# Preference Signaling and Worker-Firm Matching: Evidence from Interview Auctions*

Ron A. Laschever and Russell Weinstein†

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**Abstract**

We study whether there are improvements in worker-firm matching when employers and applicants can credibly signal their interest in a match. Using a detailed résumé dataset of more than 400 applicants from one university over five years, we analyze a matching process in which firms fill some of their interview slots by invitation and the remainder are filled by an auction. We find that less desirable firms are more likely to make offers to, and hire, high-quality auction winners relative to the interviewees they invited. This is not true for higher desirability firms. Further, auctions increase overlooked-candidates' representation among hires, including for non-US citizens and those with less prestigious work experience. Finally, counterfactual analysis shows the number of firms failing to hire would be 13% larger without an auction. Auctions appear to benefit firms by identifying a pool of applicants that is more likely to accept offers, as well as potentially more preferred candidates.

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†Laschever: Compass Lexecon. E-mail: rlaschever@compasslexecon.com; Weinstein: School of Labor and Employment Relations and Department of Economics, University of Illinois at Urbana-Champaign. E-mail: weinst@illinois.edu. The opinions expressed in this article are the authors' own and do not reflect the views of Compass Lexecon.

# 1 Introduction

The way in which employers match with job applicants is central to understanding labor markets. Yet, this process largely remains a black box. Improving worker and firm outcomes through a more efficient matching process requires understanding the underlying frictions, as well as mechanisms that might reduce these frictions. We study worker-firm matching in a market with one such potential mechanism: allowing job applicants to credibly signal their interest in an employer through an auction for interviews.

Interview auctions may address two important frictions in the matching process. First, they may help employers to identify interested candidates from their pool. While employers may successfully identify desirable applicants, it is far more challenging to identify which candidates are truly interested in the job and would accept an offer with high probability. In recent years the cost of job applications has fallen as more postings and applications are online, further raising the potential that many applicants will have a low likelihood of accepting an offer. For example, unemployed jobseekers on CareerBuilder sent an average of 13 job applications over a three month period (Marinescu and Rathelot, 2018), while the average Economics Ph.D. applicant in 2006-2008 applied to an average of 80 employers (Coles et al., 2010), and the average corporate job opening attracted 250 résumés (Glassdoor, 2015).[1] The cost of identifying interested applicants may imply firms interview, and make offers to, candidates who are unlikely to accept. This could have important effects on the number and quality of matches in the market.

Interview auctions provide an opportunity for interested individuals to credibly identify themselves. These auctions may particularly help less desirable firms who compete for applicants with more desirable firms, and thus face a higher rejection rate. Moreover, effects should be concentrated among desirable candidates, as less desirable candidates should be unlikely hired even if they are enthusiastic about the firm.

Second, interview auctions may identify more preferred candidates whose quality is not revealed through a résumé, and who firms are unlikely to select for interviews. However, interviewing face-to-face with the employer may identify their quality. If

[1] Faberman and Kudlyak (2019) show that among people searching for hourly jobs on the SnagAJob website for more than a week, they on average sent roughly 10 applications over an average five-and-a-half-week search spell.

candidates with high unobservable quality win the interview auction, this could improve matching, as well as representation of workers with less desirable résumés. As an example, firms may be very unlikely to invite candidates for an interview if they have nontraditional work experience. However, if given the opportunity to interview, these candidates may be able to reveal their true quality.

Though not common, there are a few settings in which applicants can credibly signal their preferences for an employer. One example is the American Economic Association (AEA) job signaling mechanism, which allows candidates to send a signal of interest to two departments. Importantly, there is no requirement that employers interview the applicants sending the signal. In contrast, in our setting, an employer is compelled to meet with a jobseeker.

A second example, and the focus of this paper, is the auction system used in the market for professional master's degree students, most commonly MBA students, at many top-ranked programs. These programs allow employers to choose some percentage of the applicants they interview, but require the remainder of the interview slots are allocated through an auction. Each student is provided with an equal allotment of "bid points," and the auction winners are guaranteed interviews with the firm. To the best of our knowledge, this is the first paper to study such auctions and their impact on initial hiring decisions.[2]

The auction we study provides a unique opportunity to learn about the underlying frictions in worker-firm matching. Moreover, while interview auctions are currently used in markets for individuals with advanced degrees, they could be implemented much more widely in the labor market. Most notably, they could be used in local job centers, where employers post vacancies through the center. Additionally, they could be implemented in online job posting and job application sites, as the Economics Ph.D. job market incorporates applicant signals. Alternatively, these mechanisms could be used for applicants to a single firm which has multiple job openings. Given the information asymmetries in labor markets, combined with the high cost of applicant screening, it is important to evaluate whether mechanisms in which workers "self-screen" improve worker-firm matching. If so, this would be reason to implement them more broadly.

[2]Budish et al. (2017) study an MBA course allocation system that finds a price for each course, and assigns students to schedules based on their reported preferences and an endowment of fake money.

We use detailed résumé data for over 400 job applicants enrolled in one professional master's degree program in the U.S. over five years. This master's program has a formal campus recruiting component, and a high placement rate with many students working at Fortune 500 companies. Employers who participate in the campus recruiting program are instructed to choose 50% of their interview slots, with the remainder allocated through an auction. We focus on recruiting for internships, as this represents initial entry into this market after enrolling in the degree program. In addition, for over 50% of interns in our sample, their internship converts to a fulltime job with the same employer.[3]

Several facts indicate the auction could be helpful in our setting. The number of applications to a firm far exceeds the number of invited interviews. This suggests firms may pass over many interested and desirable applicants, whom the auction could reveal. Second, interview invitations suggest firms have correlated preferences over candidates, implying a potentially high offer rejection rate. The auction could help firms identify the most interested candidates, perhaps especially important for less desirable firms, as we show their interview choices overlap with more desirable firms. Finally, offers appear costly. Approximately half of firms that make offers, but fail to hire, make only one offer. If offers were costless, identifying interested applicants would be less important, as firms could make offers until one is accepted.

We have four key findings. First, less desirable firms use auctions to hire high desirability applicants. These firms are over five percentage points more likely—nearly twice as likely—to hire high desirability auction winners, relative to high desirability candidates they invited for an interview. Our evidence suggests the mechanism is that auctions identify candidates more likely to accept offers, as well as potentially more preferred candidates.

Second, interview auctions improve overlooked-candidates' representation among hires. The average interviewed auction winner has characteristics conceivably seen as less desirable compared to the average invited interviewee. However, while the auction guarantees these applicants an interview it does not imply they will be hired. We find the auction increases representation of overlooked groups. For example, we find applicants hired through the auction by higher desirability firms are less likely to have Fortune 1000 or Global 2000 company experience. For job postings without

[3]Using data from a highly-ranked MBA program, Kuhnen and Oyer (2016) show firms use summer internships to learn whether students are a good fit for the industry.

citizenship restrictions, the auction dramatically improves representation among hires for non-US Citizens. Interestingly, less desirable firms hire auction winners who look like hired invitees, because these firms do not hire the most desirable invitees.

Third, firms in the middle of the desirability distribution have the highest rate of unfilled vacancies, and this appears due to underutilization of the auction. These middle-tier firms face more competition when making offers to their invitees, relative to lower desirability firms. By increasing the offer rate to auction winners, these firms would face less competition.

Finally, we see evidence suggesting the auction represents an improvement in matching relative to the counterfactual in which firms choose all of their interviewees.[4] This is a relevant counterfactual for many of the programs which use these auctions, and in fact the program for which we have data eventually stopped using these auctions. It is also relevant for understanding the benefits of implementing interview auctions more broadly in the labor market. One hypothesis is that if the firm rather than the auction determined the additional candidates, the firm's choices would also include candidates who are more likely to accept offers. This may imply the auction is not an improvement relative to a no-auction counterfactual. However, several tests suggest auctions do represent an improvement.

First, we find that the differential likelihood of hiring high desirability auction winners increases with the bid of the auction winner, even though employers do not observe bids. This suggests applicants are correctly assessing where their match quality is highest. If it is hard for firms to identify these highest bidders in the pool of applicants, then the auction is providing relevant information to firms that would be less accessible if firms chose all of their interviewees.

While the effect is not statistically significant, we also find that hired interns who were auction winners are substantially more likely to stay for a fulltime job than hired interns who were invitees. This provides suggestive evidence that the auction improved match quality for these lower desirability firms, based on a post-employment measure of match quality. This also suggests the auction is revealing important information to firms that may be much less accessible otherwise.

Additionally, we conduct simulations of an offer-and-acceptance game comparing scenarios with auctions to counterfactuals without auctions. Our simulations isolate

[4]Throughout, our discussion of a counterfactual considers the case where the number of interview slots remains the same, but none of the slots are filled via auction.

one advantage of the auction: distributing applicants more evenly across employers' interview schedules. The median number of firms failing to hire without the auction is 13% greater than with the auction. This is likely an underestimate of the benefit of auctions, as our simulation abstracts away from allowing firms to purposefully make offers to auction winners based on their higher likelihood of accepting.

As we describe in Section 2, unlike studies that only observe hires or even interviews for a particular firm, we observe the interview selection process of many firms considering the same group of applicants. We are interested in whether an applicant credibly revealing their interest influences hiring, relative to other similar applicants. Given the comparison group consists of applicants chosen by the firm, they may have higher unobservable quality. Our data allow us to use the information on an applicant's interview invitations from other firms as a proxy for what would otherwise be unobservable quality. Rather than having to address issues of selection we directly observe the selection process.

This paper contributes to a large literature on matching (see, e.g., Roth, 2018), and specifically on the role of preference signaling. Several theoretical papers study preference signaling in matching markets. In a setting similar to ours, Coles, Kushnir, and Niederle (2013) show theoretically that allowing applicants to signal to one employer increases the number of matches in the market, increases worker welfare, and has an ambiguous effect on firm welfare.[5]

Few papers empirically identify how matching is improved if applicants can credibly reveal their preferences over vacancies. An important exception is Coles et al. (2010), who study AEA signaling and find it increases likelihood of obtaining an interview, and particularly when detecting applicant preferences may be more difficult. They do not consider the impact on hires. Lee and Niederle (2014) implement a field experiment in an online dating market, in which participants are endowed with a fixed quantity of signals they can use when asking for a date. These signals substantially increase the likelihood the offer is accepted. Horton and Johari (2018) implement a field experiment in an online labor market, and show improved matching when stronger signals of preferences are sent by employers, the opposite side as in

[5]Lee and Schwarz (2017) model firms' interview decisions in two-sided matching markets, and Lee and Schwarz (2007) model this when applicants can credibly signal preferences. Abdulkadiroglu, Che, and Yasuda (2015) show that allowing students to signal their preferences over schools in a centralized school choice market, and using these to break ties, leads to an increase in ex ante efficiency.

our setting. Again, in contrast to our setting, in none of these settings can a signal actually compel a meeting or interview to occur.[6]

Early action and early admission programs at U.S. universities are another setting in which applicants signal their preferences to the other side of the market. Avery et al. (2003) find suggestive evidence that applicants applying early are more likely to be admitted than those applying through the regular admission deadline, especially among lower-SAT-score students.[7] Avery and Levin (2010) develop a model to match these facts, focusing on early applications as a signal of enthusiasm for the college.

Finally, in comparing firms' interview selections to interviewees not chosen by the firms' employees, the paper is also related to a growing literature on the use of algorithmic screening or testing in hiring (Cowgill and Tucker 2018; Hoffman, Kahn, and Li 2018; Li, Raymond, and Bergman 2020). Importantly, the résumé screening algorithms that are the focus of these papers do not take into account credible student preferences as conveyed by the auction.

The paper proceeds as follows. In Section 2 we describe the data and the setting. In Section 3 we examine the differential role of the auction for lower and higher desirability firms; section 4 examines whether auctions improve representation of overlooked candidates among hires; Section 5 evaluates the impact of the auction on labor market efficiency, and Section 6 concludes.

## 2 Data

We examine the job interviews and employment outcomes for students in a specialized professional master's degree program in the U.S. The program takes about two years to complete. Students typically are encouraged to have an internship during their first summer in the program. Our data consist of both internship and fulltime applications and outcomes.

The meeting of applicants and employers is centralized and standardized in this market. The recruiting timeline for the semester is as follows. Employers register to

[6]Related work shows the impact on matching when providing employers with additional information on job applicants' quality or work experience. Groh et al. (2015) find little improvement in matching when providing employers with psychometric assessments of unemployed recent university and community college graduates in Jordan. Agrawal (2013) and Pallais (2014) find that providing more information about applicants in online labor markets improves outcomes.

