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Alison Cathles, Dongshu Ou, Simone Sasso, Mary Setrana, Tom van Veen

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Poschingerstr. 5, 81679 Munich, Germany
Telephone +49 (0)89 2180-2740, Telefax +49 (0)89 2180-17845, email office@cesifo.de
Editors: Clemens Fuest, Oliver Falck, Jasmin Gröschl
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Where Do You Come from, where Do You Go? Assessing Skills Gaps and Labour Market Outcomes of Young Adults with Different Immigration Backgrounds.

Abstract

This paper analyzes numeracy and literacy skills of migrants, using PISA and PIAAC data from twelve OECD countries. Our results first show some convergence of the skills gap between the second generation immigrants and the natives over time. Second, the gap in literacy skills among the first-generation and natives and among first-generation and second-generation immigrants has increased over time. Third, demographics and family background contribute to the achievement gaps between different groups. Fourth, school input variables do contribute to skills gaps of young adults with different immigrant backgrounds. Fifth, an immigrant background does not appear to affect the chances of studying in a STEM field.

JEL-Codes: I240, I250.

Alison Cathles
UNU/MERIT Maastricht University
The Netherlands - 6211 AX Maastricht
cathles@merit.unu.edu

Dongshu Ou
Faculty of Education
Chinese University of Hong Kong
Shatin / NT / Hong Kong
dongshu@cuhk.edu.hk

Simone Sasso
UNU/MERIT Maastricht University
The Netherlands - 6211 AX Maastricht
sasso@merit.unu.edu

Mary Setrana
Center for Migration Studies
University of Ghana
Legon / Accra / Ghana
mobkjowat@yahoo.com

Tom van Veen
School of Business and Economics
Maastricht University
The Netherlands - 6211 LM Maastricht
t.vanveen@maastrichtuniversity.nl

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1. Introduction

Economic and social integration of immigrants and their children is an issue that has gained traction in European policy agendas and piqued the interest of scholars and society. This is partly because of real or perceived tensions in the dynamics of the pool of resources available to labour markets, which can imply either a crucial opportunity or a challenge for countries that face high or increasing levels of immigration. Whereas some policy makers and international organizations have expressed concerns about challenges associated with changing demographics and skill-profiles (Bakewell, 2012; De Haas, 2010), existing literature has stressed the importance of immigrants as a knowledge transmission channel[2] and the potential role that they can play to foster innovation, productivity and growth rates in destination countries. Many researchers and policy makers are focusing on how to benefit from immigration through transnational integration policies. Until recently, migration management was more geared towards restricting immigrant movement. Nonetheless, especially with the emerging phenomenon of second and third generation immigrants, European governments are restructuring their policies to focus on how immigrants and their children could better integrate for the benefit of their host countries with ripple effects on the home countries (Dustmann et al., 2012).

Young people with immigrant backgrounds are often used as the benchmark for the degree of immigrant integration in a country, and their educational and economic achievement can be seen as an indicator of how well immigrants and their decedents are positioned to take and share advantage of opportunities presented by a more mobile global society (OECD/EU, 2015). Large and persistent or growing achievement gaps between young people with and without immigrant backgrounds can indicate ineffective institutions in the host country to reduce inequalities. Governments tend to rely on education and the school system as an equalizer for young people from all kinds of different backgrounds. A recent IMF policy note argues that access to education is crucial to benefit from international labour mobility; more specifically, "school systems with well-developed pre-schools, lower school segregation, and limited early tracking of students have been found to be more suitable to the educational success of immigrants' children" (Aiyar, 2016, p.34).

While family background has long been established as a key determinant of educational attainment and achievement, the contribution of school quality as a vital element of schooling inputs has recently been highlighted as a policy relevant determinant of educational attainment and cognitive skills (García et al., 2016; Woessmann, 2016; Hanushek and Zhang, 2009). The lifecycle framework underscores the foundational early years, because as Cunha et al., (2006) put it simply: skill-begets-skill. The effects of key determinants, however, may not be the same at each stage of the lifecycle. The effect of family background, for example, on the probability to continue education weakens at higher grade levels (Cameron and Heckman, 1998). There are several inflection points along the educational lifecycle at

[2] Skilled mobile individuals bring with them knowledge, expertise, and know-how from a certain geographical context that, - when coupled with new knowledge in their country of destination – means these individuals can be strategic "knowledge spillovers agents" (Trippl and Maier, 2011) who promote new combinations of scientific, technical, and managerial knowledge that ultimately leads to innovation.

which young people (and their caretakers) must make decisions about whether or not to continue further in education. One such inflection point is around the age of 15[3] and skills disparities at this age can have a long lasting influence on life outcomes (Borgonovi et al., 2017). Although there is plenty of speculative debate about educational and economic outcomes of young people with immigrant backgrounds, all too often this debate hinges on preconceived notions, rather than credible facts (OECD/EU, 2015).

This paper adds three contributions to the literature. First, we apply an empirical framework that includes demographic, family background, and school quality variables to establish an evidence-based understanding of the extent to which cognitive skills of young people with immigrant backgrounds can be explained by the foreign origin of their parents. Second, using the Oaxaca decomposition technique, we empirically explore how the contributions of these factors evolve over time. We use data from the Programme for International Student Assessment (PISA) and the Programme for International Assessment of Adult Competencies (PIAAC). Throughout our analysis, we look for country group patterns using a classification from the OECD/EU to try to identify countries in which policies or institutional arrangements may contribute to narrowing the gaps. Finally, we use the PIAAC dataset to analyze educational attainment, employment and skills match, and whether the area of study and occupation are in Science, Technology, Engineering, or Math (STEM) fields. The argument is that 1st generation immigrants are more likely to pursue STEM fields because of disadvantages in language skills. We find that the skills young adults possess are more important for labor market outcomes than their immigrant background status. This finding underscores the necessity of closing skills gaps through education. Skills gaps that persist into adulthood have economic consequences for individuals and society. The extent to which schools actually act as equalizers has long lasting consequences.

2. Comparing Achievement of Young people with and without Immigrant Backgrounds: literature review

Family Background and skill acquisition

There is quite some evidence that family background is an important determinant of school attainment. Research using cross-national data from the 2000, 2003, and 2009 PISA assessments on 15 year old pupils identify immigrant achievement gaps in literacy and numeracy ranging between 30 and 80 points relative to an OECD average of 500 points (Azzolini, Schnell & Palmer 2012; Levels, Dronkers & Kraaykamp 2008; Marks 2005; Sori, Susteric & Gaber 2011). The achievement gap with native students is more sizable for first generation immigrants (Azzolini et al. 2012; Portes & Fernandez-Kelly 2008). The results also indicate that first generation immigrants who arrive later in their school career (i.e., arriving at secondary school age compared to arriving at elementary school age) are at a disadvantage in comparison to those that have arrived at a younger age (Smith, Brezicha, & Persson, 2014). In these

[3] In many countries, 15 or 16 is the age at which school is no longer compulsory.

studies, the primary determinants of the immigrant achievement gap are family background variables, including socio-economic status, home language[4], parental education, and family structure.

In a comparative study among ten OECD countries with high immigration flows, Schnepf (2007) found that socio-economic background and school segregation explained the low educational achievement of immigrant groups in continental Europe, whereas in the US and the UK, language skills were the main factor explaining why achievement scores of immigrants were lower than of the natives. In an earlier study Marks (2005), from a comparative study of twenty countries, also concluded that immigrant students' performance was dependent on socio-economic factors, while socio-cultural and school factors played just a minor role.

Flisi et al. (2016) use PISA and PIAAC data to assess skills differences of 15 year old pupils and young adults in comparison to native pupils and young adults. They conclude that parental education characteristics and socio-economic index of occupational status (ISEI) impacts the performance of different immigrant groups along a variety of education indicators (achievement tests / cognitive skills scores, drop-out rates, tertiary attainment and employment upon graduation). Systematically across the EU, second generation immigrants come from more socio-economically disadvantaged backgrounds than their native peer group. In a sub-sample of their analysis, they divided first generation immigrants into two groups by the threshold 'arrival age of 15' and found empirical evidence that first generation immigrants who arrived before the age of 15 performed better than those who arrived after the age of 15. Gaps in performance for both first and second generation immigrants persisted even after they controlled for socio-economic family background characteristics. One of their main conclusions is that education systems are an essential part of the integration process. They do not explore school quality in their analysis, but they note differences among country groups suggesting further research is needed to better understand heterogeneity in different EU countries.

In other studies (EC, 2016), PIAAC and PISA are used to investigate the relation between socio-economic factors such as parent's education, occupation, age, gender, and income levels, and labor market outcomes such as employment status, terms of job contract. Second, they further measure cognitive and non–cognitive skills with respect to labor market outcomes. In these studies, it is acknowledged that basic skills are important for young people to access the labor market and for adults to retain employment in high quality and stable jobs. These studies conclude that socio-economic background remains one of the main determinants of skills acquisition in schools (Krassel and Sorensen, 2015). However, young people in initial education according to PISA and working-age adults according to PIAAC are lacking these basic skills which impede their capacity to find stable employment and participate in economic and social life.

[4] For example, Zinovyeva, Felgueroso and Vazquez (2014) investigate the role of language in educational achievement of students who migrate to Spain using PISA 2003-2009 finding initial gaps that improve as they continue to live in Spain. Admittedly, immigrants who had Spanish as their prior language should have an advantage over those who do not have any initial skills in the language at all (Portes, Aparicio, Haller, and Vickstrom 2010). Although Latin Americans enjoy this privilege when they migrate to Spain, Azzolini et al (2012) argue that they only benefit linguistically, while they have lower achievement in other areas.

Duong et. al. (2016) conduct a meta-analysis on the literature that empirically investigates the academic outcomes among immigrants' youths. The studies that they take into account are limited to studies about US immigrants. They reach two interesting conclusions. First, while the second generation immigrants perform better than the first generation immigrants, the third generation immigrants performs worse than the second generation immigrants. Second, school performance of immigrants differs significantly between groups of immigrants. Asian immigrants perform in general better than black immigrants. This might be related to the difference in social economic background and implicitly, school quality as the funding of schools in the US differs between rich and poor areas.

It is an empirical regularity that family background plays a major role in skills accumulation. The challenge is that family background variables leave less room for policy intervention than variables related to school quality. School quality inputs are more easily modified by policy makers. The question is, to what extent does school quality affect skills acquisition?

School Quality and skill acquisition

School quality has a relationship with labour market performance in different ways. School quality influences the amount of education an individual can obtain and determines an immigrants' ability to find and maintain a job. Despite the logic and clear rationale for school quality as an important determinant of skills acquisition, empirical studies have not arrived at the same kinds of consistency of results as have been established by family background. This does not mean an absence of a relationship between school quality and skills production. For example, Bernal (2016) traces the crucial role of school quality on skill production by estimating the test scores of students and comparing school quality data for public and private schools[5], Kim (2011) concludes that school quality variables such as teacher quality and the number of math courses taken, determine a student's future income. The results however, tend to differ between studies and there is not yet as much literature on school quality.

Under the umbrella of school quality, there are a number of variables (i.e., quality of teacher education, school autonomy and school accountability) that explain variability in achievement assessments to a greater or lesser extent. Note however, that although they influence immigrants' educational outcomes, in general school quality variables are difficult to measure. Many scholars use an education (or cognitive skill) production function to explain skills acquisition. However, this method neglects school quality and many scholars claim this to be out of date (Hanushek and Zang, 2009; Hanushek et al., 2016, Pritchett and Viarengo, 2015) arguing that recent empirical results make a *'prima facie case for the relevance of school systems'* (Woessmann, 2016, pp. 15).

