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Three spheres of stratification in how social origin relates to educational achievement: a large-scale analysis

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ABSTRACT

This paper proposes to broaden the focus of analysis when studying the importance of parental context for a child's educational achievement and attainment. Research has assessed the relevance of social origin primarily in the form of effects of parental characteristics. However, two additional aspects require further attention: first, individual-level distributions of the respective characteristics, and second, the composition or associations of context characteristics at the family level. This means that, in fact, three spheres of stratification need to be considered when assessing social origin's relevance for education.

Going beyond parent-specific effects, this paper compares 61 countries with regard to the relevance of parental context in children's educational achievement. Using large-scale data from the Programme for International Student Assessment (PISA) 2015 study, individual-level information on school students and their parents is used to derive country-specific macro-level indicators. These indicators are then used for comparative analyses. The analyses are also replicated using different measures for social origin and achievement. The results confirm that it is reasonable to consider various components when conceptualising and interpreting the level of origin-based inequality in education. There are marked international differences in the specific relevance of these components, but there are no clear associations between these dimensions.

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Education; social inequality; parental context; assortative mating; comparative research; PISA

1. Introduction

The importance of the family context for children's educational achievement and attainment is not only a central argument in theories of socialisation and education. The relevance of family background or 'social origin' has also been confirmed by many empirical studies (Boudon, 1974; Breen & Jonsson, 2005; Breen, Luijkx, Müller, & Pollak, 2009; Coleman et al., 1966; Duncan, Featherman, & Duncan, 1972; Hauser & Featherman, 1976; Shavit & Blossfeld, 1993). While a variety of indicators have been used for measuring family background (cf. Buchmann, 2002), research has concentrated primarily on assessing the relevance of social origin in the form of estimated (net) *effects* of parental characteristics (for meta-studies, see Sirin, 2005; White, 1982). This paper proposes to go beyond

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that. Research on origin effects has advanced our knowledge about the mechanisms of social inequality in education, but effects of parental characteristics give only a partial account of the relevance of the family context as a source of variation in educational achievement and attainment. In particular, two additional phenomena – macro- and meso-level aspects of social origin – require further attention. First, it seems important to account for the *distributions* of context characteristics in the respective populations. In general, for a determinant's effects to become salient within a population, there must be variation in the determinant. Second, it is important to study the internal structure of parental contexts. It is known that both parents are important for a child's educational development, though not necessarily to the same degree (Hillmert, 2013a, 2015). The parental context is also not unitary (Acker, 1973) but is instead a specific combination of parents. Therefore, it is important to study the social composition of family contexts as well as the associations of context characteristics at the family level. In stratification research, there has also been a long-standing debate about ways of dealing with inner-family social heterogeneity; see, for example, the 'dominance approach' to social origin in analyses of social mobility (Erikson, 1984). Hence, including the issue of origin effects, there are three major aspects to consider, and the range of social origin mechanisms might readily be measured through three sets of empirical indicators that are widely available from survey data.

Following this strategy, this paper aims to give a more comprehensive description of the parental context as a source of differentiation in education by comparing a substantial number of countries with regard to distributions of parental characteristics, their associations at the family level, and their effects on the children's educational achievement. Section 2 starts with conceptual and theoretical considerations about the relevance of the parental context for education and the different aspects of this relevance. The arguments are then illustrated by select empirical analyses that compare 61 countries using large-scale data from the Programme for International Student Assessment (PISA) 2015 study (Section 3). In the first step of analysis, country-specific macro-level indicators were derived from this individual-level data on school students and their parents. In the second step, those indicators were used for comparative analyses. Section 4 presents the empirical results, looking at aspects of distributions, the composition of the family context, and international associations among selected indicators. Finally, Section 5 gives a summary of the results and offers some conclusions that may be relevant for study designs in stratification research in general.

2. Conceptual and theoretical considerations

Focusing on individual students, we can conceptualise the relevance of the parental context as parents' sociological characteristics having an impact on students' educational development. Assuming an ideal-typical two-parent family context, such a relationship applies to both parents, although the corresponding effects may be different. Moreover, the relevant characteristics of both parents may influence each other via mechanisms such as selective partner choice or adaptive behaviour (see Figure 1, panel a).

From a macro-level perspective, the phenomenon of 'social' (i.e. origin-related) inequality in education in a particular society has two components: first, the *impact* of social origin characteristics, and second, the *distribution* of these origin (parental) characteristics, in

particular the dispersion (inequality) found in this distribution. Parental characteristics have an individual distribution, but they also form specific configurations on the level of the couple or family. This adds a third component. A simple way of looking at this is as the joint distribution of parental characteristics. Even more informative, however, is to look at family-specific associations and configurations because that allows for studying

