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Benchmarking London in the PISA rankings

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The Programme for International Student Assessment (PISA) is an important international study of 15-year-olds' academic achievement. Although PISA has traditionally been used to draw comparisons across countries, there is growing interest in the production of regional (i.e. city, state, or provincial level) results. In this paper we present the first attempt to benchmark London in the PISA rankings. Pooling data across the 2009 and 2012 survey waves, we estimated a 95 per cent confidence interval for London's mathematics, reading, and science PISA scores. These are compared not only to country-level averages, but also to the scores of other major world cities and states. The paper concludes by discussing how these results should be interpreted, and possible directions for future research.

Introduction

The Programme for International Student Assessment (PISA) is conducted every three years by the Organisation for Economic Co-operation and Development (OECD), and the results are widely cited by academics and policymakers alike. In recent years, a number of countries have also started to produce regional PISA results – benchmarking educational achievement at the city, state, or province level. Prominent examples include Spain (e.g. Catalonia), Brazil (e.g. São Paulo, Rio de Janeiro), Italy (e.g. Lombardy, Lazio) and the United States (e.g. Florida). This has not escaped the attention of prominent policymakers in England, who have shown much interest in sub-national PISA results. For instance, Liz Truss MP (former Under Secretary of State for Education) recently stated how 'forward-thinking education authorities in England, like Essex, are … proposing to benchmark themselves internationally' (DfE, 2012). The Greater London Authority (GLA) has shown particular interest in such an exercise, with the London Assembly (2014) and the former Mayor of London (Boris Johnson MP) reportedly keen to benchmark England's capital city in the PISA rankings (Stewart, 2014).

There has also been much wider interest in benchmarking London's educational performance internationally. This has partly stemmed from a small but growing literature highlighting the educational 'success' of England's capital city, which emerged only very recently, following reports in the media of London pupils' apparent over-achievement (Cook, 2011). According to Blanden *et al.* (2015: Figure 1), in 2002 only one in three children in Inner London obtained five or more A*–C grades in their GCSE (General Certificate of Secondary Education) examinations (including maths and English), compared to half of all children in England as a whole. However, by 2013, Inner London's performance had improved to such an extent that levels of academic achievement were consistent with the national average (with around two-thirds of children obtaining at least five good GCSEs). Yet it is the high level of achievement among disadvantaged youth in London that is particularly striking. For instance, whereas only 25 per cent of children eligible for free school meals (FSM) achieve five good GCSE grades in the rest of England, 40 per

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cent of FSM pupils achieve this benchmark in Outer London, and up to 50 per cent within Inner London (ibid.). Hence, it is the especially strong performance of young people from low income backgrounds in London that has particularly caught policymakers' attention.

Several explanations for this finding have been ventured within the academic literature. A number of policy reports have highlighted recent changes to school policy (Wyness, 2011; Hutchings *et al.*, 2012), and particularly the effect of the London Challenge programme. However, Greaves *et al.* (2014) point out that the so-called 'London effect' emerged before London Challenge and many of the other most prominent policy changes affecting London. Others, such as Burgess (2014), argue that the strong educational performance of London is actually due to the demographic make-up of England's capital city; particularly the number of young people from ethnic minority backgrounds. He points out that high performing ethnic groups make up a larger fraction of students in London than in the rest of the country, and that such children make greater progress through school. Yet Blanden *et al.* (2015) have recently countered that the London effect cannot be explained by the demographic composition of London's schools, and that differences in the ethnic composition of London account for only about one-sixth of London's improved performance over time. The authors also attempt to isolate the learning stage at which the London effect emerges. Their analysis reveals that most of the London effect observed at GCSE level can be 'explained' by pre-secondary school attainment (pupils entering secondary school with better test scores), and they conclude that the 'London advantage' seems to emerge during primary school.

Thus, the above papers attempt to compare young people's performance in London to that of those in the rest of the UK, with the majority concluding that London's young people are performing better (with a number of explanations as to why, and at what stage, the London advantage emerges). However, an important omission to the literature is that none of these papers considers London in an international context. Comparing London to other UK cities or regions may be an 'unfair comparison'. As the capital city, London may simply be incomparable to other parts of the UK for many reasons. Indeed, Greaves *et al.* (2014) do find some evidence that disadvantaged pupils in the UK's other major cities – that is, Manchester and Birmingham – also experienced rapid growth in GCSE performance between 2002 and 2012, and that pupils in these cities perform better at key stage 4 – although, as is the case with London, prior primary school attainment appears to account for most of their advantage. Moreover, while within-UK comparisons potentially help us find strategies to improve other regions in the UK, they tell us little about whether London is a suitable benchmark to aim for. In other words, if we were to bring the performance of the rest of the UK up to that of London, how would this affect the UK's global standing in academic terms?

In this paper, we take a rather different approach to considering the academic skills of young people in London. Specifically, rather than focusing upon London children's performance in national assessments, we attempt to benchmark London internationally in the PISA rankings. Not only do we compare England's capital to the leading PISA countries, but also to other major economies (e.g. Singapore), cities (e.g. Madrid), and states/provinces (e.g. Ontario). All three major PISA domains are considered (reading, mathematics, and science), as well as children's problem-solving skills and sub-domains, on the mathematics and reading tests. Moreover, recognizing that achievement measures such as PISA capture only one dimension of children's development, we also compare London to other economies in terms of young people's 'non-cognitive' skills.

From a national perspective, this paper contributes to the existing literature by attempting to benchmark London's position in the OECD PISA rankings. To our knowledge, this has never been attempted before. Likewise, we make an international contribution by being the first study to benchmark a number of other important regional economies in the PISA rankings, including

Attica (Athens), Riga, Reykjavik, and Lisbon (among others). Providing such comparisons are important; although London has been highlighted as an education success story within England, we currently do not know if London is also a success story from an international perspective. In other words, do educational standards in London continue to look as strong when we take a broader international view? Similarly, the OECD has been the subject of criticism for comparing cities (e.g. Shanghai) to entire countries (e.g. England), as they are not comparing like with like. Arguably, focusing upon analysis at a sub-national level therefore provides a fairer basis for comparison (e.g. it is more appropriate to compare London to Shanghai than to compare Shanghai to England as a country, as a whole).

A further important contribution this paper makes is that it is the first to examine the London effect using data other than the UK national test data. Specifically, PISA attempts to measure different skills to GCSE exams, with a greater focus upon the application of skills in 'real world' situations rather than mastery of curriculum-based tasks. Finding a London effect in this very different type of test is important to confirm the superior achievement of London's young people compared to the rest of England. On the other hand, if no effect is apparent in PISA, this opens up questions as to the importance of national high-stakes tests for London's performance.

Finally, by benchmarking London children on their non-cognitive as well as their academic achievements, this paper also contributes to the literature on the importance of non-cognitive skills. There is extensive literature that highlights the importance of non-cognitive skills for economic and social outcomes, over and above cognitive skills, in determining future labour market outcomes and educational attainment (e.g. Heckman and Rubinstein, 2001; Heckman *et al.*, 2006), as a driver of intergenerational income persistence (Blanden *et al.*, 2007; Osborne Groves, 2005), and for social behaviours such as involvement in crime (Carneiro *et al.*, 2006). As far as we are aware, ours is the only paper that attempts to benchmark London's young people in this dimension.

The paper now proceeds with a description of the PISA data, and how individual cities/states within a country can be identified. London's position in the PISA rankings is then provided, and this is followed by the conclusions.

Data

As a cross-national study of 15-year-olds' educational achievement, PISA involves children completing a two-hour test covering three 'core domains' (reading, mathematics, and science), with one of these being the focus in any given year. In 2009 and 2012, the rounds considered in this paper, the focus was reading in the former and mathematics in the latter. The 2012 wave also included an additional assessment of children's problem-solving skills. For each cognitive domain, the survey organizers produced five 'plausible values' using a one-parameter item-response (Rasch) model. These plausible values represent different estimates of children's 'true' proficiency in each subject area, and have a mean of approximately 500 and a standard deviation of 100 across OECD countries. To aid interpretation, throughout this paper we report differences between London and other cities/states in terms of an effect size (ES), using the international standard deviation of 100 test points.

The aim of this paper is to benchmark London, along with a number of other cities and states, in the PISA rankings. As noted in the introduction, some countries (e.g. Italy, United States, Australia, Canada) have purposefully oversampled within certain geographic areas to facilitate such regional reports. However, although countries like England have not gone through this oversampling process, it is still possible to produce unbiased PISA estimates for certain geographic

sub-regions. (The main cost of not oversampling is that all estimates will be accompanied by quite wide confidence intervals, as we shall discuss below.)

To identify individual cities and states (including London) in PISA, it is important to understand this study's complex survey design. First, each country selects a set of 'explicit stratification' variables. Although these differ across countries, geographic region and school type are common choices. In England, twelve explicit strata were used; a combination of four geographic regions (North, Midlands, South, and Greater London) and three school types (maintained selective, maintained non-selective, and independent). In PISA 2009 (OECD, 2010a), 6 per cent of the London sample attended an independent school, compared to 7 per cent for England as a whole (sampling weights applied). The analogous figures for PISA 2012 are 9 per cent each for London and England. This information, contained within the 'STRATUM' variable in the public use dataset, means London schools can be identified and investigated within our analysis.

Within each of these explicit strata, schools are then ranked by a variable (or set of variables) that are likely to be strongly associated with PISA test scores. This is known as implicit stratification, with historic GCSE performance of the school the most important variable used for this purpose in England (although school gender composition and local education authority area also play a role). Schools are then randomly selected, with probability proportional to size, within each of the explicit strata. This process has important implications; the combination of implicit stratification and random sampling means that a representative sample should be drawn within each explicit stratum. As Greater London was an explicit stratum for England, a representative sample of London schools should have been collected in PISA 2009 and 2012. The same is true for key cities in other countries (e.g. Riga, Attica, Lisbon) that were also used as explicit stratification variables.

