# Online Appendix

This document contains supplemental material to the paper

Neugebauer, M., Heisig, J. P., & Bol, T. (2025). What does successful university graduation signal to employers? A factorial survey experiment on sheepskin effects. *European Sociological Review*.

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# Appendix A: Sampling and representativeness

### *Job titles*

**Table A1.** ISCO-08 codes and job titles for which the hiring was made

| Field | ISCO-08 | Job title |
|---|---|---|
| IT | 2511 | • Computer scientist (HE degree) with a focus on system integration |
| | 2512 | • Computer scientist (HE degree) with a focus on software development |
| Business | 2411 | • Controller<br>• Financial analyst<br>• Insurance operations manager |
| | 2412 | • Fund manager<br>• Portfolio manager<br>• Investment advisor<br>• Underwriter |

### *Comparison of respondents and non-respondents*

We checked whether respondents differed from employers who were invited to the survey but did not participate, based on the information available in the job advertisements (see Table A2). The marginal distributions of most variables are very similar. Smaller firms are slightly overrepresented among respondents as well as employers offering IT (as opposed to business) positions. Both characteristics are included as controls in all models in the analysis, although removing these covariates does not change our substantive findings.

**Table A2.** Comparison of respondents and non-respondents (in %)

| | non-respondents | respondents |
|---|---|---|
| Female recruiter | 62.37 | 62.42 |
| Firm size | | |
| 0-49 employees | 34.29 | 46.59 |
| 50-499 employees | 46.72 | 40.34 |
| ≥ 500 employees | 18.99 | 13.07 |
| IT jobs (vs. business jobs) | 49.58 | 54.03 |
| Sector | | |
| industry | 10.36 | 11.29 |
| market services | 75.53 | 77.82 |
| non-market services | 14.11 | 10.89 |
| Based in (population) | | |
| rural community (< 5,000) | 3.48 | 1.94 |
| small town (5,000-19,999) | 11.53 | 14.19 |
| medium sized town (20,000-99,999) | 21.19 | 23.87 |
| big city (> 100,000) | 63.80 | 60.00 |
| West Germany (vs. East Germany incl. Berlin) | 83.12 | 80.06 |

*Note:* The information in this table is based on details from the N = 4,000 job postings collected from job platforms, whereas the analyses in the main article rely on data provided by the survey respondents. In some cases, employers have provided different information—for example, in firm size—so the values do not match those reported in Table 2 in the main article. The values in Table A2 are based on non-imputed variables.

## Appendix B: Further details on the experimental design

**Figure A1.** Example of job offer priming (HE graduate position in IT)

### *Vignette dimensions and levels*

We designed the dimensions of the vignettes based on a combination of theoretical considerations and practical insights gained from a pre-study. The pre-study involved a thorough examination of real-life applications and in-depth qualitative interviews with employers and job counselors. Here we elaborate on the reasoning behind our choices regarding the levels of these dimensions.

(1) *Education:* Time of leaving higher education (HE) was varied between an early discontinuation in the 2nd semester, indicating a short study episode, and late discontinuation in the 6th semester, which equals the standard period of study. The de facto median time to obtain a bachelor's degree in Germany is between 7 and 8 semesters (Autorengruppe Bildungsberichterstattung 2020: 195). 47% of dropouts leave higher education in the first two semesters, but for 13% this takes seven semesters or longer (Heublein et al. 2017). 6 semesters is realistic for both graduates who finish their degree on time and for non-completers who drop out rather late.

(2) For *academic performance (GPA) in university* we chose as levels the first and third quartile of the grade distribution (that in Germany ranges from "1.0 – very good" to "4.0 – sufficient"), indicating applicants' good (1.7) or bad (3.3) academic performance.

(3) *Practical experiences* were signaled via a job-relevant three-month internship (yes/no) which had been completed either in an IT-company or credit institution/bureau, depending on the occupational field. Duration of the internship was fixed at three months as it has been shown

that short-term internships (e.g. for only one moth) are not considered by employers as relevant for applicants' hiring chances (Piopiunik et al. 2020).

(4) When applying for IT jobs, *informally acquired skills* were indicated by using a scripting language to create modifications for video games or running a server for an internet community, depending on the specific occupation (i.e. software development vs. system integration, see Table A1). When applying for business jobs, informally acquired skills were signaled by advising family members on trading in stocks (for occupations in the area of financial consulting) or helping family members to check insurance contracts (for occupations in the area of insurance).

(5) *Fitting course specialization*: When screening real-world vacancies we observed that firms expect skills and knowledge in certain areas within a field of study. In our IT occupations, a common specialization was operating systems vs. software development, and in business occupations it was financial vs. insurance services. A distinction between these specific course specializations, thus, seemed relevant in practice. While high fit was given by a perfect match between course specialization in college and job description, low fit was described as a mismatched course specialization within a fitting field of study (e.g., computer sciences studies with focus on operating systems when applying for a job as computer science expert in software development as opposed to operating systems).

(6) With regard to *English language skills*, we differentiated two levels, namely intermediate (B2) and proficient (C1) language skills in accordance with prior studies (e.g. Piopiunik et al. 2020).

(7) *International experience* was varied by having studied abroad for one semester (yes/no).

(8) *Academic performance (GPA) in school* was varied by the grade values that mark the first and third quartile of the empirical distribution of upper secondary school leavers in Germany (KMK 2016). A GPA of 1.7 indicated a good academic performance, while a GPA of 3.3 described a bad academic performance.

(9) *First names* are connoted with social background, as one of our pre-studies showed, and may thus evoke reactions that could influence the evaluation of applicants. To keep those influences under control, we selected German first names which have been shown to be associated either with lower class or middle class. Lower class names comprised 'Justin', 'Kevin', 'Pascal' and 'Steven', whereas 'Jakob', 'Felix', 'Konstantin' and 'Julius' represented middle class names. Applicants' last name was randomly sampled from a list of the 100 most common family names in Germany.

### *Pairwise correlations between vignette dimensions*

**Table A3.** Pairwise correlations between vignette dimensions

| | | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
|---|---|---|---|---|---|---|---|---|---|---|
| (1) | Education | 1 | | | | | | | | |
| (2) | GPA college | 0.02 | 1 | | | | | | | |
| (3) | Internship | -0.01 | -0.02 | 1 | | | | | | |
| (4) | Informal skills | 0.00 | 0.00 | -0.01 | 1 | | | | | |
| (5) | Matching study focus | 0.00 | **-0.04** | 0.01 | **0.04** | 1 | | | | |
| (6) | Abroad experience | 0.00 | -0.02 | -0.01 | -0.01 | -0.01 | 1 | | | |
| (7) | English skills | 0.01 | -0.01 | 0.01 | -0.01 | -0.01 | -0.01 | 1 | | |
| (8) | GPA high school | 0.00 | -0.03 | 0.01 | 0.01 | -0.01 | 0.01 | -0.01 | 1 | |
| (9) | First name | 0.00 | 0.02 | 0.00 | 0.00 | 0.00 | 0.02 | 0.01 | 0.00 | 1 |

*Note*: *N*=335 employers, 2680 vignettes. Significant coefficients ($p < .05$) are in bold.

