School segregation across the world: has any progress been made in reducing the separation of the rich from the poor?

Gabriel Gutiérrez

John Jerrim

Rodrigo Torres

UCL Institute of Education

November 2017

Abstract

The segregation of secondary school students into different schools has important implications for educational inequality, social cohesion and intergenerational mobility. Previous research has illustrated how between-school segregation varies significantly across countries, with high levels of segregation occurring in central European nations which 'track' children into different schools, and much lower levels in Scandinavia. In this paper we contribute to this literature by illustrating whether industrialised countries have made any progress in reducing levels of between-school segregation over time. Using six waves of the Programme for International Student Assessment (PISA) data, we illustrate how the segregation of rich and poor pupils has remained broadly unchanged across OECD countries. This is despite major economic and political events occurring over this period, along with the introduction of numerous policy initiatives designed to reduce socio-economic gaps. We consequently conclude that structural factors are likely to be the main drivers of between-school segregation (e.g. neighbourhood segregation, long-standing school admission policies), and that education policymakers may need to be much more radical if they are to foster greater levels of integration between the rich and the poor.

Key Words: School segregation, PISA, School composition

Contact Details: Department of Social Science, UCL Institute of Education, University College London, 20 Bedford Way London, WC1H 0AL

Acknowledgements: Gabriel Gutiérrez and Rodrigo Torres acknowledge the support of Becas Chile-CONICYT, 72150359- 72130207

1. **Introduction**

The uneven distribution of students from different social classes across schools is a matter of concern to educational policymakers across the world. Although the extent and mechanisms by which school composition effects are displayed is a contested topic, there is a general agreement that composition matters and shapes educational outcomes (Trupp 1995). Indeed, previous research has suggested that having a higher proportion of students from advantaged backgrounds as one's peers has a positive effect on a range of educational outcomes (Van Ewijk and Sleegers 2010). Moreover, student performance is more strongly related to socio-economic status than to other compositional characteristics such as gender, immigrant condition or race (Rumberger and Palardy 2005). Consequently, schooling systems which tend to cluster low socio-economic status students together could be increasing educational inequality and reducing social mobility over time (Levacic and Woods 2002). The effects of social segregation between schools is not limited, however, to student achievement alone; previous research has also found that greater levels of between-school segregation also has an effect on school attendance, grade retention and behaviour (Palardy 2013 and Palardy, Rumberger and Butler 2015). The extent of between-school segregation in an education system therefore matters, with some believing that encouraging greater mixing of young people from different social backgrounds is key to reducing educational inequalities. Indeed, some scholars have even argued that socioeconomically segregated schools fail to prepare students for facing diversity (Masey and Fisher 2006) and may even be a threat to social cohesion (Gorard 2009; Mickelson and Nkomo 2012).

Yet despite the significant academic and policy interest that has been shown in school segregation, relatively little work has investigated how between-school segregation compares across countries, and whether this cross-national picture has changed over time. This is despite comparative benchmarks (be they historical levels of segregation within a country or relative standings compared to other countries) being critical to interpreting the results. In other words, the only way to really judge whether segregation is 'too high', is to draw comparisons either (a) across countries and/or (b) over time. Important exceptions include Gorard and Smith (2004), who use PISA 2000 to estimate segregation levels in 15 European Union (EU) countries. They concluded that segregation based on parental occupation was greatest in Greece and Portugal and lowest in Luxembourg, Sweden and Ireland. Likewise, Jenkins, Micklewright and Schnepf (2008) also used PISA data (from 2000 and 2003) to compare school segregation levels in England with other 26 industrialised countries. England was found to have average levels of segregation, with Austria, Belgium, Germany and Hungary being high-segregation countries, while Scandinavia had comparatively low-levels of between-school segregation. More recently, Chmielewski and Savage (2015) analysed the segregation of the United States (US) and Latin-American countries. Their estimates, based upon PISA 2012, found that Latin-American countries were more segregated than the OECD average and the United States. This is consistent with the results of Murillo and Martinez (2017) who found that Latin-American countries exhibit high levels of segregation – and is perhaps the most socially-segregated region anywhere in the world.

In this paper, we aim to contribute to this small but growing literature on how between-school segregation compares across the world. We do so in several ways. First, rather than focusing on only one region or "type" of education system, we include all OECD countries. This

provides us with a more comprehensive set of benchmarks to compare each country against. Second, some previous papers has focused upon segregation using a single threshold – typically the median value upon a socio-economic status index (e.g. Jenkins, Micklewright and Schnepf, 2008). However, such an approach potentially misses out important and interesting differences, such as segregation between the poorest (or richest) students and the rest of the population, and may therefore give only a partial insight into the level of segregation across education systems. In contrast, we provide a range of results for each country using different thresholds to separate students into different groups. Third, the two previous cross-national studies of school segregation using PISA based their estimates on the parental occupation of the students (Gorard & Smith, 2004; Jenkins, Micklewright and Schnepf, 2008). There are some limitations with this measure, such as it is based upon parental occupational status alone and is only quasi-continuous. In contrast, we use the PISA Economic, Social, and Cultural Status index, which is a more comprehensive measure of students' socio-economic status, encompassing maternal and paternal education, maternal and paternal occupation and household possessions (a commonly used proxy for household wealth).

Finally, a significant limitation of the existing literature is that it is cross-sectional, and has not considered whether countries have made any progress in reducing between-school segregation over time. With six cycles and 15 years of PISA data now available, this represents the first study to consider this issue. This is important as the world has changed in many ways over the last decade and a half, including a major worldwide recession and significant changes to the distribution of income. Moreover, many countries have introduced educational policies attempting to widen school choice for parents, while also attempting to increase competition between schools. At the same time, a lot of policy attention has focused upon 'narrowing the gap' between the richest and poorest pupils, all of which could influence the segregation of students from different social classes into different schools.

With the above in mind, this paper therefore attempts to answer two research questions:

Research Question 1. How does between-school segregation compare across OECD countries? Do particular countries stand out as more highly segregated than others?

Research Question 2. How has between-school segregation changed across the OECD between 2000 and 2015? Which countries have made progress in reducing segregation, and which have regressed?

The paper now proceeds as follows. Section 2 describes common measures of between-school segregation, with section 3 describes the PISA data. Results follow in section 4, with conclusions and directions for future research in section 5.

2. **Measures of segregation**

A variety of indexes have been developed to measure the segregation of individuals across different groups. These indices differ in terms of their statistical properties (Massey and Denton, 1988; Allen and Vignoles, 2007) as well as whether they attempt to measure segregation between just two or multiple groups (Reardon and Firebaugh, 2002). For instance, Massey and Denton (1988) classified indices of residential segregation according to five

different dimensions: evenness, exposure, concentration, centralization, and clustering[1]. In the school-segregation literature, measures usually incorporate "evenness" and "exposure". Evenness refers to differences in the distribution of two social groups among schools in a country. A school system is even if the allocation of students to schools matches their overall proportion at a national level. A school system is uneven if the proportion of students within one or both groups at schools greatly differs from their national proportion.

Exposure refers to the degree of potential contact, or the possibility of interaction, between two different groups within schools in a country. The probability of interaction between groups is given by the proportion of individuals per school who are part of each group. A very segregated school shows low exposure, as there are very few students from other groups than the majority group. Examples of indicators measuring exposure are the interaction index or the isolation index.

The most used indexes of segregation in education are the Dissimilarity Index (D), also usually called Duncan Index (Duncan and Duncan, 1955), and the Square Root Index (H), or Hutchens index (Hutchens, 2001). We will be working in this paper with these two indices. Both are measures of evenness, as they assess whether the distribution of students in two defined groups within a school differs or not from the overall proportions in the population.

The Dissimilarity Index is a measure which aims to reflect the different distribution of two groups (e.g. high and low socio-economic status students) among specific units (e.g. schools). Formally, and in order to measure school segregation among groups A and B in country C, the D-index is defined as follows:

$$(1) \qquad D_c = \frac{1}{2}\sum_{i=1}^{S}\left|\frac{a_i}{A} - \frac{b_i}{B}\right|$$

In reference to this paper, A and B represent the total number of students in country c who belong to groups A and B respectively. The total number of schools in country c is S, and the number of pupils in school *i* for group A and B are a_i and b_i respectively. The index ranges from zero to one. A value of zero indicates that the proportion of both groups in every school is equal to the proportions found in the population (i.e. there is no segregation). In contrast, a value of one indicates that there is complete segregation of pupils, such that all schools only have one group of students represented. The dissimilarity index thus measures the percentage of students from a group that would have to change school, in order for each school to have the same percentage of that group as is found in the national population.

The Square Root (H) index also aims to reflect the distribution of two groups of students across schools. The main advantage of H over the D index is that it is possible to decompose segregation into different parts (e.g. into segregation that occurs within state schools to segregation that occurs within private schools). Using the same notation as for the dissimilarity index above, the square root index is defined as:

[1] Concentration, centralization and clustering are measures of geographical segregation which take into account the spatial dimension.

$$(2) \qquad H_c = \sum_{i=1}^{S} \left(\frac{a_i}{A} - \sqrt{\frac{a_i}{A}\frac{b_i}{B}} \right)$$

For each school (i) we measure how far students from group B are from the average proportion of students in group A. If the proportion of students in group B is exactly the same as the proportion of students in Group A in each school, then there is no segregation and the index takes the value zero. On the other hand, when the proportion of Group B students is zero, there is complete segregation, meaning the index is then equal to 1.

