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The Educational Performance of Children of Immigrants in Sixteen OECD Countries

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Non-Technical Abstract

Using Program for International Student Assessment [PISA] 2006 data, we examine the science performance of 9.279 15-year-old children of immigrants, originating from 35 different countries, living in 16 Western countries of destination. Whereas former research has mainly paid attention to the influence of individual-level characteristics on the educational performance of immigrants, this study's focus is on macro-level characteristics. Using a cross-classified multilevel approach, we examine the impact of educational systems and political, economic, and religious features of both countries of origin and destination. The results show that at the destination level the degree of teacher shortage has a negative, and a longer history of migration has a positive, effect on science performance. Moreover, comprehensive educational systems have a positive influence on immigrant children's performance, but this is only the case for higher class children. At the origin level, the compulsory period of education has a positive effect on immigrants' science performance. Moreover, whereas immigrants from countries with an Eastern religious affiliation perform better than immigrants from Christian countries, immigrants from Islamic countries perform worse.

Keywords: immigrants, educational performance, PISA, origin countries, destination countries, educational systems.

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Introduction

This study focuses on the influence of both societal and educational system characteristics of immigrants' countries of origin and destination on the educational achievement of their 15-year old children. In doing so, it aims to combine two lines of research: one focusing on the influence of countries' immigrant policies and other macro-characteristics, the other focusing on countries' educational system characteristics. Both separate lines of research will be described below. The research question is the following: *to what extent is the educational performance of 15 year old immigrant children influenced by the educational system and other macro-characteristics of both countries of origin and destination?*

Theoretical framework

Countries' educational systems

There are large differences between countries in the way education is organized. 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 children of immigrants is partly influenced 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 mentioned in the literature (Shavit and Blossfeld, 1993; Wössmann, 2003; Buchmann and Hannum, 2001) as the most important system features, which might cause different educational outcomes of pupils in different societies.

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. 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 educational systems that differentiate students early negatively influence the educational choices of children with lower parental resources. 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 differentiated educational labyrinth.

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 varies by school-type or the level of the stream. One of the most important differences 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 and the higher the criteria for academic success, but also the opportunities for the students to learn more and perform better (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 on average have more students with higher scholastic skills, while the less demanding school-types or streams will on average have 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 and the peer-group pressure for academic and non-academic success (Scheerens and Bosker, 1997; Dronkers, 2010).

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 children of immigrants 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 conducting 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 children of immigrants 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 children of immigrants 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. 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).*

Resources to teach and learn

Educational achievement can be influenced 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. 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 (Dronkers, 2010).

The picture might however look differently for children of immigrants. 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. The educational achievement of children of immigrants is therefore expected to depend more on the resources provided by their educational systems. We test the following hypothesis: *the quality of resources of a destination country's educational system positively affects the educational performance of children of immigrants living in this country (hypothesis 3A).*

The same reasoning applies to the resources educational systems in origin countries possess. The educational achievement of children of immigrants 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. It is expected that *the quality of resources of an origin country's educational system positively affects the educational performance of children of immigrants 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).*

Other macro-characteristics

In line with the earlier cited studies, we expect several social, cultural, and economic characteristics of countries of origin and destination to influence immigrants' scientific literacy as well.

Destination

In order to evaluate destination countries' immigration policies, we use the Migrant Integration Policy Index [MIPEX]. This index takes into account over a hundred policy indicators in order to influence to what extent immigrants living in a European Union member state profit from policies on long-term residence, access to nationality, anti-discrimination, family reunion, political participation, and labour market access (Niessen, Huddleston, and Citron, 2007). Since countries that score high on these policy dimensions are expected to have a positive influence on their immigrant population's economic, political, and social integration, performing well at school pays off for immigrant children. We therefore hypothesize that *immigrant children living in countries that have more favourable immigrant policies outperform immigrant children in countries with less favourable immigrant policies (hypothesis 4).*

Destination countries also differ in their immigration admission policies. During the past 50 years, traditional immigrant-receiving countries such as Australia, Canada, and New Zealand have instituted skills-based 'point systems' that reward certain socio-economic traits in the admission formula. In general, people with higher educational levels, more job experience, and a better command of English have higher chances to be admitted. In doing so, these countries match immigrant skills with labour market needs and reduce the fiscal burden that immigration would place on the host country's system of social assistance (Borjas, 2001). Research suggests that this careful selection of immigrants positively influences the attitude of natives towards immigrants in traditional immigrant-receiving countries (Bauer, Lofstrom,

and Zimmerman, 2000). Following the above line of argument, we expect that *immigrant children living in traditional immigrant-receiving countries outperform immigrant children in non-traditional immigrant-receiving countries (hypothesis 5).*

Origin

At the origin level, we expect an effect of the level of economic development. Since the education systems of economically developed countries transfer skills and diplomas that are also of value in immigrants' new economically developed countries of destination, immigrants from economically more developed countries are likely to have more favourable background characteristics. So, *we expect immigrants originating from more (economically) developed countries to have higher levels of scientific literacy than their counterparts from less (economically) developed countries. However, after controlling for composition effects, this effect will disappear (hypothesis 6).*

Moreover, *we expect lower scientific performance of children originating from politically unstable countries (hypothesis7)* for several reasons. First, politically motivated migrants are not so much attracted by the expected better (economic) condition in their destination countries, but are more or less pushed out by threats experienced in their origin countries (Chiswick, 1999). Depending on the degree of political instability, immigrants from less stable political countries are often traumatized by the migration process. Second, immigrants from politically instable countries might perceive their stay in their new country of destination as only temporary.