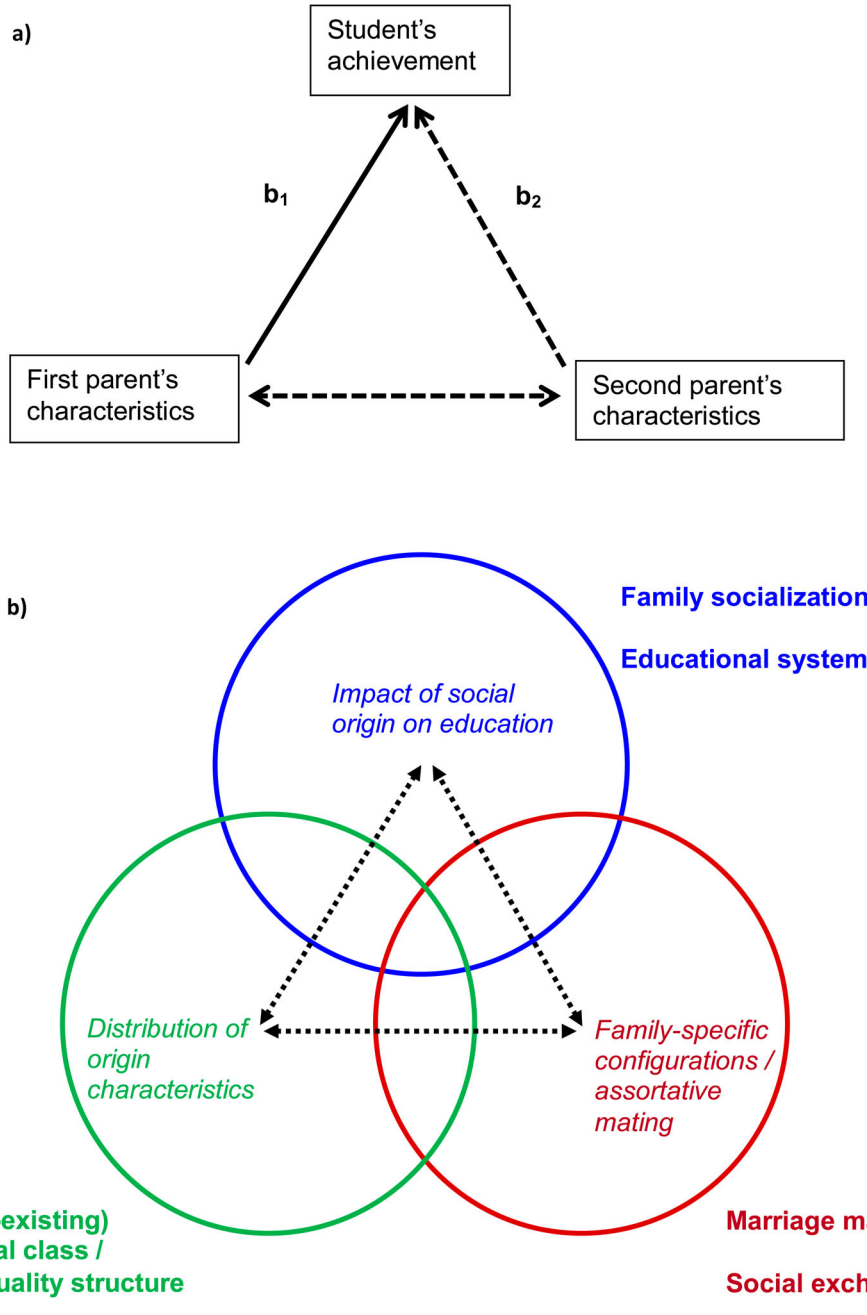

Figure 1. Determinants of social inequality in educational achievement, and spheres of stratification.

more explicitly the formation of the joint distribution. Hence, a comprehensive assessment of origin-specific inequality in education comprises three groups of interconnected indicators (see Figure 1, panel b). First, there is the impact of social origin on education – represented, in particular, by effect coefficients in analyses that regress individual-level education on social origin. This follows the micro-level considerations discussed at the beginning of this section. Second, there is the (individual) distribution of origin characteristics (a macro-level aspect), which is typically characterised by a considerable amount of dispersion or inequality. Together, the distributions and effects of parental characteristics can 'explain' variations in educational outcomes. Third, the formation of parental contexts is not a sociologically random process. Rather, there is systematic 'assortative mating' in all societies, although it varies by degree (Blossfeld & Timm, 2003; Mare, 1991). Adequate indicators describe associations or typical family configurations (meso-level aspects), and these may modify the relevance of individual parental characteristics.

Each of the groups of specific indicators represents a particular form of social stratification and highlights different aspects. The three groups of indicators can therefore be integrated into a more general perspective of social inequality that asks about the different mechanisms generating inequality in society and their institutional or market-based correlates. One could call these clusters of mechanisms different spheres of stratification (represented by the circles in Figure 1, panel b). Indicators of the *impact* of social origin are conventionally associated with aspects of socialisation and education, and explanations for specific forms and levels of such impacts have often referred to mechanisms of learning, choice, and selection within the family or educational systems (Boudon, 1974; Breen & Goldthorpe, 1997). Indicators of the *distribution* of origin characteristics refer to general structures of social inequality in a society, including the structure of occupations and social classes. These are conventionally associated with economic processes, particularly the labour market (Giddens, 1973). Finally, indicators of family *configurations* refer to specific conditions in the marriage market and the level of a society's social openness as it is expressed in patterns of social intermarriage. These are the result of both individual preferences and collective opportunity structures (Kalmijn, 1998).

Country-specific values of indicators in any of these spheres result from a variety of conditions, including specific institutional features, and are also contingent on historical circumstances. Regarding the effects of social origin on education, probably most prominent are characteristics of educational systems, such as (early) tracking (Kerckhoff, 1995; Pfeffer, 2008). However, a comprehensive discussion of substantive (causal) explanations relating to country-specific characteristics in all three spheres of stratification is beyond the scope of this paper, and in the following comparative and joint analyses, the country-level indicators will be treated as exogenous.

Going even beyond international comparisons regarding each of the spheres of stratification, the possible *associations* among the three spheres will also be investigated: Are there any specific links and possible trade-offs between spheres of stratification when comparing countries? Depending on the results of such analyses, very different conclusions for a general assessment of social stratification would follow. *No* associations or only minor ones between the macro-level indicators representing the different spheres would mean that these are quite separate. All of them would represent some relevant aspect of stratification in societies, but they would have little connection. *Positive* associations would indicate a high degree of consistency in stratification patterns. This would

imply a general, one-dimensional hierarchy between countries of lower stratification and countries of higher stratification. In contrast to this, *negative* associations would suggest a tendency towards overall similarity in national stratification levels in general, combined with some degree of equivalence of social inequality or closure in different stratification spheres. This means that a country's relatively high degree of stratification in one sphere would often be compensated for by a comparatively low level of stratification in another sphere. Theory on these kinds of trade-offs is even scarcer than theory on the conditions in each sphere separately. Only a small number of such relationships have already been the subject of research and public discussion. In particular, (negative) links between the level of inequality and social mobility have been reported (the '*Great Gatsby* Curve': see Corak, 2013; Krueger, 2012). However, those reports have been primarily with regard to income inequality and mobility, not occupational variation and educational inequality. Therefore, these analyses of possible trade-offs are essentially exploratory.

3. Data and variables

For the following empirical analyses, the data used were from the international PISA 2015 study (OECD, 2019). PISA is a regularly conducted assessment of 15-year-old students that focuses on reading ability, mathematics, and science. The following analyses are based upon information from $N = 61$ countries, 34 of which are OECD countries; this is the complete list of OECD member states except for Poland (which had outliers in analyses of parental variables, in particular, inter-parental correlations). Also, regarding non-OECD countries, obvious outliers and PISA cases that represented regions or cities within a nation were dropped from the analysis. The joint total of the remaining individual cases was $N = 422{,}372$. Further information on the data including an explanation of the country codes is given in Tables A1 and A2 in the appendix.

Individual-level data from PISA were used to generate country-level indicators, in particular, estimates of social origin's effects on student achievement and the corresponding explained variances. This was done by performing country-wise linear regressions of individual achievement on social origin characteristics. The primary individual-level dependent variable was individual achievement (test scores), in the first instance, regarding the reading and understanding of texts. This competency is crucial for not only academic success in school but also later in life. It is associated with other learning activities and can be expected to be reasonably influenced by social environments beyond just the immediate school context. Ability measures in PISA are internationally standardised, with a mean of 500 and a standard deviation of 100. The primary independent variables in the student-level regressions were related to parental education and socio-economic status (International Socio-Economic Index [ISEI]; cf. Ganzeboom, De Graaf, & Treiman, 1992). The corresponding information came from the students. Employment rates tend to be low in some countries, particularly among women, and valid ISEI values for parents in PISA require economic activity (at least in the past). This fact may explain the relatively high levels of missing data in the analyses using occupational status. The analyses using parental education are not affected by this condition.

