Labour market discrimination

Relative, additive, and multiplicative effects

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Labour market discrimination: Relative, additive, and multiplicative effects

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Abstract

In a preregistered nationwide factorial survey experiment among 5,017 representative Danish employers and 20,068 vignettes, we examine labour market discrimination across five applicant characteristics spanning gender, age, ethnicity, employment status, and preferences for working time. The experiment enables us to examine how job applicant characteristics have relative, additive, and multiplicative effects on labour market discrimination. Our findings suggest that discrimination in previous correspondence studies is mostly additive, meaning that multiple disadvantageous characteristics add up to high levels of discrimination. The most disadvantaged profile has a hireability score of 1.1 on a 0-10 scale and a five percent chance of being selected over other applicants. The most advantaged profile has a hireability score of 6.9 and an 84 percent chance of being selected. As for relative effects, age discrimination against older applicants outweighs other manipulated characteristics in our study. Finally, we find that male employers and production workplaces favor male applicants.

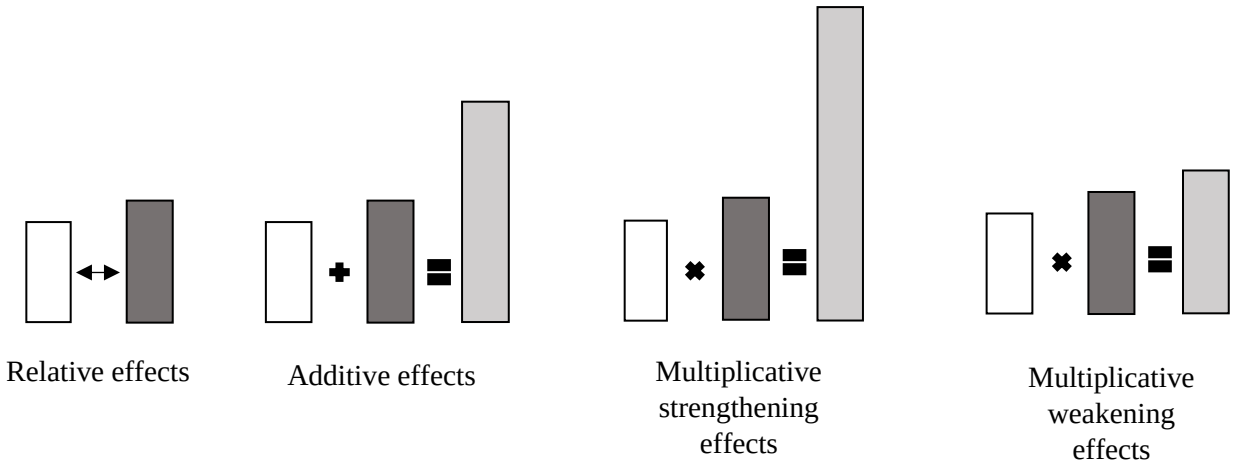
Main

Getting a job is pivotal in market-based economies and is significantly related to positive individual outcomes such as mental health[1,2] and future labour market prospects [3]. Nevertheless, as the rich literature on labour market discrimination indicates, employment opportunities are unequally distributed between sub-populations. Evidence from correspondence and audit studies consistently suggests discrimination against ethnic minorities and unemployed while gender discrimination is less visible or, in some cases, absent[4,5]. Although less explored, studies also find substantial levels of ageism in hiring decisions, which increases with the applicant's age[6]. Correspondence studies, i.e., studies that examine call-back rates to actual job advertisements using fictional applications, are often considered the golden standard to analyze discriminatory behaviour because researchers conduct these studies in the field, and employers are uninformed about the experiment [7,8]. However, because the experimental variation of these studies aims to isolate the effect of one or few characteristics, it remains largely unknown how the combination of different application characteristics interact. This is unfortunate as real-world applicants and employers embody multiple characteristics, which are likely to interact with each other [9]. For example, the disadvantaging effect on employment opportunities from unemployment could be more prominent for ethnic minority groups than natives, as suggested but not confirmed in previous literature [10]. Another plausible mechanism is that various application characteristics might mitigate each other, e.g., in Bertrand and Mullainathan's seminal study on race discrimination in the U.S. labour market [11], the improving of qualifications in Black Americans' resumes did not increase call-backs to the same extent as for White Americans. As such, race discrimination made other selection mechanisms irrelevant.

In a preregistered large factorial survey experiment, we examine employers' hiring discrimination across five applicant characteristics spanning gender, age, ethnicity, employment status, and preferences for working full-time or less than full-time. Our scenario-based design allows us to

examine applicant characteristics' relative, additive, and multiplicative effects on employers' hiring discrimination. The various effects of discrimination on two characteristics are illustrated in Figure 1. Additive effects refer to the combined effect of various characteristics arrived at by summing up their individual effects. In contrast, multiplicative effects refer to the interaction between two or more characteristics that can change the strength or direction of their effects on employment opportunities. As for the latter, our study for example provides some evidence that older Muslim females face a multiplicative disadvantage in the labour market. As for the former, our study shows substantial additive effects. Our experimental combination of "negative" characteristics leads to hireability scores close to zero.

Figure 1. Illustration of different forms of discrimination effects



Another contribution of our study is that uses a nationwide representative sample of employers drawn from administrative register data. Thus, compared to correspondence studies that are often limited to particular job types or rely on online platforms with publicly announced job advertisements that may not represent all employers or more informal recruitment processes[8], our estimates cover a nationwide labour market, which is important to secure external validity[12].

Additionally, correspondence studies measure discrimination based on a binary indicator for whether an applicant gets a job, either callbacks or invitations to job interviews. Our study measures discrimination based on employers' assessment of a given profile's likelihood of employment on a scale ranging from 0 to 10, which allows for better measurement of employers' productivity assessment (see below). Following Lössbroek et al., we use the term "hireability score" to label the employers' assessment of applicants on a 0-10 scale[13]. Subsequently, we ask the employer to choose between a pair of randomized profiles, thereby bringing us a step closer to simulating the decision-making process involved in recruitment. Overall, our study finds consistent results across the two indicators.

Our theoretical starting point builds on neoclassical economic perspectives, which assert that employers strive for profit maximization and establishing a dominant firm position by searching for the most productive employee [14]. In a state of perfect competition and full information, an applicant would only be judged on her specific productivity. However, most labour is *not* a standard commodity, where the price (the wage) is the only relevant information needed to recruit employees. To assess the profitability of a specific applicant, the employer also needs knowledge about job motivation, the ability to cooperate with co-workers, the ability to adapt to technological and organizational changes, the ability to interact with customers, etc. This additional information is asymmetrically distributed, as the applicant knows more about their labour supply than the employer. At the same time, the applicant has a clear incentive to present themselves in the best way [15]. As such, asymmetric information makes the hiring process a risky venture, where employers, in various ways, attempt to compensate for the lack of (trustworthy) information about a given applicant. A classic strategy is to assess the individual applicant by the perceived or actual average productivity of the group to which the applicant belongs. When an employer deselects applicants because they belong to groups with low average productivity, it is labeled statistical

discrimination or selection[16]; we use the words selection and discrimination interchangeably. Statistical discrimination is a market-based explanation for why employers who seek to hire the most productive employee may deselect ethnic minorities, older applicants, and women. Arrow's classic work involved the deselection of Black Americans in the U.S. Our contribution is based on the argument that applicants have multiple traits, which employers use in these productivity assessments.

Statistical discrimination is often contrasted with taste discrimination. Taste discrimination is defined as an employer's willingness to hire a less productive worker due to a preference for a particular characteristic, for example, being white. Thus, taste discrimination occurs when a less productive white worker is chosen over for example a more productive non-white worker [17]. It has proven notoriously difficult for researchers to distinguish between statistical and taste discrimination. The critical task is to keep information on productivity across matched applicants constant, which is typically done through similar resumes. However, this method is troubled by resumes not including all relevant information for productivity assessment[18] for example, co-workers willingness to cooperate with an applicant, and by the employers simply not paying attention to long resumes[4]. Keeping productivity constant is also a challenge for our study. We ask employers to assess the likelihood of employment for (random) profiles, which all have the formal competencies to do the workplace's core task. However, having the formal competencies and randomizing five profile characteristics, which are kept constant through statistical modeling, does not mean that we can keep applicants' (imagined) productivity constant, such that taste discrimination can be isolated. We aim to describe employers' selection of essential job applicant characteristics as well as their combinations while accepting their underlying motivation to be somewhat of a black box for experimental research in this field.

Hypotheses

In our preregistration, we posit a number of hypotheses that focus on 1) the main effects of applicant characteristics, 2) the multiplicative effects of applicant characteristics, and 3) the multiplicative effects of applicant and employer characteristics.

Regarding the main effects of applicant characteristics, we expect that increasing age, having a Non-Christian background, in particular a Muslim background, being unemployed, particularly for a longer time, and a preference for working less than full-time increases employer discrimination. The rationale for these hypotheses is based on previous literature, which proposes that such characteristics are detrimental to one's employment chances. First, age discrimination in hiring processes tends to increase with age because employers perceive older employees' productivity to decrease due to a decline in physical and cognitive impairments [6,13,19,20]. Second, having a Non-Christian background, predominantly Muslim background, has been pinpointed as challenging to integrate/assimilate into the European context, including Denmark. Findings from meta-analysis of European correspondence studies on labour market discrimination find that call-back rates are low for Muslim names/origin countries[21]. This could be attributed to a lack of human capital, given that numerous Muslim minorities have immigrated as humanitarian migrants. However, public opinion studies have found a Muslim penalty for permanent residence and citizenship even when human capital and other characteristics by means of conjoint experiments are kept constant[22,23]. Such findings signal discrimination based on taste, which might spill over into the taste of employers. In addition, employers may discriminate against applicants with Muslim backgrounds if they, in a broader productivity assessment, also take the "taste" of native co-workers or native customers into account. Third, there is strong evidence that unemployment, notably longer spells of unemployment, has "scarring effects" as unemployment deteriorates future labour market opportunities[3,24], partially because employers may perceive unemployment as a negative signal of

unobserved characteristics, e.g., job motivation or a decay of human capital. Fourth, among the various flexible working arrangements employers are adopting in the current job market, reduced working hours are one of them [25,26]. Such arrangements, if voluntary, are attractive to many employees, mainly due to family caregiving responsibilities or the prevention of health problems. Yet, due to cost and management issues, employers may be reluctant to select applicants who prefer to work less than full-time. Finally, we also included gender as a varying characteristic in our study. Regarding the main effect of gender, we expect no gender discrimination, given that our study takes place in a Danish context characterized by gender-equality norms and high female employment rates [27]. Furthermore, women may often be subject to statistical discrimination, mainly when pregnancy and subsequent parental leave are possible [28]. Since we only include applicants aged 45 and above, we expected no gender discrimination.

