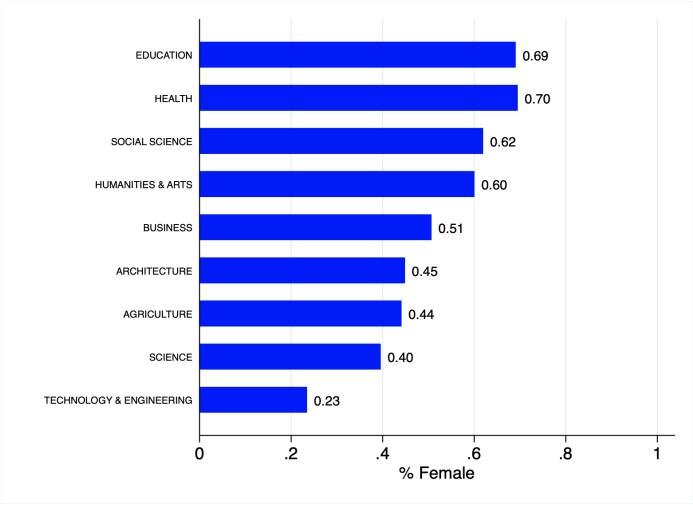
Joining the Old Boys' Club: Women's Returns to Majoring in Technology and Engineering

EEA ESEM 2022

Josefa Aguirre, *PUC*
Juan Matta, *UDP*
Ana María Montoya, *U.Chile*

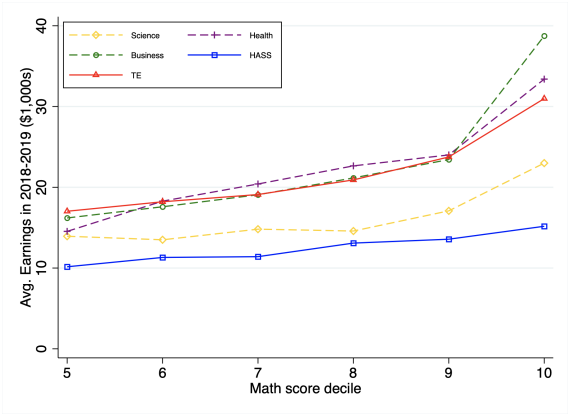
August, 2022

Gender compositions of college fields in Chile

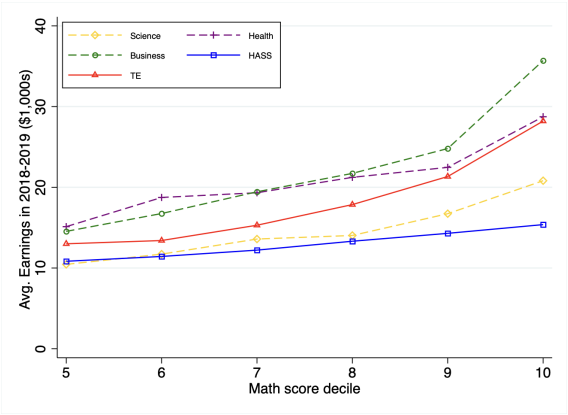


Female share among 1^{st} year college students in different areas

Gender compositions and Average Earnings by Field of Study



Men



Women

Motivation

- Women who pursue college majors in TE fields are more likely to switch majors or drop out than comparable men (e.g., Astorne-Figari and Speer, 2019)
- Women employed at firms managed by men negotiate worse wage bargains and are promoted less frequently (e.g., Biasi and Sarsons, 2022; Cullen and Perez-Truglia, 2021; Casarico and Lattanzio, 2019; Sato and Ando, 2017)
- Family-friendly jobs with more flexibility or shorter distances could be particularly costly to obtain in TE (Goldin 2014a; Goldin and Katz 2016, Le Barbanchon 2020).
- Gender identity concerns could contribute to occupational segregation within TE (Akerlof and Kranton 2000, Bertrand et al. 2015, and Goldin 2014b)

This paper

- We estimate the causal effects for men and women of pursuing majors in technology and engineering (TE) as opposed to majors in low-earnings, non-male-dominated fields of humanities, arts, and social science (HASS)
- We link individual data on applications to higher education in Chile with administrative records on earnings, marriage and fertility
- Exploit Chile's centralized college admission system, which generates discontinuities in admission into TE vs. HASS fields for a subset of applicants.

