Job-Seekers Send Too Many Applications:

Experimental Evidence and a Partial Solution

John Horton & Shoshana Vasserman

These slides: https://bit.ly/3crW089

The paper: https://bit.ly/3sunrDS

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SHARE

If you are unable to complete this application due to a disability, contact this employer to ask for an accommodation or an alternative application process.

Term Research Assistant

Other Full-Time
Cambridge, MA, US

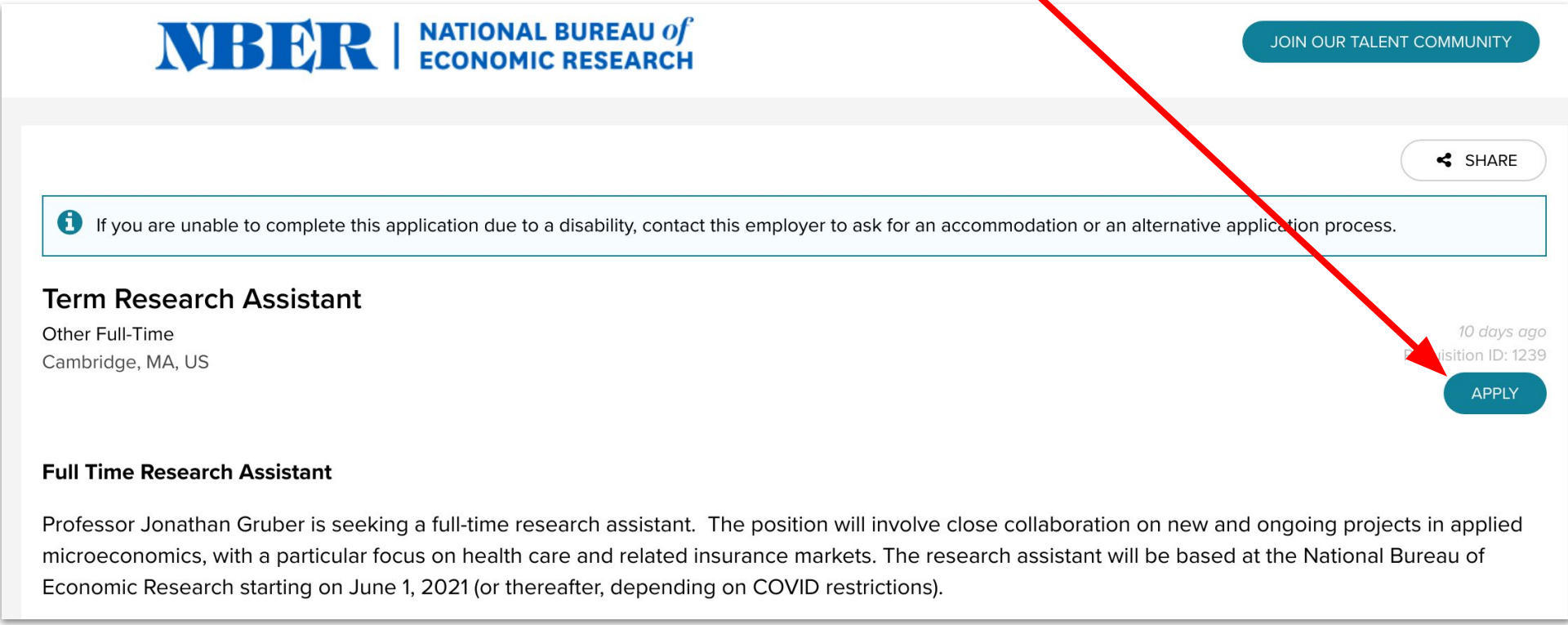
10 days ago
Requisition ID: 1239

APPLY

Full Time Research Assistant

Professor Jonathan Gruber is seeking a full-time research assistant. The position will involve close collaboration on new and ongoing projects in applied microeconomics, with a particular focus on health care and related insurance markets. The research assistant will be based at the National Bureau of Economic Research starting on June 1, 2021 (or thereafter, depending on COVID restrictions).

Should I apply?
Does the social planner want me to apply?



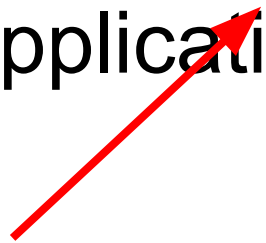
The marginal social benefit of a job application equals the marginal social cost of that application

As a job-seeker, I don't consider the employer's surplus from creating a match

personal

The marginal social benefit of a job application equals the marginal social cost of that application

The marginal ~~social~~ *personal*
benefit of a job application
equals the marginal ~~social~~ *personal*
cost of that application



As a job-seeker, I don't
consider how my application
crowds-out other applicants

These observations aren't novel---they are the heart of the DMP perspective on matching.

But they were not typically viewed as something we could do much about, at least directly.

But in online marketplaces & job boards, there are some interesting market design opportunities

This paper: An experiment in an online labor market to reduce the number of job applications without reducing match quality or quantity.

Empirical context

- A large online labor market for work that can be done remotely:
  - Computer programming, graphic design, data entry, etc.

1. Employer posts job opening

Orthopaedic Surgery Research - Statistical Analysis

Statistical Analysis Posted 13 hours ago

Hourly Job
As needed - Less than 10 hrs/week
Less than 1 month

$$ Intermediate
I am looking for a mix of experience and value

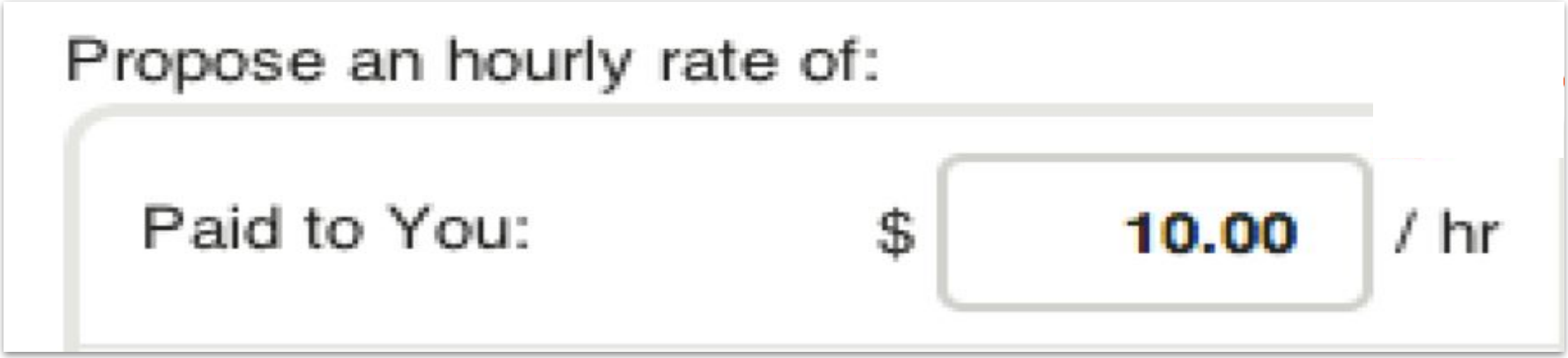
Job Description

I have a data set that needs statistical analysis. It consists of multiple reviewers' (10-20) analyses of patient's x-rays. I need to examine the reviewers' overall agreement on the x-rays and their ability to judge surgical technique from the x-rays.

Skills Required

Data Science Scientific Writing Statistics

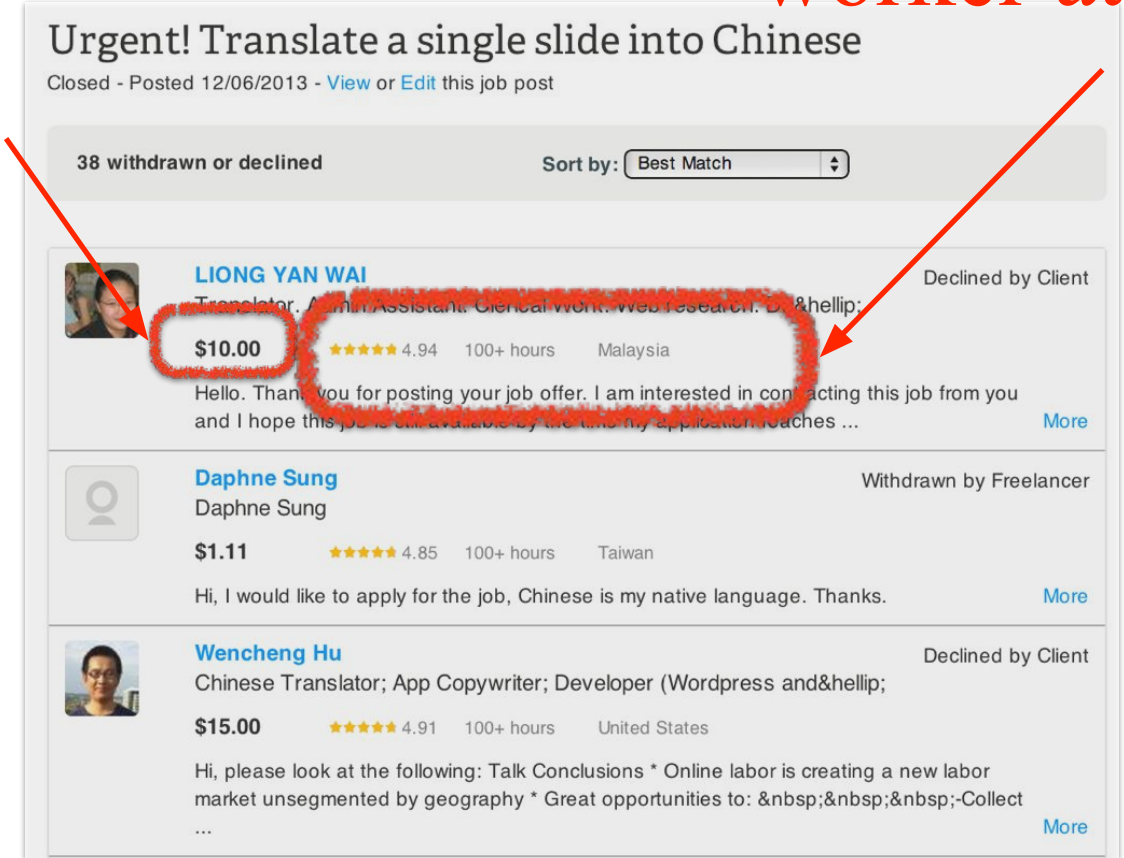
2. Workers apply, submitting hourly wage bids



3. Employers screen applicants

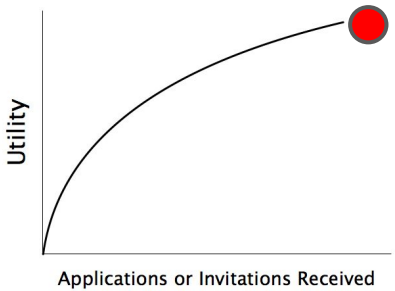
Productivity-relevant worker attributes

Wage bid



Platform's perspective was that many applications were:

Job posts with low marginal returns / Lots of crowd-out



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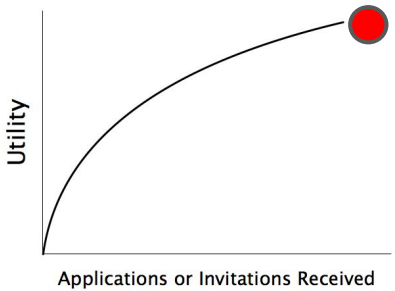
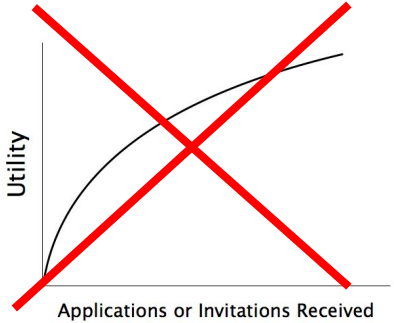


Going to job posts that had already been filled but job-seekers did not know it yet



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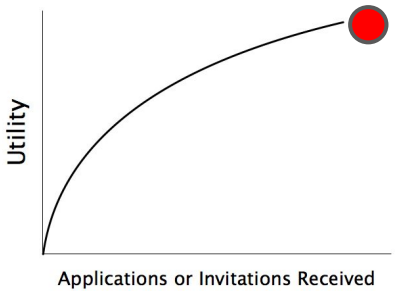

