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The socio-economic gradient in teenagers' literacy skills: how does England compare to other countries?

John Jerrim[*]

Abstract. A number of studies have explored the link between family background and children's achievement in a cross-national context. A common finding is that there is a stronger association in England than other parts of the developed world. Rather less attention has been paid, however, to England's comparative position at different points of the conditional achievement distribution. Is the test score gap particularly big between the most able children from advantaged and disadvantaged homes, or are differences particularly pronounced between low achievers? This issue is investigated using the Programme for International Student Assessment (PISA) 2009 dataset. The association between family background and high achievement is found to be stronger in England than other developed countries, and that there is little evidence that this has changed over time. However, socio-economic differences at the bottom of the achievement distribution are no more pronounced in England than elsewhere. I discuss the implications of these findings for social mobility and educational policy in the UK.

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1. Introduction

Social mobility has emerged as one of the key academic and political topics in England over the past decade. Ground breaking studies by leading economists have suggested that intergenerational income mobility decreased between children born in 1958 and 1970 (Blanden et al 2004), and that the association between fathers' and sons' incomes is stronger here than elsewhere (Blanden 2009). Prominent policymakers from across the political divide have thus described how England is becoming a "closed – shop" society (Alan Milburn), that "social mobility has ground to a halt" (Conservative Party 2008) and that even bright children from poor backgrounds are unable to succeed (deputy Prime Minister Nick Clegg). Although sociologists have cast doubt on some of these claims (Erikson and Goldthorpe 2010), there seems to be broad disciplinary agreement that education is one of the key drivers of intergenerational persistence (the criticisms of Saunders 2010 withstanding). The link between family background and children's academic achievement is therefore central to concerns over England's lack of social mobility, and has become a major field of study in its own right. This paper thus investigates the strength of the association between socio-economic position (measured by parental occupation) and children's reading skills at age 15, with specific attention paid to whether this intergenerational link is stronger in England than elsewhere.

I draw upon Haveman and Wolfe's (1995) framework of intergenerational transmission to explain why it is important to consider this topic from a cross-national perspective. This can be found in Figure 1. Children's achievement is assumed to have two proximate determinants: home investments (time and goods input) and heredity. The former (determined partly by family income) reflect the environments in which children grow up. The latter (heredity) illustrates that at least part of the association between socio-economic background and children's outcomes is due to genetic inheritance; bright parents tend to hold high socio-economic positions and produce offspring of above average intelligence (who will thus do well in later achievement tests)[1]. The implication is that estimates of the association between family background and children's achievement reflect both "genetic" and "environmental" factors. Therefore, without a comparative context, such simple associations tell us little about the extent to which disadvantaged children's lower test scores are

[1] As Blanden (2009) notes, it is therefore difficult to imagine a world where there is no link between generations. Beller (2009) goes a step further, stating that the absence (or near absence) of an association between family background and children's outcomes is neither plausible nor (perhaps) desirable.

attributable to the poor environments in which they have been brought up[2].

Figure 1

Beller (2009) and Blanden (2009) note that one way around this problem is to compare estimates of such associations across a set of similar nations. The intuition is that, if one assumes that the influence of genetic inheritance is roughly the same in each country, then any cross-national difference in the strength of association between family background and children's outcomes will be due to "environmental" factors. In other words, countries where this relationship is strong are the ones in which disadvantaged children do not receive the inputs they need to succeed.

It is therefore concerning that at the end of the 20th century England did not perform well in this respect. Using TIMSS data from the 1990's, Schütz et al (2008) found that the association between family background and children's achievement was stronger in England (on average) than most other countries. Wößmann (2008), using data from roughly the same period, found a similar result. Yet there has been much investment in disadvantaged children over the last ten to fifthteen years. Educational expenditure has risen in England from 4.5% of GDP in 1997 to near 6% in 2010 (Crawford et al 2009), while child poverty has declined by more than any other developed country[3]. This begs the question, do such findings (which remain widely cited) still hold? Indeed, what is likely to be of upmost concern to the present coalition government is (a) how inequality in educational achievement in England currently compares to that in other developed countries and (b) if the achievement gap between rich and poor has narrowed over the last decade.

The second major limitation of the existing literature is that socio-economic differences are only considered in terms of average test scores. In contrast, this paper explicitly considers the size of the socio-economic gradient at different points of the achievement distribution. A particular concern is whether the *most able* children from disadvantaged homes are able to keep up academically with their more advantaged peers[4].

[2] Most frameworks of intergenerational persistence do not explicitly consider the possibility of gene by environment (G*E) interactions. The presence of such interactions would suggest such simple partitioning of environment and genetics is not sensible. See Perry (2002), Turkheimer et al (2003) and McGrath et al (2007) for evidence of G*E interactions. Manski (2010) also discusses this issue. If G*E interactions do play an important role in the development of children's cognitive skill, then this could also be responsible for the differences that we observe across countries.

[3] See http://www.oecd.org/dataoecd/61/32/47701096.pdf and http://www.oecd.org/dataoecd/52/43/41929552.pdf (Table C02.2.A) for further details

[4] A similar topic has indeed caught the imagination of British academics and policymakers before; Feinstein

This has important implications for those concerned with widening access to higher education (particularly to "elite" institutions) and the top professions. In particular, socio-economic differences towards the top of the achievement distribution need to be sufficiently narrow to make such pathways a viable option for disadvantaged groups. If this is not accomplished, then England is unlikely to foster the "top-end" social mobility that many see as a desirable goal.

These issues are discussed in reference to five specific comparator countries (Australia, Canada, Germany, Finland and the US), while also being put in the broader context of 22 OECD nations. England's coalition government has shown much interest in such cross-national comparisons since coming to power, with the five aforementioned countries receiving particular attention[5]. Some key information (e.g. inequality, intergenerational income mobility, average PISA achievement scores) can be found in Table 1. With regards to socio-economic inequalities, some countries (e.g. Canada and Australia) stand out as being quite socially mobile despite having reasonably high levels of income inequality (see Bjorkland and Jantti 2009 and Ermisch et al, forthcoming, for further discussion). Others are both unequal and immobile (e.g. the US) or are generally high achieving with (comparatively) little income/educational inequality (e.g. Finland). Such diversity makes this a particularly interesting group with which to compare.

Table 1

In the following section I describe the Programme for International Student Assessment (PISA) data on which this paper is based. The most recent wave (2009) is used to study how socio-economic differences in PISA test scores varies across countries, both on average and across the achievement distribution. I also investigate whether there has been a reduction in socio-economic inequalities in educational attainment in England since the first PISA wave in 2000, and if this has been concentrated amongst the most or least able pupils. Results suggest that:

(2003) specifically focused on how the development of advantaged and disadvantaged children differed amongst those who performed *particularly well* on an early test, and is arguably the piece of research that has had greatest impact on social policy in England over the past decade. Jerrim and Vignoles (2011), however, discuss this paper at length.

[5] Comparisons between England and Finland are not so common as with the other countries listed. This country has been included as it has been described as one of the "PISA winners" (Dobbins and Martens, forthcoming) with high average test scores and low educational inequality.

- The difference between advantaged and disadvantaged children's PISA 2009 reading test scores in England is similar (on average) to that in most other developed countries (including Australia, Germany and to some extent the US).
- Yet the association between family background and high achievement seems to be stronger here than elsewhere.
- There is some evidence that the socio-economic achievement gradient has been reduced in England over the last decade, although not amongst the most able pupils from advantaged and disadvantaged homes.

