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Veröffentlichungsversion / Published Version
Zeitschriftenartikel / journal article

Empfohlene Zitierung / Suggested Citation:
Borgonovi, F., & Pokropek, A. (2022). The Role of Birthplace Diversity in Shaping Education Gradients in Trust: Country and Regional Level Mediation-Moderation Analyses. *Social Indicators Research*, *164*(1), 239-261. https://doi.org/10.1007/s11205-022-02948-z

Social Indicators Research (2022) 164:239–261
https://doi.org/10.1007/s11205-022-02948-z

ORIGINAL RESEARCH

The Role of Birthplace Diversity in Shaping Education Gradients in Trust: Country and Regional Level Mediation-Moderation Analyses

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Accepted: 2 May 2022 / Published online: 9 June 2022

Abstract
This paper examines between-country differences in why education promotes trust using data from 29 countries (and 146 regions) participating in the OECD's Survey of Adult Skills (PIAAC). Results indicate that education is strongly associated with trust and that individuals' literacy, income, and occupational prestige are important mediators of this association. Contrary to previous studies we do not find that country level or regional level birthplace diversity is associated with average levels of trust. However, education gradients in trust and the extent to which these are due to social stratification or cognitive mechanisms vary both at the country and regional level depending on birthplace diversity. Multilevel mediation-moderation analyses reveal that in countries and regions with greater birthplace diversity there is a greater polarization in levels of trust between individuals with different educational qualifications. This polarization is primarily due to cognitive mechanisms.

Keywords Trust · Diversity · Migration · Cross-country

1 Introduction

Trust characterizes social dynamics between an individual at the giving end of the trust relationship (the person who trusts) and an individual at the receiving end of such relationship (the person who is trusted).

Generalized trust reflects the "expectation that other members of the community will behave in a cooperative and honest way" (Fukuyama, 1995). To trust others is to believe that

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strangers will not knowingly hurt us and will consider our well-being when acting (Barber, 1983; Hardin, 2006). Generalized trust expresses confidence in the benevolent behavior of others (Delhey et al., 2011).

Quantitative differences in the number of interactions, lead to qualitative differences in levels of trust, with important implications for precursors, antecedents, and outcomes of trust (Welch et al., 2005). The focus on generalized trust in social research reflects the key function trust in unfamiliar others plays in increasingly complex societies (Nannestad, 2008) and the social and economic benefits of generalized trust. In societies with high trust, individuals share new ideas and exchange information efficiently and interact with each other to overcome collective action problems (Fukuyama, 1995; Ostrom 1990; Putnam, 1993; Tavits, 2006). Empirical work confirms that generalized trust is an important social and economic resource (Algan & Cahuc, 2010; Knack & Keefer, 1997; Putnam, 1993). Moreover, generalized trust is positively associated with health status and behaviors (Rocco et al., 2014), and with lower rates of criminality and juvenile delinquency (Sampson et al., 1997).

Research has indicated that levels of trust are lower in societies that are more diverse—in terms of race, ethnicity, and place of birth (Alesina & La Ferrara, 2002; Delhey & Newton, 2005; Dinesen & Sonderskov, 2015; Gustavsson & Jordahl, 2008; Knack & Keefer, 1997; Putnam, 2000; Schaeffer, 2013; Zak & Knack, 2001). However, it remains underexplored if diversity induces polarization in trust. The fact that some individuals could develop higher levels of trust than others in response to diversity could be problematic not only from a distributional standpoint but also from an efficiency standpoint since the social benefits of trust arise from relationships between individuals who trust each other.

The literature has identified large differences in levels of generalized trust across socio-economic and demographic groups defined in terms of age, gender, socio-economic status, and educational attainment. In particular, better educated individuals appear to be more likely to express feelings of trust than individuals with lower education (Borgonovi, 2012; Putnam, 2000; Paxton, 2007; Alesina & La Ferrara, 2002; Nannestad, 2008). Nonetheless, surprisingly little is known about the mechanisms shaping the association between education and trust in different environments.

Our contribution is threefold: first, we identify if overall levels of trust vary depending on levels of birthplace diversity. Second, we identify if education gradients in generalized trust vary across countries and regions depending on levels of birth diversity. Third, we identify the mechanisms that underlie education gradients in generalized trust and if these vary depending on levels of birthplace diversity.

2 Theory and Hypotheses

2.1 Mechanisms Determining Education Gradients in Trust

Three mechanisms can be considered to shape differences in generalized trust across individuals with varying levels of educational attainment: social sorting, cognitive and direct/socialization processes (Hooghe et al., 2012; Nie et al., 1996).

The first mechanism is social sorting. Higher educated individuals tend to be more active in the labor market and to command higher wages than individuals with worse qualifications

insulating them from the negative consequences of misplacing trust (Hooghe, 2007; Hooghe et al., 2012; Huang et al., 2011; Nie et al., 1996).

The second mechanism is cognitive. Education promotes the acquisition of information processing abilities (Marks, 2014) thus reducing the likelihood that individuals will misplace trust (Sturgis et al., 2010b). Because individuals who misplace trust suffer penalties, being able to appreciate the trustworthiness of specific individuals in given situations is a prerequisite to be able to hold general expectations on the trustworthiness of unspecified others (Yamagishi, 2001). Individuals who possess greater information processing abilities can be expected to perform better at the problem-solving task represented by social interactions and to be able to trust generalized others.

The third mechanism is socialization. Children internalize their parents' attitudes and values (Borgonovi & Montt, 2012; Putnam 1993; Stolle & Hooghe, 2004). Therefore, individuals with high levels of education are more likely to have internalized high levels of trust from their parents. Moreover, starting in primary school, children develop norms of reciprocity based on a broader social environment. In most countries, children from better educated parents tend to attend school with other children from highly educated households, leading to further differences in the development of trust across social groups. In secondary and postsecondary education social networks become larger and more diverse and individuals encounter curricula that expose them to diverse world views, civic and citizenship education, and an understanding of the institutional frameworks that guide social relations (Cantoni & Yuchtman, 2013; Helliwell & Putnam, 2007; Schulz et al., 2018). Because of the intergenerational transmission of education, individuals with highly educated parents are more likely to attend secondary and post-secondary education and thus develop high levels of trust.

2.2 The Role of Diversity

Group threat theory provides a useful framework to assess how and why greater diversity may lead to lower trust and greater polarization of trust across individuals with different education. Although group threat theory was originally developed to frame expectations on the attitudes held by members of one group towards out-of-group members, research has considered it to predict the consequences of diversity on trust (Gijsberts et al., 2012; Putnam 2007). Group threat theory predicts that members of a group will exhibit negative attitudes towards out-of-group individuals because of a perceived threat from out-of-group members to the interest of the group (Blumer, 1958; Bobo & Hutchings, 1996; Quillian, 1995). It also predicts that attitudes will be negatively related to the size and diversity of out-of-group populations (Blalock, 1967; Blumer, 1958).

