Student exposure to socio-economic diversity and students' university outcomes – Evidence from English administrative data

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Abstract

Many countries encourage universities to increase the ethnic and socio-economic diversity of their student bodies, for example, through affirmative action policies. We use unique administrative data for all undergraduate degree students entering English universities between 2008 and 2010 to investigate the role of a more diverse environment for students' degree outcomes. We find a complex picture – a more diverse environment is beneficial for students, but so is meeting some students from the same background. These effects are different for good and top degrees, interact with each other and vary across institutions, subjects and student subgroups.

JEL Codes: H23, I23, I24, I26, I28, J15

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1. Introduction

A range of countries operate policies that mandate or encourage universities to admit students from hitherto underrepresented groups, usually defined by characteristics such as ethnicity or socio-economic background. Such policies have often been justified by one of two arguments. The first is that positive discrimination of a certain demographic group during university admissions is necessary to adjust for prior disadvantages of that group. In the context of the UK, for example, this argument has been used in response to the under-representation of low income and ethnic minority students at elite universities. However, it has proven controversial due to the possible discrimination of students from majority or privileged groups. For example, in the US universities have frequently been taken to court over affirmative action policies.[2] The second argument is that a more diverse student body brings positive externalities with all students benefiting from the exposure to a wider set of ideas and experiences than a more homogeneous student body. In a prominent example, US Supreme Court Justice Lewis Powell's opinion on the 1978 case *Regents of the University of California v. Bakke* stated that "The atmosphere of `speculation, experiment and creation' - so essential to the quality of higher education - is widely believed to be promoted by a diverse student body…. [I]t is not too much to say that the `nation's future depends upon leaders trained through wide exposure' to the ideas and mores of students as diverse as this Nation of many peoples." This paper is – to the best of our knowledge – the first attempt to test this idea using nationwide data on all undergraduate degree students and all universities[3] in a country.

A link between increased diversity and a broader educational experience seems intuitively plausible. One can imagine that a discussion of ethnicity-based discrimination in a sociology or labour economics class is enriched by the presence of ethnic minority students. Similarly, a discussion of poverty or policies designed to combat poverty will likely be different in a class that has students from both affluent and poor backgrounds than in a more homogeneous class. However, previous research in a range of contexts, from workplaces to local labour markets, suggests a more complex picture. Previous studies have highlighted the existence of beneficial

[2] Well-known examples in the context of university admissions that were decided by the Supreme Court of the United States were *Regents of the University of California v. Bakke,* 438 U.S. 265 in 1978, *Grutter v. Bollinger*, 539 U.S. 306 in 2003, *Gratz v. Bollinger,* 539 U.S. 244 in 2003, *Fisher v. University of Texas,* 570 U.S. ___ in 2013, *Schuette v. Coalition to Defend Affirmative Action*, 572 U.S. ___ in 2014 and most recently *Fisher v. University of Texas*, 579 U.S. ___ in 2016.

[3] In the following, we use the term "university" for all higher education institutions in the UK offering undergraduate qualifications at degree level. In addition to universities proper these also include institutions such as conservatories and schools of arts.

effects of a more diverse workforce (e.g., Leonard and Levine, 2006; Herring, 2009; Hoogendorn, Oosterbeck and van Praag, 2013; Garnero et al. 2014), and found evidence that more diverse local labour markets and regions tend to fare better in terms of wages, employment and productivity (e.g., Ottaviona and Peri, 2005, 2006; Sparber, 2010; Suedekum, Wolf and Blien, 2014; see Alesina and La Ferrara, 2005, for a review). Theoretically, these effects have been linked to a better understanding of diverse customers and a better quality of services and products due to the interaction of diverse customers and a diverse workforce (e.g., Cox, 1993; Cox and Beale, 1997; Hubbard, 2004; Richard, 2000; Smedley, Butler and Bristow, 2004), as well as a broadening of employee perspectives and beneficial creative conflict (Cox, 2001; Gurin, Nagda, and Lopez, 2004). However, other research has pointed out potential losses in group cohesion and tension (Tsui, Egan, and O'Reilly 1992, Skerry, 2002), people's desire to be among people similar to themselves (Byrne, 1971; Tajfel and Turner, 1986; Turner 1985; Card et al., 2008) and negative effects of being a member of a "too small" group (e.g., Leonard and Levine, 2006). There is also evidence that demographically more diverse groups find it more difficult to communicate even among native speakers of the same language (e.g., Lang, 1986; Tannen, 1990), which could attenuate any positive effect of a more diverse set of ideas being present.

In educational settings, previous evidence has suggested that more diverse environments affect outcomes such as friendships (e.g, Mouw and Entwisle, 2006; Smith, van Tuebergen, Maas and McFarland, 2016), dating (e.g., Strully, 2014; Merlino, Steinhardt and Wren-Lewis, 2018) and attitudes towards ethnic groups (e.g., Burgess and Platt, 2018). The effects of changing the socio-economic composition of classes or other groups have been primarily studied in primary or secondary schools, but most studies focus on one or at most a fairly small set of characteristics, such as the presence of non-native speakers or immigrants (e.g., Geay et al, 2013; Ohinata and van Ours, 2013, 2016; Schneeweis, 2015), the gender composition of classes (e.g., Hoxby, 2000; Lavy and Schlosser, 2011; Black, Devereux and Salvanes, 2013; Oosterbeek and van Ewijk, 2014; Eisenkopf et al, 2015; Schøne, von Simson and Strøm, 2016; Anelli and Peri, 2017; Bertoni, Brunello and Cappellari, 2017), ethnicity (Hoxby, 2000), age (Black, Devereux and Salvanes, 2013) or parental characteristics (Black, Devereux and Salvanes, 2013, Bertoni, Brunello and Cappellari, 2017).[4] In contrast to this literature we allow

[4] Our paper is also complimentary to a small literature studying effects of peer composition in university settings. This literature has a slightly different focus than our work and concentrates mostly on peer effects arising from differences in ability rather than the socio-economic characteristics considered in this paper. Examples are Sacerdote (2001), Lyle (2009), , Carrell, Fullerton and West (2009) and Waldinger (2010, 2012). Most recently,

for a greater intersectionality of these different socio-economic characteristics and consider, for example, a white man from an affluent background to be different to both a white man from a poor background and a black man from an affluent background.[5]

We use unique administrative data for all students entering English universities to study for an undergraduate degree in the academic years 2008/09, 2009/10 and 2010/11 to evaluate the effects of increasing diversity of a student's peers on their performance at university. Our data allows us to construct fine-grained measures of different student types, defined by all possible combinations of gender, country of origin, age, ethnicity and various measures of socio-economic background. Crucially, our data also provides information for each student on which other students they are exposed to in the various classes (modules) they attend during their studies. We account for the intersectionality of characteristics, i.e., the possibility that, say, a black woman has different perspectives than either a black man or an Asian woman, by grouping students into 1200 types based on all possible combinations of the aforementioned variables. Our analysis then focuses on two complementary measures of overall diversity. The first is the proportion of peers that share all background characteristics with a given student, i.e. who are of the same type. The second is a Herfindahl-style index based on the proportion of students from each type encountered by a given student. Descriptively, we find significant variation in the extent to which students are exposed to similar peers – on average 10% of a student's peers share the same background, but at the same time 18% of all students encounter not a single similar peer and 7% encounter more than 50% similar peers. Similar patterns can be found for almost all demographic groups and the findings are robust to changes in the definition of student types.

As our measures of peer diversity are based on pre-determined characteristics, we do not have to worry about reverse causality caused by the reflection problem (Manski, 1993). The main econometric issue is dealing with self-selection of different students into different courses and universities. We address these issues using several complementary identification strategies.

Booji, Leuven and Oosterbeek (2017) exploit the random assignment of undergraduate students to tutorial groups to study the effects of ability composition on performance. There is also related evidence from primary and secondary school settings that sorting students by ability into different educational tracks – and thus effectively making the student body more homogeneous – may have differential effects on students of different ability (see, e.g., Hanushek and Woessmann, 2006; Duflo et al, 2011; Malamud and Pop-Eleches, 2011; Hall 2012; Kerr et al., 2013; Guyon et al., 2012 Dustmann et al., 2017). In addition, ability peer effects have also been studied in the context of schools (e.g., Lavy, Paserman and Schlosser, 2012; Lavy, Silva and Weinhard, 2012).

[5] Our paper is also complimentary to a literature looking at the effects of affirmative action policies on outcomes such as minority enrolment and college composition (e.g., Card and Krueger, 2005; Dickson, 2006; Alon and Tienda, 2007; Alon, 2011; Backes, 2012; Francis and Tannuri-Pianto, 2012a,b; Hinrichs, 2012). In contrast to this literature, we are concerned with the effects of increased *peer* diversity on individual students.

Our main strategy relies on the use of multiple types of fixed effects, including institution-programme and institution-year FEs as well as institution-programme-year FEs. We also account for the possible remaining endogeneity of the diversity measures caused by selective dropouts and transfers of students. As an additional robustness check, we also use a Bartik-style instrument familiar from the immigration literature (e.g., Card and DiNardo, 2000, and Card, 2001) where we exploit the fact that certain student demographics are concentrated in certain universities. Nationwide changes in the number of students from this demographic will more greatly affect universities that historically admitted more students from this demographic. While Bartik-style instruments have recently come under criticism (e.g., Jaeger, Joyce and Kaestner, 2018; Jaeger, Ruist and Stuhler, 2018; Goldmsith-Pinkham, Sorkin and Swift, 2018), the fact that all our approaches lead to conclusions that are qualitatively identical and quantitatively very similar is reassuring.