A total of 524 (533) London pupils from 21 (21) London schools participated in PISA 2009 (2012). As PISA is designed to be representative of the 15-year-old school population, the sample also considers immigrant pupils, including those who have been in the country a short period of time. (This of course represents just one of the many challenges that different countries – and different cities – face.) Consequently, although we can obtain unbiased estimates of London's PISA scores, these will be accompanied by quite wide confidence intervals (reflecting uncertainty owing to sampling variation). To maximize statistical power and reduce sampling error, we pooled our analysis across the 2009 and 2012 PISA waves whenever possible, as combining groups or pooling estimates is a common response to limited sample sizes. Although it does not bias the estimates, it does, however, change the interpretation. In this instance, it means the population of interest is defined as 15-year-olds attending London schools *across* 2009 and 2012. We also needed to pool data across the PISA 2009 and 2012 waves in order for the central limit theorem and the 'law of large numbers' at the school level to approximately hold. A common rule of thumb is that at least 30 primary sampling units (schools in PISA) are needed for the central limit theorem to hold. Using data from PISA 2009 or 2012 alone would mean we would fall below this threshold. Our population of interest therefore refers to 15-year-olds who were attending a London school in either 2009 or 2012. (Appendices A, B, and C also present results for the 2009 and 2012 waves separately.) This leads to a total sample size of 1,057 pupils attending 42 London schools. The same process of pooling data across the 2009 and 2012 waves is followed where possible for all other countries/cities/states. Where pooling data across PISA rounds was not possible (e.g. a city could be identified in PISA 2009 but not 2012) we used information from just a single year.

Table 1: Sample sizes for cities/states

PISA explicit stratum	Assigned city/state label	2009	2012	Pooled
Macau	Macau	5,952	5,335	11,287
Singapore	Singapore	5,283	5,546	10,829
Dubai	Dubai	5,620	4,974	10,594
Shanghai	Shanghai	5,115	5,177	10,292
Hong Kong	Hong Kong	4,837	4,670	9,507
Ontario	Ontario	4,151	3,699	7,850
Quebec	Quebec	3,676	4,166	7,842
New South Wales	Sydney	3,313	3,447	6,760
Victoria	Melbourne	2,296	2,406	4,702
Urban Southern Finland	Helsinki	-	4,312	4,312
British Columbia	Vancouver	2,367	1,816	4,183
SE Wales	Cardiff	1,568	1,995	3,563
Attica	Athens	1,648	1,662	3,310
Reykjavik	Reykjavik	2,148	1,123	3,271
Western Australia	Perth	1,486	1,738	3,224
Abu Dhabi	Abu Dhabi	-	3,163	3,163
São Paulo	São Paulo	1,164	1,948	3,112
Lombardy	Milan	1,512	1,523	3,035
Madrid	Madrid	1,453	1,542	2,995
Lazio	Rome	1,462	1,486	2,948
Catalonia	Barcelona	1,381	1,435	2,816
Riga	Riga	1,187	1,321	2,508
Lisbon	Lisbon	1,161	1,149	2,310
Mexico State	Mexico State	1,245	972	2,217
Florida	Florida	-	1,896	1,896
Massachusetts	Massachusetts	-	1,723	1,723
Connecticut	Connecticut	-	1,697	1,697
Rio de Janeiro	Rio de Janeiro	763	694	1,457
Buenos Aires	Buenos Aires	-	1,336	1,336
Algarve	Algarve	611	723	1,334
Belgrade	Belgrade	1,157	-	1,157
SW Wales	Swansea	549	564	1,113
Greater London	London	524	533	1,057
Port of Spain	Port of Spain	916	-	916
Belfast	Belfast	379	463	842
Moscow	Moscow	480	-	480
Limburg	Maastricht	280	-	280

Source: Authors' calculations using the PISA 2009 and 2012 datasets.

Table 2 provides further evidence that the PISA data for London is representative of the city's population of 15-year-olds. Specifically, the right-hand side provides information on gender, FSM eligibility, and national examination scores at ages 11, 14, and 16 for the PISA 2012 sample. This is possible as the authors have access to PISA data for England that has been linked to the National Pupil Database (NPD), and can thus see how the PISA sample selected for London compares to the London population. The left-hand side provides analogous summary statistics for all 82,290 15-year-olds enrolled in London schools in 2012 (i.e. the target population that the PISA-London data should represent). By comparing figures across these columns, we are able to gain further insight into the representativeness of the PISA-London sample.

Table 2: A comparison of the PISA-London sample to the population

	NPD (population)	**PISA (sample)**		
	per cent	**per cent**	**Lower 95% CI**	**Upper 95% CI**
Free school meals				
% FSM	24	25	15	36
Gender				
% Male	51	50	45	55
GCSE maths grade				
% A*	8	7	5	10
% A	14	10	6	15
% B	20	19	16	23
% C	29	38	32	44
% D	10	13	10	17
% E	5	5	3	6
% F	4	4	2	6
% G	3	2	0	5
% U	1	1	0	2
Missing	6	0	-	-
KS3 maths level				
% Level 2	1	1	0	2
% Level 3	4	3	1	5
% Level 4	11	13	9	16
% Level 5	21	29	21	37
% Level 6	26	29	23	36
% Level 7	20	16	9	22
% Level 8	8	9	6	12
% Missing	6	1	0	2

	NPD (population)	PISA (sample)		
	Mean	**Mean**	**Lower 95% CI**	**Upper 95% CI**
GCSE TPS				
Mean	335	354	342.8	364.5
KS2 maths score				
Mean	63.6	62.1	58.0	66.3
KS2 total score				
Mean	82.1	81.6	78.5	84.6

Notes: All figures refer to state school pupils only (children attending independent schools have been excluded). Left-hand side based upon NPD data (for the population of 15-year-olds in London). Right-hand side based upon the PISA sample.

The PISA-London sample seems to match the population in terms of gender composition (50 per cent) and FSM eligibility (25 per cent versus 24 per cent).[1] Likewise, a similar proportion achieved a D or below in their GCSE mathematics exam (25 per cent in PISA-London versus 23 per cent in the population). Slightly more children in the population gained an A or A* than in the PISA sample (17 per cent versus 22 per cent) and slightly fewer a grade C (38 per cent versus 29 per cent). In contrast, the PISA-London sample did slightly better overall across all their GCSEs (key stage 4 capped points score of 354 versus 335). However, the 95 per cent confidence interval suggests these modest differences are not unexpected, given sampling variation. A similar finding emerges with regard to key stage 2 (age 11) and key stage 3 (age 14) test scores. Table 2 therefore suggests that a representative, though moderately sized, sample of London pupils has indeed been collected. As the PISA sample has been designed in a similar way in other countries, a representative sample for the other major international cities/states listed in Table 1 should also have been drawn (as is the case in London). However, as we are unable to produce an equivalent of Table 2 for these other cities/states, the empirical evidence we can provide to verify this is limited.

The PISA 2009 and 2012 data contain information on children's reading, science, and mathematics test scores. The 2012 wave also includes results on seven mathematics sub-domains – formed of four 'content' areas (change and relationships, quantity, space and shape, and uncertainty and data) and three 'process' skills (employ, formulate, and interpret) – with full details available from OECD (2010b).

As part of PISA, children also completed a detailed background questionnaire. In 2012 this included a rotated background questionnaire (which meant only two-thirds of the sample were randomly assigned to answer these questions – hence, this part of our analysis is restricted to only these children); and a battery of Likert-scale questions designed to capture children's 'work ethic', 'perseverance', and 'attributions to failure' (i.e. whether they blame others or external circumstances for not doing well on a test). Exemplar questions included:

- work ethic: 'I study until I understand everything'
- perseverance: 'When confronted with a problem, I give up easily'
- attributions to failure: 'This week I made bad guesses on the quiz'.

Children responded to these questions using a four-point scale (from strongly disagree to strongly agree). Responses have been converted into scales by the survey organizers using item-response theory techniques. Given the now extensive literature on the significance of such 'non-cognitive' skills (Heckman and Rubinstein, 2001), it is important we also attempt to benchmark this aspect

of London children's development. To aid interpretation, we standardized each scale to mean 0 and standard deviation 1 across countries, for all children, with the relevant data available. Thus, when presenting the non-cognitive skills results, all figures can be interpreted as differences in terms of standard deviations.

We followed recommended practice throughout our analysis (OECD, 2009a). Final student weights were applied to produce population estimates and to adjust for the small amount of non-random non-responses. The complex survey design (stratification and clustering of children) was accounted for via the application of the balanced repeated replication weights. All estimates involving PISA test scores were produced five times, once using each plausible value, then averaged and aggregated as recommended by OECD (2009b). The above was facilitated by the Stata 'repest' command developed by Avvisati and Keslair (2014).

Results

Mathematics

The left-hand column of Table 3 places London into the pooled PISA 2009 and 2012 mathematics rankings. (Appendix A presents separate results for these two years.) Overall, London's performance does not appear to be particularly strong; the estimated 95 per cent confidence interval ranges between 458 and 500 test points. It is significantly below 22 countries, including Slovenia, Vietnam, and Macedonia. It is also notable that the point estimate for London is below that for the rest of the UK (ES = 0.16), though this difference is not statistically significant at the conventional thresholds. Moreover, although London's mean mathematics score declined from 489 in 2009 to 470 in 2012, this change also does not reach statistical significance at conventional levels. Additional analysis is also provided in Appendix E, where London's position in the PISA mathematics rankings is presented separately for boys and girls. Interestingly, it seems to be the comparatively weak performance of London girls in PISA mathematics (mean score of 462, compared to 495 for London boys) that is driving this result.