# Appendix C: Additional results

## *Full model results for baseline specifications*

### Table A4. Full model results underlying Table 3 in main article

| | Invitation probability | | Annual starting wage | |
|---|---|---|---|---|
| | Coefficient estimate | Standard error | Coefficient estimate | Standard error |
| **Graduation/dropout status** | | | | |
| (Ref: Degree completed) | | | | |
| Non-completers (6 semesters) | -28.95*** | (1.31) | -5855.15*** | (275.80) |
| Non-completers (2 semesters) | -39.03*** | (1.40) | -7886.87*** | (341.06) |
| **High school GPA** | | | | |
| (Ref: Bad [2.9]) | | | | |
| Good (1.8) | 1.68** | (0.64) | 193.13 | (166.96) |
| **University GPA** | | | | |
| (Ref: Bad [2.3]) | | | | |
| God (1.7) | 8.21*** | (0.62) | 847.24*** | (153.15) |
| **Job-relevant internship** | | | | |
| (Ref. None) | | | | |
| 3-month internship | 6.10*** | (0.61) | 737.40*** | (156.86) |
| **Informally acquired skills** | | | | |
| (Ref: None) | | | | |
| Programming/stock consulting[a] | 1.50* | (0.62) | 156.27 | (169.03) |
| **Match of study focus** | | | | |
| (Ref: low match quality) | | | | |
| High match quality | 1.39* | (0.60) | 56.98 | (160.34) |
| **English proficiency** | | | | |
| (Ref: Intermediate[B2]) | | | | |
| High (C1) | 0.12 | (0.60) | 108.35 | (152.46) |
| **Experience abroad** | | | | |
| (Ref: None) | | | | |
| One semester abroad | 1.96** | (0.60) | 454.54** | (160.05) |
| **Middle-class name** | | | | |
| (Ref: lower-class name) | | | | |
| Middle-class name | 0.41 | (0.66) | -129.71 | (145.47) |
| **Vignette set** | | | | |
| (Ref: Set #1) | | | | |
| #2 | 3.50 | (5.89) | 548.63 | (1645.06) |
| #3 | 2.70 | (5.90) | 2964.80 | (1678.35) |
| #4 | 6.64 | (5.68) | 131.65 | (1581.39) |
| #5 | -5.84 | (5.86) | -1950.80 | (1650.53) |
| #6 | 0.33 | (6.20) | 482.26 | (1729.08) |
| #7 | 1.81 | (5.74) | 513.48 | (1603.13) |
| #8 | 11.83* | (5.98) | 624.54 | (1665.19) |
| #9 | 9.44 | (5.67) | 2091.02 | (1604.25) |
| #10 | 5.60 | (5.99) | 510.16 | (1681.92) |
| #11 | 3.31 | (5.86) | 2254.10 | (1641.98) |
| #12 | 3.95 | (5.87) | 1067.82 | (1629.05) |
| #13 | 3.29 | (5.90) | 1992.31 | (1658.74) |
| #14 | 1.89 | (5.74) | 3397.75* | (1601.55) |
| #15 | 3.87 | (5.95) | 4645.79** | (1694.28) |
| #16 | 10.39 | (5.99) | 973.44 | (1666.20) |

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**Table A4 continued**

| | | | | |
|---|---|---|---|---|
| **Vignette position** | | | | |
| (Ref: 1st) | | | | |
| 2nd | 1.94 | (1.28) | -315.17 | (297.98) |
| 3rd | 4.71*** | (1.30) | -227.38 | (309.34) |
| 4th | 3.37** | (1.28) | -374.83 | (300.90) |
| 5th | 5.69*** | (1.25) | -463.84 | (327.76) |
| 6th | 6.67*** | (1.32) | -360.82 | (300.32) |
| 7th | 6.51*** | (1.27) | -344.42 | (321.89) |
| 8th | 8.03*** | (1.31) | -219.85 | (326.02) |
| **Difficulty filling positions** | 0.16 | (1.63) | 225.42 | (449.70) |
| **Number of employees** | | | | |
| (Ref: 0-49) | | | | |
| 50-499 | -0.45 | (2.90) | 465.93 | (790.46) |
| >=500 | 1.09 | (3.03) | 1371.16 | (847.13) |
| **Sector** | | | | |
| (Ref: Industry) | | | | |
| Market Services | 7.83* | (3.53) | -1228.65 | (981.27) |
| Non-Market Services | 3.33 | (3.60) | -809.36 | (1023.07) |
| **Occupational field** | | | | |
| (Ref: business) | | | | |
| IT | 15.75*** | (2.18) | 2079.02*** | (613.51) |
| **Constant** | 33.88*** | (7.44) | 36885.67*** | (2117.34) |
| ***N (vignettes)*** | 2680 | | 2680 | |
| ***N (employers)*** | 335 | | 335 | |

*Note*: Linear mixed models with random respondent-level random intercept and random slopes on the education (dropout) indicators. Only fixed effects are reported, random effects variances and covariances not shown. Ref=reference category. Difficulty filling positions was included as a continuous predictor taking the values 1 no suitable applicants, 2 – very few suitable applicants, 3 – few suitable applicants, 4 – many suitable applicants, 5 – very many suitable applicants. [a] skills mentioned depend on field. Standard errors in parentheses. * $p < .05$, ** $p < .01$, *** $p < .001$ (two-tailed).

