American Educational Research Journal
Winter 2005, Vol. 42, No. 4, pp. 575–603

Effects of Resources, Inequality, and Privilege Bias on Achievement: Country, School, and Student Level Analyses

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This study examined how resources, distribution inequality, and biases toward privileged students affected academic performance. Fifteen-year-olds from 41 countries completed a questionnaire and tests in mathematics, reading, and science. Multilevel regression analyses showed that students scored higher in all subjects when they had more resources in their country, family, or school. Students in countries with higher inequality, clustering of privileged students, or unequal distribution of certified teachers typically had lower scores. Distribution inequality favored privileged students, in that schools with more privileged students typically had more resources. Overall, students scored lower when parent job status had a larger effect on student performance (privileged student bias) in a school or country. These results suggest that equal opportunity is linked to higher overall student achievement.

Keywords: distribution inequality, hierarchical linear modeling, international comparisons, socioeconomic status

Students with more resources (e.g., books, teacher attention, family income) typically have more learning opportunities and capitalize on them to perform better academically (e.g., Baker, Goesling, & Letendre, 2002). Given limited resources, a country must decide how to distribute them efficiently to maximize its overall student achievement. Because people typically "benefit more from the first apple eaten than from the last apple eaten" (or the first book read or first dollar spent, and so on; i.e., the concept of *diminishing marginal returns* [Mankiw, 2004, p. 273]), more equal distribution of resources might yield better overall outcomes.

Suppose that students receive diminishing marginal returns from books. If so, an extra $100 in books would probably improve a poor student's reading score more than a rich student's reading score. Hence, governments that allocate more resources to poorer students than to richer students (equalizing their resources) will see higher overall reading scores, ceteris paribus. A more equal distribution of educational resources allows students to use the resources more efficiently, thereby improving overall scores.

When a school system's educational resources are distributed unequally, privileged parents can use their superior socioeconomic capital to divert more educational resources to their children (*privileged student bias,* or PSB). PSB might differ across countries or across schools, and it can occur through explicit bribes of teachers (e.g. Korea, see Hani, 2005), special favors through cronyism (Lloyd & Blanc, 1996), or greater affinity with teachers as a result of similar social norms or cultural capital (Bourdieu, 1977; Heath, 1983). PSB exacerbates existing distribution inequalities by moving resources away from poorer students toward richer students. Because of diminishing marginal returns, PSB lowers resource allocation efficiency. Thus, countries or schools with greater PSB might show lower overall student performance than others with less PSB.

Using data on 15-year-olds from 41 countries (N = 193,076) in reading, mathematics, and science, we sought to extend this area of research in three ways. First, we examined how resources at several levels (country, family, and school) can affect a student's academic performance. Second, we tested how resource distribution affects student performance by looking at how effect sizes of per capita gross domestic product (GDP) differ for richer and poorer countries and by assessing the effects of distribution of family income in a country, allocation of privileged students among schools, and distribution of school resources. Third, we examined whether greater PSB affects overall academic performance at the school or country level. We used multilevel analyses and other advanced statistical methods to identify more precisely the effects observed at the country, school, and student levels.

Resources, Distribution Inequality, and Privileged Student Bias

We begin with a discussion of the effects of resources at various levels on student performance. Then, we examine different avenues of resource distribution. We also consider several mechanisms by which PSB can operate. Finally, we consider the interrelationships among resources, their distribution, and PSB.

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Country, Family, and School Resources

Extra resources at the country, family, or school level provide students additional learning opportunities, which students can use to learn more (e.g., Arum, 1998; Bradley & Corwyn, 2002; Heyneman & Loxley, 1982). At the country level, richer nations tend to spend more on education than poorer nations do, thereby giving students direct access to more resources and more learning opportunities (Baker et al., 2002). Students in richer countries can also benefit indirectly through an increased number of cultural opportunities and better health and safety standards (e.g., Murphy et al., 1998; Neisser et al., 1996).

In richer countries, families often have more human, financial, or social capital (higher socioeconomic status [SES]). Parents with more human capital have more education and skills, which they can use to teach their children cognitive skills, social skills, and social and cultural norms more effectively (Ochs, Taylor, Rudolph, & Smith, 1992; Snow, Perlmann, Berko Gleason, & Hooshyar, 1990; Swick & Broadway, 1997). Since mothers are the primary caregivers in most families, their human capital typically affects their children's performances more than that of the father (Darling-Fisher & Tiedje, 1990; Emery & Tuer, 1993; Stafford & Dainton, 1995). Highly educated parents also tend to earn higher incomes and use them to buy more and better educational resources for their children (e.g., books, computers, tutoring; Astone & McLanahan, 1991; Entwisle & Alexander, 1995; LeMasters & DeFrain, 1989). Finally, parents with more human and financial capital tend to have larger social networks made up of more highly skilled and educated people (i.e., social capital; Horvat, Weininger, & Lareau, 2003). Children can benefit from these networks directly via immediate interactions with network members or indirectly via their parents, who can access more social and cultural parenting resources (Cochran & Dean, 1991; Swick & Broadway, 1997; Wells & Crain, 1994).

Richer students typically live in richer neighborhoods and attend neighborhood schools with superior physical, teacher, and student resources (Rothstein, 2000). These schools typically are in better physical condition and have more educational materials than other schools (Berner, 1993; Comber & Keeves, 1973; Fuller, 1987; Fuller & Clarke, 1994). The students attending such schools also typically benefit from higher teacher-to-student ratios and better-qualified teachers (Ferguson, 1991; Greenwald, Hedges, & Laine, 1996; Rivkin, Hanushek, & Cain, in press). They also benefit from their privileged schoolmates' parental capital, material resources, and higher academic expectations (i.e., "spillover" effects; Coleman et al., 1966; Jencks et al., 1972; Pong, 1997, 1998; Pritchett, 2001).

In earlier years, poorer countries did not systematically fund schools, and differences in resources across schools in these countries had larger effects than across-school differences in richer countries. In recent years, however, most countries have systematically funded their schools, and school differences have shown weak effects at best (Baker et al., 2002; Hanushek, 1997; Heyneman & Loxley, 1982, 1983).

Distribution Inequality

As noted earlier, diminishing marginal returns might result in distribution effects. For example, diminishing marginal returns are visible in the log-linear effect of country income (measured via per capita GDP) on academic performance (Baker et al., 2002). As per capita GDP increases, each extra dollar of per capita GDP yields smaller and smaller (diminishing) average academic benefits. Within a country, distribution of family income, allocation of privileged students among schools, and distribution of school resources might affect overall student performance.

Greater equality of family income in a country might yield better overall outcomes in education, as it does in health (i.e., income equality predicts longer life expectancy; Duleep, 1995; Jencks, 2002). Thus, many countries reduce inequalities in family wealth via progressive taxes, social support programs, and tuition-free schools (Organization for Economic Cooperation and Development [OECD], 2002). Benabou (1996) argued that if parents paid the full cost of their children's education, poorer parents could not afford the optimal amount of education for their children. In the case of countries with similar per capita GDPs, those with greater inequality of family wealth have a lower proportion of parents who can afford the optimal amount of education for their children. Thus, family inequalities in wealth can yield underinvestments in education for the society as a whole, resulting in poorer overall educational outcomes. Governments can mitigate these underinvestments by providing universal access to educational resources (e.g., universal primary schooling; OECD, 2002) or targeting resources for poorer students (e.g., free lunch programs; Rothstein, 2000).

