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Semiparametric decomposition of the gender achievement gap: An application for Turkey☆

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HIGHLIGHTS

- We examine the gender test score gap in science/mathematics in Turkey.
- We use a semiparametric Oaxaca-Blinder decomposition.
- This technique decomposes the mean gap for the common support population.
- It also allows us to explore the gap across the test score distribution.
- The failure to recognize the common support problem leads to inconsistent estimates.

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ABSTRACT

This study employs a semiparametric Oaxaca–Blinder (OB) decomposition to investigate the gender PISA test score gap in mathematics/science in Turkey. This technique, which has not previously appeared in the gender achievement gap literature, relaxes the parametric assumptions of the standard OB decomposition, accounts for the possible violation of the common support assumption, and allows us to explore the gender test score gap not only at the mean but also across the test score distribution. The results from the semiparametric OB decomposition of the mean test score gap indicate that girls outperform boys in science whereas the gap is not statistically significant in mathematics. We also find that the mean gap fails to uncover the heterogeneous pattern that the gap exhibits across the distribution.

1. Introduction

Gender differences in educational outcomes have been the subject of much research over recent decades. It is widely recognized that achieving gender equality in education is associated with greater equality in employment outcomes, low infant mortality rates, a decrease in the number of early marriages, and better investments in the education and health of future generations (OECD, 2010). Using the data from the 2006 Programme for International Student Assessment (PISA), this study explores the gender gap in the mathematical and scientific achievements of 15-year-olds in Turkey. We apply a semiparametric Oaxaca–Blinder (OB) decomposition to investigate the gender test score gap. Understanding the gender patterns in these subject fields allows us to gain insight into the gender wage gap and differential education and labor market choices across genders (Paglin and Rufolo, 1990). For instance, if girls lag behind boys in terms of the accumulation of mathematical skills in childhood and adolescence, they are less likely than boys to choose science and engineering as a field of study at tertiary level, thereby promoting gender inequality in employment opportunities, such as the underrepresentation of women in mathematics-intensive fields.

This study contributes to the gender test score gap literature in three ways. First, although OB decomposition (Oaxaca, 1973; Blinder, 1973) has been widely used to examine discrimination in the labor market, the application of this methodology in the economics of education is quite recent. It has been applied to examine the test score gap between countries (Ammermüller, 2007), schools (private versus public) (Duncan and Sandy, 2007; Krieg and Storer, 2006) and ethnic groups (indigenous versus non-indigenous) (Sakellariou, 2008; McEwan, 2004). There are only two studies that apply decomposition methods to analyze the gender test score gap. Sohn (2012) uses the quantile version of the OB decomposition while Hille (2011) uses the detailed OB decomposition at mean to investigate the gender test score gap in mathematics.

Our decomposition method has several advantages over the standard OB decomposition. The semiparametric decomposition relaxes the parametric functional form assumption of the standard OB decomposition. It

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Table 1
Descriptive statistics by gender.

