# Families, Schools, and National Contexts: The Effects of Institutions and Inequality on Educational Achievement across Industrialized Countries

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## Abstract

This paper focuses on the direct and indirect effects of family background and school quality on the educational achievement scores of high school students in developed countries. Not only does the educational, occupational, and economic characteristics of one's family have a direct impact on how well one does on high school achievement tests, but it can also have an indirect effect through the school that one attends. The quality of schools thus may serve both as a mediator of family background and an independent source of variation in student achievement scores. Therefore, the structure of a country's educational system – particularly the variation in school quality and the process of student assignment to schools – can impact the relationship between family background and achievement scores and serve as a source of inequality in educational achievement.

Little research has properly disentangled family and school effects on achievement and even fewer studies have attempted to make comparisons across developed countries. Given the growing interest in the role of institutions in shaping stratification processes it is important to properly account for the differential effect that schools may have in various types of educational systems. The mediating effects of schools will likely vary as the processes of resource allocation and student assignment to schools vary across educational systems.

In addition, little educational research has attempted to compare the inequality in achievement scores across countries, and no research has attempted to decompose inequality in achievement into the amount due to inequalities in family background and inequalities in school quality. The focus on inequality is extremely important given the propensity for policy-makers to focus solely on comparisons of mean scores across countries.

In sum, the main goals of this project are to: 1) the extent of variation in achievement inequality that exists across countries; 2) the total, direct and indirect effects of family background and school quality on educational achievement, specifically in the domain of reading literacy, and how these effects differ across national contexts; 3) the role of schools as determinants of achievement, both independently and in conjunction with family background, 4) the extent to which variation in achievement inequality can be attributed to cross-national differences in school inequality or family background inequality, and 5) the effect of the structure of national educational systems on the size and shape of family and school effects of achievement.

**Families, Schools, and National Contexts: The Effects of Institutions and Inequality on Educational Achievement across Industrialized Countries**

## Introduction

This paper focuses on the direct and indirect effects of family background and school quality on the educational achievement scores of high school students in developed countries. Not only does the educational, occupational, and economic characteristics of one's family have a direct impact on how well one does on high school achievement tests, but, if family background helps determine where children are sent to school, it can also have an indirect effect through the school that one attends. The quality of schools thus may serve both as a mediator of family background and an independent source of variation in student achievement scores. Therefore, the structure of a country's educational system – particularly the variation in school quality and the process of student assignment to schools – can impact the relationship between family background and achievement scores and serve as a source of inequality in educational achievement.

Since the expansion of mass education in industrialized countries there has been an interest in evaluating school performance by comparing student performance. With the implementation of the first international assessments of educational achievement in the 1970s educational researchers and policy-makers began comparing achievement scores across countries. A substantial portion of the current debate over the effectiveness of educational systems in the U.S. and across the world is driven by the comparison of mean achievement scores across countries. As Lynn Hollen Lees states in her 1994 article, "Schoolchildren today represent not only themselves and their families in an imaginary competition but also their countries in an international race for superiority" (65).

International assessments of educational achievement advanced the debate over school performance by expanding the debate beyond national borders. This international focus provides a broader range of school and classroom practices and programs for researchers to evaluate while also highlighting the effect of different national systems of education on achievement scores. Scholars interested in the effects of national-level education practices such as the type of student assignment to schools or centralized versus decentralized educational systems can only study these issues within an international context. Nonetheless, there are shortcomings in previous attempts to compare achievement scores across countries that have limited the usefulness of these cross-national comparisons. This paper will address some of these shortcomings and produce a more comprehensive comparison of cross-national achievement scores.

In particular, this paper will help clarify the determinants of educational achievement by illuminating the following relationships: 1) the role of schools as determinants of achievement, both independently and in conjunction with family background, and 2) the effect of the structure of national educational systems on the size and shape of family and school effects of achievement. These results can help develop a better insight into the processes of educational achievement in various institutional settings and the overall impact that proposed educational reforms are likely to have.

Another shortcoming of previous comparisons of achievement scores across countries has been the focus on cross-national comparisons of mean achievement scores while ignoring the distribution of both achievement and the determinants of achievement within societies (Buchmann 2002). Cross-national comparisons of the distribution of achievement scores within countries can better reveal the overall effectiveness of a

country's educational system. Two countries, A and B, can have the same mean achievement score but, if country A has a smaller distribution of scores than country B, then the achievement scores of students at the same point in the distribution of scores within each country are not equal. While comparisons of distributions will provide more information than comparisons of mean scores, we also want to know why distributions of achievement scores vary across countries.

Little research has attempted to show how the country-level inequalities of determinants of educational achievement are related to the distribution of achievement scores within countries.[1] Using variance decomposition methods, I can determine how inequalities in the determinants of educational achievement in a country affects the distribution of achievement scores in that country. Specifically, I will determine the amount of inequality in achievement scores that results from inequalities in family background variables and school quality. The impact of this knowledge will increase our understanding of the processes that determine educational achievement within nations.

In sum, this paper will make significant contributions to our understanding of cross-national educational achievement by establishing: 1) the total, direct and indirect effects of family background and school quality on educational achievement, specifically in the domain of reading literacy, and how these effects differ across national contexts; 2) the extent of variation in achievement inequality that exists across countries; and 3) the extent to which this variation in achievement inequality can be attributed to cross-national differences in school inequality or family background inequality.

[1] There are some examples of this type of analysis being conducted by economists who decompose income inequality into its various components (Lam and Levison 1992a, 1992b; Lemieux 2002).

## Literature Review

In general, educational research by sociologists has focused on the effect of family SES on educational attainment while education and policy researchers have focused on the effect of schools on achievement scores. There are some notable exceptions where sociologists have made important contributions to research on school effects and achievement (e.g., Coleman et al. 1966; Coleman 1975), especially in recent work focusing on the achievement gap between racial groups in the U.S. (Jencks and Phillips 1998; Roscigno 1998, 2000), but the majority of sociological research still tends to focus on educational attainment. Even though achievement is not the educational outcome of choice for many sociologists, there is sociological merit to its use as an indicator of the processes whereby individuals are stratified within societies. Achievement has a direct effect on educational attainment and, in turn, also affects occupational attainment (Coleman 1961; Blau and Duncan 1967; Jencks et al. 1972; Kao and Thompson 2003). Achievement scores can be used to predict students' later school performance along with their eventual level of educational attainment. Since family background and school effects have relationships to both attainment and achievement, I will review literature on the determinants of both outcomes.

### Determinants of Educational Outcomes

The Blau-Duncan model of status attainment (Blau and Duncan 1967) linked social origin with educational attainment and eventual occupational outcomes and defined a generation of stratification research focused on the processes that transfer the status of parents to their children. Around the same time the Coleman Report in the U.S.

(Coleman et al. 1966) and the Plowden Report in Great Britain (1967) established a link between family characteristics and educational achievement and showed that it was more important than the effects of school factors on achievement. Reviews of the field since that time (Eckstein 1977; Roscigno 1998; Buchmann 2002) indicate that educational research has fragmented into separate lines of research – one focused solely on family background effects and the other focused solely on school effects.

Continuing research on family effects has utilized more complex measures of family SES to show that family background, in particular parental educational and family income, is the best predictor of eventual educational outcomes (Roscigno 2000; Kao and Thompson 2003). Much of this research has been conducted within the U.S. (Alexander, Entwisle, and Thompson 1987; Warren 1996; Roscigno 1998, 2000), but research in other countries has found similar effects of family background on educational outcomes (Burstein, Fischer and Miller 1980; Shavit and Blossfeld 1993). This research has established the important impact of family background on educational attainment and achievement, but findings on the effects of schools are less clear.

The importance of schools to educational outcomes has been of interest to researchers since the Coleman Report (Coleman et al. 1966) and its contemporaries (Peaker 1971; Comber and Keeves 1973; Thorndike 1973; Purves 1973). Research focused solely on school effects mostly began as a reaction against findings in the Coleman Report, which seemed to indicate that schools had almost no effect on student achievement. Since that time researchers have found that many characteristics of the schools children attend affect their educational outcomes.

School effects research can be split into two broad types. The first type is concerned with between-school processes such as race and class composition or resource differentials, and the second type is interested in within-school processes such as tracking and teacher expectations. Findings from these two lines of research have revealed a variety of ways that schools affect educational outcomes. The question, however, still remains about how schools and family background simultaneously affect educational outcomes. Of particular interest is how schools may mediate the effect of family background on achievement and function as independent sources of achievement inequality. Most past research on the simultaneous effects of families and schools, such as the Coleman Report, the Plowden Report, and subsequent cross-national IEA studies (Comber and Keeves 1973; Thorndike 1973; Purves 1973), was primarily interested in family effects and simply wanted to see if school characteristics were able to explain away these effects. Then, in 1995, Alan Kerckhoff proposed the beginning of a new generation of stratification research that would systematically account for the role of institutions, such as schools and national education systems, in shaping core stratification processes. Since then others have supported the need for this new focus within the field of educational research by arguing that student achievement, and the effect of families on achievement, is embedded within national systems and institutions (Arum 2000; Baker and LeTendre 2000; Roscigno 1998, 2000; Buchmann and Dalton 2002). Kerckhoff, too, saw the relevance of institutional research to the role of schools when he acknowledged that the relationship between family background and educational outcomes may exist because institutional arrangements favor high status students such that advantaged family

status leads to more favorable educational opportunities like "better schools, more academically challenging courses, and …'better' teachers" (1995:328).

This view of schools as social institutions highlights the ways they can affect the relationship between families and student achievement while also directly impacting the distribution of achievement. Schools provide pathways to certain desirable outcomes and families can influence student's access to and progression along those pathways. Families can, in fact, create educational opportunities for children by affecting their school experiences. This type of interaction has been noted in research on tracking (Lucas 1999) and parent-school interaction (Lareau 1987; Schneider 1993), which shows that family background affects student assignment to curricular tracks and teacher perceptions of students. The fact that family background may affect achievement through the character and resources of the school makes the relationship between families and schools one of the most important and interesting relationships in industrialized societies (Roscigno 2000; Kao and Thompson 2003).

Research on the relationship between family background and schools in the U.S. has shown that the socio-economic status of the family has a strong effect on school experiences such that advantaged family background has been associated with better educational opportunities like better schools, higher quality of instruction, better school peers, a broader range of courses, and more challenging courses (Wilson 1987; Massey and Denton 1993; Roscigno 1998; Roscigno and Ainsworth-Darnell 1999; Kao & Thompson 2003). On the other hand, if schools are structured in a manner that equalizes opportunities for all students, they can actually overcome, or at least reduce, the effects of inequalities in family background on achievement (Lee and Bryk 1988).

Little research has attempted to model schools as independent, institutional factors that directly affect educational achievement outcomes and intervene in the relationship between family background factors and educational achievement. It is this conceptual model of educational achievement that is of interest in this paper, and is shown graphically in figure 2. Since the publication of the Coleman Report, which concluded, "schools bring little influence to bear on a child's achievement that is independent of his background and general social context" (Coleman et al. 1966: 325), much debate has surrounded research on "school effects". However, according to Coleman (1975) this finding has been somewhat exaggerated in that the original study was not set up to compare the relative sizes of the total effects of both family background and school factors. The Coleman Report and much of the research that followed it were interested in the incremental effect of schools after controlling for family background to see if schools explained away the effect of family background on achievement. However, this approach does not represent a true comparison of family and school effects since the total effects of schools are not provided.

By neglecting to model the total school effects the effects of schools will often be underestimated. This occurs because there is a correlation between family background and school resources such that schools enrolling students from high status families will have more and better resources. Consequently, when family background variables are controlled this not only extracts the variance due to student inputs into schools but also the variance due to school variables that are correlated with family background. School effects in areas with stronger correlations between family background and school resources will be more underestimated by this approach than school effects in areas with

weak correlations, thereby undermining any attempts to compare school effects across contexts. Results based on the full model indicated in figure 2 will provide information on the total effects of family background and school quality as well as the effects of each factor controlling for the other; this allows one to determine the true effect that schools have on achievement along with the ways that schools and families interact to produce achievement.

Due partly to the methodological confusion surrounding the Coleman Report, few studies have modeled family and school effects in a way that allows for the comparison of all relationships shown in figure 2. A study by Roscigno (2000) finds that two school factors – social class composition and instructional expenditures – have significant direct effects on achievement and remain significant after controlling for family background. These school factors also mediate the effect of family background on achievement. An earlier study by Roscigno (1998) comes to similar conclusions but does not estimate the total effect of school factors on achievement. Lee and Bryk (1988) find that track placement and course of study serve to mediate the family background-achievement relationship, but they also find that the level of track differentiation in the school impacts the size of the mediating effect. These studies show that school characteristics are important both in their own right and in the way they reduce the size of family background effects; they also show that school effects decrease when family background variables are added to the analyses. This indicates that schools and families interact in fairly complex ways to produce observed achievement patterns.

Importance of Cross-National Research

Even though institutional research implicitly calls for comparative studies to determine how mechanisms operate in different contexts, little research on the effects of families and schools on educational outcomes has taken place outside the U.S. Cross-national research on this topic is important because the relationships between families, schools and educational outcomes within nations are conditioned by the structural and institutional context of each nation. In particular, the role of schools in the processes of educational achievement is strongly conditioned by the arrangements of a country's education system. As Meyer and Baker state:

> [I]t may be useful to think of research on school effects as being at a crossroads. One direction leads back over covered ground with only minor improvements of established findings. The other direction leads to work with greater and more multidimensional organizational variations. The latter route will inevitably rely heavily on international comparisons of various organizational arrangements in a fashion that usually cannot be done in domestic studies," (1996:124).

To develop an understanding of the role of institutions like schools in shaping educational processes it is necessary to look at a range of contexts with a variety of structural arrangements. This is especially true when studying educational outcomes because the structure and characteristics of schools are heavily influenced by the structure of the national education system (Eckstein 1977; Lees 1994; Baker and LeTendre 2000). For example, the level of centralized control of a nation educational system plays a key role in determining the variation in school quality across that country. Decentralized systems such as the U.S. system base school funding on the economics of the area the school serves and allow individual school systems to develop their own policies. This decentralization naturally leads to wide variations in school funding and curricular coverage (Burstein, Fischer and Miller 1980). Similarly, national policies concerning

whether students will be tracked between-schools or within-schools will impact the climate and composition of schools throughout the nation. Since school funding, curricular coverage, climate, and student composition have been shown to affect educational outcomes, it is easy to see how different national education policies can directly affect the relationship between schools and achievement in each country.

Cross-national research on effects of family and school factors on educational outcomes was a part of early achievement studies because of the IEA's efforts to begin collecting international achievement data in the late 1960s. However, beyond literature addressing the Heyneman-Loxley effect (Heyneman and Loxley 1982, 1983; Baker, Goesling, and LeTendre 2002), the amount of cross-national, comparative research on educational achievement has declined over time and studies that include both family and school variables are rare. Current research has become more focused on the complexities of specific school effects of achievement within individual countries.

## Data

For this project I will utilize international achievement data from the Organisation for Economic Co-operation and Development (OECD) Programme for International Student Assessment (PISA) 2000. PISA assesses whether 15-year olds across multiple industrialized countries have the skills and knowledge necessary to fully participate in modern society. Students are given assessment tests in reading, mathematical, and scientific literacy that go beyond the mastery of school-based curriculum and measure the students' ability to apply their knowledge to authentic life situations. This is a unique focus since most assessment studies focus solely on "school knowledge." As in past

international assessments, a great deal of effort has also focused on creating a method of assessing students that is valid across countries so that researchers can make valid international comparisons of students.

In addition to the student assessments, PISA also collects data from student and school questionnaires. The student questionnaire is administered to all students participating in the assessment and collects information about the student's family, home environment, reading habits, school, and everyday activities. Besides the school information collected from the student, school data is also collected from a questionnaire administered to the principal or head administrator of each participating school. This instrument collects information such as school demographics, staffing, school environment, human and material resources, student selection policies, funding, and decision-making practices.

PISA will be conducted every three years with each assessment focusing a majority of its testing time on one of the three domains – reading literacy, mathematical literacy, and scientific literacy. All three domains will be tested at each assessment, but only the "major" domain will be included in the test booklets of all participants. The schedule of major domains is: Reading literacy in 2000, mathematical literacy in 2003, and scientific literacy in 2006. PISA 2000 utilized a rotated test design methodology in which students were randomly assigned one of nine different test booklets with different combinations of the assessment domains, but all test booklets included the reading literacy component.

The target population for PISA is the entire 15 year-old student population in a country. A sample of students is drawn from this population using a two-stage stratified

sample with a minimum of 150 schools sampled systematically from a stratified, comprehensive list of schools and then a minimum sample of 4,500 students drawn from the selected schools.[2] The student sample was selected from a list of each sampled school's 15-year-old students. If the list contained more than 35 students, then 35 students were selected with equal probability and if there were fewer than 35 students on the list, then all students were selected. All educable retarded, functionally disabled, and non-native language speaking students were excluded from sampling, and all schools judged to be too inaccessible or small or with student population comprised entirely of excluded student groups were also excluded.

Of the 32 countries participating in PISA 2000 only 21 countries are included in my analyses. The countries to be studied are Australia, Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, the Republic of Korea, Luxembourg, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, the United Kingdom, and the United States.[3]

## Variables

The dependent variable will be the student's achievement score on the reading literacy test. It is important to realize that past research has found that family and school

[2] Three countries used a three-stage stratified sample where geographical areas were sampled first (called first-stage units) using probability proportional to size sampling, and then schools (called second-stage units) were selected within sampled areas. Students were the third-stage sampling units in three-stage designs.

