IMMIGRANT PUPILS' SCIENTIFIC PERFORMANCE: THE INFLUENCE OF EDUCATIONAL SYSTEM FEATURES OF COUNTRIES OF ORIGIN AND DESTINATION

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IMMIGRANT PUPILS' SCIENTIFIC PERFORMANCE: THE INFLUENCE OF EDUCATIONAL SYSTEM FEATURES OF COUNTRIES OF ORIGIN AND DESTINATION

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Abstract

This paper explores the extent to which educational system features of destination and origin countries can explain differences in immigrant children's educational achievement. Using data from the 2006 PISA survey, we performed cross-classified multilevel analysis on the science performance of 9.279 15-year-old immigrant children, originating from 35 different countries, living in 16 Western countries of destination. We take into account a range of educational system characteristics of the countries of destination and origin, in order to measure the importance of differentiation, standardization, and the availability of resources. Our results show that differences in educational achievement between immigrants cannot be fully attributed to compositional differences. Educational system characteristics of countries of destination and origin are also meaningful. At the origin level, the length of compulsory education positively influences educational performance. This is especially the case for immigrant pupils who attended education in their countries of origin. Results show that at the destination level, teacher shortage negatively affects immigrant pupil's scientific performance. Moreover, immigrant children perform less in highly stratified systems than they do in moderately differentiated or comprehensive ones. Specially immigrant children with high educated parents perform worse in highly stratified systems.

Keywords: immigration, origin, destination, educational system, educational performance, PISA

Introduction

A large body of research has shown that the educational success of immigrant children varies between different origin groups. Substantive variation exists in educational outcomes of different ethnic groups in the United States: Mexican Americans and blacks obtain lower average grades than Asians and whites (Bankston and Zhou, 2002; Kao, Tienda, and Schneider, 1996; Miller, 1995), they are more likely to drop out of high school (White and Kaufman, 1997), and less likely to earn a college degree (Camburn, 1990; Mare, 1995). Similar gaps in educational success between different immigrant groups and the native population have been observed in most other Western countries such as the Netherlands (van Tubergen and van de Werfhorst, 2007), Belgium (Phalet, Deboosere, and Bastiaenssen, 2007), Germany (Worbs, 2003), and France (Brinbaum and Cebolla-Boado, 2007). In order to explain these differences, research has often relied on classic individual-level determinants. These individual-level explanations have focused on differences in the cultural position (e.g. their motivation to perform) and the structural characteristics (e.g. parental capital and the time of arrival) of different immigrant groups (Kao and Thompson, 2003).

Although individual-level characteristics explain an important part of the variance in educational performance across immigrant groups, they do not tell the whole story. After controlling for a wide range of individual background characteristics (e.g. the educational attainment and occupational status of both parents, educational resources available at home, the immigrant generation, and the language spoken at home), differences in educational performance continue to exist across immigrants from different regions of origin and across immigrants living in different countries of destination (Schnepf 2006; Marks 2005; Levels

and Dronkers, 2008). In order to explain the remaining cross-group and cross-national variation, Levels, Dronkers, and Kraaykamp (2008) have examined the relevance of a range of contextual features of both countries of origin and destination. Their results indicate that several country characteristics of both destination and origin countries affect the educational performance of immigrant children. For example, immigrant children from politically stable origin countries perform better at school than their counterparts from less stable countries. Also, origin countries' level of economic development negatively affect educational performance. At the destination level, immigrant children living in traditional immigration countries (Australia and New Zealand) have higher levels of educational performance. Levels et al. (2008) conclude that an exclusive focus on individual qualities cannot sufficiently explain the educational performance of immigrant children. Contextual features of both origin and destination countries do affect the educational performance of immigrant children, and must be part of any explanation of immigrant children's school success. Moreover, in order to fully disentangle the various origin and destination effects, they must be analyzed simultaneously.

The scientific study of contextual effects on immigrant pupils' scholastic performance is relatively recent. This study offers an important improvement upon the previous literature. We examine the influence of educational systems on the educational performance of immigrant children. The educational system is one of the core institutions of contemporary Western societies. Not only does it regulate the transfer of knowledge, general skills, and labor market qualifications, it also conveys societies' values and norms. Policy makers and social scientists have underscored the vital role education plays in socially and economically integrating immigrant children. There are large differences between countries in the way education is institutionalized. National education systems differ for instance in the number of distinct educational programs at secondary education, the age at which children are selected into different educational programs, and the existence of nationally standardized examinations at the end of primary and secondary education (Shavit and Blossfeld, 1993; Shavit and Müller, 1998). Although these different educational structures have been suggested to explain differences in the educational success of immigrants across countries, little systematic research has actually tested this (Buchmann and Parrado, 2006; Heath and Birnbaum, 2007). Moreover, no study so far has taken into account educational system features of immigrant children's countries of origin. Since a substantial share of immigrant children have attended education in their countries of origin (Rumbaut, 2004), their educational performance is partly determined by the structure and organization of education in their home countries. Therefore, in order to establish the effects of educational systems on the scholastic performance of immigrant children, characteristics of educational systems of origin countries must be studied. Levels et al. (2008) analyzed only general macro-characteristics of the countries of origin and destination and found significant effects of economic development and political stability of the countries or origin. However, these results might explained by features of the educational systems of the countries of origin and destination. Therefore we try to answer is the following research question: *To what extent is the educational performance of 15-year-old immigrant children determined by the educational system of their countries of origin and destination, also after controlling for the economic macro-characteristics of the countries of origin?*

Countries' educational systems

There are large differences between countries in the way education is organized (Shavit and Müller, 1998). National education systems differ for instance in the number of distinct educational programs at secondary education, the age at which children are selected into different educational programs, and the existence of nationally standardized examinations at the end of primary and secondary education. We assume that the educational achievement of

immigrant children is partly determined by the degree of differentiation, the degree of standardization, and the availability of resources of origin and destination countries' educational systems. These three characteristics (differentiation, standardization, resources) are the most common mentioned in the literature (Shavit and Müller, 1998; Wössmann, 2003; Buchmann and Hannum, 2001) as the most important system features, which might effects different educational outcomes of pupils in different societies.

Origin countries' educational systems affect immigrant children's educational performance in their destination country only if they have received part of their education in their country of origin. This implies that we do not expect direct effects of origin countries' education systems for the scholastic performance of second generation immigrant children, who are born in a country to which their parents migrated. Moreover, the more time first generation immigrant children have received education in their origin country, the more relevant the education system of the origin country will be. Rumbaut (2004) has shown that educational performance of first generation immigrant children differs extensively between children who have migrated at an early age and children who have migrated later in life. We distinguish within the first generation based on first generation pupils' age of migration. Following Rumbaut's (ibid.) terminology, we distinguish between first generation children who have migrated before the age of 5 ('1.75 generation'), children who have migrated between the age of 5 and 12 ('1.5 generation'), and pupils who migrated after the age of 12 ('1.25 generation').

Differentiation

Differentiation of the education system refers to the extent to which pupils of the same age are divided into separate types of education. Whereas highly stratified systems track pupils into different types of secondary education at a relatively young age, systems that are less stratified postpone that decision until a later age. In addition to this institutional differentiation, pupils can also be streamed early inside schools according to ability. Although for instance at first glance the American high school system offers the same type of education to all high school pupils, it is characterized by a high degree of internal ability grouping. High achievers are generally assigned to 'honors' sections of a certain course, low achievers attend 'remedial' sections (Slavin, 1990; Gamoran, Nystrand, Berends and LePorc, 2004). This early differentiation of students between different school types or streams increases differences in educational performance in at least three ways: 1. different educational choices by immigrant parents; 2. differentiation in curriculum of school-types and streams; 3. different ability composition of streams and schools;.

