UKSCQA
UK Standing Committee for Quality Assessment

THE DRIVERS OF DEGREE CLASSIFICATIONS

Universities UK

Distinction and Diversity in Higher Education
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The drivers of degree classifications

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Abstract

This report provides an analysis of ‘grade inflation’ in UK higher education. It considers the rise in the proportion of upper degrees (ie, first-class and upper-second classifications) awarded to first-degree graduating students and quantifies the extent to which this increase can be explained by ‘input’ variables and what remains ‘unexplained’. This involves modelling the impact that student ‘quality’ and the ability of universities to produce graduates efficiently have on degree outcomes. The data used in the analysis is compiled at the institution level from the Heidi Plus database and covers the academic years from 2007/8 to 2016/17 inclusive. The findings suggest that from the academic year 2010/11 onwards, the input variables explain increasingly less of the change in upper degrees, suggesting an increase in the potential risks of grade inflation. Similar findings emerge in the consideration of first-class degrees. The data set employed in the analysis and the modelling framework adopted also allow for sub-themes to be explored which, when tested, reveal similar results.

Executive summary

This report was commissioned by Universities UK on behalf of the UK Standing Committee for Quality Assessment (UKSCQA) in May 2018 to undertake an analysis of potential grade inflation in UK higher education. It builds on work previously conducted that examined the potential incidence of grade inflation in England, Wales and Northern Ireland between 2006 and 2012 (Bachan 2017). The proportion of upper degrees (ie, first-class and upper-second classifications) has shown a substantial increase in the UK over the last decade, ranging from just over 60% in 2007/08 to 75% in 2016/17. The percentage of first-class degrees has also seen a large increase over the same time period, rising from just over 13% to 26%.[1]

The methodological framework adopted allows the estimation of an 'unexplained' component that remains after accounting for the influence on degree outcomes that a range of student entry characteristics and university inputs have. This unexplained component is a phenomenon which institutions will each need to interrogate and understand, to identify where they can demonstrate unaccounted-for improvements and acknowledge whether, and if so where, they are at risk of grade inflation.

The study is conducted at the university level using data sourced from the Heidi Plus database.

Key findings

- There is evidence of 'unexplained' increases – those that cannot be explained by student quality and/or characteristics, or university expenditure on student and staff facilities and academic services – in the upper degree category from the academic year 2010/11 onwards, relative to 2007/08.
- The level of 'unexplained' increase differs by university type and has increased over time. The extent of this increase, and its persistence, remain after controlling for a variety of student characteristics, suggesting the potential for grade inflation in UK higher education.
- There is also evidence of 'unexplained' increases in the first-class degree category, which also shows an upward trend and varies across institutions.
- The extent of the 'unexplained' increase, and the potential for grade inflation, are found to be higher in the first-class degree category compared with upper-degree classifications.
- The study finds that elements of a graduating cohort's characteristics affect degree classification. These include: the average UCAS entry score, gender, the previous school attended prior to university entry, subject mix, ethnicity, the socio-economic group students belong to, and the nature of participation in higher education in the neighbourhoods from which students originate. These results confirm previous findings in the literature. However, the significance of these characteristics varies across the specifications reported.

[1] Higher Education Statistics Agency (HESA) - Chart 9 - Classified first degree qualifications by class 2006/07 to 2016/17, https://www.hesa.ac.uk/data-and-analysis/students/chart-9

1: Introduction

The proportion of upper degrees awarded by UK universities has increased significantly over the past decade.[2] Part of this increase is sometimes referred to as grade inflation, which has been defined as ‘an upward shift in [student grades] over an extended period of time without a corresponding increase in student achievement’ (Rosovsky and Hartley 2002: 4). Applied to the UK, this would mean an increase in ‘upper’ degree awards without improvement in student attainment.

If grade inflation exists, it should be a concern for the sector. It has the effect of lowering educational standards and brings into question the integrity of the degree classification system. The issue has become a staple focus for the education press and government ministers and agencies. For instance, the incumbent universities minister, Sam Gyimah, has directed the newly formed Office for Students (OfS) to monitor grade inflation on an annual basis (DfE 2018).