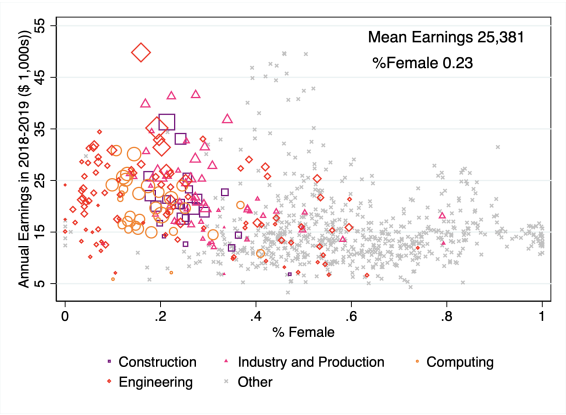
Preview of results

- Enrollment into TE instead of HASS increases annual earnings (81%) and employment (30%) for men, but has no effects on earnings or employment for women.
- In contrast, effects of enrollment into high-earnings, gender-balanced Business and female-dominated Health (vs. HASS) are positive for both men and women.
- Mechanisms:
  - Differences in employment at high-paying & male-dominated industries
  - No effect on fertility and no returns in the marriage market.
  - Differences in returns are aggravated by childbearing
  - Survey: women face greater discrimination in TE than in other disciplines

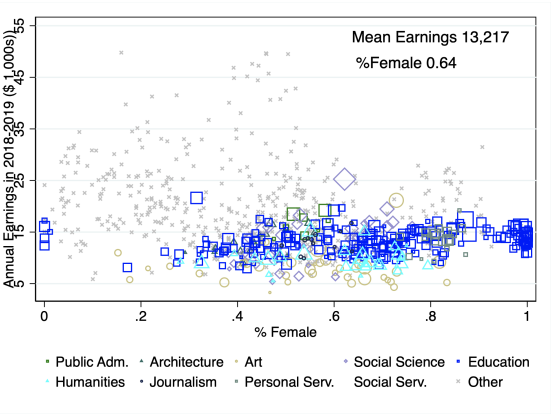
Data

- Administrative records on preferences, test scores and admission cutoffs for cohorts beginning college between 2000 and 2008 from Chile's Ministry of Education.
- Labor earnings data 2000-2019 (ages 30 to 38):
  - Chile's Unemployment Insurance (all private sector, except the self-employed which represent $\approx 15\%$)
  - Public sector records for 2018-2019
- Fertility and marriage records from the civil registration system.
- Survey that we designed and administered

Sample Construction



TE



HASS

Sample Construction

- We take all applicants near a margin involving both TE and HASS
- This includes:
  1. applicants with a cutoff program in TE and a fallback program in HASS
  2. applicants with a cutoff program in HASS and a fallback program in TE
- We then compare the outcomes of those who where offered admission to TE and those who were offered admission to HASS

Empirical Strategy

- Multi-cutoff regression discontinuity (Kirkboen et al., 2016)
- Cutoff-crossing indicator:

$$Z_{ijt} = \begin{cases} 1(r_{ijt} \geq 0) & \text{if } j \in TE \text{ and } k \in HASS \\ 1(r_{ijt} < 0) & \text{if } j \in HASS \text{ and } k \in TE, \end{cases}$$

where:

- Admission offers:

$$Z_{ijt} = 1 \quad \Rightarrow \quad \text{Admission to TE program}$$
$$Z_{ijt} = 0 \quad \Rightarrow \quad \text{Admission to HASS program}$$

Regression Discontinuity

- Reduced form specification:

$$y_{isjt} = \pi_{1sj} \cdot r_{isjt} + \pi_{2sj} \cdot (Z_{isjt} \times r_{isjt}) + \tau_s \cdot Z_{isjt} + \mu_j + \eta_t + \gamma_s + \varepsilon_{isjt}$$

  - y_{isjt} outcome of interest for student i of sex s in margin j, applying for admission in year t.
  - $Z_{ijt} \in \{0, 1\}$: 1 if $r_{ijt} \geq 0$
  - τ_s captures average effect of admission offer.
  - Fixed effects for the students' gender, application year, and preferred program
  - Estimated by OLS, using a uniform kernel with bandwidth $h = 40$.
  - s.e. clustered at the applicant level.

