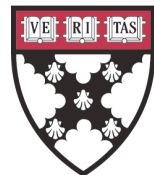# Rewiring the Gender Distribution of Technical Jobs: Online Training Programs and (In)equality

Jackie Ng Lane (HBS), Karim Lakhani (HBS) and Roberto Fernandez (MIT)

MIT MANAGEMENT SLOAN SCHOOL
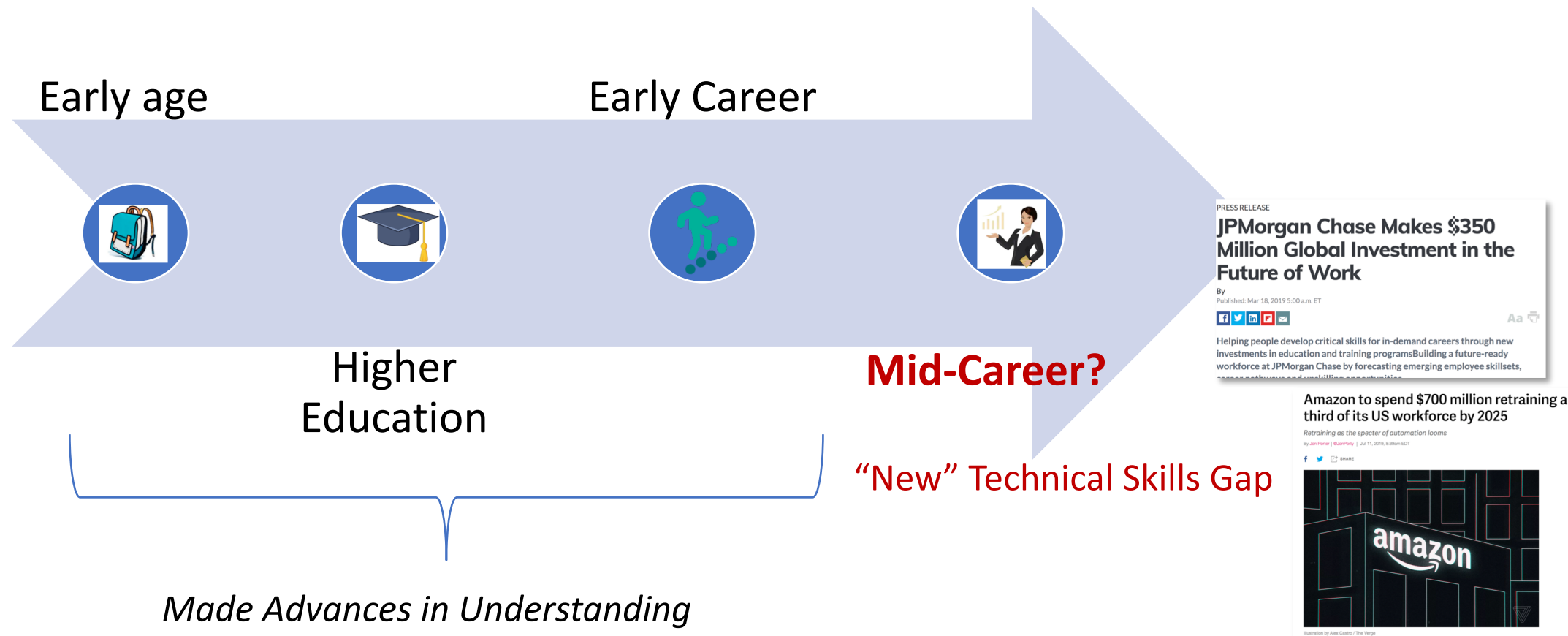
HARVARD BUSINESS SCHOOL

LISH Laboratory for Innovation Science at Harvard

Agenda

- Motivation and Research Question
  - Do STEM Online Training Programs Ameliorate the Leaky STEM Pipeline?
- Theories on Gender Differences in STEM/Technical Fields
- Research Setting & Data
  - Online Executive-Level Training Program in Business Analytics
  - Natural Experiment
  - Lifecycle of admissions process
- Findings
- Conclusions, Limitations, and Future Work

Female STEM "Leaky" Pipeline

Early age

Higher Education

Early Career

Mid-Career?

