Search Costs, Belief Formation, and Firm Hiring: Evidence from a Hiring Intervention in Ethiopia*

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Abstract

We introduced professional employment agencies to a random subset of 799 Ethiopian firms to help them find college-educated applicants. Treated firms received more college-educated applicants but were not more likely to interview or fill the vacancy. Instead, they became less optimistic about the productivity of college graduates, and a subset of them became less likely to interview and hire any college graduate. This is likely triggered by college-educated applicants with imperfect signals of their qualifications. Using a search model with imperfect information, we demonstrate that lowering search costs may be ineffective in job creation, but may still improve matching efficiency.

JEL Classification: O12, O21, J23, M51

Keywords: Firm Hiring, Search Costs, Belief Formation, Matching Efficiency, Job Creation, Employment Agency, Ethiopia

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Youth unemployment rates are high in many urban areas of low- and middle-income countries. In particular, highly educated workers face great challenges when searching for jobs, and yet many private firms complain about the lack of adequately educated workers.[1,2] This puzzling gap suggests potentially high search frictions in the labor market. To address this gap, new hiring channels have emerged to facilitate more interactions between firms and highly educated workers (Kelley et al., 2022; Fernando et al., 2023). Policymakers have also introduced active labor market policies (ALMPs) to lower search costs, such as subsidizing transportation for job seekers (Franklin, 2018; Abebe et al., 2021) and organizing job fairs (Abebe et al., 2024). Although these new hiring channels and policies tend to induce more job search by job seekers, their impact on employment outcomes is often negligible (McKenzie, 2017). Why?

We provide a new explanation from the perspective of firm hiring. In a simple framework with perfect information, lowering search costs in the labor market should increase the number of successful matches. However, the assumption of perfect information tends to fail in low- and middle-income countries. In these labor markets, some firms have very few interactions with highly educated workers (Hensel et al., 2024; Abebe et al., 2024); applicants also tend to send noisy signals about their productivity (Abebe et al., 2021; Bassi and Nansamba, 2022; Carranza et al., 2023). An increase in the number of applicants does not simply enlarge the pool that firms can choose from; it can also provide new information about the productivity of highly educated workers and trigger firms to update their beliefs. Depending on the direction of learning, the overall effect of reducing search costs on hiring can be ambiguous.

To test this learning hypothesis, we conducted a randomized controlled trial with 799 formal private firms actively hiring in Addis Ababa, Ethiopia, and collected detailed data on firms' perceptions. We partnered with local professional employment agencies to provide a random subset of firms with access to a larger pool of college-educated applicants. The intervention successfully reduced search costs for these firms, increasing their number of college-educated applicants by 35% relative to the control group. In general, the intervention had no effect on whether a firm interviewed any applicants or filled its vacancy, which resonates with other findings on ALMPs. However, it triggered a significant learning effect. Among firms that initially expressed a desire to hire a college graduate, treated firms became less optimistic about the productivity of college graduates and less likely to hire one. We discuss what potentially triggered learning and provide

[1] As of 2022, according to the estimates of International Labor Organization (ILO), 25.7% youth population aged between 15 and 24 are not in employment, education, or training. Workers with advanced education do not significantly outperform other demographics. See the discussion in https://ilostat.ilo.org/blog/african-youth-face-pressing-challenges-in-the-transition-from-school-to-work/.

[2] According to the Enterprise Surveys from the World Bank (http://www.enterprisesurveys.org), 19.9% of firms identify an inadequately educated workforce as a major or very severe constraint.

new insights on the effectiveness and efficiency of ALMPs when accounting for learning.

Our setting, the city of Addis Ababa, exemplifies many challenges of firm hiring. Firms in our sample used various channels to search for job seekers, but on average, each posted vacancy only received 1.8 applicants, with 65% vacancies receiving zero college-educated applicant. On the other hand, an estimate from Abebe et al. (2021) shows that 33% college graduates were not engaged in any employment three years after graduation. To address the mismatch, a new type of professional employment agency that specializes in high-skilled formal jobs has recently emerged. These agencies maintain a pool of college-educated job seekers and match them to firms at a faster pace, creating an ideal setting to test our hypothesis. We thus collaborated with 11 major agencies to experimentally study how firms react to an increased supply of college-educated applicants.

We conducted a randomized controlled trial where 41% of vacancies in our sample were randomly matched with one of 11 employment agencies, which were asked to provide one or two applicants for the matched vacancy within two weeks. Among firms initially assigned to treatment, 46% received at least one applicant from the employment agency. We prevented direct communication between firms and employment agencies, so firms could only obtain information on applicants through their résumés or interactions with the applicants themselves (e.g. interviews). During follow-up surveys, we constructed a list of all applicants for each vacancy and collected (i) firms' perceptions of each applicant's education, experience, and productivity, and (ii) firms' interviewing and hiring decisions for each applicant. For 80% of the applicants, we conducted a phone survey to collect information on education, experience, employment status, and other demographics.

The intervention worked as intended: agency applicants were primarily college-educated (81% vs. 44% from other channels) but similar to other applicants in experience, gender, age, and employment status. Consequently, compared to control firms, treated firms received 0.39 more college-educated applicants (35% increase), suggesting a credible increase in the access to college-educated applicants. Given that college education is the main selection criterion of employment agencies, we pre-registered heterogeneity analyses regarding firms' baseline request for college graduates.

We find that firms initially assigned to treatment were only 9.4 pp. more likely to interview any agency applicant; only seven treated firms hired anyone from the agency. At endline, treated firms were not more likely to interview any applicant or fill the vacancy. Instead, we discover a decrease in the perceived average productivity of college graduates. For each firm, we elicited firms' perceptions of all applicants and calculated the percentage of college-educated applicants perceived to be productive. We find that this statistic among treated firms is 26.2 pp. less than that among control firms (p-value 0.021, 34% decrease). Such a decrease in perception did not exist for non-college applicants. To address the concern that this could be driven by firms that would not have

had any college-educated applicants absent the treatment, we further confirm that the decrease in perception is also significant for treated firms that received at least one college-educated applicant from other hiring channels. We also asked all firms at endline whether they agreed college graduates are more productive than non-college workers on average, an outcome that is not subject to the same concern of potential selection induced by treatment. Treated firms were 8.7 pp. less likely to agree with such a statement (p-value 0.051, 11% decrease).

Consistent with the belief update, we observe a significant change in hiring behavior among firms initially seeking a college graduate. Those treated firms were 11.7 pp. less likely to interview (p-value 0.098, 19% decrease) and 19.7 pp. less likely to hire any college graduate (p-value 0.012, 34% decrease). Instead, they were 11.3 pp. more likely to interview (p-value 0.050, 86% increase) and 8.8 pp. more likely to hire at least one non-college worker (p-value 0.106, 80% increase). This result cannot be explained through the interactions of the initial treatment assignment and all other baseline characteristics, is robust to various statistical inference techniques, and is unaffected by the concerns of attrition, matching strategy of employment agencies, demand effect, or negative spillover on the control firms. We also find that among firms initially seeking a college graduate, treated firms were less likely to plan to post any jobs in the next three months after endline, suggesting the change in hiring behavior is likely to persist.

To test whether learning explains the shift in hiring behavior, we examine whether treatment effects are stronger among firms with less prior interaction with college graduates, as they should be more affected by the new information from college-educated applicants. Using the baseline share of college-educated employees (henceforth college share) as a proxy for past interaction, we find that among firms that requested a college graduate at baseline, treated firms with below-median college share were 27.8 pp. less likely to hire a college graduate and 14.9 pp. more likely to hire a non-college worker. Consistent with the learning hypothesis, the treatment effects on firms with above-median college share are neither significant nor robust.

What triggered learning? In our qualitative interviews with firms at endline, treated firms mentioned that some applicants lacked qualification, most importantly experience. We verify this qualitative observation with applicants' self-reported information. 67% of all college-educated applicants from the agencies met the minimum requirement for years of experience, which is not significantly different than other college-educated or non-college applicants. To test whether applicants' qualification alone explains the main results, we examine the treatment heterogeneity regarding minimum experience requirement, leveraging the fact that higher requirement for experience is correlated with fewer applicants with qualified experience. Among firms that requested a college graduate at baseline, we still find a salient shift in hiring behavior for treated firms with

low experience requirement, suggesting the shift in hiring behavior exists even among firms where it is *objectively* easier to find college-educated applicants with qualified experiences.

However, leveraging the detailed records of firms' perceptions of applicants, we find that of all college-educated applicants whose experiences met the minimum requirement, 33% were perceived unqualified by the firms *subjectively*. This gap is significantly higher than that of non-college applicants, cannot be explained by other applicants' demographics or whether the applicant's experience matched the job requirement, and is negatively correlated with the perceived productivity. College-educated applicants from agencies were not more likely to be considered unqualified. We find suggestive evidence that applicants' poor résumé writing is to blame: college-educated applicants with a résumé were still less likely to be considered qualified than non-college applicants. Reviewing more than 500 résumés from both agency applicants and a major online job search platform, we find that 20% of applicants did not list any experience, and another 12% only listed their employer and position without any descriptions. This is consistent with anecdotes suggesting that college graduates may not know how to effectively communicate their qualifications in their résumés, a fact that has been increasingly documented in the literature (Abebe et al., 2021; Bassi and Nansamba, 2022; Carranza et al., 2023). The descriptive evidence implies a key information friction: college-educated applicants sent a noisy signal of their productivity to potential employers.

We then discuss several alternative mechanisms. First, firms might have learned about college graduates' outside options and thought that college graduates would have rejected the offers. We find direct evidence that if anything, firms were *less* likely to perceive college graduates with more outside options than non-college workers. We also predict whether firms received agency applicants who would turn down interview invitations with baseline firm characteristics, and we do not find a significant shift in hiring behavior among firms with higher likelihood of being rejected. Second, firms might have updated their beliefs of non-referral applicants instead of college graduates because almost all agency applicants had no prior connections with the firms. Indeed, we find that treated firms became less optimistic of the productivity of non-referral applicants, but this decrease in belief only applies to college-educated ones. We also examine whether treated firms were more likely to use referral than non-referral hiring, but we only find such treatment effects among firms initially seeking for a college graduate. Both evidence suggests that college graduates are still the essential dimension. Third, firms might have perceived higher search costs when the employment agency failed to provide a college graduate as requested. We predict whether firms received any applicants from agencies with baseline firm characteristics, and we do not find treatment heterogeneity with respect to the likelihood of receiving an agency applicant.

However, there is a remaining question: college-educated applicants might have sent a noisy

signal of their productivity, but the signal is not necessarily biased in nature. Why was the learning effect negative? Guided by a simple equilibrium search model à la Diamond (1982), Mortensen (1977), and Pissarides (2000), we show that in a search economy with imperfect information, firms who formed a pessimistic belief about workers' productivity would have exited the search economy. Therefore, firms that posted vacancies for college graduates were positively selected with respect to initial beliefs of workers' productivity. Existing evidence from Abebe et al. (2024) suggests that indeed, firms tended to overestimate college graduates' performance in a Raven's test. Similarly, we conducted an exercise to elicit firms' perceptions of the outside options of college-educated applicants in our sample, and we find that firms also overestimated the likelihood of these applicants having a higher-paid outside option. The evidence above provides support for the prediction of overoptimistic firms in the search equilibrium.

Our model further predicts that even if the intervention did not increase successful matches, the matching efficiency could still be improved because firms would not inefficiently create vacancies for college graduates based on overoptimistic beliefs. Empirically, we find that among firms initially seeking a college graduate, treated firms did not experience productivity loss, and our complier analysis suggests that treated firms might benefit from paying less for non-college workers. Our findings thus provide a silver lining for ALMPs that lower search costs: Although these policies may not be an effective tool for creating more jobs, they may still improve matching efficiency by decreasing the number of inefficient vacancies.

Related Literature and Contributions. This paper provides a new explanation for the lack of effectiveness of ALMPs in low- and middle-income countries from the perspective of firm hiring. Current literature has documented the existence of prohibitive search costs in low- and middle-income countries, yet interventions that simply reduce search costs do not often improve job seekers' employment outcomes meaningfully (Abebe et al., 2021; Abel et al., 2019; Bandiera et al., 2023; Banerjee and Sequeira, 2022; Caria et al., 2024; Dammert et al., 2015; Franklin, 2018; Kelley et al., 2022). Some recent evidence from Ethiopia and India shows that simply reducing search costs for firms also do not lead to significant increase in successful matches (Fernando et al., 2023; Hensel et al., 2024). Meanwhile, interventions that reduce information asymmetries are often more successful (Abebe et al., 2024; Abel et al., 2020; Alfonsi et al., 2023; Banerjee and Chiplunkar, 2022; Banerjee and Sequeira, 2022; Bassi and Nansamba, 2022; Beam, 2016; Carranza et al., 2023; Pallais, 2014).[3] Our work connects these streams by demonstrating how lowering search costs for

[3]Search frictions and information frictions can be intertwined. For example, Banerjee and Sequeira (2022) incentivized job seekers in South Africa to conduct more job searches and found that job seekers adjusted their beliefs about the labor market. Abebe et al. (2024) conducted a job fair in Addis Ababa and found that firms and workers

firms can induce a negative learning effect and fail to increase successful matches. However, we do not wish to discredit ALMPs too hastily because job creation may not fully capture matching efficiency when firms may inefficiently create jobs based on overoptimistic beliefs of workers. A different metric may be needed to evaluate the impact on matching efficiency where information frictions are severe.[4]

Second, this paper adds to the emerging literature of firm hiring in low- and middle-income countries, where research has been limited by the availability of data on private firms. The growing literature on hiring in high-income countries rely on detailed personnel data from large corporations, which is almost non-existent in sub-Saharan African countries with some exceptions (Hjort, 2014; Donald and Grosset-Touba, 2024). We managed to collect detailed hiring records from a large sample of medium-sized private firms in a low-income country. Crucially, we collected firms' perceptions on applicants, which allows us to examine the learning mechanism directly. Evidence from high-income countries suggests a high level of information frictions faced by firms before making hiring decisions (Li et al., 2023; Friedrich and Zator, 2024; Benson and Lepage, 2024; Cullen et al., 2022). Our findings, although indirectly, suggest that such information frictions are potentially even more severe for firms in low- and middle-income countries.

Finally, this paper contributes to a smaller branch of literature on labor market intermediaries. Existing evidence documents that labor market intermediaries can credibly send a positive signal of workers to firms by inducing a positive selection of workers in the first place (Stanton and Thomas, 2016; Autor, 2008, 2001). In our setting, employment agencies consistently provide college-educated applicants as their main strategy and are able to lower search costs, but with little success in creating more matches, which reveals limitations of positive selection where information frictions are more severe. Our findings suggest that labor market intermediaries may not be sustainable in these labor markets if they do not provide additional services to address information frictions faced by firms.

The rest of the paper is structured as follows. Section I discusses the context. Section II describes our research design. Section III discusses the main results on hiring and belief update. Section IV discusses factors that might induce learning. Section V discusses the implications of matching efficiency in the framework of equilibrium search. Section VI concludes.

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both updated their beliefs about the labor market through mutual interactions. Our results show that firms updated their beliefs about the average productivity of college-educated applicants after being exposed to more of them.

[4]This implication can be potentially applied to high-income countries because their labor markets also feature a non-negligible level of search costs and information asymmetry (Altmann et al., 2018; Belot et al., 2019; Jäger et al., 2021; Algan et al., 2020). Research on ALMPs in high-income countries also finds a limited impact on job creation at least in the short run (see Card et al. (2018) for a review).

I Context

A Labor Market in Ethiopia

Ethiopia has undergone a significant increase in the number of college-educated population over the last three decades. In the early 1990s, there were only three public universities across the whole country enrolling 1% of all young people aged 18–25. In 2018, the gross attendance rate in tertiary education in Ethiopia jumps to 12% (Ethiopian Socioeconomic Survey), compared to 9.4% across Sub-Saharan Africa (UNESCO). However, the unemployment rate among college graduates has become alarming recently. Abebe et al. (2021) followed 510 young job seekers in Addis Ababa with a college diploma or degree, among whom 33% were not engaged in any employment activities three years after graduation.

This seems at odds with the high labor demand for college graduates we observe from our sample of 799 firms, of which we will discuss the sampling method in the next section. 35% firms from our sample were looking for college graduates, much higher than the estimated attendance rate in tertiary education according to Ethiopian Socioeconomic Survey. Indeed, most firms valued college education. We asked firms at the baseline whether they think college graduates are more productive and have more job opportunities than non-college educated workers. 70% of the firms agreed that college graduates are more productive than non-college educated workers, and 61% believed that there are more job opportunities for college graduates in the current labor market. It is consistent with the common heuristic that higher educational attainment is correlated with higher productivity, either through the value-added to human capital (Becker, 1964) or through the selective procedure of tertiary education (Spence, 1978) .

One explanation to reconcile these two opposing facts is high search frictions. Firms in our sample used multiple ways to search for job seekers, yet the number of applicants for the posted vacancies remained abysmal. 47% of the firms posted their vacancies on the notice boards, the most common job platforms located in the city center of Addis Ababa. 45% of the firms would ask for internal referrals through friends, family, and current employees. 35% would search for job seekers from informal brokers scattered around the city, mostly for low-skill jobs such as construction work. A smaller proportion of firms would use more costly platforms such as newspapers (11%), online job platforms (13%), and formal employment agencies (8%), to seek for high-skill workers. Figure 1 shows the distribution of the number of applicants for our sampled vacancies over the period of five months (excluding those from the employment agencies in our intervention). The median number of applicants was merely one, the average 1.8, with 22% of firms having no applicants at all. Panel

B focuses on the distribution of college educated applicants. 65% of these vacancies did not receive any college educated applicant. The descriptive evidence confirms the severity of search frictions in this labor market.

In addition, given the rapidly growing private sector in Addis Ababa, many private firms are potentially inexperienced in hiring. For the firms in our sample, the median age is seven years, and the median number of vacancies posted is one per year. Combined with the small number of applicants per vacancy, private firms may not be able to obtain enough information of productivity for specific groups of workers, for instance, college graduates, which may result in inaccurate beliefs of their productivity.

B Employment Agencies

Can the labor market correct search frictions itself? We observe a new, specialized type of labor market intermediary, employment agency, that might act as a market self-correction. Responding to the increasing gap between unemployed college graduates and firms' demand for skilled workers, some job brokers in informal sectors started to tailor the recruitment service to highly educated job seekers and became professional employment agencies.[5] By strategically locating at the city center, these employment agencies are able to attract a large group of job seekers with a college diploma or degree as well as firms with higher-paid formal jobs, effectively acting as a new job platform that matches firms and college graduates at a much faster pace. Appendix B provides more details on the recent increasing trend of professional employment agencies.

We interviewed the owners of 25 employment agencies between July and August 2021, in Bole sub-city where most recruitment services located, to observe their daily operations and interactions with job seekers. In general, employment agencies did not seem to provide sophisticated recruitment services. Most employment agencies only checked applicants' basic documents such as identifications and education certificates. Some might recommend vocational training facilities to job seekers or check previous employers' recommendation. Most did not provide additional training that potentially enhanced workers' productivity or conduct additional grading test that potentially improved the signals of workers' productivity. In addition, we asked 539 job seekers in our sample about their perceived benefits from employment agencies. Job seekers mostly agreed that employ-

[5]In 2018, the new Ethiopian government issued an initiative to encourage qualified brokers to register in the government in hope for boosting private and formal employment. To qualify for registration, an employment agency should obtain a business license for taxation purpose, hire at least one expert with professional license in human resources, have at least four employees, have a physical office, and deposit 200,000 Ethiopian birr (ETB) in a security account. The Ministry of Labor and Skills of Addis Ababa appoints local officials to specifically regulate and audit all registered employment agencies. Upon successful matches, employment agencies usually charge 10–20% first-month salary from firms, although informally they also charge job seekers an entry fee between 100–500 ETB.

ment agencies provided some advice on which jobs to apply to, but did not help with networking, interview preparation or résumé writing. This corroborates our observation that employment agencies did not increase human capital or provide better signals of productivity. We thus believe that qualitatively, the main function of employment agencies is to reduce search costs and facilitate matching between firms and college-educated job seekers. Given that very few firms in our sample used any professional employment agencies for hiring in the past, we were able to design an RCT to leverage these employment agencies to lower search costs for a random subset of firms.

II Data and Intervention

We first conducted a pilot during early May 2022. We then conducted two rounds of data collection: May–October 2022 (Round 1), November 2022–April 2023 (Round 2).

A Sampling

We conducted the following approach to collect a representative sample of active job vacancies. First, we consulted with local government officials from five sub-cities (Bole, Akaki Kality, Yeka, Nefas Silk-Lafto, Lemi Kura) to understand where most businesses are located within the sub-cities. We then delineated 88 business areas in total where most firms conduct businesses; each business area has about 50–100 formal firms. In each business area, enumerators enlisted as many formal firms as possible. Enumerators then selected 10 firms from each business area following three criteria: (1) at least four employees; (2) currently hiring or planning to hire within one month; (3) respondents agreed that hiring is challenging.[6]

This sampling method has a number of unique advantages. First, we were able to observe currently operating firms in a much faster way. An alternative sampling method is to obtain a firm registry from the Ministry of Trade. Such registry, however, may have outdated information. During our pilot, we obtained a list from the firm registry and only succeeded in contacting less than 20% of the listed firms. Our sample includes 35% firms from manufacturing sector and 39% from hospitality sector, slightly different than other firm samples in Ethiopia. Second, we were able to observe firms that did not post jobs on public platforms such as notice boards or online job search platforms which charged a relatively high job-posting fee. As a result, our vacancy sample captures more lower-paid jobs. Third, we targeted formal firms with at least four employees. The

[6]We enlisted 3,369 firms in total. 958 firms had at least four employees and were currently hiring or planning to hire within one month. We included the third selection criterion to target firms in need for recruitment service; however, among these 958 firms, 97% agreed that hiring is challenging, and thus this criterion is not as binding.

median firm size in our sample is 20 employees. Such firms may have a higher labor demand that cannot be met through internal network, hence more likely to hire externally. Appendix C provides additional details comparing our sample with other existing firm samples in Ethiopia.

B Intervention

During the baseline, enumerators collected basic information of sector, workforce structure, and hiring practices. We then selected one active job vacancy from each firm and collected vacancy details including minimum requirements on education and experience, job descriptions, and highest salaries that firms are willing to pay, or reservation wage. We use "firm" and "vacancy" interchangeably in the main analysis. 80% firms in our sample posted only one vacancy during the baseline survey. For those who posted more than one vacancy, we avoided collecting low-skill positions such as janitors, or positions requiring many years of experience such as executive managers.

At the end of the baseline, we implemented the following intervention. We first selected 11 employment agencies that were actively operating during the survey period and had a large labor pool. Only 8% of firms in our sample had worked with any professional employment agency previously. Among firms with reservation wage at least 2,000 ETB (henceforth eligible firms), we randomly selected 326 firms into treatment group, stratified by business areas. Firms that were not willing to pay more than 2,000 ETB were not considered for the intervention.[7] To examine the extent of spillover effect, in Round 2, we randomly selected 21 business areas, and randomly assigned 75% eligible firms per business areas to the treatment; the other 20 business areas in Round 2 were not selected for the treatment.

The matching process followed three steps. First, enumerators quasi-randomly matched each treated firm with one of the 11 employment agencies.[8] Second, the employment agency was requested to select 1–2 qualified applicants within two weeks for each matched vacancy. We did not interfere with the selection process. Following conventions, we guaranteed 20% first-month salary

[7]We implemented the 2,000 ETB threshold to ensure the cooperation with the employment agencies because some specifically mentioned they would not provide applicants for jobs with too low salary. We used the first two weeks of survey to pilot the treatment. During the pilot, we did not enforce the 2,000 ETB threshold and faced backlash from the employment agencies. As a result, the survey team decided to match some firms initially assigned to control group to the employment agencies. After the pilot, we strictly implemented the initial random assignment and the additional threshold of 2,000 ETB. In the main analysis, we include the pilot sample and use initial random assignment to obtain causal effects.

[8]The initial matching between firms and employment agencies was random. However, when the initially matched agency could not find some specific types of workers (e.g., coffee tasters), occasionally, the survey team rematched the vacancy to a different agency to increase the likelihood of finding a qualified worker. We argue that it is less important whether the matching between firms and the 11 employment agencies is strictly random for two reasons. First, all 11 employment agencies function similarly. All agencies check personal identification and educational certificates, some check previous recommendations, and none provide additional grading or training. Second, in reality, firms may consult with multiple agencies at the same time and select the best recruitment service.

for employment agencies on behalf of treated firms if the match was successful. No extra costs were incurred to treated firms. We thus preserved the main function of employment agencies — increasing the number of job applicants — without altering monetary incentives for both employment agencies and treated firms.

Third, we deliberately prevented direct communication between the employment agencies and treated firms. We only informed the employment agencies of the job descriptions and vague locations of treated firms; as such, agencies did not know to which firms they were providing the job seekers. Once employment agencies completed the selection process, the survey team collected the résumés of the selected applicants and directly delivered to the treated firms in-person, or directly informed the selected applicants to contact the treated firms. Treated firms only knew whether the applicant was recommended from an employment agency, without knowing exactly which agency. We thus prevented any direct information exchange between firms and employment agencies, and any learning would happen only through interacting with the applicants, such as reading résumés or conducting interviews. The survey team did not interfere with any subsequent hiring process.

C Hiring Data

We conducted two follow-up surveys for each firm. One month after the baseline (midline), enumerators visited each firm and asked for a list of all applicants for the sampled vacancy. The survey team recorded as many applicants as possible. Enumerators asked firms to go through all printed résumés, applications through online platforms, and personal recommendations, and recorded information of each applicant by enumerators themselves. Our survey protocols potentially omitted some informal applications, for example, workers directly showing up and asking for jobs without any paper records, which were not the majority among applications in the formal sector.

For each applicant, we collected the firm's perception on education, experience, and how productive the applicant would be if hired. We further asked whether the applicant was invited to the interview and whether the applicant passed the interview and got an offer. For firms that successfully hired at least one worker, we recorded salary information. In addition, enumerators conducted a phone survey of up to six applicants from each firm and elicited self-reported education and experience, which allows us to examine the accuracy of firms' perceptions in Section IV. We also collected age, gender, residential district, and current employment status from each applicant.

Five months after baseline, enumerators visited each firm again (endline). We first collected applicant details for firms that did not make the final decision at midline but had hired anyone for the sampled vacancy since then. We then collected following outcomes of the hired worker: (1)

turnover (whether the worker still stayed on the job, quit voluntarily, or had been fired by the firm), (2) performance records (whether firm considered the worker to be more productive compared to similar workers, percentage of targets met in the recent month), (3) effort (absent days in the last 30 days and overtime hours in the last 7 days). We further collected firms' perceptions of the average productivity of college graduates in general and future hiring plans. Appendix C provides additional details of variables used in the paper and data cross-validation.

Figure 2 presents the number of firms that received agency applicants from the intervention. Among eligible firms, 46% of the treated firms received at least one agency applicant. Zero eligible control firms received any agency applicant; almost none of the non-eligible firms received any agency applicant. For those treated firms that did not receive agency applicants, many posted their vacancies during the off-season, for example, firms hiring teachers during the school year. We will discuss the relevant caveats in robustness checks and alternative mechanisms.

We then examine what types of applicants were provided by the employment agencies. We first examine whether applicants were more likely to have a college diploma or degree. 81% applicants recommended by employment agencies had a college diploma or degree, significantly higher than the average rate 44% observed among other applicants in our sample. We also compare agency applicants to non-agency applicants applying to the same job in Figure D1 regarding other characteristics (experience, gender, age, family background, employment status at baseline), controlling for firm fixed effects and clustered at the firm level. Agency applicants did not look significantly different regarding any of these dimensions. This supports our qualitative observation that employment agencies mainly provided college-educated applicants and did not screen applicants through other criteria.

III Effect of Employment Agencies on Hiring

A Specification

We use the following specification for the firm-level analysis:

$$Y_{jc} = \alpha_c + \beta T_{jc} + \delta X_{jc} + \epsilon_{jc} \tag{1}$$

T_{jc} is the initial treatment assignment of firm j in business area c. X_{jc} is a vector of baseline characteristics of firms and the posted vacancies. Y_{jc} is the outcome of interest for firm j. β is the parameter of interest, that is, the effect of being matched to an employment agency on

outcome Y_{jc}. Since we stratified the treatment by business area, we include business area fixed effects α_c for all regressions to obtain within-cluster comparison. ϵ_{jc} is the idiosyncratic error clustered at the level of the business area. We only include firms with reservation wage at least 2,000 ETB (eligible firms) in the regression because non-eligible firms were not considered for the treatment implementation. Table A1 shows the balance between eligible firms initially assigned to treatment and control groups across all baseline characteristics. Given that not all firms assigned to treatment received applicants from agency, Equation 1 obtains an intention-to-treat (ITT) estimate of the effect of receiving applicants from the employment agencies.[9]

Given that employment agencies mainly reduced search costs to find college-educated applicants, we pre-registered a heterogeneity analysis regarding firms' baseline request of college graduates with the following specification:[10]

$$Y_{jc} = \alpha'_c + \beta_0 T_{jc} \times (C_{jc} = 0) + \beta_1 T_{jc} \times (C_{jc} = 1) + \delta' X_{jc} + \epsilon'_{jc} \tag{2}$$

C_{jc} is whether firm j in business area c requested a college graduate at baseline for the posted vacancy, which is included in the vector of baseline characteristics X_{jc}. Our main parameter of interest is β_1, the treatment effect among firms that requested a college graduate at baseline, and we will specifically look at whether firm j interviewed or hired any college graduates or non-college workers. One may worry that given the identification assumption is $\mathbb{E}[T_{jc}C_{jc}\epsilon'_{jc}] = 0$, the estimate of β_1 may not be entirely causal because C_{jc} might be correlated with other unobserved characteristics in ϵ'_{jc}. We will provide a series of robustness checks to rule out confounding factors and discuss other mechanisms that may explain some but not all the findings.

B Effects on Vacancy Filling

We first confirm the treatment effect on receiving applicants from the employment agencies. Table 1, Column 1 shows that on average, firms initially assigned to treatment (henceforth treated firms) received 0.37 more agency applicant five months after the intervention. Column 2 shows that the number of non-agency applicants is unaffected. Column 4 shows that this increase is mainly driven by the provision of college-educated applicants. Eventually, Column 6 shows that treated

[9] Appendix G replicates all main results using three alternative specifications. (1) Include non-eligible firms in the control group. (2) Use the initial treatment assignment T_{jc} as an instrument to the actual treatment status. This is to address the concern that the actual treatment status is not exactly equal to the initial treatment assignment during the first two weeks of piloting due to logistical constraints. (3) Exclude the pilot sample. All regressions control for all baseline characteristics listed in Table A1. All results remain largely similar.

[10] Appendix H discusses original pre-analysis plan, replicates all pre-specified regressions, and discusses the deviations of current presentation from original pre-analysis plan and the reasons why.

firms received 0.39 more college-educated applicant by endline (p-value 0.019), a 35% increase compared to control firms. We also try different outcome specifications in Table D1, Panel A (whether the number of applicants was at least 1, 2, or 3), and find that our intervention mainly increased the number of college-educated applicants from one to two, not from zero to one, the pure extensive margin. Table D1, Panel B further shows that treatment effect on the total number of college-educated applicants is more salient among firms that requested a college graduate at baseline, although among firms that did not request a college graduate at baseline, treated firms also received 0.11 more college-educated applicant from employment agencies.