Regression Discontinuity

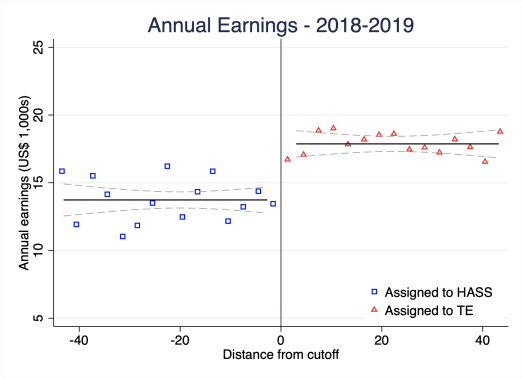
- Instrumental variables estimates:

$$y_{isjt} = \delta_{1sj} \cdot r_{isjt} + \delta_{2sj} \cdot (d_{isjt} \times r_{isjt}) + \beta_s \cdot d_{isjt} + \xi_j + \zeta_t + \kappa_s + \epsilon_{isjt}$$

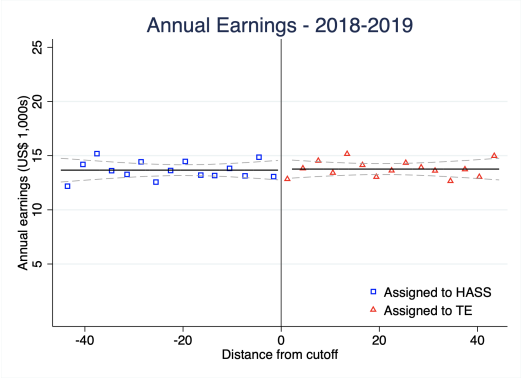
$$d_{isjt} \in \{0, 1\} \quad : \quad 1 \text{ if } i \text{ ever enrolls in } j$$
$$Z_{isjt} \quad \rightarrow \quad d_{isjt}$$

  - Cutoff-crossing indicator Z_{isjt} is used as instrument for enrollment d_{isjt}
  - Exclusion restriction: An admission offer to program j only affects outcome y_{isjt} through its effect on enrollment (d_{isjt}).

Effects of TE on Earnings



Men

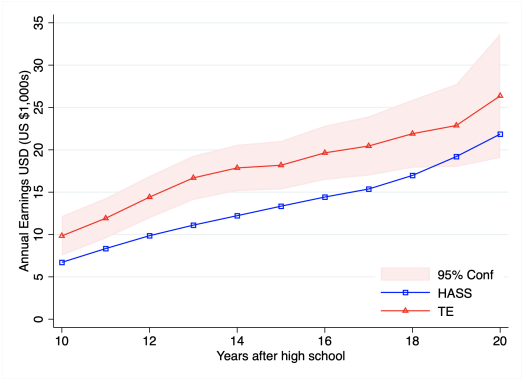


Women

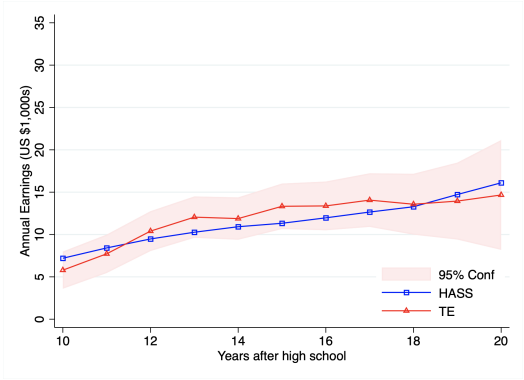
Effects of TE on Earnings

	Works at least one month in 2018-2019	Annual earnings	Annual earnings: $0 < I \leq 15k$	$15k < I \leq 30k$	$30k < I \leq 40k$	$I > 40k$
	(1)	(2)	(3)	(4)	(5)	(6)
Enrolls - TE						
Men	$0,089^{**}$	6.585^{***}	$-0,002$	$-0,028$	$0,038$	$0,082^{***}$
	(0,039)	(1.735)	(0,042)	(0,039)	(0,024)	(0,025)
Women	$-0,042$	558	$-0,039$	$-0,047$	$0,033$	$0,014$
	(0,050)	(1.663)	(0,053)	(0,051)	(0,031)	(0,026)
Men-Women	$0,132^{**}$	6.027^{**}	$0,037$	$0,019$	$0,006$	$0,068^{*}$
	(0,063)	(2.378)	(0,067)	(0,063)	(0,038)	(0,036)
Mean - HASS						
Men	0,717	14.255	0,327	0,256	0,067	0,067
Women	0,740	13.572	0,344	0,284	0,063	0,048
N Clusters	11.557	11.557	11.557	11.557	11.557	11.557