[3] The following 7 countries were included in PISA 2000 but are excluded from my analysis because they are considered developing countries by the World Bank – Brazil, the Czech Republic, Hungary, Latvia, Mexico, Poland, and the Russian Federation. Liechtenstein is excluded because data were collected on only 314 students in 11 schools. Canada and Japan are excluded because they did not collect data on many of the key school variables in which I am interested. The Netherlands are excluded because problems with the data collection caused the OECD to recommend against using their data to make comparisons across schools.

effects vary depending on the subject area being tested, and school effects are the smallest for reading achievement (Coleman 1975; Roscgino 2000). Consequently, my estimates of school effects in this study will be at the low-end of the spectrum of school effects on overall achievement.

To measure a student's family background I will use the following variables: father's occupational status, father completed tertiary education, mother's occupational status, mother completed tertiary education, presence of father at home, number of siblings, and family wealth. Occupational status is measured using the International Socio-economic Index (ISEI). The ISEI variables created for mother's and father's by OECD are measured using the student's report of the father's/mother's occupation, which was coded according to the International Standard Classification of Occupations (ISCO-88) and then assigned the corresponding ISEI score as detailed by Ganzeboom, de Graaf, and Treiman (1992). ISEI scores have been shown to be valid cross-national indicators of the education and income of individuals within each ISCO category; however, the use of ISEI scores for women is a problem because of the missing data associated with women who have never been in the labor force. If a student's mother or father was not currently in the labor force, the student was asked for the respective parent's most recent occupation, so only parents who were never in the labor market should have missing data.[4] I am not using a continuous or categorical measure of mother's and father's education because of concerns over the cross-national comparability of the ISCED classification scheme. The ability of the ISCED categories to capture the variation and scale of each country's natural education categories is inconsistent (Kerckhoff, Ezell &

[4] To address missing ISEI data for both mothers and fathers, I have imputed missing ISEI scores based on the respective parent's ISCED value and the grand mean within each country.

Brown 2002). I will instead use a binary variable indicating whether each parent completed tertiary education as the measure of parental education.[5]

The presence of the respondent's father in the home and the number of siblings are measures of the respondent's family structure that have been shown to impact educational achievement. These measures of family structure are often thought to affect achievement through their impact on family resources available to children. A father present in the household is generally associated with higher family income (Thompson, Entwisle and Alexander 1988), and the number of siblings decreases the parental resources available for each child (Downey 1995).

Due to difficulties in collecting comparable family income data across countries the OECD decided that family wealth would provide a more accurate cross-national measure of a family's economic standing. Family wealth is an index created by OECD that is derived from students' reports on the availability of the following in their own home – a dishwasher, a room of their own, a link to the Internet, and educational software – along with the numbers of cell phones, televisions, computers, cars, and bathrooms in the household. Positive values on this index indicate more family wealth while negative values indicate less wealth. In addition to these family variables, I will control for the following individual characteristics of students – gender and whether they are foreign born.

[5] To evaluate the impact of using imputed ISEI scores instead of non-imputed ISEI and completion of tertiary education instead of ISCED scores I ran several iterative models including the following variables for respondents' mothers and fathers: SEI, ISCED, imputed SEI, and tertiary education. A comparison of BIC statistics indicated that the two preferred models included original SEI scores and parent's tertiary education status or imputed SEI scores and parent's tertiary education status. While the most preferred model included non-imputed parental SEI scores, the inclusion of these variables resulted in substantive missing variable problems. Consequently, the model with the second lowest BIC, which included parental tertiary education and imputed parental SEI variables, was the most preferred because of the low BIC and lower numbers of missing cases.

School quality will be measured using the following variables: school size (number of students), student-teacher ratio, proportion of qualified/certified teachers, quality of educational materials, and school science achievement. Past research has consistently shown that these variables have a significant effect on educational attainment (Altonji and Dunn 1995) and achievement both in the U.S. (Roscigno 1998, 2000) and cross-nationally (OECD 2001; Baker, Goesling and LeTendre 2002). The proportion of certified or qualified teachers is the proportion of teachers in each school with either an ISCED5a qualification (equivalent of a bachelor's degree) in pedagogy or a full certificate from the national educational board. The quality of educational materials for each school is an index created from the school principal's reports on how much students' learning was hindered by a lack of certain educational materials – instructional materials, computers, library resources, multi-media resources for instructors, science laboratory equipment, and facilities for the fine arts. Positive scores on the index indicate that student learning was not hindered by a lack of educational materials. The school science achievement score is meant to measure the quality of students within each school.[6] It has been shown that the academic stature of one's fellow students has an impact on one's own educational achievement (Oakes 1985; Gamoran 1986, 1992; Hallinan 1994; Lucas 1999). Students who are surrounded by high achieving students will tend to have higher achievement regardless of their own academic acumen. I used student achievement scores on the PISA science assessment that was administered to

[6] I originally intended to use the proportion of students in the post-secondary track as the measure of student quality within each school. This measure was the percentage of 15-year-olds studying in ISCED programs 2A, 3A, or 3B. However, this data was not uniformly collected in all countries, leading to serious problems with missing data.

approximately one-third of the students who took the PISA reading assessment. Since the science and reading scores are not highly correlated, and only a sub-sample of tested students were administered the science assessment, I am confident that the mean science achievement score of each school serves as a valid measure of the academic quality of a school's student body.

## Research Design

To determine the effect of schools on achievement it is important to know the role that family background plays in the assignment of students to particular schools, the effect of schools on students' achievement, and the effect of family background on achievement. The literature on these areas, while incomplete from a comparative standpoint, have given us a good idea of what each of those relationships are likely to look like in various contexts, but the question of what these relationships look like as part of a complete model remains open.

In Coleman's (1975) critique of three International Association for the Evaluation of Educational Achievement (IEA) studies of educational achievement he sets forth the four relationships that must be tested to fully explore the model shown in figure 2:

1. The <u>total</u> effect of family background variables on achievement both directly and indirectly through its impact on schools (relationships 31, 21-32).
2. The <u>total</u> effect of school variables on achievement not controlling for family background effects (relationship 32). This can be thought of as the potential school effects if school variables were completely independent of family background.

3. The direct effect of school variables on achievement that is independent of family background effect (32 minus 21 and 31). This is the school effect after controlling for the direct and indirect family background effects.
4. The direct effect of family background variables that is independent of the effect of family background on schools (relationship 31).

As mentioned previously, education research has been interested in the comparison between family effects and school effects on achievement since the Coleman Report. This research is most often interested in discovering the incremental effect that schools have on achievement after controlling for students' family backgrounds. Studies that use this sequential modeling approach with family background variables entered first followed by school factors only allow us to compare effects 1 and 3 above. As mentioned previously, by neglecting to model the other effects of families and schools in the manner suggested by Coleman, school effects will be underestimated and incomparable across countries.

## Methodology

The decomposition of achievement inequality into the variation that can be attributed to cross-national differences in the inequality of schools or family background within each country is methodologically tied to the estimation of the regression equations necessary to establish the total and direct effects of family background and schools. One must estimate the regression equations to obtain the family and school coefficients in order to conduct the decomposition of achievement inequality. I will first discuss the

estimation of the regression equations and then discuss the variance decomposition procedures to be used.

The estimation of the total and direct effects of family background and school quality is best approached using path analysis methods. One can estimate these effects using structural equation modeling programs such as LISREL or with multiple regression equations. Since the model proposed by figure 2 is fairly simple, I will estimate the effects using multiple regression equations as described by Otis Dudley Duncan (1966). This involves estimating three separate equations. Equation 1 estimates the total effect of family background on educational achievement, equation 2 estimates the total effect of school variables on achievement not controlling for family background, and equation 3 estimates the direct effect of school variables and family background variables by combining equations 1 and 2 and estimating new coefficients.[7] One can then subtract the coefficient in equation 1 or 2 from the coefficient in equation 3 to obtain the size of the indirect effect of each variable. Since observations are not independent within schools Stata's cluster option will be used in all analyses to obtain standard errors that are corrected for this dependence.

Variance Decomposition

The estimates obtained from equations 1-3 provide important information about the direct and indirect effects of family background and school quality on educational achievement, along with the effects of family background on school quality, across

[7] The coefficient for each variable in equations 1 and 2 do not reflect the full total effect of that variable because there are other variables in the models acting as controls. I am using the term "total effect" in a broader sense to mean that these variables reflect the effect of the overall construct (family background or school quality) on educational achievement when the other construct is not included in the model.

multiple countries with various institutional arrangements. To make it easier to interpret the mediating effect of inequality in the school quality variables, I will determine the dominant school quality factor to use in the variance decomposition discussed below.

There are many different measures of inequality one can use and many arguments concerning which measures are the best for certain situations [see Atkinson (1970), and Allison (1978)]. The variance is one of the few measures of inequality that can be decomposed, and the fact that it is easily obtained from descriptives statistics and regression equations makes it a popular inequality measure (Lam and Levison 1992a, 1992b). A generic regression equation with two independent variables ($X_1$, $X_2$) would imply the following variance in the dependent variable (Y):

$$(4) \qquad V(Y) = \beta_1^2 V(X_1) + \beta_2^2 V(X_2) + V(u) + 2\beta_1\beta_2 C(X_1 X_2) + 2\beta_1 C(X_1, u) + 2\beta_2 C(X_2, u)$$

where $\underline{V(Y)}$ is the variance in the dependent variable, $\underline{V(X_1)}$ is the variance in independent variable $\underline{X_1}$, $\underline{V(X_2)}$ is the variance in independent variable $\underline{X_2}$, $\underline{V(u)}$ is the variance in the dependent variable that is uncorrelated with the independent variables, $\underline{C(X_1,X_2)}$ is the covariance between $\underline{X_1}$ and $\underline{X_2}$, $\underline{C(X_1,u)}$ is the covariance between $\underline{X_1}$ and variables omitted from the equation, and $\underline{C(X_2,u)}$ is the covariance between $\underline{X_2}$, and variables omitted from the equation. Under OLS assumptions the covariance terms are equal to zero, so the last three terms in equation 4 drop out.

The first term on the right hand side of equation 4, $\beta_1^2 V(X_1)$, is the variance in $\underline{Y}$ that is explained by the returns to and variance in $\underline{X_1}$. Similarly, the second term, $\beta_2^2 V(X_2)$, is the variance in $\underline{Y}$ that is explained by the returns to and variance in $\underline{X_2}$, while $\underline{V(u)}$ represents the variance in Y that is left unexplained by the covariates in the model. As one can see, the 'explained variance' terms are a function of both the variance

(inequality) of the independent variable and the returns to that variable as estimated by the original regression equation. (Lam and Levison 1992a, 1992b; Greene 2000)

Using this methodology, the variance of educational achievement from equation 1 would be represented by this equation:

$$
\begin{aligned}
V(Y) &= \beta_m^2 V(M) + \beta_f^2 V(F) + \beta_n^2 V(N) + \beta_w^2 V(W) + \beta_d^2 V(D) + V(u) \\
&+ 2\beta_m\beta_f C(M,F) + 2\beta_m\beta_n C(M,N) + 2\beta_m\beta_w C(M,W) + 2\beta_m\beta_d C(M,D) \\
&+ 2\beta_m C(M,u) + 2\beta_f\beta_n C(F,N) + 2\beta_f\beta_w C(F,W) + 2\beta_f\beta_d C(F,D) \\
&+ 2\beta_f C(F,u) + 2\beta_n\beta_w C(N,W) + 2\beta_n\beta_d C(N,D) + 2\beta_n C(N,u) \\
&+ 2\beta_w\beta_d C(W,D) + 2\beta_w C(W,u) + 2\beta_d C(D,u)
\end{aligned} \tag{5}
$$

where V(Y) is the variance in educational achievement, V(M) is the variance in mother's socioeconomic status, V(F) is the variance in father's socioeconomic status, V(N) is the variance in number of siblings, V(W) is the variance in family wealth, V(D) is the variance in the presence of a father, and V(u) is the variance in variables omitted from the model. As one can see, the number of covariance terms becomes unwieldy as the number of independent variables increases. Since the covariance terms are assumed to be zero under OLS assumptions and will not be directly interpreted, I will omit the covariance terms from the remaining equations to save space. The 'explained variance' terms in equation 5 [ $\beta_m^2 V(M), \beta_f^2 V(F)$ , etc.] show the proportion of variance in educational achievement is explained by the variance of and total returns to each family background variable.

The remaining variance equations based on equations 2 and 3 are shown in equations 6 and 7 respectively.

$$V(Y) = \beta_{sq}^2 V(SQ) + V(u) \tag{6}$$

where SQ is the dominant school quality factor, so V(SQ) is the variance in the dominant school quality factor and V(u) is the variance in variables omitted from the model. Equation 6 provides the amount of achievement variance explained by the total effect of school quality and its variance.

$$V(Y) = \beta_{m2}^2 V(M) + \beta_{f2}^2 V(F) + \beta_{n2}^2 V(N) + \beta_{w2}^2 V(W) + \beta_{d2}^2 V(D) + \beta_{sq2}^2 V(SQ) + V(u) \quad (7)$$

The 'explained variance' terms in equation 7 represent the variance explained by the direct effects of family background variables and the dominant school quality factor along with the distribution of those variables variable. As in equation 3, the subscripted '2' attached to each coefficient indicates the direct effects of each variable.

These variance decomposition results allow me to show how the relationship between the distribution of achievement and the distributions of family background and school quality differs among different countries. The results will illustrate how various distributions of family and school factors interact with various sizes of effects to produce different distributions of achievement across countries. The level of achievement inequality within a country is determined by both the size of inequalities of its determinants and by the importance of those determinants. For instance, if a country has a high level of family wealth inequality, but family wealth has a small effect on achievement, then the inequality of family wealth will explain a smaller proportion of achievement inequality than in a country with high family wealth inequality and a large effect of family wealth on achievement. Furthermore, by using the total and direct effects of family and school variables obtained in regression equations 1-3, I can compare how the total and direct effects of family background and school quality affect the amount of achievement inequality explained by inequalities in its determinants.

## Results

Descriptive Statistics

This section will create measures of central tendency and inequality for family background factors, school quality and reading achievement scores for each country and present them in a descriptive format. Within this descriptive analysis, I will also develop a typology of countries on similarities of national education systems and will indicate how school and achievement inequality are related to the structure of a country's education system and the country's socioeconomic inequality. This section will address the following research questions and their associated hypotheses:

**1) Are there differences in mean levels of educational achievement, school quality, or family socioeconomic status among industrialized countries?**

H1a: There are significant differences in educational achievement among the studied countries.

H1b: There are significant differences in school quality among the studied countries.

H1c: There are significant differences in family SES among the studied countries.

**2) Are there differences in levels of inequality of educational achievement, school quality, or family socioeconomic status among industrialized countries?**

H2a: There are differences in levels of inequality of educational achievement among the studied countries.

H2b: Countries with standardized systems of education have lower levels of achievement inequality than countries with non-standardized systems.

H2c: Countries with highly stratified systems of education have higher levels of achievement inequality than countries with less stratified systems.

H2d: There are differences in levels of inequality of school quality among the studied countries.

H2e: Countries with standardized systems of education have lower levels of school inequality than countries with non-standardized systems.

H2f: Countries with highly stratified systems of education have higher levels of school inequality than countries with less stratified systems.

H2g: There are differences in levels of inequality of family SES among the studied countries.

Table 1 contains the means and standard deviations of the variables for each country. The countries are in alphabetical order with the exception of Germany, Austria, and the Republic of Korea (hereafter South Korea), which are placed at the end of the table because each is missing one or more of the independent variables. As stated earlier, the variables that each country is missing (Germany: proportion of qualified teachers; Austria: proportion of certified teachers; South Korea: foreign born, proportion of qualified teachers, and proportion of certified teachers) are not key variables in my analysis, and I did not want to omit these countries from my analyses because of these minor issues.

Comparison of Means

Table 1 shows there is significant variation in the means of each variable between countries.[8] Luxembourg has the lowest mean reading achievement score at 465, followed by Greece (475) and Portugal (485). Finland and New Zealand have the highest achievement scores – 548 and 540 respectively. The United States has the seventh highest mean reading score at 523. Comparisons of some of the key independent variables show that the South Korea has the lowest mean of father's occupational status (41), while Luxembourg (43), Greece (42) and Portugal (42), which had the lowest mean reading achievement scores, also had low means for father's occupational status (seventh, fourth, and second lowest means respectively). The United States has the third highest mean (47), only surpassed by Belgium (47) and Norway (49).

The United States has the highest mean family wealth (6.78) followed closely by Sweden (6.75). Norway, Denmark and Iceland complete the top five. Greece and South Korea have the lowest mean family wealth – 5.57 and 5.76 respectively – with Spain, France, and Portugal being the only other countries with a mean family wealth below 6.

Looking at the school variables it is important to note the difference between the student and family variables and the school variables. For instance, a country's mean school science achievement score is different than a country's mean reading achievement score. The mean of reading achievement scores is the mean of a score that varies between students while the mean of school science achievement scores is a score that varies between schools. The mean science achievement score within each school is assigned to all students in the dataset, so the country-level mean school science achievement score is basically a weighted average of schools science achievement scores within that country.

[8] ANOVA models confirmed that the differences in each variable between countries is significant at $p<.001$.

This is also true of the other school variables in Table 1. We note a substantial amount of variation in the mean student-teacher ratio. At the low end, Portugal, Italy, and Norway have mean student-teacher ratios of 8.9, 9.0, and 9.2 respectively while South Korea and Germany have the two highest mean student-teacher ratios of 20.9 and 18.0.

There is also interesting variation in the mean quality of educational materials. Switzerland, France, the United States and Belgium have the lowest means while Greece and Norway have the highest means. It is somewhat unexpected that the United States is near the bottom of the distribution while Greece is at the top given their mean scores for variables discussed previously. The United Kingdom and Finland have the highest mean school science scores – 528 and 523 respectively – while Norway, Greece, Luxembourg, and Denmark have the four lowest scores. The United States has the sixth highest mean school science score at 505, right behind Germany, Sweden, and South Korea.

