Discrimination in an Online Labor Market

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1 Model and Treatments

Assuming risk neutrality, a worker $i \in \{B, W\}$ solves the following problem when working for an employer $j \in \{B, W\}$ where B and W denote the black or white race of an agent (employer or worker) respectively;

$$\underbrace{max}_{e_{ij} \geq 0} U_{ij} = \underbrace{max}_{e_{ij} \geq 0} (F + (s_i + d_{ij} + p_j)e_{ij} + \rho_{ij}\zeta_{ij}(p_j)\sigma_{ij}(e_{ij}) - c(e_{ij})) \tag{1}$$

where e_{ij} is the number of points (on a button-pressing task) scored by worker i when working for employer j, F is the fixed money paid for participating in the experiment, s_i (as in Dellavigna and Pope (2018)) captures the sense of duty, norm, intrinsic motivation, and competitiveness of worker towards the task. d_{ij} is the the taste (like or dislike) of worker i towards the employer j's identity per unit of effort e_{ij} a' la Becker (1957). p_j is the piece rate chosen by the employer j, we allow employers to select piece rate between 0 cents and 10 cents per 100 points (in increments of 3 cents). The term $\rho_{ij}\zeta_{ij}(p_j)\sigma_{ij}(e_{ij})$ models reciprocity a' al Falk and Fischbacher (2006).ρ_{ij} is the sensitivity of reciprocity by worker i towards employer j. $\zeta_{ij}(p_j)$ is the kindness term that associates kindness perception to the piece rate p_j by the worker i towards employer j. $\sigma(e_{ij})$ is the reciprocity term that capture the reciprocal response by worker i towards employer j given the kindness of the employer. These terms are defined as follows;

$$\zeta_{ij}(p_j) = \underbrace{\big(F + (s_i + d_{ij} + p_j)e''_{ij} - c(e''_{ij})\big)}_{\text{Worker's belief about employer's belief of worker's payoff.}} - \underbrace{\big((v - p_j)e''_{ij}\big)}_{\text{Worker's belief about employer's belief of employer's payoff.}}$$

$$\sigma_{ij}(e_{ij}) = \underbrace{\big((v - p_j)e_{ij}\big)}_{\text{Employer's payoff}} - \underbrace{\big((v - p_j)e''_{ij}\big)}_{\text{Worker's belief about employer's belief of employer's payoff.}}$$

where e''_{ij} denote the second order belief of worker about the effort i.e. worker's belief about employer's belief of worker's effort.[1] v is the exogenous per unit return (value) to employer from worker's effort.

$c(e_{ij})$ is the cost of effort, which is assumed to be same for all workers i. We assume the regularity conditions $C'() > 0$, $C''() > 0$, and $lim_{e\to\infty}C'(e) = \infty$. Following Dellavigna and Pope (2018) we assume cost function to be a power function or exponential function i.e.

$$c(e) = \frac{ke^{1+\gamma}}{1+\gamma} \tag{2}$$

or

$$c(e) = \frac{kexp^{\gamma e}}{\gamma} \tag{3}$$

These functions differ in their elasticity of effort with respect to the value of effort. Power cost function 2characterize a constant elasticity of effort given by $1/\gamma$ while exponential cost function 3 implies a decreasing elasticity as effort increases. Both functions requires the estimation of unknowns k, and γ which we will back out using observed effort at different piece rates.

[1] These beliefs can be elicited directly from workers by asking questions such as *"How many points do you think your employer expects you to score in this task?". And to incentive such elicitation we can say "Your employer already revealed his/her guess of points that you will score, if your guess is within 100 points of the employer's guess, you will be paid extra 10 cents.". Obviously, we will collect data on employer's belief from employer when they choose piece rate.*

Solving 1 leads to following solution (when interior);

$$e_{ij}^{\star} = c'^{-1}\left(s_i + d_{ij} + p_j + \rho_{ij}(v - p_j)\zeta_{ij}(p_j)\right)$$

With power cost function this translates to;

$$e_{ij}^{\star} = \left(\frac{s_i + d_{ij} + p_j + \rho_{ij}(v - p_j)\zeta_{ij}(p_j)}{k}\right)^{1/\gamma}$$

While exponential cost function lead to the solution

$$e_{ij}^{\star} = \frac{1}{\gamma} log\left(\frac{s_i + d_{ij} + p_j + \rho_{ij}(v - p_j)\zeta_{ij}(p_j)}{k}\right)$$

Given the above set-up, we design our treatments to be able to identify k, γ, s_i, d_{ij}, and ρ_{ij}. We make a simplifying assumption that the workers of type i are homogeneous given a treatment i.e. they will make the same effort choice in a given treatment.