Our results point towards a complex picture: We generally find that students benefit *both* from being exposed to a more diverse set of student types *and* from having peers similar to themselves. These effects are strongest when looking at the probability to obtain a good (upper second class or better) degree and weaker for the probability to obtain a top (first class) degree, where students benefit more from a more homogeneous peer group. We also find evidence for significant non-linearities and interactions between these two measures: Holding overall diversity constant, students generally benefit from having more similar peers. In particular, having no peers sharing the same background is highly detrimental to university performance. We also find that the effect of increasing overall diversity depends on the share of identical peers. Increased diversity is particularly beneficial for students who have no similar peers or a large number of similar peers. The former effect likely reflects that, if one is alone in a course, it is beneficial for everyone else to also be alone. One can imagine, for example, that a sole black, working-class woman finds it easier to integrate into a highly diverse course than one that is otherwise dominated by upper-class white men. The latter effect fits the idea that exposure to a too narrow set of backgrounds might stifle learning due to students not being exposed to a diverse set of ideas.

In additional analyses, we also explore the effects of changing one characteristic of a student's environment at a time. We find evidence of negative effects for a higher proportion of mature students and increased ethnic heterogeneity, but positive effects for the share of women and increased heterogeneity of social backgrounds. We also explore treatment effect-heterogeneity across student subgroups and find similar qualitative effects across all subgroups. Finally, we

explore treatment-effect heterogeneity across universities and subjects and find that, while the majority of institutions and subjects follow the same pattern as our base results, there are some cases where effects go in the opposite direction.

The paper proceeds as follows. Section 2 (briefly) describes the institutional background, i.e., the basic organisation of UK undergraduate degrees, as well as the data and the basic empirical strategy. Section 3 presents results for our main question – whether increased diversity improves university outcomes. Section 4 has further analysis by disentangling the effects of the sources of peer diversity as the effects of diversity on different student subgroups and across different universities. Section 5 concludes.

2. Institutional background, data and empirical strategy

2.1 Institutional background and data

Undergraduate degree students in English universities enrol for a course (*degree programme*) in a specific subject such as economics or sociology (*single honours degree*) or a combination of subjects such as "economics and politics" or "sociology and education" (*joint honours degree*). Degrees usually last for three or sometimes four years and are organised into stages, which are equivalent to years of study. The vast majority of degrees have stages further split into modules, such as "introductory economics" or "statistics", some of which are compulsory and some of which are optional. Earlier stages typically have a higher share of compulsory modules, while later stages usually offer more choice. For example, in our home institution students enrolling into a (fairly typical) 3-year single honours degree in economics would take 5 compulsory modules and 1 optional module in year 1, 5 compulsory and up to three optional modules in year 2 and 2 compulsory modules and between 4 and 8 optional modules at stage 3.

Modules are often shared between different degree programmes. For example, a first-year introductory economics module might be taken by students enrolled in a range of programmes with economics content, such as "economics", "economics and business management", "economics and finance", "economics and politics" or "accounting". Similarly, a first-year course in quantitative methods for the social sciences might be taken by students from sociology, political science, criminology and social work. As a consequence, students from one degree programme are exposed to students from other degree programmes, with the extent of this exposure depending on the amount of content shared between the programmes and the optional modules choices made by each student.

Degree programmes usually end with the award of a specific degree classification, depending on a student's average mark and a decision by the programme's board of examiners. Degree classifications are in ascending order fail, pass, third class honours, lower second class honours, upper second class honours and first class honours. Upper second and first class honours are generally seen as favourable outcomes that allow access to a wider range of jobs. For example, large employers often require at least an upper second class degree for entry into graduate job schemes. Some degrees, such as medicine and dentistry, end with "unclassified degrees". We omit these students and focus only on those studying for degrees that end with a classification.[6] In our data, approximately 60% of all students achieve an upper second or first class degree, while 16% achieve a first class degree.

Our data is administrative data from the Higher Education Statistics Agency, the UK's official statistical agency for higher education institutions. We have individual-level information on the universe of students enrolling into undergraduate degrees in all (122) English universities for three full cohorts, specifically those entering university in the academic years 2008/09, 2009/10 and 2010/11.[7] The data comprise socio-economic information as well as degree information, such as university attended and the degree outcomes, and – crucially – information on the modules taken by each student during all years of their degree. We use the latter to construct information on the peers that each student has encountered during their studies. In total we have information on 953,727 students.

Our interest in this paper lies in estimating the effect of being exposed to a more diverse environment during university studies. To measure diversity, in our preferred approach we first classify students into 1200 "types" defined by all possible combinations of

- gender (male vs. female),
- country of residence before studies (UK vs. rest of the world),
- age ("mature", i.e., above 21 years of age vs. young student),
- 5 social classes of the student's parents ("Managerial and professional occupations", "Intermediate occupations", "Small employers and own-account workers", "Lower supervisory and technical occupations" and everyone else),

[6] These students can however serve as peers where they share modules with students in programmes leading to classified degrees. For example, a medical student would not be included in the main regressions but could serve as a peer to an economics student if they sat in the same health economics module.

[7] These cohorts attended university under a fee regime that meant each undergraduate student paid £3000 per year of university attendance with the remainder of the cost born directly by the state. This system was replaced with a purely fee-based system for entrants from the academic year 2012/13.

- 5 self-assessed ethnicities ("White", "Black", "Indian, Pakistani, Bangladeshi", "Other Asian" and "Other"),
- and a measure of the typical participation in higher education based on a student's residence (POLAR quintiles[8], plus one category for students resident outside of the UK).

In additional robustness checks we omit certain characteristics from the definition of types, of which more details can be found in section 3.3.

We then create two measures of the level of diversity for each student *i* based on the "types" of other students they encounter in all the modules attended over the course of their degree. The first measure is simply the proportion of students that student *i* encounters during their studies that share the same background as *i*, i.e., who are identical in all characteristics. We can think of this measure as capturing the idea that people might like to be among individuals similar to themselves (Byrne, 1971; Tajfel and Turner, 1986; Turner 1985; Card et al., 2008) and that being isolated is detrimental (e.g., Leonard and Levine, 2006). This measure is bounded between 0 and 1 with values closer to the upper bound indicating lower diversity.

The second is a measure of the overall homogeneity of a student's peers. It captures the idea that a more diverse set of peers exposes people to a greater set of different ideas and backgrounds. This measure is a Herfindahl-style index that averages the sum of squared shares of all student types across all modules taken by *i* or more specifically

$$Overall\ homogeneity_i = \frac{1}{M_i}\sum_{m=1}^{M_i}\sum_{j=1}^{1200}\left(\frac{n_{jm}^{-i}}{N_m}\right)^2,$$

where $\frac{n_{jm}^{-i}}{N_m}$ is the share of students other than *i* belonging to type *j* in module *m*. It is bounded between close to zero and one. At its lower bound every group makes up a small proportion of the students encountered by *i*, as the index increases a student encounters less diversity and at the upper bound all students encountered by *i* belong to the same group.

Table 1 provides summary information on these two measures for our whole sample as well as subgroups of students. As we can see, for the average UK undergraduate student 10% of their peers are identical in terms of their background. This share is slightly higher for women than

[8] The acronym POLAR stands for "participation of local areas". Areas are classed into quintiles by the proportion of resident 18-year olds that enter higher education. They are commonly used for area targeting of widening access policies. See http://www.hefce.ac.uk/analysis/yp/POLAR/ for details.

for men, reflecting a slightly higher university participation of women. There is considerable variation both within and across student subgroups. For example, mature students encounter a much more homogeneous set of peers, with on average 21% of their peers having the same background. At the other extreme, students of Bangladeshi, Indian or Pakistani ethnicity encounter a much higher proportion of peers who are different from them with only 4% of their peers sharing the same characteristics. Table 1 also reveals considerable differences within broadly-defined student groups – the proportion of similar peers ranges from 0% to 100% for all subgroups and the standard deviations also indicate considerable variation within each group. Similar patterns hold for our measure of overall diversity.

(Table 1 about here.)

Figure 1 looks at two extreme cases of exposure to diversity – namely having no similar peers or having more than 50% similar peers. In terms of gender and country of origin the data suggests a comparatively similar picture: There are sizeable proportions of students who do not meet comparable peers in their degree as well as of students for whom >50% share the same characteristics. Mature students are more likely to be in courses with a high number of similar peers, which is consistent with these students specialising in certain courses and institutions. In terms of ethnicity, we see that – unsurprisingly – white students are more likely than other ethnicities to encounter a high proportion of similar peers. Students from other ethnic groups are consistently more likely to be on their own and unlikely to be among many similar peers. In terms of socio-economic background, we see that students from less common backgrounds, such as intermediate occupations, are (consequently) more likely to be on their own. Overall, the results confirm the earlier picture – for each background there are sizeable proportions of students who either meet no or a very large number of similar peers.

(Figure 1 about here.)

2.2 Empirical Approach

Econometrically, identifying the effect of student diversity on individual outcomes is essentially an issue of identifying exogenous peer effects (Manski, 1993), i.e., the impact of the composition of a peer group on individual outcomes. The two main empirical issues that need to be addressed in this context are defining the correct peer group and the potential of self-selection of students into courses and universities that might render peer characteristics endogenous.

Peer group definition: We define the peer group for student *i* as the set of students that *i* encounters during formal tuition at universities, i.e., those students who take the same modules and consequently sit in the same lectures and seminars as *i*. It is important to be clear that these will not be the only students *i* encounters during their studies. A student in a relatively homogeneous course might encounter a more diverse set of students outside of formal tuition, for example, in student societies, sports clubs or at student parties. In this sense, our measure of peer group diversity is the minimum level of diversity a student encounters at university. It is, however, the type of diversity a university can control via its admission process. Admitting more students from underrepresented backgrounds onto a degree programme will increase the minimum level of diversity all students on that programme will be exposed to during tuition. There is, though, no way for a university to control who interacts with whom outside of formal tuition. In this sense, our measure can be seen as the policy-relevant treatment effect from the perspective of a university trying to decide on specific admission rules for entrance onto a specific programme.