Table 2 presents the first result on whether firms interviewed or hired any worker to the vacancy. Surprisingly, treated firms were only 9.4 pp. more likely to interview any agency applicants and 1.6 pp. more likely to hire any agency applicants (p-value 0.172).Table D2 further shows that treated firms did not interview a larger number of applicants in general, which suggests a lack of treatment effect on the intensive margin. Regarding hiring, only seven treated firms in total hired any agency applicants, less than 5% of firms who received at least one agency applicant. Eventually, despite the 35% increase in the number of college-educated applicants, the intervention failed to encourage more firms to fill the vacancy. This result rejects a simple search model in which having more applicants should strictly increase the chance of filling the vacancy.

One may wonder if the experimental results reflect some confounding features of the intervention that overshadow the search effect. Table D3, Panel A presents correlational evidence where we restrict the sample to firms with at least one college-educated applicant or at least one non-college applicant. We do not find significant correlation between whether a firm interviewed or hired any college graduates and the number of college-educated applicants. If there only exists search effect, more college-educated applicants should only increase the likelihood of hiring at least one college graduate, against the correlational evidence. Interestingly, Panel B shows that having more non-college applicants is positively correlated with whether a firm interviewed or hired any non-college applicant, suggesting that search effect was dominant when conducting hiring decisions regarding non-college workers. Our results are thus consistent with other recent evidence that also suggests that simply lowering search costs for firms does not necessarily lead to more successful matches (Fernando et al., 2023; Abebe et al., 2024; Hensel et al., 2024).

C Belief Update

We now estimate whether our intervention induced a negative update belief about the productivity of college graduates, leveraging the detailed records of firms' perceptions on applicants. For

each firm, we compute the percentage of college-educated applicants considered with good productivity.[11] Table 3, Column 1 shows that on average, control firms perceived 78% of college applicants to be productive, but this statistic is 26.2 pp. less among treated firms (p-value 0.021), or treated firms perceived 34% less applicants with good productivity. In Column 2, we calculate the same productivity measure for non-college applicants and do not find such a treatment effect, suggesting that the belief update is specific to college-educated applicants.

One may worry that this statistic only exists in firms that had at least one college-educated applicant. Since the intervention increased the number of college-educated applicants by 35%, firms who would not have had any college-educated applicants were also selected into the estimation. To address this concern, first, in Table 3, Column 3, we interact the treatment status with whether or not firms received at least one college-educated non-agency applicant and control for the number of college-educated non-agency applicants. We find that among firms with at least one college-educated non-agency applicant, treated firms still decreased their perception of college graduates' productivity by 24.6 pp. (p-value 0.008).[12] Second, in the endline survey, we asked all firms if they agreed that college graduates are more productive compared to non-college educated workers in general. Column 5 shows that treated firms are 8.7 pp. less likely to agree with such a statement (p-value 0.050, 11% decrease); this statistic is not subject to the selection bias discussed above. Column 6 shows the treatment effect is strong among firms with at least one college-educated non-agency applicant. We further employ Equation 2 to look at heterogeneous treatment effect regarding baseline request for college graduates. Interestingly, Column 4 and 7 show a lack of heterogeneity. This is consistent with the fact that treated firms that did not request a college graduate at baseline also received more agency applicants who tended to have a college diploma or degree, thus undergoing a similar belief update process.

Our evidence thus suggests that treated firms became less optimistic about college graduates' productivity. Some treated firms might thus have a different hiring preference and hire different types of workers to the vacancy. We now formally test this prediction.

[11] For each applicant, we asked the employer, "How productive do you think this applicant would be if hired on the job, very productive, somewhat productive, somewhat not productive, not productive at all?" In the main analysis, an applicant was considered productive if the employer answered "very productive" or "somewhat productive". We only elicited this perception in Round 2.

[12] Compared to control firms with at least one college-educated non-agency applicant, treated firms with zero college-educated non-agency applicant had a much lower belief of college graduates' productivity, possibly because the one negative signal from college applicant would have a higher impact on the belief update process of these firms. Also, although suggestive, the coefficient before the number of college-educated non-agency applicants is negative, also consistent with the direction of learning.

D Shift in Hiring Behavior

Table 4 presents the treatment effects on whether firms interviewed or hired any college graduates in general. Among firms that requested a college graduate at baseline, treated firms were 11.7 pp. less likely to interview (p-value 0.098, 19% decrease) and 19.7 pp. less likely to hire (p-value 0.012, 34% decrease) any college graduates; instead, they were 11.3 pp. more likely to interview (p-value 0.050, 86% increase) and 8.8 pp. more likely to hire (p-value 0.106, 80% increase) any non-college workers, despite the general increase in the number of college-educated applicants. The differences between these two sets of estimates are significant (p-value 0.028 and 0.008), suggesting a significant shift away from interviewing and hiring any college graduates. Table D4 examines whether firms interviewed or hired any college graduates that were not recommended from the employment agencies and presents similar patterns, suggesting this shift in hiring behavior is not simply driven by firms not interviewing or hiring agency applicant.

Table D5 examines whether the heterogeneous treatment effect regarding baseline request for college graduates can be explained by other firm or vacancy characteristics listed in Table A1. Column 1 and 3 control for the interaction of treatment status and all other baseline characteristics; Column 2 and 4 project the baseline request for college graduates on all other baseline characteristics and replace the intermediate variable with the residual. The treatment effects on hiring a college graduate remain significant with larger magnitudes, suggesting the decrease in the hiring of college graduates cannot be explained by, at the very least, all other observable characteristics. The treatment effects on hiring a non-college worker are not significant in one of the specifications, but the magnitudes remain similar.

Leveraging the timing of the intervention, we further provide evidence on the dynamics of the treatment effects. All agency applicants were delivered to firms before we conducted midline, but some firms continued to receive applicants afterwards and made hiring decisions between midline and endline. Table A2 shows that treatment effects were already salient by midline: Among firms that requested a college graduate at baseline, treated firms were 12.2 pp. (p-value 0.057, 31% decrease) less likely to hire any college graduates by midline, and 10.0 pp. (p-value 0.050, 120% increase) more likely to hire any non-college workers by midline. After midline, the treatment effect on hiring any college graduates decreases from -12.2 pp. to -19.7 pp., yet the treatment effect on hiring any non-college workers stays around the same magnitude. One explanation is that, although some firms became less optimistic about the *absolute* level of college graduates' productivity within a short amount of time, they might still perceive college graduates to be *relatively* more productive than non-college workers and thus did not switch to hiring non-college workers. However, because

firms became more pessimistic about all job seekers in general, firms may simply stop hiring and leave the vacancy unfilled if firms perceive the cost of training a new hire too high. This may explain why the negative treatment effect on hiring any college graduates is more salient and robust than the positive treatment effect on hiring any non-college workers.

We also find suggestive evidence that this treatment effect may not be a one-off phenomenon. At the endline, we asked each firm if they planned to post more jobs in the next three months. Table A2, Column 7 shows that among firms that requested a college graduate at baseline, treated firms were 12.4 pp. less likely (p-value 0.088, 19% decrease) to plan to post any job in the next three months. Our results thus present a significant, and potentially persistent, change in the hiring behavior, particularly among firms that requested a college graduate at baseline.

E Explaining the Shift in the Hiring Behavior with Learning

If firms update their beliefs after receiving one signal from college-educated applicants, firms with less exposure to college graduates in the past would experience a more significant belief update, hence larger treatment effects on hiring outcomes. We use the percentage of current employees with a college diploma or degree, or college share, as the main proxy for exposure to college graduates. One standard deviation increase in baseline college share is correlated with 56% increase in the likelihood of firms requesting a college graduate, with 16% explanatory power. In contrast, one standard deviation increase in the number of current employees is only associated with 15% increase in the likelihood of requesting a college graduate, with 1.3% explanatory power. Figure D2, Panel A shows the distribution of college share across firms.

We first verify that lower college share is correlated with a more significant update on the beliefs of college graduates' productivity. Table D6 examines the heterogeneous treatment effects on the two direct measures of beliefs. At first sight, it seems that both treated firms with above-median and below-median college share experienced a similar level of belief update. We then conduct a robustness check by residualizing whether the college share is above median on all baseline characteristics. Among below-median firms, the treatment effects on beliefs remain significantly negative; among above-median firms, however, the treatment effects become insignificant, possibly because the effects are absorbed by other types of treatment heterogeneity. Although suggestive, the evidence is consistent with the hypothesis that firms with less exposure to college graduates experience a more statistically significant belief update.

We now examine the heterogeneous effects on hiring outcomes in Table 5. Among firms that requested a college graduate at baseline, treated firms with below-median college share were 22.1

pp. less likely to interview (p-values 0.086) and 27.8 pp. less likely to hire a college graduate (p-value 0.047), 16.9 pp. more likely to interview (p-value 0.061) and 14.9 pp. more likely to hire a non-college worker (p-value 0.079); the differences between the two sets of estimates are significant (p-values 0.047 and 0.038). No significant treatment effects are found among firms with above-median college share. Figure D3 presents the binscatter plots between the college share and the percentage of firms hiring at least one college graduate or non-college worker, and further shows the treatment effect grows larger as the college share decreases, suggesting our results in Table 5 are not driven by the artificial cutoff of the college share.

We also attempt to impute the number of past interactions with college graduates of each firm in the following way. We first calculate the number of years since the firm was established (age), multiply it by the number of vacancies posted in the last 12 months (this data only exists in Round 1), assume each vacancy hires one person, and then multiply it by the current college share. We then add this number to the number of current employees with a college diploma or degree. Figure D2, Panel B presents the truncated distribution of the imputed number of past interactions. Table D7, Panel B replicates Table 5 with the imputed number of past interactions and finds similar patterns. Thus, our evidence suggests that learning can explain the shift in hiring behavior.

F Robustness

We examine the robustness of the main results in Table 4 with the following five exercises. First, we examine the robustness of statistical inference in Table D8. Panel A examines the effect on hiring a college graduate. Column 2 does not cluster the standard errors at the level of business area. The standard errors are slightly smaller than the main estimate, which suggests positive correlations within cluster but does not affect the significance. Concerned about statistical inference from a small number of clusters, we use bootstrapping to compute clustered standard errors in Column 3 and conduct a permutation test in Column 4. Standard errors do not vary much. Concerned with the efficiency of the estimates due to heteroskedasticity, in Column 5, each observation is weighted by the inverse of the total number of applicants because vacancies with more applicants may conduct interview or hiring decisions faster. To avoid the potential bias induced by the correlation of treatment status and the number of applicants, in Column 6, each observation is weighted by the inverse of the total number of non-agency applicants. Results from both weighting methods remain similar. Panel B examines the effect on hiring a non-college worker with the same specifications; the effect becomes not significant in most specifications. This implies that the treatment effect on hiring a non-college worker may not be robustly significant on average. For the following discussions, we will show robustness on both treatment effects on hiring a college graduate and hiring a non-college

worker, but will mainly discuss the former.

Second, we examine whether attrition of firms affects the main results systematically. Table D9, Column 1 regresses attrition of firms on the treatment status and finds that treated firms did not have a significantly higher attrition rate on average. In Column 2, we predict attrition likelihood from the entire set of baseline characteristics, and control for the interaction of treatment status and whether the attrition likelihood is above average. The treatment effect on hiring a college graduate remains significantly negative among firms with low attrition likelihood. We also conduct sensitivity analysis in two hypothetical scenarios, assuming no attrited firms hired any college graduate or all attrited firms hired at least one college graduate. The extreme estimates are only 1–2 percentage points away from the main estimates, suggesting very limited influence of attrition.

Third, we examine whether the main results can be explained by the strategic matching behavior of employment agencies. Anecdotal evidence suggests that employment agencies preferred selecting candidates for higher-paid jobs from which they might get a higher commission fee. We first compare the reduced-form effects of receiving agency applicants to the IV estimates using initial treatment assignment as an instrumental variable; the difference between OLS and IV estimates implies the direction of the selection bias. Table D10, Column 1 presents the reduced-form estimates. Among firms that requested a college graduate at baseline, firms receiving agency applicants were 14.8 pp. less likely to hire any college graduate (p-value 0.050), although with a smaller magnitude. Column 2 presents the IV estimate and replicates a significant causal effect of receiving agency applicants. The difference between the IV estimate and the OLS estimate suggests a *positive* selection bias: employment agencies might target firms that were *more* likely to hire a college graduate, not the opposite. In Column 3, we examine whether treatment effect is different for firms with above-average reservation wage. We find negative, although insignificant, heterogeneous treatment effects regarding reservation wage, confirming that the potential strategic matching regarding salary does not drive the main results. We conduct another exercise where we predict the likelihood of receiving applicants from the employment agencies using all baseline characteristics, and examine the treatment effects on firms with below-average likelihood. Column 4 does not find any such heterogeneity at a significant level.

Fourth, we examine whether demand effect explains the main hiring patterns. In response to the intervention, treated firms might provide one out of several vacancies that might have a lower chance of hiring a college graduate. Table D11, Column 1 does not show any significant heterogeneous treatment effect regarding whether firms posted more than one vacancy. Another possibility is that treated firms might hope to engage less with the survey team to decrease hassle from employment agencies. From the discussion with the survey team, when the respondent was the

owner of the firm, this situation was more likely to happen due to less time availability. Column 2 shows that treatment effect diminishes among firms where respondents were the owners, suggesting that if anything, firms that wished to engage less did not hire fewer college graduates.

Fifth, the interpretation of main result might differ if there is a spillover effect to non-treated firms. To examine potential within-cluster spillover, we leverage the clustered treatment design in Round 2. Table D12, Column 1 examines whether non-treated firms (including non-eligible firms) in intensely treated areas were affected by the treatment, controlling for local district fixed effects. We find no such spillover on non-treated firms. Column 2 shows that the treatment effect does not differ significantly in intensely treated areas. We further look at whether the spillover effect extended beyond clusters. Within each business area, firms in different locations might be subject to different levels of spillover from outside of the cluster. Using the geo-coordinates of firms, we compute the percentage of treated firms within a given radius, excluding firms in the same business area. Column 3 examines whether the treatment effect is stronger among firms with above-average beyond-cluster treatment intensity within 500 meters; we do not find supportive evidence of such spillover. Figure D4 further varies the length of radius and replicates this exercise. We do not find heterogeneous treatment effects in any specification.

IV What Triggered Learning?

We now investigate what potentially induced firm learning. We first show that unqualified applicants can only partially explain the shift in hiring behavior. We then show that applicants might send noisy signals about their qualifications. Finally, we discuss potential alternative mechanisms.

A Applicants' Qualification

One may suspect that although employment agencies provided mostly college-educated applicants, they might not be qualified for the vacancy with respect to other dimensions. Indeed, when we conducted qualitative interviews with some treated firms at endline, the main reason they did not interview or hire applicants recommended by the agencies is the lack of experience. We now formally examine whether college-educated applicants were less qualified for the vacancy, with a particular focus on past experiences because most firms mentioned experience as one of their most important hiring criteria.

For each applicant, we define a qualified applicant if their years of experience met the minimum requirement of experience set by the firm at baseline. Figure 3 uses blue hollow bars to show the

percentages of qualified applicants separately for college-educated and non-college applicants. On average, 70% of all college-educated applicants met the experience requirement, slightly less than non-college applicants (78%). Table E1, Column 2 shows that this negative difference disappears once we control for demographics. Importantly, for a subset of applicants, we collected their descriptions of past experiences, which we compare to the description of the posted vacancy and determine whether their experiences were a match to the vacancy. Column 3 shows that among applicants with matched experiences, college graduates were more likely to have required years of experience (p-value 0.097). Column 4 further shows that after controlling for firm fixed effects, college graduates were more qualified compared to non-college applicants that applied to the same job (p-value 0.071). College-educated applicants from agencies were slightly less likely to be qualified, but the differences are not significant using various specifications.

One may argue that although college-educated applicants may not be less qualified on average, the unqualified ones from the agencies may still drive the shift in hiring behavior. We now formally examine this hypothesis. A simple heterogeneity test with respect to whether firm received an unqualified agency applicant would be problematic because this itself is an outcome of the intervention. To address this concern, we leverage firms' baseline requirement for applicants' years of experience. Figure E1 shows a negative correlation between baseline experience requirement and the percentage of agency applicants with qualified experience. Specifically, firms that required less than one year of experience saw a significantly higher percentage of qualified applicants from the agencies. We thus choose one year as the threshold and examine the treatment heterogeneity regarding whether firm required at least one year of experience. If we observe stronger treatment effects among firms with higher experience requirement, hence less qualified applicants, this would provide supportive evidence that unqualified applicants drive the main results.

Table 6 presents the results of this exercise. Among firms that requested a college graduate at baseline, although we find suggestive evidence of a shift in hiring behavior for firms with high experience requirement, the estimates are not statistically significant at conventional levels. Instead, for firms with low experience requirement and thus supposedly less concerned about applicants' qualification, we find a significant and consistent shift in the hiring behavior. Table E2 shows that results cannot be explained by treatment heterogeneity through all other baseline characteristics.[13]

Although the above evidence may lack the statistical power to make definitive conclusions, if we interpret it in a conservative way, it suggests the possibility that some college-educated applicants with unqualified experience may drive the shift in hiring behavior, but only partially. For firms that

[13]Interestingly, Table E2 shows more significant treatment effects among firms with high experience requirement, suggesting that other treatment heterogeneity may mask the results in Table 6.

received a qualified college-educated applicant, why do we still observe a shift in hiring behavior? In the next subsection, we present a possible explanation: There is a discrepancy between applicants' true qualifications and firms' perceptions of their qualifications.

B Noisy Signaling from Applicants

Using our detailed records of firms' perceptions of each applicant, we now examine whether applicants with qualified experience were actually considered qualified by firms. In Figure 3, we use blue areas to show the percentage of applicants whose *perceived* years of experience met the minimum requirement. Interestingly, only 53% non-college applicants and 47% college-educated applicants were perceived as qualified by firms. Among all qualified applicants, 33% were considered to have insufficient years of experience compared to the minimum requirement. Table E3, Columns 1–3 further show that college-educated applicants were significantly less likely to be considered qualified after controlling for actual years of experience, other demographics, and whether applicants' past experience was a good match to the vacancy. College-educated applicants from agencies were not perceived to be significantly less qualified than the non-agency ones. Evidence suggests that applicants, especially college-educated, might have sent a noisy signal of their experience to firms. Column 4 shows a positive correlation between whether an applicant is perceived as qualified and whether an applicant is perceived as productive, after controlling for actual years of experience and other demographics, suggesting that the negative noisy signal could translate into negative perception of productivity.

This perception gap is especially salient for college-educated applicants from vacancies with low experience requirement. Figure E2 conducts a similar exercise as in Figure 3, separately for firms that required applicants to have at least one year of experience and those that did not. For firms with low experience requirement, most applicants had sufficient years of experience. However, while 66% non-college applicants were perceived as qualified by the firms, only 46% college-educated applicants were perceived as such. Many college-educated applicants had some experience in the past, but were often considered to have zero experience by firms; this explains 97% the perception gap for college-educated applicants among firms with low experience requirement. The perception gaps among firms with high experience requirement are similar for non-college and college-educated applicants. This provides a possible explanation for why the treatment effects in Table 6 are significant among firms with low experience requirement: Even if most college-educated applicants from the agencies were qualified for these jobs, firms perceived them somehow with no experience, which led to a negative update in college graduates' productivity in general.

Where did this noisy signal originate? We provide one possible explanation: College-educated applicants did not effectively signal their experience through résumés. When elicited perceptions on applicants, many firms simply referred to the applicants' résumés about their education and experience. We collected 25 additional résumés from employment agencies and 518 résumés from a major online job search platform, most of which came from college graduates, and conducted a simple text analysis on these résumés in Table E4.[14] 20% of these résumés did not specify any previous experience including internship. Another 12% of the résumés only listed their employer and position and did not provide any further descriptions. In total, 48% of the résumés did not list any references to their previous employers so that the new employers could reach out and verify the listed experience. Many résumés also look disorganized and unprofessional. The existing literature has also documented that some college graduates in low- and middle-income countries do not know how to write a good résumé (Carranza et al., 2023; Abebe et al., 2021).

Using our hiring data, we provide support evidence that college graduates' résumés may explain the perception gap. Figure E3, Panel A shows that more than 80% college-educated applicants sent in their résumés when applying for the vacancies, compared to only 24% among non-college workers. Panel B shows that college-educated applicants who sent in their résumés were slightly more likely to be considered qualified compared to other college-educated ones, but still less likely to be considered qualified compared to non-college ones. Table E5, Column 1–3 use various specifications to show the robustness of such comparison. Although suggestive at best, our descriptive evidence shows that résumés did not mitigate, if not exacerbate, the noisy signal from college-educated applicants.

Can firms look past the noisy signal? Our evidence suggests that firms may be constrained to conduct more screening. Recall that in Table D2, treated firms interviewed fewer non-agency applicants while interviewing more agency applicants, suggesting that firms might have a fixed interviewing quota and were unable to expand the quota.[15]

Combined with the results in the previous subsection, our evidence thus suggests a potential mechanism for the shift in hiring behavior: Firms face uncertainty about the productivity of college graduates, either due to within-group variation (qualified versus unqualified applicants) or noisy signaling. Our evidence suggests the latter is more likely to drive our main results, although as will

[14]The text analysis is conducted with the assistance of the AI model Gemini 2.5 Pro. We manually examined 80 copies of résumés; the results are very similar to the AI-generated results.

[15]We find suggestive evidence that firm-specific characteristics may contribute to the perception gap of applicants' qualification. Table E3, Column 5 shows that college applicants were not considered less qualified after controlling for firm fixed effects. Column 6 shows that the negative perception gap is not significantly correlated with the productivity perception after controlling for firm fixed effects. Table E5, Column 4 shows that college-educated applicants with résumés were not considered less qualified after controlling for firm fixed effects. Such firm-specific characteristics can be previous experience with college-educated applicants, as suggested by our evidence, or the ability to conduct more interviews and mitigate noisy signals.

be seen in Section V, the implications of the two factors in the equilibrium are similar.

C Alternative Mechanisms

Here, we discuss whether other mechanisms may explain some of the empirical results. First, we discuss whether firms updated their beliefs about other attributes of college graduates. One hypothesis is that by interacting with more college-educated applicants, firms might realize that college graduates have better outside options and were less likely to take up the offer. We provide direct evidence by eliciting firms' perceptions of workers' outside options.[16] Table E6 shows that treated firms became less likely to perceive college-educated applicants with good outside options, consistent with the direction of the belief update in productivity. Treated firms were not more likely to agree that college graduates are easier to get a job in general. We further observe whether each applicant rejected an interview invitation or a job offer at endline. On average, only 4.8% applicants rejected interview invitations, 2.6% rejected job offers. Table E7 further shows that college graduates were not significantly more likely to reject interview invitations or job offers.[17]

However, Table E7 shows that agency applicants were significantly more likely to reject interview invitations. Firms might interpret it as lack of trustworthiness or responsibility for all college graduates. To examine whether this drives the main results, we assume that some firm characteristics might explain why applicants did not show up for interviews, predict whether firms received agency applicants who turned down interview invitations using all baseline firm characteristics, and examine the treatment heterogeneity in Table E8. We find that the shift in hiring behavior is not salient among firms with higher likelihood of receiving agency applicants who turned down interview invitations. Therefore, although we cannot rule out all other attributes of college graduates that may drive the belief update, it is unlikely that firms stopped hiring college graduates because they perceived them to have more outside options or more likely to reject the offer.

Second, we discuss whether firms updated their beliefs of applicants from non-referral hiring channels instead of college graduates. Almost all agency applicants were outside of the firms' internal hiring networks. Table E9 first shows that treated firms were indeed less optimistic of the productivity of external applicants in general; no effects were found for the internally recommended

[16] For each applicant, we asked the employer, "How like do you think this applicant would get a better offer elsewhere, very likely, somewhat likely, somewhat not likely, not likely at all?" An applicant was considered to have good outside options if the employer answered "very likely" or "somewhat likely". We only elicited this perception in Round 2.

[17] Our findings are not inherently against the recent empirical evidence of the high reservation wages of college graduates (Banerjee and Chiplunkar, 2022; Kelley et al., 2022; Alfonsi et al., 2023). The college graduates we observe in the sample, either through firms' own hiring channels or through employment agencies, were potentially already selected to be more willing to take up the jobs in our sample.

applicants. However, the decrease in belief only exists among college-educated applicants, not among non-college ones. We also examine the treatment effects on whether firms used referral hiring. On average, there is no significant shift towards referral hiring, but among firms who requested a college graduate and did not plan to use referral at baseline, we observe a 17.1 pp. increase in using referral hiring (p-value 0.075), suggesting that the shift in referral hiring, if any, only exists among firms that requested a college graduate at baseline. These results demonstrate that college graduates are still the essential dimension to understand firm hiring in this context.[18]

Third, we discuss whether firms updated their beliefs about the search costs of finding college-educated applicants. When employment agencies were unable to find a match, firms may update how difficult it is to find college graduates and stop the search earlier. Recall that in Table D10, among firms with high likelihood of receiving an agency applicant, we observe a similar decrease in the hiring of college graduates, suggesting that this hypothesis alone is unlikely to drive the main patterns. Another possibility is that firms may update their beliefs about the marginal benefit of finding college-educated applicants. Suppose that firms chose to stop searching when the marginal benefit of having one more applicant was equal to the marginal cost. When employment agencies provided more college-educated applicants to treated firms, the marginal benefit of having one more applicant decreased, thus leading to an earlier stop in the hiring process. This hypothesis cannot explain why treated firms were less likely to hire college graduates especially when they received more college-educated applicants. To the best of our ability, we cannot think of an explanation purely based on standard search model that can justify our main results.

V Equilibrium Search Model with Imperfect Information

So far, we show empirical evidence of a negative learning effect when search costs were lowered for firms, potentially due to the uncertainty of the productivity of college graduates. However, there are two remaining questions: (i) Why was the direction of learning effect negative on average? (ii) What were the implications on matching efficiency if there was no positive effect on job creation? To properly discuss these two issues, we need to formalize the equilibrium concept under imperfect information. Here, we outline a sketch of an equilibrium search model following Diamond (1982),

[18] On a positive note, these results help rationalize the magnitudes of our empirical findings. Indeed, some firms may have had some previous interactions with college graduates, but these college graduates were potentially mainly recommended through their internal networks, and firms were not familiar with average college graduates from the external applicant pool. Thus, even if some firms had some previous interactions with college graduates or had a higher college share among current workers, receiving a college-educated applicant from employment agencies might still induce a large learning effect. This may also reflect that firms value the informational advantages of referral hiring, as shown in an established literature (Swanson, 2024; Heath, 2018; Beaman and Magruder, 2012).

Mortensen (1977), and Pissarides (2000) with uncertainty about the productivity of job seekers. For the full model, see Appendix F.

A Basics of the Model

Suppose there is a continuum of identical workers with mass normalized to 1. All workers are infinitely lived and risk neutral. On the other side, there is a continuum of identical firms that are also risk neutral. Assume firms have a perfectly complementary (Leontief) production function. In a search economy, when a firm matches with a worker, the firm would produce μ_0 unit of good. In each period, a firm pays an upfront cost to post a vacancy. Workers and firms are randomly matched with conventionally defined matching function and engage in Nash bargaining afterwards.

The key addition to the model is the uncertainty of productivity. Suppose firm j's initial perception of productivity is μ_j and is drawn from a given distribution $F(\cdot)$ with mean $\overline{\mu}$. This uncertainty can result from imperfect signaling of workers prior to matching. Firm j's perception would be corrected once they match with a worker. In a different version where the uncertainty stems from within-group variation in workers' productivity, firms' perception will be partially corrected upon matching with a worker; all the following implications remain similar.

After each period, old firms with sufficiently low perceptions of workers' productivity exit the market permanently.[19] New firms draw their initial perceptions from the same distribution $F(\cdot)$. Firms enter and exit freely until the expected value of opening a vacancy is equal to zero. The economy thus consists of two types of firms in each period: (i) new firms whose perception follows $F(\cdot)$, and (ii) old firms that are positively selected. The following proposition describes that, in any given equilibrium, firms are on average overoptimistic about workers' productivity:

Proposition 1. *Suppose the mean of the initial perception distribution $F(\cdot)$ is equal to the truth $\overline{\mu} = \mu_0$. If there exists an equilibrium in period T, the average perception of workers' production among firms in the search economy is greater than μ_0.*

Abebe et al. (2024) conducted a belief-elicitation exercise among 498 large firms (minimum size 40 workers) in Ethiopia to measure their beliefs about the ability of job seekers with tertiary education. They found that 75% firms overestimated college-educated job seekers' performance in a Raven's test. Although we are not able to provide similar direct evidence on the perception of productivity, we conducted an exercise at endline to elicit firms' perceptions of college graduates'

[19] Lepage (2024) provides a theoretical framework for why firms may not return to the search economy because they do not have the incentives to learn about workers' productivity again. Benson and Lepage (2024) provides supportive empirical evidence in the US context.

outside options, for which we can measure the benchmark from worker's survey. On average, firms in our sample perceived 46% college-educated applicants to have a higher-paid outside offer, while only 23% college-educated applicants in our sample were able to find a job elsewhere with higher salary. Given the positive correlation between firms' perception of productivity and outside options, our evidence is consistent with over-optimism about college graduates' productivity in the equilibrium.

B Characterization of the Equilibrium

Without any assumptions imposed on belief formation, multiple equilibria can emerge in the standard search model. For any level of average perception $\overline{\mu}$, one can find a corresponding level of market tightness θ such that the marginal firm would be indifferent between posting a vacancy or not. If firms become more optimistic in general, more firms will enter the search economy and post a vacancy, thus higher market tightness. Figure 4, Panel A describes this positive relation between average perception $\overline{\mu}$ and market tightness θ driven by free entry condition.

Our assumption of belief update introduces another relation between $\overline{\mu}$ and θ. In period T, the average perception in equilibrium $\overline{\mu}_T$ is above the truth according to Proposition 1. When market tightness decreases, firms are more likely to match with a worker and correct their initial misperceptions, thus bringing down the average perception $\overline{\mu}_T$ closer to the truth. Figure 4, Panel A describes this relation between $\overline{\mu}$ and θ driven by the belief update. Because $\overline{\mu}_T$ is bounded, as long as workers' real productivity μ_0 is above a certain level, a unique equilibrium is guaranteed as illustrated in the following proposition:

Proposition 2. *For any period T, under the regularity condition given by Equation F.15, there exists a unique steady-state equilibrium characterized by average perception of workers' production $\overline{\mu}_T$ and market tightness θ_T.*

The following Proposition 3 describes a type of matching inefficiency in this equilibrium: there are too many vacancies because the overoptimistic firms have not corrected their misperceptions. One can reinterpret vacancy cost as a cost of learning. It is inefficient for some firms to wait so long to learn about the true productivity of workers and unable to compensate the learning cost by keeping the vacancy idle, which further generates a congestion externality by lowering the matching likelihood for other firms.

Proposition 3. *For any period T, the equilibrium market tightness under imperfect information θ_T is greater than the optimal equilibrium market tightness under perfect information.*

C Implications on Active Labor Market Policies

We model ALMPs as an improvement in search technology such that more matches are formed given the same market tightness. Figure 4, Panel B illustrates the impact of ALMPs on equilibrium outcomes. Holding belief update curve constant, more firms will enter the search economy because the expected value of vacancies increases (search effect, from point A to C). However, because more overoptimistic firms will learn about the true productivity, the belief update curve will shift closer to the truth, which will induce more firms to exit (learning effect, from point C to B). If the learning effect is dominant, we may not be able to observe an overall increase in job creation or a decrease in the unemployment rate.