1.1 Baseline Treatment

We design baseline treatment to identify baseline parameters of the above model (i.e. γ, k and s_i). So to ensure that other parameter values are set to zero, we do following;

1) Employer's identity is not revealed to worker ensuring $d_{ij} = 0$, i.e. there is no taste/distaste towards the employer's identity because the identity is not revealed, 2) Employer do not choose piece rate for worker rather piece rate is given exogenously to the worker ensuring $\rho_{ij} = 0$. This implied that the effort in this treatment is given as;

$$e_{ij}^{\star} = c'^{-1}\left(s_i + p_j\right)$$

This treatment will give us the baseline measure of effort of worker i for the given piece rate p. For each i, the solution of effort has one behavioral unknown (s_i), and two unknowns from cost function (k and γ). To back out these parameters we use effort corresponding to three different piece rates which gives us three equations to identify three parameters. Using 3 values for piece rate, we can exactly identify the 3 unknown param-

eters. These piece rates provide evidence on the responsiveness of effort to incentives for this particular task and hence allow us to estimate baseline parameters which will be used to estimate other behavioral parameters.

1.2 Race Salient Treatments

In the race salient treatment, workers will observe the race of the matched employer along with the selected piece rate and then work on a task. In the presence of group biases i.e. when workers derive different level of social preference for different employer's group then;

$$e_{ij}^{RS} = c'^{-1}\left(\left(s_i + \Delta s_{ij}^{p}\right) + p\right)$$

We are implicitly assuming $s_{ij} = s_i + \Delta s_{ij}$ i.e. the parameter s_{ij} can be separated into two components 1) s_i, which is independent of the employer type and include everything such as sense of duty, norm, intrinsic motivation, competitiveness of worker etc. and 2) Δs_{ij}, which represents additional utility or dis-utility from working for the employer of type j which we interpret as taste towards the employer a' la Becker (1957).

$\Delta s_{ij}^{RS} > 0$ $\left(\Delta s_{ij}^{RS} < 0\right)$ will represent the increase (decrease) in effort because of taste of worker i towards (against) the employer j. For $j \neq i$, $\Delta s_{ij}^{RS} < 0$ will be interpreted as the decrease in effort due to taste bias of worker i towards the opposite group employer j. In other words, the difference in provided effort between the white employer and black employer $\left(e_{iW}^{RS} - e_{iB}^{RS}\right)$ for a given piece rate is construed as a difference which is only driven by the taste bias of the workers of group i. The main goal of this research is to identify the parameter Δs_{ij}^{RS} at different piece rates which we do in Section 6.

2 Experiment Design

The main goal of this study is to document the evidence of discrimination in the online labor market. We designed the experiment to allow for the possibility of discrimination in effort by workers towards the employers. Our experiment is carefully designed to ensure that observed difference in effort could only realize because of the taste bias of workers.

2.1 Recruitment of Subjects

The subjects for this experiment were recruited from an online labor market, Amazon's Mechanical Turk. Mechanical Turk is a crowd-sourcing web-service that allows employers (called requester) to get tasks (called Human Intelligence Tasks (HITs)) executed by employees (called workers) in exchange for a wage (called reward). Mechanical Turk is a widely used platform in research in economics and give access to large pool of applicants at a much affordable rate hence allowing for the well powered study. See Paolacci, Chandler, and Ipeirotis (2010) and Paolacci and Chandler (2014) for discussion on demographic characteristics and representation of subjects from Mechanical Turk.

To recruit subjects we posted the screen-er survey as the HIT on Mechanical Turk with the following description *"Fill out this 2-minutes screener survey to qualify for the immediate second study (that study will take ~15 minutes and pay 1 dollar plus bonus). You MUST use your webcam and take a picture (following guidelines) to be considered for the study."*. The screen-er survey is given in the Appendix A.

Based on the responses in the screen-er survey, we invited participants above the age of 18 who reported their race as "Black or African American" or "White or Caucasian" to participate in the experiment. Everyone else was shown the exit screen.

