I Z A Institute
of Labor Economics
Initiated by Deutsche Post Foundation

DISCUSSION PAPER SERIES

IZA DP No. 15187

The Effect of Foreign Students on Native Students' Outcomes in Higher Education

Julián Costas-Fernández
Greta Morando

MARCH 2022

I Z A Institute
of Labor Economics

Initiated by Deutsche Post Foundation

DISCUSSION PAPER SERIES

IZA DP No. 15187

The Effect of Foreign Students on Native Students' Outcomes in Higher Education

Julián Costas-Fernández
University College London

Greta Morando
University College London and IZA

MARCH 2022

Any opinions expressed in this paper are those of the author(s) and not those of IZA. Research published in this series may include views on policy, but IZA takes no institutional policy positions. The IZA research network is committed to the IZA Guiding Principles of Research Integrity.

The IZA Institute of Labor Economics is an independent economic research institute that conducts research in labor economics and offers evidence-based policy advice on labor market issues. Supported by the Deutsche Post Foundation, IZA runs the world's largest network of economists, whose research aims to provide answers to the global labor market challenges of our time. Our key objective is to build bridges between academic research, policymakers and society.

IZA Discussion Papers often represent preliminary work and are circulated to encourage discussion. Citation of such a paper should account for its provisional character. A revised version may be available directly from the author.

ISSN: 2365-9793

IZA – Institute of Labor Economics

Schaumburg-Lippe-Straße 5–9
53113 Bonn, Germany

Phone: +49-228-3894-0
Email: publications@iza.org

www.iza.org

ABSTRACT

The Effect of Foreign Students on Native Students' Outcomes in Higher Education*

This paper offers new evidence of the role of immigration in shaping the educational and labour market outcomes of natives. We use administrative data on the entire English higher education system and exploit the idiosyncratic variation of foreign students within university-degree across four cohorts of undergraduate students. Foreign peers have zero to mild effects on natives' educational outcomes, such as graduation probability and degree classification. Large effects are found on displacement across universities and degree types after enrolment, although these outcomes are rare occurrences. In line with the mild effects on education outcomes, we also find little effect of foreign peers affecting early labour market outcomes of native graduates.

JEL Classification: F22, I21, I23, I24, I26, J15, J24
Keywords: peer effects, higher education, immigration

Corresponding author:
Greta Morando
Social Research Institute
University College London
27 Woburn Square
London WC1H 0AA
United Kingdom
E-mail: g.morando@ucl.ac.uk

* We are grateful to Ben Etheridge, Matthias Parey, David Jaeger, Michel Serafinelli, and to seminar participants at the University College London, the London School of Economics, and Royal Holloway University of London for useful comments. Costas-Fernández acknowledges the support of the ESRC Doctoral Fellowship (award no. ES/J500045/1) and Morando of the ESRC Postdoctoral Research Fellowship (award no. ES/S011900/1). The data is supplied by the Higher Education Statistics Agency. The use of the data in this work does not imply the endorsement of any of the organizations cited above in relation to the interpretation or analysis of the data. All remaining errors are our own.

1 Introduction

Worldwide, more that six million individuals study in a country different from their country of origin.[1] Such inflows of international students may change the learning environment for native students, affecting natives' human capital acquisition while in education and, therefore, their economic outcomes beyond graduation.

We can think of various mechanisms through which foreign peers might affect the educational performance of natives. For example, foreign peers may change the ability distribution of students within the degree programme, thus changing the comparison group natives use to infer their own perceived ability. This could result in a shift in their effort provision (Elsner and Isphording, 2017; Murphy and Weinhardt, 2018). Moreover, foreign students may create a more diverse pool of skills that may help natives when engaging in cooperative work, similar to the effects of skill mix on firm productivity (Iranzo et al., 2008). Furthermore, foreign students might decrease the quality of the learning environment due to their lack of English proficiency (Anelli et al., 2017).

In this paper we investigate the effect of foreign peers on natives' educational outcomes in Higher Education (HE henceforth). We use administrative data from the HE Statistical Agency (HESA) which covers all universities and degree programmes in England. For four cohorts of undergraduate students (enrolled in years 2007/8-2010/1) we observe the university and degree programme attended and follow them until they leave HE. Thus, we know whether each student successfully graduated, the degree classification she has been awarded, and whether

[1] As reported by UNESCO international mobile students data.

any change in university or degree happened while at university.

HESA data allow us to observe where students resided before enrolling into HE; thus we can distinguish students as either *native* or *foreign*, depending on whether they resided in the UK or in another country, respectively. Furthermore, within the foreign student group, we consider students coming both from and outside of European Union countries, which we label as *EU* and *non-EU* students, respectively. We make this distinction as during the period that we consider EU and non-EU students were subject to different entry requirements in HE.

To estimate the effect of foreign peers on their native counterparts we follow Hoxby (2000) in exploiting the idiosyncratic variation in the share of foreign students across cohorts within university-degree programmes.[2] This idiosyncratic variation enables us to identify the effect of foreign peers on natives' HE outcomes in terms of graduation and the degree classification obtained. We also consider whether foreign students affect the probability of native students changing their initial university and degree. More specifically, we focus on switching from a university belonging to the Russell Group[3] to a non-Russell Group university, and switching from a STEM (Science, Technology, Engineering and Mathematics) to a non-STEM degree and viceversa. Graduating in prestigious universities and STEM degrees have sizeable effects on later economic outcomes.[4]

[2]See also Anelli and Peri (2017); Carrell et al. (2018); Chevalier et al. (2019); Cools et al. (2019); Bostwick and Weinberg (2022).

[3]The most prestigious universities in the UK belong to the so-called Russell Group. The twenty-four universities in this group are research-focused institutions, nationally and internationally well recognised as those with the highest standards of research and teaching. The Russell Group is the equivalent of the American Ivy League of prestigious universities.

[4]Alongside the final grade obtained (Feng and Graetz, 2017; French et al., 2015; Jaeger and Page, 1996; Jones and Jackson, 1990), there is ample evidence that, within graduates, labour market returns largely depend on the university attended (Black and Smith, 2006; Broecke, 2012; Chetty et al., 2020; Cunha and Miller, 2014; Dale and Krueger, 2014; Dillon and Smith, 2020; Hoekstra, 2009; Mountjoy and Hickman, 2020; Walker and Zhu, 2018) and the degree studied

We find that foreign students do not affect the probability of native students successfully graduating from an undergraduate course. Foreign students have a small effect on the final degree classification of natives. For example, a one standard deviation increase in non-EU students decreases the probability of getting an upper second classification degree by about 4 percent relative to the mean; a one standard deviation increase in EU students increase the probability of getting a third by 11 percent relative to the mean. EU students also increases the probability of staying in a non-STEM degree vs. changing to a STEM degree and of changing to a non-Russell from a Russell university. The magnitude of these last two effects is important (75 and 42 percent for a one standard deviation increase in the share of EU students, respectively) due to the low occurrence of switches across universities and degrees.

When we investigate the mechanisms that could drive our findings, we discover that grading on a curve cannot completely explain the displacement of natives in the grade distribution. Next, we test whether foreign students affect differently natives belonging to different ability groups. First, we find that EU students who, on average, perform well in HE, negatively affect the grades of natives at the middle-top of the ability distribution. We interpret this as suggestive evidence that foreign students affect the group which natives compare themselves with and from which they perceive their own academic ability. Second, we find that the retention effect of EU students in non-STEM degrees is similar across the whole

(Altonji et al., 2012; Blundell et al., 2000; Britton et al., 2021; Chevalier, 2011; Kirkeboen et al., 2016; Walker and Zhu, 2011, 2018). Notably, differences in earnings across degrees can be more important than those across different levels of qualification (Altonji et al., 2012). Figure A1 shows the Kernel density of the UCAS tariff score of natives by whether they are in a university belonging to Russell group and whether they are in a STEM degree. Students in Russell universities have higher UCAS tariff score than in non-Russell universities. There is no evidence that STEM and non-STEM degrees differ in the ability distribution of their students.

distribution of the ability of the natives. We take this as suggestive evidence that the lack of English proficiency of foreign students plays a positive role in shaping natives' perceived ability in degrees which heavily rely on language proficiency.

For three of the four cohorts observed in the HESA data we can follow graduates at six months after graduation by linking the HESA student record data to the Destination of Leavers from HE (DLHE). We find that foreign students do not importantly affect the activity status of native graduates and, if employed, their occupation. Overall, EU students slightly decrease the probability of working in favour of being unemployed and of doing something else (i.e. internships, gap year) similarly for different ability groups. Among high ability native graduates, non-EU students decrease the probability of studying, instead of working, and for those employed, they increase the likelihood of being in a high occupation.

Finally, we document heterogeneous effects of foreign students across natives belonging to different socio-economic status (SES henceforth) groups. The direction of the effect of foreign peers depends on the outcome considered. For example, EU students increase the SES gap in degree classification (on average, high SES students have higher grades than low SES students), but decrease the SES gap in participation in prestigious universities (on average, high SES students are more likely to study in universities belonging to the Russell group than low SES students). This additional evidence reinforces the previous findings that when looking at the impact of foreign peers on native students a large range of outcomes should be considered as it is unlikely that there is a unique unidirectional effect of studying with foreign peers.

This paper provides new evidence on the *direct* effect of studying with foreign peers in HE on a rich set of natives' outcomes. By doing so, it contributes to

the literature on the effect of foreign students on natives educational performance, which has largely focused on pre-tertiary levels of education (e.g. Ballatore et al., 2018; Fletcher et al., 2019; Gould et al., 2009; Ohinata and Van Ours, 2013). For example, Geay et al. (2013) find a negative effect of foreign students on native performances at primary school in England which is completely driven by selection, i.e. foreign students are more likely to attend low quality schools. Once selection is taken into account, they find no significant foreign peer effects.

The effect of foreign peers in HE has been less studied. There are two main exceptions we are aware of. Anelli et al. (2017) show that the share of foreign classmates in introductory math classes in a university in the USA displace domestic students from STEM majors by driving them to non-STEM majors. Chevalier et al. (2019) consider the random allocation of students into Economic seminars in an English university and find that native English speakers are not affected in terms of performances and educational choices by a more language diverse environment. Positive effects on performances are found for non-native speaker students exposed to a higher language diversity in the classroom.

These studies are based on one course and one department in a single university. We contribute to this literature by extending the analysis from a single department-course to the full HE system.[5] We see two main contributions in this direction. First, our results are representative of the whole population of native students in England thus addressing possible concerns relating to external validity. Second, having data on the whole population of students allows us to perform inference for detailed demographics. This allows us, for example, to document heterogeneous

[5]Braakmann and McDonald (2018) consider all English universities, but they focus on the impact of exposure to socio-economic diversity on students educational outcomes.

effects along the ability distribution and the socio-economic background of natives.

2 Institutional Settings

The UK is the second country in the world, after the USA, in terms of foreign students in HE. In 2019/20 about one-fifth of all students in the UK HE system came from outside the UK: 6% from the EU and 17% from the rest of the world.[6] In science (non-science) subjects, international students constitute 13% (16%) of undergraduate students, 26% (39%) of postgraduate taught students, and 42% (42%) of postgraduate research students.

This paper focuses on the English system of HE. English universities represent the largest part of the UK system of HE. Around 84% of all HE students in the UK are enrolled in an English university. The English system of HE is an ideal setting to study the effect of foreign peers. This is because the composition of students at entry in HE is stable along the whole period of study. Differently from other countries, such as the USA and Scotland, in England students begin their programme starting from their first year. No general curriculum is offered initially and each university course is usually associated with one or two specific fields of study. An undergraduate degree usually lasts three years, and its duration is fixed because students cannot choose when to take exams, unlike what happens in other European countries. As a result of the rigidity of the system, dropout and changes of degree and university once enrolled are rare (Vignoles and Powdthavee, 2009).

Enrollment at university is centralized. Students in their final year of secondary school apply to the Universities and Colleges Admissions Service (UCAS) by listing

[6]Data source for official statistics on international students: `https://www.hesa.ac.uk/data-and-analysis/students/where-from`

their ordered choices of HE institutions and degrees. Allocation works at national level and depends on the match of the requirements of each university and students' final predicted score at the end of secondary school. This is the UCAS tariff score, a numerical score of the predicted grades in each type of post-16 qualification.