Self-selection of students: There are in principle three different selection mechanisms that could render a measure of peer group composition endogenous: (a) Selection into specific universities, (b) selection into specific degree programmes and (c) selection into specific modules within a course and institution. (a) is problematic as English universities are partially segregated along socio-demographic lines. For example, the research-intensive universities that make up the Russell Group have historically attracted more students from affluent backgrounds who are also often privately educated. Institutions like the former polytechnics that obtained university status through the Further and Higher Education Act 1992 (*New universities*) usually cater more for the local population and will consequently often be more diverse than pre-1992 universities. (b) is potentially problematic as there are, for example, substantial gender-imbalances across different subjects. For example, economics tends to be more male-dominated than marketing, while sociology and psychology typically attract a higher proportion of women than the sciences. Other courses might be segregated along other lines, such as country of origin or socio-economic background. Finally, (c) could be problematic if students selectively chose modules based on group composition, for example if ethnic minority students try to choose modules taken by other ethnic minority students.

We tackle the endogeneity problems arising due to self-selection of students into universities and degree programmes in a multitude of ways. Our preferred approach relies on the use of

multiple set of fixed effects that control for unobserved factors leading to student selection. In our two preferred specifications, we estimate

$$y_{icut} = \delta_{cu} + \phi_{ut} + \tau * diversity_{icut} + \varepsilon_{icut} \quad (1)$$

or alternatively

$$y_{icut} = \gamma_{cut} + \tau * diversity_{icut} + \varepsilon_{icut} \quad (2),$$

where *i* indexes individuals, *c* indexes degree programmes, *u* indexes universities and *t* indexes entry cohorts. We generally adjust standard errors for clustering at the level of universities, which is the most conservative number of clusters. Specification (1) controls for university-programme specific factors through the inclusion of δ_{cu} and for any university-year specific factors through ϕ_{ut}. The variation in $diversity_{icut}$ that is used to identify τ comes from two sources: year-to-year variation in the composition of a student body for a specific degree programme at a specific university, and within-programme variation due to different students choosing different modules and being exposed to different peers in each of them. An eventual bias in this specification could arise because of time-varying factors that are specific to a programme and a university. An example could be a programme redesign that makes the course more attractive to a different student demographic and also affects individual student outcomes. Specification (2) addresses this issue through the inclusion of programme-university-cohort fixed effects, γ_{cut}. This, however, implies that the only variation used to identify τ is the within-programme variation arising through different module choices. Fortunately enough, we will see that results from (1) and (2) are essentially identical. They are in fact also identical to a simpler specification (3) that replaces the university-time effects, ϕ_{ut}, with year effects and estimates

$$y_{icut} = \delta_{cu} + \eta_{t} + \tau * diversity_{icut} + \varepsilon_{icut}. \quad (3)$$

These strategies do not address the potential problems of students self-selecting into modules based on peer composition. Fortunately, this problem will likely be less severe than selection into universities and degree programmes. Firstly, students generally choose modules individually and to some extent simultaneously over a certain time period, making it difficult for them to coordinate among a wider group of people. Secondly, student cohorts in a degree programme are often large, which means that every individual student will likely be unaware of the modules choices of large parts of his cohort. Thirdly, some modules are taken by students from more than one degree programme, which again makes it less likely that an individual

student would be aware of other students' choices. In consequence, while it is entirely possible for a group of friends to coordinate amongst themselves and attend the same module, a large part of a module's student composition will be outside of the control of each individual student. We provide some supplementary evidence that individual student characteristics are indeed only loosely related to our diversity measures. Specifically, we estimate specifications (1) to (3) using the respective diversity measure as the outcome and adding individual characteristics on the right hand side. Table 2 provides a comparison of the R^2 of these estimates with and without the individual characteristics. As we can see from the table a fairly comprehensive set of individual characteristics, including socio-economic background, ethnicity, gender, nationality, age and POLAR quintiles, only explain 0.5% of the variation in overall peer diversity and around 3% of the variation in the share of similar students. Given this evidence and the fact that results from the various fixed effects specifications are essentially identical, it seems safe to assume that self-selection of individual students into modules does not matter much for the diversity encountered by individual students over the course of their degree.

(Table 2 about here.)

We complement this approach with a range of robustness checks and the use of an alternative identification strategy. In terms of the former, we begin by addressing the potential concern that measures of diversity calculated across all three stages might be endogenous: If diversity has an effect on student performance, it might well affect dropout and transfer decisions taken at the end of a student's first or second year. Dropouts and transfers of students other than *i* might change the diversity student *i* experiences in stages 2 and 3. To account for this, we instrument for the diversity measures calculated over all years of study with the corresponding measure calculated over stage 1 modules, where dropouts and transfers do not yet play a role and students typically have had little opportunity to select modules.

We also check for the robustness of our results with regards to the definition of student types. In particular, we calculate both diversity measures based on a smaller number of student types, excluding either parental background (leading to 240 student types instead of 1200) or the POLAR quintiles (200 student types). Both of these measures capture aspects of a student's socio-economic background, namely whether the student comes from a more affluent family or area and including both might lead us to overweight socio-economic characteristics relative to other variables such as ethnicity. We also calculate diversity measures omitting socio-economic diversity completely and instead focusing on characteristics that are either easily

observed by peers, such as gender and ethnicity, or revealed comparatively quickly during interactions, such as age or whether someone is a native. This approach leads to 40 different student types.

Our alternative identification strategy is a simple Bartik-style instrument, where we exploit the fact that certain student demographics are more likely to attend certain universities. A university that attracted more mature students in the past, for example, will likely experience a larger increase in students when the overall number of mature students increases. This instrument is also commonly used in the immigration literature where it was introduced by Card and DiNardo (2000) and Card (2001) and has been subsequently widely used.[9] We construct the instrument as follows: We use the 2008 entry cohort to measure the initial distribution of students of certain demographics across institutions. We then calculate the nationwide changes in each student group from 2008 to 2009 and from 2008 to 2010 and redistribute these according to the initial distribution. If, for example, a university enrolled 5% of all mature students in 2008, it would receive 5% of the nationwide change in mature students over the respective time period. The specification is based on (3) as the instruments again vary on the institution-year level. For the construction of the instrument we use the same basic characteristics we used for the construction of the student types and in Table 2.

3. Does diversity improve degree outcomes?

3.1 Fixed effects specifications

Table 3 presents results from various fixed effects specifications ranging from simple OLS without any fixed effects in column (1) to our preferred specifications with university-programme and time effects column (5), university-programme and university-time effects in column (6) and finally university-programme-time effects in column (7). We also present some alternative specifications using institution and cohort effects (column (2)), broad subject and cohort effects (column (3)) and institution-cohort effects in column (4). We present results from 3 specifications, using each of the diversity measures separately and jointly.

(Table 3 about here).

[9] See for example, Bianchi et al. (2012), Braakmann (2016), Card (2009), Cortes (2008), Gonzalez and Ortega (2013), Hunt (2012), Ottaviano and Peri (2006), Sá (2015) and Saiz (2006).

We can see that the inclusion of university-programme fixed effects in column (5) generally leads to the largest change in results. This result is hardly surprising – studying economics at Oxford is likely to be very different from either studying classics at Oxford or studying economics at a post-1992 university and will consequently appeal to different student groups. The inclusion of more detailed fixed effects in columns (6) and (7) generally does not change results. Given this observation the discussion of results will focus on columns (5) to (7).

The effects of increased diversity appear to differ depending on whether we look at top (first class) or "good" (first class and upper second) degrees. For the former, the results consistently indicate that a larger number of similar peers and a more homogeneous peer group increases the probability of a first class degree. Specification 3 suggests that these effects are driven by the proportion of similar peers rather than the overall homogeneity of the student group. In terms of effect size, increasing the proportion of similar peers by one standard deviation (or 0.18) increases the probability of a first class degree by around 1 percentage point ($1/16^{th}$ of the mean).

The picture is different when looking at "good" degrees instead. We still find a positive impact of the proportion of similar peers which ranges from 0.037 when entered alone in specification 1 to 0.096 when entered together with overall peer homogeneity in specification 3. In terms of economic size, the effects are fairly modest and range from 0.7 percentage points (specification 1) to 1.7 percentage points (specification 3) for a one-standard deviation increase. These effects are equal to between $1/100^{th}$ and $3/100^{th}$ of the mean. For overall peer homogeneity, however, we find results that are very different from those found at the first class threshold. Increasing overall peer diversity always increases the probability of an upper second or first class degree. The effects range from (-)0.083 (specification 2) to (-)0.124 when entered with the proportion of similar peers in specification 3. In terms of effect size, these results suggest between 1.5 to 2.2 percentage point increases in the probability of at least an upper second following a one-standard deviation increase in peer diversity (equal to a 0.18 reduction in the index).

3.2 Robustness check 1: Adjusting for endogenous dropouts and transfers

The top panel of Table 4 presents first stage estimates where we instrument the diversity measures calculated over all years of studies with the corresponding measures calculated over all first year modules. As expected there is a strong, but not perfect correlation between first year and overall diversity. First stage F-values indicate the absence of any weak instrument problems.

(Table 4 about here).

In the bottom panel of Table 4, we present second stage estimates corresponding to columns (5) to (7) from table 3. For the proportion of similar peers, there is very little difference in either signs or size of the effects between tables 3 and 4. The picture is very different for overall homogeneity of the peer group. For the probability of a good (at least upper second class) degree, there is an increase in effect size. These larger effects suggest that a one-standard deviation increase in peer diversity increases the probability of an upper second or better by 8 to 9 percentage points. More starkly, the effect of greater peer homogeneity on the probability of a first class degree changes from being insignificant to a highly significant negative effect. The latter suggests that increasing peer diversity by one-standard deviation increases the probability of a first class degree by 2 percentage points.

The pattern of results suggests that the positive effects of overall diversity are strongest in stage 1, but weaken, and are entirely cancelled out for first class students by an opposite effect of overall diversity in stages 2 and 3. It seems plausible that diversity has a larger effect early in studies when students make the initial transition from school to university and settle into their studies as at this point students generally make new friends and engage in new behaviours, all of which might plausibly lead to a larger influence of a more diverse peer group on their way of thinking and view of the world. Diminishing effects might mean that this effect weakens over the course of a degree. It is also plausible that this process occurs more quickly for top than for merely good students. It is, however, somewhat surprising that the effects for top students are effectively cancelled out over the course of their studies.