When estimating segregation between two groups, the dissimilarity index has several attractive features. It is straightforward to compute, can be interpreted by a wide audience, and has the important properties of composition and scale invariance when measuring segregation between two groups[2]. However, one of its main weaknesses is that it does not comply with the so-called principle of exchanges (see Reardon and Firebaugh, 2002). That is, the D index does not remain constant after a fixed number of students exchange places between two schools which are over or underrepresented with certain group[3]. It also does not allow for the decomposition of segregation between and within schools.

On the contrary, one of the main advantages of the H index is its property of decomposability, which allows to decompose segregation by subcategories. For instance, total segregation can be decomposed between and within schools, or between private and public schools. In practice, however, it produces very similar estimates to the D-index, as we shall illustrate in this paper (see Appendix 2). Consequently, throughout this paper we focus upon results using the dissimilarity index (D) due to its desirable interpretation and previous use throughout a wide literature spanning across the social sciences (e.g. Gorard 2009; Burgess & Wilson, 2005; Jargowsky, 1996). Nevertheless, in Appendix 1 and Appendix 2 we report alternative results using the Hutchens index instead, illustrating that this does not have an impact upon the substantive conclusions that we reach.

3. **Data**

We use data from six waves of the Programme for International Student Assessment (PISA), covering the years 2000 to 2015. Most current OECD members have participated in every round, though a handful began their participation later than 2000[4]. Consequently, for most of the 37 OECD member states, we are able to consider how between-school segregation compares over this 15-year period. Our analysis focuses upon the OECD nations only as (a) non-OECD members have tended to enter PISA post-2006, and hence have limited data

[2] Composition invariance refers to the fact that a measure of segregation does not change if all inputs change their scale simultaneously (for instance, if they are weighted for a specific factor). Scale invariance on the other hand means that the index will not be affected by the size of the groups under analysis as soon as they are representative.
[3] For instance, if n people from group A are transferred from school x to school y, and another group of n people from group B are transferred from school y to school x, then the final index remains constant if school x or y are under or overrepresented by a certain group.
[4] The following OECD countries are included in our analysis: Australia, Austria, Belgium, Canada, Czech Republic, Chile, Germany, Denmark, England, Spain, Estonia, Finland, France, Greece, Hungary, Ireland, Iceland, Israel, Italy, Japan, South Korea, Luxembourg, Mexico, Netherlands, Northern Ireland, Norway, New Zealand, Poland, Portugal, Scotland, Slovakia, Slovenia, Sweden, Switzerland, Turkey, United States and Wales.

available for us to consider trends over time and (b) some suffer from the problem of having a significant number of 15-year-olds who are no longer enrolled in school (Spaull 2017).

The PISA target population are 15-year-old students who are in school, irrespective of school type and grade[5]. A two or three stage sampling procedure is used in each country in order to draw a nationally representative sample. Specifically, a random sample of schools is first drawn as the primary sampling unit (with probability proportional to size) and then at least 30 pupils are then randomly selected within each school. To be included in the PISA study, the OECD demands each country achieve a high response rate (above 80 percent for pupils and above 85 per cent for schools), with most countries able to meet these criteria. Response weights have been calculated by the OECD to correct for non-random non-response, and these are applied throughout our analyses. Although the total number of participating students and schools varies across countries, in each nation at least 150 schools and 2,069 students take part.

To estimate between-school segregation within each country we use the PISA Economic, Social and Cultural Status (ESCS) index. This combines students' self-reported information on parental occupation, parental education and household possessions into a continuous index via a principal components analysis[6]. With the release of PISA 2015, the OECD has created a re-scaled version of the ESCS index to ensure it is comparable across all years (this is available from http://www.oecd.org/pisa/data/2015database/).

Measuring segregation in schools

We begin by dividing the population into two groups, and then estimating the Dissimilarity index detailed in equation (1). In other words, we calculate the proportion of "high" and "low" socioeconomic status pupils within each school, and compare this to the proportion of high and low socio-economic status students in each country's population. Given that the ESCS index is continuous, any particular cut-off point could be used to divide pupils into high and low socio-economic groups. For instance, previous international comparative research has chosen the national median of the ESCS index, with half of pupils defined as "high SES" and half the population as "low SES".

However, given that the decision on where to set this cut-off point is arbitrary, we present a series of results using multiple different values. Specifically, for each country, we divide the country into high and low SES groups defined using each national ESCS decile. For instance, to estimate how segregated the poorest 20 percent are from the remaining 80 percent, we divide the population in each country into two groups based upon the 20th ESCS percentile. We then apply the formula for the Duncan index given in equation (1), using the PISA Balanced-Repeated-Replication (BRR) weights to calculate the appropriate standard error. We then repeat this process using a different decile of the ESCS index as a cut-off point (e.g. dividing the bottom 30 percent of the national population according to the ESCS index from the remaining 70 percent). This has been done for each OECD country, and each round of PISA.

[5] More specifically, PISA covers a set of skills, knowledge and competences defined by OECD as relevant for personal, social and economic well-being, in four domains: Mathematical literacy, Reading Literacy, Scientific Literacy and Problem Solving Skills. For more information see, for example, OECD (2004).

[6] Although the ESCS is coded for the great majority students, still a proportion of pupils do not answer the student questionnaire or show incomplete answers. In this case and in case one item was missing, multiple imputation techniques were used to complete the missing information. In case two or more items were missing, the ESCS index was defined as missing. In general, the response rates to the students' questionnaire is very high.

For selected countries with interesting findings, we present in graphs illustrating the full set of results. Otherwise, we focus upon:

- Segregation of the bottom ESCS quintile from the remaining 80 percent (P20 cut-point)
- Segregation at the ESCS median (P50 cut-point)
- Segregation of the top ESCS quintile from the bottom 80 percent (P80 cut-point)

4. **Results**

Comparisons of segregation across countries

Before considering trends over time, we first begin by documenting how between-school segregation compares across countries. To maximise the sample size for this cross-country comparison, we pool together data from across all six PISA rounds. These results are presented in Figure 1, using the median value of the ESCS index as the cut-point. Alternative results using P20 and P80 are provided in Appendix 3, with the cross-national picture not differing substantially regardless of which cut-point is used (indeed the correlation between results is typically above 0.90 using the various different threshold values). The horizontal red line in Figure 1 illustrates the OECD average.

<< Figure 1 >>

The average value of the D-index across OECD countries is 0.38. There are 12 countries where between-school segregation is significantly below this value (Norway, Finland, Wales, Scotland, Iceland, Sweden, Denmark, Ireland, Estonia, Canada, New Zealand and Switzerland), while 13 other countries have a D-index above this value (Austria, Spain, Australia, Slovakia, Germany, Slovenia, Belgium, Japan, Israel, France, Hungary, Mexico and Chile). In terms of general patterns, these results are similar to those of Jenkins, Micklewright and Schnepf (2008) in highlighting how Scandinavia has comparatively low-levels of between-school segregation, while central and Eastern European countries with heavily "tracked" secondary school systems are amongst the most segregated. However, we do produce different results for Japan and Australia, which we find to have somewhat higher levels of segregation. This difference may be due to the different measure of socio-economic status that we use (the PISA ESCS index rather than the ISEI measure of occupational prestige).

We also find that there are important differences in the value of the segregation index depending upon the threshold used to define the socioeconomic groups. For the vast majority of countries, segregation is higher in the extremes of the socioeconomic distribution rather than in the middle of it. Figure 2 presents the D-Index values using the 20th and 80th percentiles (representing poor and rich students, respectively) and comparing them with the values obtained using the median (50^{th} percentile)[7]. It is immediately clear that values of the segregation index are higher for the poorest and richest students rather than for middle-class pupils in almost all countries. However, there are also some differences in countries where segregation of pupils is most intense. Hungary and Mexico stand out as countries where the most disadvantaged 20 percent of pupils are very highly segregated from the remaining 80 percent. In contrast, Chile has particularly pronounced segregation of the most socioeconomically advantaged students, with radical separation from all the other social

[7] The D-Index values presented is an average based on the rounds of PISA each country participated on.

groups. Portugal and Luxembourg present similar values of the D-index for the middle-class and wealthy students, but differ with respect to the poorest pupils, where the segregation index is lower. Finally, in some countries, such as England, Belgium, Japan and Korea, there is less evidence of differences in the segregation index depending upon where the threshold to divide socio-economic groups is drawn.

<< Figure 2 >>

Trends for the OECD and across countries over time

Before analyzing the trends of socioeconomic segregation for each country, we use data pooled across OECD countries to illustrate the aggregate change is school-segregation within developed countries over time. This is done by averaging the segregation index for each of the 25 countries[8] for each round. Figure 3 shows the OECD segregation values for each decile of socioeconomic status. No major change has occurred over time, regardless of where the threshold to divide 'rich' and 'poor' pupils is drawn. The results are very similar across each of the rounds, suggesting that segregation in industrialized countries has (on average) not changed over the last decade and a half.