The following proposition illustrates the efficiency implications of ALMPs, using the difference between the equilibrium market tightness levels under imperfect information and under perfect information as a measure of matching (in)efficiency:

Proposition 4. *Suppose search technology improves such that the matching likelihood increases for any level of market tightness.*
(i) If the equilibrium market tightness θ_T does not increase, then the matching efficiency improves;
(ii) If the average perception in the equilibrium $\overline{\mu}_T$ increases and the matching function belongs to a class characterized by Equation F.17, then the matching efficiency worsens.

The first sufficient condition in Proposition 4 comes from two facts, that firms post too many vacancies in the equilibrium with imperfect information, and that the optimal level of market tightness increases when the search technology improves. Thus, even if we do not observe any changes in the equilibrium market tightness, matching becomes more efficient because it is closer to the optimal level under perfect information. The second sufficient condition provides a simple way to examine whether the matching efficiency worsens by simply measuring the level of misperceptions; the condition is valid under a large class of matching functions.

Taken at the face value, Proposition 4 implies that under imperfect information, our intervention actually improves the matching efficiency given that some treated firms hire fewer college graduates. It is difficult to directly test this efficiency implication; instead, we provide suggestive evidence that treated firms were not worse off by not hiring college graduates.[20] Table A3 examines the treatment effects on endline outcomes for firms that requested a college graduate at baseline. The endline outcomes include four categories: (i) Salary, truncated at the 95% percentile. (ii) Turnover: whether

[20]We can expand the model to allow firms to post a vacancy in a separate labor market where the average productivity of workers is lower, but there is no uncertainty about productivity and search costs are lower, an analog to hiring a non-college in our empirical setting. In this way, we can approximate the value of not posting a job for college graduates using the value of posting a job for non-college workers for firms with similar characteristics.

the new hires quit the job voluntarily and whether firms fired the new hires. (iii) Productivity: whether the hired workers were perceived with above-average productivity, whether the percentage of targets met for the hired workers was higher than average workers in similar positions. (iv) Effort: whether the new hires had zero days of absence in the last 30 days, whether the new hires worked overtime in the last seven days. We find no significant treatment effect on any of these outcomes. Concerned about the extensive margin effect on hiring, we conduct a complier analysis in Table A4 using the technique from Abadie (2003), where the endogenous variable is whether firms hired a college graduate or a non-college worker, instrumented by the interaction of the initial treatment assignment and whether firms requested a college graduate at baseline. Results remain insignificant for most variables, except for salary where we find suggestive evidence that complier firms might pay lower salary for non-college workers. Although suggestive at best, our evidence is consistent with the interpretation that treated firms were not worse off when they discontinued hiring college graduates.

VI Conclusion

We conducted a hiring intervention with 799 private firms with an active job vacancy in Addis Ababa, Ethiopia, where we leveraged a specialized type of employment agency to increase the access to college-educated applicants for a subset of firms. We find that treated firms were not more likely to fill the vacancy despite a 35% increase in the number of college-educated applicants. Instead, treated firms were significantly less optimistic of the productivity of college graduates in general. Among firms that requested a college graduate at baseline, treated firms became 34% less likely to hire any college graduate. Learning is potentially triggered by the uncertainty of the productivity of college-educated applicants due to imperfect signaling.

Our findings highlight the importance of imperfect information when firms search in the labor market. With imperfect information, the number of successful matches, or job creation, is not equivalent to matching efficiency. Active labor market policies may not be an effective tool to create more jobs for a certain type of job seekers (e.g. college graduates) of which firms may have little interaction in the past, but they can still be efficiency-improving because some vacancies may have been inefficiently created initially. Findings that do not take into account information frictions may generate misleading implications and induce policymakers to abandon these active labor market policies too soon.

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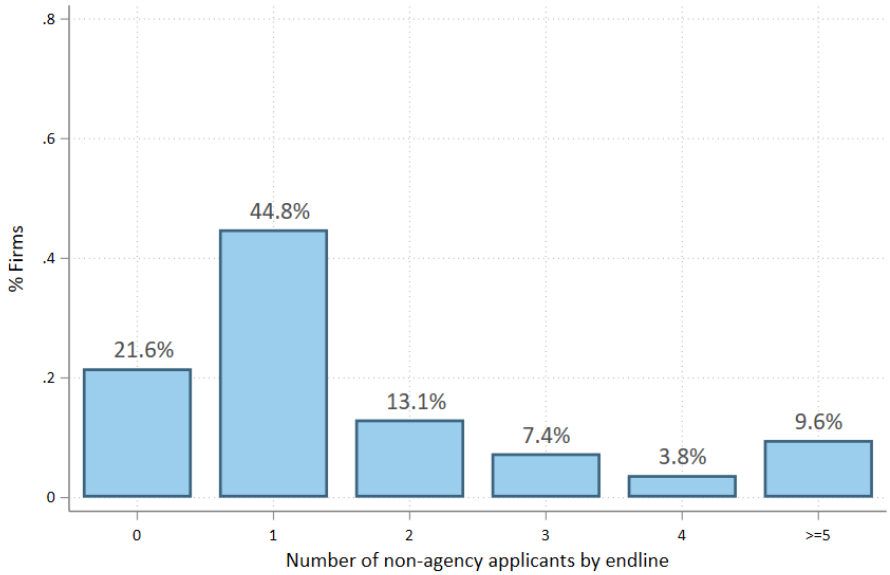
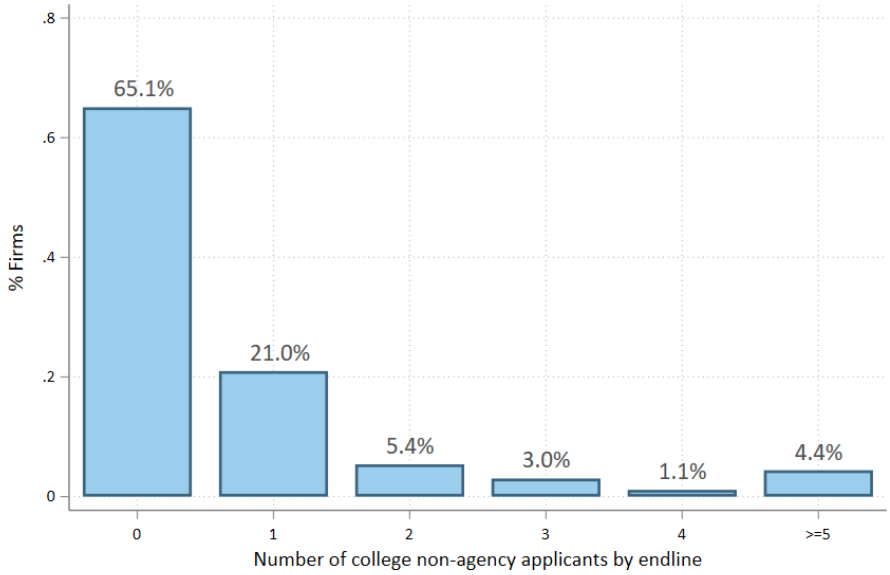
FIGURES

Figure 1: Distribution of the Number of Applicants

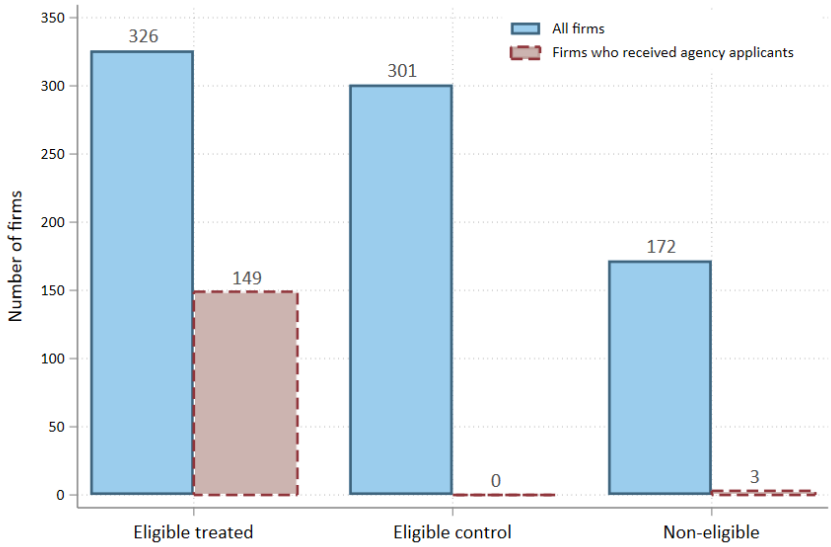


Panel B. College-educated applicants



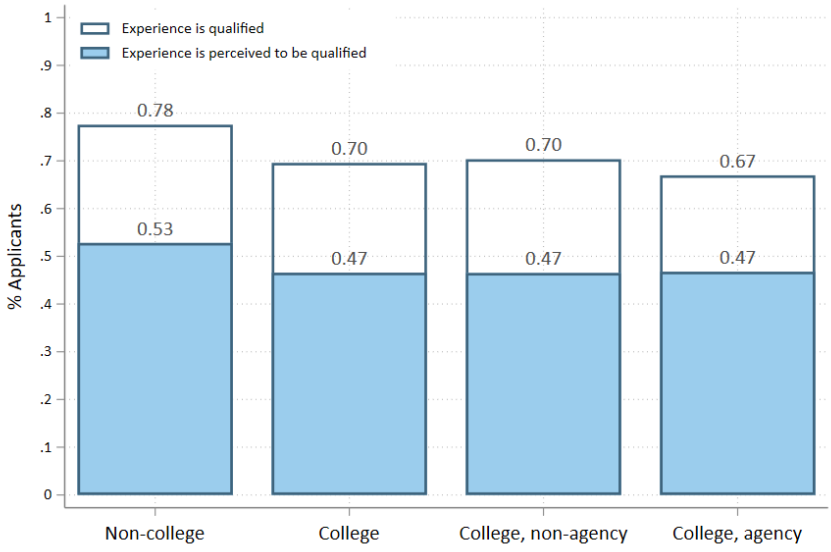
Notes: This figure presents the distribution of the total number of applicants for the posted vacancies by endline, not including applicants from the employment agencies introduced by the intervention. Panel A: Total number of applicants. Panel B: Total number of college-educated applicants.

Figure 2: Matching between Employment Agencies and Firms



Notes: This figure shows the matching between employment agencies and firms. We classify firms into three groups: (1) Eligible firms (reservation wage at least 2,000 ETB) selected into treatment group, (2) eligible firms selected into control group, (3) non-eligible firms. Blue bars show the number of firms assigned to each group. Red bars with dashed contour show the number of firms in each group that received at least one agency applicant.

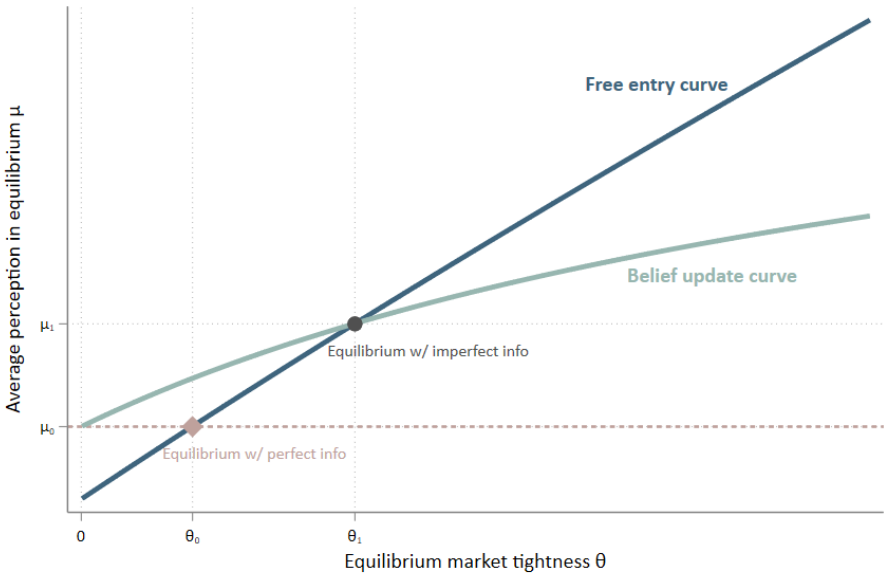
Figure 3: Actual and Perceived Qualifications of Applicants' Experience



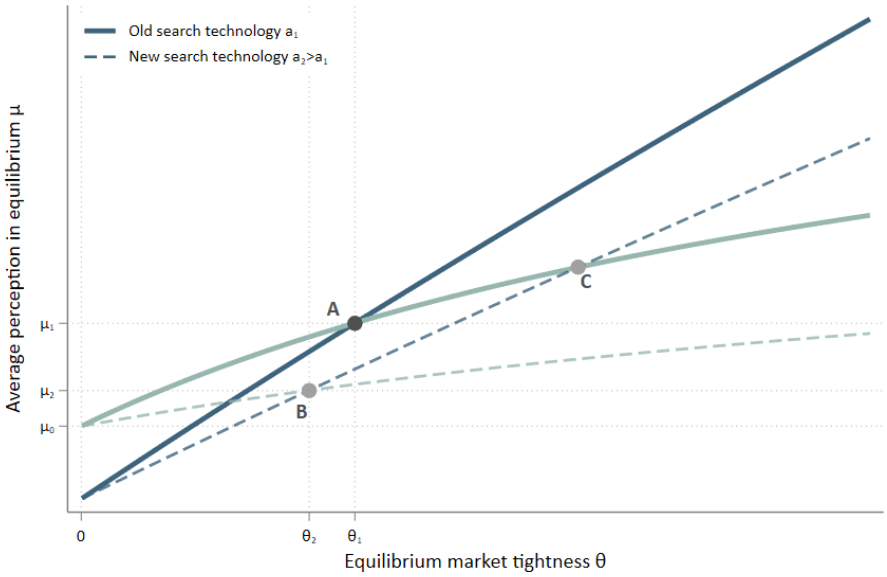
Notes: This figure shows the qualification of applicants' experience. We define an applicant was qualified if their years of experience met the minimum requirement of the posted vacancy. We show the percentage of applicants that were qualified among non-college applicants, college applicants on average, college agency applicants, and college non-agency applicants. The blue contour uses applicants' self-reported years of experience to construct the qualification indicator. The solid area uses firms' perceived years of experience for each applicant to construct the qualification indicator.

Figure 4: Equilibrium Search Under Imperfect Information

Panel A. Equilibrium determination



Panel B. Active labor market policies and new equilibrium



Notes: This graph illustrates the relations between firms' average perceptions of workers' productivity, $\overline{\mu}$, and the market tightness in the equilibrium θ. Panel A illustrates how free entry condition and the belief update dynamics determine a unique equilibrium in the search economy, which is different than the optimal equilibrium with perfect information. Panel B illustrates how active labor market policies that improve search technology may shift the equilibrium outcomes. See more discussion in Section V.

TABLES

Table 1: First-stage Treatment Effects on the Number of Applicants

	(1)	(2)	(3)	(4)	(5)	(6)
	All applicants			College-educated applicants		
	# Agency	# Non-agency	# All	# Agency	# Non-agency	# All
Assigned to treat	0.373	-0.028	0.345	0.317	0.076	0.393
	(0.078)	(0.192)	(0.204)	(0.065)	(0.153)	(0.163)
	[0.000]	[0.884]	[0.095]	[0.000]	[0.621]	[0.018]
Observations	583	583	583	586	586	586
R-squared	0.420	0.344	0.344	0.448	0.352	0.395
Control baseline char.	Yes	Yes	Yes	Yes	Yes	Yes
Business area FE	Yes	Yes	Yes	Yes	Yes	Yes
Cluster at business area	Yes	Yes	Yes	Yes	Yes	Yes
Control mean	0.137	2.119	2.257	0.0955	1.072	1.167

Notes: This table examines the treatment effects on the number of applicants. The sample is restricted to firms eligible for treatment with reservation wage at least 2,000 ETB. Observation with above 99.5 percentile are truncated (number of applicants above 13). Dependent variables: Column 1–3, number of applicants, including both college-educated and non-college. Column 4–6, number of college-educated applicants. Column 1 and 4 only count the applicants recommended from the employment agencies. Column 2 and 5 only count the applicants not recommended from the employment agencies. Column 3 and 6 count both agency and non-agency applicants. All regressions include a full set of baseline characteristics from Table A1, include business area fixed effects, and cluster at the business area level. Standard errors are shown in parentheses; p-values are shown in brackets.

Table 2: Treatment Effects on Vacancy Filling

	(1)	(2)	(3)	(4)	(5)	(6)
	Interview Agency	Interview Non-agency	Interview Any	Hire Agency	Hire Non-agency	Hire Any
Assigned to treat	0.094	0.004	0.052	0.016	-0.004	0.000
	(0.032)	(0.053)	(0.048)	(0.011)	(0.052)	(0.051)
	[0.004]	[0.937]	[0.281]	[0.172]	[0.937]	[0.996]
Observations	580	580	580	580	580	580
R-squared	0.229	0.270	0.268	0.206	0.268	0.264
Control baseline char.	Yes	Yes	Yes	Yes	Yes	Yes
Business area FE	Yes	Yes	Yes	Yes	Yes	Yes
Cluster at business area	Yes	Yes	Yes	Yes	Yes	Yes
Control mean	0.024	0.756	0.762	0.003	0.744	0.747

Notes: This table presents whether treated firms interviewed or hired the applicants recommended from the matched employment agencies. The sample is restricted to firms eligible for treatment with reservation wage at least 2,000 ETB. Dependent variables: Column 1 and 4, whether the firm interviewed or hired any applicant recommended by the employment agency. Column 2 and 5, whether the firm interviewed or hired any applicant not recommended by the employment agency. Column 3 and 6, whether the firm interviewed or hired any applicant at endline. All regressions control for all baseline firm and vacancy characteristics, include business area fixed effects, and cluster at the business area level. Standard errors are shown in parentheses; p-values are shown in brackets.

Table 3: Belief Update in the Productivity of College Graduates

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	% Applicants perceived productive by firm				Whether firm agreed		
	College	Non-college	College	College	College grads are more productive		
Assigned to treat	-0.262	0.027			-0.087		
	(0.108)	(0.087)			(0.044)		
	[0.021]	[0.755]			[0.050]		
# Non-agency (NA) college applicants			-0.045			0.001	
			(0.012)			(0.006)	
			[0.001]			[0.854]	
Treated x Zero NA college applicants			-0.559			-0.057	
			(0.160)			(0.045)	
			[0.001]			[0.205]	
Treated x $\geq$ 1 NA college applicants			-0.246			-0.135	
			(0.088)			(0.062)	
			[0.008]			[0.032]	
Treated x Not requesting college				-0.398			-0.082
				(0.212)			(0.057)
				[0.069]			[0.150]
Treated x Requesting college				-0.210			-0.093
				(0.113)			(0.053)
				[0.070]			[0.085]
Observations	151	154	151	151	568	568	568
R-squared	0.393	0.505	0.463	0.399	0.329	0.332	0.329
Control baseline char.	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Business area FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cluster at business area	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Control mean	0.779	0.851			0.782		
Control mean: Not requesting college				0.767			0.720
Control mean: Requesting college				0.772			0.897
Control mean with one NA college app			0.878			0.772	
Control mean with zero NA college app						0.782	

Notes: This table presents whether treated firms updated beliefs of the average productivity of college graduates. The sample is restricted to firms eligible for treatment with reservation wage at least 2,000 ETB. In Column 1–4, for each firm, we compute the percentage of applicants perceived with good productivity in each category (college graduates, non-college workers); this data only exists in Round 2. Column 5–7 look at whether firm agreed that college graduates are more productive than non-college workers. In Column 3 and 6, we interact the initial treatment assignment with whether firm received at least one non-agency (NA) college-educated applicants, and control for the number of college-educated non-agency applicants. In Column 4 and 7, we interact the initial treatment assignment with whether firm requested a college graduate at baseline. All regressions control for all baseline firm and vacancy characteristics, include business area fixed effects, and cluster at the business area level. Standard errors are shown in parentheses; p-values are shown in brackets.

Table 4: Shift in Hiring Behavior

VARIABLES	(1) Interview College	(2) Interview Non-college	(3) (2)-(1)	(4) Hire College	(5) Hire Non-college	(6) (5)-(4)
Treated x Not requesting college	0.057	0.001	-0.055	0.033	-0.002	-0.036
	(0.059)	(0.049)	(0.072)	(0.063)	(0.048)	(0.077)
	[0.342]	[0.976]	[0.443]	[0.595]	[0.964]	[0.643]
Treated x Requesting college	-0.117	0.113	0.230	-0.197	0.088	0.285
	(0.070)	(0.057)	(0.103)	(0.076)	(0.053)	(0.105)
	[0.098]	[0.050]	[0.028]	[0.012]	[0.106]	[0.008]
Observations	580	580		580	580	
R-squared	0.348	0.493		0.327	0.502	
Control baseline char.	Yes	Yes		Yes	Yes	
Business area FE	Yes	Yes		Yes	Yes	
Cluster at business area	Yes	Yes		Yes	Yes	
Control mean: Not requesting college	0.231	0.714		0.198	0.692	
Control mean: Requesting college	0.614	0.131		0.586	0.110	

Notes: This table presents the treatment effects on whether firms hired a college graduate or a non-college worker. The sample is restricted to firms eligible for treatment with reservation wage at least 2,000 ETB. We interact initial treatment assignment and whether or not firm requested a college graduate at baseline. Dependent variables: Column 1 and 4, whether the firm interviewed any college-educated or non-college applicant at endline. Column 2 and 5, whether the firm hired any college graduate or non-college worker at endline. Column 3 computes the differences between the estimates in Column 1 and 2. Column 6 computes the differences between the estimates in Column 4 and 5. Panel B excludes agency applicants from constructing the outcome variables. All regressions control for all baseline firm and vacancy characteristics, include business area fixed effects, and cluster at the business area level. Standard errors are shown in parentheses; p-values are shown in brackets.

Table 5: Explaining the Shift in Hiring Behavior with College Share

VARIABLES	(1) Interview College	(2) Interview Non-college	(3) (2)-(1)	(4) Hire College	(5) Hire Non-college	(6) (5)-(4)
Treated x Not requesting college	0.050	-0.028	-0.078	0.023	-0.024	-0.047
	(0.065)	(0.064)	(0.092)	(0.071)	(0.065)	(0.097)
	[0.446]	[0.664]	[0.400]	[0.747]	[0.719]	[0.632]
Treated x Requesting college	-0.091	0.020	0.111	-0.189	0.011	0.200
x Above-median college share	(0.127)	(0.114)	(0.199)	(0.127)	(0.115)	(0.194)
	[0.476]	[0.864]	[0.580]	[0.142]	[0.926]	[0.306]
Treated x Requesting college	-0.221	0.169	0.389	-0.278	0.149	0.427
x Below-median college share	(0.127)	(0.089)	(0.193)	(0.138)	(0.084)	(0.202)
	[0.086]	[0.061]	[0.047]	[0.047]	[0.079]	[0.038]
Observations	580	580		580	580	
R-squared	0.351	0.495		0.328	0.504	
Control baseline char.	Yes	Yes		Yes	Yes	
Business area FE	Yes	Yes		Yes	Yes	
Cluster at business area	Yes	Yes		Yes	Yes	
Control mean: Not requesting college	0.231	0.714		0.198	0.692	
Control mean: Requesting college	0.614	0.131		0.586	0.110	

Notes: This table examines whether previous interaction with college graduates can explain the shift in hiring behavior in Table 4. The sample is restricted to firms eligible for treatment with reservation wage at least 2,000 ETB. We interact the initial treatment assignment, whether or not firm requested a college graduate at baseline, and whether the percentage of college-educated workers in the firm at baseline (henceforth college share) was above median. We control for the interaction of the treatment status and whether college share was above median to guarantee full saturation. Dependent variables: Column 1 and 4, whether the firm interviewed and hired any college-educated worker at endline. Column 2 and 5, whether the firm interviewed and hired any non-college worker at endline. Column 3 computes the differences between the estimates in Column 1 and 2. Column 6 computes the differences between the estimates in Column 4 and 5. All regressions control for all baseline firm and vacancy characteristics, include business area fixed effects, and cluster at the business area level. Standard errors are shown in parentheses; p-values are shown in brackets.

Table 6: Explaining the Shift in Hiring Behavior with Experience Requirement

VARIABLES	(1) Interview College	(2) Interview Non-college	(3) (2)-(1)	(4) Hire College	(5) Hire Non-college	(6) (5)-(4)
Treated x Not requesting college	0.111	-0.016	-0.127	0.086	-0.035	-0.121
	(0.072)	(0.065)	(0.101)	(0.072)	(0.064)	(0.100)
	[0.129]	[0.805]	[0.212]	[0.235]	[0.591]	[0.232]
Treated x Requesting college	-0.215	0.135	0.350	-0.363	0.078	0.441
x Low experience requirement	(0.138)	(0.116)	(0.196)	(0.139)	(0.121)	(0.196)
	[0.124]	[0.247]	[0.078]	[0.011]	[0.520]	[0.027]
Treated x Requesting college	-0.056	0.092	0.148	-0.110	0.063	0.172
x High experience requirement	(0.078)	(0.066)	(0.113)	(0.078)	(0.060)	(0.109)
	[0.469]	[0.169]	[0.193]	[0.162]	[0.302]	[0.118]
Observations	580	580		580	580	
R-squared	0.357	0.493		0.338	0.503	
Control baseline char.	Yes	Yes		Yes	Yes	
Business area FE	Yes	Yes		Yes	Yes	
Cluster at business area	Yes	Yes		Yes	Yes	
Control mean: Not requesting college	0.231	0.714		0.198	0.692	
Control mean: Requesting college	0.614	0.131		0.586	0.110	

Notes: This table examines whether college graduates' qualifications can explain the shift in hiring behavior in Table 4. The sample is restricted to firms eligible for treatment with reservation wage at least 2,000 ETB. We interact the initial treatment assignment, whether or not firm requested a college graduate at baseline, and whether firm required less than one year of experience (low experience requirement). We control for the interaction of treatment status and whether firm had low experience requirement to guarantee full saturation. Dependent variables: Column 1 and 4, whether the firm interviewed and hired any college-educated worker at endline. Column 2 and 5, whether the firm interviewed and hired any non-college worker at endline. Column 3 computes the differences between the estimates in Column 1 and 2. Column 6 computes the differences between the estimates in Column 4 and 5. All regressions control for all baseline firm and vacancy characteristics, include business area fixed effects, and cluster at the business area level. Standard errors are shown in parentheses; p-values are shown in brackets.

A Appendix Tables

Table A1: Balance Table

	(1)	(2)	(3)	(4)	(5)	(6)
	Mean outcomes					P-value
	All	Eligible control		Eligible treated		T−C
Observations	627	335		292		
Sector						
Manufacturing and construction	0.42	0.41	(0.49)	0.43	(0.50)	0.71
Hospitality (hotels, restaurants)	0.27	0.28	(0.45)	0.26	(0.44)	0.58
Education	0.11	0.12	(0.32)	0.11	(0.32)	0.91
Health	0.05	0.07	(0.25)	0.03	(0.18)	0.10
Current employees						
Number of current employees	66.30	57.84	(87.18)	76.00	(152.09)	0.16
Pct of female employees	0.53	0.54	(0.27)	0.52	(0.26)	0.26
Pct of employees with college diploma/degree	0.37	0.38	(0.29)	0.37	(0.29)	0.62
Pct of employees with zero experience	0.20	0.19	(0.23)	0.20	(0.24)	0.70
Pct of temporary employees	0.16	0.15	(0.27)	0.17	(0.28)	0.70
Pct of employees hired through referrals	0.15	0.16	(0.22)	0.14	(0.22)	0.38
Hiring practices						
The firm has a HR department	0.51	0.50	(0.50)	0.51	(0.50)	0.77
Posting jobs on notice board	0.54	0.55	(0.50)	0.53	(0.50)	0.70
Posting jobs on newspaper	0.14	0.15	(0.35)	0.14	(0.34)	0.79
Posting jobs on online platforms	0.16	0.14	(0.35)	0.17	(0.38)	0.30
Hiring from formal employment agencies	0.08	0.07	(0.25)	0.10	(0.30)	0.19
Hiring from informal brokers	0.25	0.28	(0.45)	0.22	(0.42)	0.17
Hiring through referrals	0.50	0.50	(0.50)	0.49	(0.50)	0.83
Posted vacancy						
Reservation wage (USD)	91.49	87.83	(61.29)	95.78	(91.71)	0.26
Requiring college diploma or degree	0.44	0.45	(0.50)	0.44	(0.50)	0.92
Requiring vocational certificate	0.08	0.07	(0.25)	0.09	(0.28)	0.32
Requiring high school degree	0.14	0.15	(0.35)	0.14	(0.34)	0.70
Requiring no experience	0.20	0.21	(0.41)	0.19	(0.39)	0.45
Requiring more than 2y experience	0.19	0.16	(0.37)	0.21	(0.41)	0.23
Skilled task	0.55	0.55	(0.50)	0.55	(0.50)	0.99
Manual task	0.64	0.65	(0.48)	0.63	(0.48)	0.55
Routine task	0.69	0.70	(0.46)	0.69	(0.46)	0.76

Notes: This table shows the balance between 292 eligible firms initially assigned to treatment and 335 eligible firms initially assigned to control group. Standard deviations are shown in parentheses. Column 6 shows the p-value of a simple comparison of each characteristics between eligible treated and eligible control firms, clustered at the level of business area.

Table A2: Dynamics of Treatment Effects

VARIABLES	(1) Hire College Midline	(2) Hire Non-college Midline	(3) (2)-(1)	(4) Hire College Endline	(5) Hire Non-college Endline	(6) (5)-(4)	(7) Hire Any Planned
Treated x Not requesting college	0.007	0.066	0.059	0.033	-0.002	-0.036	0.005
	(0.049)	(0.054)	(0.074)	(0.063)	(0.048)	(0.077)	(0.071)
	[0.887]	[0.226]	[0.429]	[0.595]	[0.964]	[0.643]	[0.949]
Treated x Requesting college	-0.122	0.100	0.222	-0.197	0.088	0.285	-0.124
	(0.063)	(0.050)	(0.084)	(0.076)	(0.053)	(0.105)	(0.072)
	[0.057]	[0.050]	[0.010]	[0.012]	[0.106]	[0.008]	[0.088]
Observations	580	580		580	580		568
R-squared	0.279	0.442		0.327	0.502		0.324
Control baseline char.	Yes	Yes		Yes	Yes		Yes
Business area FE	Yes	Yes		Yes	Yes		Yes
Cluster at business area	Yes	Yes		Yes	Yes		Yes
Control mean: Not requesting college	0.154	0.571		0.198	0.692		0.652
Control mean: Requesting college	0.393	0.0828		0.586	0.110		0.653

Notes: This table presents the dynamics of the treatment effects on hiring. The sample is restricted to firms eligible for treatment with reservation wage at least 2,000 ETB. We interact initial treatment assignment and whether or not firm requested a college graduate at baseline. Dependent variables: Column 1 and 4, whether the firm hired any college-educated at midline or at endline. Column 2 and 5, whether the firm hired any non-college worker at midline or at endline. Column 3 computes the differences between the estimates in Column 1 and 2. Column 6 computes the differences between the estimates in Column 4 and 5. Column 7, whether the firm planned to hire any workers in the next three months following endline. All regressions control for all baseline firm and vacancy characteristics, include business area fixed effects, and cluster at the business area level. Standard errors are shown in parentheses; p-values are shown in brackets.