Last, the degree of social distance between origin and destination cultures is likely to influence educational performance. Originally advanced by Bogardus, people feel more distant and less understanding towards some groups of people than towards others. According to Portes and Rumbaut (2001), the ranking of social distance is based on differences in cultural values, socio-economic background, and physical appearance. Greater social distance

between natives and immigrant groups has often been related to labour market discrimination, but very likely also translates into lower educational performance of those immigrant pupils that differ culturally and economically from native pupils. We examine this idea by taking into account one dimension of immigrant children's origin cultures: their origin countries' dominant religion. Since all countries of destination analyzed in this chapter are predominantly Christian, *we expect that immigrant children from predominantly Islamic or Eastern religious origin countries perform less than immigrant children from origin countries with a predominantly Christian religion or with no dominant religion (hypothesis 8).*

Data and operationalization

PISA 2006 and its focus on scientific literacy

Since 2000, the Organization for Economic Co-operation and Development (OECD) has tri-annually conducted large scale tests among 15-year-olds living in its member states and partner states in order to assess pupils' mathematical, reading, and scientific literacy. In doing so, the OECD has aimed to find out to which extent pupils near the end of compulsory education have acquired some of the knowledge and skills essential for full participation in society. Alongside information on pupils' educational performance, PISA also provides information on their individual characteristics (e.g. on parental education and careers, resources that are available in the child's home, the language spoken at home, the birth countries of both the parents and the student) and the school they attend (e.g. the teacher-student ratio, the number of vacant science positions, the school's location) through respectively administering a student and a principal questionnaire.

The dependent variable of this study is scientific literacy, which was the main focus of the PISA 2006 wave (OECD 2007). 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 of 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 (also called booklets) 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. However, since two booklets can never have exactly the same average difficulty, Item Response Modeling was used to establish comparable science results across students. Item Response Modeling involves the estimation of five plausible values for each student. Since the scale of these five plausible science values has a Cronbach's alpha of 0.987, the average of these 5 values is an unbiased estimate of a student's science performance, and this average will be used as the dependent variable of this study.

Determining pupils' country of origin and immigrant status

Since specific information on the country of birth of both the parents and the student is necessary to be able to determine a pupil's country of origin, countries that did not allow enough specificity in birth countries could not be taken into account. Therefore, although no less than 57 countries participated in the 2006 PISA wave, only data from the following 16 developed countries are suited to test the hypotheses: Australia, Austria, Belgium, Denmark, Finland, Germany, Greece, Latvia, Liechtenstein, Luxembourg, the Netherlands, New Zealand, Norway, Portugal, Switzerland, and Scotland.

In order to determine pupils' country of origin, several decision rules have been used based upon their own birth country and the birth countries of both of their parents. Next to the pupil's country of origin, we identified his/her immigrant status. Students of whom at least one of the parents was born in a country different from the destination country were identified as immigrants. Immigrant students were either classified as first or second generation immigrants, with the former being those students who were born abroad themselves as well.

Finally, the decision rules used to identify pupils' country of origin and immigrant status amounted up to a final sample of 9,414 immigrant students, originating from 46 different countries of origin.

Table 1. Average scientific literacy of immigrant pupils per country of destination and country of origin (N=9414)

	Destination countries																
	AU	AT	BE	CH	DE	DK	EL	FI	LI	LU	LV	NL	NO	NZ	PT	SC	Mean
Origin countries																	
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
Bangladesh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	476	476
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 Herzegovina	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
The 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
Czech Republic	0	569	0	0	0	0	0	0	0	0	0	0	0	0	0	0	569
Denmark	0	0	0	0	0	0	0	0	0	0	0	0	411	0	0	0	411
Estonia	0	0	0	0	0	0	0	437	0	0	0	0	0	0	0	0	437
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
Greece	0	0	0	0	419	0	0	0	0	0	0	0	0	0	0	0	419
Hungary	0	561	0	0	0	0	0	0	0	0	0	0	0	0	0	0	561
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
Liechtenstein	0	0	0	496	0	0	0	0	0	0	0	0	0	0	0	0	496
Macedonia	0	407	0	0	433	0	0	0	0	0	0	0	0	0	0	0	411
Morocco	0	0	438	0	0	0	0	0	0	0	0	0	0	0	0	0	438
The 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
The Philippines	512	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	512
Poland	0	523	439	0	497	0	0	0	0	0	0	0	0	0	0	0	473
Portugal	0	0	0	454	0	0	0	0	445	420	0	0	0	0	0	0	428
Romania	0	439	0	0	0	0	0	0	0	0	0	0	0	0	0	0	439
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 Montenegro	0	426	0	427	414	0	0	0	417	0	0	0	0	0	0	0	467
Slovakia	0	507	0	0	0	0	0	0	0	0	0	0	0	0	0	0	507
Slovenia	0	416	0	0	435	0	0	0	0	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	445	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: AU=Australia; AT=Austria; BE=Belgium; CH=Switzerland; DE=Germany; DK=Denmark; EL=Greece; FI=Finland; LI=Liechtenstein; LU=Luxembourg; LV=Latvia; NL=the Netherlands; NO=Norway; NZ=New Zealand; PT=Portugal; SC=Scotland.
Source: PISA 2006.