3.3 Robustness check 2: Alternative definitions of student types

Table 5 compares results, calculated analogous to those in Table 3, using alternative definitions of student types. Columns (1) and (2) replicate columns (6) and (7) from Table 3. Columns (3) and (4) present the results from the same specifications using diversity measures calculated over 240 student types (omitting parents' social class), columns (5) and (6) use 200 student types omitting the POLAR quintiles and columns (7) and (8) use 40 student types omitting both POLAR and parental background. The table shows that this has little impact on the results, although omitting socio-economic background entirely does affect their statistical significance.

(Table 5 about here).

3.4 Alternative identification strategy: Bartik-style instrument

Table 6 presents results from an instrumental variables strategy that exploits the segregation of English universities along various dimensions to construct Bartik-style instruments. Due to the large number of variables in the first stage, we only present summary results, in particular statistics for instrument strength. We present results excluding 2008, as we use this year to measure initial university "specialisation". First stage statistics indicate that the instruments are reasonably strong.

(Table 6 about here).

The second stage results point in the same direction as previous results: Effects are somewhat weaker for the probability of first class degree, but the pattern of results is identical to Table 3 for the probability of achieving at least an upper second class degree.

4. Further Analyses

4.1 Non-linearities and interactions

An important question arising is how the two measures of diversity interact and whether their effect is actually linear. It is, for example, conceivable that being the only student of a certain background is particularly harmful as indicated by some of the results on workplace mobility (e.g., Leonard and Levine, 2006). It is, however, also plausible that too many students of the same background are detrimental due to a greater uniformity of views and prior experiences. Finally, it also seems possible that the two measures of diversity interact in some way. It could, for example, be possible that students need some similar peers to feel secure enough to engage with a more diverse set of people.

To test this idea, we group the proportion of similar students into five categories and include four of them as dummy variables. These are (a) having no similar peers (18% of the sample), (b) encountering at least one similar peer, but fewer than the 25th quantile (7% of the sample), (c) having a proportion of similar peers that is above the 75th quantile (equal to 10% of peers being of the same type), but less than 50% (19% of the sample) and (d) having more than 50% similar peers (7% of the sample). Students with a proportion of peers above the 25th quantile and below the 75th quantile serve as the reference group. We also interact these four dummies with our overall diversity measure.

(Table 7 about here).

Results can be found in Table 7. Estimates are based on columns (6) and (7) from Table 3 and include institution-programme and institution-year effects in columns (1) and (3) and institution-programme-year effects in columns (2) and (4). The results paint a comparatively complex picture, but a clear finding is that having no similar peers is detrimental to achieving both top and good degrees. Increasing the proportion of similar students only has a positive effect on the probability of achieving a first class degree, but this probability increases monotonically with increases in the proportion of similar peers. For the probability of achieving at least an upper second, the effects are essentially flat as soon as there is at least one similar peer.

The effects of overall diversity depend strongly on the proportion of similar students. For the probability to achieve a first class degree, a more homogeneous student body is beneficial for students who have between one and less than 50% similar peers and essentially zero for other students. When looking at the probability of an upper second or better, the effects of increased diversity are essentially zero for students who have between one and less than 50% similar peers. For students who are on their own, a more diverse environment is unambiguously better. This result seems intuitively plausible: If everyone is alone, everyone needs to interact with people different from themselves and, in this sense, no one is isolated. There is also a suggestive result that increased diversity is beneficial for students with more than 50% similar peers. This result is again plausible: If increased socio-economic diversity increases the diversity of ideas, this effect might well be strongest in an otherwise very homogeneous environment.

4.2 Peer effects of individual characteristics

Previous studies of the effects of peer composition in educational settings have tended to focus on a single dimension of diversity, but – as intersectionality may matter – an important question is how these results compare to those when just one characteristic, such as the gender distribution of a cohort, is changed at a time. Table 8 presents evidence examining this. The results are again highly consistent across specifications: Increasing the proportion of mature students tends to negatively affect degree outcomes. Increasing socio-economic homogeneity (measured by both parental background and the students' residence) decreases degree outcomes, while increasing ethnic homogeneity tends to increase the probability of a good degree. The proportion of men does not matter for the probability of a first class degree, but it decreases the probability of obtaining at least an upper second class honours degree. Overall,

the results suggest that the effects of an overall more diverse cohort are different from those arising because of changes in the distribution of single characteristics.

(Table 8 about here).

4.3 Student subgroups

Table 9 considers the effects on different student subpopulations. Results are largely similar to the overall results from section 3, but with some important qualitative and quantitative differences. The positive effects of increased diversity appear to be weaker for white students, who appear to benefit more from a more homogeneous environment. For non-white students, the effects are different for top and good degrees – the probability of the former increases, while the latter increases with increased diversity. UK students benefit more from increased diversity than foreign students, who appear to benefit relatively more from a higher proportion of similar peers. There are few differences by age, gender or socio-economic background.

(Table 9 about here).

4.4 Heterogeneity across universities

Another important question is to what extent these effects are similar across universities. Firstly, large parts of the literature are based on evidence from a single university (e.g., Dartmouth in Sacerdote, 2001, West Point in both Lyle, 2009, and Carrell, Fullerton, and West, 2009, and the University of Amsterdam in Booji, Leuven and Oosterbeek, 2017). If effects were broadly similar across institutions, it would imply a higher external validity of studies based on a single institution. Secondly, if there are national policies or initiatives to increase student diversity, it is important to know whether these would result in benefits for all students or only for those at certain universities. Thirdly, large cross-university differences would point towards an important role of institutional policies and pedagogical approaches to determine whether increased diversity is beneficial or detrimental to student outcomes.

(Figures 2 and 3 about here).

Figures 2 and 3 plot institution-specific treatment effects for both diversity measures and the probability of either a first class degree (Figure 2) or at least an upper second class degree (Figure 3). Figure 2 suggests comparatively little heterogeneity across universities, even though effects switch signs at some point. Both measures of diversity have beneficial effects across the majority of institutions, even though statistical significance differs due to very

different underlying student numbers (ranging from several hundred to more than 10,000). At the upper second margin, Figure 3 suggests that the effects are much more heterogeneous across institutions. Increasing overall diversity has a positive impact at the vast majority of institutions and the same holds for increases in the proportion of similar students. In other words, our main results pertain qualitatively to the majority of students in English universities.

Table 10 investigates one potential source of this heterogeneity – the selectivity of the respective institution. We split institutions into four groups following a grouping used by the Office for Students and the Higher Education Statistics Agency. The grouping distinguishes between institutions with 60% or more of their provision in one or two subjects (*specialist institutions*) and groups the remaining institutions based on the selectivity of their undergraduate provision. The former includes mainly colleges of arts and music, but also the London School of Economics and Political Sciences. The remaining institutions are split into three groups based on the average entry score of their young (under 21) UK-domiciled undergraduate entrants in the 2011/12 academic year. High, medium and low entry tariff institutions correspond to the top, middle and bottom third of institutions.

(Table 10 about here).

We find fairly similar effects across types of institutions and outcomes: Having more peers from the same background increases both the probability of a first class degree and the probability to achieve at least an upper second class degree across all institutions. For overall peer diversity, we find that increased diversity increases the probability of a first class degree in medium and low tariff institutions and the probability of at least an upper second class degree in all but specialist institutions.

4.5 Heterogeneity across subjects

Finally, we examine the heterogeneity of effects across subjects. Since subjects differ in the extent to which they involve learning a fixed curriculum or are based around the discussion of various topical issues that might benefit from diverse perspectives then we might expect the impact of diversity to across these. For example, a sociology lecture on socio-economic class is more likely to benefit from the perspectives of students from various backgrounds than a lecture on molecular genetics

(Table 11 about here).

Table 11 presents estimates by broad subject categories. These are based on the Joint Academic Coding System of subject used by HESA. The results suggest mixed effects when looking the probability of a first class degree: Increasing the proportion of similar students generally increases the probability of a first class degree, even though effects differ in their statistical significance. Increasing overall peer diversity has effects ranging from increasing the probability of a top degree in subjects such as mathematical sciences, engineering, business and administrative studies or creative arts and design, but lowers the probability of a first class degrees in subjects such as historical and philosophical studies, some languages and humanities subjects, law, social studies and physical and biological sciences. When looking at the probability of at least an upper second degree, the picture becomes more homogeneous: For the majority of subjects we now find the results as in our overall sample: It is both beneficial to have a larger proportion of similar peers, but students also benefit from increased overall diversity.

5. Conclusion

We have investigated the effects of increased exposure to diversity during university studies on university outcomes. Our results suggest quantitatively important effects of the exposure to both different and similar students. In terms of their university performance, we find that effects differ for the probabilities of obtaining a top or a good degree. Overall, students benefit *both* from being exposed to a more diverse set of student types *and* from being among students from the same background as themselves, but these effects are both stronger and more diverse when looking at the probability to obtain a good rather than a top degree. There also exist significant non-linearities and interactions between these two measures: Holding overall diversity constant, students generally benefit from having more similar peers. In particular, having no peers sharing the same background is highly detrimental to university performance. We also find that the effect of increasing overall diversity depends on the share of identical peers. Increased diversity is particularly beneficial for students who have no similar peers or a large number of similar peers. The former effect likely reflects that, if one is alone in a course, it is beneficial for everyone else to also be alone. The latter effect fits the idea that exposure to a too narrow set of backgrounds might stifle learning due to students not being exposed to a diverse set of ideas.

