NBER Research Grant Program: Economics of Digitization
Gender Discrimination in the Technology Industry

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Project Description

In 2015, women held only 25 percent of computing-related occupations, and this percentage of has been declining since the 1990s (Ashcraft et al. 2016). This trend exacerbates gender inequality in the labor market, as STEM occupations offer higher average salaries and show a smaller gender wage gap. The lack of representation of women in the technology industry in particular has become a growing concern in recent years. Several major tech companies have developed initiatives to attract and retain talented applicants from a diverse candidate pool, with an increasing number of companies seeking to go beyond just the resume by blinding the interview process or observing a candidate performing a task in a realistic work context.

In this project, I propose to assess the efficacy of one potential tool for addressing the underrepresentation of women in the technology industry. Together with my coauthor Ashley Craig, I have partnered with an online platform that provides job applicants in the technology industry with an opportunity to practice their interview and coding skills. In 2017, the platform decided to introduce a new algorithm that allowed interviewers to learn in real time about interviewees' objective coding performance and use this as input in their final subjective evaluations. We use the introduction of this device to explore whether providing an evaluator with objective information about a candidate's coding performance affects how she/he evaluates the performance of a job applicant. Our goal is to explore whether it ultimately reduces the gender gap in subjective ratings.

Our preliminary results suggest that women receive lower subjective ratings on the platform that men, even when we control for the interviewee's and interviewer's level of education, years of experience and self-declared preparation level, and the gender of the interviewer. The objective of this project is to assess whether once interviewers are provided with objective information, the gender gap in ratings decreases, both through the supply (interviewees) and demand side (interviewers). On the supply side, it could reduce gender differences in self-confidence and self-assessments, as

women are less likely than men to self-report knowledge in programming (Murciano-Goroff 2018). On the demand side, more precise information on performance could lead recruiters to update and reduce statistical discrimination (Spence 1973, Fryer Jr 2007). On the other hand, recent studies have shown that information about objective performance can be interpreted differently according to the gender of the person being evaluated (Sarsons 2019, Bohren et al. 2019). Therefore, it is critical to assess whether providing algorithmically based information about a candidate's ability is enough to reduce gender gaps in ratings. Investigating this question in the technology industry is particularly relevant because women have been traditionally under represented in this industry, and it is an environment in which workers are highly skilled, yet ability and performance can be quantified with objective measures of code ability.

With this project, we also aim to contribute to the literature on digitization of labor markets. The global reach of online platforms enables employers to access a larger and potentially more diverse pool of workers (Brynjolfsson et al., 2003). Additionally, design choices relying on new technologies could help mitigate systematic biases that occur in reviews and reputation systems at play in the hiring process (Cowgill, 2018; Bohnet, 2016). However, the increasing use of algorithms to automate decision-making has sparked concerns that these automated choices may produce discriminatory outcomes (Lambrecht and Tucker, 2019; Chan and Wang, 2018; Edelman et al., 2017; Fisman and Luca, 2016). With this project, we aim at shedding light on how an algorithmic tool affects the assessment of job applicants and hiring decisions in an online labor market.

Methodology

To first document these gender gaps in subjective ratings, we are leveraging data on over 60,000 online interviews for software developers. After July 2017, the new device was activated for 7 percent of new pairs of users chosen at random. The introduction of this device allows us to estimate the causal effect of the provision of objective information on the subjective ratings the candidate receives, because access to the device is uncorrelated with candidates' characteristics by virtue of the randomization. Formally, we estimate the following model:

$$Y_{it} = \alpha + \beta T_{it} + \theta_t + \epsilon_{it} \tag{1}$$

where Y_{it} is the score of individual i for a session on date t, and θ_t are date fixed effects. T_{it} corresponds to a pair of users for whom the new feature was activated.

To guide our analysis, we have developed a simple model of statistical discrimination in the spirit of Lundberg and Startz (1983) in which the role of an interviewer is to estimate the ability of each job candidate based on an imperfect signals. The introduction of the new device reduces the variance in the signals that interviewers observe

about candidates. The effect of providing more information depends on whether interviewers believe that the gender gap in coding ability is larger than it is in reality, which we can directly measure in our dataset. Thanks to the introduction of objective information about coding performance, we can investigate whether men and women are receiving different subjective ratings for a given level of objective performance. Additionally, we want to test whether gender biases are more likely to emerge in situation where candidate's performance is more ambiguous, using the fact that candidates are assigned problems of different degrees of difficulty.