Independent variables at the individual-, origin-, and destination-level

Educational system features of countries of destination

Quality of educational resources is an index composed by PISA that indicates to what extent instruction at a 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 *degree of teacher shortage* is an index provided by PISA 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. Positive values refer to higher teacher shortages.

A nationally standardized exam 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).

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 school-types pupils can choose between, and the presence of more hidden types of ability grouping. 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

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 *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.

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.

Social, cultural and economic macro-characteristics

At the destination level, a dummy was created to distinguish the *traditional immigration countries* Australia and New Zealand that have received large inflows of immigration from the 19th century onwards, from the European destination countries where immigration became important after World War II (Bauer et al, 2000).

A more direct measure of destination countries' immigrant policies is *the Migrant Integration Policy Index (MIPEX)*, which displays on a scale from 0 to 100 to what degree a country's immigrant policies foster integration.

At the origin level, a country's level of economic development was approached by its *Human Development Index (HDI)*. 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.

Origin countries' political situation is measured with the *Kaufmann's indicator for political stability*. Ranging from -2.5 to 2.5 (standardized scores), the Kaufmann's indicator assesses the probability that an origin country's government in function will be overthrown in the near future by unconstitutional or violent means (Kaufmann, Kraay, and Mastruzzi, 2006). Higher scores refer to less chance of violence and therefore higher levels of political stability.

To take into account *origin countries' religious backgrounds*, dummy variables were created to indicate whether or not at least fifty percent of the countries' inhabitants are Catholic, Protestant, Christian (others), Eastern Orthodox, non-religious, Eastern religious, Islamic. The first five categories are reference and Islam and Eastern Religion are included as dummy variables.

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 2: Descriptive statistics of the variables in the analysis (N=9.279)

	Average	**Standard deviation**
Dependent variable		
Science score	468.63	103.20
Educational characteristics op destination level		
Average Science score natives	523.08	12.68
Resources		
Quality of Resources	0.29	0.29
Teacher shortage	0.24	0.43
Student-Staff ratio	13.64	2.59
Standardization		
Standardized exams	0.57	0.50
Differentiation		
Strongly differentiated system	0.31	0.46
Moderately differentiated system	0.25	0.47
Hardly differentiated system (ref.)	0.44	0.48
Educational characteristics op origin level		
Resources		
EDI-score	0.94	0.05
Student-Staff ratio	19.70	7.41

Standardization		
Number of years compulsory education	9.76	1.55
Other Societal characteristics		
Integration promoting policies (destination level)	53.46	9.37
Traditional immigration societies (destination level)	0.22	0.42
Economic development(origin level)	.85	0.10
Political stability (origin level)	0.04	0.74
Eastern religion (origin level)	0,05	0.23
Islam (origin level)	0.23	0.42
Individual variables		
Vocational stream	0.16	0.37
Grade	0.04	0.64
Female	0.50	0.50
Educational level parents	3.92	1.85
Occupational status parents	44.55	16.87
Resources at home	-0.11	0.87
Immigrant characteristics		
2e generation (ref.)	0.51	0.50
1.75 generation	0.24	0.43
1.5 generation	0.16	0.36
1.25 generation	0.06	0.23
Generation unknown	0.04	0.19
One native parent	0.06	0.23
Home language official language of destination country	0.50	0.50
Home language unknown	0.11	0.31

Source: PISA 2006, own computations

Results

Multilevel Analysis

To analyze data in a double comparative design, multilevel techniques have to be used. By using individual-level techniques (such as OLS regression) on data with multiple levels, standard errors of the macro-level effects will be underestimated and consequently, parameters may unjustly appear to be significant (Raudenbush and Bryk, 2002; Snijders and Bosker, 1999). To analyze non-hierarchically structured data, cross-classified multilevel regression analyses are appropriate.