Concerning the multiplicative effects of job applicant characteristics on employer discrimination, we expected that discrimination against unemployed increases with age as previous research shows that unemployed older workers are less likely to reenter employment compared to their younger counterparts and that negative age stereotypes have remained remarkably constant among employers and employees[29]. Moreover, we also expected that discrimination is stronger for older females with Muslim backgrounds. This hypothesis is grounded on the empirical finding that unemployment rates are substantially lower for older females with a Muslim background. One potential explanation for this phenomenon is a combination of traditional gender roles and a lack of human capital within this group[30]. Although empirical studies of the actual work motivation of this group strongly dispute this[31], persistently low employment rates, resulting from various factors, might in themselves turn into a negative signal about the average productivity of this particular group.

Finally, we also proposed hypotheses on the multiplicative effects of applicant and employer characteristics. Our first expectation is rooted in the concept of homophily and the tendency to favor in-groups[32,33], which implies that employers would prefer job applicants who are similar to them in specific traits. Having information on the gender and age of the responding employer, we hypothesize that age discrimination against older applicants is stronger among younger employers than older employers and that gender discrimination against female applicants is stronger among male employers than female employers. About the latter, we also expected employers to use gender-specific job characteristics to assess male and female applicants differently. E.g., previous literature indicates that employers view females as less physically strong[34], which may result in differences in male and female applicants' assessment from employers where physical strength is advantaged. This systematic gender bias can contribute to gender segregation in the workplace, which might reinforce exclusion[35]. Therefore, we also expected that gender discrimination against female applicants is stronger among employers in production workplaces compared to other workplaces.

Results

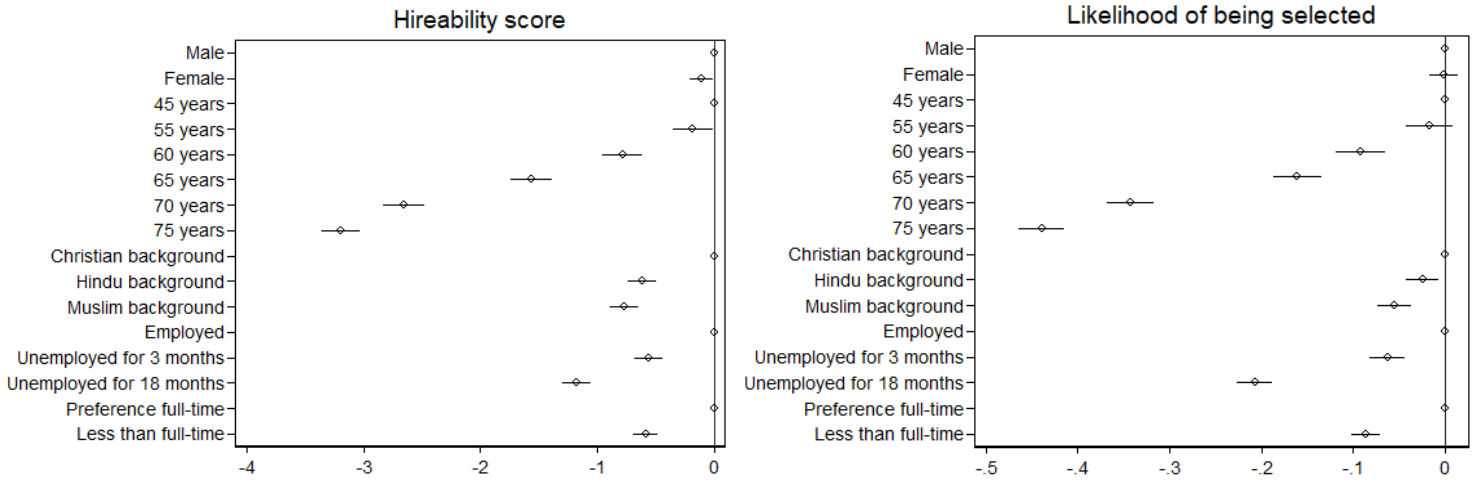
Relative effects of job applicant characteristics

The study included 5,017 employers who assessed the likelihood of recruitment of four randomized vignettes on a scale from 0 (very unlikely) to 10 (very likely). The vignettes appeared in pairs on separate screens, and subsequently, the employers were asked to select which one of the two applicants the employer would hire, see methods. The mean hireability score across all job profiles was 4.15 (sd=3.24), and the forced selection of applicants naturally gives 50 percent of profiles chosen over other (randomized) profiles.

Figure 2 (left panel) shows the estimates of employers' assessment of having a specific characteristic compared to a reference group on a hireability score from 0-10 while keeping the effects from all other characteristics constant. The left panel shows the likelihood for each

characteristic the employer selects over other randomized profiles. The panels illustrate the main effect of a characteristic, controlled for all other (manipulated) characteristics, and thereby the relative strength of various forms of discrimination.

Figure 2. The relative effects of applicant characteristics on hireability score (left panel) and the likelihood of being selected (right panel).



Note: Based on models without interaction terms, see Extended Data Table 1.

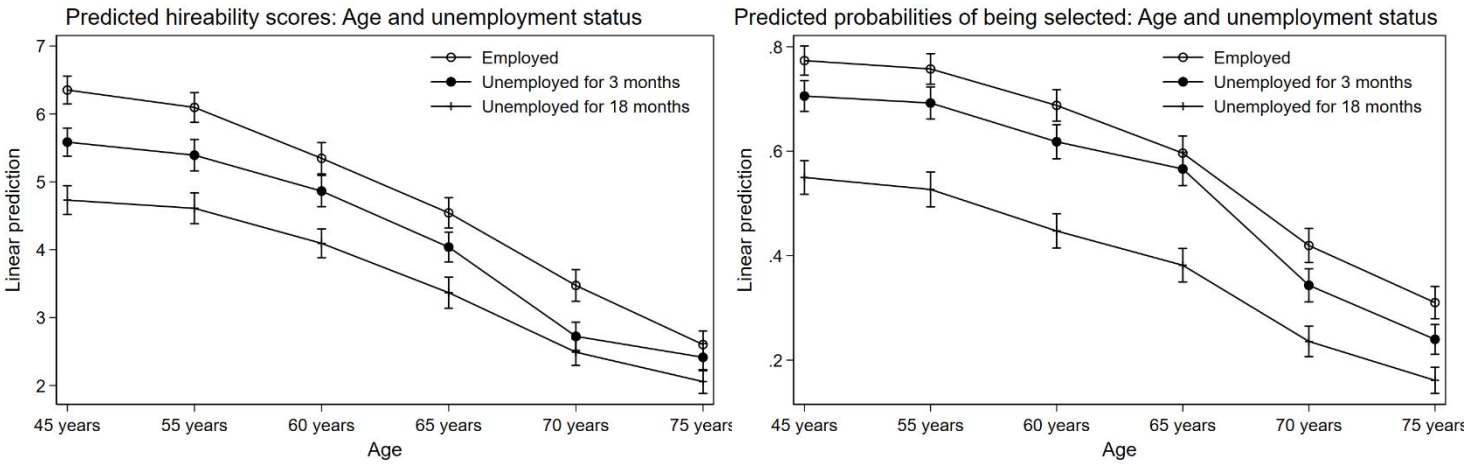
The left panel shows that female applicants have a 0.11 lower hireability score than male applicants (95 % CI -0.21; -0.09). However, when we look at gender differences in the likelihood of being selected by the employer, the results (Figure 2, right panel) show that female applicants do not have a lower chance of being chosen over other candidates than male applicants. In our preregistration, we hypothesized that gender discrimination was absent for applicants aged 45 years and above. This expectation is largely confirmed (but see below for gender discrimination). We observe that employers assess and select applicants based on their age, remarkably increasing age, which also aligns with our preregistered thesis. Figure 2 shows that a 55 years-old applicant has an estimated 0.19 (95 % CI -0.36; -0.09) lower hireability score than a 45 years-old applicant. The hireabilty

score is 0.79 (95 % CI -0.96; -0.61) lower for a 60 years-old applicant, 1.57 (95 % CI -1.74; -1.39) for a 65 years-old applicant, 2.66 (95 % CI -2.83; -2.48) for a 70 years-old applicant and 3.20 (95 % CI -3.36; -3.03) lower for a 75 years-old applicant compared to a 45-years-old applicant. From the right panel we observe that the lower likelihood of being selected (over other candidates) in comparison with a 45 years-old are respectively 2 percent (95 % CI -4; 0.01), 9 percent (95 % CI -12; -7), 16 percent (95 % CI -19; -13), 34 percent (95 % CI -37; -32) and 44 percent (95 % CI -46; -42). Applicants with non-Christian backgrounds also have significantly lower hireability scores than applicants with Christian backgrounds. The hireability score is 0.62 (95 % CI -0.74; -0.50) lower for profiles with Hindu backgrounds and 0.78 (95 % CI -0.89; -0.65) lower for profiles with Muslim backgrounds. Their chances of being selected over other profiles are respectively 2 percent (95 % CI -4; -1) and 6 percent (95 % CI -7; -4) lower than applicants with Christian backgrounds. These findings confirm our preregistered hypothesis. Also, in support of our preregistered hypothesis, we find that employed applicants are favoured over unemployed applicants, and this effect increases with the length of unemployment. The hireability score is 0.57 (95 % CI -0.69; -0.44) lower for profiles with three months without employment and 1.18 (95 % CI -1.30; -1.05) lower for profiles with 18 months without employment compared to employed applicants. Their chances of being selected over other profiles are 6 (95 % CI -8; -4) and 21 (95 % CI -23; -19) percent lower than for employed applicants. Finally, in line with our preregistered thesis, a preference for working less than full-time gives a 0.59 (95 % CI -0.69; -0.49) lower hireability score and a 9 percent (95 % CI -10; -7) lower likelihood of being chosen over other profiles. In this experimental setup, the manipulation of age supersedes any other manipulations. This even holds for hireability scores if we only include the manipulation of applicants aged 65, which is below the statutory retirement age. In the Extended Data Figure 1-4, we show that the manipulation of age also supersedes any other manipulations when we break down the analysis into different industries and sectors.