[7]However, the authors did not have full admissions-relevant information on applicants, and early application also screens based on financial need of the applicants (Kim 2010).

formally recruit on campus, and they specify the number of interview slots they would like for each posting. Applicants then submit résumés. After reviewing the résumés, employers invite applicants to fill 50% of their interview slots.[8] After the employer's 50% of the slots are filled, and non-selected applicants are aware they have not been selected, the interview auction takes place for the remaining 50% of the slots.

Applicants can only participate in the auction if they applied to the firm, and were not selected by the employer for an interview. If there are remaining slots after the auction, applicants can sign up through a free-for-all period. Each applicant is given an allotment of 1000 points for the entire semester, and can allocate those points as they like. They may decide to spend 1000 points on one employer, or bid 200 points on five different employers. If an applicant's bid is not high enough to obtain an interview, their points are returned to their allotment.

The auction is conducted by a computer. If there are $n$ interview slots, the highest $n$ bids win that slot. Ties are resolved at random. Employers do not know the bid amount. The recruiting schedule given to the recruiters who arrive on campus does not designate those chosen by the employers, and those who obtained a slot via the auction. However, as the initial choices were made by the employer, they could keep their own record as to how each interviewee obtained an interview slot.

Our dataset contains two types of information. First, we have detailed information on each student compiled from several sources: their graduate school application, their profile on the job application system, their résumé, and surveys and records of employment outcomes. We observe data for nine semesters of recruiting, from Spring 2008 through Spring 2012.

The graduate school application provides information such as race and standardized test scores (e.g., GRE or GMAT). Profiles on the job application system include sex and citizenship status. Résumés for internship or fulltime recruiting provide the student's undergraduate institution, undergraduate major, undergraduate GPA, and employment history.

For each résumé-listed job, we classify the occupation using the five-digit Standard Occupational Classification (SOC) code. We determine which résumé-listed jobs were held prior to the start of the master's degree program. We then determine whether applicants had any prior experience in the occupation in which their master's program

[8]Employers also select alternates who can fill these slots if their first-choice applicants decline the interview.

specializes. We also collect data on whether each pre-master's program employer is in The Fortune 1000, or The Global 2000 list of largest public companies from Forbes, in the year 2008.[9]

All additional résumé information was also coded such as awards and honors, leadership in university activities, participation in professional clubs, and volunteering.

When employers screen applicants to select interviewees they have the résumé and a short application. Thus, we observe all the same information as the employers and in some cases we have additional information from the admissions record (e.g. standardized test score).

Data on employment outcomes include internship and fulltime employer, and for each of these positions: salary, bonus, moving allowance, and location. For some years, information on non-accepted offers was collected as well. For those years we have information on the employer making the offer and the terms of the offer including salary and bonus.

The second type of information contains detailed matched job posting-applicant data. For each job posting-applicant pair, we observe whether the firm invited the student for an interview, whether the student participated in the interview auction, and whether the employer ultimately interviewed the student for the posting.[10]

Some employers post openings for more than one type of position, and so students may apply to one or several positions for each employer within a semester. We will refer to each employer's position as a job posting or an employer schedule.

We focus on internship recruiting for several reasons. First, internship recruiting represents these students' entry into this market after enrolling in the degree program. Second, individuals participating in the formal fulltime recruiting program will be a selected sample. For over 50% of interns in our sample, their internship converts to a fulltime job. A nontrivial percentage of students who accept jobs at their internship employer do not apply to any other jobs posted through career services.

As a result, participants in fulltime recruiting are those who were not offered a fulltime job at their internship employer, or who wanted another draw at a better job. The set of firms recruiting may also be selected, as these are firms that did not

[9]We do not code individuals as having Fortune 1000 or Global 2000 experience if their listed position at one of these companies was sales or food preparation. This suggests they may have been working in a particular establishment of a large retail or restaurant company as a waiter or retail clerk. We wish to distinguish this from corporate work experience.

[10]For only some seasons we observe the actual amount of the bid.

fulfill their fulltime needs through their interns. This could be because they were not satisfied with their interns or because their interns did not accept their offer. Firms may be better at screening applicants for fulltime jobs given the selected sample of applicants. Alternatively, they may apply different standards in screening or hiring for fulltime relative to internship recruiting, consistent with results from a study of the labor market at a prestigious MBA program (Kuhnen and Oyer 2016).

We code individuals as obtaining their interview through an invitation if they were invited or they obtained their interview after being selected as an alternate by the firm. We code individuals as obtaining their interview through the auction if they were auction winners or obtained their interview through the free-for-all period.

Our data consist of 182 employer interview schedules (job postings), with an average of 20 per semester (Table 1).[11] Our sample consists of interview schedules in which at least one person received their interview through an invitation, and at least one through the auction. This comprises 83% of all campus recruiting interview schedules. We confirm that roughly 50% of the firm's interview slots are filled by invitations with the remainder filled by the auction (Table 1).[12] On average, approximately one applicant is hired per schedule, but a nontrivial proportion of job postings do not result in a hire. We examine the reasons behind this high rate of unfilled vacancies, despite the auction, in Section 5.1.

For students in this program, campus recruiting is an important part of their job search. More than 80% of our sample of applicants end up being hired for an internship through some method. Nearly 90% of all students hired for internships, regardless of whether this was through campus recruiting, apply to one of the job postings in our sample. However, partly since there are many more students than firms, only 44% of these applicants are ultimately hired by a sample firm.

### 2.1 Congestion and Coordination in the Labor Market

This labor market has several characteristics implying auctions may be beneficial. First, the number of applications received by firms far exceeds the number of applicants they invite for interviews (Figure 1a; Table 1). On average, firms invite roughly seven applicants for interviews, but receive 42 applications per job posting. This

[11] Recruiting is more concentrated in the Fall than in the Spring, and all of our results include semester fixed effects.

[12] Roughly 75% of the auctions in our sample have losing bids.

congestion in applications suggests firms may pass over many applicants to whom the firm would make an offer, and who would accept the offer. The auction could reveal some of these candidates.

Second, firms appear to have correlated preferences over candidates. Candidates invited for interviews are invited by many other firms recruiting on campus. When a firm invites a candidate for an interview, on average the candidate has 5.7 interview invitations (Figure 1b), and roughly a quarter of invitees have eight interview invitations (seven from other firms). Further, there are applicants who have far fewer invitations, as the average applicant to a job has only 3.2 interview invitations. Roughly 55% of all applications come from students who receive two or fewer invitations.

The auction could help address this firm coordination problem. Applicants have a fixed endowment of points and there is a fixed number of winners in the auction. Thus, auction winners will not be auction winners for many jobs and so the mechanism distributes applicants across employers' interview schedules. Further, auction winners have revealed an interest in the firm, and this will be especially important in a setting where applicants have many interviews and the offer rejection rate will be high. This may be most important for lower desirability firms, as they invite candidates also invited by many higher desirability firms (Figure 1c). When a below-median desirability firm invites a candidate for an interview, the candidate has on average 2.7 invitations from above-median desirability firms.[13] Over 80% of below-median desirability firm invitees have received an invitation from an above-median desirability firm.

Finally, offers appear costly. If offers were costless, identifying interested applicants would be less important, as firms could make offers until someone accepts. Two facts in our data suggest offers are costly. If offers were costless, when an offer is rejected we would expect firms to make another offer. However, we see that an additional rejected offer is associated with an increase of less than one total offer (Appendix Figure A1). Alternatively, firms with more rejected offers may have fewer vacancies and fewer total offers. Second, of the firms making offers in the subset of semesters for which we observe all offers, more than a quarter do not hire. Fifty percent of these make only one offer and 90% make one or two offers. This is a more specialized master's program than many, training students to enter a specific field. Firms may recruit entry-level employees for these positions on other campuses,

[13]We describe our classification of high and low desirability firms below.

though the number of other campuses is likely small.

### 2.2 Employer and Jobseeker Heterogeneity and Differences between Invitees and Auction Winners

When examining a matching setting, it is important to consider characteristics of each side (e.g., employers and jobseekers), and the extent to which those characteristics are observable to the other side.

For tractability, it is of use to have a unidimensional measure of desirability both for employers and applicants. For example, for applicants, a measure of desirability is important for two reasons. First, firms may only want to hire the more desirable candidates. Second, if offers are costly, firms may make inferences about acceptance likelihood before making an offer.

For applicants, we examine the total number of firms inviting a student for an interview as a proxy of the student's desirability. Firms will unlikely have information on a candidate's actual number of invited interviews, but they may make predictions based on the candidate's characteristics. For this reason, we use the predicted number of interview invitations for each candidate as a measure of an applicant's desirability. For student $i$ applying to jobs in semester $t$, we estimate

$$TotalInvites_{it} = X\beta + \gamma TotalApplications_{it} + \delta_t + \epsilon_{it}$$

where $X$ includes student characteristics described in Table 2 and $\delta_t$ are semester fixed effects. We use $X\hat{\beta}$ as our measure of predicted total interview invitations, and we standardize it so it has mean zero and standard deviation of one among the sample of all applicants.

Table 2, column 3 shows the coefficients from the regression.[14] The predicted number of interview invitations is higher for non-Asians, students with pre-Master's experience similar to their degree program, students with experience at Fortune 1000 or Global 2000 firms, high GPA students, students with volunteering experience on their résumé, and business majors. Interestingly, the coefficient on GRE/GMAT is not statistically significant from zero. This information is not observable to employers. The lack of significance implies these test scores do not have additional predictive

[14] We also construct the index using a Poisson regression with exposure equal to total applications per person, which yields similar results.

content correlated with some variable unobservable to the researcher but observable to employers.

Table 2 and Figure 2 show the characteristics of students obtaining their interview through an invitation and those obtaining their interview through the auction. Relative to students invited for an interview, and consistent with the regression predicting interview invitations, students obtaining their interview through the auction are more likely Asian, less likely US Citizens, less likely to have previously worked in an occupation similar to the degree program, less likely to have worked for a Fortune 1000 or Global 2000 firm, and more likely to have had a low undergraduate GPA.

This suggests auctions are identifying a different pool of applicants with observable characteristics, such as experience and academic quality, which are conceivably less desirable to firms. By winning the auction, these applicants have revealed a strong interest in the firm, and they may also have higher unobservable quality, or match-specific quality. If they have private information about their match-specific quality, they could identify that to the firm after winning the auction.

As a unidimensional proxy for firm's desirability we create an index measuring the firm's percentile in the semester's salary distribution, averaged over the nine semesters in our data.[15] In particular, we use the internship salary reported by hired students.[16] We observe salary only if the firm hires a student that semester, and many firms recruit without hiring. We calculate the firm's percentile in the salary distribution each semester, and then take the average across all semesters. This allows us to include firms that recruit without hiring in one semester, but do hire in another semester. Taking the average over many semesters also avoids the concern that salary may depend on whether the hire was an auction winner or invitee. For robustness, we create the same index but instead use the fulltime salaries reported by hired students. The correlation between the two indices is roughly 0.7.

For much of the analysis, we use an indicator for whether the firm's desirability is at least equal to the median among firms recruiting that semester. In nominal dollars, the average base internship salary between 2008 and 2012 for the lower desirability firms is roughly $4300 per month, while for the higher desirability firms in our sample

[15] Applicants likely care about many other non-wage job and employer attributes, though note that wages are often positively correlated with other desirable job features.

[16] Some students report base salary as well as bonus and relocation benefit. However, these are reported less consistently, and so we use only the base salary to construct the index.

the average is roughly $5300 per month.[17]

Figure 3 shows the distribution of student desirability for auction winners is shifted to the left of that for invited applicants. However, roughly 40% of auction winners have desirability index around or above the mean. Importantly, while employers tend to invite higher desirability candidates on average, they also invite lower desirability candidates and leave some of the higher desirability candidates in the pool of applicants. This suggests we can compare outcomes of auction winners and invitees, conditional on desirability. Figure 3 also shows the distribution of desirability for invitees is quite similar for above- and below-median desirability firms. This is further evidence that these firms are inviting similar candidates, yielding coordination problems for which auctions may be an effective solution.

Figure 4 shows descriptive evidence that lower desirability firms are more likely to hire high desirability auction winners relative to high desirability students they invited for interviews, but this is not true for the higher desirability firms. Among lower desirability students, firms are more likely to hire invitees than auction winners, across all bins of firm desirability. These results are consistent with lower desirability firms benefiting more from a mechanism that identifies interested, high-quality applicants in a market where they face substantial competition. These plots are based on binscatter estimation, additionally adjusting for semester fixed effects and total number of students interviewed for that job posting. We define high desirability students as students with desirability index greater than or equal to the mean. Below, we more formally test this relationship, including job posting fixed effects.

We do not address the optimal bidding strategy in this paper, and we see this as an area for future work. We find that winning an auction, conditional on participating, is not correlated with GMAT/GRE scores. These test scores are not observable to the employers. This alleviates concerns that winning the auction is a signal of ability rather than a signal of match quality or true interest in an offer.