Since our choice of task is same as Dellavigna and Pope (2018), we can use results from their study to determine the sample size that can achieve sufficient power for our study. Dellavigna and Pope (2018) found that the points scored in each treatment have a standard deviation of around 660 points. Assuming this standard deviation for each treatment and assuming a minimum detectable effect of 185 points between two treatments, we will need around 200 observations in each sub-treatment to have a power of 80 percent. This implies that we will need 200 x 12= 2,400 observations in total for all 12 sub-treatments. In our design one observation constitute two subjects - one employer and one worker - therefore we need to recruit around 400 subjects in each treatment implying a total sample of size 4,800. These calculations are obviously for the full study, and they assume that we have control on the number of subjects in each treatment. As we learned from the pilot, we need to recruit 10 white employers to find one black employer and thus these sub-treatments are not going to have balanced sample sizes. In the light of this, we will be revising our design for the full study.

2.2 Task

We designed this experiment to observe whether workers discriminate in their effort when working for different employer types and then to back out the behavioral parameter of distaste. For this purpose we needed a task which is costly to workers. We settled on a button-pressing task as in Dellavigna and Pope (2018). The task involves alternating presses of "a" and "b" on keyboard for 10 minutes. We settled on this task because it is simple to understand and have features that parallel clerical jobs: it involves repetition and it gets tiring, thus testing the motivation of the workers.

2.3 Experiment Flow

The experiment proceeded as follows: (1) HIT was posted on Mechanical Turk for a screen-er survey, (2) subjects were presented with the consent form, (3) those who consented and met the criteria were shown a screen to initiate the experiment, (4) upon initiation a subject was randomly assigned to one of the treatment groups and then to the role of employer or worker. The first person to initiate the experiment was always assigned the role of employer while the second person was made the worker. One employer and one worker formed a group for this experiment. The flow of the screenshots of the screens that subjects saw are given in Appendix A. The application for the experiment was designed using oTree (Chen, Schonger, & Wickens, 2016).

The instructions to the employers and workers for each treatment are given in Appendix A.

2.3.1 Baseline Treatment

In the baseline treatment employers were informed (truthfully) that they will be paid 10 cents for every 100 points scored by the randomly matched worker and they can choose if they want to transfer part of 10 cents to workers as piece rate. Employers were allowed to select a piece rate of 0, 3, 6 or 9 cents for the matched worker. Employers did not know the identity of worker for whom the piece rate was selected neither did worker observe the identity of employer before starting to work. Once an employer selected a piece rate, a matched workers was informed of the selected piece rate and was given 10 minutes to

work on the task.

2.3.2 Race Salient Treatment

The race salient treatment was identical to baseline treatment except that when a worker observed the selected piece rate, he/she also saw the picture that was taken by the matched employer when he/she selected the piece rate. When employers selected the piece rate they were instructed to write the selected piece rate on a piece of paper and take a picture with only the part of their hand showing in the picture. Showing hand with piece rate is a subtle way of revealing the race (Doleac & Stein, 2013) and avoid psychological confounds which are associated with facial pictures such as attractiveness and trustworthiness (Eckel & Petrie, 2011).

References

Becker, G. S. (1957). *The economics of discrimination*. University of Chicago Press.

Chen, D. L., Schonger, M., & Wickens, C. (2016). oTree-An open-source platform for laboratory, online, and field experiments. *Journal of Behavioral and Experimental Finance*, *9*, 88–97.

Dellavigna, S., & Pope, D. (2018). What motivates effort? Evidence and expert forecasts. *Review of Economic Studies*, *85*(2), 1029–1069.

Doleac, J. L., & Stein, L. C. D. (2013). The visible hand: Race and online market outcomes. *Economic Journal*, *123*(572), 469–492.

Eckel, C. C., & Petrie, R. (2011). Face value. *American Economic Review*, *101*(4), 1497–1513.

Falk, A., & Fischbacher, U. (2006). A theory of reciprocity â©. *Games and Economic Behavior*, *54*, 293–315. doi: 10.1016/j.geb.2005.03.001

Paolacci, G., & Chandler, J. (2014). Inside the Turk: Understanding Mechanical Turk as a Participant Pool. *Current Directions in Psychological Science*, *23*(3), 184–188.

Paolacci, G., Chandler, J., & Ipeirotis, P. (2010). Running experiments on amazon mechanical turk. *Judgment and Decision making*, *5*(5), 411–419.