Universities are funded by the state through the HE Funding Council for England (HEFCE). In the period here considered the HEFCE set caps on the number of British and EU nationals that each university could enrol. This cap was binding as universities had to face monetary fines, offsetting additional gains derived from student fees, if they enrolled students above the cap (Machin and Murphy, 2017). Non-EU students were not considered for the cap and their enrollment was only subjected to visa restrictions and capacity constraints of the university.

3 Empirical Strategy

We follow the literature on peer effects which has mainly relied on quasi-random variation across cohorts within a unit, e.g. a school or a firm, to analyze a vast range of outcomes.[7] As pointed out in (Manski, 1993), estimating peer effects requires to disentangle contextual and the endogenous effect, i.e. individual outcomes vary with both the characteristics and the outcomes of the group of interest.[8] To separate peer effects from correlated own characteristics we consider the outcomes of native students only (Angrist, 2014; Carrell et al., 2018).

The main challenge for identifying a causal effect of foreign students on natives' outcomes is that we need to net out confounding characteristics that are hardly

[7] See Sacerdote (2011) for a comprehensive literature review on identifying peer effects in education.

[8] In our set-up, the reflection issue is not a problem since being native or foreign is a fixed characteristic pre-determined before university entry.

measurable, such as studying facilities or recruitment effort by university. Omitting such characteristics could impair the causal interpretation of our estimates. For example, those universities that are perceived as delivering an education of high quality might be more attractive to foreign students. If the quality of the university also affects the outcomes of native students, we would obtain an upward biased estimate of the effect of foreign peers on native performances. We account for such correlated effects by introducing a comprehensive set of fixed effects. We use university, degree, and university-degree fixed effects. These take into account the "typical" characteristics of each university and programme degree, and of each degree within a university, which are invariant over time.

To account for transitory common shocks we include cohort (defined by year of enrolment) fixed effects; to account for university-specific and degree-specific shocks we additionally interact the university and degree identifier with cohort dummies. The inclusion of these additional fixed effects allows us to net out certain shocks, such as on labor demand for specific subject degrees,[9] that may affect simultaneously both the flow of international students and the composition of native students. Similar to Lavy and Schlosser (2011), we argue that students may know whether a degree or university or even a degree within a university typically has a high share of foreign students. However, they are unlikely to know, ex-ante, the exact share of students within a cohort in a university and degree.

Therefore, our estimating equation is:

$$y_{iduc} = \alpha_0 + \alpha_1 \bar{s}_{duc} + \tau_{du} + \upsilon_{dc} + \omega_{uc} + \epsilon_{iduc}, \tag{1}$$

[9]For example, it has been found that the macroeconomic environment affects the probability of enrolling into HE and the type of degree chosen (Blom et al., 2021; Clark, 2011; Meschi et al., 2011; Taylor, 2013; Tumino and Taylor, 2015; Rampino and Taylor, 2012).

where i stands for each student in the data, d represents the undergraduate degree, u the university, and c the cohort to which the student belongs to (i.e. the first year in which students enroll in an undergraduate course). The share of foreign students is $\bar{s}_{duc}$, hence the coefficient of interest to estimate is α_1. In our analysis we standardise the share of foreign students, i.e. we transform it to have mean zero and standard deviation of one; thus α_1 measures changes in percentage points (pp henceforth) in the outcome given by a 1 standard deviation (SD henceforth) increase in the share of foreign students. Equation 1 is estimated with a linear probability model as all HE outcomes are dummy variables. The standard errors are clustered within university.

Given that EU and non-EU students enter the HE system through different channels, as explained in Section 2, and their average ability differ, as shown later in the paper, in an additional specification we allow EU and non-EU students to have an heterogeneous impact on the outcomes of natives. This is done by estimating separated coefficients, β_1 and β_2, as shown in 2.

$$y_{iduc} = \beta_0 + \beta_1 \bar{s}_{duc}^{EU} + \beta_2 \bar{s}_{duc}^{NonEU} + \upsilon_{dc} + \omega_{uc} + \epsilon_{iduc}. \tag{2}$$

Summarising, the full set of fixed effects τ_{du}, υ_{dc}, and ω_{uc} includes controls for cohort, university, degree, university-cohort, degree-cohort, and degree-university. We observe four cohorts of students, 120 universities and 19 degrees. The variation exploited in the empirical strategy just discussed is the idiosyncratic change in the share of foreign students across cohorts within the same university and degree. In this, our specification is similar to Cornelissen et al. (2017), where they have fixed effects for occupations within firms across years. This is more flexible than

some specifications in the literature that account only for institution fixed effects and institution-specific linear time trends (e.g. Hanushek et al., 2003; Geay et al., 2013). To identify the causal effect of foreign peers we rely on the assumption (for which we provide some evidence in Section 5) that conditional on the the full set of fixed effects the share of foreign students to which natives are exposed to is as good as random.

An increase in the share of international applicants (keeping the number of native applicants constant) is equivalent to a rise in the number of potential students that universities have to choose from. As explained in Section 2, universities are capacity constrained, particularly when it comes to the number of EU and national students. Hence when the share of international students increases, the competition among prospective undergraduate students increases. The acceptance threshold rises and this results in an increase in the UCAS tariff score of the marginally accepted native students. We account for this by controlling for the UCAS tariff score of native students. The latter is transformed in a continuous variable ranging from 0 to 1 within each cohort.[10] Hence, our estimates, by controlling for native students ability, can be considered to depict the "pure" peer effects: the estimated effect of sharing an undergraduate degree with foreign peers on natives' outcomes is not confounded by any possible effect that foreign students might have in displacing native students at the stage of the HE application process.

Finally, as we may be concerned about estimating a composite effect of foreign students and course size (e.g. Angrist and Lavy, 1999; Krueger, 2003), we

[10]The UCAS tariff score is unknown for about 14% of students within each cohort, i.e. these students entered through another channel, such as clearing. We retain these students in the main analysis by imputing the average value of the tariff score to these students while including a dummy variable indicating that the score is actually missing for them. Several checks about the UCAS tariff score are implemented in Section 7.

additionally control for the (log of the) size of the university-degree cells.[11]

4 Data, Sample, and Main Variables

We use administrative data from the Student Record provided by the Higher Education Statistical Agency (HESA). This contains information on the whole population of students that enrolled in an HE institution in the UK in academic years 2007/08 to 2010/11. We focus on undergraduate degrees lasting 3 years in England.[12] Each individual is observed up to three years after the year of enrollment to avoid observing a longer spell of time for the early cohorts compared to the later cohorts (we have Student Record data up to academic year 2013/4).

Definition of Native and Foreign Students and of Peers

We define the native status by looking at whether a student was domiciled in the UK prior to enrolment into HE.[13] The peer group is defined as all students

[11] We test whether the share of foreign students affects the number of students withing a degree-university by regressing the log of the size of the university-degree cells on the share of foreign students conditioning on the full set of fixed effects and on the UCAS tariff score. The standard errors are clustered at university level. A 1SD increase in the share of foreign students increases the size of the university-degree cells by 4.2%; a 1SD increase in the share of EU decreases the size of the cells by 0.2%, while a 1SD increase in the share of non-EU students decreases it by 4.8%. This is consistent with the finding that in the UK non-EU students subsidies native students (Machin and Murphy, 2017). However, all these estimates are not statistically significant at conventional level.

[12] We consider degrees studied at 100% (which is over 80% of all undergraduate students) as this allows us to identify the foreign group of peers for each native in a clean way - see below on how we construct the share of foreign peers. However, considering also mixed degrees were more than one subject is studied and weighting the population of foreign peers for the proportion of the studied subject does not affect the main results.

[13] A popular definition for native in the literature is whether the individual was born in the country (e.g. Dustmann et al., 2013; Manacorda et al., 2012). However, we have no information about country of birth. We have information on nationality (although this information is not available for all students) and when we cross-tabulate this information with domicile prior university entry we find a very good match, making us confident that residence before entering

that are enrolled in the same university, undergraduate degree, and cohort. For each peer group we compute foreign exposure as the share of foreign peers over native students as:

$$\bar{s}_{duc} = \frac{N_{duc}^{EU} + N_{duc}^{NonEU}}{N_{duc}^{UK} + N_{duc}^{EU} + N_{duc}^{NonEU} - 1} \tag{3}$$

$$\bar{s}_{duc}^{EU} = \frac{N_{duc}^{EU}}{N_{duc}^{UK} + N_{duc}^{EU} + N_{duc}^{NonEU} - 1} \tag{4}$$

$$\bar{s}_{duc}^{NonEU} = \frac{N_{duc}^{NonEU}}{N_{duc}^{UK} + N_{duc}^{EU} + N_{duc}^{NonEU} - 1}, \tag{5}$$

where N indicates the total number of undergraduate students within a university-degree in the enrollment year.

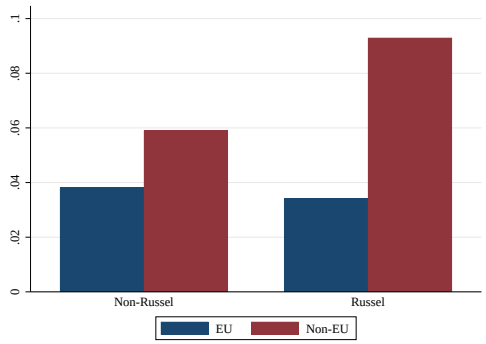
Figure 1 shows that EU students represent about 4% (the SD is 0.042) of all undergraduate students population and their share is equally spread among Russell and non-Russell universities and among STEM and non-STEM degrees. The highest share of EU students is found among Business studies, Architecture, European languages, Engineering, Mathematics & computer sciences. On the other hand, non-EU students, which are about 8% of total undergraduate students (the SD is 0.103), are more present in Russell universities, compared to non-Russell universities (7% and 11%, respectively). The degrees with the highest share of non-EU students are: Engineering, Business studies, Mathematics & computer sciences, Law, and Technologies. Overall, the degree least popular for non-natives

HE is a good information to determine whether a students is native. A major benefit of defining natives and migrants by place of domicile prior to HE is that students who were residing in the UK likely received secondary education in the UK. Hence, they represent an homogenous group in terms of the education received and the determinants they faced before enrolling into HE.

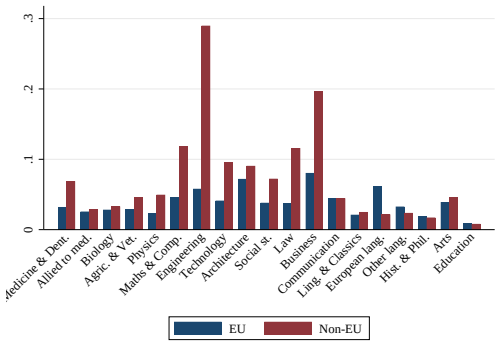
students is Education.

Figure 1: Share of EU and non-EU students by type of university and of degree

(a) By university type



(b) By degree



Notes: Authors' computation from HESA data. Russell group universities include: University of Birmingham, University of Bristol, University of Cambridge, Durham University, University of Exeter, Imperial College London, King's College London, University of Leeds, University of Liverpool, London School of Economics and Political Science, University of Manchester, Newcastle University, University of Nottingham, University of Oxford, Queen Mary University of London, University of Sheffield, University of Southampton, University College London, University of Warwick, and University of York.

Analysis Sample

As for the analysis sample, we focus on those native students that at the time of entering an undergraduate degree are 18-21 years old and come from high school, without any prior experience in HE. This is equivalent to 80% of the entire population of native undergraduate students. We implement these restrictions to avoid possible selection concerns from students that might have had some previous experience in HE or in the labour market and to limit heterogeneity in terms of the type of their educational background. Selecting young students additionally eliminates possible heterogeneity due to different determinants of entry in HE between young and mature students.