Schoolmates can also serve as a resource for one another. Students can benefit from resources made available by their friends, so governments can mitigate disparities in family wealth by mixing rich and poor students together in each school (rather than clustering rich students together in the same schools and poor students together in other schools). As a consequence of diminishing marginal returns, mixing students should benefit poorer students more than it benefits richer students (Coleman et al., 1966; Jencks et al., 1972).

Mixing students also hinders the targeting of more resources to richer students through the school system and hence hinders PSB. In contrast, clustering students facilitates targeting of extra resources to schools with mostly rich students, yielding diminishing returns and lower overall academic performance. Furthermore, mixing students might provide richer students extra learning opportunities from poorer students' different experiences. Hence, mixing students might yield higher overall educational outcomes than clustering students, ceteris paribus.

Since school resources overlap with family resources, extra school resources typically benefit poorer students more than they benefit richer students, again as a result of diminishing marginal returns. Hence, governments might also mitigate disparities in family wealth by allocating more resources to poorer schools or to schools with poorer students. In practice, however, richer students attend richer schools (e.g., Rothstein, 2000). In the United States, funding per student in one school can be 25 times higher than in another as a consequence of preferential government funding, private school alumni donations, and local tax funding of schools (Rothstein, 2000). Even if school budgets are similar, the best teachers may work in a few elite schools, whether by choice or by government assignment (Darling-Hammond & Post, 2000).

Finally, a school can distribute its resources unequally among its students. For example, teacher time and equipment can differ across courses (piano vs. drawing) and extracurricular activities (yacht club vs. math club; Rothstein, 2000). In addition, experienced teachers within a school might choose to teach specific classes (e.g., calculus vs. remedial math; Darling-Hammond & Post, 2000).

Privileged Student Bias

In school systems with larger distribution inequalities, privileged parents have more incentive to use their capital to obtain more educational resources for their children. Schools that allocate more resources to richer students exacerbate the effects of disparities in income. Because of diminishing marginal returns, greater PSB probably results in lower overall student achievement.

Some methods of resource allocation (open markets, cronyism, and social-cultural affinity) allow privileged parents to direct more resources to their children relative to other methods (uniform or truly random allocations). In open markets, privileged parents can use their financial capital by moving to affluent neighborhoods, thereby providing their children with richer schoolmates, for example. They can use their social capital through cronyism (Lloyd & Blanc, 1996); for instance, they can ask the vice-principal to assign their child to a course with a better teacher. Through their human capital, privileged parents can teach their children social norms and cultural capital to create greater affinity with teachers (Bourdieu, 1977; Heath, 1983). Teachers have higher expectations of these students and often give them more attention and assistance ("cultural gatekeeping"; Roscigno & Ainsworth-Darnell, 1999).

Links Among Resources, Distribution Inequality, and Privileged Student Bias

The relationships among resources, distribution inequality, and degree of PSB are complex and not well understood. Kuznets (1955) hypothesized that inequality follows an inverted U-shaped trajectory. As a country develops, income inequality will rise, peak, and eventually decline.

However, the cause of the fall in distribution inequality remains unclear, although often education of the poor is involved. Kuznets (1955) attributed the rise and fall of inequality to workers moving out of the agricultural sector into the industrial sector. Meanwhile, Williamson (1985) argued that human capital replaces physical capital as the main engine of growth in the later stages of development. According to Aghion and Bolton (1997), larger savings at higher levels of income lower interest rates, allowing the poor to invest in themselves and catch up. Finally, Acemoglu and Robinson (2002) claimed that inequality-induced political change redistributes resources toward the poor. Specifically, the threat of political revolution leads elites to introduce social programs and mass education that reduce distribution inequality.

In contrast, the growth rate of per capita GDP, and hence the overall resources available, may depend in part on income distribution. Common misconceptions are that marginal propensity to save is high among the rich and low among the poor and that greater income inequality results in higher savings, thus allowing more resources to be invested in economic growth. In reality, the opposite is true: Higher inequality tends to lead to lower economic growth. Greater income inequality is associated with higher population growth, which in turn retards the rate of economic progress (Barro, 2000).

The relationship between income distribution and PSB is unclear. It may be that higher inequality enhances both the incentives and the means for the privileged to divert extra resources to themselves and their children. When there is less inequality, in contrast, the privileged have both less incentive and less means to increase PSB. How these links among resources, inequality, and PSB play out at the country and school levels remains an open question.

Summary of Research Questions

This study addressed three major questions: Do resources at the country, family, and school levels affect a student's academic performance? Does distribution inequality of these resources affect a school's or a country's overall academic performance? Does PSB affect a school's or a country's overall academic performance? Figure 1 summarizes our model.

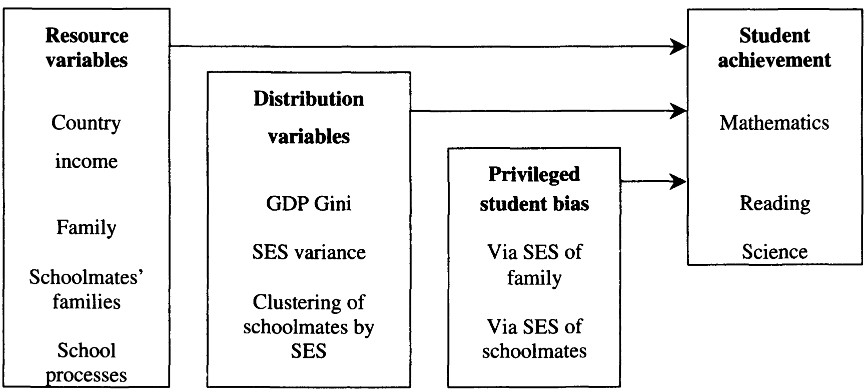

Figure 1. **Model of possible effects of country, family, and school resources; resource distribution; and privileged student bias on school mean student performance in mathematics, reading, and science. GDP = gross domestic product; SES = socioeconomic status.**

Method

To investigate our research questions across a large number of countries and schools, we had to address the following major difficulties: test design, representative sampling, questionnaire measurement error, missing data, and clustered data. We did so using (a) balanced incomplete block tests and a graded Rasch model, (b) weights adjusted for schools and students, (c) Warm estimated indices, (d) Markov chain Monte Carlo imputation, and (e) multilevel analyses. After describing the data, we discuss these five elements in detail. We then introduce the variables and specify our analyses.