## Comparisons of Inequality

It is important to note at this point that, as discussed previously, comparisons based exclusively on means can be misleading. Comparing the distribution of variables within countries is just as, if not more, important than comparing the means of those variables. This is especially true for measures of family and individual SES, school resources, and educational achievement. For instance, cross-national comparisons of the distribution of achievement scores within countries can better reveal the overall effectiveness of a country's educational system at teaching children at all points in the distribution.

I created coefficients of variation for each variable in order to compare the inequality of the variables within each country. I decided to use the coefficient of variation (CV) for two reasons. First, it has some attractive characteristics that other measures of inequality – specifically the standard deviation and variance – do not have. The most important characteristic for my purposes is the fact that the CV accounts for the magnitude of the variable. The CV will decline if a variable's distribution is shifted to a higher point, such that a distribution with a standard deviation of 10 and a mean of 15 will have a larger CV than a distribution with the same standard deviation and a mean of 40. The CV is also one of the few measures of inequality that is both scale invariant – meaning that multiplying a variable by a constant will not change the inequality value – and satisfies the principle of transfers, which states that the measure of inequality should increase whenever money is transferred from a poorer person to a richer person [Allison 1978]. The second reason for using the CV over other measures of inequality with similar characteristics is a pragmatic one: It is very easy to calculate. The CV is equal to a variable's standard deviation divided by its mean $\left(CV = \sigma/\mu\right)$.

Table 2 presents the CVs for all continuous variables in each country. Measures of inequality are relatively uninformative for binary variables, so they are excluded from this comparison. Focusing on the comparison of inequality in reading achievement scores produces some interesting findings. Luxembourg and Greece, the countries with the lowest mean reading scores, have the highest CVs (.21 and .20 respectively). Norway, Portugal, and Switzerland have the next highest CVs for reading scores. The United States, which has the seventh highest mean reading score, has the sixth highest CV (.19). The country with the highest mean reading score – Finland – has the second lowest CV

(.16), right behind South Korea, which has a CV of .14. However, there is not a direct negative correlation between mean reading scores and the CV of reading scores: New Zealand, which has the second highest mean, has one of the highest CVs for reading scores.

Family wealth inequality is always a topic of interest. According to these data, Portugal, Greece, the U.S., Luxembourg, and Spain have the five highest levels of family wealth inequality. The U.S. has the highest and Luxembourg has the eighth highest mean family wealth, but Portugal, Greece, and Spain have three of the five lowest mean family wealth indices.

Comparing inequality of school variables across countries shows that Switzerland, which has the lowest mean quality of educational resources, has the highest level of inequality of educational materials across schools (.41) while Norway, which has the second highest mean, has the lowest inequality (.21). The United States, which had the third lowest mean, has the sixth highest level of inequality across schools (.36). On the other hand, Greece had the highest mean and also has the second lowest level of inequality of educational materials (.24). The coefficients of variation for school science scores indicate that Germany, Greece, and the United States have the highest inequality in science scores across schools while Luxembourg, Finland, and Ireland have levels of inequality that are two-to-three times lower.

To this point my discussion of Tables 1 and 2 has purely descriptive. I have established that there are significant differences in educational achievement, school quality, and family SES across the countries in my sample, which supports hypotheses H1a, H1b, and H1c. In support of hypotheses H2a, H2d, and H2g, I have also shown that

there is variation in the amount of inequality of educational achievement, school quality, and family SES across countries. However, this paper also seeks to address a more theoretical set of comparisons based on the structure of national systems of education. These comparisons are addressed in the next section.

## Typology of Educational Systems

When conducting institutional research with data from a large number of countries it is helpful to utilize a classification scheme to group countries by similarities in the areas of interest to the study. In this study, I am interested in grouping countries by the structure of national education systems. An excellent typology of educational systems was constructed by Müller and Shavit (1998) for use in their edited volume on the effects of educational qualifications on occupational outcomes across multiple countries. In this typology, national educational systems are classified according to three criteria – standardization, stratification, and vocational content. I will classify the national education systems of countries by their level of standardization and stratification.

The level of standardization of an education system is based on the level of centralized control over school curriculum, policies, funding, and degree requirements. The degree of stratification of an education system is determined by the type of student tracking that occurs at the secondary level within a country's schools. Müller and Shavit (1998) coded countries into three categories based on the stratification of their secondary education system. Countries were assigned to the first category if schools were allowed to decide on their tracking practices and/or students from all tracks attended the same schools. The second category contains countries that practice between-school tracking

where students attended different schools based on the curricular track to which they are assigned. The last category contains systems that practice between-school tracking and students are sorted into tracks at very early ages. This typology of countries will allow me to organize my results and determine if variation in national context results in noticeable differences in educational achievement scores.

The countries in my data that were also in Müller and Shavit's study will be assigned to these categories of standardization and stratification of education systems based on their classification. Buchmann and Dalton's (2002) classification of a number of additional countries according to the stratification of their education systems will serve as another source of information. I will classify the remaining countries according to the descriptions of their education systems found in the International Encyclopedia of National Systems of Education (Postlethwaite 1995).

Table 3 shows how the educational system of each country in my sample is categorized along the dimensions of standardization and stratification. Sixteen of the twenty-one countries in my sample have a standardized system of education. The only non-standardized countries are Australia, Belgium, Denmark, the United Kingdom, and the United States. Only three countries fall into the highest category of stratification – Austria, Germany, and Switzerland. The other eighteen countries are split evenly into the lowest and middle categories.

Table 4 presents the descriptive statistics and coefficients of variation for countries grouped by the standardization and stratification of their educational systems. Comparing countries with standardized educational systems to countries with non-standardized educational systems we see that non-standardized countries have higher

means on nearly every variable. Their mean reading scores are nearly 22 points higher, 9 percent more father's have tertiary degrees, and they hold a slight advantage in father's occupational status. Countries with non-standardized systems of education also have higher mean school science scores than standardized countries, but their mean quality of educational materials is lower. All of the differences in means between standardized and non-standardized countries are statistically significant with the exception of the percent of female students and the percent of foreign born students.

Since a standardized education system displays centralized control over school curriculum, policies, funding, and degree requirements, it is natural to assume they will display less inequality in school characteristics and, in turn, student achievement. This is the rationale behind hypotheses H2b and H2e. The CVs in Table 4 show that standardized and non-standardized educational systems have similar levels of inequality in reading scores, which does not support hypothesis H2b. The comparison of inequality in school variables shows a split. Standardized educational systems have more inequality in school size and student-teacher ratios across schools, but they have less inequality in the quality of educational materials and school science scores. However, I believe an argument can easily be made for the preeminence of the quality of educational materials and school science scores as measures of school quality, which would indicate that there is less inequality in the quality of schools within standardized educational systems and support hypothesis H2e.

The second part of Table 4 compares countries on the level of stratification within and between their schools. Countries with no formal system of between school tracking have significantly higher mean reading achievement scores than systems of moderate or

high stratification. Non-stratified educational systems also have the least inequality in reading scores while highly stratified systems have the most inequality, which supports hypothesis H2c. Family SES (mother's and father's SES and family wealth) is significantly higher in non-stratified education systems and inequality of family SES is also higher. Hypothesis H2f, which states that countries with highly stratified systems of education have higher levels of school inequality than other countries, is supported by the CVs in Table 4: Non-stratified systems have the lowest levels of inequality on all school variables while high stratification education systems have the highest levels for all variables except school size.

**Regression Results**

In this section I will obtain total, direct, and indirect effects of family background and school quality as indicated in figure 1, and, using the estimated coefficients from the first stage of the analysis, I will decompose the variance in educational achievement in each country to see how much of this can be explained by variance in family background and school quality. The country-specific results will be grouped according to the typology created in the previous chapter to determine if national contexts affect the size of the family and school effects along with the amount of achievement inequality explained by family and school inequalities. These analyses will address the following research questions and associated hypotheses:

**3) Are there differences in the size of family socioeconomic status effects on achievement among industrialized countries?**

H3a: Effects of family SES that are independent of school quality (direct effects) are smaller in countries with standardized systems of education.

H3b: Effects of family SES that are independent of school quality (direct effects) are smaller in countries with stratified systems of education.

**4) Do school quality effects vary by the type of national education system in a country?**

H4a: Countries with stratified systems of education will have larger school effects.

H4b: Countries with standardized systems of education will have smaller school effects.

**5) Is the effect of family socioeconomic status mediated by school quality?**

H5a: School quality variables, when added to a model, decrease the size of family SES effects.

**6) If family socioeconomic status is mediated by school quality, is there variation in the size of the mediated effect among countries?**

H6a: More of the family SES effect operates through school quality in countries with standardized education systems.

H6b: More of the family SES effect operates through school quality in countries with highly stratified education systems.

**7) Do the proportions of achievement inequality explained by family socioeconomic inequality and school inequality vary among countries? If so, do the proportions of achievement inequality explained correspond to the type of national education system?**

Table 5 presents results of country-specific models regressing family, student, and school variables on students' reading achievement scores. All variables were standardized to have a mean of 0 and a standard deviation of 1 to produce coefficients that can be compared between variables. As discussed in the methods section, three regressions are conducted for each country. The first model includes family and student variables and represents the total effect of these variables on students' reading achievement. The second model gives the total effect of school quality variables on reading achievement. The third, and final, model adds all family, student, and school variables into the regression and represents the direct effects of each variable on reading achievement controlling for all other effects. With the data from these three models you can calculate the indirect effects of each variable by subtracting the direct effect from the total effect. For instance, by subtracting the coefficient for father's occupational status in model 3 from the coefficient in model 1 you will get the size of the effect of father's occupational status that operates through school quality.

The results presented in Table 5 are somewhat unwieldy owing to the large number of models – 63 models across 21 countries. Consequently, I will only discuss a few notable findings from Table 5. First, there is a great deal of variation in the size of family background effects. The total effect of father's occupational status varies from a

high of 26 in Belgium to a low of 6.6 in South Korea. Second, the school science achievement score – a measure of the quality of a school's student body – is significant in all models and is consistently the largest school effect. Third, the amount of variation explained by school quality effects varies greatly across countries from the lowest R-squared value of .029 for Sweden to the highest of .431 for Germany. I will also point out that the negative coefficient for mother's and father's tertiary education for some countries occurs only when mother's and father's occupational status is included in the same model. This indicates that, apart from the higher occupational status obtained as a result of completing tertiary education, having a parent with a tertiary degree is not beneficial to student's reading achievement in all countries.

To enable a more comprehensive discussion of the regression results, I will again use the standardization and stratification of national education systems to categorize countries (see Table 3) and condense the regression results into a smaller number of cases. Table 6 contains the regression results for these categories. Many of my hypotheses can be tested using these models. First, looking at the total family effects for standardized and non-standardized education systems, there are only slight differences in mother's and father's occupational status between the two models. However, the effects of a father being present, the number of siblings, and family wealth are larger for non-standardized systems. Overall, the amount of variance explained by family and student variables is nearly equal between the two systems with an R-squared of .145 for non-standardized systems and .143 for standardized systems. There are larger differences in the direct effects of family SES between standardized and non-standardized systems. The direct effects of mother's and father's occupational status and family wealth are smaller

in countries with standardized systems, but the direct effect of fathers with tertiary degrees is slightly larger. Overall, these findings support hypothesis H3a, which states that standardized systems would have smaller direct effects of family SES.

Hypothesis H3b states that direct family SES effects will be smaller in more highly stratified education systems. The results in Table 6 provide some support for this hypothesis. The direct effects of mother's and father's occupational status and family wealth become smaller as the level of stratification of the education system increases even though highly stratified systems have the highest total effects of parent's occupational statuses. Similar to the finding for standardized systems, the effect of fathers completing tertiary education does not behave as expected: The direct effect of this variable is largest for highly stratified systems.

The table also shows an increase in school quality effects corresponding to increases in the stratification and standardization of education systems. The total effects of school size, the proportion of qualified teachers, and the school science score are larger for standardized systems than non-standardized ones, and the R-squared value is nearly twice as high. There is a similar increase in the effects of the proportion of qualified teachers and the school science score, as well as the R-squared, between non-, moderately, and highly stratified systems. I expected an increase in school effects as systems become more stratified, a finding that supports hypothesis H4a, but I did not expect countries with standardized systems of education to have larger school effects than ones with non-standardized systems, which leads me to reject hypothesis H4b. The rationale behind the latter hypothesis is that there should be less variation in school quality within standardized systems of education, so it would have less explanatory

power. Part of the reason this hypothesis was rejected is the fact that analyses in the previous section (Table 4) showed that school quality variables do not always have less variation in standardized systems.

One of the main explanatory interests of this paper is how, or if, school quality mediates the effect of family background in different countries. A comparison of the country-specific total and direct coefficients for family variables in Table 5 shows that school quality does mediate family background effects in all countries, but the magnitude of the mediated effect (a.k.a. the indirect effect of family background) varies greatly across countries. Table 6 allows a better view of these results. A column is added to the results for each group that contains the percentage change between the total effect and direct effect of each variable. I have only calculated this percentage for variables with significant coefficients. These percentages reveal an extremely interesting finding. First, a comparison of the percentage of family SES explained by school quality between standardized and non-standardized countries reveals that a larger percentage of the family SES effects are mediated by school quality in countries with standardized education systems. School quality variables reduce the coefficients for mother's and father's occupational status by 11.5% and 23.8%, respectively, in non-standardized systems while the decrease is much higher – 31.1% and 38.3% – in countries with standardized systems. The effect of family wealth becomes non-significant for both groups. These findings support my expectation, which was formalized in hypothesis H6b. Since a main goal of a standardized system of education is to ensure educational experiences that are similar for all children independent of family background and residential location, then schools

should decrease the direct effect of family background on students' educational achievement.

The variation in the mediating effects of school quality is equally impressive when countries are grouped by the level of stratification in national education systems. The mediating effect of school quality is largest for the most highly stratified systems and smallest for non-stratified systems. In non-stratified systems the direct effects of mother's and father's occupational status is 12.8% and 16.7% smaller, respectively, than their total effects. This decrease in coefficients increases to 33.1% and 34.7% for moderately stratified systems, and highly stratified systems see a decrease of 54.7% and 62.4% in the size of occupational status effects when school quality is added to the model. These results definitely provide support for hypothesis H6a.

**Variance Decomposition**

The regression results presented in Tables 5 and 6 are very interesting in themselves, but they also exist to provide the information necessary to decompose the variance in student achievement. The regression results presented above allow one to see how changes in one variable affect reading achievement. By standardizing the variables, one can even compare the size of effects between different independent variables. However, it is also important to know the amount of inequality in reading achievement that is explained by each independent variable or, thinking of it another way, the amount of inequality in achievement that is the result of inequality in each independent variable. Variance decomposition is the best way to achieve these results. As shown in the methods section, decomposing the variance in reading achievement into its component

parts accounts for both the size of each variables coefficient in the preceding regression analyses and the amount of inequality displayed by that variable, as measured by the variance. This provides a much clearer picture of the impact of each variable on reading achievement by accounting for the impact of differences in both the magnitude and distribution of explanatory variables on achievement across countries and groups of countries.

Table 7 presents the results of the variance decomposition separately for each country. This table serves as a reference for readers interested in the results for a specific country, but I will not focus on it in my discussion. As mentioned in the methods section, I have reduced the school quality variables to the one dominant schooling factor, which is the mean science achievement score within each school. Table 8 presents the variance decomposition results for countries grouped by the standardization and stratification of their education systems. The top row in Table 8 shows the total variance in reading achievement for each standardization/stratification category. Beside each variable is the amount of variance in reading achievement that is contributed/explained by that variable. You can compare the amount of explained variance between variables within the same model or across models within the same group of countries using this value. Beneath this value is the percentage of the total variance in reading achievement that is explained by each variable. This percentage can be used to compare variables across groups.

The results in Table 8 provide answers to research question 7. In the decompositions based on the total family and student effects, father's occupational status consistently contributes the most variance of any family variable, usually by a substantial margin. After controlling for school science scores, father's occupational status still

contributes the most variance except in non-stratified systems where mother's occupational status takes over the top spot. These findings contrast slightly with the findings in the regression analyses and illustrate the value added by the variance decomposition. In the regression results father's occupational status always has the largest coefficient, but the margin between the coefficients for mother's and father's occupational status is very slight.

The amount of variance accounted for by school science scores is the largest single amount of any other variable across all decompositions within each group. Even when the variance accounted for by all family variables is added together, it only exceeds the amount accounted for by school science scores in the decomposition using the direct effects of all variables in non-stratified systems. This finding is somewhat surprising since most people believe schools have relatively small effects on achievement when compared to family background effects.[9] It is also important to note that this finding does not hold for each individual country. Table 7 shows that there is a great deal of variation across individual countries in the amount of variance accounted for by school science scores relative to other variables. There are some countries where the variance explained by school science scores is not the largest of any other single variable, but a majority of countries conform to the finding in Table 8.

The decomposition results reinforce the mediating effect of school quality on the relationship between family background and educational achievement. In general, the amount of variance accounted for by family variables is much lower after accounting for

[9] Part of the reason for my findings might be that my choice of a school quality measure – mean science score within the school – picks up other, non-school effects. The other measures of school quality included in the regressions do not have effects that are as large as school science scores. I will need to address this concern in the future.

the variance explained by school science scores in all standardization/stratification groups. Similar to the results in the regression analyses, the decrease is larger for standardized systems and stratified systems than it is for non-standardized and non-stratified systems. The degree to which the explained variance is reduced, however, is much larger than the degree to which the size of coefficients were reduced in Table 6.

