Faculty Entrepreneurship and the Gender Earnings Gap

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U.S. Census Bureau

NBER SI 2022
Science of Science Funding
July 21, 2022

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Motivation

- Universities have substantially increased commitment to tech transfer (Bozeman, 2000; Bozeman et al., 2015)

- Faculty are key agents facilitating tech transfer through commercial engagement

- Faculty frequently receive earnings from entrepreneurial activities such as consulting or startups (Perkmann et al., 2013; Miller et al., 2018; Staudt, Forthcoming)

- Differences in commercial engagement by gender could exacerbate (or mitigate) earnings gaps between female and male faculty

Large existing bodies of work on:

- Faculty commercial engagement: Bird and Allen (1989) [27%], Blumenthal et al. (1996) [65%], Boardman (2008) [38%], Boardman and Corley (2008) [38%], Boardman and Ponomariov (2009) [38%], Boardman (2009) [38%], Bozeman and Gaughan (2007) [38%], Campbell and Slaughter (1999) [34%], Lee (1996) [43%], Lee (1998) [43%], Lee (2000) [64%], Lin and Bozeman (2006) [44%], Link et al. (2017) [38%], Louis et al. (2001) [64%], Ponomariov (2008) [38%], Ponomariov and Boardman (2008) [37%], Renault (2006) [14%]

- Faculty gender earnings gap: Li and Koedel (2017) [State govt. websites], Ceci et al. (2014) [SDR], Renzulli et al. (2013) [IPEDS], Kelly and Grant (2012) [NSOPF]

- My approach:
  - Link university administrative data (UMETRICS) to universe of W2 and 1099 tax records.
  - Explicitly examine *interaction* between faculty entrepreneurship and faculty gender earnings gap.

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Research Questions

- How often do university faculty engage in entrepreneurial activities outside the university?

- Are there gender gaps in faculty commercial engagement?
    - Participation gaps (i.e. extensive margin)
    - Earnings gaps

- Do entrepreneurial activities expand or shrink gender gaps in total earnings?

Result Highlights

- Commercial Engagement:
    - Over 40% of UMETRICS faculty commercially engage each year
    - Self-employment twice as common as work at employer firm

- Gender Participation Gap:
    - Male faculty 20 percentage points more likely to commercially engage
    - Engagement gap completely driven by self-employment

- Gender Earnings Gap:
    - At mean, female faculty earn $63k (40%) less than male faculty. Non-university earnings account for $18k (29%) of total gap.
    - As faculty move up earnings distribution, total earnings gap grows. Non-university earnings become larger fraction of total gap.
    - Gaps are small at career outset, and grow over time. Contribution of non-university earnings is steady over lifecycle.

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Data Sources

- **IRIS/UMETRICS data**: Comprehensive research grant data for 25 research universities
    - Individual-level monthly payments for all employees on grant:
        - Faculty–19%
        - Grad students & post-docs–44%
        - Undergrads–13%
        - Staff–29%

- **Census/IRS data**: Complete earnings history (2005-2018) for each UMETRICS faculty
    - W2 tax records
    - UI wage records from LEHD program
    - Universe of non-employers (self-employment) from ILBD
    - Augmented with the LBD

Earnings Variables

$$\text{Total} = \text{University} + \text{Non-University}$$

$$\text{Non-University} = \text{Self-Employment} + \text{Employer}$$

$$\text{Employer} = \text{Incumbent} + \text{Young/Startup}$$

$$\text{Employer} = \text{High Tech} + \text{Low-Tech}$$

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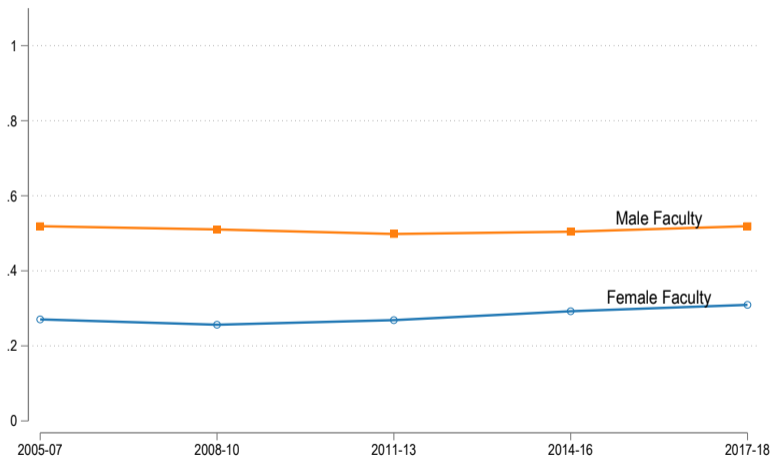$$\text{Employer} = \text{Incumbent} + \text{Young/Startup}$$