Table A3: Treatment Effects on Salary and Match Quality

VARIABLES	(1) Salary (USD)	(2) Voluntary quit	(3) Fired by firm	(4) Above-avg prod (surveyed)	(5) Above-avg prod (measured)	(6) No absent days	(7) Overtime work
Assigned to treat	0.731	-0.138	0.085	0.036	0.108	-0.005	-0.020
	(10.09)	(0.160)	(0.076)	(0.186)	(0.261)	(0.163)	(0.211)
	[0.943]	[0.392]	[0.268]	[0.850]	[0.683]	[0.975]	[0.924]
Observations	116	142	142	142	82	142	142
R-squared	0.702	0.487	0.429	0.601	0.787	0.511	0.517
Control baseline char.	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Business area FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cluster at business area	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Control mean	90.6	0.111	0.020	0.535	0.476	0.636	0.333

Notes: This table presents the treatment effects of employment agencies on salary and match quality at endline. We only include firms that requested a college graduate at baseline, were eligible for treatment with reservation wage at least 2,000 ETB, and hired someone to the posted vacancy. All regressions include a full set of baseline characteristics from Table A1, control for business area fixed effects, and cluster at business area level. Dependent variables: Column 1, monthly salary in US dollars. Column 2, whether the hired worker voluntarily quit. Column 3, whether the hired worker was fired by firms. Column 4, whether the hired worker was considered to be more productive than average workers on the similar positions. Column 5, whether the percentage of targets met in the recent month of the hired worker was above that of similar workers (this data only exists in Round 2). Column 6, whether the hired worker had zero absent day in the last 30 days. Column 7, whether the hired worker worked overtime in the last 7 days. Standard errors are shown in parentheses; p-values are shown in brackets.

Table A4: Complier analysis

VARIABLES	(1) Salary (USD)	(2) Voluntary quit	(3) Fired by firm	(4) Above-avg prod (surveyed)	(5) Above-avg prod (measured)	(6) No absent days	(7) Overtime work
$E[Y_n\|H_n(1) > H_n(0)]$	55.5	.305	.0603	.53	.31	.544	.531
	(7.15)	(.103)	(.0437)	(.122)	(.152)	(.122)	(.122)
	[0.000]	[0.003]	[0.168]	[0.000]	[0.041]	[0.000]	[0.000]
$E[Y_c\|H_c(1) < H_c(0)]$	121	.153	.0246	.622	.647	.577	.302
	(15.8)	(.103)	(.0593)	(.149)	(.232)	(.147)	(.143)
	[0.000]	[0.135]	[0.678]	[0.000]	[0.005]	[0.000]	[0.035]
Difference	-65.8	.151	.0357	-.0926	-.337	-.0324	.229
	(17)	(.144)	(.0712)	(.199)	(.295)	(.2)	(.194)
	[0.000]	[0.294]	[0.616]	[0.642]	[0.252]	[0.871]	[0.240]

Notes: This table presents complier analysis results on salary and match quality at endline, following Abadie (2003). Endogeneous variables: Whether firm hired any college graduates (H_c), and whether firm hired any non-college workers (H_n). Instrument: Interaction of initial treatment assignment and baseline request for college graduates. No other controls are included in the complier analysis. Dependent variables: Column 1, monthly salary in US dollars. Column 2, whether the hired worker voluntarily quit. Column 3, whether the hired worker was fired by the firm. Column 4, whether the hired worker was considered to be more productive than average workers in similar positions. Column 5, whether the percentage of targets met in the recent month of the hired worker was above that of similar workers (this data only exists in Round 2). Column 6, whether the hired worker had zero absent day in the last 30 days. Column 7, whether the hired worker worked overtime in the last 7 days. Standard errors are shown in parentheses; p-values are shown in brackets.

B Additional Materials on Employment Agencies

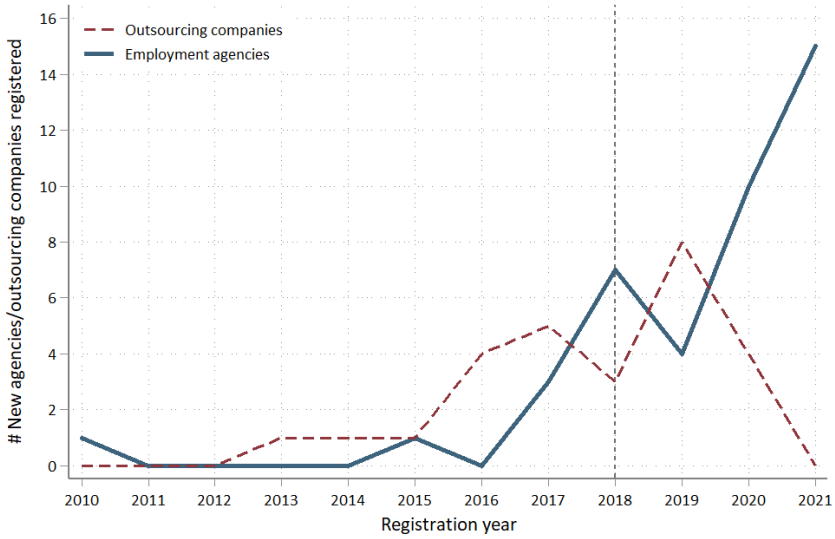
Figure B1 shows a representative employment agency. Figure B2, Panel A shows that the number of new registered employment agencies in Bole sub-city after 2018 increases drastically. There is another form of labor market intermediary, outsourcing company, that was more prevalent in Addis Ababa prior to 2018. Firms outsource low-skill occupations to these companies such as janitors and security guards, similar to Goldschmidt and Schmieder (2017) and Dorn et al. (2018) in the context of Germany and US. Instead, we see a downward trend of registered outsourcing companies post 2019, which may imply an increase in the demand for high-skill instead of low-skill workers.

The trend of employment agencies is also observed in many other low- and middle-income countries. Figure B2, Panel B shows a time series of newly established employment agencies observed from one of the largest online business-to-business platforms. Despite omitting many employment agencies not able to be observed online, there has been an increasing number of new employment agencies since 2005 across low- and middle-income countries providing recruitment services to private firms.

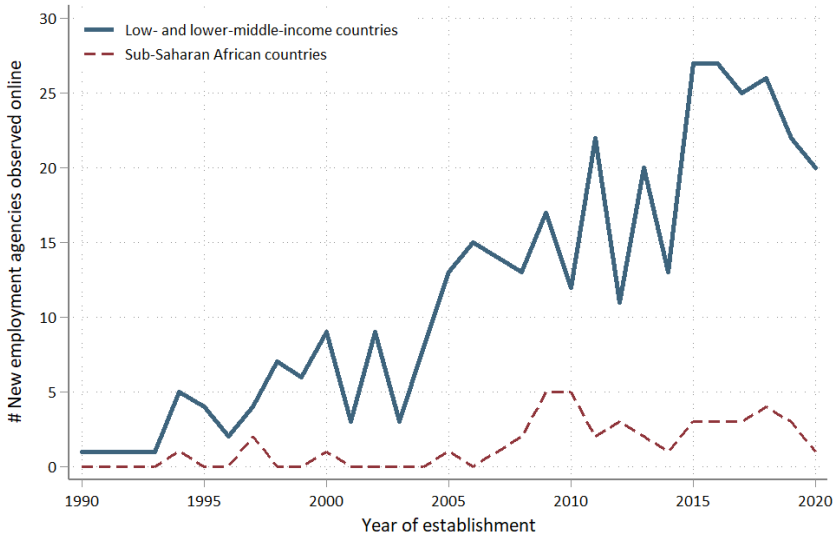
Figure B1: A Typical Employment Agency

Figure B2: Trends of Employment Agencies

Panel A. Number of employment agencies in Bole sub-city, 2010–21



Panel B. Number of employment agencies in low- and middle-income countries, 1990–2020



Notes: This figure shows the trend of employment agencies in the recent decades. We show the number of registered labor market intermediaries in Bole sub-city during 2010–21. The data come from the registry of employment agencies from Bole sub-city. Blue solid line shows the trend of employment agencies. Red dashed line shows the trend of outsourcing companies, another form of labor market intermediaries that focus exclusively on low-skill occupations such as construction, security guards, and janitors. Panel B shows the number of new employment agencies observed online from 1990–2020. The data comes from a large business-to-business service platforms where we search for all existing records of employment agencies of each country. Blue solid line shows the time series for low- and lower-middle-income countries according to World Bank definition. Red dashed line shows the time series only for sub-Saharan African countries.

C Additional Materials on Sampling and Data

Figure C1 shows the geographic distribution of 88 sampled business areas and 799 firms selected for the baseline survey. Table C1, Panel A compares the sampling of firms to that of Hensel et al. (2024), who sampled from the firm registry from the Ministry of Trade. Our firm sample includes more firms from hospitality sector and of a larger number of current employees in general. Other existing firm surveys of Ethiopia, such as Large Manufacturing and Electricity Industries Survey, mostly focus on manufacturing firms of much larger sizes.

Franklin (2018) discusses potential sampling bias of only sampling from notice boards in the city center. During our pilot, we collected 150 job posts from 3 major notice boards of Addis Ababa; we also collected 2,073 job posts from a major online job search platform of Ethiopia from 2019–22. Table C1, Panel B compares the posted salary distribution between the three different samples. Our vacancy sample is able to capture more lower-paid jobs, particularly those with salary between 2,000–4,000 ETB per month. Notice boards and online platforms select higher-paid jobs, possibly because these firms are able to afford higher job-posting costs on these platforms.

Table C1: Sample Selection across Different Data

Panel A. Sampling of Firms

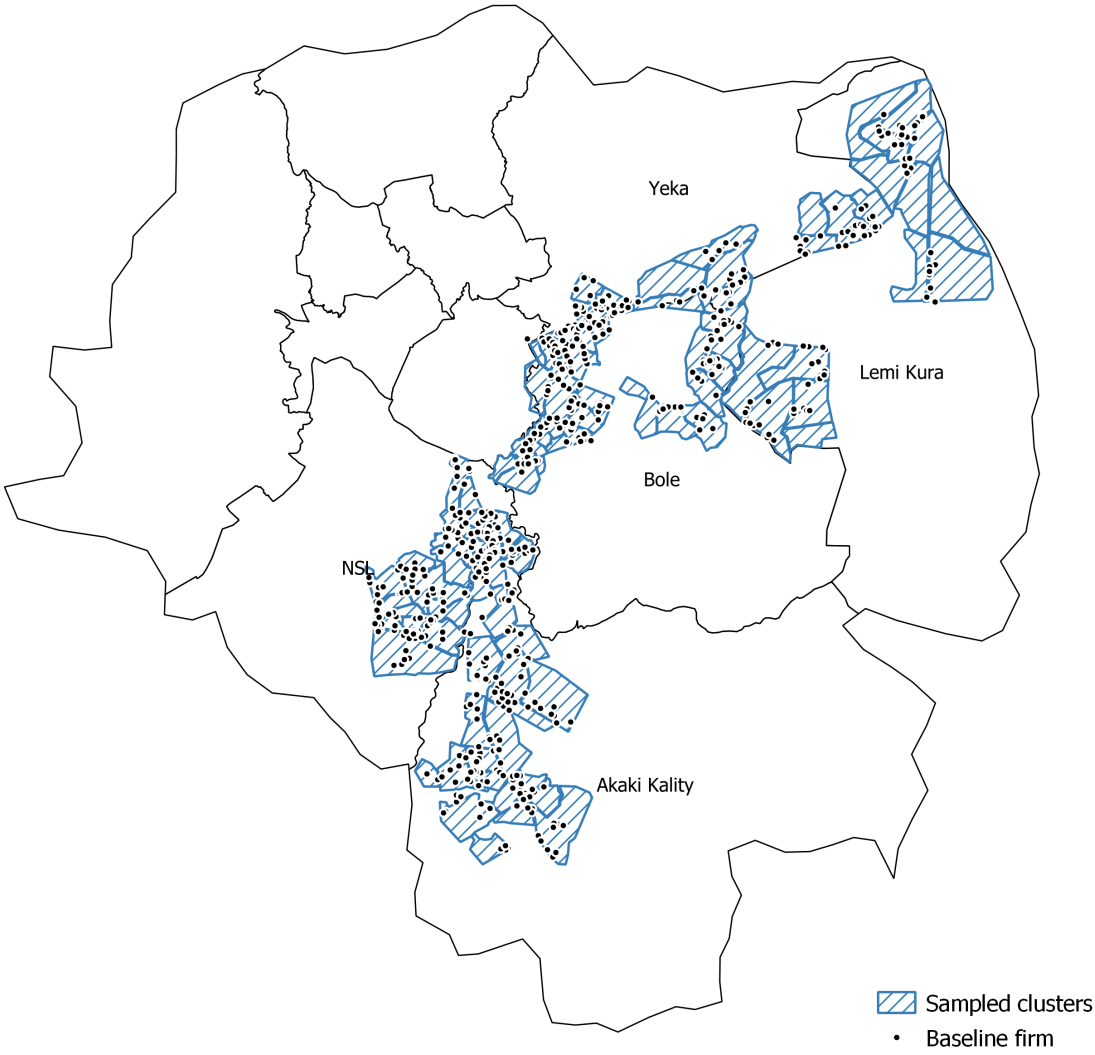
	This paper	Hensel et al. 2022	LMMIS 2014
Sector: Manufacturing	0.36	0.51	1.00
Sector: Hospitality	0.39	0.27	0.00
Sector: Others	0.25	0.22	0.00
Number of employees: Average	58	14	99
Number of employees: Median	20	10	32

Panel B. Sampling of Vacancies

Salary (birr)	This paper	Notice board pilot	Major online platform
25 percentile	2,000	3,500	4,609
50 percentile	3,000	4,020	8,017
75 percentile	4,800	5,208	13,926
Average	3,878	4,737	12,429

Notes: This table compares sampling of firms of vacancies between this paper and other data sources. Panel A compares the sampling of firms between this paper, Hensel et al. (2024), and Large and Medium Manufacturing and Electricity Industries Survey (LMMIS, the latest available year is 2014). Panel B compares the sampling of vacancies between this paper, vacancies collected from three major notice boards of Addis Ababa during our pilot in November 2020, and job posts from a major online job search platform in Ethiopia.

Figure C1: Sampling Map



Notes: This figure shows the geographical distribution of 88 business areas from five sub-cities and 799 firms selected in the baseline survey.

Table C2: Description of Firm-Level Variables

Module	Survey questions	Variables	Use in paper
Baseline sector	What is the main business of this company?	Manufacturing and construction	Baseline control
		Hospitality (Hotels, restaurants)	Baseline control
		Education	Baseline control
		Health	Baseline control
Baseline workforce	How many employees are currently in your company? (including both permanent and temporary)	Number of current employees	Baseline control
	What's the percentage/number of female workers currently hired in the company?	Pct of female employees	Baseline control
	What's the percentage/number of well-educated workers (at least diploma) currently hired in the company?	Pct of employees with college degree	Baseline control, mechanism test
	What's the percentage/number of workers with zero year of experience currently hired in the company?	Pct of employees with zero experience	Baseline control
	What's the percentage/number of temporary workers currently hired in the company?	Pct of temporary employees	Baseline control
	What's the percentage/number of workers currently hired through referrals or recommendations?	Pct of employees hired through recommendation	Baseline control
Baseline hiring	What's the respondent's position in the firm?	The firm has a HR department (the respondent is a human resource manager or expert)	Baseline control
		The respondent is less engaging (the respondent is the owner)	Robustness
	Have you tried to hire labor from notice boards, newspaper, or online platforms before?	Hiring only from formal channels	Baseline control
	Have you tried to hire labor from agencies or informal brokers before?	Hiring from agencies or brokers	Baseline control
	Which agency did you go to most often before?	Experience with emp agencies	Footnote
	Have you tried to hire labor through personal recommendation?	Hiring through recommendation	Baseline control, mechanism test
Baseline vacancy	What will be the highest salary you would pay for this position?	Reservation wage	Eligibility, baseline control, robustness
	How many vacancies are you posting?	Posting more than one vacancy (only in Round 2)	Robustness
	What is the minimal requirement on education?	Required college-level diploma or degree (incl. TVET Level 3–4)	Main specification
		Required vocational certificate (excl. TVET Level 3–4)	Baseline control
		Required high school degree	Baseline control
	What is the minimal requirement on experience?	Required no experience	Baseline control
		Required $<$1y experience	Mechanism test
		Required $\geq$2y experience	Baseline control
	What will be the brief job description for this new position?	Skilled task, manual task, routine task	Baseline control, mechanism test
Endline outcome	What is the agreed monthly salary when you first hire this person?	Monthly salary	Efficiency
	Did the hired worker quit voluntary?	Voluntary quit	Efficiency
	Did you fire this hired worker?	Fired by firm	Efficiency
	Compare this worker to the average 1-3 workers in the similar positions. How productive do you think this worker is on the job?	Above-average prod. (surveyed)	Efficiency
	What's the percentage of targets met by this worker in the recent month?	Above-average prod. (estimated)	Efficiency
	How many days was this worker absent in the last 30 days?	Zero absent days	Efficiency
	How many overtime hours did this worker work in the last week?	Overtime work	Efficiency
	Do you think it is easier for a college graduate to get a job in Addis Ababa, compared to someone who didn't go to college?	Perception: College graduates have more job opportunities	Mechanism test
	Imagine two workers. They came from the same subcity, went to the same secondary school, and have the same work experience. The only difference is that one went to college and the other one didn't. For the vacancy you posted, which one do you think will be more productive?	Perception: College graduates are more productive	Mechanism test

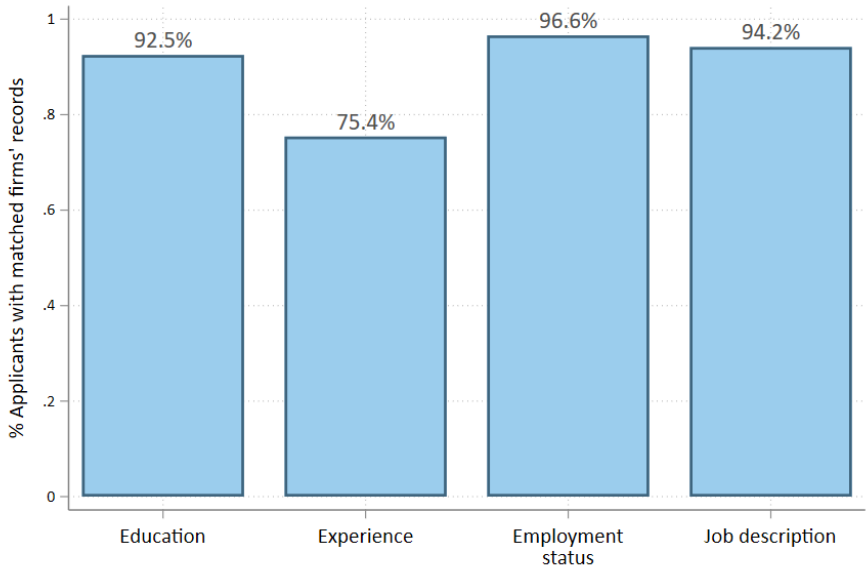
Table C3: Description of Applicant-Level Variables

Module	Survey questions	Variables	Use in paper
Firm applicant form	What's the education level of the applicant?	Educ: College-level diploma or degree (incl. TVET Level 3–4)	Main outcome
		Educ: Vocational (non-diploma, excl. TVET Level 3–4)	Balance
		Educ: At most high school	Balance
	Years of work experience	Experience met minimum requirement	Mechanism test
	Was this worker sent by one of our employment agencies?	Agency/non-agency applicants	Main outcome
	Did you invite this applicant to interview?	Invited to interview	Main outcome
	Did the applicant reject the interview invite?	Reject interview	Mechanism test
	Did you offer a job to this applicant and the applicant accepted?	Hired	Main outcome
	Did you offer a job to this applicant and the applicant reject the offer?	Reject offer	Mechanism test
	If this worker was to be hired on the job, how productive would this worker be?	Perceived to be productive (only Round 2)	Mechanism test
	How likely would this worker get a better offer elsewhere?	Perceived with good job opportunities (only Round 2)	Mechanism test
	Did the worker provide a résumé?	Provided a Résumé	Mechanism test
Worker survey	Gender	Gender	Balance
	What is your age?	Age: Above median	Balance
	What is your education level?	Educ: College-level diploma or degree	Data validation
	Are you currently employed?	Currently employed	Balance, data validation
	What is your current job?		Data validation
	What was your father's education level?	Father is educated (family background)	Balance
	How many years of job experience do you have?	Years of experience	Balance, mechanism test
	What kind of experience do you have?	Descriptions of past experience	Mechanism test

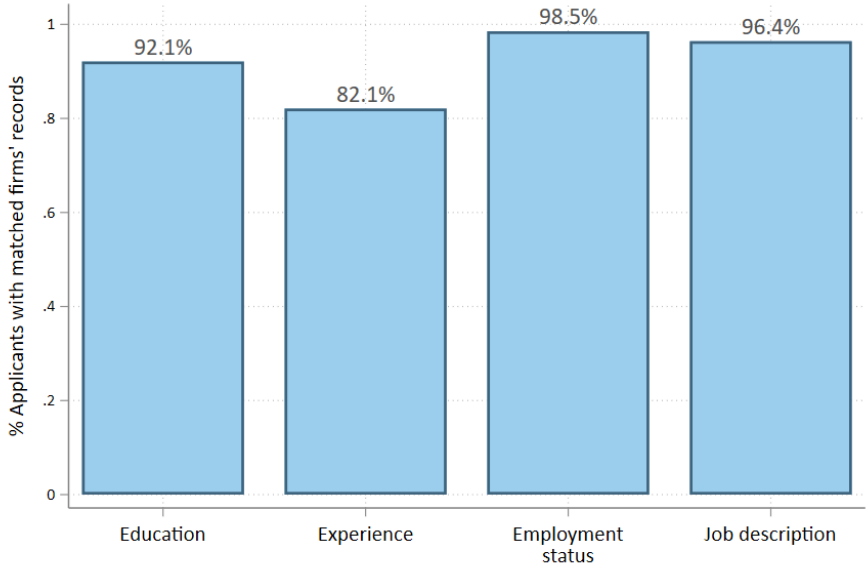
We cross-validate the firm-reported and applicant-reported data in Figure C2, separately for college-educated and non-college applicants. In general, firms perceived correctly for 98% applicants whether they obtained a college diploma or degree, and 92% perceived correctly the exact level of education. Among the 683 workers who were sampled in the worker survey and hired by firms, 98% workers confirmed that they were indeed hired, and 96% reported the same job description. These statistics did not differ regarding college education, suggesting no systematic misreporting regarding the employment status of college-educated applicants. We do observe one difference regarding applicants' years of experience: only 75% of the college-educated applicants were correctly perceived regarding the years of experience; this statistic among the non-college applicants is 82%. Section IV provides an explanation for this discrepancy.

Figure C2: Data Validation

Panel A. College-educated applicants



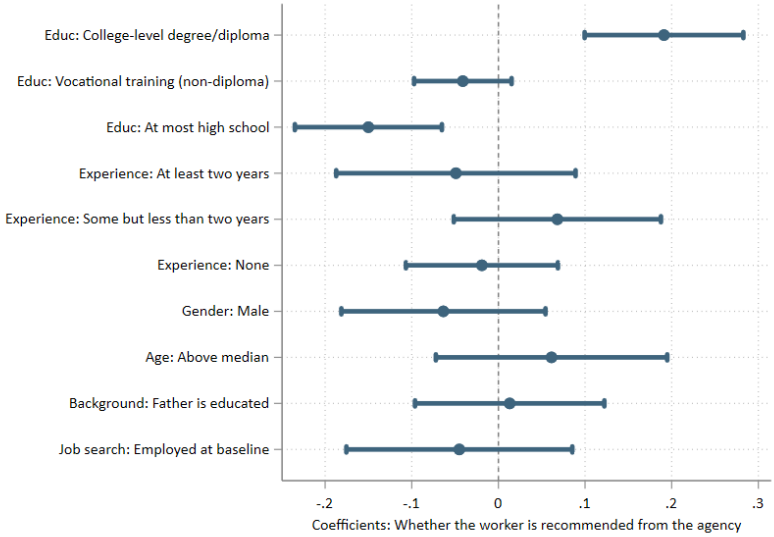
Panel B. Non-college applicants



Notes: This figure shows the results from a data validation exercise, separately for college-educated and non-college workers. For education and experience, we focus on 1,050 workers who were sampled in the worker survey at midline. For employment status and job description, we focus on 683 workers who were sampled in the worker survey and hired by firms for the sampled vacancies according to firms' reports. We calculate the percentage of records with the same education level, the same years of experience, and among those who were hired by firms according to firms' report, the same employment status, and the same job description.

D Appendix Materials on the Effects on Hiring

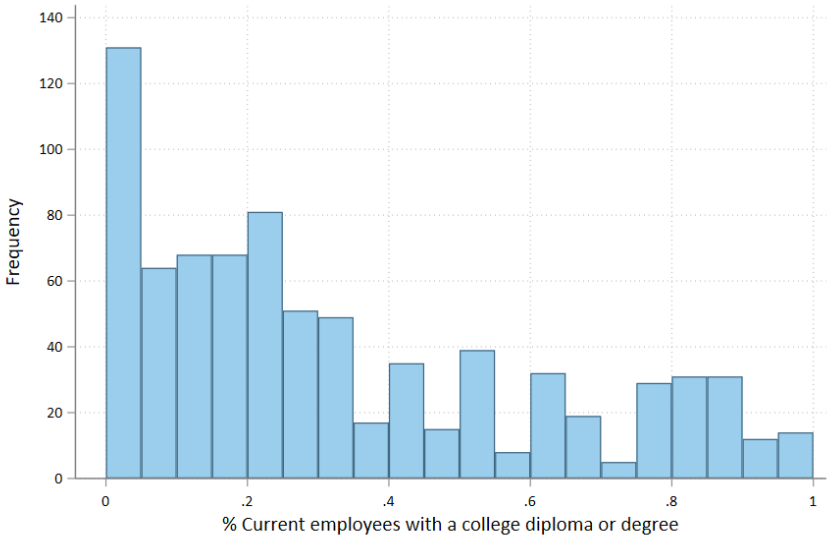
Figure D1: Selection of Applicants from Employment Agencies



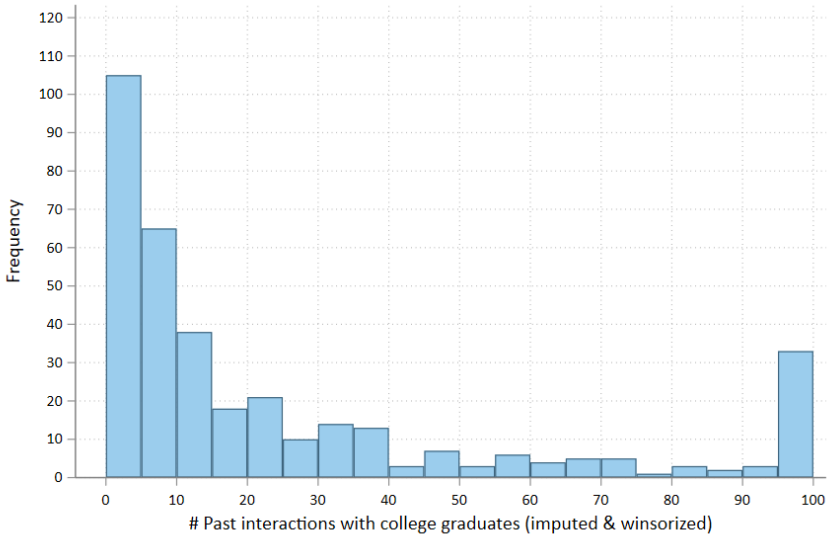
Notes: This figure shows the selection of applicants from the employment agencies in terms of observable characteristics. For each characteristics, we compare agency applicants to non-agency applicants, controlling for firm fixed effects and cluster at the firm level. 95% confidence intervals are shown for each estimate.

Figure D2: Firms' Past Interaction with College Graduates

Panel A. College share as proxy



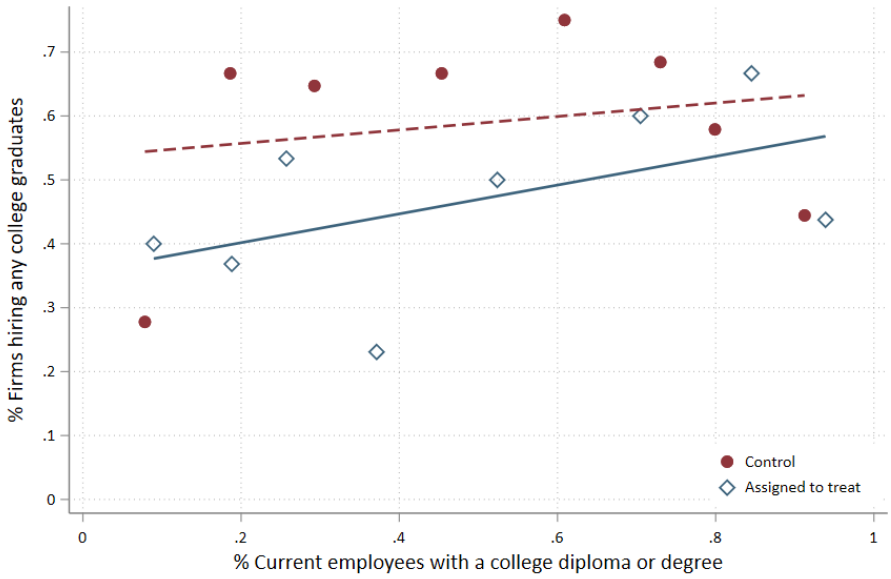
Panel B. Imputed number of past interactions



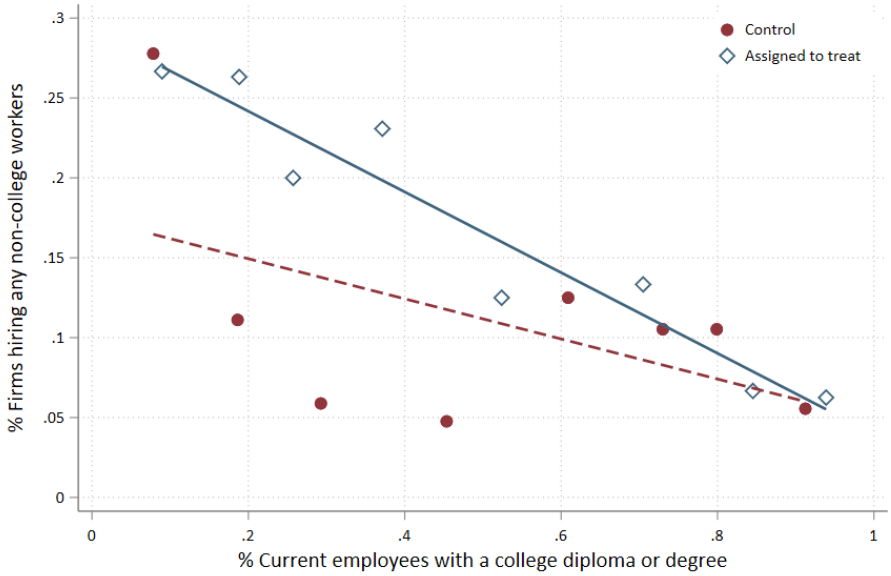
Notes: Panel A shows the distribution of the college share over the whole sample, defined as the percentage of current employees with a college diploma or degree. Panel B shows the distribution of the imputed number of past interactions with college graduates. Only Round 1 sample is included in Panel B, and we winsorize the right tail at 100. To impute the past interactions, for each firm, we first calculate the number of years since the firm was established, multiply it by the number of vacancies posted in the last 12 months (this data only exists in Round 1), and then multiply it by the college share, assuming each vacancy hires one person. We further add this imputed number with the number of current employees with a college diploma or degree.