"New" Technical Skills Gap

Made Advances in Understanding

PRESS RELEASE
JPMorgan Chase Makes $350 Million Global Investment in the Future of Work
By
Published: Mar 18, 2019 5:00 a.m. ET

Helping people develop critical skills for in-demand careers through new investments in education and training programsBuilding a future-ready workforce at JPMorgan Chase by forecasting emerging employee skillsets,

Amazon to spend $700 million retraining a third of its US workforce by 2025
Retraining as the specter of automation looms
By Jon Porter | @JonPorty | Jul 11, 2019, 8:39am EDT

Blau et al. 2010; Cech et al., 2011; Deming & Noray, 2019; Ellis et al., 2016; Moss-Racusin et al., 2012; Reuben et al., 2014; Seron et al., 2016; Silbey, 2016; Williams & Ceci, 2015

Motivation | Theory | Research Setting & Data | Findings | Conclusions

Demand-Side: Competitive Online (Blended) STEM/Technical Training Programs

Key Features:

- Tenured Faculty + Live Instruction

- Blended Learning: Online + In-Person on campus experiences

- Tuition: $50-$75K

- Degree and certificate programs
    - Can qualify as STEM degree

Supply-Side: A Closer Look into STEM/Technical Training Programs & Gender (In)equality

Features Attracting Mid-Career Females:

- Online Learning = flexibility (learn from home/anywhere)

- Attracts systemically different women vs. general population

- Admissions process is both evaluative and collaborative

Adams & Funk, 2012; Bloom et al. 2011; Choudhury et al.; Goldin, 2014; Padavic et al., 2019

Online Program Management (OPM) Partners & Online Education

- Universities partner w/ OPMs to build, market, recruit and deliver online programs

- Full-service: multi-year contract, cut of tuition

- OPM staffs program-dedicated admissions counselors to convert prospects into applicants

Grushka-Cockayne & Lakhani, 2019; McKenzie, 2018

Motivating Question:
Do STEM Online Training Programs Ameliorate the Leaky STEM Pipeline?

Context: Mid-Career Professionals Seeking Online STEM Training Programs

- We examine this question from three different perspectives:

  - Supply-side factors (Prospective students): Do female prospects shy away from applying?

  - Demand-side factors (Admissions counselors): Are female prospects being screened out?

  - Gender similarity factors (Prospect-Counselor pair): How does the gender of the screener affect the application decisions of female prospects?

Research Setting & Data

- 9-18 month blended executive-level training program in business analytics

- Sample coursework: Programming in R and $Python$, People Analytics, Data Science Pipeline, Digital Strategy, Leadership

- Tuition: $50,000

- Demographics: Average age 42, 18 years of work experience, 65% with advanced degree, ~30% female

- 125 students per cohort (~500 students/year)

Summary of Findings

We find that three factors contribute to gender differences in application decisions:

- Supply-side (prospects): women shy away from applying at each stage of the admissions process

- Demand-side (admissions counselors): Admissions counselors (AC) less likely to contact women

- Gender similarity (prospect-counselor pairs): Gender similarity with AC reduces likelihood that women apply
    - Gender disparities larger at early stages of admissions process
    - Supply-side effects > Gender similarity effects

Admissions Process is a Multi-Staged, Multi-Decision Process

| | Pre-Application | Application | | | Post-Application | |

| Lead (Randomly Assigned 1 of 42 AC) | → AC → | Started | → AC → | Engaged | → AC → | Completed | → Univ. → | Admitted | → Univ. → | Registered |

	180,186 observations	20,374 observations	12,871 observations	1,136 observations	981 observations	427 observations
% advancing from lead stage:		11.3%	7.1%	0.6%	0.5%	0.2%
% advancing bet. stages:		11.3%	63.1%	8.8%	86.4%	43.5%

