STEM Women and Gender Pay Gap in IT Career

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Introduction

- Technology advancement provides more high-pay jobs that require high skills.
- However, the question remains whether **long-lasting gender pay gap continues among high-skilled jobs**.
- With broad adoption of computerization, Information Technology (IT) jobs are prevalent in almost all industries (Goldin, 2014). O*NET has clustered these emerging IT jobs as ***IT Career*** since 2016, which requires worker to have specific knowledge, abilities and skills to enter.
- The demand for high skilled workers has been increasing under technological change. **STEM skills** (science, technology, engineering, and math) play the core role in productivity and innovation, which are the key ingredients for specific human capital formation (Bianchi & Giorcelli, 2019; Deming & Noray, 2019).
- Prior evidence shows that the pay gap may be alleviated when women can gain similar STEM skills as their male counterparts. Extended from this stream of literature. Using a large-scale archived behavioral data from an online recruitment platform, we study gender pay gap with STEM background in the matched job application-position pairs.

Theoretical Background

Job Search and Gender Wage Disparity

- Preference, work-life considerations and identity norm are the three main reasons for gender disparity of employment (Petrongolo, 2019).
- In job search, employers' biased beliefs and stereotypes against women increase gender discrimination (Uhlmann & Cohen, 2007; Hensvik, 2014).
- Women are less preferred in the male-dominated jobs (Fernandezmateo & King, 2011; Ludsteck, 2014; Koch et al., 2015).

Theoretical Background

Asking Wage and Bargaining

- Women tend to avoid exhibiting competitive preference in bargaining and career choice relative to men (Croson & Gneezy, 2009; Flory et al., 2015; Janssen et al., 2016).
- Integrating from asking for wages and bargaining, we follow the literature on women's confidence levels (Heckman, 1974; Gronau, 1974; Barnes, 1975; Nakamura et al., 1979; Maani & Studenmund, 1986; Hashimoto & Zhao, 2000; Babcook & Laschever, 2007; Exley et al., 2020).
- First explored the phenomena in China, this study echoes discoveries that women exhibit less confidence in asking for higher wages and bargaining to avoid negotiations with employers (Card et al., 2016; Exley et al., 2020).

Theoretical Background

Women with STEM Skills

- STEM abilities are the key ingredients in human capital for technic workers, both for men and women (Bianchi & Giorcelli, 2019; Deming & Noray, 2019).
- Female workers are less participative in the STEM field even they are equipped with STEM knowledge (Ceci & Williams, 2011; Sheltzer & Smith, 2014; Kahn & Ginther, 2017).
  - Buser et al. (2014) find even if female and male workers perform the same-level tasks, men are still more likely to be hired by employers in STEM jobs.
  - Cech et al. (2011) find that women are lack of confidence in their skills in STEM jobs and undervalued by the employers.
- Recently, women with STEM abilities are shown higher probability to be hired and earn higher wage (Bianchi & Giorcelli, 2019; Deming & Noray, 2019).
- Cassar et al. (2016) find gender gap can be eliminated while females gain the equivalent skills and incentive for competition for the same jobs.

Hypotheses

H1: Female applicants ask for lower wages than their male counterparts when seeking IT jobs.

H2: Female IT job applicants with STEM education will ask for higher wages compared with fellow female applicants without STEM background.

H3: The payment offered by employers will be lower for female job applicants compared with their male counterparts, and the same gender difference will apply to job applicants with or without STEM background.

H4: A higher level of skill match between the job applicant and the position can alleviate the gender pay gap for female job applicants with STEM backgrounds.

Methods

- **Data**: the data is from one of the largest online labor markets in China. The platform users are naturally divided into two sides: the job applicants (employees-to-be) and the job posters (employers).
- The platform allows users communicate with each other, the job applicants need to provide their job expectations and demographic information; the employers provide the job descriptions and company information.
- **Sampling**: To construct the dataset, we start with applicant ID and employer ID with the dynamic behavioral data to link the two-sided matched records. We identify each application-position pair from applicant and the employer with time dimension, based on the decision whether the employer gives a formal job interview offer.
  - The time span of the final sample is between January 1st and December 31st, 2018.
  - The IT jobs category is consistent with the O*NET classification of the IT career cluster.
- We include full-time job positions only, the final sample for analysis is 608,763 observations of matched application-position pair.

Results

Table 1 Asking Wages, Gender and STEM Background

	(1)Full Sample max_exp_wage	(2)Full Sample min_exp_wage	(3)Women max_exp_wage	(4)Women min_exp_wage
female	-1.121***	-0.707***		
	(0.019)	(0.014)		
STEM	0.681***	0.483***	0.445***	0.304***
	(0.022)	(0.016)	(0.038)	(0.029)
Applicant Characteristics	Control	Control	Control	Control
Expected City Fixed	Yes	Yes	Yes	Yes
Application Sequence Fixed	Yes	Yes	Yes	Yes
Expected Industry Fixed	Yes	Yes	Yes	Yes
Expected Job Position Fixed	Yes	Yes	Yes	Yes
N	608763	608763	94955	94955
Adj. R^2	0.482	0.475	0.489	0.500

Notes: Robust standard errors adjusted are in parentheses; * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

H1

Upper: 1121 RMB/month
Lower: 707 RMB/month

H1: Female job applicants ask lower wage than male competitors in finding a IT job.