*Results from models with two-way interactions between non-completer status and other applicant characteristics*

**Table A5. Selected coefficient estimates from models with two-way interactions between non-completer status and other applicant characteristics**

| | (1) School GPA | (2) University GPA | (3) Job-relevant internship | (4) Informally acquired skills | (5) Match of study focus | (6) English proficiency | (7) Experience abroad | (8) Middle-class name |
|---|---|---|---|---|---|---|---|---|
| **Graduation/dropout status** (Ref: Degree completed) | | | | | | | | |
| Non-completer (6 semesters) | -30.75*** | -26.06*** | -28.14*** | -29.27*** | -28.77*** | -28.37*** | -27.98*** | -29.12*** |
| | (1.53) | (1.52) | (1.50) | (1.53) | (1.47) | (1.56) | (1.54) | (1.52) |
| Non-completer (2 semesters) | -38.72*** | -35.74*** | -37.53*** | -39.12*** | -38.32*** | -38.86*** | -40.05*** | -38.57*** |
| | (1.58) | (1.65) | (1.57) | (1.60) | (1.57) | (1.61) | (1.59) | (1.63) |
| **Interacted vignette characteristic** (see column header) | | | | | | | | |
| Main effect | 1.08 | 11.31*** | 7.36*** | 1.42 | 1.94* | 0.72 | 2.14* | 0.89 |
| | (0.87) | (0.87) | (0.83) | (0.87) | (0.84) | (0.83) | (0.86) | (0.87) |
| Interaction with late dropout | 3.33* | -6.17*** | -1.86 | 0.40 | -0.60 | -1.38 | -2.17 | 0.08 |
| | (1.61) | (1.65) | (1.59) | (1.56) | (1.47) | (1.65) | (1.57) | (1.61) |
| Interaction with early dropout | -1.17 | -7.11*** | -3.58* | -0.36 | -1.96 | -0.88 | 1.53 | -1.45 |
| | (1.55) | (1.74) | (1.53) | (1.53) | (1.51) | (1.66) | (1.62) | (1.65) |
| *N (vignettes)* | 2680 | 2680 | 2680 | 2680 | 26802680 | 2680 | 2680 | 2680 |
| *N (employers)* | 335 | 335 | 335 | 335 | 335 | 335 | 335 | 335 |

*Note:* The table shows results from mixed models interacting the vignette characteristic provided in the column header with graduation/dropout status. Interactions were included one at a time (i.e., results come from eight separate models). All models include all of the other vignette characteristics as well as the firm/respondent characteristics included in the main analysis (coefficient estimates not shown). Levels of the interacted variables are (reference category shown in italics): school GPA: *bad (2.9)* vs. good (1.8); university GPA: *bad (3.3)* vs. good (1.7); job relevant-internship: *none* vs. 3 months internship; informally acquired skills: *none* vs. programming/stock consulting (depending on field); match of study focus: *low match* quality vs. high match quality (specific treatment depends on field and position); English proficiency: *intermediate (B2)* vs. high (C1): experience abroad: *none* vs. studied abroad for one semester; middle-class name: *lower-class name* vs. middle-class name. Ref=reference category.
* p < .05; ** p < .01; *** p < .001 (two-tailed tests).

***Strengths and weaknesses of graduates vs. non-completers: Dimensions not shown in the main article***

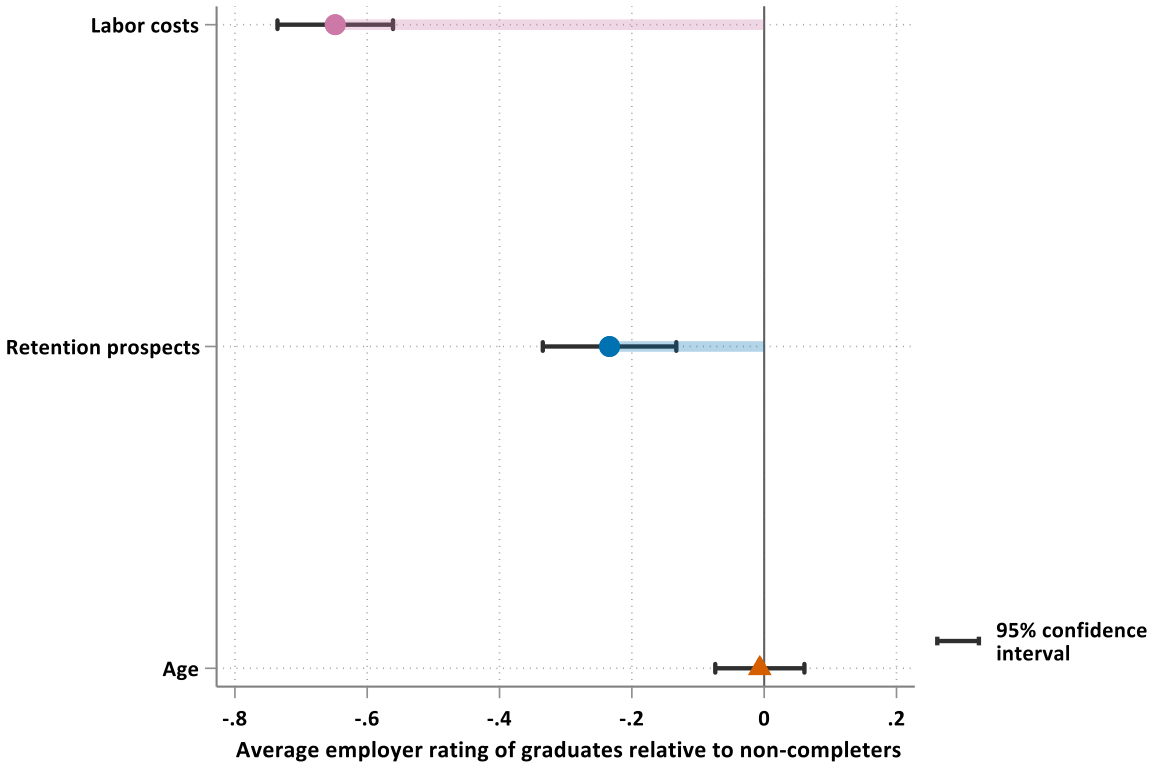


**Figure A2.** Perceived strengths and weaknesses of graduates relative to non-completers: Remaining dimensions not shown in the main article

*Note:* Mean ratings and 95 confidence intervals based on five-point scale ranging from -2 (strong disadvantage of graduates) to 2 (strong advantage of graduates). *N* (employers) = 335.

***Invitation probabilities and starting salaries of graduates and non-completers: Additional results on the role of employer perceptions***