## Conclusion

The goal of this paper has been to make significant contributions to our understanding of cross-national educational achievement by establishing: 1) the extent of variation in achievement inequality that exists across countries; 2) the total, direct and indirect effects of family background and school quality on educational achievement, specifically in the domain of reading literacy, and how these effects differ across national contexts; 3) the role of schools as determinants of achievement, both independently and in conjunction with family background, 4) the extent to which variation in achievement inequality can be attributed to cross-national differences in school inequality or family background inequality, and 5) the effect of the structure of national educational systems on the size and shape of family and school effects of achievement.

The results presented here show that the amount of achievement inequality does, in fact, vary across countries and that the effects of family background and school quality on achievement also vary across countries. Results from both the regression analyses and variance decomposition reveal that school quality measures are a powerful explanatory variable in some countries and can also mediate a large amount of the family background effect on achievement. A great deal of the variation in these effects is explained by the

characteristics of the education system – especially the degree of between-school stratification. As the degree of stratification in the education system increases, both the amount of variance explained by school quality measures AND the amount of total family background effects mediated by school quality increases. This pattern is also true for standardized education systems, although the size of the increases is somewhat smaller.

The results of this research gives sociologists, educational researchers and policy-makers a better understanding of the processes by which families and schools affect students' educational achievement across various contexts. Policy-makers can be informed by the institutional focus and international scope of the analyses. While an understanding of the individual and family processes that produce achievement is important and informative for theoretical reasons, public policies are limited in their ability to affect these processes. Policies can, however, have a substantial impact on institutions, so a better understanding of how institutions shape the process of educational achievement can be extremely helpful for educators and policy-makers as they consider the most effective way to structure educational institutions.

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Figure 1. Conceptual Model of Family Background and School Quality Effects on Educational Achievement.

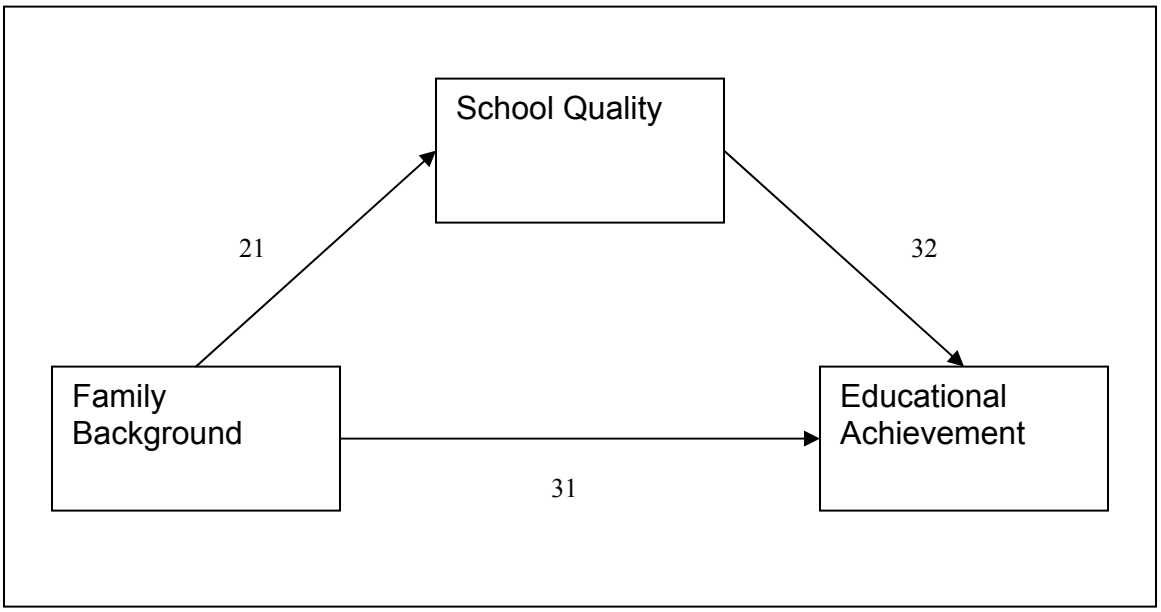

Table 1a. Descriptive Statistics of Family, Student, and School Variables from PISA 2000 for All Included Countries

| | Min. | Max. | Australia Mean (s.d.) | Belgium Mean (s.d.) | Denmark Mean (s.d.) | Finland Mean (s.d.) | France Mean (s.d.) | Greece Mean (s.d.) | Iceland Mean (s.d.) | Ireland Mean (s.d.) | Italy Mean (s.d.) | Luxembourg Mean (s.d.) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ***Dependent Variable*** | | | | | | | | | | | | |
| Reading Achievement Score | 23 | 915 | 533.06 | 527.15 | 514.50 | 547.56 | 507.07 | 474.64 | 508.16 | 533.67 | 494.89 | 465.28 |
| | | | (99.20) | (97.86) | (91.98) | (85.74) | (89.87) | (94.70) | (90.48) | (89.15) | (89.32) | (98.19) |
| ***Family Variables*** | | | | | | | | | | | | |
| Mother's Socioeconomic Status | | | | | | | | | | | | |
| Mother's Occupational Status (ISEI) | 16 | 90 | 46.32 | 43.61 | 43.74 | 42.77 | 41.95 | 42.49 | 44.31 | 43.04 | 42.23 | 38.54 |
| | | | (15.47) | (16.09) | (15.54) | (15.47) | (16.26) | (14.54) | (16.46) | (14.76) | (14.56) | (14.83) |
| Mother Completed Tertiary Education | 0 | 1 | .32 | .35 | .52 | .26 | .34 | .23 | .22 | .28 | .13 | .15 |
| | | | (.47) | (.48) | (.50) | (.44) | (.47) | (.42) | (.42) | (.45) | (.34) | (.36) |
| Father's Socioeconomic Status | | | | | | | | | | | | |
| Father's Occupational Status (ISEI) | 16 | 90 | 46.21 | 46.76 | 45.43 | 44.03 | 43.72 | 42.48 | 45.78 | 42.71 | 42.91 | 43.03 |
| | | | (17.25) | (16.81) | (16.60) | (16.85) | (16.14) | (17.05) | (17.99) | (16.18) | (15.24) | (16.12) |
| Father Completed Tertiary Education | 0 | 1 | .33 | .40 | .37 | .25 | .36 | .33 | .28 | .27 | .15 | .28 |
| | | | (.47) | (.49) | (.48) | (.43) | (.48) | (.47) | (.45) | (.45) | (.35) | (.45) |
| Father Present | 0 | 1 | .79 | .86 | .82 | .82 | .86 | .95 | .81 | .94 | .86 | .88 |
| | | | (.41) | (.34) | (.39) | (.39) | (.35) | (.21) | (.39) | (.23) | (.35) | (.32) |
| Number of Siblings | 0 | 12 | 2.06 | 1.73 | 1.85 | 1.98 | 1.85 | 1.48 | 2.46 | 2.59 | 1.30 | 1.62 |
| | | | (1.29) | (1.29) | (1.24) | (1.32) | (1.24) | (1.04) | (1.26) | (1.39) | (.89) | (1.28) |
| Family Wealth | 1 | 9 | 6.47 | 6.01 | 6.60 | 6.29 | 5.93 | 5.57 | 6.58 | 6.14 | 6.17 | 6.41 |
| | | | (.88) | (.77) | (.73) | (.71) | (.73) | (.82) | (.79) | (.84) | (.78) | (.90) |
| ***Student Control Variables*** | | | | | | | | | | | | |
| Female | 0 | 1 | .50 | .50 | .49 | .51 | .50 | .50 | .49 | .53 | .52 | .53 |
| | | | (.50) | (.50) | (.50) | (.50) | (.50) | (.50) | (.50) | (.50) | (.50) | (.50) |
| Foreign Born | 0 | 1 | .11 | .05 | .05 | .02 | .03 | .05 | .05 | .04 | .02 | .17 |
| | | | (.32) | (.22) | (.22) | (.15) | (.18) | (.21) | (.23) | (.19) | (.14) | (.38) |
| ***School Variables*** | | | | | | | | | | | | |
| School Size | 3 | 4789 | 823.37 | 688.69 | 429.34 | 370.88 | 953.56 | 274.77 | 363.63 | 568.13 | 732.90 | 1492.58 |
| | | | (351.10) | (332.08) | (194.23) | (154.41) | (543.57) | (139.33) | (209.59) | (228.35) | (354.40) | (662.80) |
| Student-Teacher Ratio | .1 | 49 | 13.99 | 10.33 | 11.72 | 11.38 | 12.68 | 9.89 | 12.14 | 15.05 | 9.01 | 9.50 |
| | | | (2.54) | (4.14) | (2.50) | (1.80) | (2.70) | (2.94) | (2.75) | (1.72) | (2.31) | (1.80) |
| Proportion of Qualified Teachers | 0 | 1 | .65 | .20 | .96 | .92 | .77 | .25 | .44 | .97 | .04 | .80 |
| | | | (.33) | (.24) | (.08) | (.09) | (.25) | (.33) | (.34) | (.07) | (.10) | (.11) |
| Proportion of Certified Teachers | 0 | 1 | .97 | .85 | .84 | .90 | .79 | .86 | .82 | .96 | .76 | .57 |
| | | | (.11) | (.31) | (.34) | (.15) | (.36) | (.23) | (.19) | (.13) | (.30) | (.37) |
| Quality of Educational Materials | 1 | 6 | 2.63 | 2.48 | 2.64 | 3.14 | 2.42 | 3.88 | 3.07 | 3.06 | 2.79 | 2.76 |
| | | | (.93) | (.97) | (.77) | (.76) | (.92) | (.94) | (.86) | (1.03) | (.96) | (.74) |
| School Science Achievement Score | 178 | 694 | 500.68 | 493.73 | 485.38 | 525.57 | 490.89 | 483.67 | 493.27 | 496.62 | 492.27 | 484.53 |
| | | | (42.92) | (47.67) | (34.82) | (26.61) | (38.09) | (50.84) | (28.23) | (26.14) | (47.58) | (22.24) |
| ***N*** | | | 3,325 | 4,558 | 1,973 | 3,730 | 2,554 | 3,742 | 1,919 | 3,212 | 2,908 | 2,039 |

Table 1b. Descriptive Statistics of Family, Student, and School Variables from PISA 2000 for All Included Countries (cont.)

| | New Zealand Mean (s.d.) | Norway Mean (s.d.) | Portugal Mean (s.d.) | Spain Mean (s.d.) | Sweden Mean (s.d.) | Switzerland Mean (s.d.) | United Kingdom Mean (s.d.) | United States Mean (s.d.) | Germany Mean (s.d.) | Austria Mean (s.d.) | South Korea Mean (s.d.) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ***Dependent Variable*** | | | | | | | | | | | |
| Reading Achievement Score | 540.38 | 514.55 | 485.40 | 497.08 | 521.05 | 502.25 | 536.09 | 523.03 | 515.09 | 501.96 | 518.27 |
| | (101.09) | (100.56) | (93.41) | (84.71) | (90.40) | (95.72) | (95.94) | (98.48) | (95.06) | (91.30) | (73.33) |
| ***Family Variables*** | | | | | | | | | | | |
| Mother's Socioeconomic Status | | | | | | | | | | | |
| Mother's Occupational Status (ISEI) | 46.46 | 46.43 | 38.01 | 37.29 | 43.41 | 40.89 | 43.52 | 47.59 | 44.01 | 41.94 | 38.70 |
| | (15.66) | (15.37) | (15.32) | (14.72) | (15.93) | (13.34) | (15.40) | (14.35) | (14.00) | (13.95) | (10.45) |
| Mother Completed Tertiary Education | .43 | .42 | .16 | .17 | .49 | .15 | .40 | .41 | .25 | .17 | .12 |
| | (.50) | (.49) | (.36) | (.37) | (.50) | (.36) | (.49) | (.49) | (.43) | (.38) | (.32) |
| Father's Socioeconomic Status | | | | | | | | | | | |
| Father's Occupational Status (ISEI) | 45.33 | 49.16 | 42.19 | 42.29 | 46.00 | 45.00 | 45.87 | 46.63 | 45.55 | 44.76 | 41.29 |
| | (18.32) | (16.49) | (15.36) | (15.71) | (16.21) | (17.05) | (16.84) | (16.53) | (16.74) | (14.62) | (13.46) |
| Father Completed Tertiary Education | .43 | .46 | .17 | .23 | .44 | .33 | .36 | .46 | .40 | .20 | .24 |
| | (.49) | (.50) | (.38) | (.42) | (.50) | (.47) | (.48) | (.50) | (.49) | (.40) | (.43) |
| Father Present | .81 | .87 | .91 | .89 | .84 | .86 | .88 | .71 | .84 | .86 | .95 |
| | (.39) | (.33) | (.29) | (.31) | (.36) | (.35) | (.33) | (.45) | (.37) | (.35) | (.22) |
| Number of Siblings | 2.17 | 2.01 | 1.42 | 1.50 | 2.13 | 1.68 | 2.04 | 2.28 | 1.46 | 1.62 | 1.30 |
| | (1.35) | (1.29) | (1.18) | (1.07) | (1.33) | (1.07) | (1.31) | (1.54) | (1.12) | (1.16) | (.88) |
| Family Wealth | 6.37 | 6.67 | 5.99 | 5.92 | 6.75 | 6.08 | 6.46 | 6.78 | 6.34 | 6.31 | 5.76 |
| | (.87) | (.79) | (.97) | (.83) | (.79) | (.80) | (.82) | (.96) | (.83) | (.77) | (.67) |
| ***Student Control Variables*** | | | | | | | | | | | |
| Female | .49 | .48 | .53 | .51 | .48 | .50 | .50 | .55 | .50 | .51 | .44 |
| | (.50) | (.50) | (.50) | (.50) | (.50) | (.50) | (.50) | (.50) | (.50) | (.50) | (.50) |
| Foreign Born | .16 | .05 | .05 | .02 | .08 | .13 | .05 | .06 | .06 | .07 | |
| | (.37) | (.22) | (.23) | (.15) | (.27) | (.33) | (.21) | (.24) | (.24) | (.26) | |
| ***School Variables*** | | | | | | | | | | | |
| School Size | 929.03 | 235.94 | 1018.41 | 765.95 | 465.03 | 426.88 | 915.57 | 1193.06 | 686.67 | 565.61 | 1323.40 |
| | (446.57) | (116.82) | (575.03) | (380.28) | (177.15) | (315.36) | (365.14) | (771.73) | (376.96) | (426.24) | (544.85) |
| Student-Teacher Ratio | 12.45 | 9.20 | 8.90 | 14.34 | 12.77 | 12.29 | 15.48 | 14.88 | 18.04 | 12.57 | 20.91 |
| | (2.27) | (1.87) | (3.48) | (4.73) | (2.91) | (4.58) | (2.47) | (3.71) | (4.57) | (7.80) | (4.59) |
| Proportion of Qualified Teachers | .73 | .39 | .43 | .03 | .91 | .59 | .89 | .92 | | .89 | |
| | (.17) | (.35) | (.31) | (.04) | (.12) | (.33) | (.21) | (.19) | | (.18) | |
| Proportion of Certified Teachers | .72 | .90 | .76 | 1.00 | .88 | .83 | .90 | .96 | .97 | | |
| | (.19) | (.15) | (.22) | (.02) | (.11) | (.25) | (.27) | (.11) | (.13) | | |
| Quality of Educational Materials | 2.83 | 3.42 | 2.78 | 2.67 | 2.91 | 2.30 | 3.17 | 2.46 | 3.05 | 2.81 | 2.93 |
| | (.85) | (.71) | (1.03) | (1.06) | (.90) | (.95) | (.99) | (.88) | (.86) | (.84) | (.83) |
| School Science Achievement Score | 494.00 | 481.19 | 490.14 | 497.68 | 506.19 | 503.07 | 527.72 | 504.89 | 507.93 | 495.87 | 505.70 |
| | (32.38) | (30.26) | (38.04) | (33.42) | (33.85) | (44.65) | (49.36) | (51.48) | (62.36) | (40.19) | (34.30) |
| ***N*** | 2,391 | 2,190 | 3,729 | 4,259 | 2,858 | 4,235 | 5,223 | 1,221 | 3,047 | 3,220 | 4,360 |

Table 2a. Coefficients of Variation for Family, Student, and School Variables from PISA 2000 for All Included Countries

| | Australia | Belgium | Denmark | Finland | France | Greece | Iceland | Ireland | Italy | Luxembourg |
|---|---|---|---|---|---|---|---|---|---|---|
| | Coef. of Variation | Coef. of Variation | Coef. of Variation | Coef. of Variation | Coef. of Variation | Coef. of Variation | Coef. of Variation | Coef. of Variation | Coef. of Variation | Coef. of Variation |
| ***Dependent Variable*** | | | | | | | | | | |
| Reading Achievement Score | .186 | .186 | .179 | .157 | .177 | .200 | .178 | .167 | .180 | .211 |
| ***Family Variables*** | | | | | | | | | | |
| Mother's Socioeconomic Status | | | | | | | | | | |
| Mother's Occupational Status (ISEI) | .334 | .369 | .355 | .362 | .388 | .342 | .371 | .343 | .345 | .385 |
| Father's Socioeconomic Status | | | | | | | | | | |
| Father's Occupational Status (ISEI) | .373 | .360 | .366 | .383 | .369 | .401 | .393 | .379 | .355 | .375 |
| Number of Siblings | .627 | .744 | .671 | .664 | .671 | .699 | .514 | .536 | .685 | .791 |
| Family Wealth | .136 | .128 | .111 | .112 | .123 | .147 | .119 | .137 | .126 | .140 |
| ***School Variables*** | | | | | | | | | | |
| School Size | .426 | .482 | .452 | .416 | .570 | .507 | .576 | .402 | .484 | .444 |
| Student-Teacher Ratio | .182 | .401 | .213 | .158 | .213 | .297 | .227 | .115 | .256 | .190 |
| Quality of Educational Materials | .355 | .392 | .293 | .243 | .380 | .243 | .282 | .338 | .343 | .269 |
| School Science Achievement Score | .086 | .097 | .072 | .051 | .078 | .105 | .057 | .053 | .097 | .046 |
| ***N*** | 3,325 | 4,558 | 1,973 | 3,730 | 2,554 | 3,742 | 1,919 | 3,212 | 2,908 | 2,039 |