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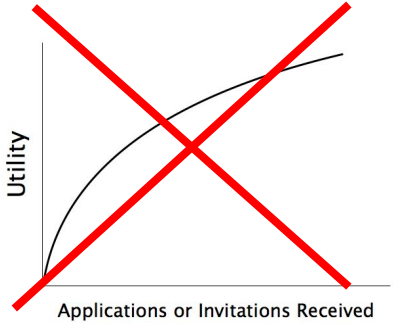
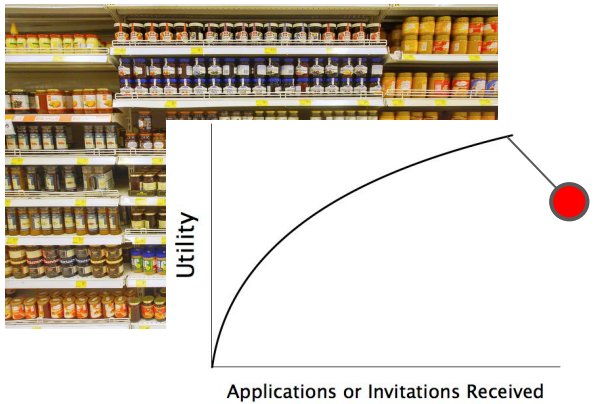
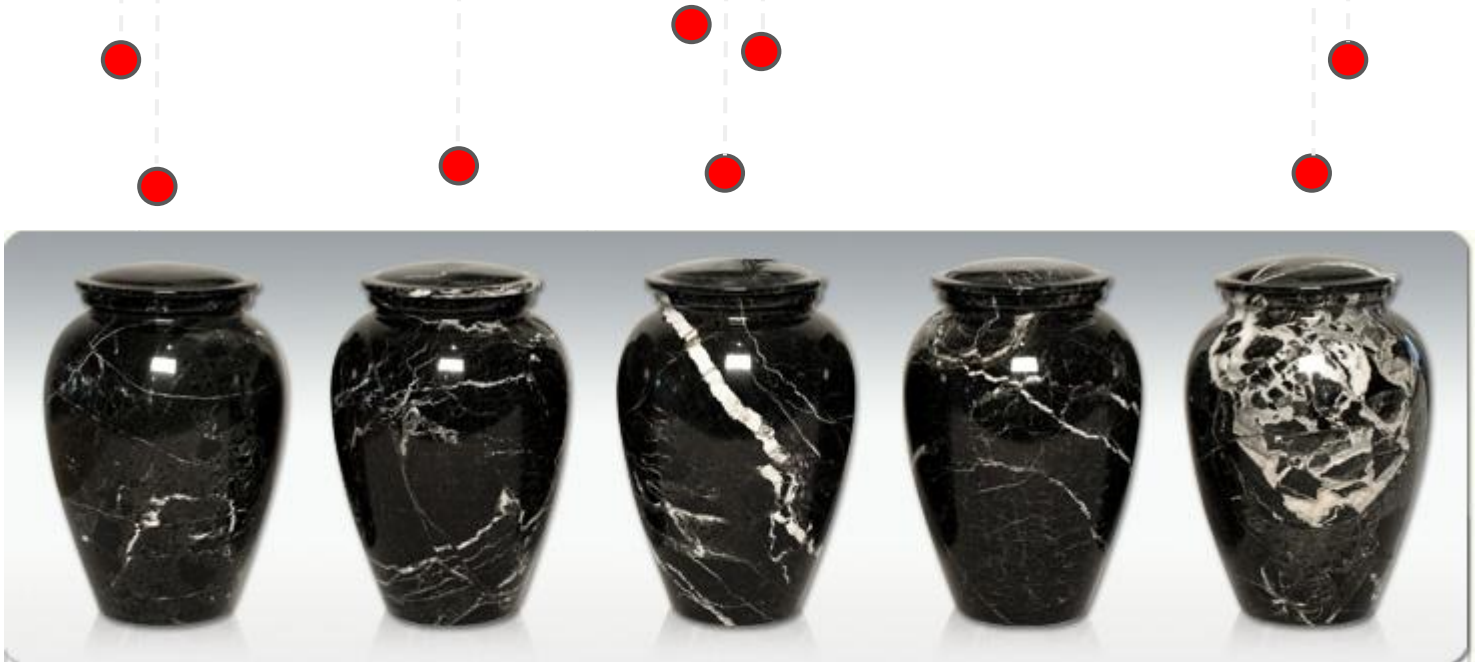


Contributing to "choice overload" for would-be employer



- **Platform design question**: Could the platform reduce such applications without harming matching process?

“Ball and Urn” Matching Frictions

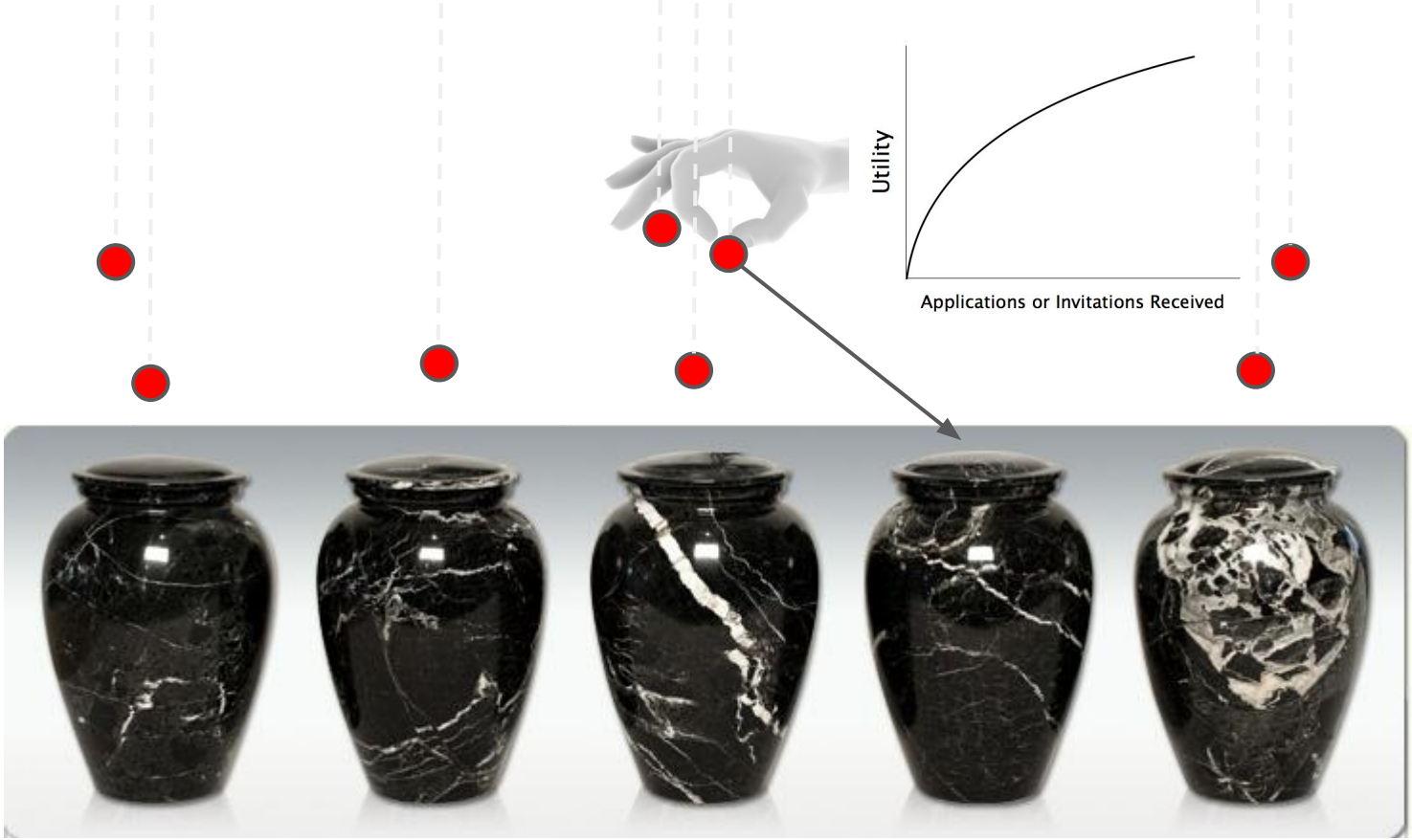


I = 2 I = 1 I = 3 I = 0 I = 2

Over Subscribed

Under Subscribed

See Petrongolo & Pissarides (2001) for overview; Albrecht & Gautier (2003)



I = 2

I = 1

I = ~~3~~ 2

I = ~~0~~ 1

I = 2

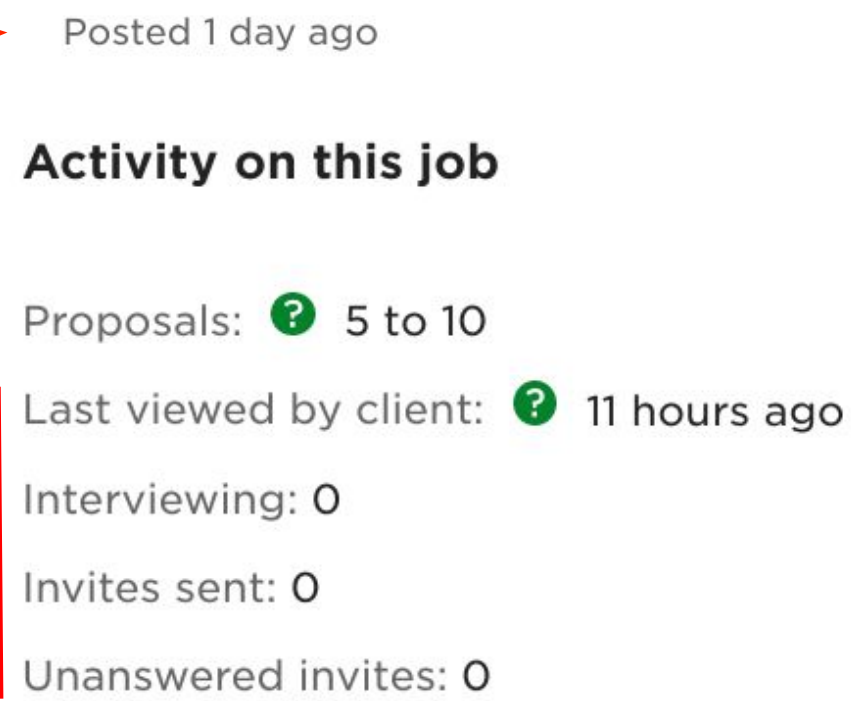
Bar for improvements is high, as job-seekers here already know a great deal

For every job post, job-seekers already knew:

When posted

About how much competition

Employer activity (including recruiting)