A 2000 study of the OECD's Program for International Student Assessment (OECD-PISA) assessed how well 15-year-olds nearing the end of compulsory education have acquired the knowledge and skills needed for participation in society. International experts from participating OECD countries defined mathematics, reading, and science (MRS) literacy; built assessment frameworks; created and translated test items; and pilot tested these items to ensure their validity and reliability (for details, including reliability and validity checks, see OECD, 2002). PISA defines MRS literacy as the ability to understand, use, and reflect on mathematical concepts, written texts, and scientific ideas to achieve one's goals, develop one's knowledge and potential, and participate effectively in society. PISA test items represent the kinds of MRS literacy that 15-year-olds would require in the future. Example assessment items are available at the PISA Web site (www.pisa.oecd.org). Each participating student completed a 2-hour assessment booklet and a 30–40-minute questionnaire.

In the PISA balanced incomplete block test, each student answered only a subset of questions from the overall test ("subtest") to maximize coverage of MRS content while reducing student fatigue and learning effects during the test (Lord, 1980). All of the subtests included reading questions, but only about half included mathematics and science questions, resulting in unequal samples for each subject. The test included both multiple-choice and open-ended questions. Because there were overlapping questions on each pair of subtests, OECD (2002) analyzed the test scores by fitting a graded response Rasch model to the balanced incomplete block test data. The Rasch model estimated the difficulty of each item and the achievement score of each student on the basis of the subtest responses (adjusting for the difficulty of each test item and calibrating all test items; Lord, 1980). Furthermore, the graded response aspect of the model captured partial credits for student responses to open-ended questions (Samejima, 1969).

The student MRS scores estimated by the Rasch models were calibrated to a mean of 500 and a standard deviation of 100 based on data from only the participating OECD countries (OECD, 2002). The scores of non-OECD countries were added later. Since many non-OECD countries scored below the mean, averaging in their lower scores yielded lower overall means (469, 471, and 473 for math, reading, and science, respectively).

OECD (2002) first sampled about 150 schools from each of the 41 countries.[1] To represent a broad spectrum of schools, OECD used stratified sampling with respect to neighborhood SES and student intake. Next, they sampled about 35 students from the selected schools. Each country sampled at least 4,500 students. OECD then weighted the participant test scores and variables accordingly to represent the schools and the 15-year-old student populations of each country (for sampling details, see OECD, 2002).

Single questions with limited numbers of possible responses (e.g., yes/no or a simple Likert scale) probably measure underlying constructs coarsely, resulting in substantial measurement error. To minimize this measurement error, OECD (2002) included multiple measures for each theoretical construct and computed a single value from these measures with a Rasch model (Warm [1989] estimates).

Aside from the test items, students did not answer all questionnaire items, resulting in missing data (6%). These missing data could reduce estimation efficiency, complicate data analyses, and bias results (Rubin, 1996). Using Markov chain Monte Carlo multiple imputation, we addressed these problems more effectively than would have been the case with other approaches (e.g., deletion, mean substitution, or simple imputation; Rubin, 1996).

Traditional ordinary least squares regressions tend to underestimate standard errors in clustered data (students within schools within countries) and hence can improperly yield significant findings. To address this concern, we modeled school- and country-level effects with multilevel analyses (Goldstein, 1995; also termed hierarchical linear modeling [Bryk & Raudenbush, 1992]).

Variables

We modeled students' MRS scores using measures of country income, family SES, and average family SES in a school. Other predictors were also compiled from country-, school-, and student-level data. Unless otherwise indicated, all variables were obtained or computed from the OECD data. With the exception of the OECD indices, all continuous variables were standardized to means of zero and standard deviations of one for the regression analyses. In the case of OECD countries, OECD (2000) standardized the teacher shortage and teaching material shortage indices to a mean of zero and a standard deviation of one. OECD (2002) computed the indices for non-OECD countries afterward on the basis of the OECD mean and standard deviation.

We used *real GDP per capita,* adjusted for inflation to represent country resources (data were derived from Heston, Summers, & Aten, 2002). We also tested whether log real GDP per capita would fit the data better, since per capita GDP showed a log-linear relationship with many of the outcomes (e.g., death rates; World Bank, 2004). A log-linear relationship between real GDP per capita and an outcome variable suggests that changes in income have larger effects when incomes are low and smaller effects when income are high. This is consistent with diminishing marginal returns.

Indicators of SES (*mothers' years of schooling, fathers' years of schooling,* and *highest job status of parents*) may reflect one or many phenomena (Ostrove, Feldman, & Adler, 1999). Thus, we tested intercorrelations among these variables and allowed for separate effects in the regression analyses by entering each one separately and then together. OECD (2000) used Ganzeboom, de Graaf, and Treiman's (1992) index to measure the highest job status among a student's parents (values ranged from 16–90). OECD (2002) did not collect data on family income, which, together with education and job status, could have improved our measure of SES. We also computed the *school means* of the SES indicators to measure the SES of a student's schoolmates. In addition, we tested the effect of gender (i.e., *female*) as well as *percentage of girls in a school.*

As a measure of distribution, we used *GDP Gini* (data were derived from Heston et al., 2002) and computed total country variances in *mother's years of schooling, father's years of schooling,* and *parents' highest job status.* These total country variances were computed from sample variances of mother's years of schooling, father's years of schooling, and parents' highest job status in each country. We also computed variances across schools within a country in terms of mother's years of schooling, father's years of schooling, and parents' highest job status using the variances of the school means. Using these two sets of measures, we computed the *ratios of variance across schools over total country variance* for mother's years of schooling, father's years of schooling, and parents' highest job status. We also computed and tested these variables' standard deviations, which showed similar but slightly smaller effects. Hence we report only the effects of the variances. OECD's (2002) only measure of ability distribution was the grade at which a country began grouping students according to past achievement ("streaming" or tracking).

OECD (2002) derived three variables—*time per week spent in mathematics courses, in national language courses, and in science courses*—from the product of the following two measures: (a) number of class periods students had spent in mathematics/national language/science courses during the past full week and (b) number of instructional minutes in the average single class period. OECD (2002) collected data on two aspects of teacher qualifications: *proportion of certified teachers in a school* and *proportion of mathematics/national language/science teachers with a tertiary degree in a school.*

OECD (2002) derived an *index of teacher shortage* (see Warm, 1989) from school principals' views on how much learning among students was hindered by a shortage of teachers or inadequacy of teachers (a) in general, (b) in mathematics, (c) in language, and (d) in science. Response options for each item were *not at all, a little, somewhat,* and *a lot.* The reliability of this Warm (1989) index was .88 (OECD, 2002).

In addition, OECD (2002) derived an *index of education/teaching material shortage* (see Warm, 1989) from principals' reports regarding the extent to which learning among students in their school was hindered by the following problems: (a) lack of instructional material, (b) not enough computers for instruction, (c) lack of instructional materials in the library, (d) lack of multimedia resources for instruction, (e) inadequate science laboratory equipment, and (f) inadequate fine arts facilities. The response options for each item were *not at all, very little, to some extent,* and *a lot.* The reliability of this Warm (1989) index was .85 (OECD, 2002).