The early differentiated educational systems influence the educational choices of children of lower class parents (natives and immigrants) negatively. The rationale behind this is that educational choices made at a relatively early age are more heavily influenced by parental background than by children's actual achievements (Mare, 1981; Shavit and Blossfeld, 1993). Pfeffer (2008) has recently underscored the importance of parents' strategic knowledge of the education system as a crucial resource that translates into different educational choices. Parents' strategic knowledge is especially important in highly stratified systems. Immigrants are on average less knowledgeable of the different educational options in their countries of destination and will therefore be less able to navigate their children successfully through the educational labyrinth, especially of the more differentiated educational systems. More general, as a result of a lower level of resources of immigrants (educational, occupational, knowledge of the educational system, a lower command of the host country's language) their children are more likely to be selected and allocated into lower educational streams and school types (van de Werfhorst and van Tubergen, 2007). However, children of some immigrant groups have higher educational performance than others, despite

of the low social background of their parents due to their specific cultural background and culture (Kao et al, 1996; Koa & Thompson, 2003; Levels et al, 2008).

The early institutional differentiation, either by different school types, or by streams within undifferentiated secondary schools, is related to curricular differentiation between the students. The taught curriculum is varying by school-type or the level of the stream. One of the most important difference in curriculum is that between vocational and general education. The curriculum offered in vocational education tends to be more restricted to practical skills instead of more abstract knowledge. This might lead to differences in educational performance between comparable students from general and vocational education. Also the more a school-type or a stream prepares students for college or university entrance, the more demanding the curriculum, the higher the criteria for academic success but also the opportunities for the students to learn more and perform better. This curriculum differentiation at an early age gives comparable 15-year old immigrant students in school-types and streams unequal opportunities to learn certain knowledge and skills (Baker & LeTendre, 2005).

One of the aims of this early institutional differentiation is the creation of homogeneous learning environments. The central argument behind institutional tracking or types of ability grouping is that homogeneous learning environments permit a focused curriculum and paced instruction, which increases the average performance of all students (Hanushek and Wössmann, 2005). This homogenization influences the ability composition of the school type and the stream. The more demanding school-types or streams will have on average more students with higher scholastic skills, while the less demanding school-types or streams will have on average more students with lower demanding skills. This differentiation of ability composition of the student body between school-types and streams creates different opportunities for teaching and learning, both by the available time-on-task, the various criteria of teachers and students and the peer-group pressure for academic and non-academic success (Coleman et al, 1966; Scheerens and Bosker, 1997; Dronkers, 2008) .

Given the lower resources of many immigrant parents, their larger difficulties to gain early access for their children to those streams or school-types, which offer a more demanding curriculum and teaching and learning environment, we hypothesize that *the educational achievement of 15-year-old immigrant children will be lower in destination countries with highly stratified educational systems (hypothesis 1).*

Standardization

Standardization refers to the degree to which clear external standards or incentives exist in an educational system to maintain the quality level of the education it provides. It indicates the extent to which educational systems have a set of standard rules and guidelines education should comply with (Wössmann, 2003). An example of a clear external standard is the conduction of nationally standardized exams at the end of secondary education. Since this means that all students in a country attending the same school type will face the same test at the end of secondary education, schools have an incentive to keep the quality of their education sufficiently high. After all, failing to warrant high quality education in a standardized system would most likely lead to lower average scores on the exams and might consequently damage an educational system's reputation (Bishop, 1997). We therefore hypothesize that *external standards implemented by the educational system in a country of destination have a positive influence on the educational achievement of immigrant children living in this country (hypothesis 2A).*

Moreover, the degree of standardization of the educational system of immigrant children's countries of origin is expected to affect the educational achievement of immigrant children who attended part of their education in their origin country. Whereas second and 1.75

generation immigrants did not attend education in their country of origin, 1.25 and 1.5 generation immigrants have been shaped by their origin countries' educational systems. Following the same line of reasoning, it is therefore expected that the educational achievement at age 15 of 1.5 and (especially) 1.25 generation immigrant children profits from a standardized educational system in the country of origin. We hypothesize that *standardization of the educational system of immigrant children's countries of origin positively affects the educational achievement of immigrants originating from these countries, and this is especially the case for the 1.25 generation, less for the 1.5 generation, and not for the 1.75 and second generation (hypothesis 2B).*

As a measure of standardization at the destination level we take into account the existence of nationally standardized exams in science. As a measure of standardization at the origin level we use the number of compulsory years of education. Because we will also control for the degree a country of origin succeeds in providing education for all with the *Education for All Development Index (EDI)*, the number of compulsory years of education will reflect the level of legal standardization of education in a country.

Resources to teach and learn

Educational achievement can be expected to be determined by the amount of time spent on teaching ('teaching time') and learning ('learning time'). Overall, the more teaching hours students receive and the more time they spend processing this information, the better their educational performance is likely to be (Ammermüller, 2005; Scheerens & Bosker, 1997). The learning and teaching time an educational system can provide for depends on the allocation of its human and material resources. National governments invest money in educating teachers, reducing teacher shortages, and equipping schools with modern information technologies in order to keep the quality of education high. However, research into the influence of school quality on educational achievement has suggested that school resources only have a very limited influence on pupils' performances. The research into the influence of school quality on educational achievement mainly originated with James Coleman et al.'s "Equality of Educational Opportunity" (1966). The outcome of this report revealed that, relative to students' individual background characteristics, measured differences in school resources (e.g. per pupil spending) matter little in determining educational outcomes of pupils in the US. Later studies focusing on the US or other Western countries have revealed a similar weak influence of material school resources (Dronkers, 2008). Studies focusing on educational achievement in less developed countries have suggested that this might be related to the relatively low variance in educational resources within and across developed industrial nations. In developing nations, material and human resources such as the availability of textbooks and teacher training have shown to strongly determine achievement (see e.g. Heyneman and Loxley, 1983, and an elaborate review by Buchmann and Hannum, 2001).

Despite the limited support for a positive influence of educational systems' resources on educational achievement across developed countries, the picture might look differently for immigrant children. Next to having a socioeconomic disadvantage to natives, immigrant children's educational performance is also hindered by specific immigrant characteristics. Immigrant parents' limited knowledge of the education system and their often restricted language skills hinder their possibilities to help their children with their homework or prepare them for tests. Due to a lack of support provided by immigrant children's parents, the educational achievement of immigrant children is expected to depend more on the resources provided by their educational systems. We therefore test the following hypothesis: *the quality of resources of a destination country's educational system positively affects the educational performance of immigrant children living in this country (hypothesis 3A).*

The same reasoning applies to the resources educational systems in origin countries possess. The educational achievement of immigrant children who attended part of their education in their country of origin (the 1.25 and 1.5 generation), is likely to be affected by the quality of the resources of their origin country's educational system. Since the origin countries in our analysis are more heterogeneous with regard to development level than the destination countries, the variance in educational system's resources will be larger at the origin level. It is expected that *the quality of resources of an origin country's educational system positively affects the educational performance of immigrant children originating from this country, and this is especially the case for the 1.25 generation, less for the 1.5 generation, and not for the 1.75 and second generation (hypothesis 3B).*

At the destination level, we take into account the average student-teacher ratio in primary education, the degree of teacher shortage, and the average quality of educational resources. Since those measures of an education system's resource level are not available for the majority of origin countries, we use the degree to which an educational system provides education for all (the so-called EDI-index; see UNESCO, 2007) as a proxy. Moreover, the average student-teacher ratio in primary education is taken into account at the origin level as well. We assume that a low student-teacher ratio, a low teacher shortage, high quality of educational resources, and a high score on the EDI-scale are characteristic for educational systems providing high quality resources. We will also control our results for two macro-characteristics of the countries of origin shown to affects educational performance of immigrant children: i.e. economic prosperity and political stability (Levels et al. 2008). Both indicators refer to two important push factors for immigration: lack of economic prosperity and political unrest. We control for these characteristics to ascertain that the effects of the educational systems are not spurious, and to examine whether the effects of economic prosperity and political stability are interpreted by differences in educational systems.