In a next step, we are working on conducting a survey of users of the platform, which will allow us to understand how software developers evaluate the quality of a code, how they interpret their own ratings and how they form hiring decisions between different types of ratings. We are also planning to dig into mechanisms in a more controlled way. Using primary data from the our partner platform of solved coding problems, we will ask freelancers recruited on Upwork to rate a piece of code, and we will randomize whether the gender of the person who wrote the code is visible, controlling for the objective measure of coding performance. The goal of this experiment is to assess whether blind recruitment is enough to improve diversity in hiring, or if male and female software developers code differently. This will let us definitively exclude the possibility that there is any unobservable dimension of performance that is correlated with gender and driving the results. In addition, we will be able to see whether the fact that objective performance measures will be provided leads people to put in more effort. In an incentivized version of the experiment, we will ask coders to predict the rating of a candidate, and we will condition their payoff on how close their prediction is from the algorithmic score. This will clarify whether software developers evaluate a piece of code differently when they know the gender of the coder, because they anticipate that certain coding styles are valued more than others by the algorithm.

Proposed Budget

Expense Item	Description	Amount in USD
Graduate student research assistant	10 hours/week x 20 USD/hour x 24 weeks +15% vacation pay and benefits	5,520
Payment to subjects	200 subjects, expected cost 30 USD by subject	6,000
Total		11,520

References

Ashcraft, Catherine, Brad McLain, and Elizabeth Eger, *Women in tech: The facts*, National Center for Women & Technology (NCWIT), 2016.

Bohnet, Iris, *What works*, Harvard University Press, 2016.

Bohren, J Aislinn, Alex Imas, and Michael Rosenberg, "The dynamics of discrimination: Theory and evidence," *American Economic Review*, 2019, *109* (10), 3395–3436.

Brynjolfsson, Erik, Yu Hu, and Michael D Smith, "Consumer surplus in the digital economy: Estimating the value of increased product variety at online booksellers," *Management Science*, 2003, *49* (11), 1580–1596.

Chan, Jason and Jing Wang, "Hiring preferences in online labor markets: Evidence of a female hiring bias," *Management Science*, 2018, *64* (7), 2973–2994.

Cowgill, Bo, "Bias and productivity in humans and algorithms: Theory and evidence from resume screening," Technical Report, Columbia Business School, Columbia University 2018.

Edelman, Benjamin, Michael Luca, and Dan Svirsky, "Racial discrimination in the sharing economy: Evidence from a field experiment," *American Economic Journal: Applied Economics*, 2017, *9* (2), 1–22.

Fisman, Raymond and Michael Luca, "Fixing discrimination in online marketplaces," *Harvard business review*, 2016, *94* (12), 88–95.

Jr, Roland G Fryer, "Belief flipping in a dynamic model of statistical discrimination," *Journal of Public Economics*, 2007, *91* (5-6), 1151–1166.

Lambrecht, Anja and Catherine Tucker, "Algorithmic bias? An empirical study of apparent gender-based discrimination in the display of STEM career ads," *Management Science*, 2019, *65* (7), 2966–2981.

Lundberg, Shelly J. and Richard Startz, "Private Discrimination and Social Intervention in Competitive Labor Market," *American Economic Review*, 1983, *73* (3), 340–347.

Murciano-Goroff, Raviv, "Missing Women in Tech: The Role of Self-Promotion in the Labor Market for Software Engineers," 2018.

Sarsons, Heather, "Interpreting Signals in the Labor Market: Evidence from Medical Referrals," 2019.

Spence, M., "Job market signaling," *Quarterly Journal of Economics*, 1973, *87* (3), 355–374.