<< Figure 3 >>

Table 1 turns to the country-level results for changes in segregation over time. First, we will focus upon results using the median as the cut-off point for defining the two socio-economic groups. Although there are some countries with variation when comparing the first and last rounds (e.g. Luxembourg rises from 0.34 to 0.43 from 2000 to 2015 while Poland decreases from 0.43 to 0.34 in the same span), there is important fluctuation in the scores in the intermediate years. Other countries such as Estonia, Japan or Turkey participated in less rounds making even more difficult to establish if the observed changes correspond to a trend. Regarding the most disadvantaged students (percentile 20), the D-index decreases from 2000 to 2015 for Switzerland (0.40 to 0.35), Poland (0.44 to 035) and Iceland (0.34 to 0.29), while in Mexico it increases from 0.50 to 0.55 over the same period. Netherlands and Luxembourg show some upward variation between 2000 and 2015 (0.35 to 0.41 and 0.38 to 0.46, respectively) and Mexico and Poland show downwards variation (056 to 0.50 and 0.51 to 0.36). However, the general message from Table 1 is that countries have typically seen (at best) only minimal changes in the amount of between-school segregation. Overall, the amount of between-school variation in most countries has not changed, and seems to be structurally ingrained.

< Table 1>

To further illustrate this point, Figure 4 investigates further the results for six countries where the variation in segregation across the period seems to be greatest. These are Mexico, Switzerland, Iceland, Netherlands, Poland and Luxemburg. This includes the estimated 95 percent confidence interval for each round, thus illustrating whether one can rule out sampling variation as a potential explanation for any apparent change in between-school segregation that has occurred in these countries over time. For five of the six countries under consideration, the

[8] The countries included are: Australia, Belgium, Canada, Czech Republic, Germany, Denmark, Spain, Finland, France, Greece, Hungary, Ireland, Iceland, Italy, Korea, Luxembourg, Mexico, Netherlands, Norway, New Zealand, Poland, Portugal, Sweden Switzerland, and United States.

confidence intervals overlap at each socioeconomic deciles. (The exception is Poland, where the PISA 2000 round stands out as an outlier from the rest). Hence this strongly suggests that sampling variation is likely to be responsible for the (small) changes in segregation that we have found in these countries. In other words, this provides further support for our key finding; almost no progress has been made in reducing the segregation of rich and poor pupils in any industrialised country since 2000, when the PISA study began.

<< Figure 4 >>

5. Conclusions

The extent to which social groups mix is thought to be an important factor influencing inequality, social cohesion and social mobility (Gorard 2009; Levacic & Woods 2002). As long-lasting friendships and peer groups are developed during young people's time in school, the extent of between-school segregation is a key indicator of whether particular social groups live in isolation from one another. Moreover, previous research has suggested that greater levels of between-school segregation may have negative effects upon a range of outcomes, including attendance, behaviour, grade retention and greater inequality in students' test scores. Understanding the extent of between-school segregation is therefore important for our understanding of social and economic inequality, including how this varies across the industrialised world.

Previous international comparative research on this topic has found countries that separate students into different school tracks at an early age (e.g. Germany, Austria, Hungary) also tend to be more socially-segregated (Micklewright, Schnepf and Jenkins 2008). The present study has attempted to contribute new evidence to this literature by considering the extent to which industrialised countries have made progress in reducing between-school segregation over the last 15 years. Using six cycles of the PISA data, our key conclusion is that the level of between-school segregation has remained stable within almost every OECD country. This is a striking and perhaps surprising finding, given how much the world has changed over this period. In particular, despite a host of school-system reforms occurring across the world, and major world events such as the Great Recession of 2008, the segregation of students from different backgrounds into different schools has hardly altered at all.

Consequently, in the latest round of PISA data (2015), we continue to find that the Nordic countries are amongst the most socially integrated, whereas Chile, Mexico and Hungary have particularly socially-segregated schools. In all countries, segregation of the wealthiest and poorest 20 percent of students from other groups remains pronounced, though this pattern is especially marked in countries with high levels of segregation.

There are several possible explanations for our key finding that school segregation has hardly changed in any OECD country over time. First, many factors will have already shaped school segregation before 2000, when the PISA data became available. In other words, one interpretation of our results is that long-run structural factors about a country and its school system (e.g. long-standing admissions criteria used to gain entry into schools) are much more important for between-school segregation than the set of policy changes and economic shocks to have occurred over the last 15 years. Second, in many countries location matters for parental school choice, meaning residential segregation of parents is pivotal in determining the

segregation of students into different schools. In many countries, there may have been less effort in tackling residential segregation than the range of education policy and initiatives that have been implemented. Yet it could be that tackling the residential segregation of parents directly is critical to reducing the segregation of students to different schools, thus enhancing educational inequality and social mobility. Third, many education policy reforms implemented in several OECD countries have attempted to incentivize competition between schools (e.g. the routine publication of schools' results), but may not necessarily have led to changes in the socioeconomic composition of the student body.

Yet it is also important for us to recognise the limitations of the present study, and possible directions for future research. First, the measure of socio-economic status preferred in this paper is based upon information reported by students themselves, rather than from their parents. Although this could mean that measurement error may have some impact upon our results, existing evidence from the literature suggests that the impact this is likely to have upon our comparative analysis of countries over time is likely to be minimal (Jerrim and Micklewright 2012). Secondly, as PISA is a sample survey, the number of schools included in our study for each country per year is quite limited (typically around 150). Hence the results for any given year are subject to a non-trivial degree of sampling error, and are surrounded by quite wide confidence intervals. Given this limitation, it is perhaps even more striking how highly correlated our results are between the various PISA cycles; the correlation for the between-school segregation results based upon PISA 2000 and 2015 is 0.85 for P20 0.86 and P50 and 0.79 for P80 (in Appendix 5 country-level correlations across PISA waves for all applications are available. They are all very high, especially for ESCS percentiles 20 and 50). Third, due to PISA focusing upon the 'within-school' populations, our analysis has been limited to OECD countries only. Further work should consider how robust and comparable measures of between school segregation can be estimated to include the lower and middle income countries that now also take part in PISA. Fourth, this paper has focused exclusively on between-school tracking, and not on the use of 'setting' or 'streaming' within schools. Yet, as noted by Chmielewski (2014), such within-school segregation is likely to be just as significant, and effectively cutting off lower socio-economic status pupils from their higher socio-economic status peers. Further work in the spirit of Chmielewski (2014) is required to help us to better understand how countries separate pupils' between-schools versus within-schools. Finally, our analysis has been limited to a medium time horizon (15 years). Although the world has changed dramatically over this period, significant structural factors of a country's education system such as school-segregation perhaps take much longer to change.

Despite these limitations, we believe that this paper has made an important contribution to the literature. It has highlighted how, in many countries, the children of the rich are still effectively segregated from the children of the poor. Moreover, we have shown how we should not expect this situation to change any time soon. Despite a lot of rhetoric and policy efforts designed to 'narrow the achievement gap', provide high quality education to all pupils and raise the educational attainment of disadvantaged groups, there remains significant levels of school segregation for young people from different social backgrounds. In our view, much more radical thinking will be needed in order to change this situation over the coming 15 years, and if real progress is to be made in narrowing the achievement gap between the rich and poor, as many policymakers hope.

References

Allen, Rebecca, and Anna Vignoles. (2007). "What Should an Index of School Segregation Measure?" *Oxford Review of Education* 33(5): 643-68.

Burgess, Simon, Deborah Wilson, and Ruth Lupton. (2005) "Parallel Lives? Ethnic Segregation in Schools and Neighbourhoods." *Urban Studies* 42(7): 1027-056.

Chmielewski, Anna. (2014) An International Comparison of Achievement Inequality in Within- and Between-School Tracking Systems. *American Journal of Education* 120(3): 293-324.

Chmielewski, Anna, and Savage Corey (2015). "Socioeconomic Segregation between Schools in the US and Latin America, 1970-2012." Pp. 394-423 in Land and the City: Proceedings of the 2014 Land Policy Conference, edited by George McCarthy, Gregory Ingram, and Samuel Moody. Cambridge, MA: Lincoln Institute of Land Policy.

Duncan, Otis Dudley, and Duncan, Beverly. (1955) "Residential Distribution and Occupational Stratification." *American Journal of Sociology* 60(5): 493-503.

Gorard, Stephen, and Smith, Emma. (2004) "An International Comparison of Equity in Education Systems." *Comparative Education* 40.1 15-28.

Gorard, Stephen. (2009) "Does the Index of Segregation Matter? The Composition of Secondary Schools in England since 1996." *British Educational Research Journal* 35.4 639-52.

Hutchens, Robert, (2001). "Numerical measures of segregation: desirable properties and their implications," Mathematical Social Sciences, Elsevier, vol. 42(1), pages 13-29, July.

