

NBER WORKING PAPER SERIES

“I STILL HAVEN’T FOUND WHAT I’M LOOKING FOR”:
EVIDENCE OF DIRECTED SEARCH FROM A FIELD EXPERIMENT

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Working Paper 28660
<http://www.nber.org/papers/w28660>

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
April 2021

We owe a huge thanks to the job board on which we ran our experiment. We are grateful for helpful comments from Xiaoming Cai, Chao He, Daniel Houser, Binglin Gong, Zhiyun Li, David Ong, Xiangquan Zeng, participants at 2020 ESA Global Online Conference, 2020 Beijing Normal University Conference on Experimental Economics, 2020 International Symposium on Labor Economics, and seminar participants at Harbin Institute of Technology at Shenzhen, Jinan University, Peking University, Shandong University, Wuhan University, and Xiamen University. We thank Shiwen Chen, Yiqiang Guo, Wanyu Jiang, Kelin Lu, Yue Yin, Zhuo Zhang, and especially Shuqing Luo, for research assistance. Financial support from the National Natural Science Foundation of China (Project Nos. 71503255 & 71973016), the Beijing National Natural Science Foundation (Project No. 9192013), and MOE (Ministry of Education in China) Project of Humanities and Social Sciences (Project No. 18YJA790032) is gratefully acknowledged. The views expressed herein are those of the authors and do not necessarily reflect the views of the National Bureau of Economic Research.

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“I Still Haven’t Found What I’m Looking For”: Evidence of Directed Search from a Field Experiment

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NBER Working Paper No. 28660

April 2021

JEL No. E24,J64

ABSTRACT

We explore the impact of wage offers on job applications, testing implications of the directed search model and trying to distinguish it from random search. We use a field experiment conducted on a Chinese job board, with real jobs for which we randomly varied the wage offers across three ranges. We find that higher wage offers raise application rates overall, which is consistent with directed search but can also arise with random search. We also find that higher wage offers raise application rates for job seekers with wage offers above reservation wages, and that – among the latter – the increase in application rates is stronger for those with higher reservation wages. The latter two types of evidence are consistent with directed search but not random search. Hence, our evidence lends support to directed search models.

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1. Introduction

Existing models of the labor market in the search and matching literature often describe a specific way in which workers search for jobs and employers attract workers, i.e., either random search or directed search. Random search models assume that job seekers and employers meet exogenously and at random (e.g., Diamond, 1982; Mortensen, 1982, 1986; Pissarides, 1985). Whether a meeting results in a hire, and at what wage (and/or other terms of trade), is endogenously determined by post-meeting bargaining. As a consequence, changing these terms has no influence on attracting workers to jobs. In contrast, models of directed search (also known as competitive search) assume that agents target their search towards particular counterparts based on the terms posted, and therefore these terms, such as higher wages, influence who meets whom (e.g., Peters, 1984, 1991; Hosios, 1990; Montgomery, 1991; Moen, 1997; Menzies et al., 2016; see Wright et al., 2019 for a review). The nearly mutually exclusive assumptions of these two types of models lead to different predictions for market efficiency and the effectiveness of certain labor market policies.¹

Researchers tend to choose random or directed search for analytical convenience (although theoretical implications can differ), rather than based on the best characterization of job seekers' behavior. There is, however, some work that tries to test which type of model is supported empirically by job seekers' search behavior. In labor markets with informational frictions, job seekers' search behavior may involve both randomness, such as which job ads to

¹ Random search in general yields inefficient equilibrium trading prices in the Diamond-Mortensen-Pissarides tradition, unless the vacancy-elasticity of the matching function equals the employer's bargaining power (Hosios, 1990). In contrast, the efficiency of directed search equilibrium depends on specific model assumptions, such as the number of (sub)markets workers can search in, whether it is on-the-job search, whether agents can enter the market, etc. (Wright et al., 2019). For policy effects, see, e.g.: Flinn (2006) on the minimum wage; Acemoglu and Shimer (2000) and Braun et al. (2016) on unemployment insurance; and Acemoglu (1997) and Moen and Rosén (2004) on training subsidies.

open, and direction, such as which job ads to apply to conditional on opening them. Thus, the question is not so much whether the evidence is completely consistent with one model or the other, but which model provides a better characterization of job seekers' behavior – and, in particular, whether there is evidence that the random search assumption is too simple and we therefore have to allow for directed search. Our goal in this paper is to contribute new evidence on this question from a field experiment.

The prediction that is derived from directed search models with heterogeneous firms (e.g., in terms of productivity or technology, hence offering different wages) but homogeneous workers (e.g., in terms of reservation wage or quality), and is most commonly tested to attempt to differentiate between the two types of search models, is that holding other things equal the number of applications firms receive should not vary with the wage offered – consistent with random search. In contrast, it should vary with offered wages under directed search (Moen, 1997). In particular, under directed search the number of applications should increase if the potential gain from higher wages exceeds the potential cost from the lower probability of getting the job because higher wages generate more search and applications by other job seekers; it should decrease otherwise.² An additional prediction of directed search models with heterogeneous firms and heterogeneous workers is that job seekers direct their search effort to a particular (sub)market where employers post wage offers specifically to attract them (Shi, 2002; Menzio et al., 2016). The directed search mechanism generates this kind of endogenous sorting/segmentation of the labor market, whereas random search does not.

² As discussed below, the empirical literature examining evidence on directed search mainly focuses on applications as the outcome of interest, because it is difficult to observe search *per se*, and applications should be a good proxy for search (Belot et al., 2018). Moreover, applications are a better measure of search behavior than hires because higher wage firms might be more successful in hiring even under random search.

In this paper, we present a series of tests for these predictions using data from our field experiment to examine whether and how job search (i.e., applications) responds to the wages offered, for job seekers as a whole, and then accounting for heterogeneous quality. We pay particular consideration to the role of job seekers' reservation wages (RWs hereafter) relative to offered wages – which, as we explain below, is central to trying to distinguish between directed and random search.

There is a growing empirical literature trying to test for directed search by investigating the effects of offered wages on job applications. Evidence based on observational data is mixed. Some studies find a positive effect (e.g., Banfi and Villena-Roldán, 2019; Cable and Judge, 1994; Krueger, 1988), while others find a negative effect (e.g., Faberman and Menzio, 2018; Holzer et al., 1991).³ Marinescu and Wolthoff (2020) obtain mixed evidence, finding that higher wages are associated with fewer applications across job titles within occupations and firms, but more applications within job titles. (It is possible that job titles better capture heterogeneity across jobs, so that within job titles the effect of wage offer variation is better isolated from variation in other characteristics of jobs.)

However, testing for a causal impact of wages on job applications based on observational data faces the challenge that variation in wages tends to be correlated with other features of jobs (perhaps included in job ads, or perhaps just assumed by job seekers).⁴ This challenge can be overcome by comparing job seekers' search and application responses to homogeneous real jobs

³ Some papers focus on the effect on the quality of applicants, in isolation from quantity (Ferraz and Finan, 2009; Crawford and Disney, 2018) or in addition to quantity (Krueger, 1988; Marinescu and Wolthoff, 2020).

⁴ For instance, observed characteristics such as words used to describe the job title, region, and quarter explain 57.7% of the variance of log intended wages and 62.2% of the variance of log wages when wages are hidden or are posted explicitly in job ads, respectively (Banfi and Villena-Roldán, 2019). Moreover, ads for managerial and highly-paid jobs also tended to request particular sets of skills (Bennett, 2002).

that differ only in exogenously varied offered wages, under the underlying assumption that these jobs are perceived as identical in terms of unlisted job conditions.⁵ In line with this strategy, recent research uses field experiments in which wages for otherwise identical jobs (in a single occupation) are randomly assigned to real job seekers. This research finds that job applications increase with offered wages (e.g., Abebe et al., 2020; Dal Bo et al., 2013; Deserranno, 2019; Hedblom et al., 2019).⁶

However, another potential issue that most of the existing experimental studies ignore is that job seekers' RWs can influence whether job seekers apply for certain jobs, generating spurious evidence in favor of directed search if RWs are not considered. In particular, if job seekers use random search but only apply for jobs with offered wages higher than their RWs, one will still find evidence of more applications when offered wages are higher, because the higher the offered wage is, the larger is the share of job seekers for whom the offered wage exceeds the RW (Belot et al., 2018). Thus, without accounting for the RW, a positive effect of offered wages on job applications cannot definitively be viewed as evidence for directed search.