In a cross-section analysis using PISA data, Cobb-Clark et al. (2012) find a significant relationship between school quality variables (such as the percentage of private schools, quality of teacher education, and ability tracking) and migrant-native achievement gaps. However, other school quality

[5] Kim (2011) compares the school quality of catholic schools which in this case represent a private school and public schools. Kim uses data from the Wisconsin Longitudinal Study.

variables did not have a significant relationship with the achievement gap. Sometimes, interaction terms between school quality variables help to draw a more complete picture. For example, Woessmann (2016) finds that some school autonomy variables are negatively correlated to the achievement gap, but the interaction between external exit exams and these autonomy variables result in strong positive correlation.

The quality of the school system may also have an indirect long-term effect, to the extent that it influences parental education attainment (McEwan and Marshall, 2004) an element of family background that is consistently linked with children's educational attainment. Lack of educational resources for the immigrant parents results in low performance of second generation immigrants comparing them to their native counterparts (Schnell and Azzolini 2015). Immigrant parents are found at the periphery of the labour market engaged in menial jobs even when they have been highly educated. Their incomes are low and this also determines the educational resources they can afford at home. The ability of the immigrant parent to speak at home the language the immigrant child learnt in school, also determines the reading scores of immigrant children.

Country groups and skills acquisition

Depending on the objective of the study, European countries have been categorized into north-west European countries (Heath, Rothon and Kilpi, 2008); Continental Europe versus English Speaking countries (Schnepf, 2007); Southern European countries (Levels et. al. 2008) and new immigration/destination countries (Azzolini, Schnell and Palmer, 2012). These studies show that immigration laws and integration policies are key factors in the educational achievement of immigrants. Countries with strict immigration regimes have less complex conditions for integrating immigrants. In particular countries with guest worker agreements make sure the better qualified adults are given the permission to enter the country and they are better integrated and have better achievements (Levels, 2008).

In a further refinement, OECD and EU countries have been grouped into seven categories along criteria such as immigrant populations size, length of residence, age, educational level, language predominant entry categories, and share coming from high income countries (OECD/EU, 2015: see page 27/28 of this paper). These classifications are significant because they have impact on immigrants' integration outcomes in the host countries.

Within these groups, the size of the immigrant population does not play a significant role when it comes to immigrant integration. Among all other factors, education is an important determinant for immigrant integration into the labour market (OECD-EU, 2015). The unemployment gap between native-born and immigrants is estimated at 5 per cent in Europe showing an increase since 2007 (OECD-EU, 2015). In terms of school performers, the report shows that on average immigrant children have significantly less chances of being among the top 25 percent of performers in school than children of native-born parents who are relatively disadvantaged economically. According to this report, "It has taken 5 to 10 years for most previous generations of family migrants and refugees to be employed in Europe and as much as 15

to 20 years for them to reach a similar level of employment as natives -if ever (OECD-EU, 2015: 7,)".

3. Definitions and Data

The focus of our study is on a comparison of educational attainment and skills gaps of two groups of pupils with immigrant backgrounds (first and second generation immigrants), to natives. Second, we investigate whether differences in educational attainment change over time.

We define the groups of pupils as follows. We refer to pupils who were foreign-born and who came to the destination country before the age 15 and spent at least some time in secondary school in the destination country as first generation immigrants. Pupils who were native-born with at least one immigrant parent as second generation immigrants and native-born pupils with no immigrant parents are referred to as natives and this is our reference group. These definitions link up with Flisi et al. (2016).

We use data from the OECD's Programme for International Students Assessment (PISA) and Programme for International Assessment of Adult Competencies (PIAAC) to examine the achievement and skill gaps among natives, first-generation and second-generation immigrants. Both programmes test cognitive skills in literacy and numeracy. PISA tests people at age 15 and our PIAAC sample is restricted to young adults whose age range (typically 23-28) matches the birth-cohort of PISA test takers in 2000 or 2003. To investigate how the gaps in literacy among the three groups changed over time, we compare the reading and math test scores of 15-year-olds from PISA in the 2000 and 2003 waves with the literacy and numeracy skill scores of the adults who participated in PIAAC 2011-12 and 2014-15 who belonged to the same birth cohort as the PISA test takers.[6, 7] To make our samples as comparable as possible, our PIAAC sample only contains first generation immigrants if they migrated to the destination country before the age of 15. Second generation immigrants and natives were, by definition, educated in the destination country's school system. This means that all three groups spent at least some time in the school system of the destination country.

The connection between PISA and PIAAC tests is not a one-to-one relation. The adults that are tested by PIAAC are not necessarily the same as the pupils that were tested by PISA and this hampers the performance of a real cohort analysis. In addition, there are small differences in the set-up of the tests.

[6] PIAAC data are collected via surveys of people aged 16-65 in 33 countries. The PIAAC surveys were conducted in 2 rounds. The first round of surveys was collected in 2011 and 2012 in 24 countries. The second round was collected in 9 additional countries in 2014 and 2015. All countries in our sample, except Greece, participated in the first round of the survey. (OECD, retrieved from http://www.oecd.org/skills/piaac/publicdataandanalysis/#d.en.408927.

[7] The data did not allow us to perform a real cohort analysis, because it is not possible to identify whether adults who took the PIAAC test also took the PISA test. Therefore, we use the age group in PIAAC who could have been 15 at the time of the PISA test which means they were in roughly the same birth cohort as the 15 year old PISA test takers in 2000 and 2003. See Table 2 for more detail.

Table 1 gives an overview of the similarities and the differences between the PISA and the PIAAC tests. Gal and Tout (2014) conclude that it is possible to compare results from PISA and PIAAC tests, but comparisons must be cautious and they recommend using age cohorts of people in PIAAC who can be matched with cohorts of students who participated in earlier PISA assessment. That is exactly our approach.

Table 1 Similarities and differences between PISA and PIAAC tests.

Similarities between PISA and PIAAC	*Differences between PISA and PIAAC*
Both are designed to have large stratified random and nationally representative samples.	They use different testing methodologies in different contexts. PISA only assesses 15-year-olds enrolled in secondary school and the test is taken in a class. PIAAC assesses adults ages 16-65 in their homes. The timeframe of the PIAAC test is shorter; it is approximately 60 minutes (30 minutes for a survey about background characteristics and 30 minutes for the assessment).
Both comply with accepted standards of sampling and international tests.	The scales are different. PISA's scale is from 0 to 1,000 (or, 200-800). PIAAC's scale is from 0 to 500. The continuous scales can be standardized and therefore can be compared.
Both are designed to be internationally comparable	The PISA and PIAAC reading and numeracy scores are provided in the data as plausible values, PISA uses 5 plausible values and PIAAC uses 10 plausible values.
Both (a) directly assess cognitive skills in literacy and numeracy *and* (b) collect demographic information and other variables of interest as well.	
Testing constructs are conceptually similar. That means both assessments are based on constructs that are testing for 'real world' applications of cognitive skills.	

Source: Gal and Tout (2014)

Following the recommendations of Gal and Tout (2014), we have to 'match' the cohorts from the PISA data with the cohorts from the PIAAC data in our sample. For this, we follow the decision rules described in Table 2. For example, the PISA test given in 2000 to 15-year-old pupils, can be 'matched' with the nationally representative data from PIAAC test administered in the same country roughly 11 years later (in 2011/2012) with people who range in age from 26-28. We select three possible ages because, depending on the exact date of birth (including month) and the exact date of PIAAC assessment (including month), it is feasible that the cohort in the range of ages 26-28 corresponds with the cohort tested by PISA in 2000. A similar matching methodology for the same two datasets has

recently been used by the OECD in an analysis comparing skills of teenagers and young adults (Borgonovi et al., 2017).

Table 2 Mapping of PISA and PIAAC sample

PISA	PIAAC 2011-12	PIAAC 2014-15 (Greece only)
2000	26-28	29-31
2003	23-25	26-28

Note that Greece is the only country in our sample to implement PIAAC in 2014/2015. The other 13 countries in the sample implemented PIAAC in 2011/2012.

In total there are 106,090 15 year old students who sat for the PISA test, in our sample: 91,187 natives, 4,315 first generation immigrants and 10,588 second generation immigrants. For PIAAC, there are 7,441 adults who participated in the cognitive skills assessment in our sample: 6,778 natives, 270 first generation immigrants and 693 second generation immigrants. There are fewer observations for PIAAC, because for PIAAC, countries typically survey a representative sample of 5,000 adults. We lose many observations because we have to restrict the age range. The sample should remain representative of adults in those countries in the appropriate age-range.

Our achievement variables of interest are: cognitive skills in reading and math (PISA), cognitive skills in literacy and numeracy (PIAAC), and tertiary education attainment (PIAAC). We seek to explain whether these education outcomes differ systematically for young people with immigrant backgrounds and how any differences in cognitive skills found at age 15 have evolved as the cohort entered adulthood.

The independent variables to explain scholastic achievement and skills have to be roughly similar in the two datasets. Consequently, as an example, since PISA collects more detailed information about parental educational attainment, we had to re-scale the information to a more aggregate level to make it comparable with the PIAAC data. Second, we cannot use all the information we have. For example, PISA collects information on the Socio-economic background of the students who take the test, but we cannot compare that information with information from the PIAAC data. We present descriptive information about this variable, but we do not use it in any of our regressions.

Table 3 lists the variables that we have used in our research. For demographic variables we use gender, age (for PIAAC only) and whether the test language is the same as the language spoken most often at home.[8] To proxy family background, we chose two socio-economic variables that PISA and PIAAC do have in common, parental education and the number of books in a household[9]. The number of books in the home can be a proxy for income, or for family 'culture' towards learning. For school quality we use a number of variables from the PISA dataset. We use the percentage of government funding, shortage of language (or math) teachers, percentage of full-time certified teachers, the log of school size, and the

[8] In PIAAC, this variable is derived and coded by the OECD (PIAAC documentation files).
[9] PISA respondents were asked about the number of books in the household at age 15 and PIAAC respondents were asked about the number of books in the household at age 16 (OECD, 2016).

percentage of girls in school to capture resources and features of the schools. We also include a set of variables to assess school autonomy, which can be measured from our dataset in autonomy in hiring teachers, determining salaries, formulating the budget, and determining course content. Third, we use school accountability as another proxy for school quality. School accountability relates to accountability to inform parents of the child's progress, deciding grade retention/promotion, group students, compare the school to national performance, and judge teachers' effectiveness. All school quality variables are drawn from the PISA dataset and are observed at the school level in 2000 and 2003. For PISA, after merging the school level variables with the data for the students who took the PISA test with the appropriate weights, these can be used at the student level as any other student attribute (OECD, 2009). For PIAAC, country means for each school quality variable are calculated separately, again using the appropriate weights, and merged with the PIAAC participant data according to the mapping in Table 2.
Our employment outcomes of interest are: high-low skill employment, area of study in a STEM field, and employment in a STEM sector (PIAAC).

Since we are interested in country group patterns to identify countries in which policies or institutional arrangements may contribute to narrowing the achievement gaps, we divided the fourteen countries for which we have the common pertinent variables from PISA and PIAAC[10] into 4 country groups based on immigrant population characteristics as classified by OECD/EU, 2015. The country groupings are as follows:

1. *Long standing destinations*: United Kingdom, Belgium, France and Netherlands[11];
2. *Significant recent migration and humanitarian countries*: Demark, Finland, Sweden and Norway;
3. *New destinations*: Ireland, Greece, Italy and Spain;
4. *Eastern European destinations*: Czech Republic and Russian Federation.

The Country Classification used in this study is based on the immigrant population characteristics as proposed by the OECD/European Union classification on indicators of immigrant integration in 2015. This classification groups OECD/EU countries into peer country-groups that have immigrants with similar characteristics in terms of language, predominant entry categories, length of residence, share with education and from high/low income country of origin, and size of the immigrant population. So classified, the peer-country groups face similar integration challenges (OECD/EU, 2015).