Figure D3: Hiring of College Graduates and Non-College Workers By College Share

Panel A. Hiring of college graduates



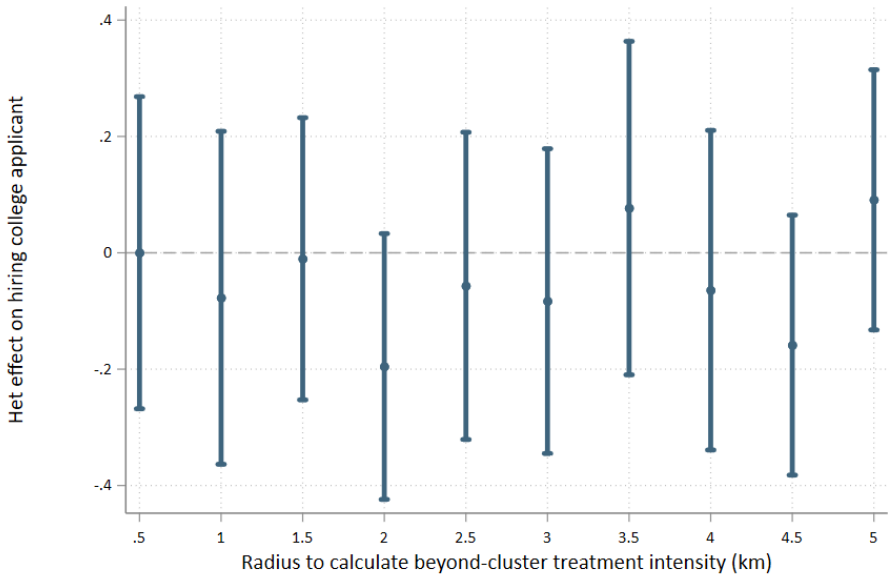
Panel B. Hiring of non-college workers



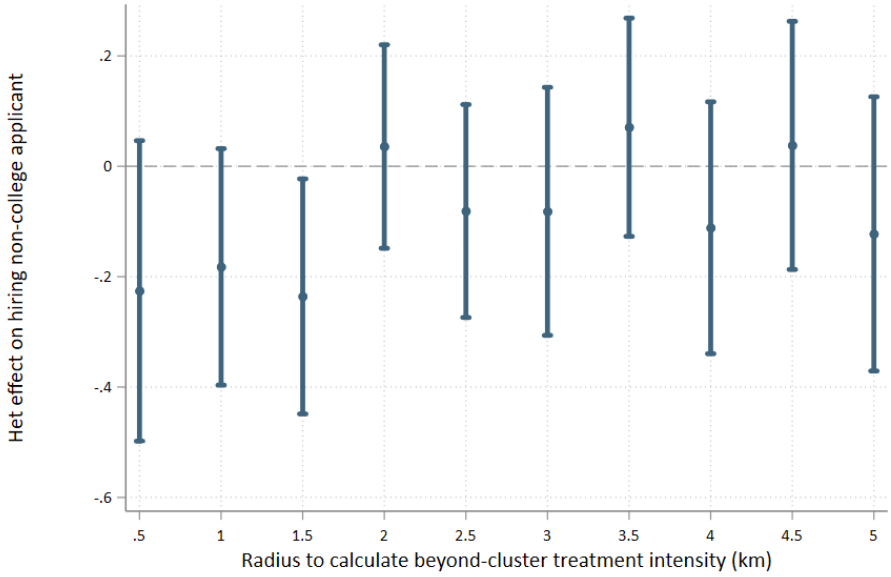
Notes: This figure presents the bin-scatter plots of the hiring of college graduates and non-college educated workers. Only firms with reservation wage at least 2,000 ETB (eligible firms) and requesting a college graduate at baseline are included. The horizontal axis is the percentage of current employees with a college diploma or degree, a proxy for the exposure to college graduates. The vertical axis in Panel A is the percentage of firms hiring at least one college graduate; In Panel B, the percentage of firms hiring at least one non-college worker. Blue diamonds are firms initially assigned to treatment. Red dots are firms initially assigned to control group.

Figure D4: Heterogeneous Effects by Treatment Intensity

Panel A. Hiring any college graduate



Panel B. Hiring any non-college worker



Notes: This figure shows the heterogeneous treatment effects by beyond-cluster treatment intensity in the nearby regions. Only firms with reservation wage at least 2,000 ETB (eligible firms) are included. In each regression, we regress whether firm hired any college or non-college workers on (i) initial treatment assignment, (ii) interaction of treatment assignment and whether the firm requested a college graduate at baseline, and (iii) triple interaction of treatment assignment, whether the firm requested a college graduate at baseline, and whether the treatment intensity is above average. Treatment intensity is calculated by the percentage of firms within the radius of $x - 0.5$ and x kilometers (excluding own business area) selected for treatment. We control for the interaction of the treatment assignment and whether the treatment intensity is above average to guarantee a fully-saturated model. We only report coefficients of the triple interaction terms. 95% confidence intervals are shown.

Table D1: Additional Specifications on the First-stage Treatment Effects

Panel A. Different outcome variables

	(1)	(2)	(3)	(4)	(5)	(6)
	All applicants			College-educated applicants		
	# App ≥1	# App ≥2	# App ≥3	# App ≥1	# App ≥2	# App ≥3
Assigned to treat	0.098	0.126	0.047	0.052	0.126	0.042
	(0.050)	(0.063)	(0.046)	(0.049)	(0.041)	(0.032)
	[0.052]	[0.048]	[0.315]	[0.285]	[0.003]	[0.194]
Observations	583	583	589	586	589	586
R-squared	0.256	0.309	0.322	0.443	0.365	0.337
Control baseline char.	Yes	Yes	Yes	Yes	Yes	Yes
Business area FE	Yes	Yes	Yes	Yes	Yes	Yes
Cluster at business area	Yes	Yes	Yes	Yes	Yes	Yes
Control mean	0.800	0.403	0.275	0.448	0.215	0.143

Panel B. College-educated applicants by baseline request for college graduates

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	# Agency	# Non-agency	# All	# App ≥1	# App ≥2	# App ≥3
Treated x Not requesting college	0.113	0.103	0.211	0.068	0.051	0.016
	(0.053)	(0.161)	(0.169)	(0.065)	(0.043)	(0.032)
	[0.035]	[0.522]	[0.217]	[0.296]	[0.244]	[0.613]
Treated x Requesting college	0.621	0.038	0.657	0.029	0.248	0.068
	(0.101)	(0.273)	(0.293)	(0.060)	(0.076)	(0.063)
	[0.000]	[0.890]	[0.028]	[0.631]	[0.001]	[0.278]
Observations	586	586	586	586	589	586
R-squared	0.492	0.350	0.396	0.443	0.373	0.330
Control mean: Firms not requesting college	0.038	0.481	0.519	0.243	0.103	0.060
Control mean: Firms requesting college	0.168	1.685	1.846	0.698	0.336	0.228

Notes: This table examines the treatment effects on the number of applicants. The sample is restricted to firms eligible for treatment with reservation wage at least 2,000 ETB. Observation with above 99.5 percentile are truncated (number of applicants above 13). Dependent variables: Panel A, Column 1–3, at least one, two, or three applicants. Panel A, Column 4–6, at least one, two, or three college-educated applicants. Panel B, Column 1–3, number of college-educated applicants from agencies, not from agencies, or from both. Panel B, Column 4–6, at least one, two, or three college-educated applicants. All regressions include a full set of baseline characteristics from Table A1, include business area fixed effects, and cluster at the business area level. Standard errors are shown in parentheses; p-values are shown in brackets.

Table D2: Intensive Margin Effects on Interviewing

VARIABLES	(1) # Applicants Interviewed	(2) # Agency apps Interviewed	(3) # Non-agency apps Interviewed	(4) All non-agency apps Interviewed
Assigned to treatment	-0.080	0.092	-0.171	-0.197
	(0.114)	(0.036)	(0.112)	(0.074)
	[0.485]	[0.012]	[0.129]	[0.009]
Observations	589	589	589	580
R-squared	0.808	0.238	0.822	0.345
Control baseline char.	Yes	Yes	Yes	Yes
Business area FE	Yes	Yes	Yes	Yes
Cluster at business area	Yes	Yes	Yes	Yes
Control mean	1.633	0.027	1.606	0.631

Notes: This table examines whether treated firms conducted more interviews. The sample is restricted to firms eligible for treatment with reservation wage at least 2,000 ETB. We also control for the number of non-agency applicants and the interaction with treatment status to control for the mechanical effect through the number of applicants. Dependent variables: Column 1, the number of applicants that were invited for interviews, including agency and non-agency. Column 2, the number of agency applicants invited for interviews. Column 3, the number of non-agency applicants invited for interviews. Column 4, whether firm invited all non-agency applicants for interviews. All regressions control for all baseline firm and vacancy characteristics, include business area fixed effects, and cluster at the business area level. Standard errors are shown in parentheses; p-values are shown in brackets.

Table D3: Correlational Evidence of Search Effect

Panel A. Number of college-educated applicants and hiring outcomes

VARIABLES	(1) Interview Any	(2) Interview College	(3) Interview Non-college	(4) Hire Any	(5) Hire College	(6) Hire Non-college
# College applicants	-0.003	0.000	-0.027	-0.005	-0.001	-0.018
	(0.014)	(0.014)	(0.006)	(0.016)	(0.013)	(0.006)
	[0.855]	[0.999]	[0.000]	[0.746]	[0.909]	[0.005]
Observations	135	135	135	135	135	135
R-squared	0.641	0.666	0.827	0.612	0.609	0.828
Control baseline char.	Yes	Yes	Yes	Yes	Yes	Yes
Business area FE	Yes	Yes	Yes	Yes	Yes	Yes
Cluster at business area	Yes	Yes	Yes	Yes	Yes	Yes
Mean dep var	0.781	0.336	0.536	0.759	0.303	0.515

Panel B. Number of non-college applicants and hiring outcomes

VARIABLES	(1) Interview Any	(2) Interview College	(3) Interview Non-college	(4) Hire Any	(5) Hire College	(6) Hire Non-college
# Non-college applicants	0.019	0.009	0.022	0.019	0.000	0.019
	(0.009)	(0.022)	(0.011)	(0.009)	(0.022)	(0.011)
	[0.041]	[0.674]	[0.039]	[0.041]	[0.992]	[0.105]
Observations	206	206	206	206	206	206
R-squared	0.621	0.607	0.658	0.621	0.612	0.712
Control baseline char.	Yes	Yes	Yes	Yes	Yes	Yes
Business area FE	Yes	Yes	Yes	Yes	Yes	Yes
Cluster at business area	Yes	Yes	Yes	Yes	Yes	Yes
Mean dep var	0.781	0.336	0.536	0.759	0.303	0.515

Notes: This table presents the correlation between the number of college-educated or non-college applicants and the interviewing and hiring outcomes. In Panel A, the sample is restricted to firms with at least one college-educated applicant, controlling for the number of non-college applicants. In Panel B, the sample is restricted to firms with at least one non-college applicant, controlling for the number of college-educated applicants. Dependent variables: Column 1 and 4, whether the firm interviewed or hired any applicant at endline. Column 2 and 5, whether the firm interviewed or hired any college graduate at endline. Column 3 and 6, whether the firm interviewed or hired any non-college worker at endline. All regressions control for all baseline firm and vacancy characteristics, include business area fixed effects, and cluster at the business area level. Standard errors are shown in parentheses; p-values are shown in brackets.

Table D4: Heterogeneous Treatment Effects on Hiring Non-Agency Applicants

VARIABLES	(1) Interview College	(2) Interview Non-college	(3) (2)-(1)	(4) Hire College	(5) Hire Non-college	(6) (5)-(4)
Treated x Not requesting college	0.019	-0.018	-0.038	0.022	-0.004	-0.025
	(0.060)	(0.050)	(0.070)	(0.063)	(0.048)	(0.076)
	[0.747]	[0.712]	[0.593]	[0.730]	[0.941]	[0.741]
Treated x Requesting college	-0.152	0.091	0.243	-0.196	0.080	0.276
	(0.081)	(0.056)	(0.110)	(0.077)	(0.053)	(0.103)
	[0.065]	[0.106]	[0.030]	[0.012]	[0.133]	[0.009]
Observations	580	580		580	580	
R-squared	0.333	0.495		0.330	0.507	
Control baseline char.	Yes	Yes		Yes	Yes	
Business area FE	Yes	Yes		Yes	Yes	
Cluster at business area	Yes	Yes		Yes	Yes	
Control mean: Not requesting college	0.231	0.714		0.192	0.692	
Control mean: Requesting college	0.600	0.131		0.586	0.110	

Notes: This table presents the treatment effects on whether firms hired a college graduate or a non-college worker, excluding agency applicants from constructing outcome variables. The sample is restricted to firms eligible for treatment with reservation wage at least 2,000 ETB. We interact initial treatment assignment and whether or not firm requested a college graduate at baseline. Dependent variables: Column 1 and 4, whether the firm interviewed any college-educated or non-college applicant at endline. Column 2 and 5, whether the firm hired any college graduate or non-college worker at endline. Column 3 computes the differences between the estimates in Column 1 and 2. Column 6 computes the differences between the estimates in Column 4 and 5. All regressions control for all baseline firm and vacancy characteristics, include business area fixed effects, and cluster at the business area level. Standard errors are shown in parentheses; p-values are shown in brackets.

Table D5: Testing the Identification Assumption for Heterogeneous Treatment Effects

VARIABLES	(1) Hire College	(2) Hire College	(3) Hire Non-college	(4) Hire Non-college
Treated x Not requesting college	0.030	-0.061	-0.008	0.035
	(0.219)	(0.054)	(0.183)	(0.036)
	[0.893]	[0.258]	[0.965]	[0.338]
Treated x Requesting college	-0.417	-0.494	0.223	0.291
	(0.239)	(0.131)	(0.188)	(0.129)
	[0.086]	[0.000]	[0.238]	[0.027]
Observations	580	580	580	580
R-squared	0.366	0.332	0.522	0.506
Business area Fixed effects	Yes	Yes	Yes	Yes
Cluster at business area	Yes	Yes	Yes	Yes
Specification	All interactions	Residual	All interactions	Residual
Control mean	0.311	0.311	0.505	0.505

Notes: This table examines the robustness of the effects on hiring college graduates or non-college workers regarding the identification assumption. The sample is restricted to firms eligible for treatment with reservation wage at least 2,000 ETB. All regressions include a full set of baseline characteristics from Table A1, control for business area fixed effects, and cluster at business area level. Specifications: Column 1 and 3, controlling for the interaction between the initial treatment assignment and a full set of baseline characteristics from Table A1. Column 2 and 4, we first regress whether the firm requested a college graduate at baseline on all other baseline characteristics from Table A1, extract the residual, and interact the initial treatment assignment with the residual. Standard errors are shown in parentheses; p-values are shown in brackets.

Table D6: Explaining the Belief Update with College Share

VARIABLES	(1) % Perceived productive College applicants	(2) % Perceived productive College applicants	(3) Agreed college grads are more productive	(4) Agreed college grads are more productive
Treated x Above-median college share	-0.285		-0.077	
	(0.133)		(0.0476)	
	[0.038]		[0.112]	
Treated x (Resid.) above-median college share		-0.347		-0.091
		(0.391)		(0.094)
		[0.380]		[0.335]
Treated x Below-median college share	-0.237		-0.010	
	(0.129)		(0.0567)	
	[0.076]		[0.083]	
Treated x (Resid.) below-median college share		-0.273		-0.087
		(0.120)		(0.044)
		[0.029]		[0.051]
Observations	151	151	568	568
R-squared	0.394	0.394	0.329	0.329
Control baseline char.	Yes	Yes	Yes	Yes
Business area FE	Yes	Yes	Yes	Yes
Cluster at business area	Yes	Yes	Yes	Yes
Control mean	0.785	0.785	0.808	0.808

Notes: This table examines whether the belief update in Table 3 is more significant among firms whose percentage of college-educated workers in the firm at baseline (college share) is below median. The sample is restricted to firms eligible for treatment with reservation wage at least 2,000 ETB. In Column 1 and 3, we interact initial treatment assignment and whether the college share is above median. In Column 2 and 4, we regress whether the college share is above median on other baseline firm and vacancy characteristics and extract the residual. We then interact initial treatment assignment and the residual. Dependent variables: Column 1 and 2, percentage of college-educated applicants perceived with good productivity. Column 3 and 4, whether firm agreed that college graduates are more productive than non-college workers. All regressions control for all baseline firm and vacancy characteristics, include business area fixed effects, and cluster at the business area level. Standard errors are shown in parentheses; p-values are shown in brackets.

Table D7: Explaining the Shift in Hiring Behavior with College Share with a Different Proxy

VARIABLES	(1) Interview College	(2) Interview Non-college	(3) (2)-(1)	(4) Hire College	(5) Hire Non-college	(6) (5)-(4)
Treated x Not requesting college	-0.078	-0.084	-0.006	-0.019	-0.036	-0.017
	(0.102)	(0.090)	(0.136)	(0.102)	(0.096)	(0.146)
	[0.450]	[0.359]	[0.966]	[0.855]	[0.714]	[0.909]
Treated x Requesting college	-0.246	-0.117	0.129	-0.211	-0.159	0.051
x Above-median interaction	(0.167)	(0.155)	(0.239)	(0.155)	(0.151)	(0.226)
	[0.150]	[0.455]	[0.593]	[0.182]	[0.297]	[0.821]
Treated x Requesting college	-0.295	0.236	0.531	-0.367	0.139	0.506
x Below-median interaction	(0.156)	(0.132)	(0.226)	(0.170)	(0.129)	(0.245)
	[0.067]	[0.083]	[0.025]	[0.037]	[0.288]	[0.046]
Observations	247	247		247	247	
R-squared	0.321	0.517		0.316	0.500	
Control baseline char.	Yes	Yes		Yes	Yes	
Business area FE	Yes	Yes		Yes	Yes	
Cluster at business area	Yes	Yes		Yes	Yes	
Control mean: Not requesting college	0.231	0.714		0.198	0.692	
Control mean: Requesting college	0.614	0.131		0.586	0.110	

Notes: This table examines the robustness of the results from Table 5. The sample is restricted to firms eligible for treatment with reservation wage at least 2,000 ETB. We first impute the number of past interactions with college graduates. We then interact initial treatment assignment, whether firm requested a college graduate at baseline, and whether the imputed past interaction is above median. We further interact the treatment status with whether the imputed past interaction is above median to guarantee full saturation. Dependent variables: Column 1 and 4, whether the firm interviewed or hired any college-educated worker at endline. Column 2 and 5, whether the firm interviewed or hired any non-college worker at endline. Column 3 computes the differences between the estimates in Column 1 and 2. Column 6 computes the differences between the estimates in Column 4 and 5. All regressions control for all baseline firm and vacancy characteristics, include business area fixed effects, and cluster at the business area level. Standard errors are shown in parentheses; p-values are shown in brackets.

Table D8: Robustness: Statistical Inference

Panel A. Hiring college graduates

	(1)	(2)	(3)	(4)	(5)	(6)
	Hire	Hire	Hire	Hire	Hire	Hire
VARIABLES	College	College	College	College	College	College
Treated x Not requesting college	0.033	0.033	0.033	0.033	-0.030	-0.033
	(0.063)	(0.061)	(0.059)	(0.075)	(0.082)	(0.083)
	[0.595]	[0.582]	[0.570]	[0.657]	[0.713]	[0.694]
Treated x Requesting college	-0.197	-0.197	-0.197	-0.197	-0.226	-0.187
	(0.076)	(0.071)	(0.075)	(0.079)	(0.088)	(0.086)
	[0.012]	[0.006]	[0.008]	[0.014]	[0.012]	[0.033]
Observations	580	580	580	580	489	455
R-squared	0.327	0.327	0.327	0.327	0.445	0.496
Control baseline char.	Yes	Yes	Yes	Yes	Yes	Yes
Business area FE	Yes	Yes	Yes	Yes	Yes	Yes
Cluster at business area	Yes	Yes	Yes	Yes	Yes	Yes
Specification	Main	Robust sd	Bootstrap	Permutation test	Weighted by # apps	Weighted by # non-agency app
Control mean	0.372	0.372	0.372	0.372	0.460	0.472

Panel B. Hiring non-college workers

	(1)	(2)	(3)	(4)	(5)	(6)
	Hire	Hire	Hire	Hire	Hire	Hire
VARIABLES	Non-college	Non-college	Non-college	Non-college	Non-college	Non-college
Treated x Not requesting college	-0.002	-0.002	-0.002	-0.002	0.028	0.060
	(0.048)	(0.054)	(0.050)	(0.055)	(0.061)	(0.059)
	[0.964]	[0.968]	[0.965]	[0.968]	[0.645]	[0.313]
Treated x Requesting college	0.088	0.088	0.088	0.088	0.070	0.052
	(0.053)	(0.064)	(0.059)	(0.084)	(0.061)	(0.062)
	[0.106]	[0.172]	[0.140]	[0.303]	[0.261]	[0.405]
Observations	580	580	580	580	489	455
R-squared	0.502	0.502	0.502	0.502	0.719	0.748
Control baseline char.	Yes	Yes	Yes	Yes	Yes	Yes
Business area FE	Yes	Yes	Yes	Yes	Yes	Yes
Cluster at business area	Yes	Yes	Yes	Yes	Yes	Yes
Specification	Main	Robust sd	Bootstrap	Permutation test	Weighted by # apps	Weighted by # non-agency app
Control mean	0.433	0.433	0.433	0.433	0.544	0.557

Notes: This table examines the robustness of the treatment effects on hiring college graduates or non-college workers regarding statistical inference. The sample is restricted to firms eligible for treatment with reservation wage at least 2,000 ETB. We interact initial treatment assignment and whether firm requested a college graduate at baseline. Panel A examines the effect on hiring college graduates; Panel B examines the effect on hiring non-college workers. Specifications: Column 1, main. Column 2, only robust standard errors. Column 3, bootstrapping standard errors. Column 4, permutation test. Column 5, observations weighted by the total number of applicants. Column 6, observations weighted by the total number of non-agency applicants. All regressions include a full set of baseline characteristics from Table A1, include business area fixed effects, and cluster at the business area level. Standard errors are shown in parentheses; p-values are shown in brackets.

Table D9: Robustness: Attrition

VARIABLES	(1) Attrition	(2) Hire College	(3) Hire College	(4) Hire College	(5) Hire Non-college	(6) Hire Non-college	(7) Hire Non-college
Treated x Not requesting college	0.026	0.054	0.031	0.057	-0.008	-0.018	0.008
	(0.023)	(0.079)	(0.063)	(0.064)	(0.063)	(0.049)	(0.051)
	[0.273]	[0.497]	[0.623]	[0.376]	[0.899]	[0.715]	[0.872]
Treated x Requesting college	0.021	-0.168	-0.197	-0.177	0.058	0.083	0.103
	(0.014)	(0.072)	(0.076)	(0.078)	(0.060)	(0.053)	(0.054)
	[0.123]	[0.023]	[0.012]	[0.026]	[0.337]	[0.125]	[0.059]
Treated x Requesting college		-0.126			0.167		
x Attrition likelihood		(0.166)			(0.144)		
		[0.448]			[0.250]		
Observations	589	580	581	581	580	581	581
R-squared	0.224	0.330	0.327	0.308	0.506	0.497	0.507
Control baseline char.	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Business area FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cluster at business area	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Specification	Main	Interaction	All attrited firms hired	No attrited firms hired	Interaction	All attrited firms hired	No attrited firms hired
Control mean	0.015	0.372	0.371	0.386	0.433	0.432	0.447

Notes: This table examines the robustness of the effects on hiring college graduates or non-college workers regarding attrition. The sample is restricted to firms eligible for treatment with reservation wage at least 2,000 ETB. All regressions include a full set of baseline characteristics from Table A1, control for business area fixed effects, and cluster at business area level. Specifications: Column 1, attrition as dependent variable in Specification 2; Column 2 and 5, including an interaction of treatment status, whether the firm requested a college graduate at baseline, and whether the predicted attrition likelihood is above average. The predicted attrition likelihood is constructed by regressing attrition on the entire set of baseline characteristics. Column 3 and 6, assuming all attrited firms interviewed or hired at endline; Column 4 and 7, assuming no attrited firms interviewed or hired at endline. All regressions are fully saturated. Standard errors are shown in parentheses; p-values are shown in brackets.

Table D10: Robustness: Matching Strategy of Employment Agencies

VARIABLES	(1) Hire College	(2) Hire College	(3) Hire College	(4) Hire College	(5) Hire Non-college	(6) Hire Non-college	(7) Hire Non-college	(8) Hire Non-college
Received x Not requesting college	0.034	0.175			-0.150	-0.000		
	(0.075)	(0.385)			(0.087)	(0.296)		
	[0.657]	[0.650]			[0.090]	[0.999]		
Received x Requesting college	-0.148	-0.358			0.007	0.164		
	(0.074)	(0.148)			(0.057)	(0.106)		
	[0.049]	[0.018]			[0.898]	[0.126]		
Treated x Not requesting college			0.015	0.030			0.021	-0.021
			(0.067)	(0.115)			(0.049)	(0.089)
			[0.824]	[0.795]			[0.666]	[0.818]
Treated x Requesting college			-0.199	-0.192			0.058	0.085
			(0.103)	(0.088)			(0.075)	(0.053)
			[0.058]	[0.031]			[0.441]	[0.118]
Treated x Requesting college			-0.121				0.206	
x High reservation wage			(0.131)				(0.149)	
			[0.359]				[0.171]	
Treated x Requesting college				-0.027				-0.014
x Unlikely received				(0.131)				(0.112)
				[0.837]				[0.904]
Observations	580	580	580	580	580	580	580	580
R-squared	0.321	0.178	0.328	0.327	0.504	0.377	0.505	0.502
Control baseline char.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Business area FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cluster at business area	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Specification	OLS	IV	OLS	OLS	OLS	IV	OLS	OLS
Control mean	0.372	0.372	0.372	0.372	0.433	0.433	0.433	0.433
F-statistic		5.984				5.984		

Notes: This table examines the robustness of the effects on hiring college graduates or non-college workers regarding strategic matching of employment agencies. The sample is restricted to firms eligible for treatment with reservation wage at least 2,000 ETB. All regressions include a full set of baseline characteristics from Table A1, control for business area fixed effects, and cluster at business area level. The main independent variable for Column 1, 2, 5, and 6 is whether firm received at least one agency applicant, denoted as D_{jc}. Specifications: Column 1 and 5, replacing initial random assignment T_{jc} with D_{jc} in Specification 2; Column 2 and 6, using T_{jc} as an instrument for D_{jc}; Column 3 and 7, interacting treatment status, whether the firm requested a college graduate at baseline, and whether the reservation wage was above average; Column 4 and 8, interacting treatment status, whether the firm requested a college graduate at baseline, and whether the predicted likelihood of receiving an agency applicant is below average. The predicted likelihood is constructed by regressing whether the firms received at least one agency applicant on the entire set of baseline characteristics. All regressions are fully saturated. Standard errors are shown in parentheses; p-values are shown in brackets.

Table D11: Robustness: Demand Effect

VARIABLES	(1) Hire College	(2) Hire College	(3) Hire Non-college	(4) Hire Non-college
Treated x Not requesting college	0.024	0.039	0.010	0.013
	(0.080)	(0.072)	(0.071)	(0.060)
	[0.763]	[0.588]	[0.883]	[0.827]
Treated x Requesting college	-0.213	-0.221	0.152	0.070
	(0.091)	(0.080)	(0.079)	(0.055)
	[0.023]	[0.007]	[0.058]	[0.206]
Treated x Requesting college	-0.011		-0.140	
x Posting $\geq$ 1 vacancies	(0.148)		(0.124)	
	[0.939]		[0.263]	
Treated x Requesting college		0.156		0.157
x Less engaging		(0.159)		(0.137)
		[0.330]		[0.257]
Observations	485	580	485	580
R-squared	0.356	0.329	0.496	0.504
Control baseline char.	Yes	Yes	Yes	Yes
Business area FE	Yes	Yes	Yes	Yes
Cluster at business area	Yes	Yes	Yes	Yes
Control mean	0.393	0.372	0.464	0.433

Notes: This table examines the robustness of the effects on hiring college graduates or non-college workers regarding demand effects. The sample is restricted to firms eligible for treatment with reservation wage at least 2,000 ETB. All regressions include a full set of baseline characteristics from Table A1, control for business area fixed effects, and cluster at business area level. Specifications: Column 1 and 3, interacting treatment assignment, whether the firm requested a college graduate at baseline, and whether there is more than one vacancy during baseline (Round 2) or whether the firm usually posts more than one job vacancy per year (Round 1). Column 2 and 4, interacting treatment status, whether the firm requested a college graduate at baseline, and whether the respondents were the owners themselves, a proxy for less engagement. All regressions are fully saturated. Standard errors are shown in parentheses; p-values are shown in brackets.

