Gender gap in high school choices: do achievements and peers play a role?

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Torino, 24/9/2021 – Workshop on Gender and Mathematics

Background and motivation

- "In education and labour market, women and men are set apart by gender. This poses a real threat to the sustainable and inclusive growth of the EU" (EIGE, 2018, *Study and work in the EU: set apart by gender*).

- Gender gaps and segregation in education and labour market weakens economic growth and economic opportunities for individuals and their families.

- Narrowing the gender gap in STEM education would lead to increased number of jobs and increased GDP over the long-term (EIGE, 2018).

Gender differences in education and labour market

- The share of women among STEM graduates in the EU (in both tertiary and vocational education) has dropped in the recent years, while the share of men remained constant.
- The segregation is higher in vocational than tertiary education.
- Variation of gender segregation exists across sub-fields in STEM, with ICT and engineering showing the largest gaps.
- Similarly, men are significantly under-represented in education, health and welfare fields.

(EIGE, 2018)

Proportion of female and male graduates (EU-28, 2015)

	Men %	Women %
	EU average	EU average
Education	18	82
Health and welfare	24	76
Arts and humanities	32	68
Social sciences, journalism and information	32	68
Business, administration and law	40	60
Natural sciences, mathematics and statistics	43	57
Agriculture, forestry, fisheries and veterinary	44	56
Services	50	50
Engineering, manufacturing and construction	72	28
Information and communication technologies	79	21

Source: EIGE, 2018

Proportion of women and men in STEM and EHW occupations (EU-28, %, 2013-2014)

	Men % EU average	Women % EU average
STEM		
Science and engineering professionals	75	25
ICT professionals	84	16
Science and engineering associate professionals	84	16
ICT technicians	82	18
Building and related trades workers	97	3
Metal, machinery and related trades workers	96	4
Electrical and electronic trades workers	96	4
Stationary plant and machine operators	67	33
EHW		
Health professionals	30	70
Teaching professionals	31	69
Health associate professionals	20	80
Personal care workers	10	90

Source: EIGE, 2018

Gender gaps in educational outcomes

- Typically, girls outperform boys in humanities/languages, but boys do better in Maths (PISA, 2019; OECD, 2016).
- Gender gaps continue to be a source of concern, as they have important long-term consequences for the career paths of girls and boys (PISA, 2019)

- Which mechanisms affect differences in educational choices between boys and girls?
- Can performance gaps explain the observed differences in subject choices in high school?

Contribution (1/3)

- We expand the existing literature analysing gender gap in subject choice at university, by providing new evidence on the existence and possible consequences of gender gap at a (relatively) young age.

- An analysis of the gender gap in middle/high school is very relevant for kids who do not go to university and enter the labour market straight after high school.

- Our study sheds light on the possible sources of the gender wage gap and labour market gender segregation in the market for university and (in particular) high-school graduates.

Contribution (2/3)

- New administrative dataset, which includes observations of Italian children in middle school, when they choose the track for secondary education, and covariates for family's characteristics.

- Important focus on type of school (more/less academic) and subject studied (STEM/Humanities/Other focus).

- Focus on gendered impact of grades and test scores, absolute and relative ranks and peers' performance.

Contribution (3/3)

Main research questions:

1. How do educational choices differ by gender at age 14?
2. What are the determinants of gender differences in educational choices?
   - What is the role of ability/grades in these gender differences?
   - What other factors affect gender differences in educational choices (eg ranking by subject, socio-economic context, peer effects)?
3. Can gender gaps in school choices be explained by differences in test scores, ranking and peer context?

Literature

- Impact of gender composition on students' outcomes
  - Results are mixed (Hoxby (2000) and Lavy and Schlosser (2011); Black et al (2013)
  - Gender composition is not random in high school, so this analysis can be problematic (Anelli and Peri, 2019)
- Comparison effects
  - Impact of peers' performance and role of female and male "high achievers" (Cools et al, 2019)
- Role of gender stereotypes (Carlana, 2019)
- Gender differences in performance in situations with various levels of competitiveness (Delaney and Devereux, 2021)

Literature

- Gender-equality paradox
  - Gender segregation across occupations is more pronounced in more egalitarian and more developed countries (Breda et al., 2020)
  - Stereotypes relating math typically to men can mediate the link between development and segregation across fields of study. (Breda et al., 2020)
  - Gender segregation will not naturally decrease with increased economic development and therefore appropriate policies are needed to tackle the inequality and its sources