OPM Managed — Univ. Managed

AC = Admissions Counselor; Univ. = University

Descriptives:
Gender Composition Across Admissions Stages Drops from 37 to 30 Percent Female From Lead to Completed Stage
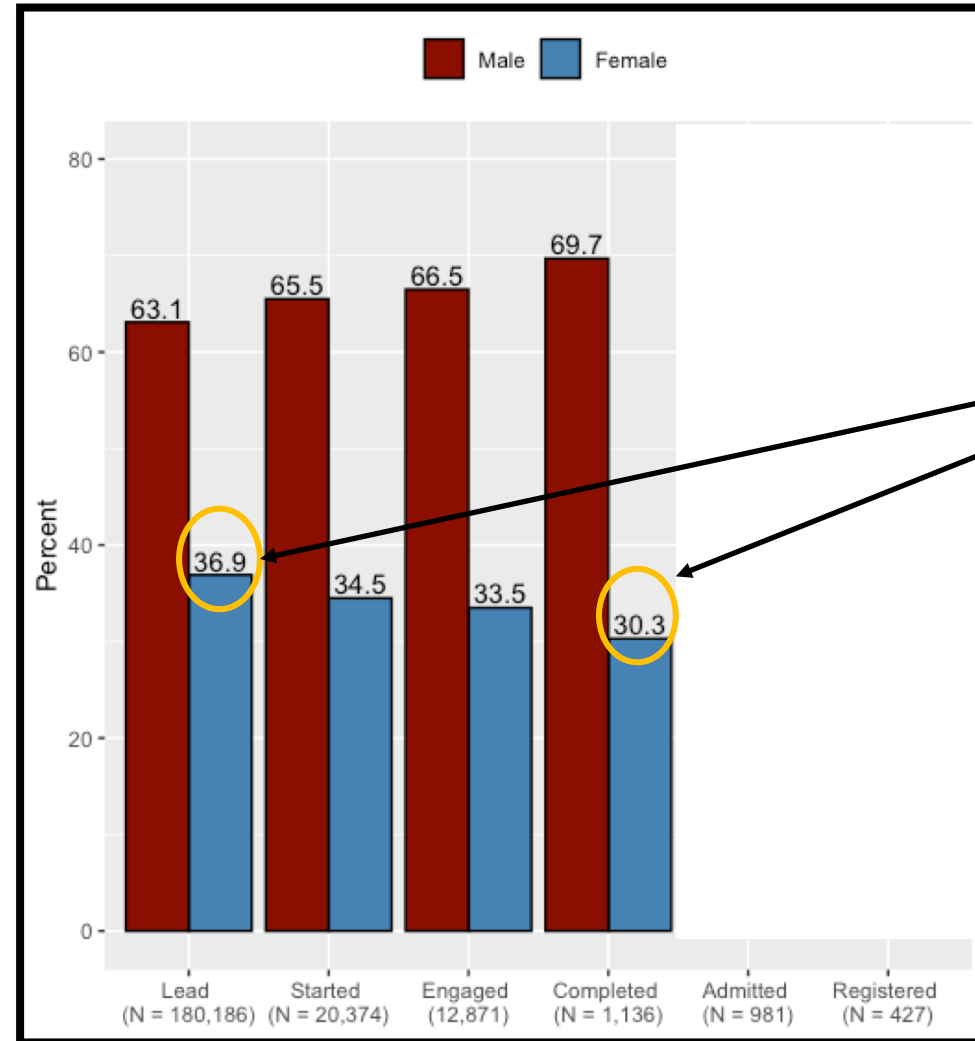

Female representation drops 7% from lead to completed stage (counselor managed)

Likelihood of Advancing Through Admissions Process from Lead Stage Shows Gender Disparity in 4 of 5 Stages