Our paper tries to address both challenges. First, we test for directed search by exogenously varying wages, in a large-scale natural field experiment (Harrison and List, 2004),

⁵ It is possible that job seekers believe that unlisted job conditions vary with the wage. However, in our experiment, at least, this is unlikely to influence our analysis, for three reasons. First, our experimental job ads (and most ads on the job board we use) include many details about the job conditions that may affect applications, including job description, job responsibilities, and employer information, and these details are identical across wage offers. Second, the experimental job ads are posted by a single employer, which may minimize any assumed unobserved employer differences. Third, we control for any differences in the job description and job responsibilities in our regression analysis. In addition, based on an online labor market experiment, Horton and Johari (2018) provide evidence that job seekers' response differences across treatments are not caused by applicants perceiving job amenities/disamenities differently in ways that might be correlated with variation in employers' willingness to pay for job seekers' quality.

⁶ All of these studies also present some evidence on effects on applicant quality, in each case finding positive effects on applicant quality (measured in different ways).

for otherwise identical real jobs (in multiple occupations) that are offered to real job seekers by a single firm.⁷ Second, we account for how job seekers' RWs affect their responses to better distinguish between random and directed search.⁸

Belot et al. (2018) is the only other study of which we are aware that tries to address both of these issues in testing for directed search.⁹ They bring unemployed job seekers to the lab to search for jobs once a week, for a duration of 12 weeks. Job seekers were informed that fewer than 2% of the jobs were pairs of fictitious job vacancies posted only for research purposes. One job in the pair offered the original salary of the real job vacancies, and the other offered a higher or lower salary.¹⁰ Belot et al. test the key implication of directed search models that higher wages generate more interest in (the fictitious) vacancies (measured as viewing and saving the vacancies), and also explore whether there are job seekers who apply only to the low-wage jobs even if high-wage jobs are present as a strategy to avoid competition at high-wage jobs. They find affirmative answers to both questions, consistent with directed search. However, the authors do not provide conclusive evidence that perceived competition (obtained via a survey by rating each pair of fictitious vacancies) can explain job seekers' interest in the jobs above and beyond

⁷ We use only one firm in our experiment. Although the setting differs from typical models with heterogeneous firms, we are interested in worker responses to wage offers rather than studying equilibrium behavior; that is, our focus is on testing a behavioral assumption about how workers search. In addition, it is common (almost universal) in experiments manipulating behavior of real firms to use only one firm, probably to avoid the logistical difficulties of using multiple firms (e.g., Abebe et al., 2020; Dal Bo et al., 2013; Deserranno, 2019; Hedblom et al., 2019).

⁸ There is also random variation in job flexibility in the experiment, for which we control in the present analysis. This experiment was originally designed to study job seekers' valuation of flexible working conditions (He et al., 2020). We use the same data to test alternative search models in the present study.

⁹ There are two studies trying to account for RWs when testing for evidence of directed search, using observational data. Godoy and Moen (2011) use the current job's wage (as we do), while Braun et al. (2016) use individual demographics such as education and urban status as proxies for the RW. However, both studies face the shortcoming of using observational data.

¹⁰ Since they are doing within-individual comparisons over vacancies within pairs, the RWs are implicitly held constant.

the salary difference, although they do find that job seekers expected to face more competition when applying for high-wage jobs.¹¹

Two other studies, with seemingly contradictory evidence, also shed light on competition avoiding behavior. In an experiment, Gee (2019) finds that a higher number of applicants to a job does not deter applications, in contrast to the prediction of directed search models. On the other hand, Horton and Johari's (2018) experimental evidence indicates that allowing employers to signal their willingness to pay for employees with varying quality induces substantial sorting of job seekers by quality, which is consistent with directed search.

Our analysis proceeds in three steps. First, we follow the common practice in existing empirical studies of testing whether higher wage offers attract more applications. However, an affirmative answer to this question alone – without considering RWs – cannot provide decisive evidence of directed search.

Second, we examine whether higher wage offers attract more job applications when wage offers are always above RWs – which is consistent with directed search but not random search.¹² Because in our data the wage offers are in ranges, as are the measures of RWs, this analysis

¹¹ Their design, although innovative, may have some limitations. First, it may suffer from sample selection bias; only about one-quarter of the eligible job seekers they approached participated in the experiment (about half signed up, and about half of those showed up). It may also suffer from sample attrition bias, with subjects leaving the experiment before its end, perhaps due to accepting job offers. Both issues are likely to result in a sample of job seekers with lower quality than average, which could contribute to their finding that a significant share (42%) of job seekers are only interested in low-wage jobs even when the otherwise identical high-wage jobs are present. Hence, this finding may overstate the evidence for directed search. Second, this study may encounter a potential threat to external validity from inducing the perception of scrutiny because subjects were pre-informed that a small proportion of vacancies were fictitious and were immediately informed once they saved these fictitious vacancies. Third, there may be an experimenter demand effect because subjects were told the research purpose was “to learn whether they would find these vacancies attractive and would consider applying to them if they were available.”

¹² RW is measured by the current/most recent job's monthly wage, and hence in our context means the minimal wage that a job seeker is willing to accept a new job, rather than the usual meaning of the minimal wage to enter the labor market.

focuses on job seekers with RWs capped at the upper limit of the lowest wage offer range. By restricting the sample to the job seekers always having RWs below (loosely or strictly) the higher wage offers, we eliminate the possibility that the number of applications increases with higher wages because the share of job seekers for whom the offered wage exceeds the RW increases. This analysis hence examines the pure tradeoff between higher wage offers and the lower probability of getting a job offer, which provides more decisive evidence on directed search.

Third, we test whether, among the job seekers with wage offers always above their RWs, the response to wage offers varies with the RW. We assume that higher quality job seekers have higher RWs, so that the probability of getting a job, conditional on the same wage offer, should increase with the RW, and hence the response to higher offered wages should be stronger for those with higher RWs. Thus, this final analysis addresses how search responds to competition.¹³ Evidence of a stronger response to higher wage offers as the average quality of job seekers improves would provide additional evidence in favor of directed search.¹⁴

Our findings are consistent with predictions from directed search models. First, in analyses that ignore job seekers' RWs, higher wage offers significantly raise application rates. Second, higher wage offers raise application rates of job seekers for whom all variation in wage offers is above their RWs. Finally, the positive relationship between wage offers and application rates is stronger for job seekers with higher reservation wages. All three findings are consistent with directed search, while the second and third findings provide more definitive support for

¹³ Directed search models explicitly consider the probability of getting a job, thereby incorporating a tradeoff between higher wages and greater competition. In past research, as Kircher (2020, p. 7) concludes in his review, "which individual characteristics are most prone to avoid the competitive but high-paying jobs is not answered... but could be important for future work."

¹⁴ For this analysis, we vary the job seekers included in the analysis depending on their RWs; the upper limit of the RW is always kept at the upper limit of the lowest wage offer, while the lower limit of the RW is gradually raised, to focus on workers with higher reservation wages.

directed search in contrast to random search.

2. Experimental design

The experimental design was originally developed to study job seekers' valuation of job flexibility in a prior paper of ours (He et al., 2020). But the same data – used in different ways – can be used to assess evidence on directed vs. random search. Since many of the details are provided in our prior paper, here we describe key design features while leaving some of the details out. Also, consistent with our original intention, we only pre-registered the experiment for the initial study.¹⁵

Experimental setting

Our field experiment was run on a very large nationwide online job board in China, which posts tens of millions of job openings per year, with over 100 million job seekers in total of whom millions are active each day. The job board specializes in white-collar, high-education jobs and hence most job seekers are well educated.

Designing job ads for the experiment was simplified because the ads are produced using a standard template capturing information about the job and employee requirements. Importantly, the job information includes the range of the pre-tax monthly wage offered (mostly with a fixed monthly rate), or pay is stated as “negotiable.”

We collaborated with a start-up company in the information technology (IT) industry. The company had real recruitment demand for several positions and was interested in exploring how varying wages offered and flexible working conditions would affect its recruitment. IT jobs are common on the job board (about 40% of jobs), and companies in this industry frequently

¹⁵ Prior to data collection, the experiment described in He et al. (2020) was registered on the AEA RCT registry website (AEARCTR-0002645) in December 2017. The registration did not mention the analysis conducted in the present paper.

allow flexible working conditions (about one-quarter of the above-mentioned jobs). Using a small (20-99 employees) and not well-known company helped minimize the effect of our intervention on the market. Using a single employer keeps the employer-specific characteristics fixed across jobs. We transferred the resumes of the job applicants to the company, and its HR department contacted selected applicants for further recruitment procedures.¹⁶

The five job positions included in the experiment – java engineer, financial executive, human resource manager, marketing executive, and sales executive – were dictated by the needs of the company. These could be classified in the following broader occupations that could be listed on the job board: software, finance, personnel, marketing, and sales management.