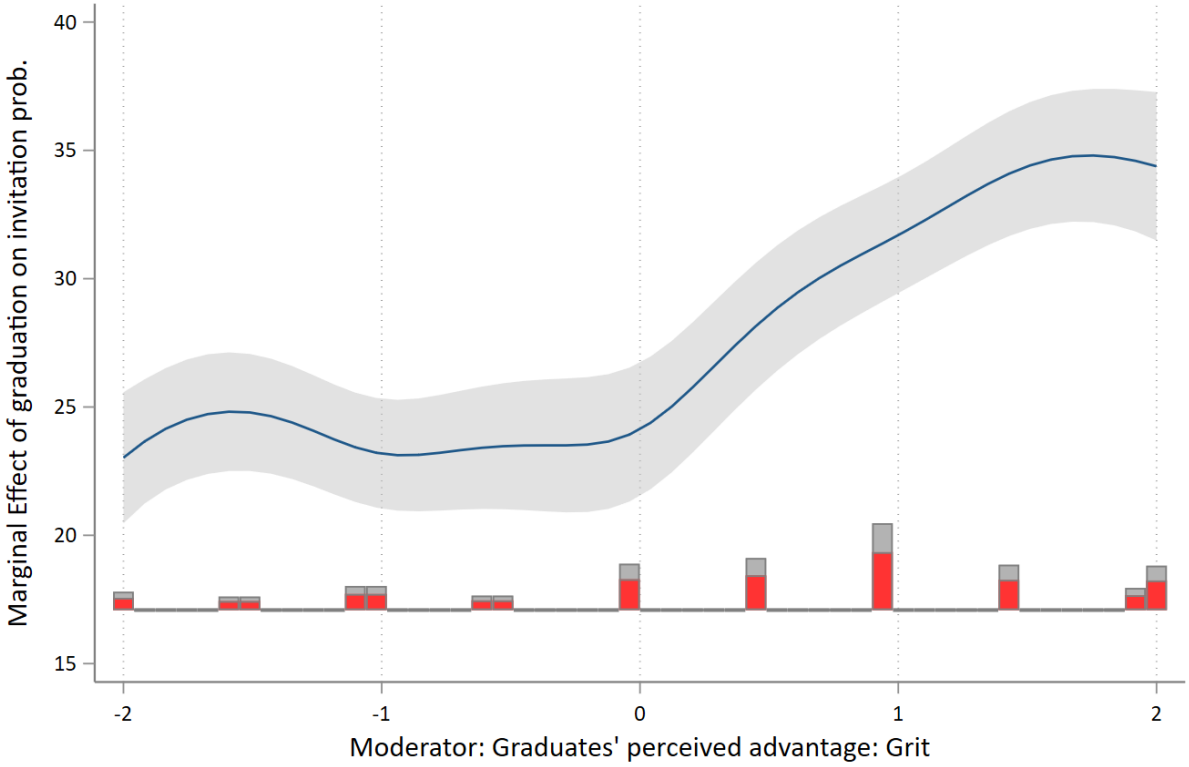


**Figure A3.** Kernel smoothing estimates of the conditional effect of graduation (vs. late non-completion) on the invitation probability over the range of graduates perceived advantages in the grit domain

*Note*: The graph shows estimates of the effect of graduation conditional on graduates perceived advantage in the grit domain, based on the kernel smoothing estimator described in Hainmueller et al. (2019), as implemented in the authors' Stata ado *interflex*. Early non-completer vignettes are dropped from the analysis, because the Stata program accepts binary treatments only. The bandwidth is 0.4, as selected by the program's default algorithm. *N* (employers) = 335; *N* (vignettes) = 2,010.

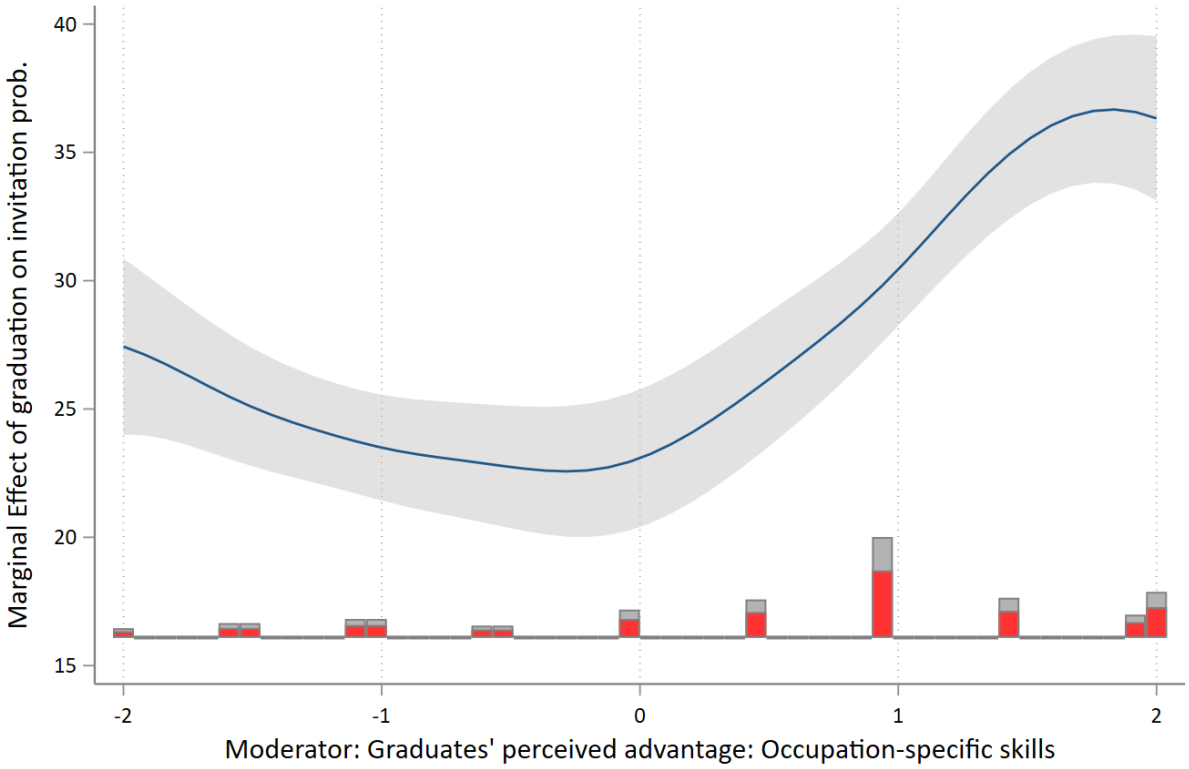


**Figure A4.** Kernel smoothing estimates of the conditional effect of graduation (vs. late non-completion) on the invitation probability over the range of graduates perceived advantages in the occupation-specific skills domain

*Note*: The graph shows estimates of the effect of graduation conditional on graduates perceived advantage in the occupation-specific skills domain, based on the kernel smoothing estimator described in Hainmueller et al. (2019), as implemented in the authors' Stata ado *interflex*. Early non-completer vignettes are dropped from the analysis, because the Stata program accepts binary treatments only. The bandwidth is 0.4, as selected by the program's default algorithm. *N* (employers) = 335; *N* (vignettes) = 2,010.