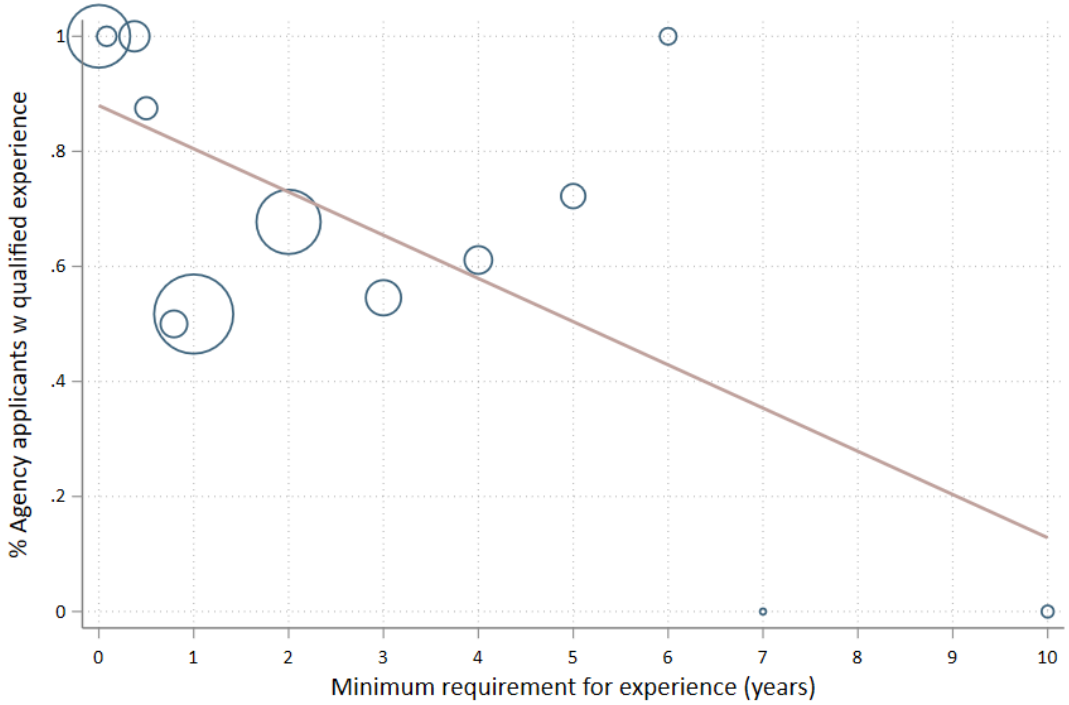
Table D12: Robustness: Spillover

VARIABLES	(1) Hire College	(2) Hire College	(3) Hire College	(4) Hire Non-college	(5) Hire Non-college	(6) Hire Non-college
Intensely treated area	0.045			0.013		
x Not requesting college	(0.100)			(0.109)		
	[0.657]			[0.905]		
Intensely treated area	0.016			-0.037		
x Requesting college	(0.158)			(0.096)		
	[0.921]			[0.702]		
Treated x Not requesting college		0.031	-0.057		0.013	0.052
		(0.075)	(0.097)		(0.056)	(0.076)
		[0.684]	[0.556]		[0.813]	[0.497]
Treated x Requesting college		-0.272	-0.204		0.100	0.225
		(0.102)	(0.107)		(0.065)	(0.090)
		[0.010]	[0.059]		[0.124]	[0.014]
Treated x Requesting college		0.148			0.008	
x Intensely treated area		(0.130)			(0.107)	
		[0.259]			[0.942]	
Treated x Requesting college			-0.142			-0.102
x High intensity w/n 500m			(0.121)			(0.118)
			[0.246]			[0.391]
Observations	315	580	563	315	580	563
R-squared	0.341	0.330	0.334	0.493	0.502	0.502
Only non-treated firms	Yes			Yes		
Local district FE	Yes			Yes		
Business area FE		Yes	Yes		Yes	Yes
Cluster at business area	Yes	Yes	Yes	Yes	Yes	Yes
Control mean	0.311	0.372	0.372	0.505	0.433	0.433

Notes: This table examines the robustness of the effects on hiring college graduates or non-college workers regarding spillover on control firms. The sample is restricted to firms eligible for treatment with reservation wage at least 2,000 ETB. All regressions include a full set of baseline characteristics from Table A1 and cluster at business area level. The main independent variable in Column 1 and 4 is whether the business area was selected for the intense treatment arm, denoted as G_c. Specification: Column 1 and 4, replacing firm-specific treatment status T_{jc} with G_c in Specification 2; only control firms are included, controlling for local district fixed effects (each local district includes 4–5 business areas). Column 2 and 5, interacting the treatment assignment, whether the firm requested a college graduate at baseline, and whether the business area was selected for the intense treatment arm, controlling for business area fixed effects. Column 3 and 6, interacting the treatment assignment, whether the firm requested a college graduate at baseline, and whether the treatment intensity within 500-meter radius was above average, controlling for business area fixed effects. Treatment intensity is calculated by the percentage of firms in nearby 500 meters (excluding own business area) selected for treatment. All regressions are fully saturated. Standard errors are shown in parentheses; p-values are shown in brackets.

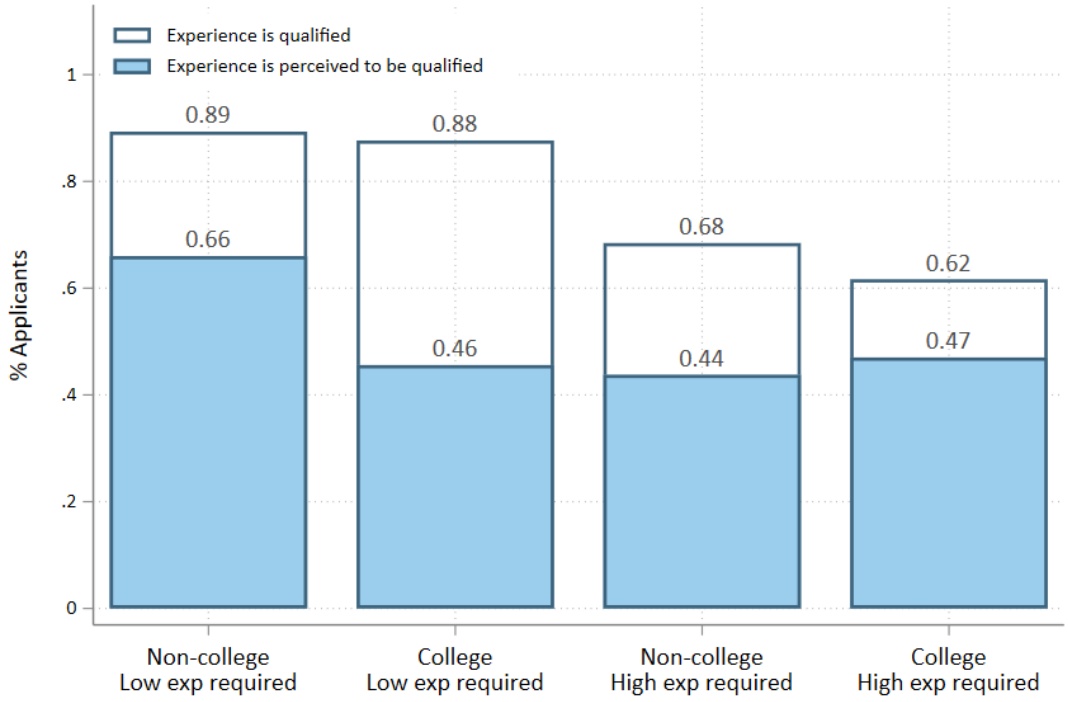
E Additional Materials on Mechanisms

Figure E1: Correlation Between Applicant Qualification and Minimum Experience Requirement



Notes: This figure shows the binscatter plot of the percentage of agency applicants whose years of experience met firms' minimum requirement for experience. The size of the plots indicates the number of firms at each value of the experience requirement.

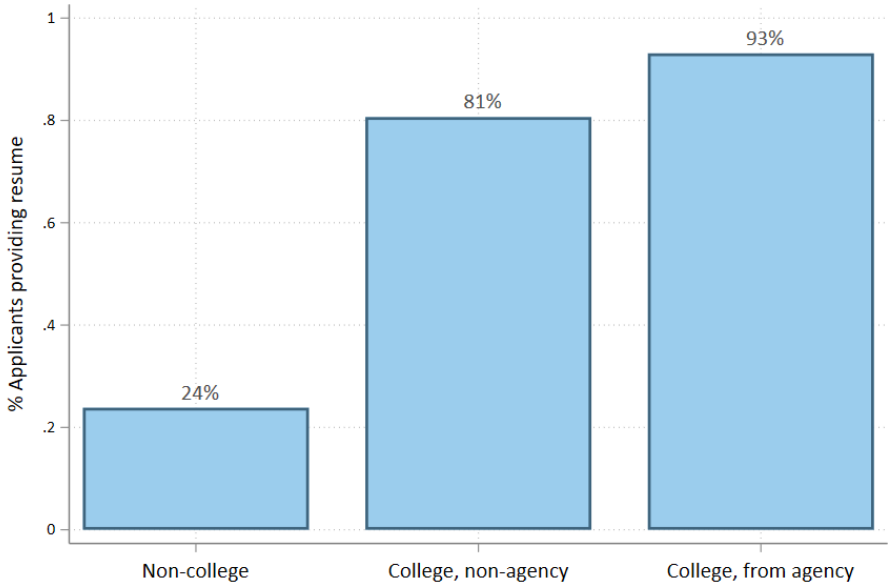
Figure E2: Actual and Perceived Qualification of Applicants' Experience by Minimum Experience Requirement



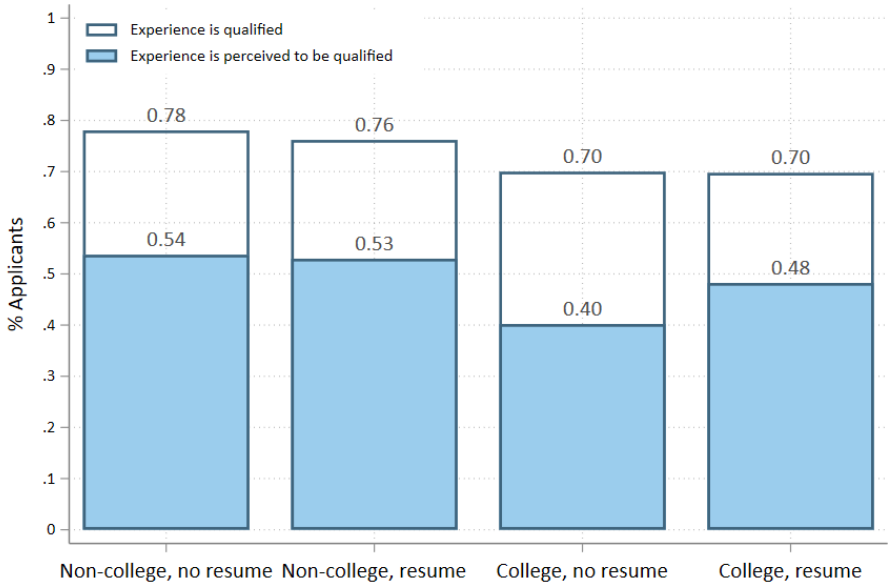
Notes: This figure shows the qualification of applicants' experience for non-college and college-educated applicants by minimum experience requirement. We define an applicant was qualified if their years of experience met the minimum requirement of the posted vacancy. We show the percentage of applicants that were qualified among non-college applicants in firms that required less than one year of experience, college applicants in firms that required less than one year of experience, non-college applicants in firms that required at least one year of experience, and college applicants in firms that required at least one year of experience. The blue contour uses applicants' self-reported years of experience to construct the qualification indicator. The solid area uses firms' perceived years of experience for each applicant to construct the qualification indicator.

Figure E3: Résumé and Applicants' Qualification

Panel A. Usage of résumé



Panel B. Perceived qualification of applicants' experience by résumé usage



Notes: Panel A shows the percentage of applicants providing résumé, among non-college workers, college graduates not recommended from the employment agency, and college graduates recommended from the employment agency. Panel B shows the qualification of applicants experience for non-college applicants with no résumé, non-college applicants with résumé, college-educated applicants with no résumé, and college-educated applicants with résumé. A qualified applicant is defined as whether their years of experience met the minimum requirement of the posted vacancy. The blue contour uses applicants' self-reported years of experience to construct the qualification indicator. The solid area uses firms' perceived years of experience for each applicant to construct the qualification indicator.

Table E1: Qualification of College Graduates' Experience

VARIABLES	(1) Qualified	(2) Qualified	(3) Qualified	(4) Qualified
College	-0.072	0.036	0.075	0.093
	(0.036)	(0.036)	(0.045)	(0.051)
	[0.047]	[0.309]	[0.097]	[0.071]
From agency (i)	0.032	0.003	-0.105	-0.065
	(0.081)	(0.083)	(0.139)	(0.121)
	[0.692]	[0.971]	[0.451]	[0.593]
College x From agency (ii)	-0.066	-0.042	0.037	0.066
	(0.097)	(0.096)	(0.159)	(0.130)
	[0.500]	[0.661]	[0.818]	[0.610]
Observations	1,050	1,013	436	741
R-squared	0.009	0.117	0.075	0.647
Control applicant char.	No	Yes	Yes	Yes
Only matched experience	No	No	Yes	No
Firm FE	No	No	No	Yes
Cluster at firm	Yes	Yes	Yes	Yes
Mean: Non-college	0.758	0.758	0.758	0.758
P-value: (i) + (ii) = 0	0.548	0.462	0.382	0.986

Notes: This table examines whether college applicants were more qualified for the job regarding their experiences. An applicant was qualified for the job if their years of experience met the job requirement. We regress whether the applicant was qualified on whether the applicant had a college diploma or degree, whether the applicant was recommended from the employment agency, the interaction of the college indicator and the agency indicator. We report the average mean of non-college applicants, and the p-value of the t-test whether the summation of the agency indicator and its interaction with the college indicator equals zero. Specifications: Column 2–4, controlling for a series of applicant characteristics (age, age squared, gender, whether the applicant's father has at least eight years of schooling, whether the applicant was employed at baseline). Column 3, sample restricted to applicants whose description of their past experiences suited the job description of the vacancy; the description of applicants' past experiences only exists in Round 2. Column 4, control for firm fixed effects. All regressions cluster at the firm level. Standard errors are shown in parentheses; p-values are shown in brackets.

Table E2: Robustness: Explaining the Shift in Hiring Behavior with Experience Requirement

VARIABLES	(1) Interview College	(2) Interview Non-college	(3) (2)-(1)	(4) Hire College	(5) Hire Non-college	(6) (5)-(4)
Treated x Not requesting college	0.059	-0.001	-0.060	0.037	-0.005	-0.042
	(0.059)	(0.050)	(0.070)	(0.062)	(0.048)	(0.076)
	[0.326]	[0.978]	[0.396]	[0.549]	[0.923]	[0.578]
Treated x Requesting college	-0.194	0.199	0.394	-0.358	0.173	0.531
x (Resid.) low experience requirement	(0.167)	(0.129)	(0.222)	(0.164)	(0.135)	(0.225)
	[0.249]	[0.126]	[0.081]	[0.032]	[0.205]	[0.021]
Treated x Requesting college	-0.108	0.108	0.216	-0.180	0.080	0.260
x (Resid.) high experience requirement	(0.069)	(0.059)	(0.102)	(0.074)	(0.055)	(0.103)
	[0.120]	[0.070]	[0.038]	[0.018]	[0.146]	[0.014]
Observations	580	580		580	580	
R-squared	0.350	0.493		0.333	0.503	
Control baseline char.	Yes	Yes		Yes	Yes	
Business area FE	Yes	Yes		Yes	Yes	
Cluster at business area	Yes	Yes		Yes	Yes	
Control mean: Not requesting college	0.231	0.714		0.198	0.692	
Control mean: Requesting college	0.614	0.131		0.586	0.110	

Notes: This table examines the robustness of the results from Table 6. The sample is restricted to firms eligible for treatment with reservation wage at least 2,000 ETB. We regress whether firm required less than one year of experience on other baseline firm and vacancy characteristics and extract the residual. We then interact initial treatment assignment, whether firm requested a college graduate at baseline, and the residual. We control for the interaction of treatment status and the residual to guarantee full saturation. Dependent variables: Column 1 and 4, whether the firm interviewed or hired any college-educated worker at endline. Column 2 and 5, whether the firm interviewed or hired any non-college worker at endline. Column 3 computes the differences between the estimates in Column 1 and 2. Column 6 computes the differences between the estimates in Column 4 and 5. All regressions control for all baseline firm and vacancy characteristics, include business area fixed effects, and cluster at the business area level. Standard errors are shown in parentheses; p-values are shown in brackets.

Table E3: Perceived Qualification of College Graduates' Experience

VARIABLES	(1) Perceived Qualified	(2) Perceived Qualified	(3) Perceived Qualified	(4) Perceived Productive	(5) Perceived Qualified	(6) Perceived Productive
College	-0.149	-0.135	-0.116	-0.065	-0.053	-0.031
	(0.031)	(0.035)	(0.052)	(0.048)	(0.049)	(0.086)
	[0.000]	[0.000]	[0.027]	[0.171]	[0.279]	[0.722]
From agency (i)	-0.018	-0.003	-0.011	-0.193	-0.052	-0.317
	(0.080)	(0.083)	(0.137)	(0.137)	(0.109)	(0.143)
	[0.825]	[0.970]	[0.934]	[0.162]	[0.636]	[0.028]
College x From agency (ii)	0.013	-0.000	-0.101	0.117	0.042	0.263
	(0.090)	(0.091)	(0.152)	(0.161)	(0.115)	(0.180)
	[0.886]	[0.999]	[0.510]	[0.468]	[0.716]	[0.147]
Years of experience	0.070	0.079	0.061	0.003	0.085	0.003
	(0.004)	(0.005)	(0.007)	(0.007)	(0.008)	(0.011)
	[0.000]	[0.000]	[0.000]	[0.704]	[0.000]	[0.779]
Perceived qualified				0.085		0.043
				(0.047)		(0.057)
				[0.068]		[0.455]
Observations	1,050	1,013	436	592	741	427
R-squared	0.292	0.334	0.238	0.086	0.685	0.558
Control applicant char.	No	Yes	Yes	Yes	Yes	Yes
Only matched experience	No	No	Yes	No	No	No
Firm FE	No	No	No	No	Yes	Yes
Cluster at firm	Yes	Yes	Yes	Yes	Yes	Yes
Mean: Non-college non-agency	0.519	0.519	0.519	0.779	0.258	0.779
P-value: (i) + (ii) = 0	0.916	0.938	0.115	0.363	0.853	0.623

Notes: This table examines whether college applicants are more likely to be considered qualified for the job regarding their experiences. An applicant was considered qualified for the job if firms' perception of the applicant's years of experience met the job requirement. In Columns 1–3 and 5, we regress whether the applicant was considered qualified on whether the applicant had a college diploma or degree, whether the applicant was recommended from the employment agency, the interaction of the college indicator and the agency indicator, and the actual years of experience. The dependent variable in Column 4 and 6 is whether the applicant was perceived with good productivity; we further control for whether the applicant was considered qualified. All regressions cluster at the firm level. We report the average mean of non-college applicants, and the p-value of the t-test whether the summation of the agency indicator and its interaction with the college indicator equals zero. Specifications: Column 2–6, controlling for a series of applicant characteristics (age, age squared, gender, whether the applicant's father has at least eight years of schooling, whether the applicant was employed at baseline). Column 3, sample restricted to applicants whose description of their past experiences suited the job description of the vacancy; the description of applicants' past experiences only exists in Round 2. Column 5 and 6, controlling for firm fixed effects. All regressions cluster at the firm level. Standard errors are shown in parentheses; p-values are shown in brackets.

Table E4: Text Analysis of Résumés

	All	Mean outcomes			
		Online platform		Agencies	
Observations		518		25	
Panel A: Years since graduation					
Total years since graduation	3.26	3.08	(2.69)	7.25	(2.82)
Graduated less than one year	0.08	0.08	(0.27)	0.00	(0.00)
Panel B: Formatting					
The application profile has a summarized résumé	0.94	0.94	(0.23)	0.92	(0.28)
Language skills found in the application profile	0.81	0.81	(0.40)	0.80	(0.41)
Other skills found in the application profile	0.91	0.92	(0.27)	0.76	(0.44)
Professionalism score (1 lowest, 5 highest)	3.10	3.10	(1.09)	3.04	(1.43)
Panel C: Experience					
Previous experience is found	0.80	0.80	(0.40)	0.84	(0.37)
Previous experience is found in the résumé with descriptions	0.62	0.64	(0.48)	0.28	(0.46)
Previous experience is found in the résumé without descriptions	0.12	0.11	(0.31)	0.48	(0.51)
Previous experience is found in the attached documents	0.06	0.06	(0.23)	0.08	(0.28)
Total years of experience	2.23	2.11	(3.17)	4.80	(5.01)
Panel D: References					
References of previous employers are found	0.52	0.51	(0.50)	0.68	(0.48)
References of previous employers are found in the résumé	0.46	0.46	(0.50)	0.48	(0.51)
References of previous employers are found in the attached documents	0.05	0.04	(0.20)	0.20	(0.41)

Notes: This table presents the summary statistics of a text analysis conducted on 518 résumés collected from a major online job search platform and 25 résumés collected from employment agencies, using the AI model Gemini 2.5 Pro. Standard deviations are shown in parentheses.

Table E5: Perceived Qualification And College Graduates' Résumé

VARIABLES	(1) Perceived Qualified	(2) Perceived Qualified	(3) Perceived Qualified	(4) Perceived Qualified
College (i)	-0.109	-0.071	-0.121	-0.029
	(0.049)	(0.054)	(0.092)	(0.055)
	[0.028]	[0.187]	[0.189]	[0.600]
Résumé (ii)	-0.109	-0.082	-0.063	0.048
	(0.054)	(0.054)	(0.101)	(0.090)
	[0.045]	[0.130]	[0.531]	[0.595]
College x Résumé (iii)	0.032	-0.016	0.041	-0.053
	(0.073)	(0.073)	(0.138)	(0.088)
	[0.659]	[0.822]	[0.764]	[0.547]
Years of experience	0.071	0.079	0.060	0.085
	(0.004)	(0.005)	(0.007)	(0.008)
	[0.000]	[0.000]	[0.000]	[0.000]
Observations	1,045	1,008	435	737
R-squared	0.296	0.337	0.237	0.684
Control applicant char.	No	Yes	Yes	Yes
Only matched experience	No	No	Yes	No
Firm FE	No	No	No	Yes
Cluster at firm	Yes	Yes	Yes	Yes
Mean: Non-college	0.519	0.519	0.519	0.258
P-value: (i) + (ii) + (iii) = 0	0.000	0.000	0.011	0.689

Notes: This table examines whether college applicants are more likely to be considered qualified for the job regarding their experiences if they provided a résumé. An applicant was considered qualified for the job if firms' perception of the applicant's years of experience met the job requirement. We regress whether the applicant was considered qualified on whether the applicant had a college diploma or degree, whether the applicant provided a résumé, the interaction of the college indicator and the résumé indicator, and the actual years of experience. All regressions cluster at the firm level. We report the average mean of non-college applicants, and the p-value of the t-test whether the summation of the college indicator, the résumé indicator, and its interaction with the college indicator equals zero. Specifications: Column 2–4, controlling for a series of applicant characteristics (age, age squared, gender, whether the applicant's father has at least eight years of schooling, whether the applicant was employed at baseline). Column 3, sample restricted to applicants whose description of their past experiences suited the job description of the vacancy; the description of applicants' past experiences only exists in Round 2. Column 4, controlling for firm fixed effects. All regressions cluster at the firm level. Standard errors are shown in parentheses; p-values are shown in brackets.

Table E6: Belief Update in the Outside Options of College Graduates

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	% Apps perceived w high outside options				Whether firm agreed		
	College	Non-college	College	College	College grads are easier to find jobs		
Assigned to treat	-0.258	-0.052			-0.042		
	(0.127)	(0.110)			(0.044)		
	[0.050]	[0.637]			[0.347]		
# Non-agency (NA) college applicants			-0.028			0.004	
			(0.015)			(0.012)	
			[0.074]			[0.736]	
Treated x Zero NA college applicants			-0.485			-0.057	
			(0.177)			(0.058)	
			[0.010]			[0.325]	
Treated x $\geq$ 1 NA college applicants			-0.227			-0.014	
			(0.117)			(0.056)	
			[0.060]			[0.804]	
Treated x Not requesting college				-0.295			-0.071
				(0.236)			(0.056)
				[0.218]			[0.205]
Treated x Requesting college				-0.244			0.002
				(0.122)			(0.064)
				[0.053]			[0.976]
Observations	152	154	152	152	568	568	568
R-squared	0.455	0.491	0.488	0.455	0.344	0.345	0.345
Control baseline char.	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Business area FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cluster at business area	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Control mean	0.687	0.703			0.588		
Control mean: Not requesting college				0.630			0.535
Control mean: Requesting college				0.712			0.683
Control mean with one NA college app			0.767			0.713	
Control mean with zero NA college app						0.528	

Notes: This table presents whether treated firms updated beliefs of the outside options of college graduates. The sample is restricted to firms eligible for treatment with reservation wage at least 2,000 ETB. In column 1–4, for each firm, we compute the percentage of applicants perceived with high outside options in each category (college graduates, non-college workers); this data only exists in Round 2. Column 5–7 look at whether firm agreed that college graduates have more outside options than non-college workers. In Column 3 and 5, we interact the initial treatment assignment with whether or not firm received at least one non-agency (NA) college-educated applicants, and control for the number of college-educated non-agency applicants. In Column 4 and 6, we interact the initial treatment assignment with whether or not firm requested a college graduate at baseline. All regressions control for all baseline firm and vacancy characteristics, include business area fixed effects, and cluster at the business area level. Standard errors are shown in parentheses; p-values are shown in brackets.

Table E7: Applicants' Rejection of Interview Invites or Offers

VARIABLES	(1) Reject interview	(2) Reject interview	(3) Reject offer	(4) Reject offer
College graduate	0.009	0.008	-0.054	-0.056
	(0.056)	(0.076)	(0.070)	(0.077)
	[0.874]	[0.915]	[0.439]	[0.470]
Agency	0.289	0.352	0.004	0.003
	(0.147)	(0.162)	(0.015)	(0.024)
	[0.049]	[0.030]	[0.800]	[0.914]
Observations	1,007	851	754	681
R-squared	0.522	0.545	0.723	0.766
Control applicant char.	No	Yes	No	Yes
Firm FE	Yes	Yes	Yes	Yes
Cluster at firm	Yes	Yes	Yes	Yes
Control mean	0.021	0.021	0.019	0.019

Notes: This table presents whether college graduates and agency applicants were more likely to reject interview invites or offers compared to non-college, non-agency workers. All regressions control for firm fixed effects and cluster at firm level. Column 1 and 2 only include applicants who received the interview invite. Column 3 and 4 only include applicants who received an offer. Column 2 and 4 also control for workers' experience, gender, and age. Standard errors are shown in parentheses; p-values are shown in brackets.

Table E8: Explaining the Shift in Hiring Behavior with the Likelihood of Agency Applicants Rejecting Interview Invitations

VARIABLES	(1) Interview College	(2) Interview Non-college	(3) (2)-(1)	(4) Hire College	(5) Hire Non-college	(6) (5)-(4)
Treated x Not requesting college	0.090	-0.042	-0.132	0.038	-0.072	-0.110
	(0.078)	(0.067)	(0.099)	(0.083)	(0.064)	(0.106)
	[0.250]	[0.535]	[0.184]	[0.644]	[0.267]	[0.303]
Treated x Requesting college	-0.054	0.004	0.058	-0.167	-0.071	0.096
x High rejection likelihood	(0.118)	(0.102)	(0.170)	(0.119)	(0.100)	(0.180)
	[0.648]	[0.967]	[0.734]	[0.167]	[0.481]	[0.597]
Treated x Requesting college	-0.189	0.138	0.328	-0.288	0.129	0.417
x Low rejection likelihood	(0.114)	(0.124)	(0.197)	(0.112)	(0.125)	(0.195)
	[0.101]	[0.269]	[0.100]	[0.012]	[0.305]	[0.036]
Observations	580	580	580	580	580	580
R-squared	0.352	0.498	0.498	0.328	0.508	0.487
Control baseline char.	Yes	Yes		Yes	Yes	
Business area FE	Yes	Yes		Yes	Yes	
Cluster at business area	Yes	Yes		Yes	Yes	
Control mean: Not requesting college	0.231	0.714		0.198	0.692	
Control mean: Requesting college	0.614	0.131		0.586	0.110	

Notes: This table examines whether the tendency of agency applicants rejecting interview invitations can explain the shift in hiring behavior in Table 4. The sample is restricted to firms eligible for treatment with reservation wage at least 2,000 ETB. We first regress whether a firm had an agency applicant who turned down the interview invitations on all baseline firm characteristics. We then predict the likelihood of agency applicants rejecting interview invitations. We interact the initial treatment assignment, whether or not firm requested a college graduate at baseline, and whether the likelihood of agency applicants rejecting interview invitations is greater than zero. We also control for the treatment status with whether the likelihood of agency applicants rejecting interview invitations is greater than zero to guarantee full saturation. Dependent variables: Column 1 and 4, whether the firm interviewed and hired any college-educated worker at endline. Column 2 and 5, whether the firm interviewed and hired any non-college worker at endline. Column 3 computes the differences between the estimates in Column 1 and 2. Column 6 computes the differences between the estimates in Column 4 and 5. All regressions control for all baseline firm and vacancy characteristics, include business area fixed effects, and cluster at the business area level. Standard errors are shown in parentheses; p-values are shown in brackets.

Table E9: Treatment Effect on Referral Hiring

Panel A. Belief update

	(1)	(2)	(3)	(4)
	% Perceived productive			
VARIABLES	External	Internal	External, college	External, non-college
Assigned to treat	-0.186	0.205	-0.304	0.091
	(0.111)	(0.208)	(0.132)	(0.087)
	[0.101]	[0.336]	[0.028]	[0.299]
Observations	226	52	131	121
R-squared	0.322	0.891	0.432	0.541
Control baseline char.	Yes	Yes	Yes	Yes
Business area FE	Yes	Yes	Yes	Yes
Cluster at business area	Yes	Yes	Yes	Yes
Control mean	0.774	0.886	0.774	0.774

Panel B. Effect on hiring

	(1)	(2)	(3)	(4)	(5)	(6)
	Hire	Hire		Hire	Hire	
VARIABLES	Non-referral	Referral	(2)-(1)	Non-referral	Referral	(5)-(4)
Treated x Using referral	-0.024	0.000	0.024	0.004	0.002	-0.002
	(0.068)	(0.074)	(0.123)	(0.079)	(0.086)	(0.146)
	[0.727]	[0.995]	[0.843]	[0.958]	[0.981]	[0.989]
Treated x Not using referral	-0.033	0.054	0.087			
	(0.070)	(0.059)	(0.116)			
	[0.641]	[0.363]	[0.455]			
Treated x Not using referral				0.066	-0.022	-0.089
x Not requesting college				(0.085)	(0.065)	(0.137)
				[0.435]	[0.733]	[0.518]
Treated x Not Using referral				-0.105	0.171	0.276
x Requesting college				(0.108)	(0.095)	(0.171)
				[0.334]	[0.075]	[0.111]
Observations	578	578		578	578	
R-squared	0.285	0.263		0.293	0.270	
Control mean: Not requesting college	0.516	0.286		0.516	0.286	
Control mean: Requesting college	0.497	0.179		0.497	0.179	

Notes: This table examines whether firms hired through referrals after receiving a negative signal induced from the treatment. The sample is restricted to firms eligible for treatment with reservation wage at least 2,000 ETB. Panel A shows the treatment effect on the percentage of applicants being perceived as productive by firms, in four categories, respectively: (1) External applicants, (2) internal applicants, (3) external college-educated applicants, (4) external non-college applicants. Panel B shows the heterogeneous treatment effect on hiring. Dependent variables: Column 1 and 4, whether the firm hired from a non-referral channel. Column 2 and 5, whether the firm hired from internal referrals. Column 1 and 2 interact the initial treatment assignment with whether the firm relied on referral at baseline; Column 4 and 5 further interact the initial treatment assignment, whether the firm relied on referral at baseline, and whether the firm requested a college graduate at baseline. We control for the interaction of the treatment assignment and whether the firm requested a college graduate at baseline to guarantee a saturated model. Column 3 calculates the differences between the estimates in Column 1 and 2. Column 6 calculates the differences between the estimates in Column 4 and 5. All regressions control for all baseline firm and vacancy characteristics, include business area fixed effects, and cluster at the business area level. Standard errors are shown in parentheses; p-values are shown in brackets.

F Full Equilibrium Search Model

Suppose there is a continuum of identical workers with mass normalized to 1. All workers are infinitely lived and risk neutral. On the other side, there is a continuum of identical firms that are also risk neutral. Time is discrete; all agents have a discount rate r for future return.

Assume that firms have a perfectly complementary (Leontief) production function. In a search economy, each firm needs to match with one and only one worker to produce. When the match is successful, the worker will produce μ_0 of goods together; we refer to μ_0 as worker's productivity.