In terms of admission policies our results cautiously suggest that the increases in student diversity that affirmative action or widening participation policies are trying to achieve are

indeed beneficial for university students. An important caveat is that this increased diversity needs to be balanced with students' need not to be isolated and to have some peers sharing the same background. Our results also suggest some trade-offs between maximising the proportion of students achieving top degrees or the proportion achieving good degrees. Our results also suggest that the effects of increasing overall student diversity across a range of characteristics are different from the effects of targeting a specific characteristic such as gender, i.e., the intersectionality of characteristics appears to be important. Increases in peer diversity also seem to benefit almost all student subgroups. There is some evidence that effects differ across universities which suggests that institutional policies or other university characteristics might be a moderating factor.

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Table 1: Descriptive statistics and exposure to student diversity, all students and subgroups

	Observations	Mean	Std.dev.	Min	Max
Outcomes all students					
First class degree	953,757	0.16	0.37	0	1
At least upper second honours degree	953,757	0.60	0.49	0	1
All students					
Overall homogeneity	953,757	0.16	0.18	0.01	1
Proportion of similar students	953,757	0.10	0.18	0.00	1
Men					
Overall homogeneity	428,164	0.16	0.18	0.01	1
Proportion of similar students	428,164	0.08	0.15	0.00	1
Women					
Overall homogeneity	525,563	0.17	0.19	0.01	1
Proportion of similar students	525,563	0.12	0.19	0.00	1
Foreign students					
Overall homogeneity	128,786	0.18	0.19	0.01	1
Proportion of similar students	128,786	0.12	0.17	0.00	1
UK students					
Overall homogeneity	824,941	0.16	0.18	0.01	1
Proportion of similar students	824,941	0.10	0.18	0.00	1
Mature students					
Overall homogeneity	252,729	0.27	0.23	0.01	1
Proportion of similar students	252,729	0.21	0.26	0.00	1
Non-mature students					
Overall homogeneity	700,998	0.13	0.16	0.01	1
Proportion of similar students	700,998	0.06	0.12	0.00	1
White students					
Overall homogeneity	663,763	0.16	0.18	0.01	1
Proportion of similar students	663,763	0.11	0.18	0.00	1
Black students					
Overall homogeneity	60,978	0.17	0.20	0.01	1
Proportion of similar students	60,978	0.06	0.14	0.00	1
Bangladeshi/Indian/Pakistani students					
Overall homogeneity	72,322	0.13	0.18	0.01	1
Proportion of similar students	72,322	0.04	0.11	0.00	1
Other Asian students					
Overall homogeneity	52,695	0.20	0.21	0.01	1
Proportion of similar students	52,695	0.11	0.19	0.00	1
Other ethnic background					
Overall homogeneity	103,969	0.17	0.18	0.01	1
Proportion of similar students	103,969	0.09	0.15	0.00	1
Social background managerial/professional					
Overall homogeneity	312,923	0.13	0.15	0.01	1
Proportion of similar students	312,923	0.07	0.12	0.00	1
Social background intermediate occupations					
Overall homogeneity	80,970	0.12	0.14	0.01	1
Proportion of similar students	80,970	0.03	0.09	0.00	1
Social background own-account workers and small employers					
Overall homogeneity	43,551	0.12	0.15	0.01	1
Proportion of similar students	43,551	0.02	0.09	0.00	1
Social background lower supervisory and technical occupations					
Overall homogeneity	27,538	0.12	0.14	0.01	1
Proportion of similar students	27,538	0.02	0.09	0.00	1
Other social background					
Overall homogeneity	488,745	0.20	0.21	0.01	1
Proportion of similar students	488,745	0.14	0.22	0.00	1

Overall homogeneity is a Herfindahl index calculated over 1200 student "types" defined by gender, UK vs. foreign born, age (mature vs. young student), 5 social classes of the student's parents ("Managerial and professional

occupations", "Intermediate occupations", "Small employers and own-account workers", "Lower supervisory and technical occupations" and everyone else), 5 self-assessed ethnicities ("White", "Black", "Indian, Pakistani, Bangladeshi", "Other Asian" and "Other") and HE participation of the student's postcode (POLAR quintiles). It is bounded between close to zero (every group makes up a small proportion of students) and one (all students belong to the same group). The proportion of similar students is the proportion of other students that are identical in terms of the aforementioned characteristics.

Table 2: Auxiliary regressions, relationship between individual characteristics and diversity measures

Specification	(1)	(2)	(3)
Outcome: Overall homogeneity			
R^2 with individual characteristics	0.435	0.437	0.465
R^2 without individual characteristics	0.430	0.432	0.460
Change in R^2 due to individual characteristics	0.005	0.005	0.005
Outcome: Proportion of similar students			
R^2 with individual characteristics	0.490	0.490	0.513
R^2 without individual characteristics	0.456	0.457	0.480
Change in R^2 due to individual characteristics	0.034	0.033	0.031
Cohort FEs	Yes	No	No
Course* Institution FEs	Yes	Yes	No
Institution * Cohort FEs	No	Yes	No
Course * Institution * Cohort FEs	No	No	Yes

Table 3: Student diversity and university outcomes

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
First class honours degree							
Specification 1: Proportion of similar students							
Proportion of similar students	-0.033 (0.053)	0.033*** (0.008)	-0.008 (0.037)	0.033*** (0.008)	0.055*** (0.007)	0.055*** (0.007)	0.055*** (0.007)
Specification 2: Overall student heterogeneity (higher values = more homogeneous)							
Overall homogeneity	-0.042 (0.039)	0.013 (0.009)	-0.024 (0.024)	0.013 (0.009)	0.033*** (0.010)	0.033*** (0.010)	0.033*** (0.010)
Specification 3: Overall student heterogeneity and proportion of similar students							
Proportion of similar students	-0.007 (0.049)	0.040*** (0.011)	0.011 (0.037)	0.039*** (0.011)	0.049*** (0.011)	0.049*** (0.011)	0.049*** (0.012)
Overall homogeneity	-0.038*** (0.011)	-0.010 (0.013)	-0.030*** (0.009)	-0.010 (0.013)	0.012 (0.014)	0.012 (0.014)	0.013 (0.014)
First class and upper second honours degree							
Specification 1: Proportion of similar students							
Proportion of similar students	-0.307* (0.166)	-0.060** (0.025)	-0.205* (0.121)	-0.060** (0.025)	0.037*** (0.009)	0.037*** (0.009)	0.037*** (0.009)
Specification 2: Overall student heterogeneity							
Overall homogeneity	-0.355*** (0.135)	-0.155*** (0.025)	-0.281*** (0.091)	-0.154*** (0.025)	-0.082*** (0.027)	-0.082*** (0.027)	-0.083*** (0.029)
Specification 3: Overall student heterogeneity and proportion of similar students							
Proportion of similar students	-0.110 (0.153)	0.065*** (0.020)	-0.040 (0.119)	0.064*** (0.020)	0.098*** (0.021)	0.097*** (0.021)	0.096*** (0.021)
Overall homogeneity	-0.286*** (0.037)	-0.191*** (0.030)	-0.258*** (0.025)	-0.191*** (0.030)	-0.124*** (0.035)	-0.123*** (0.035)	-0.124*** (0.036)
Observations	953,757						
Institution FEs	No	Yes	No	No	No	No	No
Cohort FEs	No	Yes	Yes	No	Yes	No	No
Subject FEs	No	No	Yes	No	No	No	No
Course*	No	No	No	No	Yes	Yes	No
Institution FEs							
Institution * Cohort FEs	No	No	No	Yes	No	Yes	No
Course * Institution * Cohort FEs	No	No	No	No	No	No	Yes

Coefficients, standard errors clustered at the institution level in parentheses. */**/*** denote statistical significance at the 10%, 5% and 1% level respectively. Overall diversity is a Herfindahl index calculated over 1200 student "types" defined by gender, UK vs. foreign born, age (mature vs. young student), 5 social classes of the student's parents ("Managerial and professional occupations", "Intermediate occupations", "Small employers and own-account workers", "Lower supervisory and technical occupations" and everyone else). Ethnic homogeneity is Herfindahl index calculated over 5 self-assessed ethnicities ("White", "Black", "Indian, Pakistani, Bangladeshi", "Other"), 5 self-assessed ethnicities ("White", "Black", "Indian, Pakistani, Bangladeshi", "Other Asian" and "Other") and HE participation of the student's postcode (POLAR quintiles). It is bounded between close to zero (every group makes up a small proportion of students) and one (all students belong to the same group). The proportion of similar students is the proportion of other students that are identical in terms of the aforementioned characteristics.

Table 4: Robustness check: Adjusting for endogenous dropout and transfers

	First stage regressions					
	(5) in table 3		(6) in table 3		(7) in table 3	
	Overall homogeneity	Proportion of similar students	Overall homogeneity	Proportion of similar students	Overall homogeneity	Proportion of similar students
Proportion of similar students (stage 1)	0.056*** (0.012)	0.736*** (0.032)	0.056*** (0.012)	0.736*** (0.032)	0.050*** (0.011)	0.738*** (0.033)
Overall homogeneity (stage 1)	0.0451*** (0.012)	-0.034*** (0.009)	0.450*** (0.012)	-0.034*** (0.009)	0.449*** (0.012)	-0.035*** (0.009)
F-Value (excl. instruments)	909	1724	912	1732	868	1675
Cohort FEs	Yes	Yes	No	No	No	No
Course* Institution FEs	No	No	Yes	Yes	No	No
Institution * Cohort FEs	No	No	Yes	Yes	No	No
Course * Institution * Cohort FEs	No	No	No	No	Yes	Yes
Second stage regressions						
First class honours degree						
Proportion of similar students	0.043*** (0.008)		0.043*** (0.008)		0.041*** (0.008)	
Overall homogeneity	-0.115*** (0.014)		-0.114*** (0.014)		-0.122*** (0.015)	
First class and upper second honours degree						
Proportion of similar students	0.100*** (0.014)		0.101*** (0.014)		0.094*** (0.013)	
Overall homogeneity	-0.472*** (0.039)		-0.474*** (0.039)		-0.495*** (0.042)	
Observations	953,757					
Cohort FEs	Yes		No		No	
Course* Institution FEs	No		Yes		No	
Institution * Cohort FEs	No		Yes		No	
Course * Institution * Cohort FEs	No		No		Yes	

Coefficients, standard errors clustered at the institution level in parentheses. */**/*** denote statistical significance at the 10%, 5% and 1% level respectively. Estimates based on columns (5) to (7) in table 3. Instrument are calculated using all modules in a student's first year at university.