The paper now proceeds as follows. Section 2 describes the PISA data and my empirical methodology. This is followed in section 3 by estimates of (a) socio-economic differences in average test scores (b) how this varies at different points of the PISA test distribution and (c) whether this has changed over time. Conclusions and policy recommendations follow in section 4.

2. Data

Data are drawn from the Programme for International Student Assessment (PISA); a study of 15 year-olds' achievement conducted across the OECD nations every three years[6]. In each country, a minimum of 150 schools are selected with probability proportional to size, with 35 pupils then randomly selected from within. Average response rates of both schools and pupils are high (around 90% in most countries)[7].

As part of the PISA study, participants sat a two hour test which measures their cognitive ability in three areas (reading, maths and science)[8]. In 2000 and 2009 the vast majority of questions examined children's reading skills, and is hence the focus of this paper[9]. All questions included in this test were designed with cross-national comparability in mind. Children's answers were summarized by the survey organizers using an 'item-response model', producing five 'plausible values'. These are five different estimates of children's 'true' reading ability at age 15. The first of these plausible values is used throughout the

[6] Throughout my analysis I treat England and Scotland as separate countries ('England' includes Wales and Northern Ireland).
[7] A set of sampling weights are provided by the survey organisers that attempt to correct for non-response and scale the sample up to the size of the national population. These weights are applied throughout the analysis.
[8] Micklewright et al (2010) show the correlation between scores on the PISA test and achievement on national exams in England is high ($r \approx 0.8$). These national exams are an important determinant of children's future employability and the availability of certain educational pathways (e.g. which university they are able to attend).
[9] In 2003 and 2006 reading was a so called "minor domain" with children asked fewer questions on this topic.

analysis[10]. This variable has a mean of roughly 500 points across all OECD children who took the test and a standard deviation of 100. To aid interpretation, the survey organisers state that 40 PISA test points is equivalent to roughly one additional year of schooling (OECD 2010 b – page 157)[11]. Table 2 illustrates the distribution of this variable across the key countries considered.

Table 2

There are several ways one may use the PISA data to divide children into those from "advantaged" and "disadvantaged" homes. One common way of doing so is on the basis of parental education, playing directly into a growing literature on intergenerational educational mobility and cross-national studies in this area (e.g. Hertz et al 2007, Chevalier et al 2009). Measurement of parental education in cross-national studies is, however, problematic. Educational qualifications differ dramatically across countries, with cross-national comparability a major concern (Steedman and McIntosh 2001). Similarly, the proportion of parents holding a particular qualification (e.g. a degree) may be very different. It thus becomes unclear as to whether this captures the same degree of "advantage" in one country as it does another. The wording of questions used to capture information on parental education also changed between the 2000 and 2009 PISA survey waves, making it inappropriate to use for measuring change over time. There have also been concerns voiced over the extent of measurement error in the parental education data within PISA, given it is reported by the sampled children rather than their parents (Schulz 2005, Kreuter et al 2010). Thus, despite the conceptual attraction of parental education as a measure of social stratification, the above concerns mean that alternatives must be considered.

The main measure of family background used in this paper is the HISEI index of occupational status (a widely used measure in the sociological literature), which assigns each occupation a score between 16 and 90 based upon the "inputs" (educational level required) and "outputs" (the salary commanded) from that particular job. The creators (Ganzeboom et al 1992) explicitly designed this index to improve the measurement of socio-economic status in cross-national research, and have thus validated it across a range of developed countries, making it particularly attractive for this piece of work.

[10] I experimented using the other plausible values, and by running five separate models and averaging the estimated coefficients and standard errors. Results are very similar to those presented.
[11] They state that 6 years of additional schooling is equivalent to 242 PISA test points. This roughly converts into 40 test points for one school year.

The HISEI index is included in PISA as a pre-defined variable, which has been created by the survey organizers based upon children's reports of their mother's and father's occupation (whichever is the higher)[12]. The distribution of this variable across countries can be found in Table 2. This index is divided (*within* each country) into five quintile groups, with the top quintile defined as "advantaged" and the bottom quintile as "disadvantaged"[13]. To give readers unfamiliar with this measure some feel for the data, the bottom quintile in England includes occupations such as Roofers, Labours, Waiters/Waitresses and Chambermaids, while the top quintile contains Judges, Doctors, Architects and professional Engineers (amongst others). The motivation for using this "quintile" definition is that it has been widely used in the existing literature on socio-economic gradients (Chowdry et al 2010, Crawford et al 2010) and, as noted by Feinstein and Bynner (2004), is widely understood in policy circles[14]. Moreover, it ensures that results will not be driven by a different proportion of children being defined as "advantaged" and "disadvantaged" in the different countries. There are, of course, also limitations to this choice (e.g. one could argue that it results in some information loss). My experimentations with the data suggest, however, that the broad pattern of results still holds when using various alternatives (e.g. the HISEI index values as a simple linear term).

Measurement error in the HISEI data might be another concern. Schulz (2005) has, however, investigated this issue using PISA field trial data, where a sub-sample of parents were asked about their occupation in a piloted "parental questionnaire". He finds a strong correlation ($r \approx 0.8$) between parental and child reports of the HISEI index in 14 out of the 15 countries considered. Jerrim and Micklewright (forthcoming) also find evidence that children's reports of parental occupation in PISA are generally consistent with those drawn from their parents. Moreover, I have used a sub-sample of the PISA 2006 data to test the sensitivity of my results to who reports the information on family background. Estimates do indeed seem robust to whether the sampled children or their parents report the information on family background and that, although this does not completely rule out the possibility of measurement error, the signs are nevertheless encouraging (further details are available upon request).

[12] In other words, socio-economic status is measured in this paper using highest parental occupation (with "high" defined on the HISEI scale).

[13] I have checked that my results are robust to using the HISEI index in a different way (enter it as a continuous term). The main conclusions drawn in this paper remain largely intact.

[14] This method does, of course, lead to some information loss. For instance, it might also be interesting to compare outcomes for the least advantaged and average child, versus the average child and the most advantaged. This would, however, produce a very large number of estimates. Hence going into such finer details is not practical when using a (cross-national) quantile regression approach.

In the next section, the aforementioned variables enter as covariates in OLS and quantile regression models of children's reading achievement. For those not familiar with quantile regression, I provide the intuition behind this technique in Figure 2. This presents hypothetical test score distributions for low SES and high SES children[15]. M^L and M^H represent the mean test score for these two groups. OLS regression that includes a dummy variable for socio-economic status (low versus high) captures the difference between these two points (conditional upon any other factors that have been included in the model). Quantile regression can be thought of in a similar way. The points Q^L and Q^H in Figure 2 represent the 90^{th} percentile of the low SES distribution and the 90^{th} percentile of the high SES distribution. A quantile regression analysis at the 90^{th} percentile will capture the difference between these two points (again, conditional upon any other factors that have been included in the model). An analogous interpretation holds when estimates are made at other points of the test distribution (e.g. a quantile regression estimate at the 10^{th} percentile). Again, I stress the purpose of this description has been to provide the intuition behind such estimates for readers who are unfamiliar with this technique. Koenker and Bassett (1978) offer a more technical description.

