National education systems and gender gaps in STEM occupational expectations

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Abstract

The study examines associations between features of national education systems and the gender gap in STEM-related occupational expectations across 49 countries. Using data from the Program for International Student Assessment (PISA), the study finds no association between uniformity of curricula at the national level (standardization) and the gender gap in STEM occupational expectations; in contrast, the availability of more school types at the secondary level (stratification) is associated with a larger gender gap in STEM occupational expectations. In addition, this positive association between stratified systems and the gender gap in STEM occupational expectations is stronger for top-performers than for low-performers.

Keywords: stratification; standardization; occupational expectations; STEM; gender inequality; PISA

Highlights

- The study examines gender gaps in STEM career expectations in 49 countries.
- Girls are more likely than boys to expect to have health service occupations.
- Boys are more likely than girls to expect to have computing and engineering careers.
- Standardized curricula do not explain the gender gap in STEM career expectations.
- Number of school types is positively linked to the gender gap in STEM career plans.

1. Introduction

Gender gap in science, technology, engineering, and mathematics (STEM) educational and occupational expectations has been the subject of extensive research in education because studies of gender inequality suggest that high school students' expectations of pursuing science/engineering careers is the most important factor in gender differences in the likelihood of majoring in science/engineering in college (Xie & Shauman, 2003). Recent cross-national research has also shown that the size of the gender gap in expressed affinity for mathematics at the eighth-grade level is the most important predictor of gender segregation by field of study, the degree to which men and women in higher education choose different majors, in advanced industrial countries (Charles & Bradley, 2009). These gender differences in college majors can contribute to persisting gender wage gaps (Bobbitt-Zeher, 2007; Gerber & Schaefer, 2004).

A large amount of research in the United States and other countries has focused on individual- and school-level factors, including attitudes toward math, self-assessments, math and science achievement, and gender socialization, in explaining gender gaps in STEM educational and occupational expectations (Correll, 2001; Sikora & Pokropek, 2012b; Xie & Shauman, 2003). In addition to individual-level factors, it is important to examine the extent to which macro-level factors are associated with gender differences in occupational preferences (for example, Xie & Shauman, 1997) because macro-level factors such as the organization of national education systems also affect student achievement as well as attitudes, motivations, and aspirations. A significant rise of large-scale international achievement data, such as the Trends in Mathematics and Science Study (TIMSS) and the Program for International Student Assessment (PISA), offers rich opportunities for researchers to examine national contexts related to gender gaps in STEM educational and occupational expectations across countries. Cross-national

comparative studies have investigated the sources of between-country differences in the gender gap in science-related career expectations (Sikora & Pokropek, 2011, 2012a); this prior research has focused primarily on the level of stratification of secondary education systems in explaining between-country differences. Stratification indicates the degree to which students are sorted into separate school types with clearly differentiated kinds of school curricula (e.g., academic versus vocational schools). While researchers have also proposed that standardization, the degree to which centrally prescribed curricular, learning and assessment standards for all students, teachers, and schools are implemented nationwide, is another key features of the organization of national education systems (Allmendinger, 1989; Kerckhoff, 2001), little is known about the degree to which standardized education systems influence gender differences in STEM occupational expectations. Because prior research has shown that the standardization of educational systems diminishes the effects of social origin on educational outcomes, and the stratification of educational systems perpetuates the effects of social origin on educational outcomes, it is important to consider both standardization and stratification when examining the relationship between national education systems and educational decision making (Van de Werfhorst & Mijs, 2010). I build on earlier research by using the standardization-stratification framework to examine gender gaps in STEM occupational expectations across countries. In addition, I assess the degree to which the association between features of secondary education systems and gender gaps in STEM occupational expectations differs by student ability as well as across STEM subfields.

2. National Education Systems and Gender Gaps in STEM Occupational Expectations: A Comparative Perspective

Following Kerckhoff's (1995, 2001) work on institutional arrangements and stratification processes in industrial societies, a growing body of comparative research has investigated the ways in which the institutional arrangement of educational systems—namely, the level of standardization, stratification, and vocational specificity—affect patterns of educational inequality and occupational attainments (Ayalon & Gamoran, 2000; Kerckhoff, Haney, & Glennie, 2001; Shavit & Blossfeld, 1993; Shavit, Müller, & Tame, 1998); these studies have inspired cross-national research on students' expectations. Standardization refers to the degree to which education systems must meet the same standards throughout a society (Allmendinger, 1989); stratification (differentiation) refers to the degree to which educational systems have distinct curriculum, programs, or tracks, differentiated by academic performance, socioeconomic characteristics, or interests; and vocational specificity refers to the degree to which educational systems offer vocation-specific training opportunities and award vocationally specific credentials (Kerckhoff, 2001). Stratification and vocational specificity overlap to a degree because stratified education systems tend to offer pre-vocational or vocational programs. Within the standardization-stratification framework, the United States and Australian education systems are characterized by low levels of both standardization and stratification, while the Japanese education system is characterized by a high level of standardization but a low level of stratification (Shavit et al., 1998). Germany, the Netherlands, and Switzerland have highly stratified and standardized education systems, while education systems in France and Italy are characterized by high levels of standardization and moderate levels of stratification (Shavit et al., 1998).

Using these three features of national education systems (standardization, stratification, and vocational specificity), prior research has expanded the focus from educational and

occupational attainments to educational and occupational expectations. These studies have examined the extent to which the structural features of national education systems affect the educational and occupational expectations of students from different social backgrounds (Buchmann & Dalton, 2002; Buchmann & Park, 2009). Recently, studies in this area have attempted to document cross-national differences in gender gaps and determine which features of national education systems are associated with these gender gaps (McDaniel, 2010; Sikora & Pokropek, 2011, 2012a). This research has focused primarily on the extent to which stratification in educational systems explains cross-national variation in gender gaps in educational and occupational expectations. The empirical evidence suggests that while the level of stratification in a country's secondary education system (as measured by the number of school types available to 15-year-old students) is negatively associated with students' expectations, this association is consistent across student gender (McDaniel, 2010). That is, both boys and girls have lower educational expectations in stratified educational systems than in non-stratified educational systems.

In addition to gender gaps in the vertical dimension of educational and occupational expectations (e.g., expectations of completing a bachelor's degree or above, plans to be a highly qualified professional such as a lawyer, medical specialist, or teaching professional), researchers have begun to pay greater attention to gender gaps in the horizontal dimension of expectations (e.g., expecting to have a science-related career versus a career in another field) (Sikora & Pokropek, 2011, 2012a). Recent cross-national studies have shown that the occupational expectations of adolescents remain gender segregated in that boys and girls (at the aggregate level) expect to have careers in different fields (Organisation for Economic Co-operation and Development (OECD) & UNESCO Institute for Statistics, 2003; Sikora & Pokropek, 2011). For

example, among boys and girls who expect to have professional occupations, male students more often expect careers associated with physics, mathematics, or engineering, while female students more often expect careers in the life sciences or health-related professions. This horizontal gender segregation in occupational expectations occurs in almost all OECD member and partner countries, although there is cross-national variation in the magnitude of the gender gaps (Sikora & Pokropek, 2011).