Whether grade inflation is a serious issue for UK higher education is not clear, particularly if the rise in the proportion of upper degrees is accompanied by improvement in student ability, together with improvements in university efficiency, such as the introduction of better learning and teaching methods and curriculum developments that *produce* high-achieving graduates.

This report considers the extent to which the increase in the proportion of upper degrees – so-called ‘good’ honours degrees – witnessed in the UK over the past decade, can be potentially attributable to grade inflation. The exercise is then repeated for first-class degrees.

The methodology adopted is couched within a production function framework. It allows for an ‘unexplained’ component to be estimated (an indicator of potential grade inflation) after controlling for key ‘raw materials’ and ‘inputs’ into the educational process. The ‘raw materials’ include the graduating cohort’s UCAS entry score and other student characteristics, and the ‘inputs’ include university spending on student and staff facilities, academic services and human resources (ie, the ratio of students to teaching staff). Moreover, it allows for a measure of university efficiency to enter the analysis (ie, the university’s ability to turn these inputs and raw materials into graduates with upper degrees), which is very rarely found in the literature.

This report is arranged as follows. Section 2 presents a description of the general trends in UK degree classifications using the sample data. This is followed by a review of the literature on grade inflation in Section 3. Section 4 provides a description of the methodology employed and Section 5 describes the data used in the primary analysis, focusing on the key input variables. The results from the primary analysis are presented in Section 6. The primary analysis is extended in Section 7 to include variables that describe student characteristics that have been found to be associated with particular aspects of student performance. University efficiency is examined in Section 8, and the final section provides concluding remarks.

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[2] The term ‘universities’ is used to collectively refer to higher education institutions (HEIs).

2: Trends in degree classification

The data used in the primary analysis is compiled at the institution level from the HEIDI Plus database and covers the academic years from 2007/8 to 2016/17 inclusive, giving a 10-year timeframe. The sample includes all UK universities, but excludes postgraduate institutions, the Open University and specialist universities and colleges of the arts, medical schools and institutes, and small institutes of the University of London and University of Wales. These institutions are omitted due to the nature of the degrees undertaken and their atypical student intake. Moreover, relevant data is not available for many of these institutions over the sample period, partly due to mergers and the reporting requirements of UK higher education agencies. In total, 128 UK universities are included in the sample, providing 1,280 observations. The universities included in the analysis are found in Annexe A.

Table 1 shows the sample trends in UK degree classifications. The proportion of upper degrees, as a proportion of all degree outcomes (including unclassified and ordinary degrees and fails), increased from 56% to around 71% of all undergraduate degrees awarded in 2017, rising by 15 percentage points over the 10-year period. This represents a 55% increase in the actual number of upper degrees awarded, almost identical to the increase in upper degrees awarded by universities found in the UK population.[3] This implies that, on average, these awards have increased by around 2.6% a year. It is worth noting that the number of upper degrees has not only increased, in line with an expanding sector, but that the proportion of students graduating with a first-class degree has doubled. There has also been a simultaneous continual decline in the proportion of lower-second and third-class degrees, and a decline in the failure rate and unclassified awards. These trends are shown in Table 1.

Table 1: Distribution of sample degree classifications UK universities, 2008–2017