Table 3: London's position in the PISA rankings

Maths			**Reading**			**Science**		
Country	**Effect size**	**P**	**Country**	**Effect size**	**P**	**Country**	**Effect size**	**P**
Shanghai	1.27	0.00	Shanghai	0.80	0.00	Shanghai	0.81	0.00
Singapore	0.89	0.00	Hong Kong	0.56	0.00	Hong Kong	0.55	0.00
Hong Kong	0.79	0.00	South Korea	0.55	0.00	Finland	0.53	0.00
Chinese Taipei	0.73	0.00	Singapore	0.51	0.00	Singapore	0.50	0.00
South Korea	0.71	0.00	Finland	0.47	0.00	Japan	0.47	0.00
Liechtenstein	0.57	0.00	Japan	0.46	0.00	South Korea	0.41	0.00
Japan	0.54	0.00	Canada	0.41	0.00	Estonia	0.38	0.00
Switzerland	0.54	0.00	New Zealand	0.34	0.00	Vietnam	0.32	0.00
Macedonia	0.53	0.00	Australia	0.31	0.01	Canada	0.31	0.00
Finland	0.51	0.00	Netherlands	0.27	0.02	Australia	0.28	0.01
Netherlands	0.46	0.00	Ireland	0.27	0.02	New Zealand	0.27	0.01
Canada	0.44	0.00	Chinese Taipei	0.26	0.02	Germany	0.26	0.01
Estonia	0.37	0.00	Poland	0.26	0.02	Liechtenstein	0.26	0.02
Belgium	0.36	0.00	Vietnam	0.25	0.03	Netherlands	0.26	0.02

Maths			Reading			Science		
Country	**Effect size**	**P**	**Country**	**Effect size**	**P**	**Country**	**Effect size**	**P**
Germany	0.34	0.00	Estonia	0.25	0.02	Chinese Taipei	0.25	0.01
Vietnam	0.33	0.01	Belgium	0.25	0.03	Poland	0.20	0.06
New Zealand	0.31	0.00	Liechtenstein	0.24	0.03	Rest of UK	0.20	0.06
Australia	0.30	0.01	Switzerland	0.22	0.05	Switzerland	0.19	0.06
Poland	0.26	0.02	Norway	0.21	0.06	Macedonia	0.19	0.06
Denmark	0.23	0.04	Germany	0.20	0.08	Ireland	0.19	0.07
Slovenia	0.22	0.04	France	0.18	0.11	Slovenia	0.16	0.11
Austria	0.22	0.05	United States	0.16	0.16	Belgium	0.09	0.37
Iceland	0.21	0.05	Rest of UK	0.16	0.15	Czech Republic	0.07	0.48
France	0.17	0.11	Macedonia	0.14	0.18	Austria	0.03	0.74
Czech Republic	0.17	0.13	Denmark	0.13	0.24	United States	0.03	0.76
Rest of UK	0.16	0.13	Iceland	0.09	0.41	Denmark	0.02	0.82
Ireland	0.16	0.15	Hungary	0.09	0.43	Hungary	0.02	0.83
Norway	0.15	0.17	Sweden	0.08	0.45	France	0.02	0.84
Slovak Republic	0.11	0.30	Portugal	0.06	0.60	Latvia	0.01	0.94
Luxembourg	0.11	0.31	Italy	0.05	0.63	Norway	0.01	0.95
Portugal	0.08	0.45	Latvia	0.03	0.77	LONDON	0.00	1.00
Sweden	0.08	0.45	Spain	0.02	0.88	Lithuania	–0.03	0.76
Latvia	0.07	0.54	Czech Republic	0.02	0.88	Spain	–0.04	0.68
United States	0.05	0.61	LONDON	0.00	1.00	Italy	–0.05	0.60
Italy	0.05	0.62	Perm (Russia)	0.00	0.97	Portugal	–0.05	0.60
Hungary	0.05	0.63	Slovenia	–0.01	0.96	Sweden	–0.06	0.55
Spain	0.05	0.63	Luxembourg	–0.02	0.82	Croatia	–0.08	0.46
Perm (Russia)	0.05	0.69	Croatia	–0.02	0.82	Luxembourg	–0.09	0.39
LONDON	0.00	1.00	Israel	–0.03	0.81	Iceland	–0.09	0.36
Lithuania	–0.01	0.91	Greece	–0.03	0.80	Russia	–0.14	0.17
Russia	–0.04	0.70	Austria	–0.03	0.78	Slovak Republic	–0.15	0.16
Croatia	–0.13	0.22	Lithuania	–0.10	0.35	Perm (Russia)	–0.17	0.15
Malta	–0.16	0.14	Slovak Republic	–0.12	0.29	Greece	–0.28	0.01
Greece	–0.19	0.07	Turkey	–0.13	0.26	Israel	–0.34	0.00
Israel	–0.22	0.05	Russia	–0.16	0.15	Malta	–0.35	0.00
Turkey	–0.32	0.00	Chile	–0.37	0.00	Turkey	–0.38	0.00
Serbia	–0.33	0.00	Serbia	–0.39	0.00	Chile	–0.50	0.00
Romania	–0.43	0.00	Malta	–0.41	0.00	Serbia	–0.53	0.00
Bulgaria	–0.46	0.00	Costa Rica	–0.41	0.00	UAE	–0.53	0.00
Azerbaijan	–0.48	0.00	UAE	–0.46	0.00	Bulgaria	–0.54	0.00

Notes: Authors' calculations using the pooled PISA 2009 and 2012 datasets. Table restricted to top 50 performing economies only (results for another 26 not reported). P refers to P-value for difference compared to London. Grey shading indicates difference statistically significant at the 5 and 1 per cent levels, respectively. Final student and replicate weights applied.

How does London compare to other major international cities/states in terms of children's mathematics skills? The answer can be found in Table 4. A total of 17 cities/states outperform London at the 5 per cent level (including Riga, Reykjavik, and Milan), with children in the top-performing city (Shanghai) approximately three years of schooling ahead (ES = 1.27) of children in England's capital. Indeed, in additional analysis we found that only the top 10 per cent of London pupils have mathematics skills equal to the average child in Shanghai. (The 90th percentile of the PISA mathematics distribution in London is 602 test points; this compares to an average PISA mathematics score of 606 in Shanghai.)

Table 4: London compared to other major international cities and states

Mathematics			**Reading**			**Science**		
City/state	**Effect size**	**P**	**City/state**	**Effect size**	**P**	**City/state**	**Effect size**	**P**
Shanghai	1.27	0.00	Shanghai	0.80	0.00	Shanghai	0.81	0.00
Singapore	0.89	0.00	Hong Kong	0.56	0.00	Hong Kong	0.55	0.00
Hong Kong	0.79	0.00	Singapore	0.51	0.00	Singapore	0.50	0.00
Maastricht	0.64	0.00	British Columbia	0.47	0.00	Helsinki	0.50	0.00
Quebec	0.61	0.00	Ontario	0.47	0.00	British Columbia	0.43	0.00
Macau	0.53	0.00	Massachusetts	0.44	0.00	Western Australia	0.40	0.00
British Columbia	0.44	0.00	Helsinki	0.43	0.00	Maastricht	0.37	0.01
Western Australia	0.43	0.00	Connecticut	0.39	0.00	Ontario	0.32	0.00
Ontario	0.41	0.00	Lombardy	0.38	0.00	New South Wales	0.32	0.00
Helsinki	0.39	0.00	Quebec	0.38	0.00	Lombardy	0.31	0.01
Lombardy	0.38	0.00	Perth	0.38	0.00	Massachusetts	0.31	0.01
Massachusetts	0.35	0.01	Maastricht	0.33	0.01	Connecticut	0.24	0.04
New South Wales	0.32	0.00	Victoria	0.33	0.00	Quebec	0.24	0.02
Moscow	0.31	0.06	New South Wales	0.31	0.01	Victoria	0.23	0.03
Reykjavik	0.31	0.00	Riga	0.26	0.03	Macau	0.19	0.06
Victoria	0.27	0.01	Madrid	0.24	0.03	Moscow	0.19	0.24
Connecticut	0.27	0.03	Belfast	0.22	0.08	SW Wales	0.18	0.11
Riga	0.27	0.03	Moscow	0.19	0.26	Riga	0.16	0.15
Madrid	0.21	0.05	Reykjavik	0.17	0.12	Madrid	0.16	0.13
Catalonia	0.15	0.17	Catalonia	0.17	0.14	Belfast	0.13	0.28
Lisbon	0.09	0.43	Macau	0.14	0.18	LONDON	0.00	1.00
Belfast	0.09	0.47	SW Wales	0.13	0.28	Lisbon	0.00	0.98
SW Wales	0.05	0.68	Lisbon	0.11	0.34	Reykjavik	–0.01	0.95
LONDON	0.00	1.00	Athens (Attica)	0.11	0.33	Catalonia	–0.02	0.86
Rome (Lazio)	–0.05	0.66	Florida	0.09	0.45	SE Wales	–0.10	0.34
Athens (Attica)	–0.08	0.48	LONDON	0.00	1.00	Florida	–0.12	0.34
Algarve	–0.09	0.43	Rome (Lazio)	–0.02	0.87	Rome (Lazio)	–0.14	0.21
Florida	–0.12	0.32	SE Wales	–0.10	0.38	Athens (Attica)	–0.15	0.18
SE Wales	–0.14	0.19	Algarve	–0.13	0.28	Algarve	–0.20	0.06
Belgrade	–0.17	0.19	Belgrade	–0.17	0.16	Dubai	–0.26	0.01
Dubai	–0.20	0.06	Dubai	–0.18	0.09	Belgrade	–0.31	0.01
Port of Spain	–0.48	0.00	Mexico State	–0.44	0.00	Abu Dhabi	–0.57	0.00

Mathematics			Reading			Science		
City/state	**Effect size**	**P**	**City/state**	**Effect size**	**P**	**City/state**	**Effect size**	**P**
Abu Dhabi	–0.57	0.00	Port of Spain	–0.48	0.00	Port of Spain	–0.64	0.00
Mexico State	–0.58	0.00	Abu Dhabi	–0.52	0.00	Mexico State	–0.72	0.00
Buenos Aires	–0.61	0.00	Buenos Aires	–0.53	0.00	Buenos Aires	–0.72	0.00
São Paulo	–0.82	0.00	São Paulo	–0.60	0.00	São Paulo	–0.82	0.00
Rio de Janeiro	–0.90	0.00	Rio de Janeiro	–0.72	0.00	Rio de Janeiro	–0.95	0.00

Notes: Authors' calculations using the pooled PISA 2009 and 2012 datasets. P refers to P-value for difference compared to London. Grey shading indicates difference statistically significant at the 5 and 1 per cent levels, respectively. Final student and replicate weights applied.