Descriptives: Unconditional Probability of Advancing From Lead Stage by Gender

Gender disparity largest at early stages
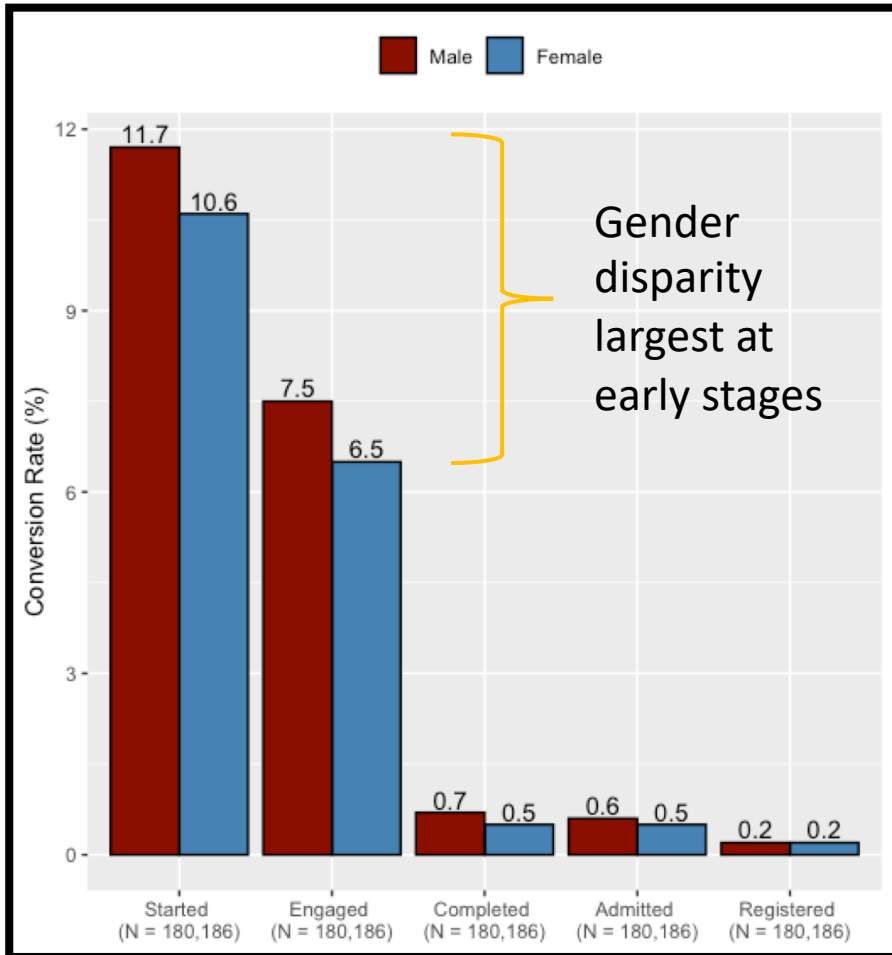
Coef. Plots w/ 95% CI: OLS Reg. of Probability of Advancing from Lead Stage w/ controls, counselor-month FE and clustered robust SE
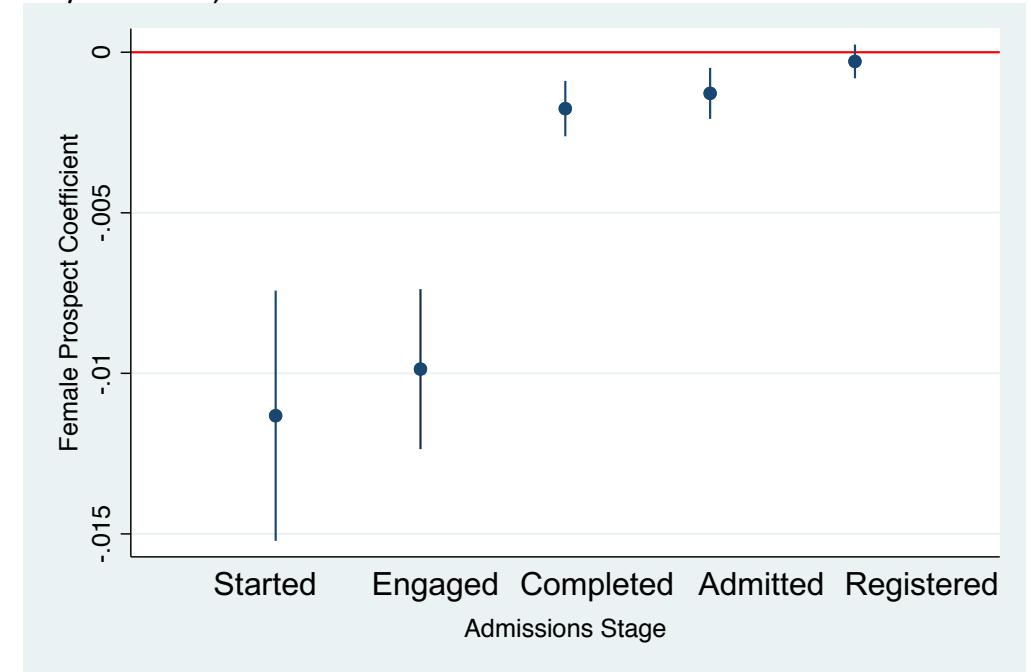
Negative Coefficient for female prospect from lead stage to 4 subsequent adm. stages