Table 5: Robustness check – alternative construction of student types

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Original student types		Student types w/o parents' socio-economic status		Student types w/o POLAR quintiles		Student types without socio-economic characteristics	
	First class honours degree							
Proportion of similar students	0.049***	0.049***	0.048***	0.049***	0.048***	0.049***	0.042***	0.043***
	(0.011)	(0.012)	(0.008)	(0.008)	(0.008)	(0.008)	(0.006)	(0.006)
Overall homogeneity	0.012	0.013	0.019	0.020	0.019	0.020	0.041***	0.044***
	(0.014)	(0.014)	(0.013)	(0.013)	(0.013)	(0.013)	(0.012)	(0.013)
	First class and upper second honours degree							
Proportion of similar students	0.097***	0.096***	0.142***	0.141***	0.142***	0.141***	0.169***	0.168***
	(0.021)	(0.021)	(0.020)	(0.020)	(0.020)	(0.020)	(0.014)	(0.014)
Overall homogeneity	-0.123***	-0.124***	-0.125***	-0.126***	-0.125***	-0.126***	-0.072*	-0.072*
	(0.035)	(0.036)	(0.036)	(0.038)	(0.036)	(0.038)	(0.036)	(0.039)
Observations	953,757							
Course* Institution FEs	Yes	No	Yes	No	Yes	No	Yes	No
Institution * Cohort FEs	Yes	No	Yes	No	Yes	No	Yes	No
Course * Institution * Cohort FEs	No	Yes	No	Yes	No	Yes	No	Yes

Coefficients, standard errors clustered at the institution level in parentheses. */**/*** denote statistical significance at the 10%, 5% and 1% level respectively. Estimates based on columns (6) and (7) of table 3.

Table 6: Alternative identification strategy: IV using Bartik-style-instrument

	2009 – 2010	
	First class honours degree	**First class and upper second honours degree**
Proportion of similar students	1.19	3.074***
	(0.745)	(0.939)
Overall homogeneity	-0.501	-2.020***
	(0.342)	(0.534)
First stage F-Value (instruments)		
Proportion of similar students	11.6	
Overall homogeneity	9.3	
Observations	640,589	640,589
Course* Institution FEs	Yes	Yes
Year FEs	Yes	Yes

Note: Coefficients, standard errors clustered at the institution level in parentheses. */**/*** denote statistical significance at the 10%, 5% and 1% level respectively.

Table 7: Interactions and non-linearities

	(1)	(2)	(3)	(4)
	First class honours degree		**First class and upper second honours degree**	
No similar students (1= yes)	-0.011***	-0.011***	-0.023***	-0.023***
	(0.002)	(0.002)	(0.004)	(0.004)
Proportion of similar students > 0 and below 25th quantile (1= yes)	-0.004	-0.004	-0.000	-0.000
	(0.003)	(0.003)	(0.004)	(0.004)
Proportion of similar students > 75th quantile and < 50% (1= yes)	0.016***	0.015***	0.006	0.005
	(0.003)	(0.003)	(0.006)	(0.006)
Proportion of similar students > 50% (1= yes)	0.047***	0.048***	0.040	0.039
	(0.014)	(0.016)	(0.041)	(0.043)
Overall homogeneity	0.096***	0.096***	-0.016	-0.014
	(0.012)	(0.012)	(0.022)	(0.022)
Overall homogeneity * no similar students	-0.106***	-0.108***	-0.162***	-0.167***
	(0.012)	(0.012)	(0.017)	(0.018)
Overall homogeneity * Proportion of similar students > 0 and below 25th quantile	0.012	0.013	0.074***	0.074***
	(0.021)	(0.022)	(0.027)	(0.027)
Overall homogeneity * Proportion of similar students > 75th quantile and < 50%	0.005	0.005	0.046***	0.043***
	(0.011)	(0.011)	(0.016)	(0.016)
Overall homogeneity * Proportion of similar students > 50%	-0.113***	-0.114***	-0.065	-0.067
	(0.030)	(0.033)	(0.073)	(0.080)
Observations	953,757		953,757	
Course* Institution FEs	Yes	No	Yes	No
Institution * Cohort FEs	Yes	No	Yes	No
Course * Institution * Cohort FEs	No	Yes	No	Yes

Note: Coefficients, standard errors clustered at the institution level in parentheses. */**/*** denote statistical significance at the 10%, 5% and 1% level respectively.

Table 8: Student diversity and university outcomes, different dimensions of diversity

	(1)	(2)
First class honours degree		
% male	0.002	0.004
	(0.007)	(0.007)
% foreign students	-0.019	-0.012
	(0.014)	(0.016)
% mature students	-0.017*	-0.024**
	(0.009)	(0.010)
Socio-economic homogeneity	-0.035***	-0.046***
	(0.011)	(0.014)
Ethnic homogeneity	0.101***	0.106***
	(0.011)	(0.013)
Area HE participation homogeneity	0.007	0.015
	(0.012)	(0.013)
First class and upper second honours degree		
% male	-0.126***	-0.130***
	(0.017)	(0.019)
% foreign students	-0.012	0.024
	(0.027)	(0.030)
% mature students	-0.122***	-0.115***
	(0.017)	(0.019)
Socio-economic homogeneity	-0.272***	-0.353***
	(0.026)	(0.031)
Ethnic homogeneity	0.274***	0.321***
	(0.024)	(0.028)
Area HE participation homogeneity	-0.046*	-0.006
	(0.023)	(0.026)
Observations	953,757	
Course* Institution FEs	Yes	No
Institution * Cohort FEs	Yes	No
Course * Institution * Cohort FEs	No	Yes

Coefficients, standard errors clustered at the institution level in parentheses. */**/*** denote statistical significance at the 10%, 5% and 1% level respectively. Socio-economic homogeneity is a Herfindahl index calculated over 5 social classes of the student's parents ("Managerial and professional occupations", "Intermediate occupations", "Small employers and own-account workers", "Lower supervisory and technical occupations" and everyone else). Ethnic homogeneity is Herfindahl index calculated over 5 self-assessed ethnicities ("White", "Black", "Indian, Pakistani, Bangladeshi", "Other Asian" and "Other"). Area HE participation homogeneity is a Herfindahl index calculated over the 5 POLAR quintiles.

Table 9: Diversity effects by student subgroup

	(1)	(2)	(3)	(4)
	First class honours degree		**First class and upper second honours degree**	
	White students			
Proportion of similar students	0.037**	0.036**	0.084***	0.083***
	(0.015)	(0.016)	(0.030)	(0.031)
Overall homogeneity	0.060***	0.061***	-0.090*	-0.090*
	(0.017)	(0.018)	(0.047)	(0.050)
	Non-white students			
Proportion of similar students	0.028***	0.030***	0.016	0.013
	(0.007)	(0.008)	(0.012)	(0.013)
Overall homogeneity	-0.003	-0.002	-0.054***	-0.050***
	(0.006)	(0.006)	(0.017)	(0.018)
	Mature students			
Proportion of similar students	0.029***	0.026***	0.075***	0.074***
	(0.008)	(0.008)	(0.013)	(0.013)
Overall homogeneity	-0.007	-0.000	-0.084	-0.073
	(0.025)	(0.027)	(0.071)	(0.079)
	Non-mature students			
Proportion of similar students	0.061***	0.062***	0.121***	0.121***
	(0.009)	(0.009)	(0.018)	(0.018)
Overall homogeneity	0.018*	0.017	-0.133***	-0.134***
	(0.010)	(0.011)	(0.018)	(0.018)
	Men			
Proportion of similar students	0.060***	0.059***	0.104***	0.101***
	(0.013)	(0.013)	(0.021)	(0.022)
Overall homogeneity	-0.003	-0.004	-0.152***	-0.154***
	(0.015)	(0.015)	(0.033)	(0.035)
	Women			
Proportion of similar students	0.054***	0.055***	0.095***	0.093***
	(0.013)	(0.014)	(0.025)	(0.025)
Overall homogeneity	0.018	0.018	-0.099**	-0.097**
	(0.015)	(0.015)	(0.040)	(0.042)
	UK students			
Proportion of similar students	0.060***	0.060***	0.121***	0.120***
	(0.016)	(0.017)	(0.029)	(0.030)
Overall homogeneity	0.023	0.023	-0.126***	-0.126***
	(0.016)	(0.017)	(0.042)	(0.044)
	Foreign students			
Proportion of similar students	0.027*	0.029**	0.102***	0.094***
	(0.014)	(0.014)	(0.019)	(0.020)
Overall homogeneity	-0.005	-0.003	-0.026	-0.016
	(0.011)	(0.012)	(0.021)	(0.022)
	Managerial/professional background			
Proportion of similar students	0.073***	0.074***	0.198***	0.198***
	(0.011)	(0.011)	(0.014)	(0.014)
Overall homogeneity	0.032**	0.031**	-0.157***	-0.161***
	(0.014)	(0.014)	(0.016)	(0.016)
	Not managerial/professional background			
Proportion of similar students	0.040***	0.040***	0.066***	0.064***
	(0.012)	(0.013)	(0.019)	(0.019)
Overall homogeneity	0.009	0.010	-0.103**	-0.100**
	(0.016)	(0.017)	(0.044)	(0.046)
Course* Institution FEs	Yes	No	Yes	No
Institution * Cohort FEs	Yes	No	Yes	No
Course * Institution * Cohort FEs	No	Yes	No	Yes

Note: Coefficients, standard errors clustered at the institution level in parentheses. */**/*** denote statistical significance at the 10%, 5% and 1% level respectively.