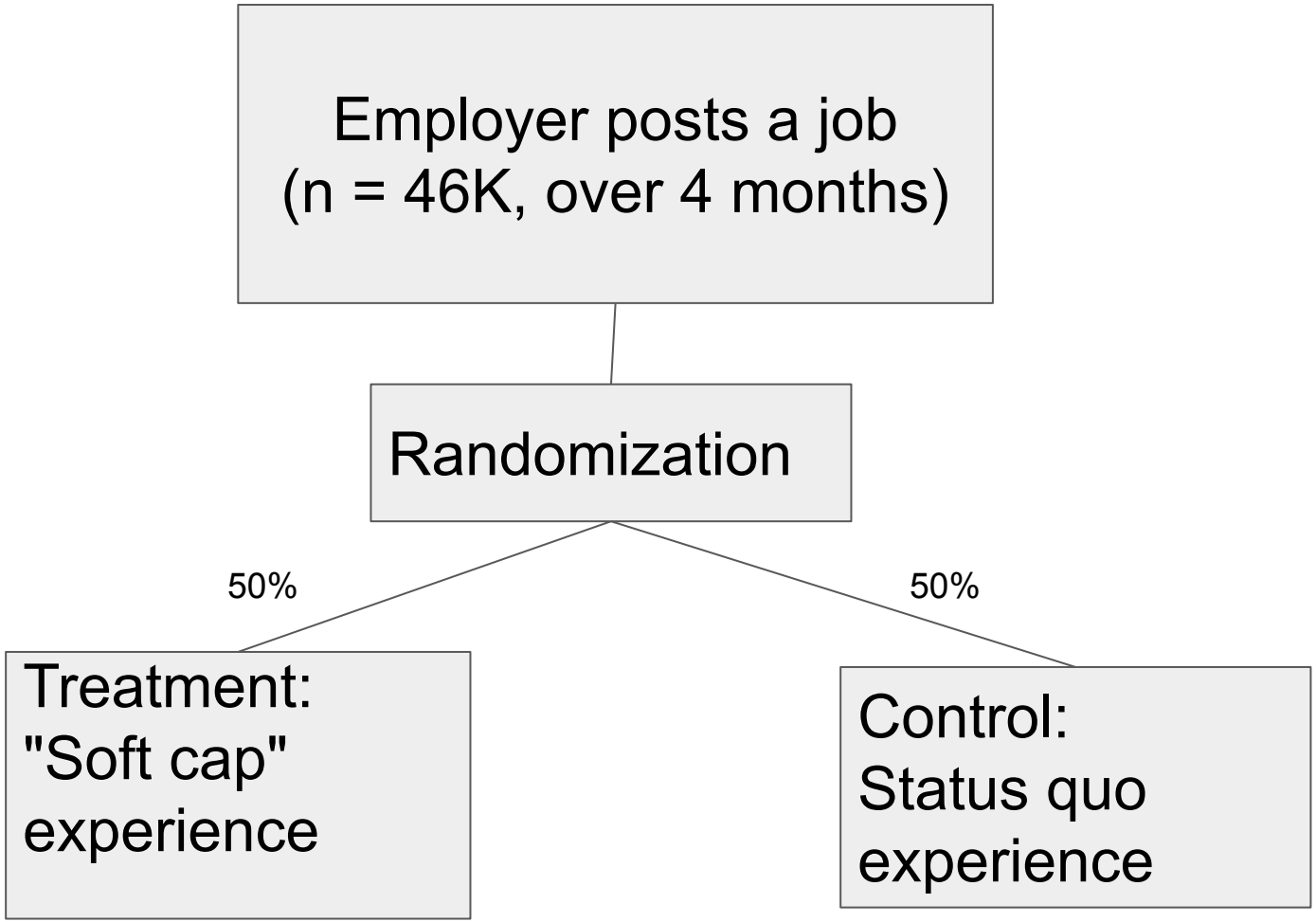


Platform intervention idea

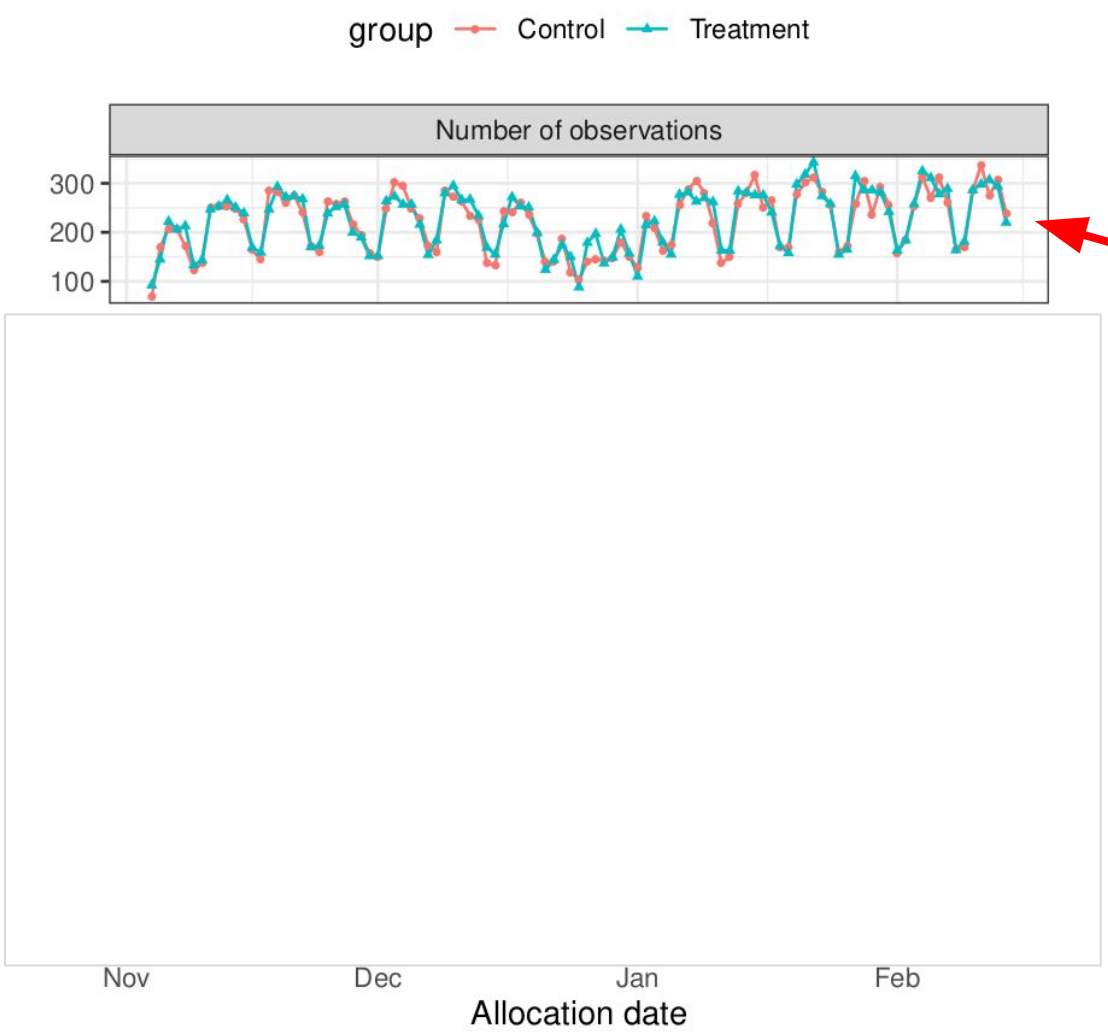
- Turn a job **"private"** (invisible to other applicants) after:
  - the job has 50 active applications **OR**
  - 5 days have elapsed since posting
- A treated employer that "needs" more applications could opt out by pushing a button *after* job was private
  - We call this "opt out" aspect a *soft cap*

By pushing a single button, employers could make their job "public" and receive applicants again.

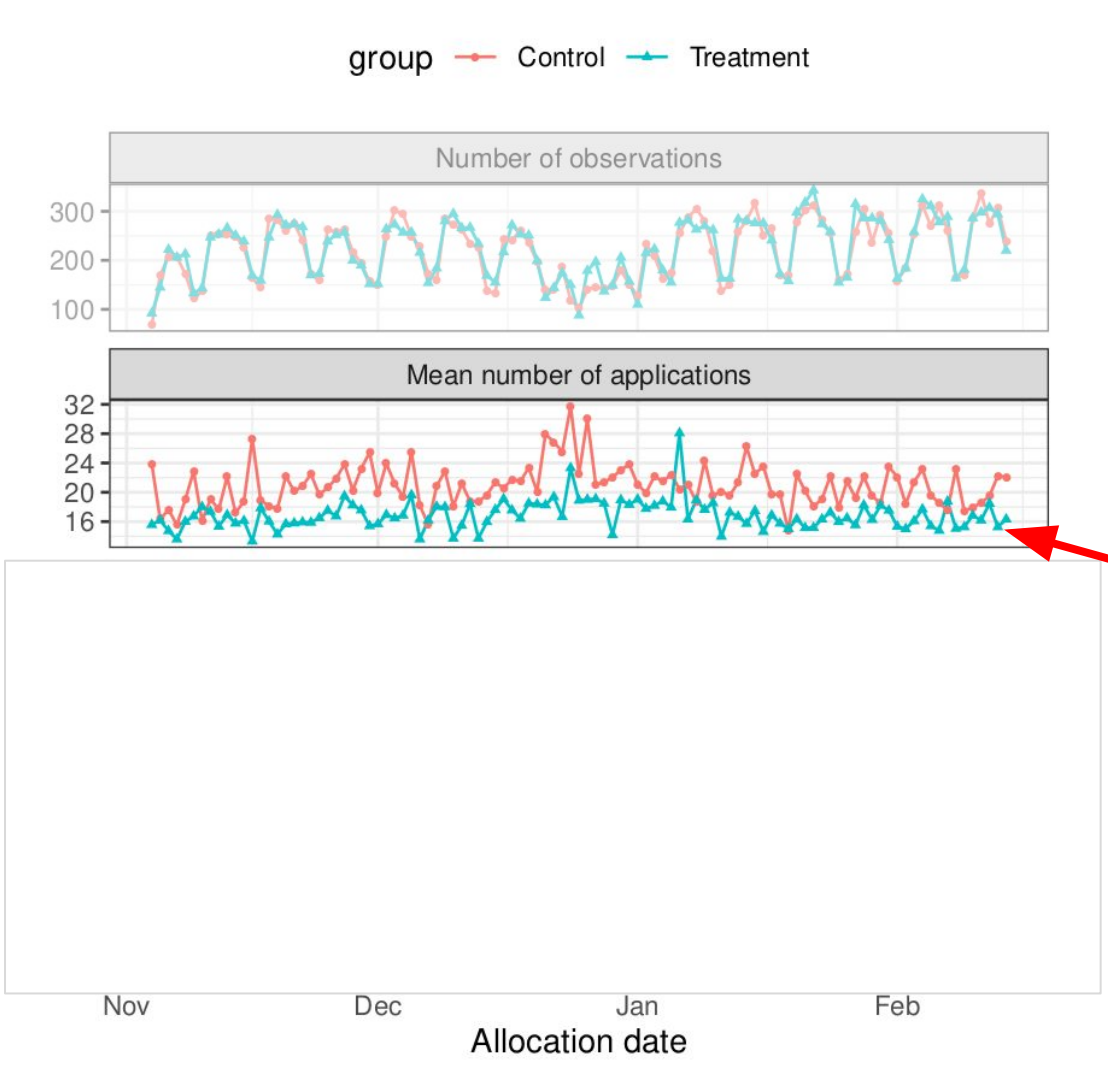
(c) Button to make a private job public


Employer posts a job
(n = 46K, over 4 months)
Randomization
50%
50%
Treatment:
"Soft cap"
experience
Control:
Status quo
experience

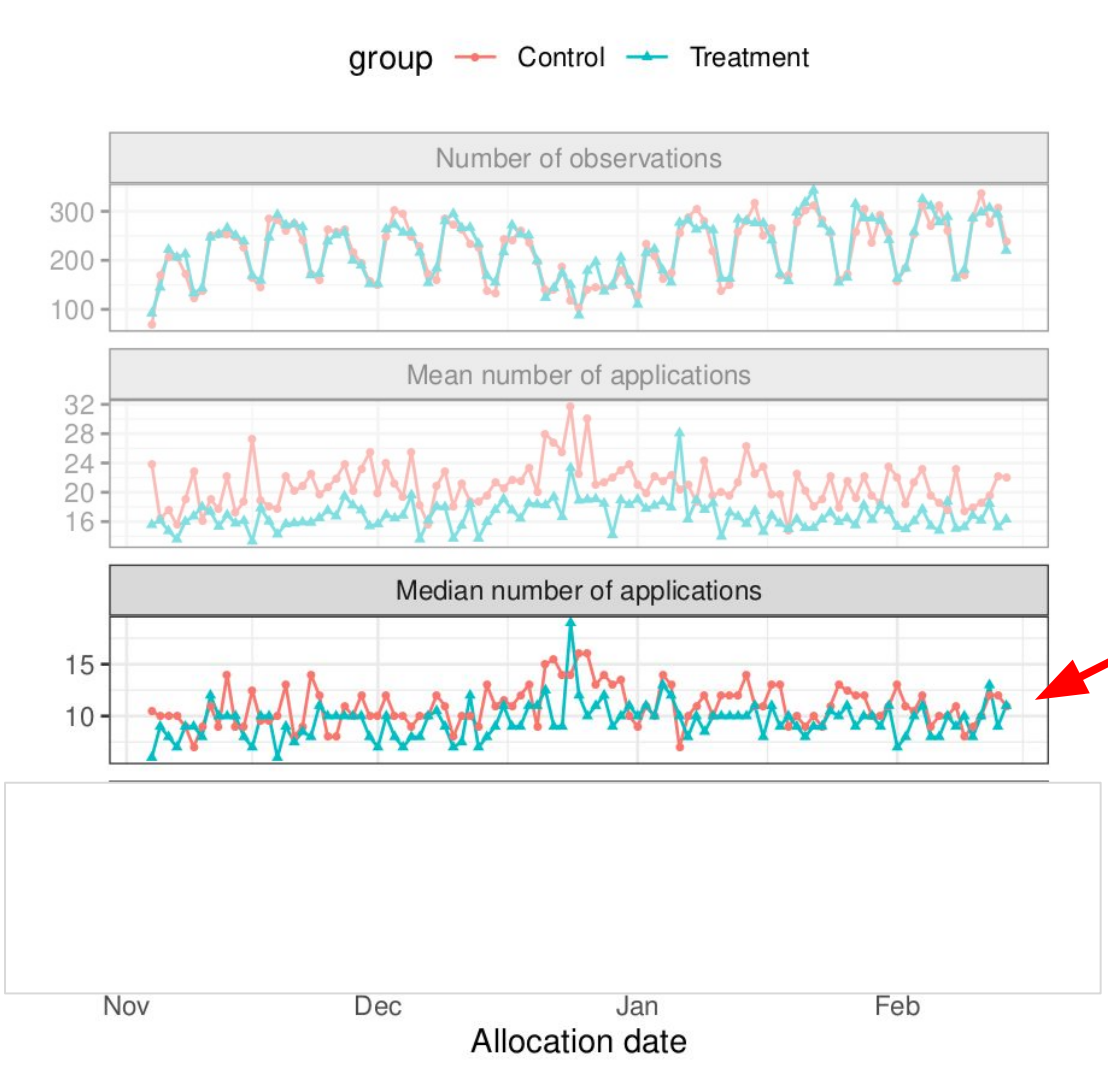
What happened, day-by-day



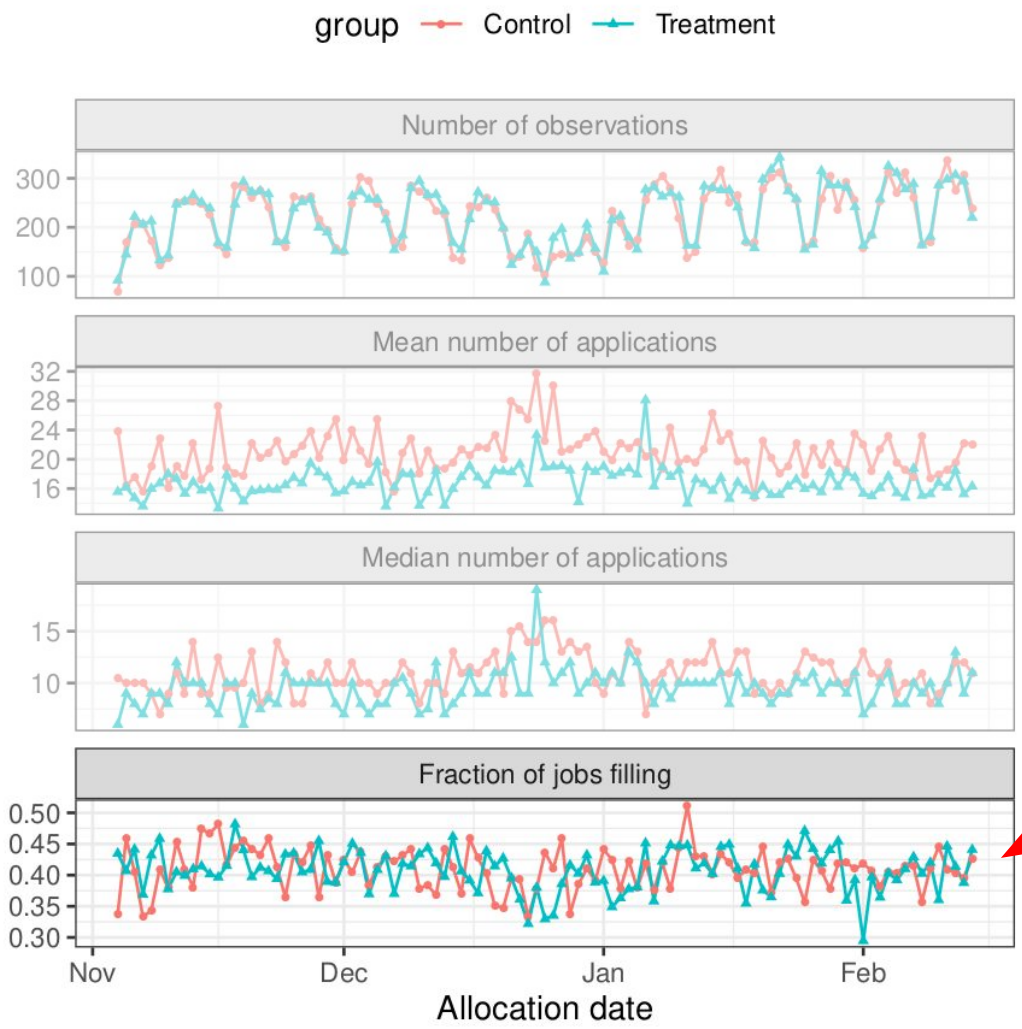
Number of job posts allocated per day, over the course of the experiment.