Data

The 2006 data from the Program for International Student Assessment [PISA], initiated by the Organization for Economic Co-operation and Development [OECD], were used to test the hypotheses of this study. Since 2000, the OECD has conducted large scale tests among 15-year-olds living in its member states and partner states every three years. Pupils' mathematical, reading, and scientific literacy were assessed. In doing so, the OECD aimed to find out to what degree pupils near the end of compulsory education have acquired knowledge and skills essential for full participation in society. The main focus of the 2006 study was on scientific literacy, meaning that the majority of questions related to scientific matters. A relatively small number of questions related to reading and mathematics (OECD, 2007). PISA also provides information on individual and school characteristics by respectively administering a student and a principal questionnaire. Information on the school a child is enrolled in is provided through the principal questionnaires. Each school's principal is asked to provide information on numerous school characteristics, such as the teacher-student ratio, the number of vacant science positions, and the school's location. The student questionnaire asks students to provide detailed information on parental education and careers, resources that are available in the child's home, the language spoken at home and the birth countries of both the parents and the student. Since specific information on the birth country of both the parents and the student is essential to our analysis, countries that did not allow enough specificity in birth countries could not be taken into account. Therefore, although not less than 57 countries participated in the 2006 PISA wave, only data from the following 16 developed countries are suited to test hypotheses: Australia, Austria, Belgium, Denmark, Finland, Germany, Greece, Latvia, Liechtenstein, Luxembourg, the Netherlands, New

Zealand, Norway, Portugal, Switzerland and Scotland. We excluded all pupils from those countries of origin, which had in total less than 30 cases.[2] Therefore we analyze 9.279 immigrant pupils from 35 different countries of origin in 16 countries of destination.[3] We used the *World Data on Education* [WDE] as an additional data source. The sixth edition of the WDE (UNESCO, 2007) contains profiles of the educational systems of 161 UNESCO member states, focusing in particular on official school curricula and curricular structures at the primary and secondary education levels. With the use of this database, characteristics such as compulsory years of education and student-teacher ratio could be determined for countries of origin.[4]

Variables

Dependent variable

The dependent variable of this study is scientific literacy, which was the main focus of the 2006 PISA wave. In order to be able to cover as many facets from the scientific field as possible (in general, the scientific field should be regarded as a combination of the disciplines Biology, Physics, Chemistry and Geography, covering topics such as health, natural resources and environment), a test with a total assessment time of 390 minutes was developed. However, since it would not be sensible to administer a test of more than 6 hours to an individual pupil, 13 largely comparable item clusters, with a duration of 2 hours each, were derived from the core test. These booklets were allocated to individual students according to a random selection process. Each participating student spent two hours carrying out pencil-and-paper tasks, of which approximately 54 per cent of the testing time was devoted to science, 31 per cent to mathematics and 15 per cent to reading. Since two booklets can never have exactly the same average difficulty, Item Response Modeling was used to establish comparable science results across students. The science scores are standardized scores with a mean of 500 and a standard deviation of 100.

Educational system features of countries of destination

Information on destination countries' educational systems has been derived from PISA 2006.

Quality of educational resources is an index composed by PISA (IRT scaling) that indicates to what extent instruction at school is hindered by the following factors: shortage or inadequacy of science laboratory equipment, shortage or inadequacy of instructional materials (e.g. textbooks), shortage or inadequacy of computers for instruction, lack or inadequacy of internet connectivity, shortage or inadequacy of computer software for instruction, shortage or inadequacy of library materials, shortage or inadequacy of audio-visual resources. The index is based on answers provided by principals and positive values refer to higher quality resources.

The *degree of teacher shortage* is an index provided by PISA (IRT scaling) that indicates the extent to which extent instruction is hindered by the following factors: a lack of qualified science teachers, a lack of qualified mathematics teachers, a lack of qualified language teachers, and a lack of qualified teachers of other subjects. Again, the index is based on answers provided by principals. Positive values refer to higher teacher shortages.

Nationally standardized exams is a dummy variable that indicates whether a country of destination has nationally standardized examinations in science at the end of secondary education. This is the case in Australia, Germany, Denmark, Finland, Liechtenstein, Luxembourg, Latvia, the Netherlands, Norway, New Zealand, and Scotland (1) and not in Austria, Belgium, Switzerland, Greece, and Portugal (0, reference category). This information has been derived from additional information provided by PISA (OECD, 2007, table 5.2).

To measure the level of *differentiation* of the educational system, we classified countries according to their stratification level. We define Austria, Switzerland, Germany, Liechtenstein, and the Netherlands as highly stratified systems; Belgium, Greece, Portugal, and Luxembourg as moderately stratified systems; and Finland, Norway, Denmark, New Zealand, Australia, Scotland, and Latvia as systems that are hardly stratified. This division is based on information on the first age at which pupils have to choose between different educational types, the number of types pupils can choose between, and the presence of more hidden types of ability grouping. Although PISA provides this information for all countries in the sample, we have consulted additional descriptions of national experts (Schneider, 2008; Shavit and Müller, 1998; UNESCO, 2007). Overall, the different sources have revealed a similar pattern. In the highly stratified countries, children can choose between at least 3 different educational types at age 10 (Germany, Austria), 11 (Liechtenstein), or 12 (Switzerland, the Netherlands). In comprehensive systems, children are not tracked into different educational types before age 15. We use dummy variables indicating whether countries have highly stratified, moderately differentiated or comprehensive education systems. The latter are reference.

Educational system features of countries of origin

Information on educational systems of origin countries' educational systems has been derived from WDE 2006/2007.

The *Education for All Development Index (EDI)* is a composite expressing to what degree a country of origin succeeds in providing education for all. It consists of a country's total primary net enrolment ratio (the percentage of primary-school-age children who are enrolled in either primary or secondary school), the survival rate up to grade 5, adult literacy, and gender parity in primary and secondary education. It ranges from 0,75 (Morocco) to 0,99 (e.g. Germany, France, and Sweden). The EDI-scores reflect the situation in 2004.

The *student-teacher ratio in primary education* was taken into account at both the origin and destination level. At the origin level, it ranges from 10 to 40 students per teacher, with an overall average of slightly less than 20 students per teacher for all origin countries. At the destination level, it ranges from 10 to 18. Data have been gathered in 2006.

Years of compulsory education refers to the duration of compulsory schooling in countries of origin. On average for all origin countries in our data, pupils are obliged to attend school for slightly less than 10 years. The mandatory length of schooling varies considerably between origin countries, from 5 to 13 years. Again, data reflect the situation in 2006.