Figure 2

The specification of the model estimated follows that used in the existing literature on international comparisons of socio-economic achievement gradients (e.g. Schütz et al 2008, Wößmann 2008, Jerrim and Micklewright 2011a). Socio-economic status (quintiles of the HISEI index) is the covariate of interest, with controls included for gender and whether the child was a first or second generation immigrant[16]. As argued by Wößmann (2008) other characteristics (e.g. type of school attended) are intentionally not controlled, so that the SES parameter captures all the channels by which family background influences children's test performance at age 15 (through both nature and nurture)[17]. The estimated coefficients will thus capture the *cumulative* impact of family background on children's test performance, including their experiences during the first years of life (which Cunha et al 2006, amongst

[15] In this example, I have set the shape of the high SES and low SES test score distributions to be different for illustration purposes.
[16] Children had to answer three questions regarding whether they, their mother or their father was born outside the country that they are taking the test in. I define a child as an "immigrant" if they answer yes to any of these three questions.
[17] 'Missing' categories (dummy variables) are also included to ensure children are not dropped from the analysis when pieces of information are unavailable.

others, have stressed are extremely important). The final form of the model is:

$$A_{ijk} = \alpha + \beta_1.SES_i + \beta_2.Sex_i + \beta_3.I_i + \beta_4.SES_i * I_i + \varepsilon_{ij} \quad \forall k \qquad (1)$$

Where:

A = Children's score on the PISA reading test

Sex = A binary indicator of the child's gender (0 = female, 1 =male).

I= Whether the child is a first or second generation immigrant (0 = Native , 1 = Immigrant)

SES = A set of four dummy variables reflecting quintiles of the HISEI distribution (Reference: Bottom quintile)

ε = Error term, where there is clustering of children within schools. In OLS estimation, this is taken into account by making the appropriate adjustment to the estimated standard errors. It is not possible to do the same in a quantile regression approach. Thus I bootstrap by cluster (schools) using 50 replications when calculating the standard errors in the quantile regression models[18].

i= Child i

j = School j

k = Country k

All estimates refer to socio-economic gaps at *national* deciles of the test distribution. This approach therefore abstracts from absolute differences in test performance across countries, and instead focuses upon SES gaps at the same *relative* point of the *national* achievement scale. One implication of this is that these percentiles will refer to a different level of skill. My exploration of the data suggests, however, that results are robust to this choice (i.e. substantive findings still hold if absolute skill thresholds are used instead). Summary statistics for all variables used in the analysis can be found for a selection of countries in Table 2.

[18] I have not, however, made any adjustment for the stratification in the PISA data, which may induce some upward bias into my estimated standard errors.

One final issue is the comparability of the PISA data across the four survey waves (this is important for my analysis of change over time). Even though PISA has been explicitly designed with this in mind, there have been some difficulties in this respect for England. Firstly, non-response in 2000 and 2003 did not quite meet the strict requirements of the OECD (it fell 3% short). A recent report by the survey organisers states that the bias induced by this was "likely [to be] negligible" (OECD 2010a page 30 footnote 3), although some (e.g. Micklewright et al 2010) have questioned this claim. Secondly, data for "England" in the PISA 2009 study includes pupils from both England and Wales. On the other hand, in the 2000 study, Wales did not take part. Thirdly, the test was sat by children in the 2000 and 2003 waves in March/April while in 2006 and 2009 it was notably earlier in the school year (November/December). Finally, and possibly related to each of the factors above, the distribution of test scores in England has changed dramatically over this nine year period. This can be seen in Table 3 where I present the distribution of test scores for England compared to the OECD average. Jerrim (2011b) discusses this issue at length.

Table 3

I have tested the robustness of my results to the above difficulties in various ways. Firstly, I have investigated the sensitivity of my results to different sample selections (e.g. to the inclusion or exclusion of children from Wales in the 2003, 2006 and 2009 datasets). Similarly, I have tested whether my substantive results still hold when I explore socio-economic differences at specific points thresholds which have kept the same meaning over time (e.g. say 400 points), rather than at certain percentiles, to try and take the different distribution of test scores into account. Finally, the fact that response rates met the OECD threshold in the 2006 and 2009 waves, while the target population and test month were also consistent, makes comparison between these years a useful check for the consistency of results (and will hence be explicitly discussed in my analysis of change over time in the following section) [19].

[19] Response rates in PISA 2006 and 2009 exceeded the OECD's desired threshold. Moreover, the PISA 2006 and 2009 tests were conducted at the same point (November/ December) in the school year. The 2006 to 2009 comparison therefore overcomes most of the concerns about the comparability of the data over time, although an obvious limitation is that it only allows one to examine change between cohorts born just three years apart.

3. Results

This section attempts to summerise the main findings from the OLS and quantile regression models in a simple and accessible way. A full set of parameter estimates for England, Australia, Canada, Finland, Germany and the US are provided in Appendix 2.

3.1 The socio-economic gap in <u>average</u> test scores

Figure 3 illustrates the size of the socio-economic gap in average PISA reading test scores (based upon OLS estimates). The size of the bar refers to the difference in PISA test points achieved by "advantaged" and "disadvantaged" groups (i.e. the top and bottom ISEI quintile). The thin black line running through the centre is the estimated 95% confidence interval.

Figure 3

England sits around the middle of the international ranking, with the socio-economic gap standing at roughly 95 PISA test points. In other words, by the final year of compulsory schooling, the reading skills of English children from disadvantaged backgrounds are (on average) two and a half years behind those from the most affluent homes. Although this difference may seem large, it is not atypical to that seen in other countries (estimates for both Germany and Australia are of a similar magnitude). In contrast, the US stands out as a country where socio-economic differences in educational achievement are particularly big (more than 100 PISA test points). This is perhaps what one might expect for a country with high levels of inequality and low levels of intergenerational income mobility (recall Table 1). One cannot conclude, however, that the US is significantly different to England (nor Australia or Germany) at the 5% level.

At the other extreme are Finland and Canada. These two countries sit amongst a set of (mainly northern European) countries where the association between family background and the average level of children's achievement is particularly weak. For instance, the OLS estimates suggest that the socio-economic test score gap in Finland is (on average) just 50 PISA test points (little more than one year of schooling) which is roughly half the size of that in England, Germany or the US. This is consistent with research suggesting that these two countries (Finland and Canada) are amongst the most socially mobile (see Blanden 2009 and Table 1).

3.2 The size of the socio-economic gap across the achievement distribution

Figure 3 has established that there are (a) large socio-economic differences in average PISA test scores and (b) that there is variation in the size of this gap across developed countries. Quantile regression estimates now illustrate how this varies across the achievement distribution. Results can be found in Figure 4[20]. Running along the x-axis are deciles of the PISA test distribution, with the magnitude of socio-economic test score gap on the y-axis. This is supplemented by Table 4 which ranks each country by the size of the socio-economic gap at each PISA test decile (those with weak associations are found towards the top of the table). Countries shaded in green/red illustrate where the strength of association is significantly weaker/stronger than in England[21].

Figure 4 and Table 4

In the US the association between family background and achievement is particularly strong at all points of the PISA test distribution, while in Finland (a country with high income mobility and low inequality) the relationship is always comparatively weak. The situation in other countries is more complex, with the socio-economic gradient only standing out as atypically large or small (compared to other countries) at certain test deciles. Of particular interest for this paper, the link between family background and high achievement is stronger in England than most other countries. For instance, Table 4 reveals that socio-economic test score differences at the 90th percentile are greater here than in 19 out of the 23 OECD countries considered (and significantly so on 12 occasions). The same is not true, however, at the bottom of the PISA reading test distribution, where England is actually ranked above the median.