Table 10: Effects by broad institution type

	Specialist institutions	High-entry tariff institutions	Medium-entry tariff institutions	Low-entry tariff institutions
	First class honours degree			
Proportion of similar students	0.011**	0.021***	0.094***	0.059***
	(0.005)	(0.007)	(0.006)	(0.006)
Overall homogeneity	0.091***	0.081***	-0.040***	-0.023***
	(0.007)	(0.007)	(0.005)	(0.005)
	First class and upper second honours degree			
Proportion of similar students	0.032***	0.046***	0.169***	0.131***
	(0.007)	(0.007)	(0.008)	(0.008)
Overall homogeneity	0.116***	-0.057***	-0.206***	-0.179***
	(0.010)	(0.007)	(0.007)	(0.007)
Observations	101171	307623	291200	245119

Note: Coefficients, standard errors clustered at the institution level in parentheses. */**/*** denote statistical significance at the 10%, 5% and 1% level respectively. All estimates include course*institution and institution*years fixed effects. Specialist institutions are those with 60% or more of its provision concentrated in one or two subjects. Examples are music and arts colleges, but this group also includes the London School of Economics and Political Sciences. Non-specialist institutions are grouped based on the average entry score of their young (under 21) UK-domiciled undergraduate entrants in the 2011/12 academic year. High, medium and low corresponds to the top, middle and bottom third of institutions.

Table 11: Effects by subjects

	First class honours degree	First class and upper second honours degree
	Subjects Allied to Medicine	
Proportion of similar students	0.077***	0.101***
	(0.009)	(0.011)
Overall homogeneity	-0.025**	-0.104***
	(0.010)	(0.013)
	Biological Sciences	
Proportion of similar students	0.068***	0.137***
	(0.010)	(0.013)
Overall homogeneity	0.061***	-0.049***
	(0.009)	(0.011)
	Veterinary Sciences, Agriculture and related subjects	
Proportion of similar students	0.089*	0.212***
	(0.050)	(0.066)
Overall homogeneity	0.055	-0.168***
	(0.044)	(0.058)
	Physical Sciences	
Proportion of similar students	0.025	0.044**
	(0.019)	(0.022)
Overall homogeneity	0.093***	0.016
	(0.017)	(0.020)
	Mathematical Sciences	
Proportion of similar students	0.015	0.006
	(0.014)	(0.016)
Overall homogeneity	-0.067***	-0.120***
	(0.012)	(0.014)
	Engineering	
	b/se	b/se
Proportion of similar students	0.043***	0.036**
	(0.014)	(0.015)
Overall homogeneity	-0.075***	-0.175***
	(0.014)	(0.015)
	Technologies	
Proportion of similar students	0.087**	0.033
	(0.039)	(0.046)
Overall homogeneity	-0.048	-0.209***
	(0.035)	(0.041)
	Architecture, Building and Planning	
Proportion of similar students	-0.019	0.007
	(0.020)	(0.027)
Overall homogeneity	0.019	-0.117***
	(0.018)	(0.023)
	Social Studies	
Proportion of similar students	0.051***	0.102***
	(0.009)	(0.012)
Overall homogeneity	0.056***	-0.050***
	(0.009)	(0.012)
	Law	
Proportion of similar students	-0.020	0.021
	(0.013)	(0.021)
Overall homogeneity	0.035***	-0.066***
	(0.011)	(0.018)
	Business and Administrative Studies	
Proportion of similar students	0.015	0.040***
	(0.010)	(0.013)
Overall homogeneity	-0.050***	-0.191***
	(0.008)	(0.010)
	Mass Communication & Documentation	
Proportion of similar students	0.130***	0.297***
	(0.022)	(0.032)
Overall homogeneity	-0.017	-0.326***
	(0.015)	(0.022)
	Linguistics, Classics and Related Subjects	
Proportion of similar students	0.066***	0.145***
	(0.015)	(0.017)
Overall homogeneity	0.152***	-0.025
	(0.014)	(0.016)
	European Languages, Literature and Related Subjects	
Proportion of similar students	0.018	0.096***
	(0.026)	(0.025)
Overall homogeneity	0.165***	-0.119***
	(0.028)	(0.027)

Eastern, Asiatic, African, American and Australasian Languages, Literature and Related Subjects		
Proportion of similar students	0.140**	0.226***
	(0.064)	(0.078)
Overall homogeneity	0.035	-0.285***
	(0.055)	(0.068)
Historical and Philosophical Studies		
Proportion of similar students	0.025*	0.132***
	(0.015)	(0.016)
Overall homogeneity	0.206***	0.018
	(0.014)	(0.016)
Creative Arts and Design		
Proportion of similar students	0.118***	0.255***
	(0.012)	(0.015)
Overall homogeneity	-0.043***	-0.315***
	(0.009)	(0.011)
Education		
Proportion of similar students	0.060***	0.151***
	(0.014)	(0.019)
Overall homogeneity	-0.011	-0.238***
	(0.015)	(0.021)

Note: Coefficients, standard errors clustered at the institution level in parentheses. */**/*** denote statistical significance at the 10%, 5% and 1% level respectively. Sample sizes range from 3,773 (Eastern, Asiatic, African, American and Australasian Languages, Literature and Related Subjects) to 127,603 (Business and Administrative Studies)

Figure 1: Proportion of students with no similar peers and more than 50% similar peers across socio-economic groups

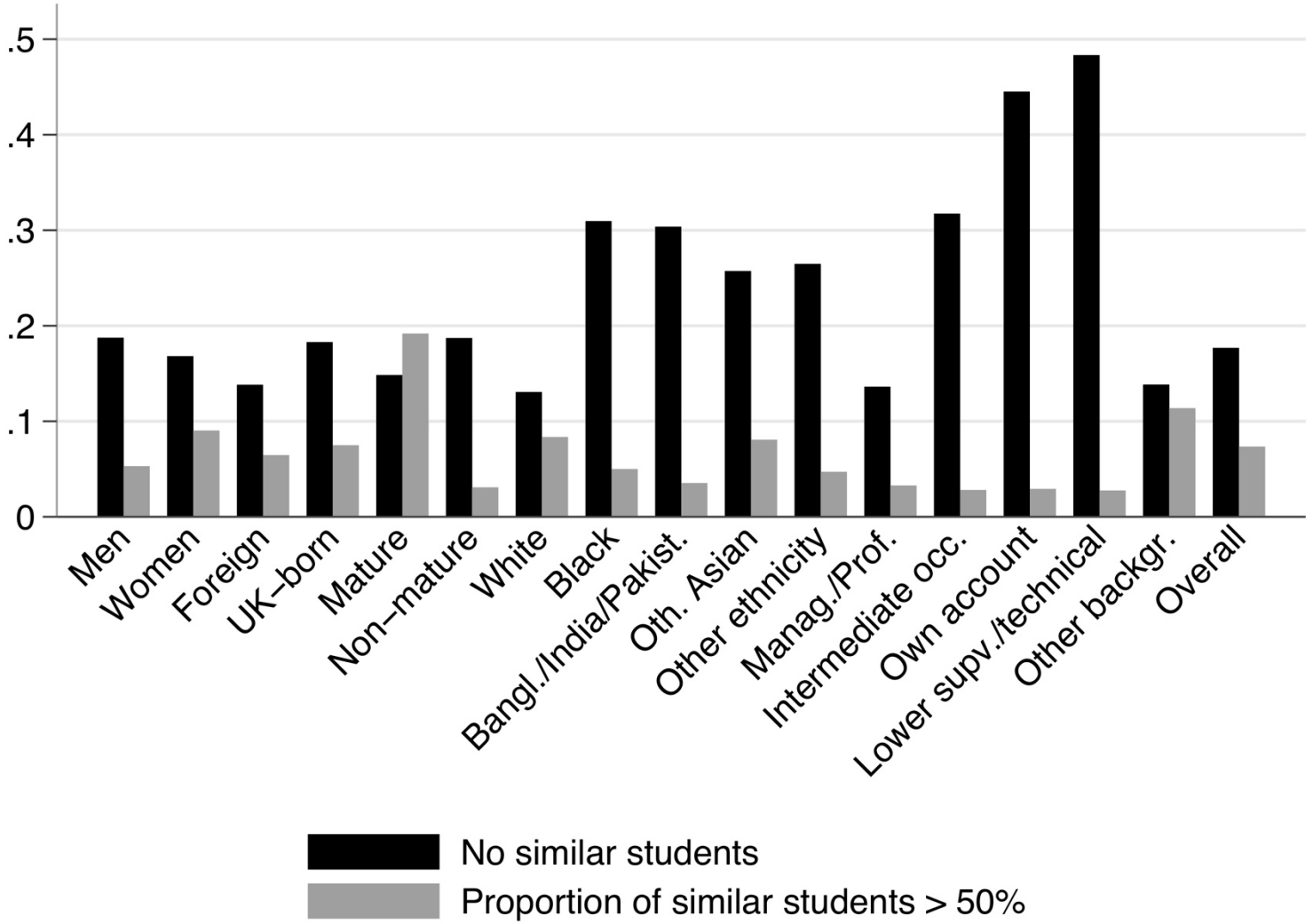
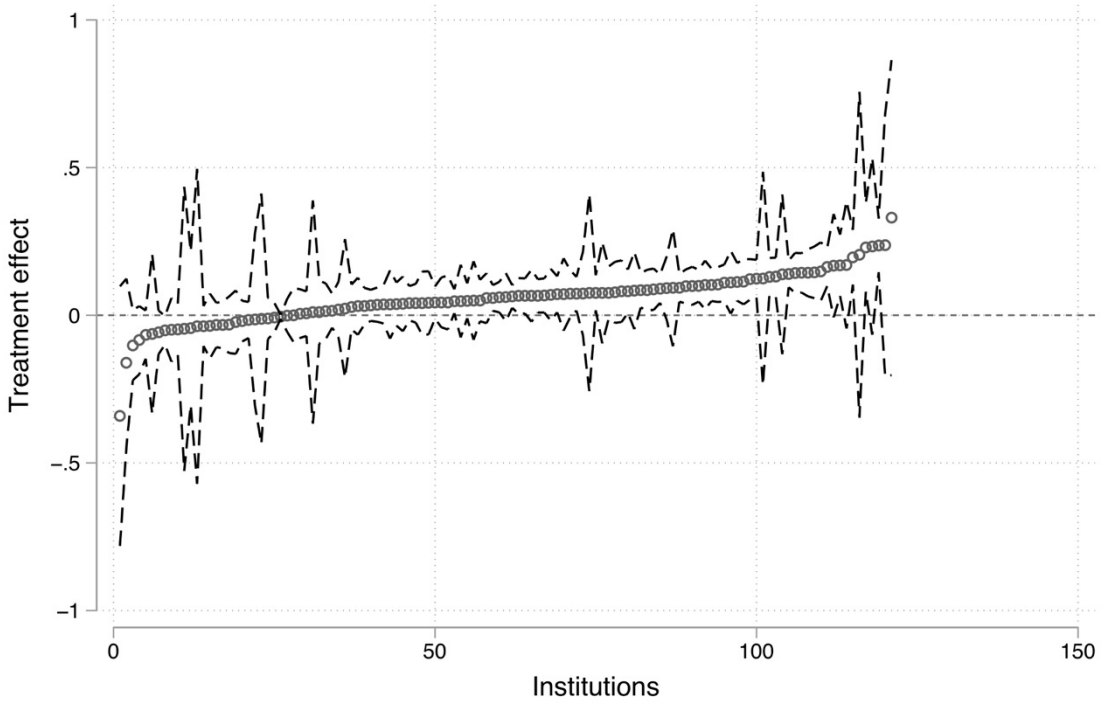
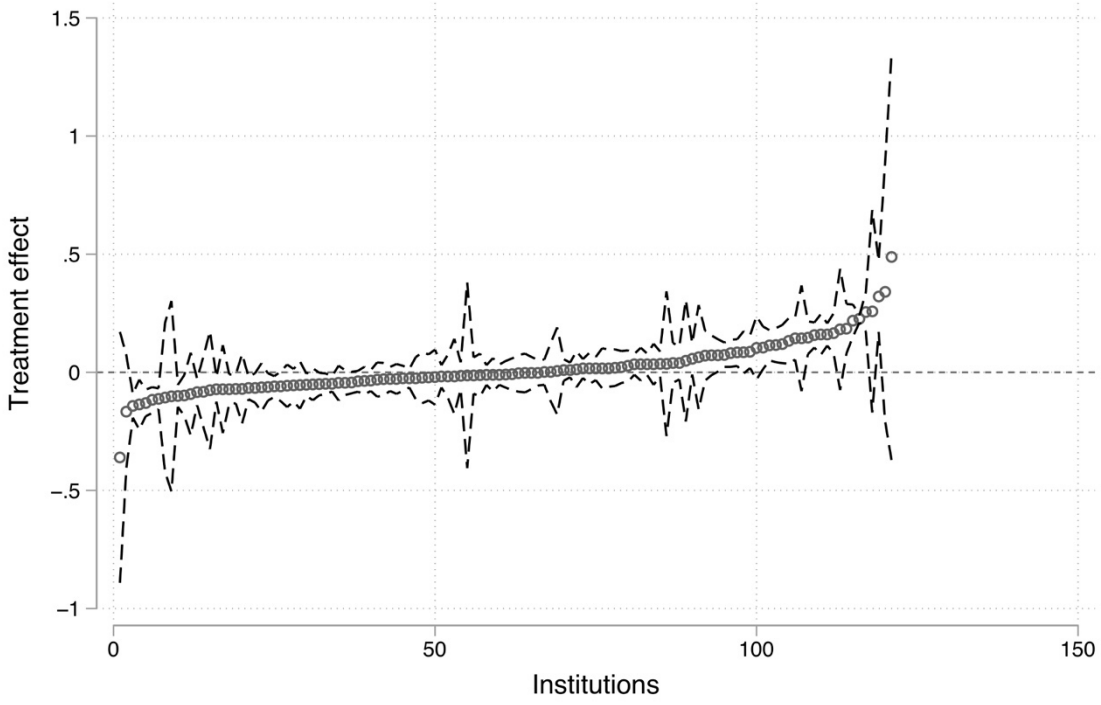