Macro-economic characteristics of countries of origin

A country's level of economic development was approached by its *Human Development Index (HDI)* (2007). It provides a broad picture of a county's human development level. Ranging from 0 to 1, the Human Development Index (2007/2008) combines information on countries' life expectancies, adult literacy rates, gross enrolment ratios in primary, secondary, and tertiary education, and GDPs in order to measure countries' levels of human development. The countries political stability is measured with the World Bank Government Indicator for political stability (Kaufmann, Kraay and Mastruzzi 2005). The measurement represents the perceived likelihood of revolutionary regime-change by violent or otherwise unconstitutional means. A higher score refers to a more stable political situation.

Individual level variables

In line with Rumbaut (2004), we have constructed immigrant generation variables that combine information on the birth countries of both the parents and the pupil and his/her age of migration. *Second generation* immigrant children are those pupils of whom at least one parent

was born abroad, but who have been born in the current country of destination themselves. *First generation* immigrant pupils have been born abroad themselves as well. If the age of migration of first generation immigrant pupils was before age 5, those pupils have been labeled *1.75 generation* immigrant pupils. The *1.5 generation* refers to first generation pupils who have migrated between the age of 5 and 12, and the *1.25 generation* refers to those pupils who migrated after the age of 12. Immigrant pupils of whom the generation could not be determined were taken into account by creating an *immigrant generation missing dummy variable*. Second generation immigrants are used as the reference category.

One native parent. A dummy variable was used to identify pupils who had one immigrant and one native-born parent (1); pupils with two non-native parents represent the reference group (0).

Official language of destination country spoken at home. We included a dummy variable to differentiate immigrant children who speak one of their destination country's official languages at home (1) from children who speak a foreign language (0). A *language missing dummy variable* was taken into account in order to compare pupils of whom their language spoken at home is unknown (1) to children who speak a foreign language at home.

Parental occupational status is measured according to the ISEI scale (Ganzeboom, de Graaf, Treiman, and de Leeuw, 1992), which ranges from 16 to 90. We use the ISEI score of the parent with the highest occupational status.

Parental educational level is measured according to the ISCED scale (UNESCO, 2006) and ranges from 0 to 6. We use the ISCED level of the most educated parent.

Home possessions is a summary index of the amount of material and cultural goods that are available in children's homes. It is a combined measure of the availability of a study desk, a private room, a quiet place to study, a computer, educational software, access to the internet, classic literature or poetry books, works of art, books to help with school work, a dictionary, a dishwasher, and more than 100 books. A higher score indicates a higher level of home possessions.

Vocational education. A dummy variable indicates whether a pupil is currently enrolled in a vocational (1) or general (0) type of education. This division has been adopted from the ISCED classification. Whereas vocational types of education are mainly focused on preparing pupils for the labor market, general types of education are overall aimed at preparing pupils for additional education at the same or a higher level. Although countries differ in their content of and the degree to which they offer vocational education, vocational education types generally refer to lower education levels than the more general (or academic) types. Also the curriculum offered in vocational education tends to be more restricted to practical skills instead of more abstract knowledge offered in general education.

Grade. Since not all pupils attend the same grade, we have included a variable to account for this. As a result of between-country variance in the counting of grades, we have standardized grade around the modal grade in a country.

Female. We control for gender-effects by using a dummy variable indicating whether a pupil is female (1) or male (0).

Table 1 provides an overview of minimum and maximum scores, the mean and the standard deviation of all variables in our analysis.

Table 1 here

Analyses and results

Methods

To analyze non-hierarchically structured data, cross-classified multilevel regression analyses are appropriate (Snijders and Bosker, 1999). We used Iterative Generalized Least Squares (IGLS) estimation techniques from the statistical analysis program MLwiN to estimate models (Browne, 2003). Although originally designed to fit hierarchical models, IGLS can also be adapted to non-hierarchical data structures. IGLS is based on an iterative procedure which provides point estimates for all parameters, including their standard deviations. We make use of a double comparative design (*cf.* Van Tubergen, 2006; Levels et al., 2008), that models variance between origin countries and variance between destination countries simultaneously. This is necessary in order to disentangle the various macro-level effects.

As a result of the nature of the double comparative design, native pupils cannot be included in our analysis. Since for native pupils the country of origin equals the country of destination, origin and destination variance cannot be distinguished. However, in order to account for the fact that in some countries of destination the average performances of all pupils are higher than in others, the average science performance of natives per country of destination is added as a control variable to the analysis. This approach has been suggested by van Tubergen (2006) and was adopted by Levels et al. (2008). We apply this approach because in this analysis we do not want to explain differences in average performances of pupils (both natives and immigrant) in different countries, but we focus on the differences in the performance of immigrant pupils in these countries.[5]

Descriptive results

Table 2 presents the average scientific performance of immigrant pupils per country of destination and country of origin. On average, the 9.279 immigrant pupils living in our 16 countries of destination have a scientific literacy score of 468, which is 32 points below the OECD mean. However, as becomes clear from the table, the overall immigrant mean of 468 conceals the considerable variation by country of origin and country of destination. The difference between the lowest and highest performing origin group is almost 200; immigrant pupils from Cap Verde have an average science score of 380, immigrant pupils from the United States have an average score of 571. Other high performers are the Chinese and Australian immigrants (552 and 548 respectively). Those variable scores of immigrants originating from different countries might indicate the existence of origin effects and they once more underscore the necessity to take into account immigrants' roots. Next to those apparent origin effects, destination effects seem to exist as well. Whereas immigrant pupils living in Australia have an average science score of 536, immigrant pupils in Denmark have a score of no higher than 388. So, irrespective of country of origin, average science performance of immigrants also differs across different countries of destination.

Table 2 here

Variance components

Table 3 provides insight into the extent to which the variance in educational performance of immigrant children may be attributed to differences across origin countries, destination countries, and individuals. Model 0, also called 'empty model', does not take into account explanatory variables at any of the levels yet. It displays the distribution of unexplained variance across levels. By far the most variance occurs at the individual level (74 per cent). Since our data set contains 16 relatively homogeneous (developed) destination countries, the small variance at the destination level (7 per cent) is not surprising. A larger amount of variance can be attributed to variance across origin groups: 19 per cent of all variance in the educational achievement of immigrant pupils can be attributed to the countries immigrant

children migrated from. So, although variance at the individual level accounts for the largest share of differences in educational achievement, a quarter of those differences exists at contextual levels.

Table 3 here

Individual effects

In model 1 of table 4, a range of individual-level characteristics is added to the initial empty model. Taking into account individual-level variables is not only important because the majority of variance in scientific literacy is caused by individual-level predictors, but also because they allow the detection of composition effects. Composition effects occur whenever the composition of groups (e.g. schools, origin countries, destination countries) with respect to individual background variables is not identical for all groups (Hox, 2002). Immigrants in one country of destination might outperform immigrants in another, not because of contextual effects, but because destination countries host immigrant pupils with different individual background characteristics. The same reasoning applies to immigrants originating from different origins. In order to rule out individual background differences across different origin groups, individual-level variables have to be taken into account.