4. Descriptive Statistics

The descriptive statistics for our variables of interest, control variables and the average scores of PISA reading test and PIAAC literacy skill test are listed in Table 3. The descriptive statistics are reported by immigrant group. For example, the mean PISA reading score for native 15 year olds in our sample is

[10] Austria, Canada, Germany, New Zealand, United States do not report information on the respondents' age in PIAAC data. Chile, Cyprus, Estonia, Israel, Lithuania, Singapore, Slovak Republic, Slovenia, and Turkey did not participate in both the PISA waves (2000 and 2003) we are analyzing in this paper. For Indonesia no PIAAC information is publicly available. Japan, Korea, and Poland do not report information on the PISA respondents' country of origin or they contain only very few individuals who are first or second generation immigrants.

[11] UK attracts mainly high-skilled immigrants, whereas the other three countries tend to attract low-skilled immigrants.

510.87 with a standard deviation of 93.63. Possible scores for PISA range from zero to 1,000. The mean PIAAC literacy score for native adults in our sample is 286.27 with a standard deviation of 44.27. Possible scores for PIAAC range from zero to 500. When appropriate, the standard deviation is reported below the mean (in parentheses). Categorical variables are presented as shares. For example, with respect to the number of books in the home for PISA test takers in our sample, 14.86 percent of natives had 10 books (or less) in their households, compared with 29 percent of 1st generation immigrants and 18.28 percent of 2nd generation immigrants. Almost half (49.35%) of natives have between 11 and 100 books at home compared with about 45 percent of 1st generation immigrants and roughly 47 percent of 2nd generation immigrants. This indicates that the natives tend to come from households with more books in the home, which might be an indication of household wealth or 'family attitude toward learning'.

Table 3 Descriptive statistics based on PISA (2000, 2003) and PIAAC (2011/12, 2014/15).

[Insert Table 3 Here]

The descriptive statistics show that the cognitive skills assessment scores differ between young people with and without immigrant backgrounds. Across the board, first generation immigrants under-perform in comparison to both second generation immigrants and natives. At first sight, it is surprising that these differences for young adults (PIAAC) appear to be stronger for numeracy scores than for literacy scores, since literacy assessments are more likely to reflect fluency in the testing language than numeracy assessments. Recall, however, the group of first generation immigrants in this study is constrained to young people who arrived before the age of 15. Therefore, learning the language of the host country may have been the first priority and might have taken time away from studying mathematics.

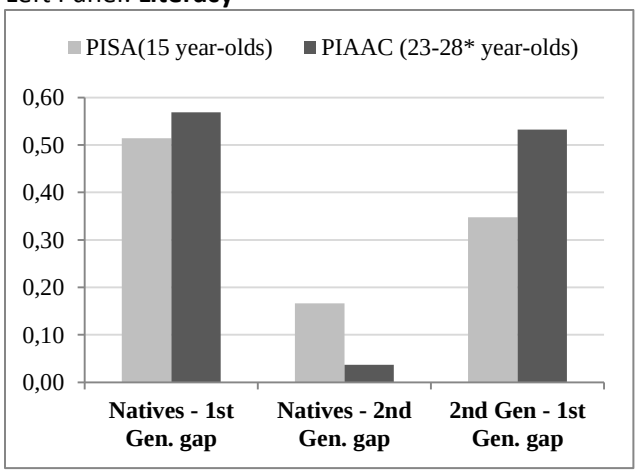
Second generation immigrants are born in the same country as the natives and have thus passed through the same education system as the natives. Therefore, it is not surprising that their scores are more alike to natives than to first generation immigrants, who were born outside the country. From the descriptive statistics, it is also evident that in our sample, first and second generation immigrants are coming from more disadvantaged socio-economic backgrounds than their native peer group. First generation immigrants' parents tend to have received less education and there are fewer books in the home. Socio-economic characteristics of the second generation immigrants seem to be closer to natives than to first generation immigrants. Therefore, it is important to control for these variables to disentangle whether the differences in testing scores are driven by socio-economic backgrounds rather than by their immigrant backgrounds. Demographic variables such as gender and age and school quality statistics are similar across the three groups. Whether the test language is the same as the language spoken most often at home is, as expected, much lower for first generation immigrants than for second generation immigrants, which is again lower than for natives.

Figure 1 illustrates the standardized skills-gaps between the young people with different immigrant backgrounds. The left hand panel compares standardized PISA score literacy gaps of 15 year-olds (light grey bars) with standardized PIAAC score literacy gaps (dark grey bars) of the same cohort roughly 10 years later. Reading from left to right, the first gap comparison is between natives and first-generation immigrants, the second gap comparison is between natives and second-generation immigrants and the third gap comparison is between second-generation and first-generation immigrants. The set-up of the right hand panel is the same but now for numeracy. According to the literature, differences in standardized gaps are considered small if the difference is less than 0.3, medium if the difference is between 0.3 and 0.5, and large if it is greater than 0.5.

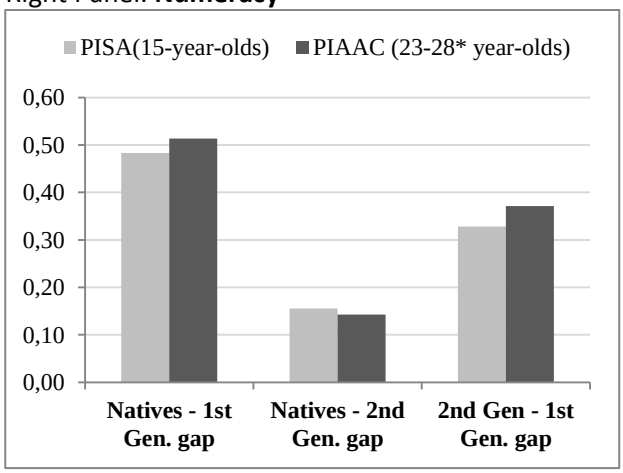
We observe different trends for the different groups and differences between literacy and numeracy gaps. The literacy gaps for the first generation immigrants widen over time. The difference in literacy between natives and second-generation immigrants disappears almost completely by early adulthood (PIAAC). The t-test shows that the difference (in this case only) is not statistically different from zero.[12] This finding is promising, because it suggests convergence in literacy between immigrants and natives over time, starting with the second generation immigrants. However, the gap in literacy skills among the first-generation and natives as well as the one among first-generation and second-generation immigrants has increased over time.

Figure 1 Standardized skill-gaps between natives, first- and second- generation migrants

Left Panel: **Literacy**



Right Panel: **Numeracy**



Notes: We follow Borgonovi et al. (2017) in the way we calculate 'standardized skill gaps'. The gap refers to the difference in means for each immigrant group divided by the standard deviation for the entire sample. For Greece, the PIAAC age-range is 26-31 year-olds. Greece is the only country in our sample to implement PIAAC in 2014/2015. The other 13 countries in the sample implemented PIAAC in 2011/2012.

[12] The t-test of the gaps in PIAAC proficiencies indeed shows that the difference between natives and second generation immigrants is statistically insignificant.

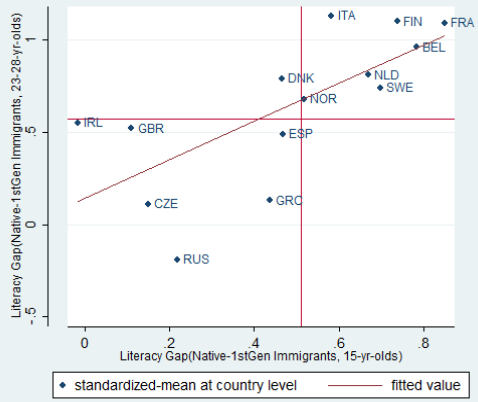
We observe similar patterns for numeracy as for literacy, but the size of the gaps differs. For PISA, the standardized numeracy gaps between natives and first generation immigrants is slightly lower than for literacy (medium just shy of 0.5) and widen (just over 0.5) in early adulthood, but the widening is less dramatic than for literacy. The narrowing of the small standardized gaps between natives and second generation groups is also less dramatic for numeracy and the gap remains statistically different into young adulthood.

The standardized gaps presented in Figure 1 pool the results from the fourteen countries in our sample. Figure 2 shows how the gaps have evolved over time by country. The top panel plots the evolution of literacy gaps between the three groups of young people with and without an immigrant background for each country. The x-axis represents the PISA score gaps at age 15 and the y-axis represents the PIAAC score gaps of roughly 10 years later. The bottom panel plots the numeracy gaps in the same way as the top panel. The upper right corner of each scatter plot shows the countries for which gaps were large (typically above 0.5) at age 15 and remained large into early adulthood. The lower right corner of each scatter plot contains countries for which gaps were high at age 15, but narrowed as the cohort entered adulthood. In the lower left corner of each scatter plot we find countries where the gaps started and remained relatively small. The upper left corner contains countries where gaps were originally relatively small, but widened over time.

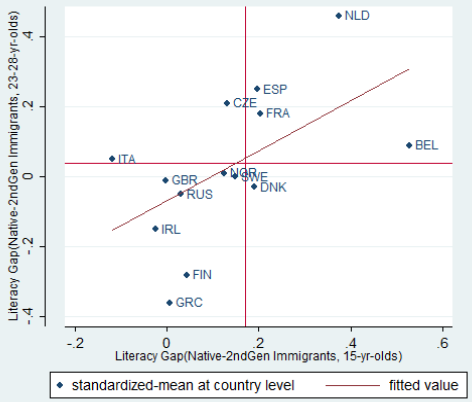
Figure 2 Evolution of Literacy and Numeracy Gaps between Young People with and without Immigrant Backgrounds

Top Panel: **Literacy Gaps -** Snapshots at age 15 (PISA) and Adult Cohort ~10 Years later (PIAAC)

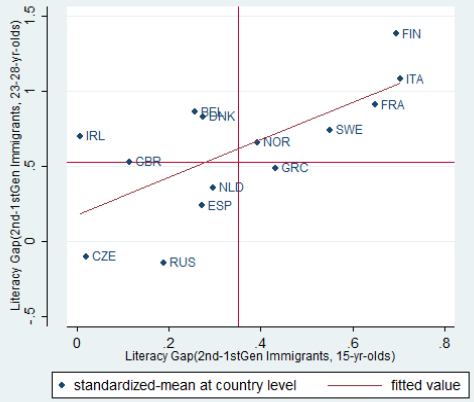
Between Native and 1st Gen. Immigrants



Between Native and 2nd Gen. Immigrants

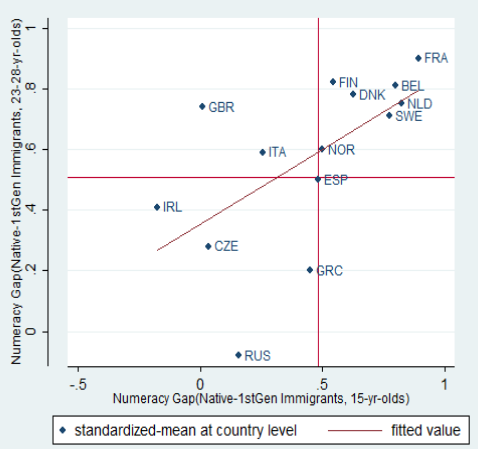


Between 2nd and 1st Generation Immigrants

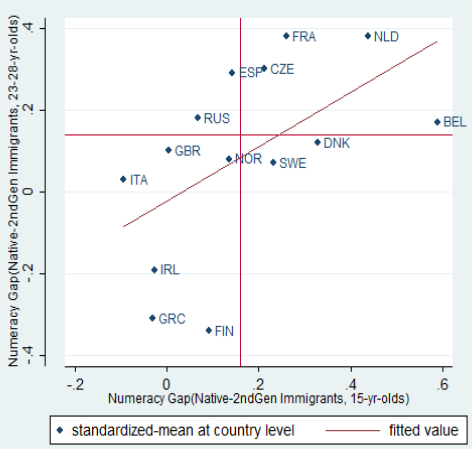


Bottom Panel: **Numeracy Gaps -** Snapshots at age 15 (PISA) and Adult Cohort ~10 Years later (PIAAC)

Between Native and 1st Gen. Immigrants



Between Native and 2nd Gen. Immigrants



Between 2nd and 1st Generation Immigrants

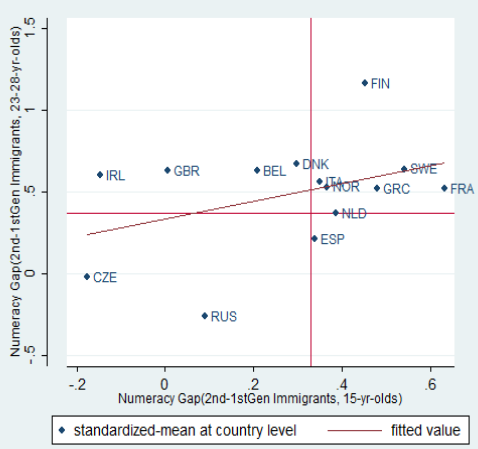


Figure 2 clearly shows that the gaps between natives and 1st generation immigrants tend to be the largest and most persistent gaps. The gaps between natives and second generation immigrants start and stay relatively small, in Norway, Sweden and the UK gaps between these groups tend to hover around zero for both PISA and PIAAC. In Belgium and the Netherlands on the other hand, gaps between natives and second generation immigrants appear to be large and persist into young adulthood. Gaps between second and first generation immigrants appear to be large and stay large in France and Finland. From this figure, we expect to find the largest and most persistent achievement differentials between the native and first generation immigrant group, despite the fact that the first generation immigrants in our sample would have arrived in the destination country before the age of 15.