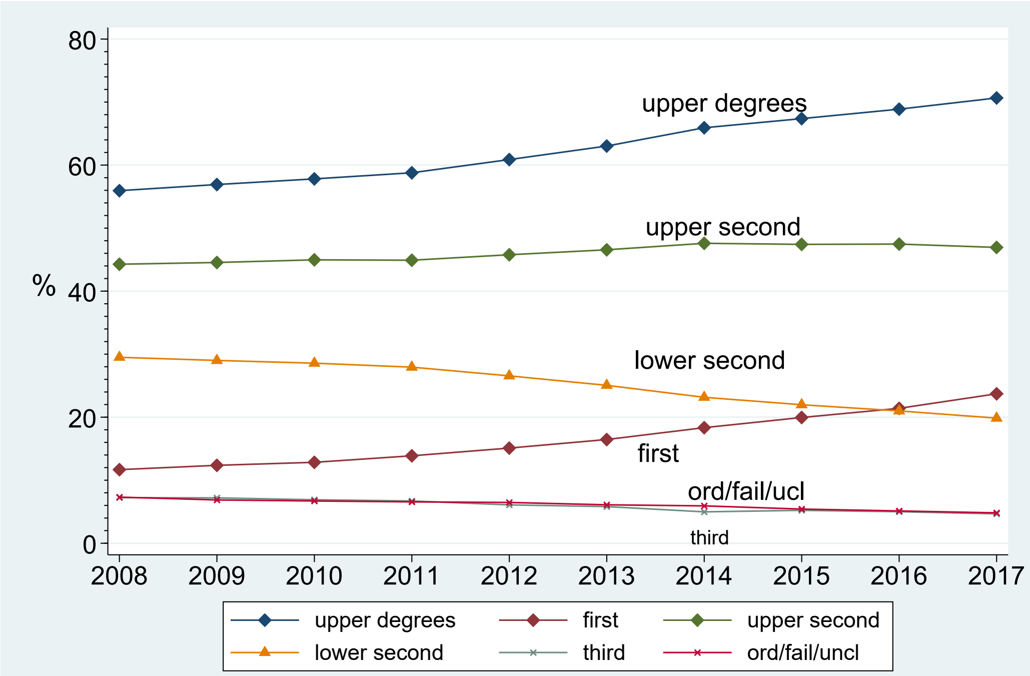
Year	% good	% first class	% upper second	% lower second	% third	% ordinary/fail/ unclassified
2008	55.9	11.7	44.3	29.5	7.2	7.3
2009	56.9	12.4	44.6	29.0	7.2	6.9
2010	57.8	12.8	45.0	28.6	6.9	6.7
2011	58.8	13.9	44.9	27.9	6.7	6.6
2012	60.9	15.1	45.8	26.6	6.1	6.5
2013	63.0	16.5	46.6	25.1	5.8	6.1
2014	65.9	18.3	47.6	23.2	5.0	5.9
2015	67.4	20.0	47.4	22.0	5.2	5.4
2016	68.9	21.4	47.5	21.0	5.0	5.1
2017	70.7	23.7	46.9	19.9	4.7	4.8

N=128

The data is presented in graphical form in Figure 1. We see that around 2012 (the year when tuition fees increased to £9,000 in England and the cap on student numbers was lifted), the proportion of upper degrees experienced a sharp increase, rising by about 10 percentage points between 2011/12 and 2016/17. It is important to note that cohorts affected by this fee change join the dataset from 2014/15, if undertaking a standard three-year undergraduate degree.

[3] HESA student record, 2007/08 to 2016/17

Figure 1: All classifications of first degrees awarded by UK universities, 2008–2017



Source: HEIDI Plus (HESA various years)

Note: Excludes postgraduate institutions, medical schools, universities of the arts and the Open University

UK universities differ in terms of their history, mission, research and teaching intensities, size, income, subject mix and the type of students and staff they attract. We may expect the proportion of upper degrees awarded to differ across university type, and note that there is no single classification distribution. For the purposes of this study, the universities included in the sample are classified according to the year of formation (ie, the year they were granted university status by Royal Charter) and research and teaching intensities, so that as far as possible, each group contains comparable institutions. Four general classifications (groupings) are used in the analysis:

- pre-1992 (universities that were in existence prior to the Further and Higher Education Act 1992)
- post-1992 (universities created in the wake of the Further and Higher Education Act 1992)
- post-2003 and post-2012 universities (combining all those universities created by Royal Charter after 2003 and 2012)[4]
- Scottish universities