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Current position	Assistant Professor, University of Toronto, Department of Economics	2019 -
Education	Postdoctoral Fellow, Harvard Kennedy School	2017 - 2019
	Ph.D., Economics, Paris School of Economics (PSE) - EHESS	2013 - 2017
	Master, Economics, Paris School of Economics (PSE) - EHESS	2009 - 2011
	Bachelor, Economics, Panthéon Sorbonne-University	2008 - 2009
	École Normale Supérieure, Paris	2008 - 2013
Fields	Gender Economics, Labor Economics, Public Economics, Economics of Education, Political Economy	
Affiliations	Research Affiliate at the Institute for the Study of Labor (IZA)	2016 -
	Research Affiliate at the Institut des Politiques Publiques (IPP)	2014 -
Honors, Scholarships, Fellowships	Department of Economics Award for Excellence in Undergraduate Teaching	2020
	Best Ph.D. Dissertation Award, French Economic Association	2018
	Richelieu Ph.D. Thesis Prize, Chancellerie Sorbonne	2018
	Arthur Sachs Foundation, Full Fellowship	2017 - 2019
	PSE Doctoral Program Call for International Mobility	2016 - 2017
	European Doctoral Program in Quantitative Economics	2015 - 2016
	Columbia University Alliance Call for Doctoral Mobility	2015 - 2016
	French Ministry for Research, Full Fellowship	2013 - 2016
	Princeton Exchange Fellowship from the Lisa Procter Fund	2011 - 2012
	École Normale Supérieure, Full Fellowship	2008 - 2013
Grants	Pedagogical Innovation and Experimentation (PIE) Fund	2021 - 2022
	School of Cities University of Toronto Small Grant Fund	2020 - 2021
	SSHRC Bridge Fund, University of Toronto	2020 - 2021
	"Women & Science" Chair Grant, Paris Dauphine	2019 - 2021
	Pivotal Research Fund, WAPPP, Harvard Kennedy School	2018 - 2019
	Cepremap "Public Economics and Redistribution" Grant	2018 - 2019
	"Changes at Work" Fellowship, Social Science Foundation	2017 - 2018
	PSE Research Fund Labex OSE	2015 - 2016
	Young Researcher Mobility Fund, Institut du Genre	2016

Publications

"Papa Does Preach. Daughters and Polarization of Attitudes toward Abortion", *Journal of Economic Behavior and Organization*, vol. 179: 188-201 (2020).

Working Papers

"School Schedule and the Gender Pay Gap" (with Emma Duchini), *Conditionally Accepted, Journal of Human Resources*
IZA Discussion paper 13791, October 2020.

"Do Female Role Models Reduce the Gender Gap in Science? Evidence from Classroom Interventions in French High Schools" (with Thomas Breda, Julien Grenet & Marion Monnet), *submitted*
IZA Discussion paper 13163, April 2020.

Research in Progress

"Can More Objective Performance Information Overcome Gender Differences in Interview Evaluations" (with Iris Bohnet & Ashley C. Craig)

"Stereotypes and Gender Identity" (with Avner Seror & Manuela Collis)

"Pitch Perfect: Closing the Gender Gap in Confidence among Elementary School Children" (with Sa-kiera Hudson & Siri Isaksson)

"Gender Gap in Technology Entrepreneurship" (with Milan Miric & Pai-Ling Yin)

Other publications

"Rencontrer des femmes scientifiques peut-il encourager les lycéennes à poursuivre des études en sciences ?", Breda T., Grenet J., Monnet M., Van Effenterre C. (2021)
in *Lettre de l'InSHS*, vol. 72, pp. 20-23.

"Les différences de genre en termes d'aspirations professionnelles : le cas des diplômé.e.s du supérieur en Italie", Van Effenterre, C. (2019) in *Les mutations du travail*, sous la direction de François Dubet, édition La Découverte collection Recherches, pp. 215–237.

"Les filles et les garçons face aux sciences. Les enseignements d'une enquête dans les lycées franciliens", Breda T., Grenet J., Monnet M., Van Effenterre C. (2018)
in *Éducation & Formations*, Vol. 2 No. 97, pp. 5-29.

"The Effectiveness of CEOs in the Public Sector: Evidence from Further Education Colleges in England", Terrier C., Ruiz-Valenzuela J., Van Effenterre C. (2017)
CVER Briefing Note 005, December 2017, 33 p.

"Post 16 Remedial Policies: a Literature Review", Van Effenterre C. (2017),
CVER Discussion Paper Series 005, April 2017, 35 p.

Media Contribution, Policy briefs

"Les femmes : premières victimes de la pandémie", panel at *Journées de l'Économie*, Cercle des Économistes, November 2021.

"Monde du travail : ces inégalités persistantes entre hommes et femmes", interview in *Moteur de Recherche*, Radio Canada, November 2020.

"What the decision whether to reopen schools this fall means for the recovery", interview in the *Financial Post* Podcast *Down to Business*, July 2020.

"Reforming the School Schedule: an Indicator of Inequality in the Labour Market?", Duchini, E., & Van Effenterre, C. (2017), IPP Policy Brief No. 26, April 2017.

"Female Role Models: Are They Effective at Encouraging Girls to Study Science?", Breda, T., Grenet, J., Monnet, M., & Van Effenterre, C. (2019), IPP Policy Brief No. 45, September 2019.

"École, le retour à la semaine de quatre jours pénalise les femmes", Duchini, E., & Van Effenterre, C. (2017), Fondation Jean Jaurès Policy Brief, November 2017.