We also compute variances of each of the school resources to test for the effects of school resource distribution inequality. Hence, we had variances of (a) time spent in each class, (b) proportion of certified teachers, (c) proportion of teachers with a relevant tertiary degree in their subject, (d) teacher shortages, and (e) teaching material shortages.

Analysis

Whereas ordinary regressions tend to underestimate the standard errors of predictor effects in clustered data, multilevel analyses produce more precise estimates. Hence, we tested the extent to which students' MRS test scores varied substantially across schools and across countries with a multilevel variance component model via the MLn software (Rasbash & Woodhouse, 1995). If scores were to show significant differences across schools and across countries as well as across students, then three-level analyses would be needed (Goldstein, 1995).

We modeled students' MRS scores with two sets of multilevel regressions (also known as hierarchical sets; Cohen & Cohen, 1983) to estimate the variance explained by each set of predictors. Country variables might affect school properties, and families can choose the schools that their children attend. Thus, country and family variables were entered before school variables. The first set of variables included per capita GDP and distribution inequality, SES, gender, school mean SES, and SES variance. In the second set, we added school processes.

It was possible that the effects of each predictor would differ across countries or across schools. Thus, we estimated these predictor differences using random parameters for each explanatory variable at the country and school levels (Goldstein, 1995). To facilitate comparisons of predictor effects, we standardized all continuous predictors in these analyses.

We modeled the effects of PSB by examining whether overall scores (intercepts) were lower in countries with larger SES effects (slopes). Specifically, we examined whether countries' slope-intercept relationship was significant and estimated the correlation (*r*) between PSB size and average scores (Goldstein, 1995). Likewise, we examined whether overall scores were lower in schools with larger SES effects. Hence, PSB was not an explicit variable but was incorporated into the multilevel analysis model at the country and school levels via random slope-intercept effects.

An alpha level of .05 was used in all statistical tests. For purposes of comparison, we also report results for alpha levels of .01 and .001 in the tables. Conducting many tests on one set of data increases the likelihood of a spurious correlation. To address this problem, we adjusted the alpha level based on the number of predictors via Hochberg's (1988) variation on Holm's (1979) method. We assessed whether each added set of predictors was significant with a nested hypothesis test (chi-square log-likelihood; Cohen & Cohen, 1983).

To facilitate interpretation of the results, we report the effect on a student's MRS literacy of a 10% increase in each continuous predictor above its mean: 10% effect = $\beta \times SD \times (10\%/34\%)$, where one standard deviation is approximately 34% and β is the standardized regression coefficient. Because of the specific mathematical properties of logarithmic transformations of independent variables, we computed the effect of a 10% increase in per capita GDP with its unstandardized coefficient, $b \times \ln(1.1)$. We also tested for mediation effects using a multilevel version of the Sobel (1982) test (Krull & MacKinnon, 2001). When the mediation was significant, we also report the percentage change in the effect, computed as $1 - (\beta'/\beta)$. The regression coefficient of the predictor without the mediator in the model is indicated by β, and β' is the regression coefficient when the mediator is in the model.

Results

Summary Statistics

The countries in this study were fairly wealthy (mean per capita real GDP = \$10,325), with mean per capita real GDPs of \$13,002 for participating OECD countries and \$5,871 for non-OECD countries (see Table 1 for summary statistics and the Appendix for correlation and variance-covariance matrices). The students' mothers were relatively well educated, with a mean of 11 years of schooling; however, the range in education levels was wide, from 0 to 18 years. Highest family job status scores ranged from 16 to 90, with a mean of 46.8. Country variances in highest family job status ranged from 152 to 354. Finally, ratios of variance across schools over total country variance (clustering) ranged from 0.13 to 0.38.

On average, students spent 192, 194, and 208 minutes in mathematics, national language, and science courses per week. The overall means of the indices of teacher shortage and education/teaching material shortage (0.07 and 0.23 respectively) were larger than zero (OECD means), showing that the non-OECD countries suffered more from problems related to shortages of teachers and educational resources than the OECD countries. Many teachers had completed a university degree in their subjects (72%, 75%, and 77% overall in mathematics, reading, and science, respectively). Also, many teachers were certified (79% overall), but there was a wide range in country-specific percentages, from 28% (Chile) to 99.8% (South Korea).

Explanatory Model

Resources, distribution inequality, and PSB all affected MRS scores (see Table 2). The differences among students were similar in all subjects. About half occurred at the student level (45%, 46%, and 52% for mathematics,

Table 1
Summary Statistics

Variable	*M*	*SD*	Minimum	Median	Maximum
Mathematics score	469.09	115.63	108.94	476.32	864.04
Reading score	470.85	108.84	48.80	476.90	854.69
Science score	472.50	107.97	28.14	474.03	844.51
Country income (Log real GDP per capita)	9.09	0.60	7.63	9.21	9.88
Highest parent job status (possible range: 16–90)	46.85	16.59	16	45	90
Mother's years of schooling (possible range: 0–18)	11.15	3.65	0	12	18
Female (female = 1, male = 0)	.51	.50	0	1	1
School mean of highest parent job status	46.84	8.78	17.13	46.46	74.20
School mean of mother's years of schooling	11.15	2.24	1.09	11.61	16.15
Total country variance of highest parent job status	255.62	35.28	152.01	254.34	354.44
Clustering: highest parent job status variance across schools divided by total country variance of highest parent job status	0.24	0.06	0.13	0.24	0.38
Proportion of girls in school	.51	.20	0	.50	1
Minutes spent in mathematics courses per week	192.04	74.10	0	192	980
Minutes spent in language courses per week	193.50	80.83	0	190	990
Minutes spent in science courses per week	207.92	72.85	0	200	721
Teacher shortage	0.07	1.04	−0.99	−0.17	3.47
Education/teaching material shortage	0.23	1.11	−1.90	0.29	3.38
Proportion of mathematics teachers with university degree	.72	.32	0	.80	1
Proportion of language teachers with university degree	.75	.29	0	.86	1
Proportion of science teachers with university degree	.77	.30	0	.89	1
Proportion of certified teachers	.79	.30	0	.93	1
Proportion of certified teachers: variance across schools	.06	.04	.001	.05	.17

Note. The values shown were derived primarily from the reading sample. The values for the predictors in the science and mathematics samples were similar to those for the reading sample and are available from the authors on request. GDP = gross domestic product.

reading, and science, respectively). Another quarter occurred at the school level (24%, 30%, and 26% for mathematics, reading, and science), and the remaining quarter occurred at the country level (31%, 24%, and 22% for mathematics, reading, and science).

Results of some of the intermediate regressions are not reported here owing to space considerations. All omitted regression results are consistent with the ones presented in the tables and are available upon request from the authors.