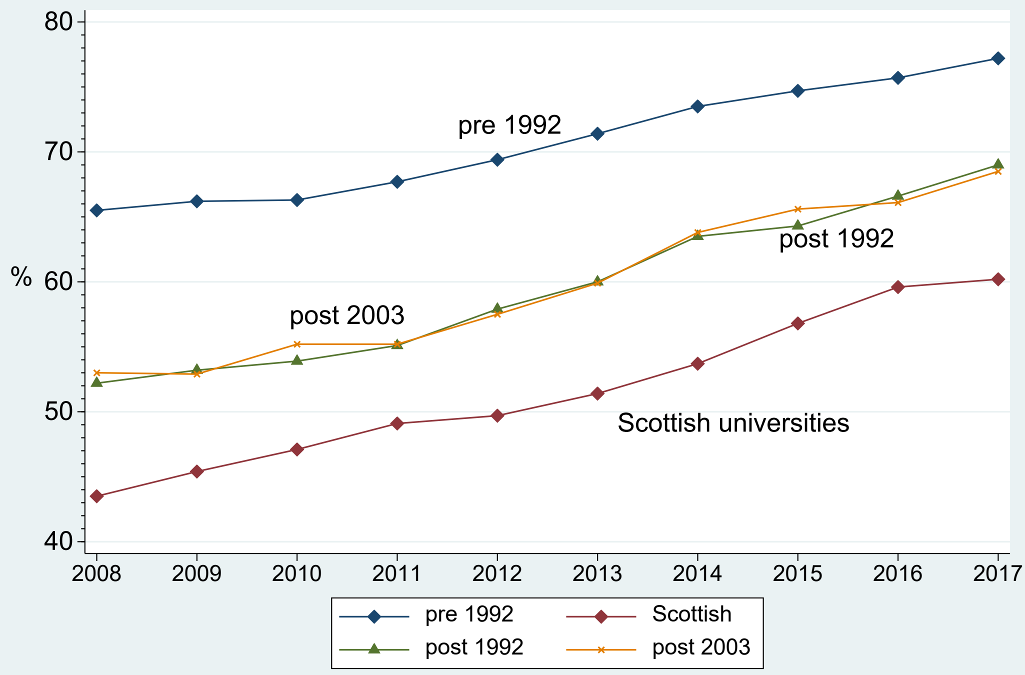
The first three groupings exclude Scottish universities and a separate grouping is created for institutions within the Scottish sector. This is because it typically takes an extra year to graduate from a Scottish university with an honours degree compared with other UK universities. The award of non-honours degrees by Scottish institutions is not given a differential classification but can be bestowed after three years of study. This last issue

[4] For the purposes of this report, the combined grouping of post-2003 and post-2012 universities are referred to as 'post-2003'.

increases the proportion of ordinary degrees in the sample data and supresses the proportion of upper degrees awarded by these institutions.[5] [6]

The proportion of upper degrees awarded by universities included in the sample, relative to *all* classifications, is shown in Figure 2. We see that pre-1992 universities award the highest proportion of upper degrees, which increased from 65% in 2008 to just over 77% in 2017. Post-1992 and post-2003 universities award a similar proportion of upper degrees, rising from around 52% in 2008 to about 69% in 2017. The proportion of upper degrees awarded by Scottish universities in the sample has been historically lower than for other UK universities. However, upper degrees awarded by Scottish universities increased by 19 percentage points, from 43% to 62%, over the period, compared with a combined increase of 14 percentage points, from 58% to 72%, for universities located in England, Wales and Northern Ireland. Moreover, it is evident (and regardless of university grouping), that the trend is upward. It is also notable that some will have more headroom to increase the proportion of upper degrees over the period.

Figure 2: Upper (honours) degrees (first degrees) awarded by university type, 2008–2017



Source: HEIDI Plus (HESA various years)

Note: Excludes postgraduate institutions, medical schools, universities of the arts and the Open University; groupings for pre-1992, post-1992 and post-2003 exclude Scottish institutions.

[5] Scottish institutions in the sample awarded an average of 50.25% upper degrees (see Annexe B). This figure is calculated using all degree outcomes (including unclassified, failed and ordinary degrees). If we remove unclassified and ordinary degrees from the calculation, the average rises to 69%.

[6] Due to small sample sizes and institutional mergers over the period, it has not been possible to conduct separate analysis for Wales and Northern Ireland.