Results of individual characteristics

In model 1 of table 3 we include in the first step a number of individual characteristics. Generally speaking, the outcomes are in line with previous research on educational achievement of pupils with an immigrant background. Parental education (b=4.94**), parental occupational status (b=0.89**) and the resources at home (b=9.47**) have a strong positive effect on the science scores. This strong influence of parental class on educational achievement is elaborately studied for native pupils in many western societies (for instance Shavit en Blossfeld, 1993, and more recently, Breen, Luijkx, Muller en Polak, 2009). Moreover, speaking the language of the country of destination at home has also a positive effect on achievement (b=16.66**). The significant effect of attending vocational education is remarkable. Children of immigrants who attend a vocational training or school score on average 57 point lower on the science test than comparable children of immigrants who attend general education. This can perhaps be explained by the curriculum differences between vocational and general education. The results also underline the importance of the age of child while migrating. Second and 1.75 generation children of immigrants have the highest sciences scores, the 1.5 generation scores 7 point less and the 1.25 generation 31 points lower. This suggests that the earlier children of immigrants arrive in the countries of destination and thus have spend more time in the education of the country of destination, the better are their educational achievement.

In an “empty” model the vast majority of the variance in educational achievement can be found at the individual level (74%), while there is 19% at the destination level and 7% at the destination level. By the addition of the individual characteristics and the average sciences score of the natives in model 1, the variance on the destination level falls with 33% and that on the origin level with 62%. This shows that an important part of the differences in science achievement between pupils with an immigrant background originating from very different

countries of origin and living in various countries of destination can be explained by differences in individual characteristics.

Table 3. Multilevel regression analysis of educational characteristics en other societal characteristics of origin en destination countries on de Science scores van 15 years-old children of immigrants; N_d=16, N_o=35, N_i=9.279

	Model 1	Model 2	Model 3	Model 4	Model 5
Intercept	462.62**	483.79**	373.36**	389.99**	409.70**
	(7.62)	(9.13)	(38.17)	(34.92)	(35.40)
Educational characteristics destination					
Average Science score natives		0.77**		0.33	0.27
		(0.31)		(0.26)	(0.26)
Teacher shortage		-33.95**		-33.84**	-35.29**
		(12.39)		(7.77)	(7.81)
Strongly differentiated system		-39.13**		-11.29	-9.68
		(13.12)		(10.46)	(10.50)
Moderately differentiated system		0.41		13.67	15.26**
		(13.60)		(11.09)	(11.14)
Strongly differentiated system * occupational status parents					-0.45**
					(0.13)
Moderately differentiated system * occupational status parents					-0.58**
					(0.15)
Educational characteristics origin					
Years of compulsory education		8.45**		6.71**	4.61**
		(1.84)		(2.01)	(2.10)
Years of compulsory education* 1.75 generation					2.91*
					(1.41)
Years of compulsory education* 1.5 generation					3.48**
					(1.50)
Years of compulsory education* 1.25 generation					12.94**
					(2.18)
Other societal characteristics destination					
Integration promoting policies			0.37	0.08	0.13
			(0.37)	(0.36)	(0.36)
Traditional immigration countries			29.64**	35.10**	33.85**
			(11.07)	(10.65)	(10.72)
Other Societal characteristics origin					
Economic development			80.33**	6.60	2.88
			(35.74)	(38.36)	(38.61)
Political stability			-1.73	0.42	0.11
			(4.88)	(4.39)	(4.43)
Eastern religion			36.68**	37.68**	36.37**
			(13.45)	(11.97)	(12.02)
Islam			-25.23**	-22.93**	-27.88**
			(9.03)	(7.81)	(7.82)
Islam * occupational status parents					-0.55**
					(0.14)
Individual characteristics					
Grade	47.54**	47.53**	47.43**	47.56**	47.70**
	(1.41)	(1.41)	(1.41)	(1.41)	(1.41)
Vocational stream	-56.50**	-56.58**	-55.88**	-55.86**	-57.43**
	(2.73)	(2.72)	(2.71)	(2.69)	(2.69)
Female	-7.92**	-7.90**	-7.95**	-7.97**	-8.07**
	(1.62)	(1.62)	(1.62)	(1.62)	(1.62)
Educational level parents	4.94**	4.92**	4.95**	4.97**	5.20**
	(0.56)	(0.56)	(0.56)	(0.56)	(0.56)
Occupational status parents	0.89**	0.88**	0.88**	0.88**	1.31**
	(0.06)	(0.06)	(0.06)	(0.06)	(0.10)