Figure 2: Heterogeneity across universities, outcome = first class honours degree

Panel (a): Proportion of similar students



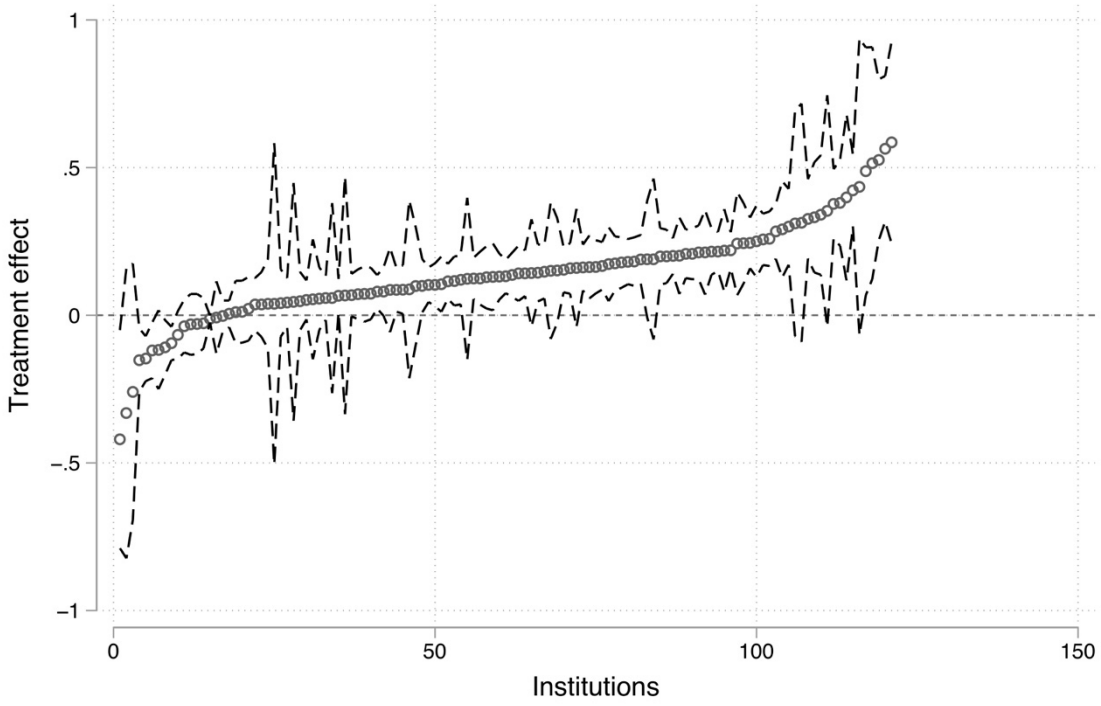
Panel (b): Overall homogeneity



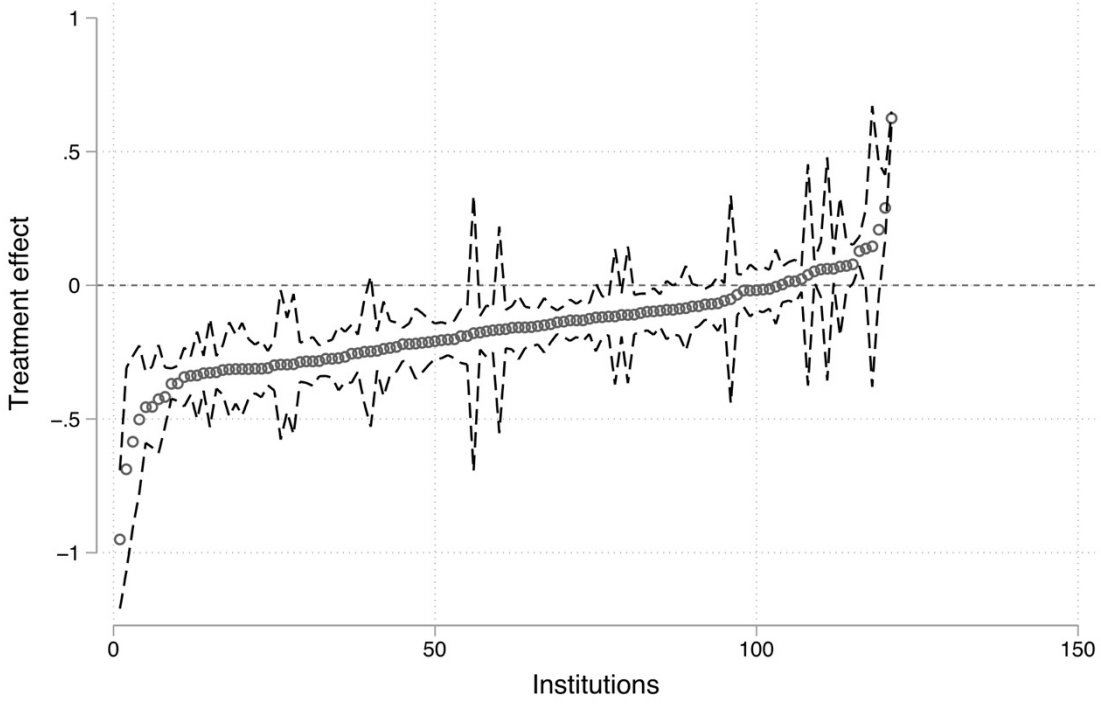
Note: Treatment effects ordered by size. Coefficients and 95% confidence intervals. Specification based on equation (1) with both diversity measures included simultaneously.

Figure 3: Heterogeneity across universities, outcome = first class or upper second honours degree

Panel (a): Proportion of similar students



Panel (b): Overall homogeneity



Note: Treatment effects ordered by size. Coefficients and 95% confidence intervals. Specification based on equation (1) with both diversity measures included simultaneously.