Most results are in line with earlier research. Parental education (b=4.94**), parental occupation (b=0.89**), and home possessions (b=19.47**) have a large positive influence on scientific literacy. This strong influence of parental class position on educational achievement or attainment has been widely documented for natives in many Western countries (see e.g. Shavit and Blossfeld, 1993, and more recently, Breen, Luijkx, Müller, and Pollak, 2009). Moreover, immigrant children who speak their host country's language at home perform better at school than their counterparts who do not (b=16.66**). Interesting is the large negative effect of attending vocational types of education. Comparable immigrant pupils who attend vocational education perform 57 points less on the science scale than immigrant pupils who attend general types of education. This finding might reflect the differences in the offered curriculum: whereas vocational education types pay more attention to practical skills needed at the labor market, general types of education more heavily focus on more abstract knowledge, also related to later entrance of college or university.

The results furthermore underscore the importance of taking into account immigrant children's age of migration. Second generation immigrants and 1.75 generation immigrants have the highest educational performance, 1.5 generation immigrants score 7 points lower, and 1.25 generation immigrants score 31 points lower. These results indicate that the more time immigrant children have spent in their host country's educational system, the better they perform.

As can be seen from comparing the variance components of model 1 (table 4) to the components of the empty model (table 3), composition effects indeed explain an important share of the initial variance in scientific performance. After inclusion of individual-level characteristics and the average performance of the natives of the destination countries, the initial variance at the destination level is reduced by 33 per cent and the variance at the origin level by 62 per cent. Apparently, a substantial share of the differences in educational achievement across different origin groups and across immigrants living in different countries of destination can be attributed to differences in individual background characteristics of these groups. This finding underscores the importance of aggregate individual qualities for explaining macro-level differences. The average educational performance of natives in the destination countries affects the performance of the immigrant children positively, which reflects a general effect of the general quality of educational systems on outcomes.

Tables 4 and 5 here

The effect of educational systems

Due to the relatively large number of educational system characteristics in comparison to the rather limited degrees of freedom at the destination and partly at the origin level, we have added all characteristics at the destination and origin levels one by one to model 1 of table 4. The parameters of this stepwise addition are shown in table 5. The degree of teacher shortage and highly stratified educational system in the destination countries are detrimental for the science performance of immigrants' pupils. A high EDI score (Education for All Development Index) and more years of compulsory education in the country of origin is favorable for the science performance of immigrants' pupils. Subsequently, educational system characteristics have been added simultaneously, starting with the characteristics that resulted in the largest improvement in model fit in table 5. In model 2 of table 4, only the significant educational system features of countries of origin and destination are presented. In model 3, cross-level interactions are added.[6]

At the destination level, the degree of differentiation of an educational system significantly affects immigrant children's educational performance. The educational performance of immigrant children in highly stratified educational systems is on average 40 points lower than the performance of their counterparts in comprehensive systems. This finding supports partly hypothesis 1. But the effect van moderately differentiated education system on education performance is more positive than that of a comprehensive education system, and that runs partly against the hypothesis that any differentiation in educational systems is detrimental for the educational performance of immigrant children. The inclusion of cross-level interactions between the degree of differentiation and parental background (model 3) reveals some interesting additional information. Whereas former research has repeatedly shown that the effect of social class origin on the educational performance of native pupils is larger in countries with differentiated educational systems (see e.g. Dupriez et al., 2008; Duru-Bellat and Suchaut, 2005; Pfeffer, 2008; and Schütz, Ursprung, and Wössmann, 2005), we find the opposite pattern for immigrant pupils. As can be seen from figure 1, the influence of parental education on the educational performance of immigrants is weaker in highly and moderately differentiated education systems than in comprehensive systems. Stated differently, no matter how well immigrants' parents are educated, their performance is lowest in highly stratified systems, and the highest in moderately differentiated systems.

Figure 1 here

No support has been lent to hypothesis 2A on the importance of external standards. The existence of nationally standardized examinations in science has no significant influence on immigrant pupils' performance. Hypothesis 3A on the resources of a destination country's educational system receives some support from our findings. As can be seen in model 2, the educational performance of immigrants is lower in countries with high levels of teacher shortage (b=-33.95). In another additional analysis we added the GDP of the countries of destination to model 3 (results not shown but available on request). This inclusion of GDP at the destination level had hardly an effect on the coefficients.

At the origin level, the duration of compulsory education has a substantial positive influence on scientific performance (b=8.45; model 2). In line with hypothesis 2B, this positive influence is strongest for immigrant children who attended part of their education in their country of origin (the 1.25 generation, and to a lesser extent, the 1.5 generation). Figure 2 graphically displays this finding. Whereas the difference in educational performance

between second generation immigrants who originate from countries with 5 or 13 years of compulsory education is 54 score points, the difference for the 1.75 generation is 76 points, for the 1.5 generation 81 points, and for the 1.25 generation no less than 156 points.

In order to rule out the possibility that years of compulsory education are a mere reflection of origin countries' level of economic and political prosperity, we add both origin countries' scores on political stability and economic prosperity (HDI). Model 4 of table 4 shows that those indicators did not significantly influence immigrants' educational performance and their inclusion hardly affected the coefficients. The significant effect of the EDI-score at the origin level (in table 5) turned insignificant in combination with other variables, like compulsory years, as shown in model 5 of table 4. Hypothesis 3B has to be rejected. However, if we run analyses (not shown, available on request) without years of compulsory education but with the two indicators of political stability and economic prosperity, the effect of HDI is positive and significant while the effect of political stability remains negative but still insignificant.

The variance in scientific performance at the destination level has declined by 72 per cent after addition of the educational system characteristics and the cross-level interactions in model 3. The variance at the origin level has been reduced by 73 per cent.

Figure 2 here

Conclusion and discussion

The focus of this study was on educational system features of countries of origin and destination and their relation with the educational performance of 15-years old immigrant children. Relying on the literature on educational systems, we assumed that educational systems broadly differ in their degree of differentiation, their level of standardization, and the availability of resources and that these system features are significant for the educational performance of immigrant children. Using PISA 2006 data, this research has examined the scientific performance of 9.279 immigrant pupils from 35 different countries of origin living in 16 different Western countries of destination. Although former and also our research underscore the importance of individual in explaining immigrant children's educational performance (Levels et al., 2008) we show that the features of the educational systems of both origin and destination countries also affect the educational performance of immigrant children, independently of the economic and political prosperity of the origin countries or the average educational performance of the natives in the destination countries. .

At the destination level, our analysis reveals that differences in average scientific performance across immigrants living in different countries of destination cannot be solely attributed to compositional differences of the immigrants or the average educational performance of the natives in the countries of destination. Our results show that the degree to which an educational system is highly stratified has an important influence on immigrant children's educational performance. In line with expectations, the average science performance of immigrants is lower in highly stratified educational systems than it is in educational systems with a moderate level of differentiation. In highly stratified systems, pupils have to choose between different educational tracks at a relatively young age. As a result of their lower linguistic resources and their lower knowledge of the educational options in highly stratified systems immigrant pupils are more likely to be selected into lower educational tracks, in which they have a less demanding curriculum and a less favorable school composition. Interestingly, our results indicate that the educational performance of lower class immigrant children is highest in moderately differentiated systems, and not in comprehensive or highly stratified systems. But immigrant pupils from higher social class backgrounds perform less in highly stratified educational systems than immigrant pupils from

higher social class in moderately differentiated or comprehensive systems. These findings suggests that the educational performance of the average immigrant pupils is only hampered in highly stratified systems, but not in moderately differentiated systems. The latter result deviates from those for natives pupils from lower classes, who perform also less in moderately differentiated educational systems (Pfeffer, 2008). In addition to the negative effect of differentiation, our results show that immigrant pupils perform less in destination countries that have a high degree of teacher shortage. This shortage might lower the quality of teaching in those societies, because more lessons are skipped or given by unqualified teachers. Immigrant pupils might be more vulnerable for a lower quality of teaching due to their lack of linguistic resources and their lower knowledge of their country of destination. The strong effect of attending vocational track on educational performance of comparable immigrant pupils is another indication of the importance of early curriculum differentiation. Vocational education types pay more attention to practical skills needed at the labor market, while general types of education focus on more abstract knowledge, related to later entrance of college or university. This different curriculum offered in vocational and general education relates to different educational performance of the pupils. The negative effect of stratified educational systems on the educational performance of immigrant children can not be explained by the existence of a vocational stream within these systems. Our results show that both features have independent negative effects on educational performance of comparable immigrant children.