Of course, cities and states differ in their socioeconomic and immigrant compositions. How does the ranking of economies presented in Table 4 change once such differences have been taken into account? The answer can be found in Table 5. The left-hand side presents the unconditional difference in mean scores between London and the other international economies (replicating the results of Table 4). In contrast, the right-hand side demonstrates how this changes once the gender, immigrant, and socioeconomic compositions have been taken into account.

Table 5: London's position in the pooled PISA 2009 and 2012 PISA mathematics rankings: before and conditional upon demographic characteristics

Unconditional			Conditional		
City/state	**ES**	**P**	**City/state**	**ES**	**P**
Shanghai	1.27	0.00	Shanghai	1.42	0.00
Singapore	0.88	0.00	Hong Kong	1.03	0.00
Hong Kong	0.79	0.00	Singapore	1.01	0.00
Limburg (Maastricht)	0.64	0.00	Macau	0.76	0.00
Quebec	0.61	0.00	Limburg (Maastricht)	0.58	0.00
Macau	0.52	0.00	Quebec	0.52	0.00
British Columbia	0.44	0.00	Lombardy (Milan)	0.38	0.00
Western Australia	0.43	0.00	Western Australia	0.37	0.00
Ontario	0.41	0.00	British Columbia	0.33	0.00
Helsinki	0.39	0.00	Ontario	0.29	0.00
Lombardy (Milan)	0.37	0.00	Helsinki	0.29	0.01
Massachusetts	0.34	0.01	New South Wales	0.26	0.01
New South Wales	0.32	0.00	Massachusetts	0.25	0.02
Moscow	0.31	0.04	Catalonia (Barcelona)	0.24	0.02
Reykjavik	0.31	0.00	Madrid	0.24	0.02
Victoria	0.27	0.01	Moscow	0.23	0.09
Connecticut	0.27	0.05	Victoria	0.21	0.03
Riga	0.27	0.03	Riga	0.20	0.05
Madrid	0.21	0.07	Lisbon	0.12	0.25
Catalonia (Barcelona)	0.16	0.18	Connecticut	0.11	0.32
Lisbon	0.09	0.43	Algarve	0.06	0.59
Belfast	0.09	0.46	Belfast	0.04	0.74

Unconditional			**Conditional**		
City/state	**ES**	**P**	**City/state**	**ES**	**P**
SW Wales	0.05	0.67	Reykjavik	0.02	0.83
LONDON	**REFERENCE**		SW Wales	0.02	0.86
Lazio (Rome)	–0.05	0.66	**LONDON**	**REFERENCE**	
Attica	–0.08	0.48	Lazio (Rome)	–0.10	0.34
Algarve	–0.09	0.43	Attica	–0.14	0.17
Florida	–0.12	0.32	Florida	–0.16	0.13
SE Wales	–0.14	0.19	SE Wales	–0.18	0.07
Belgrade	–0.17	0.18	Mexico State	–0.25	0.03
Dubai	–0.20	0.06	Dubai	–0.30	0.00
Port-of-Spain	–0.48	0.00	Belgrade	–0.31	0.01
Abu Dhabi	–0.58	0.00	Port-of-Spain	–0.37	0.00
Mexico State	–0.58	0.00	Buenos Aires	–0.51	0.00
Buenos Aires	–0.61	0.00	São Paulo	–0.52	0.00
São Paulo	–0.82	0.00	Rio de Janeiro	–0.60	0.00
Rio de Janeiro	–0.90	0.00	Abu Dhabi	–0.63	0.00

Notes: Authors' calculations using the pooled PISA 2009 and 2012 datasets. P refers to P-value for difference compared to London. Grey shading indicates difference statistically significant at the 5 and 1 per cent levels, respectively. Final student and replicate weights applied. 'Conditional' estimates where gender, socioeconomic status, and immigrant status have been controlled.

There are four notable features of Table 5. First, London's position relative to the spectrum of other cities is largely unchanged. For instance, it moves in the ranking by just one position (24th to 25th), with mathematics scores significantly lower than 17 other cities/states at the 5 per cent level in these conditional rankings (compared to 18 in the unconditional results). Second, the East Asian cities/states at the top of the table further extend their lead. For instance, Shanghai is estimated to be 127 points (ES = 1.27) ahead of London in the unconditional results, with this increasing to 142 points (ES = 1.42) once the gender, immigrant, and socioeconomic compositions of these cities have been taken into account. The same is true for comparisons between London and Singapore (ES = 0.88 versus 1.01), Hong Kong (ES = 0.79 versus 1.03), and Macau-China (ES = 0.52 versus 0.76). Third, in a similar manner, London's lead over some of the poorer world states has been reduced. This includes Port-of-Spain (0.48 ES difference in the unconditional estimates versus 0.37 in the conditional estimates), Buenos Aires (ES = 0.61 versus 0.51), Mexico State (ES = 0.58 versus 0.25), São Paulo (ES = 0.82 versus 0.52), and Rio de Janerio (ES = 0.90 versus 0.60). Finally, the difference between London and the rest of the UK has shrunk from 0.16 standard deviations (unconditional estimates) to 0.04 (conditional estimates). However, on neither occasion are these differences significant at conventional levels.

Reading

The middle column of Table 3 turns to London's position in the PISA reading rankings. The mean score is estimated to be 483, with a 95 per cent confidence interval ranging between 461 and 504 test points. The reading skills of children in London are therefore significantly below the reading skills of children in countries such as Liechtenstein (ES difference = 0.24), Estonia (ES difference = 0.25), and Vietnam (ES difference = 0.25). At the same time, mean PISA reading

scores are significantly higher in London than Serbia (ES difference = 0.39), Malta (ES difference = 0.41), and the United Arab Emirates (UAE) (ES difference = 0.46). However, although the point estimate is below that for the rest of the UK (ES difference = 0.16), this difference is not statistically significant at conventional thresholds. Similarly, despite mean PISA reading scores being higher in 2009 relative to 2012, the small sample size means one cannot rule out the possibility that this difference is due to sampling variation alone.

Table 4 (middle column) compares London's reading scores to other cities/states. London is significantly below other major European cities such as Lombardy (Milan) (ES difference = 0.38), Riga (ES difference = 0.26), and Madrid (ES difference = 0.24) at the 5 per cent level. In contrast, reading achievement in London is significantly above that of a number of South American and Middle Eastern cities such as Rio de Janeiro (ES difference = 0.72), Buenos Aires (ES difference = 0.53), and Abu Dhabi (ES difference = 0.52) (again, all differences are significant at the 5 per cent level).

Science

The right-hand side of Table 3 presents the PISA science results. London sits in 37th position with a mean score of 497 (95 per cent confidence interval ranging from 477 to 516 test points). This level of performance is below 15 other countries at the 5 per cent level, including the leading East Asian economies (e.g. Japan and South Korea), and major European countries (e.g. Germany and the Netherlands). At the other extreme, 34 countries have significantly lower mean science scores, including Greece, Turkey, Chile, and the UAE. Again, additional analysis presented in Appendix E highlights the particularly low PISA science scores of London girls (mean score 484 compared to 509 for London boys).

Analogous results comparing London to other major cities and states can be found in the right-hand side of Table 4. Average science scores are higher in London than in many developing cities such as São Paulo (ES difference = 0.82), Belgrade (ES difference =0.31), and Dubai (ES difference = 0.26), but below international powerhouses such as Massachusetts (ES difference = 0.31), Helsinki (ES difference = 0.50), and Shanghai (ES difference = 0.81). Although Appendix C indicates that the point estimate for London was higher in 2009 (506) than in 2012 (488), one is unable to reject the null hypothesis of there being no genuine difference in science scores between these two timepoints.

Non-cognitive skills

Table 6 compares children in London to children in other cities/states in terms of 'non-cognitive' skills. All results refer to effect size differences compared to London. The left-hand and middle columns present results for the work ethic and perseverance scales. Higher values indicate a positive outcome (e.g. greater perseverance or willingness to work hard). On both occasions, London is not significantly different from most other economies. For instance, children in only two out of the 32 comparator regions report a significantly higher work ethic (Dubai and Abu Dhabi) and six, a greater level of perseverance. Indeed, London children's work ethic and perseverance are consistently better than some other major European cities, including Lombardy (Milan), Attica (Athens), and Catalonia (Barcelona).

