

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.
- 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 & Giorelli, 2019; Deming & Noray, 2019).
- In 2019, China's Ministry of Human Resources and Social Security, the Ministry of Education, the Supreme People's Court, and other departments jointly released a legal notice to prohibit firms from rejecting job applications based on gender.
- Prior evidence shows the pay gap may be alleviated when women can gain similar STEM skills as their male counterparts. 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.

Significance

It is commonly believed that STEM education gives women greater confidence in asking for higher wages, which could ultimately close the gender pay gap. However, both intuitive perceptions at work and mounting evidence from previous research have proven otherwise. Studying this topic is key to understanding how technological changes are impacting gender equality in the workplace. Our study discovers existence of gender pay gap throughout the hiring process. Even with STEM backgrounds, women are discouraged from earning higher wages due to employers' biased offers. Our results have important policy implications: women with matched STEM skills should lean in while pursuing IT career and employers should abandon their bias as competent women often have as adequate skills as men.

Theoretical Background

Job Search and Gender Wage Disparity

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).

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). First explored the phenomena in China, this study echoes discoveries from asking for wages and bargaining, and 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).

Women with STEM Skills

STEM abilities are the key ingredients in human capital for technic workers, both for men and women (Bianchi & Giorelli, 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. Recently, women with STEM abilities are shown higher probability to be hired and earn higher wage (Bianchi & Giorelli, 2019; Deming & Noray, 2019).

Method

- 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.