Resources at home	9.47**	9.40**	9.34**	9.34**	8.95**
	(1.06)	(1.06)	(1.06)	(1.06)	(1.06)
1.75 generation	2.19	2.12	2.31	2.12	-26.34
	(2.28)	(2.28)	(2.27)	(2.27)	(13.77)
1.5 generation	-7.05**	-7.22**	-7.14**	-7.40**	-41.57**
	(2.58)	(2.58)	(2.58)	(2.58)	(15.06)
1.25 generation	-30.93**	-30.94**	-31.09**	-31.12**	-161.85**
	(3.83)	(3.83)	(3.83)	(3.83)	(22.38)
Generation unknown	-19.96**	-20.19**	-20.10**	-20.31**	-18.93**
	(4.36)	(4.36)	(4.36)	(4.35)	(4.36)
One native parent	5.69	4.96	5.42	5.23	5.17
	(3.84)	(3.84)	(3.84)	(3.84)	(3.89)
Home language national language destination country	16.66**	15.83**	16.49**	15.69**	15.14**
	(2.29)	(2.30)	(2.28)	(2.29)	(2.29)
Home language unknown	-22.95**	-23.20**	-23.01**	-23.25**	-23.76**
	(2.87)	(2.87)	(2.87)	(2.87)	(2.86)
Variances components[a]					
Destination	511 (33)	201 (74)	95 (88)	00 (00)	00 (00)
Origin	771 (62)	549 (73)	535 (117)	402 (83)	408 (84)
Individual	5996 (32)	5996 (37)	5995 (88)	5996 (88)	5943 (88)
Deviance (IGLS; -2*LL)	107244	107216	107209	107185	107093

Source: PISA 2006, own computations. Standard deviations between parentheses; ** = significant on 0.05 level. [a] Between parentheses the explained variance (in %) at respectively destination, origin and individual level, relative to an empty model. The explained variance at the individual level computed as the change in the total variance Snijders en Bosker (1999.

Results of educational systems

In Model 2 of table 3 we have added all significant characteristics of the educational systems of destination and origin countries to model 1. The degree of differentiation of an educational system seems to have the expected effect on the science achievement; children of immigrants who live in countries with a strongly differentiated system score lower than comparable children of immigrants living in countries with a moderate or comprehensive system (b=-39.13**, model 2). However, after inclusion of the other macro-characteristics in model 4, this negative effect is not longer significant (b=-11.29, model 4). Our results suggest that children of immigrants in countries with strongly differentiated educational systems do not perform worse because of the high level of differentiation, but because these countries have a shorter immigration history than countries with a moderately differentiated educational system. Model 5 in table 3 shows however an interesting interaction. The effect of parental occupational status on the educational achievement of children is dependent of the level of differentiation within the educational system. It is remarkable that the effect of parental occupational status on the educational achievement of children is largest in destination countries with the lowest level of differentiation. This result contradicts theories and results

about the effects of differentiation within educational systems on the inequality in educational achievements of native pupils from different parental backgrounds (see for instance Dupriez et al., 2008; Duru-Bellat & Suchaut, 2005; Pfeffer, 2008; Schütz, Ursprung and Wössmann, 2005). We find that especially children of immigrants with a high occupational status perform well in educational systems with low levels of differentiation. Thus, irrespective of the parental occupational status, children of immigrants perform worse in strongly differentiated educational systems. Hypothesis 1 is therefore partly confirmed.

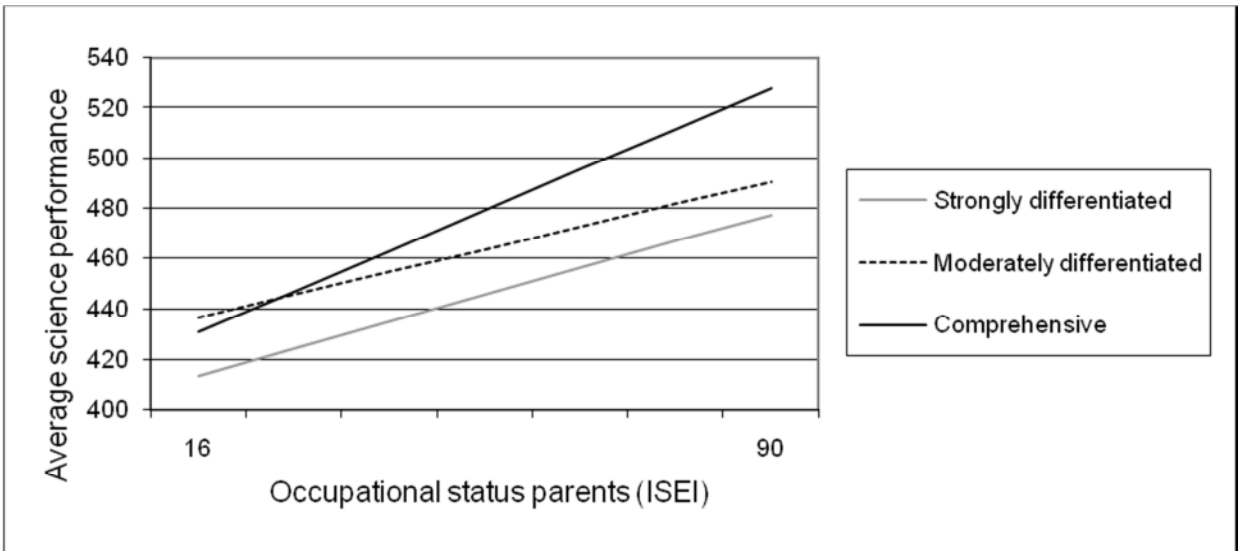

Figure 1. The average science score of children with an immigrant background in relation to the occupational and the level of differentiation of the educational system of the destination country (based on model 5, table 3).