5 Empirical Framework

Empirical studies that use international assessments to analyze underlying determinants of cognitive skills tend to use the education production function as the point of departure (Hanushek and Woessmann 2017). We use such a production function as well and start with

$$T = \alpha_0 + \alpha_1 IM + \alpha_2 D + \alpha_3 FB + \alpha_4 SQ + \alpha_5 A + \alpha_6 CG + \varepsilon \qquad (1)$$

where *T* is the outcome of the process of educational production (educational performance), measured by test scores in Literacy and Numeracy; *IM* indicates the categorical group (natives, first or second generation immigrant); *D* is a vector of personal traits (listed under demographic variables in Table 3) that may impact cognitive skills. *FB* is a vector of Family Background characteristic; *SQ* stands for a vector of measures of School Quality; *A* represents individual ability and it remains unobservable in our analysis. *CG* represents the country group which is assigned based on a classification of peer-countries with similar immigrant population characteristics. The error term ε captures unmeasured variables and the randomness of learning.

The empirical set-up allows us to perform two types of analyses. First, we can analyse differences in educational performance and attribute these to family background and school quality. Second, we can analyse the educational and economic implications of these differences in terms of education attainment and labour market position. We can use our independent variables to assess the significance of these variables.

To analyse differences in educational performance we first estimate equation 1 using OLS. In the first specification, we include IM as a categorical variable with natives as the reference group. The results of this regression are presented in Table 4 and discussed in the next section. We then follow McEwan and Marshall (2004) and employ the Blinder-Oaxaca decomposition to empirically assess achievement gaps between groups of young people with and without immigrant backgrounds and decompose these gaps into each of the components of interest: family background, school quality, demographics, and country group. McEwan and Marshall's successful application of this methodology in the context of international assessment (achievement scores) to compare high-versus-low achieving countries suggests that the technique will also be useful to decompose gaps between relatively higher and lower achieving sub-groups.

For this decomposition, we first re-estimate equation 1 for each of the categorical groups in IM (using OLS). Second, since the fitted line ($\overline{X}\ \ \hat{\beta}$) passes through the means (*T*), we know that for each group it holds:

$$\overline{T}_N = \overline{X}_N \hat{\beta}_N \quad (2)$$

$$\overline{T}_{1stGen} = \overline{X}_{1stGen} \hat{\beta}_{1stGen} \quad (3)$$

$$\overline{T}_{2ndGen} = \overline{X}_{2ndGen} \hat{\beta}_{2ndGen} \quad (4)$$

where $\overline{T}$ and $\overline{X}$ are the means for each group: in equation (2) the subscript N stands for natives, in equation (3) the subscript 1stGen stands for first generation immigrants, and equation (4) 2ndGen stands for second generation immigrants. In equations (2)-(4), X represents a vector of all independent variables used in the regression. In each equation $\hat{\beta}$ represents the coefficients from the OLS regressions for the specific groups. These coefficients are not directly reported in Table 5. Third, from (2)-(4) we can calculate the achievement gaps by calculating the differences between the dependent variables in the equations. Using the difference between native and first generation immigrant groups as an example, to derive the achievement differentials between the two groups, we subtract equation (3) from equation (2). Rewriting it, we can express this difference as follows:

$$\overline{T}_N - \overline{T}_{1stGen} = \left(\overline{X}_N - \overline{X}_{1stGen}\right)\hat{\beta}_N + \overline{X}_{1stGen}\left(\hat{\beta}_N - \hat{\beta}_{1stGen}\right) \quad (5)$$

The first term on the right hand side of equation 5 represents the difference in educational achievement due to variation in the independent variables. The second term on the right hand side is that part of the gap that can be accounted for by the differences in the marginal effects of the independent variables across the groups and also includes the part of the variation in achievement differences that cannot be explained by our independent variables. We focus on the part of the achievement differential that we can explain with the independent variables. We show the determinants of the total achievement gaps between each group for both literacy and numeracy in Table 5. We also report the part of the achievement gap that can be explained by all of our independent variables together. We further attribute which portion of the gap can be attributed each of the independent variables. This can be done separately for each variable or as a group of independent variables (i.e., for family background, school quality, demographic and country group components). We also calculate which fraction of the explained difference is accounted for by each independent variable which we sum (to a subtotal) for each component of interest (family background, school quality, demographics, and country group). We repeat this procedure for the decompositions of the achievement gaps between natives and second generation immigrants, and between first and second generation immigrants. The decomposition results are presented in Table 5 and discussed in the next section.

Up until this point, our analysis focuses on the determinants of cognitive skills scores and gaps, but ultimately we are interested in the educational and economic implications of these achievement differentials. One major economic implication of achievements gaps is wage differentials.

Recall that we have restricted our PIAAC sample to include only the adults who were (feasibly) in the same cohort as the 15 year olds who took the PISA test ten years before. The majority of the young

adults in our PIAAC sample are between the age of 23 and 28.[13] Estimating wages directly with Mincer-type equation with a sample restricted to only this age group is likely to suffer from a downward bias (Hanushek et al., 2015). Therefore, we look at two alternative possible channels through which the accumulation of higher skills can have an impact in the relatively short run; tertiary attainment and employment. These outcomes are likely to be associated with higher wages.

Tertiary attainment is commonly associated with a wage premium. Despite doubts raised by some scholars questioning whether the tertiary wage premium could withstand an influx in the supply of potential workers with tertiary education (sometimes referred to as the 'massification of higher-education'), Machin and McNally (2007) found that the tertiary wage premium did not change much in many European countries from the 1990s to the early 2000s.

The relationship between cognitive skills and tertiary attainment could go both ways. Many tertiary education institutions in the countries in our sample require entrance exams, or scores from secondary exit exams, as part of the application package (McGrath and Frearson, 2016). Better test scores prior to entering tertiary education may thus be a determinant of access to tertiary education. On the other hand, individuals who have attained tertiary education may have gained additional cognitive skills as adults. With our current dataset, it is not possible to clearly establish a causal link between tertiary education and cognitive skills. Since the youngest adults in our sample are 23, most of them should have taken the PIAAC test after attaining at least some tertiary education which subsumes skills prior to entering tertiary and those picked up in tertiary. In Figure 3 in Appendix 1, we look at whether there is a descriptive difference in the skills gaps between young adults with different immigrant backgrounds who have (and do not have) at least some tertiary education. If tertiary education attainment is an 'equalizer', we might expect to see greater gaps between young adults with different immigrant backgrounds who do not enter tertiary education. In Figure 3 in Appendix 1, we observe that those who attained tertiary education have higher scores than those who did not. This holds for all three groups. The difference in the gaps between groups with different immigrant backgrounds with (and without) at least some tertiary education, however, is not easy to discern.

To ascertain whether having an immigrant background plays a role in the probability of tertiary attainment in the first place, we estimate the probability that young adults in our sample attained tertiary education using a linear probability model and include our categorical IM variable (immigrant group, with natives as a reference group). In this model, the binary dependent variable is tertiary education attainment. We also estimate the probability of studying in a STEM field, since wage returns to a degree in Science, Technology/Engineering, Math have been found to be higher than wage returns to other degrees (Social Science, Arts, Medicine) in at least two countries[14] in our sample (Machin and McNally (2007). The results are reported in Table 6.

In the final part of our analysis, we shift our focus to evaluate the probability of the young adults in our sample achieving three separate labour market outcomes and we use numeracy skills as one of our explanatory variables. There is a growing body of literature that uses adult cognitive skills data from PIAAC to evaluate labour market returns to human capital in a cross-country empirical setting. One such recent study finds that an increase of one standard deviation in PIAAC numeracy scores is associated with an 18 percent increase in wages of workers aged 35 to 54 (Hanushek et al., 2015).[15] In this study,

[13] The young adults from Greece are between the ages for 26 and 31.
[14] France and the UK.
[15] They argue that this is a lower bound and emphasize that results vary by country.

Hanushek et al. (2015) establish that PIAAC numeracy and literacy scores are highly correlated (0.87), so in their preferred specification, they opt for numeracy skills, because they believe them to be most suitable in the international context. Sasso and Ritzen (2016) use differences in PIAAC numeracy skills to account for differences in productivity across sectors and countries. Since these studies (and others)[16] use numeracy scores to evaluate the economic implications of higher achievement scores in international settings, we follow suit.

We use the PIAAC data to estimate the probability that the young adults in our sample had paid employment in the past 12 months. We then estimate the probability that the employed young adults in our sample have a high or medium skill job. We also estimate the probability that the employed young adults in our sample are working in a STEM sector.

In all of the linear probability estimations we keep the same set of independent variables as in our initial OLS regression. We run the baseline model with the demographic variables and add the numeracy scores and subsequently the components of interest (family background and school quality) in a stepwise fashion.[17] This analysis allows us to empirically explore how the skills differentials we observe and decompose in the first part of the paper, may affect the economic integration of young people with immigrant backgrounds. Table 7 reports the results of this analysis.

6 Results and Discussion

Table 4 shows the results of the estimation of equation (1) with simple OLS. Panel A presents the results for PISA (at age 15) for both literacy and math. Within each subject area, the first column reports the results without school quality variables and the second column presents the results with the school quality variables. Panel B presents the results for PIAAC which should reflect the same cohort who took the PISA test roughly ten years earlier. In these regressions, we specify IM (immigrant group) with a categorical variable that uses the group of natives as a reference. Thus a – sign means that the result is lower than for natives. The dependent variable is achievement scores - as measured by cognitive skills tests - in math and reading for 15 year olds (PISA) and literacy and numeracy for adults (PIAAC). As we might have expected from our descriptive analysis, being a first generation immigrant is strongly negatively associated with lower performance in both PISA and PIAAC. This is also true for second generation immigrants, with the exception of PIAAC literacy scores, where the sign on the coefficient is negative, but it is not statistically significant. Adult numeracy scores (PIAAC) for first generation immigrants are 20.65 points lower than adult numeracy scores of natives, on average, without controlling for school quality variables. When we include the school quality variables, this difference is reduced to 17.83. The standard deviation in PIAAC numeracy scores for the entire sample is 48.8 (not shown in the tables). Recall that these are first generation immigrants who would have come to the destination country before the age of 15 and spent at least some time in the destination country's education system. Yet still, the difference in numeracy scores between natives and first generation immigrants (17.83 points on the numeracy score) is roughly one third (36 percent) of the standard deviation in PIAAC numeracy scores for our total sample. Relating this to the study by Hanushek et al. (2015) where they concluded that a one standard deviation increase in adult PIAAC numeracy scores is

[16] Hanushek and Woessmann (2012) use assessments in math to demonstrate an empirical relationship between cognitive skills and long-run economic growth in Latin America, something which – in that region is not well explained with educational attainment data.