Table 1 reports the summary statistics of the main characteristics of native students in the first year in which they enrolled in an undergraduate degree. Some variables, such as ethnicity and disability, are collapsed to smaller categories than those that we use in the regression analysis for readability. The large majority of undergraduate students come from families with high SES: about 45% of natives have a parent in the highest socio-economic classification categories.[14] Furthermore, 10% of enrolled native students come from a private school, and 31% come from a neighborhood where a high proportion of residents attended HE (i.e. high LPN).[15] About 29% of students attend a STEM degree[16] and about 26% attend a university belonging to the prestigious Russell group.

[14]We know the highest SEC (socio-economic classification) of the student's parents. In the table we group the 8 SEC categories into 3 groups. *High* parental SEC comprises: Higher managerial & professional occupations and Lower managerial & professional occupations; *Medium* parental SEC: Intermediate occupations and Small employers & own account workers; and *Low* parental SEC: Lower supervisory & technical occupations, Semi-routine occupations, Routine occupations, and Never worked & long-term unemployed.

[15]The Low Participation Neighborhood (LPN) quintiles is a variable indicating whether students are coming from a neighborhood where participation in HE is high (fifth quintile) or low (first quintile).

[16]We define as STEM degrees: Biological sciences, Veterinary sciences, agriculture & related, Physical sciences, Mathematical & computer sciences, Engineering, Technologies, Architecture, building & planning. As non-STEM degrees: Medicine & dentistry, Allied to medicine, Social studies, Law, Business & administrative studies, Mass communications & documentation, Linguistics & classics, European languages, Other languages, Historical & philosophical studies, Creative arts & design, Education.

Table 1: Native Students' Characteristics

Variable	Mean	Std.dev.	Min	Max	Variable	Mean	Std.dev.	Min	Max
Female	0.573	0.495	0.000	1.000	High LPN	0.313	0.464	0.000	1.000
Age	18.835	0.840	18.000	21.000	Medium LPN	0.580	0.494	0.000	1.000
High Parental SEC	0.445	0.497	0.000	1.000	Low LPN	0.099	0.298	0.000	1.000
Medium Parental SEC	0.173	0.378	0.000	1.000	LPN Unknown	0.008	0.092	0.000	1.000
Low Parental SEC	0.193	0.394	0.000	1.000	No Disability	0.682	0.466	0.000	1.000
Unknown Parental SEC	0.190	0.392	0.000	1.000	Some Disability	0.079	0.270	0.000	1.000
Private School	0.104	0.306	0.000	1.000	Disability Unknown	0.239	0.426	0.000	1.000
Public School	0.851	0.356	0.000	1.000	UCAS Score	0.305	0.121	0.000	1.000
Unknown School	0.045	0.206	0.000	1.000	(log-)Size	6.214	0.904	0.693	8.891
White	0.787	0.409	0.000	1.000	Russel Group	0.259	0.438	0.000	1.000
Non-White	0.201	0.401	0.000	1.000	Stem Major	0.290	0.454	0.000	1.000
Ethnicity Unknown	0.011	0.106	0.000	1.000					

Note: Authours' computation from HESA data using the sub-population of native students that at the time of entering an undergraduate degree are 18-21 years old and come from high school, without any prior experience in HE. This sub-population contains a total of 513,000 observations. We observe the UCAS score of 439,000 of these students.

Higher Education Outcomes

The main HE outcomes are divided into two groups: i) *performance*, i.e. whether successfully graduated within four years since enrolling in an undergraduate degree, and whether got a first, upper second, lower second or third degree classification; and ii) *displacement*, i.e. whether switched from a STEM to a non-STEM degree and viceversa and whether switched from a university belonging to the Russell group to a university not belonging to this group.[17]

We consider whether native students changed their degree and university type to understand the channels through which foreign students affect natives' HE performances. More precisely, foreign students could have a direct effect on the probability of graduating and on the final grade attained by natives but also an indirect effect, by displacing students in other types of universities and degrees. In our analysis we focus on displacement from Russell-group universities and from/to STEM degrees. Universities belonging to the Russell group and STEM degrees have, on average, high economic returns and are more competitive than universities non belonging to the Russell group and to non-STEM degrees, respectively (Britton et al., 2021; Walker and Zhu, 2018).

Table 2 shows that about 86% of native students successfully completed an undergraduate degree within four years from enrollment. The large majority of natives obtains an upper second degree classification (44%). First and third degree classifications are more rare, respectively comprising 12% and 3.5% of natives students. Changes across different types of universities and degrees are not common.

[17] We do not consider the movement from non-Russell to Russell universities as this is extremely rare; less than 0.4% of the analysis sample population made such change.

Table 2: Higher Education Outcomes

	Performance Outcomes			
	Mean	Std.dev.	Min	Max
Graduated	0.856	0.351	0.000	1.000
Graduated - First	0.121	0.327	0.000	1.000
Graduated - Upper Second	0.444	0.497	0.000	1.000
Graduated - Lower Second	0.212	0.409	0.000	1.000
Graduated - Third	0.035	0.185	0.000	1.000
	Displacement Outcomes			
Changed to Non-Russell	0.024	0.154	0.000	1.000
Changed to Non-STEM	0.049	0.215	0.000	1.000
Changed to STEM	0.016	0.125	0.000	1.000

Note: Authours' computation from HESA data using the sub-population of native students that at the time of entering an undergraduate degree are 18-21 years old and come from high school, without any prior experience in HE. This sub-population contains a total of 513,000 observations (all observations in the paper are rounded to comply with the rules of the data provider). Of these, 132,700 start in a Russell group university, 364,300 in a STEM degree and 148,700 in a non-STEM degree.

Labour Market Outcomes

For those students enrolling in HE in 2007/8-2009/10 we are able to link the HESA Student Record with the Destination of Leavers from Higher Education (DLHE) survey that collects information of graduates six months after graduation. The DLHE response rate is about 80% for natives and 60% for EU students, with international students not included for the period considered. In our analysis we consider only the outcomes of natives.

The DLHE survey collects information such as activity status of graduates and in which occupation they are working, if employed. Despite this information is collected a short-time after graduation, the literature has shown that early labor market outcomes have economic relevance as they largely affect the future working

Table 3: Labour Market Outcomes

	Activity Status			
	Mean	Std.dev.	Min	Max
Working	0.614	0.487	0.000	1.000
Studying	0.228	0.420	0.000	1.000
Unemployed	0.089	0.285	0.000	1.000
Other	0.068	0.252	0.000	1.000
	Job Attributes			
High SEC	0.241	0.428	0.000	1.000

Note: Authors' computation from HESA data using the sub-population of native students that at the time of entering an undergraduate degree are 18-21 years old and come from high school, without any prior experience in HE. We have labour market data for graduates who enrolled in HE in 2007/8-2009/10. This sub-population contains a total of 237,200 observations.

trajectories of graduates (Baert et al., 2013; Del Bono and Morando, 2021; Kahn, 2010; Oreopoulos et al., 2012; Raaum and Røed, 2006; Von Wachter and Bender, 2006).

The labour market outcomes are divided into: i) *activity status*, i.e. whether working, studying, being unemployed, or other (e.g. gap year, voluntary work); and in ii) *job attributes*, i.e. for those working we can observe whether they work in a high socio-economic occupation, which is a professional or managerial position.

Table 3 shows that about 61% of native graduates work six months after graduation, while 23% keeps studying, and 9% is unemployed. Among those working, 24% are employed in a high occupation job.

5 Validity of the Identification Strategy

If variation across cohorts within university and degree is as good as random, once we condition on our set of fixed effects, we should not observe any correlation between the share of foreign peers and student characteristics which pre-date the entry into HE and, thus, any interaction with foreign peers. To test this we estimate the following equation:

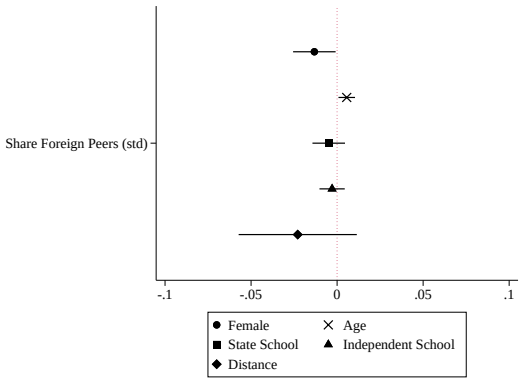
$$x_i = \gamma_0 + \gamma_1 \bar{s}_{duc} + \gamma_2 \bar{a}_i + \gamma_3 log(N)_{duc} + \tau_{du} + \upsilon_{dc} + \omega_{uc} + \epsilon_{iduc}. \quad (6)$$

We show that, conditional on individual academic ability (i.e. UCAS tariff score, $\bar{a_i}$), the cohort-specific log of the size of the university-degree ($log(N)_{duc}$), and the full set of fixed effects, the cross-cohort variation of the share of foreign students ($\bar{s}_{duc}$) is uncorrelated with a comprehensive set of predetermined characteristics of native students, such as ethnicity and socio-economic background, see Figure 2.[18] Point estimates are typically close to zero also when we split foreign students into EU and non-EU peers, see Figure A2. To be thorough, despite the evidence of the lack of any significant correlation between the share of foreign students and natives' characteristics, in the main analysis we condition on natives' individual characteristics.

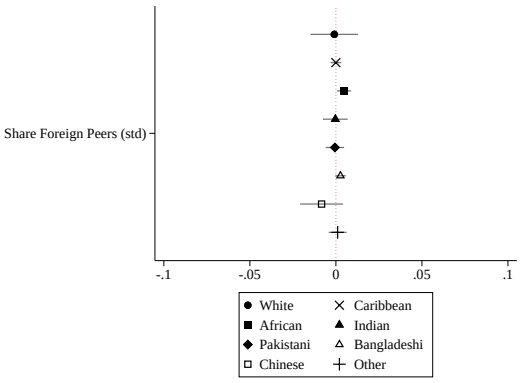
[18] This balance test is amply used in the peer effects literature (e.g. Anelli et al., 2017; Chin et al., 2013; Cools et al., 2019; Lavy and Schlosser, 2011).

Figure 2: Balance test: share of foreign students

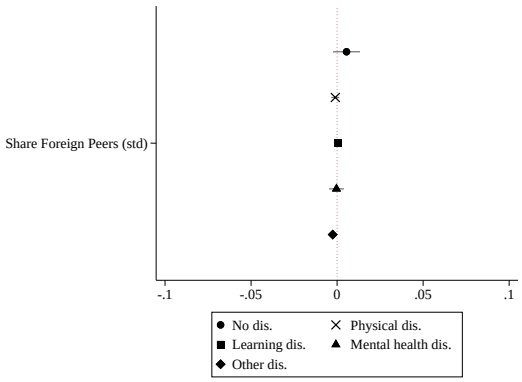
(a) Gender, age, school, distance original residence to uni



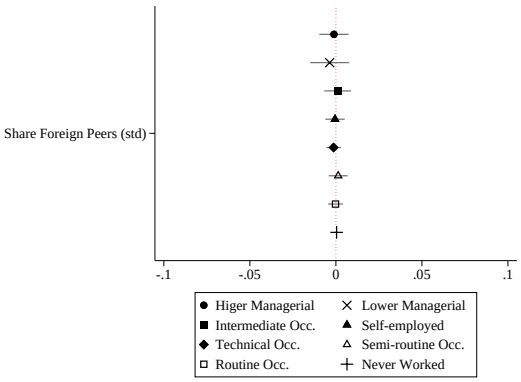
(b) Ethnicity



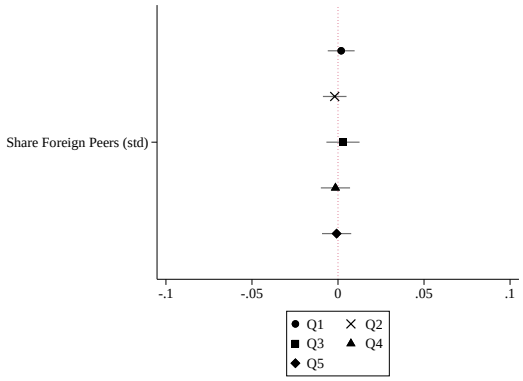
(c) Disability



(d) Socio-economic classification (parents)



(e) Low participation neighborhood (LPN)



Note: All regressions include controls for UCAS tariff score deciles and log size of the university-degree cell. Fixed effects: university, degree, year, university-degree, year-degree, and year-university. Standard errors clustered by university. 90% confidence intervals reported.