Empirical research has documented that in contexts that are characterized by greater ethnic diversity generalized trust tends to be lower (Alesina & La Ferrara, 2002; Borgonovi, 2012; Dinesen & Sonderskov, 2015; Gustavsson & Jordahl, 2008; Putnam, 2000; Schaeffer, 2013). However, recent evidence from the United States suggests that increased ethno-racial diversity reduces levels of trust only among majority populations because a higher diversity corresponds, among minorities, to a higher probability of engaging in encounters with other minorities (Abascal & Baldassarri, 2015).

2.3 Hypotheses

We characterize birthplace diversity by considering how large the group of foreign-born individuals is (share of foreign-born) and how diverse foreign-born populations are (diversity in countries of origin). Based on the mechanisms described and the theoretical frameworks examined we formulate the following hypothesis:

H1 At the country level, birthplace diversity is associated with overall lower levels of generalized trust.

Furthermore, we expect that greater birthplace diversity will result in lower levels of generalized trust among all groups, rather than simply among the majority because it increases the probability that individuals will interact with people who not only are unfamiliar but are all different from each other and different from the individual's in-group.

The prediction that greater birthplace diversity will be associated with lower generalized trust holds under equality of conditions and depends on the economic situation present in a country (Semyonov et al., 2008). Therefore, we control for economic development and the level of income inequality.

We predict that birthplace diversity will be associated with a higher degree of polarization in levels of trust between highly and poorly educated individuals. We measure the degree of polarization using education gradients in levels of trust. Our second hypothesis states:

H2 Education gradients in levels of trust are more pronounced in countries with higher levels of birthplace diversity.

Group threat theory predicts that changes in-group relations resulting from birthplace diversity affect different socio-economic and demographic groups differently depending on factors that are usually associated with educational attainment. These include labor market competition (Mayda, 2006; Scheve & Slaughter, 2001), competition for welfare and social services (Dustmann & Preston, 2007), racial intolerance and prejudice (Dustmann & Preston, 2001), and feelings of symbolic (cultural) threat (Castles & Miller, 2003; Fetzer, 2000). Most social surveys do not contain any information on cognitive skills, therefore little is known about the role of skills in shaping education gradients in trust. Data from the United Kingdom and the Netherlands (Hooghe et al., 2012; Sturgis et al., 2010b) have been used to identify such relations, but relationships could differ across countries and regions within countries and, crucially, such differences could be related to the social environment individuals experience. We are able in our work to disentangle direct socialization from cognitive and social sorting mechanisms and therefore can examine potential factors underlying systematic variations in education gradients in trust. Our third set of hypotheses is:

H3A The strength of the direct association between education generalized trust is not associated with levels of birthplace diversity.

H3B In the presence of greater birthplace diversity, the indirect association between education and trust that is mediated through cognitive skills is stronger.

H3C In the presence of greater birthplace diversity, the indirect association between education and trust that is mediated through social sorting is stronger.

We expect cognitive and social sorting mechanisms to be dependent on context. By contrast, we do not expect the direct association (that is socialization in the past) to be sensitive to the social context experienced at a particular time in adulthood.

We expect that information-processing abilities will be more strongly associated with trust in the presence of greater birthplace diversity because social interactions are less predictable and more complex in heterogeneous communities. In diverse communities, individuals are more likely to engage in interactions with others who differ on several dimensions from them and from each other. This means that each new encounter is likely to differ from previous encounters and require proficiency in evaluating situational cues. To the extent that generalized trust can be considered a problem-solving activity (Sturgis et al., 2010b), birthplace diversity should be viewed as a driver of the difficulty of the problem-solving task.

The lower social status that generally accompanies low levels of education means that individuals with low education will be more strongly affected by feelings of economic threat in the presence of out-of-group populations. Migrants in fact tend to be low-skilled, so native-born individuals with low levels of education are more likely to compete with migrants for jobs and welfare services (Dustmann et al., 2005) resulting in lower overall trust. Therefore, we expect that in countries characterized by greater birthplace diversity the indirect association between education and generalized trust mediated through social stratification will be stronger.

3 Data and Methods

3.1 Data

3.1.1 The Survey of Adult Skills

We use data from the OECD's Survey of Adult Skills (PIAAC). Around 200,000 adults were surveyed in 32 countries/national sub-regions: Australia, Austria, Belgium (Flanders), Canada, Chile, Cyprus, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Ireland, Israel, Italy, Japan, Lithuania, the Netherlands, New Zealand, Norway, Poland, Singapore, the Slovak Republic, Slovenia, South Korea, Spain, Sweden, Turkey, the United Kingdom (England and Northern Ireland), and the United States. Data collection took place between 2011 and 2012 in most countries and 2015 in Chile, Greece, Israel, Lithuania, New Zealand, Singapore, Slovenia, and Turkey. The target population for the survey was the non-institutionalized adult population, aged 16–65 years, residing in the country at the time of data collection, irrespective of nationality, citizenship, or language status. The survey was administered in the official language(s) of each participating country and some countries gave respondents the possibility of completing the survey in widely spoken minority/regional languages[1].

PIAAC has two main components: a background questionnaire and a cognitive assessment. Upon completion of the questionnaire, respondents sat the assessment, which took around one hour to complete.

We exclude from all our analyses individuals aged 16 to 24 to have a comparable measure of years of schooling completed across the whole sample (results are robust to the inclusion of 16 to 24-year-olds). We excluded four countries because of missing or poor quality data: Turkey and Cyprus (no data on relevant variables), Indonesia (data available only for Jakarta), and the Russian Federation [poor quality data – see Annex 7 in OECD. (2016a)]. Our final sample is composed of 155,267 respondents from 29 countries. Canada has a considerably larger sample size than other countries because it collected samples that allow reliable estimates at the provincial and territorial level and oversampled 16–25 year-olds, linguistic minorities, aboriginal population, and recent immigrants. Table A4 in the Supplementary Online Annex reports the number of respondents per country. When we develop analyses at the regional level the sample is 101,574 individuals from 146 subnational entities (Nomenclature of Territorial Units for Statistics – NUTS2 level for European countries and provinces for Canada) from 18 countries.

PIAAC's Technical Standards and Guidelines set a goal of a 70% unit response rate. Seven countries achieved this goal, while, for the most part, response rates were in the range of 50-60%. Participating countries were required to conduct a basic non-response bias analysis (NRBA) and report results, which are available in the PIAAC Technical Report (OECD 2016a). Overall, the level of non-response bias was considered to be minimal to low (OECD 2016a).