Demand-Side Gender Disparities: Count of Lead Stage Calls and Emails Show Female Prospects Less Likely to Be Contacted

Coef. Plots w/ 95% CI: OLS Reg. of Lead Stage Outbound/Inbound Calls and Emails
w/ controls, counselor-month FE and clustered robust SE
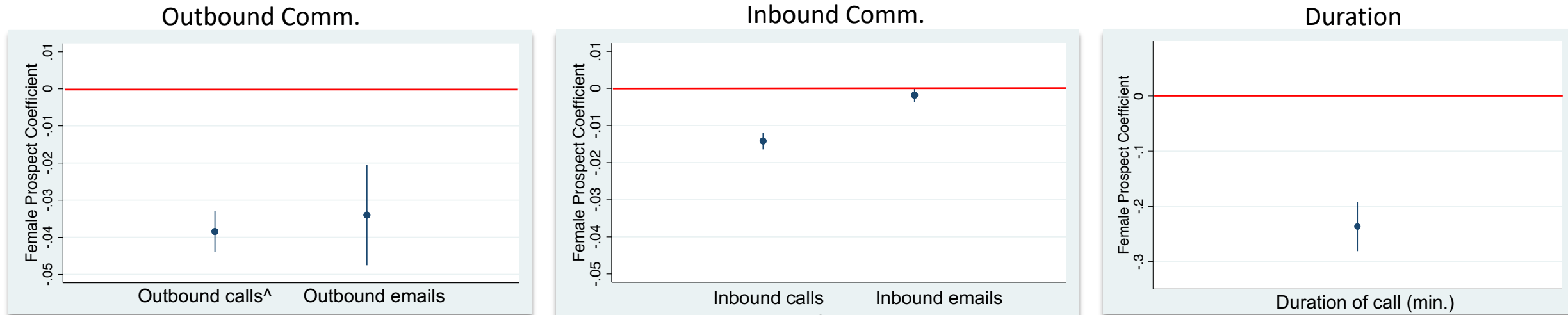
^ Outbound calls that resulted in conversation > 1 min; results robust to count models

Estimated Monthly Economic Impact:
AC's Make 7 Fewer Calls and Spend 41 Fewer Minutes w/ Female Prospects At the Lead Stage

Lead Stage Communication Type	Estimated Economic Impact (per month)	Baseline Comm. Count/Duration (avg. per month)	% of Baseline (All prospects)	% of Baseline (Fem. prospects)
Outbound calls^	-6.9***	100.0	6.9%	18.9%
Outbound emails	-6.3***	415.3	1.5%	3.8%
Inbound calls	-2.5***	37.5	6.6%	18.9%
Inbound emails	-0.3; *ns*	57.6	N/A	N/A
Duration 1st call (mins.)	-41.3***	453.9	9.1%	28.4%