Table 2b. Coefficients of Variation for Family, Student, and School Variables from PISA 2000 for All Included Countries (cont.)

| | New Zealand | Norway | Portugal | Spain | Sweden | Switzerland | United Kingdom | United States | Germany | Austria | South Korea |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Coef. of Variation | Coef. Of Variation | Coef. Of Variation | Coef. Of Variation | Coef. Of Variation | Coef. of Variation | Coef. of Variation | Coef. of Variation | Coef. of Variation | Coef. of Variation | Coef. of Variation |
| ***Dependent Variable*** | | | | | | | | | | | |
| Reading Achievement Score | .187 | .195 | .192 | .170 | .173 | .191 | .179 | .188 | .185 | .182 | .141 |
| ***Family Variables*** | | | | | | | | | | | |
| Mother's Socioeconomic Status | | | | | | | | | | | |
| Mother's Occupational Status (ISEI) | .337 | .331 | .403 | .395 | .367 | .326 | .354 | .302 | .318 | .333 | .270 |
| Father's Socioeconomic Status | | | | | | | | | | | |
| Father's Occupational Status (ISEI) | .404 | .335 | .364 | .372 | .352 | .379 | .367 | .354 | .368 | .327 | .326 |
| Number of Siblings | .620 | .643 | .831 | .714 | .628 | .636 | .643 | .675 | .767 | .717 | .675 |
| Family Wealth | .137 | .118 | .162 | .140 | .117 | .132 | .127 | .142 | .130 | .121 | .116 |
| ***School Variables*** | | | | | | | | | | | |
| School Size | .481 | .495 | .565 | .496 | .381 | .739 | .399 | .647 | .549 | .754 | .412 |
| Student-Teacher Ratio | .183 | .203 | .391 | .330 | .228 | .373 | .159 | .250 | .253 | .620 | .220 |
| Quality of Educational Materials | .300 | .207 | .369 | .396 | .309 | .412 | .313 | .359 | .282 | .298 | .284 |
| School Science Achievement Score | .066 | .063 | .078 | .067 | .067 | .089 | .094 | .102 | .123 | .081 | .068 |
| ***N*** | 2,391 | 2,190 | 3,729 | 4,259 | 2,858 | 4,235 | 5,223 | 1,221 | 3,047 | 3,220 | 4,360 |

Table 3. Typology of Countries Based on Standardization and Stratification of Education Systems

| | Standardized | Stratified[a] |
|---|---|---|
| Australia | 0 | 0 |
| Austria | 1 | 2 |
| Belgium | 0 | 1 |
| Denmark | 0 | 1 |
| Finland | 1 | 1 |
| France | 1 | 1 |
| Germany | 1 | 2 |
| Greece | 1 | 1 |
| Iceland | 1 | 0 |
| Ireland | 1 | 0 |
| Italy | 1 | 1 |
| Korea | 1 | 1 |
| Luxembourg | 1 | 1 |
| New Zealand | 1 | 0 |
| Norway | 1 | 0 |
| Portugal | 1 | 1 |
| Spain | 1 | 0 |
| Sweden | 1 | 0 |
| Switzerland | 1 | 2 |
| United Kingdom | 0 | 0 |
| United States | 0 | 0 |

[a] Stratification is coded as: '0' for systems with mostly comprehensive schools, '1' for systems with prevalent between-school tracking, and '2' for systems with between-school tracking and early differentiation into rigid tracks.

*Countries not classified by earlier authors

Table 4. Descriptive Statistics and Coefficients of Variation for Family, Student, and School Variables from PISA 2000

| | | | Non-Standardized | | Standardized | | Non-Stratified | | Moderately Stratified | | Highly Stratified | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Min. | Max. | Mean (s.d.) | Coef. of Variation | Mean (s.d.) | Coef. of Variation | Mean (s.d.) | Coef. of Variation | Mean (s.d.) | Coef. of Variation | Mean (s.d.) | Coef. of Variation |
| ***Dependent Variable*** | | | | | | | | | | | | |
| Reading Achievement Score | 23 | 915 | 529.38 (97.11) | .183 | 507.98 (93.22) | .184 | 523.55 (95.00) | .181 | 506.51 (93.55) | .185 | 505.89 (94.37) | .187 |
| ***Family Variables*** | | | | | | | | | | | | |
| Mother's Socioeconomic Status | | | | | | | | | | | | |
| Mother's Occupational Status (ISEI) | 16 | 90 | 44.44 (15.62) | .351 | 41.65 (14.82) | .356 | 43.55 (15.64) | .359 | 41.31 (14.90) | .361 | 42.12 (13.78) | .327 |
| Mother Completed Tertiary Education | 0 | 1 | .38 (.49) | --- | .23 (.42) | --- | .34 (.47) | --- | .24 (.43) | --- | .19 (.39) | --- |
| Father's Socioeconomic Status | | | | | | | | | | | | |
| Father's Occupational Status (ISEI) | 16 | 90 | 46.19 (16.87) | .365 | 43.87 (16.24) | .370 | 45.22 (16.86) | .373 | 43.51 (16.03) | .369 | 45.09 (16.25) | .360 |
| Father Completed Tertiary Education | 0 | 1 | .38 (.48) | --- | .29 (.45) | --- | .35 (.48) | --- | .28 (.45) | --- | .31 (.46) | --- |
| Father Present | 0 | 1 | .84 (.37) | --- | .88 (.33) | --- | .85 (.35) | --- | .89 (.32) | --- | .85 (.36) | --- |
| Number of Siblings | 0 | 12 | 1.95 (1.32) | .677 | 1.74 (1.23) | .707 | 2.08 (1.33) | .640 | 1.60 (1.18) | .737 | 1.60 (1.12) | .699 |
| Family Wealth | 1 | 9 | 6.38 (.86) | .134 | 6.15 (.86) | .140 | 6.40 (.88) | .137 | 6.03 (.84) | .139 | 6.23 (.81) | .130 |
| ***Student Control Variables*** | | | | | | | | | | | | |
| Female | 0 | 1 | .50 (.50) | --- | .50 (.50) | --- | .50 (.50) | --- | .50 (.50) | --- | .50 (.50) | --- |
| Foreign Born | 0 | 1 | .06 (.24) | --- | .06 (.24) | --- | .07 (.25) | --- | .05 (.22) | --- | .09 (.29) | --- |
| ***School Variables*** | | | | | | | | | | | | |
| School Size | 3 | 4789 | 795.25 (428.80) | .539 | 697.77 (520.03) | .745 | 707.89 (430.58) | .608 | 796.65 (574.00) | .721 | 544.79 (385.47) | .708 |
| Student-Teacher Ratio | .1 | 49 | 13.24 (3.80) | .287 | 12.87 (5.12) | .398 | 13.71 (3.44) | .251 | 11.89 (5.08) | .428 | 14.05 (6.30) | .449 |
| Proportion of Qualified Teachers | 0 | 1 | .66 (.38) | --- | .61 (.40) | --- | .65 (.39) | --- | .57 (.41) | --- | .72 (.31) | --- |
| Proportion of Certified Teachers | 0 | 1 | .90 (.27) | --- | .86 (.23) | --- | .91 (.18) | --- | .83 (.28) | --- | .89 (.22) | --- |
| Quality of Educational Materials | 1 | 6 | 2.75 (.99) | .359 | 2.92 (.98) | .336 | 2.93 (.98) | .334 | 2.90 (1.00) | .343 | 2.67 (.94) | .354 |
| School Science Achievement Scor | 178 | 694 | 505.86 (48.86) | .097 | 497.97 (40.31) | .081 | 503.07 (40.33) | .080 | 496.20 (41.86) | .084 | 502.27 (49.49) | .099 |
| ***N*** | | | 16,300 | | 50,393 | | 26,598 | | 29,593 | | 10,502 | |

Table 5. Regression results by country

| | Australia | | | Belgium | | | Denmark | | | Finland | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Total Coef. (s.e.) | Total Coef. (s.e.) | Direct Coef. (s.e.) | Total Coef. (s.e.) | Total Coef. (s.e.) | Direct Coef. (s.e.) | Total Coef. (s.e.) | Total Coef. (s.e.) | Direct Coef. (s.e.) | Total Coef. (s.e.) | Total Coef. (s.e.) | Direct Coef. (s.e.) |
| ***Family Variables*** | | | | | | | | | | | | |
| Mother's Occupational Status (ISEI) | 12.649 ** | | 11.930 ** | 19.413 ** | | 12.270 ** | 8.474 ** | | 6.850 ** | 8.747 ** | | 8.607 ** |
| | (2.060) | | (2.056) | (2.199) | | (1.931) | (2.647) | | (2.532) | (1.623) | | (1.604) |
| Mother Completed Tertiary Education | 6.377 ** | | 6.095 ** | -3.010 | | -5.489 * | 10.778 ** | | 10.455 ** | -2.039 | | -1.867 |
| | (2.385) | | (2.238) | (2.395) | | (2.302) | (2.419) | | (2.337) | (1.821) | | (1.777) |
| Father's Occupational Status (ISEI) | 13.096 ** | | 11.347 ** | 26.052 ** | | 16.980 ** | 14.913 ** | | 12.661 ** | 10.322 ** | | 9.950 ** |
| | (1.967) | | (1.933) | (2.104) | | (1.921) | (2.645) | | (2.548) | (1.881) | | (1.866) |
| Father Completed Tertiary Education | 10.451 ** | | 10.579 ** | -8.305 ** | | -8.177 ** | 9.474 ** | | 9.973 ** | 4.296 * | | 3.913 |
| | (2.229) | | (2.092) | (1.873) | | (1.734) | (2.428) | | (2.547) | (2.134) | | (2.090) |
| Father Present | 0.541 | | 0.939 | 3.736 * | | 2.636 | 3.793 | | 2.823 | 3.544 | | 3.630 * |
| | (2.112) | | (2.142) | (1.574) | | (1.469) | (2.554) | | (2.284) | (1.853) | | (1.743) |
| Number of Siblings | -8.820 ** | | -8.627 ** | -16.345 ** | | -9.886 ** | -7.023 ** | | -5.647 * | -3.796 * | | -4.408 * |
| | (1.890) | | (1.861) | (2.519) | | (1.273) | (2.502) | | (2.440) | (1.759) | | (1.714) |
| Family Wealth | 2.747 | | 1.536 | -3.428 | | -2.621 | -1.417 | | -2.959 | 4.770 * | | 4.840 * |
| | (2.007) | | (2.198) | (1.793) | | (1.453) | (2.448) | | (2.288) | (2.264) | | (2.043) |
| ***Student Control Variables*** | | | | | | | | | | | | |
| Female | 17.427 ** | | 16.933 ** | 14.300 ** | | 9.509 ** | 13.602 ** | | 13.844 ** | 24.658 ** | | 24.279 ** |
| | (2.606) | | (2.581) | (2.615) | | (1.925) | (2.203) | | (2.192) | (1.497) | | (1.439) |
| Foreign Born | -3.933 | | -3.693 | -9.022 ** | | -7.120 ** | -7.338 ** | | -7.049 ** | -5.535 ** | | -4.661 * |
| | (2.305) | | (2.220) | (1.740) | | (1.487) | (2.270) | | (2.241) | (1.911) | | (1.888) |
| ***School Variables*** | | | | | | | | | | | | |
| School Size | | 8.080 ** | 4.646 * | | -1.004 | -0.385 | | 5.309 | 0.520 | | -0.146 | -2.031 |
| | | (2.628) | (2.224) | | (3.823) | (3.248) | | (2.717) | (2.556) | | (2.212) | (2.142) |
| Student-Teacher Ratio | | -1.126 | -0.777 | | 21.087 * | 16.368 | | 5.975 | 4.227 | | 1.700 | 1.517 |
| | | (3.202) | (2.229) | | (10.584) | (8.765) | | (3.175) | (2.838) | | (2.201) | (2.096) |
| Proportion of Qualified Teachers | | -4.183 | -3.440 | | -6.690 | -5.911 | | 10.112 ** | 10.628 ** | | 7.148 ** | 6.120 ** |
| | | (4.573) | (3.354) | | (4.583) | (3.982) | | (3.631) | (3.191) | | (2.115) | (1.992) |
| Proportion of Certified Teachers | | 0.795 | -0.432 | | 3.364 | 2.510 | | -0.750 | -0.172 | | -3.245 * | -1.621 |
| | | (1.739) | (1.286) | | (3.650) | (2.963) | | (3.028) | (2.563) | | (1.435) | (1.263) |
| Quality of Educational Materials | | -7.864 * | -4.595 | | -3.036 | -1.401 | | -0.413 | -0.041 | | 1.587 | 2.876 |
| | | (3.568) | (2.898) | | (3.468) | (3.048) | | (2.734) | (2.404) | | (2.220) | (2.093) |
| School Science Achievement Score | | 15.433 ** | 12.167 ** | | 42.303 ** | 36.138 ** | | 13.808 ** | 9.065 ** | | 14.193 ** | 12.264 ** |
| | | (3.644) | (2.502) | | (3.612) | (3.021) | | (2.711) | (2.393) | | (2.571) | (2.368) |
| Constant | 532.964 ** | 534.660 ** | 533.800 ** | 519.789 ** | 520.242 ** | 519.319 ** | 511.750 ** | 513.782 ** | 512.185 ** | 547.589 ** | 547.357 ** | 547.771 ** |
| | (3.135) | (3.627) | (2.662) | (4.129) | (3.487) | (3.008) | (2.614) | (2.626) | (2.275) | (2.091) | (1.850) | (1.762) |
| $R^2$ | .154 | .043 | .175 | .185 | .286 | .354 | .156 | .065 | .189 | .139 | .033 | .165 |
| *N* | 3325 | 3325 | 3325 | 4558 | 4558 | 4558 | 1973 | 1973 | 1973 | 3730 | 3730 | 3730 |

| France | | | Greece | | | Iceland | | | Ireland | | | Italy | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total Coef. (s.e.) | Total Coef. (s.e.) | Direct Coef. (s.e.) | Total Coef. (s.e.) | Total Coef. (s.e.) | Direct Coef. (s.e.) | Total Coef. (s.e.) | Total Coef. (s.e.) | Direct Coef. (s.e.) | Total Coef. (s.e.) | Total Coef. (s.e.) | Direct Coef. (s.e.) | Total Coef. (s.e.) | Total Coef. (s.e.) | Direct Coef. (s.e.) |
| 14.441 ** | | 7.108 ** | 13.496 ** | | 8.560 ** | 10.197 ** | | 9.499 ** | 15.776 ** | | 14.776 ** | 12.316 ** | | 6.283 ** |
| (1.888) | | (1.745) | (2.107) | | (2.101) | (2.554) | | (2.455) | (1.928) | | (1.938) | (2.829) | | (2.213) |
| 0.456 | | 0.896 | 3.621 | | 2.031 | 7.233 ** | | 6.725 ** | 0.755 | | 0.657 | -4.284 | | -4.492 * |
| (2.109) | | (2.081) | (1.975) | | (1.844) | (2.104) | | (1.946) | (2.069) | | (2.055) | (2.328) | | (1.909) |
| 16.454 ** | | 10.785 ** | 15.838 ** | | 11.061 ** | 13.634 ** | | 13.717 ** | 18.348 ** | | 17.236 ** | 15.093 ** | | 6.229 ** |
| (2.203) | | (1.933) | (2.411) | | (2.211) | (2.445) | | (2.360) | (1.993) | | (1.949) | (2.580) | | (2.011) |
| -0.095 | | -0.550 | 1.428 | | -0.497 | -4.808 * | | -5.401 * | -4.215 * | | -3.922 | 4.612 | | 1.057 |
| (2.110) | | (1.910) | (2.296) | | (2.038) | (2.196) | | (2.146) | (2.112) | | (2.068) | (2.482) | | (2.116) |
| 2.966 | | 0.260 | 0.305 | | 0.466 | 3.831 | | 3.803 | 0.713 | | 0.624 | 0.785 | | 0.764 |
| (1.830) | | (1.671) | (1.733) | | (1.638) | (2.158) | | (2.110) | (1.507) | | (1.474) | (1.600) | | (1.575) |
| -9.298 ** | | -6.670 ** | -10.254 ** | | -6.346 ** | 1.723 | | 1.562 | -8.608 ** | | -8.026 ** | -12.161 ** | | -6.397 ** |
| (2.208) | | (1.841) | (2.075) | | (1.840) | (2.316) | | (2.321) | (1.814) | | (1.778) | (2.333) | | (1.768) |
| 6.679 ** | | 4.017 * | 0.248 | | -0.754 | -8.112 ** | | -7.694 ** | -1.350 | | -2.335 | -1.732 | | -1.615 |
| (2.148) | | (1.810) | (2.098) | | (1.818) | (2.562) | | (2.459) | (2.078) | | (2.084) | (2.357) | | (2.253) |
| 15.442 ** | | 13.013 ** | 17.038 ** | | 14.127 ** | 16.742 ** | | 16.915 ** | 12.800 ** | | 11.962 ** | 15.767 ** | | 11.045 ** |
| (2.023) | | (1.720) | (1.977) | | (1.688) | (2.272) | | (2.220) | (1.836) | | (1.758) | (3.098) | | (2.377) |
| -4.864 * | | -3.630 * | -9.525 ** | | -9.829 ** | -4.531 * | | -4.603 * | 1.435 | | 1.808 | -3.435 | | -2.643 |
| (1.922) | | (1.758) | (2.370) | | (2.359) | (1.918) | | (1.953) | (1.502) | | (1.487) | (1.833) | | (1.677) |
| | 20.683 ** | 16.564 ** | | 8.122 | 5.371 | | -2.984 | -3.313 | | 6.134 | 3.498 | | -0.907 | 1.736 |
| | (3.781) | (3.440) | | (5.847) | (4.584) | | (3.152) | (3.137) | | (3.404) | (2.976) | | (3.823) | (3.603) |
| | -11.626 ** | -13.045 ** | | -2.217 | -1.564 | | 2.707 | -0.145 | | 3.134 | 3.600 | | 13.891 ** | 10.767 ** |
| | (3.858) | (3.346) | | (6.089) | (5.364) | | (3.668) | (2.925) | | (3.817) | (2.782) | | (4.124) | (3.949) |
| | 3.667 | 3.474 | | -4.482 | -3.924 | | -0.862 | -0.477 | | 5.176 * | 2.954 | | 2.487 | 2.139 |
| | (3.293) | (2.860) | | (3.816) | (3.191) | | (2.763) | (2.843) | | (2.482) | (1.956) | | (1.708) | (1.258) |
| | 1.937 | 2.841 | | 19.440 ** | 16.028 ** | | 2.308 | 0.731 | | -2.306 | -0.500 | | 1.970 | 0.856 |
| | (3.603) | (3.053) | | (4.743) | (4.060) | | (2.433) | (2.392) | | (1.876) | (1.481) | | (3.061) | (3.011) |
| | -1.314 | -2.028 | | -0.797 | -0.556 | | -2.755 | -3.065 | | -5.082 | -2.034 | | -3.731 | -4.092 |
| | (3.977) | (3.481) | | (4.512) | (3.557) | | (2.537) | (2.175) | | (2.990) | (2.316) | | (3.905) | (3.710) |
| | 34.512 ** | 29.221 ** | | 34.750 ** | 30.533 ** | | 18.404 ** | 16.117 ** | | 12.209 ** | 8.506 ** | | 46.067 ** | 41.910 ** |
| | (3.208) | (2.821) | | (5.221) | (4.331) | | (2.841) | (2.179) | | (2.865) | (2.185) | | (2.880) | (2.699) |
| 507.882 ** | 505.490 ** | 506.199 ** | 477.793 ** | 469.915 ** | 472.620 ** | 508.311 ** | 509.198 ** | 508.646 ** | 532.115 ** | 532.147 ** | 532.104 ** | 495.130 ** | 491.826 ** | 492.036 ** |
| (4.634) | (3.760) | (3.281) | (4.383) | (3.870) | (2.960) | (3.082) | (2.733) | (2.091) | (2.344) | (2.811) | (2.187) | (4.883) | (3.052) | (2.861) |
| .153 | .293 | .352 | .151 | .231 | .305 | .095 | .042 | .131 | .122 | .038 | .139 | .125 | .328 | .357 |
| 2554 | 2554 | 2554 | 3742 | 3742 | 3742 | 1919 | 1919 | 1919 | 3212 | 3212 | 3212 | 2908 | 2908 | 2908 |