Table 6: London children's 'non-cognitive' skills

Work ethic			**Perseverance**			**Attributions to failure**		
City/state	**Effect size**	**P**	**City/state**	**Effect size**	**P**	**City/state**	**Effect size**	**P**
Helsinki	–0.57	0.00	Catalonia	–0.37	0.00	Shanghai	–0.09	0.08
Riga	–0.46	0.00	Lombardy	–0.28	0.00	Singapore	–0.08	0.09
Buenos Aires	–0.38	0.00	Athens (Attica)	–0.23	0.01	Massachusetts	–0.05	0.37
New South Wales	–0.27	0.01	Reykjavik	–0.18	0.05	Reykjavik	–0.02	0.69
Athens (Attica)	–0.27	0.01	SW Wales	–0.16	0.08	LONDON	0.00	1.00
Western Australia	–0.26	0.01	Helsinki	–0.14	0.09	Hong Kong	0.01	0.91
Lombardy	–0.26	0.02	SE Wales	–0.14	0.10	Connecticut	0.01	0.84
Hong Kong	–0.25	0.01	Quebec	–0.14	0.10	Florida	0.08	0.20
Catalonia	–0.21	0.06	Western Australia	–0.07	0.41	Mexico State	0.10	0.12
Lisbon	–0.19	0.07	São Paulo	–0.07	0.44	Ontario	0.12	0.03
Macau	–0.18	0.07	Victoria	–0.06	0.49	British Columbia	0.12	0.03
Victoria	–0.18	0.09	Hong Kong	–0.05	0.58	SE Wales	0.14	0.01
Algarve	–0.17	0.23	Buenos Aires	–0.04	0.66	New South Wales	0.15	0.00
Madrid	–0.15	0.16	New South Wales	–0.04	0.65	Belfast	0.15	0.05
Ontario	–0.13	0.19	Macau	–0.01	0.86	Western Australia	0.16	0.01
Rome (Lazio)	–0.13	0.24	Belfast	–0.01	0.93	Victoria	0.16	0.01
São Paulo	–0.10	0.31	LONDON	0.00	1.00	SW Wales	0.18	0.01
British Columbia	–0.09	0.37	Rome (Lazio)	0.02	0.85	Helsinki	0.26	0.00
SW Wales	–0.09	0.40	Madrid	0.03	0.76	Dubai	0.26	0.00
Quebec	–0.07	0.48	Shanghai	0.08	0.35	Macau	0.27	0.00
Rio de Janeiro	–0.01	0.94	Rio de Janeiro	0.08	0.39	São Paulo	0.39	0.00
LONDON	0.00	1.00	British Columbia	0.11	0.20	Quebec	0.44	0.00
SE Wales	0.02	0.86	Riga	0.12	0.20	Abu Dhabi	0.46	0.00
Mexico State	0.03	0.74	Singapore	0.13	0.13	Lombardy	0.49	0.00
Florida	0.05	0.64	Ontario	0.14	0.10	Rome (Lazio)	0.51	0.00
Shanghai	0.09	0.39	Algarve	0.16	0.13	Riga	0.51	0.00
Singapore	0.11	0.26	Mexico State	0.18	0.06	Catalonia	0.52	0.00
Massachusetts	0.14	0.18	Massachusetts	0.18	0.04	Rio de Janeiro	0.53	0.00
Connecticut	0.15	0.15	Lisbon	0.20	0.03	Madrid	0.61	0.00
Belfast	0.17	0.15	Florida	0.21	0.02	Algarve	0.63	0.00
Reykjavik	0.18	0.10	Abu Dhabi	0.23	0.01	Buenos Aires	0.65	0.00
Dubai	0.32	0.00	Dubai	0.26	0.00	Lisbon	0.65	0.00
Abu Dhabi	0.49	0.00	Connecticut	0.27	0.00	Athens (Attica)	0.69	0.00

Notes: Authors' calculations using the pooled PISA 2009 and 2012 datasets. P refers to P-value for difference compared to London. Grey shading indicates difference statistically significant at the 5 and 1 per cent levels, respectively. Final student and replicate weights applied.

The right-hand column of Table 6 presents analogous results for the 'attributions to failure' scale. Here, higher positive values represent worse outcomes (i.e. a greater tendency to blame others or bad luck for poor performance on a test). Children from London perform well in this respect, with no cities/states having a significantly better outcome at the 5 per cent level. Indeed, 23

out of the 32 other cities/states have a significantly worse outcome on this scale than London. Together, this indicates that children in England's capital are more likely than those in other cities/states to take responsibility when they perform poorly on a test.

Why do we not find the 'London effect' in PISA?

The results in the previous sub-section are somewhat surprising, particularly the fact that we find London to perform no better than the rest of the UK. This is perhaps in contrast to what one would expect, given the widespread belief that London schools perform strongly in national examinations (e.g. GCSEs). One possible explanation is that PISA is a measure of children's 'real world' skills and involves applied/contextualized rather than curriculum-based tasks. There are, however, several others including timing of the test (children in England sit PISA six months before their GCSE examinations) and the fact that PISA is a 'low-stakes' test (i.e. children and schools have little riding upon the results). We now provide further insight into the difference between London pupils' GCSE and PISA scores, using PISA 2009 and PISA 2012 data that have been linked to the NPD.[2] It is important to note that the analysis in this sub-section refers to state school pupils only (as NPD data for private school pupils could not be linked) and compares London to the rest of England (rather than, as previously, the rest of the UK).

Table 7 provides our results. All figures refer to differences in terms of ES. The column labelled 'M1' illustrates the difference in PISA mathematics scores between children in London and children in the rest of England. The ES of –0.19 confirms that children in London do worse on the PISA test, although the magnitude of this difference is imprecisely determined. However, the surprisingly low performance of London schools in PISA is further emphasized by model 'M2', which controls for children's GCSE mathematics grades and capped key stage 4 points scores. The intuition is that we want to see whether London's performance in PISA mathematics is significantly below what one would expect, given children's GCSE scores. There is strong evidence that this is indeed the case; conditional upon GCSE test scores, children in London obtain PISA scores 22 points (ES = 0.22) below their peers in the rest of England (i.e. 22 points below what one would expect). This difference is large, and statistically significant at the 5 per cent level. (In additional analysis, we find that this result also holds within both the 2009 and 2012 cohorts, individually.)

Table 7: OLS regression model estimates

	M1		M2		M3		M4	
	Beta	**SE**	**Beta**	**SE**	**Beta**	**SE**	**Beta**	**SE**
Location (Ref: Rest of England)								
London	–0.19*	0.11	–0.22**	0.07	–0.11	0.07	–0.11*	0.06
SES (Ref: Most advantaged 20%)								
Second quintile	-	-	-	-	–0.03	0.02	–0.02	0.02
Third quintile	-	-	-	-	–0.10**	0.03	–0.08**	0.03
Fourth quintile	-	-	-	-	–0.14**	0.03	–0.12**	0.03
Most disadvantaged 20%	-	-	-	-	–0.19**	0.03	–0.16**	0.03
Ethnicity (Ref: White)								
Other	-	-	-	-	–0.19**	0.08	–0.11	0.08
Asian	-	-	-	-	–0.30**	0.04	–0.22**	0.04

	M1		M2		M3		M4	
	Beta	**SE**	**Beta**	**SE**	**Beta**	**SE**	**Beta**	**SE**
Black	-	-	-	-	–0.26**	0.06	–0.18**	0.06
Mixed	-	-	-	-	–0.03	0.05	–0.01	0.05
Unclassified	-	-	-	-	–0.07	0.08	–0.03	0.08
Additional controls								
GCSE maths score	-	-	√	√	√	√	√	√
GCSE capped points score	-	-	√	√	√	√	√	√
Gender	-	-	-	-	√	√	√	√
Key stage 2 points scores	-	-	-	-	-	-	√	√
R-Squared	0.01		0.58		0.61		0.63	
Number of observations	7,311		7,310		7,310		7,310	

Notes: Authors' calculations using the PISA-NPD 2009 and 2012 datasets. All estimates refer to state school children only (figures may therefore differ slightly compared to previous tables); * and ** indicate parameter estimates significantly different from zero at the 10 per cent and 5 per cent levels, respectively; SES refers to socioeconomic status.

As mentioned above, one possible explanation for this finding is that PISA is a low-stakes test. We explored this possibility in additional analysis by including a control for children's self-reported effort on the PISA test. (This analysis was conducted using the 2012 dataset only, as self-reported effort is not available in the 2009 wave.) Specifically, children were asked a battery of questions about how hard they tried on the PISA test, and how this would change were the scores to count towards their final school grade. Adding this variable to the model leads to only a small decline in the London parameter estimate (ES drops from –0.22 down to –0.18), with the difference remaining significant at conventional thresholds. We therefore find little evidence that London's poor PISA performance (compared to the rest of England) is because of the low stakes nature of this test.

Model 'M3' attempts to explain the difference between London and the rest of England in terms of demographic characteristics, with controls added for gender, socioeconomic status, and ethnicity. This leads to a 50 per cent reduction in the London parameter estimate, which now sits at 11 PISA test points (ES = 0.11), and is no longer statistically significant at conventional thresholds. It therefore seems that at least part of London's disappointing PISA score is driven by the under-performance of certain socioeconomic and ethnic groups (compared to how these groups perform in their GCSEs).

Table 7 provides further insight. First, notice the large, negative, and statistically significant coefficient for the bottom three socioeconomic quintiles. In particular, the most disadvantaged children score 19 fewer points (ES = 0.19) on the PISA test than one would expect, given their performance on the GCSE exams. Second, there are similarly large, negative, and significant coefficients for the black (ES = 0.19), Asian (ES = 0.30), and other (ES = 0.26) ethnic groups. Again, this suggests that these groups significantly underperform on the PISA mathematics tests (compared to white pupils) relative to their performance in GCSE exams.

However, it is important to recognize that 'Asian' pupils within this analysis covers pupils from quite diverse backgrounds, with some more likely to be higher achievers (on average) than others. Unfortunately, it has not been possible to conduct a more nuanced analysis of PISA scores by ethnic group within London owing to the small sample size. The same holds true for

sub-analysis of London pupils with English as an additional language. Furthermore, as less than 1 per cent of the PISA sample in England is of Chinese ethnicity, they have been included in the 'other' ethnic group (Chinese pupils tend to be very high achieving pupils, on average, in GCSE exams).

Moreover, model 'M4' suggests that the same broad finding continues to hold even if we are to add additional controls for children's scores on their key stage 2 (age 11) exams. Of course, as Appendix D illustrates, London has a disproportionate share of children from low socioeconomic status and ethnic minority backgrounds. Together, this therefore explains the substantial decline in the difference between London and the rest of England between M2 and M3.