Using stratification to measure cross-national differences in education systems, a few studies have investigated cross-national variation in gender gaps in science-related career expectations (Sikora & Pokropek, 2011, 2012a). In one example, Sikora and Pokropek (2011) determined that the extent of stratification at the national level of education systems (measured by the number of school types available to 15-year-olds) had different consequences for boys and girls. Specifically, a higher level of stratification was associated with a lower chance of expecting a career in computer science or engineering for girls but not boys. However, these studies used only one indicator to measure the stratification level of education systems: the number of school types available to 15-year-olds in each country. Another key feature of stratified education systems is the *early* tracking of students into separate and different curricular tracks¹ (Horn, 2009; Shavit et al., 1998). Highly stratified systems provide more opportunities for gender-differentiated choices and placements by offering gender-typed secondary programs (e.g., health care, education, and industrial design) (Bradley & Charles, 2004; UNESCO., 1995). If these choices and placements occur at younger ages, they may have a greater or lesser influence on gender gaps in STEM occupational expectations because previous research has

¹ The more stratified a system, the earlier the age of selection. However, some countries (e.g., Ireland and Switzerland) have education systems with high number of school types or distinct educational programs available to 15-year-olds but no early sorting into these different programs (OECD 2007a).

indicated that as students get older, perceived ability and interest in math and science decline (Jacobs, Lanza, Osgood, Eccles, & Wigfield, 2002; Watt, 2004) and this downward trend varies by gender (for example, Jacobs et al., 2002; Pajares, 2005).

In contrast to the research focus on the effects of stratification in educational systems, comparative studies of gender inequality have paid little attention to the extent to which the standardization of education systems is associated with cross-national variation in gender gaps in STEM occupational expectations. Since the early 1980s, national education reform in many countries, including the United States and Germany, has focused on improving the quality and equity of student outcomes by increasing the standardization of the education system, specifically by creating and enforcing centrally prescribed curricular, learning, and assessment standards for all students, teachers, and schools (Ertl, 2006; National Commission on Excellence in Education, 1983; OECD, 2010). Several country-level case studies have shown that when education systems allow individual freedom of choice in curriculum, gender segregation tends to increase (Catsambis, 1994; Kontogiannopoulou-Polydorides, 1991; Plateau, 1991). Research on gender inequality in STEM offers several possible explanations of the link between flexible education systems and gender segregation. For example, within more flexible systems girls might be less likely than boys to enroll in physics courses because girls: tend to prefer biology over physics; have less confidence in their ability to succeed in science than boys even when their aptitudes are similar; and are discouraged from pursuing a career in physics during their educational life courses, even in early grades (Correll, 2001; Cunningham, Hoyer, & Sparks, 2015; Ecklund, Lincoln, & Tansey, 2012). Moreover, a recent study showed that a higher level of standardization in a country's secondary system is associated with a reduced gender gap in math test scores because standardized education systems lead to less variation in exposure to

knowledge (Ayalon & Livneh, 2013). These findings suggest that a higher level of standardization might be associated with smaller gender gaps in STEM occupational expectations. Moreover, recent studies showed that the factors that make STEM occupations attractive might differ across student performance levels (Han, 2013, 2015). Understanding the ways in which features of secondary education systems and student performance levels interact as they affect STEM occupational expectations is important because policymakers and researchers in many countries are working to reduce gender inequality in academically talented students' interest in STEM education and occupations.

3. The Present Study

The purpose of the present study is to examine gender gaps in STEM occupational expectations across countries as well as the association between these gender gaps and the features of secondary education systems. While a small number of comparative studies have examined how differences in national education systems are linked to gendered science career expectations (Sikora & Pokropek, 2011, 2012a), these studies focused on only one feature of national education systems: *the number of schools types available to students*. I expand on the literature by addressing three research objectives.

First, I examine the degree to which the level of standardization in a country's secondary education system is associated with gender gaps in STEM occupation expectations. Second, I investigate the extent to which the level of stratification in educational systems is associated with cross-national variation in gender gaps in STEM occupational expectations, when other features of education systems are held constant. Third, I assess the degree to which the association between features of secondary education systems and gender gaps in STEM-related occupational

expectations differ by student ability. This is important because policymakers and researchers in many countries are working to reduce gender gaps in STEM higher education and professional occupations. These three research objectives are addressed by comparing students who expect STEM-related occupations with those who expect non-STEM related occupations.

4. Data and Methods

This study uses data from the PISA 2006, which was administered in OECD member and partner countries. PISA is a triennial survey that measures the knowledge and skills of representative samples of 15-year-old students nearing the end of compulsory education at either public or private schools in each participating country. PISA assessed performance in reading, mathematics, and science literacy. In each PISA survey wave, three subject domains were tested and one of three was assessed as the major domain. PISA 2000 focused on reading; PISA 2003 focused on mathematics; and PISA 2006 focused on science. Unlike other international student achievement data sources, which only collected data on educational expectations, PISA also included information on the occupations students plan to have around age 30. This study focuses on PISA 2006, which assessed scientific literacy as a primary focus. Several countries are excluded from the analyses due to missing data on the dependent variable or key independent variables. First, no data on the dependent variable are available for Qatar in PISA 2006. Second, no data on the characteristics of the Albanian education system are available. Third, no data on the national-level gender inequality indicator, Gender Empowerment Measure (GEM), are available for Chinese Taipei, Hong Kong, Liechtenstein, Luxembourg, Macao-China, and Montenegro. The analytic sample includes 360,264 students from the remaining 49 countries that were surveyed in PISA 2006.

Complete performance data are available for all students who participated in PISA; however, some students failed to answer certain items on the background questionnaire. Among the full sample of 360,264 students, 102,227 students had incomplete responses on the PISA background questionnaires. Because dropping all students with missing data on dependent variables (i.e., students' STEM occupational expectations) or some explanatory variables from the analyses will introduce bias if observations are not missing at random, I implement multiple imputation for missing responses in the PISA student questionnaires (Allison, 2002). Least-squares and logit models were estimated to impute missing values on continuous and categorical variables, respectively. After imputing scores for student background items, a student-level socioeconomic status variable (i.e., PISA index of economic, social and cultural status [ESCS]) was aggregated to measure school-level mean SES.

4.1.Dependent Variables

The outcome measures for the current study are binary variables, each indicating whether or not a student expected to have a certain type of STEM-related occupation around the age of 30. The PISA student questionnaire included a single open-ended question measuring students' occupational expectations: "What kind of job do you expect to have when you are about 30 years old?" Students' responses to this question were manually coded and classified using the International Standard Classification of Occupations 88 (ISCO-88). This study focuses on professional STEM-related occupations that require at least a bachelor's degree at entry (Elias, 1997). The STEM-related fields include mathematics, natural science, engineering/computing, and health services such as health professionals excluding nursing-related professionals (see Appendix 2). Because prior research has indicated that boys and girls, on average, expect to have science-related careers in different STEM subfields, this study also examines expectations

separately for two STEM subfields: (a) computing and engineering (CE) and (b) health services excluding nursing (HS) (Sikora & Pokropek, 2011).