Jargowsky, Paul. (1996) "Take the Money and Run: Economic Segregation in U.S. Metropolitan Areas." *American Sociological Review* 61(6): 984.

Jenkins, Stephen, John Micklewright, and Sylkev. Schnepf. (2008) "Social Segregation in Secondary Schools: How Does England Compare with Other Countries?" *Oxford Review of Education* 34.1 21-37.

Jerrim, John and John Micklewright, J. (2012). Parental socio-economic status and children's cognitive achievement at ages 9 and 15: how do the links vary across countries? in J. Ermisch, M. Jantti and R. Erikson (eds) *Inequality from Childhood to Adulthood: A Cross-National Perspective on the Transmission of Advantage*, New York: Russell Sage Foundation.

Levaçić, Rosalind, and Philip A. Woods. (2002) "Raising School Performance in the League Tables (Part 1): Disentangling the Effects of Social Disadvantage." *British Educational Research Journal* 28.2 207-26.

Massey, Douglas S. and Denton, Nancy A. (1988) "The Dimensions of Residential Segregation." Social Forces 67(2): 281-315.

Mickelson, Roslyn Arlin, and Nkomo, Mokubung. (2012) "Integrated Schooling, Life Course Outcomes, and Social Cohesion in Multiethnic Democratic Societies." *Review of Research in Education* 36.1 197-238. W

Murillo Torrecilla, Francisco Javier, and Martínez Garrido, Cynthia A. (2017) "Estimación De La Magnitud De La Segregación Escolar En América Latina." *Magis: Revista Internacional De Investigación En Educación* 9.19 11-30.

Palardy, Gregory J. (2013) "High School Socioeconomic Segregation and Student Attainment." *American Educational Research Journal* 50.4 714-54.

Palardy, Gregory J., Rumberger, Russell W., and Butler, Truman. (2015) "The Effect of High School Socioeconomic, Racial, and Linguistic Segregation on Academic Performance and School Behaviors." *Teachers College Record* 117.12 Teachers College Record, 2015, Vol.117 (12).

Reardon, Sean F., and Glenn Firebaugh (2002). "Measures of Multigroup Segregation." *Sociological Methodology* 32: 33-67.

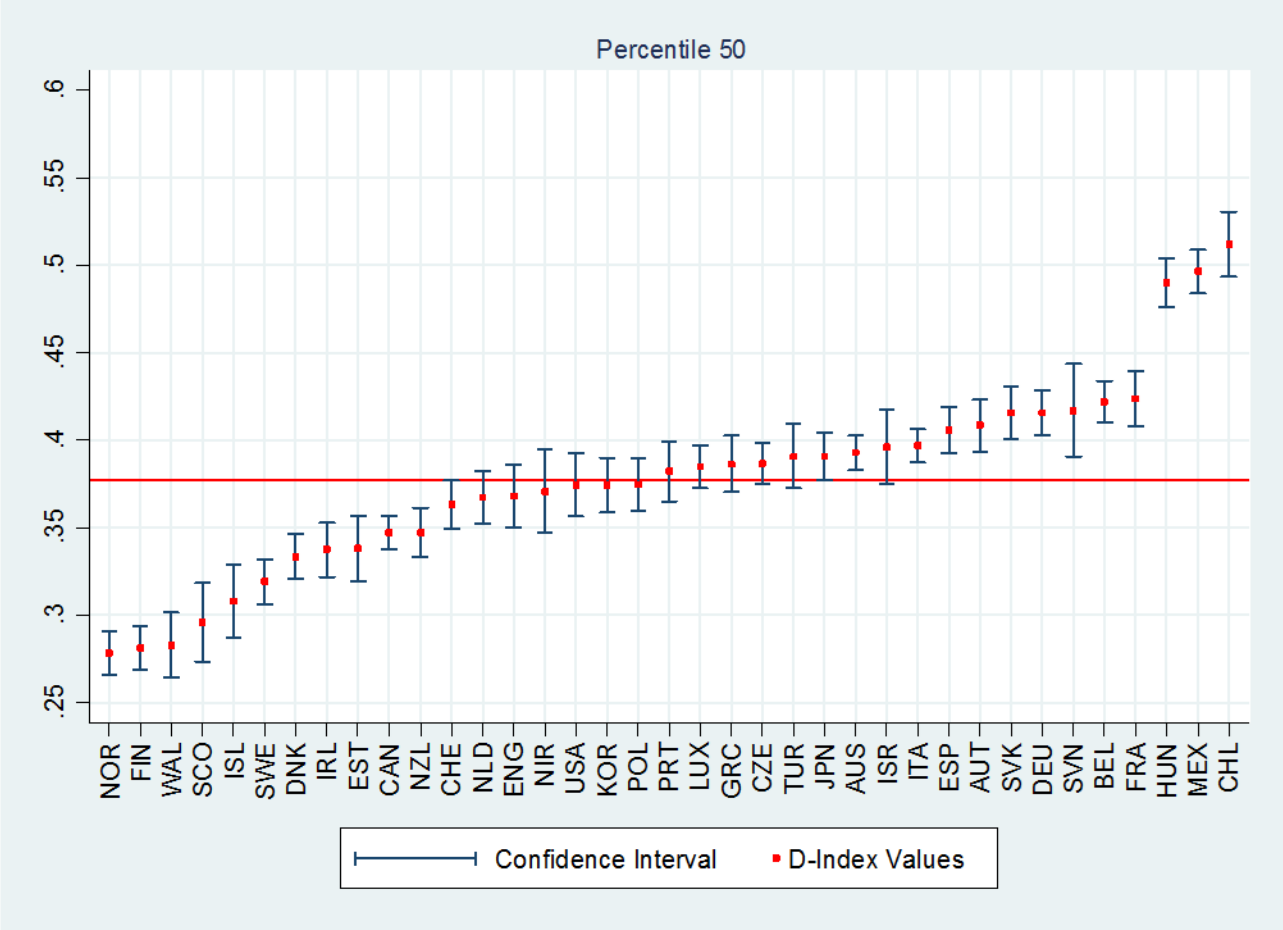
Rumberger, Russell W., and Palardy, Gregory J. (2005) "Does Segregation Still Matter? The Impact of Student Composition on Academic Achievement in High School." Teachers College Record 107(9): 1999-2045.

Spaull, N. (2017) "Who Makes It Into PISA?: Understanding the Impact of PISA Sample Eligibility Using Turkey as a Case Study (PISA 2003 - PISA 2012)", OECD Education Working Papers, No. 154, OECD Publishing, Paris. http://dx.doi.org/10.1787/41d175fc-en

Thrupp, Martin. (1995) "The School Mix Effect: The History of an Enduring Problem in Educational Research, Policy and Practice." *British Journal of Sociology of Education* 16.2: 183-203.

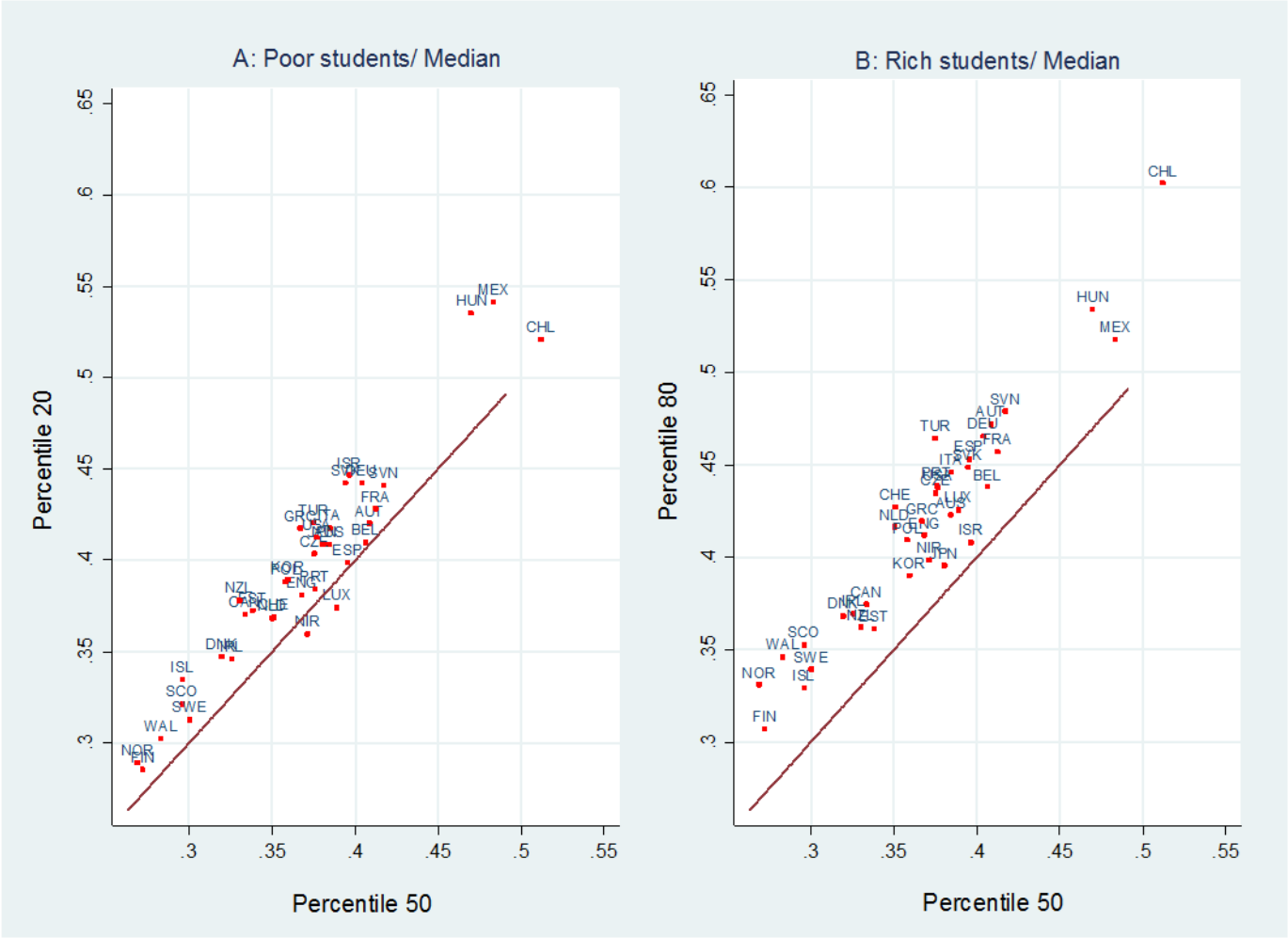
Van Ewijk, Reyn, and Sleegers, Peter. (2010) "The Effect of Peer Socioeconomic Status on Student Achievement: A Meta-Analysis." *Educational Research Review* 5.2: 134-50.