Job seekers need to first register and provide individual information to construct a standardized resume. The required information includes, among other things: the current (if currently employed) or most recent (if currently unemployed) job’s monthly wage, and generic monthly wage expectations (pre-tax).^{17,18} After registering, job seekers can apply for job ads listed on employers’ webpages. When they click on an ad, they see a full-page description, and

¹⁶ As far as we know, the company contacted 87 applicants for interviews and the rest of them received a rejection letter via their account on the job board.

¹⁷ Both variables are measured in ranges, selected from a drop-down menu, including below 1,000, 1,001-2,000, 2,001-4,000, 4,001-6,000, 6,001-8,000, 8,001-10,000, 10,001-15,000, 15,001-25,000, 25,001-35,000, 35,001-50,000, 50,001-70,000, 70,001-100,000, and above 100,000 CNY. Job seekers can choose not to reveal this information to potential employers.

¹⁸ The other required information includes: individual details (name, contact information, gender, year and month of birth, year and month when she started her first job, place of *Hukou*, highest educational degree and dates of start and completion, school name, major, and overseas work/study experience); information about work or internship experience (industry, job title, and length of job); type of job sought (occupation, industry, and location); current work status (employed and unemployed). Providing marital status is optional. In the self-reported resume data on individual characteristics, there are sometimes inconsistencies related to the dates of events reported, such as a birth date later than other events, or start dates for specific spells (such as education) that are later than ending dates. There are also some less clear inconsistencies, such as completing education at too young an age (e.g., completing college before age 18 or university before age 22). We clean the data to eliminate these kinds of inconsistent cases. The various criteria end up excluding fewer than 1.6% of observations.

they can then click the “apply” button in the ad to apply for that job and send their generated resume to the employer. The employer then receives the generated resume along with contact information. Most employers choose to contact applicants offline outside of the job board’s communications system, by telephone or email, so the job board does not capture the subsequent outcomes of the search process (callbacks, job offers, and pay).

We define the population of eligible job seekers targeted by our experiment based on the following criteria: (1) residence in Beijing at the time of the experiment; (2) college degree or higher; (3) active in job search (having logged onto their job board account within one month from when we first extracted their resumes for inclusion in the experiment);¹⁹ and (4) a match between any of the “intended occupations” chosen by the job seeker (they could indicate up to three) and our chosen occupations.²⁰ We drew the population of job seekers for the study, which was all job seekers registered on the job board fulfilling these criteria, a week before the experimental contacts were made.

Treatments

The treatment manipulation we exploit in this paper is the pay variation that was part of the manipulation in the experiment conducted in He et al. (2020). Specifically, in the present study, we used a 1×3 between-subjects factorial design in which we exogenously varied the pre-tax monthly wage offered for the same posted jobs in three ranges: 10,000-15,000 CNY,

¹⁹ The one-month cutoff was chosen to correspond to the usual definition of unemployment. In the United States a worker is defined as unemployed if she searched for a job in the past month (see https://www.bls.gov/cps/cps_htgm.htm#unemployed, viewed August 15, 2018). In China, the criterion is three months (see http://www.stats.gov.cn/tjsj/tjzd/gjtjzd/201807/t20180717_1610135.html, in Chinese, viewed August 18, 2018). We chose the more restrictive U.S. standard to have a more active sample of job searchers.

²⁰ For a job seeker who had multiple “intended occupations” that matched our occupations, we randomly assigned her to one of the jobs with equal probability.

15,000-20,000 CNY, and 20,000-25,000 CNY, which are referred as *Low*, *Medium*, and *High* level treatments, respectively.^{21,22} These ranges were derived from the distribution of wage ranges of over 8,000 real job ads we collected from the job board a few months before our experiment, which were recruiting for our five experimental occupations and required at least college education and at least 5-10 years of work experience, which are also the education and experience requirements of our experimental jobs.^{23,24}

The wage offer range treatment conditions were presented in the job ad emails and app messages that were sent to the subjects. Given that thousands of job ads are posted every day for most occupations, the job board uses a matching algorithm to identify potentially suitable candidates and to facilitate matches between jobs and workers.²⁵ Based on these matches, the job board provides two services to employers – email pushing and message pushing. Email pushing entails sending a brief description of selected job openings via email to candidates. Message pushing plays a similar role. Both emails and messages include a link to the full job ad. A job seeker receives on average 1-2 emails and app messages per day during the time she

²¹ 1 CNY = 0.15 USD at the time of the experiment in early 2018. We used a monthly wage instead of an hourly wage in the experiment because it was natural for full-time jobs of similar types (most ads on the job board) to set a fixed monthly wage. We also explicitly mentioned in the job ads that the work day was eight hours, to try to preclude higher wages being viewed as compensation for longer working hours.

²² Given the goal of the original experiment, we also manipulated the flexibility of working conditions. These are orthogonal to the pay variation, but we retain the flexibility conditions as control variables in our analysis.

²³ We separately computed the 25th, 50th, and the 75th percentiles for the lower and upper limits of the wage ranges, which were 10,001, 15,001, and 20,001 CNY for the lower limits, and 15,000, 20,000, and 30,000 CNY for the upper limits, respectively. Appendix A provides the distributions of the lower and upper limits of wage ranges of the 8,000+ jobs. To keep the width of the ranges comparable, we used 25,000 as the upper limit for the high range. We also computed the corresponding wage range distributions for the five experimental occupations and found that they were similar to the full sample.

²⁴ Employers could select from no degree requirement, below college, college, bachelor, or master or above, and could select from no experience requirement, 0-1, 1-3, 3-5, 5-10, or >10 years.

²⁵ The matching algorithms can rely on information in the resumes, job seekers' previous job search, and application behavior on the job board.

frequently logs onto her account or searches for jobs.

For job ad emails, the treatment condition appeared in both the subject line and right after the title of the job position with highlighted fonts in the main body of the emails. The app messages simply contained information on the job title and the wage offer range for each treatment. Both the job ad emails and app messages included a link to the job ads. Appendix B presents examples of the job ad email and the app message for the financial executive position. We set the monthly wage offered to be “negotiable” in the job ads published on the employers’ webpage, to avoid direct contradictions with variation in wage offer ranges in the emails and app messages.²⁶ Appendix C provides an example of the job ad, for the financial executive position.

Experimental procedure

Our experiment includes an application stage and a survey stage, which enable us to collect job seekers’ application decisions, and then questionnaire completion decisions conditional on applying. In the application stage, the company published the job ads on the job board, and then the job board pushed the corresponding job ads via both emails and app messages to the population of eligible job seekers, with one job seeker being sent one ad through both an email and an app message. The job ads of the five job positions were published simultaneously on Thursday morning and all ads stated that the application deadline was 9 AM the following Wednesday. For the job seekers who were sent emails and app messages, applying for a job involves two steps. First, they needed to click the link to the job ad, which directed them to the corresponding job ad on the employer’s webpage on the job board. Second, they needed to click the “apply” button on the webpage. The redirection from the email or app system

²⁶ It would have been far more complex, and perhaps not feasible, to try to coordinate the company’s webpage job ads to vary with the timing of our treatments. Specifying the wage as “negotiable” is not contradictory to the “direct search model” setup, since it is negotiable within the indicated pay ranges.

to the webpage was standard for all email or message recipients contacted through these means, and applications taken on the job board could be recorded. Any job seeker, whether or not they were sent an email or an app message, could search the job board and find and apply for the experimental jobs.

In the second stage, we sent an email and a text message to all job seekers who had applied for our jobs, inviting them to voluntarily answer an online questionnaire within three days, prompting them by writing: “Your qualifications match our position well. We would like to know more about you.”²⁷ We did not provide additional incentive to respond to the questionnaire because we believed job seekers who were interested in the job would have enough incentive to complete the questionnaire, and it seemed unnatural for a company evaluating job applicants to offer incentives to complete the survey. Completion of the questionnaire required additional effort and thus serves as an alternative measure of interest in our job, which we use in a parallel analysis to our analysis of job applications as, effectively, an alternative measure of applying for the job.

Compared to the procedure adopted by Flory et al. (2015) and Hedblom et al. (2019), in which randomized treatment conditions were revealed only after job seekers had expressed interest in the job by emailing their resumes, our treatment conditions were presented to job seekers in the job ads at first contact. In our view, this procedure had two advantages: it preserved the normal way of presenting key job conditions on the job board we used; and it allowed us to collect data on responses to treatment conditions in one stage.

The experiment was conducted in January and early February of 2018. We randomly assigned eligible job seekers into the wage offer range conditions and gave the subsample for

²⁷ The information collected was used in our original experiment (He et al., 2020).

each treatment to the job board to operate the email and app message pushing. Throughout the experiment, there were no communications between the applicants and the experimenters, except for the carefully scripted job ad emails and app messages sent in the first stage, and emails and text messages regarding questionnaire completion in the second stage.