In each period, firm j pays k up front to post a vacancy. Then, firm j will draw an initial perception of productivity μ_j from a given distribution $F(\cdot)$ with mean $\overline{\mu}$. Define the mass of unemployed workers as u, the mass of vacancies v, and market tightness $\theta = v/u$. The likelihood of a vacancy matched with any worker q is a decreasing function of market tightness θ and an increasing function of matching technology a: $q = q(\theta, a)$. Assume q is a twice-differentiable function. The matching technology parameter a captures search costs while holding market tightness constant; search costs are higher when a is smaller. The likelihood of a worker matching any vacancy is $\theta q(\theta, a)$. When a match is successful, firm and worker engage in Nash bargaining; workers' bargaining power is β. For steady state, suppose all matches separate at the rate s exogenously.

Bellman equations. Suppose firm j's value for open vacancy is V_j and expected value for a filled position J_j. To solve for V_j and J_j, we need to discuss the hypothetical scenario in which firm j matches with a worker with productivity μ_i, firm j observes the productivity perfectly, and firm j has not updated the perception yet. Firm j's value for the position $J_j(\mu)$ is a function of μ_i:

$$rJ_j(\mu_i) = \mu_i - w(\mu_i, \mu_j) + s(V_j - J_j) \tag{F.1}$$

As will be discussed later, the wage for the worker with productivity μ_i is a linear function of μ_i and firm's perception μ_j. Due to linearity, firms' expected value for a filled position J_j follows:

$$rJ_j = \mu_j - w(\mu_j, \mu_j) + s(V_j - J_j) \tag{F.2}$$

The value for open vacancy V_j follows:

$$rV_j = -k + q(\theta, a)(J_j - V_j) \tag{F.3}$$

Suppose workers' expected value for employment is E, and value for unemployment U. Even

though workers are identical, because firms may perceive workers with various level of productivity, we need to discuss the hypothetical scenario in which the worker with productivity μ_i is working in firm j with perception μ_j, firm j observes the productivity perfectly, and firm j has not updated the perception yet. Worker's value of employment follows:

$$rE_i(\mu_j) = w(\mu_i, \mu_j) + s(U_i - E_i) \tag{F.4}$$

Due to wage linearity, worker's expected value for a filled position E_i follows:

$$rE_i = w(\mu_i, \overline{\mu}) + s(U_i - E_i) \tag{F.5}$$

Assume unemployment benefit is z. The value for unemployment U_i follows:

$$rU_i = z + \theta q(\theta, a)(E_i - U_i) \tag{F.6}$$

Wage bargaining. Suppose firm j with perception μ_j matches with worker i with productivity μ_i. The wage function $w(\mu_i, \mu_j)$ is determined by Nash bargaining as follows:

$$(1 - \beta)[E_i(\mu_j) - U_i] = \beta[J_j(\mu_i) - V_j] \tag{F.7}$$

Because wage $w(\mu_i, \mu_j)$ enters Equations F.1–F.7 linearly, $w(\mu_i, \mu_j)$ is a linear function of μ_i and μ_j. Denote $w(\theta|\mu_j) \equiv w(\mu_j, \mu_j)$. If we only consider average value functions given $\overline{\mu}$, all value components J, V, E, U can be written as functions of θ.

Free entry. We need to impose an additional assumption on firms' initial perceptions before posting a vacancy. Suppose that before entry, firms can observe the average value of open vacancies in the search economy, and firms will stop entering the market if the expected value of open vacancies is equal to zero:

$$E[V_j] = 0 \tag{F.8}$$

One possible way to rationalize this assumption is to have a competitive market of labor market intermediaries, who are able to charge firms to post a vacancy on their platforms with first-best discrimination. Given the competitive structure of the market, intermediaries will elicit enough firms to post jobs such that Equation F.8 holds.

With Equations F.2, F.3, and F.8, we have the following for firms with the average perception:

$$J_j(\overline{\mu}) - V_j(\overline{\mu}) = \frac{k}{q(\theta, a)} = \frac{\overline{\mu} - w(\theta|\overline{\mu})}{r+s}$$

With Equations F.5, F.6, and F.7, taking expectations of μ_i, combined with the previous equation, we have the following:

$$(1-\beta)\frac{w(\theta|\overline{\mu}) - z}{r+s+\theta q(\theta, a)} = \beta\frac{\overline{\mu} - w(\theta|\overline{\mu})}{r+s}$$

After some rearrangement:

$$w(\theta|\overline{\mu}) = \beta(\overline{\mu} + \theta k) + (1-\beta)z \tag{F.9}$$

Plug the wage determination equation F.9 back in Equations F.5 and F.6, we derive the first relation between average perception $\overline{\mu}$ and market tightness θ:

$$\overline{\mu} = \frac{(r+s)k}{(1-\beta)q(\theta, a)} + \frac{\beta k}{1-\beta}\theta + z \tag{F.10}$$

Because $q(\theta, a)$ is a decreasing function in θ, Equation F.10 establishes a positive relation between average perception $\overline{\mu}$ and market tightness θ induced by the free entry condition. The intuition is simple: When firms are on average more optimistic about workers' productivity, the expected value of opening a vacancy increases, thus driving more new firms to enter the search market and increasing the market tightness.

Belief update. Firms tend to have more accurate perceptions if the matching rate is higher. We now formalize this intuition. Suppose firm j with perception μ_j matches with a worker, upon which firm j would immediately correct the perception to the true level μ_0. For those who did not match with a worker, firm j would permanently exit the market if the perceived value for an open vacancy is below the cost k. Notice that because the vacancy cost is paid up front, in a given period, a firm with pessimistic view of workers would still participate in matching because the vacancy cost is sunk, but they would not commit to posting more vacancies in the next period. Lepage (2024) provided a theoretical framework why firms with overly pessimistic perception would not return to the search economy because the cost of learning is too high.

We further denote the average firm's perception in each period T is $\overline{\mu}_T$. Before the first period starts, the average firm's perception is simply the mean of the perception distribution $F(\cdot)$: $\overline{\mu}_0 = \overline{\mu}$.

In the periods afterwards, the economy consists of two types of firms in each period: (i) new firms whose perceptions are drawn from $F(\cdot)$, and (ii) old firms from the last period $T-1$ who stay. Denote the proportion of new firms ϕ_T in period T. The following condition describes the belief dynamics; θ_T is the market tightness in period T.

$$\overline{\mu}_T = \phi_T \overline{\mu} + (1-\phi_T)\big[\underbrace{(1-q(\theta_T,a))\cdot E[\mu_j|V_j^{T-1}>k]}_{\text{Old firms that haven't learned about } \mu_0} + \underbrace{q(\theta_T,a)\mu_0}_{\text{Old firms that learned about } \mu_0}\big] \tag{F.11}$$

Steady state. Notice that the model is not closed yet because one can exogenously set the proportion of new firms ϕ at any given level to reach a desired level of $\overline{\mu}_T$. Therefore, we impose a new steady-state condition such that the rate of new firms entering the search market equals to the rate of old firms exiting:

$$\phi_T = P[V_j^{T-1} < k] \tag{F.12}$$

Along with the conventional steady-state condition about unemployment rate:

$$u = \frac{s}{s+\theta q(\theta,a)} \tag{F.13}$$

Proof of Proposition 1. Suppose there is no inherent bias to begin with, that is, the average perception $\overline{\mu} = \mu_0$. If the uncertainty stems from workers' imperfect signaling of their productivity, this assumption is justified as long as the noise distribution is unbiased.

We can write down the value of open vacancy:

$$V_j^{T-1} = \frac{q(\theta_{T-1},a)}{r+s+q(\theta_{T-1},a)}[\mu_j - w(\theta|\mu_j)]$$

One can derive the explicit form of $w(\theta|\mu_j)$ and find that V_j^{T-1} is an increasing function in μ_j.[21] Intuitively, $w(\theta|\mu_j)/\mu_j < 1$ because workers will not get paid more than their marginal productivity, and firm j's claim of the residual is close to proportional to $(1-\beta)\mu_j$. As long as $F(\cdot)$ has full

[21] $w(\theta|\mu_j) = A(\theta)\mu_j + B(\theta)z + C(\theta)k$, with

$$A(\theta) = \frac{\beta(r+s+\theta q(\theta,a))}{r+s+q(\theta,a)(1+\beta\theta-\beta)} < 1$$

$$B(\theta) = \frac{(1-\beta)(r+s+q(\theta,a))}{r+s+q(\theta,a)(1+\beta\theta-\beta)}$$

$$C(\theta) = \frac{\beta(r+s+\theta q(\theta,a))}{r+s+q(\theta,a)(1+\beta\theta-\beta)}$$

.

support, we can always find a μ_j such that $V_j^{T-1} > k$, hence $\phi_T < 1$. Intuitively, there will always be old firms who are optimistic enough to stay in the search economy.

Similarly, one can find a threshold μ_{T-1} such that $V_j^{T-1} > k$ if and only if $\mu_j > \mu_{T-1}$. Thus,

$$E[\mu_j | V_j^{T-1} > k] = E[\mu_j | \mu_j > \mu_{T-1}] > E[\mu_j] = \overline{\mu} = \mu_0$$

From Equation F.11, we will have $\overline{\mu}_T > \mu_0$ for any period T as long as $q(\theta_T, a) < 1$, which holds for all values $\theta_T > 0$. It is easy to see that $\theta_T = 0$ will never be an equilibrium in the search economy.

Proof of Proposition 2. Rewrite Equation F.11 as follows:

$$\begin{aligned}\overline{\mu}_T = & \underbrace{[1 - Pr(\mu_j < \mu_{T-1})](\mu_0 - E[\mu_j | \mu_j > \mu_{T-1}])}_{\equiv M_{T-1}} q(\theta_T, a) \\ & + \underbrace{Pr(\mu_j < \mu_{T-1})\mu_0 + [1 - Pr(\mu_j < \mu_{T-1})]E[\mu_j | \mu_j > \mu_{T-1}])}_{\equiv N_{T-1}} \end{aligned} \tag{F.14}$$

Where μ_{T-1} is defined as in the proof above. Given μ_{T-1}, Equation F.14 describes another positive relation between $\overline{\mu}_T$ and θ_T; the positive direction is determined by (a) $\mu_0 < E[\mu_j | \mu_j > \mu_{T-1}]$ from Proposition 1 and (b) that $q(\theta_T)$ is a decreasing function in θ_T.

Both Equations F.10 and F.14 describe a monotonic, positive relation between μ_T and θ_T. To show the single crossing property, we simply have to examine extreme scenarios where $q(\theta_T) = 0$ and $q(\theta_T) = 1$. When $q(\theta_T) = 0$, that is, when there are infinite amount of firms posting vacancies and virtually no firms can match with a worker, by the free entry condition, μ_T approaches infinity. By the belief update dynamics, μ_T will not go beyond $Pr(\mu_j < \mu_{T-1})\mu_0 + [1 - Pr(\mu_j < \mu_{T-1})]E[\mu_j | \mu_j > \mu_{T-1}])$ which is determined by the old firms from the previous period.

When $q(\theta_T) = 1$, that is, when there are no firms posting vacancies and firms can guarantee a match as long as they enter the search economy, by the belief update dynamics, $\mu_T = \mu_0$; by the free entry condition, to guarantee single-crossing property, the following regularity condition should be met:

$$\mu' = \frac{(r+s)k}{1-\beta} + z < \mu_0 \tag{F.15}$$

Intuitively, this regularity condition guarantees that workers are productive enough such that more firms would enter the market and post vacancies under the free entry condition. As long as

Equation F.15 holds, there exists a unique equilibrium level μ_T and θ_T such that both Equations F.10 and F.14 are satisfied in any period T.

Proof of Proposition 3. When there is no imperfect information, all firms have the correct belief μ_0. The optimal market tightness θ_0 would be simply determined by Equation F.10:

$$\mu_0 = \frac{(r+s)k}{(1-\beta)q(\theta_0, a)} + \frac{\beta k}{1-\beta}\theta_0 + z$$

Calculate the difference $\Delta_T(\mu) = \overline{\mu}_T - \mu_0$:

$$\begin{aligned}\Delta_T(\mu) &= \frac{(r+s)k}{1-\beta}\big[\frac{1}{q(\theta_T, a)} - \frac{1}{q(\theta_0, a)}\big] + \frac{\beta k}{1-\beta}(\theta_T - \theta_0) \\ &= \big[-\frac{(r+s)k}{1-\beta}\frac{q_\theta(\theta_m, a)}{q(\theta_m, a)^2} + \frac{\beta k}{1-\beta}\big]\Delta_T(\theta) \end{aligned} \tag{F.16}$$

The second line follows the Mean Value Theorem: There exists $\theta_m \in [\theta_0, \theta_T]$ such that $\frac{1}{q(\theta_T,a)} - \frac{1}{q(\theta_0,a)} = -\frac{q_\theta(\theta_m,a)}{q(\theta_m,a)^2}(\theta_T - \theta_0)$ as long as $q(\cdot)$ is differentiable along θ. Since $q(\theta, a)$ is a decreasing function in θ and thus $q_\theta(\theta_m, a) < 0$, Δ_T has the same sign as $\overline{\mu}_T - \mu_0$. With Proposition 1, we have $\Delta_T > 0$.

Proof of Proposition 4. Suppose new search technology $a_1 > a_0$ is introduced such that $q(\theta, a_1) > q(\theta, a_0)$ for any level of θ. Active labor market policies that lower search costs can be considered as an improvement in search technology. It is ambiguous whether the new equilibrium market tightness would increase or decrease because it depends on whether the search effect or the learning effect is stronger. Assume an indirect function $\theta_T(a)$; with Equations F.10 and F.14,

$$\big[\underbrace{\frac{-(r+s)k}{(1-\beta)q(\theta_T,a)^2}q_\theta + \frac{\beta k}{1-\beta}}_{\text{Search effect (+)}} + \underbrace{(-M_{T-1}q_\theta)}_{\text{Learning effect (-)}}\big]\frac{\partial\theta_T}{\partial a} = \big[\frac{(r+s)k}{(1-\beta)q(\theta_T,a)^2} + M_{T-1}\big]q_a$$

Whether θ_T increases in a depends on whether the search effect of the learning effect is stronger. The learning effect can be more salient if M_{T-1} also changes with a.

We use $\Delta_T(\theta) = \theta_T - \theta_0$ as the proxy for matching inefficiency. Simply observing $\frac{\partial\theta_T}{\partial a}$ does not fully capture the effect on matching efficiency because the optimal market tightness θ_0 is also affected by the new search technology. However, because there is no learning effect under perfect information, θ_0 would be strictly increasing when the search technology is improved. Therefore, $\frac{\partial\theta_T}{\partial a} \leq 0$ is a sufficient condition for $\frac{\partial\Delta_T(\theta)}{\partial a} < 0$, or improved matching efficiency, but $\frac{\partial\theta_T}{\partial a} > 0$ is not a sufficient condition for $\frac{\partial\Delta_T(\theta)}{\partial a} > 0$.

If we wish to infer matching efficiency through the changes in belief, take differentiation with respect to a in Equation F.16:

$$\frac{\partial \Delta_T(\mu)}{\partial a} = \frac{\partial \overline{\mu}_T}{\partial a} = \Big[-\frac{(r+s)k}{1-\beta}\frac{q_\theta(\theta_m, a)}{q(\theta_m, a)^2} + \frac{\beta k}{1-\beta}\Big]\frac{\partial \Delta_T(\theta)}{\partial a} + \frac{(r+s)k}{1-\beta}\frac{2q_\theta(\theta_m, a)q_a(\theta_m, a) - q_{\theta a}(\theta_m, a)q(\theta_m, a)}{q(\theta_m, a)^3}\Delta_T(\theta)$$

$\frac{\partial \overline{\mu}_T}{\partial a} > 0$ is thus a sufficient condition of $\frac{\partial \Delta_T(\theta)}{\partial a} > 0$ if the matching function satisfies the following condition:

$$q_{\theta a}(\theta, a) > \frac{2q_\theta(\theta, a)q_a(\theta, a)}{q(\theta, a)} \quad \forall \theta, a \tag{F.17}$$

This condition covers a large class of matching functions, including functions where $q_{\theta a} = 0$, or a variant of Cobb-Douglas function $q = a\theta^{\eta-1}, \eta \in (0,1), a \in (0,1)$.

Sorting Efficiency. One may be curious if firms with specific types of skill requirement would have differential responses to our intervention. In fact, 39% of the jobs that requested a college graduate involved primarily routine tasks, 29% involved manual tasks, 29% did not require more than two years of previous experience, and 9% did not have specific skill requirement. We construct a skill index based on these four indicators and examine treatment heterogeneity with respect to the skill index in Table F1. Among firms that requested a college graduate at baseline, we observe the shift in hiring behavior both among treated firms with lower skill index and firms with higher skill index. If we assume that it is more efficient to match firms with higher skill index to college graduates, our intervention has ambiguous implications on sorting efficiency because although it is more efficient when firms with lower skill index hired fewer college graduates, it is less efficient when firms with higher skill index did so. We defer the full discussion of such sorting efficiency to future investigation.

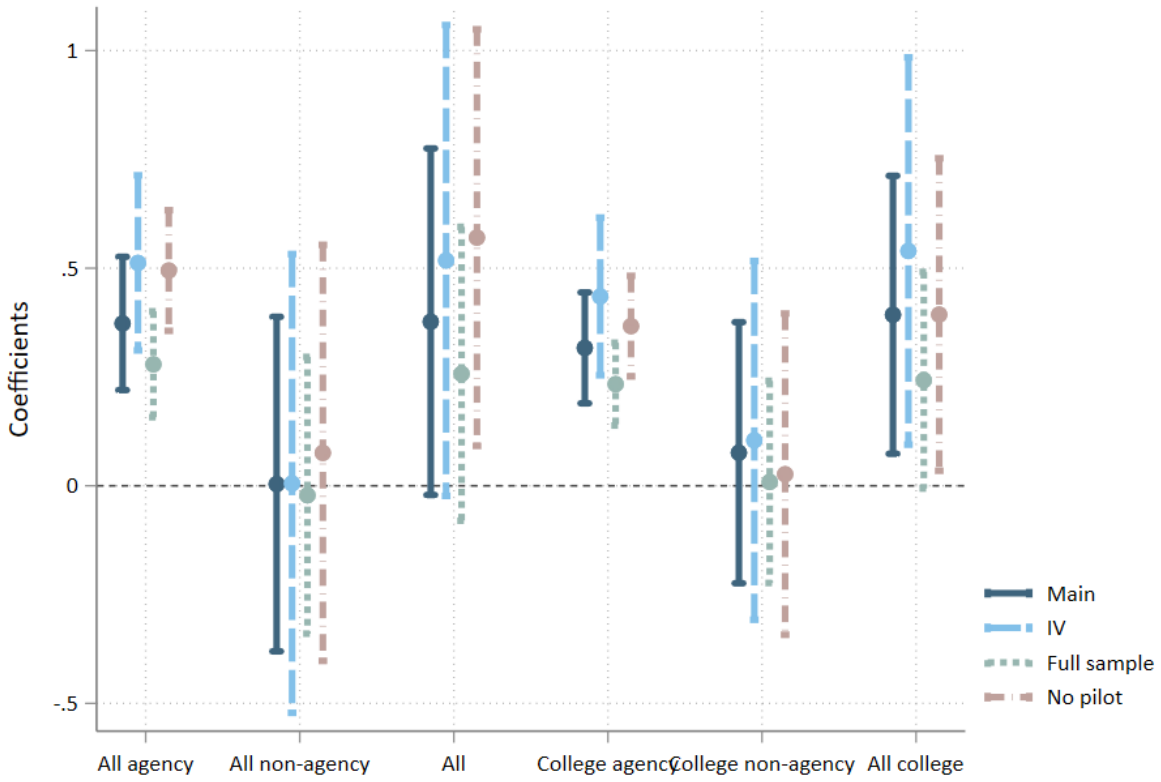
Table F1: Treatment Effects by Skill Requirement

VARIABLES	(1) % Perceived prod. College	(2) Agreed college more productive	(3) Hire College	(4) Hire Non-college	(5) (5)-(4)	(6) Hire Any, planned
Treated x Not requesting college	-0.384	-0.026	0.083	-0.033	-0.116	-0.022
	(0.222)	(0.058)	(0.076)	(0.070)	(0.115)	(0.079)
	[0.092]	[0.653]	[0.276]	[0.640]	[0.314]	[0.785]
Treated x Requesting college	-0.322	-0.122	-0.334	0.241	0.575	-0.163
x Skill index < 0	(0.200)	(0.105)	(0.090)	(0.085)	(0.149)	(0.106)
	[0.117]	[0.247]	[0.000]	[0.006]	[0.000]	[0.126]
Treated x Requesting college	-0.225	-0.091	-0.201	0.093	0.295	-0.128
x Skill index > 0	(0.116)	(0.054)	(0.077)	(0.053)	(0.105)	(0.072)
	[0.059]	[0.098]	[0.010]	[0.079]	[0.006]	[0.079]
Observations	151	568	580	580		568
R-squared	0.402	0.333	0.332	0.508		0.326
Sample	All	All				All
Control baseline char.	Yes	Yes	Yes	Yes		Yes
Business area FE	Yes	Yes	Yes	Yes		Yes
Cluster at business area	Yes	Yes	Yes	Yes		Yes
Control mean: Not requesting college	0.787	0.736	0.198	0.692		0.652
Control mean: Requesting college	0.785	0.896	0.586	0.110		0.653

Notes: This table presents the treatment effects on interviewing and hiring outcomes by skill requirement. The sample is restricted to firms eligible for treatment with reservation wage at least 2,000 ETB. We interact the initial treatment assignment with whether or not firm requested a college graduate at baseline for all regression, and whether the constructed skill index is greater than zero. The skill index is constructed by extracting principal components of four vacancy characteristics: whether the vacancy required specific skill requirement, whether the vacancy involved manual task, whether the vacancy involved routine task, whether the vacancy required at least two years of experience. We also control for the interaction between the initial treatment assignment and whether the constructed skill index is greater than zero to guarantee full saturation. Dependent variables: Column 1, percentage of college-educated applicants perceived with good productivity. Column 2, whether firm agreed that college graduates are more productive than non-college workers. Column 3 and 4, whether the firm hired a college graduate or a non-college worker. Column 5 computes the difference between the estimates in Column 3 and 4. Column 6, whether the firm planned to post any jobs in the next three months after endline. All regressions include a full set of baseline characteristics, control for business area fixed effects, and cluster at business area level. Standard errors are shown in parentheses; p-values are shown in brackets.

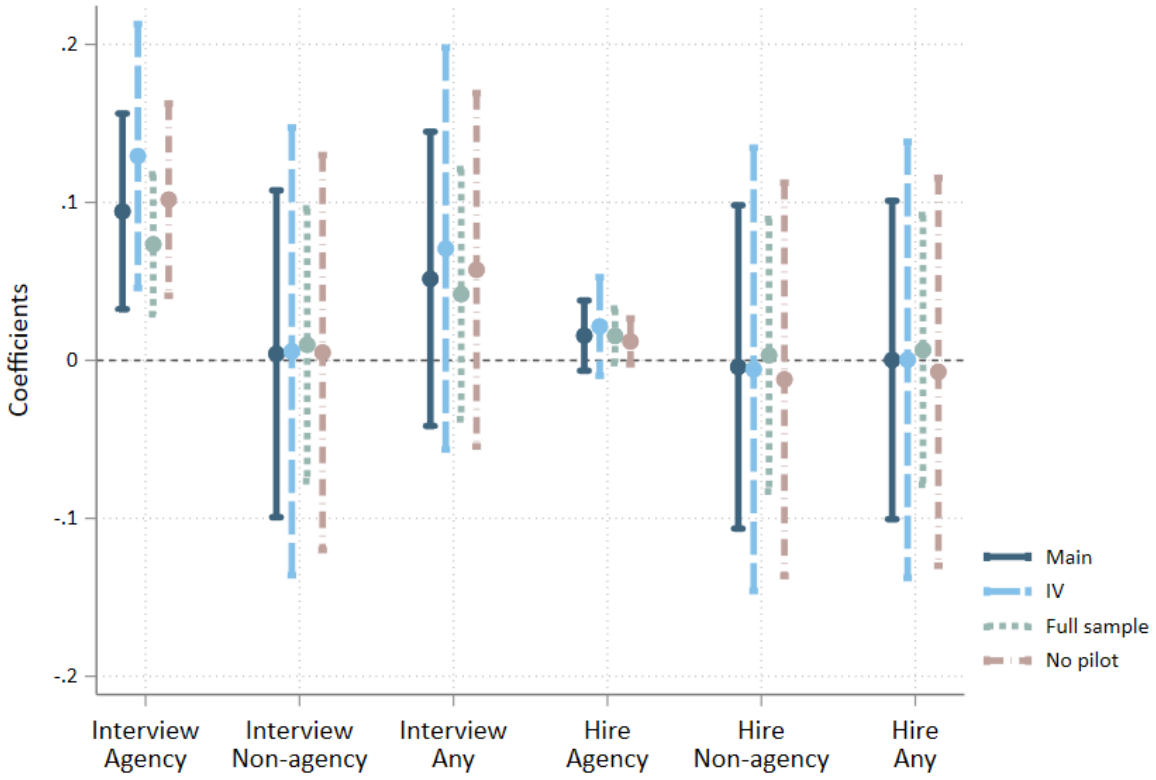
G Specification Tests

Figure G1: Replication of the First-Stage Effects on the Number of Applicants



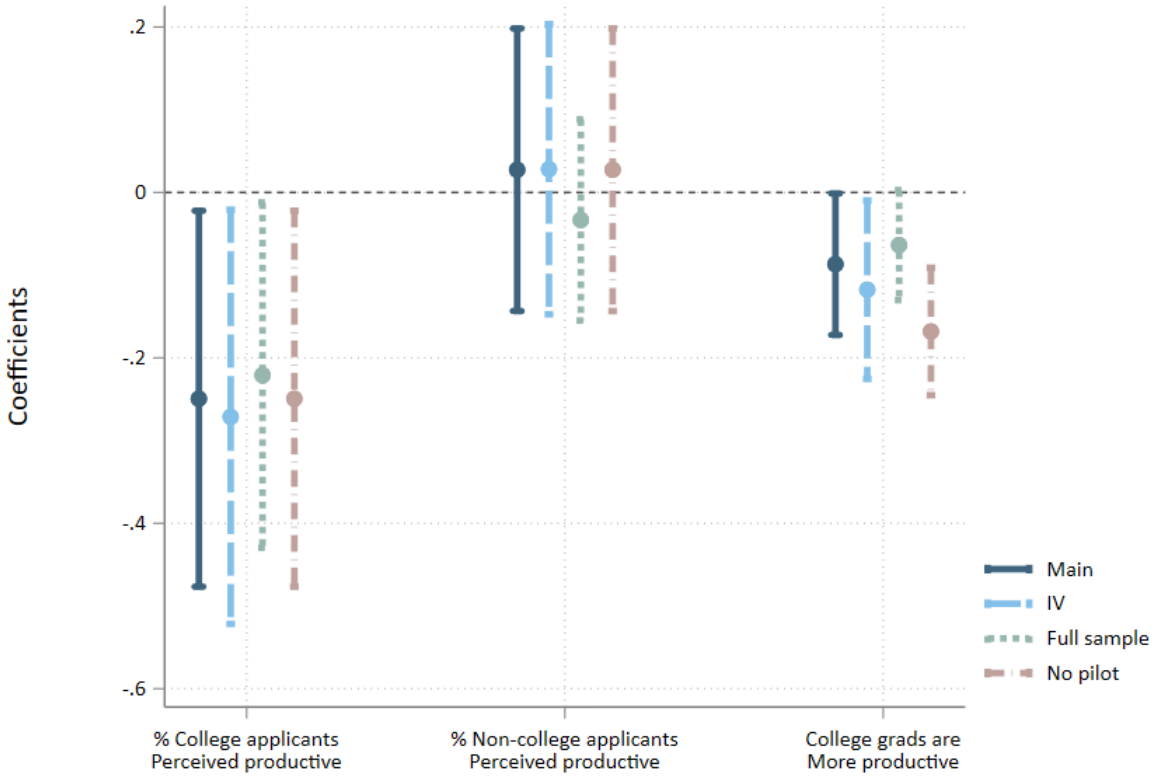
Notes: This figure replicates the main results in Table D1. All regressions include a full set of baseline characteristics, control for business area fixed effects, and cluster at business area level. For each dependent variable, we show (1) reduced-form estimate from the main specification, (2) IV estimate on the actual treatment status, (3) reduced-form estimate using full sample, and (4) reduced-form estimate excluding pilot sample. 95% confidence intervals are shown.

Figure G2: Replication of the Effects on Vacancy Filling



Notes: This figure replicates the main results in Table 2. All regressions include a full set of baseline characteristics, control for business area fixed effects, and cluster at business area level. For each dependent variable, we show (1) reduced-form estimate from the main specification, (2) IV estimate on the actual treatment status, (3) reduced-form estimate using full sample, and (4) reduced-form estimate excluding pilot sample. 95% confidence intervals are shown.

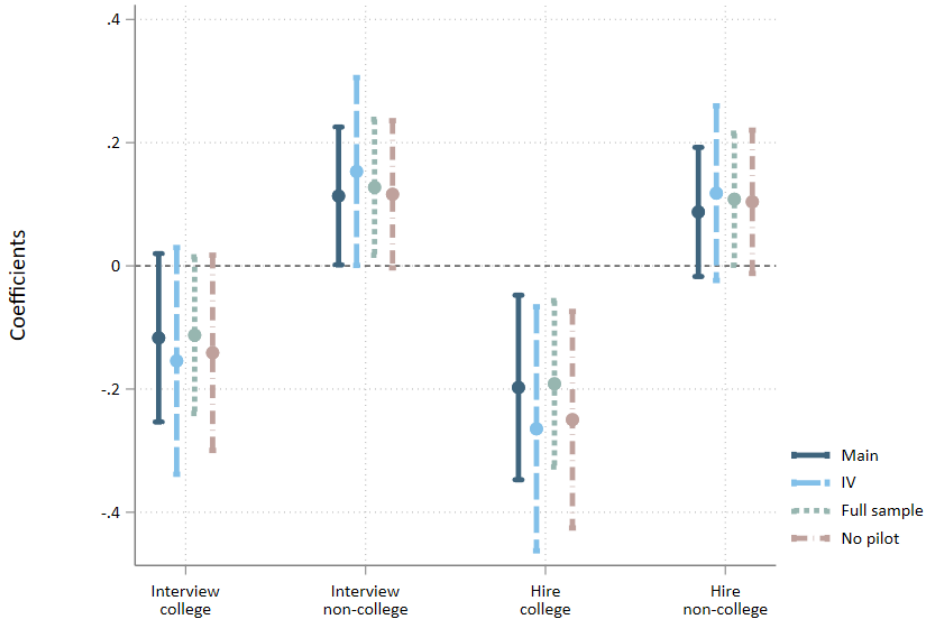
Figure G3: Replication of the Effects on Belief Update



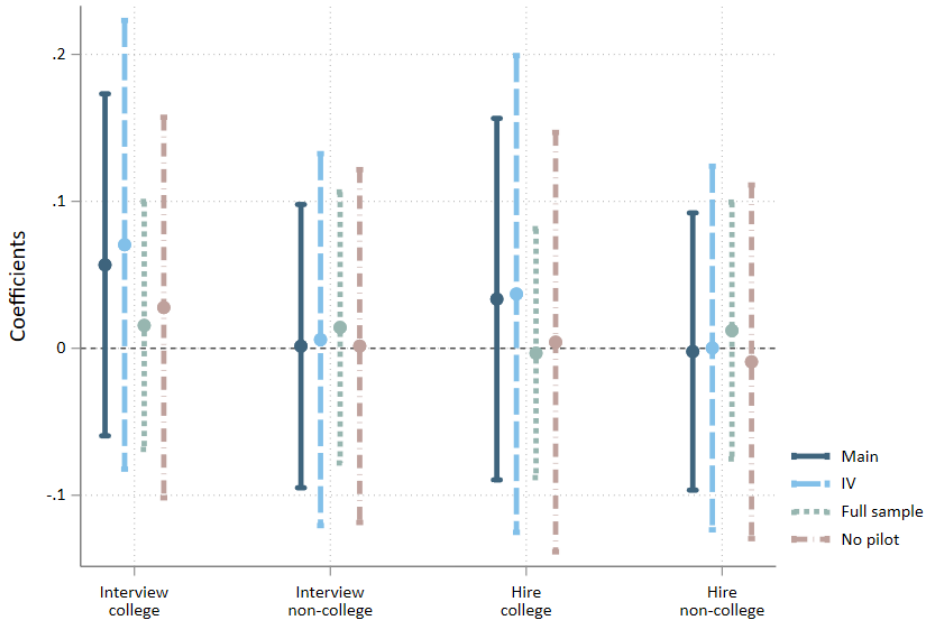
Notes: This figure replicates the main results in Table 3, Column 1, 2, and 5. All regressions include a full set of baseline characteristics, control for business area fixed effects, and cluster at business area level. For each dependent variable, we show (1) reduced-form estimate from the main specification, (2) IV estimate on the actual treatment status, (3) reduced-form estimate using full sample, and (4) reduced-form estimate excluding pilot sample. 95% confidence intervals are shown.