Clear reduction in mean number of applications per job, in the treatment group



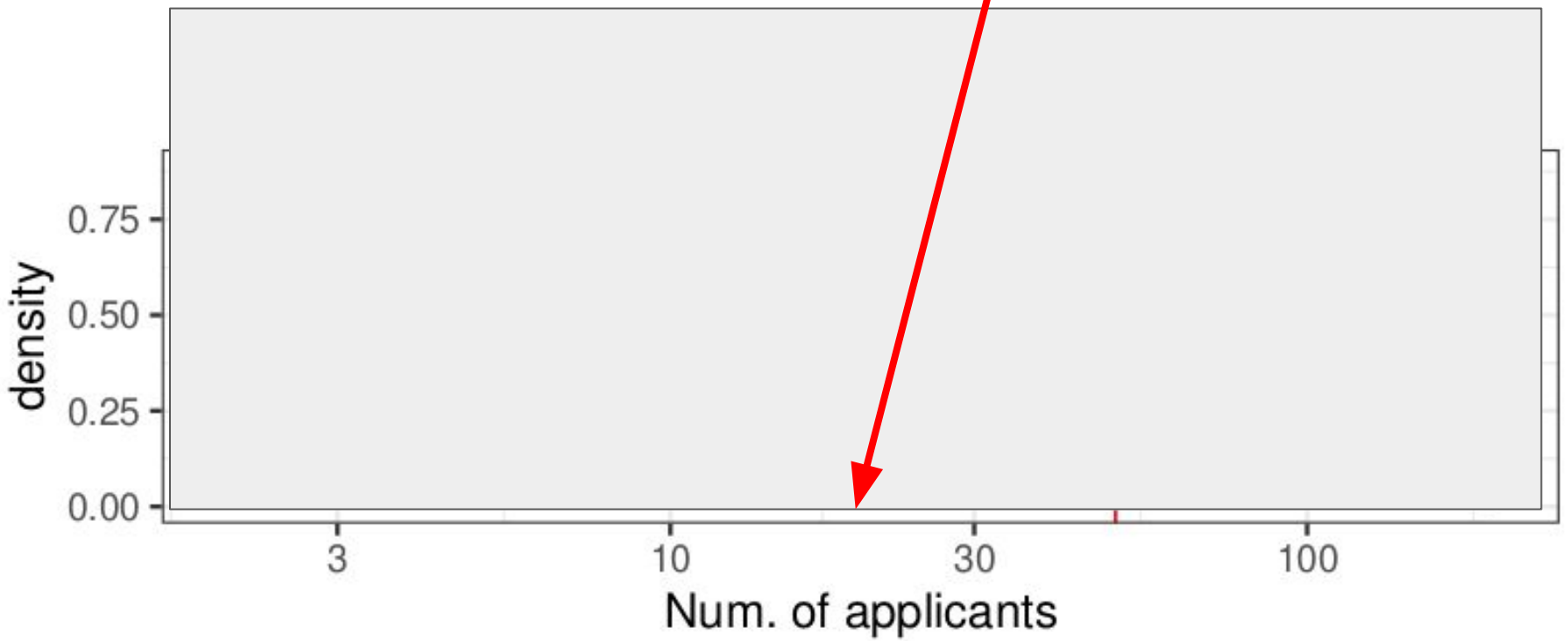
Reduction in **median** applications per job is far less obvious

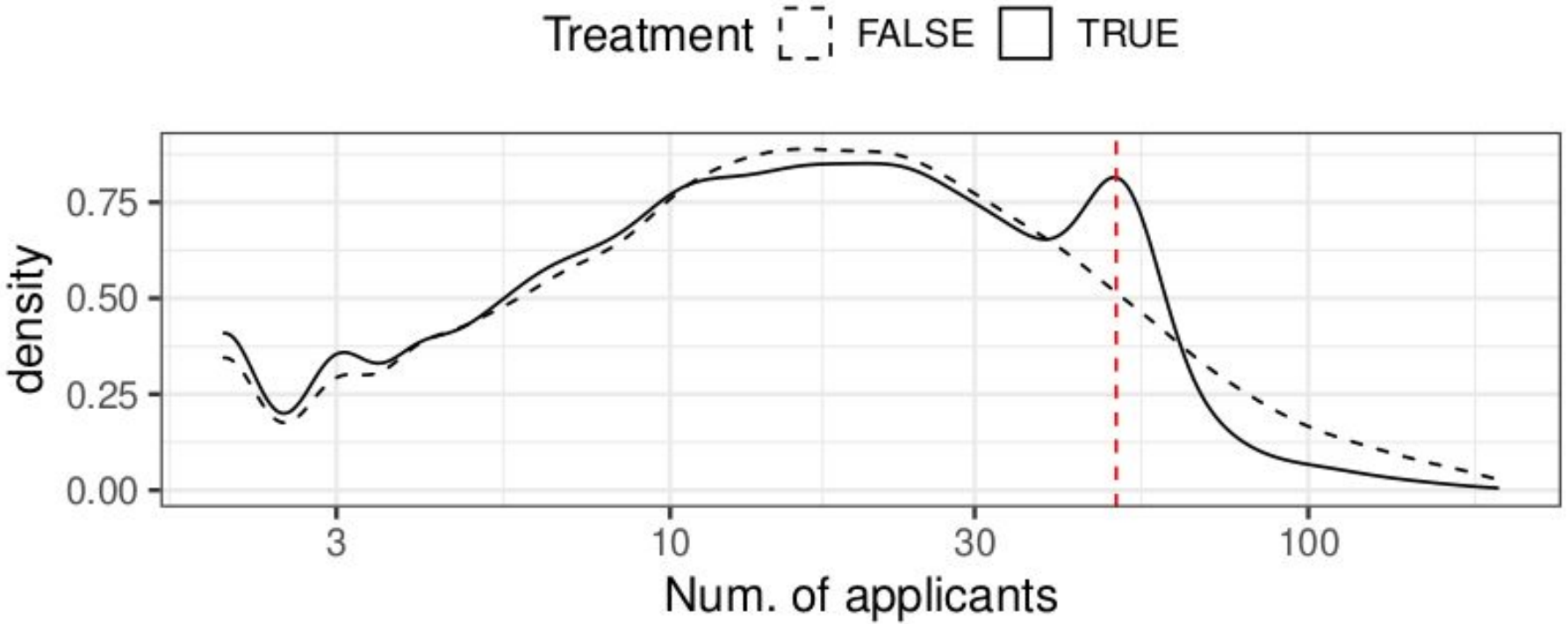


No visual evidence of a difference in probability a match was made

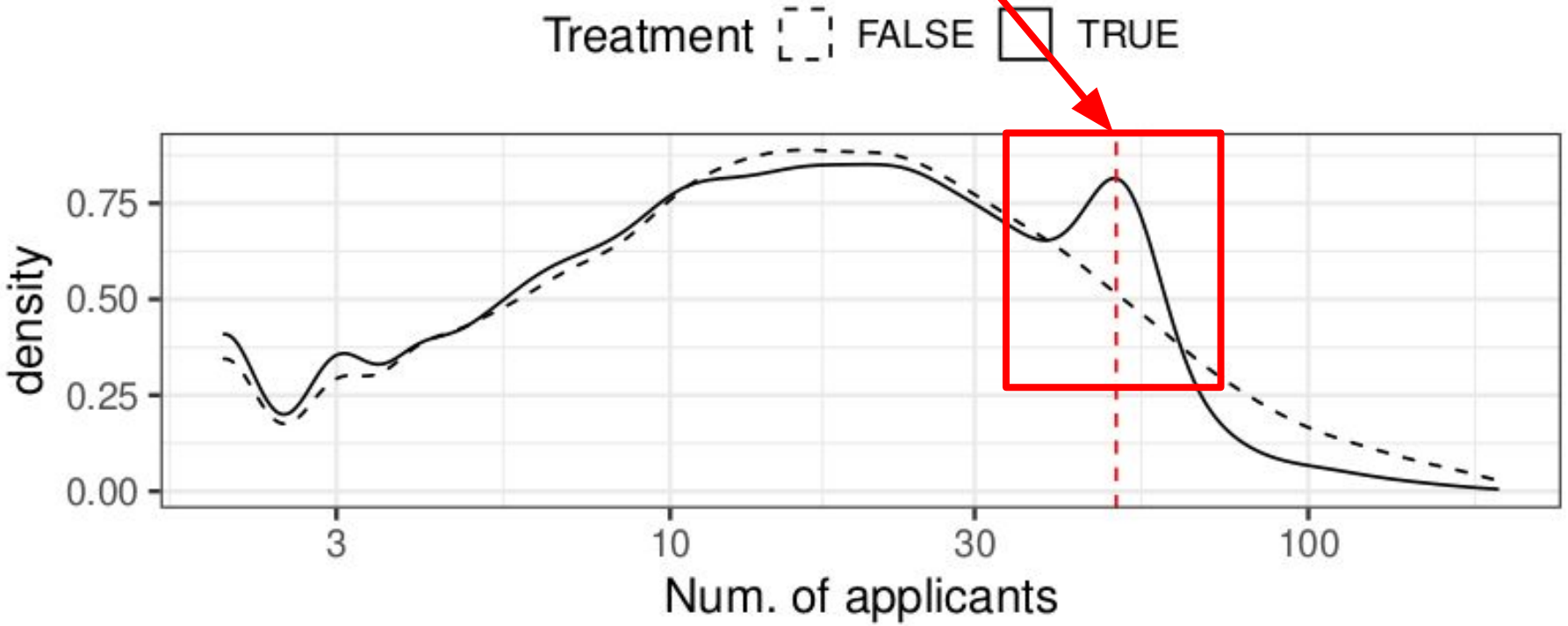
What did the treatment
do to the applicant pool, in detail?

x-axis: Number of applications received by a job opening (log scale)