Data

- Longitudinal data on students' careers linking together data from:
  - The National Register of Students (Anagrafe Nazionale Studenti)
  - The National Institute for the Evaluation of the Educational System (INVALSI)
- Students enrolled in first year of lower-secondary school in 2013/14 (*year 6 – prima media*) are followed till school year 2016/17 (first year upper-secondary school in *year 9 – prima superiore*) when tracking begins
- Drop-outs, grade repetitions and changes of school/class are collected in the data
- Data from Piedmont, Lombardy and Veneto regions
- N= 168,445 students (1,837 schools)
- Interestingly, we have information on both teachers' grades and standardised test scores in both Italian and Maths

High School classification

- Horizontal classification (subject-related)
  - STEM
  - Humanities
  - Other content (mainly economics, but also e.g. hospitality sector)
- Vertical classification (academic content and prestige)
  - Traditional lyceum
  - Non traditional lyceum
  - Technical track
  - Professional/vocational track

High school classification: 7 categories

	STEM	Other	Humanities
Traditional lyceum	Scientific lyceum		Classical lyceum
Non-traditional lyceum		Human sciences lyceum with socio-economic focus	Linguistic lyceum/ Artistic lyceum/ Human sciences lyceum
Technical track	Technical paths e.g. Informatics, Chemistry, Electronics	Technical paths e.g. accounting, marketing	
Professional track	Vocational paths e.g. Agricultural or Mechanical operator	Vocational paths e.g. Commercial operator, Catering school, Hotel management school	

Descriptive statistics (1/3)

Horizontal classification (subject)		
	Males %	Females %
STEM	*66.84*	*27.03*
Other	*22.9*	*35.23*
Humanities	*10.26*	*37.74*
Vertical classification (type of school)		
	Males %	Females %
Traditional lyceum	27.57	23.64
Non-traditional lyceum	9.43	36.25
Technical track	48.3	25.12
Professional track	14.7	14.99

Descriptive statistics (2/3)

School choice		
	Males %	Females %
Traditional STEM	*25.05*	*18.01*
Traditional Humanities	*2.52*	*5.63*
Non-trad/other	*13.45*	*22.31*
Non-traditional Humanities	*7.74*	*32.11*
Technical STEM	*36.54*	*6.96*
Professional STEM	*5.25*	*2.07*
Professional Other	*9.45*	*12.93*
Total	*100*	*100*

Descriptive statistics (3/3)

Test scores and teachers' grades		
	Males	Females
Test score in Italian (standardized)	-0.006	0.251
Test score in mathematics (standardized)	0.238	0.029
Grade in Italian (0-10)	7.003	7.430
Grade in mathematics (0-10)	7.152	7.324