It is also insightful to compare England to some of the specific countries of interest. Consider, first of all, the similarities and differences with Canada. Towards the bottom part of the test distribution (e.g. the 10th and 20th percentile) the socio-economic achievement gap in these two countries is almost equal (standing around 80 to 85 PISA test points). The same does not apply, however, at the top; Figure 4 reveals that there is a difference between advantaged and disadvantaged groups of almost 100 points at the 90th percentile in England, compared to less than 60 in Canada. Table 4 shows that this is a statistically significant

[20] I have not included the results for Australia in this figure for clarity of presentation.
[21] One can thus cross-reference Figure 4 with Table 4 to see where differences between England and the other countries are statistically significant.

difference between these two countries at the 5% level. It is thus clear that the reason why the socio-economic test score gradient is significantly weaker in Canada than England on average (as shown in Figure 3) is because Canada has a much weaker link between family background and high test performance. Indeed, when it comes to socio-economic differences at the top of the achievement distribution, England actually has much more in common with the US.

Another interesting country to compare England to is Germany. Recall from Figure 3 that the socio-economic achievement gap is very similar in these two countries (on average). Figure 4 reveals, however, a clear contrast in what is lying behind this broad result. At the bottom end of the test distribution (p10/p20) the socio-economic gradient is significantly steeper in Germany than England. This stands just short of 110 PISA test points (almost 3 years of schooling) in the former compared to less than 90 in the latter. But when looking at the top of the test score distribution (p80/p90), the opposite holds true. The socio-economic gradient amongst high achievers in Germany is just 60 PISA test points compared to almost 100 in England, which Table 4 again highlights as a statistically significant difference at the 5% level. Hence there is clearly more variation in socio-economic inequalities across England and Germany than simple OLS estimates suggest. Indeed, Figure 4 has highlighted the rather distinct problems that these two countries face, which are likely to require quite different policy responses.

Before turning to the issue of change over time, it is worth considering why the association between family background and high achievement is stronger in England than most other countries. Anecdotally, much of the investment made in disadvantaged children in England is designed to help this group reach a basic level of skill (i.e. to push up the lower tail). Indeed, academics, policymakers and the media frequently discuss England's "long tail of low achievement" and the need to increase the proportion of disadvantaged children (e.g. those receiving free school meals) reaching a certain floor target (e.g. 5 good GCSE's). Although this is clearly important, much less attention seems to be paid to helping disadvantaged children who are already doing reasonably well push on and reach the top grades. This is consistent with the findings presented above. Another possibility is that this is a reflection of the different schools young people attend. Able children from disadvantaged homes in England often do not have access to the best schools, while many from affluent backgrounds receive intensive private tuition. In contrast, disadvantaged children who are doing well in school at age 10 in Germany have access to high quality "Gymnasiums", which can potentially provide the educational resources this group needs to keep up academically

with their more affluent peers[22]. It is possible that this is one of the reasons why there is a weaker relationship between family background and high achievement in Germany than in England. Such interpretations should, however, be treated with caution. There are many possible explanations for the patterns observed, with identification of causal relationships that explain these cross-national differences beyond the scope of this paper.

3.3 Has the socio-economic economic gradient narrowed in England since PISA 2000?

To complete this section, I consider whether socio-economic inequalities in educational achievement have changed since the first PISA study in 2000. For brevity, discussion focuses upon the results for England. I begin by investigating whether the socio-economic achievement gradient has declined on average over this period. Results can be found in Table 5, with the "change" column illustrating the extent to which the socio-economic test score gap has increased or decreased between 2000 and 2009.

Table 5

Table 5 suggests that the socio-economic achievement gap has been reduced in England, and that there is some evidence of a trend emerging (although one should bear in mind that there are only four time points to base this upon). Specifically, the difference in PISA test scores (on average) between advantaged and disadvantaged groups was 108 points in 2000, dropping to around 98 points in 2003 and 2006, and then to 93 in 2009. This decline of 15 test points (or 0.15 of an international standard deviation) is of reasonable magnitude and sits on the boundary of statistical significance at the 10% threshold ($t = 1.62$, $p = 0.10$). To put this into context, the reading ability of low SES children has moved (on average) approximately one school term closer to that of their high SES peers[23]. This finding is consistent with other recent research (e.g. Sullivan et al 2011) which found socio-economic differences in national exam performance to have declined in England over roughly the same period. It is also interesting to note that there has been a similar decline in some of the other countries of interest (Germany, Australia), but not in others (Finland and the US)[24].

[22] However, doing well in school at age 10 will to a great extent be determined by parental inputs during the early years (see Cunha et al 2006) and hence why disadvantaged children tend to be under-represented within such schools.
[23] The PISA survey organisers state that 40 PISA test points equals roughly one year of additional schooling. As there are three school terms in England per year, 15 PISA points is approximately equal to one school term.
[24] One may note that the decline in Germany and Australia is driven by a particularly large gap in the 2000 study

Next, I consider whether this reduction in socio-economic inequalities has been concentrated amongst high or low achievers. The quantile regression results for England from PISA 2000 (square markers) are compared to those from PISA 2003 (circle markers), 2006 (diamond markers) and 2009 (triangles) in Figure 5.

Figure 5

Notice that the data points are a large distance apart on the left hand side of the graph, but are quite close together on the right. For instance, the estimated socio-economic gap at the 20th percentile for the PISA 2000 cohort was roughly 115 PISA test points, but only 90 in PISA 2009. This decline (of 25 PISA test points or 0.25 of an international standard deviation) is both large (equivalent to two terms worth of schooling) and statistically significant at the 5% level (t = 2.4). The PISA 2003 and 2006 results are consistent with this view, and suggest it is not simply due to random fluctuations in the data. In particular, I find a decline in the socio-economic gap of roughly 15 test points at the 20th percentile between the PISA 2006 and 2009 cohorts which is, in itself, on the boundary of being a statistically significant change at the 10% level (t=1.64). On the other hand, the association between family background and the 80th achievement percentile was roughly 101 test points in PISA 2000, and has dropped by just 3 test points as of 2009 (a small and statistically insignificant decline)[25,26].

Why has the socio-economic achievement gap narrowed in the lower tail of the achievement distribution but not the top? Although it is difficult to directly attribute this change to government policy, a number of initiatives were introduced over this period to improve disadvantaged children's basic skills. One example is "the literacy hour" which was specifically designed to help those with low level reading skills. This was rolled out nationally during the time in question, with an evaluation finding the scheme to be highly effective (Machin and McNally 2008). Initiatives targeting more able children in England

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that has not been replicated in any of the more recent waves. There is, in other words, less evidence of a genuine trend.

[25] There is a large drop at the 90th percentile for the 2006 results. This is not entirely unexpected, as quantile regression results in the very tails of the achievement distribution can become unstable.