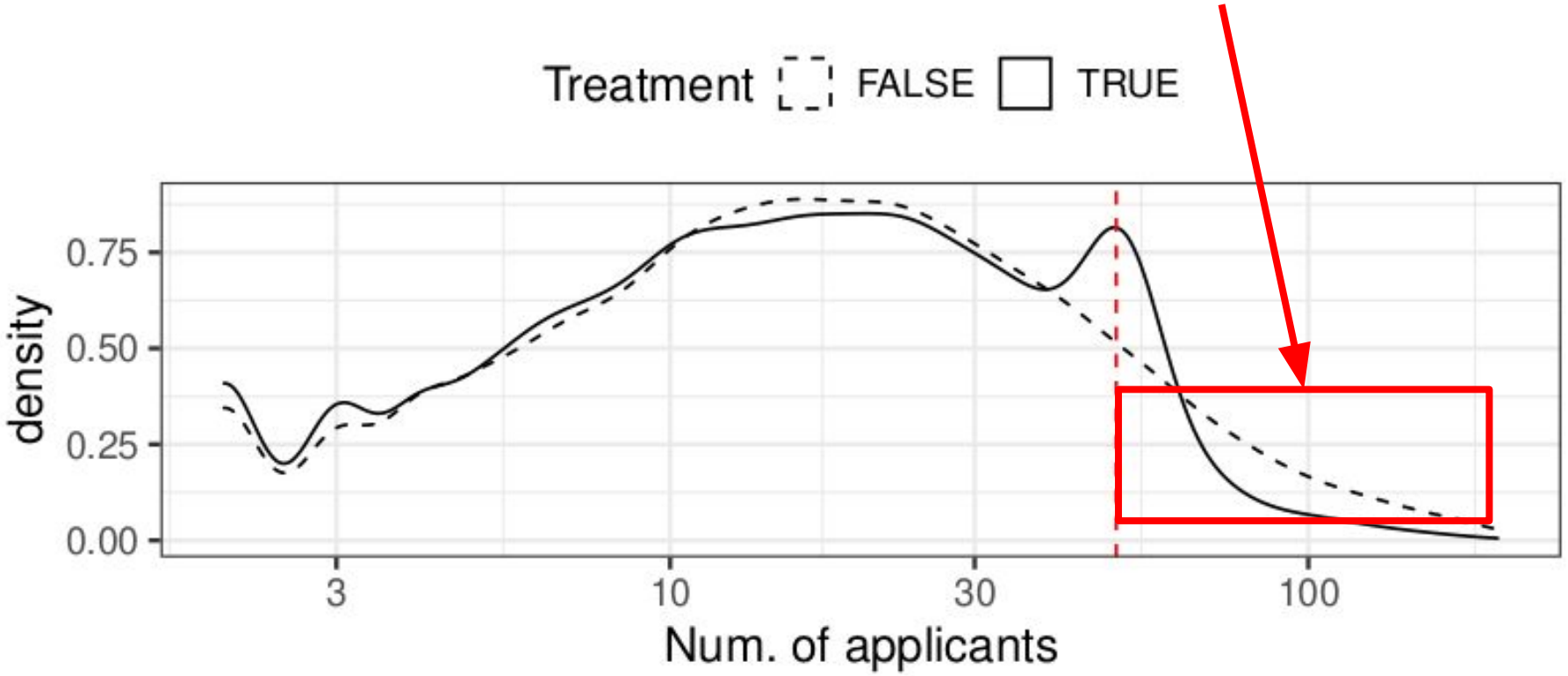



Treatment
FALSE
TRUE
density
0.75
0.50
0.25
0.00
3
10
30
100
Num. of applicants

Clear pooling in applicant # right near the soft-cap in the treatment

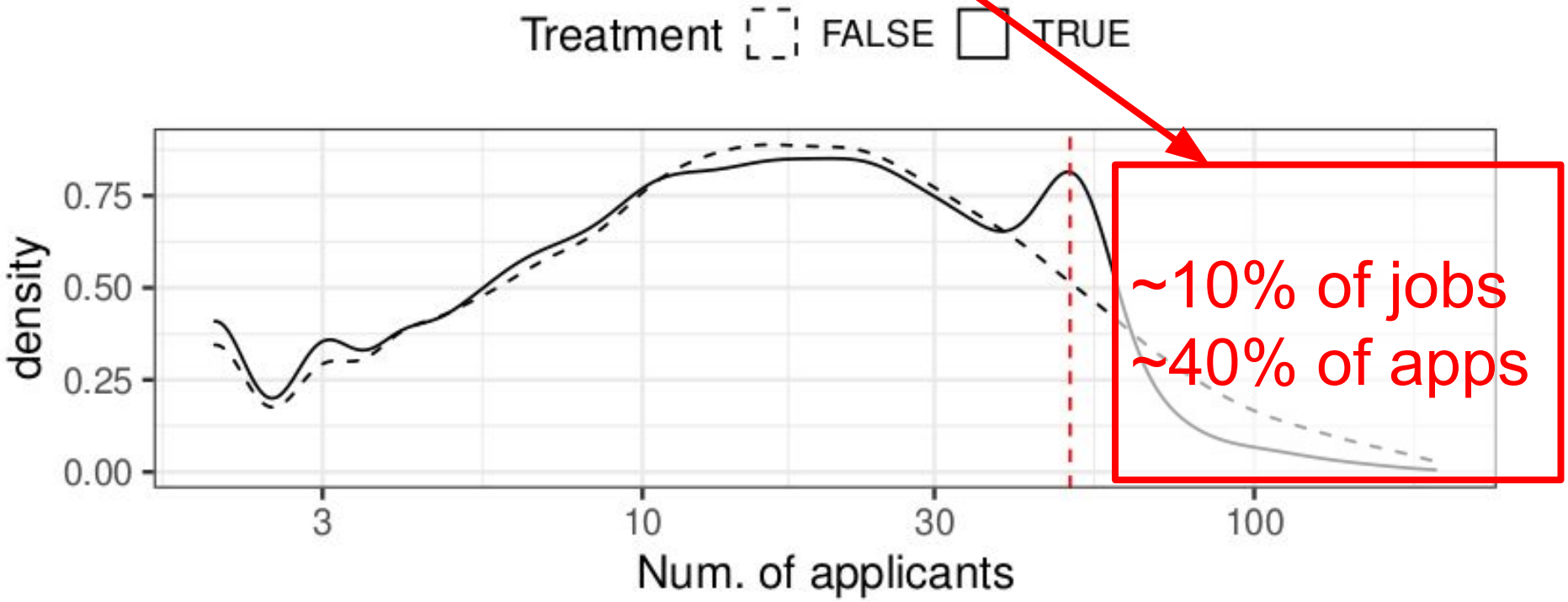


"Missing" applications
in the tail of the treatment



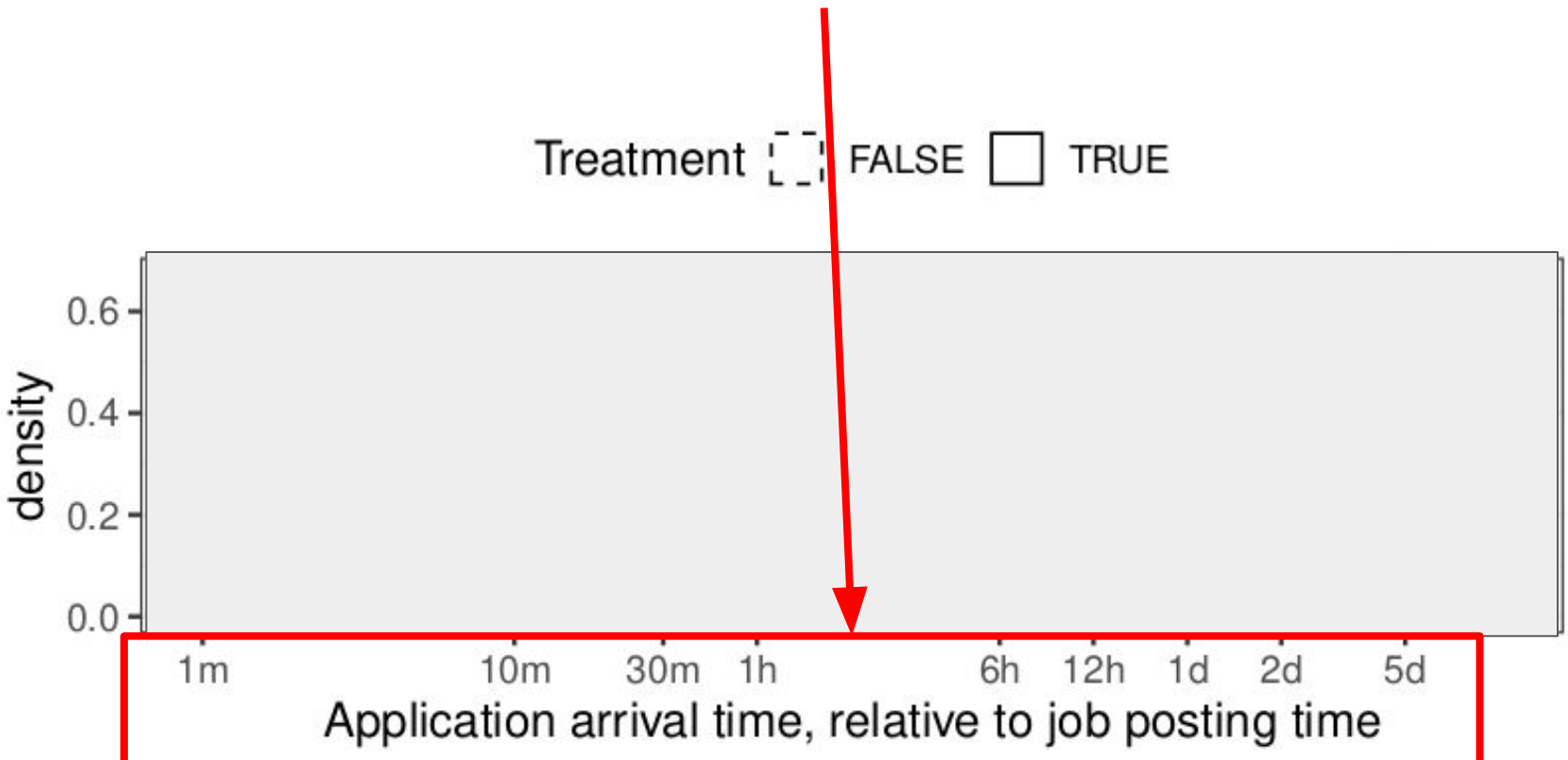
The 50 applicant cap is pretty high,
and so few jobs were affected;
does this even matter to job-seekers?

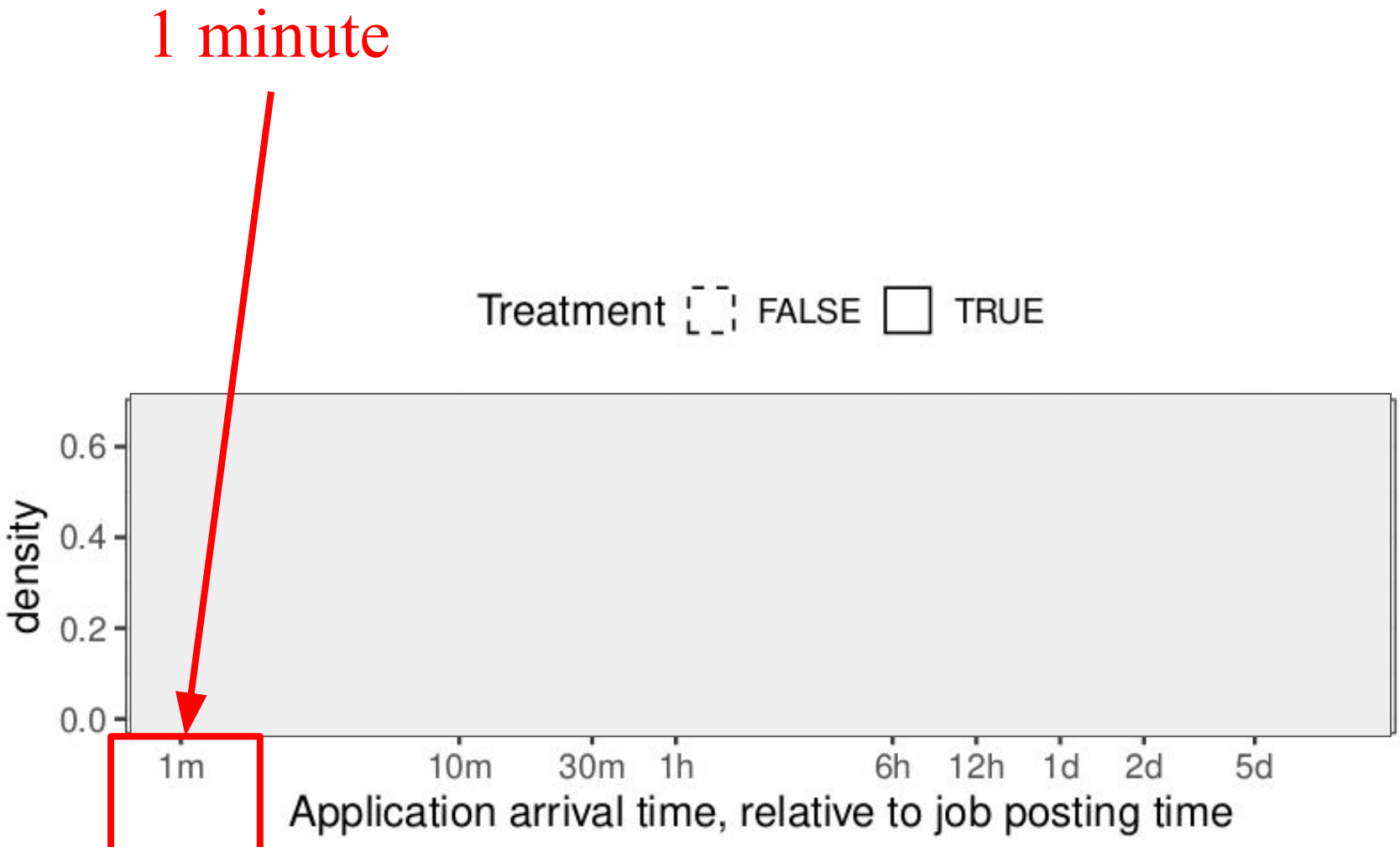
These high app count jobs are disproportionately important to the job-seeker experience