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Commercial Engagement of UMETRICS Faculty
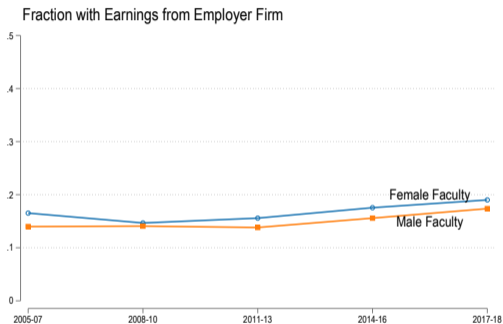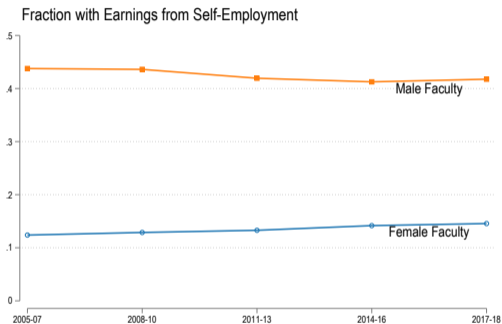

Faculty Particpation Rates
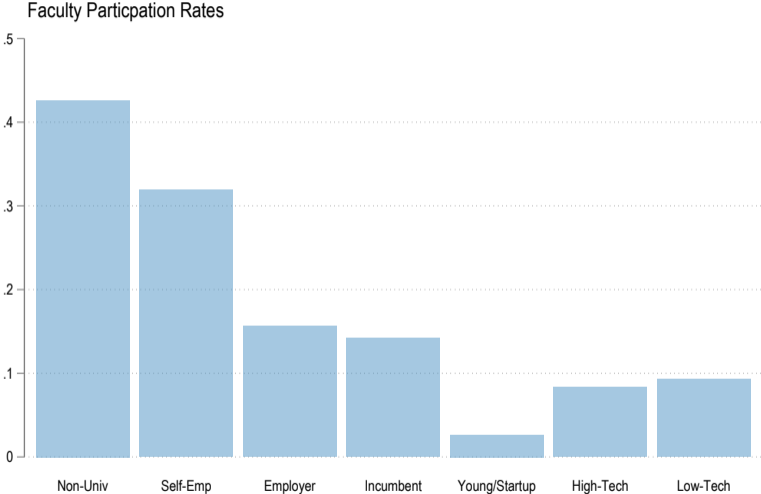
Female faculty are less likely to commercially engage ...

Fraction with Non-University Earnings

... and the entire participation difference is driven by self-employment

Fraction with Earnings from Self-Employment

Male Faculty

Female Faculty

Fraction with Earnings from Employer Firm

Female Faculty

Male Faculty

Regression Table

Female faculty earn less overall ...
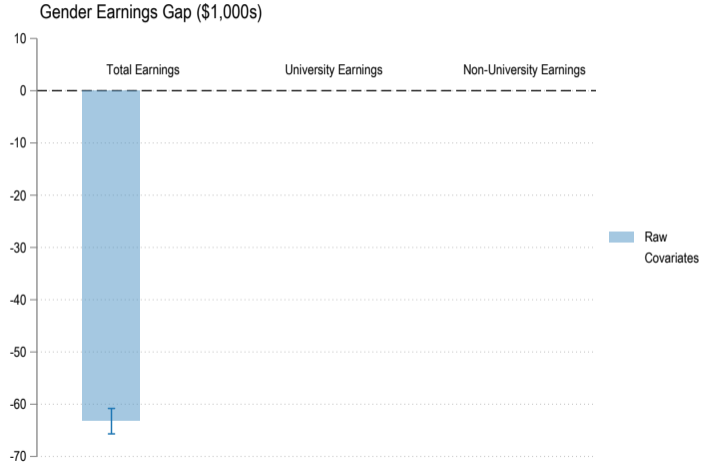
Gender Earnings Gap ($1,000s)

Female faculty earn less overall ... and from both university...

Gender Earnings Gap ($1,000s)

Female faculty earn less overall ... and from both university... and non-university sources ...

Gender Earnings Gap ($1,000s)

Total Earnings   University Earnings   Non-University Earnings

Raw
Covariates
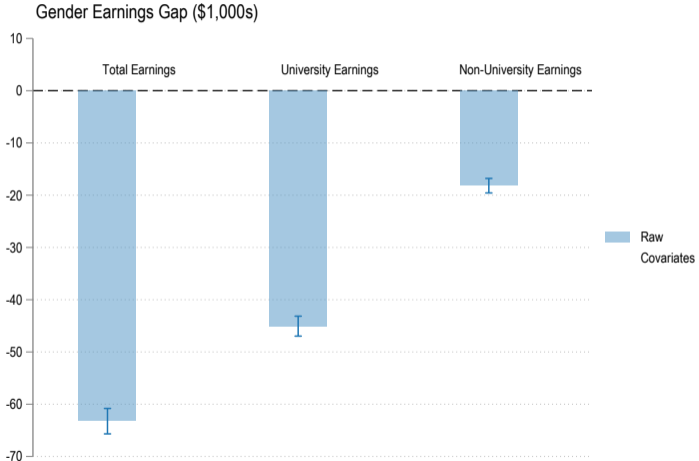
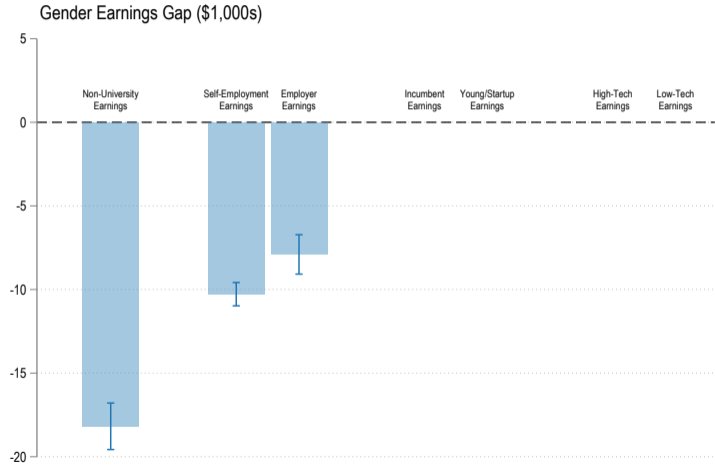# Female faculty earn less overall ... and from both university... and non-university sources ... even conditional on covariates