## 3 The Differential Benefit of Auctions to Less Desirable Firms

Based on the predictions described above, we test whether firms are more likely to hire auction winners than invitees, and whether this varies with the firm's and the

[17] In real dollars, average monthly salary is $800 (23%) higher at high desirability firms relative to low desirability firms.

student's desirability. We predicted lower desirability firms may more likely hire desirable auction winners relative to invitees, as invitees may more likely reject offers from these firms.

We estimate separately for above- and below-median desirability firms:

$$\begin{aligned} Hire_{ist} &= \beta_1 Auction_{ist} + \beta_2 StudentDesirability_{it} \\ &\quad + \beta_3 Auction_{ist} * StudentDesirability_{it} + \gamma_s + \epsilon_{ist} \end{aligned} \tag{1}$$

The sample consists of individuals who are on the interview schedule for a particular firm's job posting (denoted $s$). The dependent variable indicates whether individual $i$, applying to job posting $s$, in semester $t$ is hired by the firm. We include job posting (interview schedule) fixed effects ($\gamma_s$), and test whether individuals obtaining interviews through the auction ($Auction_{ist}$) are differentially likely to be hired relative to individuals invited by the firm for an interview.

The variable $StudentDesirability$ is a measure of student $i$'s desirability during semester $t$, based on the predicted interview invitations received by the student. The coefficient $\beta_1$ is the differential likelihood that an auction winner is hired relative to an invitee among applicants with average desirability. The coefficient $\beta_3$ measures how the differential likelihood of hiring an auction winner changes among higher desirability students. The coefficient $\beta_2$ measures how the likelihood of hiring an invitee changes with the student's desirability. We alternatively control for the student characteristics that comprise the desirability index.

Auction winners are a selected group in that they were not invited for an interview by the firm. We control for student desirability, but the absence of a firm's invitation may imply lower unobservable match quality. This should bias us towards finding auction winners are less likely hired than invited applicants. However, if auction winners have private information about their quality, match-specific quality, or likelihood of accepting an offer this could increase their likelihood of being hired relative to invitees.

We show results with bootstrapped standard errors based on 400 replications, as $StudentDesirability$ is a generated regressor.

### 3.1 Results

In column one of Table 3, we include both above- and below-median desirability firms, and find that the differential likelihood of hiring an auction winner increases with the student's desirability, but the effect is not statistically significant. We then estimate the regressions separately for low- and high desirability firms, as we hypothesized the auction could be especially helpful for lower desirability firms.

Throughout the table, the coefficient on *Auction* is small and not statistically significant. However, as can be seen in column 2, the coefficient on the interaction suggests that the differential likelihood of hiring an auction winner increases with student desirability, and the effect is statistically significant at the five-percent level. For students with desirability one standard deviation above the mean, auction winners are 4.7 percentage points more likely to be hired than invitees. Interestingly, the coefficient on *StudentDesirability* implies that for invitees, the likelihood they are hired by lower desirability firms declines with their desirability. This is consistent with invited, higher desirability students rejecting offers, or firms perceiving they will reject offers, or firms perceiving low match quality. In contrast, students with similar desirability who were auction winners, have credibly revealed they are interested in the firm. Column 3 shows auction winners with average desirability are no more likely hired than invitees at higher desirability firms, and this does not change with student desirability. The magnitude suggests that the differential likelihood of hiring an auction winner increases as student desirability decreases. The coefficients on $Auction * StudentDesirability$ are statistically different for low and high desirability firms.

Columns 4 and 5 are similar to columns 2 and 3, respectively, but include all components of the desirability index as additional controls, rather than the index itself. This yields similar, though slightly larger magnitudes. For students with desirability one standard deviation above the mean, auction winners are 5.5 percentage points more likely hired than invitees ($p\text{-}value = .06$), while for students with desirability 1.5 standard deviations above the mean auction winners are 7.8 percentage points more likely hired than invitees ($p\text{-}value = .03$).[18] The average likelihood of being hired by a lower desirability firm, for invitees with desirability .5 to 1.5 standard deviations above the mean is .07. The differential likelihood of 5.5 percentage points

[18] We also estimate these regressions with student fixed effects, which yields similar results, though not surprisingly less precise.

thus implies lower desirability firms are 1.8 times more likely to hire auction winners with desirability of one standard deviation above the mean, relative to invitees.

We see the differential likelihood that low desirability firms hire auction winners increases with the student's desirability. Column 6 shows this effect is increasing in the amount the student bid in the auction, using data on bid values available for six out of nine of our semesters. For students with desirability one standard deviation above the mean, auction winners whose bid was one standard deviation below the mean bid of winners are not statistically more or less likely to be hired relative to invitees of the same desirability. However, for these auctions winners whose bid was one standard deviation above the mean bid of winners, they are 14 percentage points more likely to be hired relative to invitees of the same desirability ($p\text{-}value \leq .05$).

This suggests that students who bid as though they have higher match quality with the firm are correct about this, and that firms learn about the match's quality during the interview without observing the bid values. If it is hard to identify these highest bidders in the pool of applicants, this provides evidence that the auction provides relevant information to firms that would be less accessible in the counterfactual, in which firms chose all their applicants. This suggests the results are not simply driven by the auction yielding applicants with fewer other opportunities—if firms instead of an auction chose additional candidates, conceivably some of those would be applicants with fewer opportunities as well.

For robustness, we estimate specification (1), but define high and low desirability firms instead using an index based on fulltime salaries. Appendix Table A3 shows that using this alternative index continues to imply lower desirability firms are more likely to hire auction winners than invitees, but this is not true for higher desirability firms. The total differential likelihood of hiring an auction winner with desirability one standard deviation above the mean is 4.2 percentage points ($p\text{-}value = .08$), remarkably similar to the 4.7 percentage points in Table 3.[19]

For additional robustness, we estimate specification (1), but interact *Auction* and $Auction * StudentDesirability$ with the firm's desirability (average percentile in the salary distribution) rather than estimating separately for above- and below-median desirability firms. Appendix Table A3 shows that for firms with desirability index

[19]Interestingly, using this alternative index implies a larger difference for the average desirability candidate (coefficient on *Auction*), with $p = .11$, and a differential effect for students with higher desirability that is smaller in magnitude than in Table 3.

one standard deviation below the mean, they are four percentage points more likely to hire auction winners than invitees for candidates with desirability one standard deviation above the mean. The effect is very similar and more precise using instead the desirability index based on the fulltime salary.[20]

### 3.2 Do Lower Desirability Firms Make Offers to Auction Winners Only After Rejection?

Table 3 shows that lower desirability firms are more likely to hire high desirability auction winners relative to high desirability candidates they invited for interviews. As discussed above, this could be explained by two mechanisms. First, firms may prefer the auction winners to the candidates they invited. This could be based on their revealed enthusiasm for the firm, or because they had other traits that were unobservable on the résumé but observable in the interview. This suggests the likelihood of receiving an offer should be higher for auction winners.

However, these lower desirability firms may have preferred the candidates they invited. Based on this preference for invitees, firms may make offers to these invitees. However, these candidates may have rejected offers because of offers from higher-quality firms, or firms where their match quality was higher. Upon being rejected by these invited applicants, firms may have then made offers to auction winners who were more likely to accept given their revealed preferences. This implies the likelihood of receiving an offer should be similar for auction winners and invitees. Alternatively, despite preferring the invitees, firms may have made offers only to the less preferred auction winners, anticipating that invitees would reject the offer. This suggests the likelihood of receiving an offer should be greater for auction winners.

We test whether firms are only making offers to auction winners after rejection from invitees, using additional survey data that contains information on all offers received by students, including rejected offers. Unfortunately, these data are only available for four of our nine semesters, and so the sample size is greatly reduced.

[20] We also investigate whether hiring an auction winner is correlated with hiring an auction winner in the next season in which the firm recruits. Controlling for the firm desirability index, the number of times the firm has recruited through the current season, and the total invitees on the schedule, as well as semester fixed effects for the current season and the last time the firm recruited, we do not find that firms hiring an auction winner last time are more or less likely to hire an auction winner this time. Using a similar specification, but using the change in the mean desirability of invitees, there is some evidence that firms invite more desirable applicants after hiring an auction winner, compared to the change in desirability for firms that did not most recently hire an auction winner.

We estimate (1) but use as a dependent variable whether individual $i$ received an offer from job posting $s$ during semester $t$. Roughly 56% of student/semester observations report more than one offer, conditional on reporting at least one offer.

Column 1 of Appendix Table A1 shows the differential effect of the auction on hires among higher desirability students in this subsample. We also see this differential effect on offers, similar in magnitude to the effect on hires and significant at the 10% level when including *StudentDesirability* rather than the variables comprising the index. The greater likelihood of making offers to high desirability auction winners suggests firms are not more likely to hire auction winners simply because their first-choice candidates rejected their offer. It remains possible that these firms preferred the invitees, but did not make them offers because of expected rejection.

**Offer Acceptance and Post-Employment Match Quality**

Finally, we directly analyze differences in offer acceptance likelihood by estimating (1), and only including applicants who received offers. Because we are only including people receiving offers, and only have data for some of the semesters, we pool low and high desirability firms and do not include job posting fixed effects, yielding a sample size of 152. Instead of job posting fixed effects we include the firm's desirability measure (average percentile in the salary distribution). Among applicants receiving offers, average desirability auction winners are nearly 22 percentage points more likely to accept offers relative to invitees ($p \leq .05$) (Table 4, column 1, coefficient on *Auction*).

This appears especially true among more desirable candidates, though the results are not statistically significant (coefficient on $Auction * StudentDesirability$). Magnitudes suggest that for students with desirability one standard deviation above the mean, auction winners are 36 percentage points more likely to accept than invitees. This specification may understate the overall difference in acceptance likelihood among all interviewees, since firms may make offers based on perceived acceptance likelihood. Appendix Table A4 shows similar results from including job posting fixed effects, with average desirability auction winners 23 percentage points more likely to accept than average desirability invitees ($p\text{-}value \leq .1$); the coefficient on $Auction * StudentDesirability$ is smaller in magnitude.

Finally, we see that among invitees, acceptance rates are lower for more desirable candidates (coefficient on *StudentDesirability*), consistent with these students having more offers. These results complement the earlier results, suggesting lower desirability

firms use auctions to hire high desirability candidates, because the auction identifies high desirability candidates who are likely to accept an offer.

We also test whether hired auction winners are more likely to stay for a fulltime job than hired invitees. This would provide important evidence for whether the match quality of hired auction winners is indeed higher than that of hired invitees, as evaluated after a period of employment. We estimate (1), again pooling low and high desirability firms, and including only hired candidates, yielding a sample of 136 hires.[21] Magnitudes suggest the average desirability auction winner is substantially more likely to stay for a fulltime job than the average desirability invitee, and this is even more true for more desirable candidates, although the estimates are imprecise (Appendix Table A4).

Including job posting fixed effects, interns who were auction winners and had desirability one standard deviation above the mean are over 20 percentage points more likely to stay for a fulltime job, relative to similar desirability interns who were invitees, though this is not statistically significant. The mean likelihood of staying for a fulltime job among interns who were invitees with desirability between .5 and 1.5 standard deviations above the mean was .4, suggesting a 50% increase for auction winners. This suggests interns who were auction winners were more likely to receive and/or accept fulltime offers from the firm, and is consistent with the auction improving match quality based on post-hire measures. This provides further evidence suggesting the auction is an improvement relative to the counterfactual in which firms choose all interviewees. The auction is providing information beyond that which is easily accessible to the firm.

When firms hire auction winners this could reflect that these candidates are higher quality as judged by all firms (intrinsic quality), rather than higher match-specific quality. However, the evidence suggests this is unlikely. First, 77% of hired auction winners are also interviewed by high desirability firms. If these candidates had higher intrinsic quality, it is more likely they would have been hired by the high desirability firms.[22] Second, we show lower desirability firms are less likely to hire high desirability invitees than auction winners. If these high desirability invitees had lower intrinsic quality, they would be less likely hired by all firms. In fact, conditional on being hired

[21] While we have 180 hires in our main sample used in Table 3, we do not have fulltime job outcomes for the last two cohorts in our data, reducing our sample here to 136.

[22] Only one of these candidates gets an offer from a higher desirability firm.

that season, we see 65% of high desirability invitees (defined as desirability at least one standard deviation above the mean) are hired by high desirability firms, versus 50% for low desirability invitees (desirability at or below the mean).

# 4 Do Auctions Improve Overlooked-Candidates Representation Among Hires?

Auction winners by definition are overlooked candidates, and we find that they systematically differ from invitees. They have lower undergraduate GPAs, they are less likely to have experience at a Fortune 1000 or Global 2000 company, less likely to have pre-Master's degree experience in the same field as their master's, and they are more likely Asian, and less likely US citizens. In this section, we examine to what extent auctions increase representation among hires of students with these characteristics, or whether auctions simply increase their likelihood of being interviewed.