The degree of standardization of education in the countries of destination does not affect the achievements of children of immigrants. Those pupils, who live in countries with standardized science examination at the end of secondary education, do not outperform comparable children of immigrants, living in countries of destination where no standardized science examination exists. Hypothesis 2A has to be rejected. However, the degree of standardization in the countries of origin is of importance. Because reliable information on the existence of standardized science examination is not available for a large number of origin

countries, we used the years of compulsory education as an indicator of standardization. As expected in hypothesis 2B, children with an immigrant background who originate from countries with a longer period of compulsory education perform better (b=8.45**). This effect remains strong and significant after controlling for the other macro-characteristics (b=6.71**, model 4), and therefore does not merely reflect the economic development of the countries of origin. Remarkable is the interaction effect between years of compulsory education and generation. As expected is the effect of years of compulsory education strongest for the 1.5 and 1.25 generation. Figure 2 pictures the results graphically. The difference in science score between second generation pupils with an immigrant background originating from countries with 5 or 13 years of compulsory education is 37 points, while it is 60 points for the 1.75 generation, 65 for the 1.5 generation and 140 for the 1.25 generation.

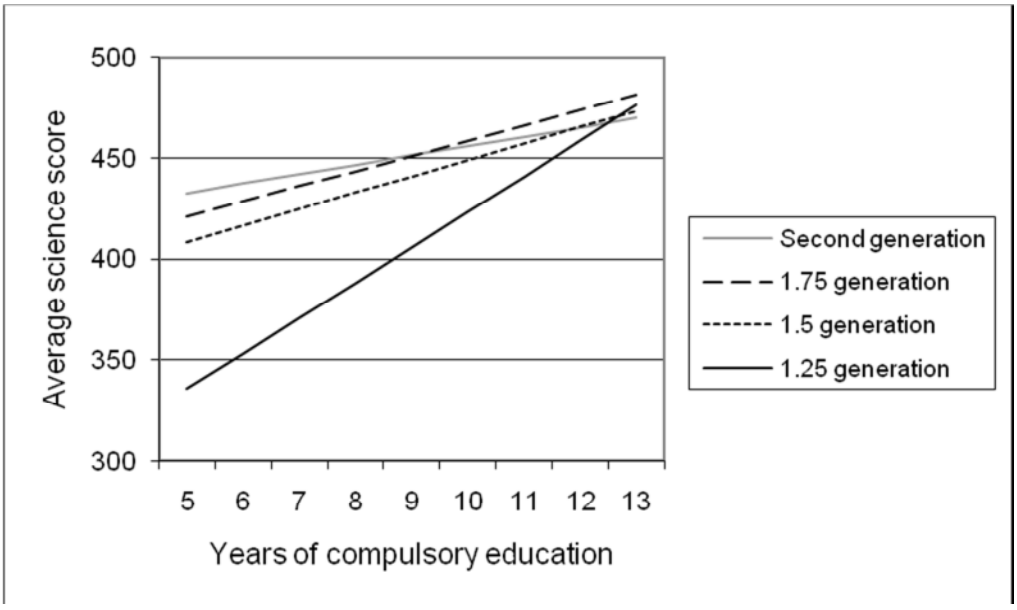

Figure 2. The average science score of children with an immigrant background in relation to per generation and the length of the period of compulsory education in the country of origin (based on model 5, table 3)

Resources available for education in destination countries seems to affect science scores. A shortage of teachers has a strong negative effect (b=-33.95**, model 2), also after controlling for other macro-characteristics (b=-33.84**, model 4). The quality of the material

resources (for instance teaching material) and the student-staff ratio has no significant effect on achievement. Hypothesis 3A is thus partly confirmed. The resources of the education in the countries of origin have no effect on the sciences scores. Hypothesis 3B has to be rejected.

Results of general macro-characteristics

Model 3 of table 3 adds the other macro-characteristics of the destination and origin countries to model 1, the model with only individual characteristics. In contrast with hypothesis 4, policies of destination countries aimed at a better inclusion of immigrants in their society (as measured by MIPEX) have no effect on the science score of pupils with an immigrant background. Hypothesis 4 must be rejected. However, the immigration history of destination countries has an important effect. Children of immigrants who live in destination countries with only substantive immigration after the Second World War score on average 34 points lower on the science test than children in destination countries with a longer immigration history. Our results confirm those of Levels et al. (2008). This positive effect of living in a traditional immigration society remains significant after the addition of educational systems' characteristics (model 4). Hypothesis 5 is therefore confirmed.