Independent variables

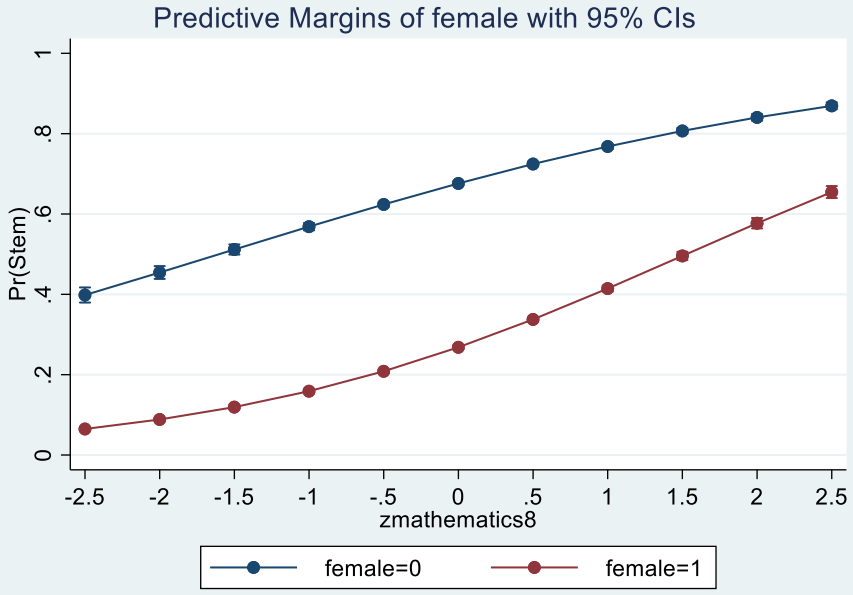
Main specification

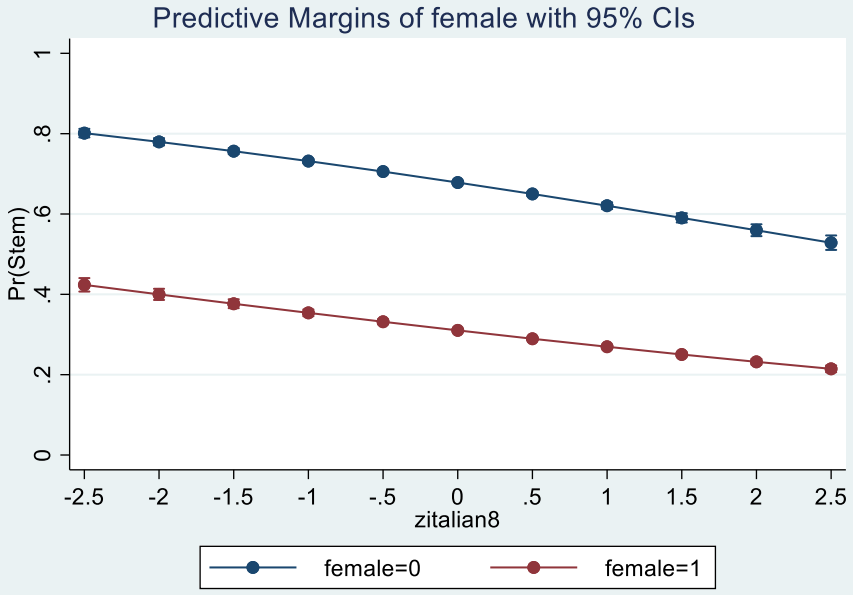
- Child's gender
- Child's immigrant status
- Parental education
- Indicator of family's SES
- Proportion of students with parents with university degree (in year 8)
- Proportion of migrants in class (in year 8)