3. Results

The key outcome data collected from the experiment include the individual-level data on who applied for the experimental jobs and who filled in the questionnaire. As outlined in the introduction, we present the results addressing three questions:

(1) Do applications respond positively to higher wages, without considering RWs, which can provide some evidence of directed vs. random search?; (2) Do applications respond positively to higher wages, conditional on offered wages exceeding the RW, which provides more decisive evidence on directed vs. random search?; and (3) Is a positive response of applications to offered wages stronger the higher the probability that the job seeker would get the job (based on higher RWs), consistent with directed search?

Do higher wages attract more applications, ignoring reservation wages?

We first test the prediction of directed search models that job seekers apply more for higher wage jobs that are otherwise identical. Here we simply follow the common practice of most of the previous empirical studies without considering the role of RWs.

Table 1 reports the distributions of applications and questionnaire completion across treatments.²⁸ The total number of job seekers included in the experiment is 99,178, almost

²⁸ Appendix Table D1 in Appendix D reports summary statistics on job seekers' individual characteristics for each treatment, to assess the randomization. The mean differences for almost all variables are small across treatments. We also ran pairwise (across three treatments) Kolmogorov-Smirnov tests of equality of distributions of these characteristics. We find no significant differences at conventional levels. In the regressions we control for these characteristics anyway, and we find that our estimated treatment effects do not vary whether or not we control for these characteristics.

equally distributed across wage offer ranges. In the upper panel, the application rates reported in the last column are computed as the number of applications divided by the number of job seekers who were sent job ad emails and app messages. The application rates for all treatments are below 0.5%. Application rates are low because there are thousands of job openings posted every day, presumably with many job descriptions similar to ours, so that getting an email or an app message as part of the experiment would not be expected to generate a large number of applications.²⁹ Nonetheless, the application rates are 22% and 50% higher for *Medium* and *High* wage jobs, respectively, than for *Low* wage jobs, and 23% higher for *High* wage jobs than for *Medium* wage jobs; the differences are statistically significant at the 1% or 10% level for the latter two comparisons, based on tests of equality of proportions.

Another indicator of interest in the experimental jobs is whether the job seekers completed the questionnaire. In the lower panel of Table 1, the completion rates reported in the last column are computed as the number of applicants who completed the questionnaire divided by the number of sampled job seekers who were sent job ad emails and app messages.³⁰ The completion rates show that 0.2%-0.3% of job seekers completed the questionnaire; the rates are 36% and 75% higher for *Medium* and *High* wage jobs, respectively, than for *Low* wage jobs and 29% higher for *High* wage jobs than for *Medium* wage jobs; the differences are statistically significant at the 1% or 10% level for all three comparisons.

Next, we turn to regression analysis. Table 2 reports the differential effects of the wage offer treatments on application and questionnaire completion decisions, with *Low* wage as the reference group, estimated from a probit model. The dependent variable in columns (1)-(3) is an

²⁹ Personal conversations with the staff at the job board indicated that a 0.5% rate of application for job ads pushed to job seekers is typical.

³⁰ Because we use this as an alternative indicator of “applying,” we do not condition on applying.

indicator for whether the job seeker applied, and in columns (1')-(3') it is an indicator for whether the job seeker completed the questionnaire.³¹ We present the implied percentage changes in the application or completion rate, relative to the comparison groups, in the top panel, and the marginal effects from the probit estimation in the bottom panel.

Column (1) includes only the treatment dummy variables. We find evidence that *High* wage offers significantly boost application rates – by 50% compared to an application rate of 0.27% for *Low* wage offers. This is computed based on a 0.14 percentage point increase (the marginal effect) relative to *Low* wage offers.³² The estimates in column (1) also indicate that the application rate is significantly higher (at the 5% level) for *High* wage offers relative to *Medium* wage offers; the implied effect is a 31% increase. The estimated effect of *Medium* wage offers relative to *Low* wage offers is not significant, although it is positive.

The increase in the monthly wage from *Low* to *High* wage offers is about 80%, and the increase from *Medium* to *High* wage offers is about 29%.³³ Converting our estimated treatment effects to elasticities, our estimated elasticities are 0.62 for *High* vs. *Low* offers and 1.09 for *High* vs. *Medium* wage offers. These are comparable in magnitude to the results in Dal Bo et al. (2013), that a 1% increase in wages leads to a 0.79% increase in applications, and Belot et al. (2018), who find that a 1% increase in wages leads to 0.7%-0.9% rise in applications.

Column (2) adds controls for job characteristics – the job flexibility condition and job

³¹ We exclude 32 applications made to job positions other than those applicants were sent. This explains the decrease in the total number of job seekers from 99,178 in Table 1 to 99,146 in columns (1), (2), (1'), and (2') in Table 2, and explains the decrease in the application and questionnaire completion rates (which occurs for the *Low* and *Medium* wage offers) from Table 1 to the same columns in Table 2.

³² Although the marginal effects are fairly small mainly due to a low “baseline” response rate as discussed in footnote 29, the relative (percentage) effects are sizable.

³³ For example, the monthly wage offer range midpoint difference between *High* and *Low* wage levels is 10,000 CNY. Dividing the difference by the midpoint of *Low* wage offer range 12,500 gives a wage offer increase of 80%.

position dummy variables; column (3) further adds controls for job seekers' individual characteristics. The estimates are little changed.³⁴

The analysis for questionnaire completion is reported in columns (1')-(3'). It uses the same specifications as in the analysis for applications, and the results are qualitatively similar. As the top panel of the table shows, the relative (percentage) effects of higher wage offers on the probability of completing the questionnaire are larger in most cases than those on the probability of applying (the estimated differences in the marginal effects in the bottom panel are smaller due to a lower "baseline" questionnaire completion rate).

Overall, the findings on job application rates – whether measured directly or based on the more-intensive measure of questionnaire completion – show that job seekers are more likely to apply for higher wage jobs, in line with most of previous empirical studies. This evidence could be more consistent with direct search than random search. Our next two analyses are needed to obtain more definitive evidence.

Do higher wages attract more applications, for offer wage variation above reservation wages?

As discussed in the Introduction, evidence of a positive response of job applications to higher offered wages is not definitive evidence in favor of directed vs. random search because job seekers using random search may only apply for jobs with offered wages higher than their RWs, generating evidence that higher offered wages attract more applications even though job seekers are not using directed search. To better differentiate whether job seekers use random

³⁴ Appendix Table D2 in Appendix D reports the summary statistics for the individual characteristics of job seekers and the treatments, job flexibility conditions, and occupations for this regression sample. Complete results showing the estimated marginal effects of all job and job seeker characteristics are available from the authors upon request. To briefly summarize the findings for the latter: the application rate rises with job flexibility, experience, the other four occupations relative to software, male, married, currently employed job seekers, and those expecting to work in Beijing.

search and simply apply when offered wages exceed RWs, or instead use directed search, we restrict our sample to job seekers with RWs capped at 15,000 CNY, which is the upper bound of the *Low* wage offer range, and re-estimate the specifications in columns (3) and (3') in Table 2.³⁵ We use the current/most recent job's monthly wage as proxy for the RW.³⁶ We call this the "less restrictive" sample because the ranges for the RW and the *Low* wage offer overlap (10,000-15,000 CNY), so an offer wage in this range can exceed the RW, but possibly could not; offer wages above 15,000 CNY clearly exceed the RW. Estimates indicating that these job applications respond positively to higher wage offers conditional on those wage offers exceeding RWs would provide evidence in favor of directed search over random search. Below, we turn to a more restrictive sample with less ambiguity about RWs vs. offer wages.

Columns (1) and (1') in Table 3 report the estimation results. For application decisions, in column (1), *High* wage offers raise application rates of job seekers relative to *Low* wage offers by a statistically significant 0.10 percentage point. Compared to an application rate of 0.40% for *Low* wage offers, this represents a 25% increase in application rates. *Medium* wage offers do not

³⁵ Capping RW at 15,000 CNY allows the inclusion of the largest subsample given our wage offer ranges.