Country, Family, and School Resources

Results showed that students with more country resources, family resources, and schoolmate resources scored higher (see Table 2). Overall, students in richer countries scored higher in all subjects. On average, increasing per capita GDP by 10% raised students' mathematics, reading, and science scores by 5, 4, and 4 points, respectively. Log values of real GDP per capita accounted for 54%, 63%, and 51% of the differences in MRS scores across countries and 17%, 15%, and 11% of the total variances in students' MRS scores (see Models 1, 3, and 5 in Table 2). Regressions with linear real GDP per capita did not fit the data as well, explaining only 48%, 50%, and 41% of the mathematics, reading, and science variances across countries, respectively. These log-linear results support the hypothesis that greater per capita GDP yields diminishing marginal returns on overall student performance.

Furthermore, parents' SES affected students' scores (see Models 1, 3, and 5 in Table 2). In all subjects, students averaged 4 points higher per extra 10% in highest parent job status rating and 2 points higher per 10% increase in years of education among students' mothers.

These results support the view that privileged parents' capital allows their children extra learning opportunities that they use to outperform their peers. When both parents' years of schooling were included in the model, the value for mothers was significant, but the value for fathers was not. This result supports past research showing that mother's schooling affects student achievement more than does father's schooling (e.g., Stafford & Dainton, 1995).

Gender also affected students' scores in all subjects (Table 2, Models 1, 3, and 5). Boys outscored girls by 15 and 4 points, respectively, in mathematics and sciences. In reading, however, girls outscored boys by 24 points.

Schoolmates' parents' SES affected students' MRS scores as well (Table 2, Models 1, 3, and 5). Students averaged 7 points higher in all subjects per 10% increase in mean highest job status of schoolmates' parents. They also averaged 6, 6, and 4 points higher in mathematics, reading, and science, respectively, per 10% increase in mean years of education among schoolmates' mothers. When school means of both parents' years of schooling were included in the model, that of the mother was significant, but that of the father was not. These results support the view that students benefit from schoolmates with privileged parents.

Students attending schools with more resources had higher scores in all subjects (see Models 2, 4, and 6 in Table 2). They averaged 2, 1, and 4 points

Table 2

Summaries of Regression Models Predicting Students' Mathematics, Reading, and Science Scores With Standardized Regression Coefficients

	Mathematics		Reading		Science	
Predictor	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Country income	.287***	.259***	.305***	.273***	.197***	.195***
(log real GDP per capita)	(.054)	(.050)	(.048)	(.043)	(.052)	(.045)
Mother's years of schooling	.048***	.048***	.052***	.052***	.058***	.057***
	(.003)	(.003)	(.002)	(.002)	(.003)	(.003)
Highest parent job status	.108***	.107***	.120***	.120***	.111***	.111***
	(.003)	(.003)	(.002)	(.002)	(.003)	(.003)
Female	−.131***	−.134***	.221***	.217***	−.045***	−.051***
	(.005)	(.005)	(.003)	(.003)	(.005)	(.005)
Mother's years of schooling:	.165***	.157***	.201***	.192***	.174***	.154***
school mean	(.018)	(.018)	(.020)	(.020)	(.018)	(.018)
Highest parent job status:	.193***	.181***	.217***	.206***	.201***	.171***
school mean	(.017)	(.016)	(.018)	(.018)	(.018)	(.017)
Total country variance of	−.110*	−.045	−.107*	−.030	−.169***	−.072
highest parent job status	(.049)	(.050)	(.043)	(.041)	(.046)	(.044)
Clustering of schoolmates	−.147**	−.152***	−.058	−.060	−.125**	−.133**
by highest parent job status[a]	(.045)	(.041)	(.042)	(.036)	(.046)	(.039)
Percentage of girls in school		.035***		.045***		.039***
		(.005)		(.005)		(.005)
Minutes spent in relevant		.057***		.023***		.127***
courses per week[b]		(.003)		(.002)		(.006)
Teacher shortage		−.015*		−.011*		−.013*
		(.005)		(.005)		(.005)

Education/teaching material shortage		−.033***		−.031***		−.033***
		(.005)		(.005)		(.005)
Percentage of teachers with relevant university degree[b]		.031***		.035***		.025***
		(.006)		(.005)		(.005)
Percentage of certified teachers		.014*		.014*		.013*
		(.006)		(.005)		(.006)
Percentage of certified teachers: variance across schools		−.107*		−.133**		−.146**
		(.052)		(.042)		(.045)
Remaining variance at each level						
Country	.095***	.080***	.077***	.058***	.073***	.052***
	(.022)	(.018)	(.018)	(.013)	(.017)	(.012)
Advantage of school mean of highest parent job status within country	−.009	−.009	−.013*	−.012*	−.004	−.002
	(.005)	(.005)	(.005)	(.005)	(.005)	(.004)
Highest parent job status: school mean variation across countries	.009***	.009***	.011***	.011*	.011***	.010***
	(.002)	(.002)	(.003)	(.003)	(.003)	(.002)
Mother's years of schooling: school mean variation across countries	.008**	.008**	.009**	.010**	.007**	.007**
	(.003)	(.003)	(.003)	(.003)	(.003)	(.003)
School	.105***	.100***	.109***	.105***	.106***	.093***
	(.002)	(.002)	(.002)	(.002)	(.003)	(.002)
Highest parent job status: advantage within each school	−.007***	−.007***	−.007***	−.007***	−.004***	−.004***
	(.001)	(.001)	(.001)	(.001)	(.001)	(.001)
Highest parent job status: variation across schools	.004***	.004***	.007***	.007***	.006	.006***
	(.001)	(.001)	(.000)	(.000)	(.001)	(.001)
Mother's years of schooling: variation across schools	.004***	.004***	.005***	.005***	.004***	.004***
	(.001)	(.001)	(.000)	(.000)	(.001)	(.001)
Student	.430***	.428***	.432***	.432***	.499***	.499***
	(.002)	(.002)	(.002)	(.002)	(.002)	(.002)

(*continued*)

Table 2 (Continued)

	Mathematics		Reading		Science	
Predictor	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Explained variance at each level						
Country	.695	.745	.690	.767	.677	.771
School	.576	.594	.645	.658	.591	.640
Student	.053	.056	.073	.074	.045	.045
Total	.378	.400	.395	.417	.327	.360

Note. Standard errors are in parentheses.

[a]The measure used for clustering of schoolmates by highest parent job status was highest parent job status variance across schools divided by total country variance of highest parent job status.

[b]"Relevant" refers to the subject tested, that is, mathematics for the regression of mathematics test scores, reading or language arts for the reading test, and science for the science test.

$^{*}p < .05$. $^{**}p < .01$. $^{***}p < .001$.

higher in mathematics, reading, and science per extra 10% of time spent in these courses, respectively. Teacher shortages had negative, significant effects on students' MRS scores. Students averaged 0.5, 0.3, and 0.4 points lower in mathematics, reading, and science, respectively, per extra 10% of teacher shortage in their schools. They averaged 1 point lower in all subjects per extra 10% of educational resource shortage in their schools.

Teacher qualifications as well affected students' scores in all subjects. Students averaged 1 point higher in each subject per extra 10% of MRS teachers with university degrees in their schools. They averaged 0.5, 0.4, and 0.4 points higher per extra 10% of certified teachers in their schools. Also, students averaged 1 point higher in all subjects per extra 10% of girls in their schools. School processes accounted for additional variances of 2%, 1%, and 2% in students' MRS scores.