We test for differences in composition between auction winners and invited interviewees, separately among interviewees and among hires, controlling for semester fixed effects and the firm's desirability measure. We estimate, for all firms, and separately for low and high desirability firms:

$$X_{ist} = \gamma_t + \beta_1 Auction_{ist} + \beta_2 FirmQ_s + e_{it}$$

The dependent variables include the student desirability index, as well as the components of that index that appeared as the most significant predictors of the number of interview invitations (in Table 2, column 3). These are descriptive regressions. We do not interpret them as showing firms discriminate based on a given characteristic $X$, as this characteristic may be correlated with other characteristics responsible for the differential outcomes. Nonetheless, we find the auction's effect on composition of hires to be informative.

Generally, auction winners have characteristics that are conceivably seen as less desirable in the interview process (Table 5). However, among hires at lower desirability firms, auction winners look similar to invitees. There are no statistically significant differences in the characteristics of hired auction winners relative to hired invitees at lower desirability firms. In most cases, the magnitude of the differences are much closer to zero than the differences among interviewees. An exception is that hired

auction winners are more likely Asian. Again this does not imply firms discriminate against Asians as Asian interviewees may systematically have other characteristics affecting outcomes. For example, this result may reflect that auctions differentially help non-US Citizens. We analyze this further below.

Figure 5 shows that hired invitees look similar to hired auction winners at less desirable firms, and the reason is that hired invitees have much lower desirability than interviewed invitees. While lower desirability firms invite high desirability candidates for interviews, they do not hire these candidates. As a result, the auction does not seem to affect the characteristics of hires, for these lower desirability firms.

However, among higher desirability firms, hired auction winners look significantly different from hired invited applicants. The desirability index of hired auction winners is .8 standard deviations below that of hired invitees, they are 25 percentage points less likely to have experience at a Fortune 1000 or Global 2000 company, and they are 14 percentage points more likely to be Asian. They also have .4 fewer activities listed on their résumé, and are 8 percentage points less likely to have had their undergraduate GPA in the top quartile. While these last two effects are large in magnitude and similar or larger than the difference among interviewed candidates, the differences relative to invitees are not statistically significant.

Figure 5 shows that at higher desirability firms, composition of invitees looks similar to hired invitees, in contrast to lower desirability firms. Hired auction winners generally look similar, and if anything less desirable, than interviewed auction winners. These results show that auctions not only increase interview opportunities for less traditional candidates, but also increase their representation among hires.

To understand the impact of auctions on representation of non-US Citizens, we focus on job postings that allow applications from non-US Citizens. More than 70% of the postings in our sample are restricted to US Citizens or permanent residents, while 20% also specify that students with an F-1 Visa may apply.[23] Given that auctions cannot benefit non-US Citizens in these restricted postings, we focus on the non-restricted postings.[24]

Auction winners for jobs without citizenship restrictions are 31 percentage points

[23]This information is missing for one of the semesters, comprising the remaining 8% of the postings. Approximately 12% of restricted postings specify they are open only to US Citizens, presumably based on this being required by law or contract.

[24]Compliance with these application restrictions is nearly perfect; only .6% of applications to restricted postings are from students who are neither US Citizens nor permanent residents.

less likely to be US Citizens than invited applicants (Table 5).[25] Among hires, auction winners are 47 percentage points less likely to be US Citizens than invited applicants. Importantly, this suggests that auctions improve non-US Citizens' representation in the interview pool, but also among hires. Firms hire non-US Citizens upon having the opportunity to interview them.

We also find that for high desirability firms that restrict applications based on citizenship, auctions improve representation of Asians in the applicant pool, and suggestive evidence that their representation also increases among hires (Appendix Table A2). The results for less desirable firms are smaller in magnitude, and also with larger confidence intervals. This suggests that not all of the earlier result for Asians is explained by citizenship status. These results relate to Oreopoulos (2011), who finds discrimination against applicants with foreign sounding names in a résumé audit study. Our results complement the audit study as we provide suggestive evidence that firms do end up hiring Asian individuals after interviewing them through the auction, and after passing them over in the résumé screening stage.

# 5 The Effect of Auctions on Labor Market Efficiency

This section evaluates whether interview auctions reduce the likelihood of unfilled vacancies. First, we analyze the likelihood a firm hires from their interview pool, and whether firms with lower hiring rates might benefit from greater use of the auction. Second, we compare outcomes when there is an auction to the counterfactual in which firms would invite all of their interviewees.

## 5.1 Are Firms Using the Auction Optimally?

Firms in the middle of the desirability distribution have the lowest likelihood of hiring from their interview pool (Figure 6a). The plot in Figure 6a is based on binscatter estimation, adjusting for total applicants interviewed by the firm. This addresses the possibility that medium-desirability firms interview more applicants, which could explain the lower hire likelihood. The figure also controls for semester fixed effects. The adjusted likelihood of hiring from the interview pool is 4.6 percentage points, or

[25] Given that some of the restricted postings are open only to US Citizens, we continue to use an indicator for US Citizenship, which is zero for permanent residents. Only 3% of the sample of applicants are permanent residents, and using an indicator for citizen or permanent resident yields very similar results.

40%, lower for medium-desirability firms relative to lower desirability firms, and 2.7 percentage points, or 28%, lower relative to higher desirability firms.

Importantly, medium-desirability firms have a much lower likelihood of hiring an invited applicant, relative to the highest and lowest desirability firms (Figure 6b). They are also less likely to hire an auction winner than the lowest desirability firms, but similarly likely relative to the highest desirability firms. Medium-desirability firms appear much more likely to make offers to invited applicants relative to auction winners, compared to lower desirability firms (Figure 6c). Together the results show medium-desirability firms are less likely to hire invited applicants than lower or higher desirability firms, and this is not explained by offer behavior.

Competition with other firms over invited applicants may explain these patterns. When firms in the middle of the desirability distribution make offers to invited applicants, they are making offers to candidates who have received more offers from other firms, relative to lower desirability firms making offers (Figure 6d). While the highest desirability firms are also making offers to candidates receiving many other offers, it is not surprising that this does not affect hiring likelihood if students accept the offer from the highest desirability firm. Figure 6e additionally shows that when firms in the middle of the desirability distribution make offers to invited applicants, these applicants have received more offers from other above-median-desirability firms.

When medium-desirability firms make offers to auction winners, these students have received offers from far fewer firms (Figure 6d). This suggests medium-desirability firms might benefit from making more offers to auction winners, thus reducing competition with other firms. In this sense they would behave more like the lower desirability firms. Columns 2 and 3 of Table 4 show that as firm desirability increases, auction winners receiving offers receive fewer other offers than invitees. This implies higher desirability firms face more competition when making offers to invitees relative to auction winners, compared to lower desirability firms.

### 5.2 Do Auctions Improve Outcomes Relative to Firms Inviting all Candidates?

To evaluate whether auctions reduce unfilled vacancies by reducing information frictions, we simulate a counterfactual in which firms invite all of their interviewees. Using the firm's actual invites from the data, and replacing auction winners with counterfactual invites, we simulate the game of offers and acceptances. We do so un-

der two different sets of assumptions. First, as a baseline case we assume firms have independent and uncorrelated preferences over interviewees.[26] The assumption that firms have uncorrelated preferences over interviewees will minimize their coordination problems, and will bias us away from finding auctions are beneficial. We have shown that firm preferences at the interview selection stage do appear correlated, but these assumptions provide a useful lower bound on coordination problems.

We allow students to agree on high and low desirability firms based on their average percentile in the salary distribution, but with independent and uncorrelated preferences within those blocks. We refer to these as block-correlated preferences. Assuming firms do not use information on other firms' interview selections, firms will make offers to their highest-ranked candidate based on their own set of preferences (or, similarly, at random).[27]

We implement a second set of counterfactuals relaxing the strong assumption that firms have uncorrelated preferences over interviewees. We allow firms to agree that the best students are those with above-median predicted interview invitations, based on all interviewees in the counterfactual.[28] Within the blocks, firms have random preferences over students. We continue to conduct the simulations assuming all firms make offers to the top students on their list. If firms know that they agree on the better students, and that students agree on the better firms, theoretically lower desirability firms might choose to make offers to the worse students. However, the data suggest low desirability firms are inviting and making offers to the same people getting offers from high desirability firms (Figure 1c and Figure 6e). Thus, we do not view offers to the highest-ranked interviewee as unrealistic in this setting.

We compare simulations without an auction to simulations with an auction. For

[26] Alternatively, we could interpret firms as being indifferent over interviewees.

[27] If firms did use information on interview selection by other firms, the best strategy is not necessarily to make offers at random. Coles, Kushnir, and Niederle (2013) also model a pure coordination game in which firms have independent and uncorrelated preferences, and students agree on high- and low desirability firms but have independent and uncorrelated preferences within those blocks.

[28] We have assumed that firms agree on student desirability in a relative, not absolute, sense by defining the median based on all interviewees not all applicants. This yields different medians in the auction and non-auction counterfactuals, as auction winners generally have lower desirability measures. Assuming that firms agree on the above-median interviewees after interviewing seems like a reasonable assumption. However, if firms agreed only on above-median applicants, the auction counterfactuals would yield fewer of these candidates, and exacerbate the coordination problem. In practice, firms might choose to make offers to auction winners because they had a higher probability of acceptance, further reducing coordination problems. We have not modeled that in our simulations in order to isolate the pure coordination problem.

simulations with auctions, we use the actual invites and auction winners on the firm's interview schedule, and similarly assume firms have random preferences over these interviewees or block-correlated preferences depending on the scenario, facilitating comparison to the non-auction simulations. These simulations isolate one attribute of the auction: easing the firm's coordination problem by distributing applicants across employers' interview schedules. Applicants have a fixed allotment of bid points, and there is a fixed number of winners from each auction, implying candidates will not be winners at many auctions. This contrasts with a setting without auctions in which firms may invite candidates that are also invited by many other firms. In this simplest exercise, firms do not take this into account when making offers, as we assume they have no information on other firms' interview selection.

Thus, in the scenario with auctions, some firms will randomly make offers to auction winners, who are less likely to be on other employers' interview schedules, and this will reduce unfilled vacancies. Again, these assumptions will minimize the benefits of the auction. Allowing firms to intentionally make offers to auction winners because they have a higher acceptance probability or they have higher match quality, would further reduce the firms' coordination problems.

### Identifying Counterfactual Invites

We showed that on average auction winners have lower desirability than invitees. However, the top of the auction winner distribution has considerably higher desirability than the bottom of the invitee distribution (Figure 3). This suggests firms are not simply inviting the highest desirability applicants in the pool.[29]

Based on these results, we identify counterfactual invites that replicate the firm's invites in the data. If firms chose one high desirability applicant, three above-average applicants, and one below-average applicant, then we assume they do the same with their additional invites. We identify counterfactual interviewees as the nearest-neighbor matches to each of the firm's invites, based on the student's desirability index, among applicants that were not invited for an interview by the firm.

To compare to the auction simulation, we constrain the number of nearest-neighbor matches to be equal to the number of auction winners.[30] These counterfactual invites

[29]Firms may invite lower desirability applicants instead of higher desirability applicants for several reasons, including to increase the likelihood of filling the vacancy or to take risks on either the high or low desirability applicants.

[30]In some cases the number of invites was greater than auction winners, and so we drop the

are very unlikely to be the people who revealed themselves to be very interested in the firm. Only 17% of auction winners at lower desirability firms, and 30% at higher desirability firms, were chosen as counterfactual invites. Only 29% of auction winners who were hired were chosen as counterfactual invites, at both high and low desirability firms. This reflects that the firm's applicant pool is large relative to the number of slots, so they may have trouble identifying the most interested applicants. This is especially important as firms are differentially likely to hire the highest bidders among the auction winners (Table 3). This provides further support for auctions providing useful information to firms, that would not be simply obtained through the firm inviting more applicants.

The counterfactual invites are also more likely to be on more employers' interview schedules than the auction winners in the data. Auction winners at lower desirability firms had 2.45 interview invitations and 3.74 interviews from the auction, implying a total of 5.2 interviews other than the interview at the firm in question. The counterfactual invites had 3.3 interview invitations in the data, and 5.3 counterfactual invites, implying a total of 7.6 interviews other than at the firm in question. This is nearly 50% more interviews than the auction winners. We assume firms do not use information on other firms' interview selection, and so they do not take this into account when making offers. However, this makes clear that a benefit of the auction is that the firm is interviewing candidates with fewer other interviews.

If we instead identified counterfactual invites by choosing randomly from the pool of noninvited applicants, this would likely reduce coordination problems relative to selecting the nearest-neighbor matches to invited applicants. As a result, this would decrease the estimated benefits from the auction. Not only does it seem unreasonable to identify counterfactual invites randomly from the pool of applicants, but this also represents another type of mechanism that could be used to reduce coordination problems.