3.2 Measurements

3.2.1 Dependent Variable

The measurement of generalized trust has a long tradition in social research starting with the single item developed by Noelle-Neumann: "generally speaking, do you believe that most people can be trusted or can't you be too careful in dealing with people?" that was further developed by Rosenberg (1957) into a three-item scale separating a "radius of trust" dimension and a "being careful/misanthropy" dimension (Uslaner, 2011). In this study we used two indicators of generalized trust that were available in PIAAC in a dedicated module designed to identify test-takers' generalized trust: "there are only a few people you can trust completely" and "if you are not careful other people will take advantage of you". Respondents could answer on a 5-point Likert scale ranging from "strongly agree", "agree", "neither agree nor disagree", "disagree" to "strongly disagree". The two indicators were deemed complementary in their measurement of feelings of generalized trust by the group of international experts that designed the PIAAC questionnaire, their format was considered adequate for administration to the diverse participants taking part in the study and are positively correlated. By underlying "complete trust" and "few people", the first indicator reflects the respondent's trust in his or her immediate social relations and refers to deep feelings of trust. The second indicator captures a larger radius of trust by underlying "other people" and establishes a baseline level of trust by referencing the condition "if you are not careful". The correlation at the individual level is 0.55 and at the country level it is 0.81.

We created a continuous trust indicator that corresponds to the sum of individual responses to the two questions. The indicator ranges between zero and eight, with zero representing the lowest level of reported trust and eight, the highest reported level.

The aggregate indicator captures a broader spectrum of trust dimensions, has high reliability and a normal distribution in all of the surveyed countries. Although questions on generalized trust are widely used in comparative studies, it is important to note that some argue that the failure to specify in the question stem which "others" and which "people" may pose problems of comparability, particularly in cross-national research (Delhey & Newton, 2005; Nannestad, 2008; Reeskens & Hooghe, 2008).

Mean values for the combined indicator as well its components are presented in Fig. 1 (detailed statistics are present in Table A1 in the appendix).

3.2.2 Core Independent Variables

In the main body of the manuscript, we present analyses in which we measure education through an indicator of the *number of years an individual spent in school*. This variable was derived by the PIAAC consortium by converting respondents' answers on country-specific educational qualifications and mapping country-specific course length into years of schooling to aid comparability. The conversion could lead to measurement problems whenever individuals require a greater/smaller number of years to complete certain educational qualifications than is customary. For example, individuals who repeated a grade are assigned a lower value on the continuous years of schooling indicator than the number of years they actually spent in school. In the Supplementary Online Annex Tables A7 to A13 we complement estimates obtained using years of schooling with results estimated using an indicator

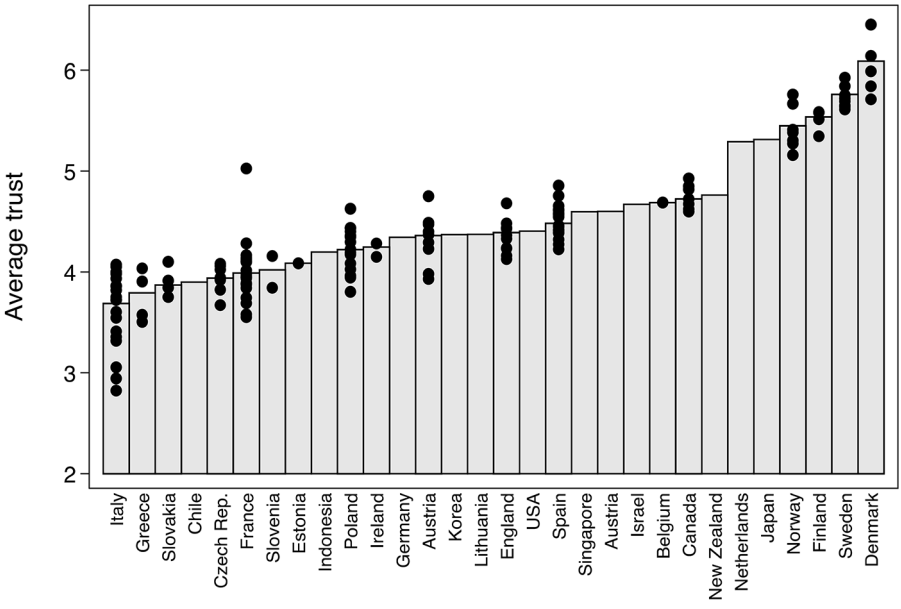

Fig. 1 Mean levels of trust in 29 countries. (*Source*: OECD Survey of Adult Skills. PIAAC 2012 and 2015 Databases. The bar represent average levels of trust in each country. The dots represent the average levels of trust in the 146 regions for which complete data are available)

reflecting the educational qualifications obtained by the respondent. We do so by introducing a dichotomous indicator that takes a value of 1 if respondents obtained at least an upper secondary qualification and zero if they did not.

Cognitive ability is introduced using indicators of respondents' literacy, which are measured through respondents' achievement in the PIAAC literacy assessment. The assessment, was designed to be comparable across countries with populations differing in language, cultural backgrounds, and average levels of education. PIAAC estimates for each respondent a set of ten plausible values that are used to assign to each respondent a probability estimate of their achievement (OECD, 2016b). The literacy scale in PIAAC was set to have a mean of 268 with a standard deviation of 47 across the subset of participating countries that belong to the OECD. Sample items that illustrate the types of problems individuals were required to solve in the PIAAC test can be found at OECD (2016b). We replicated all analyses using numeracy achievement in PIAAC. Results are comparable to those reported and can be requested from the authors.

Socio Economic Status of respondents is measured through an indicator that considers the prestige of the respondent's occupation and the respondent's income. Occupational prestige is measured by the Standard International Occupational Prestige Scale (SIOPS). The SIOPS scale is an internationally standardized gradual measure of the social standing of an occupation (Treiman, 1977). In line with other scales designed to evaluate the social prestige of occupations such as the International Socio-Economic Index (ISEI), SIOPS was designed as an instrument that would allow for cross-country comparisons (Ganzeboom & Treiman, 2010) and, compared to other measures of occupational attainment, such as income or status, occupational prestige is remarkably stable across historical time and countries (Hout & DiPrete, 2006) and is more suitable for comparisons across population subgroups (Warren et al., 1998). We decided to use SIOPS because ISEI captures, indirectly, the income returns to education through occupational placement and we have a direct measure of income in our dataset. Our income measure consists of the yearly income indicator that is provided in the restricted use PIAAC dataset. Information about income was derived from different formats and different items (e.g., hourly, monthly, yearly, daily income, etc.) gathered and converted into equivalent direct amounts and transformed into US dollars using purchasing power parity (PPP) correction. Indicator of individual SES was created as a sum of standardized income and SIOPS variables. Data constraints prevent us from using alternative indicators of prestige compared to SIOPS or indeed ISEI. These indicators may be less able to effectively characterize the occupational prestige of new and emerging occupations. Assessing in depth the properties of SIOPS is beyond the scope of this work but in the Supplementary Online Annex we provide estimates when we run models using only income and only SIOPS as robustness. These results in line with those presented. Descriptive statistics of all key variables are reported in Supplementary Online Annex Table A2.