Conclusions

PISA is an important international study of 15-year-olds' educational achievement. Although traditionally used to benchmark educational achievement within individual countries, there is growing international interest in the reporting of PISA results at a more localized level. The contribution of this paper has been to produce the first estimate of PISA test scores for London, alongside several other major international cities. In doing so, this is the first study to place educational standards in London within an international context. Using PISA 2009 and 2012 data, our analysis suggests the average PISA mathematics score in London falls between 458 and 500 test points; reading between 461 and 504 points; and science between 477 and 516 points. Overall, we find strong evidence that educational achievement is higher in London than in a number of developing cities (e.g. São Paulo, Port-of-Spain, Dubai) but behind world leaders such as Massachusetts, New South Wales (Sydney), Ontario, and Shanghai.

These findings should of course be interpreted with care, and in light of the limitations of this study. First, despite pooling data across two PISA waves (2009 and 2012), the sample size for London remains limited. Hence all our estimates are surrounded by quite wide confidence intervals, which should always be given when presenting these results. Second, it is not possible to make any concrete statement with regard to trends in London's PISA test scores over time. (The breakdown for 2009 and 2012 provided in the appendices are for reference only – and must not be used to infer any indication of a decline.) Third, our results refer to Greater London as a whole, though it should be remembered that England's capital is quite a diverse city. A more detailed geographic breakdown of PISA scores, such as by London borough, would likely yield a more nuanced perspective on our results. Fourth, the data used in this paper refers to London between 2009 and 2012, and hence all of our results can only be used to draw inferences about this period only. Whether the situation in London is any different at the time of writing (2016) is open to debate, with the upcoming release of the PISA 2015 database potentially offering an opportunity to explore this issue further. Finally, it is important to remember that PISA is cross-sectional data only. It is unable to provide any insight into the extent to which children improve during their time in compulsory education, or indeed the 'effectiveness' of London schools. Certainly, policymakers should steer clear of suggesting that PISA measures the impact of a country's (or a city's) educational system. Differences between London and other cities/states could be because of a number of factors, including culture, socio-demographic composition, and the role of parents – and not necessarily driven by differences in education systems and policies. It is important that readers remember this point when interpreting our results.

Notwithstanding these limitations, this study has the potential to contribute to academic and policy understanding about the skills of London's school pupils. Despite strong performance in England's national examinations, educational achievement in London remains some way behind

that observed in other leading economies. Further progress is therefore needed if London is to produce the global talent needed to keep its economy in competition upon the world stage.

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Notes

1 It should also be noted that FSM is a binary measure of socioeconomic status. Although it captures the percentage of pupils living in low income households, it does not capture differences between more affluent social groups.

2 The NPD-PISA 2012 data for England include state school children only. For consistency, the 2009 data have also been restricted to state school pupils only, decreasing the sample from 4,081 to 3,805 observations. Our experimentations with the 2009 data suggest that the restriction to state school pupils only makes little change to our substantive results.

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Appendix A: Results for PISA mathematics test scores (2009, 2012, and pooled)

2009			2012			Pooled		
Country	**ES**	**P**	**Country**	**ES**	**P**	**Country**	**ES**	**P**
Shanghai	1.11	0.00	Shanghai	1.43	0.00	Shanghai	1.27	0.00
Singapore	0.73	0.00	Singapore	1.03	0.00	Singapore	0.89	0.00
Hong Kong	0.66	0.00	Hong Kong	0.91	0.00	Hong Kong	0.79	0.00
South Korea	0.58	0.00	Chinese Taipei	0.90	0.00	Chinese Taipei	0.73	0.00
Chinese Taipei	0.54	0.00	South Korea	0.84	0.00	South Korea	0.71	0.00
Finland	0.52	0.00	Macedonia	0.68	0.00	Liechtenstein	0.57	0.00
Liechtenstein	0.47	0.00	Japan	0.66	0.00	Japan	0.54	0.00
Switzerland	0.45	0.00	Liechtenstein	0.65	0.00	Switzerland	0.54	0.00
Japan	0.40	0.00	Switzerland	0.61	0.00	Macedonia	0.53	0.00
Canada	0.38	0.00	Netherlands	0.53	0.00	Finland	0.51	0.00
Netherlands	0.37	0.01	Estonia	0.50	0.00	Netherlands	0.46	0.00
Macedonia	0.37	0.00	Finland	0.49	0.00	Canada	0.44	0.00
New Zealand	0.31	0.02	Canada	0.48	0.00	Estonia	0.37	0.00
Belgium	0.27	0.04	Poland	0.47	0.00	Belgium	0.36	0.00
Australia	0.26	0.05	Belgium	0.44	0.00	Germany	0.34	0.00
Germany	0.24	0.07	Germany	0.43	0.00	Vietnam	0.33	0.01

2009			2012			Pooled		
Country	**ES**	**P**	**Country**	**ES**	**P**	**Country**	**ES**	**P**
Estonia	0.23	0.07	Vietnam	0.41	0.01	New Zealand	0.31	0.00
Iceland	0.18	0.16	Austria	0.35	0.02	Australia	0.30	0.01
Denmark	0.15	0.26	Australia	0.34	0.02	Poland	0.26	0.02
Slovenia	0.13	0.32	Ireland	0.31	0.04	Denmark	0.23	0.04
Norway	0.09	0.47	Slovenia	0.31	0.04	Slovenia	0.22	0.04
France	0.08	0.54	Denmark	0.30	0.05	Austria	0.22	0.05
Slovak Republic	0.08	0.54	New Zealand	0.30	0.05	Iceland	0.21	0.05
Austria	0.07	0.58	Czech Republic	0.29	0.06	France	0.17	0.11
Poland	0.06	0.64	Rest of UK	0.27	0.07	Czech Republic	0.17	0.13
Sweden	0.06	0.67	France	0.25	0.10	Rest of UK	0.16	0.13
Rest of UK	0.04	0.75	Iceland	0.23	0.13	Ireland	0.16	0.15
Czech Republic	0.04	0.75	Latvia	0.21	0.18	Norway	0.15	0.17
Hungary	0.01	0.91	Luxembourg	0.20	0.18	Slovak Republic	0.11	0.30
Luxembourg	0.00	0.98	Norway	0.19	0.20	Luxembourg	0.11	0.31
LONDON	0.00	1.00	Portugal	0.17	0.27	Portugal	0.08	0.45
United States	–0.01	0.92	Italy	0.15	0.31	Sweden	0.08	0.45
Ireland	–0.02	0.90	Spain	0.14	0.34	Latvia	0.07	0.54
Portugal	–0.02	0.89	Perm (Russia)	0.14	0.39	United States	0.05	0.61
Spain	–0.05	0.68	Russia	0.12	0.42	Italy	0.05	0.62
Italy	–0.06	0.65	Slovak Republic	0.12	0.45	Hungary	0.05	0.63
Latvia	–0.07	0.60	United States	0.11	0.46	Spain	0.05	0.63
Lithuania	–0.12	0.35	Lithuania	0.09	0.56	Perm (Russia)	0.05	0.69
Russia	–0.21	0.11	Sweden	0.08	0.58	LONDON	0.00	1.00
Greece	–0.23	0.09	Hungary	0.07	0.64	Lithuania	–0.01	0.91
Malta	–0.26	0.05	Croatia	0.01	0.94	Russia	–0.04	0.70
Croatia	–0.29	0.03	LONDON	0.00	1.00	Croatia	–0.13	0.22
Israel	–0.42	0.00	Israel	–0.04	0.82	Malta	–0.16	0.14
Turkey	–0.43	0.00	Greece	–0.17	0.26	Greece	–0.19	0.07
Serbia	–0.46	0.00	Serbia	–0.21	0.16	Israel	–0.22	0.05
Azerbaijan	–0.58	0.00	Turkey	–0.22	0.16	Turkey	–0.32	0.00
Bulgaria	–0.61	0.00	Romania	–0.26	0.10	Serbia	–0.33	0.00
Romania	–0.62	0.00	Bulgaria	–0.31	0.04	Romania	–0.43	0.00
Uruguay	–0.62	0.00	UAE	–0.36	0.02	Bulgaria	–0.46	0.00
UAE	–0.68	0.00	Kazakhstan	–0.38	0.01	Azerbaijan	–0.48	0.00

Appendix B: Results for PISA reading test scores (2009, 2012, and pooled)