Multiplicative effects between job applicant characteristics

One of the main advantages of our large sample size with five varying job applicant characteristics is the ability to study multiplicative and additive effects. Against our preregistered thesis, older unemployed applicants were not more likely to be discriminated against than younger unemployed. We find the opposite effect, as illustrated in Figure 3. Figure 3 (left panel) shows that discrimination against the unemployed significantly decreases with age, as the gap in hireability score between being unemployed for 18 months and employed decreases as the applicant's age increases. For the likelihood of being selected over other profiles (right panel), a similar pattern can be observed for the oldest age group compared to the 45-year-old applicants. This is an example of a multiplicative weakening effect.

Figure 3. Predicted hireability scores (left panel) and predicted probabilities of being selected (right panel). Age and unemployment status.

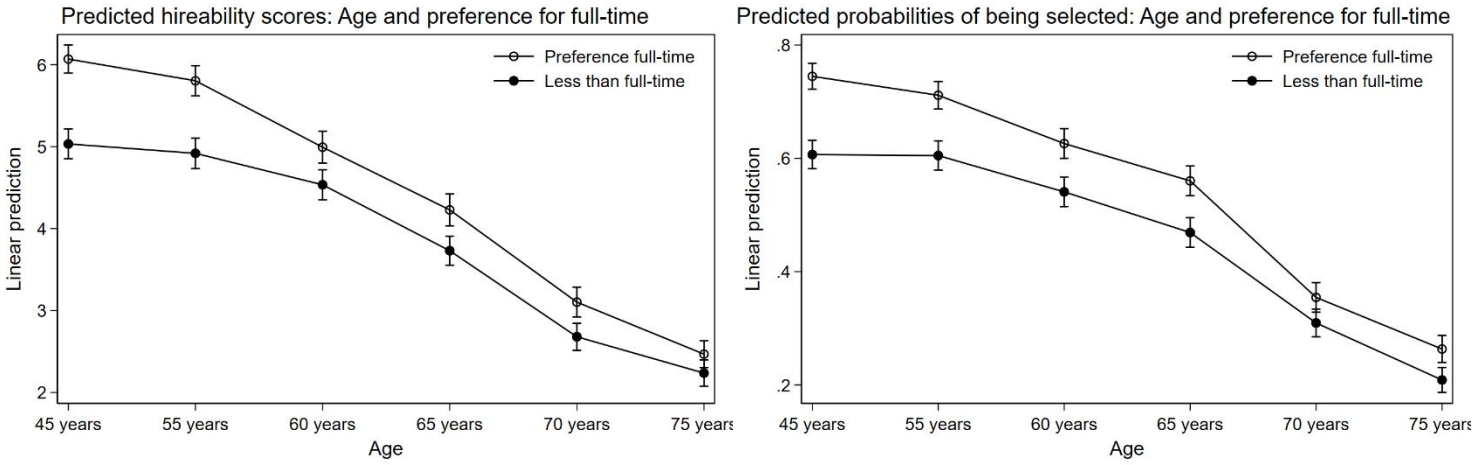


Note: Based on full models with interaction terms between age and unemployment status, see Extended Data Table 2.

We find a similar pattern when we interact age with preference for worktime, see Figure 4 (not preregistered). The gap in lower hirebility score and deselection of applicants who prefer to work

less than full-time compared to work full-time are largest for the 45-year-olds and decrease significantly with age. This is another example of a multiplicative weakening effect.

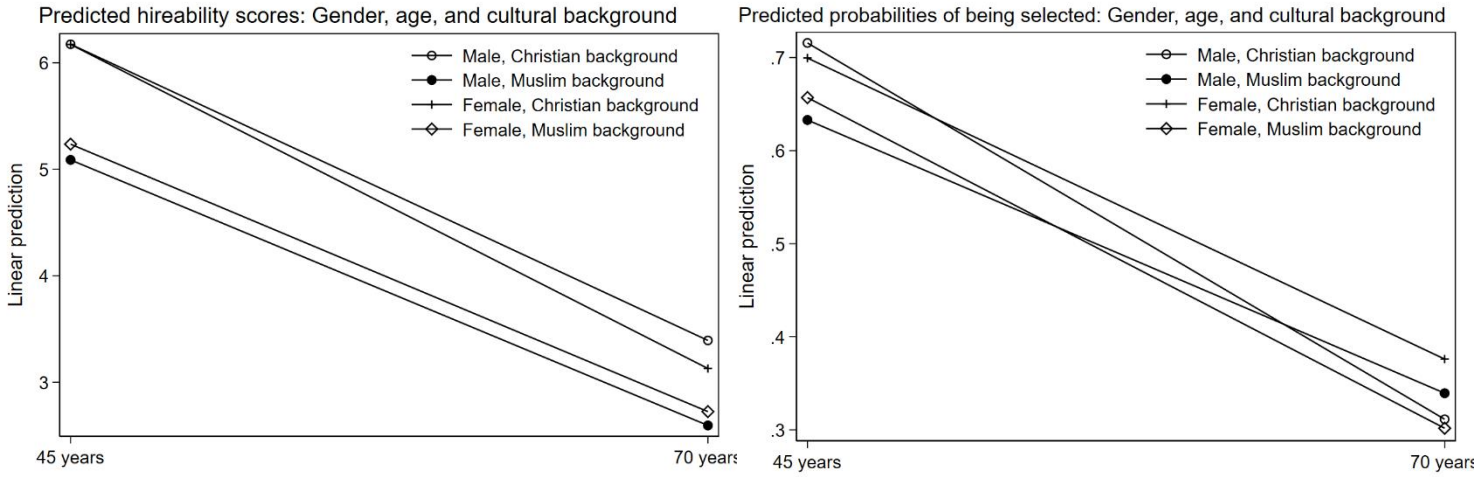
Figure 4. Predicted hireability scores (left panel) and predicted probabilities of being selected (right panel). Age and preference for full-time.



Note: Based on full models with interaction terms between age and preference for full-time, see Extended Data Table 3.

Based on our preregistered hypotheses, we also expected that gender discrimination would be notably more pronounced for older females with a Muslim background. Our findings partially confirm this. Specifically, the three-way interaction analysis revealed a significant reduction in the likelihood of being selected for 70-year-old Muslim females compared to males with similar characteristics, as depicted in Figure 5 (right panel). The chance of being selected for the 70-year-old Muslim females was 30 percent (95 % CI 25; 34). Thus, the results suggest that older females with Muslim backgrounds face a multiplicative strengthening effect of labour market discrimination. However, the results were insignificant for other age groups and hireability scores, suggesting that the broader subpopulations face additive rather than multiplicative disadvantages in the labour market.

Figure 5. Predicted hireability scores (left panel) and predicted probabilities of being selected (right panel). Gender, age, and cultural background.

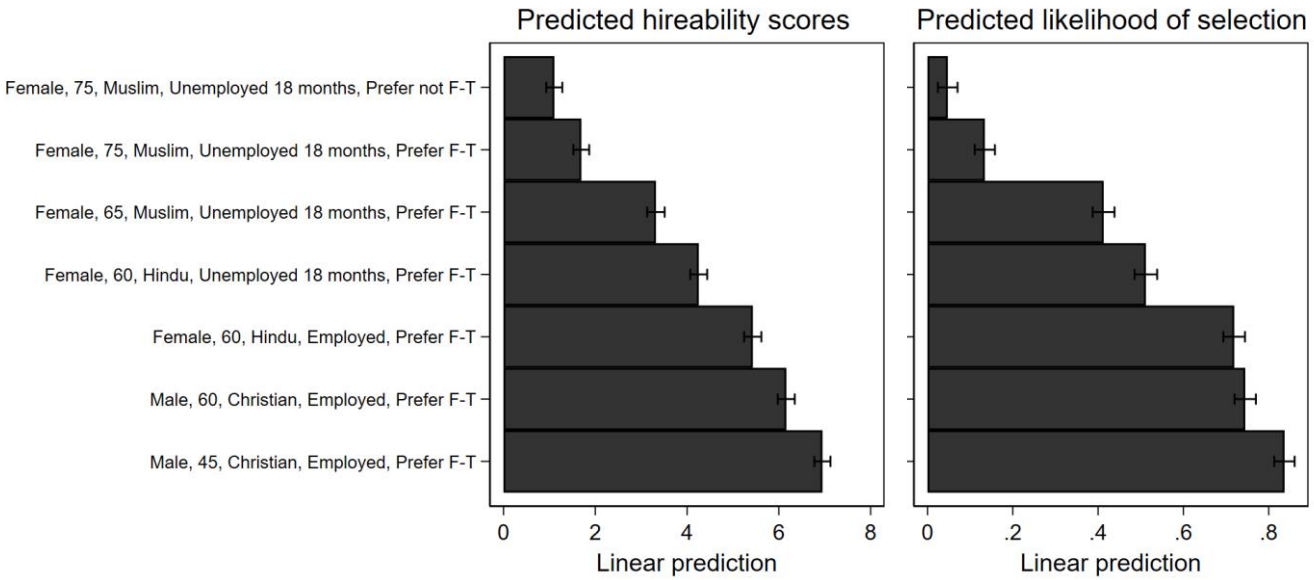


Note: Based on full models with interaction terms between gender, age and cultural background, see Extended Data Table 4. Confidence intervals not shown in figures.

Additive effects of job applicant characteristics

To illustrate the additive effects of different profiles, Figure 6 shows the estimated hireability scores (left panel) and predicted probabilities of being selected (right panel) for seven different profiles based on the full model shown in Figure 2.

Figure 6. The additive effects of applicant characteristics on hireability score (left panel) and the likelihood of being selected (right panel).



Note: Based on models without interaction terms, see Extended Data Table 1.