6 Results

The Effect of Foreign Students on Natives' HE Performance and Displacement Outcomes

Table 4 shows the estimated coefficients of the standardized share of foreign and of EU and non-EU students on the HE outcomes, which are separated in two main categories: performances in columns 1-5, and displacement outcomes in columns 6-8. There is no significant effect of foreign students on the probability of graduating. A 1SD increase in the share of foreign students decreases the probability of graduating by 0.3pp for natives, which is a negligible amount relative to the mean and not statistically significant. Most of the estimates on grade achievement are not statistically significant. However, there are some statistically significant effects: a 1SD increase in the share of foreign students decreases the probability of getting an upper second by 1.7pp, which is equivalent to a a 3.8% decline relative to the mean. The latter effect is driven by non-EU students, statistically significant at 5% level. A 1SD increase in the share of EU students increases the probability of getting a third by 0.4pp (11.4% relative to the mean).

When we analyse the displacement outcomes, we find that a higher share of foreign students increases the probability of moving to a non-Russell university and to a non-STEM degree. Nevertheless, these estimates are not statistically significant. The only statistically significant effect that we find is that a 1SD increase in foreign students decreases the probability of switching from a non-STEM degree to a STEM degree by 1.2pp, statistically significant at 5% level. This is a large effect (75% relative to the mean) given the low rate of students

Table 4: The effect of foreign peers on natives' HE outcomes

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	HE performance					Displacement		
	Graduated	First	Upper second	Lower second	Third	To non-Russell	To non-STEM	To STEM
				A. Baseline				
Foreign peers	-0.003	0.009	-0.017**	0.007	0.001	0.001	0.008	-0.012**
	(0.005)	(0.007)	(0.007)	(0.007)	(0.003)	(0.009)	(0.008)	(0.006)
				B. EU vs Non-EU				
EU peers	-0.004	0.003	-0.002	-0.003	0.004*	0.010*	0.011	-0.012***
	(0.006)	(0.005)	(0.006)	(0.007)	(0.002)	(0.005)	(0.008)	(0.004)
non-EU peers	-0.001	0.009	-0.019**	0.010	-0.002	-0.002	0.003	-0.006
	(0.005)	(0.007)	(0.008)	(0.007)	(0.003)	(0.009)	(0.008)	(0.005)
Obs.	513000	513000	513000	513000	513000	132700	148700	364300
Mean Y	0.856	0.121	0.444	0.212	0.035	0.024	0.049	0.016

Note: Controls: gender, year and month of birth, ethnicity, disability, parental socio-economic classification, state school, low participation neighborhood quintiles, UCAS tariff score, log of distance between university and domicile, and log size of the university-degree cell. Fixed effects: university, degree, year, university-degree, year-degree, and year-university. Standard errors clustered by university. * $p < .10$ ** $p < 0.05$, *** $p < 0.01$

changing degree at baseline. EU students are those driving the result on non-STEM degree retention. Furthermore, a 1SD increase in the share of EU students increases the probability of changing from a Russell to a non-Russell university by 1pp (42% relative to the mean), statistically significant at 10% level.

We run some additional analysis to understand what drives our findings. First, we consider that the effect of foreign students on natives' grades could result from grading on a curve, for which natives are mechanically pushed down in the grade distribution by the increase in foreign students. We test this by regressing the degree classification outcomes on all students, not just natives. If we do not see any change in the average degree classification, this would be indicative of a grading on a curve mechanism, i.e. foreign students mechanically displace natives in other strata of the distribution without, however, changing the overall distribution of grades. We find no evidence of the grading on a curve mechanism, see Table

A1. Non-EU students decrease the probability of getting an upper second degree classification and EU students of getting a lower second degree classification.

The other mechanism that could explain our findings is that foreign students affect the comparison group to which natives relate themselves with. If this is the case, we would expect the effect of foreign students to be heterogeneous across the ability distribution of natives. To test this we implement the following equation:

$$\begin{aligned} y_{iduc} =& \delta_0 + \delta_1 \bar{z}_{duc}^{EU} + \delta_2 \bar{z}_{duc}^{NonEU} \\ &+ \sum_{q=1}^{3} [\delta_4^q + \delta_5^q \bar{z}_{duc}^{EU} + \delta_6^q \bar{z}_{duc}^{Non-EU}] \, \mathbb{1}[a_c^{q-1} < a_i \leq a_c^q] \\ &+ \tau_{du} + \upsilon_{dc} + \omega_{uc} + \epsilon_{iduc}, \end{aligned} \tag{7}$$

where $\mathbb{1}[.]$ is the indicator function and a_c^q are cohort-specific tercile thresholds of the UCAS tariff score. Figures 3 and 4 report the estimated coefficients and the 90% confidence intervals of the impact of foreign students on each of the the tercile. More precisely, we report $\widehat{\delta_1} + \widehat{\delta_5}$ for EU students and $\widehat{\delta_2} + \widehat{\delta_6}$ for non-EU students (black and blue dots, respectively) and the ability tercile-specific mean value of the outcome (grey squares).

EU students decrease the probability of high ability natives of getting an upper second and increase the probability of getting a third. Non-EU students, on the other hand, push medium ability natives towards a first and medium and high ability natives towards a lower second instead of an upper second degree classification. The magnitude of some of these effects is not negligible. For example, the probability of getting a third for high ability natives increases by over 50% for 1SD increase in the share of EU students.

Furthermore, the displacement effect towards non-Russell universities driven

by EU students is mainly found among middle and high-ability natives. A 1SD increase in the share of EU students increases the probability of high and middle ability natives to move to a non-Russell group university by about 80% and 40%, respectively. Although less precisely estimated, also the increase likelihood of changing for a non-STEM degree is concentrated among middle and high ability native students.

The heterogeneous effect of EU and non-EU students is consistent with them representing, on average, different ability groups. Table A2 shows that EU students are over represented, compared to both native and non-EU students, among the top performers: 17% of EU students get a first and 41% an upper second degree classification. Non-EU students are, on the other hand, more likely than EU and native students to be in the lower tail of the degree classification. Thus, on average, EU students are high performers and non-EU students are low performers. The displacement effects of EU students on higher ability natives is consistent with a mechanism where high ability students infer their relative ability by comparing themselves with other high ability students, and an additional EU student means, on average, an additional higher ability students. This might bring natives to downward adjust their perceived ability, similar to the effects found in the ordinal ranking literature (see Elsner et al., 2021, and literature cited therein).

Interestingly, the magnitude and significance of the retention effect in non-STEM degrees of EU students is the same across the different ability groups of natives. This suggests that there might be another mechanism at work through which foreign students affect native students, for example the decrease in the quality of the learning environment due to the lack of English proficiency of foreign students. Indeed, despite our context is different from the US, and we observe all

universities and degree programmes in England, these findings are consistent with what has been found in Anelli et al. (2017). Looking at an introductory maths class in a university in California, they find that foreign students move domestic students towards non-STEM degrees. They show that this is driven by foreign classmates possessing weak English language ability, which they interpret as lowering in-class communication and social interactions. Also Chevalier et al. (2019), despite not finding any effect of language diversity on the performances of native English speakers, find that native speakers marginally perceive a lower quality of English spoken in the classroom when there is a high share of non-native speakers. We have no information on English proficiency of students. However, foreign students lacking proficiency in English would be consistent with our results. For example, in non-STEM degrees proficiency in English is essential, definitely more than in STEM degrees. Thus, a higher share of foreign students (which are likely to be non-native English speaker) might increase the self-perceived ability of native students. The retention effect is driven by EU students, which by definition are all non-English mother-tongue speakers as in none of the EU countries English is the official language. Non-EU students (the large majority of whom are not native Engli) also have a positive effect on non-STEM retention which is homogenous across the native ability distribution, although it is smaller than the effect of EU students and not statistically significant.

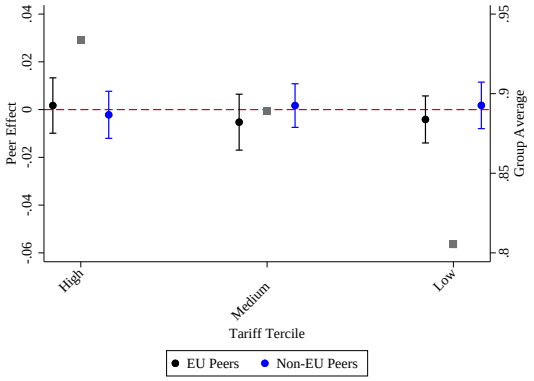
Finally, as foreign students affect the probability of natives of moving across universities and degree, we split the population of natives in stayers and movers, i.e. we re-estimate the main HE outcomes for those natives who stayed in a Russell university and in a STEM or non-STEM degree and for those who moved across. The results of this analysis are reported in Table A3. Most of the (nega-

tive) foreign peer effects on HE performances are found among the stayers. This is indicative of peer effects on HE performances mainly working through *direct* contact and interactions with non-native students in the learning environment - and not by foreign peers displacing natives across different university and degree types after enrolment. On the other hand, moving to a non-Russell universities and to a non-STEM degrees have some positive effects on graduation probability and degree classification. This is consistent with natives moving to less competitive environments.

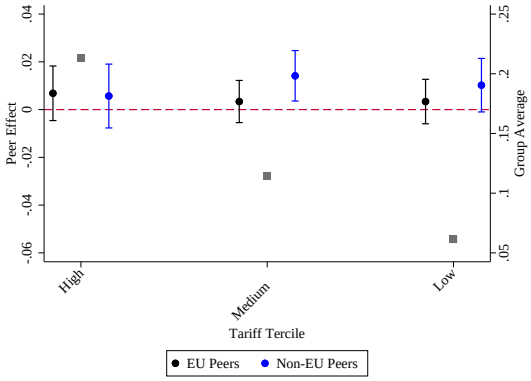
Overall, our estimates suggest that the likely mechanism underlying the impact of studying with foreign students in HE is that the latter affect the comparison group from which natives infer their own perceived ability. The fact that high ability natives are negatively affected in terms of performances and are displaced towards less competitive environments by EU students, who on average are high performers, suggests that foreign students positively affect the ability composition in the degree programme. Furthermore, the fact that the retention in non-STEM degrees affects all natives similarly, independently of their academic ability, suggests that also the lack of language proficiency of foreign students plays an important role in explaining foreign peer effects.