Figure 1. Estimates of school segregation across OECD countries



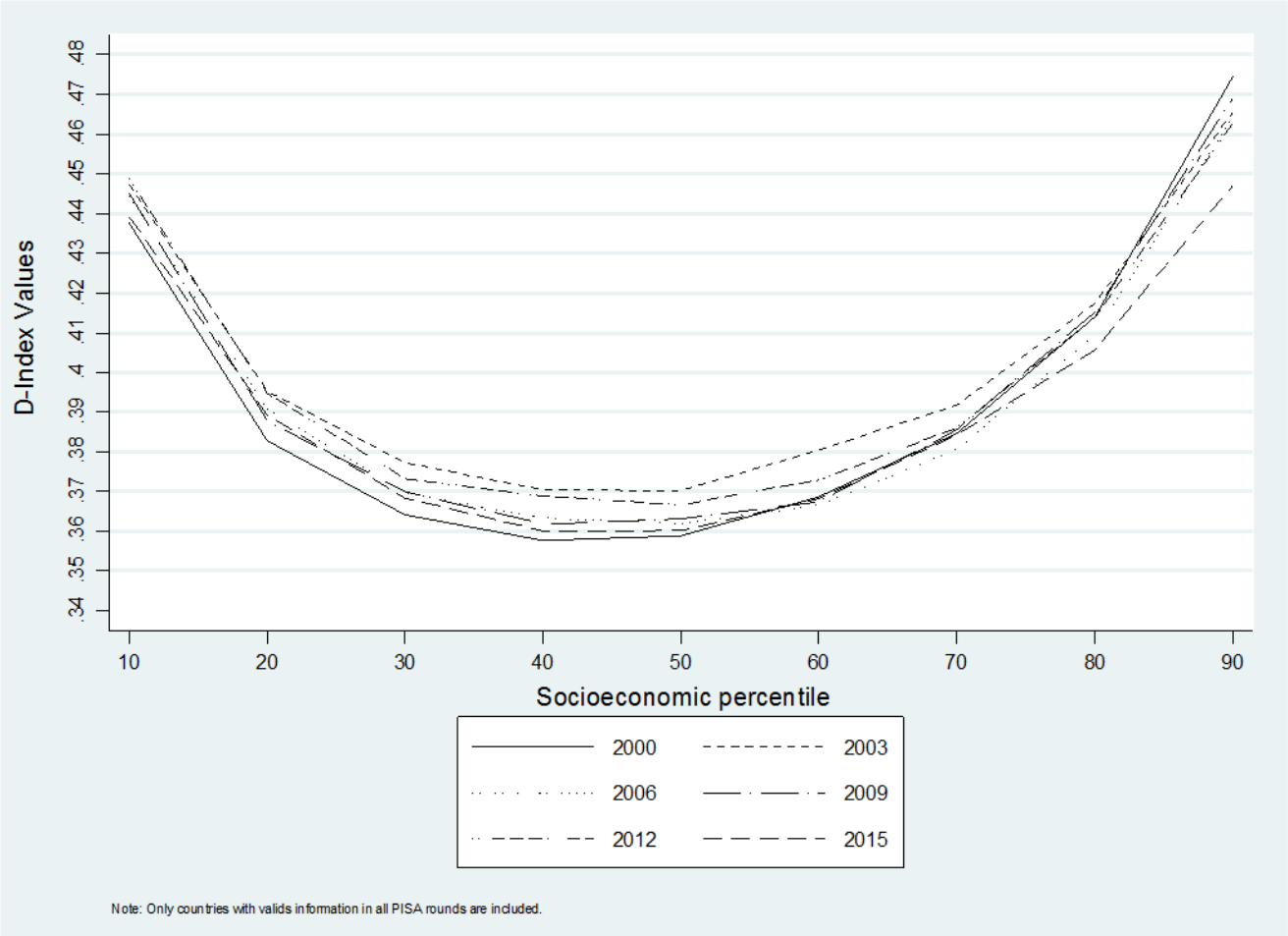
Notes: Figures refer to the value of the D index when dividing students into "high" and "low" socio-economic groups based upon the national median of the ESCS index. Thin line running through the centre of each bar refers to the estimated 95 percent confidence interval. Final student and balanced-repeated-replication weights have been applied.

Figure 2. Comparison of D-Index Values for three social groups



Notes: Figures refer to the value of the D index. Values along the x-axis refer to estimates when dividing students into "high" and "low" socio-economic groups based upon the national median of the ESCS index. The y-axis in the left-hand panel presents the estimated D-index when the 20th percentile of the ESCS is used to separate the most disadvantaged 20 percent of children from the remaining 80 percent. In contrast, the y-axis in the right hand panel uses the 80th percentile of the ESCS index to divide the most advantaged 20 percent of children from the remaining 80 percent of the population. Final student and balanced-repeated-replication weights have been applied.

Figure 3. Between-school segregation across OECD countries. Comparison across PISA waves.



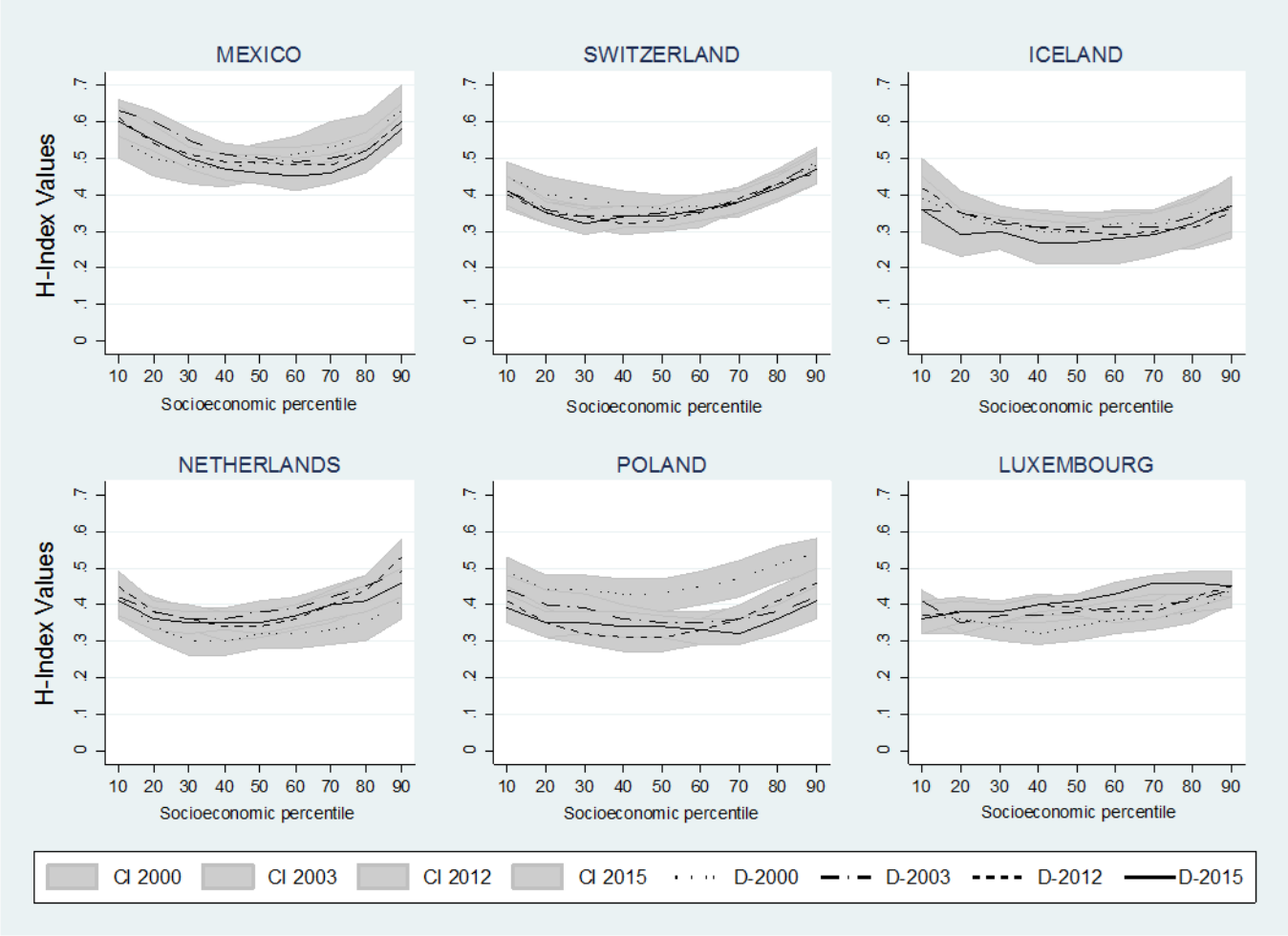
Notes: Graph based upon 25 OECD countries with complete and useable data throughout the PISA 2000 to 2015 period. These 'OECD average' figures have been calculated by averaging the estimated D-index values across the 25 countries in each of the six PISA saves. X-axis values refer to the threshold used to separate pupils into "high" and "low" socio-economic groups. The y-axis refers to our estimate of the "OECD-average" D index.