Gender Earnings Gap ($1,000s)

The non-university earnings gap …

Gender Earnings Gap ($1,000s)
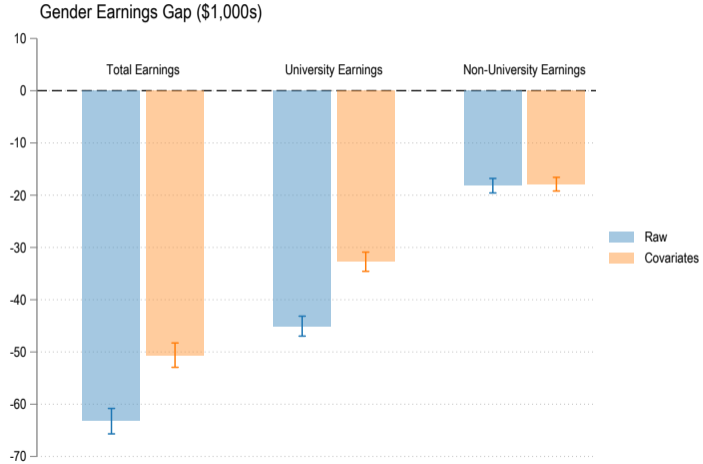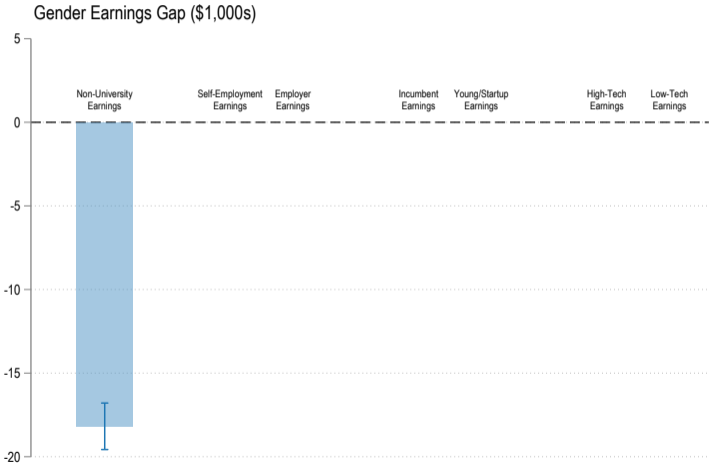
The non-university earnings gap ... is driven by self-employment and employer earnings gaps ...
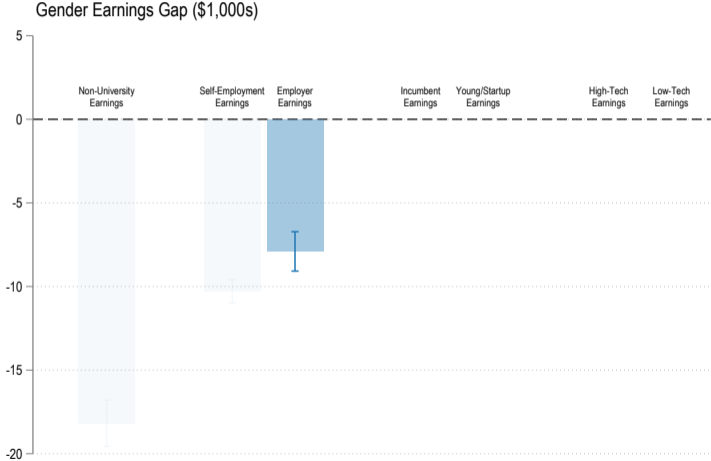
Gender Earnings Gap ($1,000s)

Employer earnings gaps ...

Gender Earnings Gap ($1,000s)

Non-University Earnings · Self-Employment Earnings · Employer Earnings · Incumbent Earnings · Young/Startup Earnings · High-Tech Earnings · Low-Tech Earnings

Employer earnings gaps ... are dominated by incumbent gaps ...