### Simulations

We conduct 1000 simulations of the auction and non-auction counterfactual. In each simulation, we keep the interviewed applicants fixed, but we draw different firm pref-

nearest-neighbor matches to the lowest desirability invites. In other cases the number of invites was less than the number of auction winners, and we add the highest desirability applicants still in the pool.

erences over the applicants and different student preferences over the firms. Firms all make offers at the same time. If a student receives multiple offers, she accepts the offer from her highest-ranked firm. If a firm's offer is rejected in this first round, we allow for a second round of offers.

We make several additional adjustments. If we observe firms hiring multiple candidates in the data, we allow them to make that many offers in the first round. If a student receives an offer from a firm that is not participating in this formal recruiting process, we assume it arrives simultaneously with the other offers. If the firm did not make any offers in the data, we do not allow them to make offers in the counterfactual. Because of this, we restrict to the semesters with information on all offers received.

Even with firm preferences over students completely random, the distribution of firms failing to hire is shifted to the left with the auction. While the median is the same, the 25th percentile of firms failing to hire without the auction (37) is 2.8% greater than the 25th percentile of firms failing to hire with the auction (36) (Figure 7a). Allowing a second round of offers considerably reduces the number of firms failing to hire, but the advantage of the auction increases slightly in percentage terms. The 25th percentile of firms failing to hire without the auction (29) is 3.6% greater than with the auction (28).

The advantages of the auction are much more apparent when assuming that firms have correlated preferences over students (Figure 7c). The median number of firms failing to hire without the auction (53) is roughly 13% greater than with the auction (47). In each set of simulations firms agree on the above-median interviewees. However, in the auction simulations some of these candidates are auction winners and are on fewer employers' interview schedules. This reduces the coordination problems and reduces unfilled vacancies. Allowing a second round of offers considerably reduces unfilled vacancies, but the advantage of the auction in percentage terms remains similar.

These results suggest the auction's distribution of applicants across schedules can address important coordination problems in interview selection.

## 6 Conclusion

Frictions in the matching of workers to firms can lead to suboptimal matching, with consequences for individuals and markets. Understanding mechanisms that can re-

duce these search frictions is important for improving worker and firm outcomes. We study a labor market with interview auctions, a mechanism that allows workers to credibly reveal their interest in a particular position.

Using data on over 400 applicants from one degree program over five years, we have several key findings. First, we find these auctions appear to benefit less desirable firms. These firms are over five percentage points more likely to hire desirable auction winners relative to the candidates they invite, nearly doubling the likelihood. We also show that the differential likelihood of hiring auction winners increases with the bid of the auction winner, even though employers do not observe bids. This suggests students are correctly assessing where their match quality is highest. If these students are difficult to identify in the pool of applicants, this suggests a counterfactual in which firms chose all invitees would not yield similar results. Auctions appear to be providing firms with additional information, helping them to identify a pool of workers that is more likely to accept offers, and potentially also more preferred applicants.

Second, we find auctions increase representation of overlooked-candidates among hires. Finally, our simulations suggest the number of firms failing to hire would be 13% larger without the auctions. These simulations isolate one advantageous attribute of the auction, namely that they distribute applicants more evenly across employers' interview schedules.

The results suggest that introducing mechanisms that allow applicants to credibly signal their interest could help improve worker-firm matching, and improve outcomes for applicants who tend to be overlooked in résumé screening. We believe this has potentially important implications for online job posting and job application sites, as well as local job centers.

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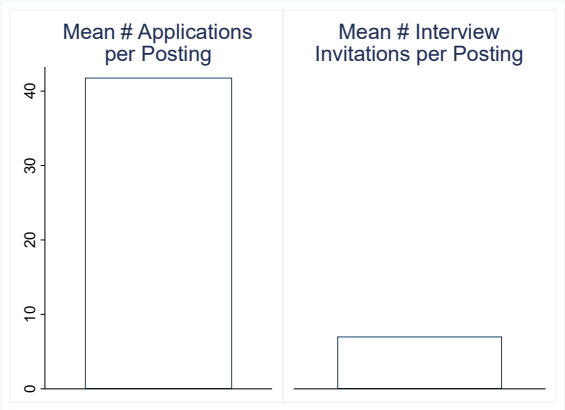
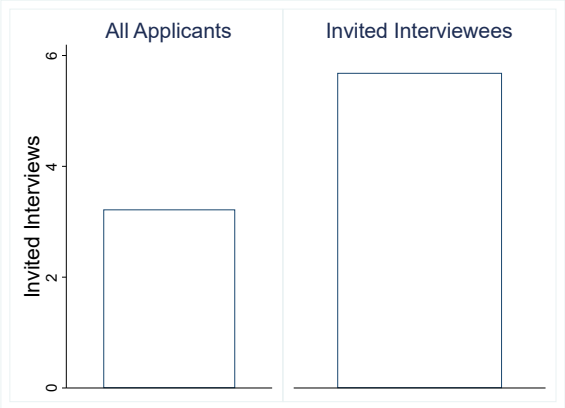
**Figure 1: Congestion and Competition Among Firms**

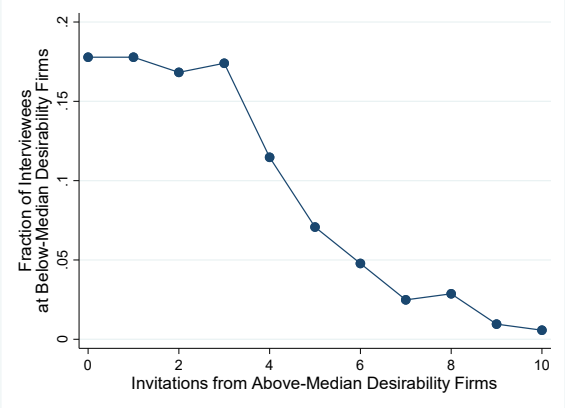
(a) Applications and Interview Invitations per Posting




(b) Total Interview Invitations per Applicant and Invited Interviewee



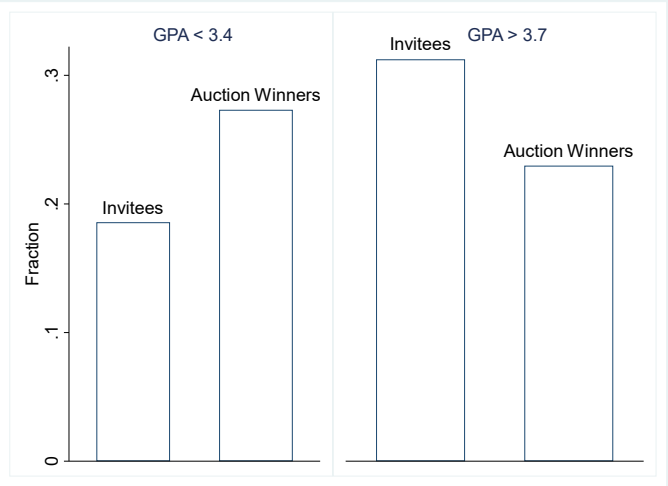

(c) Interview Invitations from High Desirability Firms, Among Invitees at Lower Desirability Firms



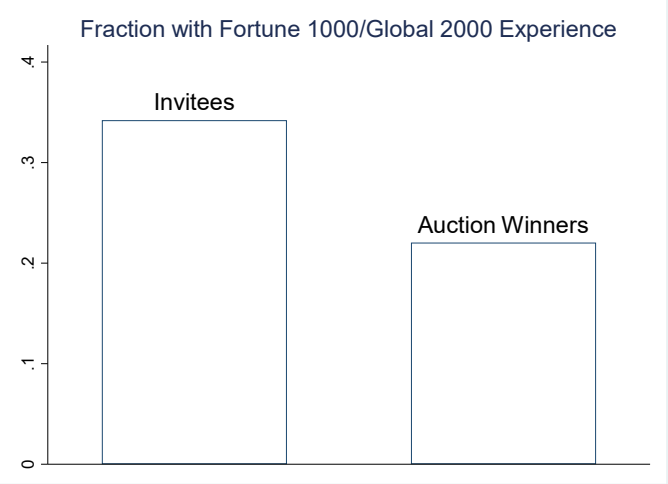

Notes: The left-hand side of Figure (b) shows the mean number of invited interviews per applicant. The right-hand side of Figure (b) shows the mean number of invited interviews per invited interviewee. Figure (c) shows a histogram of the number of invited interviews from above-median desirability firms, among invitees at below-median desirability firms.

Figure 2: Characteristics of Auction Winners Relative to Invites

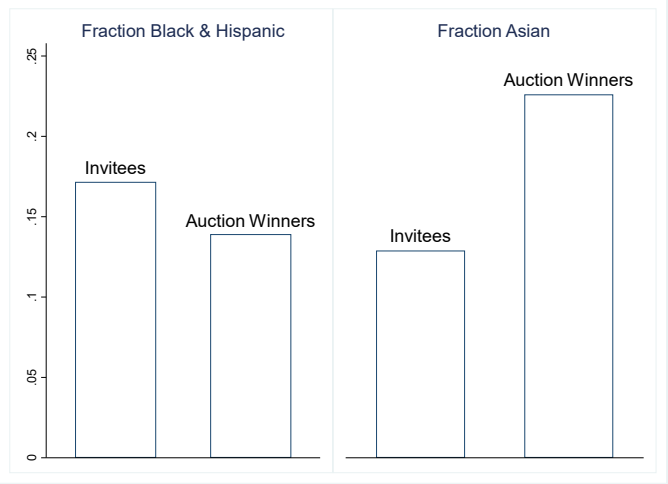
(a) Undergraduate GPA




(b) Pre-Master's Experience at Fortune 1000/Forbes Global 2000 Company



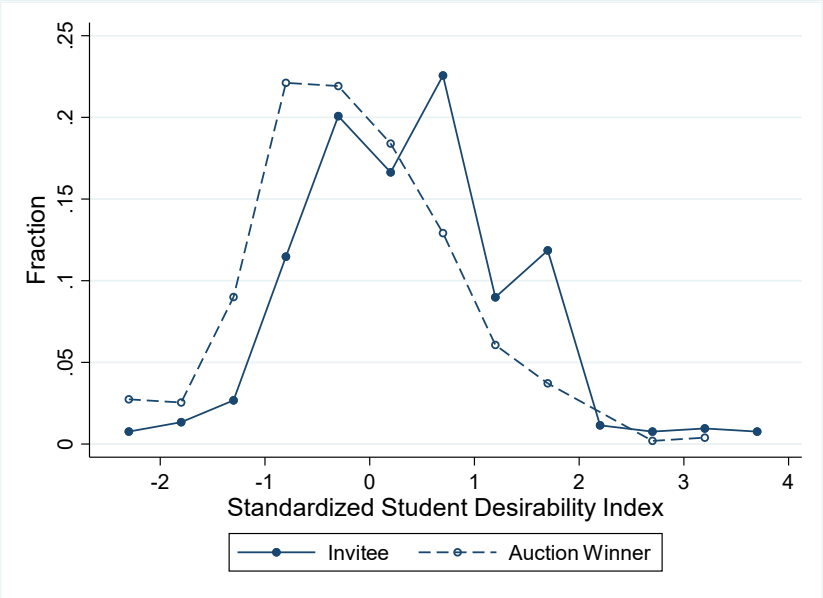

(c) Race/Origin



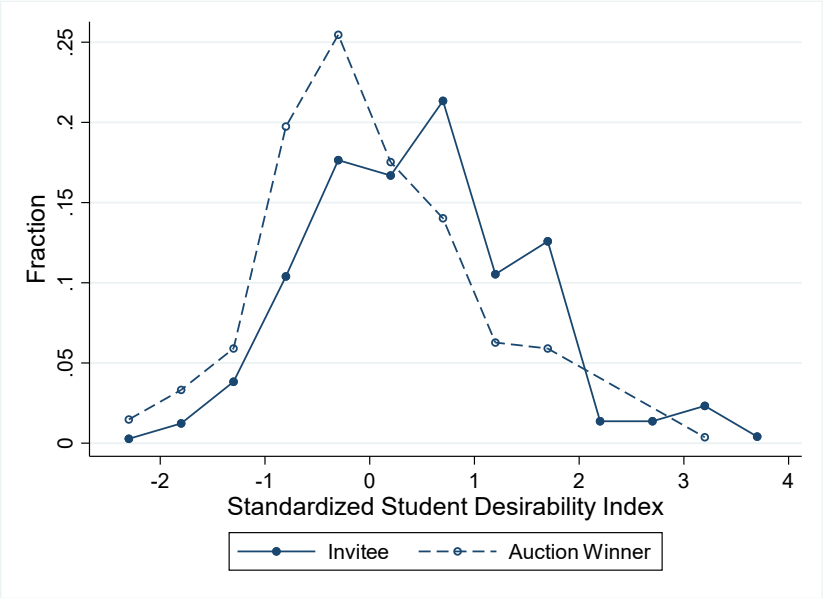

Note: Plots show the fraction of invitees and auction winners with low and high GPA, previous experience at a Fortune 1000/Forbes Global 2000 company, and by race/origin category. See text for details.