4.2. Country-Level Independent Variables

The main independent variables in this study are country-level indicators of the characteristics of national education systems. These variables include:

Standardization of educational systems. This study uses the data from Montt's (2011) classification of curricular policies. He classified curricular policies of each country into three groups: (a) countries in which there is no central government control over the curriculum (coded 0), (b) countries in which regional or local agencies have some ability to adapt a centrally prescribed curriculum (coded 1), and (c) countries in which the central government determines the curriculum (coded 2).

Stratification of educational systems. The level of stratification of each education system was measured by: (1) the number of school types or distinct educational programs available to 15-year-old students in each country (number of school type), and (2) the age of first selection into different school types or tracks (early tracking). Among the PISA-participating countries, the number of school types ranged from one to five. The age of first selection is a dummy variable for early tracking, coded 1 when countries sort students into different tracks before the age of 14, and 0 otherwise. The source of data for both indicators is the OECD report (2007b, p. 162). These two indicators were reported by the PISA National Project Manager for each country participating in PISA.

4.3. Other Control Variables

Gender empowerment measure (GEM). The Gender Empowerment Measure (GEM) is a internationally comparable composite index of the level of gender inequality. The measure was developed by the United Nations Development Programme (UNDP) and is based on three basic

dimensions of women's empowerment: political participation and decision making, participation in high-paying positions with economic power, and income relative to men. The GEM ranges from 0 to 1, with higher values indicating more gender equality. In 2006, Norway was ranked as the most gender equal society (GEM 0.932). It was followed by Sweden (0.883), Iceland (0.866), Denmark (0.861), Belgium (0.855) and Finland (0.853). Among OECD member countries, Turkey (0.289) ranked last in terms of gender equality. Korea (0.502), Chile (0.502), and Japan (0.557) were respectively second, third and fourth to last.

National economic development and educational investment. I use gross domestic product (GDP) per capita (in current U.S. dollars) for the year 2006 to capture national economic development levels, and public education expenditures per secondary education student as a percent of the GDP per capita for the year 2006 to indicate the level of educational investment. The former indicator was collected from the World Bank (<http://data.worldbank.org/indicator/NY.GDP.PCAP.CD>) and the latter was collected from the United Nations Educational, Scientific and Cultural Organization (UNESCO) Institute for Statistics (<http://data.uis.unesco.org/?queryid=181>).

Student- and school-level control variables. At the student level, I control for gender, grade level, parental educational attainment, parental occupational status, number of books at home, immigration background of both students and parents, whether parents have STEM-field occupations, and science literacy score. At the school level, I control for the school's socio-economic composition, through an indicator of school-level mean SES.

4.4. Analytic Strategy

To investigate cross-national variation in students' STEM occupational expectations and the association between this variation and macro-level features of education systems, this study uses three-level hierarchical generalized linear models (HGLMs) in which students (level 1) are

nested within schools (level 2) and within countries (level 3). Because the dependent variable (whether or not a student expects to have a STEM-related occupation around age 30) is binary, the study employs HGLMs in which the level 1 sampling model is a Bernoulli distribution (Raudenbush & Bryk, 2002). The country weight factor for normalized weights (multi-level analysis), CNTFAC, is used to ensure that each country contributes equally to the analysis (OECD, 2009, p. 368).

Model Specification for Three-Level HGLM

Level 1 (Student-level)

$$\eta_{ijk} = \log[\varphi_{ijk} / (1 - \varphi_{ijk})] = \pi_{0jk} + \pi_{1jk}(\text{Female}) + \pi_{2jk}(\text{Parent.STEM} - \text{Occp}) + \pi_{3jk}(\text{Immigrant.Background}) + \pi_{4jk}(\text{Grade}) + \dots + \pi_{Pjk}(\text{Student.PredictorP})$$

where φ_{ijk} is the probability that a student i in school j in country k expects to have a STEM-related occupation around age 30, and η_{ijk} is the log odds that a student i in school j in country k expects to have a STEM-related occupation around age 30.

Level 2 (School-level)

$$\pi_{0jk} = \beta_{00k} + \beta_{01k}(\text{Sch.SES}) + r_{0jk}$$

$$\pi_{1jk} = \beta_{10k} + r_{1jk}$$

$$\pi_{21jk} = \beta_{20k}, \pi_{3jk} = \beta_{30k}, \pi_{4jk} = \beta_{40k}, \dots, \pi_{Pjk} = \beta_{P0k}$$

Level 3 (Country-level)

$$\beta_{00k} = \gamma_{000} + \gamma_{001}(\text{Country.predictor1})_k \dots + \gamma_{00P}(\text{Country.predictorP})_k + u_{00k}$$

$$\beta_{10k} = \gamma_{100} + \gamma_{101}(\text{Country.predictor1})_k \dots + \gamma_{10P}(\text{Country.predictorP})_k + u_{10k}$$

$$\beta_{20k} = \gamma_{200}, \beta_{30k} = \gamma_{300}, \beta_{40k} = \gamma_{400}, \dots, \beta_{P0k} = \gamma_{P00}$$

Using cross-level interactions between female gender and the country-level measures of characteristics of secondary education systems (γ_{10P}), I assess the extent to which gender gaps in STEM occupational expectations are associated with the features of national education systems. To examine possible interactions between student performance and the features of secondary

education systems, the three-level HGLMs are run separately by science performance quartile.²

This approach reveals whether the associations between the features of secondary education systems and gender gaps in STEM occupational expectations differ at various levels of academic performance.

5. Results

The first step in the analysis is to examine the association between the features of national education systems and STEM occupational expectations by using full sample of students. I fit three-level HGLM models examining this question, the results of which are displayed in Table 1. The models contain both student-level and school-level variables including gender, grade level, parental educational attainment and occupational status, immigrant status, and the school's socio-economic composition. The primary purpose of entering these variables in the model is to control for differences of student and school characteristics. The first column in Table 1 displays the coefficients for STEM occupational expectations; the second and the third columns show results, respectively, for computing and engineering (CE) and health service (HS) occupational expectations. Appendix 2 contains a detailed list of the occupational titles included in the CE and HS categories. The model results show the likelihoods of expecting STEM-, CE-, and HS-related occupations relative to non-STEM, non-CE, and non-HS related occupations, respectively.

² PISA adopted a balanced incomplete block design for assessment; this method pairs every block with every other block, but does not include all possible orderings of block pairs. Because of this design, PISA student test scores were estimated as five plausible values. I use the each plausible value for science scores to create country-specific performance quartiles in each imputed data set (the first plausible value in the first imputed data set, the second plausible value in the second imputed data set, and so on), and thus cut-off scores for performance quartile varies across countries. I use this approach because I assume that students considering their future occupational expectations will compare their performance with that of their peers in their home country.