3.2.3 Control Variables

We control for whether the respondent was *not currently employed and was not in education or training* at the time of the assessment (NEET); *immigration status* (dichotomized to include foreign-born individuals and the children of foreign-born parents), *age*, *gender* (in all models we report the change in external generalized trust that is associated with being a woman) and *socio-economic status (SES) of the family of origin of the respondent*.

Since we are not interested in estimating wages or labor market participation as such, but instead use income and labor market position as indicators of respondents' SES, we decided to impute all missing variables, including earned income and labor market position in the construction of SES. Therefore, NEET status (an indicator of lack of participation in productive activities at the time of the assessment) does not overlap with test-takers' long-term SES. The NEET variable identifies adults who, irrespective of age, were not employed at the time of survey and were not in education or training in the 12 months preceding the survey.

Family SES reflects the highest level of education of the respondent's mother/female guardian, the highest level of education of the respondent's father/male guardian, and the number of books that the respondent reported having at home when he/she was 16. Parental educational attainment was measured through a categorical indicator constructed using country-specific qualifications mapped on the International Standard Classification of Education (ISCED). The indicator details if the respondent' s mother/father did not obtain upper secondary school (ISCED 1, 2, and 3 C), obtained an upper secondary qualification (ISCED 3 - excluding 3 C short – and ISCED 4), or obtained a tertiary degree (ISCED 5 and 6). The number of books available in respondents' home at age 16 was measured as a categorical variable consisting of the following six categories: the respondent had 10 books or less; 11 to 25 books; 26 to 100 books; 101 to 200 books; 201 to 500 books; more than 500 books.

We treat parental SES as a composite indicator, which we construct using principal component analysis (PCA). Because all indicators are categorical, we used polychoric correlation in a process of estimation of principal component scores (Kolenikov & Angeles, 2004). We conducted PCA after missing data imputation and performed PCA ten times (once for each imputed dataset). Parental SES was standardized to have a mean of zero and a standard deviation of one in the pooled sample of equally weighted countries across the 10 multiple imputed datasets. Descriptive statistics of control variables are available in Appendix Table A3.

3.2.4 Country Level and Subnational Level Variables

Diversity is typically measured using ethno-linguistic fractionalization (Alesina et al., 2003), ethno-linguistic polarization (Montalvo & Reynal-Querol, 2005) or birthplace diversity (Alesina et al., 2016). We chose to consider birthplace diversity. At the country level, where we have detailed information on the number of foreign-born individuals and the country of origin, we are able to develop two indices of birthplace diversity: between diversity, representing the size of the foreign-born group (share of immigrants) and within diversity, representing the variety of countries of origin among foreign-born populations (diversity of origins of immigrants) (Alesina et al., 2016). The two birthplace diversity indicators are based on the Herfindahl-Hirschmann concentration index and indicate the probability that two individuals drawn randomly from the population will have two different countries of birth [2]. Data for the construction of the between diversity and within diversity indices come from the Trends in International Migrant Stock: Migrants by Destination and Origin database for 2010 (UNDESA, 2012).

At the subnational level, we consider the percentage of foreign-born individuals using information from the OECD's regional database (OECD, 2018). Information on subnational codes was collected and made available in PIAAC only for a subset of countries. For 18 European countries, the NUTS2 code represents the Eurostat definition of subnational

entities. We complemented information from European NUTS2 units with information on Canadian provinces.

Overall, we were able to use information from the following 146 NUTS2 entities: Austria: 9, Belgium: 1, Canada :8, Czech Republic: 8, Denmark: 5, Spain: 17, Estonia: 1, Finland: 4, France: 22, UK: 10, Greece: 4, Ireland: 2, Italy: 19, Norway: 7, Poland: 15, Slovakia: 4, Slovenia: 2, Sweden: 8.

At the country level, we control for income inequality and economic development.

As an indicator of income inequality, we use the country level Gini index calculated for the year 2010 (OECD, 2011a). Gini is a summary measure representing how income is distributed in a country, which ranges between 0 and 100, where 0 represents perfect equality.

We control for the level of economic development using an indicator of per capita Gross Domestic Product (GDP) for the year 2010 reflecting purchasing power parity (OECD, 2011b).

3.3 Methods

3.3.1 Missing Data

CAPI administration ensured a high level of participation and engagement with the background questionnaire. The vast majority of variables have minimal missing information (between 1.2% and 7.3%). Country-specific rates of missing data are presented in Appendix Table A4. However, earned income and employment status have many missing observations because many respondents were not in the labor force at the time of the survey. Since we are not interested in estimating wages or labor market participation as such, but instead use income and labor market position as indicators of respondents' SES, we decided to impute all missing variables, including earned income and labor market position. This is because we consider these indicators as proxies of individuals' long-term labor market performance and prospects. Therefore, we consider that the SES of a retired individual or someone who is on parental leave or is currently outside the labor force, for example because he or she is a NEET, should not reflect their lack of earned income at the time of the assessment, but, rather, their earning potential.

To examine how robust our findings are to our treatment of income information, we run all our models examining if the effects of diversity differ for the employed and not employed by adding interaction terms. Estimates did not reveal differences across the two groups.

Although there are no perfect solutions to cope with missing data, several methods have been developed and implemented. We used multiple imputation (MI) because MI performs on a par with alternative techniques (Ibrahim et al., 2005; Schafer & Graham, 2002) and has the advantage of being easily integrated in analyses of datasets such as PIAAC, which contain plausible values.

All imputations were produced using imputation by chained equations (ICE) (Royston 2004). The imputation model included all the variables from the analyses and was performed separately for each country to account for country-specific effects. We generated 10 multiple imputed data sets to match the 10 plausible values in PIAAC.

3.3.2 Modelling Strategy

We apply the identification strategy developed by Hooghe and colleagues (2012) to determine how much the observed positive association between education and generalized trust is mediated by cognitive ability and social position. Figure 2 illustrates the hypothesized associations.

In the first step of the analysis we replicated Hooghe's strategy (Hooghe et al., 2012) using path modelling fitting the model for each country in our sample (country specific results are reported in Table A5 in the Supplementary Online Annex). In the second step, we used multilevel modelling to model (and explain) cross-country differences.