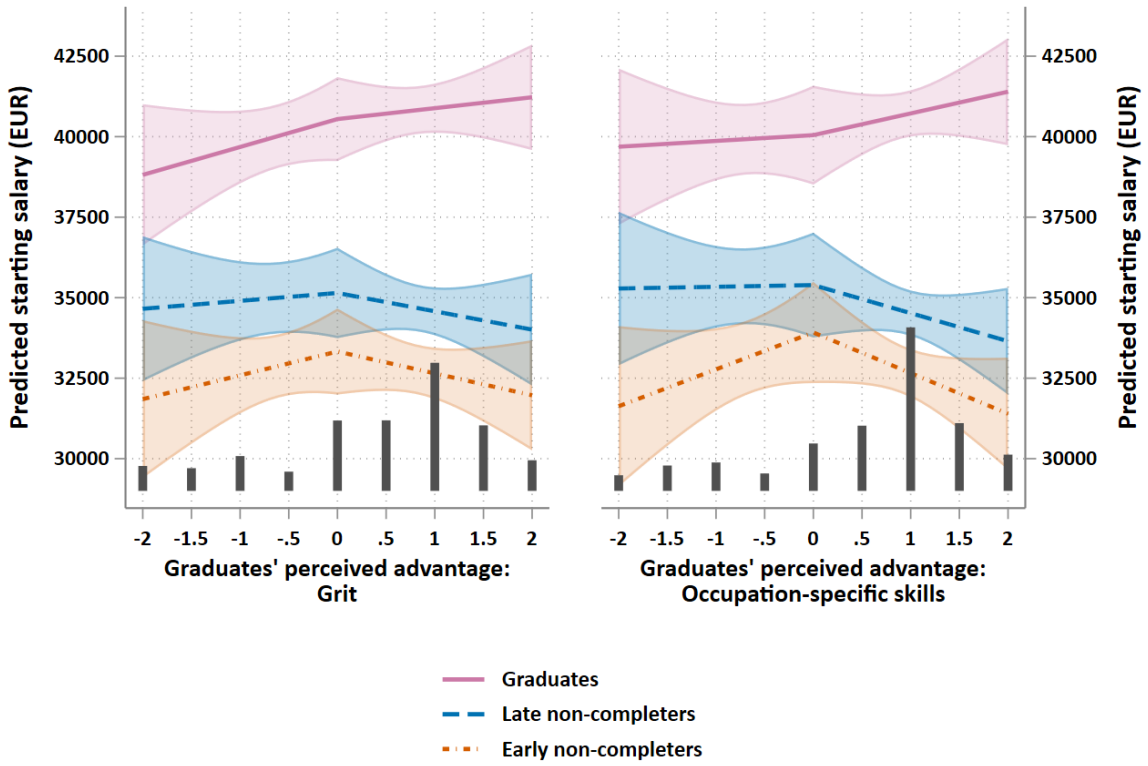


**Figure A5.** Employer perceptions (grit and occupation-specific skills) and starting salary

*Note*: Predictive margins and 95% confidence intervals based on linear mixed effects models with employer-level random intercept and random slope for graduation indicator. Perceptions based on five-point scale ranging from -2 (strong disadvantage of graduates) to 2 (strong advantage of graduates). Controls: other vignette dimensions, sector, occupational field, firm size, candidate queue, vignette set and order. Vertical bars represent employer-level distributions of the perceptions measures (relative frequencies). *N* (employers) = 335; *N* (vignettes) = 2,680.

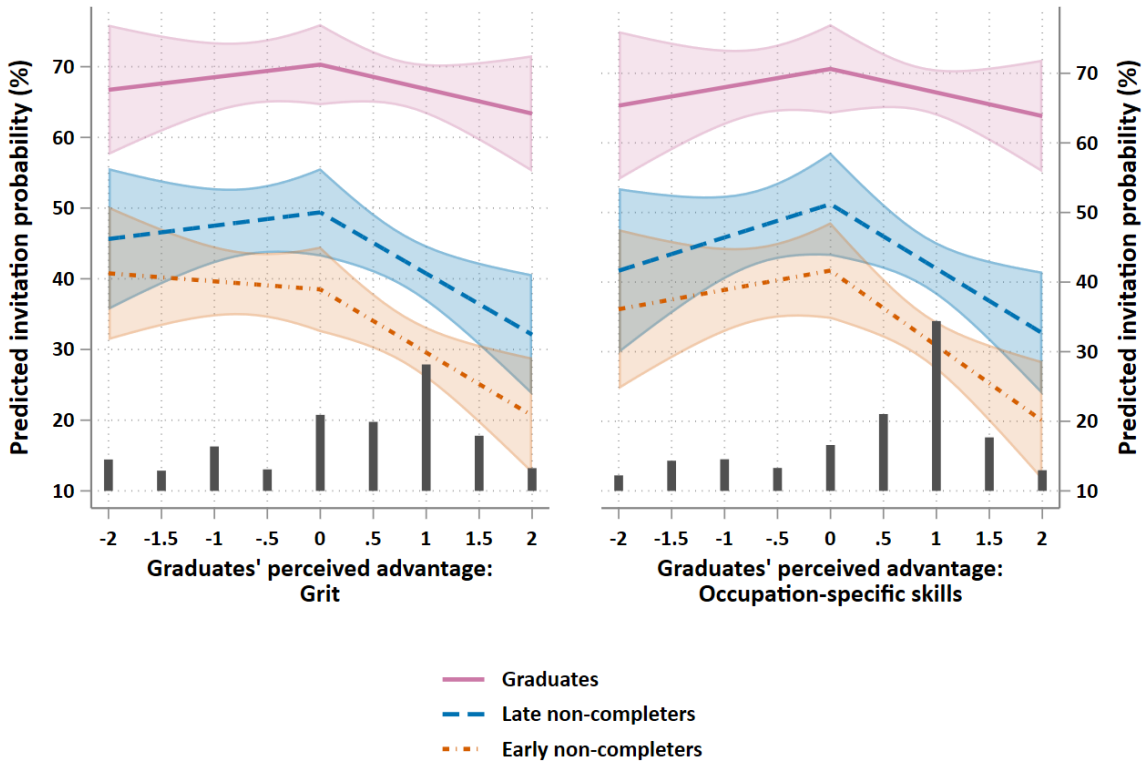


**Figure A6.** Employer perceptions (grit and occupation-specific skills) and invitation probability: 'no closure' subsample

*Note*: Predictive margins and 95% confidence intervals based on linear mixed effects models with employer-level random intercept and random-slope for graduation indicator. Perceptions based on five-point scale ranging from -2 (strong disadvantage of graduates) to 2 (strong advantage of graduates). Controls: other vignette dimensions, sector, occupational field, firm size, candidate queue, vignette set and order. Vertical bars represent employer-level distributions of the perceptions measures (relative frequencies). *N* (employers) = 226; *N* (vignettes) = 1,808.