As was the case at the destination level, differences in average scientific literacy across immigrants originating from different countries of origin cannot be solely attributed to compositional differences or to the average educational performances in their countries of destination. The years of compulsory education in the country of origin caused a substantial reduction in variance at the origin level: the longer the length of compulsory education, the better especially first generation immigrant children who have attended education in that particular country of origin perform in science. Compulsory years of education are not a mere reflection of origin countries' level of economic or political prosperity (more developed and stable nations attach a higher value to education, and therefore make standardized education compulsory for a longer length of time). The length of compulsory education might be a indicator of quality of education offered to all pupils in immigrants' origin countries. The positive effect of duration of compulsory education for immigrant children who never attended education in their country of origin (the second and 1.75 generation), can most likely be attributed to unmeasured parental resources. This unmeasured variance is likely to be related to the length of standardized compulsory education in the countries of origin, which might be an indicator of the quality of education for all pupils in their country of origin.

Overall, this study has underscored the importance of taking into account educational system features as an explanation of differences in educational achievement across different origin groups and across immigrants living in different countries of destination with different educational systems. Although individual level characteristics account for the largest educational achievement differences between immigrant pupils, educational system characteristics have an effect on top of these individual level characteristics and the average educational performance in their countries of origin. We also showed that differences in educational systems contribute to explaining the effects of economic and political macro-characteristics of the countries of origin (HDI, Political Stability) on the educational performance of immigrant children in destination countries. This means that the effects of educational system features partly interpret the effects of economic development, Our results improve those of Levels et al (2008) by showing that both features of the educational systems and the level of economic and political prosperity of countries or origin should be included while analyzing educational performance of immigrant children. Our results suggest that the

features of the educational system of origin are influenced by the level of economic and political prosperity of the origin countries, but that they have only a indirect effect via the standardized quality of the educational system, measured by length of compulsory education. Levels et al (2008) have overestimated the effect of economic and political development, because they did not include educational system features in their analysis.[7] Our results might imply that origin-related variation in the educational performance of immigrant children might be reduced if origin countries invest in their educational system. More research is needed to test this claim.

The finding that the educational performance of immigrant pupils at age 15 is to an extent determined by the educational structure of their countries of origin and destination, calls for more direct measures of countries' educational systems. Moreover, in order to provide more robust tests of hypotheses concerning effects of educational systems, information from a larger number of destination countries would be necessary. Given the importance of immigrant children success in education, it is incomprehensible that OECD destination countries like Canada, France, United Kingdom, United States or Sweden do not collect and make available this information.

Notes

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[2] Bangladesh (5), Czech republic (6), Denmark (15), Estonia (8), Greece (15), Hungary (12), Liechtenstein (4), Rumania (28), Slovakia (6), Slovenia (5), Macedonia (22).

[3] Since the OECD allows participating countries to propose their own birth country categories, some countries have allowed more detail than others. As a result, the origin countries we have been able to identify in the different countries of destination are partly dependent on the quality of the answering categories. In order to account for this, we have compared the origin countries we have identified to national statistics. In the case of Australia, Austria, Finland, Switzerland, Luxembourg, and New Zealand the three largest immigrant groups as identified by the statistical offices are also represented in our data. In the case of Belgium, Germany, Liechtenstein, the Netherlands, and Scotland, the two largest groups are represented. In Greece, Albanians are by far the largest immigrant group (42 per cent of all immigrants, Eurostat, 2008) and that is also visible in our data. Russians are the largest immigrant group in Latvia (35 per cent of all immigrants, Eurostat, 2008), a pattern that is also reflected by our data. Since the PISA data do not oversample immigrant pupils, smaller immigrant groups are understandably not always reflected in our data.

[4] Since the educational system indicators that have been derived from PISA and WDE data reflect the current nature of those systems, a temporal mismatch exists with regard to the educational system features of countries of origin. After all, immigrant pupils who have migrated at a relatively high age attended education in those origin countries up to 10 years ago. Although this produces a bias towards present conditions, we are confident that the duration of the temporal mismatch is not long enough as to significantly influence our results. Pfeffer (2008) has in this respect pointed to the great degree of path dependence educational systems' structures face.

[5] We have computed the models of table 4 also without the average science performance of the natives. The deletion of this macro-variable had hardly any effect on the coefficients in table 4.

[6] We have conducted a sensivity analysis for the results of the parameters of the countries of destination by deleting one by one each of the countries of destination (results available from the authors). The parameters happens to remain very stable and hardly affected by the deletion of one of the countries of destination.

[7] We have made analysis with more included macro characteristics of the countries of origin. Although we had fewer degrees of freedom due to the higher number of included macro-variables, the reported effects of the educational systems remain more or less equal and significant.

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Figure 1 The average science score of immigrant children by parental education and the degree of differentiation of the destination countries' educational systems (based on model 3, table 4)

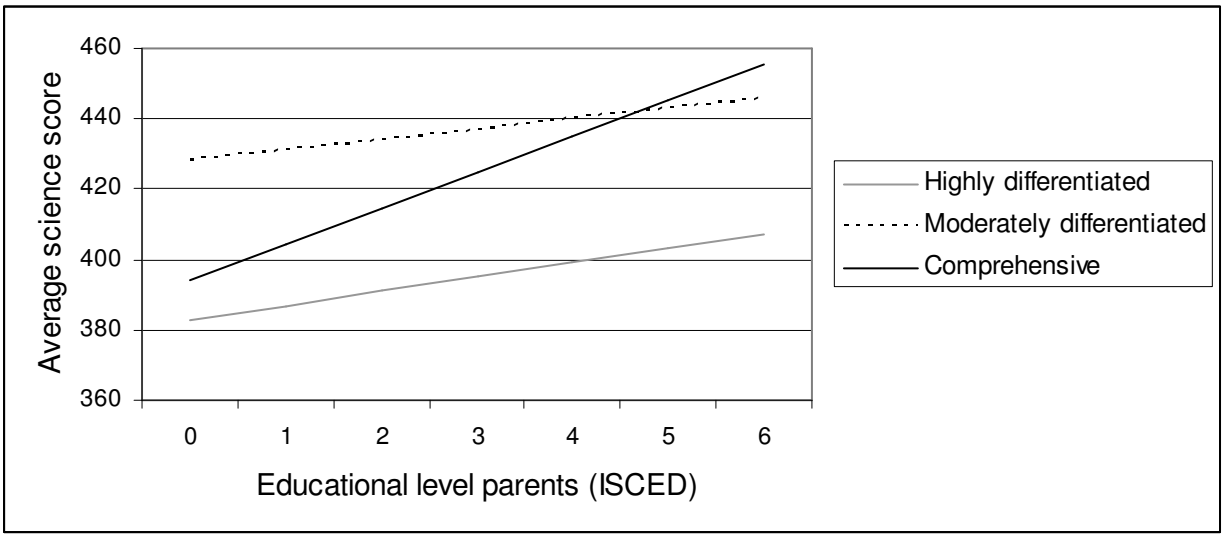

Figure 2 The average science score of immigrant children by immigrant generation and the compulsory years of education in the countries of origin (based on model 3, table 4)