Effects of TE on Earnings over Time



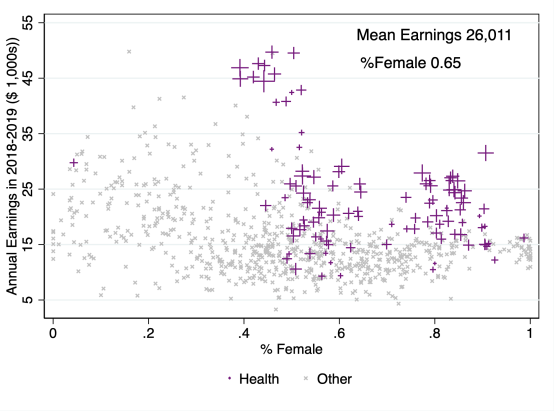
Men



Women

Contrast with other fields

Business

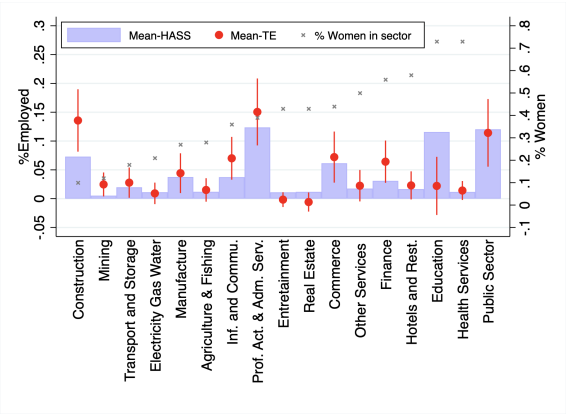


Health

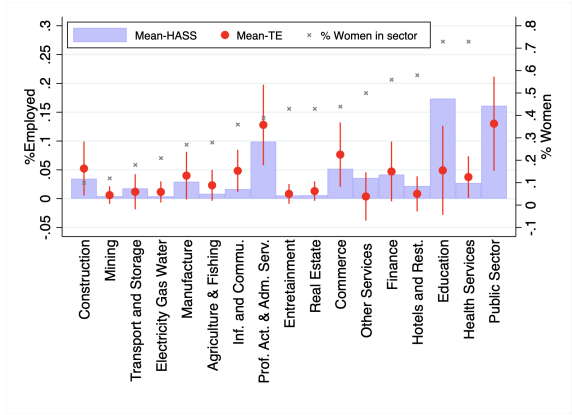
Contrast with other fields

	Business vs. HASS			Health vs. HASS		
	Annual earnings	Works at least one month a year	Months worked a year	Annual earnings	Works at least one month a year	Months worked a year
	(1)	(2)	(3)	(4)	(5)	(6)
Enrolls						
Men	$11,648^{***}$	0.15^{**}	1.74^{**}	$9,174^{**}$	0.05	1.15
	(4,206)	(0.07)	(0.84)	(3,793)	(0.08)	(0.94)
Women	$5,632^{**}$	-0.04	-0.34	$3,532^{**}$	0.05	0.38
	(2,801)	(0.06)	(0.68)	(1,552)	(0.04)	(0.48)
Men-Women	6,015	0.19^{**}	2.08^{*}	5,643	0.00	0.76
	(5,077)	(0.09)	(1.09)	(4,111)	(0.09)	(1.06)
Mean - HASS						
Men	16,745	0.65	6.63	16,063	0.70	7.04
Women	17,337	0.73	7.63	15,763	0.72	7.58
N Clusters	5,509	5,509	5,509	8,064	8,064	8,064