Note: units are count per counselor per month; each AC is assigned 177 female prospects on average each month; ^outbound calls resulting in conversation > 1 min.; * $p < 0.10$; * $p < 0.05$; ***$p < 0.01$

OLS Reg Shows Negative Effect of Gender Similarity: Female Prospect-Counselor Pairs Less Likely to Advance Through Admissions Process
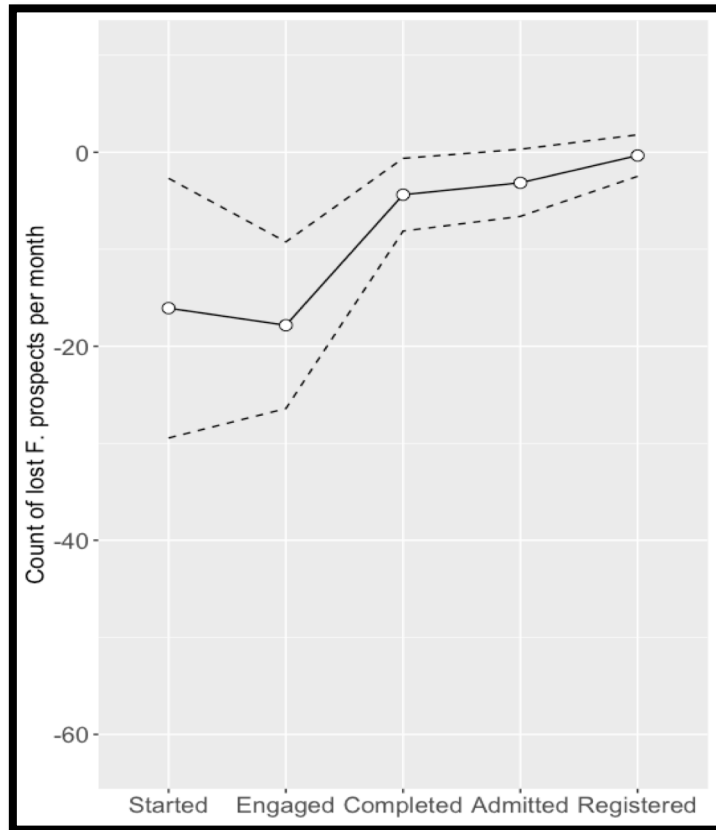
OLS Reg. of Probability of Advancing Through Admissions Process from Lead Stage
w/ controls, month FE and clustered robust SE; * $p < 0.10$; ** $p < 0.05$; *** $p < 0.001$

| VARIABLES	Model 1 Started	Model 2 Engaged	Model 3 Completed
Female prospect	-0.00483**	-0.00526***	-0.00130**
	(0.00200)	(0.00128)	(0.000563)
Female counselor	0.00318	0.00181	-0.000117
	(0.00219)	(0.00151)	(0.000746)
F. prospect x F. counselor	-0.00748**	-0.00652***	-0.00107
	(0.00340)	(0.00224)	(0.000785)
Constant	0.224***	0.139***	0.0187**
	(0.0224)	(0.0154)	(0.00926)
Controls	Y	Y	Y
Month FE	Y	Y	Y
Counselor FE	N	N	N
Observations	180,186	180,186	180,186
R squared	0.007	0.005	0.003
# of counselors	42	42	42

Negative gender similarity effect exists only at early stages of admissions process

