low	Average	High	Low	Average	High	Low	Average	High	Low	Average	High
Parental background	2.404**	0.047	4.422***	1.179	0.274	3.846**	-1.124	-0.094	4.365***	4.254***	1.665**	4.765***	-0.048	1.192**	3.267***
	[1.180]	[0.588]	[1.129]	[2.338]	[0.908]	[1.792]	[1.803]	[0.889]	[1.198]	[1.589]	[0.686]	[1.206]	[1.310]	[0.530]	[0.810]
School science score	0.288***	0.106***	0.321***	0.365***	0.098***	0.295***	0.369***	0.097***	0.243***	0.290***	0.038	0.274***	0.212***	0.089***	0.382***
	[0.025]	[0.012]	[0.016]	[0.037]	[0.013]	[0.031]	[0.048]	[0.018]	[0.033]	[0.051]	[0.026]	[0.045]	[0.037]	[0.019]	[0.033]
Index of quality of	-0.931	1.038**	-0.279	0.745	-0.501	-0.712	-2.576	0.122	1.289	0.420	2.867***	0.186	0.904	1.018**	0.350
educational resources	[1.137]	[0.433]	[0.908]	[1.671]	[0.643]	[1.114]	[1.813]	[0.746]	[1.151]	[2.021]	[0.957]	[1.594]	[0.892]	[0.493]	[0.977]
Private government	24.891**	-6.122	11.068**	-1.159	9.126***	-8.422	6.306	-2.210	-3.054	-4.497	3.367	17.602	0.000	0.000	0.000
dependent school	[10.426]	[3.792]	[5.144]	[6.431]	[2.269]	[5.860]	[4.342]	[2.131]	[3.517]	[6.048]	[3.757]	[16.999]	[0.000]	[0.000]	[0.000]
Public school	12.379	-5.103	0.650	3.630	2.934*	-0.332	3.667	0.160	-2.120	0.000	0.000	0.000	4.976	2.693*	4.187
	[9.308]	[3.871]	[4.440]	[4.368]	[1.597]	[2.511]	[3.759]	[1.940]	[3.106]	[5.454]	[3.006]	[17.901]	[5.788]	[1.532]	[3.182]
Proportion of certified	-3.065	-1.360	-10.999***	-21.116	-9.716**	3.685	-15.367***	-2.445	0.492	-6.998	6.680	-14.209	0.828	-0.644	1.448
teachers	[3.446]	[2.256]	[2.878]	[19.013]	[4.541]	[7.525]	[4.724]	[1.893]	[6.330]	[14.451]	[6.152]	[12.155]	[1.973]	[1.229]	[2.141]
Ratio of computers for	-14.358	-5.496	-12.334*	5.468	0.423	-5.992	15.953*	-2.813	1.847	-2.086	-7.290	-18.744**	3.019	1.526	-11.668
instruction to school size	[9.294]	[5.147]	[6.282]	[6.247]	[3.775]	[11.063]	[9.212]	[4.392]	[13.484]	[10.792]	[7.031]	[9.337]	[8.909]	[6.937]	[7.500]
Average student learning	0.389	0.297	0.526	0.310	0.239	-0.886	1.111	-0.174	-1.342*	-0.427	2.598**	-2.677	0.135	-0.026	-0.177
time at school	[0.621]	[0.264]	[0.490]	[0.903]	[0.328]	[0.846]	[1.099]	[0.422]	[0.766]	[2.704]	[1.139]	[1.937]	[0.465]	[0.424]	[0.711]
Average class size	-0.040	-0.168***	0.028	0.535***	0.022	-0.074	-0.151	-0.267	0.259	-2.907***	0.175	0.877	0.038	-0.037	-0.111
	[0.135]	[0.042]	[0.101]	[0.183]	[0.110]	[0.207]	[0.473]	[0.216]	[0.297]	[0.825]	[0.341]	[0.606]	[0.068]	[0.046]	[0.121]
Teacher shortage	-0.116	0.288	-2.127**	1.477	1.090	-1.383	-0.799	0.313	0.360	-5.883*	4.797***	2.213	-1.158	-0.052	0.449
	[1.096]	[0.519]	[0.892]	[1.503]	[0.892]	[1.665]	[2.029]	[0.676]	[1.125]	[3.165]	[1.556]	[3.328]	[0.921]	[0.526]	[1.065]
Female student	3.347*	-3.136***	-9.934***	0.410	-1.231	-5.780***	6.539**	-0.467	0.021	5.191*	1.914	-8.867***	-2.515	-0.314	-6.950**
	[2.000]	[0.873]	[1.568]	[2.742]	[1.143]	[1.678]	[2.850]	[1.158]	[1.801]	[2.986]	[1.447]	[2.146]	[1.921]	[1.222]	[2.833]
Migration background:	-42.970**	8.673*	-3.231	-53.645**	3.550	68.830***	0.000	19.585***	0.000	-6.551	-2.794	-8.039*	-4.622	-9.482**	-11.845**
first generation	[18.051]	[5.134]	[21.825]	[20.542]	[3.270]	[3.549]	[0.000]	[2.104]	[0.000]	[4.805]	[2.061]	[4.114]	[6.956]	[4.281]	[5.302]
Migration background:	-23.389**	-3.063	-37.823***	-12.910	5.591	-27.066***	0.000	0.000	0.000	-17.189***	-6.163**	0.940	-26.899***	-17.793**	-24.379***
second generation	[10.812]	[3.887]	[12.679]	[51.704]	[16.753]	[3.457]	[0.000]	[0.000]	[0.000]	[5.369]	[2.691]	[5.326]	[7.278]	[7.035]	[6.001]
Foreign language	4.147	-5.328	30.426*	-56.487***	-4.637	20.615	51.008***	0.000	-50.012***	-3.694	-1.988	1.776	14.392**	7.022	62.916***
spoken at home	[12.191]	[4.329]	[16.399]	[11.619]	[2.881]	[14.979]	[10.476]	[0.000]	[2.162]	[5.058]	[2.450]	[5.405]	[6.244]	[5.577]	[21.174]
Number of observations	3560	4664	6196	1685	1856	1944	1615	1636	1670	1162	1348	1447	3364	4804	4873
R-squared	0.161	0.066	0.145	0.169	0.062	0.133	0.184	0.040	0.089	0.123	0.064	0.097	0.099	0.073	0.218

	Netherlands			New Zealand			Norway			Poland			Portugal		
Achievement level	Low	Average	High	Low	Average	High	Low	Average	High	Low	Average	High	Low	Average	High
Parental background	3.613**	0.549	6.786***	12.147***	4.175***	15.374***	5.621***	2.146**	8.976***	11.696***	2.920***	9.725***	2.829**	2.030***	6.420***
	[1.577]	[0.855]	[1.229]	[2.576]	[1.117]	[1.868]	[1.725]	[0.898]	[1.953]	[1.352]	[0.755]	[1.283]	[1.345]	[0.592]	[0.975]
School science score	0.291***	0.177***	0.278***	0.130**	-0.010	0.117**	0.238***	0.108***	0.095*	0.175***	0.074***	0.215***	0.258***	0.087***	0.075
	[0.042]	[0.018]	[0.024]	[0.055]	[0.025]	[0.046]	[0.045]	[0.021]	[0.053]	[0.047]	[0.021]	[0.033]	[0.032]	[0.020]	[0.048]
Index of quality of	2.192	0.750	-2.064**	-2.653	0.844	0.424	6.242**	1.002	-1.385	1.608	-1.121	0.801	-2.347	-0.015	0.495
educational resources	[1.711]	[0.924]	[0.852]	[1.894]	[0.991]	[1.569]	[2.502]	[1.063]	[2.693]	[1.270]	[0.688]	[1.197]	[2.292]	[0.783]	[1.518]
Private government	-4.263	0.193	0.000	0.000	0.000	0.000	-6.050	-2.524	0.000	-37.449***	2.668	-1.332	-14.063	2.402	-10.130
dependent school	[4.233]	[1.312]	[1.871]	[0.000]	[0.000]	[0.000]	[8.520]	[3.810]	[6.086]	[12.735]	[6.594]	[9.745]	[17.261]	[8.451]	[6.250]
Public school	0.000	0.000	-0.374	-0.085	-3.045	-1.708	0.000	0.000	-2.403	-17.177***	0.298	0.519	-19.379	-0.671	-4.981
	[3.597]	[0.534]	[1.310]	[13.679]	[3.579]	[5.289]	[6.838]	[3.085]	[5.404]	[5.857]	[4.831]	[9.969]	[17.464]	[8.031]	[5.714]
Proportion of certified	4.396	4.933	-7.334	-13.378	-2.630	-8.772	-18.928***	2.702	6.578*	-2.504	6.469	15.713***	7.419	3.248	-14.820
teachers	[7.647]	[4.631]	[5.297]	[8.350]	[5.400]	[7.780]	[6.796]	[2.547]	[3.586]	[6.996]	[4.603]	[4.976]	[7.190]	[2.641]	[9.568]
Ratio of computers for	-18.114	9.995	-4.136	6.971	13.922	-0.178	-1.951	-2.920	2.819	10.217	-0.958	22.220	12.725	17.325	-11.133
instruction to school size	[17.396]	[9.673]	[18.108]	[26.876]	[10.386]	[17.725]	[19.849]	[7.979]	[18.354]	[22.513]	[9.980]	[22.127]	[65.991]	[14.911]	[32.648]
Average student learning	3.760***	0.715	-0.309	2.906**	0.234	-0.832	1.754	0.271	-1.489	0.341	0.494	-1.205	0.214	0.656	2.669***
time at school	[0.976]	[0.610]	[0.732]	[1.191]	[0.874]	[1.436]	[1.199]	[0.500]	[1.088]	[1.058]	[0.505]	[0.880]	[1.222]	[0.665]	[0.941]
Average class size	0.206	-0.381**	0.382	0.733*	-0.157	0.299	-0.216	0.031	-0.238	-0.026	-0.219	-0.078	0.527*	-0.008	0.240
	[0.188]	[0.168]	[0.274]	[0.415]	[0.267]	[0.521]	[0.196]	[0.084]	[0.187]	[0.370]	[0.210]	[0.362]	[0.315]	[0.150]	[0.249]
Teacher shortage	0.646	0.008	-1.294	2.249	1.320	-2.143	4.489**	1.829**	-0.270	0.875	1.165	-3.656*	2.351	0.597	-1.551
	[1.640]	[0.818]	[1.235]	[2.343]	[0.952]	[1.360]	[2.253]	[0.906]	[1.962]	[2.241]	[0.894]	[1.888]	[2.417]	[1.511]	[2.613]
Female student	-4.324	-3.981***	-9.180***	5.933*	-1.042	-6.490**	11.832***	-0.486	-2.851	3.907*	-0.777	-7.849***	3.088	0.001	-2.353
	[3.233]	[1.472]	[2.273]	[3.138]	[1.921]	[3.056]	[3.923]	[1.460]	[3.052]	[2.003]	[1.037]	[2.100]	[2.580]	[1.397]	[2.124]
Migration background:	-4.446	-10.578***	-10.845***	0.812	4.222	-6.775	-21.142**	4.013	-17.134	62.593***	-30.396***	42.775	-14.009	-3.434	-3.180
first generation	[5.476]	[3.215]	[3.578]	[5.566]	[3.726]	[5.534]	[8.785]	[6.347]	[10.550]	[3.514]	[2.353]	[32.332]	[9.230]	[4.905]	[7.008]
Migration background:	-9.644	-9.016*	-1.801	-5.477	-2.146	-3.157	-9.843	-0.904	2.779	-44.766**	0.000	-19.950***	-13.848**	2.072	1.266
second generation	[10.584]	[4.837]	[6.197]	[7.605]	[3.227]	[4.818]	[12.980]	[6.138]	[15.232]	[19.136]	[0.000]	[2.235]	[6.572]	[4.052]	[14.346]
Foreign language	-14.035	-4.704	-8.663*	-21.984**	-4.920	11.839	-3.649	-1.791	0.603	32.218***	-1.760	11.379	5.111	-6.524	-2.383
spoken at home	[10.055]	[4.810]	[5.195]	[9.410]	[3.700]	[8.392]	[11.706]	[5.586]	[13.223]	[6.524]	[9.327]	[17.659]	[7.216]	[4.871]	[12.853]
Number of observations	1074	1362	1576	1090	1254	1315	1220	1328	1320	1585	1703	1838	1267	1426	1489
R-squared	0.291	0.165	0.119	0.125	0.025	0.087	0.102	0.029	0.036	0.075	0.031	0.095	0.139	0.074	0.094