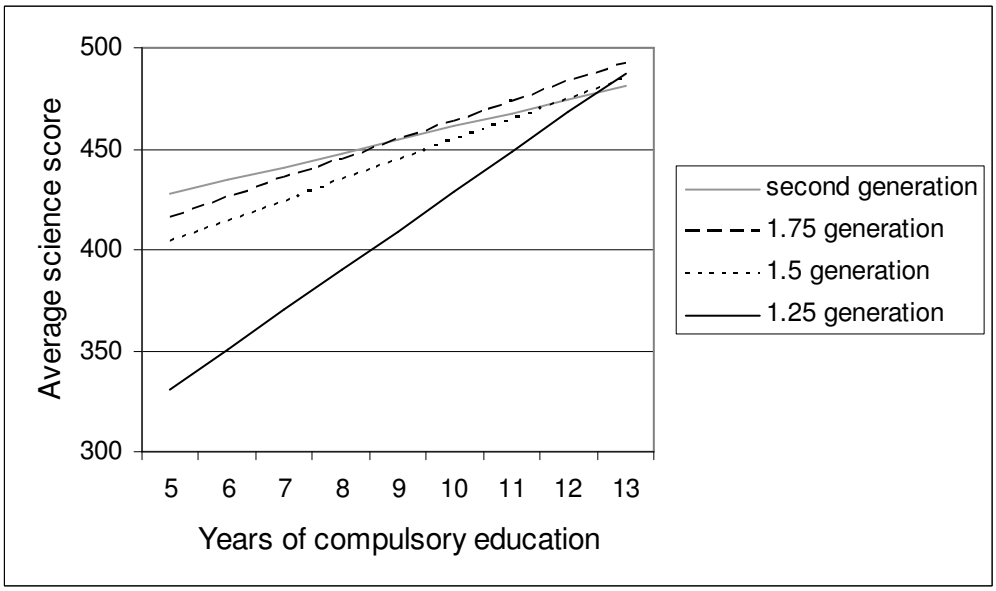

Table 1 Descriptive statistics of all variables in analysis (N=9.279)

	Min.	Max.	Mean	S.d.
Dependent variable				
Scientific literacy	130.30	841.04	468.63	103.20
Destination variables				
Average science performance natives	479.77	565.41	523.08	12.68
Resources				
Quality educational resources	-0.55	0.88	0.29	0.29
Degree of teacher shortage	-0.83	1.05	0.24	0.43
Student-teacher ratio in primary education	10	18	13.64	2.59
Standardisation				
Nationally standardized exams science	0	1	0.57	0.50
Differentiation				
Highly stratified system	0	1	0.31	0.46
Moderately differentiated system	0	1	0.25	0.47
Comprehensive system (ref.)	0	1	0.44	0.48
Origin variables				
Resources				
EDI-score	0.75	0.99	0.94	0.05
Student-teacher ratio in primary education	10	40	19.70	7.41
Standardisation				
Compulsory years of education	5	13	9.76	1.55
Economic and Political Features				
Human Development Index	0.41	0.96	.85	0.10
Political stability	-2.31	1.92	0.04	0.74
Individual-level variables				
Vocational type of education	0	1	0.16	0.37
Grade	-3	3	0.04	0.64
Girls	0	1	0.50	0.50
Parental education	0	6	3.92	1.85
Parental occupation	16	90	44.55	16.87
Home possessions	-5.12	4.02	-0.11	0.87
Immigrant characteristics				
Second generation (ref.)	0	1	0.51	0.50
1.75 generation	0	1	0.24	0.43
1.5 generation	0	1	0.16	0.36
1.25 generation	0	1	0.06	0.23
Immigrant generation unknown	0	1	0.04	0.19
One native parent	0	1	0.06	0.23
Language of test country spoken at home	0	1	0.50	0.50
Language spoken at home unknown	0	1	0.11	0.31

Source: PISA 2006, own calculations

Table 2 Average scientific literacy of immigrant pupils per country of destination and country of origin (N=9.279)

	Destination countries																
Origin countries	AU	AT	BE	CH	DE	DK	EL	FI	LI	LU	LV	NL	NO	NZ	PT	SC	Mean
Albania	0	412	0	359	0	0	434	0	358	0	0	0	0	0	0	0	404
Australia	0	0	0	0	0	0	0	0	0	0	0	0	0	548	0	0	548
Austria	0	0	0	495	0	0	0	0	554	0	0	0	0	0	0	0	519
Belarus	0	0	0	0	0	0	0	0	0	0	504	0	0	0	0	0	504
Belgium	0	0	0	0	0	0	0	0	0	528	0	0	0	0	0	0	528
Bosnia Herzegovi	0	445	0	0	451	421	0	0	0	0	0	0	0	0	0	0	440
Brazil	0	0	0	0	0	0	0	0	0	0	0	0	0	0	464	0	464
Cap Verde	0	0	0	0	0	0	0	0	0	380	0	0	0	0	0	0	380
China	562	518	0	0	0	0	0	0	0	0	0	0	0	547	458	483	552
Congo	0	0	427	0	0	0	0	0	0	0	0	0	0	0	0	0	427
Croatia	0	458	0	0	433	0	0	0	0	0	0	0	0	0	0	0	451
France	0	0	448	507	0	0	0	0	446	505	0	0	0	0	0	0	488
Germany	0	521	508	549	0	0	0	0	550	532	0	504	0	0	0	0	526
India	551	0	0	0	0	0	0	0	0	0	0	0	0	0	0	541	551
Italy	0	0	0	443	415	0	0	0	445	430	0	0	0	0	0	0	438
Rep. of Korea	514	0	0	0	0	0	0	0	0	0	0	0	0	528	0	0	521
Morocco	0	0	438	0	0	0	0	0	0	0	0	0	0	0	0	0	438
Netherlands	0	0	522	0	0	0	0	0	0	0	0	0	0	0	0	0	522
New Zealand	508	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	508
Pakistan	0	0	0	0	0	383	0	0	0	0	0	0	0	0	0	454	412
Philippines	512	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	512
Portugal	0	0	0	454	0	0	0	0	445	420	0	0	0	0	0	0	428
Russia	0	0	0	0	466	0	0	550	0	0	496	0	0	0	0	0	493
Samoa	0	0	0	0	0	0	0	0	0	0	0	0	0	425	0	0	425
Serbia Montenegı	0	426	0	427	414	0	0	0	417	0	0	0	0	0	0	0	420
South Africa	541	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	541
Spain	0	0	0	466	0	0	0	0	516	0	0	0	0	0	0	0	467
Sweden	0	0	0	0	0	0	0	522	0	0	0	0	465	0	0	0	477
Switzerland	0	0	0	0	0	0	0	0	521	0	0	0	0	0	0	0	521
Turkey	0	380	414	425	411	374	0	0	389	0	0	466	0	0	0	0	429
Ukraine	0	0	0	0	0	0	0	0	0	0	472	0	0	0	0	0	472
United Kingdom	542	0	0	0	0	0	0	0	0	0	0	0	0	569	0	0	550
United States	571	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	571
Vietnam	518	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	518
Mean immigrants	536	437	453	444	438	388	434	522	498	455	492	472	444	525	464	474	468
Mean natives	524	525	527	527	531	501	480	565	540	512	495	540	492	537	482	516	518
Difference (I-N)	12	-88	-74	-83	-93	-113	-46	-43	-42	-67	-3	-68	-48	-12	-18	-42	-50

Notes: Destination countries: AU=Australia; AT=Austria; BE=Belgium; CH=Switzerland; DE=Germany; DK= Denmark; EL=Greece; FI=Finland; LI=Liechtenstein; LU=Luxembourg; LV=Latvia: NL=Netherlands; NO=Norway; NZ=New Zealand; PT=Portugal; SC=Scotland.
Source: PISA 2006.