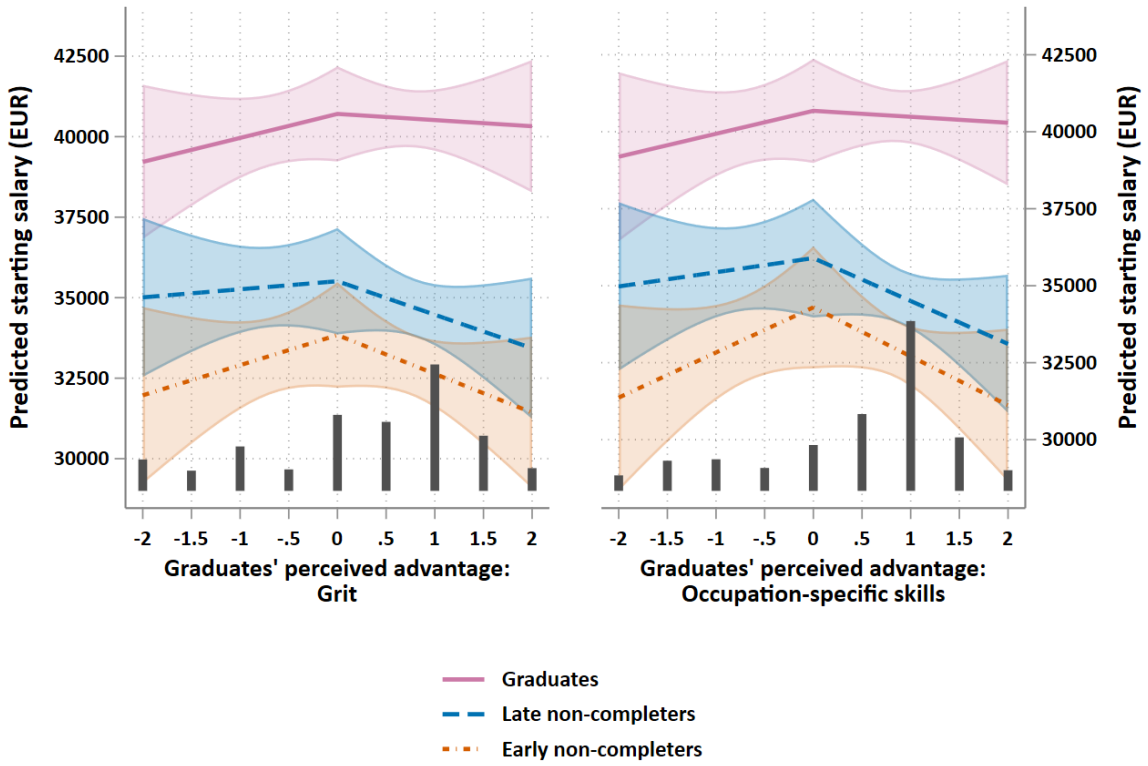


**Figure A7.** Employer perceptions (grit and occupation-specific skills) and starting salary: 'no closure' subsample

*Note*: Predictive margins and 95% confidence intervals based on linear mixed effects models with employer-level random intercept and random-slope for graduation indicator. Perceptions based on five-point scale ranging from -2 (strong disadvantage of graduates) to 2 (strong advantage of graduates). Controls: other vignette dimensions, sector, occupational field, firm size, candidate queue, vignette set and order. Vertical bars represent employer-level distributions of the perceptions measures (relative frequencies). *N* (employers) = 226; *N* (vignettes) = 1,808.

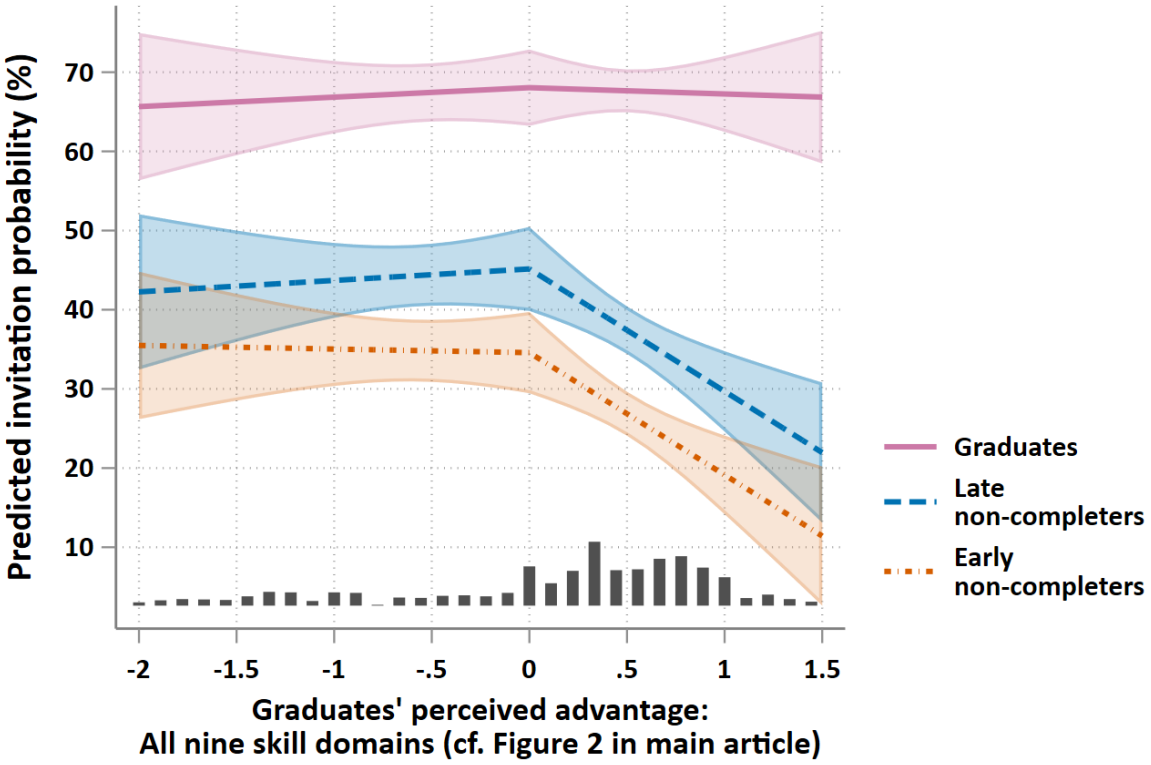


**Figure A8.** Employer perceptions (all skill domains) and invitation probability

*Note*: Predictive margins and 95% confidence intervals based on linear mixed effects models with employer-level random intercept and random-slope for graduation indicator. Perceptions based on five-point scale ranging from -2 (strong disadvantage of graduates) to 2 (strong advantage of graduates). Controls: other vignette dimensions, sector, occupational field, firm size, candidate queue, vignette set and order. Vertical bars represent employer-level distribution of the perceptions measure (relative frequencies). *N* (employers) = 335; *N* (vignettes) = 2,680.