5.1. Individual Characteristics and Gender Gaps in STEM Occupational Expectations

The analytic results show that gender segregation in occupational expectations for STEM subfields is consistent across countries. Computing and engineering (CE) occupational expectations are higher for boys than for girls, although the magnitude of this gender gap varies across countries. In contrast to CE occupational expectations, health service (HS) occupational expectations are higher among girls than boys in almost all of the countries studied; but just as for CE expectations, the magnitude of the gender gap varies across countries. This pattern of gender differences in STEM occupational expectations remains even when student, school, and national characteristics are taken into account. After controlling for all individual-, school-, and country-level factors, the overall female odds ratio for CE careers is 0.456, indicating that girls are 54 percent less likely than boys to expect CE occupations (see column 2 in Table 1). Even when the dependent variable is restricted to only computing occupations (i.e., engineering occupations are excluded), girls are less likely than boys to have computing-related occupational plans at age 30 (not reported in Table 1). In contrast, the overall female odds ratio for HS careers is 2.835, suggesting that girls are 2.8 times more likely than boys to expect HS occupations. For both CE and HS occupations, the magnitude of the gender gap in occupational expectations varies across countries (see the country-level variance components for girls in Table 1).

Next, I assess whether family background is associated with girls' and boys' occupational expectations differently by examining the interactions between each individual-level variable and being female. The presence of significant interaction terms at the individual level would explain part of the gender gaps in STEM-related occupational expectations (although it would not explain cross-national gender differences in STEM occupational expectations). The association between second-generation immigrant status and computing and engineering (CE) career

expectations varies by gender, whereas the association between second-generation immigration status and health service (HS) career expectations does not vary by gender. As shown in Table 1, the interaction between female and immigration status is significant and negative for CE careers, indicating that the association between immigrant status and CE occupational expectations is stronger for boys than girls. For boys, the second-generation immigrant student odds ratio for CE is 1.197, indicating that second-generation immigrant boys are 20 percent more likely than native boys to expect CE occupations. The second-generation immigrant girls odds ratio for CE is 0.997 (second-generation $[b=0.180]$ + female x second-generation $[b=-0.183] = -0.003$), indicating that for girls, there is no difference between second-generation immigrant and native students in the odds of expecting CE careers. In contrast, the interaction term between female and immigrant status for HS careers is not statistically significant, indicating that the association between immigration status and health service (HS) occupational expectations is consistent across gender. For boys, the second-generation student odds ratio is 1.621, indicating that second-generation boys are 62 percent more likely than native boys to expect HS related occupations. The second-generation immigrant girls odds ratio for HS is 1.464 (second-generation $[b=0.483]$ + female x second-generation $[b=-0.102] = 0.381$), indicating that second-generation immigrant girls are 46 percent more likely than native girls to expect HS occupation. Thus, among both boys and girls, second-generation immigrants are more likely than native students to expect HS careers.

The results provide partial evidence that parental occupations are associated with boys' and girls' STEM-related occupational expectations in different ways. Parental occupations are measured via two indicators in this study: (a) whether parents have STEM-related occupations that require an associate degree at job entry and (b) a Standard International Socio-Economic Index of Occupational Status. For boys, the odds ratio for having a parent in a STEM occupation

is 1.330, indicating that having a parent in a STEM occupation increases boys' likelihood of expecting STEM-related occupations by 33 percent. For girls, the effect is smaller (having a parent in a STEM occupation [$b=0.285$] + female x having a parent in a STEM occupation [$b=-0.077$] = 0.208): having a parent in a STEM career increases the likelihood of expecting a STEM occupation by only 23 percent. This pattern suggests that having a parent in a STEM-related occupation is positively associated with a student's STEM-related occupational expectations and that this association is stronger for boys than girls. In contrast, having a parent in a focal STEM subfield (computing and engineering [CE] or health service [HS]) is positively associated with a student's career expectations in that subfield but there are no gender differences in these associations. Having a parent in a CE occupation, for example, increases boys' and girls' likelihood of expecting CE-related occupations by 21 percent and 15 percent, respectively. Higher parental occupational status (as measured on a gradational continuous scale) is linked to a higher likelihood of having STEM-related occupational expectations; this overall positive association is stronger for boys than girls and differs across STEM subfields. There is no gender difference in the positive association between parental occupational status and CE occupational expectations, while parental influence on HS occupational expectations is stronger for boys than girls.

5.2.National Education Systems and Gender Gaps in STEM Occupational Expectations

I next use cross-level interactions between female gender and the country-level variables to assess the extent to which cross-national variation in gender gaps in STEM occupational expectations is associated with the features of secondary education systems. The results provide no support for an association between the degree of standardization in education systems and the

magnitude of gender gaps in STEM occupational expectations, after controlling for all individual-, school-, and country-level factors. As shown in column 1 in Table 1, neither the main coefficients for standardization nor their interactions with female gender are statistically significant. Mirroring these overall results, the level of standardization is not associated with either computing and engineering (CE) or health service (HS) occupational expectations for either boys or girls. These results suggest that highly standardized systems are not linked to cross-national variation in gender gaps in the two focal STEM subfields.

I next examine the extent to which cross-national variation in gender gaps in STEM occupational expectations is associated with the level of stratification of education systems (controlling for other features of national education systems, namely standardization). By examining the cross-level interaction terms between female gender and the level of stratification, I assess whether the association between STEM occupational expectations and stratification varies by gender. The degree of stratification of education systems is measured via two indicators in this study: (a) the number of school types available to 15-year-old students, and (b) the presence of an early tracking system (implemented before age 14).

The analytical results provide some evidence that a higher level of stratification is linked to lower STEM occupational expectations for girls but not boys. In particular, number of school types has a negative association with girls' STEM related-occupational expectations (but not boys' expectations). Early tracking, however, is not associated with either boys' or girls' expectations in a significant way. As shown in Table 1, for general STEM-related occupational expectations, the coefficient for the interaction between female gender and the number of school types is significant and negative, while the main coefficient for the number of school types is also negative, but statistically insignificant. For boys, the number of school types is not

associated with STEM-related occupational expectations. For girls, however, each additional number of school types available to 15-year-olds is associated with a 16 percent decrease in the odds of expecting to have a STEM-related occupation (number of school types $[b=-0.068] + \text{female} \times \text{number of school types} [b=-0.111] = -0.179$).