Mechanisms: Industry of employment

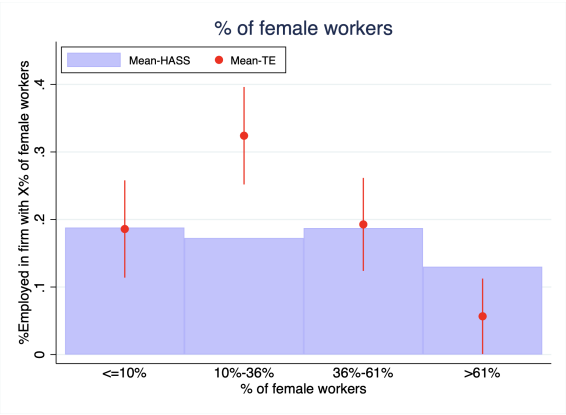


Men

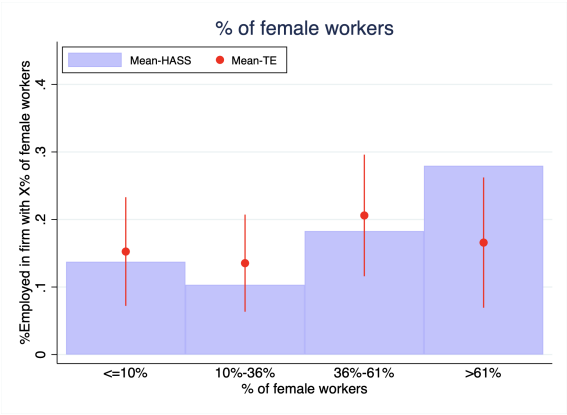


Women

Mechanisms: Percentage of Female Workers

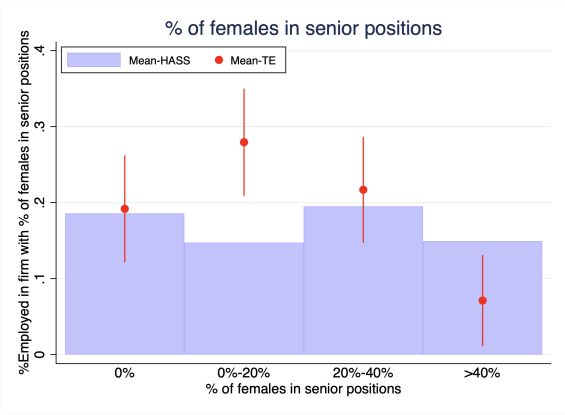


Men

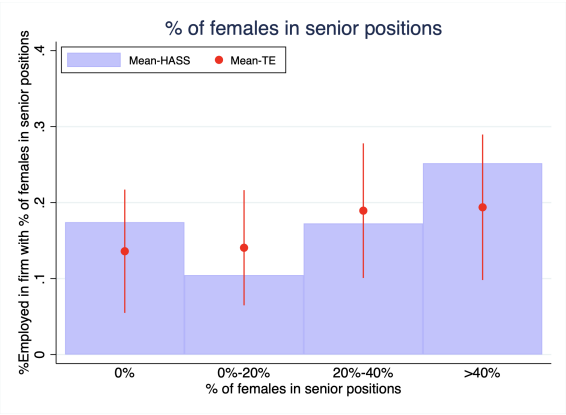


Women

Mechanisms: Percentage of Female Among 5 highest earners in firm

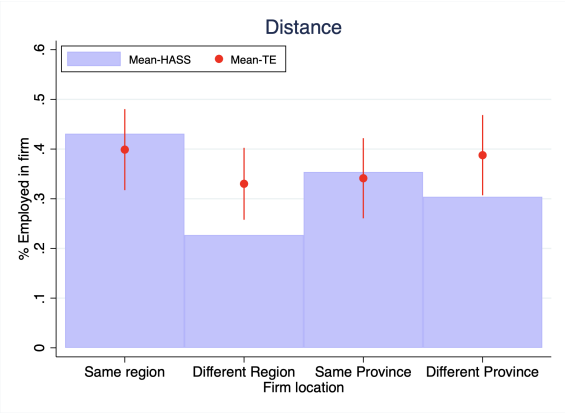


Men

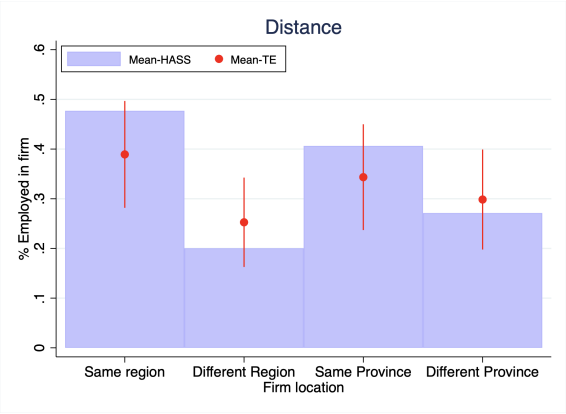


Women

Mechanisms: Firm Distance

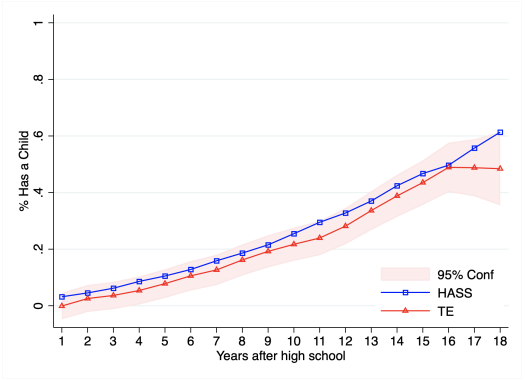


Men

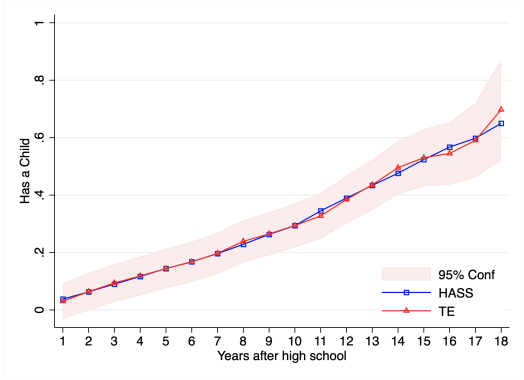


Women

Mechanisms: Fertility (%Has a Child)