On first sight the economic development of the origin countries seems to have a positive effect on the science scores of the children of immigrants (b=80.33**, model 3). After the addition of the characteristics of the educational systems, this effect is however no longer significant (b=6.60, model 4). What in first view seemed to be an effect of economic development is in reality an effect of the length of compulsory education. Economically more developed countries have on average a longer period of compulsory education, which has a positive effect on the educational achievement of especially the 1.5 and the 1.25 generation. Hypothesis 6 has to be rejected. Because they did not take into account the characteristics of the educational systems of origin and destination countries, Levels et al. (2008) wrongly observe a significant effect of the economic development of the origin countries, which we

show now, is spurious. In contrast with Levels et al. (2008) we find no positive effect of the political stability of the origin countries. Hypothesis 7 has to be rejected as well. However, the dominant religion in the origin countries has a strong effect on science score. Children with an immigrant background originating from countries with a dominant Eastern religion (Hinduism; Buddhism) score higher than comparable children with an immigrant background originating from countries with a dominant Christian religion or without a dominant religion (b=36.68**, model 3). However, children with an immigrant background originating from countries with a dominant Islamic religion score lower (b=-25.23**, model 3). The effects of religion remain significant and strong after controlling for characteristics of the educational systems. Hypothesis 8 is therefore only partly confirmed. It seems to be that not originating from a country without a dominant Christian religion is problematic, but the actual nature of the religion seems to be of key importance. Remarkable is the relative smaller effect of parental occupational status for children of immigrants originating from Islamic countries (see figure 3). It's especially the children of immigrants with higher occupational status originating from Islamic countries who perform relatively less than comparable children of immigrants with comparable occupational status from non-Islamic countries

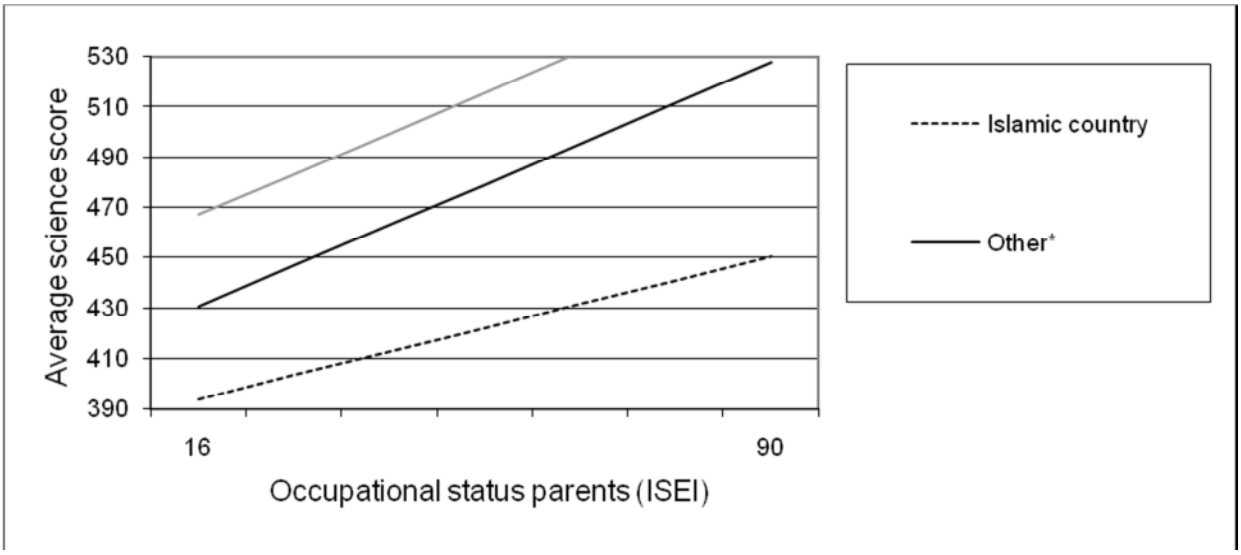

Figure 3. The average science score of children with an immigrant background in relation to the occupational status of their parents and the dominant religion in their country of origin (based on model 5, table 3).
**** Other = Catholic/Protestant/Other Christian/Eastern orthodox/no religion***

Conclusion and discussion

The focus of this chapter is the relationship between macro-characteristics of educational systems and societies of the countries of origin and destination and the achievement in solving science related problems by 15-year old children of immigrants. Given the literature, we assumed that educational systems differ in their degree of differentiation, standardization and availability of resources and that these differences affect the educational achievement of pupils with an immigrant background. Additionally, we have taken into account those political, economic, and religious macro-characteristics of the countries of origin and destination, which were already analyzed by Levels et al. (2008) and earlier studies. We used the PISA 2006 data and analyzed the science score of 9,279 pupils with an immigrant background who live in 16 OECD countries of destination and originate from 35 different countries. Since earlier studies have frequently pointed to the importance of individual background characteristics on educational achievement, we have included those as well in order not to misestimate the possible effects of the macro-characteristics.

Children with an immigrant background underachieve in destination countries with a larger shortage of teachers, independent of the general quality of the education in their destination country. Such a shortage has a negative effect on the quality of teaching, because it increases the chances a student drops out or the use of unqualified personnel. Children with an immigrant background are especially dependent on the quality of the teaching, because their parents overall possess fewer social and economic resources and are less proficient in the language of the country of destination. A shortage of teachers therefore diminishes immigrant children's opportunities to use education as a mobility channel.