Regression of students' science performance on student PISA index of economic, social and cultural status (ESCS), school-level (weighted) average performance (average across students in the same school, excluding the individual student for whom the regression is run), plus individual control variables (gender, migration status and language spoken at home) and school-level control variables (school location, school size and school size squared, index of quality of educational resources, index of teacher shortage, proportion of certified teachers, ratio of computers for instruction to school size, average class size, average student learning time at school, school type: -private independent, private government dependent or public). Regressions are run separately for each tertile of the student science score distribution, where the distribution is country specific. Tertiles are ordered as low, average and high where low refers to the first tertile and high to the last. Regressions for Italy include regional fixed effects.

Country-by-country least-squares regressions weighted by students' sampling probability. Robust standard errors adjusted for clustering at the school level. All regressions include a constant.

Balanced repeated replicate variance estimation, standard errors clustered by school in brackets, *** p<0.01, ** p<0.05, * p<0.1.
Source: OECD calculations based on the 2006 OECD PISA Database.

Table 6. **Estimates of the socio-economic gradient in OECD countries: Asymmetric contextual effects, by science score** (continued)

	Slovak Republic			Sweden			Switzerland			United Kingdom			United States		
Achievement level	Low	Average	High	Low	Average	High	Low	Average	High	Low	Average	High	Low	Average	High
Parental background	6.090***	1.668*	4.301***	5.506**	3.948***	7.925***	6.039***	2.207***	5.902***	3.974**	3.920***	7.452***	3.647	3.699***	8.069***
	[2.178]	[0.887]	[1.432]	[2.111]	[1.076]	[1.675]	[1.583]	[0.695]	[1.176]	[1.900]	[0.953]	[1.966]	[2.245]	[1.296]	[1.778]
School science score	0.374***	0.089***	0.229***	0.246***	0.033	0.089**	0.240***	0.107***	0.265***	0.280***	0.053***	0.205***	0.085**	0.039	0.241***
	[0.041]	[0.016]	[0.026]	[0.054]	[0.028]	[0.043]	[0.053]	[0.014]	[0.029]	[0.075]	[0.019]	[0.024]	[0.042]	[0.027]	[0.041]
Index of quality of educational resources	1.090	0.903	0.610	3.052**	0.145	1.360	0.101	0.379	1.678	-0.038	0.553	-1.197	-0.666	-0.374	0.046
	[1.504]	[0.801]	[1.477]	[1.518]	[0.847]	[1.816]	[1.430]	[0.481]	[1.025]	[1.856]	[0.797]	[1.029]	[1.526]	[0.852]	[1.648]
Private government dependent school	-27.500***	3.772	7.799	0.000	-3.804	6.307	-33.845*	2.339	35.490***	34.154***	-3.156	-0.351	-33.411***	7.623	17.933**
	[5.721]	[3.954]	[5.595]	[6.131]	[4.467]	[7.484]	[20.297]	[5.415]	[4.578]	[8.336]	[5.347]	[5.914]	[8.077]	[4.890]	[8.673]
Public school	-9.767***	2.007	4.958	5.406	0.000	0.000	9.561	5.730	10.053**	17.244**	-1.086	-1.535	-12.123*	1.170	8.818
	[2.571]	[1.988]	[3.095]	[5.603]	[4.039]	[6.547]	[9.372]	[4.489]	[4.387]	[8.496]	[3.882]	[3.935]	[6.982]	[4.408]	[6.583]
Proportion of certified teachers	-6.087	-0.258	11.425	39.482***	-13.651*	-0.112	11.313*	-2.748	3.022	2.028	-5.022	8.465	-6.884	7.170	-20.731**
	[8.511]	[4.149]	[7.449]	[14.776]	[8.129]	[13.103]	[5.858]	[1.957]	[3.886]	[14.766]	[3.694]	[9.036]	[7.408]	[6.426]	[9.659]
Ratio of computers for instruction to school	41.492	0.634	-40.386	11.167	10.880	-6.613	6.695	4.605	-12.825	-7.361	3.886	-5.591	-9.036	-0.668	1.718
	[49.036]	[19.475]	[32.276]	[17.251]	[12.872]	[13.206]	[7.004]	[4.035]	[8.612]	[12.932]	[7.089]	[11.093]	[12.423]	[5.816]	[9.280]
Average student learning time at school	-0.658	-0.189	-0.723	4.764***	0.642	0.536	1.272	0.152	-0.987	2.228**	0.410	-0.373	2.193*	0.967*	-2.108**
	[0.828]	[0.364]	[0.584]	[1.745]	[0.882]	[1.384]	[0.965]	[0.334]	[0.764]	[1.117]	[0.574]	[0.948]	[1.147]	[0.576]	[1.014]
Average class size	0.119	0.179*	0.086	-0.060	0.151	0.027	0.558	0.273	-0.170	-0.183	-0.250	-0.571	-0.522*	-0.026	-0.132
	[0.270]	[0.095]	[0.239]	[0.346]	[0.184]	[0.294]	[0.368]	[0.184]	[0.318]	[0.436]	[0.223]	[0.461]	[0.271]	[0.167]	[0.379]
Teacher shortage	-1.184	-0.690	-1.987	2.566	-0.315	-0.430	1.107	-0.627	0.404	-4.292***	-0.926	-0.726	0.648	-1.447	-0.021
	[1.581]	[0.562]	[1.605]	[2.202]	[1.226]	[1.877]	[1.377]	[0.572]	[1.093]	[1.556]	[0.743]	[1.292]	[1.874]	[0.871]	[1.336]
Female student	-0.225	-1.786	-11.951***	4.930	1.164	-2.034	-1.735	-1.705	-6.790***	2.955	-0.877	-6.577**	10.416***	-0.282	-8.040**
	[2.641]	[1.275]	[1.909]	[3.545]	[2.037]	[2.733]	[2.367]	[1.299]	[1.883]	[2.865]	[1.330]	[2.545]	[2.955]	[1.632]	[3.257]
Migration background: first generation	5.584	-8.152	-17.183***	-6.437	-2.163	6.167	-10.708**	-4.253**	-8.705**	21.510***	-7.164**	-10.954*	2.078	-0.718	6.252
	[20.620]	[7.762]	[5.529]	[8.043]	[3.972]	[7.437]	[4.331]	[1.699]	[3.821]	[5.086]	[3.564]	[6.119]	[5.718]	[3.653]	[6.271]
Migration background: second generation	-61.197***	22.126**	-20.927	-20.631***	-9.787*	13.061	-24.075***	-3.962	-7.005*	-7.291	-7.734	-1.565	-11.620	2.484	8.127
	[11.797]	[8.739]	[21.632]	[7.474]	[5.340]	[12.177]	[5.561]	[2.673]	[3.782]	[8.798]	[6.643]	[7.717]	[7.219]	[4.131]	[11.276]
Foreign language spoken at home	-11.633	-2.628	13.226	-7.030	3.375	-17.542**	-13.089**	-0.509	-2.326	1.904	8.340	-13.022	0.165	-5.429	-17.666**
	[27.742]	[9.627]	[49.677]	[7.350]	[4.089]	[6.726]	[5.442]	[2.322]	[5.519]	[7.879]	[5.918]	[8.252]	[6.976]	[3.720]	[8.508]
Number of observations	1401	1503	1544	1135	1202	1232	2912	3142	2899	3028	3380	3410	1244	1397	1389
R-squared	0.208	0.049	0.138	0.132	0.034	0.038	0.200	0.067	0.158	0.108	0.039	0.091	0.079	0.041	0.089

Regression of students' science performance on student PISA index of economic, social and cultural status (ESCS), school-level (weighted) average performance (average across students in the same school, excluding the individual student for whom the regression is run), plus individual control variables (gender, migration status and language spoken at home) and school-level control variables (school location, school size and school size squared, index of quality of educational resources, index of teacher shortage, proportion of certified teachers, ratio of computers for instruction to school size, average class size, average student learning time at school, school type: private independent, private government dependent or public-). Regressions are run separately for each tertile of the student science score distribution, where the distribution is country specific. Tertiles are ordered as low, average, high where low refers to the first tertile and high to the last. Regressions for Italy include regional fixed effects.