Further analyses reveal that the negative interaction between female gender and stratification differs across STEM subfields (see columns 2 and 3 in Table 1). Mirroring the results for general STEM-related occupational expectations, the results for computing and engineering (CE) occupations provide partial evidence that a higher level of stratification is linked to lower occupational expectations among girls but not boys: number of school types has a negative association with girls' CE related-occupational expectations (but not boys' expectations), whereas early tracking is not associated with either boys' or girls' expectations in a significant way. The coefficient for the main effect of the number of school types is close to zero, but the interaction term between female gender and the number of school types is negative and significant. This result suggests that boys' CE occupational expectations remain constant across levels of stratification, but girls' expectations decrease as stratification increases. For girls, each additional number of school types available to 15-year-olds is associated with a 12 percent decrease in the odds of expecting to have a CE occupation (number of school types $[b=0.017] + \text{female} \times \text{number of school types} [b=-0.145] = -0.128$).

This negative association between stratification and gender gaps in CE occupational expectations varies across science performance levels. The results in Table 2 reveal that higher levels of stratification (measured by the numb of school types) are linked to a larger gender gap in CE occupational expectations among top-quartile performers in science. For top-quartile boys, the number of school types is not associated with CE occupational expectations. For top-quartile

girls, however, each additional number of school types is linked to a 10 percent decrease in the odds of expecting a CE occupation (number of school types $[b=0.060]$ + female x number of school types $[b=-0.169] = -0.109$). In contrast, the results for upper-middle, lower-middle, and bottom quartile students show that neither the main coefficients for number of school types nor the interactions between female gender and stratification are statistically significant in the CE occupational expectation models. These results suggest that while the level of stratification of educational systems is not linked to cross-national variation in gender gaps in CE occupational expectations among students in the upper-middle through bottom-quartile students in science performance, it is positively associated with gender gaps in CE occupational expectations among academically strong performers in science. Figure 1 depicts the predicted probabilities of expectations for CE occupations for boys and girls by number of school types available to 15-year-olds, when all variables are held constant at the grand mean. As shown in the upper panel of Figure 1, among students who are academically talented in science, boys are more likely to have CE occupational expectations. In addition, higher levels of stratification are linked to larger gender gaps in CE occupational expectations.

In contrast to the results for CE occupations, the results for health services (HS) occupational expectations provide no support for an association between the degree of stratification in education systems and the magnitude of gender gaps. The analytical results show that both boys' and girls' expectations of having an HS occupation are negatively associated with the level of stratification in education systems (see column 3 in Table 1). That is, there is a negative association that does not vary by gender. For boys, each additional number of school types is associated with a 15 percent decrease in the odds of expecting to have an HS occupation. Similarly, for girls, each additional number of school types is associated with a 17 percent

decrease in the odds of expecting to have an HS occupation (number of school types [$b=-0.169$] + female x number of school types [$b=-0.012$] = -0.181). Early tracking, the second indicator of stratification, is not associated with either boys' or girls' HS expectations in a significant way. This pattern suggests that educational stratification is not associated with cross-national variation in gender gaps in HS occupation expectations.

An association emerges, however, between stratification and gender gaps in HS occupational expectations for some science performance quartiles. As shown in Table 3, for models of HS occupational expectations, the coefficient for the interaction between female gender and number of school types is significant and positive among top-quartile science performers. For boys who are academically talented in science, each additional number of school types is linked to a 15 percent decrease in the odds of expecting an HS occupation. For girls, each additional number of school types is linked to a 9 percent decrease in the odds of expecting an HS occupation (number of school types [$b=-0.161$] + female x number of school types [$b=0.070$] = -0.091). As shown in the lower panel of Figure 1, among students who are academically talented in science, girls are more likely than boys to expect to have an HS occupation, and higher levels of stratification are linked to very slightly larger gender gaps in HS occupational expectations.

However, among upper-middle, lower-middle, and bottom-quartile students, higher levels of stratification are associated with lower expectations for HS occupations. This negative association does not vary by gender, indicating that the extent of stratification is not linked to cross-national variation in gender gaps in HS occupational expectations for upper-middle, lower-middle, and bottom-quartile students. Among upper-middle-quartile students (see column 2 in Table 3), for example, the coefficient for the number of school types is negative and statistically

significant, but the interaction term between gender and number of school types is not statistically significant. These analytical results show that for both boys and girls, expectations of having an HS occupation are negatively associated with the level of stratification in the education system (measured by number of school types). For upper-middle-quartile boys, each additional school type is associated with a 13 percent decrease in the odds of expecting to have an HS occupation. Similarly, for upper-middle-quartile girls, each additional school type is associated with a 16 percent decrease in the odds of expecting to have an HS occupation (number of school types $[b=-0.141] + \text{female} \times \text{number of school types} [b=-0.037] = -0.178$). These patterns indicate that the gender gap in HS occupational expectations among upper-middle-quartile students remains constant across number of school types available to 15-year-old students. Early tracking, another feature of stratified systems, is not associated with HS expectations in a significant way for either boys or girls in the upper-middle quartile. Mirroring the results among upper-middle-quartile students, the findings for lower-middle and bottom-quartile students reveal similar associations between the two stratification measures (number of school types and early tracking) and the gender gap in HS occupational expectations. These results suggest that for upper-middle, lower-middle- and bottom-quartile students, the gender gap in HS occupational expectations is consistent across levels of stratification in secondary education.

6. Discussion and Conclusions

Gender segregation in STEM expectations is a matter of concern for education policymakers and researchers in the United States and other countries because this segregation can lead to gender inequality in STEM postsecondary education and occupations. While a small

number of studies have investigated whether differences in secondary education systems are associated with cross-national variation in the gender gap in science-related career expectations, these studies have limited their focus to curricular stratification in secondary schools. In the current study, I built on earlier research by focusing on two features of secondary education systems—standardization and stratification—and their associations with cross-national variation in gender gaps in STEM occupational expectations. Standardization indicates the degree to which school curricula are uniform at the national level while stratification refers the degree to which students are sorted into different school programs that provide access to different educational opportunities (e.g., vocational and academic). Further, I assessed whether the association between features of secondary education systems and gender gaps in STEM occupational expectations differs across academic performance levels.

The analytical results show that girls are more likely than boys to expect to have a health services (HS) occupation, but less likely than boys to expect to have a career in computing and engineering (CE). There is considerable variation in the magnitude of these gender gaps across countries: the results for the cross-level interactions between gender and the country-level variables (i.e., standardization of curriculum, number of school types available to 15-year-olds, and early tracking) show that the association between features of national education systems and gender gaps in STEM occupational expectations differ across academic performance level as well as STEM subfields.

6.1. Standardized Education Systems and Gender Gaps in STEM Occupational Expectations

This study provided no empirical evidence that education systems that do not have standardized curriculum at the national level have more gender segregation in STEM occupational expectations. Higher levels of standardization in secondary education are not

associated with gender gaps in either STEM subfield, computing and engineering (CE) or health service (HS). This null association is consistent across student performance levels. In standardized education systems, both boys and girls are more likely to learn the same math and science curriculum. Prior research has shown that this feature of standardized education systems is associated with smaller gender gaps in mathematics achievement (Ayalon & Livneh, 2013). The results of this study introduce new empirical evidence that this type of curriculum standardization is not linked to a smaller gender gap in STEM occupational expectations.