Table 1. Estimates of between-school segregation (D) across countries (2000-2015)

	D-Index Estimates																	
	Percentile 20						Percentile 50						Percentile 80					
Country	2000	2003	2006	2009	2012	2015	2000	2003	2006	2009	2012	2015	2000	2003	2006	2009	2012	2015
Australia	0.42	0.39	0.39	0.38	0.42	0.45	0.40	0.38	0.35	0.37	0.39	0.41	0.45	0.41	0.40	0.40	0.43	0.44
Austria	0.43	0.45	0.41	0.42		0.39	0.38	0.46	0.41	0.38		0.41	0.45	0.49	0.48	0.48		0.46
Belgium	0.39	0.45	0.40	0.40	0.41	0.41	0.37	0.42	0.40	0.43	0.41	0.40	0.45	0.44	0.42	0.48	0.43	0.42
Canada	0.36	0.38	0.37	0.38	0.37	0.36	0.32	0.35	0.35	0.32	0.32	0.33	0.38	0.36	0.41	0.37	0.37	0.36
Switzerland	0.40	0.40	0.36	0.35	0.35	0.35	0.36	0.37	0.35	0.33	0.34	0.34	0.43	0.44	0.43	0.43	0.42	0.42
Chile	0.52		0.53	0.51	0.54	0.51	0.51		0.52	0.52	0.52	0.49	0.60		0.63	0.59	0.62	0.57
Czech Republic	0.40	0.41	0.39	0.38	0.42	0.43	0.40	0.39	0.35	0.34	0.38	0.40	0.45	0.45	0.40	0.38	0.46	0.47
Germany	0.43	0.47	0.46	0.44	0.44	0.41	0.40	0.44	0.37	0.40	0.43	0.38	0.47	0.51	0.44	0.47	0.46	0.43
Denmark	0.34	0.33	0.33	0.35	0.36	0.38	0.30	0.30	0.30	0.34	0.34	0.33	0.37	0.39	0.33	0.37	0.38	0.37
England			0.36	0.40	0.39	0.37			0.35	0.38	0.36	0.38			0.40	0.43	0.41	0.42
Spain	0.40	0.40	0.41	0.40	0.38	0.41	0.40	0.41	0.39	0.38	0.38	0.41	0.46	0.44	0.46	0.45	0.44	0.47
Estonia				0.33	0.38	0.41				0.31	0.36	0.35				0.33	0.37	0.38
Finland	0.29	0.28	0.27	0.27	0.28	0.32	0.28	0.27	0.26	0.28	0.26	0.29	0.32	0.30	0.29	0.31	0.30	0.32
France	0.40	0.44	0.45	0.43	0.44	0.41	0.39	0.43	0.45	0.39	0.42	0.40	0.44	0.46	0.50	0.47	0.44	0.44
Greece	0.38	0.43	0.44	0.42	0.44	0.40	0.34	0.38	0.37	0.39	0.37	0.35	0.42	0.42	0.42	0.42	0.42	0.42
Hungary	0.53	0.56	0.50	0.54	0.54	0.54	0.50	0.49	0.46	0.46	0.45	0.46	0.56	0.53	0.53	0.51	0.54	0.53
Ireland	0.32	0.36	0.34	0.35	0.38	0.33	0.31	0.33	0.33	0.34	0.33	0.31	0.35	0.38	0.38	0.39	0.37	0.35
Iceland	0.34	0.34	0.35	0.35	0.33	0.29	0.30	0.32	0.31	0.30	0.28	0.27	0.35	0.33	0.34	0.31	0.33	0.32
Israel	0.47			0.44	0.44	0.43	0.43			0.39	0.41	0.35	0.47			0.39	0.42	0.34
Italy	0.40	0.45	0.42	0.42	0.40	0.42	0.39	0.41	0.37	0.40	0.38	0.36	0.45	0.49	0.42	0.46	0.44	0.42
Japan		0.42	0.46	0.39	0.39	0.39		0.41	0.39	0.39	0.36	0.36		0.43	0.39	0.36	0.42	0.38
Korea	0.39	0.43	0.38	0.41	0.37	0.36	0.36	0.39	0.36	0.36	0.36	0.33	0.40	0.43	0.38	0.39	0.37	0.38
Luxembourg	0.36	0.36	0.35	0.38	0.41	0.38	0.34	0.39	0.38	0.39	0.42	0.41	0.38	0.46	0.41	0.42	0.43	0.46
Mexico	0.50	0.50	0.60	0.54	0.56	0.55	0.49	0.47	0.50	0.49	0.49	0.46	0.56	0.50	0.52	0.52	0.51	0.50
Netherlands	0.34	0.39	0.38	0.38	0.35	0.36	0.32	0.37	0.38	0.34	0.34	0.35	0.35	0.45	0.45	0.44	0.40	0.41
Norway	0.31	0.29	0.29	0.28	0.28	0.30	0.26	0.28	0.28	0.26	0.26	0.27	0.30	0.35	0.36	0.30	0.35	0.32
New Zealand	0.35	0.37	0.37	0.37	0.41	0.39	0.33	0.31	0.31	0.34	0.35	0.34	0.37	0.33	0.36	0.39	0.40	0.34
Poland	0.44	0.39	0.40	0.35	0.40	0.35	0.43	0.34	0.35	0.31	0.38	0.34	0.51	0.39	0.38	0.41	0.42	0.36

Portugal	0.37	0.36	0.42	0.37	0.40	0.40	0.35	0.37	0.41	0.39	0.38	0.36	0.42	0.39	0.45	0.46	0.48	0.44
Scotland			0.34	0.35	0.30	0.30			0.32	0.30	0.28	0.29			0.33	0.35	0.37	0.35
Slovakia		0.46	0.44	0.39	0.47	0.45		0.41	0.40	0.37	0.42	0.37		0.46	0.45	0.42	0.48	0.44
Slovenia				0.44	0.46	0.42				0.42	0.42	0.41				0.47	0.50	0.46
Sweden	0.28	0.31	0.30	0.32	0.35	0.31	0.28	0.27	0.31	0.31	0.32	0.32	0.31	0.33	0.35	0.36	0.35	0.35
Turkey		0.43	0.43	0.43	0.40	0.41		0.43	0.35	0.39	0.35	0.36		0.52	0.44	0.47	0.45	0.44
United States	0.43	0.40	0.40	0.43	0.40	0.41	0.36	0.36	0.37	0.40	0.39	0.39	0.42	0.44	0.42	0.47	0.43	0.43
Northern Ireland			0.34	0.37	0.37	0.36			0.35	0.37	0.39	0.37			0.37	0.38	0.45	0.39
Wales			0.32	0.29	0.30	0.29			0.30	0.30	0.27	0.26			0.35	0.37	0.35	0.32

Figure 4. Estimates of between-school segregation for selected countries between 2000 and 2015



Note: Figures on the x-axis refers to the percentile used to separate students into different groups. For example, a value of 20 means that we have calculated the D-index based upon how segregated the most disadvantaged 25% of students are from the most advantaged 20%. Figures for 2006 and 2009 excluded for clarity of presentation.