Country-by-country least-squares regressions weighted by students' sampling probability. Robust standard errors adjusted for clustering at the school level. All regressions include a constant.

Balanced repeated replicate variance estimation, standard errors clustered by school in brackets, *** p<0.01, ** p<0.05, * p<0.1.

Source: OECD calculations based on the 2006 OECD PISA Database.

Table 7. **Estimates of the socio-economic gradient in OECD countries: The impact of heterogeneity in the school environment**

	Austria	Belgium	Canada	Czech Republic	Finland	Germany	Greece	Hungary	Iceland	Ireland	Italy	Japan	Korea
Individual background	7.696***	17.404***	25.581***	22.923***	28.520***	15.333***	18.139***	8.202***	27.739***	30.226***	9.354***	7.097***	10.383***
	[1.884]	[1.080]	[1.740]	[1.620]	[1.684]	[1.371]	[1.646]	[1.589]	[1.989]	[1.854]	[1.327]	[1.983]	[1.774]
School environment	68.751***	58.553***	29.425***	75.675***	4.067	70.916***	31.300***	73.048***	12.700*	37.553***	79.572***	98.088***	59.508***
	[8.465]	[7.040]	[5.988]	[9.200]	[6.783]	[7.929]	[7.120]	[5.002]	[6.509]	[6.532]	[4.751]	[11.711]	[9.440]
School-level ESCS standard deviation	11.512	30.520	-13.239	-70.335**	-44.579**	-5.041	8.996	14.363	-5.512	6.143	-94.208***	-39.736	6.505
	[26.674]	[19.396]	[18.871]	[29.087]	[18.374]	[16.025]	[22.138]	[15.348]	[17.724]	[21.362]	[19.720]	[34.285]	[30.606]
Index of quality of educational resources	1.555	1.501	-0.095	-2.207	-3.150	2.922	0.361	-0.522	-1.776	4.137	5.229**	1.120	4.061
	[3.412]	[3.264]	[2.088]	[4.059]	[2.413]	[2.742]	[3.781]	[2.564]	[2.035]	[3.051]	[2.399]	[2.760]	[3.379]
Private government dependent school	-78.602***	-5.493	6.017	96.429**	0.715	45.064**	0.000	16.142	123.954***	30.314***	50.575**	-70.706***	0.760
	[21.680]	[9.507]	[11.610]	[46.218]	[10.901]	[20.661]	[0.000]	[17.194]	[39.970]	[8.882]	[19.639]	[8.531]	[8.241]
Public school	-78.954***	-17.113*	-12.864	126.164***	0.000	40.745***	27.990**	16.100	167.977***	18.520*	46.852***	51.266***	5.199
	[22.173]	[9.168]	[9.135]	[47.755]	[6.931]	[14.130]	[11.433]	[16.419]	[33.815]	[9.472]	[12.265]	[6.649]	[6.711]
Proportion of certified teachers	-0.956	12.971	-5.842	-1.980	2.292	3.747	-21.975	38.816**	47.234**	26.410*	11.876	-46.650***	-34.358***
	[16.197]	[11.912]	[8.917]	[20.162]	[7.869]	[13.100]	[25.667]	[16.148]	[22.472]	[14.293]	[12.802]	[16.177]	[10.034]
Ratio of computers for instruction to school size	27.469	42.375**	20.087	71.926*	12.004	-13.518	47.780	41.407**	-13.012	29.473	22.236	21.478	17.023
	[19.052]	[18.628]	[13.261]	[42.964]	[20.975]	[55.118]	[36.276]	[19.693]	[27.670]	[51.566]	[21.593]	[17.190]	[24.061]
Average student learning time at school	6.960***	7.181***	1.782*	5.380***	4.757***	7.229***	16.665***	10.367***	4.556***	4.434**	7.563***	8.645***	11.889***
	[2.129]	[1.143]	[0.949]	[1.478]	[1.493]	[1.443]	[1.744]	[1.485]	[1.481]	[1.763]	[1.091]	[1.775]	[1.448]
Average class size	2.256***	0.870	1.477***	1.791***	0.203	1.701**	0.570**	0.625*	-0.359*	0.858	-0.707**	1.329***	-1.155
	[0.636]	[0.566]	[0.380]	[0.601]	[0.277]	[0.783]	[0.241]	[0.333]	[0.206]	[0.665]	[0.298]	[0.449]	[1.012]
Teacher shortage	-2.281	-10.630***	1.215	-12.070**	-4.233	-3.733	0.123	-0.336	-4.319**	2.381	9.039***	1.280	0.446
	[4.609]	[2.283]	[1.664]	[5.324]	[2.963]	[3.194]	[3.004]	[4.264]	[1.685]	[2.551]	[2.761]	[5.183]	[2.944]
Female student	-11.769***	-9.326***	-7.009***	-9.874**	1.268	-11.796***	-3.965	-23.765***	5.321*	-0.188	-10.303***	-3.577	0.828
	[3.997]	[3.064]	[2.305]	[3.870]	[3.003]	[2.722]	[3.066]	[2.579]	[3.139]	[3.703]	[2.844]	[3.204]	[3.456]
Migration background: first generation	-35.519***	-9.686**	-6.086	-49.082***	-58.706**	-32.195***	-23.003	-43.112***	-21.747	-22.897	-47.386**	-16.846	14.649*
	[8.474]	[4.788]	[4.629]	[14.601]	[27.260]	[6.927]	[15.703]	[15.813]	[20.300]	[14.903]	[21.192]	[43.729]	[7.871]
Migration background: second generation	-36.636***	-31.825***	-12.124	-34.450***	-79.701***	-19.481***	1.782	4.967	-30.929	14.358	-38.395***	34.462	0.000
	[6.897]	[9.808]	[7.357]	[12.642]	[16.283]	[6.635]	[10.613]	[8.013]	[20.233]	[9.048]	[8.897]	[28.111]	[0.000]
Foreign language spoken at home	-30.334***	-25.596***	-3.411	-1.757	-6.008	-26.417***	-28.464***	-18.845	-35.992**	-84.296***	-5.474	-104.619***	5.045
	[8.343]	[6.040]	[7.356]	[13.795]	[12.892]	[6.144]	[8.909]	[12.120]	[15.737]	[13.616]	[11.163]	[21.964]	[29.504]
Number of observations	4182	6246	14538	5112	4284	3270	3467	4014	3294	3492	14420	5485	4921
R-squared	0.432	0.448	0.109	0.377	0.106	0.479	0.389	0.496	0.094	0.184	0.334	0.351	0.255