Gender Earnings Gap ($1,000s)
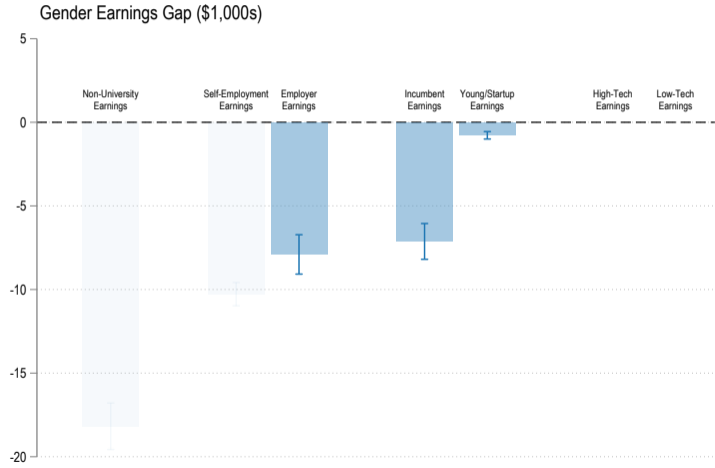
Employer earnings gaps ... are dominated by incumbent gaps ... and high-tech gaps.

Gender Earnings Gap ($1,000s)
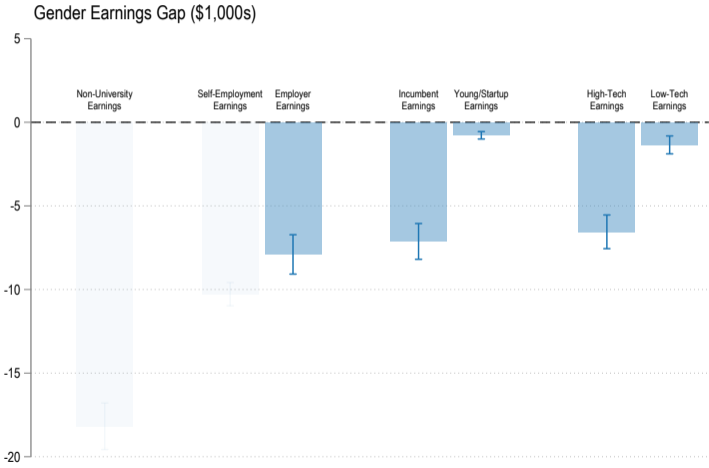
Female faculty earn less across all sources of non-university earnings.
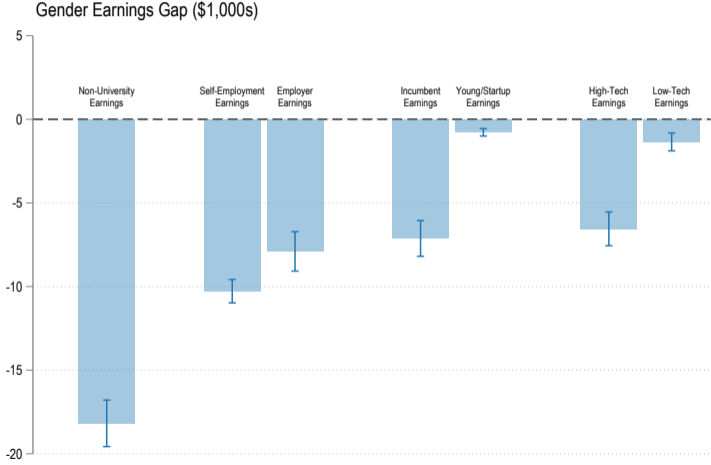
Gender Earnings Gap ($1,000s)

Across the earnings distribution, female faculty earn less overall …

Gender Earnings Gap ($1,000s)

Across the earnings distribution, female faculty earn less overall ... and less from universities ...