³⁶ In principle, we could also use the generic monthly wage expectation as a proxy. However, the current/most recent job's monthly wage is a more natural reference point to determine the RW for accepting a new job. In addition, some features of the data support this choice. First, 38% of our eligible job seekers were employed at the time of the experiment, and for them it is especially likely that the wage offer of the new job would have to exceed the wage on the current job. Second, of the 369 applicants who received our experimental job ad emails and app messages, only 231 reveal their generic wage expectation, vs. 305 who report their current/most recent wage; thus, the available sample is 32% larger. Third, comparing wage offers to which job seekers applied with their reported RWs, more than 15% (35 out of 231) applied for jobs that offered wages below generic wage expectations, which violates the definition of the RW, vs. fewer than 8% (24 out of 305) did so when the RW is measured by the wage on the current/most recent job, despite the distribution of job seekers by RW across treatments being similar. (We measure these "violations" as applications from job seekers with RWs over 15,000 CNY to *Low* wage offers and job seekers with RWs over 25,000 CNY to *Low*, *Medium*, and *High* wage offers. Since there is no RW cutoff at 20,000 CNY, no criterion violation is associated with *Medium* wage offers.) Nonetheless, we also ran the analyses in Tables 3-5 using the generic wage expectation as the RW proxy. The results were qualitatively similar but generally weaker (results available from the authors upon request).

significantly raise the application rate significantly relative to *Low* wage offers. In addition, the application rate is significantly higher for *High* wage offers than for *Medium* wage offers. Compared to an average application rate of 0.45% for *Medium* wage offers, the estimate implies a 19% increase in application rates. The result for questionnaire completion decision in column (1') is qualitatively similar and quantitatively a bit smaller (although the relative effects are larger). Compared to the results in Table 2 columns (3) and (3'), the treatment effects are smaller.

To rule out the possibility that the wage offer was below the RW, we also do this analysis using a more restrictive sample – the subsample of job seekers who were sent *Medium* and *High* wage offers and have RWs no higher than 15,000 CNY; this guarantees that wage offers exceed RWs. Columns (2) and (2') in Table 3 report the estimation results. We find a significant application rate increase for *High* relative to *Medium* wage offers (at the 10% level).³⁷

Overall, the findings on job application rates – whether measured directly or based on the more-intensive questionnaire completion measure – show that job seekers are still more likely to apply for higher wage jobs even when the offered wage variation is always above their RWs. This provides more definitive evidence in favor of directed search.

Is the response of applications to higher offered wages stronger for those with a higher probability of getting the job?

³⁷ It is possible that our RW measure is not perfect. For instance, workers' RWs for new jobs might be higher than their current/most recent job's wage if they require a pay increase to compensate for the cost of switching jobs. In such a case, with our current cutoff of 15,000 CNY, we might incorrectly classify a RW as below the wage offer when it is in fact above the wage offer. However, as long as the actual RW is no more than 5,000 CNY higher than the current/most recent job's wage, the corresponding actual RW cutoff would not exceed 20,000 CNY, which is the upper bound of our *Medium* wage offer range. Therefore, job seekers receiving our *High* wage offers would always have actual RWs below the wage offers. Thus, our analysis for the more restrictive sample in Table 3 – which supports the finding of directed search – would still be valid.

Finally, we explore whether the positive relationship between wage offers and job applications varies across job seekers in relation to their probability of getting the job, as proxied by their RWs. We use the same samples as in the prior test, restricting attention to variation in offered wages above the RW. A stronger positive effect of higher wage offers on job application when we increase the RW cutoff (keeping it below 15,000 CNY, as before) would provide additional evidence in favor of directed search. This is because job seekers with higher RWs are (we assume) of higher quality, and hence for the same offered wage should view themselves as more likely to get the job in competition with other job applicants. Therefore, under directed search, the degree of responsiveness to the higher wage job should be positively related to the competence of job seekers as proxied by their RW, while the two should be unrelated under random search.

Before implementing this test, we first investigate whether job seekers with higher RWs have higher values of observed characteristics related to worker quality. We use currently employed, tenure on the current job (zero if not employed), years of work experience, education, and whether the current/most recent job was in IT (which could reflect industry-specific human capital, or general ability).³⁸ Table 4 reports the summary statistics of these characteristics for each RW range.³⁹ In nearly every case, these quality measures are increasing with the RW, consistent with job seekers with higher RWs being higher quality.

³⁸ IT-related industries include IT service, e-commerce, online game, computer hardware, computer software, communications/ telecom & network equipment, communications/telecom operations, and value-added services – a subset of the 51 industries job seekers can indicate.

³⁹ We omit job seekers with RWs below 2,000 CNY in this analysis, for two reasons. First, job seekers with RWs this low are abnormal given the monthly minimum wage in Beijing was 2,000 CNY at the time of the experiment (Beijing Municipal Human Resources and Social Security Bureau, 2018). Second, the numbers of applications and of job seekers for RW ranges below 2,000 CNY are small, so omitting them would not change the results.

Finally, we report evidence on differences in the effects of wage offers on job applications associated with variation in RWs. The estimated relationships between wage offer ranges and job applications across job seekers with different RW lower cutoffs within the subsample capped at 15,000 CNY are reported in Table 5 including (columns (1) and (1')) and then excluding (columns (2) and (2')) job seekers who were sent *Low* wage offers.⁴⁰ We can see that regardless of the job application measure used, or the inclusion of job seekers who were sent *Low* wage offers, as we raise the lower RW cutoff from 2,001 to 10,001 CNY, the treatment effects (especially the effects of *High* wage offers) become stronger in both magnitude and statistical significance. This provides additional evidence in favor of directed search over random search, and suggests that the more competent job seekers are (i.e., the higher probability of getting the job), the more strongly they respond to higher wages.^{41,42}

4. Conclusions

We explore evidence on random vs. directed search using data from a field experiment on a Chinese job board. In the experiment, we generate random variation across job seekers in invitations to apply for jobs that differ in terms of wage offers, in three ranges (*High*, *Medium*,

⁴⁰ An alternative way to compare the relationship for job seekers across different RWs is to do the analysis for job seekers separately in each narrow RW range implied by the ranges in Table 5 (e.g., 2,000 to 4,000, 4,000 to 6,000, etc.). However, this led to some very small samples with large numbers of perfect predictions for the probit models (recall that the overall application rate is low), and hence problems of both estimation and interpretation.

⁴¹ An alternative way of imposing the “more restrictive” sample restriction in Table 3 is to use the sample of job seekers who were sent *Low*, *Medium*, or *High* wage offers and have RWs no more than 10,000 CNY. The results are qualitatively similar but generally weaker (results available from the authors upon request). This finding parallels the evidence in Table 5 that the application responses to higher wage offers are stronger for more competent job seekers due to lower quality job seekers being more likely to avoid competition for higher wage jobs.

⁴² Our findings on lower quality job seekers avoiding competition for higher wage jobs might be viewed as indirect evidence of directed search. Since our offered wages vary across job seekers (i.e., we used a between-subjects rather than within-subject design), our result shows how different job seekers apply to high wage compared to low wage jobs (though they are similar on observables), rather than showing how one particular worker sometimes avoids high wage jobs in favor of low wage jobs because high wage jobs are more competitive (as in Belot et al., 2018).

and *Low*). The experimental data allow the estimation of application responses for job ads that are otherwise identical, free from the potential bias that can arise in observational data when wage variation is correlated with other job characteristics. We also use the current/most recent wage from job seekers' resumes as a proxy for their reservation wage (RW) for accepting a new job. Combining these data allows the estimation of application responses to exogenous wage variation that is above the job seekers' RWs, which is important for distinguishing between random and directed search.

Our findings provide evidence in favor of directed search over random search. First, in line with previous field experiments, higher wage offers (ignoring RWs) significantly raise application rates. Second, for wage variation above RWs, higher wage offers raise application rates, which provides more definitive evidence of directed vs. random search because the first type of evidence could simply reflect whether the wage offer resulting from random search is above the reservation wage, which would also raise application rates under random search. Finally, among job seekers with wage offers always above their RWs, the response to higher wage offers is higher for job seekers with higher reservation wages; this provides additional evidence for directed search because it implies that job seekers respond not only to the higher wage offer but to variation in the probability of getting a job.

There are two natural directions in which this research could be fruitfully extended. First, the external validity of our findings could be strengthened if one could run the experiment in a broader range of cities, industries, and firms. Second, while our study provides evidence of directed search in the labor market, it would be valuable to quantify how much directed search is used compared to using random search – exploring questions such as what proportion of job

seekers uses directed search, and to what extent a job seeker uses directed search and under what circumstances.