Appendix 1: Estimates of between-school segregation (H) across countries (2000-2015)

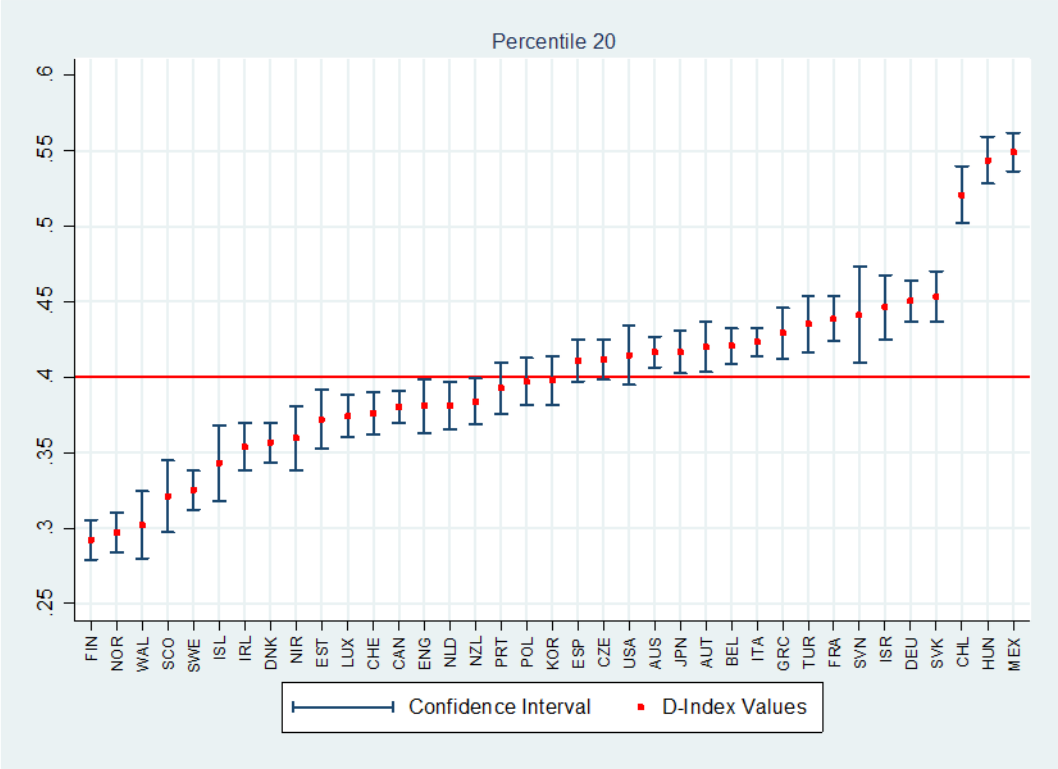
	Percentile 20						Percentile 50						Percentile 80					
Country	2000	2003	2006	2009	2012	2015	2000	2003	2006	2009	2012	2015	2000	2003	2006	2009	2012	2015
Australia	0.18	0.14	0.14	0.14	0.18	0.21	0.14	0.12	0.11	0.11	0.14	0.14	0.20	0.15	0.14	0.15	0.19	0.20
Austria	0.17	0.18	0.17	0.17		0.17	0.12	0.17	0.15	0.13		0.12	0.20	0.23	0.23	0.23		0.20
Belgium	0.14	0.19	0.16	0.16	0.15	0.15	0.12	0.15	0.13	0.16	0.14	0.14	0.18	0.19	0.16	0.21	0.18	0.16
Canada	0.12	0.14	0.15	0.14	0.14	0.13	0.09	0.11	0.11	0.10	0.09	0.09	0.13	0.13	0.16	0.14	0.13	0.12
Switzerland	0.17	0.16	0.14	0.11	0.11	0.11	0.12	0.12	0.10	0.10	0.10	0.10	0.17	0.19	0.18	0.16	0.16	0.15
Chile	0.26		0.30	0.27	0.29	0.26	0.25		0.27	0.24	0.26	0.22	0.34		0.37	0.34	0.37	0.33
Czech Republic	0.17	0.18	0.17	0.14	0.18	0.20	0.14	0.14	0.12	0.11	0.15	0.16	0.19	0.21	0.17	0.15	0.22	0.22
Germany	0.19	0.21	0.20	0.19	0.20	0.16	0.13	0.16	0.13	0.14	0.16	0.12	0.21	0.23	0.19	0.22	0.21	0.17
Denmark	0.13	0.12	0.11	0.12	0.14	0.14	0.08	0.09	0.08	0.10	0.10	0.09	0.14	0.16	0.10	0.14	0.15	0.14
England			0.13	0.14	0.14	0.13			0.11	0.11	0.12	0.13			0.16	0.16	0.16	0.16
Spain	0.16	0.16	0.16	0.16	0.15	0.18	0.14	0.15	0.14	0.13	0.12	0.15	0.21	0.18	0.20	0.19	0.17	0.20
Estonia				0.11	0.16	0.17				0.10	0.12	0.12				0.12	0.14	0.16
Finland	0.09	0.07	0.07	0.07	0.08	0.09	0.06	0.06	0.05	0.06	0.06	0.07	0.10	0.08	0.07	0.08	0.09	0.09
France	0.15	0.17	0.19	0.18	0.18	0.16	0.13	0.16	0.17	0.15	0.15	0.15	0.19	0.21	0.24	0.24	0.22	0.20
Greece	0.15	0.17	0.19	0.18	0.20	0.16	0.13	0.13	0.15	0.15	0.14	0.12	0.18	0.19	0.20	0.19	0.18	0.18
Hungary	0.27	0.30	0.25	0.29	0.27	0.28	0.23	0.21	0.20	0.20	0.19	0.20	0.30	0.29	0.26	0.27	0.27	0.26
Ireland	0.09	0.13	0.12	0.13	0.15	0.11	0.09	0.10	0.11	0.11	0.10	0.09	0.12	0.15	0.15	0.16	0.14	0.11
Iceland	0.10	0.10	0.10	0.11	0.10	0.08	0.08	0.10	0.08	0.08	0.07	0.07	0.12	0.12	0.12	0.10	0.11	0.11
Israel	0.20			0.18	0.18	0.17	0.16			0.12	0.13	0.10	0.20			0.15	0.17	0.11
Italy	0.16	0.19	0.15	0.17	0.15	0.17	0.13	0.15	0.12	0.14	0.13	0.12	0.18	0.22	0.16	0.19	0.19	0.18
Japan		0.17	0.18	0.14	0.15	0.15		0.13	0.12	0.12	0.11	0.10		0.16	0.14	0.11	0.16	0.12
Korea	0.13	0.17	0.14	0.14	0.13	0.12	0.10	0.13	0.11	0.11	0.11	0.10	0.16	0.16	0.12	0.15	0.13	0.15
Luxembourg	0.10	0.11	0.10	0.12	0.14	0.14	0.08	0.12	0.11	0.12	0.14	0.13	0.11	0.14	0.13	0.13	0.14	0.16
Mexico	0.25	0.27	0.35	0.29	0.32	0.29	0.25	0.24	0.27	0.24	0.24	0.21	0.31	0.26	0.29	0.28	0.27	0.25
Netherlands	0.11	0.14	0.14	0.14	0.12	0.12	0.08	0.12	0.12	0.10	0.10	0.10	0.13	0.20	0.18	0.19	0.14	0.16
Norway	0.10	0.09	0.09	0.08	0.08	0.09	0.07	0.07	0.07	0.06	0.06	0.06	0.09	0.11	0.13	0.08	0.12	0.10
New Zealand	0.12	0.13	0.13	0.14	0.17	0.14	0.09	0.08	0.08	0.10	0.12	0.10	0.13	0.12	0.13	0.15	0.16	0.12
Poland	0.18	0.15	0.16	0.13	0.14	0.13	0.16	0.10	0.10	0.10	0.13	0.11	0.24	0.13	0.13	0.16	0.16	0.14
Portugal	0.13	0.12	0.17	0.14	0.16	0.15	0.11	0.12	0.16	0.14	0.15	0.12	0.16	0.18	0.21	0.22	0.24	0.20
Scotland			0.12	0.12	0.09	0.09			0.09	0.08	0.08	0.08			0.10	0.14	0.14	0.12