**Figure 3: Distribution of Desirability for Invitees Relative to Auction Winners**

(a) Below-Median Desirability Firms



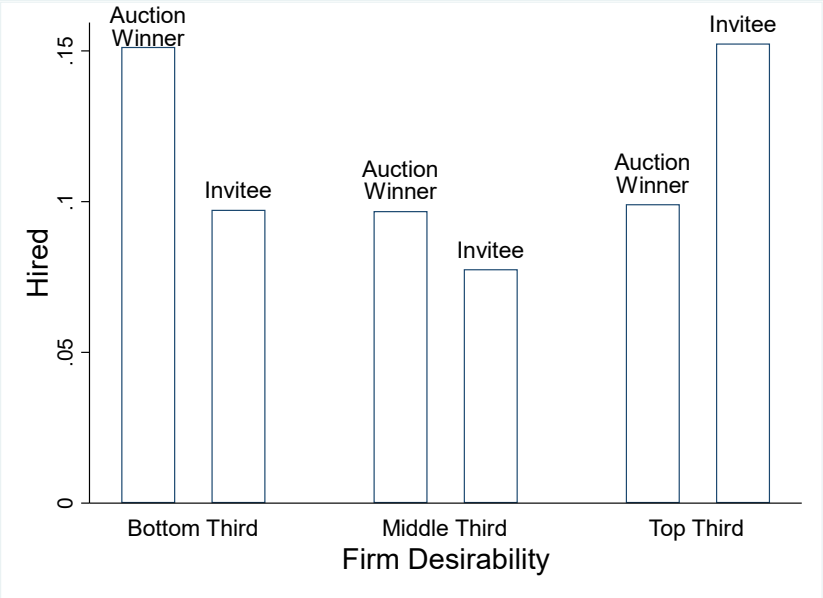

(b) Above-Median Desirability Firms



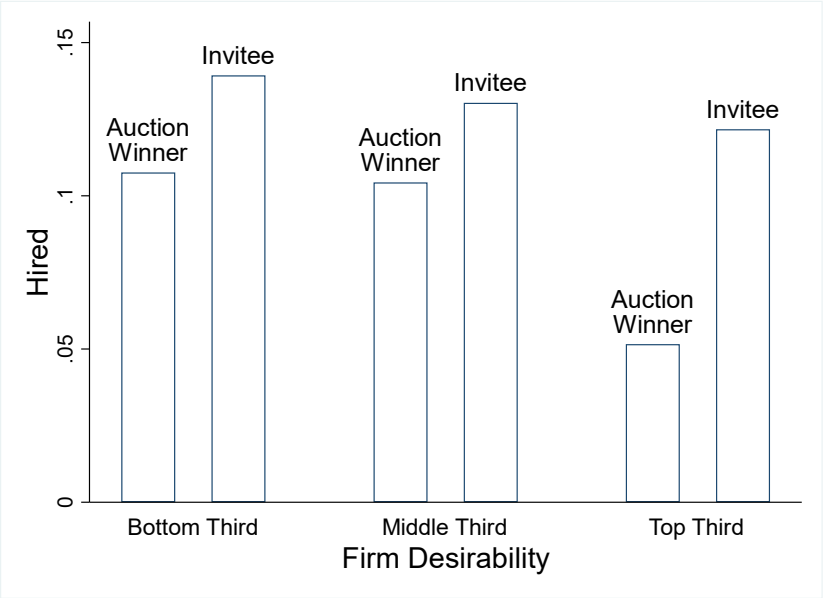

Notes: Plots show histograms of the student desirability index for invited interviewees (invitees) and auction winners. The student desirability index is based on a prediction of total interview invitations, using applicant characteristics. The index is standardized to be mean zero with a standard deviation of one among the sample of all applicants. See text for details.

**Figure 4: Likelihood of Hiring Auction Winners Relative to Invitees, by Student and Firm Desirability**

(a) Higher-Desirability Candidates: Desirability Index ≥ Mean



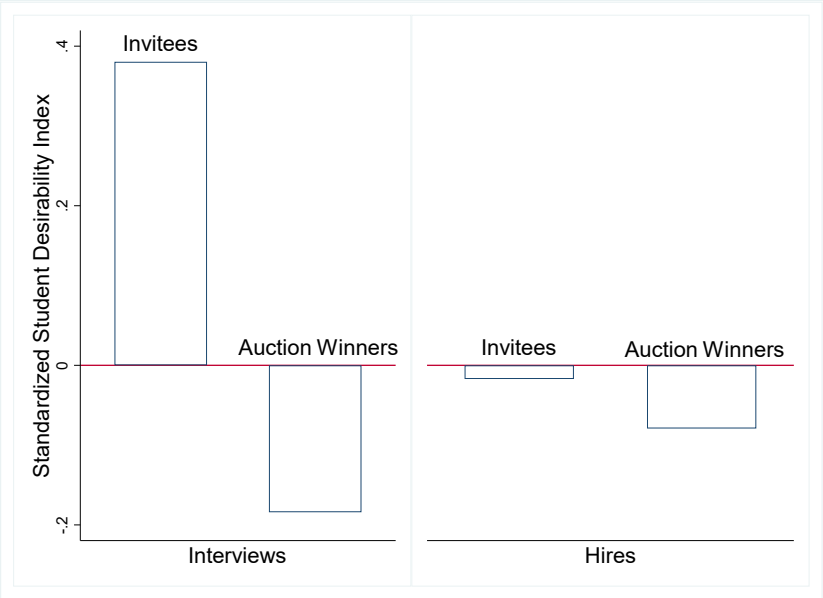

(b) Lower-Desirability Candidates: Desirability Index < Mean



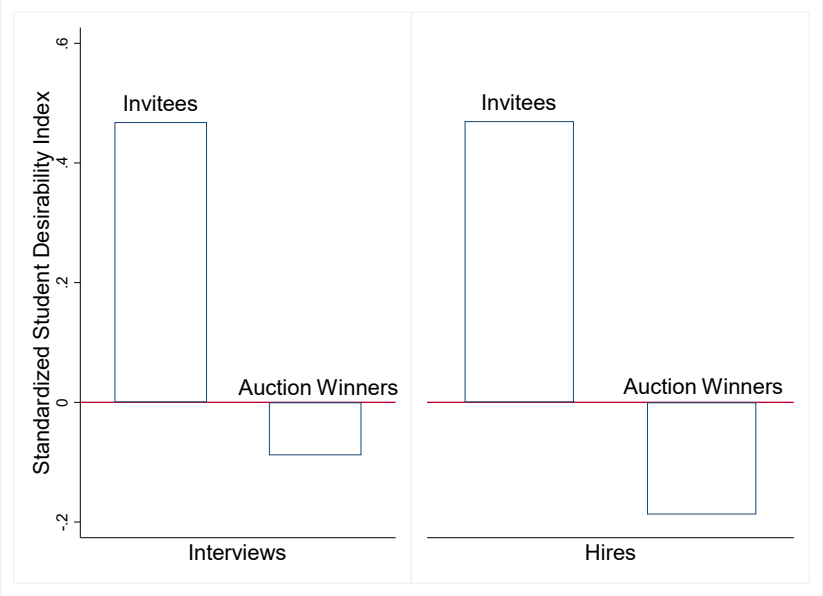

Notes: Bars show the results from a binscatter estimation, in which the observations underlying the bars are at the interviewee, job posting, semester level. The bins are based on the terciles of firm desirability (firm percentile in the salary distribution averaged over all semesters), for the sample of all interviewed applicants. The dependent variable is whether the student is hired for the job posting. The binned estimation additionally controls for semester fixed effects and total students interviewed for the job posting.

**Figure 5: Auctions and Characteristics of Hired Candidates**

(a) Below-Median Desirability Firms



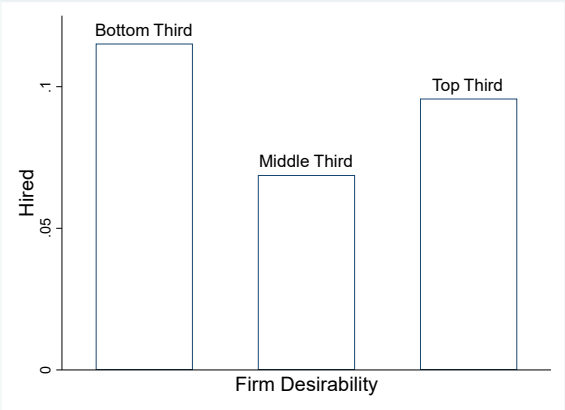

(b) Above-Median Desirability Firms



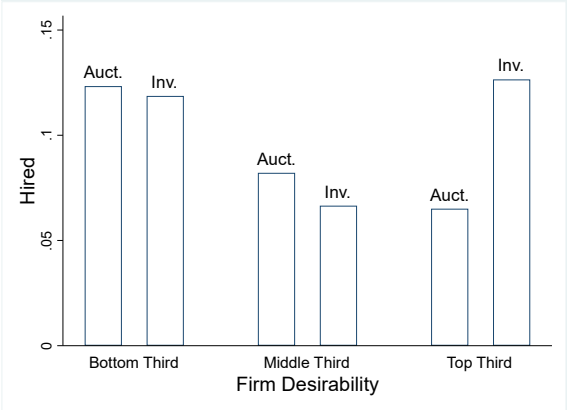

Notes: Plots show the mean student desirability index for invited applicants and auction winners. The left plot shows differences among interviewees. The right plot shows differences among hires. See text for details, including construction of the student desirability index and the firm desirability measure.

**Figure 6: Unfilled Vacancies, Offers to Auction Winners, and Competition from Other Firms**

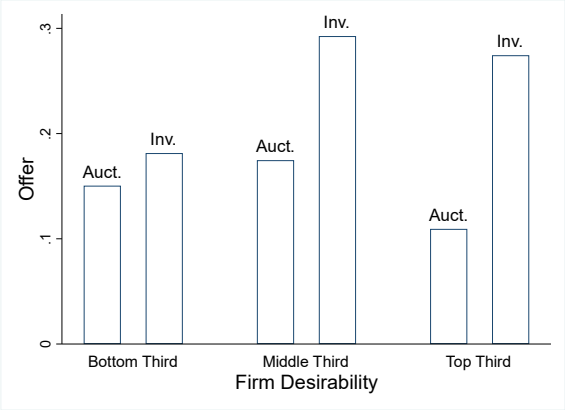
(a) Likelihood that Interviewee is Hired, by Firm Desirability




(b) Likelihood that Interviewee is Hired, by Firm Desirability and Interview Source




(c) Likelihood that Interviewee Gets an Offer, by Firm Desirability and Interview Source




(d) Other Offers, Among Students Getting an Offer from the Firm, by Firm Desirability


(e) Other Offers from High Desirability Firms, Among Students Getting an Offer from the Firm

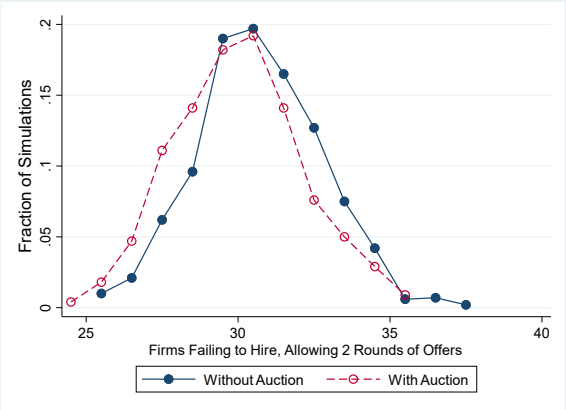

Notes: Each plot shows results of binscatter estimation, with observations binned by firm desirability (average percentile in the salary distribution, across all semesters). Observations are at the student, job posting, semester level. The binned estimation in (a) through (c) additionally controls for semester fixed effects and total students interviewed for the job posting. For (c) through (e), the sample is restricted to recruiting during the 2010-2011 and 2011-2012 academic years, as these students received surveys asking about all offers. We further restrict to respondents. For (d) and (e) the sample is limited to students receiving an offer from job posting *j* that semester. For each student, we calculate the total offers received that semester minus one, and plot by firm *j's* desirability measure. In (e), for observations with above-median desirability firms, we calculate total offers from above-median desirability firms minus one. For all others, we calculate total offers from above-median desirability firms. See text for details.