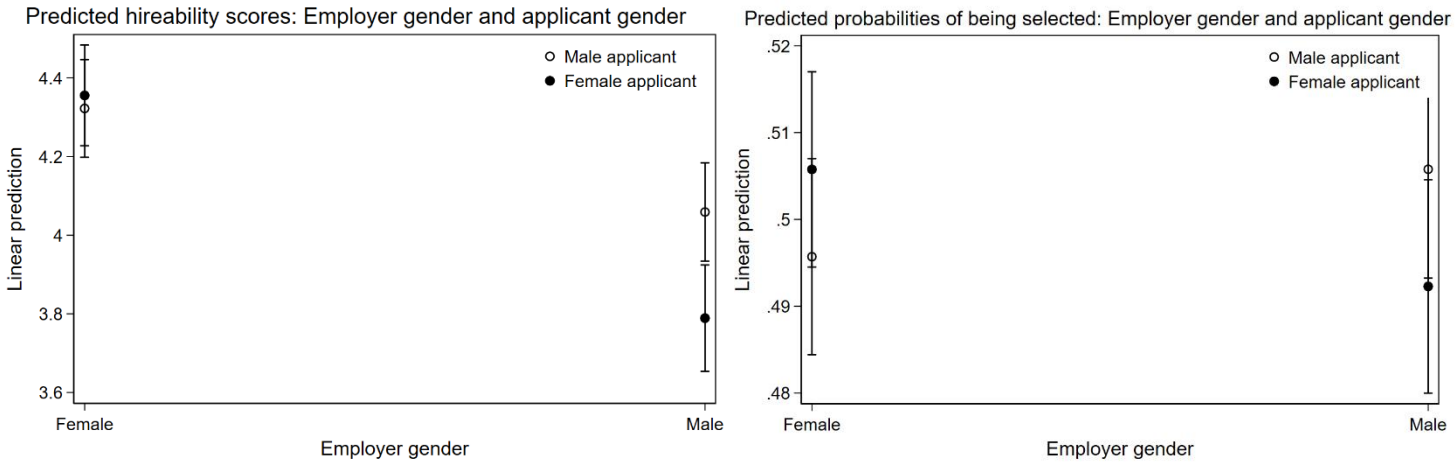
The first applicant (from the bottom) is a 45-year-old employed male with a Christian background who prefers to work full-time. This profile has a hireability score of 6.95 (95 % CI 6.77; 7.12) and an 84 percent (95 % CI 81; 86) chance of being chosen over another (randomized) profile. The most disadvantaged profile is a 75-year-old female with a Muslim background who has been unemployed for 18 months and prefers not to work full-time. This profile has a hireability score of 1.11 (95 % CI 0.93; 1.28) and a five percent (95 % CI 2; 7) chance of being chosen over another (randomized) profile. When changing the preference for not working full-time to working full-time for the most disadvantaged profile, the hireability score increases to 1.70 (95 % CI 1.52; 1.88) and the likelihood of selection to 13 percent (95 % CI 11; 16). When the age of this profile is decreased by ten years, the hireability score rises to 3.32 (95 % CI 3.13; 3.51), and the predicted probability of being selected is 41 percent (95 % CI 39; 44). When changing the age, gender, and religion of the most advantaged profile to a 60-year-old female with Hindu background (and otherwise similar

characteristics), the predicted hireability score decreases to 5.43 (95 % CI 5.24; 5.62), and the likelihood of selection decreases to 72 percent (95 % CI 69; 74). Thus, we find effect sizes that make it highly likely for some profiles to be recruited and close to impossible for other profiles to be recruited. The results in Figure 6 are based on the assumption that discrimination is additive. In Extended Data, Table 5, we also estimate the predicted hireability score of the profiles and likelihood of selection based on a full-factorial model allowing interactions between all our attributes. In such a model, the hireability score and likelihood of selection increase slightly for all profiles, suggesting only weak multiplicative weakening effects on employer discrimination across the attributes.

Multiplicative effects between job applicant characteristics and employer characteristics

In the last part of our analysis, we test how discrimination may depend on employer characteristics. Against our preregistered hypothesis, our analysis does not confirm that age discrimination would be stronger among younger employers than older employers, see Extended Data Table 6. Our analysis does find that male employers are more likely to rate male applicants higher than female applicants. This is illustrated in Figure 7 (left panel). Male employers give female applicants a predicted hireability score of 3.79 (95 % CI 3.65; 3.92), while male applicants have a predicted hireability score of 4.06 (95 % CI 3.93; 4.18). Yet, when it comes to selecting male applicants over other profiles compared to female applicants (right panel), the interaction effect is not significant. We did not find female employers to discriminate against men, see Figure 7 (not preregistered).

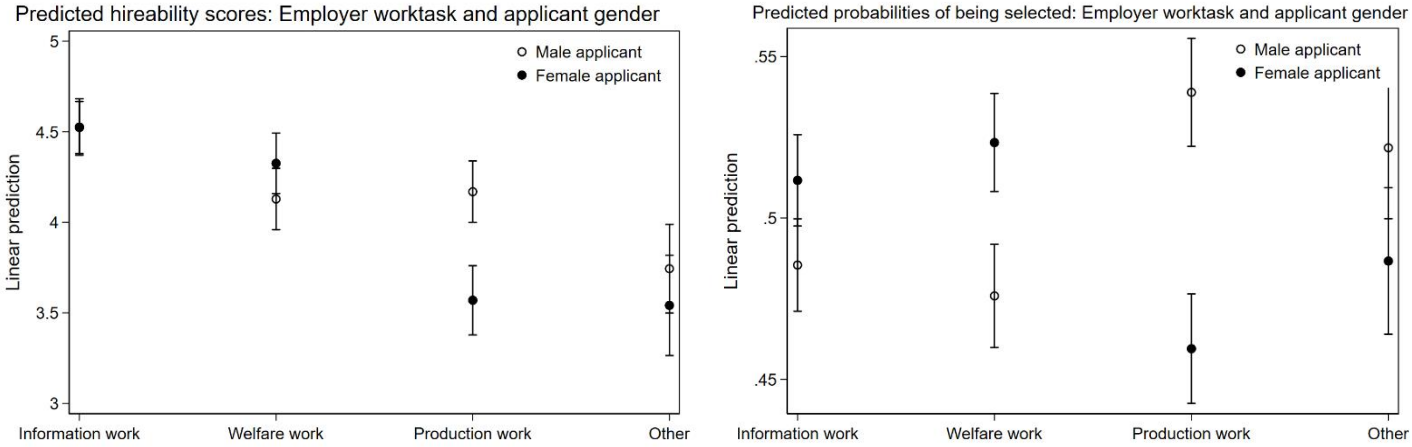
Figure 7. Predicted hireability scores (left panel) and predicted probabilities of being selected (right panel). Employer gender and applicant gender.



Note: Based on full models with interaction terms between employer gender and applicant gender, see Extended Data Table 7.

Finally, we expected that females were more likely to be discriminated against at production workplaces compared to other workplaces, which is confirmed by the data. The predicted hireability score for female applicants among employers at production workplaces is 3.57 (95 % CI 3.37; 3.76), whereas male applicants' hireability score is 4.17 (95 % CI 4.00; 4.34), see Figure 8 (left panel). This difference in hireability score is also evident in the choice of applicants selected. Female applicants have a 46 percent (95 % CI 44; 48) chance of being selected over other profiles, while male applicants have a 54 percent (95 % CI 52; 56) chance of being selected over other profiles in production workplaces, see Figure 8 (right panel). In welfare workplaces such as child-care institutions, elderly-care institutions, and hospitals, we note a gender bias in employer preferences, with a higher likelihood of female applicants being selected than male applicants. However, the model with interaction terms reveals that the interaction is insignificant.

Figure 8. Predicted hireability scores (left panel) and predicted probabilities of being selected (right panel). Employer work tasks and applicant gender.



Note: Based on full models with interaction terms between employer gender and applicant gender, see Extended Data Table 8.

Discussion

Previous literature on labour market discrimination has been dominated by correspondence studies, which primarily focus on isolating discrimination based on one characteristic such as ethnicity, gender, or unemployment status. Despite the merits of these studies, they often miss assessing the relative, additive, and potentially multiplicative effect of various forms of discrimination. Our study fills this knowledge gap by simultaneously varying five applicant characteristics in a nationwide representative sample of employers.

First, our findings indicate that the well-established forms of discrimination documented by correspondence studies are primarily additive. It suggests that effect sizes from previous correspondence studies can be summed up to receive the discrimination effect for job applicants with varying characteristics, as done in meta-studies. This finding is in line with a few previous correspondence studies that did study the interplay between two characteristics [36,37]. Our main

contribution is to show how adding up the results of the effect in some job profiles having close to zero likelihood of recruitment while others seem sure of recruitment. Consequently, our study revitalizes selection mechanisms in the recruitment processes as a potent explanation of why some groups have lower employment rates and longer unemployment spells than others. However, we also found examples of both strengthening and weakening multiplicative effects. The interaction between various forms of discrimination poses a challenge in the field, as the effects found in previous studies may mutually reinforce or undermine each other As an example, we showed that the low real-world employment rates for being 70 year-old, Muslim and female reinforces the employers' deselection of this group, suggesting that this group faces a multiplicative disadvantage in the labour market. We also found the opposite effects (see below). Such interactions are often impossible to study in a correspondence design, leading to both under- and over-estimating discrimination.

Second, the study showed that age discrimination supersedes other forms of discrimination. This finding resembles the findings from the meta-study of correspondence studies, as the difference in call-backs from employers in studies of age discrimination is typically larger than the difference in call-backs in studies of ethnic discrimination based on religion[5]. Our experiment validated this finding using the same employer sample covering an entire national labour market. This somewhat overlooked age discrimination in recruitment processes is highly relevant in a context, where people throughout the globe tend to live longer[38]. However, against our expectations, we did *not* find multiplicative strengthening effects. In fact, we found multiplicative weakening effects. For example, employers were less concerned with the unemployment status and preference for non-full-time work of older applicants, particularly those above the statutory retirement age. This tolerance of other "negative" characteristics among older applicants might be exploited in efforts to include a

growing share of older workers in the labour market, for example in the forms of reduced hours in old-age in order to ensure the economic and social sustainability of the welfare states.