2009			2012			Pooled		
Country	**ES**	**P**	**Country**	**ES**	**P**	**Country**	**ES**	**P**
Shanghai	0.61	0.00	Shanghai	0.97	0.00	Shanghai	0.80	0.00
South Korea	0.45	0.00	Hong Kong	0.72	0.00	Hong Kong	0.56	0.00
Finland	0.41	0.00	Singapore	0.70	0.00	South Korea	0.55	0.00
Hong Kong	0.39	0.00	Japan	0.66	0.00	Singapore	0.51	0.00
Singapore	0.31	0.01	South Korea	0.64	0.00	Finland	0.47	0.00
Canada	0.30	0.02	Finland	0.52	0.00	Japan	0.46	0.00
New Zealand	0.26	0.04	Ireland	0.51	0.00	Canada	0.41	0.00
Japan	0.25	0.05	Canada	0.51	0.00	New Zealand	0.34	0.00
Australia	0.20	0.11	Chinese Taipei	0.51	0.00	Australia	0.31	0.01
Netherlands	0.14	0.31	Poland	0.46	0.01	Netherlands	0.27	0.02
Belgium	0.11	0.37	Estonia	0.44	0.01	Ireland	0.27	0.02
Norway	0.09	0.50	Liechtenstein	0.43	0.01	Chinese Taipei	0.26	0.02
Estonia	0.06	0.62	New Zealand	0.40	0.02	Poland	0.26	0.02
Switzerland	0.06	0.64	Australia	0.40	0.02	Vietnam	0.25	0.03
Poland	0.06	0.65	Netherlands	0.39	0.02	Estonia	0.25	0.02
Iceland	0.06	0.65	Switzerland	0.37	0.03	Belgium	0.25	0.03
United States	0.05	0.69	Macedonia	0.37	0.03	Liechtenstein	0.24	0.03
Liechtenstein	0.05	0.71	Belgium	0.36	0.03	Switzerland	0.22	0.05
Sweden	0.03	0.82	Vietnam	0.36	0.04	Norway	0.21	0.06
Germany	0.03	0.83	Germany	0.35	0.04	Germany	0.20	0.08
Ireland	0.01	0.94	France	0.33	0.05	France	0.18	0.11
France	0.01	0.94	Norway	0.32	0.06	United States	0.16	0.16
Chinese Taipei	0.01	0.96	Rest of UK	0.31	0.07	Rest of UK	0.16	0.15
Denmark	0.00	0.98	United States	0.25	0.14	Macedonia	0.14	0.18
LONDON	0.00	1.00	Denmark	0.24	0.16	Denmark	0.13	0.24
Hungary	0.00	0.97	Czech Republic	0.21	0.22	Iceland	0.09	0.41
Rest of UK	0.00	0.97	Italy	0.17	0.30	Hungary	0.09	0.43
Portugal	–0.05	0.68	Austria	0.17	0.30	Sweden	0.08	0.45
Macedonia	–0.08	0.53	Latvia	0.16	0.33	Portugal	0.06	0.60
Italy	–0.09	0.50	Hungary	0.16	0.34	Italy	0.05	0.63
Latvia	–0.11	0.41	Spain	0.16	0.35	Latvia	0.03	0.77
Slovenia	–0.12	0.36	Luxembourg	0.16	0.35	Spain	0.02	0.88
Greece	–0.12	0.37	Portugal	0.15	0.36	Czech Republic	0.02	0.88
Spain	–0.14	0.29	Israel	0.14	0.44	LONDON	0.00	1.00
Czech Republic	–0.16	0.20	Croatia	0.12	0.47	Perm (Russia)	0.00	0.97
Slovak Republic	–0.17	0.18	Sweden	0.11	0.51	Slovenia	–0.01	0.96
Croatia	–0.19	0.15	Iceland	0.10	0.54	Luxembourg	–0.02	0.82
Israel	–0.21	0.12	Perm (Russia)	0.10	0.57	Croatia	–0.02	0.82
Luxembourg	–0.22	0.08	Slovenia	0.09	0.59	Israel	–0.03	0.81
Austria	–0.24	0.06	Lithuania	0.05	0.76	Greece	–0.03	0.80

2009			2012			Pooled		
Country	**ES**	**P**	**Country**	**ES**	**P**	**Country**	**ES**	**P**
Lithuania	–0.26	0.04	Greece	0.05	0.77	Austria	–0.03	0.78
Turkey	–0.30	0.02	Turkey	0.03	0.85	Lithuania	–0.10	0.35
Russia	–0.35	0.01	Russia	0.03	0.86	Slovak Republic	–0.12	0.29
Chile	–0.45	0.00	LONDON	0.00	1.00	Turkey	–0.13	0.26
Costa Rica	–0.52	0.00	Slovak Republic	–0.09	0.58	Russia	–0.16	0.15
Malta	–0.53	0.00	Serbia	–0.26	0.13	Chile	–0.37	0.00
Serbia	–0.53	0.00	UAE	–0.31	0.07	Serbia	–0.39	0.00
UAE	–0.63	0.00	Chile	–0.31	0.07	Malta	–0.41	0.00
Bulgaria	–0.66	0.00	Thailand	–0.31	0.07	Costa Rica	–0.41	0.00
Uruguay	–0.69	0.00	Costa Rica	–0.32	0.06	UAE	–0.46	0.00

Appendix C: Results for PISA science test scores

2009			2012			Pooled		
Country	**ES**	**P**	**Country**	**ES**	**P**	**Country**	**ES**	**P**
Shanghai	0.69	0.00	Shanghai	0.92	0.00	Shanghai	0.81	0.00
Finland	0.48	0.00	Hong Kong	0.67	0.00	Hong Kong	0.55	0.00
Hong Kong	0.43	0.00	Singapore	0.63	0.00	Finland	0.53	0.00
Singapore	0.36	0.00	Japan	0.58	0.00	Singapore	0.50	0.00
Japan	0.34	0.01	Finland	0.57	0.00	Japan	0.47	0.00
South Korea	0.32	0.01	Estonia	0.53	0.00	South Korea	0.41	0.00
New Zealand	0.26	0.03	South Korea	0.50	0.00	Estonia	0.38	0.00
Canada	0.23	0.05	Vietnam	0.40	0.01	Vietnam	0.32	0.00
Estonia	0.22	0.06	Poland	0.38	0.02	Canada	0.31	0.00
Australia	0.21	0.07	Canada	0.37	0.02	Australia	0.28	0.01
Netherlands	0.16	0.20	Liechtenstein	0.36	0.02	New Zealand	0.27	0.01
Chinese Taipei	0.15	0.22	Germany	0.36	0.02	Germany	0.26	0.01
Germany	0.15	0.22	Chinese Taipei	0.35	0.02	Liechtenstein	0.26	0.02
Liechtenstein	0.14	0.24	Netherlands	0.34	0.03	Netherlands	0.26	0.02
Switzerland	0.11	0.36	Ireland	0.34	0.03	Chinese Taipei	0.25	0.01
Rest of UK	0.09	0.45	Australia	0.33	0.03	Poland	0.20	0.06
Slovenia	0.06	0.61	Macedonia	0.32	0.03	Rest of UK	0.20	0.06
Macedonia	0.05	0.65	Rest of UK	0.29	0.06	Switzerland	0.19	0.06
Poland	0.02	0.85	New Zealand	0.27	0.07	Macedonia	0.19	0.06
Ireland	0.02	0.86	Switzerland	0.27	0.08	Ireland	0.19	0.07
Belgium	0.01	0.95	Slovenia	0.26	0.09	Slovenia	0.16	0.11
LONDON	0.00	1.00	Czech Republic	0.20	0.19	Belgium	0.09	0.37
Hungary	–0.03	0.79	Austria	0.18	0.25	Czech Republic	0.07	0.48
United States	–0.04	0.75	Belgium	0.17	0.27	Austria	0.03	0.74
Czech Republic	–0.05	0.65	Latvia	0.14	0.36	United States	0.03	0.76
Norway	–0.06	0.61	France	0.11	0.48	Denmark	0.02	0.82
Denmark	–0.06	0.58	Denmark	0.10	0.50	Hungary	0.02	0.83

2009			2012			Pooled		
Country	**ES**	**P**	**Country**	**ES**	**P**	**Country**	**ES**	**P**
France	–0.08	0.53	United States	0.09	0.55	France	0.02	0.84
Iceland	–0.10	0.38	Spain	0.08	0.59	Latvia	0.01	0.94
Sweden	–0.11	0.36	Lithuania	0.07	0.62	Norway	0.01	0.95
Austria	–0.12	0.34	Norway	0.06	0.68	LONDON	0.00	1.00
Latvia	–0.12	0.32	Hungary	0.06	0.69	Lithuania	–0.03	0.76
Portugal	–0.13	0.28	Italy	0.05	0.73	Spain	–0.04	0.68
Lithuania	–0.14	0.22	Croatia	0.03	0.84	Italy	–0.05	0.60
Slovak Republic	–0.16	0.19	Luxembourg	0.03	0.84	Portugal	–0.05	0.60
Italy	–0.17	0.15	Portugal	0.01	0.95	Sweden	–0.06	0.55
Spain	–0.18	0.13	LONDON	0.00	1.00	Croatia	–0.08	0.46
Croatia	–0.19	0.10	Russia	–0.02	0.90	Luxembourg	–0.09	0.39
Luxembourg	–0.22	0.06	Sweden	–0.03	0.82	Iceland	–0.09	0.36
Russia	–0.28	0.02	Perm (Russia)	–0.08	0.60	Russia	–0.14	0.17
Greece	–0.36	0.00	Iceland	–0.10	0.50	Slovak Republic	–0.15	0.16
Malta	–0.44	0.00	Slovak Republic	–0.17	0.27	Perm (Russia)	–0.17	0.15
Israel	–0.51	0.00	Israel	–0.18	0.25	Greece	–0.28	0.01
Turkey	–0.52	0.00	Greece	–0.22	0.16	Israel	–0.34	0.00
Chile	–0.58	0.00	Turkey	–0.25	0.11	Malta	–0.35	0.00
Serbia	–0.63	0.00	UAE	–0.40	0.01	Turkey	–0.38	0.00
Bulgaria	–0.67	0.00	Bulgaria	–0.42	0.01	Chile	–0.50	0.00
UAE	–0.68	0.00	Chile	–0.43	0.01	Serbia	–0.53	0.00
Costa Rica	–0.75	0.00	Serbia	–0.43	0.01	UAE	–0.53	0.00
Romania	–0.78	0.00	Thailand	–0.44	0.00	Bulgaria	–0.54	0.00

Appendix D: Comparison of pupil demographic characteristics in London to the rest of England (based upon PISA sample)

	Rest of England	London
Socioeconomic status		
% most advantaged 20 per cent	20	15
% second quintile	20	17
% third quintile	19	21
% fourth quintile	19	21
% least advantaged 20 per cent	19	21
Ethnicity		
White	88	50
Other	1	5
Asian	6	14
Black	2	22
Mixed	3	6
Unclassified	1	3