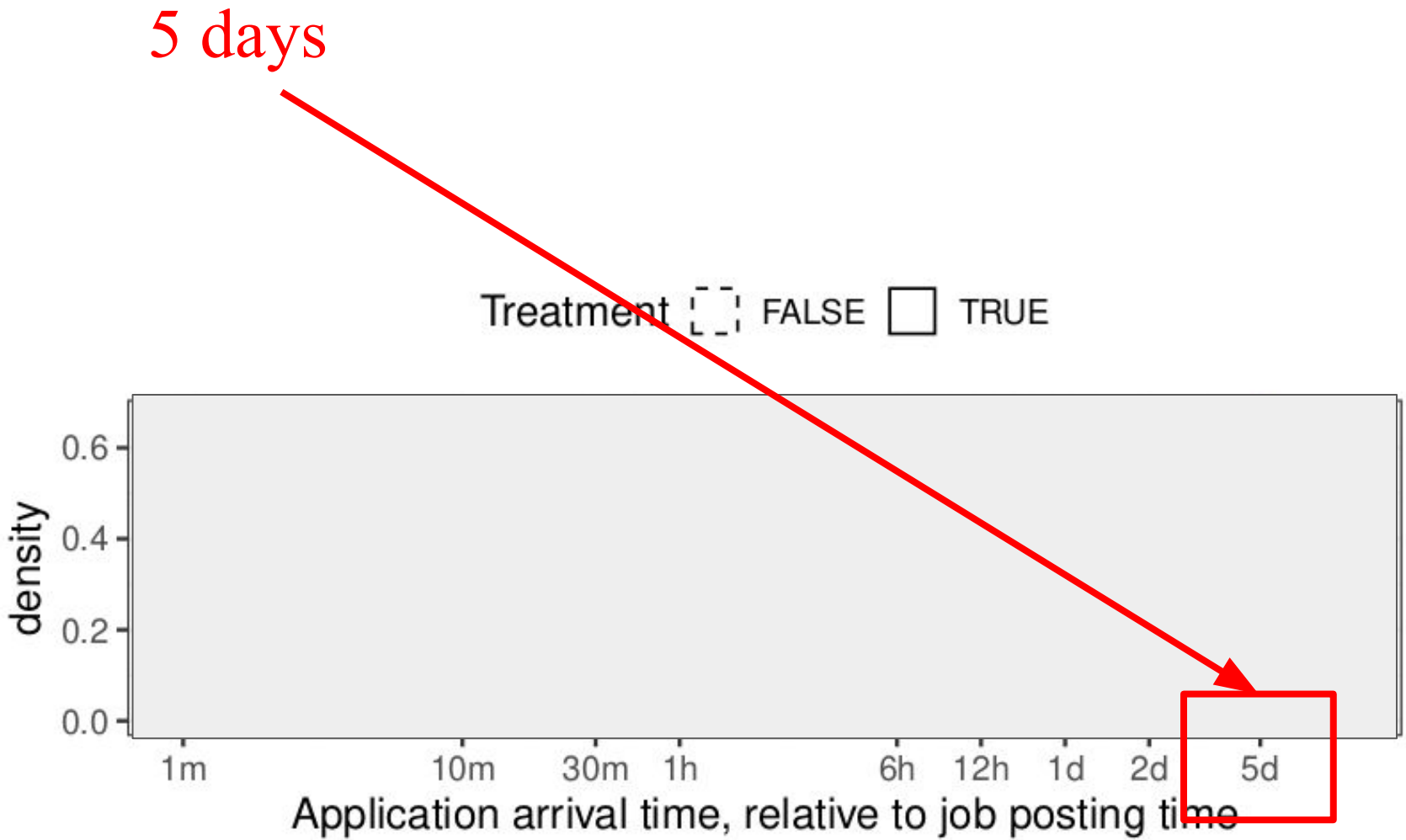


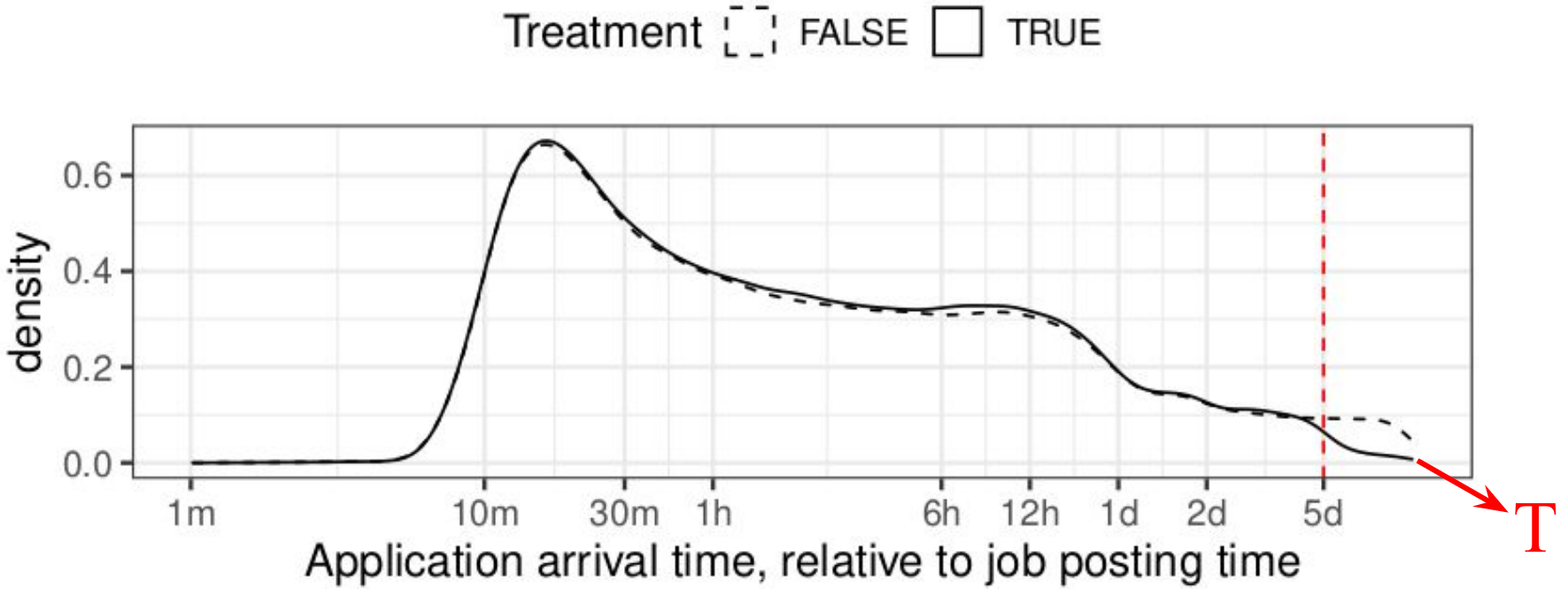
Effects of the "5 day" aspect of the intervention

Applicant arrival times (relative to when job was posted) - note log scale

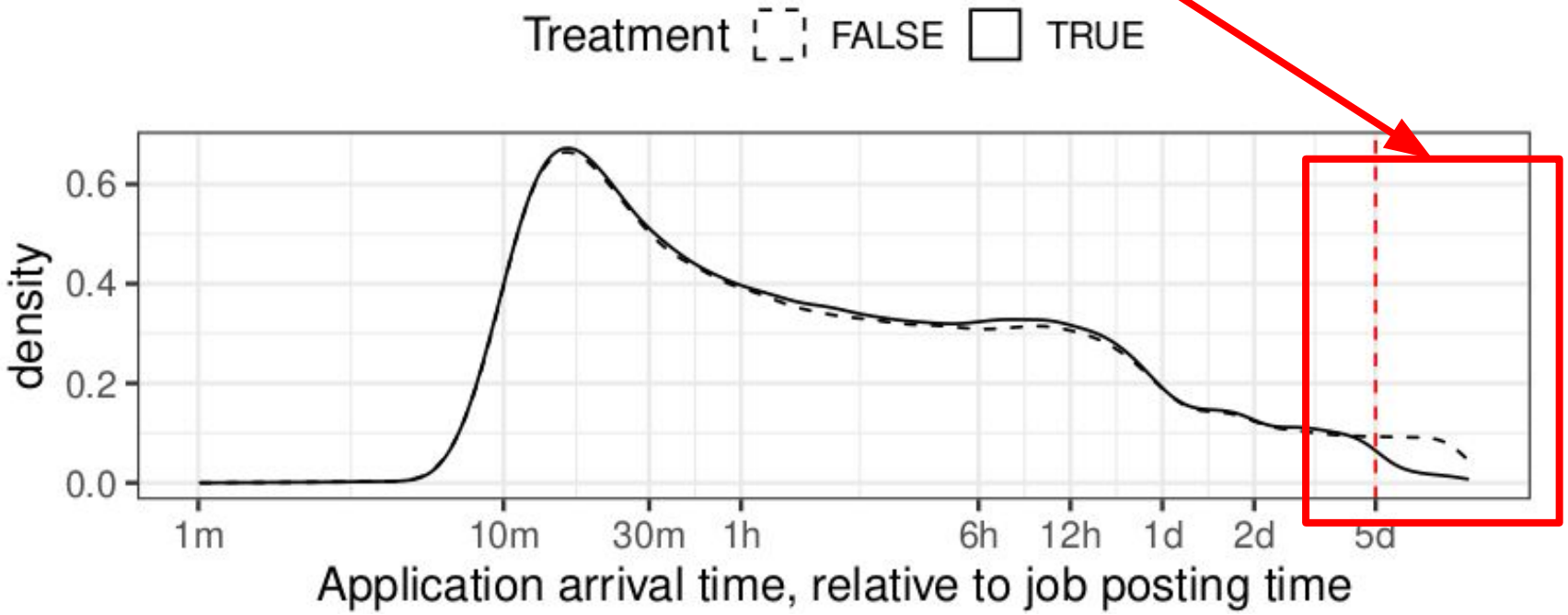



1 minute
Treatment
FALSE
TRUE
density
0.6
0.4
0.2
0.0
1m
10m
30m
1h
6h
12h
1d
2d
5d
Application arrival time, relative to job posting time

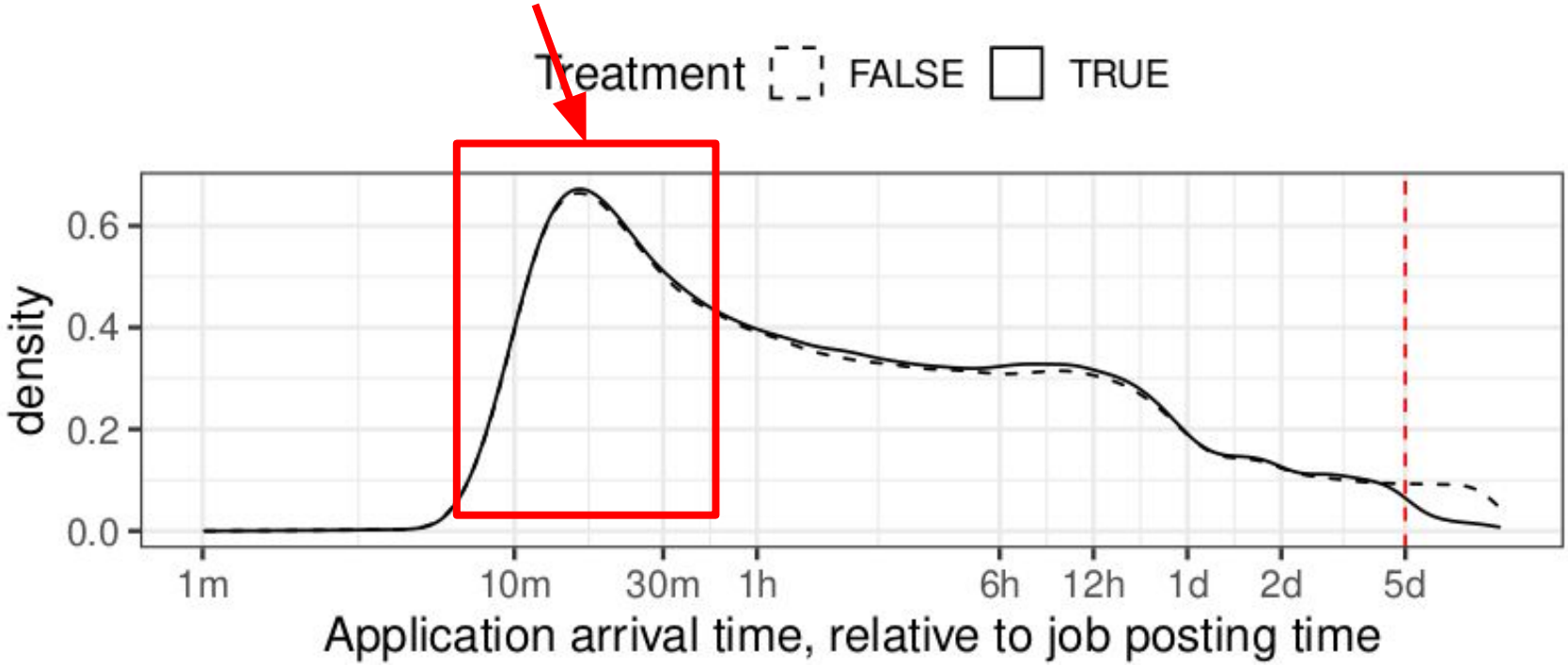

5 days
Treatment
FALSE
TRUE
density
0.6
0.4
0.2
0.0
1m
10m
30m
1h
6h
12h
1d
2d
5d
Application arrival time, relative to job posting time


Treatment
FALSE
TRUE
density
0.6
0.4
0.2
0.0
1m
10m
30m
1h
6h
12h
1d
2d
5d
T
Application arrival time, relative to job posting time