| Luxembourg | | | New Zealand | | | Norway | | | Portugal | | | Spain | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total Coef. (s.e.) | Total Coef. (s.e.) | Direct Coef. (s.e.) | Total Coef. (s.e.) | Total Coef. (s.e.) | Direct Coef. (s.e.) | Total Coef. (s.e.) | Total Coef. (s.e.) | Direct Coef. (s.e.) | Total Coef. (s.e.) | Total Coef. (s.e.) | Direct Coef. (s.e.) | Total Coef. (s.e.) | Total Coef. (s.e.) | Direct Coef. (s.e.) |
| 15.018 ** | | 9.745 ** | 16.415 ** | | 16.013 ** | 18.379 ** | | 16.934 ** | 9.125 ** | | 6.740 ** | 12.925 ** | | 11.621 ** |
| (1.893) | | (2.390) | (2.033) | | (1.983) | (2.147) | | (2.221) | (1.898) | | (1.851) | (2.050) | | (2.033) |
| 3.814 ** | | 2.067 | 3.364 | | 2.426 | -4.492 | | -3.947 | 0.983 | | 0.762 | 3.965 ** | | 3.483 * |
| (1.306) | | (1.958) | (2.185) | | (2.111) | (2.772) | | (2.760) | (1.982) | | (1.883) | (1.437) | | (1.407) |
| 16.980 ** | | 11.526 ** | 18.900 ** | | 17.240 ** | 21.875 ** | | 21.290 ** | 21.611 ** | | 16.642 ** | 15.700 ** | | 13.650 ** |
| (2.632) | | (2.694) | (2.500) | | (2.542) | (3.098) | | (3.060) | (2.481) | | (2.223) | (2.163) | | (2.086) |
| 0.405 | | -1.233 | 3.210 | | 2.453 | 1.173 | | 0.532 | -3.240 | | -3.003 | 1.154 | | 0.823 |
| (2.480) | | (2.314) | (2.331) | | (2.333) | (2.803) | | (2.739) | (2.507) | | (2.376) | (1.718) | | (1.721) |
| 3.993 | | 2.562 | 3.608 | | 3.687 | 3.964 | | 4.283 | -2.989 | | -2.634 | 2.694 | | 3.092 * |
| (2.800) | | (2.400) | (2.339) | | (2.287) | (2.481) | | (2.351) | (1.745) | | (1.592) | (1.485) | | (1.551) |
| -13.291 ** | | -11.049 ** | -9.918 ** | | -8.287 ** | -5.647 | | -5.002 | -17.912 ** | | -14.164 ** | -9.205 ** | | -8.931 ** |
| (2.258) | | (1.867) | (2.260) | | (2.104) | (3.467) | | (3.194) | (1.852) | | (1.692) | (1.787) | | (1.800) |
| 6.496 | | 2.566 | 2.740 | | 0.761 | -1.456 | | -1.940 | 13.565 ** | | 8.871 ** | 0.631 | | -0.628 |
| (3.571) | | (2.088) | (2.078) | | (1.989) | (2.505) | | (2.604) | (1.962) | | (1.873) | (1.699) | | (1.763) |
| 17.502 ** | | 14.775 ** | 19.736 ** | | 19.387 ** | 21.973 ** | | 21.458 ** | 13.338 ** | | 11.269 ** | 12.609 ** | | 12.066 ** |
| (4.012) | | (2.337) | (2.637) | | (2.498) | (2.302) | | (2.273) | (1.689) | | (1.707) | (1.473) | | (1.394) |
| -19.257 ** | | -14.495 ** | -14.536 ** | | -14.296 ** | -7.746 ** | | -8.308 ** | -2.673 | | -2.488 | -2.650 | | -2.204 |
| (3.611) | | (4.156) | (2.488) | | (2.321) | (2.463) | | (2.445) | (1.759) | | (1.472) | (1.586) | | (1.681) |
| | 5.183 | 8.754 | | 3.309 | 0.877 | | 5.312 | -0.310 | | 20.908 ** | 16.797 ** | | 5.112 | 2.224 |
| | (11.460) | (9.028) | | (3.511) | (3.488) | | (3.750) | (3.385) | | (5.850) | (4.495) | | (2.832) | (1.977) |
| | -2.308 | -1.227 | | 4.451 | 2.791 | | 0.035 | 0.746 | | -13.928 * | -11.018 * | | 8.151 * | 5.282 |
| | (5.182) | (4.449) | | (3.973) | (3.350) | | (4.112) | (3.614) | | (5.582) | (4.422) | | (4.111) | (2.912) |
| | 11.568 | 8.711 | | -6.537 | -6.111 | | -4.296 | -2.642 | | -4.957 | -2.550 | | -3.827 | -4.065 |
| | (8.279) | (6.750) | | (4.688) | (3.547) | | (2.584) | (2.146) | | (3.412) | (2.577) | | (2.953) | (2.130) |
| | 1.461 | 0.307 | | -3.772 | 0.369 | | -0.242 | -1.338 | | 2.533 | 1.736 | | -4.710 ** | -4.015 ** |
| | (6.003) | (4.347) | | (3.479) | (2.286) | | (3.285) | (2.938) | | (3.023) | (2.431) | | (.732) | (.454) |
| | -5.249 | -1.589 | | -4.900 | -2.745 | | -1.917 | -1.185 | | -4.509 | -2.027 | | -5.318 | -2.115 |
| | (5.877) | (4.817) | | (3.357) | (3.174) | | (2.914) | (2.541) | | (3.241) | (2.671) | | (3.287) | (2.196) |
| | 45.174 ** | 36.190 ** | | 19.526 ** | 13.540 ** | | 13.239 ** | 11.851 ** | | 34.160 ** | 24.483 ** | | 14.459 ** | 9.661 ** |
| | (8.904) | (7.282) | | (2.853) | (2.327) | | (3.607) | (3.308) | | (3.121) | (2.646) | | (2.357) | (1.967) |
| 459.762 ** | 463.782 ** | 461.302 ** | 538.365 ** | 538.599 ** | 537.144 ** | 514.445 ** | 515.629 ** | 514.839 ** | 479.370 ** | 479.791 ** | 479.613 ** | 497.060 ** | 496.244 ** | 496.829 ** |
| (9.029) | (5.345) | (4.420) | (2.981) | (3.223) | (2.677) | (2.757) | (2.765) | (2.315) | (3.654) | (3.447) | (2.737) | (2.363) | (2.865) | (2.253) |
| .233 | .255 | .347 | .163 | .052 | .184 | .152 | .038 | .172 | .209 | .199 | .302 | .146 | .064 | .169 |
| 2039 | 2039 | 2039 | 2391 | 2391 | 2391 | 2190 | 2190 | 2190 | 3729 | 3729 | 3729 | 4259 | 4259 | 4259 |

| Sweden | | | Switzerland | | | United Kingdom | | | United States | | | Germany | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total Coef. (s.e.) | Total Coef. (s.e.) | Direct Coef. (s.e.) | Total Coef. (s.e.) | Total Coef. (s.e.) | Direct Coef. (s.e.) | Total Coef. (s.e.) | Total Coef. (s.e.) | Direct Coef. (s.e.) | Total Coef. (s.e.) | Total Coef. (s.e.) | Direct Coef. (s.e.) | Total Coef. (s.e.) | Total Coef. (s.e.) | Direct Coef. (s.e.) |
| 13.620 ** | | 12.866 ** | 17.641 ** | | 10.394 ** | 19.407 ** | | 17.638 ** | 8.356 ** | | 6.853 * | 15.204 ** | | 6.203 ** |
| (1.821) | | (1.891) | (1.993) | | (1.633) | (2.255) | | (2.049) | (2.859) | | (2.759) | (2.857) | | (1.745) |
| -1.874 | | -1.917 | -3.841 * | | -4.172 ** | -1.862 | | -2.483 | 1.427 | | 2.184 | 1.829 | | -0.407 |
| (1.814) | | (1.765) | (1.858) | | (1.593) | (1.977) | | (1.912) | (3.358) | | (3.314) | (1.970) | | (1.495) |
| 18.860 ** | | 18.443 ** | 24.299 ** | | 16.238 ** | 19.035 ** | | 16.308 ** | 12.460 ** | | 8.334 * | 20.312 ** | | 6.396 ** |
| (1.812) | | (1.849) | (2.383) | | (1.620) | (2.310) | | (2.236) | (3.621) | | (3.348) | (2.236) | | (1.860) |
| -3.486 | | -3.683 | 1.209 | | 1.169 | 4.557 * | | 3.346 | 1.356 | | 0.093 | 9.394 ** | | 3.288 * |
| (2.113) | | (2.079) | (2.122) | | (1.930) | (1.834) | | (1.835) | (3.309) | | (3.233) | (2.071) | | (1.597) |
| 3.390 * | | 3.376 * | 0.586 | | -0.239 | 1.232 | | 1.146 | 13.764 ** | | 11.798 ** | 1.205 | | -0.958 |
| (1.651) | | (1.623) | (1.483) | | (1.156) | (1.747) | | (1.716) | (2.589) | | (2.502) | (1.721) | | (1.487) |
| -5.725 ** | | -5.343 ** | -4.190 | | -4.781 * | -11.980 ** | | -10.914 ** | -12.401 ** | | -9.360 ** | -7.360 ** | | -4.652 ** |
| (1.729) | | (1.737) | (2.332) | | (2.219) | (1.956) | | (1.846) | (3.410) | | (3.309) | (1.858) | | (1.267) |
| -1.166 | | -1.812 | -5.204 ** | | -2.305 | 1.108 | | 1.029 | 11.895 ** | | 3.367 | -3.099 | | -3.167 |
| (1.972) | | (1.925) | (1.686) | | (1.449) | (2.065) | | (2.006) | (3.214) | | (3.600) | (2.148) | | (1.631) |
| 18.529 ** | | 18.325 ** | 14.323 ** | | 11.134 ** | 12.690 ** | | 12.667 ** | 14.381 ** | | 14.052 ** | 16.079 ** | | 10.226 ** |
| (1.650) | | (1.658) | (1.677) | | (1.581) | (2.281) | | (1.792) | (2.662) | | (2.586) | (1.895) | | (1.534) |
| -12.557 ** | | -11.430 ** | -22.023 ** | | -18.517 ** | -3.889 | | -3.915 | -5.162 * | | -5.766 * | -18.912 ** | | -13.140 ** |
| (2.286) | | (1.902) | (2.302) | | (1.813) | (2.573) | | (2.064) | (2.561) | | (2.843) | (2.652) | | (2.195) |
| | 1.156 | 0.442 | | 1.652 | 2.067 | | -1.788 | -3.876 | | -3.245 | -0.550 | | 0.194 | 0.792 |
| | (2.725) | (1.975) | | (4.491) | (4.151) | | (3.720) | (2.872) | | (4.508) | (4.326) | | (2.386) | (2.023) |
| | 2.479 | 0.655 | | -1.519 | -1.516 | | -4.001 | -1.764 | | -2.838 | -3.845 | | 0.896 | 1.218 |
| | (2.986) | (1.771) | | (2.215) | (1.987) | | (4.442) | (3.447) | | (4.324) | (4.036) | | (1.752) | (1.738) |
| | -0.357 | 1.044 | | 12.812 ** | 11.338 ** | | 2.877 | 1.818 | | 1.899 | -0.038 | | | |
| | (2.058) | (1.504) | | (3.589) | (3.024) | | (4.051) | (2.856) | | (2.740) | (2.173) | | | |
| | 2.266 | -0.033 | | 2.132 | 1.687 | | 3.723 | 2.807 | | 3.870 | 4.814 | | -2.335 | -1.217 |
| | (2.590) | (2.124) | | (3.509) | (2.909) | | (2.699) | (2.035) | | (4.669) | (3.986) | | (1.911) | (1.680) |
| | -2.716 | -1.842 | | -6.809 | -5.628 | | -7.943 | -5.862 | | -2.451 | -2.220 | | -4.103 * | -4.555 * |
| | (2.426) | (1.806) | | (4.181) | (3.430) | | (5.042) | (4.085) | | (3.266) | (3.105) | | (2.068) | (1.911) |
| | 13.980 ** | 10.057 ** | | 40.758 ** | 31.157 ** | | 23.413 ** | 15.183 ** | | 43.438 ** | 34.490 ** | | 64.154 ** | 56.212 ** |
| | (2.810) | (1.930) | | (3.217) | (2.946) | | (3.432) | (2.595) | | (4.496) | (4.461) | | (2.256) | (2.402) |
| 520.843 ** | 520.751 ** | 520.689 ** | 499.590 ** | 494.988 ** | 496.357 ** | 530.888 ** | 535.707 ** | 531.780 ** | 518.927 ** | 511.326 ** | 507.628 ** | 506.170 ** | 504.545 ** | 503.388 ** |
| (2.046) | (2.410) | (1.830) | (4.195) | (2.972) | (2.441) | (2.896) | (4.062) | (3.106) | (4.883) | (3.793) | (3.604) | (3.876) | (1.911) | (1.883) |
| .147 | .029 | .161 | .223 | .260 | .365 | .160 | .075 | .191 | .151 | .163 | .237 | .205 | .431 | .468 |
| 2858 | 2858 | 2858 | 4235 | 4235 | 4235 | 5223 | 5223 | 5223 | 1221 | 1221 | 1221 | 3047 | 3047 | 3047 |

| Austria Total Coef. (s.e.) | Total Coef. (s.e.) | Direct Coef. (s.e.) | South Korea Total Coef. (s.e.) | Total Coef. (s.e.) | Direct Coef. (s.e.) |
|---|---|---|---|---|---|
| 15.091 ** | | 9.098 ** | 5.049 ** | | 2.465 * |
| (2.138) | | (1.804) | (1.597) | | (1.211) |
| 2.008 | | 1.253 | -2.492 | | -0.105 |
| (1.757) | | (1.567) | (1.503) | | (1.391) |
| 15.378 ** | | 10.338 ** | 6.621 ** | | 3.695 ** |
| (1.956) | | (1.715) | (1.575) | | (1.219) |
| 2.308 | | -1.262 | 5.745 ** | | 3.441 * |
| (1.753) | | (1.571) | (1.534) | | (1.469) |
| 1.756 | | 0.413 | 1.657 | | 0.472 |
| (1.900) | | (1.780) | (1.311) | | (1.205) |
| -4.593 ** | | -2.418 | -6.311 ** | | -4.095 ** |
| (1.730) | | (1.633) | (1.519) | | (1.289) |
| -2.303 | | -1.825 | 5.695 ** | | 1.217 |
| (1.838) | | (1.546) | (1.744) | | (1.353) |
| 12.874 ** | | 15.389 ** | 8.154 ** | | 6.352 ** |
| (2.206) | | (1.722) | (2.926) | | (2.138) |
| -13.948 ** | | -13.014 ** | | | |
| (2.025) | | (1.948) | | | |
| | 11.486 * | 12.117 * | | -4.754 | -5.332 |
| | (5.793) | (4.710) | | (3.300) | (3.008) |
| | -8.023 * | -5.864 * | | 15.792 ** | 14.678 ** |
| | (3.666) | (2.835) | | (4.282) | (3.716) |
| | 6.258 | 5.627 * | | | |
| | (3.500) | (2.606) | | | |
| | -1.976 | -1.915 | | -0.470 | -0.379 |
| | (3.121) | (2.597) | | (2.519) | (2.387) |
| | 35.617 ** | 31.094 ** | | 25.844 ** | 23.751 ** |
| | (3.408) | (2.664) | | (2.770) | (2.636) |
| 508.300 ** | 504.913 ** | 503.853 ** | 521.642 ** | 519.124 ** | 519.071 ** |
| (3.701) | (3.366) | (2.659) | (3.322) | (2.665) | (2.503) |
| .156 | .224 | .311 | .063 | .177 | .197 |
| 3220 | 3220 | 3220 | 4360 | 4360 | 4360 |