- Teachers' grades and standardised test scores in Italian and Maths

Outcomes

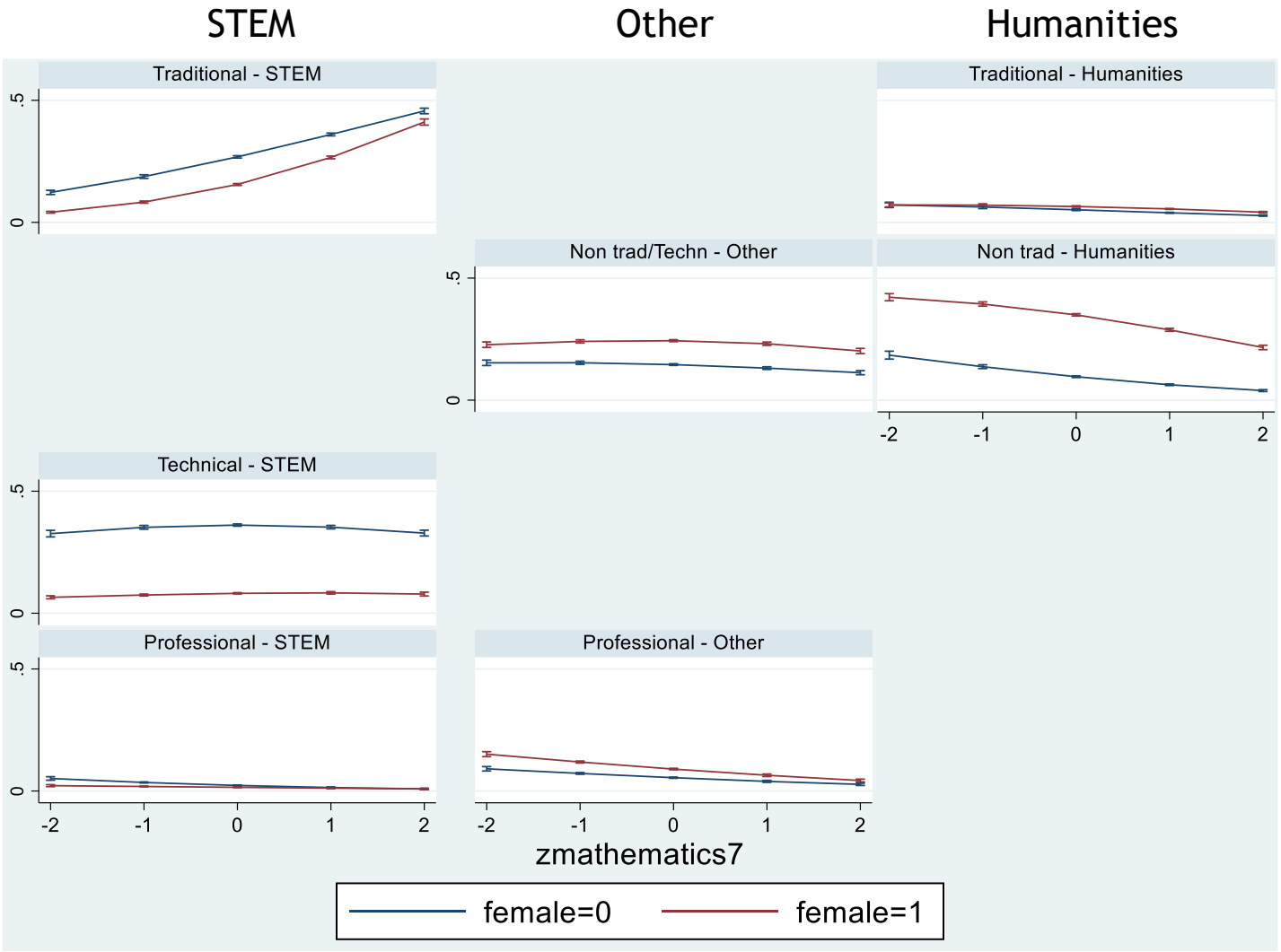
- We analyse school choices at age 14, in terms of:
  - Subjects studied (STEM; Humanities; other)
  - Academic/Vocational track
  - Intersection between the two types of classification