To examine the robustness and generalisability of the results, all analyses were replicated using various forms of operationalisation. Math and science competencies were used as competency domain alternatives to reading, and measures of parental education

as social origin variables were alternatives to socio-economic status. Valid information about education is more frequently available for both parents than information on occupational status, but there is only a very limited number of International Standard Classification of Education (ISCED) categories. Using country-specific information in PISA, parental level of education was transformed into a metric estimate of parent's years of education.

Control variables in the student-level analyses included sex, (generational) migration status, and an indicator denoting whether the test language was spoken in the student's family. These are well-known predictors of academic achievement (Hillmert, 2013b). The models used the student weights provided by PISA and were conducted stepwise, starting with a baseline model, followed by the inclusion of the father's or mother's characteristics, and finally, of both parents' characteristics. With 36 regressions per country (including the replications) and 61 countries, approximately 2,200 regressions were conducted in total in order to derive relevant macro-level parameters. These parameters included, in particular, the country-specific b coefficients (regression slopes) representing the impact of social origin indicators. Other country-level variables included the dispersion of parental education and occupational status and country-wise correlations between the respective parental characteristics. For each social origin indicator, the models were restricted to equal case numbers – the cases of the full models – to allow for stepwise comparisons and consistent decompositions. Family-level decompositions required complete information for both the mother and the father. This procedure means, of course, a simplification; it implies not only valid values for the respective parents but also the ideal-typical assumption of a two-parent 'complete family' model.

4. Empirical analyses

4.1. Distributions of predictors and outcomes

In comparative research, (absolute) variation in educational achievement is a prominent topic (cf. Van de Werfhorst & Mijs, 2010), but it is rarely linked to social origin distributions. In Figure 2, the amounts of country-level variances in school students' reading achievement scores that can be explained by the variations in parental socio-economic status have been plotted as a function of the observed (country-level) variations in this status. Panel (a) in Figure 2 refers to the father's ISEI, and panel (b) refers to the mother's ISEI. The patterns differ only slightly.

Simple ordinary least squares (OLS) regression analyses allowed for factorisation on the basis of the (rearranged) definitional equation:

$$\text{Explained variance}(Y) = r^2\ \text{Var}(Y) = b^2\ \text{Var}(X) \tag{1}$$

In the charts, straight lines through the origin link cases with an equal (squared) effect size b^2. In Figure 2, exemplary lines that represent the respective median effect sizes have been added to the charts. Cases that are located above this median line are countries where the (total) effect of parental ISEIs on a student's reading competency is greater than the international median (i.e. the *impact* of social origin is relatively high); cases that are located below the median line are countries where the (total) effect of parental ISEIs on a student's reading competency is lower than the international median (i.e. the impact of social origin is relatively low). Along each of these or other

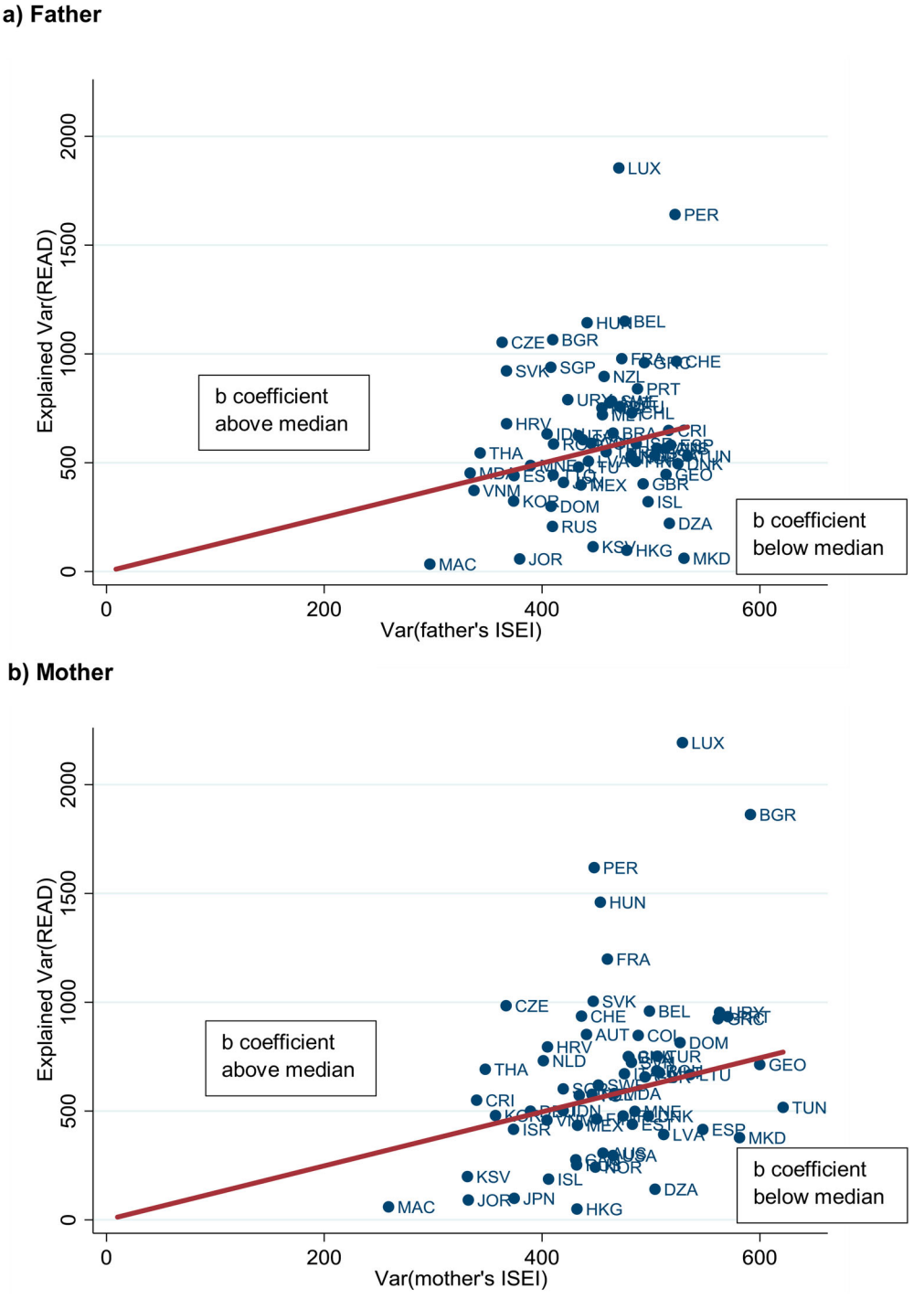

Figure 2. Variation of parent's socio-economic status and (gross) explained variance of student's reading competence score. Straight lines through origin link cases with equal b^2. Displayed are the lines based on the respective (across countries) medians of b.

imaginary lines through origin, multiple cases can be found that indicate differences in the relevance of social origin in spite of an identical level of origin effects. Hence, these panels can serve as aggregate comparative illustrations of social inequality in education in three dimensions: dispersion of social origin variable, effect size, and educational variation explained by social origin.