We use the Multilevel Structural Equations Modelling (MSEM) Framework for assessing multilevel mediation and moderation. This framework extends the multilevel modelling (MLM) paradigm by allowing mediation pathways with Level-2 outcomes and distinguishing between- and within-level components of indirect effects (Preacher et al., 2010; 2011; 2016). Within the MSEM framework, it is possible to avoid problems of conflation of between and within effects. We followed the approach developed by Preacher et al., (2010) modelling and testing between and within indirect effects concurrently. Between effects indicate country/subnational level associations between country/subnational level average educational attainment, average SES, average cognitive ability, and average trust, while within effects indicate differences within countries/subnational entities in levels of trust between individuals with different levels of education, SES and literacy levels. We specified a model with four intercepts (education, trust, SES, and abilities) and three random slopes (education→trust, SES→trust, and abilities→trust) following the MSEM 1-(1,1)-1 model introduced by Preacher et al., (2010: 217).

The within part of the analysis described in Fig. 3 captures relations at the individual level while the between part details relations at the country/subnational level. In the last step, we added our key explanatory country level variable – birthplace diversity – and country/subnational level controls to try and explain variations in each hypothesized random effect.

In the modelling phase, all individual and country/subnational level variables (binary variables excluded) were standardized to have a mean of zero and standard deviation of

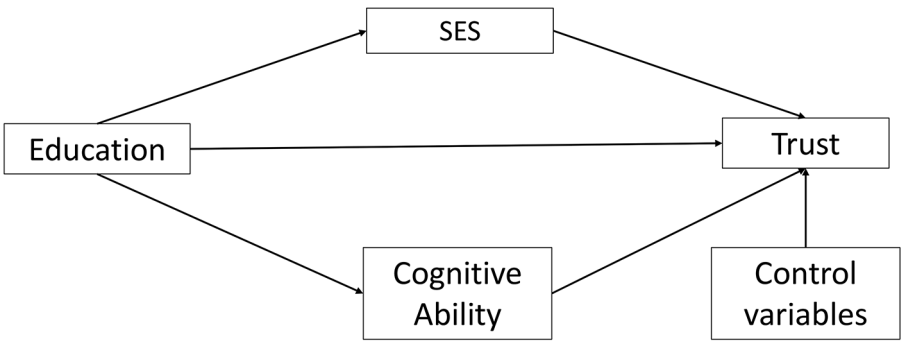

Fig. 2 Hypothesized pathways between education and trust

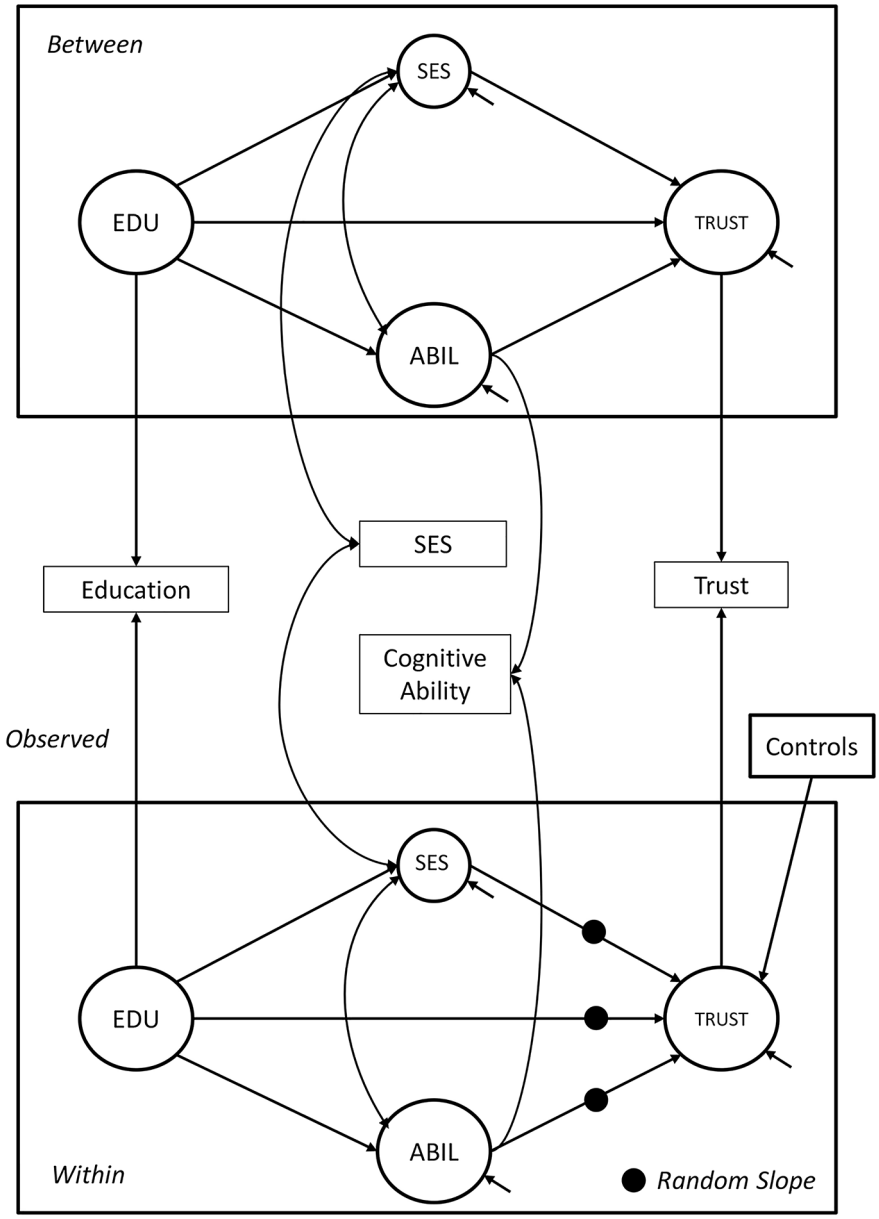

Fig. 3 Multilevel Structural Equations Model (MSEM) 1-(1,1)-1 of direct and indirect relations between education and trust. (Note: INC: Income; EDU: Years of schooling; SES: Socio-Economic Status of respondents; ABIL: Literacy)

one in the pooled dataset so that estimated coefficients could be interpreted in units of SD. We used the Mplus 7.2 software and maximum likelihood estimation with robust standard errors (MLR). We treated our dependent variable as continuous. Simulation studies have

shown that for variables with at least four categories, parameters estimated through maximum likelihood are highly accurate and, if anything, may have a small downward bias (DiStefano, 2002; Dolan, 1994). Because of the cross-sectional nature of PIAAC data and the modelling strategy that we use, estimates should not be interpreted causally. Rather, they indicate to what extent data from the countries under analyses are in line with hypothesized relationships.