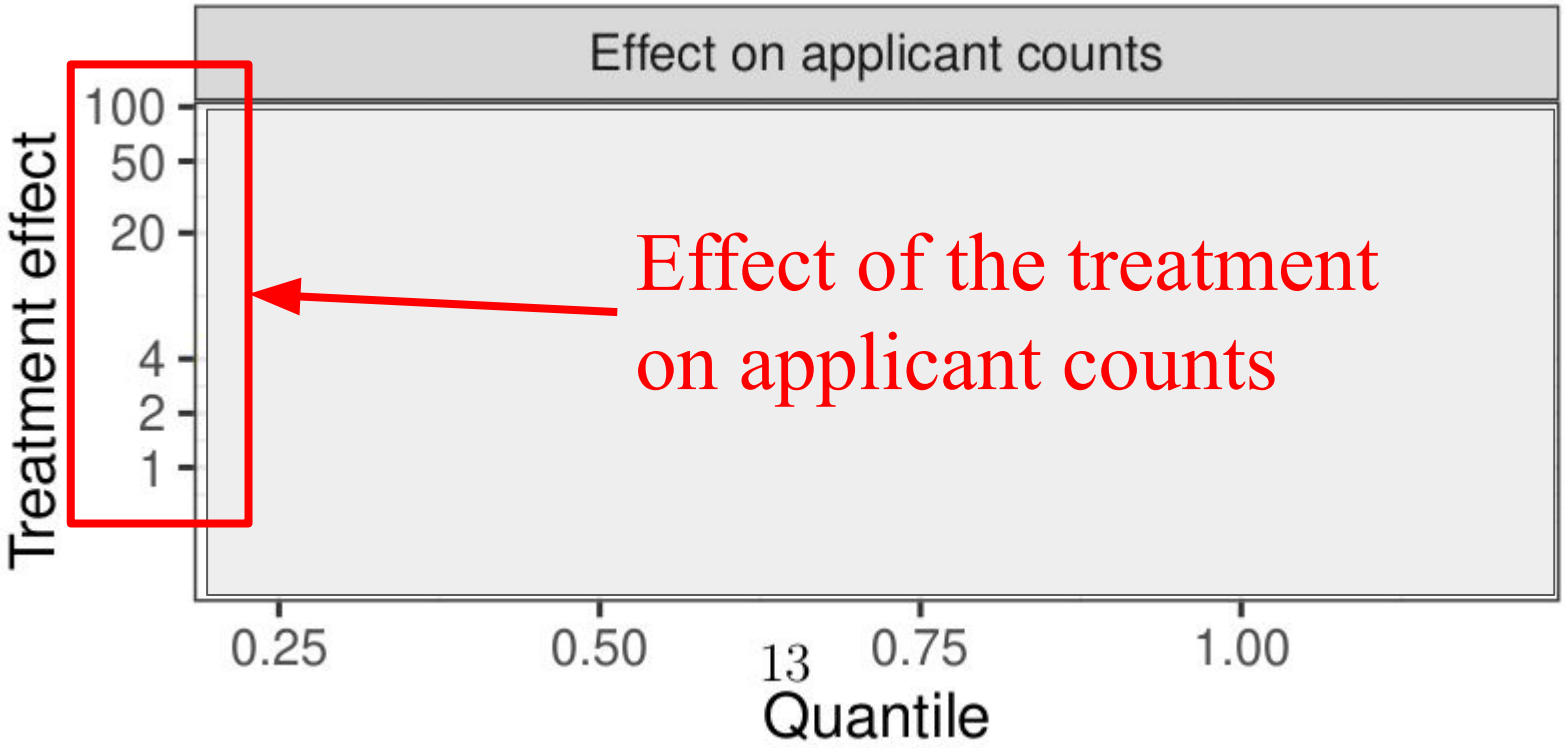
Clear fall-off in the
treatment after 5 days

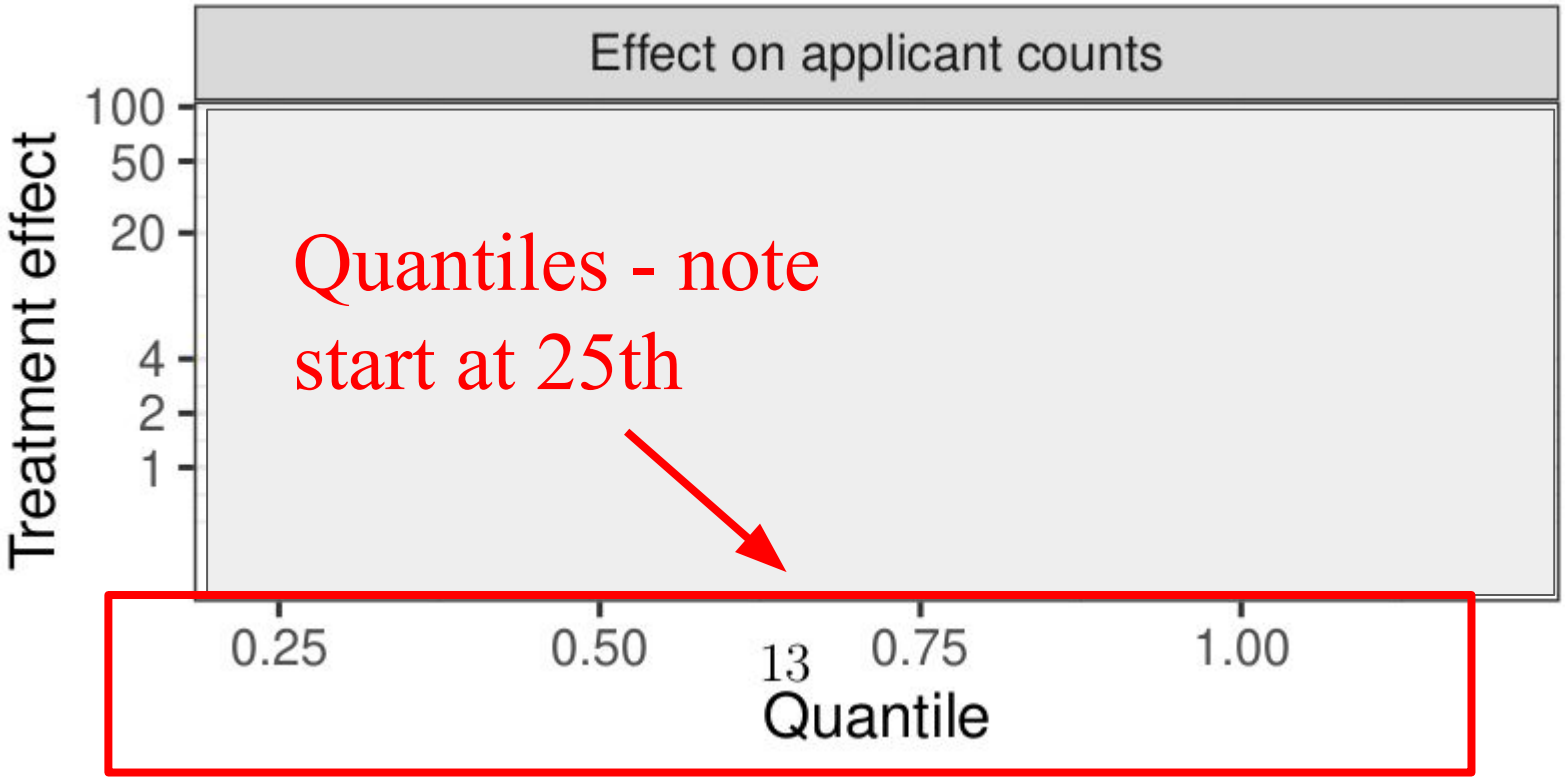


Most applicants arrive very quickly - modal arrival time ~ ½ hour after posting

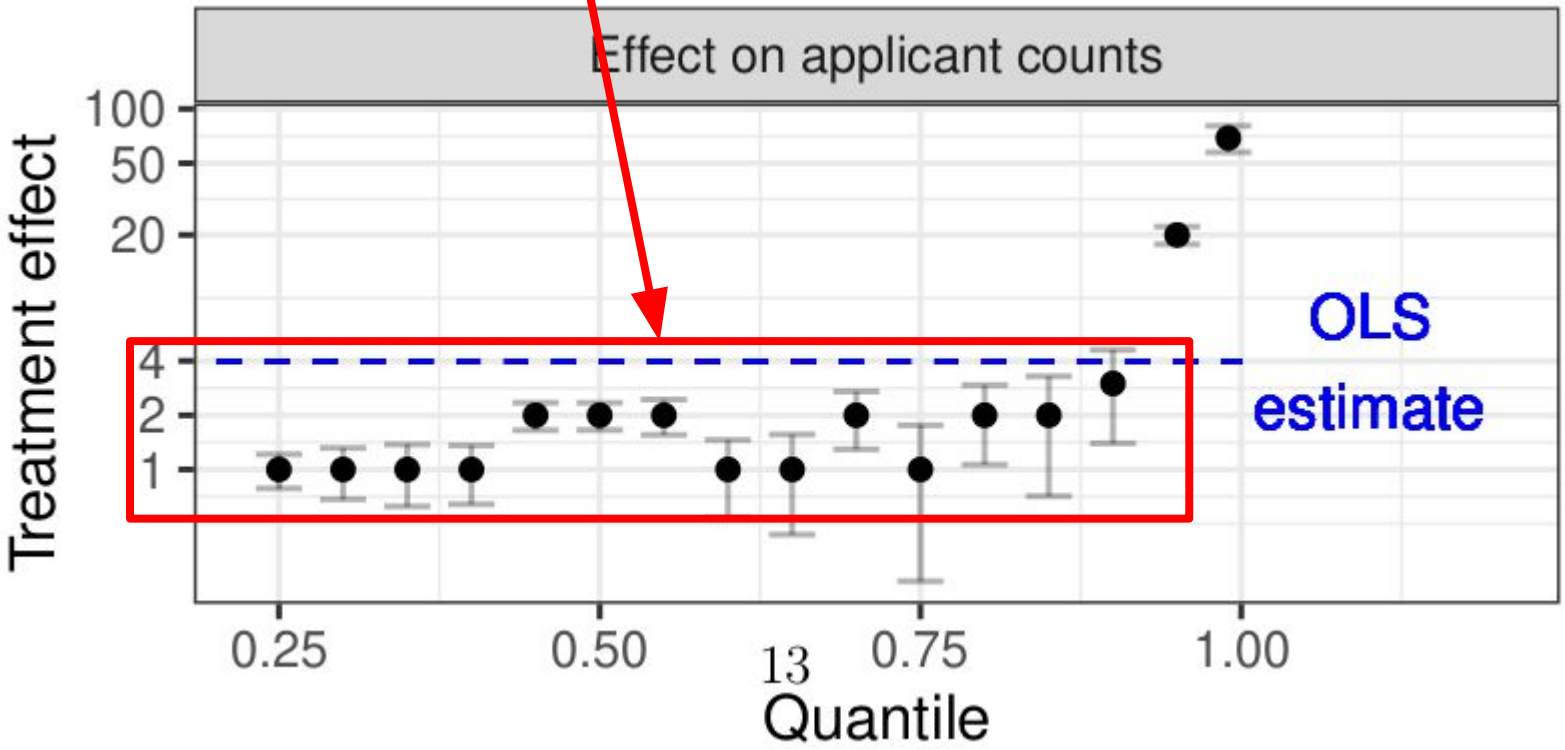


Quantile & OLS regression estimates of effects on applicant pool

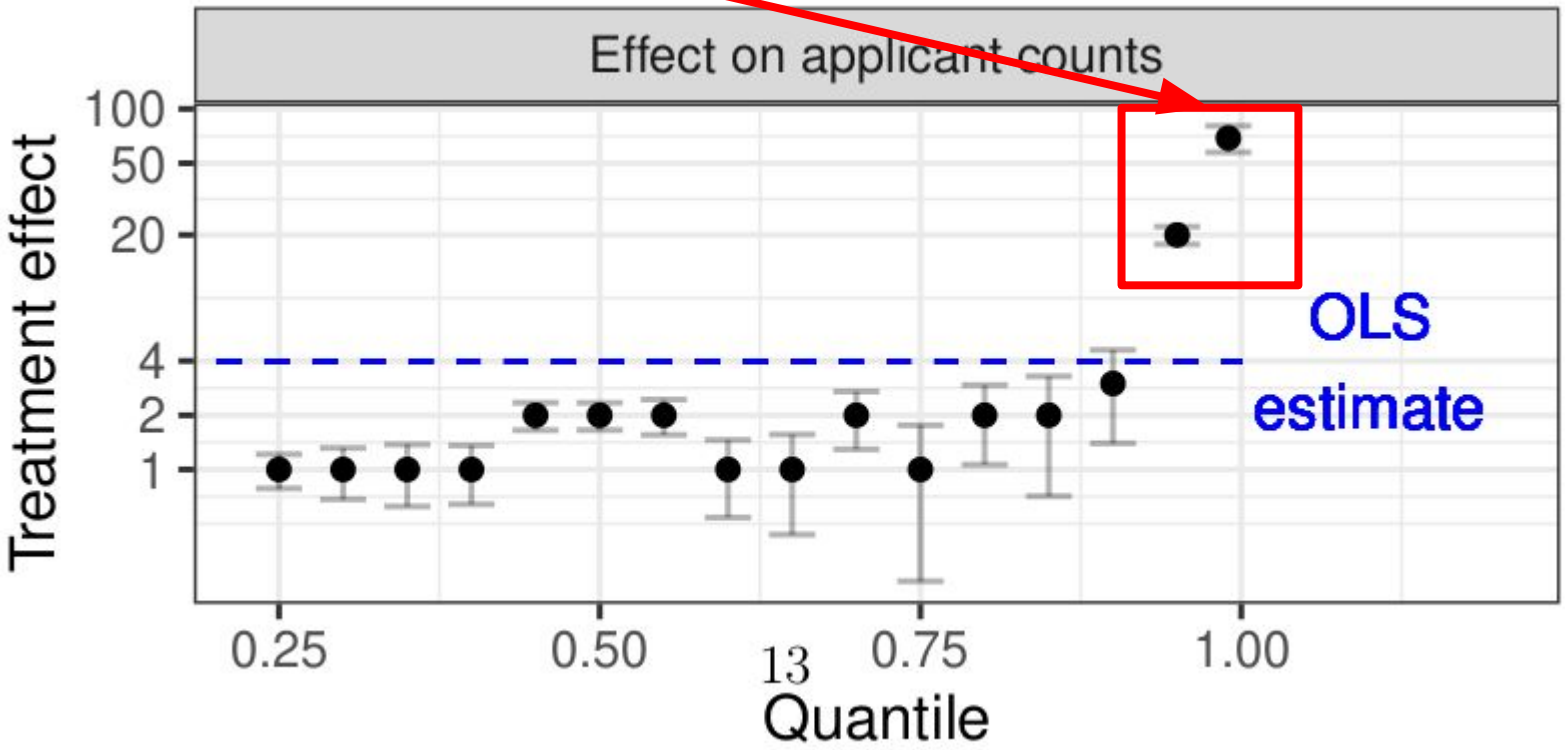



Effect on applicant counts
Treatment effect
100
50
20
4
2
1
Quantiles - note
start at 25th
0.25
0.50
0.75
1.00
Quantile

Reductions of ~2 applicants all the way up to 90th percentile



Much larger reduction for the highest quantiles



	N	Min	25th	Mean	Median	75th	Max	StDev
Number of apps								
Control	22,667	0.00	2.00	20.82	11.00	13.00	1,536.00	37.31
Treatment	23,075	0.00	1.00	16.85	9.00	11.00	3,194.00	31.37
Any hires								
Control	22,667	0.00	0.00	0.41	0.00	0.00	1.00	0.49
Treatment	23,075	0.00	0.00	0.41	0.00	0.00	1.00	0.49
Total hires								
Control	22,667	0.00	0.00	0.53	0.00	0.00	75.00	1.22
Treatment	23,075	0.00	0.00	0.51	0.00	0.00	33.00	0.92
Average wage bid								
Control	10,277	0.01	6.15	12.27	10.30	11.11	96.89	8.64
Treatment	10,459	0.01	6.06	12.17	10.22	11.06	83.33	8.58
Average wage hired								
Control	4,660	0.01	5.77	11.74	9.93	10.64	96.89	8.42
Treatment	4,694	0.01	5.83	11.72	10.00	10.75	80.00	8.19

Notes: Opening level outcomes by treatment and control group.