Men

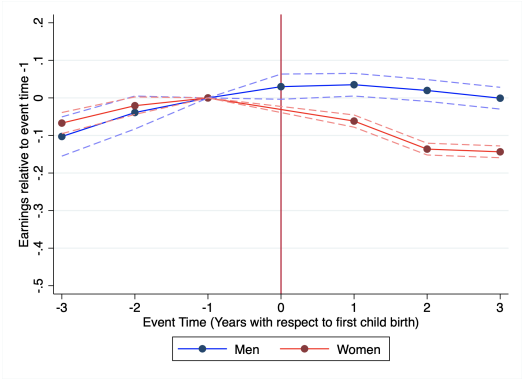


Women

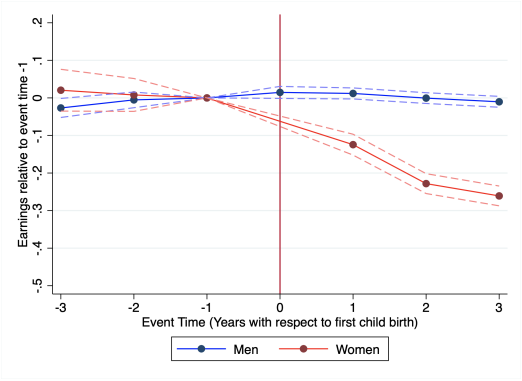
Mechanisms: Marriage

	Has a child	Married	Has a partner (married or parent of child)	Has a Partner we can find in our sample	Partner perc. math score	Partner perc. lang. score	Partner enrolls cutoff program	Partner enrolls non-cutoff TE program	Partner annual earnings
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Enrolls - TE									
Men	−0.02	−0.01	−0.03	0.04	2.83	1.70	0.05**	0.02	630
	(0.04)	(0.04)	(0.04)	(0.04)	(5.67)	(5.82)	(0.02)	(0.03)	(2,561)
Women	−0.03	0.04	0.02	−0.02	5.46	5.42	0.17***	−0.06	1,110
	(0.05)	(0.05)	(0.06)	(0.05)	(8.40)	(7.99)	(0.06)	(0.08)	(4,488)
Men-Women	0.01	−0.05	−0.05	0.06	−2.62	−3.72	−0.11*	0.08	−480
	(0.07)	(0.06)	(0.07)	(0.07)	(9.94)	(9.70)	(0.06)	(0.08)	(5,100)
Mean - HASS									
Men	0.44	0.25	0.47	0.36	41.56	42.62	-0.00	0.04	9,260
Women	0.51	0.28	0.52	0.31	48.98	44.32	0.01	0.17	15,619
N Clusters	11,550	11,550	11,550	11,550	4,039	4,039	4,039	4,039	4,039