Figure 3: HE performances by ability group

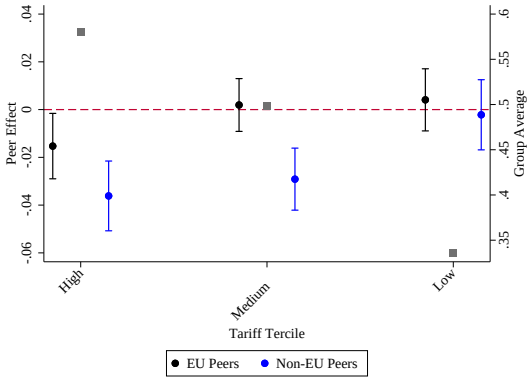
(a) Graduated



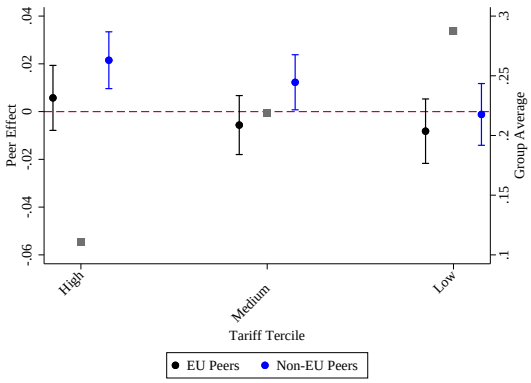
(b) First



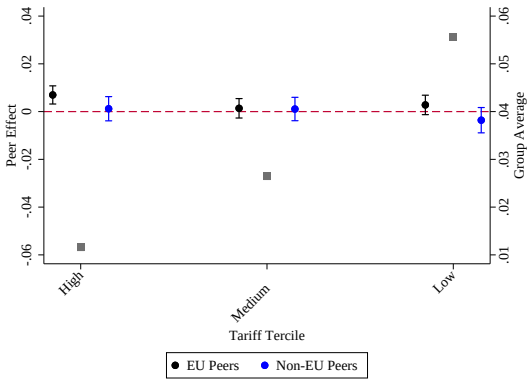
(c) Upper second



(d) Lower second



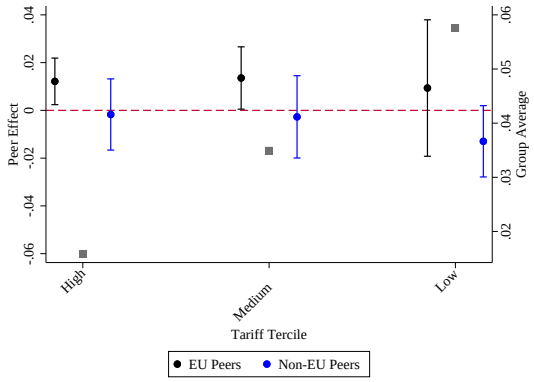
(e) Third



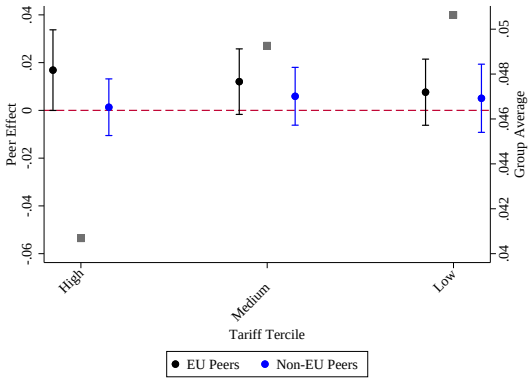
Note: Controls: gender, year and month of birth, ethnicity, disability, parental socio-economic classification, state school, low participation neighborhood quintiles, log of distance between university and domicile, and log size of the university-degree cell. Fixed effects: university, degree, year, university-degree, year-degree, and year-university. Standard errors clustered by university. 90% confidence intervals. Effects measured on the left-axis. Outcome averages, represented by grey squares, measured in the right-axis.

Figure 4: HE displacement probability by ability group

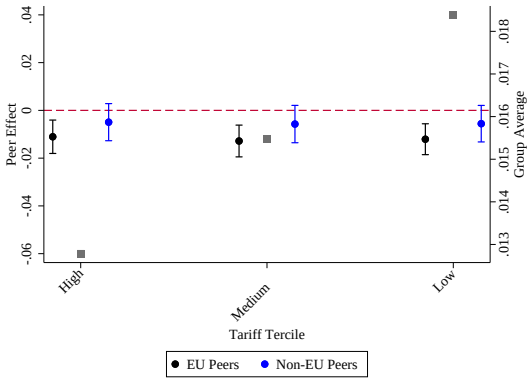
(a) Changed to a non-Russell university



(b) Changed to a non-STEM degree



(c) Changed to a STEM degree



Note: As in figure 3.

The Effect of Foreign Students on the Initial Labour Market Outcomes of Native Graduates

Table 5 shows the results for the analysis on the labour market outcomes. A 1SD increase in the share of foreign peers decreases the probability of native graduates of working and increases the one of studying and of being unemployed. However, the estimates are not statistically significant. When the analysis is split by the origin of foreign peers, we find that a 1SD increase in the share of EU students decreases the probability of working at 6 months after graduation by 2.3pp (3.7% relative to the mean) statistically significant at 5% level, and increases the probability of being unemployed by 1pp (11% relative to the mean), statistically significant at 10%. Within the sample of native graduates employed at 6 months after graduation, foreign students increase the probability of being in a professional, managerial, directorial or senior official occupation, although these effects are not statistically significant.[19]

We replicate the analysis by including as covariates: whether changed university and degree, and the degree classification obtained. By including these additional controls we aim to capture the effect of foreign students on the labour market outcomes of native graduates beyond their effects on HE outcomes. Table A4 shows that the estimates are not importantly affected by these additional con-

[19]We know the labour market outcomes of only about about 80% of graduates. To check that the results are not driven by the sample selection of graduates who responded to the DLHE survey, we build inverse probability weights on the probability of being a DLHE respondent from the HESA population and repeat the analysis. The estimates from the probit regression on whether being a DLHE respondent used to build the inverse probability weight shows that DLHE respondents are, on average, positively selected (e.g. they are more likely to have attended a Russell group university, to have got a high final grade, to have a high UCAS tariff score and to be from a high SES). When we account for sample selection in the DLHE survey, the main findings, however, remain unaltered.

Table 5: The effect of foreign peers on natives' LM outcomes

	(1)	(2)	(3)	(4)	(5)
	Activity status				Graduates in work
	Working	Studying	Unemployed	Other	High SEC
			A. Baseline		
Foreign peers	-0.014	0.008	0.004	0.001	0.028
	(0.010)	(0.010)	(0.006)	(0.005)	(0.017)
			B. EU vs Non-EU		
EU peers	-0.023**	0.007	0.010*	0.007	0.011
	(0.009)	(0.009)	(0.006)	(0.005)	(0.013)
non-EU peers	0.002	0.004	-0.003	-0.004	0.025
	(0.011)	(0.010)	(0.006)	(0.005)	(0.015)
Obs.	237200	237200	237200	237200	167000
Mean Y	0.614	0.228	0.089	0.068	0.241

Note: Controls: gender, year and month of birth, ethnicity, disability, parental socio-economic classification, state school, low participation neighbourhood quintiles, UCAS tariff score, log of distance between university and domicile, and log size of the university-degree cell. Fixed effects: university, degree, year, university-degree, year-degree, and year-university. Standard errors clustered by university. * $p < .10$ ** $p < 0.05$, *** $p < 0.01$

trols. This may suggests that the effect of foreign students on the labour market outcomes of natives cannot be completely explained by foreign students affecting the HE outcomes of native graduates. We take these estimates as only suggestive. This is because to identify the effect of foreign peers on natives' labour market outcomes through changes in educational outcomes we would need to first have identified the causal effect of the latter on the earlier outcomes. The causal estimation of education outcomes on labour outcomes is, however, something outside the scope of this paper.

We then estimate the effect of foreign students on native graduates by UCAS tariff score terciles, see Figure A3. Overall, EU students decrease the probability of working in favour of being unemployed and of doing something else (i.e. in-

ternships, gap year) similarly across the three ability groups. Non-EU students increase the probability of natives of studying instead of working for high ability natives. This (positive) selection in terms of whether observed in work, can partly explain the positive effect that non-EU students have on the job characteristics of employed graduates, which are mainly found among high ability natives.

The Effect of Foreign Students on the SES Gap in Higher Education

In the last decades there has been a constant increase in the HE participation of students from a low SES (Murphy et al., 2019). Nevertheless, it is still the case that low SES students sort disproportionally in universities not belonging to the Russell group and experience worse academic outcomes, such as graduating with a low degree classification, and labour market outcomes, such as being less likely to be employed in graduate jobs, than high SES students (Del Bono and Morando, 2021; Campbell et al., forthcoming).

To contribute to the literature on inequality in HE, we investigate whether the composition of foreign peers affects different SES groups in a dissimilar manner. We interact the share of foreign peers with the parental socio-economic classification[20] which has been collapsed in three categories, where the higher the category, the higher the SES.

[20]We use the parental SEC indicator to identify the SES of native students as the latter variable measures the individual condition of students, unlike the LPN variable which is measured at aggregate level and hence is more likely to be noisy. Moreover, parental SEC allows us to have a less polarized measure of SES compared to the state school indicator, as 90% of students are in the state school category. When we replicate the analysis of the effects of foreign peers using the LPN quintiles and the state school indicator to depict natives' SES, results are consistent with those presented in this section.

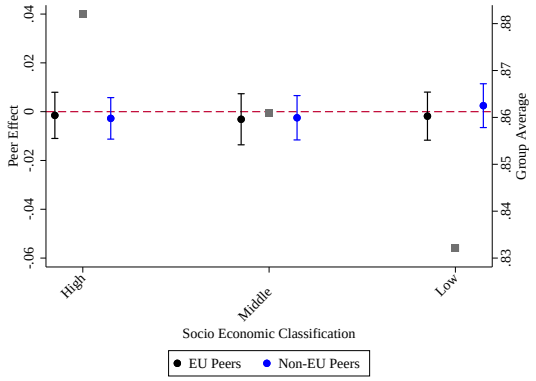
A 1SD increase in the share of EU students increases the probability of getting a third for middle and low ability natives by 15% and 10%, respectively, see figure 5. This could be seen as a negative outcome as these groups of students already have a higher probability of getting a low degree classification compared to high SES students. On the other hand, a 1SD in the share of EU students increases the probability of high and middle SES natives to change to a non-Russell university by 50%, thus decreasing the SES gap in participation in prestigious universities, see figure 6.

A 1SD increase in the share of non-EU students increases the probability of low SES students of getting a first by 16%, thus decreasing the SES gap in degree classification. Finally, non-EU and EU students effect on second degree classification and non-STEM retention is the same across the native ability distribution, thus not affecting the SES gradient in degree classification.

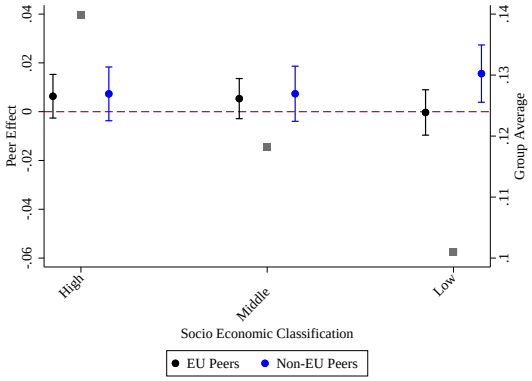
Finally, in terms of labour market outcomes (see Figure A4), EU students decrease the probability of being in work of high and low SES native students by about 3%. However, for the latter, this means mainly an increase in the probability of being unemployed, while for the former, an increase in doing other activities. Non-EU students increase the probability of native students of being in an high occupation across all SES groups.