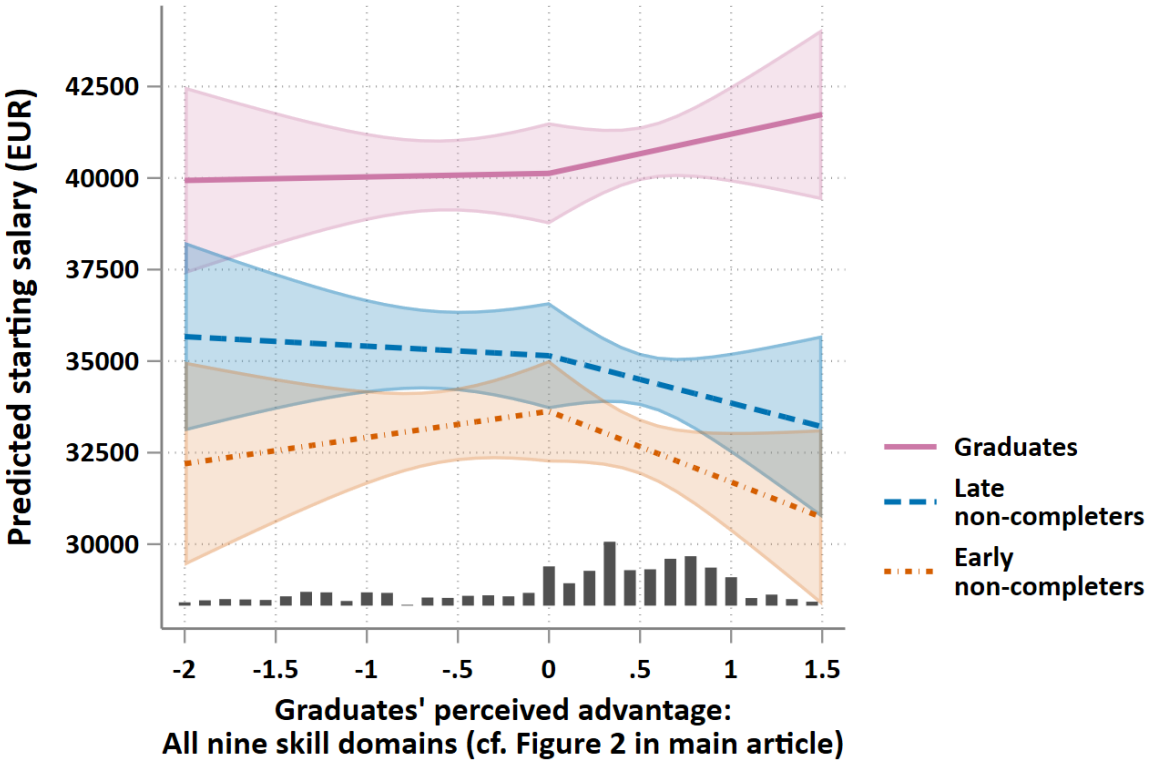


**Figure A9.** Employer perceptions (all skill domains) and starting salary

*Note*: Predictive margins and 95% confidence intervals based on linear mixed effects models with employer-level random intercept and random-slope for graduation indicator. Perceptions based on five-point scale ranging from -2 (strong disadvantage of graduates) to 2 (strong advantage of graduates). Controls: other vignette dimensions, sector, occupational field, firm size, candidate queue, vignette set and order. Vertical bars represent employer-level distribution of the perceptions measure (relative frequencies). *N* (employers) = 335; *N* (vignettes) = 2,680.

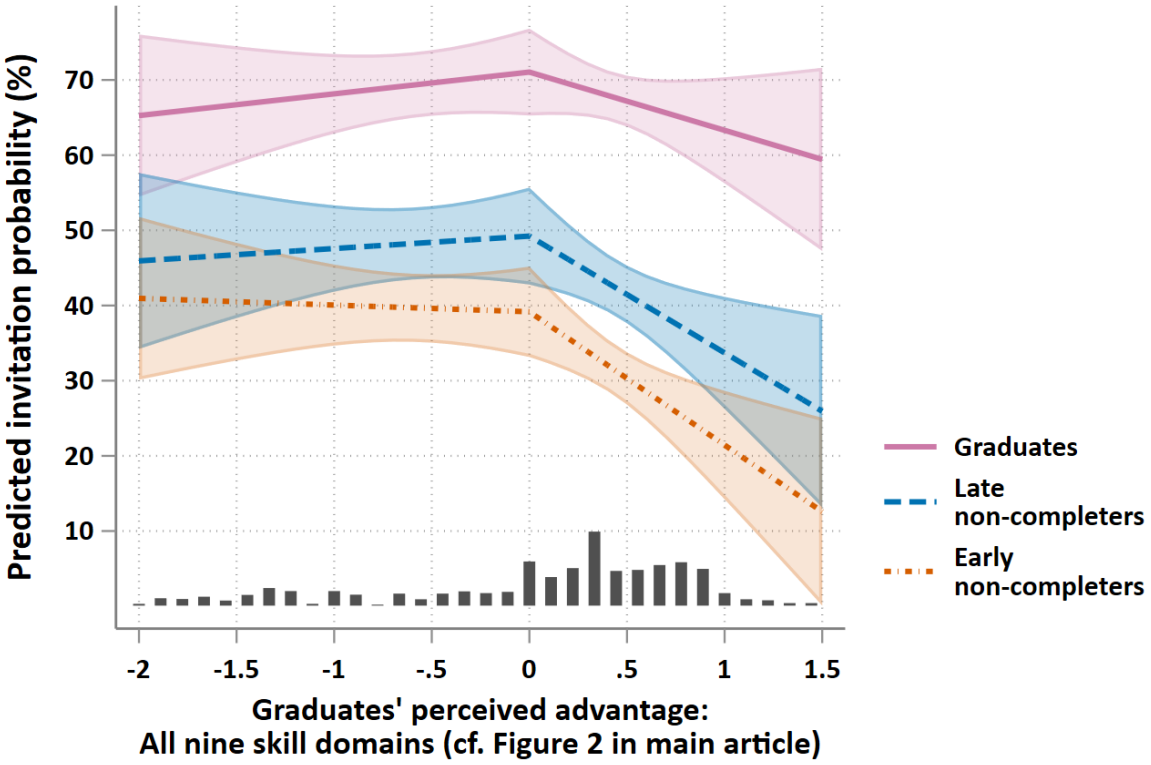


**Figure A10.** Employer perceptions (all skill domains) and invitation probability: 'no closure' subsample

*Note*: Predictive margins and 95% confidence intervals based on linear mixed effects models with employer-level random intercept and random-slope for graduation indicator. Perceptions based on five-point scale ranging from -2 (strong disadvantage of graduates) to 2 (strong advantage of graduates). Controls: other vignette dimensions, sector, occupational field, firm size, candidate queue, vignette set and order. Vertical bars represent employer-level distribution of the perceptions measure (relative frequencies). *N* (employers) = 226; *N* (vignettes) = 1,808.