The micro-level control variables have been included in the following analyses. The results are shown in Figure 3, which compares various measures of the impact or relevance of social origin across countries: effects of the origin variables, explained variance, and unexplained (error) variance.

Effect coefficients are conventional indicators of educational opportunity, but it is remarkable that the (net) effects of the father's and mother's occupational statuses are only weakly correlated ($r = 0.23$). The explained variance – here from models using information about both parents – is a measure of the relevance of social origin in the

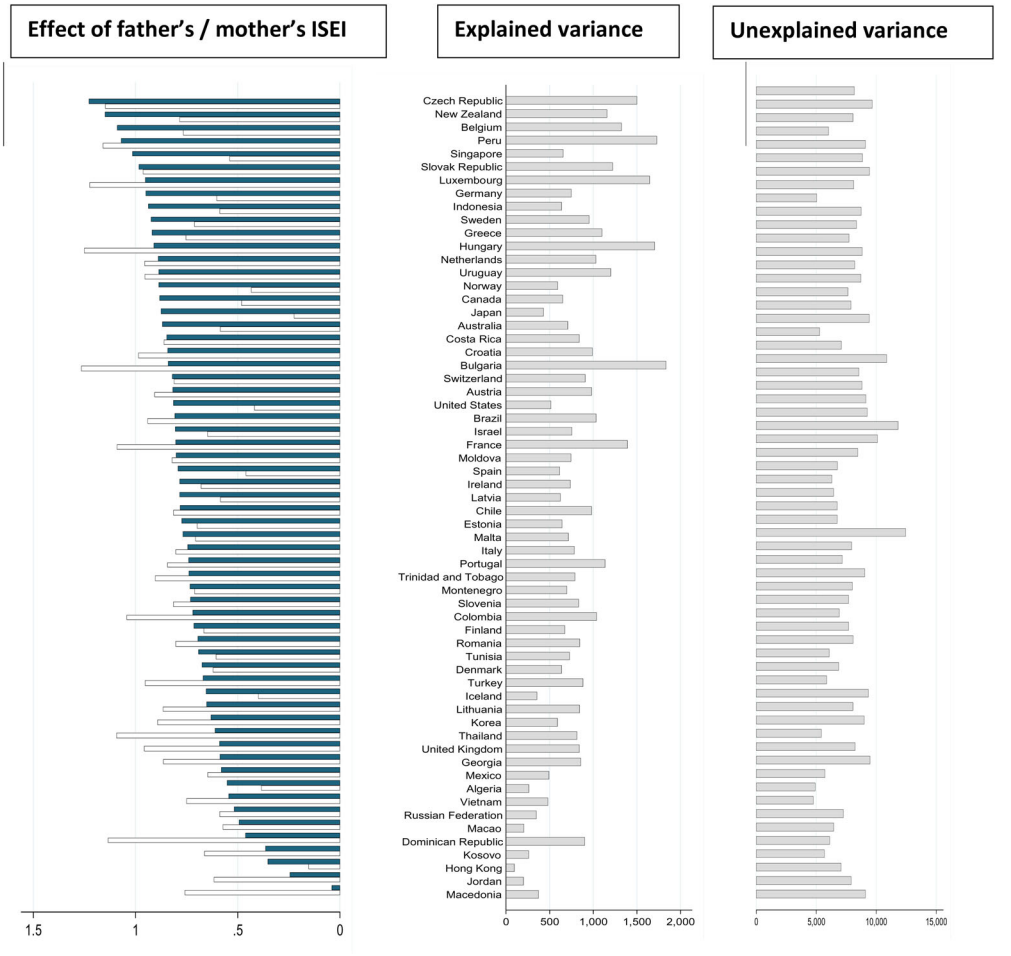

Figure 3. Reading competency and social origin – measures of impact and relevance. Dark bars, effects of father's ISEI; light bars, effects of mother's ISEI.

population. Across countries, it is markedly correlated with the effects of parental status (0.65 for fathers, and 0.81 for mothers). The correlation with the respective maximum of these effects (i.e. the 'dominant' effect) is even higher (0.86), which indicates some degree of equivalence between parental effects. Hauser (2009) criticises the use of r^2 measures in comparative achievement studies but suggests the use of error variance as an (inverse) indicator of how closely social background is related to achievement. However, in our relatively simple models, this is typically high and is only loosely associated (0.25 and below) with the effect measures. In any case, there are various indicators that allow for a multidimensional description of origin-related social inequality in education. Depending on the measures, countries are repeatedly assigned different positions in an international comparison, so using multiple measures seems to be preferable for a meaningful description of the relevance of social origin.

4.2. Composition of the parental family context

The following analyses move further beyond the characteristics of individual parents, to an analysis of the structure and the impact of the *family-level* (parental) context. Basic descriptive measures of family context structures are country-specific family-level *correlations* between parents' characteristics. In all of the countries in our study, there is a marked positive correlation between the father's ISEI and the mother's ISEI, representing the common phenomenon of assortative mating. The consequences of assortative mating can be studied in greater detail using empirical techniques of decomposition, which are based on stepwise multivariate regression analyses (cf. Cohen, Cohen, West, & Aiken, 2013, Chapter 3 and corresponding diagrams). In *variance* decompositions, the total variance in school students' reading competencies that is explained by the variables of parental ISEI (net of the micro-level controls) is split into three components (Figure 4, left panel): the part that is explained exclusively by the father's ISEI, the part that is explained exclusively by the mother's ISEI, and the part that is explained jointly by both the father's and the mother's ISEI. While there is considerable fluctuation in the degree to which either a father's or mother's ISEI explains variations in test scores (exclusively), the part that is explained jointly by both parents amounts, in most cases, to one-third or more of the total explained variance (median 37%). Still, there are international differences in this proportion. For example, particularly high values (above 55%) can be found in the cases of Thailand, Vietnam, Portugal, and Tunisia. As expected, there is also a high positive correlation ($r = 0.95$) between this proportion and the observed degree of assortative mating in the respective country, as indicated by the correlation between the father's and mother's ISEI (Figure 4, right panel). In other words, in countries where the statuses of both parents are closely correlated – which does not imply that they are similar in absolute terms – it is difficult to attribute observed status effects to a particular parent.