Figure 5: HE performances by parental SEC

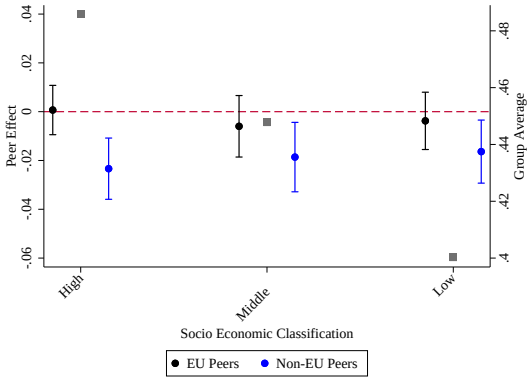
(a) Graduated



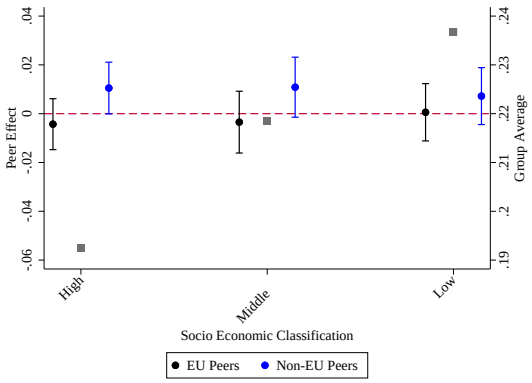
(b) First



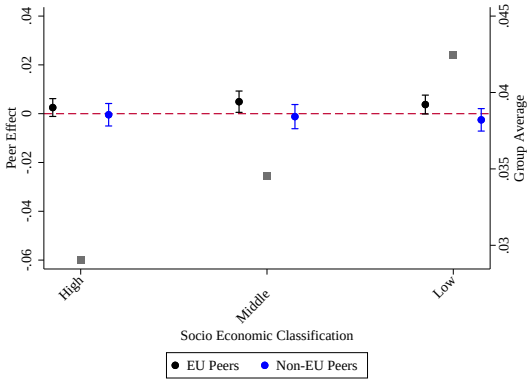
(c) Upper second



(d) Lower second



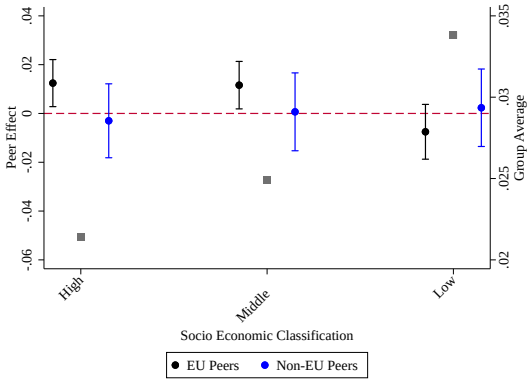
(e) Third



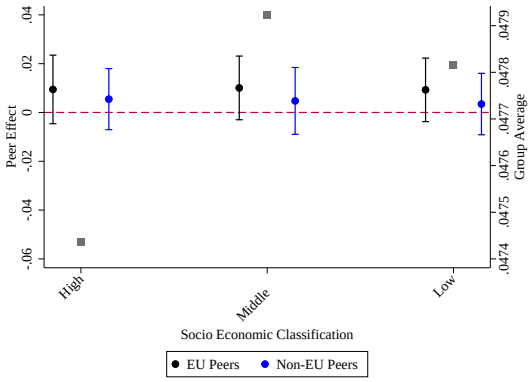
Note: *High* contains the categories higher managerial & professional occupations, lower managerial & professional occupations; *Middle* contains the categories intermediate occupations, small employers & own account workers; *Low* contains the categories lower supervisory & technical occupations, semi-routine occupations, routine occupations, never worked & long-term unemployed. Controls: gender, year and month of birth, ethnicity, disability, ability deciles, state school, low participation neighborhood quintiles, log of distance between university and domicile, and log size of the university-degree cell. Fixed effects: university, degree, year, university-degree, year-degree, and year-university. Standard errors clustered by university. 90% confidence intervals.

Figure 6: HE displacement probability by parental SEC

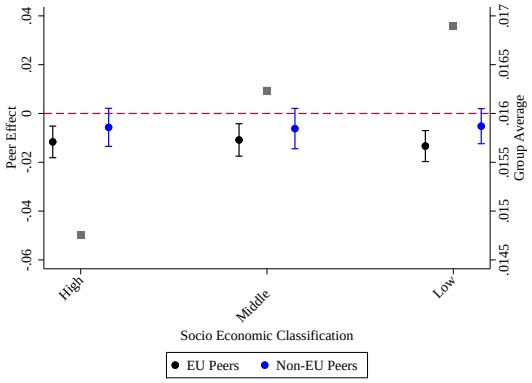
(a) Changed to a non-Russell university



(b) Changed to a non-STEM degree



(c) Changed to a STEM degree



Note: As in figure 5.

7 Robustness Checks

Without individual characteristics as control variables

Complementary to what shown in Section 5, we show that when omitting individual characteristics as control variables, the main findings are not affected. This analysis is reported in Panel I of Table A5.

Academic ability measured by UCAS tariff score

We explained in Section 3 the relevance of conditioning on natives' UCAS tariff score. However, this is not known for all native students and in the main analysis we retained all students. When we replicate the analysis without students with missing UCAS tariff score, the main findings remain unchanged, see Panel II of Table A5. Furthermore, the way in which we control for UCAS tariff score does not affect the main findings. Panel III of Table A5 shows the main results when we use UCAS tariff score quintiles instead of a continuous variable.

8 Conclusion

This paper is the first to study the impact of foreign students on the educational and early labour market outcomes of native students in the entire system of HE. Overall, we conclude that the effect of foreign students on natives' educational outcomes is mild. Thanks to the rich administrative dataset used we are able to investigate a large number of outcomes. Foreign students have no effect on the probability of graduating, mild effect on the degree classification achieved, and an

important effect on the probability of moving to a less prestigious university and to remain in a non-STEM degree. Nevertheless, the latter displacement outcomes are rare occurrences. We also find that for native graduates the impact of sharing an undergraduate degree with foreign students on the activity status and type of job (if employed) at six months after graduation is mild.

We provide some evidence that the likely mechanism underlying our findings is that foreign students affect the composition of the group against which natives compare themselves to infer their own academic ability (i.e. foreign students alter the academic ability and the language skills of the comparison group). We leave it to future research to provide additional insights about the mechanisms behind the effect of foreign students on native students. New survey data collecting information on the academic ability and language proficiency of foreign students, on self-perceived ability of native students, and on how the social network of native students is affected by foreign students will be extremely valuable for understanding the mechanisms behind foreign peer effects.

References

Altonji, J. G., E. Blom, and C. Meghir (2012): "Heterogeneity in human capital investments: High school curriculum, college major, and careers," *Annu. Rev. Econ.*, 4, 185–223.

Anelli, M. and G. Peri (2017): "The effects of high school peers' gender on college major, college performance and income," *The Economic Journal*, 129, 553–602.

Anelli, M., K. Shih, and K. Williams (2017): "Foreign Peer Effects and STEM Major Choice," *IZA Discussion Paper*.

Angrist, J. D. (2014): "The perils of peer effects," *Labour Economics*, 30, 98–108.

Angrist, J. D. and V. Lavy (1999): "Using Maimonides' rule to estimate the effect of class size on scholastic achievement," *The Quarterly Journal of Economics*, 114, 533–575.

Baert, S., B. Cockx, and D. Verhaest (2013): "Overeducation at the start of the career: stepping stone or trap?" *Labour Economics*, 25, 123–140.

Ballatore, R. M., M. Fort, and A. Ichino (2018): "Tower of Babel in the Classroom: Immigrants and Natives in Italian Schools," *Journal of Labor Economics*, 36, 885–921.

Black, D. A. and J. A. Smith (2006): "Estimating the returns to college quality with multiple proxies for quality," *Journal of labor Economics*, 24, 701–728.

Blom, E., B. C. Cadena, and B. J. Keys (2021): "Investment over the business cycle: Insights from college major choice," *Journal of Labor Economics*, 39, 1043–1082.

Blundell, R., L. Dearden, A. Goodman, and H. Reed (2000): "The returns to higher education in Britain: evidence from a British cohort," *The Economic Journal*, 110, F82–F99.

Bostwick, V. K. and B. A. Weinberg (2022): "Nevertheless she persisted? Gender peer effects in doctoral STEM programs," *Journal of Labor Economics*, 40, 000–000.

Braakmann, N. and S. McDonald (2018): "Student exposure to socio-economic diversity and students' university outcomes–Evidence from English administrative data," *Working Paper*.

Britton, J., L. van der Erve, C. Belfield, A. Vignoles, M. Dickson, Y. Zhu, I. Walker, L. Dearden, L. Sibieta, and F. Buscha (2021): "How much does degree choice matter?" Tech. rep., IFS Working Paper.

Broecke, S. (2012): "University selectivity and earnings: Evidence from UK data on applications and admissions to university," *Economics of Education Review*, 31, 96–107.

Campbell, S., R. Murphy, L. Macmillan, and G. Wyness (forthcoming): "Matching in the Dark? Inequalities in Student to Degree Match," *Journal of Labor Economics*.

Carrell, S. E., M. Hoekstra, and E. Kuka (2018): "The long-run effects of disruptive peers," *American Economic Review*, 108, 3377–3415.

Chetty, R., J. N. Friedman, E. Saez, N. Turner, and D. Yagan (2020): "Income segregation and intergenerational mobility across colleges in the United States," *The Quarterly Journal of Economics*, 135, 1567–1633.

Chevalier, A. (2011): "Subject choice and earnings of UK graduates," *Economics of Education Review*, 30, 1187–1201.

Chevalier, A., I. E. Isphording, and E. Lisauskaite (2019): "Peer Diversity, College Performance and Educational Choices," Tech. rep., Institute for the Study of Labor (IZA).

Chin, A., N. M. Daysal, and S. A. Imberman (2013): "Impact of bilingual education programs on limited English proficient students and their peers: Regression discontinuity evidence from Texas," *Journal of Public Economics*, 107, 63–78.

Clark, D. (2011): "Do Recessions Keep Students in School? The Impact of Youth Unemployment on Enrolment in Post-compulsory Education in England," *Economica*, 78, 523–545.

Cools, A., R. Fernández, and E. Patacchini (2019): "Girls, Boys, and High Achievers," Tech. rep., National Bureau of Economic Research.

Cornelissen, T., C. Dustmann, and U. Schönberg (2017): "Peer effects in the workplace," *American Economic Review*, 107, 425–56.

Cunha, J. M. and T. Miller (2014): "Measuring value-added in higher education: Possibilities and limitations in the use of administrative data," *Economics of Education Review*, 42, 64–77.

Dale, S. B. and A. B. Krueger (2014): "Estimating the effects of college characteristics over the career using administrative earnings data," *Journal of human resources*, 49, 323–358.

Del Bono, E. and G. Morando (2021): "For some, luck matters more: the impact of the great recession on the early careers of graduates from different socio-economic backgrounds," *Oxford Economic Papers*, 1–25.

Dillon, E. W. and J. A. Smith (2020): "The consequences of academic match between students and colleges," *Journal of Human Resources*, 55, 767–808.

Dustmann, C., T. Frattini, and I. P. Preston (2013): "The effect of immigration along the distribution of wages," *The Review of Economic Studies*, 80, 145–173.

Elsner, B. and I. E. Isphording (2017): "A big fish in a small pond: Ability rank and human capital investment," *Journal of Labor Economics*, 35, 787–828.

Elsner, B., I. E. Isphording, U. Zölitz, et al. (2021): "Achievement Rank Affects Performance and Major Choices in College," Tech. rep., CESifo.

Feng, A. and G. Graetz (2017): "A question of degree: the effects of degree class on labor market outcomes," *Economics of Education Review*, 61, 140–161.

Fletcher, J., J. Kim, J. Nobles, S. Ross, and I. Shaorshadze (2019): "The Effects of Foreign-Born Peers in US High Schools and Middle Schools," Tech. rep., National Bureau of Economic Research.

French, M. T., J. F. Homer, I. Popovici, and P. K. Robins (2015): "What you do in high school matters: High school GPA, educational attainment, and labor market earnings as a young adult," *Eastern Economic Journal*, 41, 370–386.

Geay, C., S. McNally, and S. Telhaj (2013): "Non-native Speakers of English in the Classroom: What Are the Effects on Pupil Performance?" *The Economic Journal*, 123, F281–F307.

Gould, E. D., V. Lavy, and M. Daniele Paserman (2009): "Does immigration affect the long-term educational outcomes of natives? Quasi-experimental evidence," *The Economic Journal*, 119, 1243–1269.

Hanushek, E. A., J. F. Kain, J. M. Markman, and S. G. Rivkin (2003): "Does peer ability affect student achievement?" *Journal of applied econometrics*, 18, 527–544.

Hoekstra, M. (2009): "The effect of attending the flagship state university on earnings: A discontinuity-based approach," *The review of economics and statistics*, 91, 717–724.

Hoxby, C. (2000): "Peer Effects in the Classroom: Learning from Gender and Race Variation," National Bureau of Economic Research, Inc.

Iranzo, S., F. Schivardi, and E. Tosetti (2008): "Skill dispersion and firm productivity: An analysis with employer-employee matched data," *Journal of Labor Economics*, 26, 247–285.

Jaeger, D. A. and M. E. Page (1996): "Degrees matter: New evidence on sheepskin effects in the returns to education," *The Review of Economics and Statistics*, 733–740.

Jones, E. B. and J. D. Jackson (1990): "College grades and labor market rewards," *The Journal of Human Resources*, 25, 253.

Kahn, L. B. (2010): "The long-term labor market consequences of graduating from college in a bad economy," *Labour Economics*, 17, 303–316.