Table 6. Regression results by standardization and stratification of national education systems

| | Non-Standardized | | | | Standardized | | | | Non-Stratified | | | | Moderately Stratified | | | | Highly Stratified | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Total Coef. (s.e.) | Total Coef. (s.e.) | Direct Coef. (s.e.) | % Diff (Total-Direct) | Total Coef. (s.e.) | Total Coef. (s.e.) | Direct Coef. (s.e.) | % Diff (Total-Direct) | Total Coef. (s.e.) | Total Coef. (s.e.) | Direct Coef. (s.e.) | % Diff (Total-Direct) | Total Coef. (s.e.) | Total Coef. (s.e.) | Direct Coef. (s.e.) | % Diff (Total-Direct) | Total Coef. (s.e.) | Total Coef. (s.e.) | Direct Coef. (s.e.) | % Diff (Total-Direct) |
| ***Family Variables*** | | | | | | | | | | | | | | | | | | | | |
| Mother's Occupational Status (ISEI) | 12.964 ** | | 11.477 ** | -11.5% | 13.206 ** | | 9.095 ** | -31.1% | 14.200 ** | | 12.380 ** | -12.8% | 11.820 ** | | 7.909 ** | -33.1% | 15.136 ** | | 6.857 ** | -54.7% |
| | (1.989) | | (1.884) | | (.871) | | (.703) | | (1.686) | | (1.609) | | (.941) | | (.852) | | (2.316) | | (1.436) | |
| Mother Completed Tertiary Education | 0.999 | | 1.025 | | 1.208 | | 0.051 | | 1.925 | | 1.447 | | 0.350 | | -0.316 | | 1.374 | | -0.607 | |
| | (2.164) | | (2.140) | | (.804) | | (.653) | | (1.831) | | (1.838) | | (1.046) | | (.902) | | (1.545) | | (1.181) | |
| Father's Occupational Status (ISEI) | 15.929 ** | | 12.141 ** | -23.8% | 15.729 ** | | 9.700 ** | -38.3% | 15.386 ** | | 12.815 ** | -16.7% | 14.186 ** | | 9.260 ** | -34.7% | 20.220 ** | | 7.598 ** | -62.4% |
| | (2.397) | | (2.230) | | (.836) | | (.686) | | (2.036) | | (1.915) | | (.986) | | (.796) | | (1.884) | | (1.544) | |
| Father Completed Tertiary Education | 1.971 | | 0.873 | | 3.747 ** | | 1.313 * | -64.9% | 2.188 | | 0.983 | | 2.537 ** | | 0.893 | | 7.626 ** | | 2.814 * | -63.1% |
| | (2.001) | | (1.953) | | (.819) | | (.653) | | (1.701) | | (1.658) | | (.983) | | (.864) | | (1.700) | | (1.293) | |
| Father Present | 8.131 ** | | 7.039 ** | -13.4% | 0.921 | | 0.541 | | 6.791 ** | | 6.342 ** | -6.6% | 0.860 | | 0.610 | | 1.151 | | -0.738 | -164.1% |
| | (1.559) | | (1.476) | | (.613) | | (.560) | | (1.367) | | (1.280) | | (.786) | | (.724) | | (1.308) | | (1.137) | |
| Number of Siblings | -10.942 ** | | -8.731 ** | -20.2% | -7.311 ** | | -6.046 ** | -17.3% | -9.447 ** | | -8.212 ** | -13.1% | -8.511 ** | | -6.282 ** | -26.2% | -6.473 ** | | -4.264 ** | -34.1% |
| | (1.821) | | (1.771) | | (.767) | | (.643) | | (1.609) | | (1.573) | | (1.019) | | (.856) | | (1.480) | | (1.023) | |
| Family Wealth | 6.572 ** | | 2.407 | | 3.613 ** | | 1.252 | | 7.408 ** | | 2.395 | | 5.481 ** | | 2.244 * | -59.1% | -3.049 | | -2.917 * | -4.3% |
| | (1.823) | | (1.934) | | (.879) | | (.715) | | (1.522) | | (1.680) | | (1.121) | | (.917) | | (1.701) | | (1.294) | |
| ***Student Control Variables*** | | | | | | | | | | | | | | | | | | | | |
| Female | 14.391 ** | | 13.648 ** | -5.2% | 14.269 ** | | 11.980 ** | -16.0% | 14.564 ** | | 13.940 ** | -4.3% | 13.589 ** | | 11.272 ** | -17.0% | 15.750 ** | | 10.792 ** | -31.5% |
| | (1.768) | | (1.696) | | (.896) | | (.689) | | (1.463) | | (1.407) | | (1.275) | | (.968) | | (1.580) | | (1.285) | |
| Foreign Born | -3.672 * | | -3.278 * | -10.7% | -9.570 ** | | -7.672 ** | -19.8% | -3.323 * | | -3.079 * | -7.3% | -6.771 ** | | -5.604 ** | -17.2% | -17.479 ** | | -13.043 ** | -25.4% |
| | (1.448) | | (1.493) | | (.916) | | (.765) | | (1.301) | | (1.338) | | (1.142) | | (1.074) | | (1.857) | | (1.534) | |
| ***School Variables*** | | | | | | | | | | | | | | | | | | | | |
| School Size | | -1.697 | -1.040 | | | 8.002 ** | 6.352 ** | -20.6% | | -1.251 | -1.012 | | | 9.843 ** | 8.152 ** | -17.2% | | 1.417 | 1.990 | |
| | | (1.956) | (1.855) | | | (1.643) | (1.415) | | | (1.800) | (1.661) | | | (2.368) | (2.073) | | | (2.209) | (1.870) | |
| Student-Teacher Ratio | | -1.962 | -2.338 | | | 1.843 | 1.523 | | | -1.018 | -1.574 | | | 4.160 | 2.394 | | | -0.214 | 0.237 | |
| | | (3.206) | (2.872) | | | (1.420) | (1.190) | | | (2.255) | (1.953) | | | (2.493) | (2.113) | | | (1.895) | (1.839) | |
| Proportion of Qualified Teachers | | -1.031 | -1.924 | | | 7.518 ** | 8.079 ** | 7.5% | | 6.995 ** | 5.051 ** | -27.8% | | 3.937 * | 5.419 ** | 37.6% | | 9.827 ** | 8.825 ** | -10.2% |
| | | (2.652) | (2.388) | | | (1.335) | (1.211) | | | (1.785) | (1.776) | | | (1.771) | (1.545) | | | (2.434) | (2.148) | |
| Proportion of Certified Teachers | | 4.924 * | 4.273 * | -13.2% | | 2.190 | 2.578 * | 17.7% | | 1.347 | 1.177 | | | 3.720 * | 3.708 * | -0.3% | | -2.044 | -0.958 | |
| | | (2.375) | (2.065) | | | (1.289) | (1.136) | | | (1.703) | (1.495) | | | (1.706) | (1.489) | | | (2.041) | (1.838) | |
| Quality of Educational Materials | | -5.413 * | -3.755 | -30.6% | | -3.128 * | -2.977 ** | -4.8% | | -5.347 ** | -3.279 * | -38.7% | | -3.600 * | -3.665 * | 1.8% | | -4.514 * | -4.851 ** | 7.5% |
| | | (2.194) | (1.951) | | | (1.213) | (1.070) | | | (1.770) | (1.565) | | | (1.648) | (1.503) | | | (1.882) | (1.715) | |
| School Science Achievement Score | | 33.723 ** | 25.861 ** | -23.3% | | 36.182 ** | 30.822 ** | -14.8% | | 25.909 ** | 19.429 ** | -25.0% | | 39.036 ** | 34.072 ** | -12.7% | | 47.937 ** | 41.383 ** | -13.7% |
| | | (2.759) | (2.601) | | | (.934) | (.901) | | | (2.085) | (1.967) | | | (1.441) | (1.339) | | | (1.562) | (1.630) | |
| Constant | 527.515 ** | 526.705 ** | 526.529 ** | | 502.468 ** | 507.692 ** | 507.150 ** | | 521.891 ** | 518.797 ** | 518.331 ** | | 500.613 ** | 506.420 ** | 505.089 ** | | 504.535 ** | 499.765 ** | 502.316 ** | |
| | (2.957) | (2.633) | (2.382) | | (1.641) | (1.611) | (1.446) | | (2.374) | (2.201) | (1.971) | | (2.484) | (2.102) | (1.835) | | (3.144) | (3.723) | (3.254) | |
| $R^2$ | .145 | .126 | .209 | | .143 | .242 | .298 | | .149 | .113 | .202 | | .129 | .238 | .287 | | .202 | .399 | .445 | |
| *N* | 29,267 | 29,267 | 29,267 | | 50,393 | 50,393 | 50,393 | | 26,598 | 26,598 | 26,598 | | 29,593 | 29,593 | 29,593 | | 10,502 | 10,502 | 10,502 | |

Table 7. Variance decomposition by country

| | Australia | | | | Belgium | | | | Denmark | | | | Finla | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Total | Total | Direct | % Diff (Total-Direct) | Total | Total | Direct | % Diff (Total-Direct) | Total | Total | Direct | % Diff (Total-Direct) | Total | Total |
| ***Variance in Reading Achievement*** | 9840 | | 9840 | | 9577 | | 9577 | | 8460 | | 8460 | | 7351 | |
| ***Family Variables*** | | | | | | | | | | | | | | |
| Mother's Occupational Status (ISEI) | 161.48 | | 76.71 | -52.5% | 381.45 | | 56.48 | -85.2% | 75.42 | | 36.17 | -52.0% | 76.50 | |
| | 1.6% | | 0.8% | | 4.0% | | 0.6% | | 0.9% | | 0.4% | | 1.0% | |
| Mother Completed Tertiary Education | 41.33 | | 5.76 | -86.1% | 9.25 | | 3.72 | -59.7% | 116.24 | | 86.36 | -25.7% | 4.02 | |
| | 0.4% | | 0.1% | | 0.1% | | 0.0% | | 1.4% | | 1.0% | | 0.1% | |
| Father's Occupational Status (ISEI) | 171.45 | | 71.47 | -58.3% | 702.84 | | 94.30 | -86.6% | 233.39 | | 112.79 | -51.7% | 106.42 | |
| | 1.7% | | 0.7% | | 7.3% | | 1.0% | | 2.8% | | 1.3% | | 1.4% | |
| Father Completed Tertiary Education | 109.68 | | 41.24 | -62.4% | 69.44 | | 36.11 | -48.0% | 90.55 | | 53.05 | -41.4% | 17.78 | |
| | 1.1% | | 0.4% | | 0.7% | | 0.4% | | 1.1% | | 0.6% | | 0.2% | |
| Father Present | 0.28 | | 1.58 | 472.3% | 12.26 | | 0.57 | -95.4% | 13.18 | | 9.78 | -25.8% | 11.27 | |
| | 0.0% | | 0.0% | | 0.1% | | 0.0% | | 0.2% | | 0.1% | | 0.2% | |
| Number of Siblings | 77.96 | | 38.85 | -50.2% | 244.08 | | 27.49 | -88.7% | 45.92 | | 21.43 | -53.3% | 13.87 | |
| | 0.8% | | 0.4% | | 2.5% | | 0.3% | | 0.5% | | 0.3% | | 0.2% | |
| Family Wealth | 7.54 | | 3.68 | -51.2% | 11.50 | | 6.64 | -42.3% | 1.85 | | 13.87 | 648.4% | 22.08 | |
| | 0.1% | | 0.0% | | 0.1% | | 0.1% | | 0.0% | | 0.2% | | 0.3% | |
| ***Student Control Variables*** | | | | | | | | | | | | | | |
| Female | 304.14 | | 193.85 | -36.3% | 204.51 | | 16.68 | -91.8% | 185.01 | | 154.02 | -16.8% | 608.19 | |
| | 3.1% | | 2.0% | | 2.1% | | 0.2% | | 2.2% | | 1.8% | | 8.3% | |
| Foreign Born | 15.04 | | 35.40 | 135.3% | 74.48 | | 16.88 | -77.3% | 46.22 | | 42.96 | -7.1% | 27.85 | |
| | 0.2% | | 0.4% | | 0.8% | | 0.2% | | 0.5% | | 0.5% | | 0.4% | |
| ***School Variables*** | | | | | | | | | | | | | | |
| School Science Achievement Score | | 248.47 | 146.31 | -41.1% | | 2517.34 | 1712.27 | -32.0% | | 248.65 | 98.50 | -60.4% | | 191.97 |
| | | 2.5% | 1.5% | | | 26.3% | 17.9% | | | 2.9% | 1.2% | | | 2.6% |

| nd | | | France | | | | Greece | | | | Iceland | | | | Ireland | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Direct | % Diff (Total-Direct) | Total | Total | Direct | % Diff (Total-Direct) | Total | Total | Direct | % Diff (Total-Direct) | Total | Total | Direct | % Diff (Total-Direct) | Total | Total | Direct | % Diff (Total-Direct) |
| 7351 | | 8076 | | 8076 | | 8968 | | 8968 | | 8186 | | 8186 | | 7948 | | 7948 | |
| 65.20 | -14.8% | 207.05 | | 10.86 | -94.8% | 172.96 | | 17.88 | -89.7% | 107.76 | | 72.79 | -32.5% | 249.72 | | 127.83 | -48.8% |
| 0.9% | | 2.6% | | 0.1% | | 1.9% | | 0.2% | | 1.3% | | 0.9% | | 3.1% | | 1.6% | |
| 4.88 | 21.6% | 0.30 | | 0.12 | -59.1% | 12.66 | | 3.76 | -70.3% | 52.60 | | 38.30 | -27.2% | 0.57 | | 0.06 | -89.3% |
| 0.1% | | 0.0% | | 0.0% | | 0.1% | | 0.0% | | 0.6% | | 0.5% | | 0.0% | | 0.0% | |
| 69.15 | -35.0% | 269.39 | | 45.50 | -83.1% | 243.00 | | 49.30 | -79.7% | 187.59 | | 123.64 | -34.1% | 343.18 | | 204.19 | -40.5% |
| 0.9% | | 3.3% | | 0.6% | | 2.7% | | 0.5% | | 2.3% | | 1.5% | | 4.3% | | 2.6% | |
| 8.86 | -50.2% | 0.00 | | 0.84 | 36138.5% | 1.99 | | 0.50 | -75.0% | 22.82 | | 38.18 | 67.4% | 17.64 | | 18.89 | 7.1% |
| 0.1% | | 0.0% | | 0.0% | | 0.0% | | 0.0% | | 0.3% | | 0.5% | | 0.2% | | 0.2% | |
| 8.38 | -25.6% | 7.61 | | 0.03 | -99.6% | 0.09 | | 0.25 | 186.3% | 13.85 | | 15.67 | 13.1% | 0.44 | | 0.30 | -30.3% |
| 0.1% | | 0.1% | | 0.0% | | 0.0% | | 0.0% | | 0.2% | | 0.2% | | 0.0% | | 0.0% | |
| 13.50 | -2.7% | 83.69 | | 6.40 | -92.3% | 96.78 | | 2.65 | -97.3% | 2.73 | | 3.14 | 15.1% | 71.33 | | 39.62 | -44.5% |
| 0.2% | | 1.0% | | 0.1% | | 1.1% | | 0.0% | | 0.0% | | 0.0% | | 0.9% | | 0.5% | |
| 11.05 | -50.0% | 41.89 | | 4.64 | -88.9% | 0.06 | | 11.19 | 19466.3% | 64.45 | | 48.83 | -24.2% | 1.79 | | 13.07 | 629.9% |
| 0.2% | | 0.5% | | 0.1% | | 0.0% | | 0.1% | | 0.8% | | 0.6% | | 0.0% | | 0.2% | |
| 563.15 | -7.4% | 240.88 | | 66.00 | -72.6% | 290.32 | | 99.81 | -65.6% | 280.31 | | 256.46 | -8.5% | 163.53 | | 47.86 | -70.7% |
| 7.7% | | 3.0% | | 0.8% | | 3.2% | | 1.1% | | 3.4% | | 3.1% | | 2.1% | | 0.6% | |
| 24.29 | -12.8% | 22.28 | | 7.45 | -66.6% | 92.57 | | 2.30 | -97.5% | 19.44 | | 21.34 | 9.8% | 1.87 | | 1.48 | -20.9% |
| 0.3% | | 0.3% | | 0.1% | | 1.0% | | 0.0% | | 0.2% | | 0.3% | | 0.0% | | 0.0% | |
| 145.81 | -24.0% | | 1723.62 | 1199.00 | -30.4% | | 1890.22 | 1372.64 | -27.4% | | 321.94 | 269.50 | -16.3% | | 168.07 | 84.97 | -49.4% |
| 2.0% | | | 21.3% | 14.8% | | | 21.1% | 15.3% | | | 3.9% | 3.3% | | | 2.1% | 1.1% | |