	Luxembourg	Mexico	Netherlands	New Zealand	Norway	Poland	Portugal	Slovak Republic	Sweden	Switzerland	United Kingdom	United States
Individual background	16.690***	7.714***	9.979***	39.934***	29.216***	36.234***	18.034***	20.520***	30.535***	20.641***	34.881***	31.795***
	[1.502]	[0.869]	[1.105]	[2.146]	[1.977]	[1.509]	[1.281]	[1.526]	[2.294]	[1.628]	[2.274]	[1.967]
School environment	48.895***	24.484***	87.607***	33.240***	28.955**	13.518*	18.983***	55.758***	22.454***	52.701***	50.186***	22.614***
	[5.438]	[3.732]	[7.352]	[8.518]	[11.056]	[7.972]	[4.297]	[9.304]	[7.537]	[5.429]	[7.520]	[7.098]
School-level ESCS standard deviation	-10.823	-17.459	80.293***	-5.557	2.026	16.978	15.020	-18.543	4.322	4.948	0.728	42.986*
	[13.609]	[11.290]	[23.794]	[14.815]	[15.819]	[19.486]	[13.651]	[23.838]	[16.544]	[14.554]	[16.240]	[24.957]
Index of quality of educational resources	5.250***	3.419*	8.154***	-3.495	-5.695	-1.447	-0.974	-3.042	3.891	4.325**	-0.679	1.921
	[1.503]	[2.051]	[2.918]	[2.519]	[4.115]	[2.172]	[2.733]	[3.959]	[2.446]	[1.936]	[2.582]	[2.864]
Private government dependent school	4.233	0.000	5.693	0.000	0.000	-17.653	12.387	10.220	22.638	-12.964	0.882	-12.359
	[5.379]	[0.000]	[7.364]	[0.000]	[40.915]	[23.190]	[20.492]	[14.451]	[22.399]	[54.348]	[19.352]	[15.293]
Public school	0.000	18.702	0.000	-9.579	-40.368	-22.567	4.788	19.239***	0.000	45.330***	-0.753	-6.968
	[4.483]	[11.761]	[5.046]	[9.238]	[37.834]	[21.400]	[21.365]	[6.950]	[22.697]	[13.381]	[12.922]	[11.416]
Proportion of certified teachers	35.842***	-11.285*	-4.277	-4.596	-22.403***	25.941	3.826	14.437	75.488***	-8.360	5.820	-5.656
	[12.045]	[6.200]	[13.970]	[6.577]	[7.426]	[20.398]	[13.528]	[16.856]	[26.149]	[6.962]	[18.116]	[23.679]
Ratio of computers for instruction to school size	3.915	40.392	-180.837***	17.250	18.044	0.145	119.194	272.316***	25.779	19.889	-14.671	-17.979
	[9.691]	[36.156]	[39.716]	[23.920]	[39.939]	[37.200]	[72.419]	[80.312]	[30.638]	[16.739]	[23.610]	[18.318]
Average student learning time at school	10.420***	5.864***	6.985***	10.645***	5.353***	5.310**	12.504***	3.629***	7.819***	8.336***	7.374***	9.494***
	[1.885]	[1.145]	[1.711]	[2.048]	[1.779]	[2.215]	[1.571]	[1.301]	[2.628]	[1.518]	[2.256]	[2.005]
Average class size	-0.172	0.402**	0.996	0.592	-0.177	0.721	0.651	0.823	0.301	1.515**	-0.541	0.191
	[0.568]	[0.166]	[0.607]	[0.692]	[0.265]	[0.712]	[0.505]	[0.654]	[0.537]	[0.613]	[0.764]	[0.825]
Teacher shortage	12.253***	0.698	1.122	-5.533**	1.303	0.470	-6.897	-11.738***	3.079	-1.521	-3.880*	1.186
	[2.546]	[2.013]	[3.146]	[2.530]	[3.567]	[4.860]	[4.277]	[3.641]	[3.067]	[2.276]	[2.313]	[2.836]
Female student	-7.069**	-8.643***	-12.520***	-6.796*	3.856	-1.673	-2.193	-10.207***	-0.360	-13.930***	-10.512***	-5.117*
	[2.707]	[2.745]	[2.424]	[3.921]	[3.787]	[2.339]	[2.385]	[3.191]	[2.848]	[2.316]	[2.888]	[2.597]
Migration background: first generation	-22.716***	-37.027***	-30.342***	-5.829	-37.079***	40.818	-32.554***	-22.822	-9.683	-34.738***	-4.316	-3.265
	[4.431]	[10.721]	[5.848]	[5.986]	[10.793]	[57.433]	[9.225]	[18.419]	[8.431]	[4.048]	[6.885]	[7.413]
Migration background: second generation	-22.392***	-65.729***	-27.326***	-7.546	-17.753	-86.461**	-49.162***	-44.724	-27.641**	-55.692***	-12.986	-8.402
	[5.135]	[11.224]	[9.490]	[6.424]	[14.385]	[42.389]	[9.623]	[30.291]	[10.776]	[5.809]	[10.839]	[9.815]
Foreign language spoken at home	-22.493***	44.471	-13.254*	-28.072***	-9.937	1.888	8.012	-13.251	-27.341***	-24.212***	-9.808	-15.404**
	[4.358]	[27.115]	[7.333]	[6.940]	[10.769]	[15.796]	[8.750]	[22.660]	[8.432]	[4.528]	[11.191]	[6.797]
Number of observations	3957	13041	4012	3659	3868	5126	4182	4448	3569	8953	9818	4030
R-squared	0.369	0.319	0.535	0.232	0.099	0.164	0.307	0.306	0.150	0.362	0.204	0.209

Regression of students' science performance on student PISA index of economic, social and cultural status (ESCS), individual control variables (migration status and language spoken at home), school-level ESCS (average across students in the same school, excluding the individual student for whom the regression is run), school –level standard deviation in student socio-economic background (calculated using student-level weights), and school-level controls (school location, school size and school size squared, index of quality of educational resources, index of teacher shortage, proportion of certified teachers, ratio of computers for instruction to school size, average class size, average student learning time at school, school type -private independent, private government dependent, public-), regressions for Italy include regional fixed effects (not reported). Country-by-country least-squares regressions weighted by students' sampling probability. Robust standard errors adjusted for clustering at the school level. Regressions for Italy include regional fixed effects.

Balanced repeated replicate variance estimation, standard errors clustered by school in brackets, *** p<0.01, ** p<0.05, * p<0.1. All regressions include a constant.
Source: OECD calculations based on the 2006 OECD PISA Database.

Table 8a. **Individual background and school environment effects[1]: The impact of education policy/school practices, regression results**

	Baseline		Number of years since first tracking		School selection policy		Ability grouping within schools		System-level number of school types programmes		Enrolment rate in vocational education	
	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
Individual background effect of the PISA index of economic, social, and cultural status on performance												
Individual background	21.488***	21.484***	22.879***	22.874***	22.530***	22.527***	21.378***	21.381***	23.147***	23.147***	22.210***	22.201***
	[0.791]	[0.373]	[0.723]	[0.390]	[0.834]	[0.384]	[0.707]	[0.375]	[0.673]	[0.396]	[1.027]	[0.432]
Interaction Individual background x policy			-2.932***	-2.941***	-0.236***	-0.236***	-0.245***	-0.245***	-4.056***	-4.074***	-0.396***	-0.397***
			[0.299]	[0.171]	[0.022]	[0.013]	[0.043]	[0.028]	[0.525]	[0.271]	[0.052]	[0.025]
School environment effect of the PISA index of economic, social, and cultural status on performance												
School environment	46.717***	46.445***	40.738***	40.496***	42.261***	41.985***	46.853***	46.687***	40.839***	40.664***	41.233***	41.059***
	[3.595]	[1.664]	[3.332]	[1.698]	[3.490]	[1.625]	[3.145]	[1.678]	[3.097]	[1.745]	[4.098]	[1.854]
Interaction school environment x policy			8.279***	8.234***	0.719***	0.719***	0.623***	0.633***	10.863***	10.696***	0.986***	0.977***
			[1.353]	[0.777]	[0.110]	[0.061]	[0.211]	[0.123]	[2.222]	[1.277]	[0.241]	[0.122]
Policy			-0.010		0.064		0.589		-0.716		-0.352	
			[2.271]		[0.202]		[0.370]		[3.790]		[0.287]	
Country fixed effects	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Number of observations	132347	132347	132347	132347	132347	132347	132347	132347	132347	132347	114133	114133
R-squared	0.316	0.316	0.320	0.320	0.320	0.321	0.317	0.317	0.319	0.319	0.325	0.326
Number of countries			27	27	27	27	27	27	27	27	24	24

1.All education policy variables are drawn from the PISA 2006 Database.

Regression of students' science performance on student PISA index of economic, social and cultural status (ESCS), individual control variables (gender, migration status and language spoken at home), school-level ESCS (average across students in the same school, excluding the individual student for whom the regression is run), school location (small town or village, city), school size and school size squared, index of quality of educational resources, index of teacher shortage, proportion of certified teachers, ratio of computers for instruction to school size, average class size, average student learning time at school, school type (private independent, private government dependent, public). Country– level controls include GDP per capita (in PPP terms) and the direct effect of the considered policy variable (Model 1), or country fixed effects (Model 2). Students' science performance on student PISA index of economic, social and cultural status (ESCS) and school-level ESCS are interacted with policy variables, entered one at a time. Country specific parameters are used for all variables except students' science performance on student PISA index of economic, social and cultural status (ESCS), school-level ESCS, and policy interactions.

Cross-country least-squares regressions weighted by students' sampling probability, rescaled so that each country receives an equal weight, while taking country–specific sample representativeness into account. Robust standard errors adjusted for clustering at the school level. All variables are mean-centred. All regressions exclude Mexico and Turkey.

Balanced repeated replicate variance estimation, standard errors clustered by school in brackets, *** p<0.01, ** p<0.05, * p<0.1. All regressions include a constant.

Sources: PISA 2006 database and OECD ADB Database.

Table 8b. **Individual background and school environment effects: The impact of education policy/resources, regression results**