Mechanisms: Childbearing

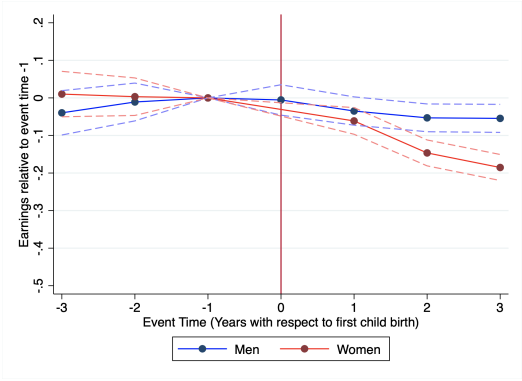


HASS

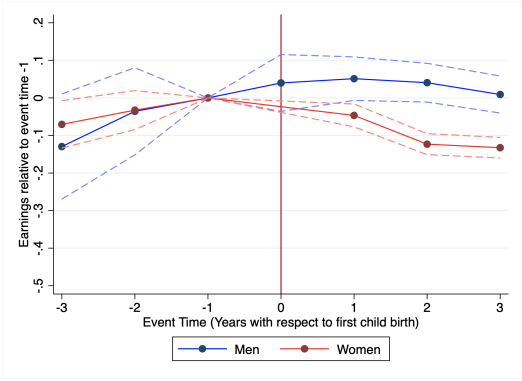


TE

Mechanisms: Childbearing



Business



Health

Earnings for individuals with and without children

	Earnings	Works	Months worked
	(1)	(2)	(3)
Women			
Ever Enrolls			
No Children	2,902	0.04	0.53
	(2,138)	(0.06)	(0.73)
Children	$-1,863$	-0.11^{*}	-1.11^{*}
	(1,833)	(0.06)	(0.67)
Difference	$4,765^{**}$	0.15^{**}	1.64^{**}
	(2,184)	(0.07)	(0.77)
Baseline Mean			
No Children	13,901	0.70	7.31
Children	13,379	0.69	7.19
N Clusters	11,557	11,557	11,557

Survey Evidence

	Male					Female				
	All	HASS	TE	Business	Health	All	HASS	TE	Business	Health
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Gender, family and work (% Agree or Strongly Agree)										
My gender has played against me in the job searching	0.07	0.09	0.08	0.06	0.11	0.35	0.29	0.49	0.45	0.18
I am willing to make sacrifices to reach high-level positions.	0.49	0.44	0.54	0.57	0.41	0.40	0.37	0.52	0.53	0.30
Observations	1,387	334	332	217	145	2,049	913	172	240	342
Felt discrimination sometimes, frequently or always in:										
Promotion at work	0.38	0.42	0.35	0.31	0.39	0.55	0.53	0.65	0.54	0.49
Earnings	0.45	0.48	0.48	0.41	0.45	0.62	0.65	0.76	0.65	0.43
Development opportunities	0.39	0.40	0.40	0.36	0.41	0.50	0.48	0.57	0.50	0.49
Observations	1,387	334	332	217	145	2,049	913	172	240	342

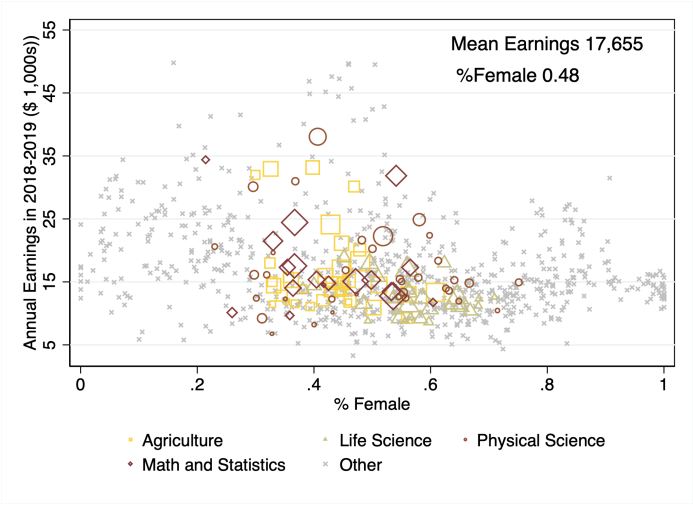
Conclusion

- Enrollment in high-earnings, male-dominated fields such as TE increases employment and earnings for men but not for women.
- These results appear to be the consequence of men and women following different career paths.
- We need more research in other contexts.

Thank you

josefa.aguirre@uc.cl

Science



Science

External Validity: TE vs. HASS

- Do applicants consider both TE and HASS?

	TE	HASS	Business	Health	Science
TE	16.9%	3.5%	2.8%	2.8%	3.0%
HASS		32.5%	2.0%	4.3%	3.3%
Business			3.0%	0.4%	0.8%
Health				18.5%	2.1%
Science					4.1%

Effects of TE on Earnings - Gender Differences in Application?

- What if men and women apply to different programs?
- Maybe men apply to higher-paying programs in TE.
- Re-weight observations so that the distribution of women's applications looks the same as the distribution of men's applications and viceversa.:

$$\frac{\phi_j^m}{\phi_j^f}$$

Effects of TE on Earnings - Re-weighted Estimates

	Using Male Distribution			Using Female Distribution		
	Earnings	Employed	Months worked	Earnings	Employed	Months worked
	(1)	(2)	(3)	(4)	(5)	(6)
Enrolls						
Men	$6,671^{***}$	0.10^{**}	1.34^{**}	$6,652^{***}$	0.09	1.31^{*}
	(2,007)	(0.04)	(0.52)	(2,363)	(0.06)	(0.74)
Women	1,870	-0.04	-0.57	692	-0.03	-0.45
	(2,609)	(0.08)	(0.88)	(1,996)	(0.06)	(0.69)
Men-Women	4,801	0.14	1.90^{*}	$5,961^{*}$	0.12	1.76^{*}
	(3,247)	(0.09)	(1.01)	(3,162)	(0.09)	(1.01)
Mean - HASS						
Men	14,213	0.65	6.61	14,618	0.67	6.73
Women	13,343	0.69	7.21	13,971	0.70	7.31
N Clusters	7,568	7,568	7,568	7,568	7,568	7,568