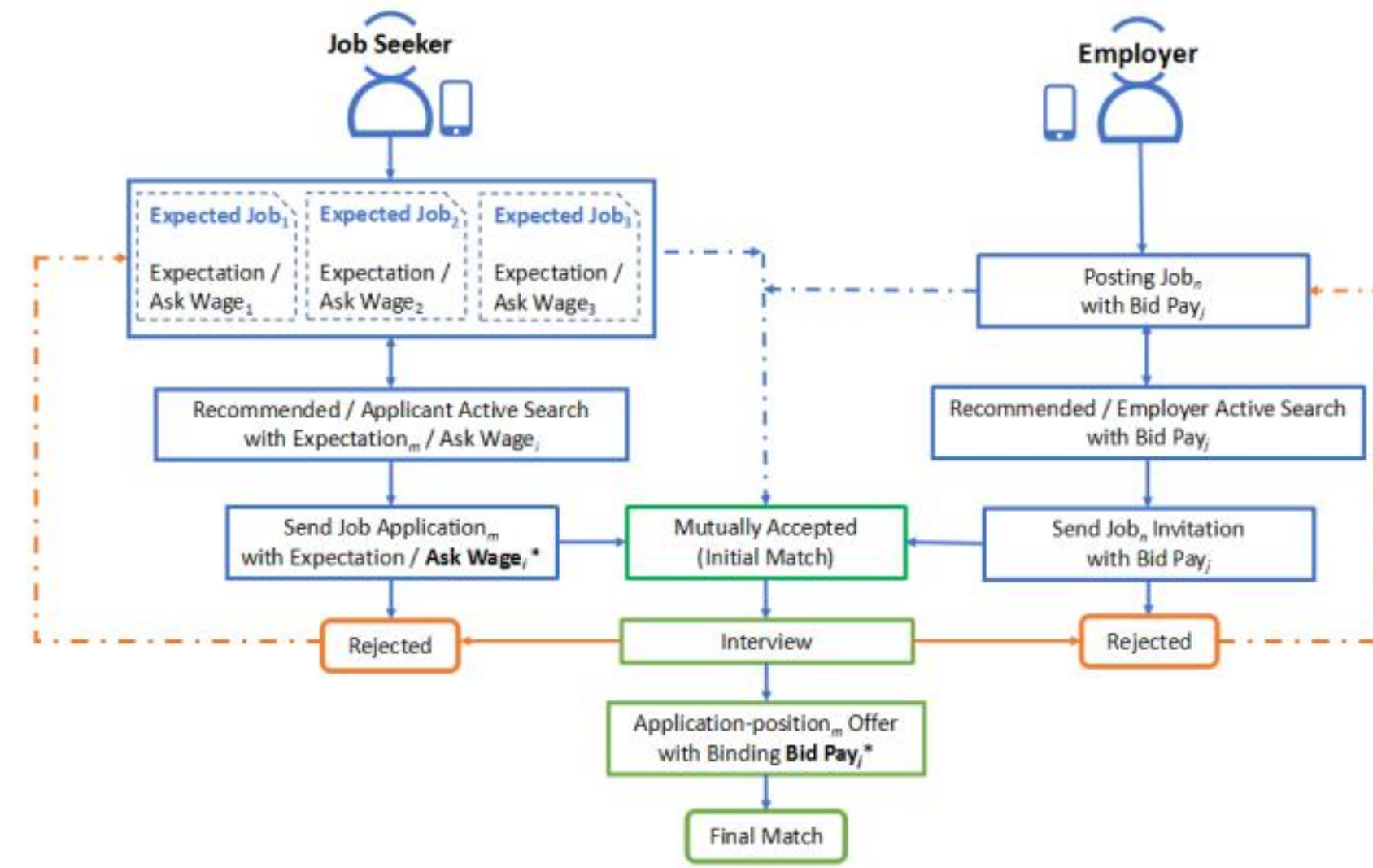


FIGURE 1. JOB MATCHING MECHANISM AND THE DATA GENERATING PROCESS

- Sampling:** To construct the dataset, we start with anonymous 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.
- Econometric Model:** Following a previous approach (Kuhn & Shen, 2013; Ludsteck, 2014; Kuhn et al., 2020), we include multiple fixed-effects dummies in the models to fully control for multiple factors.
- Individual characteristics include the applicant's age, degree, work experience, and enrolled school type. Employer characteristics controlled are employment size, financing stage, required degree, and work experience year for open positions. We further control for the application time, job location, industry, and job position.
- Measurements:** STEM Background is extracted from an applicant's online résumé. In order to classify the applicants' profiles in a uniform structure, we construct a dictionary to match the official category of higher education degrees issued by the Chinese Ministry of Education.
- Skill Match with Position** is measured as the degree of skill match with specific job position. Referencing extent research (Fernandez-Mateo & King, 2011; Park et al., 2019; Sajjadiani et al., 2019), we extend the application of a word embedding algorithm to convert text information into word vectors and calculate a correlation matrix of applicant's skills and the paired position.
- Following Flory et al. (2015), **Prior Job Match** is calculated by comparing the applicants' previous positions with the current application position, capturing whether the applicant has strong relevant experience.
- Building on Lazear et al. (2018), **Employer Active Search Match** indicates whether an employer initiates the search and actively invites the applicant to match the position.

Results

Table 1 Asking Wages, Gender and STEM Background

	(1) Full Sample	(2) Full Sample	(3) Women	(4) Women
	max_exp_wage	min_exp_wage	max_exp_wage	min_exp_wage
female	-1.121*** (0.019)	-0.707*** (0.014)		
STEM	0.681*** (0.022)	0.483*** (0.016)	0.445*** (0.038)	0.304*** (0.029)
Applicant Characteristics	Control	Control	Control	Control
Expected City	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.

Table 2 Gender Pay Gap at the Upper and Lower Bound

	(1) Full Sample	(2) Full Sample	(3) STEM	(4) STEM
	max_pay	min_pay	max_pay	min_pay
female	-0.247*** (0.021)	-0.170*** (0.014)	-0.232*** (0.024)	-0.162*** (0.016)
STEM	0.325*** (0.019)	0.165*** (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.

Table 3 Skill Match and Gender Pay Gap

	(1) STEM	(2) STEM	(3) STEM	(4) STEM	(5) STEM	(6) STEM
	max_pay	min_pay	max_pay	min_pay	max_pay	min_pay
female	-0.234*** (0.024)	-0.406*** (0.021)	-0.228*** (0.024)	-0.222*** (0.039)	-0.228*** (0.024)	-0.213*** (0.029)
skill_match	0.486*** (0.082)	0.425*** (0.090)	0.425*** (0.090)	0.304* (0.159)		
female*skill						
prior_match		0.180*** (0.026)	0.181*** (0.027)			
female*prior			-0.010 (0.049)			
employer_match				0.028 (0.017)	0.036** (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	Yes	Yes	Yes	Yes	Yes	Yes
Offered Month	Yes	Yes	Yes	Yes	Yes	Yes
Offered Industry	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.

Table 4 Skill Match and Gender Pay Gap

	(1) STEM	(2) STEM	(3) STEM	(4) STEM	(5) STEM	(6) STEM
	max_pay	min_pay	max_pay	min_pay	max_pay	min_pay
female	-0.163*** (0.016)	-0.307*** (0.059)	-0.161*** (0.016)	-0.140*** (0.028)	-0.161*** (0.016)	-0.165*** (0.020)
skill_match	0.230*** (0.048)	0.179*** (0.052)	0.255*** (0.111)			
female*skill						
prior_match		0.057*** (0.015)	0.063*** (0.017)			
female*prior			-0.035 (0.034)			
employer_match				0.023** (0.010)	0.022** (0.011)	
female*employer					0.019 (0.036)	
Applicant Characteristics	Control	Control	Control	Control	Control	Control
Firm Characteristics	Control	Control	Control	Control	Control	Control
Offered City	Yes	Yes	Yes	Yes	Yes	Yes
Offered Month	Yes	Yes	Yes	Yes	Yes	Yes
Offered Industry	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.

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 and enhances the confidence for wage bargaining in technology-intensive jobs.