3: Literature review

Grade inflation is often taken to reflect a fall in educational standards over time. The literature on academic standards identifies future wages as a channel through which grades may affect a student's future welfare. Costrell (1994) develops a theoretical model to describe how educational standards are set and demonstrates that if the policymaker seeks to promote greater equality in outcomes, then lower standards will be set.

Marks (2002) argues that educational standards share similar characteristics to those of a public good and are subject to the familiar free-riding problem. For instance, students may put pressure on faculty to award high grades and instructors may free ride on grading norms by awarding the desired grade through more lenient marking, even if other instructors will not. Johnes (2004) offers a simple game-theoretic exposition that describes how pressure put on faculty by students can potentially push up grades. McKenzie and Tullock (1981) explain this in terms of market demand and supply. They argue that, in a situation of excess supply with fixed tuition fees, students could be attracted to fill surplus places with a fall in the 'hedonistic' price through more lenient marking and grading (Johnes 2004). Thus, grades are inflated to attract students, resulting in a fall in standards for a given level of ability and effort.

Although the empirical literature on grade inflation in UK higher education is thin, the phenomenon has been widely researched in the US (see, for example, Astin 1998; Rosovsky and Hartley 2002 for reviews). This literature points to several factors that are argued to influence the increase in the grade point average (GPA) in many US universities. These include the introduction of student evaluation of teaching (Zangenehzadeh 1988; Krautmann and Sander 1999; Anglin and Meng 2000; Ewing 2012), and the need to improve enrolment on specific undergraduate programmes (Sabot and Wakeman-Linn 1991; Achen and Courant 2009; Ehrenberg 2010; Ost 2010; Rask 2010; Ewing 2012; Jewell and McPherson 2012).

Other authors offer labour market explanations for the phenomenon, suggesting that graduates from disciplines that command high wages (eg graduates of science, technological, engineering and mathematics (STEM) disciplines) are awarded lower grades than graduates in disciplines that command low wages (eg, arts graduates) to increase course enrolment (Freeman 1999).

Further, it has been observed that graduates from elite Ivy League universities in the US are awarded higher grades than those from other types of US universities and colleges (Astin 1998; Gose 1997; Kuh and Hu 1999; Healy 2001; Popov and Bernhardt 2013).

The issue of grade inflation has also attracted interest in Ireland (O'Grady and Guilfoyle 2007), Canada (Dickson 1984), Australia (Marginson 1995), Germany (Bauer and Grave 2011) and Italy (Bagues et al 2008), demonstrating that it is not the UK alone that is facing these challenges

In the UK, it is argued that the upward drift in the proportion of upper degrees, particularly since the 1990s, is due in part to the modularisation of degree programmes and changes in assessment methods, including the introduction of coursework and assignments, without changes in the boundaries delineating grade classifications (Gibbs and Lucas 1997; Elton

1998). This has formed part of a wider shift in the sector to think about ways in which it can become more accessible to a range of students and learners, and to widen participation.

Yorke (2002) examined the association between subject field and the upward drift in upper degrees in the UK between 1994/95 and 1998/99. The author offers several pedagogic reasons for the general upward trend. These include curriculum development and changing methods of assessment that focus on competences (ie, learning outcomes) with a move from norm referencing towards criterion referencing (ie, a move from assessing students on their relative performance to an absolute measure of performance). The marking processes adopted by different subject areas potentially provide a further reason why the proportion of upper degrees may differ between subject groupings. Other suggestions for the increase in upper degrees include pressure put on universities to improve their league table position and the influence of the external monitoring of standards by government agencies (Elton 1998).

It should be noted that the vast majority of empirical studies on grade inflation exploit cross-sectional or pooled data and the more rigorous studies generally employ regression techniques. It is not clear whether the grade inflation observed in many of these studies captures pure grade inflation or whether it is a result of increased student effort and diligence, or due to a better quality of student intake. Moreover, the rise in the proportion of upper degrees observed in these studies may be conflated with a rise in university efficiency in teaching and/or resource use.

To address this latter issue, Johnes and McNabb (2002) examined grade inflation in UK higher education, controlling for changes in university efficiency using a standard stochastic frontier framework. The study focused on two timeframes, 1973–1993 and 1995–2000, and exploited institution-level data that included information on the proportion of upper degrees awarded by pre-1992 universities for the earlier period and pre-1992 and post-1992 universities in the latter period. The authors report little evidence of grade inflation between 1995 and 2000.