References

- Abebe, G, Caria, S & Ortiz-Ospina, E. 2020. The selection of talent: Experimental and structural evidence from Ethiopia. *American Economic Review*, forthcoming.
- Acemoglu, D. 1997. Training and innovation in an imperfect labour market. *Review of Economic Studies*, 64(3), 445-464.
- Acemoglu, D., & Shimer, R. 2000. Productivity gains from unemployment insurance. *European Economic Review*, 44(7), 1195-1224.
- Banfi, S., & Villena-Roldán, B. 2019. Do high-wage jobs attract more applicants? Directed search evidence from the online labor market. *Journal of Labor Economics*, 37(3), 715-746.
- Belot, M., Kircher, P., & Muller P. 2018. How wage announcements affect job search – a field experiment. IZA Discussion Paper No. 11814.
- Beijing Municipal Human Resources and Social Security Bureau. 2018. Notice on adjusting the minimum wage standard of Beijing in 2018. http://rsj.beijing.gov.cn/xxgk/zcwj/201912/t20191206_943464.html, accessed on March 6, 2020.
- Bennett, R. 2002. Employers' demands for personal transferable skills in graduates: A content analysis of 1000 job advertisements and an associated empirical study. *Journal of Vocational Education and training*, 54(4), 457-476.
- Braun, C., Engelhardt, B., Griffy, B., & Rupert, P. 2016. Do workers direct their search? UC-Santa Barbara Working Paper.
- Cable, D. M., & Judge, T. A. 1994. Pay preferences and job search decisions: A person-organization fit perspective. *Personnel Psychology*, 47(2), 317-348.
- Crawford, R., & Disney, R. 2018. Wage regulation and the quality of police applicants. *Economica*, 85(340), 701-734.
- Dal Bo, E., Finan, F., & Rossi, M. A. 2013. Strengthening state capabilities: The role of financial incentives in the call to public service. *Quarterly Journal of Economics*, 128(3), 1169-1218.
- Deserranno, E., 2019. Financial incentives as signals: Experimental evidence from the recruitment of village promoters in Uganda. *American Economic Journal: Applied Economics* 11(1), 277-317.
- Diamond, P. A. 1982. Wage determination and efficiency in search equilibrium. *Review of Economic Studies*, 49(2), 217-227.
- Faberman, R. J., & Menzio, G. 2018. Evidence on the Relationship between Recruiting and the Starting Wage. *Labour Economics*, 50, 67-79.
- Ferraz, C., & Finan, F. 2009. Motivating politicians: The impacts of monetary incentives on quality and performance. National Bureau of Economic Research Working Paper No. 14906.
- Flinn, C. J. 2006. Minimum wage effects on labor market outcomes under search, matching, and endogenous contact rates. *Econometrica*, 74(4), 1013-1062.
- Flory, J. A., Leibbrandt, A., & List, J. A. 2015. Do competitive workplaces deter female workers? A large-scale natural field experiment on job-entry decisions. *Review of Economic Studies*, 82(1), 122-155.

- Gee, L. K. 2019. The more you know: information effects on job application rates in a large field experiment. *Management Science*, 65(5), 2077-2094.
- Godoy, A., & Moen, E. R. 2011. Taking competitive search to the data. Unpublished paper.
- Harrison, G.W., & List, J.A. 2004. Field experiments. *Journal of Economic Literature*, 42(4), 1009-1055.
- He, H., Neumark, D., & Weng, Q. 2020. Do workers value flexible jobs? A field experiment. *Journal of Labor Economics*, forthcoming.
- Hedblom, D., Hickman, B. R., & List, J. A. 2019. Toward an understanding of corporate social responsibility: Theory and field experimental evidence). National Bureau of Economic Research Working Paper No. 26222.
- Holzer, H. J., Katz, L. F., & Krueger, A. B. 1991. Job queues and wages. *Quarterly Journal of Economics*, 106(3), 739-768.
- Horton, J. J., & Johari, R. (2018). Buyer signaling improves matching: Evidence from a field experiment. Unpublished paper.
- Hosios, Arthur J. 1990. On the efficiency of matching and related models of search and unemployment. *Review of Economic Studies*, 57(2), 279-298.
- Kircher, P. (2020). Search Design and Online Job Search—New Avenues for Applied and Experimental Research. *Labour Economics*, 64, 101820.
- Krueger, A., 1988. The determinants of queues for federal jobs. *Industrial and Labor Relations Review*, 41(4), 567-581.
- Marinescu, I., & Wolthoff, R. 2020. Opening the black box of the matching function: The power of words. *Journal of Labor Economics*, Forthcoming.
- Menzio, G., Telyukova, I. A., & Visschers, L. 2016. Directed search over the life cycle. *Review of Economic Dynamics*, 19, 38-62.
- Moen, E. R. 1997. Competitive search equilibrium. *Journal of Political Economy*, 105(2), 385-411.
- Moen, E. R., & Rosén, Å. 2004. Does poaching distort training? *Review of Economic Studies*, 71(4), 1143-1162.
- Montgomery, J. D. 1991. Equilibrium wage dispersion and interindustry wage differentials. *Quarterly Journal of Economics*, 106(1), 163-179.
- Mortensen, D. T. 1982. Property rights and efficiency in mating, racing, and related games. *American Economic Review*, 72(5), 968-979.
- Mortensen, D. T. 1986. Job search and labor market analysis. In Ashenfelter, O., Card, D. (eds.). *The Handbook of Labor Economics*, Vol. 2, 849-919. Amsterdam: North-Holland.
- Peters, M. 1984. Bertrand equilibrium with capacity constraints and restricted mobility. *Econometrica*, 52(5), 1117-1127.
- Peters, M. 1991. Ex ante price offers in matching games non-steady states. *Econometrica*, 59(5), 1425-1454.
- Pissarides, C. 1985. Short-run equilibrium dynamics of unemployment, vacancies, and real wages. *American Economic Review*, 75(4), 676-690.

- Shi, S. 2002. A directed search model of inequality with heterogeneous skills and skill-biased technology. *Review of Economic Studies*, 69(2), 467-491.
- Wright, R., Kircher, P., Julien, B., & Guerrieri, V. 2019. Directed and competitive search: A guided tour. *Journal of Economic Literature*, forthcoming.

Table 1. Applications and questionnaire completion by treatment

Treatment	Number of applications	Number of job seekers	Application rate
Low	99	33,052	0.30%
Medium	121	33,063	0.37%
High	149	33,063	0.45% ^{***,†}
Total	369		

Treatment	Number of questionnaires completed	Number of job seekers	Completion rate
Low	56	33,052	0.17%
Medium	76	33,063	0.23% [*]
High	98	33,063	0.30% ^{***,†}
Total	230		

Notes: Application rate is computed as the number of applications divided by the number of sampled job seekers who were sent job ad emails and app messages. Completion rate is computed as the number of applications that completed the questionnaire divided by the number of sampled job seekers who were sent job ad emails and app messages. Since we cannot track who successfully received the email or app message at the individual level, we use all job seekers intended to be treated as the denominator. There are 373 (166) applications (questionnaires completed) by job seekers who were not sent email or app message but saw the job ad on the job board. We excluded these applications (questionnaires completed) from our analysis. The ^{*} symbols attached to *Medium* and *High* wage offer variables are for the statistical significance of the differences between the rates for *High* and *Medium* relative to *Low*, and the [†] symbols are for the statistical significance of the difference between the rates for *High* and *Medium*. One, two, or three symbols indicates statistical significance at the 10%, 5%, or 1% level respectively.

Table 2. Random search vs. directed search

Dependent variable	Apply or not			Complete or not		
	(1)	(2)	(3)	(1')	(2')	(3')
Average application/ questionnaire completion rate for <i>Low</i>	0.27%	0.27%	0.41%	0.16%	0.16%	0.25%
Percentage increase for <i>Medium</i> relative to <i>Low</i> average	14.43%	11.70%	11.40%	32.06%	26.21%	20.69%*
Percentage increase for <i>High</i> relative to <i>Low</i> average	49.97%***	42.75%***	38.32%***	71.67%***	60.98%***	53.55%***
Average application/ questionnaire completion rate for <i>Medium</i>	0.31%	0.31%	0.52%	0.21%	0.21%	0.36%
Percentage increase for <i>High</i> relative to <i>Medium</i> average	31.06%††	27.14%††	20.97%††	30.00%†	26.33%†	22.78%††
Medium	0.0004 (0.0004)	0.0003 (0.0004)	0.0005 (0.0004)	0.0005 (0.0003)	0.0004 (0.0003)	0.0005* (0.0003)
High	0.0014***,†† (0.0005)	0.0012***,†† (0.0004)	0.0016***,†† (0.0004)	0.0011***,† (0.0004)	0.0010***,† (0.0003)	0.0013***,†† (0.0004)
Job characteristics	No	Yes	Yes	No	Yes	Yes
Job seeker characteristics	No	No	Yes	No	No	Yes
Number of job seekers	99,146	99,146	58,151	99,146	99,146	58,151
Wald χ^2	9.71***	75.84***	377.91***	10.05***	57.87***	274.06***

Notes: The table reports marginal effects from a probit model in the bottom panel, and implied percentage changes in the upper panel. The dependent variable is indicated in column headings. The sample includes only sampled job seekers who were sent job ad emails and app messages. All applications made to job positions other than those applicants were sent are excluded. Job characteristics include job flexibility and job position dummy variables, and job seeker characteristics include gender, marital status, age and its square, highest educational degree in category, years of work experience and its square, overseas work/study experience, current work status, job tenure and its square, Beijing *Hukou*, type of job sought (full-time, part-time, or intern), and expect to work in Beijing. Job seekers with missing or inconsistent data on individual characteristics are excluded. Robust standard errors allowing for heteroskedasticity are reported in parentheses. The * symbols attached to *Medium* and *High* wage variables in the lower panel and to percentage increase in the upper panel are for the statistical significance of the *High* and *Medium* relative to *Low* estimates, and the † symbols are for the statistical significance of the *High* relative to the *Medium* estimates. Three, two, or one symbols indicate statistical significance at the 1%, 5%, and 10% level, respectively. Wald-statistic is for Wald test of joint significance of all regressors.