Estimated Economic Impact of 38 "lost" started applications per month; 753 "lost" started applications over study period
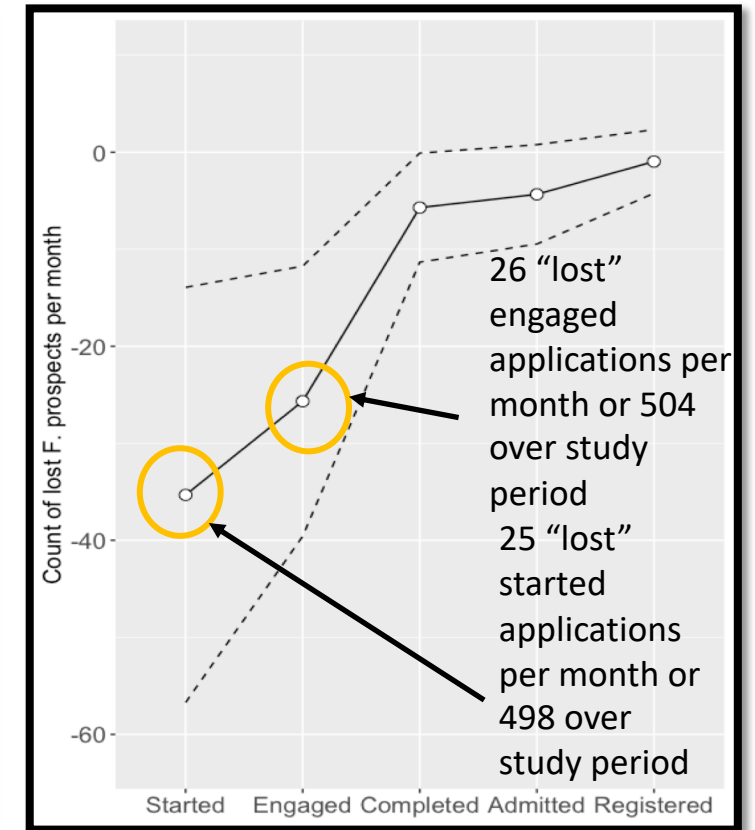

A   **Female prospect (Supply-Side)**

**B**   **Gender Similarity (Interactional)**

C   **Composite Effect (A+B)**

26 "lost" engaged applications per month or 504 over study period
25 "lost" started applications per month or 498 over study period
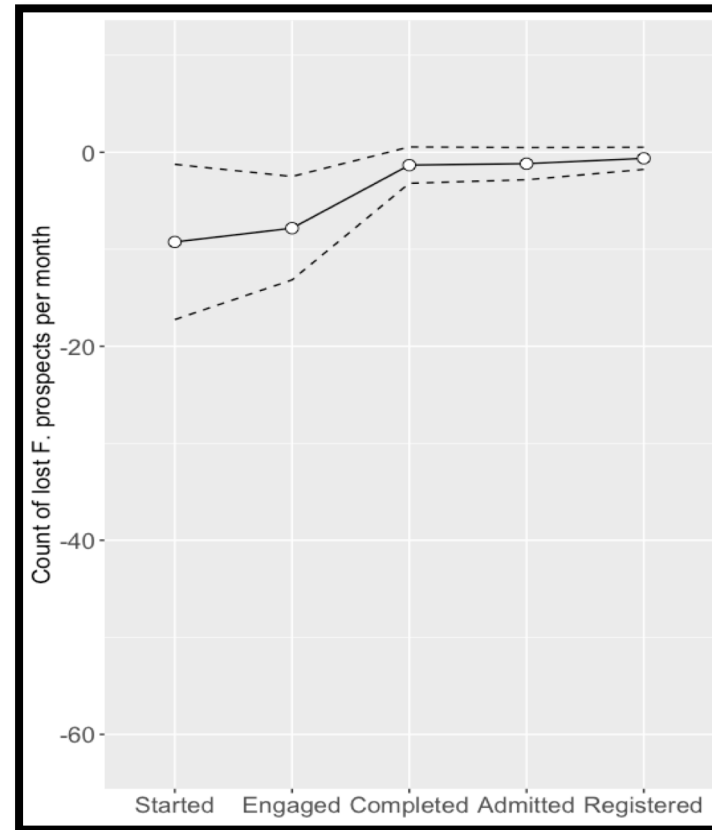
Note: There are 3,397 female prospects per month and 1,208 female prospects assigned to female AC's per month, on average; figures show means with 95% CIs