A complementary analytical strategy is using *effect* decompositions, which are again based on stepwise regressions. Figure 5 illustrates country-specific effect decompositions that split the total effect of a parent's ISEI on the child's reading achievement into two components: the direct (net) effect, and the indirect effect (i.e. the effect that is mediated by the other parent). The gross effects of parents' ISEIs are reduced significantly when the other parent's characteristics are controlled. In other words, a considerable part of the effect of a parent's socio-economic position is mediated through the other parent's

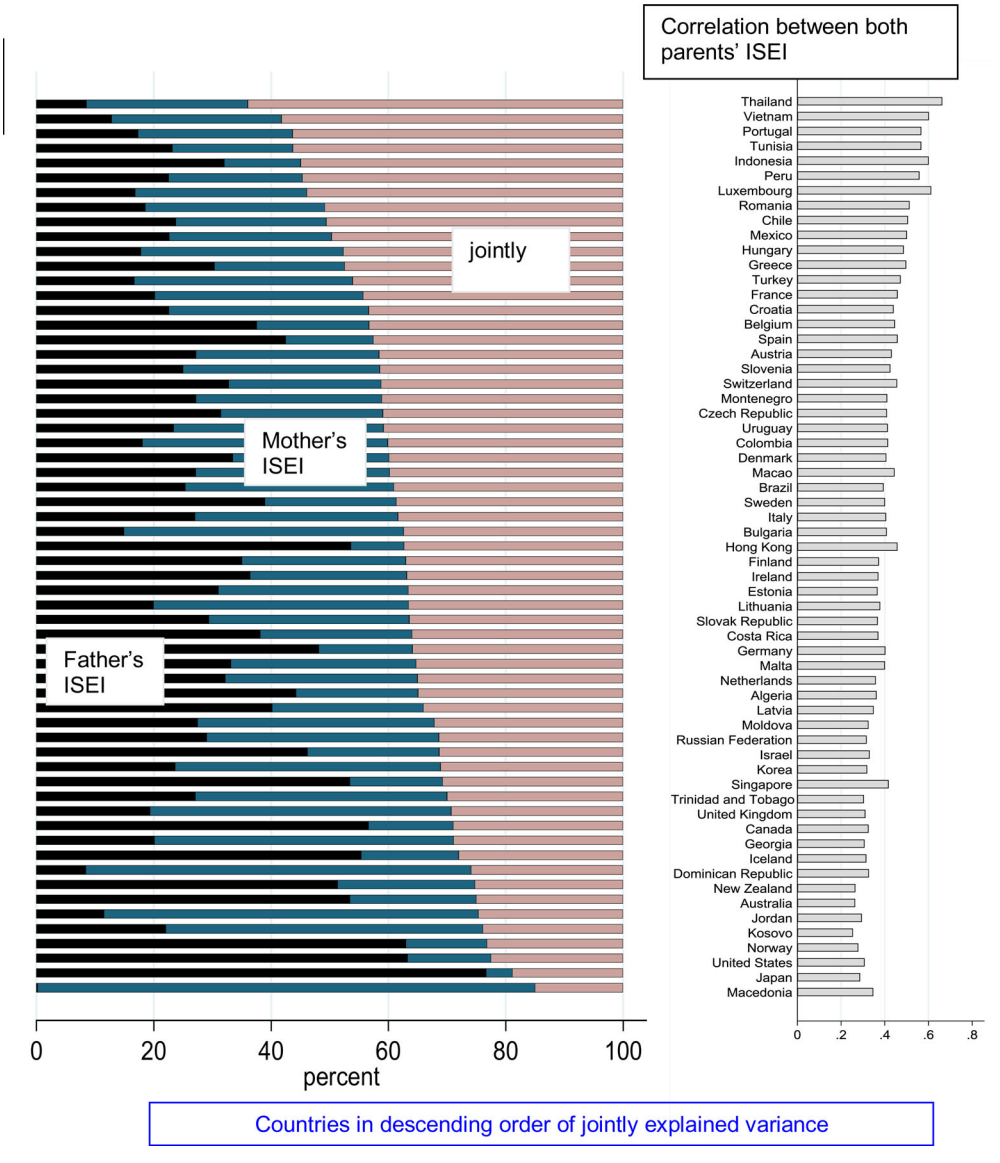

Figure 4. (Net) explained variance of reading competency by socio-economic status in the parental context (total 100%).

socio-economic position. This is again a consequence of assortative mating, meaning that a parent with particular characteristics is typically not randomly associated with another parent but instead is systematically associated with another *particular* kind of parent. On average, this mediated part amounts to nearly one-third of the total effect; the international median is 0.28 for both fathers and mothers. The proportion also correlates positively with the proportion of jointly explained variance (0.30 for fathers and 0.26 for mothers).

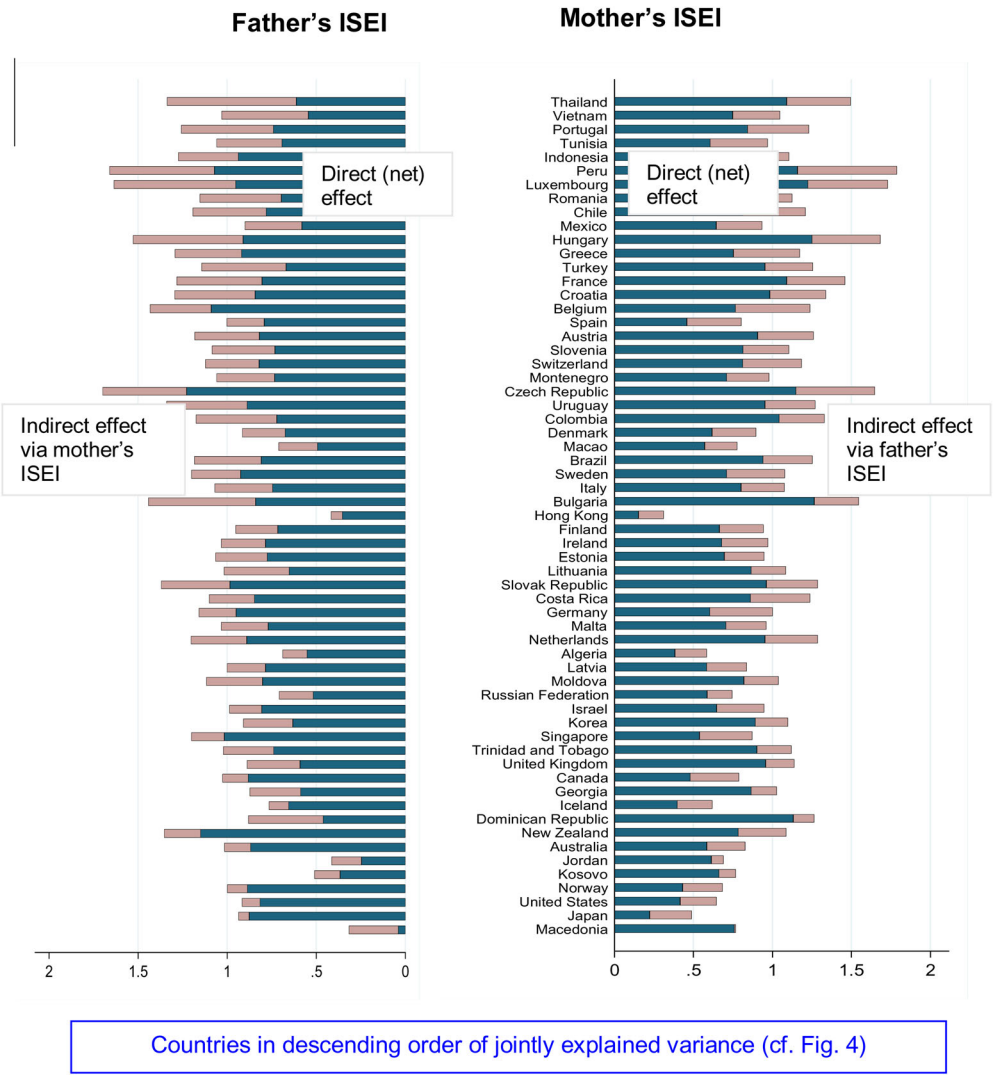

Figure 5. The effects of parents' socio-economic status on student's reading competency: effect decompositions.