[17] We maintain the demographic and country groups in every regression.

associated with higher wages (18 percent in prime-age workers); this statistically significant difference in PIAAC numeracy scores could amount to lower wages of approximately 7 percent for first generation immigrants with respect to natives. The numeracy scores for second generation immigrants are 6.69 points lower than adult numeracy scores of natives, on average. Once we control for school quality variables, this difference decreases to 6.08 which is about 12 percent of a standard deviation in PIAAC numeracy scores for our total sample (48.8) which could translate to lower wages of approximately 2 percent for second generation immigrants.

These regression results control for the socio-economic background variables that are common in the two datasets. Adding the school quality variables slightly exacerbates the negative coefficients at age 15 (PISA). However, in young adulthood (PIAAC), controlling for the quality of the education systems mitigates the negative coefficient for first generation immigrants. This finding suggests that school quality takes time to show its effect in education achievement. The present 'screen shot' analysis at two points in time (for the birth cohort) has the advantage that all cross-country comparative models have - it manages to circumvent the issue of selection that within country studies face. Using the PISA and PIAAC data together (bearing all the caveats of comparison in mind) is an iterative improvement over a purely cross-sectional analysis conducted at a single point in time, which is usually the price that cross-country studies of this kind have to pay (Hanushek and Woessmann, 2017) For example, the studies that use cross-country comparative models with PIAAC data (thus far) are constrained to cross-sectional analysis, because countries have not yet implemented a second wave of the PIAAC survey.

[Insert Table 4 Here]

Recall that comparisons between the results on PISA and PIAAC test have to be drawn cautiously (Gal and Tout, 2014). Nevertheless, the similarities between the assessments (test constructs, sample representativeness, etc.) allow us to use these analyses to investigate how the contribution of our independent variables has evolved over time. We proceed with drawing some cautious inferences on the basis of our regression results in Table 4 and our decomposition results in Table 5.

As we might expect from our descriptive analysis, for second generation immigrants, the initial difference in performance for literacy (the PISA measurement) becomes statistically insignificant as the cohort transitions into adulthood (the PIAAC measurement). This does not hold for numeracy skills however. The coefficients for second generation immigrants remain significantly negative. Note that for the second generation immigrants, the size of the coefficient is about one third of the size of the coefficient of the first generation immigrants. Second, the school quality variables do not seem to mitigate the coefficients as much as for the first generation immigrants. These results suggest that second generation immigrants start with an arrear in literacy but seem to catch-up during their time at school. We can see that when the language spoken at home is the same as the test language, this has a positive and statistically significant relationship with all achievement scores, except numeracy (when school quality variables are not included). This is less so for numeracy skills.

In line with the literature, we find that family background variables which might indicate socio-economic indicators and/or proxy the family 'culture' towards education performance, show a strong and

significant relation to achievement scores. It is often suggested that this effect may wane as teenagers leave the family home and enter adulthood[18] and that the effect of school quality may emerge later in the education lifecycle. Our results confirm this to some extent. The level of education of the parents is positively and significantly related to educational achievement and is more or less similar in both tests. Similar results are found for measuring the family background by the number of books at home. Our results also show a positive and persistent relation between the variables that proxy school quality and educational performance. For example, we find that school autonomy in hiring teachers is strongly and positively associated with cognitive skills in young adulthood, as is school accountability in decision-making regarding holding students back a year, or skipping ahead a year (retention/promotion).

The coefficients of the country peer-group show large and statistically significant coefficients, although the variability of these coefficients is quite high. The country peer-group variable has been constructed as a categorical variable with 'long standing destination' countries as a reference category. Hence, the coefficients measure the influence in comparison to 'long standing destination' countries. With respect to long standing destination countries and after controlling for other factors, on average, 'recent migration and humanitarian' countries have higher achievement scores. On the other hand, 'new destination' countries have lower scores in literacy and numeracy, but the size of the coefficients decrease once school quality variables are introduced. Eastern European[19] countries have lower literacy scores and numeracy scores that are statistically different from long standing destination countries until school quality variables are introduced, at which point the differences in literacy are no longer statistically significant and the numeracy scores are higher. The results suggest that it does matter to which group of countries immigrants go.

[Insert Table 5 Here]

Table 5 reports the results of the Oaxaca linear decomposition of the achievement gaps. We consider negative signs in the decomposition results to be an indicator that the variable serves to narrow the gap and positive signs to be an indicator that the variable serves to widen the gap, except when we compare the differentials between first and second generation immigrants, when the signs work in the opposite direction.[20] Panel A presents the results from the PISA skills assessments and panel B presents the results from the PIAAC skills assessments. The first two columns in panel B are based on equation 5 and represent the differentials for the predicted achievement scores between natives and first generation immigrants on the PIAAC test. The total mean difference (found in the row labeled 'Total Achievement Gap = (g)' in Table 5) in scores between natives and first generation immigrants is 24.4 points in literacy and 23.14 points in numeracy. The decompositions indicate that for literacy, virtually none (0.0004 rounded to 0.00) of the difference between natives and first generation immigrants can be explained by

[18] Coleman and Heckman (1998) found that the effect of family background diminished with higher levels of education, but a corollary may be that family background effect might simply fade with age.

[19] Note that since the language variable is not available for Russia, this peer country group is represented by the Czech Republic only. The results in Table 3 exclude Russia.

[20] Please note that the gap between first and second generation immigrants is negative and therefore the signs for widening, or narrowing the gap move in the opposite direction.

being female. On the other hand, for numeracy 0.09 points of the total achievement gap (23.14 points) between natives and first generation immigrants can be explained by being female. A much bigger part of the gap is explained by the test language being the same language spoken at home, more so for literacy (3.94 points) than numeracy (1.73 points), as we might expect.

Subtotal (a) sums the part of the gap explained by our demographic variables. Of the 'Total Achievement Gap = (g)', the sum of the variables for demographic characteristics can explain 0.18 or 18 percent (a/g) of the gap in literacy and 0.10 or 10 percent of the total achievement gap in numeracy. We also sum subtotals for family variables (subtotal b), school inputs (subtotal c), school autonomy (subtotal d), and school accountability (subtotal e) and at the bottom of the table we present how much of the gap can be explained by each sub-total. In the case of the achievement gap (as measured by PIAAC scores) between natives and first generation immigrants, 18 percent of the literacy gap and 21 percent of the numeracy can be explained by family background variables. The gap is not explained by our school input or school autonomy variables. On the other hand, school quality and school autonomy variables do not explain the gap well and may be said to be narrowing the gap although their contribution to reducing the gap between natives and first generation immigrants is relatively small (ranging from 3 to 9 percent). A large part of both the literacy gap (33 percent) and the numeracy gap (30 percent) is explained by our school accountability variables. Country groupings do not seem to explain much of this particular gap. From these results, we can observe that school quality does matter and contributes in different ways to narrowing or widening the gaps between groups. School autonomy variables almost always appear to be narrowing the gaps both for PISA and PIAAC test takers, with the exception of gaps between first and second generation and first generation immigrants, for these gaps other school quality variables seem to compensate and play a role in narrowing the gaps.

Taken together, the row labeled 'Total explained'[21] indicates how much gap in achievement scores can be explained by of the all of the independent variables. All of our independent variables together can explain 8.34 (or 34 percent) of the total achievement gap between adult natives and first generation immigrant literacy scores (24.40) and 4.96 (around 20 percent) of the total gap in numeracy (23.14) measured by PIAAC. Our results are in line with McEwan and Marshall's decomposition results for which they could account for around 30 percent of the gaps in scores in Cuba and Mexico. They emphasize the point that there is still a lot we cannot explain in achievement differentials.

Our independent variables can account for a much larger part of the gap in the PISA scores (sometimes up to 71 percent). We therefore concur with McEwan and Marshall that (especially in the case of PIAAC) we are not yet capturing the full story. Our determinants are leaving quite a bit of the gap 'unexplained', which means that there are other determinants of achievement that should explain a good portion of the gaps between groups with and without immigrant backgrounds. We also agree that school quality variables do not consistently relate to achievement in the same predictable and steady

[21] Typically the total explained should be equal to the sum of the subtotals. In Table 5, however, for the sake of presentation, we do not show the decomposition results for all of our variables (for example, school input variables are missing school size or percent of females in the school). Therefore the total explained is taken from the regression output and cannot be easily related to the subtotals in the table.

way that family background variables do. While that may lead to the temptation to conclude that school quality 'doesn't matter', our empirical results help to confer that we cannot dismiss school quality as important, especially because the importance may take time to emerge. It means that we need to gain a better understanding of why the school quality variables are relating to achievement scores in the way that they are and why some might help to narrow the gaps and others might slightly exacerbate the gaps.

[Insert Table 6 Here]

Table 6 presents the results for the linear probability models where we estimate the probability that the various groups of pupils attain tertiary education. For this analysis, we revert back to using a categorical variable for IM (immigrant group) with natives as the reference group and we estimate the probabilities that the educational and employment outcomes discussed in the previous section occur.

Initially (column 1) the chance of attaining tertiary education is negatively and significantly correlated with being a first generation immigrant, but once we account for numeracy scores the sign switches and the coefficient is statistically insignificant. This is re-enforced when we add school quality variables as explaining variables. These results suggest that for given numeracy scores, the chances of attaining higher education is not statistically different for young people with and without immigration backgrounds and second, that increasing school quality increases educational achievement. In particular the latter conclusion is important from a policy perspective. Table 6 also reveals that whether or not a pupil comes from an immigrant background does not appear to affect the chances of studying in a STEM field (columns 5-8) or working in a STEM sector.

Finally, Table 7 shows the results of our estimates on employment of immigrants. Having paid employment in the past 12 months is not significantly related to the first generation immigrant group, but negatively associated with the second generation immigrant group. This confirms for what the OECD/EU (2015) conclude, that second generation immigrants tended to experience more discrimination than first generation immigrants. We find that first generation immigrants are employed, but the quality of the job is very low. However, despite the lower probability of getting a job, second generation immigrants are more likely to have a high or medium skilled job than their native counterparts, once we control for numeracy and family background. So, it could be that the barrier to workforce entry is the most binding constraint for second generation immigrants who may be aiming for higher-skill jobs than their first generation immigrant peers. Perhaps they are even willing to wait outside the workforce (without paid employment) until such an opportunity can be realized.

One striking feature of these results is that whereas gender was not notable as a demographic factor in our analysis of determinants of skills, it is clearly a factor for other outcome variables and often seems to work in different direction. Generally speaking, being female increases the chances of tertiary attainment, reduces the chances of studying in STEM field or being employed in a STEM sector. Being female decreases the chances of paid employment, but increases the chances of high or medium skill employment. In general, the gender variable behaves as we would expect, which provides some face

validity to the analysis, interestingly it also seems (robustly) to wash out the effect of any of the other demographic variables.

7. Conclusions

In this paper we investigate differences in educational performance between first generation immigrants, second generation immigrants and natives. These differences matter as they can be a barrier for immigrants to enter the labour market (if negative) or be an added value for immigrants to enter the host country (if positive). And it is well-known that integration of immigrants in the labour market is key for a successful immigration policy. In particular we are interested in the dynamics of skills gaps and whether policy that targets the school quality is effective to decrease skills gaps if they exist. Our results first show some convergence of the skills gap between the second generation immigrants and the natives over time. Second, the gap in literacy skills among the first-generation and natives and among first-generation and second-generation immigrants has increased over time. Our decomposition results show that demographics (gender and language) and family background contribute to the achievement gaps between different groups. We also find that school input variables, such as school autonomy and school accountability factors do contribute to decreasing skills gaps of young adults with different immigrant backgrounds, in particular to numeracy gaps. Finally, whether or not a young person comes from an immigrant background does not appear to affect the chances of studying in a STEM field or working in a STEM sector.