What-if Scenario: Gender-Equitable Intake Process Results in Nearly Balanced Gender Comp. at Registered Stage
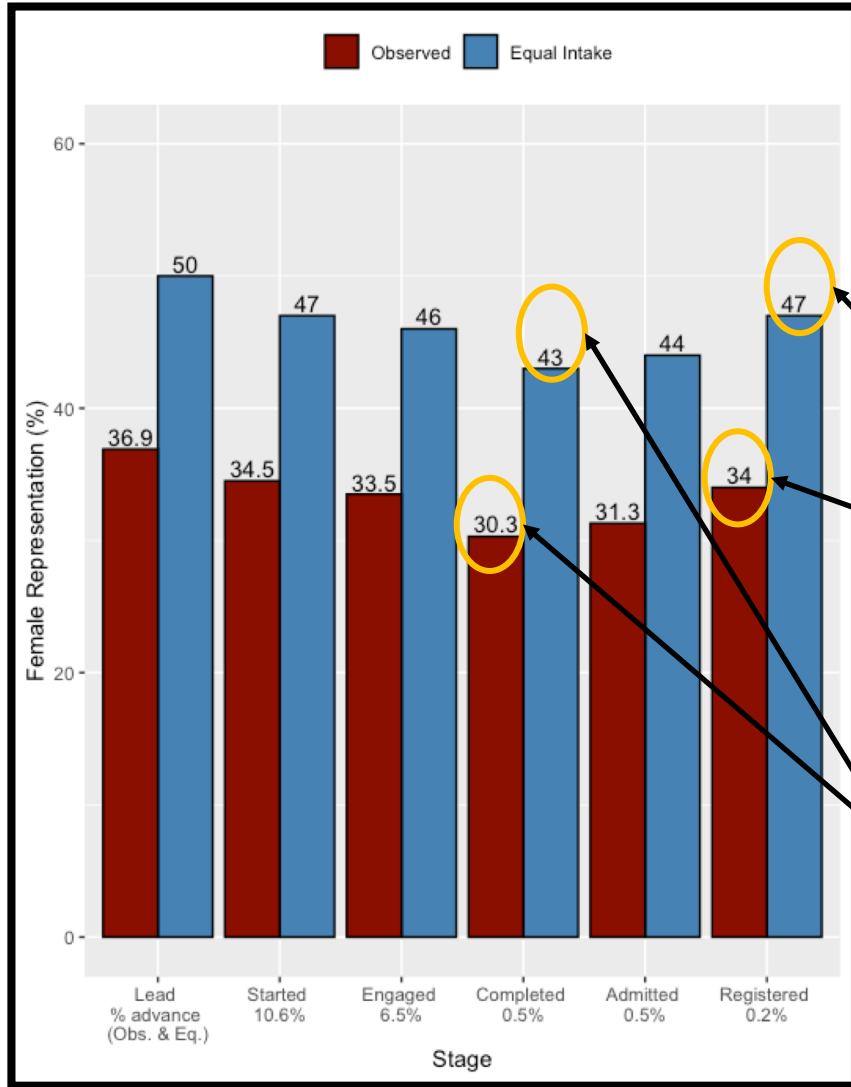
A. Gender-Balanced Incoming Prospect Pool Composition Increases Female Rep. in Later Admissions Stages

- Retrospective analysis on 180K prospects (2 year study period)
- Assumes observed "as-is" conversion rates by gender

Female representation at registered stage improves by 13% over observed process

Female representation at completed stage improves by 12.7% over observed process

Conclusions and Contributions to Literature

- Motivating Question:
  - Do Online STEM Training Programs Ameliorate the Leaky STEM Pipeline?
  - Multi-staged, multi-decisioned *process*: complete lifecycle of admissions process
  - Multi-party decision-makers
  - Supply-side, demand-side, gender similarity factors

- Findings Implications:
  - Female prospects (supply-side) greater impact than gender congruity
  - Toughest part is early decision to apply (Barbulescu & Bidwell, 2013; Fernandez-Mateo & Fernandez, 2016)
  - Framing initial encounter critical (What-if scenarios)

Thank You. Q&A. Discussion.