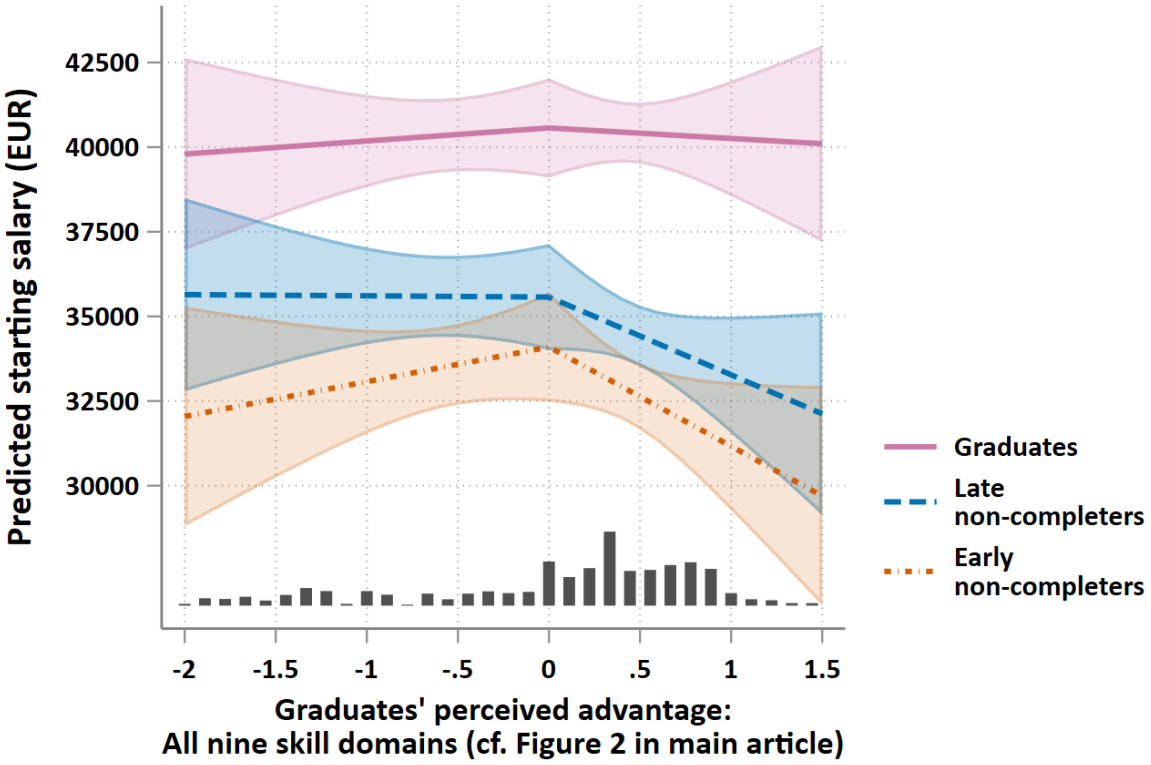


**Figure A11: Employer perceptions (all skill domains) and starting salary: 'no closure' subsample**

*Note*: Predictive margins and 95% confidence intervals based on linear mixed effects models with employer-level random intercept and random-slope for graduation indicator. Controls: other vignette dimensions, sector, occupational field, firm size, candidate queue, vignette set and order. Vertical bars represent employer-level distribution of the perceptions measure (relative frequencies). *N* (employers) = 226; *N* (vignettes) = 1,808.

*Effects of graduation/non-completer status by vignette position*

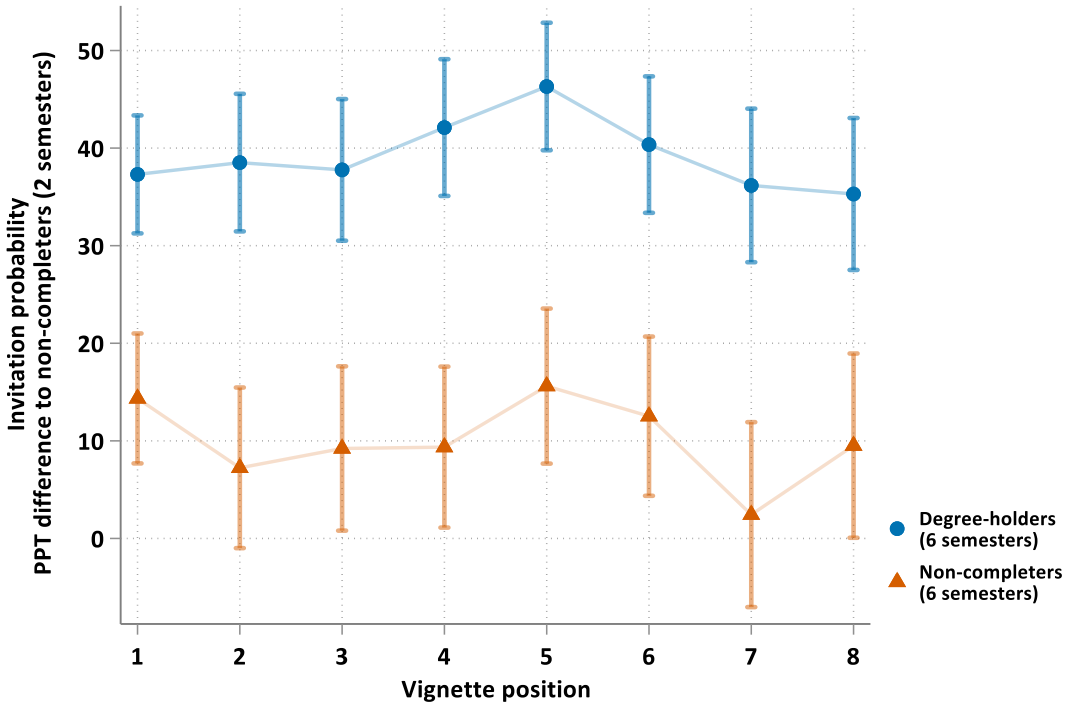


**Figure A10: Effects of graduation/non-completer status on invitation probability by vignette position**

*Note*: Figure shows coefficient estimates and 95% confidence intervals for late non-completion (dropout after 6 semester) and completion (after 6 semesters) relative top early dropout (after 2 semesters), separately by vignette position. Results are based on linear regressions with respondent-level cluster-robust standard errors rather than mixed linear models to allow for faster estimation. Controls: other vignette dimensions, sector, occupational field, firm size, candidate queue, vignette set and order. *N* (employers) = 335; *N* (vignettes) = 2,680.

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