In a recent study, Johnes and Soo (2017) exploit data from the Sunday Times University Guide for the period 2005 to 2012. They find some evidence of grade inflation in the UK in the academic years 2011 and 2012 in their most austere model. Bachan (2017), using a true random effects stochastic frontier estimator and data sourced from HESA covering the period 2006 to 2012, found evidence of potential grade inflation between 2010 and 2012.

It is also instructive to note that there is a large body of research that is focused on the factors that are associated with student degree success, which should not be confused with grade inflation. It is well established in this literature that prior entry qualifications (A-levels, BTECs, Scottish Highers, for example) are a significant and important determinant of UK degree outcomes (see, for example, Chapman 1996; Rogers and Ghosh 2001; Smith and Naylor 2001; Naylor and Smith 2004; Crawford 2014). The literature also suggests that females outperform their male counterparts in achieving an upper degree (McNabb et al 2002; Woodfield and Earl-Novell 2006; Barrow et al 2009); UK-domiciled students perform better than their non-UK counterparts (Makepeace and Baxter 1990; Marshall and Clinton 1995; De Vita 2002; Leslie 2005; Morrison et al 2005; Iannelli and Huang 2013); and students from state schools and colleges excel more at university than their counterparts from private schools (Smith and Naylor 2001, 2005; Naylor and Smith 2004; Crawford 2014). It is worth noting that for Italian universities, it is found that larger class size impacts negatively on student performance (De Paola and Scoppa 2011).

The Higher Education Funding Council for England (Hefce 2018) examined the effect that certain student characteristics have on upper-degree outcomes using individual-level data for UK-domiciled graduates in 2016/17. From the models presented, the study found evidence to suggest that students entering higher education with A-levels performed better than those with BTEC qualifications, and that females outperform their male counterparts. Further evidence was presented to show that students from non-state schools performed better than their state-school counterparts, that students from disadvantage backgrounds performed less well than students from more advantageous backgrounds, and that white students perform better than non-white students. There was some evidence to suggest that science graduates were more harshly graded in some disciplines (Hefce 2018).

4: Methodology

To model the impact that the variables chosen and available for this analysis have on degree classification (and what this means for the possibility of grade inflation), regression techniques are used. The estimating equations are specified in terms of an educational production function, ie, universities use 'inputs' to transform 'raw materials' into 'outputs'. The output of the process are degrees, which is the dependent variable (measured by the proportion of upper- or first-class honours degrees awarded as a proportion of all classifications).

The modelling technique adopted (true random effects stochastic frontier) allows an estimate of 'unexplained' changes in degree outcomes, controlling for student 'quality' (measured by UCAS score (raw material) and university inputs (staff–student ratio, and expenditure on student and staff services and facilities). In addition, and most importantly, the modelling technique allows for changes in university efficiency to enter the analysis alongside the input variables (ie, an institution's ability to 'transform' students into graduates using available resources).

In this framework, universities are assumed to be operating within a production 'frontier' but they cannot operate above it. The error term in the regression model contains two elements. The first is a 'classical' disturbance that captures measurement error and other classical 'noise'. The second component is a one-sided disturbance (half normal), which is used to capture efficiency using the transformation suggested by Jondrow et al (1982). This is an improvement compared with other conventional regression techniques in which the 'line of best fit' passes through the centre of the data and does not allow universities to differ in terms of efficiency. For a technical description of the methodology, see Annexe C.

The 'unexplained' change is then accounted for, in the model, by time- or year dummy variables.[7] If statistically significant, these will provide evidence of other factors being involved in affecting the distribution of classification awards, beyond the input variables and the raw materials used in the year in question. This can include legitimate changes in practice and policy, and genuine improvements that are not accounted for by the efficiency function. It could also, however, include instances of inadvertent inflationary activities, highlighting whether or not institutions may need to review the risks associated with particular policies and practices. It should be noted that, given the logarithmic form of the

[7] When referring to 'unexplained' change, we are referring to significant estimated coefficients on the year dummies which identify where there are changes in the proportion of upper degrees that are not explained by the variables in the model and university efficiency. This should not be confused with the classical notion of 'unexplained' contained within the error term of the given model.

models, the coefficients on the year dummies are presented for interpretation in terms of percentage-point changes using the sample mean for first-class and upper degrees.