6.2.Stratified Education Systems and Gender Gaps in STEM Occupational Expectations

In contrast, there is evidence that, in some cases, students in countries with stratified education systems are more likely to have gender-typed occupational expectations than students in countries with non-stratified systems. This study measured the stratification level of each education system via two indicators: the number of school types available to 15-year-old students in each country and the age of selection into different school types or tracks. Each additional school type available to 15-year-olds in secondary schools is associated with lower STEM occupational expectations for girls but not boys, indicating that a having a higher number of school types available to 15-year-olds is associated with a larger gender gap in STEM-related occupational expectations. However, early tracking (i.e., sorting before the age of 14) into curricular tracks is not associated with the likelihood of aspiring to enter STEM careers for either boys or girls, and thus the analyses provide no evidence that early sorting into curricular tracks is associated with the size of the gender gap. Prior research has found that the level of stratification in secondary education (measured by the number of school types available to 15-year-olds) is negatively associated with students' science-related career plans but is not associated with the gender gap in science-related career plans (Sikora & Pokropek, 2012a). The difference in

findings between some previous studies and the current study may be partially the result of differences in the definition of STEM careers. Prior research has focused on science-related careers that require either a bachelor's or associate's degree (Sikora & Pokropek, 2012a), whereas the present study focused on professional STEM careers that require a bachelor's degree or above at job entry. Combined, the findings from this study and previous research suggest that greater stratification in education systems is associated with a larger gender gap in expectations for high-status professional STEM occupations, but not a larger gender gap in expectations for relatively lower-status STEM occupations.

Building on prior research on the association between stratified education systems and the gender gap in science-related career expectations (Sikora & Pokropek, 2011, 2012a), the present study examined the influence of stratification on gender differences in STEM career expectations separately by science ability groups. Results revealed that higher levels of stratification were linked to larger gender gaps in STEM-related occupational expectations among strong performers in science. In addition, the findings from the study suggest that, among strong performers in science, students in countries with stratified education systems are more likely than those in countries with non-stratified systems to expect to have certain gender-typed occupational expectations (i.e., computing and engineering [CE] occupations for boys and health service [HS] occupations for girls).

Reducing the gender gap in STEM occupational expectations among students who are well prepared for college-level STEM studies is likely pivotal to the reduction of gender gaps in STEM degree attainment. Thus, the positive association between levels of stratification in secondary schools and the gender gap in professional STEM career expectations among students who are academically strong in science is problematic and should be considered in future efforts

to reduce the STEM gender gap. Despite many efforts to promote gender equality in OECD countries and at the EU level (e.g., teaching materials and training policies that help teachers avoid gender stereotyping), the proportion of women in science has remained stable at 41% over the past decade (OECD, 2011; 2014). Further, some specific STEM fields show slightly downward trends in the percentage of women attaining a degree. For example, the percentage of women who earned a bachelor's degree in computing dropped from 23% in 2000 to 20% in 2012 (OECD, 2014). Because having STEM career expectations matters for students' educational and occupational attainment in STEM fields (Morgan, Leenman, Todd, & Weeden, 2013; Tai, Liu, Maltese, & Fan, 2006) and the structure of secondary education systems can exacerbate gender inequality in STEM occupational expectations, initiatives to promote gender equality in STEM should focus on the structure of secondary education systems.

The findings in the current study should be interpreted with caution because the study used a single wave of data. Due to the limitations of the cross-sectional data, for example, it is not possible to determine exactly *why* countries with higher levels of stratification had larger gender gaps in STEM-related occupational expectations, in particular among strong performers in science. Future research should use longitudinal data to examine the causal effects of stratification in education systems on gender gaps in STEM education and occupational expectations. For example, investigations of how changes in the features of national education systems affect students' STEM occupational expectations *within* countries can shed light on the role of stratification in exacerbating or reducing gender gaps in STEM occupational expectations. A small number of PISA-participating countries, including Bulgaria, Israel, Jordan, and Poland, reduced the number of school types available to 15-year-old students between 2000 and 2006 (OECD, 2010), whereas Hong Kong-China increased the number of school types between 2000

and 2012 (OECD, 2013); in-depth research using longitudinal data from these countries will further elucidate the causal link between stratified systems and gender gaps in STEM occupational expectations.

The findings of the current research suggest that policymakers and researchers need to pay attention to different types of academic track schools in stratified education systems. Given that a larger gender gap in STEM occupational expectations among top-performing students in science is associated with a higher level of stratification in a country's secondary system, research examining the degree to which differentiation in academic-track schools is associated with gender gaps in STEM occupational expectations would be informative. In Germany, for example, Gymnasium, state-maintained secondary school that prepares students for higher academic education, is differentiated into three main types according to curriculum: classical, modern, and mathematical and scientific. Future research needs to take into account the differentiation in academic-track schools as well as the number of school types available to 15-year-old students (e.g., academic versus vocational) in explaining cross-national variation in gender gaps in STEM occupational expectations.

Another way in which future research can strengthen the scholarly understanding of gender gaps in STEM occupational expectations is by exploring additional microlevel factors not included in the current study, such as teachers' activities and classroom teaching materials. For example, prior research has shown that teachers can foster girls' long-term interest in math and science by creating classroom environments and activities that connect mathematics and science to careers (Halpern et al., 2007; Turner & Lapan, 2005). In addition, research examining how these microlevel factors interact with the stratification of education systems at the national level would be informative. Although it was not a major research question, it is worthwhile to note

that the findings indicated that parents are deeply involved in a child's development of STEM career expectations. Results reveal that having a parent in a STEM field tends to be positively associated with students having plans to pursue a STEM occupation and this finding is consistent across gender, suggesting the importance of socialization processes at home. Research that examines how these home-based socialization processes interact with school-level and national-level education factors would help inform efforts to promote gender equality in STEM.

Several comparative studies have shown that macrolevel social and economic conditions, such as structural features of higher education systems, economies, and labor markets (e.g., Charles & Bradley, 2002, 2009; Penner, 2008) and national differences in gender-science stereotypes and gender-equal cultures (e.g., Guiso, Monte, Sapienza, & Zingales, 2008; Nosek et al., 2009), can influence gender inequality in STEM education. Because the current study shows that the structure of secondary education systems can also perpetuate the gender gap in STEM occupational expectations, future research examining gender inequality in STEM educational and occupational attainments must consider secondary education systems as well as these previously studied macrolevel social and economic conditions. Further, because the sample size was limited at the country level (N=49 countries), the current study included only one macrolevel measure of gender inequality (gender empowerment measure [GEM]); however, future research on gender-typed educational and occupational decision making should consider additional macrolevel social and economic contexts. Future studies examining how other macrolevel economic and social conditions interact with secondary education systems to shape gender-typed STEM educational and occupational expectations would enhance the scholarly understanding of gender inequality in STEM educational and occupational attainment.