Third, our study points to important mechanisms beneath the weak or absent gender discrimination found in correspondence studies. In a setup that includes only applicants well above the age of first-time parenthood and with employers who are aware of being monitored, we find gender bias favoring male applicants. However, more importantly, gender bias is most present among male employers and employers in production workplaces. This suggests a complex interplay between the gender of the applicant, the gender of the employer, and the work tasks. However, more research is needed to understand how gender discrimination in recruitment interacts with employer characteristics as well as job characteristics.

Our study comes with limitations. A dominant theme in the literature is that both the correspondence studies and our factorial survey experiment might not be able to keep the applicants' productivity constant[18,39]. Thus, one cannot be sure that discrimination/selection is based on the manipulated criterium, e.g., age, and not on unobserved characteristics related to manipulated criterium, for example, the physical health of older applicants. From our point of view, the search for distinguishing between statistical and taste discrimination has proved somewhat unproductive, as it seems to be guided by an urge to judge whether employers make legitimate or illegitimate recruitment decisions. Whether employers dislike a particular group or judge productivity as low, the outcome of not being hired is the same. Furthermore, it is an illusion to believe that employers in the best of worlds potentially could have complete information about applicants' productivity. Recruitment processes always rely on limited observable characteristics due to asymmetric information, which makes both correspondence studies and our factorial survey experiment relevant.

We consider our study a crucial supplement and not a substitute to the classic correspondence studies. The main drawback of our scenario-based setup is that employers are aware of being monitored, and the cost of not discriminating is zero as the decisions are hypothetical. Both phenomena may lower hiring discrimination, which turns our analysis into a conservative test of discrimination. Yet, existing literature indicates that responses from factorial survey experiments correspond with the responses that would have been given if the decisions were real[40]. In terms of relative strengths from manipulated applicant characteristics, our findings also align with the findings from correspondence studies in Western societies[5].

Meta-studies of correspondence studies have typically found limited differences across countries.[5] However, we recognize that discrimination might vary across countries, potentially limiting the ability to generalize our findings beyond Denmark. Denmark is a case that has ratified all UN-agreement on anti-discrimination and is obliged to follow EU-anti-discrimination laws. Additionally, the country has a major law in place since 1996 that prohibits discrimination against race, skin color, ethnicity, religion, political views, sexual orientation, and disability. Since the 1990s, shifting Danish governments and stakeholders such as highly organized unions and employers' organizations have promoted the idea of an inclusive labour market[41]. As such, the pronounced discrimination effects found in this study apply to a broad heterogeneous national labour market that potentially could have segments of employers interested in hiring those profiles that "mainstream" employers may avoid. Consequently, we would perceive Denmark as one of the least likely cases of labour market discrimination; i.e. other countries will likely face similar or greater challenges in securing inclusive labour markets.

Method

The factorial survey experiment was conducted online between October to December 2022 to a

representative sample of Danish workplaces with five or more employees at the time of survey participation. The sample was stratified by the size of the workplace and industry and drawn from the Central Company Register (CVR), where each company in Denmark has a unique identification number. We sampled the employers at the workplace level, which refers to a unit located at one address. Thus, the workplace can be an organizationally delimited part of a larger company. The survey was answered by either the owner of the workplace (26 %), the chief executive officer (24 %), the department manager (17 %), the person responsible for human resource management (19 %), or others (13 %). A total of 5,017 employers completed the survey, which generated a response rate of 25,1 %. This response rate is modest compared to individual surveys but is similar to other surveys conducted at the organizational level, where response rates typically range from 20% to 30% [42,43]. During data collection, the employers received reminders to complete the survey through telephone, e-mails, and letters to increase the response rates. We conducted the factorial survey experiment as part of a more extensive survey about managing an ageing workforce.

In our scenario-based setup, the employers were shown two randomized job applicants at once, followed by an additional screen with two randomized job applicants. Thus, employers evaluated 20,068 job applicants (4 x 5017). The employers were met with the following introduction: *"Imagine a situation where you were to hire a new employee. In the following, we will show you two applicants that you are to assess. After that, we will show you two additional applicants. All applicants have the formal competencies to conduct the workplace's core task".* For each job applicant, we asked. *"How likely is it on a scale from 0 to 10 that you will hire applicant [number]? 0 indicating "very unlikely" and 10 indicating "very likely."* Subsequently, we asked the employer to choose between the two applicants: *"Who would you choose if you were to choose one of these two applicants?"* We randomized the job applicants over the following characteristics, see Table 1:

Table 1. Characteristics of job applicant vignettes,

Characteristic	Categories
Gender	Male/Female
Age	45 years-old / 55 years-old / 60 years-old / 65 years-old / 70 years-old / 75 years old
Ethnicity	Christian background / Hindu background / Muslim background
Employment status	Currently employed / Have not had employment past 3 months / Have not had employment past 18 months
Preferences for working full-time	Preference for working full-time / preference for working less than full-time.

We also randomized the order of the characteristics such that the employers were not met with the categories in the same order. As a result of this design, we have 216 different combinations of job profiles.

For the age variable, we chose an age bracket covering individuals between 45 and 75 years old. We selected the middle-aged and older segments of the working population, as previous literature suggests that age discrimination in hiring processes tends to increase with age [6,13,19]. Additionally, this age bracket included applicants below and above the statutory retirement age (age 67). Employment after the statutory retirement age is considered a suitable way to increase labour supply among older retirees due to ageing populations [44], but it remains largely unknown how employers assess older retired applicants compared to other older but not yet retired applicants. For ethnicity, we distinguish between Christian, Hindu, and Muslim backgrounds. We use a religious-based categorization due to the significant impact of religious differences as a social factor that hinders integration in Europe and is subject to discrimination. This categorization is in contrast to race-based categorization, which is highly salient in the American context[45].

Information on the age and gender of the employer was received from questions in the survey, where we asked, *"How old are you?"* and *"What is your gender?"*. We obtained information on workplace type through the question, *"Which of the following core task is dominating at your workplace?"* with four categories 1) Office work, administration, analysis, information technology, and the like were labeled information work, 2) Working with humans, service and care were labeled welfare work, 3) Working with processing, producing, or moving objects were labeled production work and 4) Other.

We performed the analysis with ordinary least squares regression to estimate hireability scores and linear probability models to estimate whether the employer selected a specific job applicant. The hireability score is equivalent to the Likert scale employers use to assess job applicants and ranges from 0 to 10, where 0 indicates very unlikely to hire and 10 indicates very likely to hire. We use clustered standard errors on the employer level in all models to correct for heteroscedasticity due to employer-specific characteristics. We included interaction terms between two or more characteristics to test whether the applicants' employment opportunities depended on the combination of various characteristics. We use weights based on industry, workplace size, and region to correct for selection. All analyses were performed in STATA version 17. Our preregistration can be accessed here: https://osf.io/xkury?view_only=328e71380483460bbcbd9414895ecfcf

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Extended Data

Labour Market Discrimination: Relative, additive, and multiplicative effects

Table 1. The effects of applicant characteristics on hireability scores and the likelihood of being selected.

	Hireability scores	Se	Likelihood of being selected	Se
Male	0.000	(.)	0.000	(.)
Female	-0.109*	(0.051)	-0.001	(0.008)
45 years	0.000	(.)	0.000	(.)
55 years	-0.187*	(0.086)	-0.017	(0.013)
60 years	-0.787***	(0.089)	-0.092***	(0.013)
65 years	-1.569***	(0.090)	-0.161***	(0.013)
70 years	-2.656***	(0.088)	-0.343***	(0.013)
75 years	-3.196***	(0.085)	-0.439***	(0.012)
Christian background	0.000	(.)	0.000	(.)
Hindu background	-0.621***	(0.060)	-0.025**	(0.009)
Muslim background	-0.771***	(0.061)	-0.055***	(0.009)
Employed	0.000	(.)	0.000	(.)
Unemployed for 3 months	-0.565***	(0.063)	-0.063***	(0.009)
Unemployed for 18 months	-1.178***	(0.063)	-0.207***	(0.010)
Preference full-time	0.000	(.)	0.000	(.)
Less than full-time	-0.589***	(0.052)	-0.087***	(0.008)
Constant	6.949***	(0.090)	0.837***	(0.012)
Observations	20068		20068	

Note: Standard errors in parentheses * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table 2. The effects of applicant characteristics on hireability scores and the likelihood of being selected with interaction terms between age and unemployment.

	Hireability scores	Se	Likelihood of being selected	Se
Male	0.000	(.)	0.000	(.)
Female	-0.104*	(0.051)	-0.000	(0.008)
Preference full-time	0.000	(.)	0.000	(.)
Less than full-time	-0.591***	(0.052)	-0.087***	(0.008)
Christian background	0.000	(.)	0.000	(.)
Hindu background	-0.621***	(0.060)	-0.025**	(0.009)
Muslim background	-0.768***	(0.061)	-0.055***	(0.009)
Employed	0.000	(.)	0.000	(.)
Unemployed for 3 months	-0.768***	(0.143)	-0.068**	(0.021)
Unemployed for 18 months	-1.621***	(0.145)	-0.224***	(0.022)
45 years	0.000	(.)	0.000	(.)
55 years	-0.256	(0.144)	-0.016	(0.021)
60 years	-1.006***	(0.152)	-0.086***	(0.022)
65 years	-1.810***	(0.151)	-0.177***	(0.023)
70 years	-2.879***	(0.152)	-0.354***	(0.022)
75 years	-3.750***	(0.143)	-0.463***	(0.022)
Unemployed for 3 months # 45 years	0.000	(.)	0.000	(.)
Unemployed for 3 months # 55 years	0.064	(0.209)	0.003	(0.031)
Unemployed for 3 months # 60 years	0.284	(0.210)	-0.002	(0.032)
Unemployed for 3 months # 65 years	0.263	(0.205)	0.038	(0.032)
Unemployed for 3 months # 70 years	0.018	(0.207)	-0.008	(0.032)
Unemployed for 3 months # 75 years	0.580**	(0.196)	-0.003	(0.030)
Unemployed for 18 months # 45 years	0.000	(.)	0.000	(.)
Unemployed for 18 months # 55 years	0.135	(0.210)	-0.007	(0.032)
Unemployed for 18 months # 60 years	0.369	(0.211)	-0.017	(0.032)
Unemployed for 18 months # 65 years	0.446*	(0.209)	0.009	(0.033)
Unemployed for 18 months # 70 years	0.638**	(0.201)	0.040	(0.031)
Unemployed for 18 months # 75 years	1.076***	(0.191)	0.075*	(0.030)
Constant	7.165***	(0.116)	0.844***	(0.016)
Observations	20068		20068	

Note: Standard errors in parentheses * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table 3. The effects of applicant characteristics on hireability scores and the likelihood of being selected with interaction terms between age and preference for full-time.