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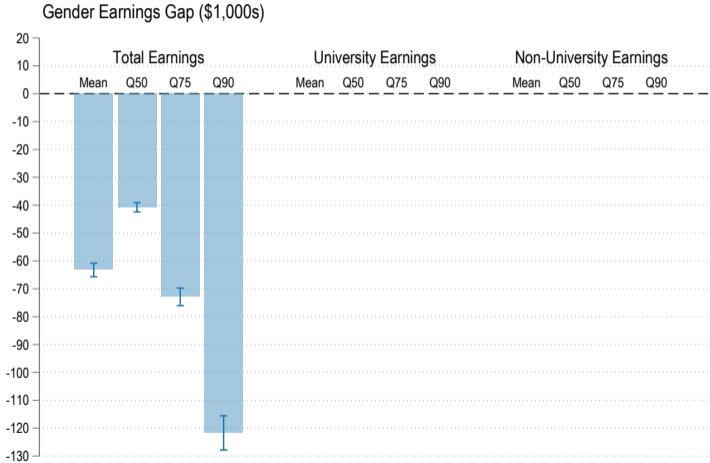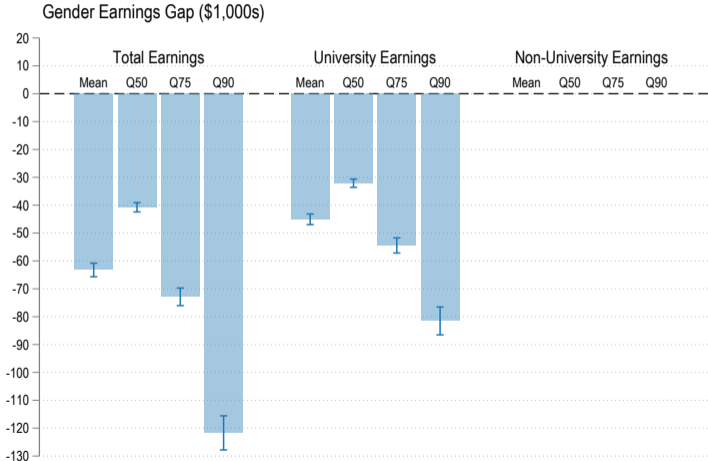
Across the earnings distribution, female faculty earn less overall ... and less from universities ... But only in the upper tail for non-university earnings.
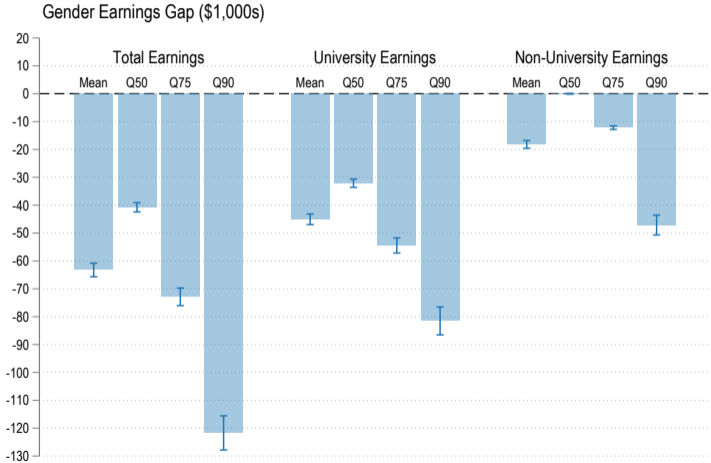
Gender Earnings Gap ($1,000s)

As faculty move up the earnings distribution, the non-university earnings gap accounts for larger share of the total gap.

Percent of Total Gap

Legend:
- Non-University Fraction
- University Fraction

Categories: Mean, Q50, Q75, Q90

Regression Table   Plot with Covariates

Earnings gaps start small, and then expand over the lifecycle.

Gender Earnings Gap ($1000s)

Non-University

University

Total

Age Group

Faculty FE Plot   Non-University Contribution
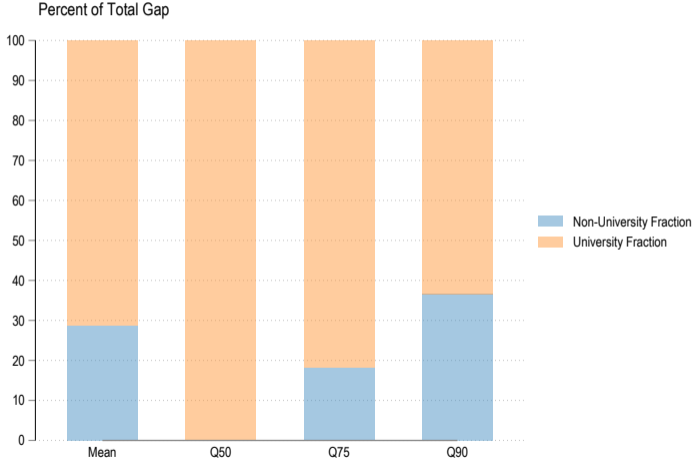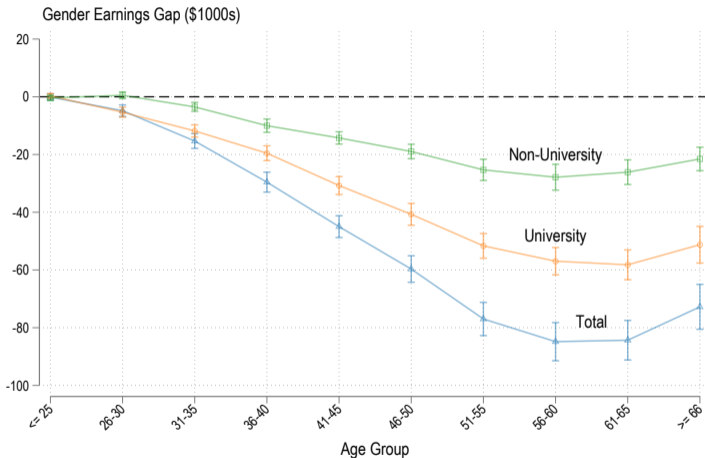
Summary and Conclusions

- First use of linked administrative data to analyze faculty commercial engagement and its impact on the faculty gender earnings gap

- Findings
    - A large fraction of faculty engage in economic activities outside their university
    - Men are much more likely to engage than women, which is driven by self-employment
    - Female faculty earn less than male faculty from both university and non-university sources
    - Entrepreneurial activities unambiguously expand the faculty gender earnings gap.

Thank You!