Table 1 Models without group level explanatory variables

	Model 1a (Country)		Model 1b (NUTS)	
	Est.	s.e.	Est.	s.e.
Within group level paths				
SES← Education	0.570**	(0.023)	0.552**	(0.015)
Literacy← Education	0.507**	(0.023)	0.468**	(0.012)
Trust← Education	0.116**	(0.009)	0.121**	(0.009)
Trust← SES	0.099**	(0.010)	0.099**	(0.010)
Trust← Literacy	0.072**	(0.013)	0.077**	(0.009)
Trust← NEET	-0.108**	(0.016)	-0.122**	(0.014)
Trust← Migrant	-0.059**	(0.023)	-0.055**	(0.020)
Trust← Age	0.056**	(0.008)	0.051**	(0.008)
Trust← Female	0.133**	(0.019)	0.128**	(0.014)
Trust← Parental SES	0.070**	(0.006)	0.060**	(0.005)
Between group level paths				
SES← Education	0.099	(0.098)	0.661**	(0.125)
Literacy← Education	0.114	(0.125)	0.398*	(0.164)
Trust← Education	-0.195	(0.139)	-0.328*	(0.141)
Trust← Literacy	0.548**	(0.172)	0.202†	(0.106)
Trust← SES	-0.294	(0.322)	0.132	(0.097)
Variance components (in SD)				
Trust	0.251**	(0.032)	0.076**	(0.007)
SES	0.137**	(0.024)	0.096**	(0.008)
Literacy	0.257**	(0.058)	0.124**	(0.015)
(Trust← Education)	0.051**	(0.005)	0.078**	(0.009)
(Trust← SES)	0.044**	(0.006)	0.092**	(0.010)
(Trust← Literacy)	0.064**	(0.009)	0.079**	(0.009)
Effect of education on trust				
Total indirect within	0.093**	(0.010)	0.091**	(0.007)
(through SES)	0.056**	(0.006)	0.055**	(0.006)
(through literacy)	0.037**	(0.006)	0.036**	(0.005)
Total indirect between	0.033	(0.058)	0.187 *	(0.076)
Total within (dir+indir)	0.209**	(0.015)	0.211**	(0.010)
(through SES)	-0.029	(0.048)	0.134$^{\leftarrow}$	(0.070)
(through literacy)	0.062	(0.063)	0.053	(0.043)
Summary				
Sample-Size Adj. BIC	1543832.216		1005886.591	
n	155,267		101,574	
N	29		146	

Note: **p < 0.01; *p < 0.05; $^{\leftarrow}$p < 0.1

The estimation procedure that we used for the regional data model was similar to the model that we specified for the country level, with the difference that we further controlled for country fixed effects, therefore estimates reflect within country between region differences. We did so by centering data at the country level and using country-level centered data in the estimation of a new multilevel model in which the 146 subnational entities are the Level 2 clusters.

Because we imputed missing information and PIAAC achievement scores are expressed as plausible values, all estimates were fitted ten times, once for each plausible value and imputed dataset, and were then aggregated to obtain correct estimates following Rubin's rule (Little & Rubin, 1987).

4 Results

Table 1 reports results from two models built in the GMSEM framework. Models 1a and 1b in Table 1 contain only individual level factors and allow us to test if education and generalized trust are positively associated, the relative contribution of direct, social sorting, and cognitive mechanisms and if estimated associations vary across countries and regions. In order to decompose within and between effects, we consider countries as level 2 units in Model 1a and regions in Model 1b. Table A7 and A8 in the Supplementary Online Annex report results when an indicator of whether the respondent obtained an upper secondary degree rather than years of schooling, is used to characterize education.

Estimates presented in Model 1a indicate that there is a quantitatively large and statistically significant positive association between education and trust. The total within (direct + indirect) effect of education on trust estimate reported in Model 1a of Table 1 indicates that a difference of one SD in education (corresponding to around 3 years of schooling) is associated with a difference of 0.209 SD in the level of generalized trust reported by respondents (more education being associated with higher trust). The strength of the total within association between education and trust is very similar when we consider subnational units in Model 1b with an estimated difference of 0.211 SD. Estimates presented in Table A7 in the Supplementary Online Annex reveal that when the association between education and trust is estimated using a measure reflecting educational qualifications results are similar (0.214 SD compared to 0.209 SD estimated using years of schooling).

Model 1a also allows us to identify the relative contribution of socialization, social sorting, and cognitive mechanisms in shaping education gradients in trust. Around 55% of the association between education and trust is direct: the estimated coefficient for the within group level path of trust ⇓ education reported in Table 1 model 1a equals 0.116 SD. Around 45% of the association between education and trust is indirect and stems from a combination of social sorting and cognitive mechanisms. Social sorting accounts for around 27% of the overall association: the estimated coefficient for the total indirect within association through SES in Table 1 Model 1a = 0.056 SD. Cognitive mechanisms account for the remaining 18% of the overall association: the estimated coefficient for the total indirect within association through literacy in Table 1 Model 1a = 0.037 SD. Table A8 in the Supplementary Online Annex reveals that subnational level results are also aligned when education is measured using an indicator of educational qualifications.

We formally test and quantify the variation of estimated coefficients in the variance components of Table 1 to assess if our data support the hypothesis that associations vary across countries/subnational entities. Readers interested in country specific associations can find estimates obtained from country specific SEM analyses in Annex Table A5 and A7 for models which characterize education in terms of educational qualifications (i.e. having obtained at least an upper secondary degree). Results on variance components in Models 1a and 1b indicate a high degree of between-country and between-region variability in the overall association between education and trust and in the relative importance of the direct association and of social sorting and cognitive mechanisms.

GMSEM models enable us to disentangle the relative strength of direct, social sorting, and cognitive mechanisms. At the country level, most between-associations are not statistically significant with an important exception: other things being equal, countries with higher levels of literacy are also countries where individuals tend to report higher levels of trust. At the regional level, all estimated between associations except for regional level SES and trust, are statistically significant at least at the 10% level.

Table 2 allows us to test **H1**, that is, if levels of trust are lower in contexts characterized by greater birthplace diversity. We report two sets of models at the country level (controlling for diversity only and additionally controlling for GDP and Gini) for each measure of diversity. Information on detailed country of birth of residents is only available at the country level, so we could only develop the between diversity indicators for regions, when we do not control for GDP and Gini but for fixed country effects.

We do not report within group level path results in Table 2 because these are virtually identical to those reported in Table 1.

We do not find a statistically significant association between most indicators of birthplace diversity and trust and therefore no strong support for **H1**. The indicator of within diversity (denoted by the between group level path: trust ⇓ Diversity in Table 2) is positively associated with overall levels of trust (opposite direction of what the literature suggests) but the association is not robust to the inclusion of country level controls and is quantitatively small (a difference of one SD in the within diversity indicator is associated with a 0.083 SD difference in trust in Model 2a but not in Model 2b).

We examined if the effects of birthplace diversity differ across native and migrant populations by adding interaction terms between immigration background and the country (subnational) level diversity indicators. Differences between native-born and foreign-born populations were small in size and statistically not significant (results are not presented in the manuscript but are available from the authors upon request).