[26] To test the robustness of the results presented in this sub-section, I have estimated similar models using the HISEI index of occupational status as a continuous measure of family background. My substantive inferences remained largely intact. In particular, I still find evidence of a decline in the family background effect for England between the two cohorts, and that this is being driven by a reduction in socio-economic inequalities amongst the lowest achievers. Moreover, I continue to find that England stands out in this respect compared to most other developed nations. I also find that the aforementioned conclusions hold true when exploring socio-economic differences at absolute skill thresholds (e.g. a certain number of PISA test points in the two surveys) rather than at certain percentiles (see Appendix 2 of Jerrim 2011a for details).

have, on the other hand, been criticised for not reaching those from lower socio-economic groups (e.g. the Gifted and Talented scheme). This is consistent with my finding that the association between family background and PISA test scores weakened between 2000 and 2009, but only towards the bottom end of the achievement distribution.

4. Summary, Discussion and Conclusions

The relationship between socio-economic status and children's cognitive achievement has become a key academic and political topic in England over the past decade. Worryingly, data from the 1990's suggested that this association was stronger (on average) in England than elsewhere. I have contributed to the existing literature by considering how this relationship varies across the achievement distribution and how it has changed over time. Results suggest that children's reading skills are heavily linked to their socio-economic background, but not by more (on average) than most other OECD countries. England does, however, stand out in international comparisons when one considers the link between family background and high achievement. Moreover, my estimates suggest that the family background effect may have weakened in this country over the last decade, although mainly in the bottom part of the achievement distribution. This finding is consistent with the large investment made by England in education, children and families since 2000, along with the emphasis on improving disadvantaged children's basic literacy skills. This finding should be considered in the context of data limitations highlighted in section 2, although similar results hold when using the more recent (and comparable) PISA waves.

There are of course limitations to this work and the need for further research. Perhaps the most pressing issue is that the causal mechanisms behind such cross-national differences need to be better understood. Although some explanations have been offered, trying to isolate the specific reason(s) why the association between family background and high achievement is particularly strong in England has not directly tackled in this particular study. Nevertheless, this paper has important implications for public policy, particularly regarding access to elite higher education institutions and the top professions. The fact that the literacy skills of the most able pupils from disadvantaged homes lags those of their more advantaged peers by over two years of schooling suggests that such pathways are not currently viable options for them. To widen participation in such areas, it is therefore vital to improve the academic achievement of the most able children from disadvantaged homes.

The key question for policymakers is, of course, how do we reach this goal? As noted

by Chowdry et al (2010), schemes to raise academically able pupils' aspirations during secondary school may be important if this has a causal influence on their later attainment. Alternatively, the government could introduce a targeted gifted and talented scheme, identifying high potential children from poor backgrounds at the start of compulsory education and investing in their development over a number of years. Much valuable research has suggested that it is most efficient to invest early, but also that inputs are complementary (e.g. Cunha et al 2006). Disadvantaged children who have reached school age doing relatively well should thus be in a particularly strong position to benefit from a period of such sustained investment[27]. Schemes of this nature could be piloted in the most deprived parts of the country and undergo a thorough evaluation before being rolled out on a national scale. Despite the fiscal limitations that the coalition government are acting under, such investment may be needed in order to reduce England's comparatively strong association between family background and high achievement, and to thus make such pathways a viable option for more children from disadvantaged homes.

[27] This is not to say that disadvantaged children who are falling behind others should be neglected. Indeed, there are many other social and economic reasons why investment may be needed in this particular group.

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Table 1. Summary of country characteristics

	Source	US	England	Canada	Germany	Australia	Finland
Poverty, inequality and social mobility							
Intergenerational income elasticity	Blanden (2009)	0.41	0.37	0.23	0.24	0.25	0.20
Income inequality (Gini coefficient)	OECD (KT)	0.381	0.335	0.317	0.298	0.301	0.269
% of children living in poverty	OECD (KT)	21.6	12.5	15.1	8.3	14	5.4
Educational achievement							
PISA reading rank in 2009	PISA 2009	17th	25th	6th	20th	9th	3rd
Mean PISA reading test score in 2009	PISA 2009	500	494	524	497	515	536
Standard deviation of PISA reading test score	PISA 2009	97	95	90	95	99	86
Youth labour market							
Unemployment rate (% 2010)	OECD (EO)	9.8	7.9	8.1	7.2	5.3	8.5
Youth unemployment rate (% 2010)	OECD (EO)	18.4	19.1	14.8	9.7	11.5	20.3
Educational expenditure							
% of GDP spent on (non-tertiary) education	OECD (EAG)	4.1	4.2	3.6	3	3.6	3.8

Notes:
1 Figures are taken from various sources. OECD (KT) stands for OECD key tables, (EO) for Employment Outlook and (EAG) for Education at a Glance.

2 Countries with a high figure for the intergeneration income elasticity are the least socially mobile.

Table 2. Summary statistics of variables used in the analysis

	US	England	Canada	Germany	Australia	Finland
PISA Reading test score (2009)						
P5	337	335	368	333	342	384
P10	371	370	406	366	384	419
P25	433	429	464	434	450	480
P50	501	499	529	505	522	543
Mean	500	494	524	497	515	536
P75	570	559	589	567	584	598
P90	626	615	636	613	638	643
P95	656	645	663	638	668	668
Standard Deviation	97	95	90	95	99	86
HISEI distribution						
P5	25	25	28	28	25	29
P10	30	30	30	30	30	30
P25	40	38	42	38	43	40
Mean	53	51	53	50	52	52
P50	52	50	53	49	53	53
P75	66	59	69	56	69	68
P90	70	69	71	70	70	71
P95	77	74	77	74	77	77
Standard Deviation	16	16	16	16	16	16
Gender						
% boys	51.3	49.1	50.3	51.1	48.9	50.1
Immigrant status						
% Immigrants	27.2	20.6	35.5	23.7	42.2	7.7
N	**5,233**	**9,548**	**23,207**	**4,979**	**14,251**	**5,810**

Notes:

1PISA reading scores and the HISEI index are continuous variables for which I provide summary statistics for the distribution.

2 Source: PISA 2009

Table 3. Distribution of PISA reading test scores in England and the OECD average

	England				OECD average			
Percentile	**2000**	**2003**	**2006**	**2009**	**2000**	**2003**	**2006**	**2009**
5	352	346	315	335	335	329	320	335
10	391	379	357	370	374	370	363	372
25	457	445	431	429	440	436	432	435
50	527	510	501	499	509	504	502	503
Mean	524	506	495	494	502	498	495	498
75	596	573	567	559	570	566	564	565
90	651	625	620	615	620	615	615	614
95	685	655	655	645	648	643	645	642
SD	101	95	102	95	96	96	98	94

Notes:

1 Figures refer to the number of points at various percentiles of the PISA test distribution

2 OECD (average) refers to when one averages the relevant figures across each of the OECD countries in the international PISA database.