Table 3 Variance components of immigrant children's scientific performance

	Destination countries	Origin countries	Individuals
Model 0 (empty model)	761 (7)	2005 (19)	7869 (74)

Source: PISA 2006, own calculations

Note: Between parentheses, the variance in % of total at respectively destination, origin, and individual level.

Table 4 Cross-classified regression of educational system characteristics of countries of origin and destination, controlled for individual characteristics, on the scientific literacy of immigrant pupils; Nd=16, No=35, Ni=9.279

	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**
Intercept	462.62**	483.79**	393.99**	382.90**	315.55**
	(7.62)	(9.13)	(20.78)	(29.58)	(61.17)
Destination effects of education					
Average science performance natives		0.77**	0.70**	0.70**	0.73**
		(0.31)	(0.31)	(0.31)	(0.31)
Degree of teacher shortage		-33.95**	-36.16**	-35.67**	-35.85**
		(12.39)	(12.57)	(11.52)	(12.63)
Highly stratified education system		-39.13**	-11.22	-12.65	-12.51
		(13.12)	(14.68)	(14.82)	(14.80)
Highly stratified education system * parental education			-6.15**	-6.14**	-6.15**
			(1.36)	(1.36)	(1.36)
Moderately differentiated education system		0.41	33.93**	33.01**	35.16**
		(13.60)	(15.25)	(15.22)	(15.32)
Moderately differentiated education system * parental education			-7.23**	-7.21**	-7.23**
			(1.48)	(1.48)	(1.48)
Origin effects of education					
Compulsory years of education		8.45**	6.71**	6.01**	5.35**
		(1.84)	(1.91)	(2.43)	(2.13)
Compulsory years of education * 1.75 generation			2.81**	2.84**	2.84**
			(1.41)	(1.42)	(1.41)
Compulsory years of education * 1.5 generation			3.42**	3.44**	3.42**
			(1.50)	(1.51)	(1.50)
Compulsory years of education * 1.25 generation			12.84**	12.86**	12.83**
			(2.18)	(2.18)	(2.18)
EDI					96.85
					(71.20)
Origin effects of economy & politics					
HDI				22.41	
				(42.89)	
Political stability				-0.02	
				(0.05)	
Individual effects					
Grade	47.54**	47.53**	47.59**	47.60**	47.61**
	(1.41)	(1.41)	(1.41)	(1.41)	(1.41)
Vocational type of education	-56.50**	-56.58**	-57.36**	-57.36**	-57.38**
	(2.73)	(2.72)	(2.72)	(2.72)	(2.72)
Girls	-7.92**	-7.90**	-7.86**	-7.85**	-7.86**
	(1.62)	(1.62)	(1.62)	(1.62)	(1.62)
Parental education	4.94**	4.92**	10.25**	10.24**	10.24**
	(0.56)	(0.56)	(1.18)	(1.18)	(1.18)
Parental occupation	0.89**	0.88**	0.86**	0.86**	0.86**
	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)
Home possessions	9.47**	9.40**	9.00**	8.99**	8.98**
	(1.06)	(1.06)	(1.06)	(1.06)	(1.06)
Immigrant characteristics					
Second generation	Ref.	Ref.	Ref.	Ref.	Ref.
1.75 generation	2.19	2.12	-25.38*	-25.71*	-25.78*
	(2.28)	(2.28)	(13.77)	(13.80)	(13.77)
1.5 generation	-7.05**	-7.22**	-40.85**	-41.04**	-41.06**
	(2.58)	(2.58)	(15.09)	(15.11)	(15.09)
1.25 generation	-30.93**	-30.94**	-160.71**	-160.80**	-160.73**
	(3.83)	(3.83)	(22.40)	(22.41)	(22.40)
Immigrant generation unknown	-19.96**	-20.19**	-18.46**	-18.44**	-18.46**
	(4.36)	(4.36)	(4.36)	(4.36)	(4.36)
One native parent	5.69	4.96	5.35	5.35	5.30
	(3.84)	(3.84)	(3.89)	(3.90)	(3.89)
Language of test country spoken at home	16.66**	15.83**	15.34**	15.34**	15.34**
	(2.29)	(2.30)	(2.30)	(2.30)	(2.30)
Language spoken at home unknown	-22.95**	-23.20**	-23.55**	-23.54**	-23.51**
	(2.87)	(2.87)	(2.86)	(2.86)	(2.86)
Variance components[a]					
Destination	511 (33)	201 (74)	214 (72)	208 (135)	225 (139)

Origin	771 (62)	549 (73)	543 (73)	542 (119)	517 (115)
Individual	5996 (32)	5996 (37)	5956 (37)	5956 (37)	5956 (37)
Deviance (IGLS; -2*LL)	107244	107216	107155	107155	107153

Source: PISA 2006, own calculations. Notes: standard deviations in parentheses; ** = significant at the 0.05 level, * = significant at the 0.1 level. [a] Between parentheses, the explained variance (in %) at respectively destination, origin, and individual level, as compared to model 0 (table 3). As recommended by Snijders and Bosker (1999), the explained variance at the individual level is computed by calculating the change in total variance.

Table 5 The coefficients, standard errors and improvement in model fit in a stepwise addition of the origin and destination educational characteristics to model 1 of table 4, relative to the performance of the natives in the countries of destination

		Co.	SE	IMF
Destination effects				
Resources	Quality educational resources	4.518	18.31	0.1
	Degree of teacher shortage	-21.73*	12.25	2
	Student-teacher ratio in primary education	-3.92	3.30	0.9
Standardization	Nationally standardized exams science	-21.07	14.37	0.6
Differentiation	Highly stratified system	-24.47*	13.72	5.9
	Moderately differentiated system	-2.88	15.53	5.9
	Comprehensive system	Ref.	Ref.	Ref.
Origin effects				
Resources	EDI-score	224.10**	70.09	9
	EDI-score * 1.25 generation	116.42	77.13	13
	EDI-score * 1.5 generation	58.71	51.19	13
	EDI-score * 1.75 generation	-25.55	51.08	13
	Student-teacher ratio in primary education	-1.65**	0.47	11.1
	Student-teacher ratio in primary education * 1.25 generation	-0.30	0.52	12.5
	Student-teacher ratio in primary education * 1.5 generation	-0.12	0.34	12.5
	Student-teacher ratio in primary education * 1.75 generation	0.24	0.31	12.5
Standardization	Compulsory years of education	8.85**	1.91	18.6
	Compulsory years of education * 1.25 generation	12.77**	2.18	53.7
	Compulsory years of education * 1.5 generation	3.43**	1.51	53.7
	Compulsory years of education * 1.75 generation	2.78**	1.42	53.7

Source: PISA 2006, own calculations

Note: ** = significant at the 0.05 level, * = significant at the 0.1 level