Table 1. Results of hierarchical Bernoulli logit models to explain variation in expectations for STEM-related occupations

	STEM			Computing and Engineering (CE)			Health Services (HS) Excluding Nursing		
	β	O.R.	S.E.	β	O.R.	S.E.	β	O.R.	S.E.
<i>Intercept</i>	-1.290	0.275	(0.181)***	-2.029	0.131	(0.161)***	-2.768	0.063	(0.200)***
Country-level:									
GEM	-2.322	0.098	(0.571)***	-1.494	0.224	(0.633)*	-2.262	0.104	(0.664)
Standardization Stratification	0.001	1.001	(0.077)	-0.038	0.963	(0.059)	0.085	1.088	(0.095)
Number of school type	-0.068	0.934	(0.035)	0.017	1.017	(0.029)	-0.169	0.845	(0.051)**
Early tracking	0.087	1.091	(0.119)	-0.024	0.976	(0.095)	0.190	1.209	(0.159)
Cross-level Interactions:									
Female x GEM	0.475	1.608	(0.249)	-0.006	0.994	(0.251)	0.218	1.244	(0.266)
Female x standardization	0.069	1.072	(0.040)	0.125	1.133	(0.070)	-0.067	0.935	(0.047)
Female x number of school type	-0.111	0.895	(0.020)***	-0.145	0.865	(0.033)***	-0.012	0.988	(0.029)
Female x early tracking	0.010	1.010	(0.052)	0.085	1.088	(0.115)	-0.087	0.917	(0.091)
School-level:									
School mean SES	-0.073	0.930	(0.039)	0.141	1.152	(0.056)*	0.088	1.092	(0.065)
Individual-level:									
Female Gender	0.356	1.427	(0.074)***	-0.786	0.456	(0.143)***	1.042	2.835	(0.096)***
Immigration Status									
Second-generation	0.285	1.330	(0.088)***	0.180	1.197	(0.087)*	0.483	1.621	(0.088)***
First-generation	0.411	1.509	(0.080)***	0.263	1.301	(0.060)***	0.606	1.833	(0.090)***
Parent's Occ status	0.005	1.005	(0.001)***	0.002	1.002	(0.001)	0.009	1.009	(0.001)***
Parents have STEM occ.	0.285	1.330	(0.034)***						
Parents have CE occ.				0.192	1.212	(0.040)***			
Parents have HS occ.							0.302	1.353	(0.033)***
Science score	0.004	1.004	(0.000)***	0.003	1.003	(0.000)***	0.003	1.003	(0.000)***
Individual-level interactions:									
Female x second-gen	-0.019	0.981	(0.058)	-0.183	0.833	(0.070)*	-0.102	0.903	(0.064)
Female x first-gen	0.007	1.007	(0.086)	-0.087	0.917	(0.104)	-0.069	0.933	(0.078)
Female x parent's Occ St	-0.003	0.997	(0.001)**	0.001	1.001	(0.002)	-0.004	0.996	(0.001)**
Female x parents in STEM	-0.077	0.926	(0.030)*						
Female x parents in CE				-0.056	0.946	(0.074)			
Female x parents in HS							-0.083	0.920	(0.075)
Female x science score	-0.001	0.999	(0.000)***	-0.002	0.998	(0.000)*	0.001	1.001	(0.000)*
Other Controls									
Grade Levels		Yes			Yes			Yes	
Parental Education		Yes			Yes			Yes	
Number of Books at Home		Yes			Yes			Yes	
GDP per capita		Yes			Yes			Yes	
Educational Expenditure		Yes			Yes			Yes	
<i>N</i>									
Students (unit of observations)		360,264			360,264			360,264	
Schools		13,493			13,493			13,493	
Countries		49			49			49	
Variance components									
School level									
Intercept		0.105***			0.124***			0.170***	
Slope of female		0.033**			0.062			0.039	
County level									
Intercept		0.162***			0.144***			0.160***	
Slope of female		0.022***			0.106***			0.045***	

Each column in each panel reports results from one regression. *** $p \leq .001$, ** $p \leq .01$, * $p \leq .05$

β = Coefficient, O.R. = Odds Ratio, S.E. = Standard Error

Table 2. Results of hierarchical Bernoulli logit models to explain variation in expectations for CE occupations by performance quartile for PISA 2006 data

	Top-quartile			Upper-middle-quartile			Lower-middle-quartile			Bottom-quartile		
	β	O.R.	S.E.	β	O.R.	S.E.	β	O.R.	S.E.	β	O.R.	S.E.
<i>Intercept</i>	-1.637	0.195	(0.171)***	-1.937	0.144	(0.202)***	-2.154	0.116	(0.222)***	-2.329	0.097	(0.200)***
<i>Country-level:</i>												
GEM	-0.802	0.448	(0.884)	-0.609	0.544	(0.795)	-0.657	0.519	(0.664)	-0.763	0.466	(0.542)
Standardization	-0.027	0.973	(0.063)	-0.100	0.904	(0.107)	-0.053	0.949	(0.095)	-0.106	0.899	(0.104)
Stratification												
Number of school type	0.060	1.061	(0.040)	0.031	1.031	(0.054)	0.046	1.047	(0.061)	-0.019	0.981	(0.049)
Early tracking	-0.031	0.970	(0.102)	-0.081	0.922	(0.149)	-0.129	0.879	(0.162)	-0.003	0.997	(0.143)
<i>Cross-level Interactions:</i>												
Female x GEM	-0.162	0.851	(0.368)	-0.346	0.707	(0.394)	0.021	1.022	(0.436)	-0.277	0.758	(0.355)
Female x standardization	0.103	1.108	(0.084)	0.101	1.106	(0.105)	0.066	1.068	(0.100)	0.136	1.146	(0.097)
Female x number of school type	-0.169	0.845	(0.038)***	-0.049	0.952	(0.070)	-0.136	0.873	(0.073)	-0.077	0.926	(0.067)
Female x early tracking	0.056	1.057	(0.113)	0.029	1.030	(0.188)	0.306	1.359	(0.182)	0.151	1.163	(0.188)
<i>Individual-level:</i>												
Female Gender	-0.836	0.434	(0.139)***	-0.984	0.374	(0.190)***	-0.791	0.453	(0.201)***	-0.667	0.513	(0.182)***
<i>N</i>												
Students (unit of observations)		93,346			91,186			89,664			86,068	
Schools		11,415			12,567			12,708			11,717	
Countries		49			49			49			49	

Each column reports results from one regression.

All regressions control for GDP per capita (\$1,000) and educational expenditure (percent of GDP) at the national level, school mean SES at the school level, and grade level, parental educational attainment, parental occupational status, number of books at home, immigrant background of both students and parents, and whether parents have a STEM-related occupation at the individual level.