3 Source: Author's calculations from the PISA datasets

Table 4. The association between family background and children's reading ability at different points of the PISA test distribution – England's comparative position

Q10	Q20	Q30	Q40	Q50	OLS	Q60	Q70	Q80	Q90
Ice	Ice	Ice	Ice	Ice	Ice	Fin	Fin	Fin	Fin
Fin	Fin	Fin	Fin	Fin	Fin	Ice	Ice	Ice	Ice
Nld	Nor	Can	Can	Nor	Can	Can	Can	Can	Ger
Nor	Can	Nor	Nor	Can	Nor	Nor	Den	Esp	Can
Can	Den	Den	Esp	Esp	Den	Esp	Nor	Den	Den
Swz	Nld	Swz	Den	Den	Swz	Ire	Esp	Ger	Esp
Den	Swz	Pol	Swz	Ire	Ire	Den	Ire	Nor	Ire
Eng	Ire	Nld	Ire	Swz	Esp	Swz	Ger	Nld	Aut
Ita	Pol	Ire	Pol	Swe	Nld	Ita	Swz	Ire	Swz
Ire	Eng	Eng	Ita	Ita	Ita	Pol	Nld	Swz	Nld
Swe	Ita	Esp	Swe	Aus	Ger	Aus	Ita	Ita	Ita
Pol	Sco	Ita	Aus	Nld	Pol	Nld	Pol	Fra	Nor
Sco	Esp	Sco	Nld	Pol	Swe	Swe	Fra	Pol	Swe
Aus	Swe	Swe	Eng	Eng	Aus	Ger	Aus	Bel	Port
Esp	Aus	Aus	Sco	Ger	Eng	Port	Bel	Aut	Pol
Aut	Cze	Cze	Fra	Sco	Aut	Fra	Port	Aus	Bel
Cze	Port	Ger	Cze	Port	Port	Eng	Swe	Port	Aus
USA	Aut	Port	Ger	Fra	Sco	Sco	Aut	Swe	Fra
Ger	USA	Fra	Port	Cze	Cze	Cze	Eng	Eng	Cze
Port	Ger	USA	USA	Aut	Fra	Aut	Cze	Cze	Eng
Fra	Fra	Aut	Aut	USA	USA	Bel	Sco	Sco	USA
NZ	Bel	Bel	Bel	Bel	Bel	USA	NZ	NZ	NZ
Bel	NZ	NZ	NZ	NZ	NZ	NZ	USA	USA	Sco

Notes:

1 Data sorted in each column by the strength of association between family background and children's reading test score. The further down the Table a country sits, the *stronger* the association (i.e. the greater the difference in test scores between the most and least advantaged quintile of the population)

2 England is highlighted in yellow. Countries near the top of the table that are highlighted in green are where the association between family background and test scores is significantly weaker than in England at the 5% level. Similarly, those at the bottom of the table and shaded in red are where the association is significantly stronger at the 5% level.

3 Country abbreviations can be found in Appendix Table 1.

4 Source: Author's calculations from the PISA 2009 dataset

Table 5. Comparing the association between family background and children's test performance (on average) across the four PISA waves

	Estimated socio-economic gradient in children's test scores				Change 2000 -2009		
Country	**2000**	**2003**	**2006**	**2009**	**Difference**	**SE**	**T-stat**
Ger	121	91	86	89	-32	16.8	-1.91
Aus	108	88	84	92	-16	8.6	-1.88
Eng	108	98	98	93	-15	9.1	-1.62
Can	77	70	79	67	-10	5.4	-1.89
Fin	55	53	49	52	-3	6.8	-0.48
OECD	88	83	86	87	-1	10	-
USA	102	-	-	106	4	12.5	0.31

Notes:

1 Figure refer to the number of PISA test points. The 'difference' column refers to the change in the socio-economic gap between 2000 and 2009. A negative figure refers to a decline in the socio-economic test score gap between advantaged and disadvantaged groups.

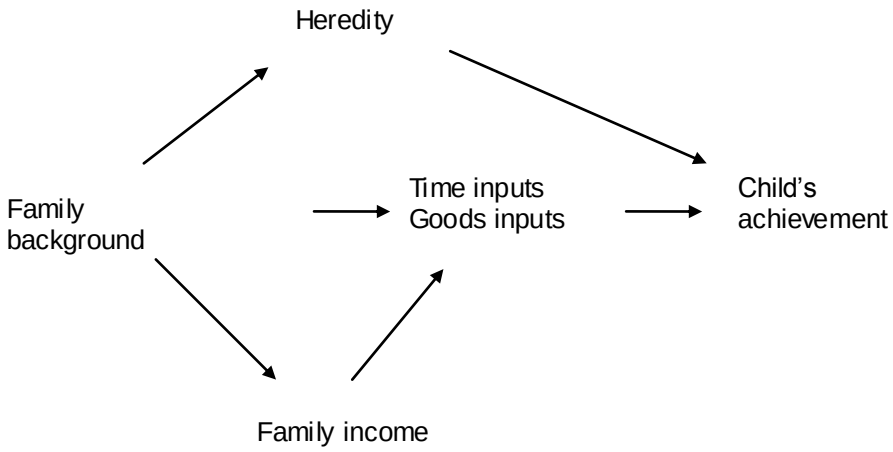
2 The 'T-stat' column illustrates results from the test of the hypothesis that the change between the PISA 2000 and 2009 cohorts is 0.

3 Country abbreviations can be found in Appendix Table1.

4 Data for US not included in 2003 and 2006 as there was a problem with the reading test data for this country in these years (when this was a minor domain).

5 Source: Author's calculation from the PISA datasets

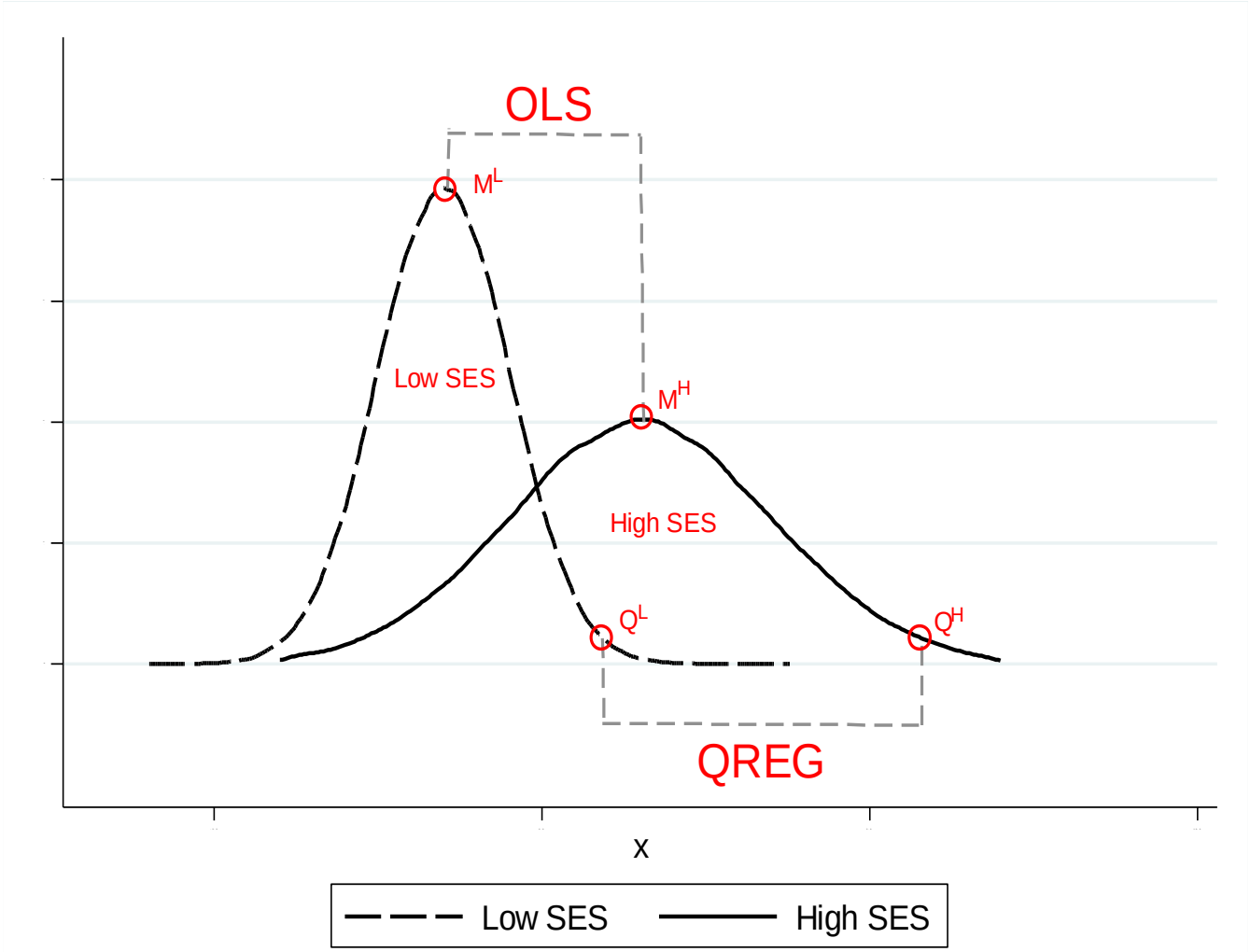
Figure 1. Haveman and Wolfe framework of children's achievement