4.3. Links between spheres of stratification

Finally, the analyses turn to potential international associations between various macro-level indicators. Are there any links and possible trade-offs between spheres of stratification? In Figure 6 (upper panels), the country-specific variation of parental ISEI is contrasted with the country-specific (net) effects of parental ISEI on reading achievement. The association is slightly positive for fathers (left-hand panel) and a little more positive for mothers (right-hand panel). In Figure 6 (intermediate panels), the (net) effect of parental ISEI on reading achievement is plotted as a function of the correlation of the parents' ISEIs (assortative mating). There is some positive association between these two variables, particularly in the case of women. In Figure 6 (bottom panels), assortative mating is compared with the

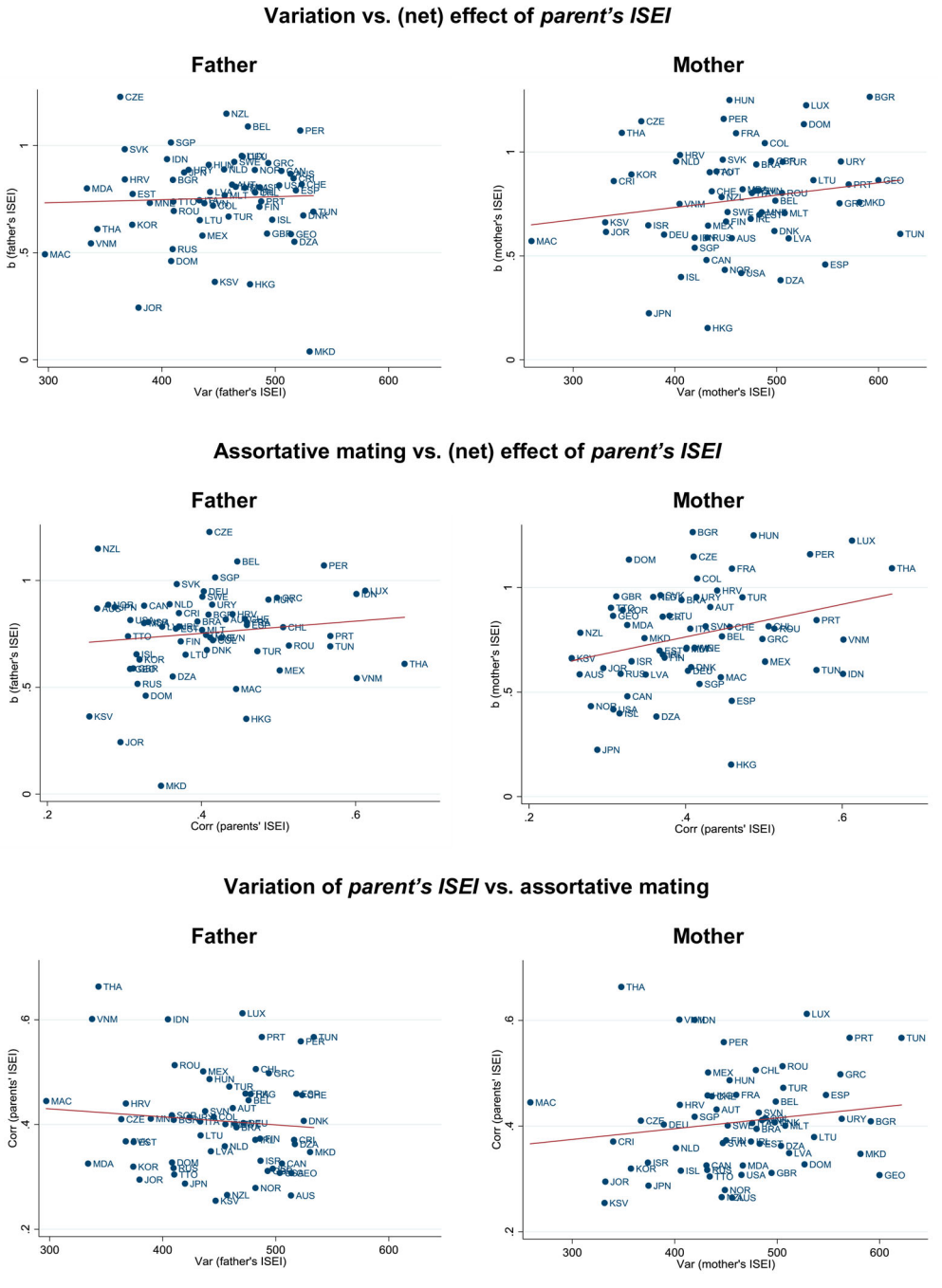

Figure 6. Associations between indicators of different spheres of stratification.

country-specific variation of the father's or mother's ISEI. There is a small negative correlation between the two variables for fathers and some positive correlation for mothers.

The configuration of these international correlations among the various spheres of stratification is illustrated in Figure 7. In addition to the previous analyses, associations

between the variation and the effects of parental status have also been assessed on the basis of total parental effects. In any case, however, and to some degree depending on the parent's gender, there are only weak positive relationships (and one negative relationship) between these two aspects. Hence, there is no clear (positive) 'reinforcement' between these two spheres of stratification. At first glance, this result seems to contradict established findings from research on the *Great Gatsby* Curve (see above). However, the two sets of results are not directly comparable. Research on income inequality not only deals with a different substantive topic but there are also technical differences, with occupational status (ISEI) being measured on an essentially limited scale. Inter-parental status correlation is not clearly associated with the variations in (individual) parental status, but there are marked associations between this correlation and the effects of occupational status on children's achievement, particularly for mothers and for total effects. This means that assortative mating is not consistently associated with variations in the father's and mother's characteristics, but it does help to explain the level of origin effects. At least in the case of mothers, there seems to be some indirect path from individual-level social stratification via assortative mating to the impact of individual status on education. Note that all associations are rather small. This supports a separate consideration of the three spheres of stratification.