	Hireability scores	Se	Likelihood of being selected	Se
Male	0.000	(.)	0.000	(.)
Female	-0.106*	(0.051)	-0.001	(0.008)
Preference full-time	0.000	(.)	0.000	(.)
Less than full-time	-1.036***	(0.124)	-0.138***	(0.018)
45 years	0.000	(.)	0.000	(.)
55 years	-0.265*	(0.119)	-0.033	(0.018)
60 years	-1.076***	(0.125)	-0.119***	(0.018)
65 years	-1.841***	(0.127)	-0.185***	(0.018)
70 years	-2.966***	(0.124)	-0.390***	(0.018)
75 years	-3.601***	(0.117)	-0.481***	(0.017)
Less than full-time # 45 years	0.000	(.)	0.000	(.)
Less than full-time # 55 years	0.150	(0.171)	0.032	(0.026)
Less than full-time # 60 years	0.577***	(0.174)	0.053*	(0.026)
Less than full-time # 65 years	0.537**	(0.171)	0.047	(0.026)
Less than full-time # 70 years	0.613***	(0.168)	0.093***	(0.026)
Less than full-time # 75 years	0.805***	(0.165)	0.083***	(0.025)
Christian background	0.000	(.)	0.000	(.)
Hindu background	-0.623***	(0.060)	-0.025**	(0.009)
Muslim background	-0.770***	(0.061)	-0.055***	(0.009)
Employed	0.000	(.)	0.000	(.)
Unemployed for 3 months	-0.564***	(0.063)	-0.063***	(0.009)
Unemployed for 18 months	-1.181***	(0.063)	-0.207***	(0.010)
Constant	7.174***	(0.104)	0.863***	(0.014)
Observations	20068		20068	

Note: Standard errors in parentheses * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table 4. The effects of applicant characteristics on hireability scores and the likelihood of being selected with interaction terms between gender, age, and cultural background.

	Hireability scores	Se	Likelihood of being selected	Se
Male	0.000	(.)	0.000	(.)
Female	-0.002	(0.203)	-0.016	(0.030)
45 years	0.000	(.)	0.000	(.)
55 years	-0.173	(0.208)	-0.047	(0.032)
60 years	-1.070***	(0.206)	-0.075*	(0.031)
65 years	-1.416***	(0.217)	-0.169***	(0.033)
70 years	-2.782***	(0.206)	-0.404***	(0.031)
75 years	-3.403***	(0.199)	-0.446***	(0.030)
Female # 45 years	0.000	(.)	0.000	(.)
Female # 55 years	-0.324	(0.290)	0.041	(0.043)
Female # 60 years	0.109	(0.300)	-0.005	(0.045)
Female # 65 years	-0.331	(0.291)	0.001	(0.046)
Female # 70 years	-0.262	(0.291)	0.081	(0.045)
Female # 75 years	-0.192	(0.280)	-0.006	(0.043)
Christian background	0.000	(.)	0.000	(.)
Hindu background	-0.722***	(0.206)	-0.037	(0.030)
Muslim background	-1.086***	(0.202)	-0.083**	(0.031)
Female # Christian background	0.000	(.)	0.000	(.)
Female # Hindu background	-0.260	(0.285)	0.009	(0.044)
Female # Muslim background	0.150	(0.288)	0.040	(0.043)
55 years # Christian background	0.000	(.)	0.000	(.)
55 years # Hindu background	0.005	(0.293)	0.038	(0.044)
55 years # Muslim background	0.112	(0.296)	0.023	(0.046)
60 years # Christian background	0.000	(.)	0.000	(.)
60 years # Hindu background	0.445	(0.292)	-0.039	(0.045)
60 years # Muslim background	0.329	(0.290)	-0.013	(0.045)
65 years # Christian background	0.000	(.)	0.000	(.)
65 years # Hindu background	-0.163	(0.295)	0.038	(0.045)
65 years # Muslim background	0.003	(0.295)	0.024	(0.046)
70 years # Christian background	0.000	(.)	0.000	(.)
70 years # Hindu background	0.158	(0.278)	0.072	(0.044)
70 years # Muslim background	0.288	(0.287)	0.111*	(0.045)
75 years # Christian	0.000	(.)	0.000	(.)

background				
75 years # Hindu background	0.222	(0.269)	-0.006	(0.042)
75 years # Muslim background	0.602*	(0.276)	0.029	(0.043)
Female # 55 years # Christian background	0.000	(.)	0.000	(.)
Female # 55 years # Hindu background	0.438	(0.411)	-0.052	(0.062)
Female # 55 years # Muslim background	0.218	(0.423)	-0.016	(0.062)
Female # 60 years # Christian background	0.000	(.)	0.000	(.)
Female # 60 years # Hindu background	-0.176	(0.422)	0.027	(0.065)
Female # 60 years # Muslim background	-0.025	(0.443)	-0.014	(0.064)
Female # 65 years # Christian background	0.000	(.)	0.000	(.)
Female # 65 years # Hindu background	0.382	(0.414)	-0.035	(0.065)
Female # 65 years # Muslim background	0.020	(0.417)	-0.046	(0.064)
Female # 70 years # Christian background	0.000	(.)	0.000	(.)
Female # 70 years # Hindu background	0.391	(0.400)	-0.099	(0.064)
Female # 70 years # Muslim background	0.244	(0.408)	-0.143*	(0.064)
Female # 75 years # Christian background	0.000	(.)	0.000	(.)
Female # 75 years # Hindu background	0.414	(0.387)	0.050	(0.061)
Female # 75 years # Muslim background	-0.231	(0.391)	-0.035	(0.060)
Employed	0.000	(.)	0.000	(.)
Unemployed for 3 months	-0.565***	(0.063)	-0.063***	(0.009)
Unemployed for 18 months	-1.174***	(0.063)	-0.207***	(0.010)
Preference full-time	0.000	(.)	0.000	(.)
Less than full-time	-0.587***	(0.052)	-0.087***	(0.008)
Constant	7.053***	(0.153)	0.850***	(0.022)
Observations	20068		20068	

Note: Standard errors in parentheses * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table 5. Marginal effects with 95 % confidence intervals based on full models with interaction between all job applicant characteristics.

	Hireability scores	Likelihood of being selected
Female, 75, Muslim, Unemployed 18 months, Prefer not F-T	1.626	0.072
	[1.159;2.093]	[0.009;0.134]
Female, 75, Muslim, Unemployed 18 months, Prefer F-T	1.858	0.156
	[1.285;2.430]	[0.059;0.253]
Female, 65, Muslim, Unemployed 18 months, Prefer F-T	3.042	0.312
	[2.301;3.783]	[0.205;0.420]
Female, 60, Hindu, Unemployed 18 months, Prefer F-T	4.175	0.514
	[3.376;4.973]	[0.397;0.630]
Female, 60, Hindu, Employed, Prefer F-T	5.504	0.778
	[4.665;6.342]	[0.677;0.879]
Male, 60, Christian, Employed, Prefer F-T	5.939	0.780
	[5.154;6.723]	[0.691;0.869]
Male, 60, Christian, Employed, Prefer F-T	7.530	0.905
	[6.900; 8.158]	[0.834;0.973]
Observations	20068	20068

Table 6. The effects of applicant characteristics on hireability scores and the likelihood of being selected with interaction terms between employer age and applicant age.

	Hireability scores	Se	Likelihood of being selected	Se
Male applicant	0.000	(.)	0.000	(.)
Female applicant	-0.116*	(0.052)	0.001	(0.008)
Employer age 21-47	0.000	(.)	0.000	(.)
Employer age 48-54	-0.409*	(0.190)	0.002	(0.024)
Employer age 55-59	-0.424*	(0.187)	-0.012	(0.024)
Employer age 60+	-0.245	(0.189)	-0.024	(0.024)
45 years	0.000	(.)	0.000	(.)
55 years	-0.360*	(0.174)	-0.033	(0.026)
60 years	-0.836***	(0.190)	-0.129***	(0.028)
65 years	-1.257***	(0.185)	-0.164***	(0.026)
70 years	-2.543***	(0.187)	-0.353***	(0.025)
75 years	-3.144***	(0.175)	-0.448***	(0.025)
Employer age 48-54# 45 years	0.000	(.)	0.000	(.)
Employer age 48-54# 55 years	0.318	(0.243)	0.011	(0.037)
Employer age 48-54# 60 years	0.003	(0.264)	0.038	(0.039)
Employer age 48-54# 65 years	-0.486	(0.250)	-0.038	(0.038)
Employer age 48-54# 70 years	0.027	(0.262)	0.003	(0.037)
Employer age 48-54# 75 years	-0.002	(0.247)	0.002	(0.035)
Employer age 55-59# 45 years	0.000	(.)	0.000	(.)
Employer age 55-59# 55 years	0.424	(0.252)	0.014	(0.038)
Employer age 55-59# 60 years	0.188	(0.257)	0.050	(0.039)
Employer age 55-59# 65 years	-0.235	(0.262)	0.007	(0.038)
Employer age 55-59# 70 years	-0.255	(0.253)	0.012	(0.037)
Employer age 55-59# 75 years	-0.180	(0.246)	0.015	(0.036)
Employer age 60+#45 years	0.000	(.)	0.000	(.)
Employer age 60+#55 years	-0.001	(0.250)	0.032	(0.037)
Employer age 60+#60 years	-0.002	(0.260)	0.052	(0.039)
Employer age 60+#65 years	-0.552*	(0.264)	0.028	(0.038)
Employer age 60+#=4 # 70 years	-0.253	(0.257)	0.017	(0.037)
Employer age 60+#=4 #	-0.115	(0.245)	0.007	(0.036)

75 years				
Christian background	0.000	(.)	0.000	(.)
Hindu background	-0.608***	(0.061)	-0.025**	(0.009)
Muslim background	-0.780***	(0.062)	-0.054***	(0.009)
Employed	0.000	(.)	0.000	(.)
Unemployed for 3 months	-0.595***	(0.064)	-0.065***	(0.010)
Unemployed for 18 months	-1.211***	(0.064)	-0.211***	(0.010)
Preference full-time	0.000	(.)	0.000	(.)
Less than full-time	-0.585***	(0.053)	-0.086***	(0.008)
Constant	7.238***	(0.149)	0.848***	(0.019)
Observations	18952		18952	

Note: Standard errors in parentheses * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Employer age is divided into quartiles. Employers with missing age values are excluded.