"Rythmes scolaires: le retour à la semaine de quatre jours risque de se faire aux dépens des femmes", Duchini, E., & Van Effenterre, C. (2017), Op-ed in *Le Monde*, July 2017.

Teaching Experience

Graduate Labor II — 2021, 2022
University of Toronto (Ph.D. Program)

Economics of Inequality — 2020, 2021, 2022
University of Toronto (Undergraduate Program)

Empirical Methods for Public Policies, Teaching Assistant — 2017
London School of Economics (Executive MPA Program)

Macroeconomics I, II, III, Paris School of Economics, Teaching Assistant — 2013 - 2015
Paris School of Economics (Graduate Program)

Relevant positions held

Research Assistant, London School of Economics	2016 - 2017
Visiting Ph.D. student, Columbia University	Spring 2016
Visiting Ph.D. student, London School of Economics	2015 - 2017
Intern, International Labour Office, Geneva	Spring 2013
Intern, Cabinet of the French Minister for women's rights, Paris	Fall 2012
Visiting student, Politics Department, Princeton University	2011 - 2012
Intern, Rise Conseil, Paris	Spring 2009

Conferences, Workshops, Seminars

2022: (scheduled) Seminars: University of Calgary, University of Laval, Conferences: ESA Special Meeting (JILAEE).

2021: Seminars: CEPEO (UCL), Penn State, UC Davis, University of Alicante, HEC Montréal, University of Michigan, University of Copenhagen, Conferences: American Economic Association Annual Meeting (AEA) (discussant), Midwest Economics Association (MEA), Princeton Northeast Labor Symposium for Early Career Economists, Western Economic International Conference (WEAI), Canadian Economics Association Conference (CEA), Southern Economic Association Conference (SEA), EALE 2021 Conference, 2021 Journées de l'Économie (panelist).

2020: Seminars: Queen's University, Temple University, Development Bank of Latin America, ENS Lyon, Conferences: NBER Economics of Digitization Meetings (discussant), CeMENT workshop San Diego (CSWEP), EALE SOLE AASLE World Conference Berlin*, Spring Meeting of Young Economists University of Bologna*.[1]

2019: Seminars: University of Toronto, UC San Diego, University of Zurich, Bocconi University, University of Mannheim, University of Cergy-Pontoise, Conferences: National Association for Business Economics (NABE) conference (panel moderator), Ottawa Applied Micro Workshop.

2018: Seminars: Harvard Labor Workshop, Harvard Political Economy Workshop, HKS WAPPP Seminar, UQAM University, Conferences: American Economic Association Annual Meeting (AEA), Society of Labor Economics (SOLE) conference, European Economic Association (EEA) conference, "Gender & Technology: How to Debias the Workplace" conference (Harvard University), National Association for Business Economics (NABE) conference.

2017: Seminars: Harvard Political Economy Workshop, LSE Public Economics Workshop, LSE Labor Market Workshop, PSE Public Policy Seminar, University of Stockholm (SOFI), IZA.

2016: Seminars: Columbia University Applied Micro Research Methods Colloquium, LSE Labor Economics workshop, PSE Applied Economics Seminar, Conferences: European Association for Labor Economics (EALE), IZA European Summer School in Labor Economics.

2015: Seminars: PSE Applied Economics, Conferences: European Economic Association (EEA) conference, International Workshop on Applied Economics of Education (IWAEE).

Professional activities

Referee for *American Economic Review*, *Quarterly Journal of Economics*, *Journal of Labor Economics*, *AEJ: Applied Economics*, *AEJ: Economic Policy*, *Economic Journal*, *Journal of the European Economic Association*, *Journal of Public Economics*, *Journal of Human Resources*, *Journal of Economic Behavior and Organization*, *Journal of Economics & Management Strategy*, *Journal of Policy Analysis and Management*, *PNAS*, *Economic Policy*, *Economics of Education Review*, *Canadian Journal of Economics*, *Review of Economics of the Household*, *IZA Journal of Labor Policy*, *European Sociological Review*, *The Economics of Transition*.

[1] *: cancelled or postponed due to Covid-19.

University of Toronto:

Empirical Microeconomics (CEPA) Seminar Co-Organizer	2020 - 2022
Junior Applied Microeconomics Seminar (JAMS) Co-Organizer	2020 - 2022
Empirical Microeconomics Brown Bag Seminar Co-Organizer	2020 - 2021
Diversity and Inclusion Committee, Economics Department	2020 - 2021
Recruitment Committee, Economics Department	2021 - 2022

Host of the Podcast *InequaliTalks* Since July 2020
`https://inequalitalks.fireside.fm/`

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