Theory and empirical results have often emphasized that a high level of educational differentiation has a negative effect on the educational achievement of native-born lower class pupils. The mechanism which can explain these findings is that a choice between various school types at a relatively young age increases the odds that pupils from lower classes will choose lower school types more often (either because of the limited perspective of their parents or because of the class-bias selection procedures, also after controlling for actual scholastic achievements). A lower level of differentiation of educational systems can improve the educational opportunities of the average lower class pupil. If we apply this line of reasoning to pupils with an immigrant background, one would expect that they would also benefit from a lower level of differentiation. Therefore, it is remarkable that our results show that children of immigrants with a low occupational status do not profit from such a low level of differentiation. In other words: the level of differentiation of educational systems has hardly any effect on the educational achievements of children of immigrants with the lowest occupational status. Further research is necessary to find out why educational differentiation has different effects on native pupils and on those with an immigrant background. There seem to be different mechanisms for native children from the lowest occupational classes and children of immigrants with the lowest occupational background. Part of the explanation of

these different mechanisms might be the negative selectivity of native parents with low occupational status and the positive selectivity of immigrants.

The positive effect of living in a traditional immigrant society as reported by Levels et al. (2008) is also found by us. As a result of their long tradition of immigration and the absence of a substantial indigenous population, those countries are better prepared for the integration of new immigrants. Their selective immigration policies better match the supply and demand on the labor market and immigrants who are allowed to enter these countries have on average better chances. This translates into higher educational achievement of their children.

The length of compulsory education in the countries of origin has an important positive effect on the sciences scores of the children of immigrants. The longer this period of compulsory education in the countries of origin, the better the children of immigrants from these countries perform in their countries of destination. This effect of compulsory education is not merely a reflection of the economic development of the origin countries, although higher economically developed countries have a longer period of compulsory education. This period might be a valid indicator of the quality of education of the country of origin, but further research is necessary. The positive effect of compulsory education is strongest for the 1.25 and 1.5 generation, but it is also significant for the 1.75 generation and the second generation. This latter point is remarkable because these second generation children have not attended education in their origin countries. The finding might be explained by the quality of the education attended by their parents in the country of origin (but not the formal educational level because we control for that). The mechanism might be that the longer the period of compulsory education, the higher the general quality of that education. Although we control for the formal educational level of the parents, the quality of education in the various countries of origin differs so much, that the length of compulsory education is still significant.

Next to the effect of compulsory education, the dominant religion of the countries of origin also has an important effect on educational achievement. Immigrant children originating from countries with a dominant Eastern religion (Hinduism; Buddhism) perform better than comparable immigrant children originating from countries with a dominant Christian religion or without a dominant religion, while immigrant children originating from Islamic countries perform worse. Various explanations can be given for these results (for instance a higher level of discrimination of pupils originating from Islamic countries; Islamic values and norms, such as honor or gender-relations, which are less suited in modern societies), but unfortunately the PISA data do not provide a measurement of individual religion. Using *European social Survey* data, Dronkers & Fleischmann (2010) show that second generation male adherents of the Islam achieve lower educational levels compared to comparable second generation males who adhere to other relgions or no religion. They also demonstrate that individual religion is more important important than the dominant religion in the country of origin. Further research and data collection is necessary to properly address this issue.

In contrast to Levels et al. (2008) we do not find significant effects of the economic development and the political stability of the origin countries. An explanation might be that Levels et al. did not take the dominant religion of the countries of origin into account.

This chapter has shown that differences in science scores of 15-year old children with an immigrant background can not only and fully be explained by differences in their individual characteristics. Macro-characteristics of the countries of destination and origin are also of importance. Levels et al. (2008) showed this already by including the economic and political characteristics of the origin and destination countries, but they neglected the characteristics of the educational systems. As a consequence of this neglect they overestimate the effect of economic development of the countries of origin, which happens to be spurious after taking into account the characteristics of the educational systems.

We also show that both the individual and macro-characteristics influence educational achievement of children of immigrants. This poses a challenge for further research: the collection of more direct measures of the relevant characteristics and processes. Especially for the heterogeneous group of origin countries this will be an important challenge. For instance, if the length of compulsory education indeed reflects the quality of education, how can we measure this quality and which are the most relevant aspects? Moreover, it is of great importance to have a more robust test of our hypotheses. Doing so requires the inclusion of more destination countries, both inside and outside of Europe. Important countries to take into account would for instance be Canada, England, France and the USA. Only 16 of the OECD countries participating in PISA 2006 have asked sufficiently detailed information about the country of birth of pupils and parents and few additional countries have done that in PISA 2009. This is not only a drawback for the scientific study of the educational achievement of children of immigrants, but it is also socially and politically irresponsible to deny or ignore the importance of the macro-characteristics of origin and destination countries (see for instance EU Commission (2008))

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