Table 7. The effects of applicant characteristics on hireability scores and the likelihood of being selected with interaction terms between employer gender and applicant gender.

	Hireability scores	Se	Likelihood of being selected	Se
Male applicant	0.000	(.)	0.000	(.)
Female applicant	0.033	(0.071)	0.010	(0.011)
Female employer	0.000	(.)	0.000	(.)
Male employer	-0.263**	(0.090)	0.010	(0.009)
Female applicant # Female employer	0.000	(.)	0.000	(.)
Female applicant # Male employer	-0.303**	(0.102)	-0.024	(0.016)
45 years	0.000	(.)	0.000	(.)
55 years	-0.198*	(0.086)	-0.017	(0.013)
60 years	-0.802***	(0.088)	-0.093***	(0.013)
65 years	-1.596***	(0.089)	-0.162***	(0.013)
70 years	-2.670***	(0.088)	-0.343***	(0.013)
75 years	-3.208***	(0.085)	-0.441***	(0.012)
Christian background	0.000	(.)	0.000	(.)
Hindu background	-0.637***	(0.060)	-0.025**	(0.009)
Muslim background	-0.784***	(0.061)	-0.056***	(0.009)
Employed	0.000	(.)	0.000	(.)
Unemployed for 3 months	-0.581***	(0.063)	-0.063***	(0.009)
Unemployed for 18 months	-1.191***	(0.063)	-0.207***	(0.010)
Preference full-time	0.000	(.)	0.000	(.)
Less than full-time	-0.587***	(0.052)	-0.087***	(0.008)
Constant	7.099***	(0.101)	0.833***	(0.013)
Observations	19964		19964	

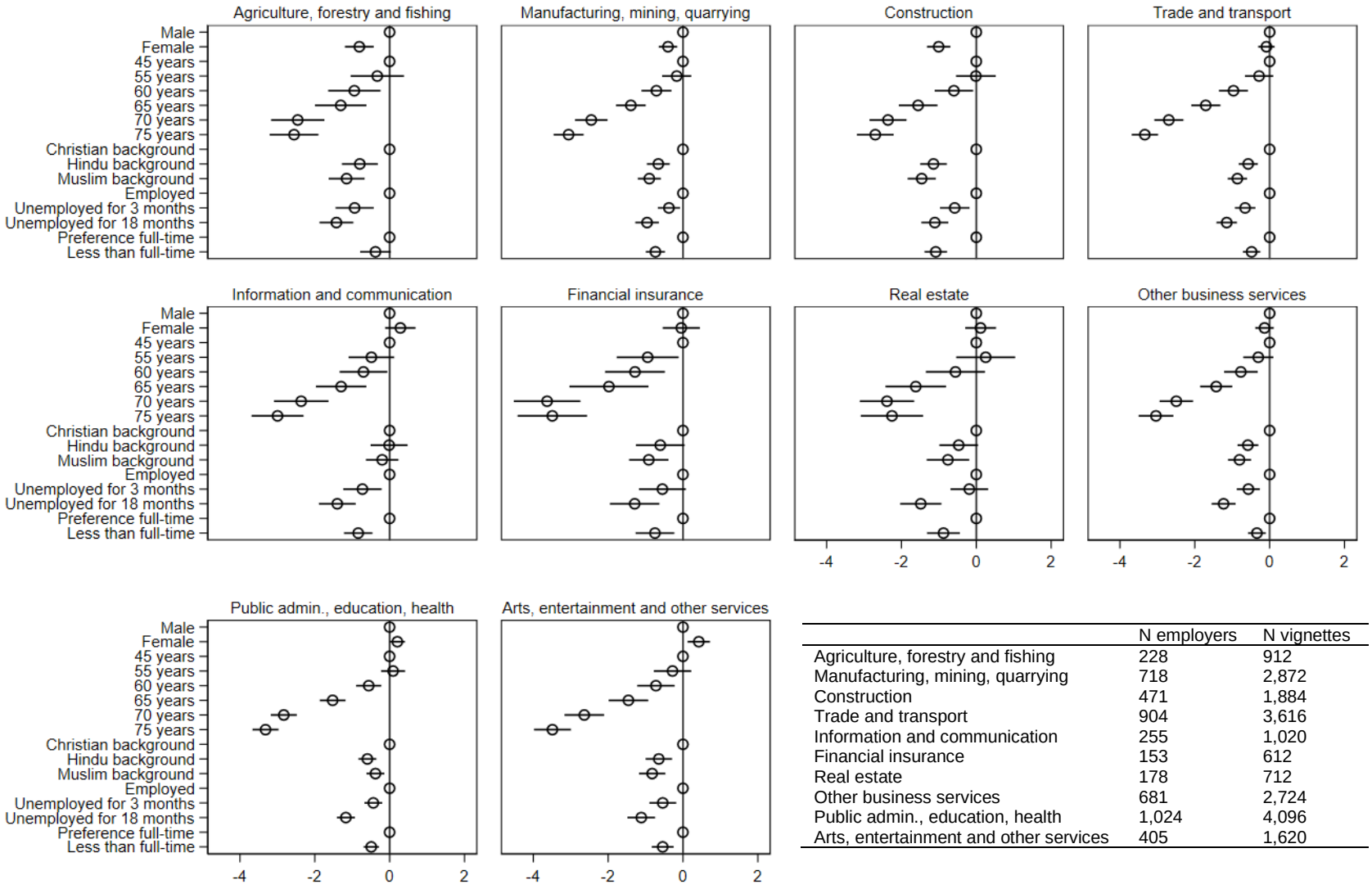
Note: Standard errors in parentheses * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Gender category "other" excluded.

Table 8. The effects of applicant characteristics on hireability scores and the likelihood of being selected with interaction terms between workplace and applicant gender.

	Hireability score	Se	Likelihood of being selected	Se
Information work	0.000	(.)	0.000	(.)
Welfare work	-0.394***	(0.113)	-0.010	(0.011)
Production work	-0.354**	(0.113)	0.053***	(0.011)
Other	-0.779***	(0.145)	0.036**	(0.013)
Male applicant	0.000	(.)	0.000	(.)
Female applicant	0.003	(0.083)	0.026	(0.014)
Welfare work # Male applicant	0.000	(.)	0.000	(.)
Welfare work # Female applicant	0.194	(0.126)	0.021	(0.020)
Production work # Male applicant	0.000	(.)	0.000	(.)
Production work # Female applicant	-0.603***	(0.132)	-0.106***	(0.021)
Other # Male applicant	0.000	(.)	0.000	(.)
Other # Female applicant	-0.206	(0.169)	-0.061*	(0.025)
45 years	0.000	(.)	0.000	(.)
55 years	-0.182*	(0.086)	-0.018	(0.013)
60 years	-0.775***	(0.088)	-0.092***	(0.013)
65 years	-1.562***	(0.089)	-0.162***	(0.013)
70 years	-2.659***	(0.088)	-0.343***	(0.013)
75 years	-3.188***	(0.084)	-0.439***	(0.012)
Christian background	0.000	(.)	0.000	(.)
Hindu background	-0.634***	(0.059)	-0.025**	(0.009)
Muslim background	-0.776***	(0.060)	-0.056***	(0.009)
Employed	0.000	(.)	0.000	(.)
Unemployed for 3 months	-0.564***	(0.062)	-0.064***	(0.009)
Unemployed for 18 months	-1.171***	(0.063)	-0.208***	(0.010)
Preference full-time	0.000	(.)	0.000	(.)
Less than full-time	-0.583***	(0.052)	-0.087***	(0.008)
Constant	7.263***	(0.105)	0.823***	(0.014)
Observations	20068		20068	

Note: Standard errors in parentheses * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Figure 1. The effects of applicant characteristics on hireability scores separated by industry.



	N employers	N vignettes
Agriculture, forestry and fishing	228	912
Manufacturing, mining, quarrying	718	2,872
Construction	471	1,884
Trade and transport	904	3,616
Information and communication	255	1,020
Financial insurance	153	612
Real estate	178	712
Other business services	681	2,724
Public admin., education, health	1,024	4,096
Arts, entertainment and other services	405	1,620

Figure 2. The effects of applicant characteristics on the likelihood of being selected by industry.