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Detailed Country Groupings and Integration outcomes

Groups	Countries	Characteristics	Integration outcomes
Settlement countries	Australia, Canada, Israel, New Zealand	Immigration is part of the country's heritage, Highly educated immigrants who entered the country as labour migrants, educational policies in the country encourage such migrants to seek further education,	Generally successful immigrant children are better integrated into the school and labour market than their non-migrant counterparts.
Long-standing destinations with many recent and highly educated migrants	Luxembourg, Switzerland, the United Kingdom, the United States	Immigration has always been an enduring part of these countries, sudden increase in the last 10yrs due to the free movement within the EU-EFTA area for employment, highly educated.	Generally successful Immigrants and their children have integration outcomes similar to the native-born
Long-standing destinations with many settled low-educated migrants	Austria, Belgium, France, Germany, the Netherlands	Migrants to these countries are low-educated They migrated through 'guest workers' programme and later joined by their families They host significant numbers of humanitarian migrants and their families, High share of native-born with at least one foreign-born parent	Generally, not successfully integrated into the labour market, High unemployment rates, Lower levels of parent education are passed on to native-born children compared to their counterparts with no migration background They have lower chances of working at the center of the labour market because lower leves of education

Groups	Countries	Characteristics	Integration outcomes
New destination countries with many recent, low educated migrants	Greece, Italy, Portugal, Spain	Large numbers of labour migrants to fill low skilled jobs in the early 2000s They are low educated Migrated from lower income countries Although in some cases there are over qualification	Integration is generally poor especially into the labour market
New destination countries with many recent highly-educated immigrants	Cyprus, Iceland, Ireland, Malta	Arrival of large numbers of labour migrants in the past 10-15 years, Highly educated immigrants with the exception of Cyprus They come from high income countries	Integration is generally better perhaps due to their high educational level as well as the socio-economic background Over-qualification leading to immigrants downgrading themselves in the labour market
Countries with an immigrant population shaped by border changes and/or by national minorities	Croatia, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, the Slovak Republic, Slovenia	Not much experience with recent migration Foreign born population are as a result of border changes or nation building	Integration is generally successful and even better than native born
Emerging destination countries with small immigrant populations	Bulgaria, Chile, Japan, Korea, Mexico, Romania, Turkey	only a handful of foreign-born population recently on the increase because of intermarriages between foreigners and nationals, return of former emigrants children, Integration policies are strong and longstanding to provide equal opportunities for both immigrants and natives	Not much information on integration outcomes

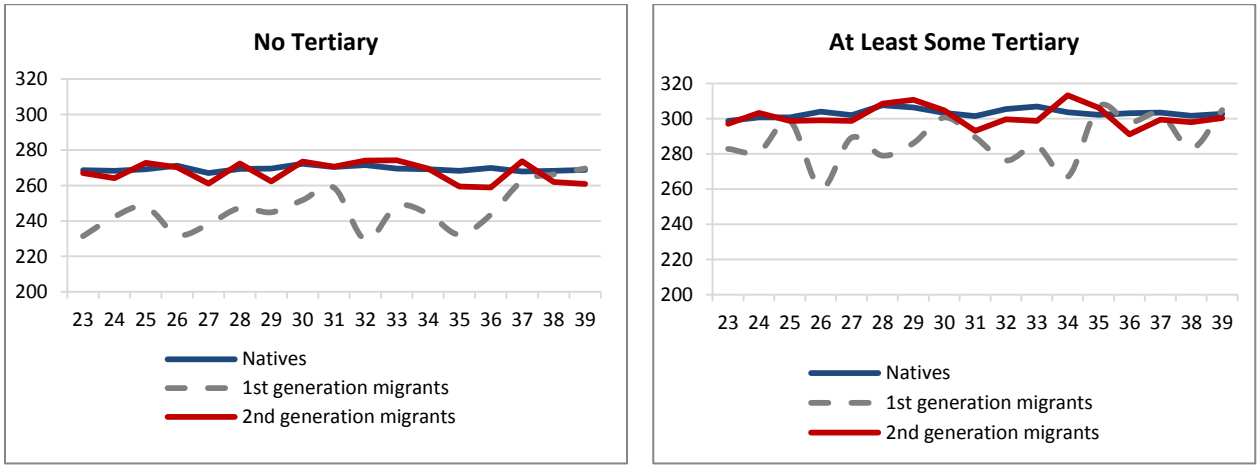
Source: authors' construct, extracted from OECD/EU (2015:27)

Appendix 1

Figure 3 looks at whether access to and/or completion of tertiary education is related to the average score discrepancies among the three groups. We are interested in seeing whether higher education is an 'equalizer', or whether the gaps persist even when higher education is attained.

The graphs show that the natives and the second generation immigrants are very similar in their path of skill accumulation. The level of literacy skills is substantially higher for all those who have accessed higher education regardless of their migration status, but it is not clear whether the gaps between groups have dissipated, thanks to their participation in tertiary education. There seems to be a smaller gap in skills between first generation immigrants and the other groups when they have attained some tertiary education; however, this is not consistent for all ages portrayed in the graphs. This might be due to the small number of observations for first generation immigrants.[22]

Figure 3. Literacy scores by migration status between ages 23 and 39.



[22] On average the number of observations for first generation immigrants without tertiary education is 21 for each age, whereas it is 641 for natives and 61 for second generation immigrants. For those who have attended at least some tertiary education, the average number of observation for first generation immigrants is 18, for natives is 641 and for second generation is 54.

Table 3 Descriptive statistics based on PISA (2000, 2003) and PIAAC (2011/12, 2014/15)

	PISA			PIAAC		
	Natives	1st Gen.	2nd Gen.	Natives	1st Gen.	2nd Gen.
Test scores						
Mean Reading/Literacy score	510.87	462.56	495.91	286.27	260.71	284.63
	(93.63)	(106.71)	(99.62)	(44.27)	(52.29)	(45.64)
Mean Math/Numeracy score	513.69	469.76	499.92	281.87	256.81	274.92
	(94.31)	(101.84)	(96.61)	(48.06)	(53.99)	(51.09)
Demographic variables						
Female (%)	48.88	51.45	47.89	52.82	53.70	54.83
Average Age (PIAAC Only)				25.68	25.43	25.52
Test language same as the language at home (%)	90.37	56.62	81.45	98.61	67.96	90.58
Family variables						
Parent's education:						
Uncompleted secondary	24.85%	19.10%	24.52%	20.24%	29.63%	22.87%
Secondary	31.18%	26.63%	27.72%	45.48%	26.34%	32.42%
Tertiary	43.98%	54.28%	47.76%	34.28%	44.03%	44.71%
Books at home:						
10 and below	14.86%	29.04%	18.28%	9.40%	24.81%	10.93%
11-100	49.35%	45.17%	46.85%	42.75%	42.48%	42.71%
101-500	31.96%	22.94%	30.42%	38.40%	25.19%	35.28%
more than 500	3.83%	2.85%	4.45%	9.45%	7.52%	11.08%
ESCS (SES) - PISA Only	0.08	-0.08	0.02			
	(0.91)	(1.00)	(0.98)			
School inputs						
% of government funding	89.87%	90.97%	90.56%	91.75%	93.14%	91.74%
Short of language teachers*	64.07%	57.61%	58.12%	61.29%	60.16%	56.58%
Short of math teachers*	59.03%	50.96%	51.70%	56.92%	56.60%	52.39%
% of full-time certified teachers	88.90%	86.41%	87.74%	86.07%	84.03%	85.54%
School size (natural log)	6.24	6.23	6.35	6.14	6.06	6.23
	(0.66)	(0.65)	(0.65)	(0.42)	(0.41)	(0.40)

	PISA			PIAAC		
	Natives	1st Gen.	2nd Gen.	Natives	1st Gen.	2nd Gen.
% of girls in school	49.77%	48.89%	50.14%	49.45%	49.13%	49.48%
School autonomy						
Hiring teachers	66.44%	70.87%	77.85%	69.90%	76.49%	70.61%
Determining salary increases	26.65%	28.41%	33.40%	32.00%	29.81%	32.17%
Formulating budget	71.54%	71.22%	71.37%	71.68%	76.91%	67.49%
Determining course content	71.73%	67.56%	71.61%	69.29%	67.71%	65.08%
School accountability						
Assessment is used to:						
Inform parents child's progress	97.62%	97.43%	97.42%	91.77%	88.78%	86.99%
Deciding grade Retention/promotion	76.61%	74.86%	75.19%	69.67%	53.97%	64.38%
Group students	44.21%	47.69%	50.97%	43.63%	41.20%	46.98%
Compare the school to national performance	42.85%	43.20%	47.36%	43.23%	37.15%	44.89%
Monitor school's progress	64.08%	61.02%	65.62%	61.56%	51.95%	60.34%
Judge teachers' effectiveness	38.87%	37.38%	42.82%	39.90%	28.87%	38.68%
Number of observations	91,187	4,315	10,588	6,778*	270*	693*

Note: Source: PISA 2000 & 2003; PIAAC 2011& 2014. Standard deviations are presented in parentheses. *The number of observations for the following may be smaller: Parent's education, books at home, % of school funding, school size, and percentage of girls in school and for all school autonomy variables. Pisa's scoring range is 0-1,000, whereas PIAAC is 0-500; ESCS (SES) stands for student socio-economic background and is only available in the PISA dataset. School size is included because PISA collects data at the school level because it is not a class-based test; it is given to 15 year olds, regardless of which class or grade they are in (which is different across OECD countries) the sample selection is affected by the school size (OECD, 2009).

Table 4: OLS Regression Family inputs, School inputs and Literacy/Numeracy Skill Scores

	Panel A: PISA scores				Panel B: PIAAC scores			
	Literacy		Math		Literacy		Numeracy	
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
Immigration Group (Natives are the reference)								
1st-generation immigrants	-12.17***	-12.56***	-13.54***	-15.19***	-20.65***	-16.19***	-21.01***	-17.83***
	(2.23)	(2.39)	(2.51)	(2.72)	(3.03)	(2.95)	(3.20)	(3.09)
2nd-generation immigrants	-5.49***	-5.85***	-9.020***	-8.78***	-2.87	-2.91	-6.69***	-6.08***
Demographic variables:	(1.25)	(1.39)	(1.48)	(1.68)	(1.79)	(1.88)	(2.01)	(2.09)
Female	-27.21***	-22.85***	13.96***	17.32***	-0.39	-0.374	-10.92***	-10.52***
	(0.82)	(0.94)	(0.99)	(1.15)	(0.97)	(0.99)	(1.05)	(1.08)
Test language same as the language at home (%)	23.89***	19.96***	16.74***	12.46***	10.15***	13.63***	4.28	7.73**
	(1.39)	(1.50)	(1.74)	(1.93)	(3.16)	(3.30)	(3.46)	(3.53)
Family variables:								
Either parent has a higher	16.34***	14.02***	17.73***	16.00***	14.69***	14.81***	15.35***	14.84***
education degree	(0.88)	(0.95)	(1.07)	(1.18)	(1.36)	(1.42)	(1.53)	(1.57)
Home owned								
11-100 books	37.18***	32.76***	36.56***	32.46***	22.57***	22.40***	24.19***	24.70***
	(1.30)	(1.46)	(1.42)	(1.62)	(1.85)	(1.88)	(2.02)	(2.03)
101-500 books	71.38***	64.86***	71.61***	65.82***	40.93***	40.74***	43.16***	43.95***
	(1.40)	(1.55)	(1.62)	(1.81)	(1.92)	(1.97)	(2.10)	(2.14)
More than 500 books	82.39***	73.96***	81.78***	75.03***	45.46***	45.25***	48.99***	49.86***
	(2.09)	(2.22)	(2.85)	(3.00)	(2.38)	(2.49)	(2.62)	(2.72)
School inputs	N	Y	N	Y	N	Y	N	Y
% of government funding		-0.26***		-0.25***		0.48		0.50
in total school funding		(0.02)		(0.03)		(0.45)		(0.50)