**Figure 7: Firms Failing to Hire in Counterfactual Simulations**

Scenario: Firms Have Random Preferences Over Interviewees, Applicants Agree on Above-Median Firms

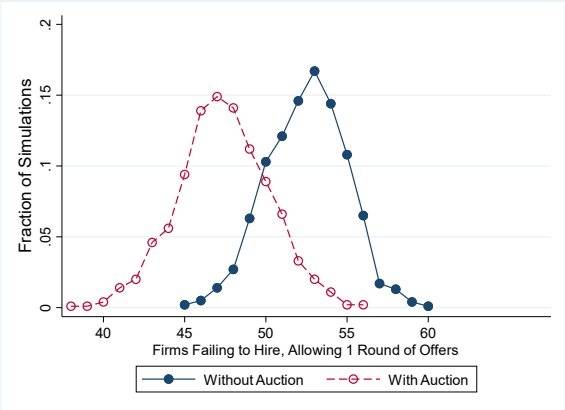
(a) One Round of Offers


(b) Two Rounds of Offers

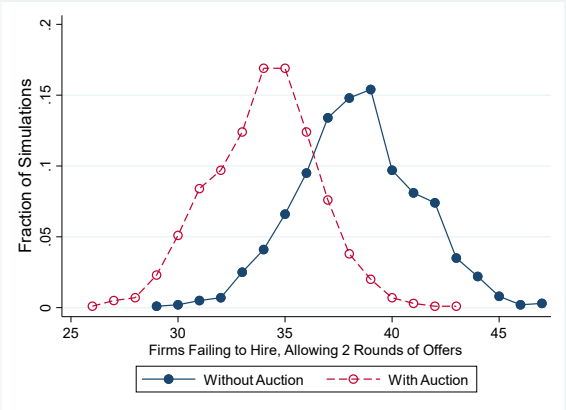



Scenario: Firms Agree on Above-Median Interviewees, Applicants Agree on Above-Median Firms

(c) One Round of Offers




(d) Two Rounds of Offers




Notes: Figures show results from 1000 simulations of a counterfactual setting without auctions, and 1000 simulations of a setting with auctions. Each point shows the fraction of simulations yielding the x-value for the number of firms who do not hire. See paper for details.

**Table 1: Summary Statistics: Job Postings and Applicants**

| | |
|---|---|
| Total Interview Schedules with Auctions | 182 |
| Interview Schedules with Auctions Per Semester | 20.2 |
| | [9.2] |
| **Interview Schedule Characteristics, Schedules with Auctions** | |
| Applicants Per Schedule | 41.8 |
| | [18.0] |
| Campus Interviews Per Schedule | 13.0 |
| | [5.6] |
| Campus Interviews Per Schedule, Invited | 7.0 |
| | [3.8] |
| Campus Interviews Per Schedule, Not Invited | 6.0 |
| | [3.0] |
| # Hires of Campus Interviewees Per Schedule | 1.0 |
| | [1.1] |
| % Schedules with Zero Hires per Semester | 0.38 |
| | [.49] |
| **Interviewee Characteristics** | |
| Total Applications Sent | 19 |
| | [8.2] |
| Total Interviews | 7.4 |
| | [3.7] |
| Total Interviews, Invited | 4.3 |
| | [3.4] |
| Total Interviews, Not Invited | 3 |
| | [2.2] |

Notes: Standard deviations in brackets. Statistics are for schedules with auctions, in which at least one person is interviewed who was an auction winner or obtained their interview through the free-for-all period, and one person is interviewed as a first-round choice of the firm.

**Table 2: Predicting the Number of Interview Invitations Per Student**

| | Mean and Standard Deviations | | Linear Prediction |
|---|---|---|---|
| | Invitees | Auction Winners | Y = Total Interview Invitations |
| Female | 0.74 | 0.73 | -0.204 |
| | [.44] | [.44] | (0.203) |
| Black or Hispanic | 0.17 | 0.14 | 0.0325 |
| | [.38] | [.35] | (0.322) |
| Asian | 0.13 | 0.23 | -0.887*** |
| | [.34] | [.42] | (0.288) |
| Years from Bachelor's ≥ 2 | 0.31 | 0.27 | -0.0300 |
| | [.46] | [.45] | (0.194) |
| US Citizen/Permanent Resident | 0.93 | 0.86 | 0.140 |
| | [.26] | [.35] | (0.291) |
| Pre-Master's Occupation Similar to Degree | 0.56 | 0.45 | 0.898*** |
| | [.5] | [.5] | (0.189) |
| Fortune 1000/Forbes 2000 Pre-Master's | 0.34 | 0.22 | 0.813*** |
| | [.47] | [.41] | (0.216) |
| Bachelor's Institution: Research 1 | 0.67 | 0.62 | 0.584 |
| | [.47] | [.48] | (0.359) |
| 3.4 < Undergraduate GPA ≤ 3.7 | 0.5 | 0.5 | 0.254 |
| | [.5] | [.5] | (0.234) |
| Undergraduate GPA > 3.7 | 0.31 | 0.23 | 0.853*** |
| | [.46] | [.42] | (0.304) |
| Undergraduate Latin Honors | 0.15 | 0.09 | 0.843* |
| | [.36] | [.29] | (0.450) |
| Any Awards or Honors | 0.61 | 0.53 | 0.156 |
| | [.49] | [.5] | (0.188) |
| Any Leadership in Univ. Activities | 0.76 | 0.69 | 0.0755 |
| | [.43] | [.46] | (0.216) |
| Team Sports | 0.08 | 0.06 | 0.340 |
| | [.28] | [.23] | (0.400) |
| Any Professional Clubs | 0.59 | 0.49 | 0.287 |
| | [.49] | [.5] | (0.194) |
| Any Volunteering | 0.52 | 0.46 | 0.366** |
| | [.5] | [.5] | (0.186) |
| Business/HR/Communications Major | 0.45 | 0.38 | 0.444** |
| | [.5] | [.49] | (0.209) |
| Psychology Major | 0.35 | 0.41 | -0.331 |
| | [.48] | [.49] | (0.233) |
| GMAT/GRE Concorded Score | 532.34 | 532.66 | 0.00100 |
| | [94.81] | [99.17] | (0.00114) |
| Total Applications Per Person | 19.18 | 18.86 | 0.177*** |
| | [8.24] | [8.2] | (0.0128) |
| N | 1277 | 1084 | 608 |
| R-Squared | | | 0.487 |

Note: *** p-value ≤ .01, ** p-value ≤ .05, * p-value ≤ .1. Standard deviations in brackets in Columns 1 and 2. Column 1 contains mean characteristics for those obtaining their interview through the firm's invitation, and column 2 for individuals obtaining their interview through the auction. Standard errors in column 3 are clustered at the student level, and shown in parentheses. The regression in column 3 includes semester fixed effects, and also includes an indicator for other race, highly selective bachelor's institution, any honor societies, and any fraternity/sorority listed on the resume (coefficients not shown). See paper for details.

**Table 3: Likelihood of Hire Conditional on Interview, by Interview Source**

| $Y_{is}$ = *Individual i Hired for Internship s* | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
|---|---|---|---|---|---|---|---|
| Interview From Auction (Auction)$_{is}$ | -0.004 | 0.006 | -0.013 | 0.011 | -0.011 | -0.039 | 0.051 |
| | (0.012) | (0.021) | (0.015) | (0.022) | (0.016) | (0.038) | (0.034) |
| Standardized Student Desirability Index$_{it}$ | -0.007 | -0.028** | 0.007 | | | | |
| | (0.008) | (0.013) | (0.011) | | | | |
| Auction$_{is}$*Student Desirability$_{i}$ | 0.009 | 0.041** | -0.014 | 0.044** | -0.019 | -0.013 | -0.017 |
| | (0.011) | (0.019) | (0.015) | (0.020) | (0.015) | (0.042) | (0.039) |
| Auction$_{is}$*Student Desirability$_{i}$ *Bid Value$_{is}$ | | | | | | 0.026** | 0.004 |
| | | | | | | (0.012) | (0.011) |
| Auction$_{is}$ *Bid Value$_{is}$ | | | | | | 0.012 | -0.016 |
| | | | | | | (0.012) | (0.011) |
| N | 2,361 | 1,034 | 1,273 | 1,034 | 1,273 | 713 | 847 |
| R-Squared | 0.096 | 0.118 | 0.073 | 0.143 | 0.088 | 0.185 | 0.122 |
| Firm Desirability | All | Low | High | Low | High | Low | High |
| Student Controls | N | N | N | Y | Y | Y | Y |
| Job Posting Fixed Effects | Y | Y | Y | Y | Y | Y | Y |

Note: *** p-value ≤ .01, ** p-value ≤ .05, * p-value ≤ .1. Each observation is an individual *i* , job posting *s* pair. We include only pairs for which the individual *i* has an interview, and is on the firm's interview schedule. The variable *Interview From Auction* denotes applicants who won the interview auction for that interview schedule and those obtaining the interview through the free-for-all period after the auction. The omitted category is interview by invitation, which includes applicants initially invited for an interview by the firm, and those obtaining their interview after being selected by the firm as an alternate. For each firm and semester, we calculate the average salary paid to the interns at that firm. We do this for all firms, including those hiring outside of formal campus recruiting. We then calculate the firm's percentile in the distribution of average salaries for that season, and then average across all recruiting seasons. High desirability (low desirability) firms refers to firms for which this average percentile is above (below) the median for the firms in the regression sample for that semester. The variable Student Desirability is based on a linear prediction of the total number of interview invitations a student receives that recruiting season, and is mean zero with standard deviation one. Columns 4 and 5 include the components of the index as linear regressors rather than the index itself. We present bootstrapped standard errors based on 400 replications. See paper for details.

**Table 4: Offer Acceptances and Other Offers Received, by Interview Source**

| | (1) | (2) | (3) |
|---|---|---|---|
| | *Y = Offer Accepted* $_{is,}$ Conditional on Offer | Other Offers Received | Other High-Wage Offers Received |
| Interview From Auction (Auction)$_{is}$ | 0.216** | 0.300 | 0.420 |
| | (0.086) | (0.584) | (0.349) |
| Standardized Student Desirability Index$_{it}$ | -0.146*** | | |
| | (0.054) | | |
| Auction$_{is}$*Student Desirability$_{i}$ | 0.153 | | |
| | (0.102) | | |
| Firm Desirability | 0.331* | 1.225* | 0.693* |
| | (0.189) | (0.649) | (0.380) |
| Firm Desirability*Auction Winner | | -2.284** | -1.635*** |
| | | (0.971) | (0.524) |
| N | 152 | 152 | 152 |
| R-Squared | 0.150 | 0.284 | 0.224 |
| Mean Y$_{is}$ | 0.458 | 2.007 | 0.789 |
| Mean, Firm Desirability | | 0.584 | 0.584 |
| S.D., Firm Desirability | | 0.221 | 0.221 |

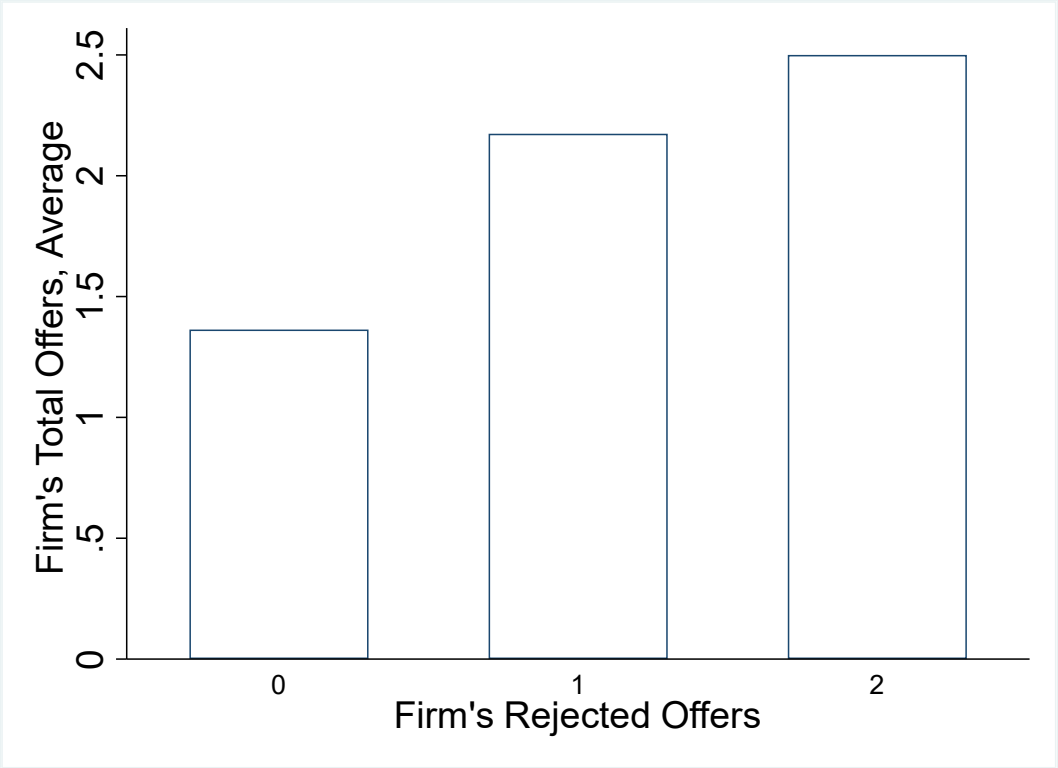
Note: *** p-value ≤ .01, ** p-value ≤ .05, * p-value ≤ .1. We present bootstrapped standard errors based on 400 replications in column (1) because student desirability is a generated regressor, and standard errors clustered at the student level in parentheses in columns (2) and (3). Observations are at the student, job posting *s* , semester level. Regressions are limited to years in which students received a survey asking for information about all offers (2010-2011 and 2011-2012 academic years), and to students who responded to the survey. Regressions are limited to students who receive an offer from job posting *s* in that semester. In column 2, for each student, we calculate the total offers received other than the offer from job posting *s* , and regress on firm *s* 's desirability (average percentile in the salary distribution, across all semesters). In column 3, we calculate the total other offers they received that semester from above-median desirability firms. For above-median desirability firms, we calculate total offers from above-median desirability firms minus one. See text for details. All columns include semester fixed effects. See paper for details.