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Table: Summary Statistics for Earnings by Source

	1[Earnings > 0]		Earnings ($)	
	Mean	SD	Mean	SD
Earnings Source				
Total	1	0	161,600	170,400
University	1	0	137,500	119,100
Non-University	0.426	0.495	24,100	116,500
Self-Employment	0.319	0.466	8,624	63,000
Employer Firm	0.156	0.363	15,480	96,650
Incumbent Firm	0.142	0.349	14,090	85,470
Young/Startup Firm	0.026	0.160	1,391	27,620
High-Tech Firm	0.084	0.277	9,865	87,610
Low-Tech Firm	0.093	0.290	5,613	39,850
Faculty Count: 59,500				

Notes – This table shows summary statistics for UMETRICS faculty. The unit of observation is a person-year, but only the person (faculty) counts are reported. A faculty member is included in the sample for a given calendar year if they: 1) receive positive W2/LEHD earnings from an IPEDS EIN (i.e. a university) in that calendar year and 2) the calendar year is in or after the first year they are classified as a faculty member in UMETRICS. These restrictions help to ensure that I only observe commercial engagement of faculty *while they are faculty*. Earnings are measured in real 2018 dollars.

Participation Plot

Table: Female-Male Participation Gap – Extensive Margin

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Non-University	Self-Employment	Employer	Incumbent	Young/Startup	High-Tech	Low-Tech
Female Faculty Indicator	-0.2128***	-0.2577***	0.0046	0.006791*	-0.000655	-0.01451***	0.02036***
	(0.003612)	(0.003192)	(0.002742)	(0.002657)	(0.000882)	(0.002032)	(0.002104)
Percent of Mean	-49.92	-80.78	2.95	4.77	-2.48	-17.37	21.89
Faculty Count	59,500	59,500	59,500	59,500	59,500	59,500	59,500
Year × Age FEs	×	×	×	×	×	×	×

Notes – This table displays OLS regressions of indicators for whether a source of earnings is positive on a female faculty indicator – i.e., extensive margin regressions. All regressions include age by year fixed effects. "Non-University" is an indicator for whether the faculty member received positive W2/LEHD earnings from a non-IPEDS EIN or positive 1099/ILBD earnings. "Self-Employment" is an indicator for positive 1099/ILBD earnings. "Employer" is an indicator for positive W2/LEHD earnings from a non-IPEDS EIN. "Incumbent" and "Young/Startup" are indicators for positive W2/LEHD earnings from a non-IPEDS EIN that belongs to a firm that is older than 5 years (incumbent) and five years old or younger (young/startup). "High-Tech" and "Low-Tech" are indicators for positive W2/LEHD earnings form a non-IPEDS EIN that belongs to a firm with a high-tech/low-tech NAICS code as defined by Goldschlag and Miranda (2020). The sample is defined so that only faculty with positive university earnings in a given year are included. Thus, by definition, the fraction of faculty receiving positive university wages is 1 for all time periods. Standard errors are clustered at the faculty level.

Participation Plots

Table: Female-Male Earnings Gaps at the Mean

	(1)	(2)	(3)	(4)	(5)	(6)
	Total Earnings		University Earnings		Non-University Earnings	
Panel A: Level Earnings (OLS)						
Female Faculty Indicator	-63,240***	-50,610***	-45,060***	-32,730***	-18,180***	-17,890***
	(1,242)	(1,189)	(974)	(938.1)	(709.2)	(668.7)
Panel B: Level Earnings (PPML)						
Female Faculty Indicator	-0.4164***	-0.3284***	-0.3444***	-0.2466***	-0.8811***	-0.8537***
	(0.007976)	(0.007604)	(0.00746)	(0.007064)	(0.03241)	(0.03166)
Panel C: Log Earnings (OLS)						
Female Faculty Indicator	-0.4096***	-0.2875***	-0.3731***	-0.2197***		
	(0.007801)	(0.006892)	(0.008876)	(0.007444)		
Year FEs	×	×	×	×	×	×
Covariates		×		×		×
Faculty Count	59,500	59,500	59,500	59,500	59,500	59,500

Notes – This table displays regressions of earnings on a female faculty indicator. Each cell contains the coefficient on the female faculty indicator from a separate regression. Panel A displays OLS estimates using the level of earnings as the outcome. Panel B displays PPML estimates. Panel C displays OLS estimates using the log of earnings as the outcome. The coefficients from the PPML and log earnings regressions have a semi-elasticity interpretation. All regressions include year fixed effects. The regressions in even-numbered columns include controls for field, university, access to scientific resources, age, race, ethnicity, and place of birth. "Total Earnings" are earnings from all sources received by a faculty member in a given year. "University Earnings" are W2 or LEHD earnings from an EIN contained in IPEDS. "Non-University Earnings" are W2/LEHD earnings from a non-IPEDS EIN or 1099/ILBD earnings. The sample is defined so that only faculty with positive university earnings in a given year are included. Thus, by definition, the fraction of faculty receiving positive university wages is 1 for all time periods. Earnings are measured in real 2018 dollars. Standard errors are clustered at the faculty level.