Table 4 *(continued)*

	Panel A: PISA scores				Panel B: PIAAC scores			
	Literacy		Math		Literacy		Math	
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
No shortage of language/math teachers*		5.16***		8.61***		-17.93		-65.78***
		(0.94)		(1.13)		(16.07)		(16.82)
% of full-time certified teachers		-0.21*		-0.21**		13.46		-14.68
		(0.11)		(0.10)		(14.51)		(15.18)
School autonomy								
Hiring teachers		15.55***		15.98***		30.97***		18.13**
		(1.02)		(1.29)		(7.38)		(8.87)
Determining salary increases		-0.55		-0.80		-8.69		3.57
		(1.13)		(1.42)		(9.24)		(8.79)
Formulating budget		-6.16***		-10.11***		-26.25*		-1.97
		(1.07)		(1.35)		(15.17)		(15.84)
Determining course content		-1.15		0.31		-24.23**		-18.86*
		(1.04)		(1.25)		(10.57)		(10.52)
School accountability								
Assessment is used to:								
inform parents child's progress		1.459		2.179		39.65		22.96
		(2.44)		(2.67)		(25.14)		(24.65)
Decide grade retention/promotion		10.72***		10.54***		38.38***		44.26***
		(1.22)		(1.66)		(6.14)		(6.48)
Group students		3.42***		1.62		8.31		10.47
		(0.99)		(1.22)		(11.18)		(11.29)
Compare the school to national performance		0.21		0.09		31.80		-11.5

Table 4 *(continued)*

	Panel A: PISA scores				Panel B: PIAAC scores			
	Literacy		Math		Literacy		Math	
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
		(1.12)		(1.38)		(21.84)		(22.46)
Monitor school's progress		-2.17**		-2.57**		-41.76**		-9.27
		(1.07)		1.31		(19.07)		(19.19)
Judge teachers' effectiveness		-9.56***		-13.88***		1.96		-5.71
		(0.90)		(1.07)		(8.09)		(8.53)
Country groups								
Significant recent migration and humanitarian countries	18.82***	40.55***	2.76**	17.38***	4.49***	38.98***	9.66***	48.27***
	(0.96)	(1.46)	(1.12)	(1.87)	(1.26)	(8.06)	(1.39)	(8.76)
New destinations	-25.72***	-13.24***	-53.63***	-46.95***	-20.35***	2.55	-19.41***	-4.36
	(0.81)	(1.10)	(0.92)	(1.36)	(1.30)	(8.26)	(1.41)	(8.10)
Eastern European destinations	-61.45***	-48.42***	-53.47***	-41.35***	-9.63***	17.04	-1.86	23.12**
	(1.02)	(1.45)	(1.23)	(1.86)	(1.57)	(11.43)	(1.70)	(11.18)
R-squared	0.27	0.29	0.22	0.23	0.21	0.25	0.22	0.25
Number of observations	106,090	106,090	106,090	106,090	6,870	6,361	6,870	6,361

Note: Source: PISA 2000 & 2003; PIAAC 2011& 2014. Dependent variable for Panel A are PISA literacy (column (1) & (2)) and math scores (Column (3) & (4)). Dependent variable for Panel B are PIAAC literacy (column (1) & (2)) and math scores (Column (3) & (4)). Each cell represents the coefficient of the corresponding variable estimated by Equation (1). Details please refer to note under Table 3. Robust standard errors are in parentheses. * significant at 10%, ** significant at 5%, *** significant at 1%

Table 5: Oaxaca Decomposition Results

	Panel A: PISA scores						Panel B: PIAAC scores					
	Native – 1st Gen.		Native – 2nd Gen.		1st Gen. – 2nd Gen.		Native – 1st Gen.		Native – 2nd Gen.		1st Gen. – 2nd Gen.	
	Read	Math	Read	Math	Read	Math	Lit	Num	Lit	Num	Lit	Num
Explained by Demographic variables												
Female	1.098	-0.79	0.19	-0.14	-0.76	0.64	0.00	0.09	0.01	0.27	0.07	0.26
Age (PIAAC Only)							0.33	0.57	0.03	0.06	-0.76	-0.71
Test language same as the language at home (%)	3.14	1.82	0.58	0.33	-3.51	-2.55	3.94	1.73	0.51	0.17	-4.40	-3.48
Subtotal (a)	4.24	1.04	0.78	0.18	-4.27	-1.91	4.27	2.39	0.55	0.50	-5.09	-3.93
Explained by Family Variables												
Either parent has a higher education degree	-1.21	-1.24	-0.42	-0.44	1.05	1.00	-1.60	-1.60	-0.60	-0.59	0.76	0.88
Books at home (All three dummies)	5.51	5.75	0.49	0.52	-5.14	-5.17	6.08	6.66	0.71	0.75	-6.46	-6.37
Subtotal (b)	4.29	4.51	0.07	0.08	-4.10	-4.18	4.48	5.06	0.11	0.16	-5.70	-5.49
Explained by School Inputs												
% of government funding	0.36	0.35	0.17	0.17	-0.27	-0.25	-0.41	-0.53	0.03	0.03	3.47	3.13
% of full-time certified teachers	-0.01	-0.01	-0.01	-0.00	-0.00	0.00	0.20	-0.55	0.12	-0.07	-1.08	0.11
No shortage of language/math teachers*	0.24	0.29	0.32	0.41	0.05	0.14	-0.59	-1.18	-0.54	-1.69	-0.82	-0.35
Subtotal (c)	0.59	0.63	0.48	0.57	-0.22	-0.11	-0.8	-2.26	-0.39	-1.73	1.57	2.89
Explained by School Autonomy												
Hiring teachers	-1.85	-1.95	-1.81	-1.88	0.20	0.13	-2.07	-1.10	-1.27	-0.75	1.01	0.87
Determining salary increases	-0.04	0.06	-0.08	0.07	-0.01	-0.01	-0.31	0.01	0.18	-0.03	-2.98	-2.36
Formulating budget	-0.12	-0.18	0.04	0.07	0.36	0.52	0.92	-0.14	0.03	0.00	-5.22	-3.73
Determining course content	0.06	0.04	0.01	-0.01	-0.01	0.09	-0.68	-0.49	-0.41	-0.35	1.36	0.93
Subtotal (d)	-1.96	-2.02	-1.83	-1.76	0.55	0.74	-2.14	-1.72	-1.47	-1.13	-5.83	-4.29

Table 5 *(continued)*

	Panel A: PISA scores						Panel B: PIAAC scores					
	Native –1st Gen.		Native –2nd Gen.		1st Gen. – 2nd Gen.		Native –1st Gen.		Native –2nd Gen.		1st Gen. – 2nd Gen.	
	Read	Math	Read	Math	Read	Math	Lit	Num	Lit	Num	Lit	Num
Explained by School Accountability												
Inform parents child's progress	0.00	-0.01	-0.00	-0.01	0.00	0.01	2.49	1.50	0.63	0.36	2.72	1.57
Deciding grade retention/promotion	-0.33	-0.31	-0.16	-0.14	0.02	-0.07	8.19	8.89	1.62	1.81	-4.48	-11.44
Group students	-0.03	-0.03	-0.08	-0.07	-0.18	-0.15	-0.07	-0.26	0.65	0.74	3.58	2.17
Compare the school to national performance	-0.08	-0.05	-0.03	-0.00	-0.01	-0.01	2.89	-0.62	-1.32	0.25	10.97	8.58
Monitor school's progress	0.22	0.16	0.13	0.14	-0.03	-0.04	-5.55	-0.95	0.29	0.08	-6.63	-2.12
Judge teachers' effectiveness	1.26	1.52	1.08	1.28	-0.26	-0.28	0.11	-1.23	0.09	-0.07	-2.08	-3.97
Subtotal (e)	1.04	1.29	0.94	1.19	-0.46	-0.55	8.06	7.33	1.96	3.17	4.08	-5.21
Explained by Country Group												
Significant recent migration and humanitarian countries	0.40	0.01	0.86	0.42	0.34	0.01	-9.01	-10.24	1.43	1.68	-0.07	13.31
New destinations	-2.29	-7.51	-2.56	-8.08	0.03	-0.99	0.35	-0.39	0.39	-0.22	0.37	0.12
Eastern European destinations	10.79	11.21	7.13	5.76	-3.35	-2.66	2.00	2.36	0.79	0.91	5.42	2.33
Subtotal (f)	8.90	3.70	5.43	-1.90	-2.99	-3.63	-6.66	-8.27	2.61	2.37	5.72	15.76
Total Achievement Gap = (g)	41.43	31.11	11.36	7.75	-30.07	-23.36	24.40	23.14	2.69	6.39	-21.71	-16.76
Demographic variables (a) / Total Gap (g)	0.10	0.03	0.07	0.02	0.14	0.08	0.18	0.10	0.20	0.08	0.23	0.23

Table 5 *(continued)*

	Panel A: PISA scores						Panel B: PIAAC scores					
	Native –1st Gen.		Native –2nd Gen.		1st Gen. –2nd Gen.		Native –1st Gen.		Native –2nd Gen.		1st Gen. –2nd Gen.	
	Read	Math	Read	Math	Read	Math	Lit	Num	Lit	Num	Lit	Num
Family variables (b) / Total Gap (g)	0.10	0.15	0.01	0.01	0.14	0.18	0.18	0.22	0.04	0.03	0.26	0.22
School variables (c) / Total Gap (g)	0.01	0.02	0.04	0.07	0.01	0.00	-0.03	-0.10	-0.14	-0.27	-0.07	-0.10
School autonomy (d) / Total Gap (g)	-0.05	-0.06	-0.16	-0.23	-0.02	-0.03	-0.09	-0.07	-0.55	-0.18	0.27	-0.07
School accountability (e) / Total Gap(g)	0.03	0.04	0.08	0.15	0.02	0.02	0.33	0.32	0.73	0.50	-0.19	0.32
Country Groups (f) / Total Gap (g)	0.21	0.12	0.48	-0.25	0.10	0.16	-0.27	-0.36	0.97	0.37	-0.26	-0.36
Total explained / Total Gap (g)	0.63	0.51	0.53	-0.14	0.69	0.71	0.34	0.21	-0.28	-0.02	0.41	0.30
Total Explained	26.22	15.84	6.03	-1.08	-20.76	-16.59	8.34	4.96	-0.74	-0.10	-8.80	-5.11

Note: Source: PISA 2000 & 2003; PIAAC 2011& 2014. Dependent variable for Panel A are PISA literacy and math scores. Dependent variable for Panel B are PIAAC literacy and math scores.