Various replications have been conducted, using alternative ways of operationalising students' achievements and social origins. Table A3 in the appendix reports selected results regarding the corresponding associations. There are two main conclusions. First, the results are fairly robust across the three achievement domains of reading, math, and science. This suggests that, at least for similar analyses on the role of social origin, the choice of specific competency measures is of minor importance. Second, the results

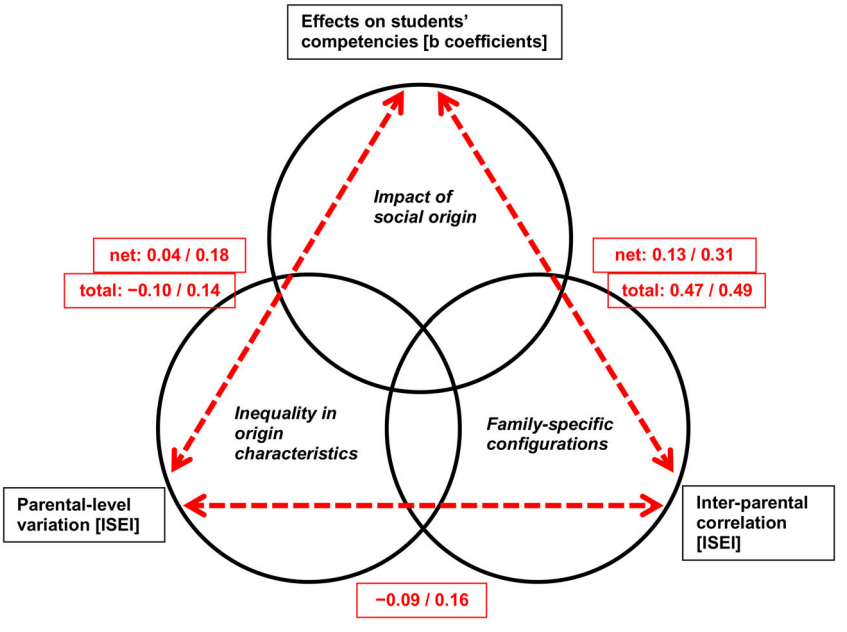

Figure 7. International links between spheres of stratification (father/mother).

tend to change significantly when parental education is used as a measure of social origin. In particular, there are negative associations between the variation in parental education and its effects on children's achievements. Further substantive research on this finding seems to be advisable. In technical aspects, educational level (years of education) is a measure that is, again, very different from both income and socio-economic status (ISEI). Educational dispersion has been less investigated than income inequality; the studies in the body of literature have focused particularly on non-monotonic trends in educational dispersion with long-term economic development (Meschi & Scervini, 2014; Morrisson & Murtin, 2013). In our data, there are, for example, marked negative correlations with national GDP per capita. In any case, multidimensional results on social inequality in education seem to be sensitive to the specific choice of social origin indicator.

5. Summary and conclusions

This paper has analysed various aspects of the fact that parental contexts can partially explain systematic differences and heterogeneity in students' educational achievements. Comparative analyses have been conducted on the basis of indicators that were derived from large-scale, student-level data in PISA 2015.

There are three major results. First, the *distributions* of origin characteristics and their explanatory power have proved to be meaningful indicators for analyses of social inequality in education when referring to characteristics of the individual parents. In other words, a more detailed investigation of the macro-level aspects of social origin is useful in considering at least one additional element of information beyond origin effect coefficients: the variation of the respective indicators of social origin or the explained variation in the dependent variable.

Second, the *joint* distribution of parental characteristics is of additional importance. Not only are both parents relevant but individual parental effects also work partially via the other parent, meaning they reflect the fact that the second parent typically has characteristics that are related to the characteristics of the first parent. This also means that the situation at the meso level of social origin is relevant. In total, all three spheres of stratification need to be considered when assessing the relevance of social origin for educational achievement.

Third, a comparative investigation of possible links and trade-offs has revealed some international relationships of the analysed three dimensions of social stratification. However, although they are rather sensitive to the choice of origin characteristics, they seem to be consistent across competency domains. The fact that associations are rather low again underscores the conclusion that the three spheres of stratification cannot be collapsed into a single dimension and are thus separately relevant.

The primary goal of this paper has been to provide an illustration of the general conceptual arguments. There have therefore been a number of simplifications. In particular, the necessary focus on 'complete family' contexts excludes single parents, and the relevance of a single parent's characteristics may be greater than the relevance of one parent in a two-parent context. There are a number of other aspects of the family context that are worth further investigation, also from a dynamic (life-course) perspective. These include specific family configurations, such as stepfamilies, biological and social parents and their characteristics, the role of siblings, etc. However, the general argument

would still hold in that both the respective distributions of such characteristics and their effects would be of interest. There are also temporal (or generational) aspects to the distinction between different spheres of stratification. The attainment of relevant characteristics in the parental generation and the formation of parental contexts typically precede by many years the processes of educational achievement and attainment in the children's generation. This means that relevant substantive explanations for specific conditions in the spheres of stratification will refer to different historical periods. A further extension along these lines could mean including patterns of fertility and following prospective models of intergenerational reproduction (cf. Breen, Ermisch, & Helske, 2019; Hillmert, 2013a; Mare, 1997; Song & Mare, 2015).

Even in the present form, however, there are important conclusions for the study of social inequality in education and possibly intergenerational aspects of social inequality in general. Analyses should estimate social origin effects, but they should also look *beyond* such effects. A broader spectrum of indicators is available for meaningfully describing social inequality in education. The empirical results suggest that the indictors cannot typically be collapsed into a single dimension. Before looking for substantive explanations for the role of social origin in education, the aim should be to get a 'sophisticated description' (Goldthorpe, 2007) in order to 'establish the phenomenon' (Merton, 1987) in the first place. In particular, relevant distributions characterising origin contexts should receive further attention. These distributions link the micro, meso, and macro levels, and they refer to relevant social mechanisms that may not immediately be viewed as relevant to educational attainment. This applies to characteristics and the formation of social class structures and assortative mating. International differences and historical changes in the observed level of social inequality in education may be due to these mechanisms rather than the *effects* of family characteristics. Also, the formation of origin contexts in which children grow up typically starts much earlier than the process of children's educational attainment.

There are also potential policy implications. Social inequality in education is certainly an issue of child education in the family and the educational system, and many policy measures rightly address perceived problems in this sphere that manifest themselves as social origin effects. However, a broader perspective reveals that (educational) policy might also look into other spheres of stratification and tackle issues related to economic inequality or gender roles, not necessarily as a goal in itself but also as a means of addressing social inequality in education. Hence, also policies should look beyond effects.

Disclosure statement

No potential conflict of interest was reported by the author(s).

Notes on contributor

Steffen Hillmert is Professor of Sociology at the University of Tübingen. His research interests include education, social inequality, the life course, and research methods. His work has appeared, amongst others, in *Comparative Social Research, European Societies, European Sociological Review, Research in Social Stratification and Mobility, Social Science Research, and Work, Employment & Society*.

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Appendix

Table A1. List of countries and country-specific numbers of cases.