Plots

Table: Components of Non-University Female-Male Earnings Gaps

	(1)	(2)	(3)	(4)	(5)	(6)
	Self-Employment Earnings	Employer Earnings	Incumbent Earnings	Young/Startup Earnings	High-Tech Earnings	Low-Tech Earnings
Panel A: Level Earnings (OLS)						
Female Faculty Indicator	-10,280***	-7,902***	-7,124***	-778.2***	-6,550***	-1,352***
	(356.1)	(600.5)	(545.4)	(113)	(513.9)	(273.5)
Panel B: Level Earnings (PPML)						
Female Faculty Indicator	-1.727***	-0.556***	-0.5498***	-0.6201***	-0.7525***	-0.2485***
	(0.05956)	(0.03989)	(0.04021)	(0.08253)	(0.05363)	(0.05051)
Year FEs	×	×	×	×	×	×
Faculty Count	59,500	59,500	59,500	59,500	59,500	59,500

Notes – This table displays regressions of earnings on a female faculty indicator. Each cell contains the coefficient on the female faculty indicator from a separate regression. Panel A displays OLS estimates using the level of earnings as the outcome. Panel B displays PPML estimates. The coefficients from the PPML regressions have a semi-elasticity interpretation. All regressions include year fixed effects. "Self-Employment Earnings" are 1099/ILBD earnings. "Employer Earnings" are W2/LEHD earnings from a non-IPEDS EIN. "Incumbent Earnings" and "Young/Startup Earnings" are W2/LEHD earnings from a non-IPEDS EIN that belongs to a firm that is older than 5 years (incumbent) and five years old or younger (young/startup). "High-Tech Earnings" and "Low-Tech Earnings" are W2/LEHD earnings form a non-IPEDS EIN that belongs to a firm with a high-tech/low-tech NAICS code as defined by Goldschlag and Miranda (2020). The sample is defined so that only faculty with positive university earnings in a given year are included. Thus, by definition, the fraction of faculty receiving positive university wages is 1 for all time periods. Earnings are measured in real 2018 dollars. Standard errors are clustered at the faculty level.

Plots

Table: Percent Contribution of Covariates to Gender Earnings Gaps

	(1)	(2)	(3)
	Total Earnings	University Earnings	Non-University Earnings
Age FEs	17.01	19.73	10.27
Field FEs	7.887	11.58	-1.263
Race/Eth FEs	0.855	0.6041	1.477
Scientific Resources	0.5792	0.9542	-.3509
University FEs	0.3126	1.671	-3.057
Year FEs	-.4078	-.2832	-.7169
Place of Birth FEs	-4.071	-3.589	-5.265
All Covariates	22.16	30.66	1.094
Unexplained	77.83	69.33	98.90
Faculty Count	59,500	59,500	59,500

Notes – This table displays the percent contributions of covariate groups to the raw gender gaps in total, university, and non-university earnings. They are derived from Oaxaca-Blinder decompositions. "Total Earnings" are earnings from all sources received by a faculty member in a given year. "University Earnings" are W2 or LEHD earnings from an EIN contained in IPEDS. "Non-University Earnings" are W2/LEHD earnings from a non-IPEDS EIN or 1099/ILBD earnings. The sample is defined so that only faculty with positive university earnings in a given year are included. Thus, by definition, the fraction of faculty receiving positive university wages is 1 for all time periods. Earnings are measured in real 2018 dollars.

Table: Female-Male Earnings Gaps Across the Faculty Earnings Distribution

|	(1)	(2)	(3)	(4)	(5)	(6)
	Total Earnings		University Earnings		Non-University Earnings	
Panel A: Level Earnings (50th Percentile)						
Female Faculty Indicator	-40,750***	-28,140***	-32,100***	-19,240***	-39.23	-27.44
	(843.5)	(794.9)	(755.2)	(696.5)	(55.31)	(41.46)
Panel B: Level Earnings (75th Percentile)						
Female Faculty Indicator	-72,880***	-58,360***	-54,450***	-38,950***	-12,170***	-12,500***
	(1,609)	(1,551)	(1,386)	(1,333)	(321.8)	(320.3)
Panel C: Level Earnings (90th Percentile)						
Female Faculty Indicator	-121,700***	-108,600***	-81,520***	-67,480***	-47,110***	-49,730***
	(3,128)	(3,222)	(2,552)	(2,612)	(1,827)	(1,836)
Year FEs	×	×	×	×	×	×
Covariates		×		×		×
Faculty Count	59,500	59,500	59,500	59,500	59,500	59,500

Notes – This table displays regressions, using recentered influence functions (RIFs), of earnings on a female faculty indicator. Each cell contains the coefficient on the female faculty indicator from a separate regression. Panel A displays RIF estimates at the 50th quantile of the faculty earnings distribution. Panels B and C display RIF estimates at the 75th and 90th quantiles of the faculty earnings distribution. All regressions include year fixed effects. The regressions in even-numbered columns include controls for field, university, access to scientific resources, age, race, ethnicity, and place of birth. "Total Earnings" are earnings from all sources received by a faculty member in a given year. "University Earnings" are W2 or LEHD earnings from an EIN contained in IPEDS. "Non-University Earnings" are W2/LEHD earnings from a non-IPEDS EIN plus 1099/ILBD earnings. The sample is defined so that only faculty with positive university earnings in a given year are included. Thus, by definition, the fraction of faculty receiving positive university wages is 1 for all time periods. Earnings are measured in real 2018 dollars. Standard errors are clustered at the faculty level and are obtained using a Bayesian bootstrap.