	Baseline		Spending per student in secondary education[3]		Decentralisation[2]		Matching resources to specific needs[2]		Class size[1]		Class size in primary[3]		Class size in lower secondary[3]		Studen -teacher ratio[1]		Student-teacher ratio lower-secondary[3]		Ratio of teacher's salary at top of scale to starting salary[3]		Proportion of qualified teachers[1]	
	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
Individual background effect of the PISA index of economic, social, and cultural status on performance																						
Individual background	21.488***	21.484***	21.311***	21.306***	21.785***	21.786***	21.084***	21.077***	21.416***	21.413***	18.585***	18.581***	19.421***	19.427***	21.659***	21.658***	21.593***	21.590***	19.727***	19.711***	21.434***	21.434***
	[0.791]	[0.373]	[0.758]	[0.383]	[0.935]	[0.414]	[0.806]	[0.401]	[0.844]	[0.372]	[0.847]	[0.415]	[0.949]	[0.447]	[0.634]	[0.376]	[0.760]	[0.416]	[0.600]	[0.422]	[0.738]	[0.380]
Interaction individual background x policy			-0.356	-0.351**	1.626***	1.634***	1.408***	1.407***	-0.740***	-0.740***	-0.364***	-0.365***	-0.590***	-0.592***	0.491**	0.493***	0.511***	0.512***	-5.939***	-5.972***	-4.601	-4.599***
			[0.411]	[0.151]	[0.220]	[0.160]	[0.286]	[0.164]	[0.131]	[0.091]	[0.126]	[0.117]	[0.121]	[0.104]	[0.187]	[0.135]	[0.160]	[0.128]	[1.050]	[0.904]	[2.834]	[1.625]
School environment effect of the PISA index of economic, social, and cultural status on performance																						
School environment	46.717***	46.445***	47.170***	46.848***	45.505***	45.256***	46.624***	46.491***	46.592***	46.388***	52.057***	51.884***	48.974***	48.903***	47.470***	47.208***	46.720***	46.538***	51.818***	51.334***	46.751***	46.582***
	[3.595]	[1.664]	[3.308]	[1.673]	[4.105]	[1.776]	[3.526]	[1.760]	[3.644]	[1.647]	[3.761]	[1.881]	[4.035]	[1.993]	[3.042]	[1.656]	[3.397]	[1.842]	[2.987]	[1.884]	[3.343]	[1.711]
Interaction school environment x policy			0.325	0.206	-3.100**	-3.167***	-3.974***	-3.904***	1.415*	1.479***	1.894**	1.900***	1.324*	1.341***	2.466***	2.465***	1.886**	1.902***	-4.315	-3.898	0.807	0.913
			[1.656]	[0.619]	[1.333]	[0.746]	[1.451]	[0.723]	[0.748]	[0.430]	[0.735]	[0.527]	[0.677]	[0.508]	[0.888]	[0.583]	[0.729]	[0.533]	[6.523]	[4.286]	[11.278]	[7.540]
Policy			7.338		-0.547		1.229		-1.902		-1.819		-4.206**		-0.304		-0.763		-2.500		-9.589	
			[4.933]		[2.544]		[2.395]		[1.381]		[2.005]		[2.019]		[1.592]		[1.469]		[17.197]		[29.618]	
Country fixed effects	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Number of observations	132347	132347	117809	117809	118808	118808	118808	118808	132347	132347	98937	98937	88679	88679	132347	132347	102480	102480	90818	90818	125015	125015
R-squared	0.316	0.316	0.319	0.320	0.333	0.334	0.333	0.334	0.316	0.317	0.348	0.348	0.329	0.329	0.316	0.317	0.321	0.322	0.350	0.351	0.317	0.318
Number of countries			26	26	24	24	24	24	27	27	21	21	19	19	27	27	21	21	21	21	26	26

1. PISA 2006 Database.
2. Index from Sutherland and Price (2006).
3. OECD Education at a Glance Database.

Regression of students' science performance on student PISA index of economic, social and cultural status (ESCS), individual control variables (gender, migration status and language spoken at home), school-level ESCS (average across students in the same school, excluding the individual student for whom the regression is run), school location (small town or village, city), school size and school size squared, index of quality of educational resources, index of teacher shortage, proportion of certified teachers, ratio of computers for instruction to school size, average class size, average student learning time at school, school type (private independent, private government dependent, public). Country– level controls include GDP per capita (in PPP terms) and the direct effect of the considered policy variable (Model 1), or country fixed effects (Model 2). Students' science performance on student PISA index of economic, social and cultural status (ESCS) and school-level ESCS are interacted with policy variables, entered one at a time. Country-specific parameters are used for all variables except students' science performance on student PISA index of economic, social and cultural status (ESCS), school-level ESCS, and policy interactions.

Cross-country least-squares regressions weighted by students' sampling probability, rescaled so that each country receives an equal weight, while taking country–specific sample representativeness into account. Robust standard errors adjusted for clustering at the school level. All variables are mean-centred. All regressions exclude Mexico and Turkey.

Balanced repeated replicate variance estimation, standard errors clustered by school in brackets, *** p<0.01, ** p<0.05, * p<0.1. All regressions include a constant.

Sources: PISA 2006 Database, OECD Education at a Glance Database, Sutherland and Price (2007), OECD ADB Database.

Table 8c. **Individual background and school environment effects: The impact of early intervention policies, regression results**

	Baseline		Enrolment rate in childcare and early education services[1]		Enrolment rate in daycare and pre-school[1]		Public expenditure on childcare and early education services/GDP[2]	
	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
Individual background effect of the PISA index of economic, social, and cultural status on performance								
Individual background	21.488***	21.484***	21.496***	21.497***	21.478***	21.478***	21.021***	21.014***
	[0.791]	[0.373]	[0.818]	[0.384]	[0.725]	[0.385]	[0.906]	[0.383]
Interaction individual background x policy			0.230***	0.231***	0.243***	0.244***	4.910**	4.983***
			[0.068]	[0.026]	[0.065]	[0.027]	[2.318]	[0.991]
School environment effect of the PISA index of economic, social, and cultural status on performance								
School environment	46.717***	46.445***	45.370***	45.163***	45.399***	45.189***	48.121***	47.869***
	[3.595]	[1.664]	[3.536]	[1.721]	[3.167]	[1.717]	[3.936]	[1.687]
Interaction school environment x policy			-0.773***	-0.762***	-0.822***	-0.810***	-32.206***	-31.265***
			[0.261]	[0.125]	[0.247]	[0.126]	[11.107]	[4.775]
Policy			0.192		0.202		13.236	
			[0.502]		[0.550]		[19.436]	
Country fixed effects	No	Yes	No	Yes	No	Yes	No	Yes
Number of observations	132347	132347	123394	123394	123394	123394	117809	117809
R-squared	0.316	0.316	0.315	0.316	0.315	0.316	0.321	0.321
Number of countries			26	26	26	26	26	26

1. OECD Family Database and OECD Education at a Glance Database.
2. OECD Social Expenditure Database.

Regression of students' science performance on student PISA index of economic, social and cultural status (ESCS), individual control variables (gender, migration status and language spoken at home), school-level ESCS (average across students in the same school, excluding the individual student for whom the regression is run), school location (small town or village, city), school size and school size squared, index of quality of educational resources, index of teacher shortage, proportion of certified teachers, ratio of computers for instruction to school size, average class size, average student learning time at school, school type (private independent, private government dependent, public). Country– level controls include GDP per capita (in PPP terms) and the direct effect of the considered policy variable (Model 1), or country fixed effects (Model 2). Students' science performance on student PISA index of economic, social and cultural status (ESCS) and school-level ESCS are interacted with policy variables, entered one at a time. Country-specific parameters are used for all variables except students' science performance on student PISA index of economic, social and cultural status (ESCS), school-level ESCS, and policy interactions.

Cross-country least-squares regressions weighted by students' sampling probability, rescaled so that each country receives an equal weight, while taking country–specific sample representativeness into account. Robust standard errors adjusted for clustering at the school level. All variables are mean-centred. All regressions exclude Mexico and Turkey.

Balanced repeated replicate variance estimation, standard errors clustered by school in brackets, *** p<0.01, ** p<0.05, * p<0.1. All regressions include a constant.
Sources: PISA 2006 Database, OECD Education at a Glance Database, OECD Family Database, OECD ADB Database.

Table 8d. **Individual background effect:**
The impact of social and labour market policies[1], regression results

	Baseline		Child poverty after taxes and transfers		Gini coefficient		Material deprivation		Tax progressivity rate		Short term net unemployment replacement rate		Long term net unemployment replacement rate	
	Model 3	Model 4	Model 3	Model 4	Model 3	Model 4	Model 3	Model 4	Model 3	Model 4	Model 3	Model 4	Model 3	Model 4
Individual background effect of the PISA index of economic, social, and cultural status on performance														
Parental background	21.451***	21.437***	22.325***	22.341***	21.512***	21.507***	20.285***	20.274***	21.599***	21.586***	21.504***	21.504***	20.903***	20.896***
	[0.781]	[0.371]	[0.579]	[0.471]	[0.504]	[0.371]	[0.874]	[0.423]	[0.501]	[0.375]	[0.692]	[0.372]	[0.663]	[0.377]
Interaction parental background x policy			0.229*	0.232***	38.603**	38.972***	0.145*	0.145**	-33.923**	-33.980**	-0.079	-0.078**	0.104***	0.104***
			[0.132]	[0.076]	[17.927]	[8.880]	[0.080]	[0.057]	[7.445]	[3.826]	[0.061]	[0.035]	[0.031]	[0.016]
Policy			-0.610		-86.825		1.282		-34.502		0.866		0.166	
			[0.886]		[119.522]		[1.244]		[50.409]		[0.588]		[0.228]	
Country fixed effects	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Number of observations	132347	132347	98708	98708	132347	132347	107652	107652	132347	132347	132347	132347	132347	132347
R-squared	0.320	0.320	0.326	0.326	0.320	0.320	0.346	0.347	0.320	0.321	0.320	0.320	0.320	0.321
Number of countries			20	20	27	27	22	22	27	27	27	27	27	27