Table 3. Random search vs. directed search conditional on RW no more than 15,000 CNY

Sample restriction	Less restrictive		More restrictive	
Dependent variable	Apply or not (1)	Complete or not (1')	Apply or not (2)	Complete or not (2')
Average application/ questionnaire completion rate for <i>Low</i>	0.40%	0.25%		
Percentage increase for <i>Medium</i> relative to <i>Low</i> average	3.69%	10.65%		
Percentage increase for <i>High</i> relative to <i>Low</i> average	24.90%**	36.37%**		
Average application/ questionnaire completion rate for <i>Medium</i>	0.45%	0.31%	0.45%	0.31%
Percentage increase for <i>High</i> relative to <i>Medium</i> average	18.61% [†]	20.67% [†]	14.81% [†]	16.74%
Medium	0.0001 (0.0004)	0.0003 (0.0003)		
High	0.0010**, [†] (0.0005)	0.0009**, [†] (0.0004)	0.0007 [†] (0.0004)	0.0005 (0.0003)
Job characteristics	Yes	Yes	Yes	Yes
Job seeker characteristics	Yes	Yes	Yes	Yes
Number of job seekers	50,641	50,641	33,708	33,708
Wald χ^2	310.84***	238.51***	259.81***	198.35***

Notes: The table reports marginal effects from a probit model in the bottom panel, and implied percentage changes in the top panel. The sample restriction and dependent variable are indicated in column headings. The RW is measured by the current/most recent wage. The sample in all models is restricted to sampled job seekers who had RW no more than 15,000 CNY. In addition, the “less restrictive” sample includes sampled job seekers who were sent *Low*, *Medium*, or *High* wage offers, whereas the “more restrictive” sample only includes sampled job seekers who were sent *Medium* or *High* wage offers. All models include control variables for job and job seeker characteristics as in columns (3) and (3') of Table 2. See also notes to Table 2.

Table 4. Summary statistics of observed characteristics related to quality for job seekers by RW range

Current/ most recent job wage range	2000<RW≤4000	4000<RW≤6000	6000<RW≤8000	8000<RW≤10000	10000<RW≤15000
Currently employed (percent)	0.18 (0.38) [0.004]	0.35 (0.48) [0.004]	0.43 (0.49) [0.005]	0.47 (0.50) [0.01]	0.52 (0.50) [0.01]
Tenure (year)	0.58 (1.78) [0.02]	0.88 (1.93) [0.02]	1.15 (2.12) [0.02]	1.39 (2.38) [0.03]	1.62 (2.62) [0.03]
Experience (year)	4.24 (3.74) [0.04]	4.42 (3.78) [0.03]	5.23 (4.00) [0.04]	6.17 (4.39) [0.05]	6.99 (4.48) [0.05]
Education					
College (percent)	0.37 (0.48) [0.01]	0.39 (0.49) [0.004]	0.31 (0.46) [0.004]	0.26 (0.44) [0.01]	0.20 (0.40) [0.005]
Bachelor (percent)	0.54 (0.50) [0.01]	0.57 (0.50) [0.004]	0.61 (0.49) [0.005]	0.61 (0.49) [0.01]	0.64 (0.48) [0.01]
Master or above (percent)	0.09 (0.29) [0.003]	0.04 (0.20) [0.002]	0.08 (0.27) [0.003]	0.13 (0.34) [0.004]	0.16 (0.37) [0.004]
IT-related industry (percent)	0.20 (0.40) [0.005]	0.23 (0.42) [0.004]	0.30 (0.46) [0.004]	0.33 (0.47) [0.01]	0.40 (0.49) [0.01]
Number of job seekers	7,372	13,428	11,036	7,621	7,315

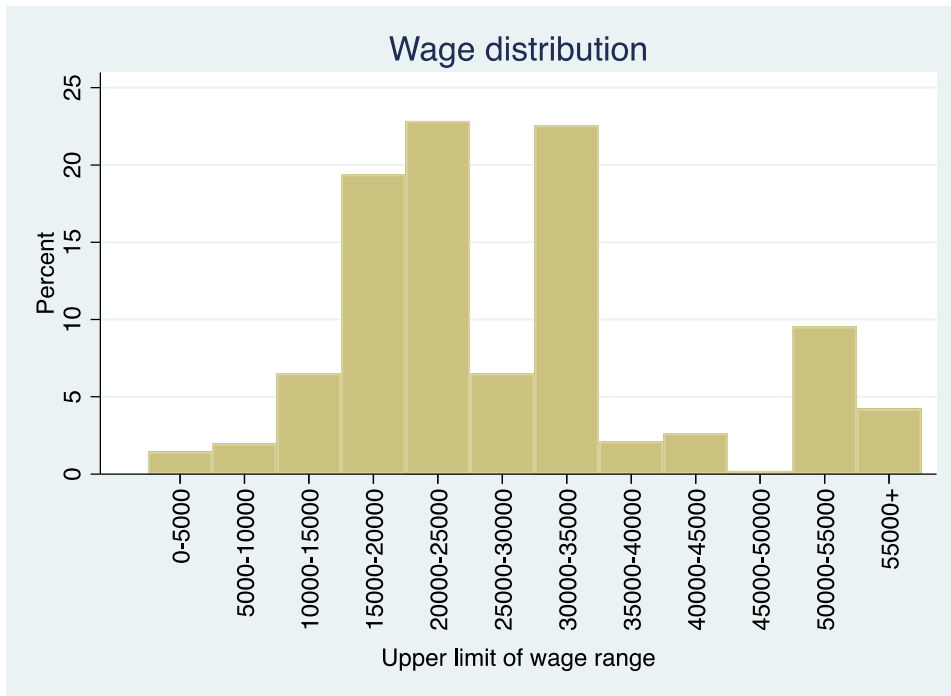
Notes: Statistics in parentheses (brackets) are the standard deviations (standard errors of means) of the indicated characteristics for job seekers in the indicated RW range. “College” refers to the tertiary education degree that requires two or three years to complete.

Table 5. Random search vs. directed search by RW range conditional on RW no more than 15,000 CNY

Sample restriction Dependent variable	Less restrictive		More restrictive	
	Apply or not (1)	Complete or not (1')	Apply or not (2)	Complete or not (2')
2,000<RW≤15,000				
Medium	0.0001 (0.0004)	0.0004 (0.0003)		
High	0.0011 ^{**} , ^{††} (0.0005)	0.0010 ^{***} (0.0004)	0.0008 [*] (0.0004)	0.0005 (0.0003)
Number of job seekers	46,772	46,772	31,134	31,134
4,000<RW≤15,000				
Medium	0.00002 (0.0005)	0.0003 (0.0003)		
High	0.0011 ^{**} , [†] (0.0006)	0.0010 ^{**} , [†] (0.0004)	0.0008 [*] (0.0005)	0.0006 [*] (0.0004)
Number of job seekers	39,400	39,400	26,165	26,165
6,000<RW≤15,000				
Medium	-0.00004 (0.0007)	0.0001 (0.0005)		
High	0.0016 ^{**} , ^{††} (0.0008)	0.0014 ^{**} , ^{††} (0.0006)	0.0013 [*] (0.0006)	0.0010 [*] (0.0005)
Number of job seekers	25,922	25,922	17,243	17,243
8,000<RW≤15,000				
Medium	0.00002 (0.0011)	0.0005 (0.0007)		
High	0.0018 (0.0012)	0.0020 ^{**} , [†] (0.0009)	0.0013 (0.0010)	0.0012 (0.0007)
Number of job seekers	14,794	14,794	9,825	9,825
10,000<RW≤15,000				
Medium	0.0003 (0.0016)	0.0008 (0.0009)		
High	0.0040 ^{**} , [†] (0.0020)	0.0032 ^{**} , [†] (0.0014)	0.0030 [*] (0.0018)	0.0021 (0.0013)
Number of job seekers	7,261	7,261	4,839	4,839

Notes: The table reports marginal effects from probit models. The sample restriction and dependent variable are indicated in column headings. The RW is measured by the current/most recent wage. The sample in all models is restricted to sampled job seekers who had RW no more than 15,000 CNY. In addition, the “less restrictive” sample includes sampled job seekers who were sent *Low*, *Medium*, or *High* wage offers, whereas the “more restrictive” sample only includes sampled job seekers who were sent *Medium* or *High* wage offers. Each panel from the top to the bottom increases the RW lower limit. All models include control variables for job and job seeker characteristics as in columns (3) and (3') of Table 2. See also notes to Table 2.