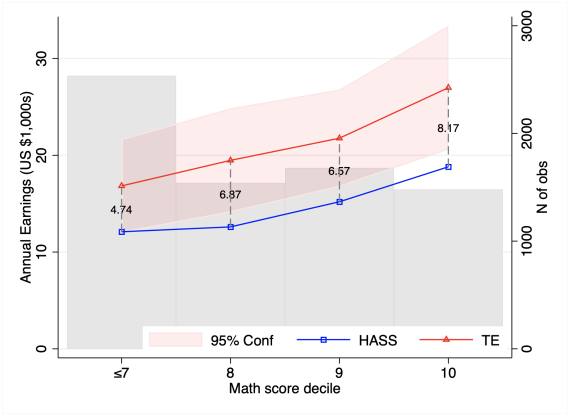
Effects of Enrolling in TE - Heterogeneity by Ability

	Earnings	Employed	Months worked
	(1)	(2)	(3)
Ever Enrolls			
Men	6,044***	0.08**	1.19**
	(1,752)	(0.04)	(0.48)
Women	1,076	−0.02	−0.24
	(1,740)	(0.05)	(0.61)
Men-Women	4,968**	0.10	1.42*
	(2,402)	(0.06)	(0.75)
Ever Enrolls ×			
GPA	−361	−0.09	−0.70
	(2,372)	(0.06)	(0.70)
Math test score	2,753*	0.07*	0.55
	(1,474)	(0.04)	(0.44)
Language test score	−517	−0.07**	−0.77*
	(1,426)	(0.04)	(0.42)
Baseline Mean			
Men	14,563	0.67	6.85
Women	13,426	0.69	7.15
N Clusters	11,557	11,557	11,557

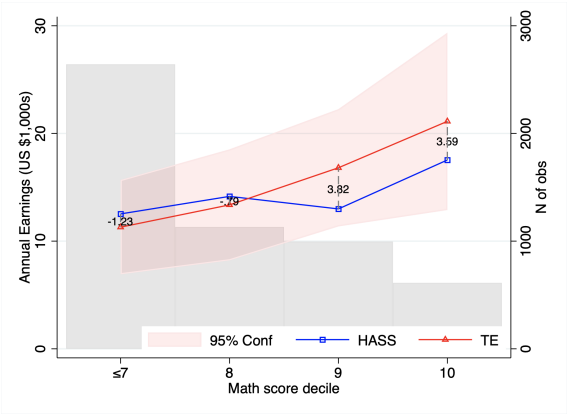
TE as a more or less preferred alternative

	TE as a:			
	Target Program		Fallback Program	
	Earnings	Months worked	Earnings	Months worked
	(1)	(2)	(3)	(4)
Enrolls - TE				
Men	4,716	0.980	7,677***	1.509**
	(2,933)	(0.705)	(2,128)	(0.599)
Women	−1,911	−1.035	2,797	0.304
	(2,241)	(0.821)	(2,472)	(0.836)
Men-Women	6,627*	2.015*	4,880	1.205
	(3,625)	(1.062)	(3,271)	(1.028)
Mean - HASS				
Men	15,844	6.930	13,390	6.719
Women	14,705	7.677	13,133	7.137
N Clusters	4,785	4,785	7,858	7,858

Effects of Enrolling in TE - Heterogeneity by Ability



Men



Women

Contrast with other fields

	Fallback				
	TE	Science	Business	Health	HASS
	(1)	(2)	(3)	(4)	(5)
Enrolls - TE					
Men	672	2.834**	−2.914	−458	6.585***
	(584)	(1.386)	(2.263)	(3.155)	(1.735)
Women	62	1.422	−1.519	3.198	558
	(1.023)	(1.553)	(2.682)	(2.813)	(1.663)
Men-Women	610	1.413	−1.394	−3.656	6.027**
	(1.178)	(2.063)	(3.502)	(4.221)	(2.378)
Mean - HASS					
Men	25.212	23.185	31.030	25.422	14.255
Women	21.707	17.623	25.062	19.192	13.572
N Clusters	41.683	18.010	7.857	6.371	11.557