H2

H2: Female job applicants with STEM background can raise their asking wage compared to fellow female job applicants without STEM background.

Table 2 Gender Pay Gap at the Upper and Lower Bound

	(1)Full Sample max_pay	(2)Full Sample min_pay	(3)STEM max_pay	(4)STEM min_pay
female	-0.247***	-0.170***	-0.232***	-0.162***
	(0.021)	(0.014)	(0.024)	(0.016)
STEM	0.325***	0.165***		
	(0.019)	(0.011)		
Applicant Characteristics	Control	Control	Control	Control
Firm Characteristics	Control	Control	Control	Control
Offered City Fixed	Yes	Yes	Yes	Yes
Offered Month Fixed	Yes	Yes	Yes	Yes
Offered Industry Fixed	Yes	Yes	Yes	Yes
Offered Job Position Fixed	Yes	Yes	Yes	Yes
N	608763	608763	492314	492314
Adj. R^2	0.592	0.581	0.589	0.571

Notes: Robust standard errors adjusted are in parentheses; $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$.

H3

H3: The employer's offered biding pay is lower for female job applicants compared to male counterparts, and the same gender difference applies to job applicants with STEM background.

H4

Table 3 Skill Match and Gender Pay Gap

	(1)STEM max_pay	(2)STEM max_pay	(3)STEM max_pay	(4)STEM max_pay	(5)STEM max_pay	(6)STEM max_pay
female	-0.234***	-0.406***	-0.228***	-0.222***	-0.228***	-0.213***
	(0.024)	(0.091)	(0.024)	(0.039)	(0.024)	(0.029)
skill_match	0.486***	0.425***				
	(0.082)	(0.090)				
female*skill		0.304*				
		(0.159)				
prior_match			0.180***	0.181***		
			(0.026)	(0.027)		
female*prior				-0.010		
				(0.049)		
employer_match					0.028	0.036**
					(0.017)	(0.019)
female*employer						-0.058
						(0.051)
Applicant Characteristics	Control	Control	Control	Control	Control	Control
Firm Characteristics	Control	Control	Control	Control	Control	Control
Offered City Fixed	Yes	Yes	Yes	Yes	Yes	Yes
Offered Month Fixed	Yes	Yes	Yes	Yes	Yes	Yes
Offered Industry Fixed	Yes	Yes	Yes	Yes	Yes	Yes
Offered Job Position Fixed	Yes	Yes	Yes	Yes	Yes	Yes
N	492314	492314	492314	492314	492314	492314
Adj. R^2	0.589	0.589	0.589	0.589	0.589	0.589

Notes: Robust standard errors adjusted are in parentheses; * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

H4: The higher level of skill match between the job applicant and the position can alleviate the gender pay gap against female job applicants with STEM background.

H4

Table 4 Skill Match and Gender Pay Gap

	(1)STEM min_pay	(2)STEM min_pay	(3)STEM min_pay	(4)STEM min_pay	(5)STEM min_pay	(6)STEM min_pay
female	-0.163***	-0.307***	-0.161***	-0.140***	-0.161***	-0.165***
	(0.016)	(0.059)	(0.016)	(0.028)	(0.016)	(0.020)
skill_match	0.230***	0.179***				
	(0.048)	(0.052)				
female*skill		0.255**				
		(0.111)				
prior_match			0.057***	0.063***		
			(0.015)	(0.017)		
female*prior				-0.035		
				(0.034)		
employer_match					0.023**	0.022**
					(0.010)	(0.011)
female*employer						0.010
						(0.036)
Applicant Characteristics	Control	Control	Control	Control	Control	Control
Firm Characteristics	Control	Control	Control	Control	Control	Control
Offered City Fixed	Yes	Yes	Yes	Yes	Yes	Yes
Offered Month Fixed	Yes	Yes	Yes	Yes	Yes	Yes
Offered Industry Fixed	Yes	Yes	Yes	Yes	Yes	Yes
Offered Job Position Fixed	Yes	Yes	Yes	Yes	Yes	Yes
N	492314	492314	492314	492314	492314	492314
Adj. R^2	0.571	0.571	0.571	0.571	0.571	0.571

Notes: Robust standard errors adjusted are in parentheses; * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

H4: The higher level of skill match between the job applicant and the position can alleviate the gender pay gap against female job applicants with STEM background.

Conclusion

- This study highlights labor market returns to the STEM education for human capital formation.
- The findings contribute to the understanding of the impact of technological change in the workplace.
- We introduce new evidence on the gender pay gap with STEM background from the online hiring process.
- We find the existence of gender pay disparity from both the employer and the job applicant sides despite women's fulfillment of STEM educational background. However, the higher level of skill match can alleviate gender-based bias in technology-intensive jobs.