Kirkeboen, L. J., E. Leuven, and M. Mogstad (2016): "Field of study, earnings, and self-selection," *The Quarterly Journal of Economics*, 131, 1057–1111.

Krueger, A. B. (2003): "Economic considerations and class size," *The Economic Journal*, 113, F34–F63.

Lavy, V. and A. Schlosser (2011): "Mechanisms and impacts of gender peer effects at school," *American Economic Journal: Applied Economics*, 3, 1–33.

Machin, S. and R. Murphy (2017): "Paying out and crowding out? The globalization of higher education," *Journal of Economic Geography*, 17, 1075–1110.

Manacorda, M., A. Manning, and J. Wadsworth (2012): "The impact of immigration on the structure of wages: theory and evidence from Britain," *Journal of the European Economic Association*, 10, 120–151.

Manski, C. F. (1993): "Identification of endogenous social effects: The reflection problem," *The Review of Economic Studies*, 60, 531–542.

Meschi, E., J. K. Swaffield, and A. Vignoles (2011): "The Relative Importance of Local Labour Market Conditions and Pupil Attainment on Post-Compulsory Schooling Decisions," IZA Discussion Papers 6143, Institute for the Study of Labor (IZA).

Mountjoy, J. and B. Hickman (2020): "The Returns to College (s): Estimating Value-Added and Match Effects in Higher Education," *University of Chicago, Becker Friedman Institute for Economics Working Paper*.

Murphy, R., J. Scott-Clayton, and G. Wyness (2019): "The end of free college in England: Implications for enrolments, equity, and quality," *Economics of Education Review*, 71, 7–22.

Murphy, R. and F. Weinhardt (2018): "Top of the class: The importance of ordinal rank," Tech. rep., National Bureau of Economic Research.

Ohinata, A. and J. C. Van Ours (2013): "How immigrant children affect the academic achievement of native Dutch children," *The Economic Journal*, 123, F308–F331.

Oreopoulos, P., T. Von Wachter, and A. Heisz (2012): "The short-and long-term career effects of graduating in a recession," *American Economic Journal: Applied Economics*, 4, 1–29.

Raaum, O. and K. Røed (2006): "Do business cycle conditions at the time of labor market entry affect future employment prospects?" *The Review of Economics and Statistics*, 88, 193–210.

Rampino, T. and M. P. Taylor (2012): "Educational aspirations and attitudes over the business cycle," ISER Working Paper Series 2012-26, Institute for Social and Economic Research.

Sacerdote, B. (2011): "Peer effects in education: How might they work, how big are they and how much do we know thus far?" in *Handbook of the Economics of Education*, Elsevier, vol. 3, 249–277.

Taylor, M. P. (2013): "The labour market impacts of leaving education when unemployment is high: evidence from Britain," ISER Working Paper Series 2013-12, Institute for Social and Economic Research.

Tumino, A. and M. P. Taylor (2015): "The impact of local labour market

conditions on school leaving decisions," ISER Working Paper Series 2015-14, Institute for Social and Economic Research.

Vignoles, A. F. and N. Powdthavee (2009): "The socioeconomic gap in university dropouts," *The BE Journal of Economic Analysis & Policy*, 9.

Von Wachter, T. and S. Bender (2006): "In the right place at the wrong time: The role of firms and luck in young workers' careers," *American Economic Review*, 96, 1679–1705.

Walker, I. and Y. Zhu (2011): "Differences by degree: Evidence of the net financial rates of return to undergraduate study for England and Wales," *Economics of Education Review*, 30, 1177–1186.

——— (2018): "University selectivity and the relative returns to higher education: Evidence from the UK," *Labour Economics*, 53, 230–249.

Appendix

Additional Tables

Table A1: Grading on a curve test

	(1) First	(2) Upper second	(3) Lower second	(4) Third
Foreign Peers	0.001	-0.017***	-0.004	0.007
	(0.005)	(0.005)	(0.007)	(0.004)
EU Peers	0.006	0.000	-0.008**	0.001
	(0.004)	(0.004)	(0.004)	(0.003)
Non-EU Peers	-0.002	-0.019***	-0.000	0.007
	(0.004)	(0.005)	(0.007)	(0.004)
Observations	758900	758900	758900	758900
Mean Y	0.121	0.400	0.218	0.045

Note: Whole sample of undergraduate students. Controls: gender, year and month of birth, ethnicity, disability, parental socio-economic classification, state school, low participation neighborhood quintiles, UCAS tariff score, log of distance between university and domicile, and log size of the university-degree cell. Fixed effects: university, degree, year, university-degree, year-degree, and year-university. Standard errors clustered by university. * $p < 0.10$ ** $p < 0.05$, *** $p < 0.01$.

Table A2: Higher Education Outcomes: Foreign Students

	Mean	Std.dev.	Min	Max
	EU Peers			
Graduated	0.855	0.352	0.000	1.000
Degree Classification:				
First	0.169	0.375	0.000	1.000
Upper Second	0.407	0.491	0.000	1.000
Lower Second	0.199	0.399	0.000	1.000
Third	0.041	0.198	0.000	1.000
	Non-EU Peers			
Graduated	0.862	0.345	0.000	1.000
Degree Classification:				
First	0.119	0.324	0.000	1.000
Upper Second	0.375	0.484	0.000	1.000
Lower Second	0.265	0.441	0.000	1.000
Third	0.068	0.252	0.000	1.000

Table A3: The effect of foreign peers on natives' HE outcomes by stayers and movers

	(1)	(2)	(3)	(4)	(5)	(6)
	Stayed in a			Moved to a		
	Russell university	Non-STEM degree	STEM degree	Non-Russell university	Non-STEM degree	STEM degree
			A. Graduated			
EU peers	0.006	-0.023	-0.000	-0.017	0.068	-0.128
	(0.011)	(0.014)	(0.006)	(0.089)	(0.061)	(0.079)
non-EU peers	-0.019*	-0.004	0.002	0.156***	-0.030	-0.137
	(0.009)	(0.011)	(0.006)	(0.045)	(0.076)	(0.110)
Mean Y	0.922	0.845	0.864	0.813	0.774	0.751
			A. First			
EU peers	0.000	0.006	0.003	0.092	0.077***	-0.048
	(0.013)	(0.009)	(0.006)	(0.074)	(0.028)	(0.030)
non-EU peers	0.025	0.014	0.006	0.001	-0.002	-0.076
	(0.017)	(0.010)	(0.007)	(0.059)	(0.044)	(0.051)
Mean Y	0.172	0.133	0.117	0.203	0.123	0.118
			A. Upper Second			
EU peers	0.010	-0.010	-0.000	-0.068	-0.015	-0.001
	(0.010)	(0.013)	(0.007)	(0.138)	(0.045)	(0.066)
non-EU peers	-0.034**	-0.022*	-0.023**	0.169*	-0.001	0.016
	(0.015)	(0.011)	(0.010)	(0.088)	(0.063)	(0.100)
Mean Y	0.578	0.399	0.465	0.389	0.373	0.337
			A. Lower Second			
EU peers	-0.006	-0.013	0.001	-0.089	0.034	-0.037
	(0.015)	(0.012)	(0.008)	(0.107)	(0.041)	(0.053)
non-EU peers	-0.006	0.005	0.020**	0.017	-0.027	-0.106
	(0.008)	(0.010)	(0.008)	(0.073)	(0.044)	(0.085)
Mean Y	0.137	0.219	0.210	0.128	0.171	0.180
			B. Third			
EU peers	0.008**	0.004	0.003	0.014	0.015	-0.022
	(0.004)	(0.005)	(0.002)	(0.025)	(0.024)	(0.023)
non-EU peers	-0.004	-0.006	-0.001	-0.023	0.037	0.021
	(0.003)	(0.005)	(0.003)	(0.019)	(0.030)	(0.035)
Mean Y	0.018	0.043	0.033	0.018	0.029	0.035
Obs.	129500	141500	358500	3100	7100	5600

Note: Controls: gender, year and month of birth, ethnicity, disability, parental socio-economic classification, state school, low participation neighbourhood quintiles, UCAS tariff score, log of distance between university and domicile, and log size of the university-degree cell. Fixed effects: university, degree, year, university-degree, year-degree, and year-university. Standard errors clustered by university. * $p < .10$ ** $p < 0.05$, *** $p < 0.01$

Table A4: The effect of foreign peers on natives' LM outcomes controlling for HE outcomes

	(1)	(2)	(3)	(4)	(5)
	Activity status				Graduates in work
	Working	Studying	Unemployed	Other	High SEC
			A. Baseline		
Foreign peers	-0.014	0.008	0.005	0.002	0.025
	(0.010)	(0.010)	(0.006)	(0.005)	(0.016)
			B. EU vs Non-EU		
EU peers	-0.023**	0.006	0.010*	0.007	0.009
	(0.009)	(0.008)	(0.006)	(0.005)	(0.013)
non-EU peers	0.001	0.005	-0.003	-0.004	0.024
	(0.011)	(0.010)	(0.006)	(0.005)	(0.015)
Obs.	237200	237200	237200	237200	167000
Mean Y	0.614	0.228	0.089	0.068	0.241

Note: Controls: gender, year and month of birth, ethnicity, disability, parental socio-economic classification, state school, low participation neighbourhood quintiles, UCAS tariff score, log of distance between university and domicile, and log size of the university-degree cell. Fixed effects: university, degree, year, university-degree, year-degree, and year-university. Furthermore, we control for the grade obtained and whether students have changed majors or university. Standard errors clustered by university. * $p < .10$ ** $p < 0.05$, *** $p < 0.01$

Table A5: Robustness checks

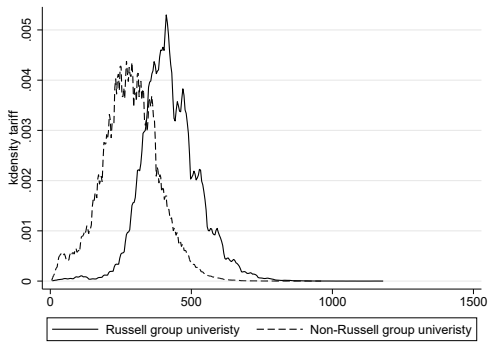
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	HE performance					Displacement		
	Graduated	First	Upper second	Lower second	Third	To non-Russell	To non-STEM	To STEM
	I: without individual characteristics as controls							
EU peers	-0.006	0.003	-0.003	-0.004	0.004*	0.010*	0.011	-0.012***
	(0.006)	(0.005)	(0.006)	(0.007)	(0.002)	(0.005)	(0.008)	(0.004)
non-EU peers	-0.001	0.009	-0.020***	0.010	-0.002	-0.002	0.003	-0.005
	(0.005)	(0.007)	(0.008)	(0.006)	(0.003)	(0.009)	(0.008)	(0.005)
Obs.	513000	513000	513000	513000	513000	132700	148700	364300
Mean Y	0.856	0.121	0.444	0.212	0.035	0.024	0.049	0.016
	II: without natives with no UCAS tariff score							
EU peers	-0.003	0.002	-0.005	-0.001	0.004*	0.013*	0.016*	-0.013***
	(0.005)	(0.005)	(0.006)	(0.007)	(0.002)	(0.006)	(0.009)	(0.004)
non-EU peers	-0.003	0.010	-0.023***	0.010	-0.001	0.000	0.011	-0.006
	(0.006)	(0.007)	(0.009)	(0.008)	(0.003)	(0.008)	(0.007)	(0.005)
Obs.	439000	439000	439000	439000	439000	127000	130000	309100
Mean Y	0.875	0.128	0.469	0.208	0.032	0.023	0.047	0.016
	III: UCAS tariff score quintiles							
EU peers	-0.005	0.003	-0.002	-0.003	0.004*	0.010*	0.011	-0.012***
	(0.006)	(0.005)	(0.006)	(0.007)	(0.002)	(0.005)	(0.008)	(0.004)
non-EU peers	-0.000	0.009	-0.018**	0.010	-0.002	-0.002	0.003	-0.006
	(0.005)	(0.007)	(0.008)	(0.007)	(0.003)	(0.009)	(0.008)	(0.005)
Obs.	513000	513000	513000	513000	513000	132700	148700	364300
Mean Y	0.856	0.121	0.444	0.212	0.035	0.024	0.049	0.016