1. See data appendix for policy variables definitions and sources.

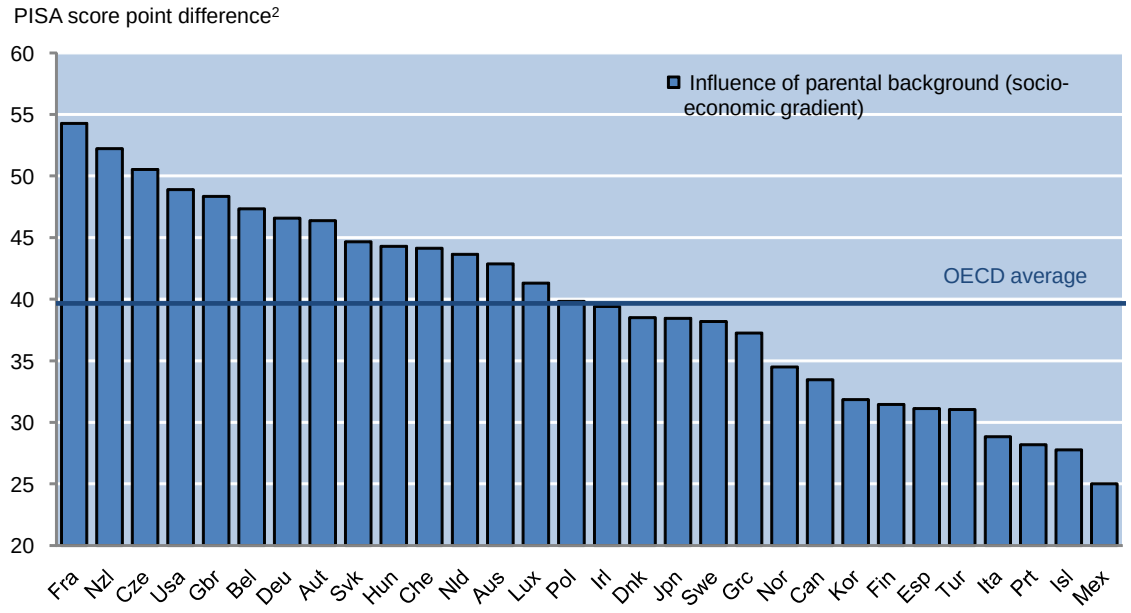
Regression of students' science performance on student PISA index of economic, social and cultural status (ESCS), individual control variables (gender, migration status and language spoken at home), school-level ESCS (average across students in the same school, excluding the individual student for whom the regression is run), school location (small town or village, city), school size and school size squared, index of quality of educational resources, index of teacher shortage, proportion of certified teachers, ratio of computers for instruction to school size), average class size, average student learning time at school, school type (private independent, private government dependent, public). Country–level controls include GDP per capita (in PPP terms) and the direct effect of the considered policy variable (Model 3), or country fixed effects (Model 4). Students' science performance on student PISA index of economic, social and cultural status (ESCS) is interacted with policy variables, entered one at a time. Country-specific parameters are used for all variables except students' science performance on student PISA index of economic, social and cultural status (ESCS) and policy interactions.

Cross-country least-squares regressions weighted by students' sampling probability, rescaled so that each country receives an equal weight, while taking country–specific sample representativeness into account. Robust standard errors adjusted for clustering at the school level. All variables are mean-centred. All regressions exclude Mexico and Turkey.

Balanced repeated replicate variance estimation, standard errors clustered by school in brackets, *** p<0.01, ** p<0.05, * p<0.1. All regressions include a constant.

Sources: PISA 2006 Database, OECD Education at a Glance Database, Boarini and Mira d' Ercole, 2006, Going for Growth Database, Taxing Wages Database, OECD ADB Database, OECD(2001c), OECD(2008).

Figure 1. **The influence of parental background on secondary students' achievement**[1]

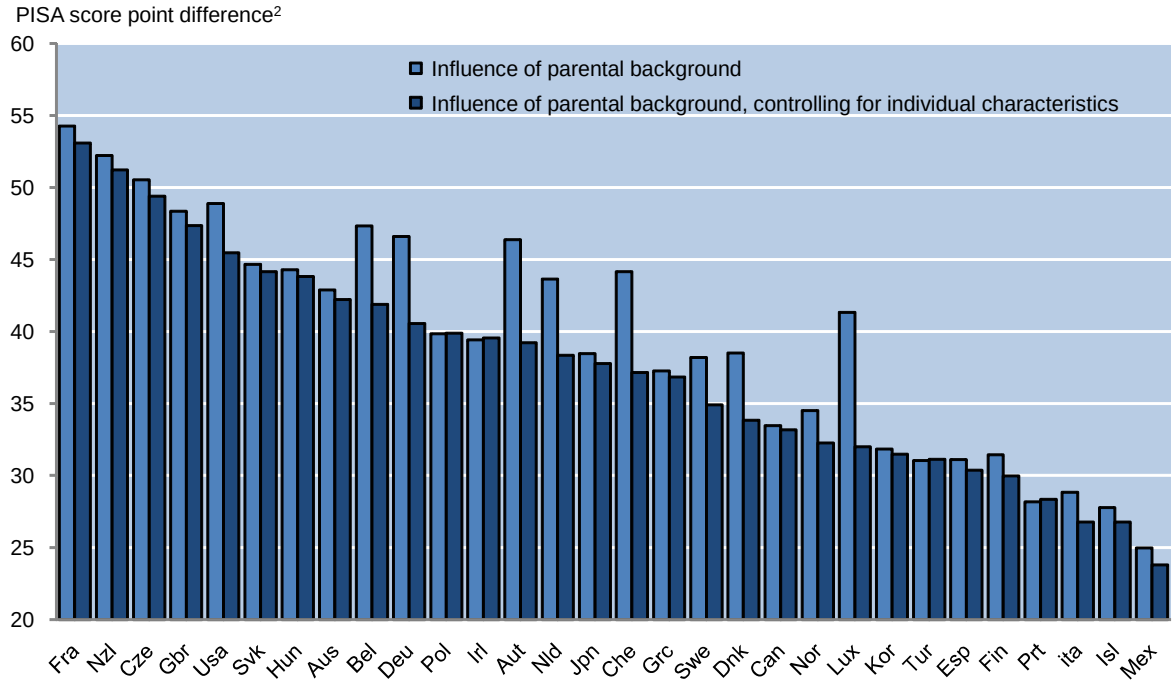


1. Regression of students' PISA science performance scores on their PISA economic, social and cultural status (ESCS), a broad indicator of family's socio-economic background. Country-by-country least-squares regressions weighted by students' sampling probability. Robust standard errors adjusted for clustering at the school level. Regressions for Italy include regional fixed effects.

2. Change in PISA science score due to an improvement of one international standard deviation in the PISA index of student socio-economic background.

Source: OECD calculations based on the 2006 OECD PISA Database.

Figure 2. **The influence of parental background on secondary students' achievement[1]: The socio-economic gradient controlling for individual characteristics**

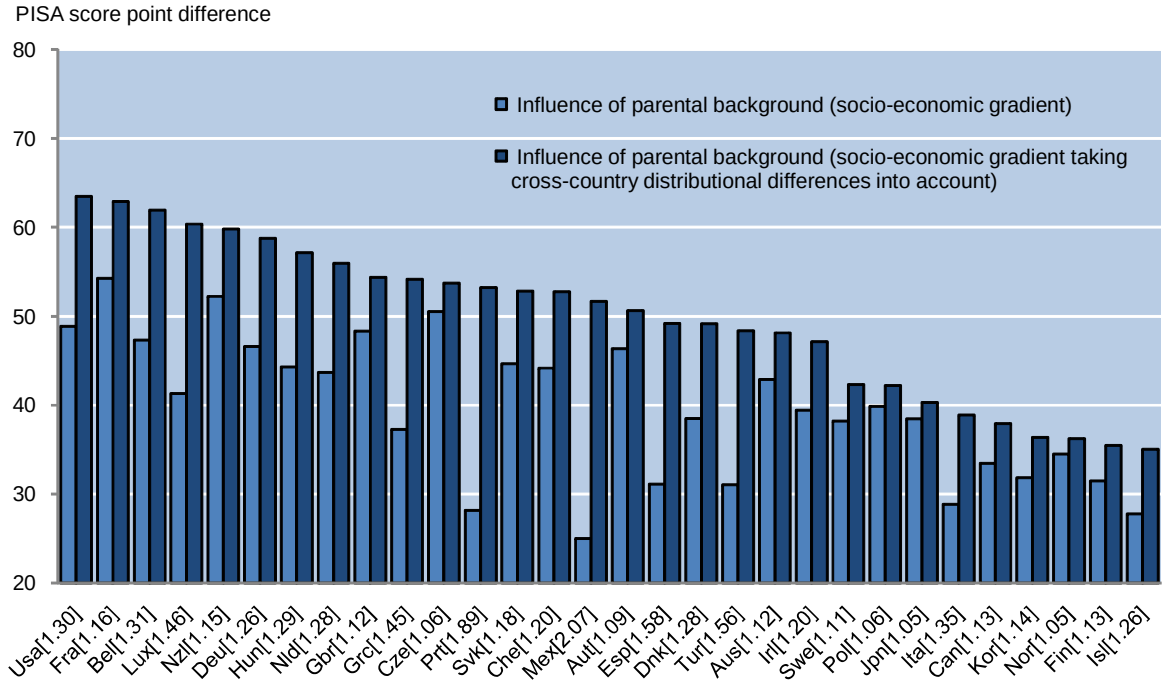


1. Regression of students' PISA science performance scores on their PISA economic, social and cultural status (ESCS), a broad indicator of family's socio-economic background, plus (when applicable) individual control variables (gender, migration status and language spoken at home). Country-by-country least-squares regressions weighted by students' sampling probability. Robust standard errors adjusted for clustering at the school level. Regressions for Italy include regional fixed effects.

2. Change in PISA science score due to an improvement of one international standard deviation in the PISA index of student socio-economic background.

Source: OECD calculations based on the 2006 OECD PISA Database.

Figure 3. **The influence of parental background on secondary students' achievement[1]: The socio-economic gradient and the socio-economic gradient taking cross-country distributional differences into account**



1. Regression of students' PISA science performance scores on their PISA economic, social and cultural status (ESCS), a broad indicator of family's socio-economic background. Country-by-country least-squares regressions weighted by students' sampling probability. Robust standard errors adjusted for clustering at the school level. Regressions for Italy include regional fixed effects.

Socio-economic gradient: change in PISA science score due to an improvement of one international standard deviation in the PISA index of student socio-economic background. Socio-economic gradient taking cross-country distributional differences into account: change in PISA science score due to an improvement of one country-specific inter-quartile change in the PISA index of student socio-economic background.