Appendix A. Distribution of the Lower and Upper Limits of Wage Ranges



Notes: These ranges were derived from the distribution of the wage ranges of over 8,000 real job ads collected from the job board a few months before our experiment, recruiting for the five experimental occupations, and requiring at least college education and at least 5-10 years of work experience.

Appendix B. Examples of Job Ad Emails and App Messages

Email subject line:

Job recommendation: Financial Executive [with both flexible work time and place/monthly wage: 15-20K]

Email content

Hi! Your qualifications match our [Financial Executive] position well! We hence recommend you this job! See below for more information.

Financial Executive (15000-20000 Yuan/month)

Company Name

Co. Ltd.

Place of Work

Beijing

Work Arrangements

The first month: working in the office from 9 am to 6 pm with one hour lunch break from Monday to Friday. Weekend off.

After one month: working in the office from 9 am to 6 pm with one hour lunch break on Monday; work at any places via logging into the company's online working system for 8 hours starting between 7 am and 10 am and ending between 4 pm and 7 pm from Tuesday to Friday. Weekend off.

Job Responsibility

1. Formulate and implement monthly, quarterly and annual financial budget, and produce corresponding financial report.
2. Control operation budget, plan and declare tax; manage capital allocation, cost and financial accounting and financial analysis.
3. Formulate, maintain and improve the company's financial management system and work procedures
.....[More]

Please note that the deadline for application is 9 am on January 24, 2018 (Wednesday).

[Learn more about the job](#)

App Message

Find your dream job here!

Click to check the job designated for you: Financial Executive [with both flexible work time and place/monthly wage: 15-20K]

Appendix C. A Job Ad on the Employer's Webpage Posted in the Experiment

Financial Executive [with both flexible work time and place]

Co. Ltd.

Five social insurance and one housing fund Double pay at year end Performance-based bonus

Communication allowance Paid annual leave Flexible working conditions

Regular health examination Holiday benefits

Monthly salary: Negotiable Place of work: Haidian District, Beijing
Publish date: In recruitment Job type: Full time
Work experience required: 5-10 years Educational degree required: College
Number of vacancies: 2 Occupation type: Financial officer

Job Description Company Introduction

Job Responsibility

1. Formulate and implement monthly, quarterly and annual financial budget, and produce corresponding financial report.
2. Control operation budget, plan and declare tax; manage capital allocation, cost and financial accounting and financial analysis.
3. Formulate, maintain and improve the company's financial management system and work procedures; establish an accountable financial accounting system and financial monitoring system to achieve effective internal control.
4. Establish and maintain good relations with industrial and commercial institutions, tax bureaus, banks, etc.

Job Requirements

1. At least 5 years relevant work experience; strong in work ethics, teamwork spirit, sense of responsibility, self-motivation and communication skills.
2. Serious working, dedicated to details, fast-learning, and pressure taking ability are valued.
3. Have comprehensive accounting knowledge, familiar with daily financial management procedures, financial and legislative regulations and common financial softwares.
4. Good at cost management, risk control and financial analysis; good management and problem-solving capabilities.

Work arrangements

The first month: work in the office from 9 AM to 6 PM for 8 hours from Monday to Friday. Weekend off.

After one month: work in the office from 9 AM to 6 PM for 8 hours on Monday; work at wherever you like via logging into the company's online working system for 8 hours starting between 7 AM and 10 AM and ending between 4 PM and 7 PM from Tuesday to Friday. Weekend off.

Inquiring Email: [Redacted]

Please note that the deadline for applying this job is **9 am on January 24, 2018 (Wednesday)**.

After reviewing your qualifications, the company will invite you for an interview, so stay tuned!

Welcome to joining us!

Work address

[Redacted]

[Apply Now](#)

Appendix D: Additional Tables

Appendix Table D1. Pairwise randomization tests between treatments

Variable	Low (1)			Medium (2)			High (3)		
	Obs.	Mean	Std. Dev.	Obs.	Mean	Std. Dev.	Obs.	Mean	Std. Dev.
Female (proportion)	32,492	0.54	0.50	32,486	0.54	0.50	32,566	0.54	0.50
Married (proportion)	19,600	0.58	0.49	19,537	0.59	0.49	19,505	0.58	0.49
Age	32,492	29.60	5.49	32,486	29.58	5.42	32,566	29.57	5.41
College (proportion)	32,492	0.26	0.44	32,486	0.26	0.44	32,566	0.26	0.44
Bachelor (proportion)	32,492	0.61	0.49	32,486	0.62	0.49	32,566	0.61	0.49
Master or above (proportion)	32,492	0.12	0.33	32,486	0.13	0.33	32,566	0.12	0.33
Experience	32,492	7.03	4.95	32,486	6.97	4.87	32,566	6.98	4.88
Overseas studying or work experience (proportion)	32,492	0.06	0.23	32,486	0.05	0.23	32,566	0.05	0.23
Currently employed	32,220	0.39	0.49	32,236	0.38	0.49	32,301	0.38	0.49
Tenure	32,220	1.34	2.66	32,236	1.35	2.66	32,301	1.33	2.64
Beijing Hukou (proportion)	32,380	0.37	0.48	32,361	0.37	0.48	32,453	0.37	0.48
Expect to work full-time (proportion)	32,472	0.97	0.16	32,468	0.97	0.16	32,550	0.97	0.16
Expect to work part-time (proportion)	32,472	0.01	0.12	32,468	0.01	0.12	32,550	0.01	0.12
Expect to work as an intern (proportion)	32,472	0.01	0.11	32,468	0.01	0.11	32,550	0.01	0.12
Expect to work in Beijing (proportion)	32,433	0.92	0.27	32,440	0.92	0.27	32,521	0.92	0.27
Generic wage expectation midpoint	26,790	10983.15	8585.36	26,721	11020.30	8736.60	26,890	11014.04	8729.20
Current/ most recent job wage midpoint	30,956	9553.92	8067.14	30,907	9585.71	8226.35	30,996	9543.86	8109.58

Notes: The sample for each individual characteristic is limited to non-missing observations after eliminating those with inconsistent dates of events.

Appendix Table D2. Summary statistics of regression variables

Variable	Mean	Std. Dev.	N	% missing values
Apply or not	0.005	0.07	97,512	40.37%
Questionnaire complete or not	0.004	0.06	97,512	40.37%
Generic wage expectation midpoint	9763.91	7648.50	80,377	39.96%
Current/ most recent job wage midpoint	8233.80	7143.59	92,828	39.89%
Female	0.58	0.49	97,512	40.37%
Married	0.58	0.49	58,612	0.79%
Age	27.97	4.67	97,512	40.37%
Age ²	803.99	293.90	97,512	40.37%
Beijing Hukou	0.28	0.45	97,162	40.15%
<i>Educational degree</i>				
College	0.30	0.46	97,512	40.37%
Bachelor	0.59	0.49	97,512	40.37%
Master or above	0.11	0.32	97,512	40.37%
<i>Work experience</i>				
Experience	5.69	4.43	97,512	40.37%
Experience ²	52.01	91.36	97,512	40.37%
Overseas studying or work experience	0.05	0.23	97,512	40.37%
<i>Employment status</i>				
Currently employed	0.38	0.49	96,725	39.88%
Tenure	1.14	2.28	96,725	39.88%
Tenure ²	6.50	27.61	96,725	39.88%
<i>Job expectation</i>				
Expect to work full time	0.97	0.17	97,458	40.33%
Expect to work part time	0.01	0.11	97,458	40.33%
Expect to work as an intern	0.02	0.13	97,458	40.33%
Expect to work in Beijing	0.90	0.29	97,362	40.27%
<i>Wage offer ranges</i>				
High	0.33	0.47	97,512	40.37%
Medium	0.33	0.47	97,512	40.37%
Low	0.33	0.47	97,512	40.37%
<i>Job flexibility conditions</i>				
NoFlex	0.24	0.43	97,512	40.37%
TimeFlex	0.27	0.44	97,512	40.37%
PlaceFlex	0.23	0.42	97,512	40.37%
FullFlex	0.26	0.44	97,512	40.37%
<i>Job occupations</i>				
Java	0.17	0.37	97,512	40.37%
Finance	0.21	0.40	97,512	40.37%
HR	0.28	0.45	97,512	40.37%
Marketing	0.20	0.40	97,512	40.37%
Sales	0.14	0.35	97,512	40.37%