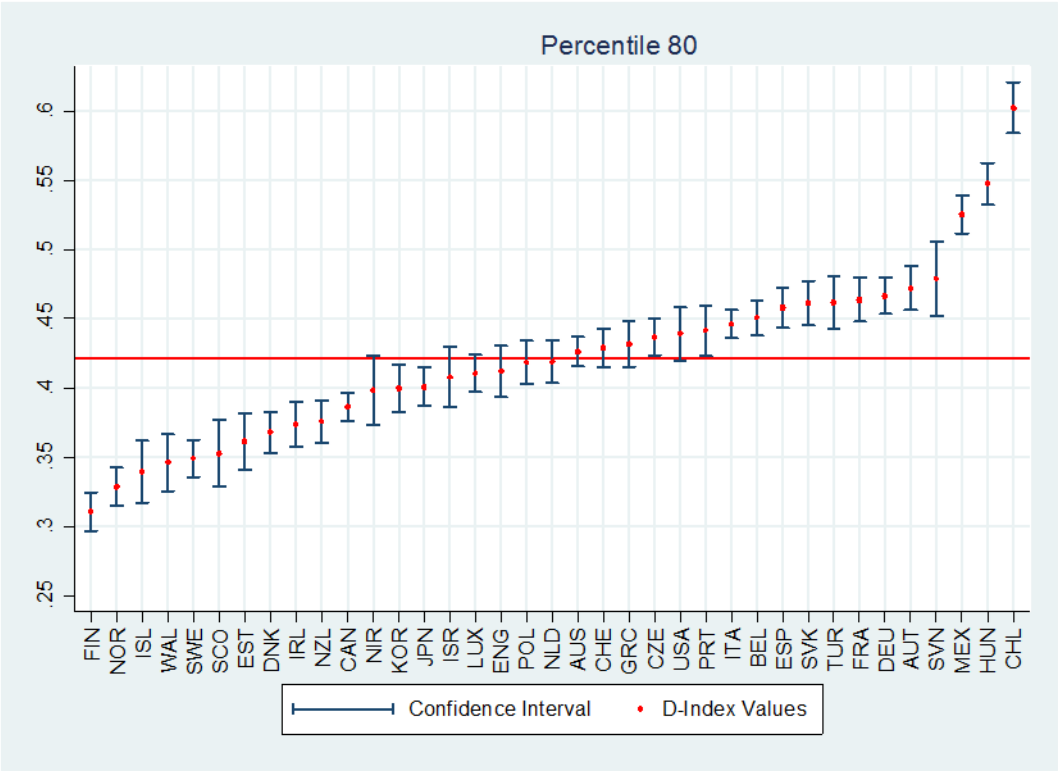
Slovakia		0.22	0.19	0.16	0.24	0.20		0.15	0.15	0.11	0.17	0.13		0.21	0.19	0.17	0.23	0.19
Slovenia				0.20	0.20	0.18				0.16	0.16	0.15				0.22	0.24	0.19
Sweden	0.09	0.10	0.09	0.10	0.12	0.10	0.07	0.07	0.08	0.08	0.09	0.09	0.08	0.10	0.12	0.11	0.11	0.11
Turkey		0.19	0.18	0.19	0.16	0.16		0.17	0.12	0.13	0.12	0.12		0.27	0.19	0.21	0.18	0.18
United States	0.21	0.18	0.14	0.18	0.17	0.16	0.12	0.13	0.12	0.15	0.13	0.13	0.19	0.21	0.18	0.22	0.17	0.17
Northern Ireland			0.11	0.12	0.14	0.11			0.10	0.11	0.12	0.10			0.15	0.13	0.17	0.13
Wales			0.10	0.08	0.09	0.09			0.07	0.07	0.06	0.06			0.11	0.12	0.12	0.10

Appendix 2: Correlation in between-school segregation measures across countries. Dissimilarity Index vs. Hutchens Index (2000-2015)

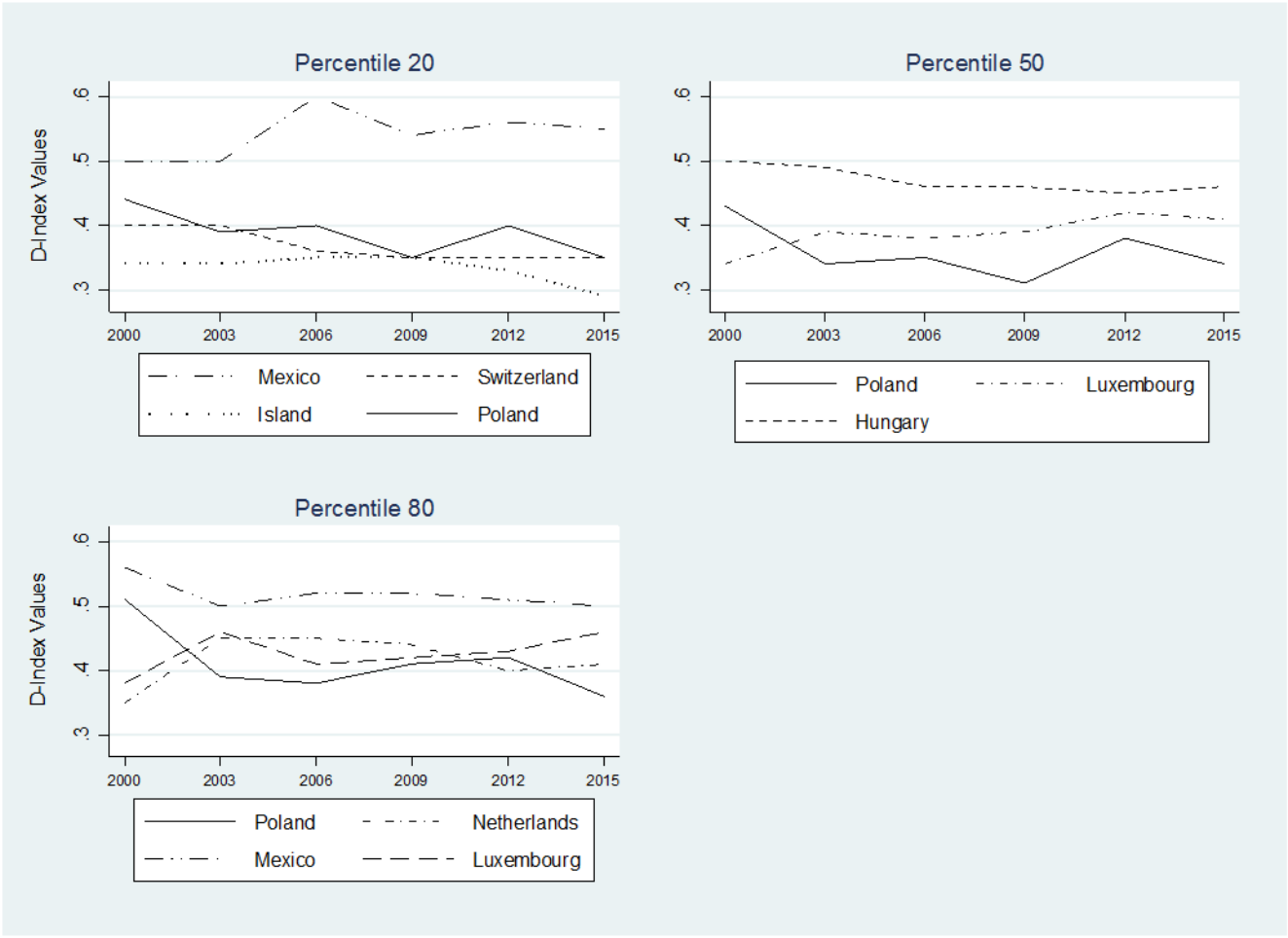
Deciles	Year	Correlation	Year	Correlation	Year	Correlation	Year	Correlation	Year	Correlation	Year	Correlation
10	2000	0.977	2003	0.966	2006	0.980	2009	0.988	2012	0.991	2015	0.989
20	2000	0.965	2003	0.966	2006	0.968	2009	0.972	2012	0.974	2015	0.983
30	2000	0.966	2003	0.959	2006	0.968	2009	0.978	2012	0.958	2015	0.976
40	2000	0.954	2003	0.951	2006	0.963	2009	0.965	2012	0.958	2015	0.964
50	2000	0.958	2003	0.943	2006	0.956	2009	0.958	2012	0.956	2015	0.944
60	2000	0.966	2003	0.943	2006	0.960	2009	0.961	2012	0.952	2015	0.947
70	2000	0.973	2003	0.939	2006	0.966	2009	0.962	2012	0.960	2015	0.937
80	2000	0.979	2003	0.938	2006	0.975	2009	0.967	2012	0.959	2015	0.955
90	2000	0.970	2003	0.958	2006	0.975	2009	0.971	2012	0.975	2015	0.964

Appendix 3: Estimates of between-school segregation (D) across OECD





Appendix 4: Greatest variations in D-Index Values over time



Appendix 5: D-Index Country-Level Correlation Matrix by PISA wave. OECD countries.

Percentile 50

	2000	2003	2006	2009	2012	2015
2000	1.000					
2003	0.841	1.000				
2006	0.880	0.880	1.000			
2009	0.816	0.860	0.903	1.000		
2012	0.891	0.846	0.908	0.909	1.000	
2015	0.851	0.833	0.872	0.877	0.923	1.000

Percentile 20

	2000	2003	2006	2009	2012	2015
2000	1.000					
2003	0.871	1.000				
2006	0.872	0.875	1.000			
2009	0.886	0.908	0.915	1.000		
2012	0.853	0.869	0.901	0.894	1.000	
2015	0.857	0.830	0.869	0.855	0.923	1.000

Percentile 80

	2000	2003	2006	2009	2012	2015
2000	1.000					
2003	0.756	1.000				
2006	0.811	0.804	1.000			
2009	0.823	0.820	0.907	1.000		
2012	0.887	0.822	0.907	0.880	1.000	
2015	0.788	0.847	0.894	0.864	0.908	1.000