Schoolmates' parents' SES showed the largest effects on all test scores. The effect of a student's parents' SES and the cumulative effect of all school resources were similar in size. Together, country, family, and schoolmate resources accounted for 31%, 35%, and 27% of the variances in students' MRS scores, highlighting the strong influence of resources on student scores.

Distribution Inequality

Students scored lower in countries with larger distribution inequalities (Table 2, Models 1, 3, and 5). Students averaged 4, 4, and 5 points lower in mathematics, reading, and science, respectively, per extra 10% of total country variance in parents' highest job status. GDP Gini and larger variances in mother's or father's education were significant in all subjects when initially entered into the model, but they were no longer significant after the addition of variance in parents' highest job status, suggesting multicollinearity in the variables.

Countries with more clustering also showed lower scores, students averaging 5 points lower in mathematics and 4 points lower in science per 10% increase in the ratio of variance across schools over total country variance of parents' highest job status. Clustering did not have a significant effect on reading scores. These results support the view that mixing students from different family SES backgrounds together tends to yield higher mathematics and science scores than clustering them. None of the distribution variables involving mother's or father's years of schooling had significant effects, even when entered before highest parent job status. In addition, streaming showed no significant effect.

Unequal distribution of school resources also significantly reduced student scores. Specifically, students scored 4, 4, and 5 points lower in mathematics, reading, and science, respectively, per 10% increase in variance of each school's percentage of certified teachers (Table 2, Models 2, 4, and 6). Furthermore, the variance of parents' highest job status in a country was no longer significant after controlling for variance of proportion of certified teachers. Together, SES variance, degree of clustering, and certified teacher variance accounted for extra variances of 5%, 3%, and 5% in students' MRS scores.

Distribution inequality was linked to country resources. The effects of per capita GDP on MRS scores fell by 12%, 12%, and 19% when highest parent job status variance was controlled; by 13%, 12%, and 21% when clustering was controlled; and by 11%, 12%, and 21% when variance of proportion of certified teachers in a school was controlled (see Table 3). GDP per capita was likewise directly correlated with both highest parent job status variance ($r = -.37$), clustering ($r = -.31$), and variance of proportion of certified teachers in each school ($r = -.39$). These negative relationships suggest that richer countries tend to have more equal distributions of resources and that these countries are on the right-hand, downward slope of the Kuznets (1955) curve.

Privileged Student Bias

School resources mediated the effects of school mean parent SES (see Table 3). Teacher shortage, educational material shortage, proportion of teachers with relevant university degrees in their teaching subject (i.e., mathematics, reading, or science), and variance of percentage of certified teachers all significantly mediated the effects of school mean parent SES. Including these school resources in regression equations mediated the effects of school means of mother's schooling and of highest parent job status on students' MRS scores by 5%, 4%, and 11% and by 6%, 5%, and 15%, respectively.

Hence, privileged parents, not underprivileged ones, enrolled their children in schools with more resources, which in turn helped their students score higher. This supports the view that larger distribution inequalities facilitate PSB.

Students in schools or countries with greater PSB had lower overall scores (Table 2, Models 1, 3, and 5). Positive effects of students' and schoolmates' parent SES varied significantly across schools and across countries. In schools exhibiting a greater bias toward students with higher parent job status, overall MRS scores were lower (rs = −.32, −.26, and −.16, respectively). Likewise, overall scores were lower in countries exhibiting a greater bias toward privileged schoolmates with higher mean parent job status, but this effect was significant only in reading ($r = -.45$).

Degree of PSB at both the school and country levels showed no significant mediation effects or correlations with other variables. Only family's highest job status, mother's education, school mean highest job status, and school mean mother's education showed significantly different effects across countries. No other predictor effects differed significantly across countries. Finally, no other predictor showed significant effects. Altogether, these models accounted for 40%, 42%, and 36% of the variance in mathematics, reading, and science scores, respectively.

Table 3

Results of Multilevel Mediation Tests

		Mathematics		Reading		Science	
Predictor	Mediator	Change (%)	z	Change (%)	z	Change (%)	z
Country income[a]	Highest parent job status variance	11.8	−2.21*	11.6	−2.51*	19.0	−3.68***
Country income[a]	Clustering[b]	13.2	−3.28**	12.4	−2.14*	21.2	−3.08**
Country income[a]	% certified teacher variance	11.2	2.05*	12.3	3.13**	21.0	3.28**
School means							
Mother's schooling	Teacher shortage	1.7	−2.90**	1.2	−2.17*	1.2	−2.50*
Parents' highest job status	Education material shortage	1.2	−6.06***	1.0	−5.81***	1.2	−5.99***
Mother's schooling	Education material shortage	1.5	−5.79***	1.3	−5.77***	1.6	−6.06***
Parents' highest job status	% teachers with tertiary degree	1.5	4.49***	1.7	1.49	1.2	4.38***
Mother's schooling	% teachers with tertiary degree	0.7	5.42***	1.1	6.14***	0.2	4.51***
Mother's schooling	% certified teacher variance	0.6	2.04*	1.5	3.12**	1.4	3.26**
Highest parent job status variance	% certified teacher variance	52.7	−2.05*	64.2	−3.13**	46.3	−3.28**

[a]Country income was measured via log real GDP per capita.
[b]The measure of clustering was highest parent job status variance across schools divided by total country variance of highest parent job status.
*$p < .05$. **$p < .01$. ***$p < .001$.

Discussion

Past research has examined how student achievement is affected by country, family, and school resources but not by a country's distribution inequality or degree of PSB. Using student MRS scores from 41 countries, we found that more resources, less distribution inequality, and less PSB are linked to higher student performance. These results suggest that educators seeking to optimize student learning must consider not only how to increase educational resources but also how to distribute them.

Country, Family, and School Resources

Students scored higher when their country, family, schoolmates, or school had more resources. The positive log-linear effect of per capita GDP was consistent with past research showing that students in richer countries benefit from more nutritious food, better health care, and safer school buildings, which in turn support higher academic performance (e.g., Alaimo, Olson, & Frongillo, 2001; Murphy et al., 1998; Neisser et al., 1996).

Likewise, our SES results support the view that students with higher parent and schoolmate parent SES enjoy greater learning opportunities and capitalize on them to learn more (Coleman et al., 1966; Entwisle & Alexander, 1995; Horowitz, 1995; Horvat et al., 2003). Students might benefit from schoolmates with higher SES parents through sharing of material and social resources or through schoolmates' parents' greater school participation or social networks (Pong, 1997, 1998).

Students scored higher when their schools had a sufficient number of teachers, sufficient teaching materials, proportionately more certified teachers, and proportionately more teachers with subject-relevant university degrees. Although each school resource had a small effect (as shown in past research; Greenwald et al., 1996; Hanushek, 1997; Rivkin et al., in press; Wilms & Somers, 2001), the cumulative effect size of a 10% increase in all of these school processes was similar to that of parent SES. Thus, teachers and schools had a substantial overall effect on 15-year-olds' academic performances in these 41 countries. Furthermore, these results show the importance of examining a wide range of school resources to capture school effects.