Effects on match formation

Was any applicant hired for the job?

	Any hires?	Total hires	Any hires after 55?
	(1)	(2)	(3)
Treatment			
Intercept			
N	45,742	45,742	45,742
R squared	0.00000	0.00006	0.00068

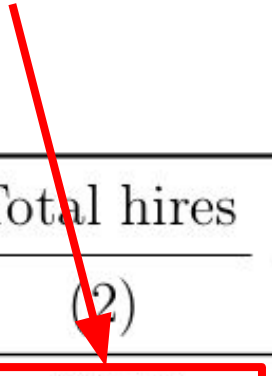
Treatment indicator

	Any hires?	Total hires	Any hires after 55?
	(1)	(2)	(3)
Treatment			
Intercept			
N	45,742	45,742	45,742
R squared	0.00000	0.00006	0.00068

Effect on whether a hire was made is a precise 0.

	Any hires?	Total hires	Any hires after 55?
	(1)	(2)	(3)
Treatment	-0.002		
	(0.005)		
Intercept	0.411***		
	(0.003)		
N	45,742	45,742	45,742
R squared	0.00000	0.00006	0.00068

Effect on **total number** of hires was also a precise 0.



	Any hires?	Total hires	Any hires after 55?
	(1)	(2)	(3)
Treatment	-0.002	-0.016	
	(0.005)	(0.010)	
Intercept	0.411***	0.528***	
	(0.003)	(0.007)	
N	45,742	45,742	45,742
R squared	0.00000	0.00006	0.00068

Maybe the applicants reduced were "bad"/irrelevant? Or every client pushed the button?

Button pushing was rare:
only about 7% of employers

Large reductions in hires from applicants arriving after 55th in the treatment. Consistent with substitution.

	Any hires?	Total hires	Any hires after 55?
	(1)	(2)	(3)
Treatment	-0.002	-0.016	-0.007***
	(0.005)	(0.010)	(0.001)
Intercept	0.411***	0.528***	0.020***
	(0.003)	(0.007)	(0.001)
N	45,742	45,742	45,742
R squared	0.00000	0.00006	0.00068

Match outcomes, conditional upon a hire

No discernible changes to wages, hours-worked or feedback.

	Log hired worker wage	Log hours-worked	Feedback on worker
	(1)	(2)	(3)
Treatment	-0.002	0.042	0.011
	(0.014)	(0.044)	(0.012)
Intercept	2.240***	2.987***	4.667***
	(0.010)	(0.031)	(0.009)
N	9,354	7,082	16,330
R squared	0.00000	0.00013	0.00005

Effect of the intervention from the job-seeker's perspective

Outcome of worker *i* applying to job *j* (e.g., hired)

$$y_{ij} = \beta \cdot \text{TRT}_j + \text{APPCOUNT}_j + \gamma_i + \epsilon$$

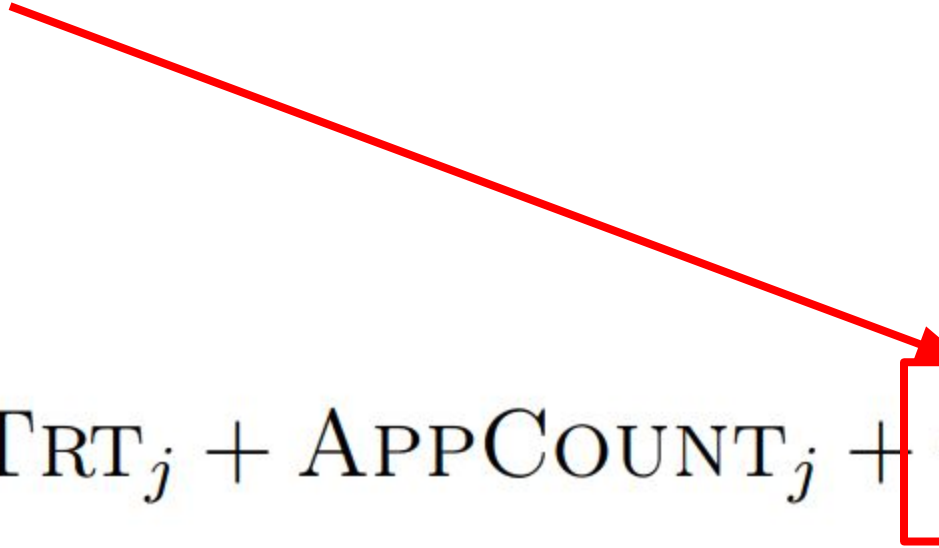
Treatment assignment of the applied-to job opening (not known to job-seeker)

$$y_{ij} = \beta \cdot \textsc{Trt}_j + \textsc{AppCount}_j + \gamma_i + \epsilon$$

Application count when the job-seeker applied

$$y_{ij} = \beta \cdot \text{TRT}_j + \boxed{\text{APPCOUNT}_j} + \gamma_i + \epsilon$$

Worker-specific fixed effect



$$y_{ij} = \beta \cdot \text{TRT}_j + \text{APPCOUNT}_j + \gamma_i + \epsilon$$

Job-seekers applying to treated jobs enjoyed a higher rank (mechanical)

	Hired	Rank
	(1)	(2)
Treatment		-13.712***
		(0.186)
DV Mean	0.02	33.23
Worker FE	Y	Y
Worker Cluster SE	Y	Y
N	738,861	738,861
R squared	0.54924	0.80494

Job-seekers applying to treated jobs enjoyed a higher win rate - about a 17% increase.

	Hired	Rank
	(1)	(2)
Treatment	0.003***	-13.712***
	(0.001)	(0.186)
DV Mean	0.02	33.23
Worker FE	Y	Y
Worker Cluster SE	Y	Y
N	738,861	738,861
R squared	0.54924	0.80494

Conclusions

- Substantial reductions in applications had no discernible effect on match formation probability or match quality
  - There is a great deal of crowd-out
- A 17% increase in win probability for job-seekers could lead to more applications, but a simple envelope theorem argument suggests they would be better off
- For many employers, the marginal return to more applications was less than the *de minimus* cost of pushing a single button

Future work

- This kind of intervention could be done on any online job board
  - Requires fairly little information
  - Lower cut-offs could be tried, potentially unleashing larger gains
- Could other platform policies get us closer to the social planner ideal?

Thank you!

Title: Job-Seekers Send Too Many Applications: Experimental Evidence and a Partial Solution

Authors: John Horton and Shoshana Vasserman

These slides: https://bit.ly/3crW089
The paper: https://bit.ly/3sunrDS

Backup Slides

What We Find:

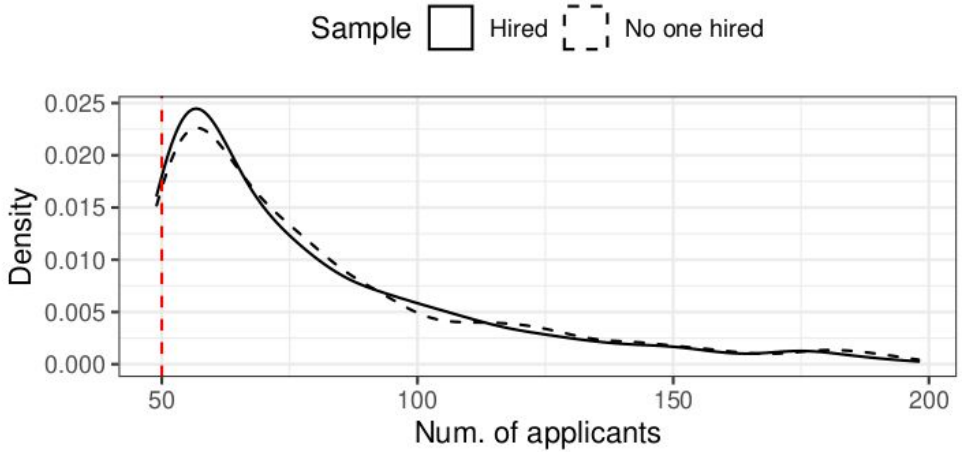
Table 4: Association between worker application wage bidding and hiring in the control group

	Hires (1/0) x 1000		
	(1)	(2)	(3)
Log wage bid	2.018***	-11.019***	-11.018***
	(0.247)	(1.117)	(1.117)
Applicant arrival rank			-0.002
			(0.008)
Intercept	9.492***		
	(0.526)		
N	262,463	262,463	262,463
DV Mean	13	13	13
Worker FE	N	Y	Y
Job Opening FE	N	Y	Y
Worker Cluster SE	Y	Y	Y
R squared	0.00025	0.75011	0.75011

Notes: The table reports regressions of application-level outcomes—namely whether the applicant was hired. In the experiment, employers posting jobs were randomized to a treatment or a control. Employers in the treatment could not receive additional applicants once they received 50 applicants or 5 days had passed since posting. However, the employer could opt out of this cap by clicking a single button. The regressions are weighted by the inverse of the total number of applications sent by

What We Find:

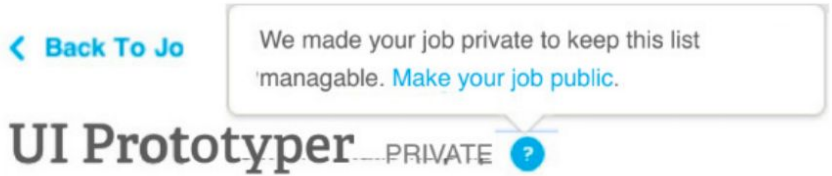
Figure 3: Distribution of applications to control job openings, by whether the opening was filled



Notes: This figure plots the kernel density estimate for the log number of applications in the control group, by whether or not the job opening led to a hire.

(c) Button to make a private job public

(b) Button to make a public job private



What is “too many”?

- Suppose applicants are equally likely to be qualified for a job
  - Social value of a hire given A applicants is V(A)
  - Given private application cost c, workers will keep applying if (θ V(A) / A) ≥ c
  - But this is not socially efficient!

- Another take: suppose applicants have uniform match quality
  - Expected match value of hire is A / (A+1)
  - Marginal change in expected match value decays with 1/(A^2)
  - Marginal cost of applying is fixed

How would we know if we have too many applications?

- Exogenous change in number of applications
  - No change in match probability
  - No change in match quality

- Complicating factors
  - Workers know (roughly) how many apps have been submitted [and bid as in an auction]
  - Most (#?) applications go to the top (%?) of jobs
  - [something else?]

	N	Min	25th	Mean	Median	75th	Max	StDev
Number of apps								
Control	22,667	0.00	2.00	20.82	11.00	13.00	1,536.00	37.31
Treatment	23,075	0.00	1.00	16.85	9.00	11.00	3,194.00	31.37
Any hires								
Control	22,667	0.00	0.00	0.41	0.00	0.00	1.00	0.49
Treatment	23,075	0.00	0.00	0.41	0.00	0.00	1.00	0.49
Total hires								
Control	22,667	0.00	0.00	0.53	0.00	0.00	75.00	1.22
Treatment	23,075	0.00	0.00	0.51	0.00	0.00	33.00	0.92
Average wage bid								
Control	10,277	0.01	6.15	12.27	10.30	11.11	96.89	8.64
Treatment	10,459	0.01	6.06	12.17	10.22	11.06	83.33	8.58
Average wage hired								
Control	4,660	0.01	5.77	11.74	9.93	10.64	96.89	8.42
Treatment	4,694	0.01	5.83	11.72	10.00	10.75	80.00	8.19

Notes: Opening level outcomes by treatment and control group.

What were the effects on:

- Match formation / probability?
- Match attributes, conditional upon a hire
- The job-seeker experience

The platform's perspective

- Many job applications were being sent to job posts where:
  - The employer already had "enough" applications
    - further applications simply crowd-out existing applicants
  - The employer has already made a hiring decision
    - unbeknownst to would-be applicants
  - "Choice overload" idea had some internal currency
    - "Job applicants are like jams"
- **Design question**: Could the platform reduce such applications without harming match formation?