	Country code*	OECD country	*N* (total)	*N* (analyses using parental ISEI)**	*N* (analyses using parental education)**
Algeria	DZA	No	5,519	1,113	4,739
Australia	AUS	Yes	14,530	10,188	12,713
Austria	AUT	Yes	7,007	5,264	6,504
Belgium	BEL	Yes	9,651	6,990	8,592
Brazil	BRA	No	23,141	11,540	19,278
Bulgaria	BGR	No	5,928	3,765	5,545
Canada	CAN	Yes	20,058	13,212	18,379
Chile	CHL	Yes	7,053	4,044	6,330
Colombia	COL	No	11,795	5,874	11,019
Costa Rica	CRI	No	6,866	5,235	6,221
Croatia	HRV	No	5,809	4,006	5,560
Czech Republic	CZE	Yes	6,894	5,009	6,418
Denmark	DNK	Yes	7,161	3,728	6,639

(*Continued*)

Table A1. Continued.

	Country code*	OECD country	*N* (total)	*N* (analyses using parental ISEI)**	*N* (analyses using parental education)**
Dominican Rep.	DOM	No	4,740	2,442	4,167
Estonia	EST	Yes	5,587	4,419	5,261
Finland	FIN	Yes	5,882	4,747	5,639
France	FRA	Yes	6,108	4,256	5,524
Georgia	GEO	No	5,316	1,969	4,856
Germany	DEU	Yes	6,504	4,305	4,845
Greece	GRC	Yes	5,532	3,525	5,377
Hong Kong	HKG	No	5,359	3,096	4,948
Hungary	HUN	Yes	5,658	4,127	5,413
Iceland	ISL	Yes	3,371	2,634	3,115
Indonesia	IDN	No	6,513	2,807	6,305
Ireland	IRL	Yes	5,741	4,063	5,277
Israel	ISR	Yes	6,598	3,988	6,043
Italy	ITA	Yes	11,583	7,680	10,967
Japan	JPN	Yes	6,647	4,390	6,003
Jordan	JOR	No	7,267	1,878	6,566
Korea	KOR	Yes	5,581	3,803	5,465
Kosovo	KSV	No	4,826	3,946	4,561
Latvia	LVA	Yes	4,869	3,168	4,582
Lithuania	LTU	No	6,525	4,206	5,947
Luxembourg	LUX	Yes	5,299	3,718	4,627
Macao	MAC	No	4,476	3,423	4,353
Malta	MLT	No	3,634	2,414	3,332
Mexico	MEX	Yes	7,568	3,946	7,226
Moldova	MDA	No	5,325	3,234	4,797
Montenegro	MNE	No	5,665	2,719	5,341
Netherlands	NLD	Yes	5,385	4,214	5,059
New Zealand	NZL	Yes	4,520	3,109	3,678
Norway	NOR	Yes	5,456	4,338	5,008
Peru	PER	No	6,971	5,179	6,775
Portugal	PRT	Yes	7,325	5,358	6,924
Romania	ROU	No	4,876	2,070	4,794
Russian Fed.	RUS	No	6,036	4,053	5,557
Singapore	SGP	No	6,115	4,210	5,920
Slovak Republic	SVK	Yes	6,350	4,066	6,057
Vietnam	VNM	No	5,826	4,473	5,676
Slovenia	SVN	Yes	6,406	4,793	6,174
Spain	ESP	Yes	6,736	4,426	6,356
Sweden	SWE	Yes	5,458	4,032	4,929
Switzerland	CHE	Yes	5,860	3,981	5,476
Thailand	THA	No	8,249	4,116	7,836
Trinidad	TTO	No	4,692	3,096	3,722
Tunisia	TUN	No	5,375	1,550	4,856
Turkey	TUR	Yes	5,895	1,049	5,688
Macedonia	MKD	No	5,324	3,440	4,876
United Kingdom	GBR	Yes	14,157	7,916	11,500
United States	USA	Yes	5,712	3,819	5,262
Uruguay	URY	No	6,062	3,621	5,483
Total			*422,372*	*261,780*	*386,080*

* As in the Pisa data. ** Using listwise deletion in full models.
Source: PISA 2015, author's calculations.

Table A2. Descriptive information on the data (country-level information; presented analyses on reading competency and parental occupational status).

	Mean	SD	Median	Min	Max	*N*
Variance of reading score	8,679	1,750	8,886	5,192	13,177	61
Total effect of father's occupational status (ISEI) on reading score	1.099	0.320	1.116	0.327	1.926	61
Total effect of father's occupational status (ISEI) on reading score (w/controls)	1.074	0.281	1.064	0.315	1.699	61
Net effect of father's occupational status (ISEI) on reading score (w/controls)	0.754	0.208	0.783	0.039	1.227	61
Total effect of mother's occupational status (ISEI) on reading score	1.094	0.333	1.114	0.319	1.976	61
Total effect of mother's occupational status (ISEI) on reading score (w/controls)	1.068	0.313	1.080	0.313	1.789	61
Net effect of mother's occupational status (ISEI) on reading score (w/controls)	0.769	0.242	0.766	0.153	1.265	61
Variance of father's occupational status (ISEI)	448.3	56.4	456.9	296.9	533.6	61
Variance of mother's occupational status (ISEI)	460.0	72.2	455.9	259.0	621.3	61
Correlation between parents' occupational statuses (ISEI)	0.407	0.095	0.403	0.254	0.663	61

Source: PISA 2015, author's calculations.

Table A3. Replications: Selected results for alternative ways of operationalising social origin and achievement.

Central independent variable (social origin variable) in individual-level analyses	Parents' ISEI			Parents' education		
Dependent variable (student's achievement) in individual-level analyses	Reading	Math	Science	Reading	Math	Science
Corr(Variation of father's *origin variable,* net effect of father's *origin variable*)	0.04	0.06	0.11	−0.51	−0.50	−0.52
Corr(Variation of mother's *origin variable,* net effect of mother's *origin variable*)	0.18	0.19	0.15	−0.67	−0.68	−0.70
Corr(Variation of father's *origin variable,* total effect of father's *origin variable*)	−0.10	−0.08	−0.04	−0.59	−0.59	−0.61
Corr(Variation of mother's *origin variable,* total effect of mother's *origin variable*)	0.14	0.17	0.11	−0.67	−0.67	−0.70
Corr(Correlation between parents' *origin variables*, net effect of father's *origin variable*)	0.13	0.13	0.03	−0.12	−0.12	−0.16
Corr(Correlation between parents' *origin variables*, net effect of mother's *origin variable*)	0.31	0.35	0.27	−0.18	−0.11	−0.20
Corr(Correlation between parents' *origin variables*, total effect of father's *origin variable*)	0.47	0.52	0.38	−0.03	−0.00	−0.06
Corr(Correlation between parents' *origin variables*, total effect of mother's *origin variable*)	0.49	0.55	0.44	−0.09	−0.04	−0.12
Corr(Variation of father's *origin variable,* correlation between parents' *origin variables*)	−0.09	−0.09	−0.09	0.46	0.46	0.46
Corr(Variation of mother's *origin variable,* correlation between parents' *origin variables)*	0.16	0.16	0.16	0.47	0.47	0.47
N (countries)	61	61	61	61	61	61

Source: PISA 2015, author's calculations.