School mean parent SES showed the largest effects in all subjects. The sizes of these effects highlight the importance of examining how the broader context of schoolmates influences student achievement.

Distribution Inequality

Students scored lower in schools and school systems with larger distribution inequalities. GDP per capita had a log-linear effect, consistent with diminishing marginal returns. This supports the claim that students in poorer countries tend to benefit from an extra dollar of resources more than those in richer countries. Furthermore, larger parent job status variation within a country, clustering of students according to parents' highest job status, and larger variation of certified teachers across schools were all negatively linked to student performance. The negative effect of clustering probably did not operate through either PSB or school resources, given that they did not show significant mediation effects. Hence, clustering's primary negative effect might stem from diminishing marginal returns or fewer learning opportunities owing to less diverse schoolmate experiences.

Our results support the view that, as a result of diminishing marginal returns, unequal distribution of resources tends to yield lower overall scores because privileged students benefit less than poorer students from the same increase in resources. They also suggest that policies that reduce distribution inequality will tend to improve students' academic performance. In comparison with an open market of private schools, for example, a school system with equal funding per student and random allocation of students reduces distribution inequality and might increase academic achievement. Furthermore, in high-population-density areas with low transportation costs, school systems can mix students with different family SES together in the same school.

Likewise, school systems can ensure that each school has similar proportions of certified and uncertified teachers. For example, some countries require certification for all new teachers, and thus the resulting variance of certified teachers will approach zero (e.g., 99.8% certified in Korea, yielding a variance of 0.0006). After certified teacher variance had been controlled, parents' highest job status variance did not significantly affect test scores. Hence, a targeted, equitable teacher certification policy that benefits students more directly might be more suitable than a politically sensitive government intervention in the job market that benefits students only indirectly.

Richer countries in our study showed more equal distributions of resources than poorer countries. Richer countries had less job status variance, less clustering, and less variance of school resources. These relationships suggest that most of these countries are on the right-hand, downward slope of the Kuznets (1955) curve. These effects are promising because they suggest that further economic growth in these countries will yield both greater distribution equality and higher academic performance.

Privileged Student Bias

Privileged students were more likely to attend schools with more resources, and students attending schools with more resources had higher scores. Thus, distribution inequality typically benefits privileged students, not underprivileged students. Furthermore, countries and schools both scored lower when the effect sizes of PSB due to parent job status at each level were higher. Interestingly, greater bias toward students whose mothers had more schooling did not significantly affect overall scores at either the school or country level. These results suggest that educators should devote more effort to reducing cronyism, perhaps with external audits or simple, transparent rules for assigning school and teacher resources regardless of family SES. Together, the PSB results support the view that allocating more resources to privileged students lowers overall achievement because the losses of underprivileged students outweigh the benefits to privileged students (diminishing marginal returns).

Degrees of PSB at both levels showed independent effects, as they were not significantly correlated with any of the other variables included in the study. Since degree of PSB at the country level was not significantly correlated with school resources, the PSB differences across countries were not primarily due to diversions of resources to schools with more privileged students. These unexplained differences in PSB across both schools and countries serve as grist for further research.

Differences Across Academic Subjects and SES Components

Our results were consistent across mathematics, reading, and science with three exceptions. Consistent with other studies, girls scored higher in reading but lower in mathematics and science (e.g., National Center for Education Statistics, 2003; Third International Mathematics and Science Study Group, 1995). Still, students (of both genders) with proportionately more female schoolmates scored higher in all subjects (Hoxby, 2001, speculated that having more girls in a school benefits other students through improved classroom behavior). Meanwhile, reading scores were lower in countries with higher PSB across schools, but mathematics and science scores did not differ significantly. Lastly, countries with greater clustering had significantly lower scores in mathematics and science, but the effect was not significant in reading.

Parent job status and parent education also had different effects. Parents' highest job status and mother's schooling improved the academic performance of both their child and their child's schoolmates. In contrast, father's schooling did not show any significant effects. These results are consistent with past studies showing that parents' social networks and mother's schooling affect students' academic performance more than does father's schooling (e.g., Stafford & Dainton, 1995). However, schools and countries exhibited lower overall scores with greater PSB via highest job status but not via parents' schooling.

Limitations and Future Research

The present study involved some limitations. First, extremely poor countries such as Haiti did not participate. Also, the students sampled were not fully representative of all 15-year-old students. For example, students at lower literacy levels might have been less likely to attend school during the day of the PISA test, and very poor children might not have attended school at all (e.g., United Nations Children's Fund, 2001).

Second, all of the variables included in the present study were correlational. Thus, we cannot interpret the results in a causal way. Indeed, some associations might have been bidirectional. Third, our data included only 15-year-old students. Hence, we cannot use these cross-sectional data to address developmental effects of family, school, or students. Fourth, only coarse, country-level measures of streaming were included. Student-level assessments of past achievement would help create better measures of streaming and clarify schooling effects.

This study also raises several questions about the mechanisms by which distribution inequality and PSB operate. If diminishing marginal returns are the only explanation for the clustering effects, then clustering might benefit rich students at the expense of poorer students. If rich students also learn less because they lack access to the diverse experiences of poor students when levels of clustering are greater, then clustering might hurt *all* students. Future studies can examine the manner in which teachers and school systems do or do not increase distribution inequality in various ways, such as differential treatment of students, differential implementation of policies across schools, misalignment of school and home expectations of students, and so on.

Likewise, educators might benefit from closer examination of how PSB operates, whether through financial, social, or human capital of privileged families. For example, costly fees for school activities might benefit richer students because poorer students cannot afford them. Studies might examine whether schools without fees for any activities show less PSB. Researchers can also examine whether external audits or simple, transparent rules for assigning school resources reduce cronyism. Guided by this information, educators can develop means to reduce PSB in their specific classrooms, schools, and school systems and thereby help their students achieve more.

Conclusion

Equality of opportunity is more than an ideal. It works in practice. Fifteen-year-olds in 41 countries scored higher in mathematics, reading, and science not only when there were more resources but also when there was more equitable distribution or less PSB. Students who enjoyed more resources within a country, in their family, in schoolmates' families, or within a school often had higher scores. However, these resources showed diminishing marginal effects. Furthermore, scores were typically lower in countries with larger distribution inequalities via clustering of privileged students or of certified teachers. Likewise, students scored lower in schools or countries with greater PSB.

Our results suggest that overall student performance would tend to increase if governments distributed limited educational resources more equally. For example, the top-scoring countries in mathematics, reading, and science (Hong Kong, Finland, and South Korea) pursue education policies that give each student equal funding (e.g., by funding their schools on a per student basis; United Nations Educational, Scientific, and Cultural Organization, 2000). In addition, these three countries all mix students of different family SES together and require all new teachers to be certified (OECD, 2003). Conversely, policies that increase resources for privileged students at the expense of underprivileged students will probably decrease overall student performance. Together, the present results support the view that equality of opportunity is linked to superior overall performance.