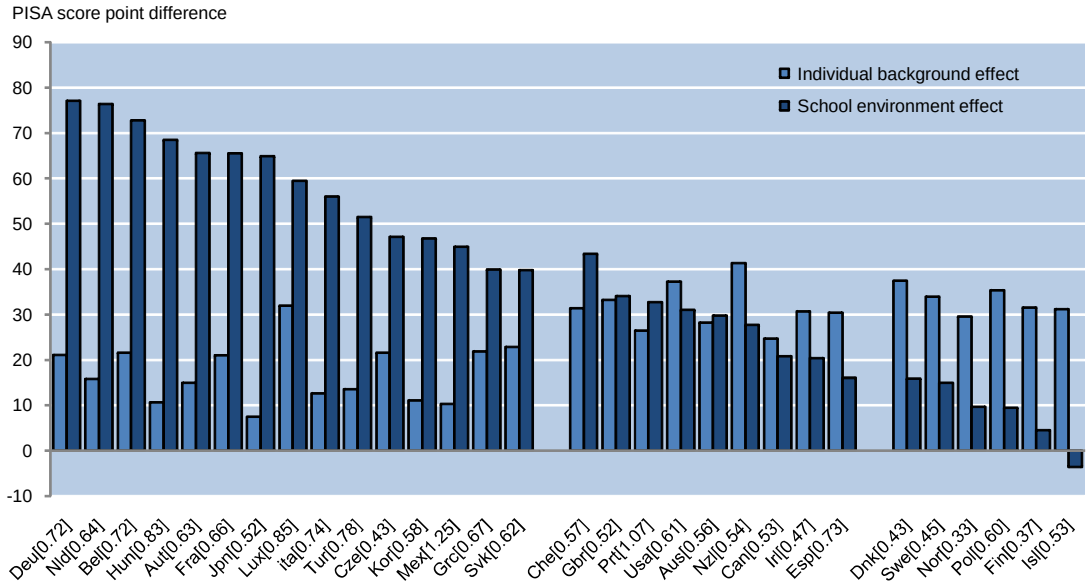
Data in brackets are values of the difference between the highest and the lowest quartiles of the country-specific distribution of the PISA index of economic, social and cultural status, calculated at the student level.

Source: OECD calculations based on the 2006 OECD PISA Database.

Figure 4. **Effects of individual background and school socio-economic environment on students' secondary achievement[1]**

Socio-economic gradient taking cross-country distributional differences into account

(Differences in performance on the science scale associated with the difference between the highest and the lowest quartiles of the country specific distribution of the PISA index of economic, social and cultural status)



1. Regression of students' science performance on students' family socio-economic background (as measured by PISA ESCS), and school-level socio-economic background (average PISA ESCS across students in the same school, excluding the individual student for whom the regression is run). Country-by-country least-squares regressions weighted by students' sampling probability. Robust standard errors adjusted for clustering at the school level. Regressions for Italy include regional fixed effects.

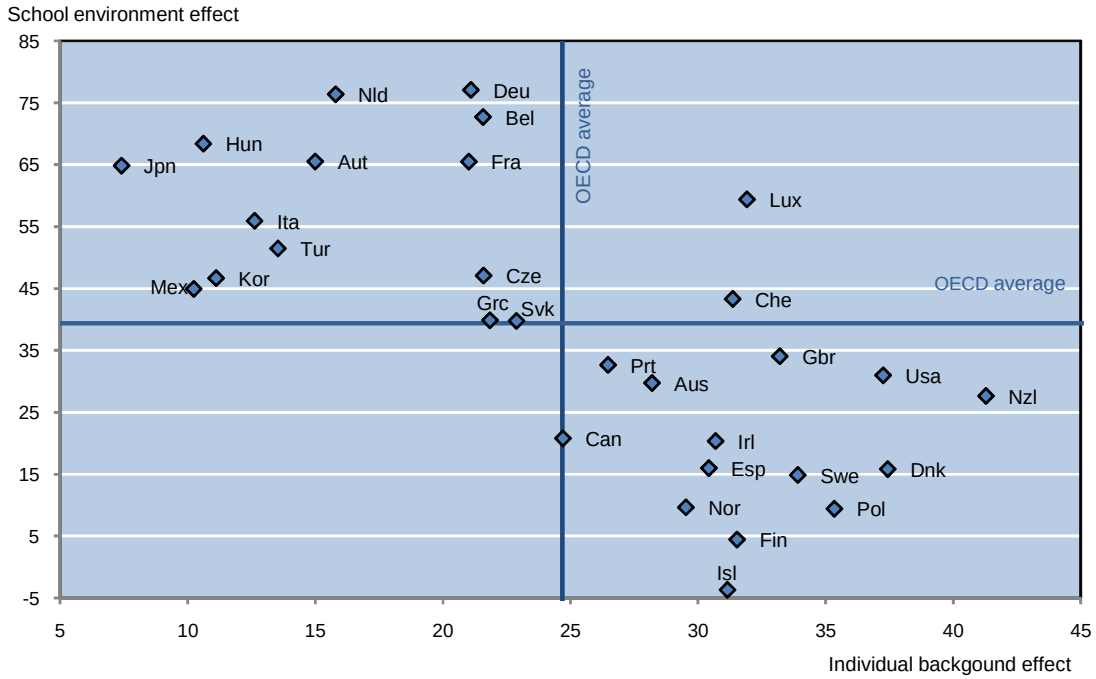
The individual background effect is defined as the difference in performance on the PISA science scale associated with the difference between the highest and the lowest quartiles of the average individual background effects distribution of the PISA index of economic, social and cultural status, calculated at the student- level. The school environment effect is defined as the difference in performance on the PISA science scale associated with the difference between the highest and the lowest quartiles of the country-specific school level average distribution of the PISA index of economic, social and cultural status, calculated at the student level.

Data in brackets are values of the difference between the highest and the lowest quartiles of the country-specific school-level average distribution of the PISA index of economic, social and cultural status, calculated at the student level.

The negative school environment effect for Iceland is not statistically significant.
Source: OECD calculations based on the 2006 OECD PISA Database.

Figure 5. **Individual background and school environment effects[1]: Cross-country pattern**

Differences in performance on the science scale associated with the difference between the highest and the lowest quartiles of the country specific distribution of the PISA index of economic, social and cultural status



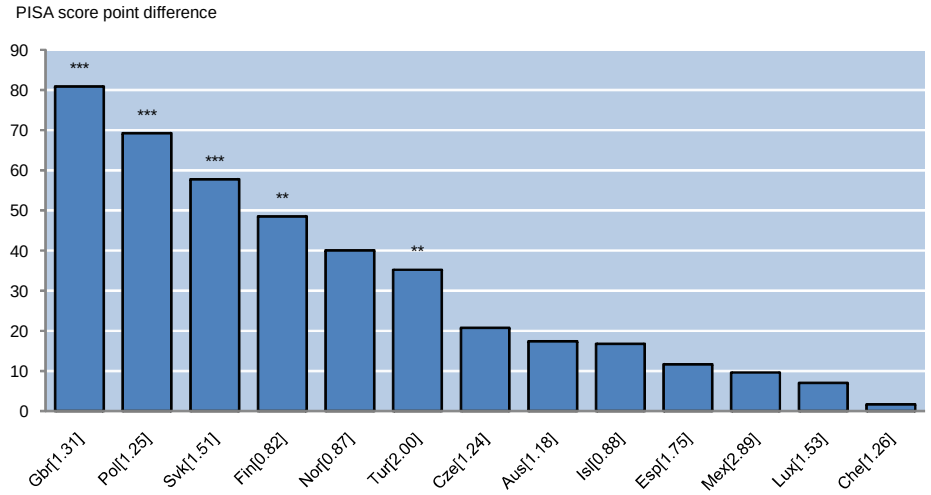
1. Regression of students' science performance on students' family socio-economic background (as measured by PISA ESCS), and school-level socio-economic background (average PISA ESCS across students in the same school, excluding the individual student for whom the regression is run). Country-by-country least-squares regressions weighted by students' sampling probability. Robust standard errors adjusted for clustering at the school level. Regressions for Italy include regional fixed effects.

The individual background effect is defined as the difference in performance on the science scale associated with the difference between the highest and the lowest quartiles of the average individual background effects distribution of the PISA index of economic, social and cultural status, calculated at the student-level. The school environment effect is defined as the difference in performance on the science scale associated with the difference between the highest and the lowest quartiles of the country-specific school level average distribution of the PISA index of economic, social and cultural status, calculated at the student level.

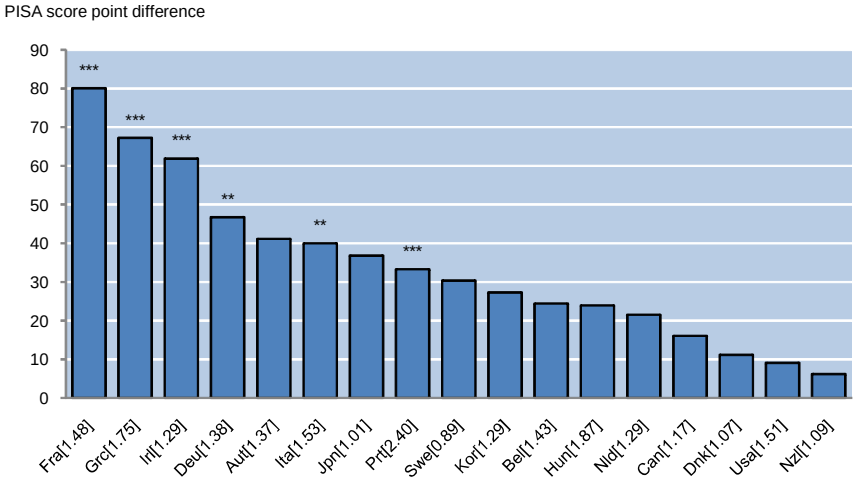
Source: OECD calculations based on the 2006 OECD PISA Database.

Figure 6. **The drivers of inequality in students' secondary educational achievement are often concentrated in top or bottom schools**

A. **Persistence driven by top schools**



B. **Persistence driven by bottom schools**



Absolute value of the difference in the school environment effect for students attending schools at the last decile of the school-level socio-economic background (top schools) and students attending schools at the first decile of the school-level (bottom schools). School-level socio-economic background is measured as the average PISA ESCS across students in the same school, excluding the individual student for whom the regression is run.