Estimates of the extent to which birthplace diversity explains between country differences in the relationship between the total effect of education and trust are graphically presented in Fig. 4. The solid line expresses the predicted strength of the association between literacy levels and trust as a function of birthplace diversity. Dashed lines express 95% coefficient intervals. The left panel presents country level estimates while the panel on the right illustrates regional level estimates. Results suggest that the relationship between education and trust is particularly strong in countries where diversity is high, such as Canada, Australia, and Singapore, and is weak in countries with little birthplace diversity, such as Chile, Japan, and Poland. These results support **H2** indicating that education gradients in trust differ depending on the level of birthplace diversity.

Table 2 Models with group level explanatory variables. Between level part only

	Country (within diversity)				Country (between diversity)				NUTS (between diversity)	
	Model 2a		Model 2b		Model 2c		Model 2d		Model 2e	
	Est.	s.e.	Est.	s.e.	Est.	s.e.	Est.	s.e.	Est.	s.e.
SES← Education	0.098	(0.099)	0.103	(0.095)	0.094	(0.099)	0.101	(0.096)	0.667**	(0.125)
Literacy← Education	0.109	(0.123)	0.186	(0.180)	0.107	(0.119)	0.183	(0.181)	0.403*	(0.163)
Trust← Education	-0.213	(0.135)	-0.205$^{\leftarrow}$	(0.124)	-0.206	(0.141)	-0.196	(0.120)	-0.332*	(0.143)
Trust← SES	-0.275	(0.288)	-0.196	(0.254)	-0.230	(0.317)	-0.209	(0.263)	0.203$^{\leftarrow}$	(0.110)
Trust← Literacy	0.651**	(0.213)	0.490$^{\leftarrow}$	(0.270)	0.592**	(0.195)	0.458$^{\leftarrow}$	(0.239)	0.135	(0.097)
Trust← Diversity	0.083**	(0.025)	0.038	(0.041)	0.055	(0.039)	-0.013	(0.059)	0.002	(0.008)
Trust← GDP	---	---	0.117**	(0.043)	---	---	0.138**	(0.053)	---	---
Trust← GINI	---	---	-0.012	(0.066)	---	---	0.000	(0.061)	---	---
Cross level interactions										
Trust← Education*Diversity	0.005	(0.008)	-0.001	(0.010)	0.010	(0.009)	0.003	(0.008)	0.018$^{\leftarrow}$	(0.010)
Trust← SES*Diversity	0.000	(0.017)	0.002	(0.009)	-0.003	(0.008)	-0.002	(0.011)	0.010	(0.012)
Trust← Literacy*Diversity	0.005	(0.008)	0.015*	(0.008)	0.011	(0.016)	0.024**	(0.009)	0.022*	(0.010)
Trust← Education*GDP	---	---	0.022*	(0.010)	---	---	0.020$^{\leftarrow}$	(0.011)	---	---
Trust← SES *GDP	---	---	-0.001	(0.010)	---	---	0.001	(0.011)	---	---
Trust← Literacy *GDP	---	---	0.005	(0.014)	---	---	-0.002	(0.015)	---	---
Trust← Education*GINI	---	---	-0.017	(0.017)	---	---	-0.017	(0.018)	---	---
Trust← SES *GINI	---	---	-0.006	(0.012)	---	---	-0.004	(0.011)	---	---
Trust← Literacy *GINI	---	---	-0.042**	(0.012)	---	---	-0.043**	(0.012)	---	---
Variance components (in SD)										
Trust	0.239**	(0.034)	0.219**	(0.028)	0.246**	(0.034)	0.221**	(0.027)	0.076**	(0.007)
SES	0.137**	(0.024)	0.137**	(0.024)	0.137**	(0.024)	0.137**	(0.024)	0.090**	(0.009)
Literacy	0.258**	(0.058)	0.255**	(0.056)	0.258**	(0.058)	0.255**	(0.056)	0.075**	(0.009)
(Trust← Education)	0.052**	(0.005)	0.039**	(0.006)	0.052**	(0.005)	0.040**	(0.006)	0.076**	(0.007)
(Trust← SES)	0.044**	(0.006)	0.044**	(0.006)	0.045**	(0.006)	0.044**	(0.006)	0.096**	(0.008)

Table 2 (continued)

	Country (within diversity)				Country (between diversity)				NUTS (between diversity)	
(Trust← Literacy)	0.064**	(0.009)	0.051**	(0.007)	0.063**	(0.011)	0.049**	(0.007)	0.124**	(0.015)
Summary										
Sample-Size Adj. BIC	1543762.706		1543812.220		1543762.875		1543810.185		1005905.047	

Note: **p<0.01; *p<0.05; ⁻p<0.1

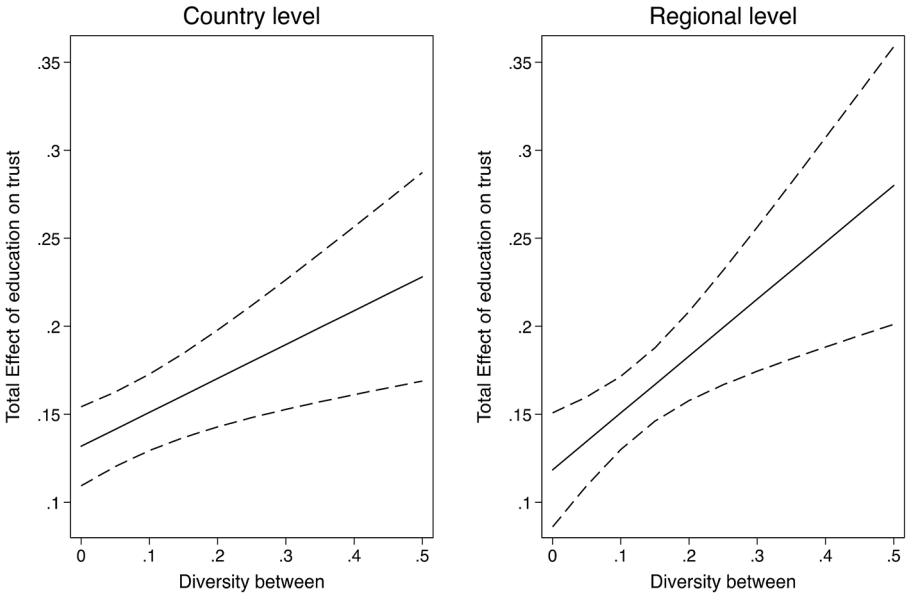

Fig. 4 Total effect of education and level of diversity

Table 2 allows us to identify the extent to which some of the mechanisms underlying the association between education gradients in generalized trust and birthplace diversity are responsible for the pattern identified in Fig. 4. In particular, Table 2 provides no evidence that the direct association between educational attainment and trust differs between countries with comparatively high levels and countries with comparatively low levels of birthplace diversity, thus supporting **H3A**. After controlling for the mediated effects of social sorting and cognitive mechanisms, the cross-level interaction of individual level education and country level diversity (indicated by the estimate for the Cross Level interaction: trust ⇓ Education*Diversity in Table 2) is statistically insignificant and quantitatively small. At the regional level, we find a statistically weak and quantitatively small positive association (the estimated coefficient for the cross-level interaction equals 0.018 and is significant at the 10% level). Results estimated using the indicator of educational qualifications are similar to those obtained when years of schooling are considered and are presented in Tables A9 and A10 in the Supplementary Online Annex.