APPENDIX

Correlation-Variance-Covariance Matrices of Outcome Variables and Significant Predictors

Variable	1	2	3	4	5	6	7	8	9	10	11
1	*13,371*	N/A	N/A	29.60	666	134	−2.81	494	110	−998	−2.03
2	N/A	*11,847*	N/A	26.48	656	125	7.44	478	102	−871	−1.48
3	N/A	N/A	*11,657*	22.91	601	117	−0.25	433	93.02	−959	−1.52
4	.42	.40	.35	*0.36*	1.98	0.53	0.00	1.97	0.53	−7.84	−0.01
5	.35	.36	.34	.20	*275*	28.63	−0.08	77.01	14.88	−5.57	−0.11
6	.32	.31	.30	.24	.47	*13.29*	−0.04	14.88	5.01	−2.78	−0.04
7	−.05	.14	.00	−.01	−.01	−.02	*0.25*	0.15	0.01	0.14	0.0004
8	.47	.50	.44	.37	.53	.46	.03	*77.02*	14.88	−5.55	−0.11
9	.42	.42	.38	.40	.40	.61	.01	.76	*5.01*	−2.78	−0.04
10	−.24	−.23	−.25	−.37	−.01	−.02	.01	−.02	−.04	*1,245*	−0.02
11	−.29	−.22	−.24	−.31	−.11	−.19	.01	−.21	−.31	−.01	*0.004*
12	.07	.13	.09	−.04	.03	.01	.31	.06	.02	−.07	−.003
13	.10	N/A	N/A	.06	.01	−.05	−.02	.01	−.09	−.03	.03
14	N/A	.09	N/A	.15	.02	−.02	.002	.02	−.04	−.05	−.03
15	N/A	N/A	.14	−.14	.09	.03	.01	.17	.05	−.01	.06
16	−.12	−.11	−.12	−.11	−.09	−.11	−.01	−.18	−.18	.14	−.02
17	−.26	−.25	−.23	−.35	−.12	−.12	.0002	−.23	−.20	.27	.02
18	.09	N/A	N/A	−.07	.06	.11	.01	.12	.17	−.16	−.15
19	N/A	.13	N/A	−.03	.07	.11	.02	.14	.18	−.19	−.11
20	N/A	N/A	.15	−.01	.06	.10	.02	.12	.16	−.23	−.15
21	.19	.19	.17	.23	.05	.08	.003	.10	.13	−.20	−.17
22	−.28	−.31	−.28	−.39	−.08	−.11	−.001	−.15	−.19	.52	.04

Note. Values below the diagonal are correlations, and values above the diagonal are covariances. Values in italics are variances. 1 = mathematics scores; 2 = reading scores; 3 = science scores; 4 = log real per capita gross domestic product; 5 = highest parent job status; 6 = mother's years of schooling; 7 = female; 8 = highest parent job status: school mean; 9 = mother's years of schooling: school mean; 10 = total country variance of highest parent job status; 11 = clustering: highest parent job status variance across schools/total country variance of highest parent job status; 12 = percentage of girls in school; 13 = time spent in mathematics courses per week; 14 = time spent in language courses per week; 15 = time spent in science courses per week; 16 = teacher shortage; 17 = education/teaching material shortage; 18 = percentage of mathematics teachers with university degree; 19 = percentage of language teachers with university degree; 20 = percentage of science teachers with university degree; 21 = percentage of certified teachers; 22 = percentage of certified teachers: variance across schools. N/A = not applicable.

12	13	14	15	16	17	18	19	20	21	22
1.53	850	N/A	N/A	−14.15	−32.99	3.22	N/A	N/A	6.58	−1.42
2.85	N/A	759	N/A	−12.72	−30.39	N/A	4.08	N/A	6.19	−1.46
1.88	N/A	N/A	1064	−12.95	−27.90	N/A	N/A	4.69	5.57	−1.32
−0.005	2.74	7.48	−6.03	−0.07	−0.23	−0.01	−0.01	−0.001	0.04	−0.01
0.10	17.43	21.78	109	−1.60	−2.23	0.34	0.36	0.31	0.26	−0.06
0.01	−13.50	−6.57	7.66	−0.43	−0.50	0.12	0.12	0.11	0.09	−0.02
0.03	−0.88	0.08	0.45	−0.01	0.00	0.002	0.002	0.003	0.00	−0.00
0.10	5.98	17.61	109	−1.60	−2.23	0.34	0.36	0.32	0.26	−0.06
0.01	−15.32	−7.28	7.67	−0.43	−0.50	0.13	0.12	0.11	0.09	−0.02
−0.51	−68.70	−138	−18.42	5.09	10.57	−1.88	−2.01	−2.46	−2.11	0.80
0.00	0.14	−0.17	0.26	−0.001	0.001	−0.003	−0.002	−0.003	−0.003	0.0001
0.04	0.004	0.19	0.12	−0.01	−0.002	0.004	0.004	0.005	0.003	−0.001
.00	*5,491*	N/A	N/A	6.35	−4.01	−3.03	N/A	N/A	−0.60	0.25
.01	N/A	*6,534*	N/A	3.84	−6.25	N/A	−2.23	N/A	0.16	0.30
.01	N/A	N/A	*5,306*	1.39	2.34	N/A	N/A	2.48	−1.97	0.44
−.05	.08	.05	.02	*1.08*	0.34	−0.04	−0.04	−0.03	−0.01	0.003
−.01	−.05	−.07	.03	.30	*1.23*	−0.01	−0.01	−0.02	−0.03	0.01
.07	−.13	N/A	N/A	−.12	−.02	*0.10*	N/A	N/A	0.01	−0.002
.07	N/A	−.09	N/A	−.13	−.04	N/A	*0.09*	N/A	0.01	−0.002
.09	N/A	N/A	.11	−.11	−.05	N/A	N/A	*0.09*	0.02	−0.003
.05	−.03	.01	−.09	−.04	−.09	.15	.17	.18	*0.09*	−0.01
−.06	.08	.09	.14	.06	.20	−.16	−.19	−.20	−.44	*0.002*

Notes

This research was partially funded by a Chinese University of Hong Kong direct grant. We appreciate Sung Wook Joh's helpful comments and Yik Ting Choi's research assistance.

[1]Participating countries included Argentina, Albania, Australia, Austria, Belgium, Brazil, Bulgaria, Chile, the Czech Republic, Denmark, Finland, France, Germany, Greece, Hong Kong–China, Hungary, Iceland, Indonesia, Ireland, Israel, Italy, Korea, Latvia, Liechtenstein, Luxembourg, FYR Macedonia, Mexico, the Netherlands, New Zealand, Norway, Peru, Poland, Portugal, Romania, the Russian Federation, Spain, Sweden, Switzerland, Thailand, the United Kingdom, and the United States.

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Manuscript received February 26, 2005
Revision received May 23, 2005
Accepted June 24, 2005