Variable	Description	Full sample		Male		Female		
		Mean	St. dv.	Mean	St. dv.	Mean	St. dv.	t-Test
Test scores								
Science	Science test score	432.05	78.42	427.41	80.19	437.51	75.94	−4.00
Math	Math test score	432.35	87.68	436.33	90.43	427.66	84.11	3.07
Student characteristics								
8th grade	=1 if the student is in 7th or 8th grade	0.04	0.19	0.04	0.20	0.03	0.18	1.28
9th grade	=1 if the student is in 9th grade	0.40	0.49	0.39	0.49	0.40	0.49	−0.49
10th grade	=1 if the student is in 10th grade	0.54	0.50	0.53	0.50	0.54	0.50	−0.42
11th grade	=1 if the student is in 11th grade	0.03	0.16	0.03	0.17	0.02	0.15	1.28
Science career	=1 if the student is expected to have a science-related career at 30	0.26	0.44	0.25	0.43	0.27	0.44	−1.66
Motivation index	Index of motivation in science	1.07	2.45	1.01	2.43	1.13	2.47	−1.54
Ability index	Index of belief in own ability in science	0.21	1.66	0.20	1.73	0.22	1.58	−0.42
Math is important	How important is math, 4 = 'very important', 1 = 'not important at all'	3.62	0.66	3.58	0.69	3.67	0.62	−4.34
Family background characteristics								
Mother-primaryedu	=1 if the mother has at most primary education	0.72	0.45	0.72	0.45	0.71	0.45	0.91
Mother-secondaryedu	=1 if the mother has secondary education	0.22	0.42	0.21	0.41	0.23	0.42	−1.81
Mother-tertiaryedu	=1 if the mother has tertiary education	0.06	0.24	0.07	0.25	0.06	0.23	1.42
Father-primaryedu	=1 if the father has at most primary education	0.55	0.50	0.55	0.50	0.54	0.50	0.91
Father-secondaryedu	=1 if the father has secondary education	0.31	0.46	0.30	0.46	0.32	0.47	−1.80
Father-tertiaryedu	=1 if the father has tertiary education	0.14	0.35	0.15	0.36	0.14	0.34	1.08
Books ≤ 10	=1 if the number of books at home ≤ 10	0.23	0.42	0.27	0.44	0.18	0.39	6.08
11 ≤ books ≤ 25	=1 if 11 ≤ the number of books at home ≤ 25	0.28	0.45	0.27	0.44	0.30	0.46	−2.56
26 ≤ books ≤ 100	=1 if 26 ≤ the number of books at home ≤ 100	0.30	0.46	0.28	0.45	0.31	0.46	−2.27
Books > 100	=1 if the number of books at home > 100	0.19	0.39	0.19	0.39	0.20	0.40	−0.81
Parents' occupational status	The index of the highest parental occupational status	39.84	15.71	39.11	15.86	40.70	15.50	−3.14
Home education resources	The index of home education resources	−0.64	1.30	−0.67	1.34	−0.61	1.25	−1.40
Mother-science career	=1 if the mother has a science-related career	0.02	0.13	0.02	0.13	0.02	0.12	0.69
Father-science career	=1 if the father has a science-related career	0.05	0.21	0.05	0.21	0.05	0.21	−0.26
Income < 0.5 median	=1 if the family income ≤ 0.5 median annual income	0.35	0.48	0.35	0.48	0.34	0.47	1.10
0.5 median ≤ income < 0.75 median	=1 if 0.5 median ≤ the family income < 0.75 median	0.36	0.48	0.35	0.48	0.38	0.48	−1.57
0.75 median ≤ income < median	=1 if 0.75 median ≤ the family income < median	0.20	0.40	0.20	0.40	0.20	0.40	−0.26
Median ≤ income < 1.25 median	=1 if median ≤ the family income < 1.25 median	0.06	0.24	0.06	0.24	0.05	0.23	1.05
Income ≥ 1.25 median	=1 if the family income ≥ 1.25 median	0.03	0.17	0.03	0.17	0.03	0.16	0.55
School's characteristics								
Percentage of girls	Percentage of girls enrolled at school	0.43	0.21	0.35	0.19	0.53	0.20	−28.63
Public	=1 if the school is public	0.98	0.15	0.97	0.17	0.98	0.14	−1.97
Class size	=1 if the average class size is more than 30 at school	0.51	0.50	0.50	0.50	0.53	0.50	−1.57
Rural	=1 if the school is in a rural area	0.79	0.40	0.82	0.39	0.77	0.42	4.01
School's educational resources	The index of the quality of the school's educational resources	−0.81	0.92	−0.83	0.91	−0.80	0.93	−0.91
General high school	=1 if the school is a general high school	0.44	0.50	0.42	0.49	0.47	0.50	−2.72
Anatolian high school	=1 if the school is an Anatolian high school	0.20	0.40	0.18	0.39	0.22	0.41	−2.42
Vocational high school	=1 if the school is a vocational high school	0.36	0.48	0.39	0.49	0.32	0.47	4.88
Marmara region	=1 if the school is in Marmara region	0.28	0.45	0.26	0.44	0.29	0.46	−2.21
Central Anatolian region	=1 if the school is in Central Anatolian region	0.21	0.41	0.21	0.41	0.21	0.41	0.16
Aegean region	=1 if the school is in Aegean region	0.14	0.34	0.13	0.34	0.14	0.35	−1.15
Mediterranean region	=1 if the school is in Mediterranean region	0.11	0.32	0.10	0.30	0.13	0.33	−2.45
Blacksea region	=1 if the school is in Blacksea region	0.13	0.33	0.15	0.35	0.11	0.31	3.85
Eastern Anatolian region	=1 if the school is in Eastern Anatolian region	0.07	0.25	0.06	0.24	0.07	0.26	−0.95
Southeastern Anatolian region	=1 if the school is in Southeastern Anatolian region	0.07	0.25	0.08	0.28	0.05	0.21	4.38
N	Number of observations	3832		2044		1788		

Notes: The last column presents t-statistics. Based on Welch's approximation, the weighted t-test compares the difference in the means of the two samples. The median annual income is 24.000 TL in Turkey.

provides useful information on the gender test score gap not only at the mean but also across the test score distribution. In addition, the standard OB decomposition ignores the common support problem. Ñopo (2008) shows that failure to account for the problem of lack of common support leads to systematically upward-biased estimates of the unexplained part. However, in the semiparametric decomposition, counterfactual outcomes are computed only for the common support subpopulation. The rationale behind this empirical strategy ensures that female and male observations that are actually comparable in terms of their observed characteristics are matched. The semiparametric matching method makes it possible to estimate the counterfactual outcome for each individual separately, allowing us to account for arbitrary individual effect heterogeneity.

Second, previous studies on the quality of education, which is measured by achievement on standardized tests, investigate the determinants of Turkish students' mathematics/science achievement without paying sufficient attention to the gender test score gap (see e.g., Dincer and Uysal, 2010; Ferreira and Gignoux, 2010; Alacaci and Erbaş, 2010). We aim to contribute to this literature by examining the gap rigorously with the help of the semiparametric OB decomposition. Moreover, Turkey is an interesting case to study as it has the largest average gender test score gap in science and one of the smallest gaps in mathematics among OECD countries.[1]

[1] According to the PISA 2006 test results, the mean gender test score gap in science across OECD countries ranges between 11.9 score points in favor of girls in Turkey and 10.06 score points in favor of boys in the UK. In mathematics, boys outscore girls in all countries except Iceland. Turkey with 4.48 score points is on the low-end while Austria has the highest gap with 22.61 score points.