Predicted probabilities of studying STEM for boys and girls by (standardised) grades in maths and italian

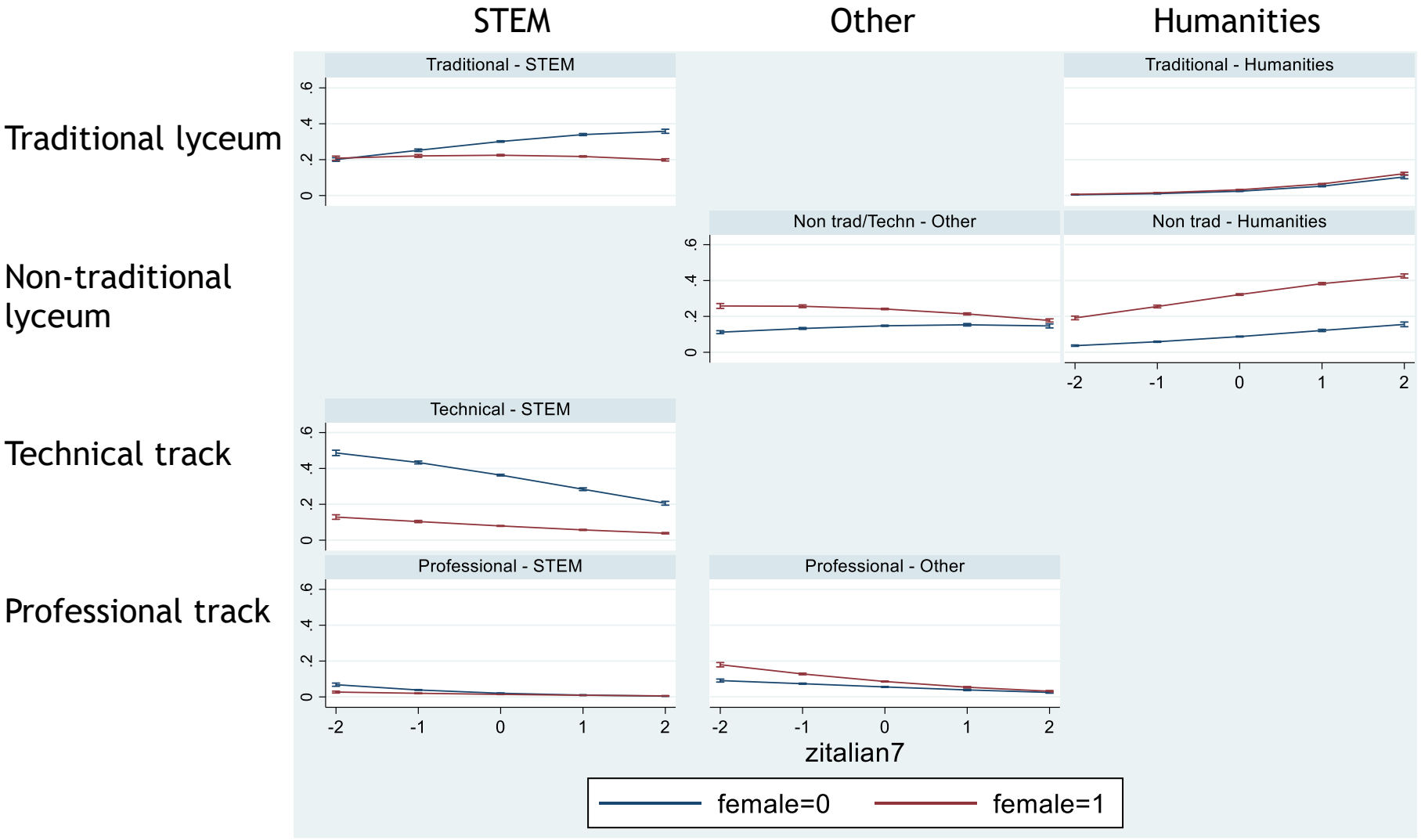




Predicted probabilities of type of school by grades in maths



Predicted probabilities of type of school by grades in Italian



Impact of individual rankings on girls' school choice (marginal effect of 1 SD change)

	Traditional STEM	Traditional Humanities	Non-trad/ Other	Non-traditional Humanities	Technical STEM	Professional STEM	Professional Other
Ranking Maths grades	0.0336*** (0.0047)	-0.0012 (0.0027)	0.0077 (0.0048)	-0.0282*** (0.0052)	-0.0036 (0.0028)	-0.0025** (0.0013)	-0.0059* (0.0032)
Ranking Maths test scores	0.0164*** (0.0047)	-0.0090*** (0.0025)	-0.0024 (0.0054)	-0.0069 (0.0061)	-0.0003 (0.0033)	0.0013 (0.0018)	0.0008 (0.0036)
Ranking Italian grades	-0.0059 (0.0040)	0.0266*** (0.0036)	-0.0056 (0.0042)	0.0201*** (0.0051)	-0.0113*** (0.0022)	-0.0031*** (0.0010)	-0.0208*** (0.0024)
Ranking Italian Test scores	0.0000 (0.0044)	0.0059** (0.0028)	0.0035 (0.0053)	-0.0079 (0.0058)	0.0020 (0.0035)	0.0013 (0.0017)	-0.0047 (0.0034)

Note: Model controlling for test scores, grades, and other independent variables listed in slide 18.
* p<0.10; ** p<0.05; *** p<0.01

Impact of individual ranking on boys' school choice (marginal effect of 1 SD change)

	Traditional STEM	Traditional Humanities	Non-trad/ Other	Non-traditional Humanities	Technical STEM	Professional STEM	Professional Other
Ranking Maths grades	0.0338*** (0.0048)	-0.0026 (0.0018)	-0.0046 (0.0039)	-0.0081*** (0.0029)	-0.0106* (0.0054)	-0.0032 (0.0022)	-0.0047 (0.0029)
Ranking Maths test scores	0.0095* (0.0050)	-0.0060*** (0.0017)	0.0049 (0.0048)	-0.0042 (0.0035)	0.0008 (0.0060)	-0.0021 (0.0023)	-0.0030 (0.0032)
Ranking Italian grades	0.0056 (0.0044)	0.0169*** (0.0027)	0.0144*** (0.0041)	0.0147*** (0.0033)	-0.0434*** (0.0048)	-0.0035* (0.0020)	-0.0046* (0.0026)
Ranking Italian Test scores	-0.0084 (0.0052)	0.0039* (0.0022)	-0.0009 (0.0046)	-0.0029 (0.0036)	0.0105 (0.0065)	-0.0022 (0.0022)	0.0000 (0.0032)

Note: Model controlling for test scores, grades, and other idnependent variables listed in slide 18.
* p<0.10; ** p<0.05; *** p<0.01

Other mechanisms investigated

- Differences in grades/test scores by subject ("I am better in maths than Italian")
- Differences in ranking by subject ("I am the best in my class in maths but I rank 3rd in Italian")
- Class performance of girls vs boys in maths
  - Proportion of girls in the top quartile of the maths test scores distribution
  - Proportion of girls in percentiles higher than the individual's one in the maths' test scores distribution
  - Average girls' class ranking by subject

- Minor effects and no differences between boys and girls

Marginal effects of gender on school choice (by model specification)

Can any of these mechanisms explain/reduce the gender gap in school choice?