Notes

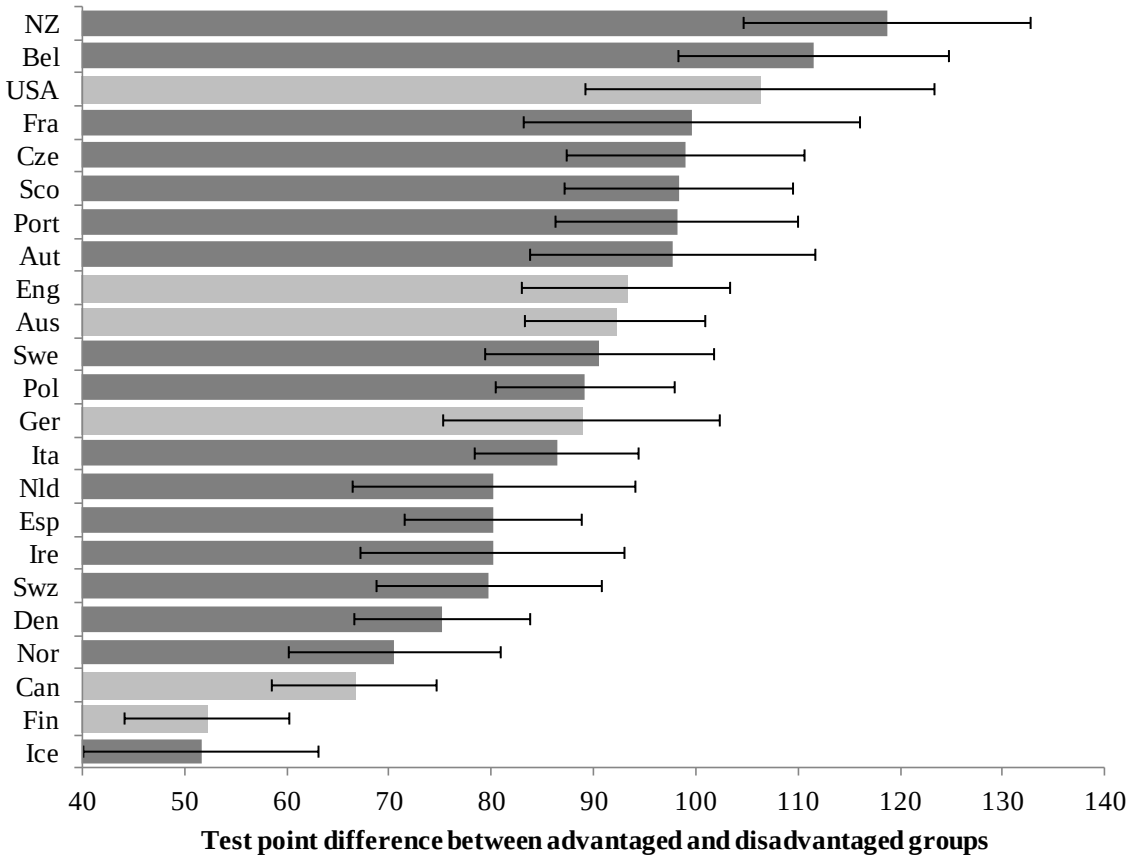
1 Source: Adapted from Haveman and Wolfe (1995, figure 1).

Figure 2. Hypothetical distribution of test scores for low and high SES children – an illustration of the difference between OLS and quantile regression estimates



Note:
This figure has been produced with simulated data, and is designed to illustrate the similarities and differences between quantile regression and OLS estimation. M^H and M^L refer to the means of the high and low SES distributions. Ordinary Least Squares regression will calculate the difference between these two points (conditional on the other explanatory terms one includes in the model). Q^H and Q^L , on the other hand, refer to the 90^{th} percentile of the high SES and low SES distribution. Quantile regression will compare the difference between these two quantities (conditional on the other terms that one includes in the model). In this example, I have set the shape of the high SES and low SES test score distributions to be different – the standard deviation of the high SES distribution is greater than for the low SES distribution. Under this scenario, the quantile regression estimate will be greater than the OLS estimate. One can see this as the dashed "QREG" line is greater than the dashed "OLS" line ($M^H - M^L < Q^H - Q^L$). For further information see my discussion in section 2.

Figure 3. The socio-economic gap in mean PISA reading test scores across 23 countries