Plots

Table: Components of Non-University Female-Male Earnings Gaps Across the Faculty Earnings Distribution

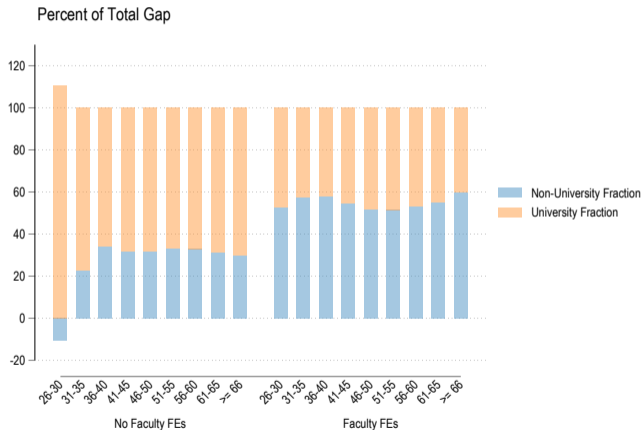|	(1)	(2)	(3)	(4)	(5)	(6)
	Self-Employment Earnings	Employer Earnings	Incumbent Earnings	Young/Startup Earnings	High-Tech Earnings	Low-Tech Earnings
Panel A: Level Earnings (50th Percentile)						
Female Faculty Indicator	1,594***	-5,637**	-4,327**	-2,076***	-5,463**	-1,194***
	(219.6)	(2,225)	(1,833)	(722.4)	(2,347)	(232.1)
Panel B: Level Earnings (75th Percentile)						
Female Faculty Indicator	-1,144***	-8,456**	-6,490**	-3,114***	-8,194**	-1,791***
	(348.9)	(3,337)	(2,750)	(1,084)	(3,521)	(348.2)
Panel C: Level Earnings (90th Percentile)						
Female Faculty Indicator	-24,410***	-7,932***	-4,156***	-3,737***	-9,833**	-7,742***
	(514.1)	(1,614)	(1,593)	(1,300)	(4,225)	(352)
Year FEs	×	×	×	×	×	×
Faculty Count	59,500	59,500	59,500	59,500	59,500	59,500

Notes – This table displays regressions, using recentered influence functions (RIFs), of earnings on a female faculty indicator. Each cell contains the coefficient on the female faculty indicator from a separate regression. Panel A displays RIF estimates at the 50th quantile of the faculty earnings distribution. Panels B and C display RIF estimates at the 75th and 90th quantiles of the faculty earnings distribution. All regressions include year fixed effects. "Self-Employment Earnings" are 1099/ILBD earnings. "Employer Earnings" are W2/LEHD earnings from a non-IPEDS EIN. "Incumbent Earnings" and "Young/Startup Earnings" are W2/LEHD earnings from a non-IPEDS EIN that belongs to a firm that is older than 5 years (incumbent) and five years old or younger (young/startup). "High-Tech Earnings" and "Low-Tech Earnings" are W2/LEHD earnings form a non-IPEDS EIN that belongs to a firm with a high-tech/low-tech NAICS code as defined by Goldschlag and Miranda (2020). The sample is defined so that only faculty with positive university earnings in a given year are included. Thus, by definition, the fraction of faculty receiving positive university wages is 1 for all time periods. Earnings are measured in real 2018 dollars. Standard errors are clustered at the faculty level and are obtained using a Bayesian bootstrap.

Earnings gaps start small, and then expand over the lifecycle.
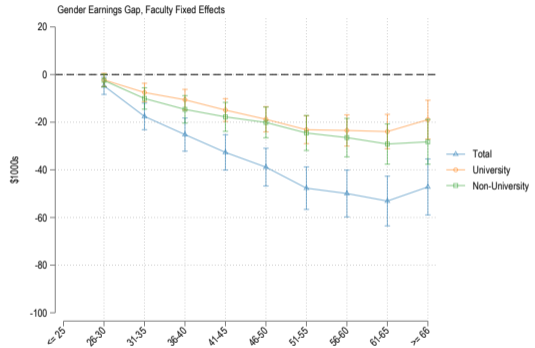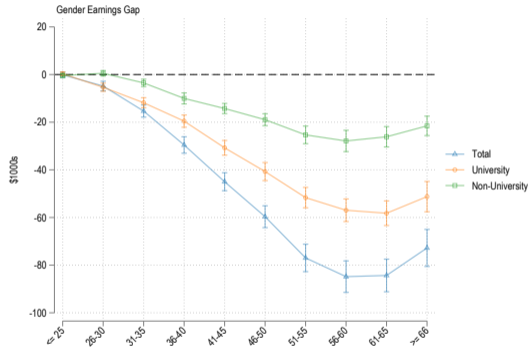
Contribution of non-university earnings gap to total earnings gap is fairly stable over the lifecycle.

Percent of Total Gap

Non-University Fraction
University Fraction

No Faculty FEs   Faculty FEs

As faculty move up the earnings distribution, the non-university earnings gap accounts for larger share of the total gap.

Percent of Total Gap

Legend:
- Non-University Fraction
- University Fraction

X-axis groups: Raw (Mean, Q50, Q75, Q90), Covariates (Mean, Q50, Q75, Q90)

Plot with Covariates