| Italy | | | | Luxembourg | | | | New Zealand | | | | Norway | | | | Portu |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total | Total | Direct | % Diff (Total-Direct) | Total | Total | Direct | % Diff (Total-Direct) | Total | Total | Direct | % Diff (Total-Direct) | Total | Total | Direct | % Diff (Total-Direct) | Total | Total |
| 7979 | | 7979 | | 9641 | | 9641 | | 10220 | | 10220 | | 10112 | | 10112 | | 8725 | |
| 154.07 | | 7.81 | -94.9% | 231.11 | | 86.03 | -62.8% | 272.88 | | 197.54 | -27.6% | 339.47 | | 234.20 | -31.0% | 86.03 | |
| 1.9% | | 0.1% | | 2.4% | | 0.9% | | 2.7% | | 1.9% | | 3.4% | | 2.3% | | 1.0% | |
| 17.90 | | 10.85 | -39.4% | 15.13 | | 1.62 | -89.3% | 11.28 | | 4.28 | -62.1% | 20.03 | | 20.61 | 2.9% | 0.99 | |
| 0.2% | | 0.1% | | 0.2% | | 0.0% | | 0.1% | | 0.0% | | 0.2% | | 0.2% | | 0.0% | |
| 231.16 | | 20.84 | -91.0% | 304.53 | | 68.21 | -77.6% | 372.59 | | 201.85 | -45.8% | 484.33 | | 339.84 | -29.8% | 475.22 | |
| 2.9% | | 0.3% | | 3.2% | | 0.7% | | 3.6% | | 2.0% | | 4.8% | | 3.4% | | 5.4% | |
| 20.88 | | 0.18 | -99.1% | 0.17 | | 1.99 | 1075.1% | 10.34 | | 2.32 | -77.6% | 1.37 | | 0.55 | -59.9% | 10.52 | |
| 0.3% | | 0.0% | | 0.0% | | 0.0% | | 0.1% | | 0.0% | | 0.0% | | 0.0% | | 0.1% | |
| 0.58 | | 0.77 | 31.6% | 13.64 | | 3.75 | -72.5% | 11.63 | | 19.38 | 66.6% | 13.59 | | 17.47 | 28.6% | 7.61 | |
| 0.0% | | 0.0% | | 0.1% | | 0.0% | | 0.1% | | 0.2% | | 0.1% | | 0.2% | | 0.1% | |
| 140.46 | | 14.59 | -89.6% | 173.93 | | 99.91 | -42.6% | 90.51 | | 27.51 | -69.6% | 28.96 | | 11.57 | -60.0% | 298.78 | |
| 1.8% | | 0.2% | | 1.8% | | 1.0% | | 0.9% | | 0.3% | | 0.3% | | 0.1% | | 3.4% | |
| 2.95 | | 3.40 | 15.1% | 42.46 | | 1.27 | -97.0% | 7.21 | | 3.97 | -45.0% | 2.16 | | 8.23 | 280.5% | 182.14 | |
| 0.0% | | 0.0% | | 0.4% | | 0.0% | | 0.1% | | 0.0% | | 0.0% | | 0.1% | | 2.1% | |
| 248.56 | | 36.05 | -85.5% | 305.64 | | 148.95 | -51.3% | 389.70 | | 218.39 | -44.0% | 482.49 | | 433.98 | -10.1% | 177.79 | |
| 3.1% | | 0.5% | | 3.2% | | 1.5% | | 3.8% | | 2.1% | | 4.8% | | 4.3% | | 2.0% | |
| 10.97 | | 2.98 | -72.8% | 361.44 | | 199.90 | -44.7% | 213.26 | | 191.79 | -10.1% | 50.58 | | 45.82 | -9.4% | 6.84 | |
| 0.1% | | 0.0% | | 3.7% | | 2.1% | | 2.1% | | 1.9% | | 0.5% | | 0.5% | | 0.1% | |
| | 2587.97 | 2074.69 | -19.8% | | 2169.72 | 1133.52 | -47.8% | | 393.86 | 180.77 | -54.1% | | 254.75 | 152.67 | -40.1% | | 1370.39 |
| | 32.4% | 26.0% | | | 22.5% | 11.8% | | | 3.9% | 1.8% | | | 2.5% | 1.5% | | | 15.7% |

| gal | | | Spain | | | | Sweden | | | | Switzerland | | | | United Kingdom | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Direct | % Diff (Total-Direct) | Total | Total | Direct | % Diff (Total-Direct) | Total | Total | Direct | % Diff (Total-Direct) | Total | Total | Direct | % Diff (Total-Direct) | Total | Total | Direct | % Diff (Total-Direct) |
| 8725 | | 7176 | | 7176 | | 8172 | | 8172 | | 9163 | | 9163 | | 9204 | | 9204 | |
| 21.82 | -74.6% | 165.20 | | 70.62 | -57.3% | 183.82 | | 112.61 | -38.7% | 316.56 | | 79.87 | -74.8% | 379.89 | | 179.08 | -52.9% |
| 0.3% | | 2.3% | | 1.0% | | 2.2% | | 1.4% | | 3.5% | | 0.9% | | 4.1% | | 1.9% | |
| 0.06 | -93.6% | 15.63 | | 2.97 | -81.0% | 3.51 | | 5.60 | 59.4% | 14.30 | | 16.92 | 18.4% | 3.48 | | 15.11 | 334.6% |
| 0.0% | | 0.2% | | 0.0% | | 0.0% | | 0.1% | | 0.2% | | 0.2% | | 0.0% | | 0.2% | |
| 119.85 | -74.8% | 243.11 | | 121.48 | -50.0% | 364.07 | | 255.31 | -29.9% | 597.37 | | 128.39 | -78.5% | 372.22 | | 118.77 | -68.1% |
| 1.4% | | 3.4% | | 1.7% | | 4.5% | | 3.1% | | 6.5% | | 1.4% | | 4.0% | | 1.3% | |
| 4.53 | -57.0% | 1.30 | | 0.71 | -44.8% | 12.13 | | 24.01 | 97.9% | 1.44 | | 0.01 | -99.0% | 20.73 | | 7.05 | -66.0% |
| 0.1% | | 0.0% | | 0.0% | | 0.1% | | 0.3% | | 0.0% | | 0.0% | | 0.2% | | 0.1% | |
| 3.56 | -53.3% | 6.40 | | 6.92 | 8.2% | 10.54 | | 10.29 | -2.3% | 0.32 | | 1.13 | 248.1% | 1.29 | | 2.88 | 123.9% |
| 0.0% | | 0.1% | | 0.1% | | 0.1% | | 0.1% | | 0.0% | | 0.0% | | 0.0% | | 0.0% | |
| 105.45 | -64.7% | 84.82 | | 50.84 | -40.1% | 30.83 | | 12.85 | -58.3% | 16.33 | | 8.37 | -48.8% | 131.41 | | 59.81 | -54.5% |
| 1.2% | | 1.2% | | 0.7% | | 0.4% | | 0.2% | | 0.2% | | 0.1% | | 1.4% | | 0.6% | |
| 29.90 | -83.6% | 0.40 | | 15.43 | 3796.3% | 1.25 | | 4.20 | 236.0% | 25.01 | | 3.74 | -85.1% | 1.18 | | 5.26 | 345.5% |
| 0.3% | | 0.0% | | 0.2% | | 0.0% | | 0.1% | | 0.3% | | 0.0% | | 0.0% | | 0.1% | |
| 79.11 | -55.5% | 159.02 | | 116.16 | -27.0% | 342.88 | | 293.59 | -14.4% | 205.18 | | 66.51 | -67.6% | 161.04 | | 127.83 | -20.6% |
| 0.9% | | 2.2% | | 1.6% | | 4.2% | | 3.6% | | 2.2% | | 0.7% | | 1.7% | | 1.4% | |
| 0.06 | -99.1% | 6.54 | | 1.96 | -69.9% | 149.80 | | 82.46 | -45.0% | 457.55 | | 251.82 | -45.0% | 14.87 | | 5.41 | -63.6% |
| 0.0% | | 0.1% | | 0.0% | | 1.8% | | 1.0% | | 5.0% | | 2.7% | | 0.2% | | 0.1% | |
| 673.64 | -50.8% | | 251.42 | 92.37 | -63.3% | | 202.46 | 103.67 | -48.8% | | 2198.10 | 1319.66 | -40.0% | | 629.44 | 257.40 | -59.1% |
| 7.7% | | | 3.5% | 1.3% | | | 2.5% | 1.3% | | | 24.0% | 14.4% | | | 6.8% | 2.8% | |

| United States | | | | Germany | | | | Austria | | | | South Korea | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total | Total | Direct | % Diff (Total-Direct) | Total | Total | Direct | % Diff (Total-Direct) | Total | Total | Direct | % Diff (Total-Direct) | Total | Total | Direct | % Diff (Total-Direct) |
| 9698 | | 9698 | | 9036 | | 9036 | | 8335 | | 8335 | | 5378 | | 5378 | |
| 67.91 | | 43.02 | -36.7% | 225.54 | | 24.17 | -89.3% | 230.77 | | 33.99 | -85.3% | 24.81 | | 0.03 | -99.9% |
| 0.7% | | 0.4% | | 2.5% | | 0.3% | | 2.8% | | 0.4% | | 0.5% | | 0.0% | |
| 2.04 | | 2.06 | 1.0% | 3.44 | | 0.06 | -98.3% | 4.05 | | 0.08 | -98.1% | 6.01 | | 0.10 | -98.3% |
| 0.0% | | 0.0% | | 0.0% | | 0.0% | | 0.0% | | 0.0% | | 0.1% | | 0.0% | |
| 169.53 | | 54.52 | -67.8% | 429.44 | | 30.62 | -92.9% | 237.27 | | 44.08 | -81.4% | 42.15 | | 0.22 | -99.5% |
| 1.7% | | 0.6% | | 4.8% | | 0.3% | | 2.8% | | 0.5% | | 0.8% | | 0.0% | |
| 1.85 | | 0.38 | -79.2% | 88.08 | | 6.84 | -92.2% | 5.26 | | 5.15 | -2.1% | 32.87 | | 6.50 | -80.2% |
| 0.0% | | 0.0% | | 1.0% | | 0.1% | | 0.1% | | 0.1% | | 0.6% | | 0.1% | |
| 170.56 | | 106.75 | -37.4% | 1.27 | | 1.65 | 29.7% | 2.73 | | 0.82 | -69.9% | 2.80 | | 0.32 | -88.7% |
| 1.8% | | 1.1% | | 0.0% | | 0.0% | | 0.0% | | 0.0% | | 0.1% | | 0.0% | |
| 133.30 | | 52.68 | -60.5% | 47.64 | | 18.32 | -61.5% | 20.95 | | 0.35 | -98.3% | 37.34 | | 7.93 | -78.8% |
| 1.4% | | 0.5% | | 0.5% | | 0.2% | | 0.3% | | 0.0% | | 0.7% | | 0.1% | |
| 140.43 | | 1.49 | -98.9% | 8.98 | | 7.50 | -16.4% | 5.21 | | 7.48 | 43.5% | 32.21 | | 1.59 | -95.1% |
| 1.4% | | 0.0% | | 0.1% | | 0.1% | | 0.1% | | 0.1% | | 0.6% | | 0.0% | |
| 205.50 | | 171.46 | -16.6% | 258.75 | | 71.65 | -72.3% | 165.67 | | 21.21 | -87.2% | 66.29 | | 13.40 | -79.8% |
| 2.1% | | 1.8% | | 2.9% | | 0.8% | | 2.0% | | 0.3% | | 1.2% | | 0.2% | |
| 19.67 | | 22.78 | 15.8% | 209.35 | | 92.46 | -55.8% | 200.66 | | 36.35 | -81.9% | 0.00 | | 683.83 | #DIV/0! |
| 0.2% | | 0.2% | | 2.3% | | 1.0% | | 2.4% | | 0.4% | | 0.0% | | 12.7% | |
| | 1624.11 | 1014.68 | -37.5% | | 3749.64 | 2912.69 | -22.3% | | 1586.96 | 1191.89 | -24.9% | | 0.00 | 0.00 | #DIV/0! |
| | 16.7% | 10.5% | | | 41.5% | 32.2% | | | 19.0% | 14.3% | | | 0.0% | 0.0% | |

Table 8. Variance decomposition by standardization and stratification of national education systems

| | Non-Standardized | | | | Standardized | | | | Non-Stratified | | | | Moderately Stratified | | | | Highly Stratified | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Total | Total | Direct | % Diff (Total-Direct) | Total | Total | Direct | % Diff (Total-Direct) | Total | Total | Direct | % Diff (Total-Direct) | Total | Total | Direct | % Diff (Total-Direct) | Total | Total | Direct | % Diff (Total-Direct) |
| ***Variance in Reading Achievement*** | 9431 | | 9431 | | 8691 | | 8691 | | 9025 | | 9025 | | 8752 | | 8752 | | 8899 | | 8899 | |
| ***Family Variables*** | | | | | | | | | | | | | | | | | | | | |
| Mother's Occupational Status (ISEI) | 164.48 | | 133.20 | -19.0% | 175.93 | | 84.84 | -51.8% | 199.54 | | 166.55 | -16.5% | 140.93 | | 61.69 | -56.2% | 227.97 | | 49.31 | -78.4% |
| | 1.7% | | 1.4% | | 2.0% | | 1.0% | | 2.2% | | 1.8% | | 1.6% | | 0.7% | | 2.6% | | 0.6% | |
| Mother Completed Tertiary Education | 1.00 | | 1.16 | 15.9% | 1.49 | | 1.08 | -27.0% | 3.73 | | 3.28 | -12.1% | 0.13 | | 0.54 | 327.7% | 1.88 | | 0.42 | -77.5% |
| | 0.0% | | 0.0% | | 0.0% | | 0.0% | | 0.0% | | 0.0% | | 0.0% | | 0.0% | | 0.0% | | 0.0% | |
| Father's Occupational Status (ISEI) | 244.59 | | 144.36 | -41.0% | 246.63 | | 98.51 | -60.1% | 232.10 | | 151.93 | -34.5% | 199.69 | | 93.37 | -53.2% | 401.63 | | 56.16 | -86.0% |
| | 2.6% | | 1.5% | | 2.8% | | 1.1% | | 2.6% | | 1.7% | | 2.3% | | 1.1% | | 4.5% | | 0.6% | |
| Father Completed Tertiary Education | 3.87 | | 1.34 | -65.5% | 14.23 | | 3.11 | -78.2% | 4.83 | | 1.93 | -60.1% | 6.49 | | 2.32 | -64.2% | 58.61 | | 7.82 | -86.7% |
| | 0.0% | | 0.0% | | 0.2% | | 0.0% | | 0.1% | | 0.0% | | 0.1% | | 0.0% | | 0.7% | | 0.1% | |
| Father Present | 77.12 | | 57.29 | -25.7% | 0.98 | | 0.32 | -67.0% | 54.32 | | 42.83 | -21.1% | 0.86 | | 0.29 | -66.6% | 1.47 | | 0.53 | -63.8% |
| | 0.8% | | 0.6% | | 0.0% | | 0.0% | | 0.6% | | 0.5% | | 0.0% | | 0.0% | | 0.0% | | 0.0% | |
| Number of Siblings | 133.28 | | 87.71 | -34.2% | 56.56 | | 25.23 | -55.4% | 96.74 | | 66.12 | -31.6% | 77.84 | | 31.65 | -59.3% | 44.83 | | 18.86 | -57.9% |
| | 1.4% | | 0.9% | | 0.7% | | 0.3% | | 1.1% | | 0.7% | | 0.9% | | 0.4% | | 0.5% | | 0.2% | |
| Family Wealth | 44.29 | | 5.29 | -88.1% | 13.29 | | 1.88 | -85.8% | 55.76 | | 11.63 | -79.1% | 30.69 | | 5.14 | -83.2% | 9.79 | | 7.32 | -25.3% |
| | 0.5% | | 0.1% | | 0.2% | | 0.0% | | 0.6% | | 0.1% | | 0.4% | | 0.1% | | 0.1% | | 0.1% | |
| ***Student Control Variables*** | | | | | | | | | | | | | | | | | | | | |
| Female | 207.09 | | 184.50 | -10.9% | 203.61 | | 146.97 | -27.8% | 212.10 | | 194.91 | -8.1% | 184.65 | | 131.85 | -28.6% | 248.05 | | 121.81 | -50.9% |
| | 2.2% | | 2.0% | | 2.3% | | 1.7% | | 2.3% | | 2.2% | | 2.1% | | 1.5% | | 2.8% | | 1.4% | |
| Foreign Born | 14.55 | | 12.06 | -17.1% | 103.65 | | 62.80 | -39.4% | 11.78 | | 9.68 | -17.8% | 51.80 | | 37.52 | -27.6% | 354.45 | | 196.45 | -44.6% |
| | 0.2% | | 0.1% | | 1.2% | | 0.7% | | 0.1% | | 0.1% | | 0.6% | | 0.4% | | 4.0% | | 2.2% | |
| ***School Variables*** | | | | | | | | | | | | | | | | | | | | |
| School Science Achievement Score | | 1102.03 | 633.32 | -42.5% | | 1502.41 | 1062.46 | -29.3% | | 745.98 | 399.92 | -46.4% | | 1794.62 | 1321.95 | -26.3% | | 2544.88 | 1913.04 | -24.8% |
| | | 11.7% | 6.7% | | | 17.3% | 12.2% | | | 8.3% | 4.4% | | | 20.5% | 15.1% | | | 28.6% | 21.5% | |
| Total Variance for Family Variables | 668.63 | | 430.33 | | 509.10 | | 214.98 | | 647.02 | | 444.27 | | 456.63 | | 194.99 | | 746.19 | | 140.44 | |
| | 7.1% | | 4.6% | | 5.9% | | 2.5% | | 7.2% | | 4.9% | | 5.2% | | 2.2% | | 8.4% | | 1.6% | |