	Traditional STEM	Traditional Humanities	Non-trad/ Other	Non-traditional Humanities	Technical STEM	Professional STEM	Professional Other
Model 1: Female	-0.0704*** (0.002)	0.0311*** (0.001)	0.0886*** (0.0019)	0.2437*** (0.0019)	-0.2959*** (0.0019)	-0.0319*** (0.0009)	0.0347*** (0.0015)
Model 2: Model 1 + socioeconomic status and context	-0.0933*** (0.0025)	0.0348*** (0.0012)	0.0865*** (0.0023)	0.2604*** (0.0023)	-0.2968*** (0.0023)	-0.0185*** (0.0009)	0.0269*** (0.0016)
Model 3: Model 2 + test scores and grades	-0.0962*** (0.0025)	0.0133*** (0.0013)	0.091*** (0.0025)	0.2293*** (0.0025)	-0.2642*** (0.0024)	-0.0129*** (0.0009)	0.0397*** (0.0017)
Model 4: Model 3 + ranking in each subject	-0.0972*** (0.0026)	0.0113*** (0.0013)	0.0903*** (0.0025)	0.2277*** (0.0025)	-0.2609*** (0.0025)	-0.0125*** (0.001)	0.0412*** (0.0017)
Model 5: Model 4 + proportion of student's peers of the same gender in top25%	-0.0963 (0.0030)	0.0113** (0.0016)	0.0906 (0.0030)	0.2255* (0.0029)	-0.2589 (0.0029)	-0.0122** (0.0011)	0.0400 * (0.0020)

* p<0.10; ** p<0.05; *** p<0.01

What if girls' test scores in maths increase?

- We analyse whether girls' school choices would change if girls' test scores in maths were more similar to boys' test scores.
- We simulate an increase in girls' test scores in order for them to have the same average test scores of boys, given their maths' grades.

	Observed choice			Simulated choice			% reduction in gender gap
	M	F	Gap M-F	M	F	Gap M-F	
Traditional STEM	30.40%	20.33%	10.08%	30.24%	22.72%	7.52%	25%
Traditional Humanities	3.04%	6.32%	-3.28%	3.14%	6.01%	-2.87%	13%
Non-traditional/Technical Other	13.24%	22.33%	-9.09%	13.17%	21.97%	-8.80%	3%
Non-traditional Humanities	7.53%	33.54%	-26.02%	7.61%	31.87%	-24.27%	7%
Technical STEM	36.27%	6.78%	29.49%	36.24%	7.31%	28.93%	2%
Professional STEM	3.19%	1.48%	1.72%	3.23%	1.45%	1.78%	-4%
Professional Other	6.32%	9.21%	-2.89%	6.37%	8.67%	-2.30%	20%

Conclusions

- We analyse educational choices of Italian boys and girls at age 14.
- We show that girls are less likely to select STEM studies, and these gaps are particularly noticeable for middle range school types (in terms of academic content and prestige).
- Gender gaps in school choices (and STEM/humanities subjects) persist throughout the grade and ranking distribution and are present for all socio-economic groups.

Conclusions

- We explore several transmission mechanisms, including individual differences across subjects, peer achievements and performance by gender in the class.
- Individual ranking significantly affects school choices (in addition to absolute performance measured by grades and test scores).
- Other mechanisms are not significant in explaining school choices.
- However, gender gap in school choice is not explained by performance differences and the other mechanisms we analyse.
- This shows the strong impact of unobserved factors such as bias, stereotypes, etc (not depending on school performance).

Conclusions

- What if girls' test scores in Maths increase and become identical to boys' ones? Would this have an effect on school choice?
- We simulate the effect of an increase in girls' maths performance and show that this would have a modest effect on the probability of selecting STEM-focused schools, especially in the middle range schools.
- A limitation of this work is that, although very rich, these data do not include information on attitudes and non-cognitive skills.
- Policy interventions should tackle girls' disadvantage in maths performance, but also at improving girls' interest and confidence in maths and STEM subjects and reducing bias and stereotypes.

Thank you for listening!