Note: Controls: gender, year and month of birth, ethnicity, disability, parental socio-economic classification, state school, low participation neighborhood quintiles, UCAS tariff score, log of distance between university and domicile, and log size of the university-degree cell. Fixed effects: university, degree, year, university-degree, year-degree, and year-university. Standard errors clustered by university. * $p < .10$ ** $p < 0.05$, *** $p < 0.01$

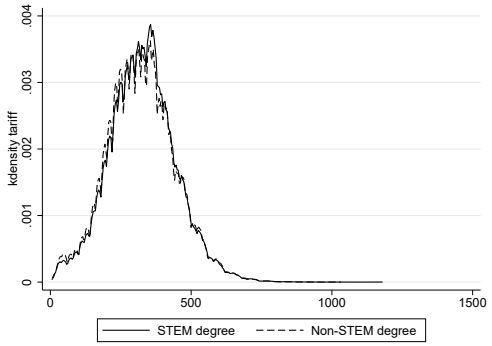
Additional Figures

Figure A1: Ability of natives by type of university and degree

(a) University type



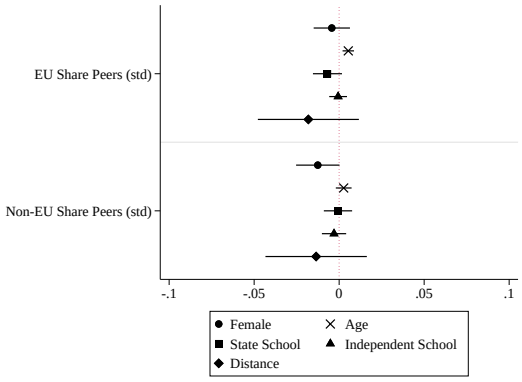
(b) Degree type



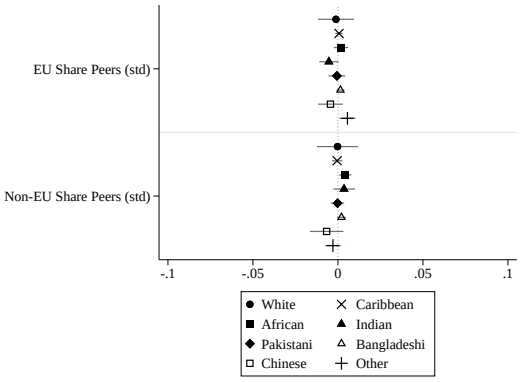
Note: Kernel density of UCAS tariff score by university and degree type. The UCAS tariff score measures pre-higher education academic merits of higher education applicants.

Figure A2: Balance test: shares of EU and non-EU students

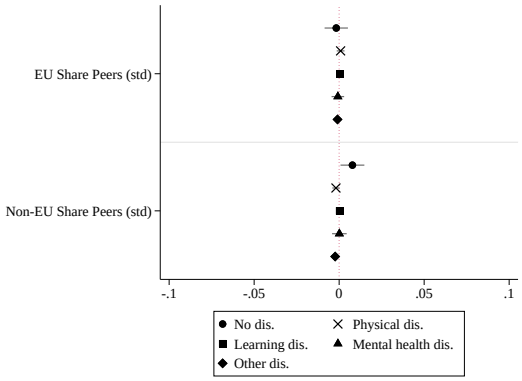
(a) Gender, age, school ,distance



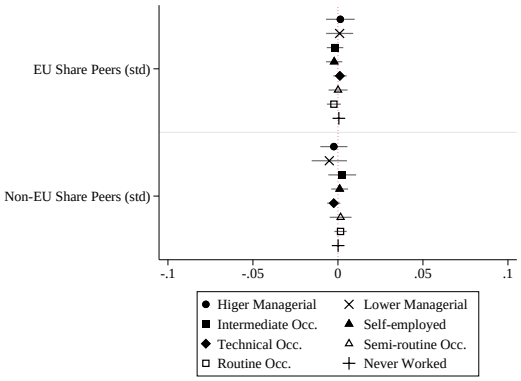
(b) Ethnicity



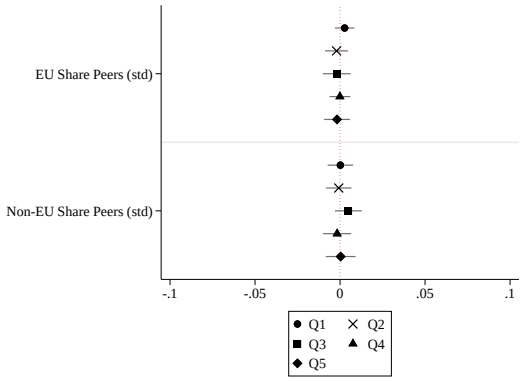
(c) Disability



(d) Socio-economic classification (parents)



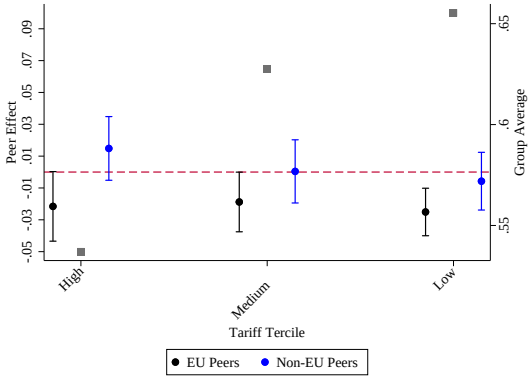
(e) Low participation neighborhood (LPN)



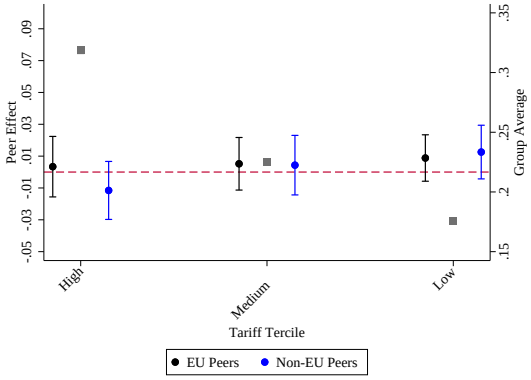
Note: All regressions include controls for UCAS tariff score deciles and log size of the university-degree cell. Fixed effects: university, degree, year, university-degree, year-degree, and year-university. Standard errors clustered by university. 90% confidence intervals reported.

Figure A3: Labour market outcomes by ability group

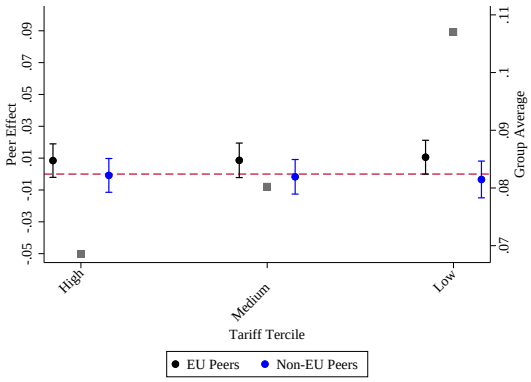
(a) Working



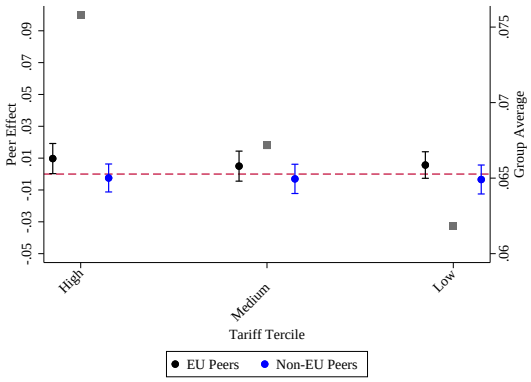
(b) Studying



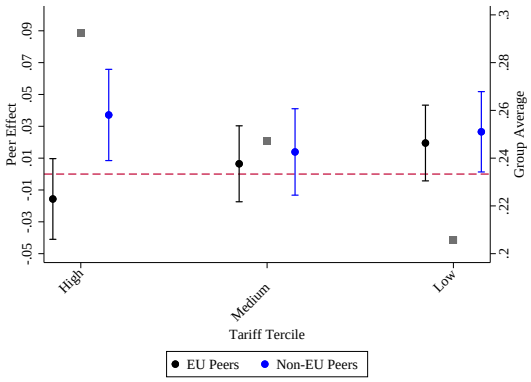
(c) Unemployed



(d) Other



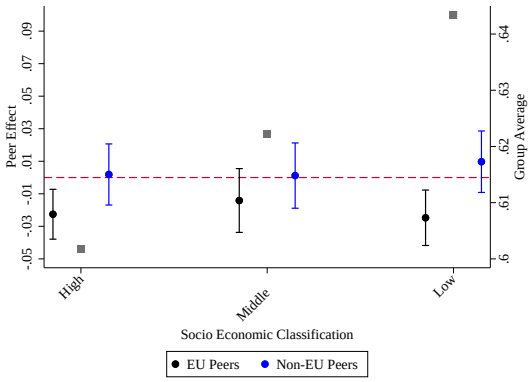
(e) Top occupation



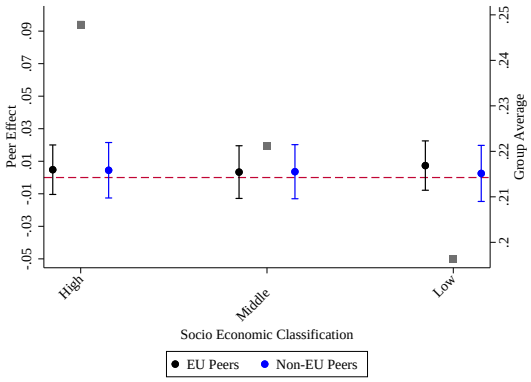
Note: As in figure 4.

Figure A4: Labour market outcomes by SEC group

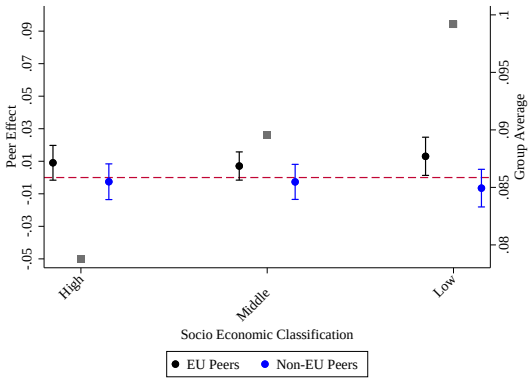
(a) Working



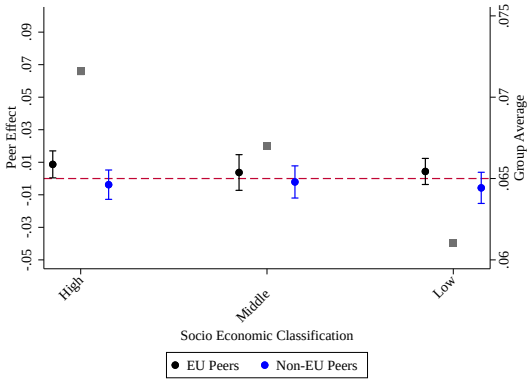
(b) Studying



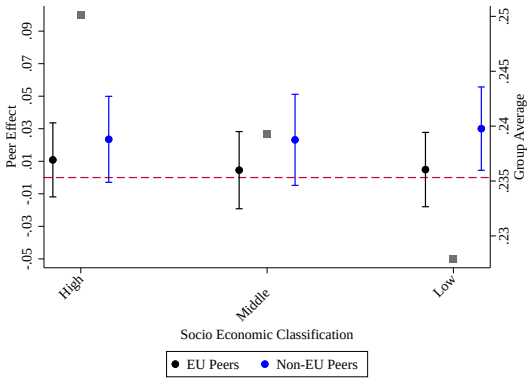
(c) Unemployed



(d) Other



(e) Top occupation



Note: As in figure 5.