**Table 5: Differences Between Invitees and Auction Winners, Among Interviewees and Hires**

| | All Firms | | Low Desirability Firms | | High Desirability Firms | |
|---|---|---|---|---|---|---|
| | Interviews | Hires | Interviews | Hires | Interviews | Hires |
| **Panel A: Y = Standardized Student Desirability Index** | | | | | | |
| Auction Winner | -0.590*** | -0.338** | -0.576*** | -0.0681 | -0.611*** | -0.828*** |
| | (0.0662) | (0.141) | (0.0746) | (0.168) | (0.0788) | (0.210) |
| N | 2,307 | 180 | 1,034 | 94 | 1,273 | 86 |
| R-Squared | 0.172 | 0.131 | 0.152 | 0.206 | 0.206 | 0.356 |
| **Panel B: Y = Fortune 1000/Forbes 2000 Experience** | | | | | | |
| Auction | -0.130*** | -0.113* | -0.131*** | -0.0438 | -0.134*** | -0.246** |
| | (0.0290) | (0.0679) | (0.0343) | (0.103) | (0.0348) | (0.0983) |
| N | 2,307 | 180 | 1,034 | 94 | 1,273 | 86 |
| R-Squared | 0.064 | 0.070 | 0.063 | 0.104 | 0.089 | 0.200 |
| **Panel C: Y = Asian** | | | | | | |
| Auction | 0.0944*** | 0.142** | 0.114*** | 0.148 | 0.0774*** | 0.137* |
| | (0.0224) | (0.0645) | (0.0306) | (0.0920) | (0.0258) | (0.0807) |
| N | 2,222 | 168 | 974 | 83 | 1,248 | 85 |
| R-Squared | 0.053 | 0.093 | 0.070 | 0.193 | 0.053 | 0.275 |
| **Panel D: Y = Resume Activities** | | | | | | |
| Auction | -0.213*** | -0.211 | -0.246*** | -0.145 | -0.194** | -0.359 |
| | (0.0704) | (0.156) | (0.0859) | (0.249) | (0.0834) | (0.236) |
| N | 2,307 | 180 | 1,034 | 94 | 1,273 | 86 |
| R-Squared | 0.071 | 0.115 | 0.065 | 0.098 | 0.074 | 0.196 |
| **Panel E: Y = Bachelor's GPA in Top Quartile GPA** | | | | | | |
| Auction | -0.0893*** | -0.0246 | -0.0758** | 0.0318 | -0.0996** | -0.0821 |
| | (0.0329) | (0.0795) | (0.0366) | (0.103) | (0.0386) | (0.122) |
| N | 1,885 | 146 | 830 | 74 | 1,055 | 72 |
| R-Squared | 0.051 | 0.031 | 0.040 | 0.146 | 0.059 | 0.053 |
| **Firms Without Citizenship Restrictions, Y = US Citizen** | | | | | | |
| Auction Winner | -0.312*** | -0.467*** | | | | |
| | (0.0523) | (0.155) | | | | |
| N | 438 | 40 | | | | |
| R-Squared | 0.287 | 0.398 | | | | |

Notes: Student Desirability Index is the predicted number of interview invitations for a student, based on a linear regression of total interview invitations on student characteristics, total applications, and semester fixed effects. The prediction is based only on the student characteristics. The variable is standardized to be mean zero and with standard deviation of one for the sample of all applicants. High desirability (low desirability) firms refers to firms for which the average salary percentile across all semesters is above (below) the median for the firms in the regression sample for that semester. Regressions also include semester fixed effects and the firm's desirability measure (average percentile in the salary distribution across all semesters). Standard errors are clustered at the student level. See text for details.

Appendix Figure A1: Relationship between Offers Rejected and Total Offers




Note: This plot shows the average number of total offers made by firms, for each value of rejected offers on the x-axis. Among firms that made offers, nearly 87% had two or fewer offers rejected. We do not show results for greater numbers of offers rejected, as the sample size per value of rejected offers is very small for these values. See paper for details.

**Appendix Table A1: Likelihood of Hire and Offer Conditional on Interview, by Interview Source**

| | Y = Hired | | Y = Offer | | Y = Offer | |
|---|---|---|---|---|---|---|
| Interview From Auction (Auction)$_{is}$ | 0.015 | 0.013 | -0.007 | -0.077** | -0.002 | -0.079** |
| | (0.028) | (0.023) | (0.037) | (0.030) | (0.040) | (0.032) |
| Standardized Student Desirability Index$_{it}$ | -0.021 | 0.001 | 0.002 | 0.053** | | |
| | (0.017) | (0.018) | (0.026) | (0.024) | | |
| Auction$_{is}$*Stud. Desirability$_{i}$ | 0.060** | 0.005 | 0.071* | -0.049 | 0.066 | -0.077** |
| | (0.027) | (0.027) | (0.041) | (0.032) | (0.047) | (0.034) |
| N | 459 | 551 | 459 | 551 | 459 | 551 |
| R-Squared | 0.127 | 0.083 | 0.177 | 0.148 | 0.216 | 0.217 |
| Firm Desirability | Low | High | Low | High | Low | High |
| Student Controls | N | N | N | N | Y | Y |
| Job Posting Fixed Effects | Y | Y | Y | Y | Y | Y |

Note: *** p-value ≤ .01, ** p-value ≤ .05, * p-value ≤ .1. Each observation is an individual *i* , job posting *s* pair. Regressions are limited to years in which students received a survey asking for information about all offers (2010-2011 and 2011-2012 academic years), and to students who responded to the survey. Columns 5 and 6 include the components of the student desirability index as linear regressors rather than the index itself. We present bootstrapped standard errors based on 400 replications. See paper for details.

**Appendix Table A2: Differences Between Invitees and Auction Winners, Among Interviewees and Hires**

| | All Firms | | Low Desirability Firms | | High Desirability Firms | |
|---|---|---|---|---|---|---|
| | Interviews | Hires | Interviews | Hires | Interviews | Hires |
| **Firms with Citizenship Restrictions, Y = Asian Applicant** | | | | | | |
| Auction | 0.0328 | 0.0575 | 0.0156 | -0.0391 | 0.0458* | 0.0938 |
| | (0.0234) | (0.0660) | (0.0287) | (0.111) | (0.0272) | (0.0775) |
| N | 1,679 | 119 | 663 | 50 | 1,016 | 69 |
| R-Squared | 0.043 | 0.084 | 0.040 | 0.126 | 0.051 | 0.248 |

Notes: Regressions also include semester fixed effects and the firm's desirability measure (average percentile in the salary distribution, across all semesters). Standard errors are clustered at the student level. Firms with citizenship restrictions are those that restrict applications to individuals who are US Citizens or permanent residents. See text for details.

**Appendix Table A3: Likelihood of Hire Conditional on Interview, by Interview Source**

| $Y_{is}$ = *Individual i Hired for Internship s* | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| Interview From Auction (Auction)$_{is}$ | 0.030 | -0.027 | 0.044 | 0.076* |
| | (0.018) | (0.017) | (0.042) | (0.044) |
| Standardized Student Desirability Index$_{it}$ | -0.009 | -0.003 | -0.040 | -0.036 |
| | (0.011) | (0.012) | (0.027) | (0.028) |
| Auction$_{is}$*Student Desirability$_{i}$ | 0.013 | 0.001 | 0.054 | 0.056 |
| | (0.017) | (0.018) | (0.037) | (0.038) |
| Auction$_{is}$*Student Desirability$_{i}$*Firm Desirability$_{s}$ | | | -0.073 | -0.078 |
| | | | (0.060) | (0.059) |
| Auction$_{is}$*Firm Desirability$_{s}$ | | | -0.083 | -0.124* |
| | | | (0.064) | (0.067) |
| Student Desirability$_{i}$*Firm Desirability$_{s}$ | | | 0.053 | 0.048 |
| | | | (0.043) | (0.047) |
| Differential Likelihood of Hiring an Auction Winner Relative to Invitee with Student Desirability 1 SD Above Mean, for | | | | |
| Firms with Desirability 1 SD Below Mean | | | 0.040 | .046** |
| | | | [.025] | [.022] |
| Firms with Desirability 1 SD Above Mean | | | -0.027 | -0.033 |
| | | | [.021] | [.022] |
| N | 972 | 1,213 | 2,307 | 2,185 |
| R-Squared | 0.093 | 0.103 | 0.097 | 0.100 |
| Firm Desirability | Low | High | All | All |
| Firm Desirability based on Fulltime or Intern Salary | FT | FT | Intern | FT |

Note: *** p-value ≤ .01, ** p-value ≤ .05, * p-value ≤ .1. Each observation is an individual *i* , job posting *s* pair. We include only pairs for which the individual i has an interview, and is on the firm's interview schedule. The variable Interview From Auction includes applicants who won the interview auction for that interview schedule and those obtaining the interview through the free-for-all period after the auction. The omitted category is interview by invitation, which includes applicants initially invited for an interview by the firm, and those obtaining their interview after being selected by the firm as an alternate. For each firm and semester, we calculate the average salary paid to the interns at that firm (column 3) or to fulltime hires (columns 1, 2, and 4). We do this for all firms, including those hiring outside of formal campus recruiting. We then calculate the firm's percentile in the distribution of average salaries for that season, and then average across all semesters. High desirability (low desirability) firms refers to firms for which this average percentile is above (below) the median for the firms in the regression sample for that semester. The variable Student Desirability is based on a linear prediction of the total number of interview invitations a student receives that recruiting season, and is mean zero with standard deviation one among the sample of all applicants. We present bootstrapped standard errors based on 400 replications. See paper for details.

**Appendix Table A4: Offer Acceptances and Conversions to Fulltime Jobs**

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| | *Y = Offer Accepted* $_{is,}$ Conditional on Offer | | *Y = Stay for FT Job* $_{is,}$ Conditional on Internship | |
| Interview From Auction (Auction)$_{is}$ | 0.216** | 0.227* | 0.042 | 0.072 |
| | (0.086) | (0.128) | (0.093) | (0.192) |
| Standardized Student Desirability Index$_{it}$ | -0.146*** | -0.125 | -0.054 | -0.150 |
| | (0.054) | (0.082) | (0.052) | (0.118) |
| Auction$_{is}$*Student Desirability$_{i}$ | 0.153 | 0.037 | 0.049 | 0.133 |
| | (0.102) | (0.135) | (0.091) | (0.177) |
| Firm Desirability | 0.331* | | 0.168 | |
| | (0.189) | | (0.214) | |
| N | 152 | 152 | 136 | 136 |
| R-Squared | 0.150 | 0.547 | 0.040 | 0.645 |
| Mean Y$_{is}$ | 0.458 | 0.458 | 0.529 | 0.529 |
| Job Posting Fixed Effects | N | Y | N | Y |

Note: *** p-value ≤ .01, ** p-value ≤ .05, * p-value ≤ .1. We present bootstrapped standard errors based on 400 replications. Observations are at the student, job posting *s* , semester level. Regressions in columns (1) and (2) are limited to years in which students received a survey asking for information about all offers (2010-2011 and 2011-2012 academic years), and to students who responded to the survey. Regressions in columns (3) and (4) exclude students who started the program in Fall 2011 or Spring 2012, since we do not observe fulltime jobs for those students. See paper for details.