*** $p \leq 0.001$, ** $p \leq 0.01$, * $p \leq 0.05$

β = Coefficient, O.R. = Odds Ratio, S.E. = Standard Error

Table 3. Results of hierarchical Bernoulli logit models to explain variation in expectations for health services (excluding nursing) occupations by performance quartile for PISA 2006 data

	Top-quartile			Upper-middle-quartile			Lower-middle-quartile			Bottom-quartile		
	β	O.R.	S.E.	β	O.R.	S.E.	β	O.R.	S.E.	β	O.R.	S.E.
<i>Intercept</i>	-1.879	0.153	(0.228)***	-2.314	0.099	(0.197)***	-2.749	0.064	(0.276)***	-3.125	0.044	(0.262)***
<i>Country-level:</i>												
GEM	-1.611	0.200	(0.507)**	-1.559	0.210	(0.449)***	-1.314	0.269	(0.569)*	-1.223	0.294	(0.650)
Standardization	-0.032	0.968	(0.095)	0.079	1.083	(0.074)	0.073	1.076	(0.101)	0.079	1.083	(0.121)
Stratification												
Number of school type	-0.161	0.851	(0.058)**	-0.141	0.868	(0.048)**	-0.158	0.854	(0.063)*	-0.132	0.876	(0.068)
Early tracking	0.075	1.078	(0.183)	0.222	1.248	(0.137)	0.207	1.230	(0.186)	0.258	1.295	(0.168)
<i>Cross-level Interactions:</i>												
Female x GEM	0.472	1.604	(0.219)*	0.506	1.659	(0.189)**	0.476	1.610	(0.377)	-1.057	0.348	(0.527)
Female x standardization	-0.021	0.980	(0.047)	0.057	1.058	(0.050)	-0.046	0.955	(0.063)	-0.266	0.766	(0.149)
Female x number of school type	0.070	1.073	(0.034)*	-0.037	0.964	(0.043)	0.004	1.004	(0.042)	-0.085	0.919	(0.062)
Female x early tracking	-0.083	0.920	(0.097)	-0.055	0.947	(0.116)	-0.200	0.819	(0.144)	-0.057	0.944	(0.116)
<i>Individual-level:</i>												
Female Gender	0.584	1.793	(0.097)***	0.676	1.965	(0.100)***	0.766	2.151	(0.152)***	1.239	3.453	(0.253)***
<i>N</i>												
Students (unit of observations)		93,346			91,186			89,664			86,068	
Schools		11,415			12,567			12,708			11,717	
Countries		49			49			49			49	

Each column reports results from one regression.

All regressions control for GDP per capita (\$1,000) and educational expenditure (percent of GDP) at the national level, school mean SES at the school level, and grade level, parental educational attainment, parental occupational status, number of books at home, immigrant background of both students and parents, and whether parents have a STEM-related occupation at the individual level.

*** $p \leq 0.001$, ** $p \leq 0.01$, * $p \leq 0.05$

β = Coefficient, O.R. = Odds Ratio, S.E. = Standard Error

Figure 1. Stratified education systems and gender gaps in STEM-related occupational expectations

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Appendix 1. Descriptive Statistics

	PISA 2006	
	Mean	Std. Dev.
Occupational Expectations		
STEM, general	0.28	0.45
Computing and Engineering (CE)	0.10	0.30
Health services excluding nursing	0.10	0.31
Student Characteristics		
<i>Grade in school</i>		
7 th or lower	0.01	0.10
8 th	0.05	0.22
9 th	0.34	0.47
10 th	0.52	0.50
11 th or higher	0.08	0.28
<i>Female gender</i>	0.51	0.50
Student Ability		
<i>Science</i>	476.66	104.17
Family Background		
<i>Parents' education</i>		
None	0.02	0.15
Primary	0.06	0.23
Lower secondary	0.11	0.31
Upper secondary 1	0.08	0.27
Upper secondary 2	0.28	0.45
University	0.44	0.50
<i>Parents have STEM occupation</i>	0.18	0.38
<i>Parent's occupational status</i>	47.74	17.06
<i>Immigration status</i>		
Native	0.93	0.26
Second-generation immigrant	0.04	0.19
First-generation immigrant	0.03	0.18
<i>Number of Books at Home</i>		
0-10 books	0.15	0.36
11-100 books	0.49	0.50
101-500 books	0.29	0.45
More than 500 books	0.07	0.26
School Characteristics		
<i>School mean SES</i>	-0.25	0.77
National Economic Development		
<i>GDP per capita (\$1,000)</i>	22,551	18,197
<i>Educational expenditure (percent of GDP)</i>	20.67	6.76
<i>GEM</i>	0.64	0.17
Characteristics of National Educational System		
<i>Standardization</i>		
Low	0.11	0.31
Medium	0.38	0.49
High	0.52	0.50
<i>Stratification</i>		
Number of school types	2.27	1.22
Early tracking	0.33	0.47

Appendix 2.

STEM-related careers

2100 physical, mathematical & engineering science professionals
 2110 physicists, chemists & related professionals
 2111 physicists & astronomers
 2112 meteorologists
 2113 chemists
 2114 geologists & geophysicists [incl. geodesist]
 2120 mathematicians, statisticians etc professionals
 2121 mathematicians etc professionals
 2122 statisticians [incl. actuary]
 2130 computing professionals
 2131 computer systems designers & analysts [incl. software engineer]
 2132 computer programmers
 2139 computing professionals not elsewhere classified
 2140 architects, engineers etc professionals
 2141 architects town & traffic planners [incl. landscape architect]
 2142 civil engineers [incl. construction engineer]
 2143 electrical engineers
 2144 electronics & telecommunications engineers
 2145 mechanical engineers
 2146 chemical engineers
 2147 mining engineers, metallurgists, etc, professionals
 2148 cartographers & surveyors
 2149 architects engineers etc professionals not elsewhere classified [incl. consultant]
 2200 life science & health professionals
 2210 life science professionals
 2211 biologists, botanists zoologists etc professionals
 2212 pharmacologists, pathologists etc profess. [incl. biochemist]
 2213 agronomists etc professionals
 2220 health professionals (except nursing)
 2221 medical doctors
 2222 dentists
 2223 veterinarians
 2224 pharmacists
 2229 health professionals except nursing not elsewhere classified
 2230 nursing & midwifery profess. [incl. registered nurses, midwives]
 2445 psychologists

Careers in computing and engineering

2130 computing professionals
 2131 computer systems designers & analysts [incl. software engineer]
 2132 computer programmers
 2139 computing professionals not elsewhere classified
 2140 architects, engineers etc professionals
 2141 architects town & traffic planners [incl. landscape architect]
 2142 civil engineers [incl. construction engineer]

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4 2143 electrical engineers
5 2144 electronics & telecommunications engineers
6 2145 mechanical engineers
7 2146 chemical engineers
8 2147 mining engineers, metallurgists etc professionals
9 2149 architects engineers etc professionals not elsewhere classified [incl. consultant]
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13 **Careers in health services (excluding nursing)**
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15 2212 pharmacologists, pathologists etc profess. incl. biochemist
16 2220 health professionals (except nursing)
17 2221 medical doctors
18 2222 dentists
19 2223 veterinarians
20 2224 pharmacists
21 2229 health professionals except nursing nec
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