By contrast, results from the mediation moderation models developed at both the country and regional level indicate that in countries and regions with higher birthplace diversity, the indirect association between education and trust that is mediated by cognitive skills is greater, thus supporting **H3B**. At the country level, the cross-level interaction effects of individual level literacy and country level measures of birthplace diversity are statically significant and quantitatively meaningful when we control for other confounders in models 2b and 2d. Cross Level interactions: trust ⇓ Literacy*Diversity in Table 2 equals 0.015 in model 2b and equals 0.024 in model 2d. At the regional level, the association is comparable in size to the estimate obtained at the country level (0.022). We do not find any evidence that the association between education and trust that is mediated by socio-economic status

is different depending on the level of birthplace diversity, and we thus fail to find support for **H3C**. Cross Level interactions: trust ⇓ SES*Diversity in Table 2 equals 0.002 in model 2b and equals −0.002 in model 2d and are not statistically significant at conventional levels.

5 Discussion

Following the work of Alesina and Putnam (Alesina et al., 1999; Putnam, 2007), a wealth of empirical and theoretical studies have contributed to the debate on the potentially negative effects of diversity on social cohesion. Such interest stems, in large part, from the recognition that international migration flows will lead to increased diversity.

Empirical estimates on the association between diversity and social cohesion reported in the literature differ depending on the measures of diversity used (ethnic, linguistic or birthplace diversity), the geographical focus of the investigation (national, regional, neighborhood), and indicators of social cohesion (trust, volunteering, participation in civic activities, voting) (Schaeffer, 2013; Sturgis et al., 2010a).

Although the literature has extensively investigated the potential consequences of social diversity for overall levels of trust, little was known about whether diversity results in steeper education gradients in generalized trust and a greater polarization in levels of trust across individuals with different levels of education. Education is one of the strongest correlates of generalized trust and, as such, could counterbalance the potentially negative effect on social cohesion of increased migration flows (Borgonovi, 2012). However, education could play a positive role at the population level only if the benefits of education do not arise from social sorting and social stratification mechanisms but from the skills, attitudes, and dispositions that education fosters.

A limitation of most existing analyses is that analyses are conducted at the country level (Sturgis et al., 2010a). Some studies attempted to identify the association between ethnic/linguistic and birthplace diversity and trust at the micro-context, with some studies finding a negative association (Dinesen & Sønderskov, 2015) and others no association (Sturgis et al., 2010a). While our data do not allow us to consider diversity at the neighborhood level, we were able to identify regional level diversity. Extending analyses at the subnational level is crucial because if social context matters for the formation of feelings of trust, country level indicators are likely to be poor proxies for the lived experiences of individuals.

We find that at the individual level, education is strongly and positively associated with trust. The association varies greatly across countries and regions because the association between cognitive skills and trust and the cognitive returns to education differ across countries/regions. By contrast, we find that overall levels of trust in a country or a region are not associated with the number and diversity of foreign-born populations.

Contrary to several previous studies, we find that birthplace diversity does not lower overall levels of trust. This difference could be due to the specific measures of trust and diversity that we use or to the sample of countries and regions considered. However, we find that even if birthplace diversity is not associated with lower overall levels of trust, it can still pose an important challenge to social cohesion because it leads to greater disparities in trust within communities. By focusing on the mechanisms underlying polarization in trust across levels of education, our study provides opportunities to consider how polarization could be reduced.

Our study is correlational in nature and therefore cannot identify causal relations. However, other studies have suggested that education is causally related to civic outcomes (Huang et al., 2011). To the extent that relations reflect causal mechanisms, our work suggests that education systems can play an important role in fostering social cohesion, especially when social interactions are rendered less predictable by the presence of multiple social and cultural groups. Our results indicate that information-processing abilities are a key pathway through which education systems can do so.

The role of information processing abilities is likely to be crucial in the presence of high levels of birthplace diversity because without the power of rationalization, in group bias and stereotyping can lead to feelings of fear and threat towards out-of-group members (Rozin et al., 2009). Although stereotyping operates at a subconscious, emotional level (Berreby, 2009) previous work suggests that education can reduce the weight such feelings have on individuals' choices and behaviors by improving information processing abilities and content knowledge (Hauser, 2000; Nie et al., 1996; Schoon et al., 2010), and by shaping critical thinking, decision making, and civic competences (Hoskins et al., 2008).

A key limitation of our study is that PIAAC data do not contain detailed information on the socialization role education can play so we can only explore social sorting and cognitive mechanisms. The socialization mechanism is therefore captured in the direct effect of education, together with other mechanisms. For example, previous research suggests that individuals' capacity for self-regulation, attitudes towards risk, self-efficacy, and sense of empowerment are important determinants of generalized trust (Bandura, 1993) and that these factors can be promoted through education (Cunha & Heckman, 2008). A fruitful area for further research is to detail all the pathways through which education can influence trust and other factors that are key to social cohesion.

5.1 Endnotes

1. See www.oecd.org/site/piaac for technical details.
2. We use the following formula to calculate the total level of birthplace diversity in a country or subnational region: $Diversity_{TOTAL} = \sum_{i=1}^{I} s_i * (1 - s_i) = 1 - \sum_{i=1}^{I} (s_i)^2$

Where, s_i is the share in total population of individuals born in country *i*, with $i = 1, \ldots I$ and $i = 1$ refers to native-born individuals. It is an Herfindahl-Hirschmann concentration index and it measures the likelihood that two randomly drawn individuals from a population will have two different countries of birth. The index can be decomposed into a between and a within component. Between diversity expresses the level of diversity between native borns and foreign-borns (without considering countries of origin of foreign-born populations): $i = 2$ and $s_1 + s_2 = 1$.

The within level diversity expresses the degree of diversity within foreign-born populations and the indicator was calculated using the following formula: $Diversity_{WITHIN} = \sum_{i=2}^{I} s_i * [(1 - s_i) - s_1]$

Supplementary Information The online version contains supplementary material available at https://doi.org/10.1007/s11205-022-02948-z.

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