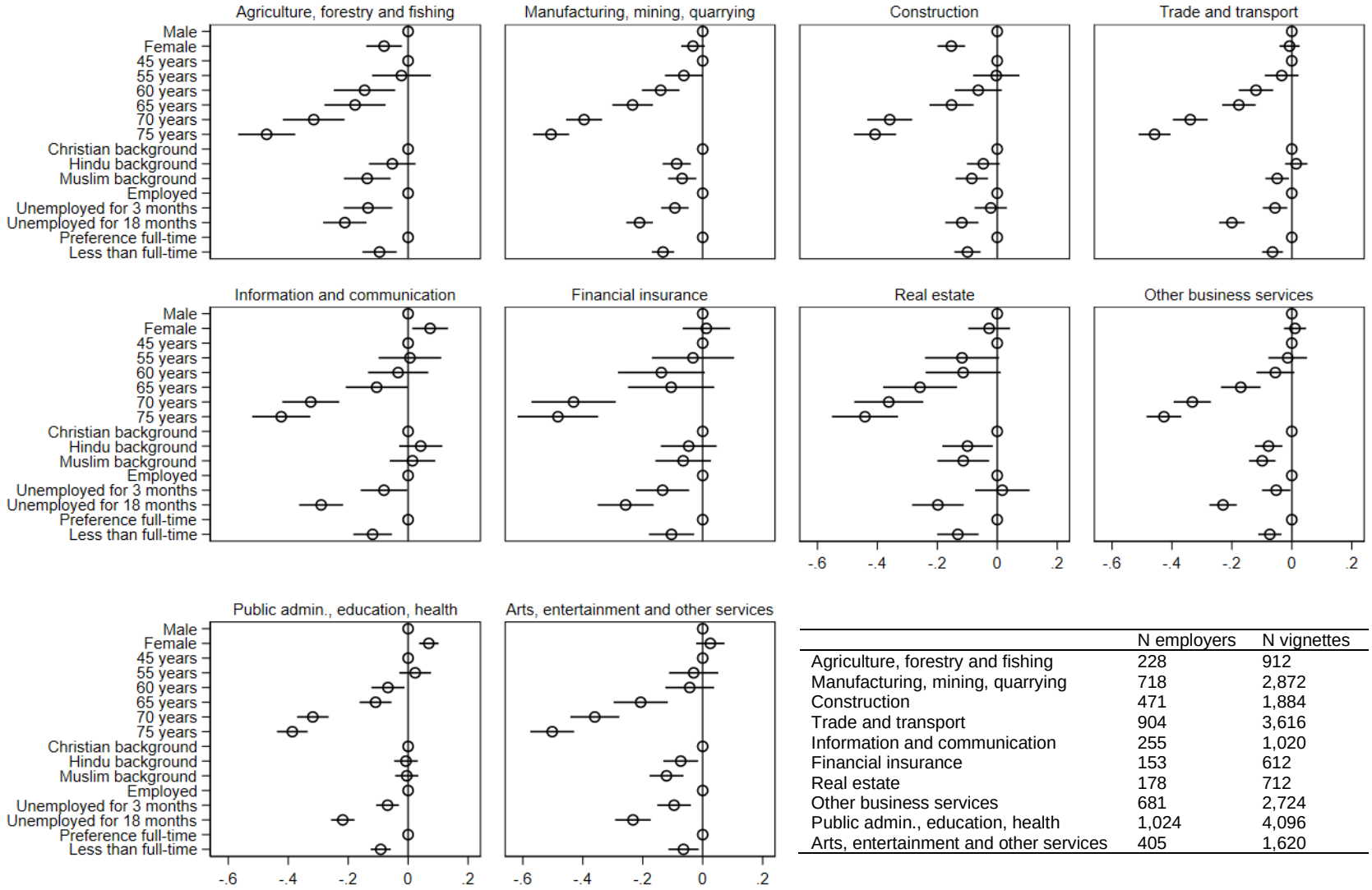


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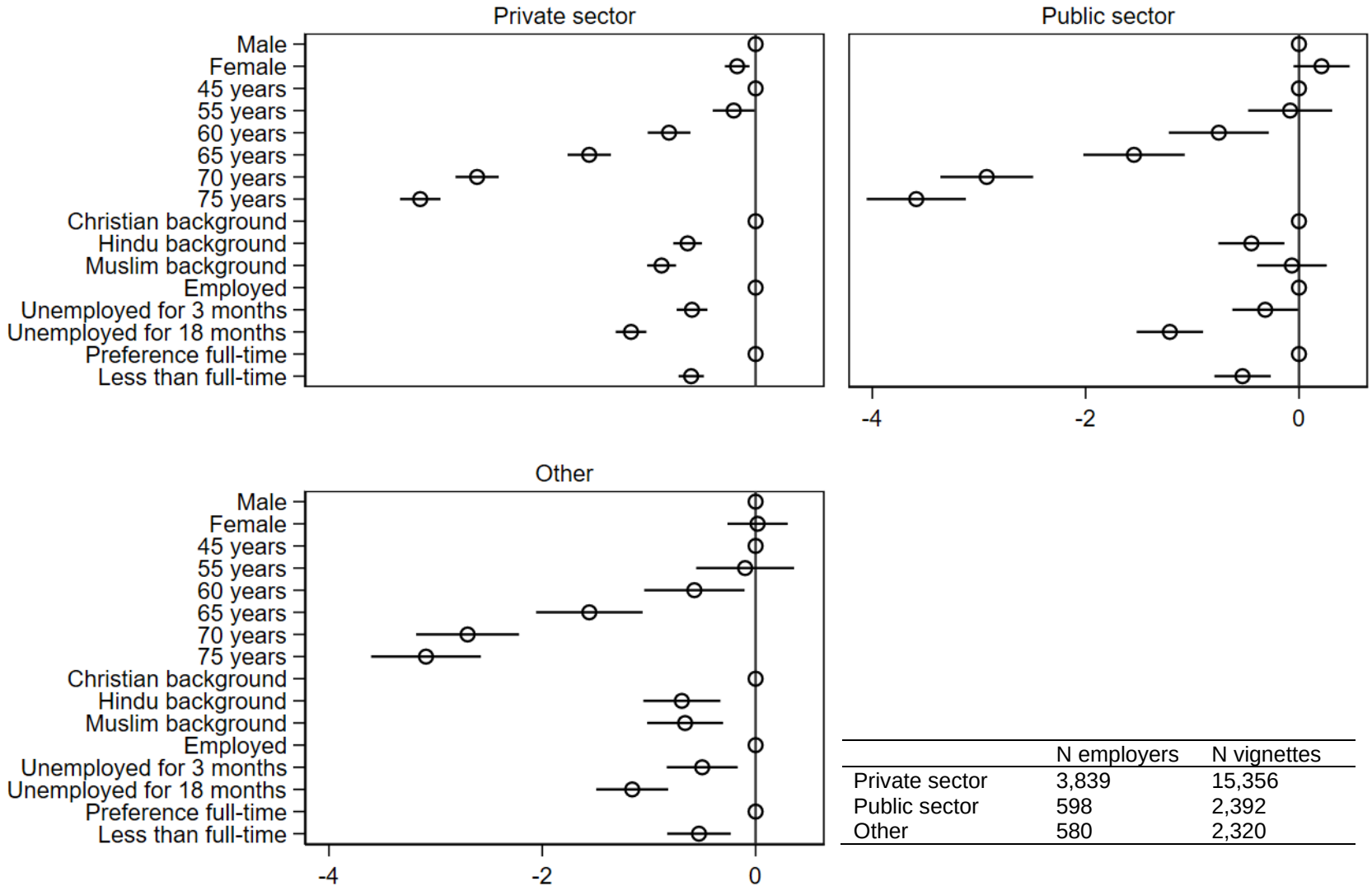
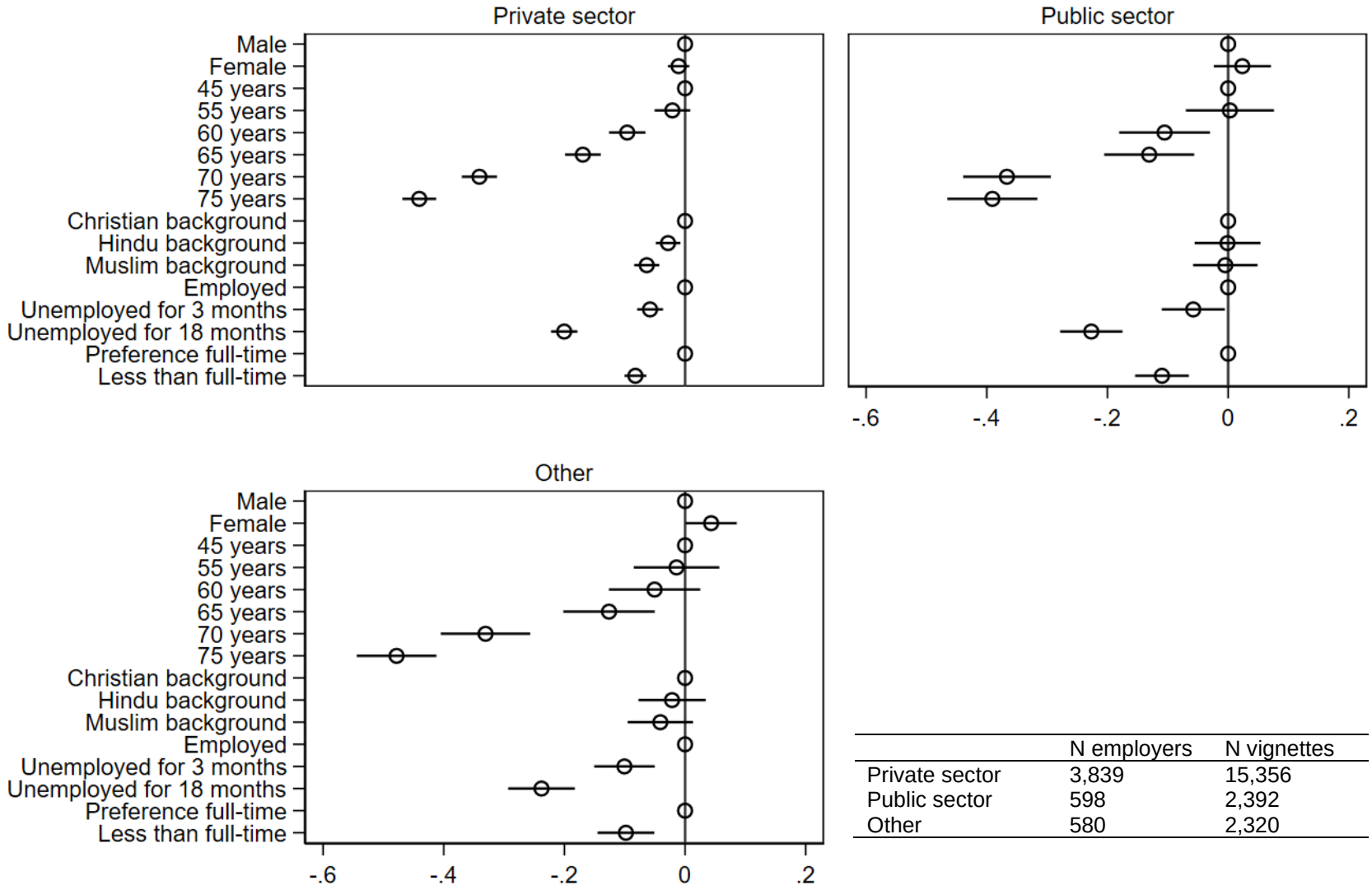
Figure 3. The effects of applicant characteristics on hireability scores separated by sector.



	N employers	N vignettes
Private sector	3,839	15,356
Public sector	598	2,392
Other	580	2,320

Figure 4. The effects of applicant characteristics on the likelihood of being selected by sector.



	N employers	N vignettes
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Public sector	598	2,392
Other	580	2,320