Appendix E: Average PISA test scores by gender (pooled 2009 and 2012 data)

a. Mathematics

Boys			Girls		
Country	**ES**	**P**	**Country**	**ES**	**P**
Shanghai	1.12	0.00	Shanghai	1.43	0.00
Singapore	0.73	0.00	Singapore	1.05	0.00
Hong Kong	0.70	0.00	Hong Kong	0.88	0.00
South Korea	0.60	0.00	Chinese Taipei	0.87	0.00
Chinese Taipei	0.59	0.00	South Korea	0.82	0.00
Liechtenstein	0.52	0.00	Finland	0.68	0.00
Switzerland	0.46	0.00	Macedonia	0.66	0.00
Japan	0.44	0.00	Japan	0.64	0.00
Macedonia	0.40	0.00	Switzerland	0.62	0.00
Netherlands	0.36	0.01	Liechtenstein	0.61	0.00
Finland	0.35	0.01	Netherlands	0.56	0.00
Canada	0.33	0.02	Canada	0.55	0.00
Belgium	0.28	0.04	Estonia	0.51	0.00
Germany	0.25	0.06	Vietnam	0.45	0.00
Estonia	0.25	0.07	Belgium	0.45	0.00
Vietnam	0.22	0.14	Germany	0.44	0.00
New Zealand	0.20	0.14	New Zealand	0.42	0.00
Australia	0.20	0.15	Australia	0.42	0.00
Austria	0.16	0.24	Poland	0.42	0.00
Denmark	0.14	0.30	Iceland	0.39	0.00
Poland	0.12	0.37	Slovenia	0.38	0.00
Rest of UK	0.08	0.58	Denmark	0.32	0.01
Slovenia	0.08	0.57	Norway	0.30	0.01
France	0.07	0.59	Czech Republic	0.29	0.01
Luxembourg	0.06	0.68	Austria	0.28	0.02
Ireland	0.05	0.70	France	0.28	0.02
Iceland	0.04	0.74	Ireland	0.27	0.02
Czech Republic	0.04	0.76	Sweden	0.26	0.02
Norway	0.00	0.97	Rest of UK	0.26	0.02
LONDON	0.00	1.00	Slovak Republic	0.25	0.03
Portugal	–0.02	0.88	Latvia	0.24	0.04
Spain	–0.02	0.87	Portugal	0.19	0.10
Slovak Republic	–0.02	0.87	Perm (Russia)	0.18	0.15
Italy	–0.03	0.84	Lithuania	0.17	0.13
United States	–0.05	0.74	Hungary	0.17	0.15
Hungary	–0.05	0.70	Luxembourg	0.16	0.15
Perm (Russia)	–0.08	0.61	United States	0.16	0.17
Sweden	–0.09	0.51	Italy	0.14	0.23

Boys			Girls		
Country	**ES**	**P**	**Country**	**ES**	**P**
Latvia	–0.10	0.48	Spain	0.13	0.25
Lithuania	–0.19	0.17	Russia	0.12	0.28
Russia	–0.20	0.15	Malta	0.08	0.47
Croatia	–0.24	0.08	LONDON	0.00	1.00
Greece	–0.30	0.03	Croatia	–0.02	0.87
Israel	–0.33	0.02	Greece	–0.08	0.49
Malta	–0.39	0.00	Israel	–0.10	0.38
Turkey	–0.43	0.00	Turkey	–0.20	0.10
Serbia	–0.44	0.00	Serbia	–0.22	0.06
Romania	–0.57	0.00	Bulgaria	–0.27	0.02
Azerbaijan	–0.60	0.00	Romania	–0.28	0.02
Chile	–0.62	0.00	UAE	–0.31	0.01

b. Reading

Boys			Girls		
Country	**ES**	**P**	**Country**	**ES**	**P**
Shanghai	0.68	0.00	Shanghai	0.90	0.00
Hong Kong	0.47	0.00	Finland	0.72	0.00
South Korea	0.46	0.00	Hong Kong	0.66	0.00
Singapore	0.41	0.01	South Korea	0.65	0.00
Japan	0.36	0.02	Singapore	0.62	0.00
Canada	0.29	0.06	Japan	0.57	0.00
Finland	0.23	0.13	Canada	0.53	0.00
Netherlands	0.20	0.21	New Zealand	0.49	0.00
New Zealand	0.19	0.21	Poland	0.44	0.00
Australia	0.18	0.24	Australia	0.43	0.00
Liechtenstein	0.16	0.32	Estonia	0.43	0.00
Ireland	0.15	0.32	Norway	0.40	0.00
Belgium	0.15	0.33	Ireland	0.39	0.00
Vietnam	0.14	0.38	Chinese Taipei	0.39	0.00
Chinese Taipei	0.14	0.37	Germany	0.36	0.00
Estonia	0.09	0.57	Switzerland	0.36	0.00
Switzerland	0.08	0.58	Netherlands	0.35	0.00
Poland	0.07	0.63	Vietnam	0.35	0.00
United States	0.07	0.63	Belgium	0.34	0.00
Rest of UK	0.07	0.64	Liechtenstein	0.34	0.00
Germany	0.04	0.79	France	0.33	0.00
Norway	0.03	0.85	Iceland	0.28	0.01
Denmark	0.03	0.85	Sweden	0.27	0.02
Macedonia	0.02	0.87	Macedonia	0.27	0.02
France	0.01	0.93	United States	0.25	0.03

Boys			Girls		
Country	**ES**	**P**	**Country**	**ES**	**P**
LONDON	0.00	1.00	Rest of UK	0.24	0.04
Hungary	–0.06	0.71	Latvia	0.23	0.04
Spain	–0.08	0.62	Slovenia	0.23	0.04
Portugal	–0.09	0.57	Hungary	0.23	0.05
Iceland	–0.10	0.51	Denmark	0.22	0.05
Italy	–0.10	0.50	Italy	0.22	0.05
Sweden	–0.10	0.49	Czech Republic	0.20	0.08
Perm (Russia)	–0.13	0.43	Portugal	0.20	0.08
Luxembourg	–0.14	0.34	Croatia	0.18	0.11
Czech Republic	–0.15	0.34	Greece	0.16	0.15
Latvia	–0.17	0.26	Perm (Russia)	0.13	0.29
Austria	–0.18	0.25	Lithuania	0.13	0.23
Israel	–0.20	0.22	Israel	0.13	0.24
Croatia	–0.21	0.16	Spain	0.11	0.32
Slovenia	–0.22	0.14	Austria	0.11	0.33
Greece	–0.23	0.15	Luxembourg	0.10	0.37
Turkey	–0.29	0.06	Slovak Republic	0.07	0.56
Slovak Republic	–0.30	0.06	Turkey	0.05	0.66
Russia	–0.32	0.04	Russia	0.00	1.00
Lithuania	–0.34	0.03	LONDON	0.00	1.00
Chile	–0.43	0.01	Malta	–0.10	0.37
Costa Rica	–0.47	0.00	Bulgaria	–0.22	0.07
Serbia	–0.55	0.00	Serbia	–0.23	0.05
Miranda-Venezuela	–0.65	0.00	UAE	–0.23	0.04
Mexico	–0.66	0.00	Chile	–0.31	0.01

c. Science

Boys			Girls		
Country	**ES**	**P**	**Country**	**ES**	**P**
Shanghai	0.69	0.00	Shanghai	0.93	0.00
Hong Kong	0.45	0.00	Finland	0.74	0.00
Singapore	0.37	0.01	Hong Kong	0.66	0.00
Japan	0.34	0.02	Singapore	0.63	0.00
Finland	0.33	0.02	Japan	0.60	0.00
South Korea	0.29	0.04	South Korea	0.54	0.00
Estonia	0.25	0.08	Estonia	0.52	0.00
Liechtenstein	0.21	0.14	Vietnam	0.44	0.00
Vietnam	0.20	0.17	Canada	0.42	0.00
Canada	0.20	0.14	New Zealand	0.41	0.00
Australia	0.16	0.23	Australia	0.40	0.00
Netherlands	0.15	0.28	Chinese Taipei	0.38	0.00

Boys			Girls		
Country	**ES**	**P**	**Country**	**ES**	**P**
New Zealand	0.15	0.29	Germany	0.37	0.00
Germany	0.15	0.29	Netherlands	0.37	0.00
Chinese Taipei	0.13	0.35	Slovenia	0.35	0.00
Rest of UK	0.12	0.38	Poland	0.35	0.00
Switzerland	0.11	0.44	Macedonia	0.33	0.00
Ireland	0.07	0.63	Ireland	0.31	0.01
Macedonia	0.06	0.67	Liechtenstein	0.30	0.01
Poland	0.05	0.71	Switzerland	0.29	0.01
LONDON	0.00	1.00	Rest of UK	0.28	0.02
Belgium	0.00	0.97	Czech Republic	0.22	0.06
Slovenia	–0.01	0.92	Belgium	0.20	0.09
Denmark	–0.04	0.75	Latvia	0.19	0.10
Austria	–0.05	0.74	Lithuania	0.18	0.12
Czech Republic	–0.06	0.65	Norway	0.15	0.18
United States	–0.06	0.65	France	0.15	0.20
Hungary	–0.09	0.51	Hungary	0.14	0.22
France	–0.10	0.47	United States	0.13	0.26
Spain	–0.13	0.35	Austria	0.12	0.30
Norway	–0.13	0.33	Denmark	0.10	0.39
Luxembourg	–0.16	0.26	Sweden	0.09	0.41
Latvia	–0.17	0.23	Portugal	0.09	0.44
Italy	–0.17	0.21	Croatia	0.08	0.48
Portugal	–0.19	0.17	Italy	0.07	0.52
Sweden	–0.21	0.13	Spain	0.05	0.66
Iceland	–0.22	0.11	Iceland	0.04	0.73
Croatia	–0.23	0.11	Russia	0.01	0.96
Lithuania	–0.23	0.09	LONDON	0.00	1.00
Slovak Republic	–0.26	0.07	Luxembourg	–0.02	0.89
Perm (Russia)	–0.28	0.07	Slovak Republic	–0.03	0.80
Russia	–0.29	0.04	Perm (Russia)	–0.05	0.70
Greece	–0.46	0.00	Malta	–0.05	0.65
Israel	–0.47	0.00	Greece	–0.10	0.41
Turkey	–0.55	0.00	Turkey	–0.19	0.11
Chile	–0.59	0.00	Israel	–0.20	0.08
Malta	–0.65	0.00	UAE	–0.26	0.03
Serbia	–0.66	0.00	Bulgaria	–0.30	0.01
Costa Rica	–0.71	0.00	Serbia	–0.38	0.00
Bulgaria	–0.76	0.00	Chile	–0.41	0.00

Note: All estimates based upon the pooled PISA 2009 and 2012 datasets.

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