TABLE 6: Educational Outcomes Linear Probability Models (PIAAC)

	Tertiary Education Attainment				STEM Area of Study			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
Immigration Group (Natives are the reference)								
1st-generation immigrants	-0.089***	0.037	0.0385	0.025	-0.046	-0.027	-0.025	-0.020
	(0.034)	(0.032)	(0.032)	(0.033)	(0.031)	(0.031)	(0.032)	(0.033)
2nd-generation immigrants	-0.017	0.010	0.005	-0.018	-0.027	-0.023	-0.024	-0.018
Demographic variables:	(0.021)	(0.020)	(0.020)	(0.020)	(0.019)	(0.019)	(0.019)	(0.021)
Female	0.072***	0.119***	0.114***	0.118***	-0.334***	-0.325***	-0.321***	-0.314***
	(0.012)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.012)	(0.012)
Age	-0.001	-0.004	-0.002	-0.002	0.001	0.001	0.000	0.013***
	(0.003)	(0.003)	(0.003)	(0.005)	(0.003)	(0.003)	(0.003)	(0.005)
Test language same as the language at home (%)	-0.071*	-0.098***	-0.104***	-0.092***	0.007	0.006	0.007	-0.004
	(0.036)	(0.031)	(0.031)	(0.032)	(0.035)	(0.034)	(0.035)	(0.036)
Numeracy		0.004***	0.004***	0.003***		0.001***	0.001***	0.001***
		(0.000)	(0.000)	(0.000)		(0.000)	(0.000)	(0.000)
Family variables								
Either parent has a higher education			0.163***	0.143***			-0.041**	-0.034**
degree			(0.016)	(0.015)			(0.016)	(0.017)
Number of Books (Childhood Home)								
11-100 books			0.108***	0.127***			-0.014	-0.015
			(0.017)	(0.018)			(0.021)	(0.021)
101-500 books			0.185***	0.225***			-0.031	-0.040*
			(0.020)	(0.020)			(0.022)	(0.023)
More than 500 books			0.193***	0.250***			-0.016	-0.024
			(0.026)	(0.026)			(0.028)	(0.030)

Table 6 *(continued)*

	Tertiary Education Attainment				STEM Area of Study			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
School inputs								
% of government funding in total school				-0.006				0.003
funding				(0.005)				(0.005)
No shortage of language/math teachers*				-0.486***				0.281
				(0.175)				(0.182)
Percentage of full-time certified teachers				-0.424***				-0.348**
				(0.155)				(0.177)
School autonomy								
Hiring teachers				0.046				0.014
				(0.088)				(0.096)
Determining salary increases				-0.155*				-0.027
				(0.091)				(0.093)
Formulating budget				0.175				-0.362**
				(0.166)				(0.174)
Determining course content				0.137				-0.131
				(0.112)				(0.115)
School accountability								
Assessment is used to:								
Inform parents child's progress				0.154				-0.546**
				(0.257)				(0.273)
Deciding grade retention/promotion				0.404***				-0.081
				(0.070)				(0.076)

Table 6 *(continued)*

	Tertiary Education Attainment				STEM Area of Study			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
Group students				0.258**				0.118
				(0.118)				(0.128)
Compare the school to national performance				0.137				-0.256
				(0.224)				(0.230)
Monitor school's progress				-0.348*				0.383*
				(0.198)				(0.205)
Judge teachers' effectiveness				-0.202**				-0.211**
				(0.088)				(0.095)
Country groups								
Significant recent migration and humanitarian countries	0.156***	0.070***	0.037**	0.367***	0.001	-0.013	-0.006	-0.266***
	(0.015)	(0.014)	(0.015)	(0.090)	(0.014)	(0.014)	(0.014)	(0.090)
New destinations	-0.154***	-0.128***	-0.135***	-0.132*	-0.039***	0.008	-0.003	0.020
	(0.013)	(0.013)	(0.013)	(0.072)	(0.014)	(0.014)	(0.014)	(0.081)
Eastern European destinations	-0.084***	-0.094***	-0.100***	0.09	-0.058***	-0.069***	-0.090***	-0.075
	(0.016)	(0.016)	(0.017)	(0.107)	(0.019)	(0.017)	(0.018)	(0.119)
Constant	0.505***	0.142*	0.100	-4.130***	0.286***	-0.319***	-0.317***	1.112
	(0.073)	(0.075)	(0.077)	(1.267)	(0.077)	(0.079)	(0.080)	(1.356)
R-squared	0.049	0.077	0.08	0.092	0.112	0.175	0.186	0.197
Number of observations	7029	7029	6869	6360	6308	6308	6163	5710

Note: Source: PISA 2000 & 2003; PIAAC 2011& 2014. Robust standard errors are presented in parentheses; Dependent variable for column (1)-column (4) is a dummy for having tertiary education attainment; Dependent variable for column (1)-column (4) is a dummy for studying in STEM area. Robust standard errors are presented in parentheses; * significant at 10%, ** significant at 5%, *** significant at 1%

TABLE 7: Employment Outcomes Linear Probability Models (PIAAC)

	Paid Employment in the Past 12 Months				High or Medium Skill Job			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
Immigration Group (Natives are the reference)								
1st-generation immigrants	-0.045	-0.005	0.004	-0.007	-0.052	0.013	0.020	-0.001
	(0.028)	(0.027)	(0.028)	(0.029)	(0.032)	(0.031)	(0.032)	(0.034)
2nd-generation immigrants	-0.071***	-0.062***	-0.059***	-0.068***	0.026	0.039**	0.041**	0.028
	(0.018)	(0.018)	(0.018)	(0.020)	(0.019)	(0.018)	(0.017)	(0.019)
Demographic variables								
Female	-0.069***	-0.054***	-0.056***	-0.059***	0.285***	0.307***	0.297***	0.299***
	(0.009)	(0.009)	(0.009)	(0.009)	(0.011)	(0.010)	(0.010)	(0.011)
Age	0.015***	0.014***	0.014***	0.021***	0.014***	0.011***	0.013***	0.004
	(0.003)	(0.003)	(0.003)	(0.004)	(0.003)	(0.003)	(0.003)	(0.005)
Test language same as the language at home (%)	0.015	0.007	0.003	0.013	-0.045	-0.061**	-0.062**	-0.091***
	(0.031)	(0.031)	(0.031)	(0.033)	(0.030)	(0.029)	(0.029)	(0.030)
Numeracy		0.001***	0.001***	0.001***		0.002***	0.002***	0.002***
		(0.000)	(0.000)	(0.000)		(0.000)	(0.000)	(0.000)
Family variables								
Either parent has a higher education degree			-0.022*	-0.016			0.074***	0.064***
			(0.013)	(0.014)			(0.014)	(0.015)
Number of Books (Childhood Home)								
11-100 books			0.056***	0.056***			0.085***	0.082***
			(0.018)	(0.019)			(0.020)	(0.021)
101-500 books			0.050***	0.055***			0.144***	0.144***
			(0.018)	(0.020)			(0.021)	(0.022)
More than 500 books			0.023	0.026			0.145***	0.141***
			(0.023)	(0.025)			(0.025)	(0.027)

Table 7 *(continued)*

	Paid Employment in the Past 12 Months				High or Medium Skill Job			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
School inputs								
% of government funding in total school funding				0.010**				-0.005
				(0.004)				(0.005)
No shortage of language/ math teachers*				-0.169				-0.136
				(0.156)				(0.170)
Percentage of full-time certified teachers				-0.090				0.17
				(0.147)				(0.156)
School autonomy								
Hiring teachers				-0.207***				-0.031
				(0.076)				(0.085)
Determining salary increases				0.076				0.097
				(0.077)				(0.088)
Formulating budget				0.139				0.123
				(0.146)				(0.165)
Determining course content				-0.054				-0.016
				(0.099)				(0.110)
School accountability								
Assessment is used to:								
Inform parents child's progress				0.417*				0.071
				(0.220)				(0.253)
Deciding grade retention /promotion				-0.101*				-0.000
				(0.057)				(0.064)
Compare the school to national performance				-0.096				0.075
				(0.188)				(0.216)

Table 7 *(continued)*

	Paid Employment in the Past 12 Months				High or Medium Skill Job			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
Monitor school's progress				-0.152				-0.07
				(0.156)				(0.188)
Judge teachers' effectiveness				-0.132*				0.183**
				(0.075)				(0.084)
Country groups								
Significant recent migration and humanitarian countries	0.045***	0.017	0.013	0.060	-0.010	-0.055***	-0.081***	0.012
	(0.010)	(0.010)	(0.011)	(0.076)	(0.013)	(0.013)	(0.013)	(0.086)
New destinations	-0.154***	-0.128***	-0.135***	-0.132*	-0.039***	0.008	-0.003	0.020
	(0.013)	(0.013)	(0.013)	(0.072)	(0.014)	(0.014)	(0.014)	(0.081)
Eastern European destinations	-0.084***	-0.094***	-0.100***	0.090	-0.058***	-0.069***	-0.090***	-0.075
	(0.016)	(0.016)	(0.017)	(0.107)	(0.019)	(0.017)	(0.018)	(0.119)
Constant	0.505***	0.142*	0.100	-4.130***	0.286***	-0.319***	-0.317***	1.112
	(0.073)	(0.075)	(0.077)	(1.267)	(0.077)	(0.079)	(0.080)	(1.356)
R-squared	0.049	0.077	0.08	0.092	0.112	0.175	0.186	0.197
Number of observations	7029	7029	6869	6360	6308	6308	6163	5710

Note: Source: PISA 2000 & 2003; PIAAC 2011& 2014. Dependent variable for the left-hand columns is a dummy for having paid employment in the past 12 months; dependent variables for the right-hand columns is a dummy for having high or medium skill job; Robust standard errors are presented in parentheses; * significant at 10%, ** significant at 5%, *** significant at 1%

TABLE 7 (continued): Employment Outcomes Linear Probability Models (PIAAC)

	Working in STEM Sector (ISIC 2-Digit)			
	(1)	(2)	(3)	(4)
Immigration Group (Natives are the reference)				
1st-generation immigrants	0.001	0.008	0.012	0.022
		(0.015)	(0.015)	(0.016)
2nd-generation immigrants		0.008	0.001	0.015
	(0.010)	(0.010)	(0.011)	(0.011)
Demographic variables				
Female	-0.036***	-0.034***	-0.034***	-0.031***
	(0.005)	(0.005)	(0.005)	(0.005)
Age	0.003***	0.003***	0.003***	0.005*
	(0.001)	(0.001)	(0.001)	(0.003)
Test language same as the language at home (%)	-0.001	-0.003	-0.003	-0.002
	(0.017)	(0.017)	(0.018)	(0.019)
Numeracy		0.000***	0.000***	0.000***
		(0.000)	(0.000)	(0.000)
Family variables				
Either parent has a higher education degree			-0.022***	-0.016**
			(0.008)	(0.008)
11-100 books			0.010	0.007
			(0.007)	(0.007)
101-500 books			0.009	0.007
			(0.008)	(0.008)
More than 500 books			0.009	0.010
			(0.012)	(0.012)
School inputs				
% of government funding in total school funding				0.004
				(0.003)

Table 7 *(continued)*

	Working in STEM Sector (ISIC 2-Digit)			
	(1)	(2)	(3)	(4)
No shortage of language/ math teachers*				-0.136
				(0.105)
Percentage of full-time certified teachers				-0.008
				(0.097)
School autonomy				
Hiring teachers				-0.054
				(0.049)
Determining salary increases				-0.105
				(0.072)
Formulating budget				0.015
				(0.080)
Determining course content				0.122
				(0.084)
School accountability				
Assessment is used to:				
Inform parents child's progress				0.295**
				(0.147)
Deciding grade retention /promotion				0.155*
				(0.080)
Compare the school to national performance				0.272
				(0.190)
Monitor school's progress				-0.294*
				(0.178)
Judge teachers' effectiveness				0.038
				(0.053)

Table 7 *(continued)*

	Working in STEM Sector (ISIC 2-Digit)			
	(1)	(2)	(3)	(4)
Country groups				
Significant recent migration and humanitarian countries	0.011	0.007	0.008	0.176**
	(0.008)	(0.008)	(0.008)	(0.070)
New destinations	-0.028***	-0.021***	-0.024***	0.093
	(0.006)	(0.006)	(0.006)	(0.070)
Eastern European destinations	-0.001	-0.002	-0.004	0.138*
	(0.009)	(0.009)	(0.010)	(0.076)
Constant	-0.026	-0.090**	-0.110**	-2.335**
	(0.038)	(0.041)	(0.043)	(0.961)
R-squared	0.016	0.02	0.022	0.031
Number of observations	4771	4771	4670	4299

Note: Source: PISA 2000 & 2003; PIAAC 2011& 2014. Dependent variable for column (1)-column (4) is a dummy for having working in STEM sector; Robust standard errors are presented in parentheses; * significant at 10%, ** significant at 5%, *** significant at 1%