Figure G4: Replication of the Effects on Hiring by Baseline Request

Panel A. Heterogeneous effect on firms requesting college graduates



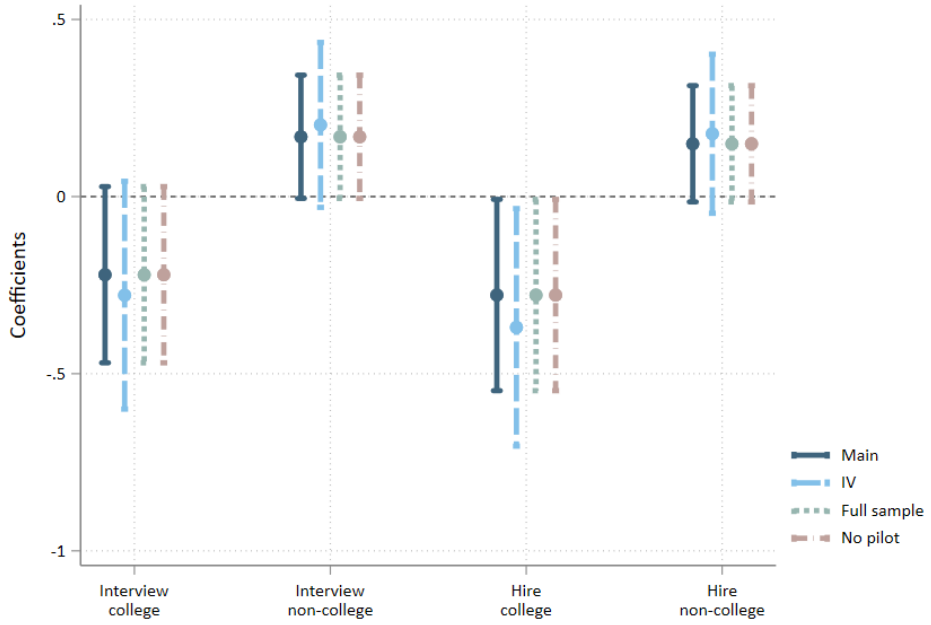
Panel B. Heterogeneous effect on firms not requesting college graduates



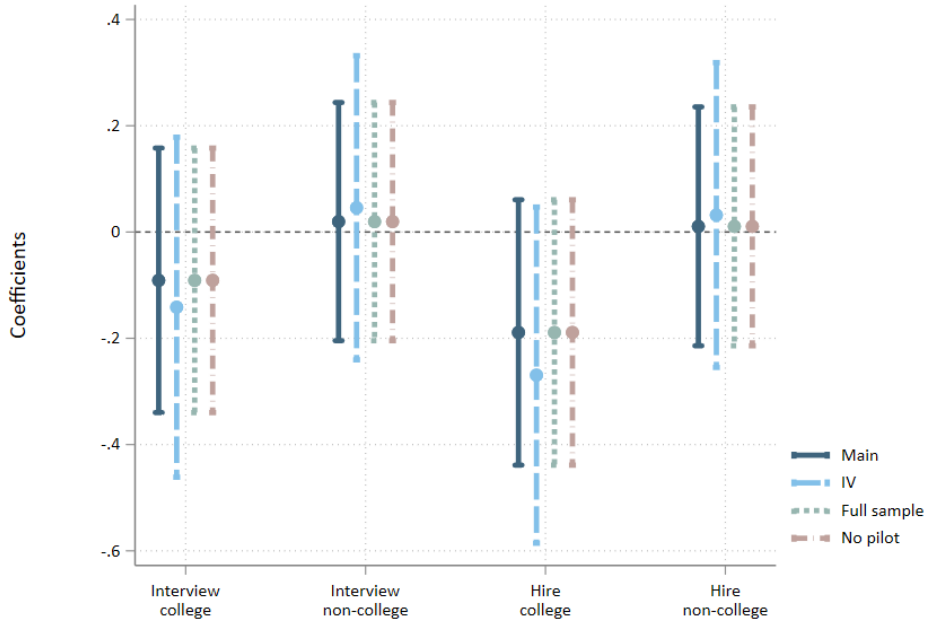
Notes: This figure replicates the main results in Table 4, Panel A. All regressions include a full set of baseline characteristics, control for business area fixed effects, and cluster at business area level. For each dependent variable, we show (1) reduced-form estimate from the main specification, (2) IV estimate on the actual treatment status, (3) reduced-form estimate using full sample, and (4) reduced-form estimate excluding pilot sample. 95% confidence intervals are shown.

Figure G5: Replication of the Heterogeneous Effects By College Share

Panel A. Firms requesting a college graduate at baseline and with below-median college share



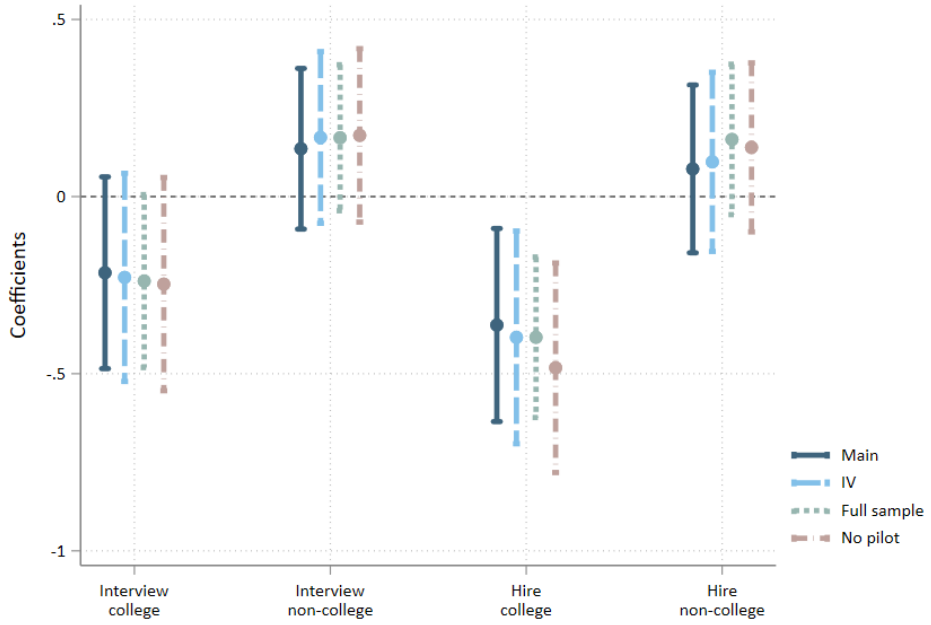
Panel A. Firms requesting a college graduate at baseline and with above-median college share



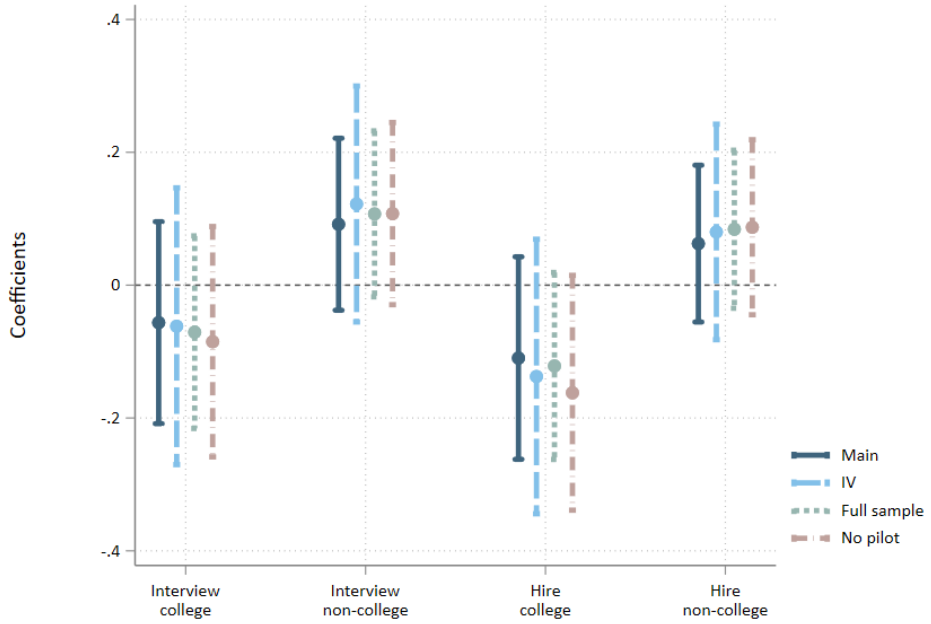
Notes: This figure replicates the main results in Table 5. All regressions include a full set of baseline characteristics, control for business area fixed effects, and cluster at business area level. For each dependent variable, we show (1) reduced-form estimate from the main specification, (2) IV estimate on the actual treatment status, (3) reduced-form estimate using full sample, and (4) reduced-form estimate excluding pilot sample. 95% confidence intervals are shown.

Figure G6: Replication of the Heterogeneous Effects By Experience Requirement

Panel A. Firms requesting a college graduate and with low experience requirement



Panel A. Firms requesting a college graduate and with high experience requirement



Notes: This figure replicates the main results in Table 6. All regressions include a full set of baseline characteristics, control for business area fixed effects, and cluster at business area level. For each dependent variable, we show (1) reduced-form estimate from the main specification, (2) IV estimate on the actual treatment status, (3) reduced-form estimate using full sample, and (4) reduced-form estimate excluding pilot sample. 95% confidence intervals are shown.

H Pre-Analysis Plan

In our pre-analysis plan (PAP), we hypothesized that the intervention should help firms fill in the vacancy in a short amount of time, and firms may hire more agency workers because they had a lower perception of workers' outside options. However, we find that firms were not more likely to fill the vacancy despite having a lower perception of workers' outside options. We thus choose not to simply adhere to the PAP but to present more coherent evidence of our main mechanism, that firms became less optimistic about college graduates' productivity. In this section, we follow each step of our PAP and describe the differences from our current analysis.

The PAP first proposed to employ the same specification as Equation 1 on four outcomes: (1) Whether firm j in business area c hired at least one worker to the posted vacancy within one month (at midline). (2) Whether firm j filled the vacancy within five months (at endline). (3) Whether firm j hired a worker from the employment agency. (4) Whether firm j hired a worker not recommended from the employment agency. Table H1 presents the results. Similar to Table 2, we do not find any significant treatment effects on vacancy filling following the PAP specification.

The PAP then proposed a few robustness checks with different outcomes: (1) Whether firm j hired at least two or three workers. (2) Whether firm j interviewed at least one, two, or three workers. (3) We examine whether the treatment leads to more attrition. (4) We use initial treatment assignment as an instrument to whether firm j actually received an agency applicant. Table H2 presents the results. We do not find any intensive treatment effect on hiring; Firms were indeed more likely to interview 1–2 applicants by midline, but this did not translate into higher vacancy filling rate. We do not find attrition to be significantly affected by the intervention; see Table D9 for more discussion. The IV estimate suggests no significant overall effect of receiving an agency applicant on hiring; see Table D10 for more discussion.

The PAP further discussed potential ways to address spillover: (1) Leveraging the clustered treatment in Round 2, we examine whether control firms in intensely treated clusters had a different hiring outcome. (2) Control for whether the cluster was intensely treated. (3) Control for the treatment intensity of each cluster. (4) Concerned by spatial correlation with firms outside of the cluster, we initially proposed to use Conley spatial correlation similar to Hsiang (2010), but given that our data structure is not a panel data, we eventually simply compute the treatment intensity within a 500-meter radius of each firm, and control for whether the treatment intensity is above median. Table H3 presents the results. We do not observe significant spillover effects to control firms; nor does accounting for spillover restore any significant treatment effect on the treated firms. Similar analysis is used in Table D12.

For mechanism, the PAP proposed to estimate the treatment effect on the perceptions of workers' productivity and outside options; see Table 3 and E6. The PAP then proposed to examine whether firms were more likely to hire workers that were perceived to have high/low productivity or outside options. Table H4 presents the results and do not find any significant results. Column 5 further examines whether firms would hire someone and pay a lower salary because they perceived workers to have fewer outside options, and we do not find such an effect on average.

The PAP further proposed that firms with different hiring experiences may have different responses to the treatment, and that we can use current workforce structure as a proxy for past hiring experience. Table H5 conducts this exercise and do not find any significant treatment heterogeneity regarding current workforce structure. However, we do conduct a similar exercise to test the learning mechanism in our current analysis; see Table 5 for more details.

Last, the PAP conjectured that firms with different characteristics such as firm size and distance to the city center, or firms with different types of vacancies, may respond differently to the intervention. Notably, because employment agencies targeted college graduates and high-skill jobs, the PAP specified heterogeneity analysis regarding these characteristics: (1) Whether the vacancy required a college graduate, at least vocational training, at least high school, or no education requirement. (2) Whether the vacancy required at least two years of experience, some but less than two years of experience, or no experience requirement. (3) Whether the vacancy involved specific skills, manual labor task, or routine task. Figure H1 presents all heterogeneity analysis on whether the firm filled the vacancy, and whether the firm filled the vacancy with certain match quality indicators as listed in Table A3. Here, we find some suggestive clues of unexpected negative treatment effects. For instance, treated firms that required workers to have at least two years of experience or with specific skills were less likely to fill the vacancy. Firms with no education requirement were more likely to hire someone that quit soon or with below-average productivity. It seems that firms with different requirements for education, experience, or skill may be affected by the intervention differently and present different hiring behaviors. Inspired by the selection pattern in Figure D1, we decided to focus on college graduates because this is the main dimension where agency applicants distinguished from non-agency applicants. Similarly, we focus on firms that requested a college graduate at baseline as the main dimension of treatment heterogeneity.

Table H1: Pre-Analysis Plan: Treatment Effects on Vacancy Filling

VARIABLES	(1) Hire w/n 1m Any	(2) Hire w/n 5m Any	(3) Hire w/n 1m Agency	(4) Hire w/n 1m Non-agency
Assigned to treat	0.038	0.000	0.007	0.032
	(0.049)	(0.051)	(0.004)	(0.049)
	[0.434]	[0.996]	[0.115]	[0.520]
Observations	582	580	582	582
R-squared	0.335	0.264	0.188	0.334
Control baseline char.	Yes	Yes	Yes	Yes
Business area FE	Yes	Yes	Yes	Yes
Cluster at business area	Yes	Yes	Yes	Yes
Control mean	0.460	0.747	0.00305	0.744

Notes: This table replicates our pre-analysis plan and presents whether treated firms filled in the vacancy. The sample is restricted to firms eligible for treatment with reservation wage at least 2,000 ETB. Dependent variables: Column 1, whether the firm hired any applicant within one month (by midline). Column 2, whether the firm hired any applicant within five months (by endline). Column 3, whether the firm hired any agency applicant within one month. Column 4, whether the firm hired any non-agency applicant within one month. All regressions control for all baseline firm and vacancy characteristics, include business area fixed effects, and cluster at the business area level. Standard errors are shown in parentheses; p-values are shown in brackets.

Table H2: Pre-Analysis Plan: Robustness Check on the Treatment Effects on Vacancy Filling

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Hire w/n 1m			Interview w/n 1m				Hire w/n 1m
VARIABLES	≥ 1	≥ 2	≥ 3	≥ 1	≥ 2	≥ 3	Attrited	Any
Assigned to treat	0.038	0.041	0.004	0.083	0.071	0.017	0.024	
	(0.049)	(0.031)	(0.031)	(0.049)	(0.043)	(0.035)	(0.016)	
	[0.434]	[0.197]	[0.909]	[0.096]	[0.102]	[0.632]	[0.128]	
Received agency applicants								0.132
								(0.174)
								[0.450]
Observations	582	582	582	582	582	582	589	582
R-squared	0.335	0.351	0.307	0.303	0.300	0.302	0.224	0.135
Control baseline char.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Business area FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cluster at business area	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Control mean	0.460	0.172	0.0816	0.554	0.266	0.172	0.0149	0.460

Notes: This table replicates our pre-analysis plan and presents the robustness checks on the main specification. The sample is restricted to firms eligible for treatment with reservation wage at least 2,000 ETB. Dependent variables: Column 1–3, whether the firm hired at least one, two, or three applicants within one month (by midline). Column 4–6, whether the firm interviewed at least one, two, or three applicants within one month (by midline). Column 7, whether the firm dropped out of the survey in the follow-up surveys. Column 8, whether the firm hired any person within one month. In Column 8, the main independent variable is whether the firm received at least one agency applicant, instrumented by the initial treatment assignment. All regressions control for all baseline firm and vacancy characteristics, include business area fixed effects, and cluster at the business area level. Standard errors are shown in parentheses; p-values are shown in brackets.

Table H3: Pre-Analysis Plan: Spillover Effects

VARIABLES	(1) Hire w/n 1m Any	(2) Hire w/n 1m Any	(3) Hire w/n 1m Any	(4) Hire w/n 1m Any
Assigned to treat		0.026	0.026	0.049
		(0.047)	(0.047)	(0.049)
		[0.587]	[0.587]	[0.321]
High-intensity treated cluster	0.320	-0.092		
	(0.239)	(0.062)		
	[0.185]	[0.142]		
Treatment intensity			-0.123	
			(0.083)	
			[0.142]	
High-intensity w/n 500m				0.029
				(0.054)
				[0.598]
Observations	303	586	586	565
R-squared	0.439	0.213	0.213	0.338
Only control firms	Yes			
Control baseline char.	Yes	Yes	Yes	Yes
Business area FE	Yes			Yes
District FE		Yes	Yes	
Cluster at business area	Yes	Yes	Yes	Yes
Control mean	0.460	0.460	0.460	0.460

Notes: This table replicates our pre-analysis plan and presents the spillover effect of the intervention. The sample is restricted to firms eligible for treatment with reservation wage at least 2,000 ETB. The dependent variable is whether the firm hired any person to the vacancy within one month (midline). Specifications: Column 1, only control firms are included, and the main independent variable is whether the firm locates in a high-intensity treated cluster. Column 2 controls for the high-intensity treated cluster indicator and replaces business area FE with district FE. Column 3 controls for treatment intensity (75%, 50%, or 0) and replaces business area FE with district FE. Column 4 controls for whether the treatment intensity within 500-meter radius of each firm (excluding firms from the own business area) is above zero and keeps the business area FE. All regressions control for all baseline firm and vacancy characteristics and cluster at the business area level. Standard errors are shown in parentheses; p-values are shown in brackets.

Table H4: Pre-Analysis Plan: Mechanism Test

VARIABLES	(1) Hire w/n 1m High productivity	(2) Hire w/n 1m Low productivity	(3) Hire w/n 1m High outside	(4) Hire w/n 1m Low outside	(5) Hire w/n 1m Low salary
Assigned to treat	0.031	0.007	0.039	-0.000	0.046
	(0.049)	(0.007)	(0.047)	(0.016)	(0.042)
	[0.523]	[0.330]	[0.417]	[0.996]	[0.275]
Observations	582	582	582	582	582
R-squared	0.311	0.264	0.302	0.348	0.312
Control baseline char.	Yes	Yes	Yes	Yes	Yes
Business area FE	Yes	Yes	Yes	Yes	Yes
Cluster at business area	Yes	Yes	Yes	Yes	Yes
Control mean	0.436	0.0231	0.380	0.0793	0.149

Notes: This table replicates our pre-analysis plan and presents whether treated firms hired a certain type of worker. The sample is restricted to firms eligible for treatment with reservation wage at least 2,000 ETB. Dependent variables: Column 1 and 2, whether the firm hired any applicant who was perceived to have high (or low) productivity. Column 3 and 4, whether the firm hired any applicant who was perceived to have high (or low) outside options. Column 5, whether the firm hired any person with below-median salary. All regressions control for all baseline firm and vacancy characteristics, include business area fixed effects, and cluster at the business area level. Standard errors are shown in parentheses; p-values are shown in brackets.

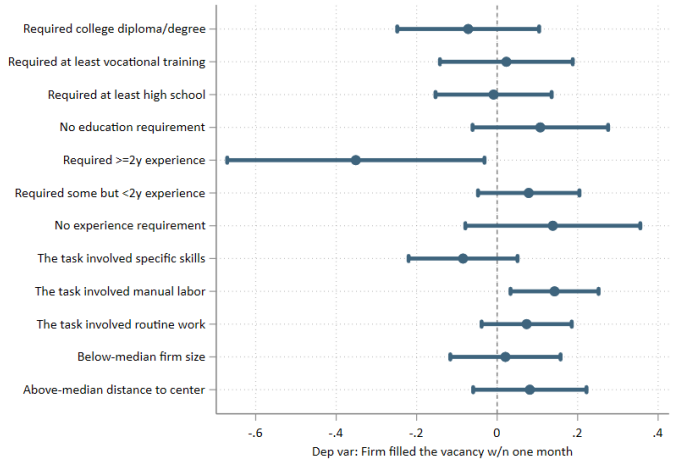
Table H5: Pre-Analysis Plan: Heterogeneity Test By Current Workforce Structure

VARIABLES	(1) Hire w/n 1m Any	(2) Hire w/n 1m Any	(3) Hire w/n 1m Any	(4) Hire w/n 1m Any	(5) Hire w/n 1m Any
Treat x (Char. $\leq$ median)	0.014	0.050	-0.004	0.005	0.020
	(0.056)	(0.063)	(0.058)	(0.057)	(0.057)
	[0.809]	[0.432]	[0.944]	[0.928]	[0.731]
Treat x (Char. $>$ median)	0.075	0.029	0.078	0.083	0.058
	(0.063)	(0.053)	(0.054)	(0.059)	(0.055)
	[0.239]	[0.582]	[0.156]	[0.162]	[0.301]
Observations	582	582	582	582	582
R-squared	0.336	0.335	0.337	0.337	0.336
Control baseline char.	Yes	Yes	Yes	Yes	Yes
Business area FE	Yes	Yes	Yes	Yes	Yes
Cluster at business area	Yes	Yes	Yes	Yes	Yes
Characteristics of current employees	Female	College	Temporary	Novices	Referred
Control mean	0.460	0.460	0.460	0.460	0.460

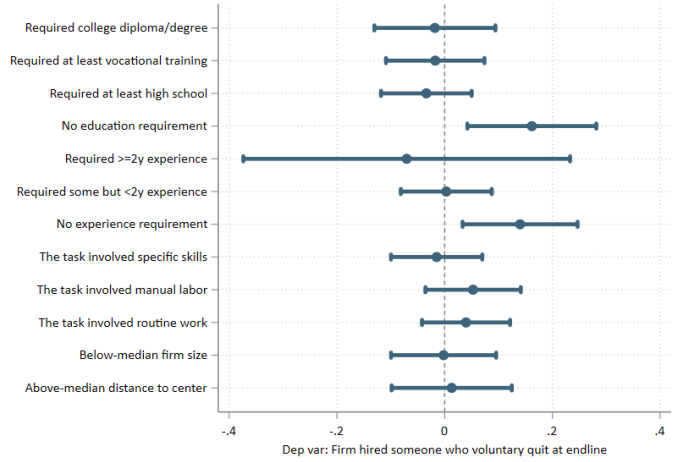
Notes: This table replicates our pre-analysis plan and presents heterogeneity analysis by current workforce structure. The sample is restricted to firms eligible for treatment with reservation wage at least 2,000 ETB. The dependent variable is whether firm hired any person to the vacancy within one month (midline). We interact the initial treatment assignment with whether the percentage of certain worker types among current workers is above or below median. Column 1 — female worker. Column 2 — workers with a college degree or diploma. Column 3 — temporary workers. Column 4 — workers with no experience. Column 5 — workers hired through internal referrals. All regressions control for all baseline firm and vacancy characteristics, include business area fixed effects, and cluster at the business area level. Standard errors are shown in parentheses; p-values are shown in brackets.

Figure H1: Pre-Analysis Plan: Heterogeneity Test By Firm and Vacancy Characteristics

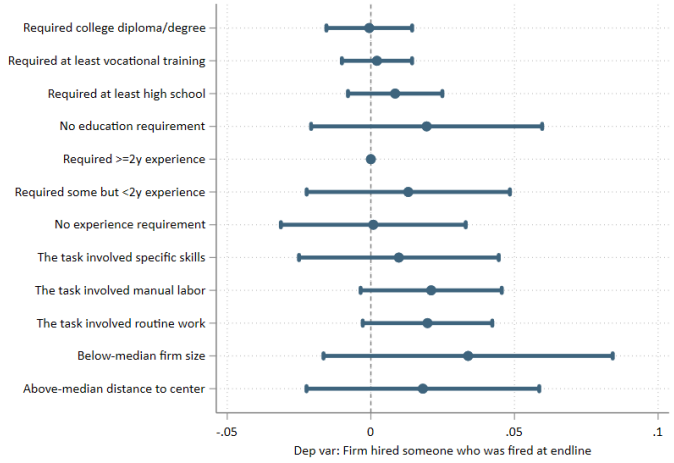
Panel A. Whether firm filled the vacancy



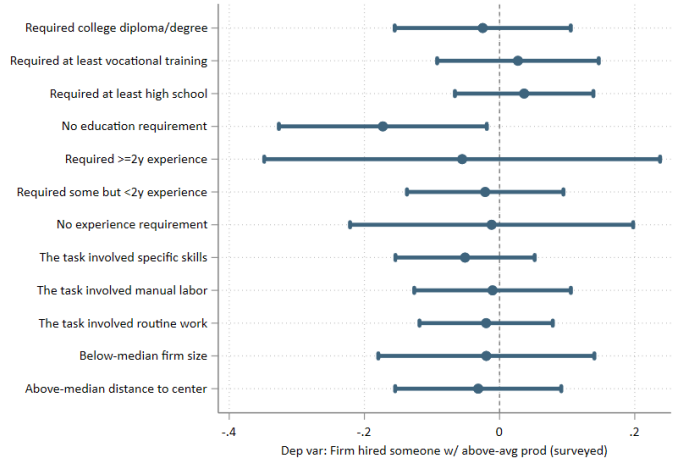
Panel B. Firm hired someone who quit



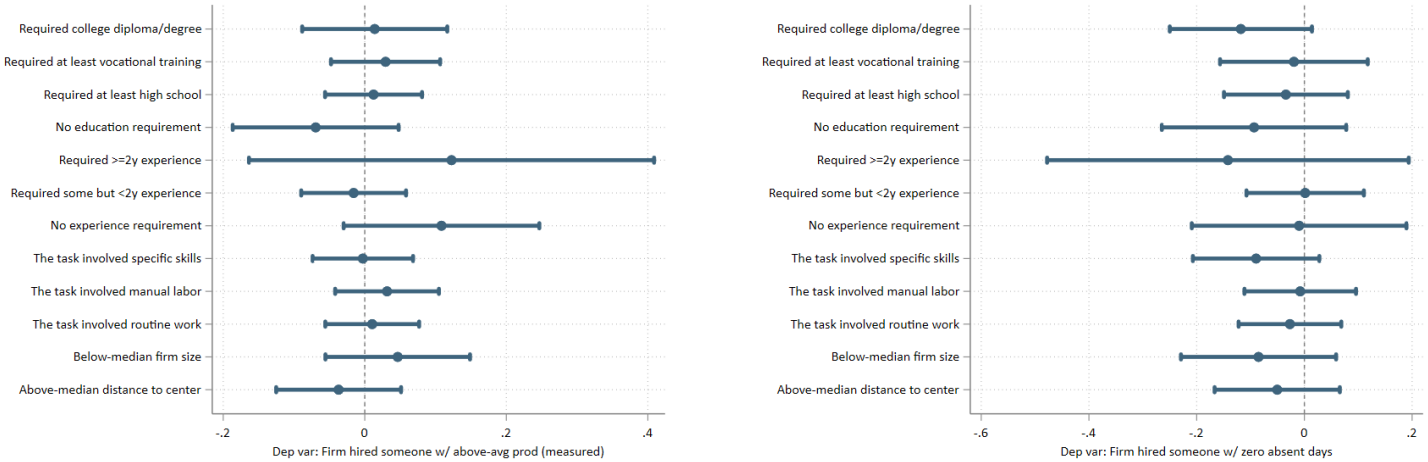
Panel C. Firm hired someone who was fired



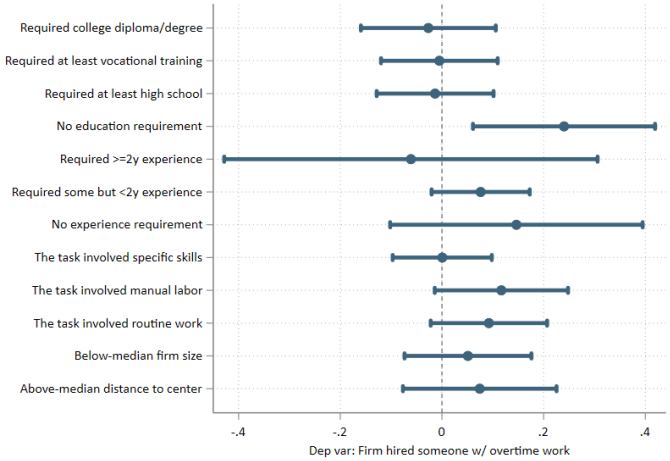
Panel D. Firm hired someone above-ave prod (surveyed)



Panel E. Firm hired someone above-ave prod (measured) **Panel F.** Firm hired someone w/ no absent days



Panel G. Firm hired someone w/ overtime work



Notes: This figure replicates our pre-analysis plan and presents treatment heterogeneity regarding vacancy and firm characteristics. The sample is restricted to firms eligible for treatment with reservation wage at least 2,000 ETB. Each panel has a different dependent variable: Whether firm hired anyone within one month (midline), whether firm hired someone who quit voluntarily by endline, whether firm hired someone who got fired by endline, whether firm hired someone with above-average productivity according to survey response, whether firm hired someone with above-average productivity according efficiency measures, whether firm hired someone with no absent days in the last 30 days, and whether firm hired someone with overtime work in the last 7 days. Each coefficient represents the treatment effect among different subgroups. All regressions control for all baseline firm and vacancy characteristics, include business area fixed effects, and cluster at the business area level. 95% confidence intervals are shown.