Regression of students' science performance on student ESCS, student ESCS squared, individual control variables (gender, migration status and language spoken at home), school-level ESCS and school-level ESCS squared. Country-by-country least-squares regressions weighted by students' sampling probability. Robust standard errors adjusted for clustering at the school level. Regressions for Italy include regional fixed effects.

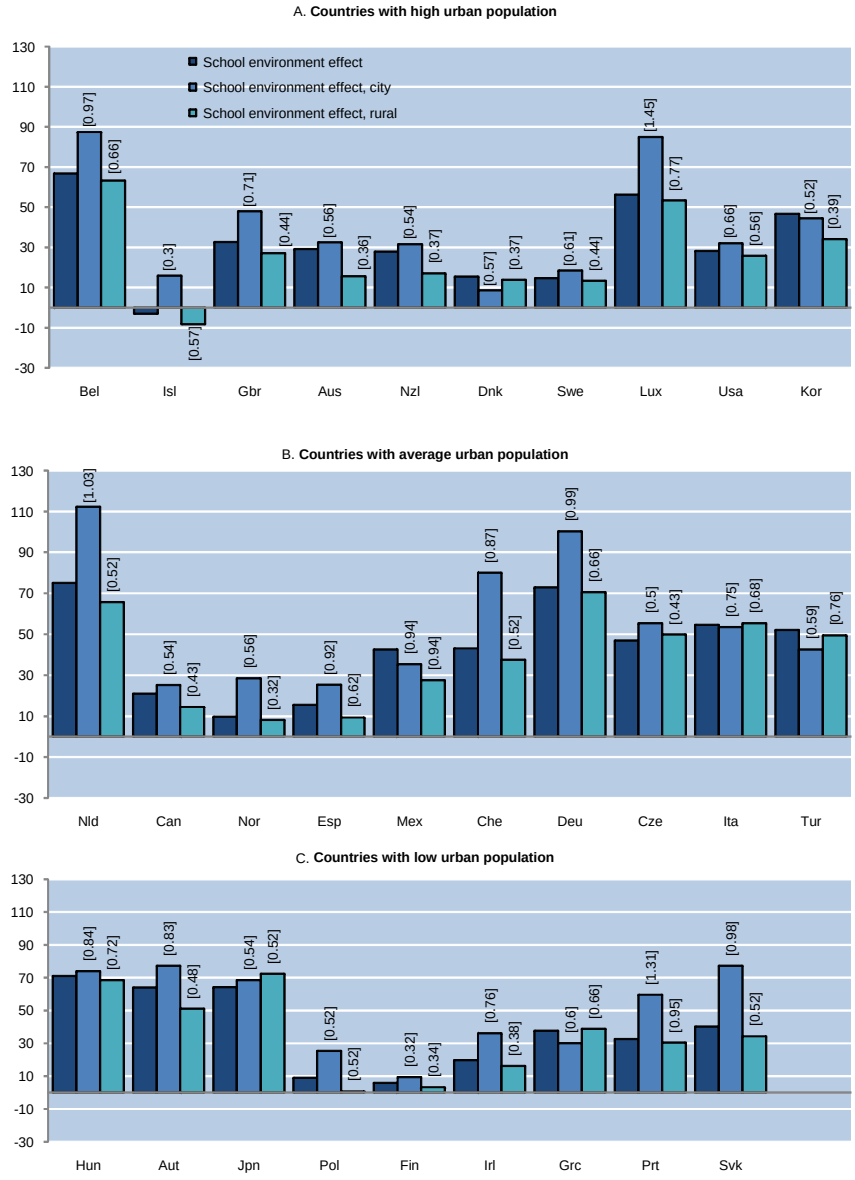
Data in brackets are values of the difference between the 9th and the 1st deciles distribution of the country-specific school-level average distribution of the PISA index of economic, social and cultural status, calculated at the student level.

*** p<0.01, ** p<0.05, * p<0.1.

Source: OECD calculations based on the 2006 OECD PISA Database.

Figure 7. **The influence of school environment on students' secondary educational achievement[1]: Cities versus rural areas**

Differences in performance on the PISA science scale associated with the difference between the highest and the lowest quartiles of the country-specific distribution of the school average PISA index of economic, social and cultural status over the entire territory or in rural and urban areas.



1. Regression of students' science performance on students' family socio-economic background (as measured by PISA ESCS), individual control variables (gender, migration status and laguage spoken at home) and school-level socio-economic background (average PISA ESCS across students in the same school, excluding the individual student for whom the regression is run). Country-by-country least-squares regressions weighted by students' sampling probability. Robust standard errors adjusted for clustering at the school level. Regressions for Italy include regional fixed effects.

Regressions run over rural and urban areas separately where urban areas are defined as communities with more than 100 000 inhabitants. Countries are classified following urban population proportion (urban population over total population where urban population is defined as the midyear population of areas defined as urban in each country and reported to the United Nations).

Data in brackets are values of the interquartile range of distribution of the school-level average ESCS calculated at the student level for rural and urban areas separately.

France is not included in the analysis because data are not available at the school level.

Sources: OECD calculations based on the 2006 OECD PISA Database, urban population as a proportion of total population is taken in World Development Indicators Database.

WORKING PAPERS

The full series of Economics Department Working Papers can be consulted at www.oecd.org/eco/working_papers/

707. *Intergenerational social mobility*
(July 2009) Orsetta Causa and Åsa Johansson

706. *Taxes or grants: what revenue source for sub-central governments?*
(July 2009) Hansjörg Blöchliger and Oliver Petzold

705. The spending power of sub-central governments: a pilot study
(July 2009) Steffen Bach, Hansjörg Blöchliger and Dominik Wallau

704. *Price and volume elasticities of Brazilian foreign trade: A profit function approach*
(July 2009) Luiz de Mello and Mauro Pisu

703. *Current account sustainability in Brazil: A non linear approach*
(July 2009) Luiz de Mello and Matteo Mogliani

702. *The incentives to participate in and the stability of international climate coalitions: a game-theoretic approach using the WITCH Model*
(July 2009) Valentina Bosetti, Carlo Carraro, Enrica De Cian, Romain Duval, Emanuele Massetti and Massimo Tavoni

701. *The economics of climate change mitigation: how to build the necessary global action in a cost-effective manner*
(June2009) Jean-Marc Burniaux, Jean Chateau, Rob Dellink, Romain Duval and Stéphanie Jamet

700. *Capital inflows, household debt and the boom bust cycle in Estonia*
(June 2009) Zuzana Brixiova, Laura Vartia and Andreas Wörgötter

699. *The effect of financial crises on potential output: new empirical evidence from OECD countries*
(May 2009) Davide Furceri and Annabelle Mourougane

698. *Employment - productivity trade-off and labour composition*
(May 2009) Hervé Boulhol and Laure Turner

697. *Labour market flexibility in Estonia: what more can be done?*
(May 2009) Zuzana Brixiova

696. *Structural policies to overcome geographic barriers and create prosperity in New Zealand*
(April 2009) Yvan Guillemette

695. *Ten years of product market reform in OECD countries – insights from a revised PMR indicator*
(April 2009) Anita Wölfl, Isabelle Wanner, Tomasz Kozluk and Giuseppe Nicoletti

694. *Structural reforms and the benefits of the enlarged eu internal market*
(April 2009) Jens Arnold, Peter Höller, Margaret Morgan and Andreas Wörgötter

693. *Co-benefits of climate change mitigation policies: literature review and new results*

(April 2009) Johannes Bollen, Bruno Guay, Stéphanie Jamet and Jan Corfee-Morlot

692. *The impact of monetary and commodity fundamentals, macro news and central bank communication on the exchange rate: Evidence from South Africa*
(April 2009) Balázs Égert

691. *Assessing the impacts of climate change: a literature review*
(April 2009) Stéphanie Jamet and Jan Corfee-Morlot

690. *The determinants of employment and earnings in Indonesia: a multinomial selection approach*
(April 2009) Margherita Comola and Luiz de Mello

689. *Inflation responses to recent shocks: do G7 countries behave differently*
(April 2009) Lukas Vogel, Elena Rusticelli, Pete Richardson, Stéphanie Guichard and Christian Gianella

688. *Infrastructure investment in network industries: the role of incentive regulation and regulatory independence*
(March 2009) Balázs Égert

687. *Government consumption volatility and the size of nations*
(March 2009) Davide Furceri and Marcos Poplawski Ribeiro

686. *Infrastructure investment: links to growth and the role of public policies*
(March 2009) Balázs Égert and Tomasz Kozluk and Douglas Sutherland

685. *Infrastructure and growth: empirical evidence*
(March 2009) Balázs Égert and Tomasz Kozluk and Douglas Sutherland

684. *The effects of population structure on employment and productivity*
(March 2009) Hervé Boulhol

683. *The macroeconomic consequences of banking crises in OECD countries*
(March 2009) David Haugh, Patrice Ollivaud and David Turner

682. *Adjusting housing policies in Slovakia in light of euro adoption*
(March 2009) Felix Hüfner

681. *Achieving fiscal flexibility and safeguarding sustainabilit - The case of Slovakia*
(March 2009) Isabell Koske

680. *Raising the flexibility of the Slovak economy during the catch-up phaseDo Latin American central bankers behave non-linearly? The experience of Brazil, Chile, Colombia and Mexico*
(March 2009) Isabell Koske

679. *Do Latin American central bankers behave non-linearly? The experience of Brazil, Chile, Colombia and Mexico*
(February 2009) Luiz de Mello, Diego Moccero and Matteo Mogliani

678. *Enhancing educational performance in Australia*
(February 2009) Vassiliki Koutsogeorgopoulou