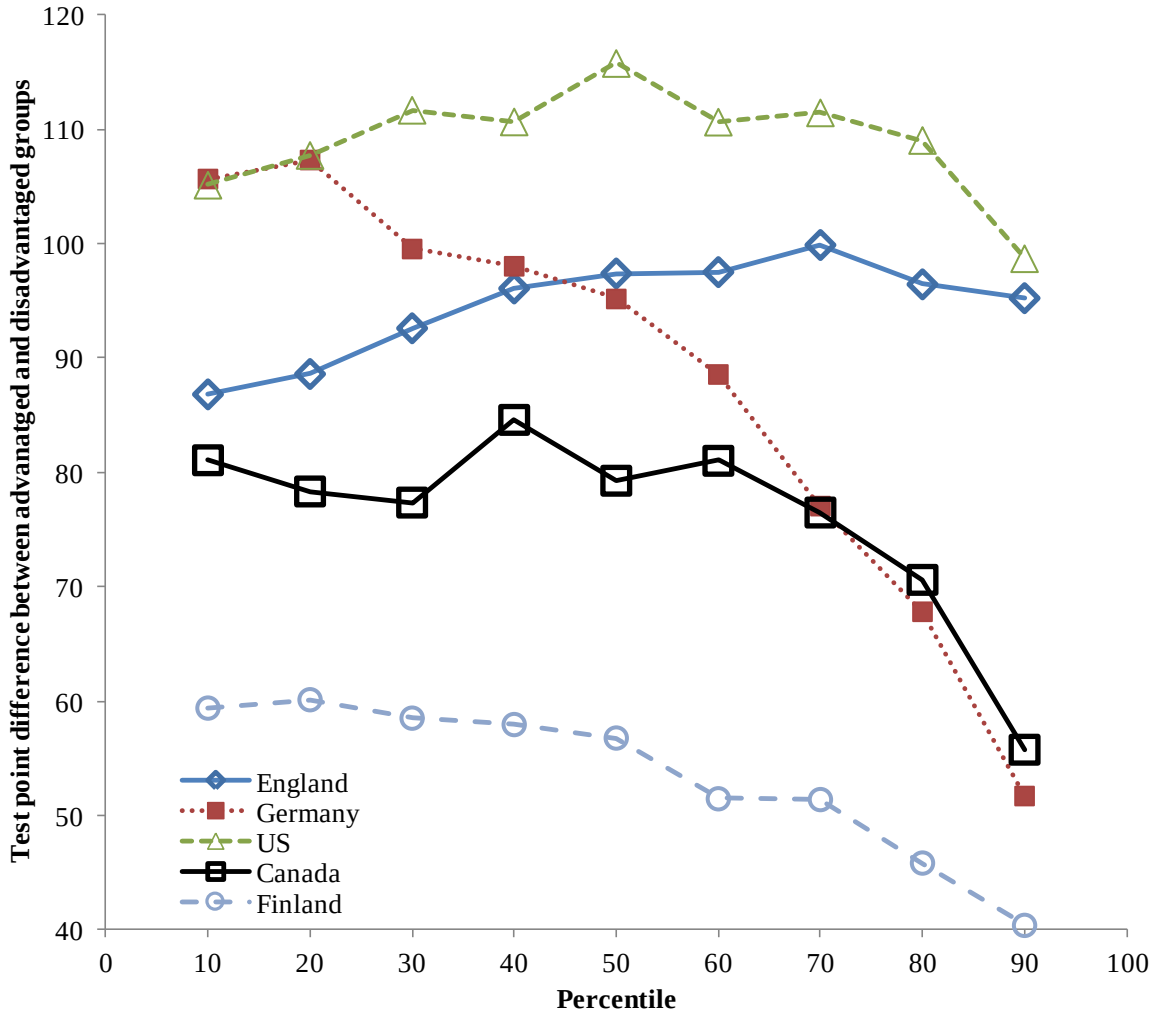


Notes:

1 Figures along the x-axis refer to the difference in PISA points scored by "advantaged" and "disadvantaged" children on average. The thin black bars refer to the 95% confidence interval of the estimate. The countries that I focus my discussion on are highlighted in grey.

2 Source: PISA 2009

Figure 4. The estimated socio-economic achievement gap at various points of the PISA reading test distribution

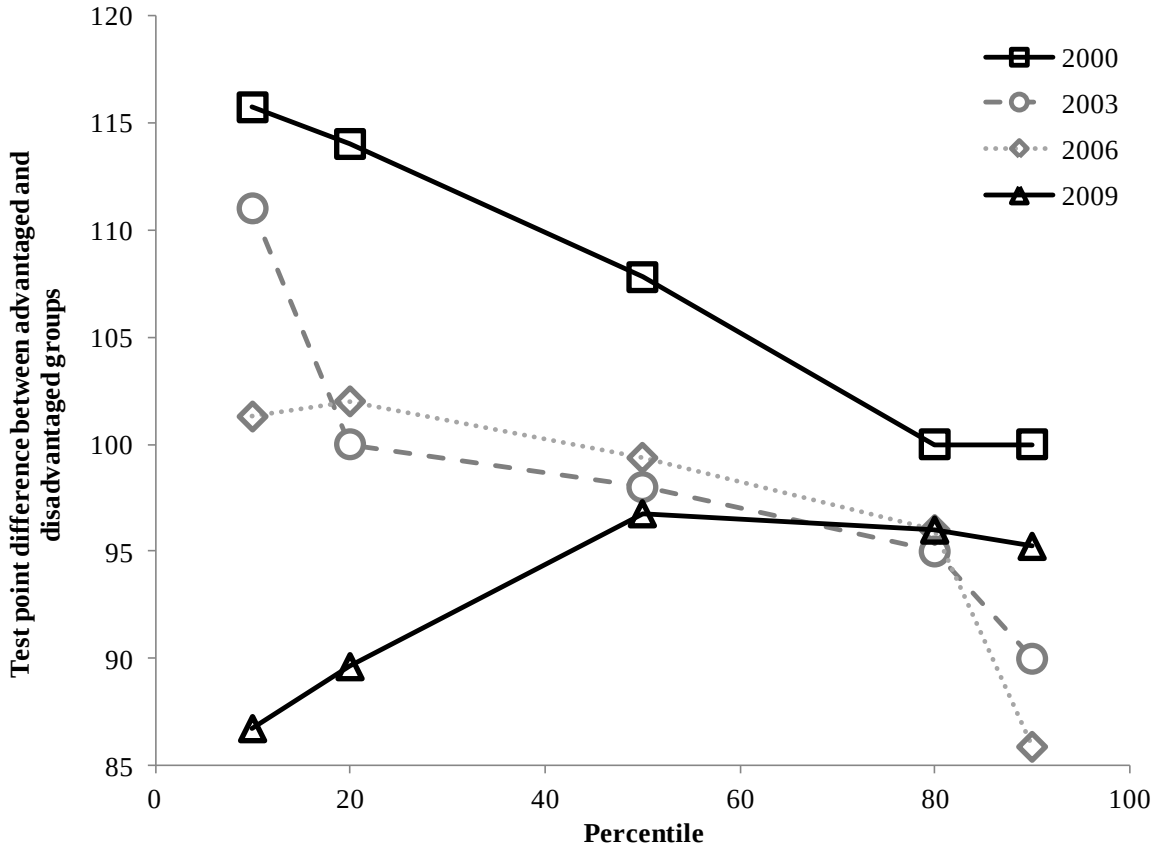


Notes:
1 Running along the x-axis are the percentiles of the national PISA reading test distribution. Figures on the y-axis, on the other hand, refer to the estimated difference in test scores between the most advantaged (top national HISEI quintile) and least advantaged (bottom national HISEI quintile) background.

2 Results for Australia have not been included for clarity of presentation

3 Source: PISA 2009

Figure 5. Comparison of quantile regression estimates for England from the PISA 2000 and 2009 datasets



Notes:
1 Running along the x-axis are the percentiles of the national PISA reading test distribution. Figures on the y-axis, on the other hand, refer to the estimated difference in test scores between children from the most advantaged (top national HISEI quintile) and least advantaged (bottom national HISEI quintile) background.

2 Source: Authors calculations based upon the PISA datasets

Appendix Table 1. Country abbreviations and sample sizes in PISA 2009

Country	Abbreviation
Australia	"AUS"
Austria	"AUT"
Belgium	"BEL"
Canada	"CAN"
Czech Republic	"CZE"
Denmark	"DEN"
England	"ENG"
Finland	"FIN"
France	"FRA"
Germany	"GER"
Greece	"GRE"
Hungary	"HUN"
Iceland	"ICE"
Ireland	"IRE"
Italy	"ITA"
Japan	"JAP"
Korea	"KOR"
Luxemburg	"LUX"
Mexico	"MEX"
Netherlands	"NLD"
New Zealand	"NZ"
Norway	"NOR"
OECD (pooled)	"OECD"
Poland	"POL"
Portugal	"PORT"
Scotland	"SCO"
Spain	"ESP"
Sweden	"SWE"
Switzerland	"SWZ"
USA	"USA"