Separate models are estimated for each university grouping as defined in Section 2. They are purposefully parsimonious in their structure in the primary analysis to emphasise university characteristics. In subsequent analysis, the models are augmented to include other performance-determining variables, such as the subject studied and student characteristics including gender, previous school status (private or state), ethnicity, domicile, socio-economic group and the nature of participation in higher education in students' originating neighbourhoods.

5: Data: primary analysis

University-level data was collected on the 'raw materials' and 'inputs' that can potentially influence the degree outcome of students in a given academic year. These include:

- average UCAS score of the graduating cohort (a measure of student quality on entry or raw materials); it is expected that as the UCAS score increases, upper degrees also increase, that is, we expect a *positive* relationship between them[8]
- real expenditure on academic services (2015=100) in the year of graduation,[9, 10] including on centralised academic services (library and learning resource services, central computers and computer networks, centrally run museums, galleries and observatories, and any other general academic services). Although variably accessed by students and arguably not wholly focused on the student experience, more expenditure on these services is expected to increase upper degrees, that is, we expect a *positive* relationship
- real expenditure on student and staff facilities (2015=100) in the year of graduation, such as careers advisory services, student societies, accommodation office, sporting facilities, transport, chaplaincy, student counselling, crèches and the provider's healthcare service. Again, while not all directly connected to the student experience, more expenditure on these facilities is expected to have a *positive* relationship with upper degrees
- staff–student ratio in the year of graduation, which is a measure of human resource input through the number of full-time equivalent students per full-time equivalent academic staff (teaching or teaching and research). Higher values of this variable, where there are more students per staff member, are expected to *reduce* upper degrees, that is, we expect a *negative* relationship

The data is available for all institutions over the sample period and therefore provides a strongly balanced panel (ie, there are no missing variables). The descriptive statistics, by university type, are reported in Annexe B. There is a large variation in these variables across university groupings. For instance, the graduating cohort from pre-1992 universities enter with a higher average UCAS score, experience a lower staff–student ratio, and receive more

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[8] It should be noted that school-level qualifications in England, Wales and Northern Ireland have been subject to reforms that aim to restrict the number of upper awards, suppressing improvement trends. Reforms have included changes to the grading scale, benchmarking, assessment timing, and mode of assessment. Elements of norm referencing have also been used.

[9] The consumer price index (2015=100) is used to covert nominal expenditures to real values.

[10] It is assumed that spending on university services (and facilities) throughout any one year is felt by graduates in that year.

spending on staff and student services and facilities, on average, compared with other types of universities.

It must be recognised that while sourced from HESA, the data is self-reported by institutions. Recording of expenditure, for example, and what is and is not included, can vary by institution. Average UCAS scores provide an indication of students' level of ability on entry but will vary across subject areas within institutions, depending on their specialisms and applicant demand. UCAS tariff scores may not always accurately capture academic potential, for example in the case of contextualised admissions, but the use of an average provides an estimation of how students would be expected to perform. Similarly, staff–student ratio for individual students will vary according to course requirements and the nature of teaching within certain subjects. Nevertheless, these represent useful sector-wide data sources on key, frequently cited input factors.

The inclusion of performance variables such as the results from student surveys (eg, the National Student Survey (NSS) overall satisfaction score) are not used here. This is because of causation challenges. It is not clear, and no instruments have yet been developed to determine, whether good NSS scores *cause* upper degrees or whether (expected and perceived) upper degrees *cause* good NSS scores. Similarly, good scores on satisfaction with assessment and feedback could *cause* upper degrees or upper degrees could result in positive NSS responses. Including such variables, particularly variables from league tables, could give a false or biased impression of their effect.

Relationship between upper degrees and key input variables

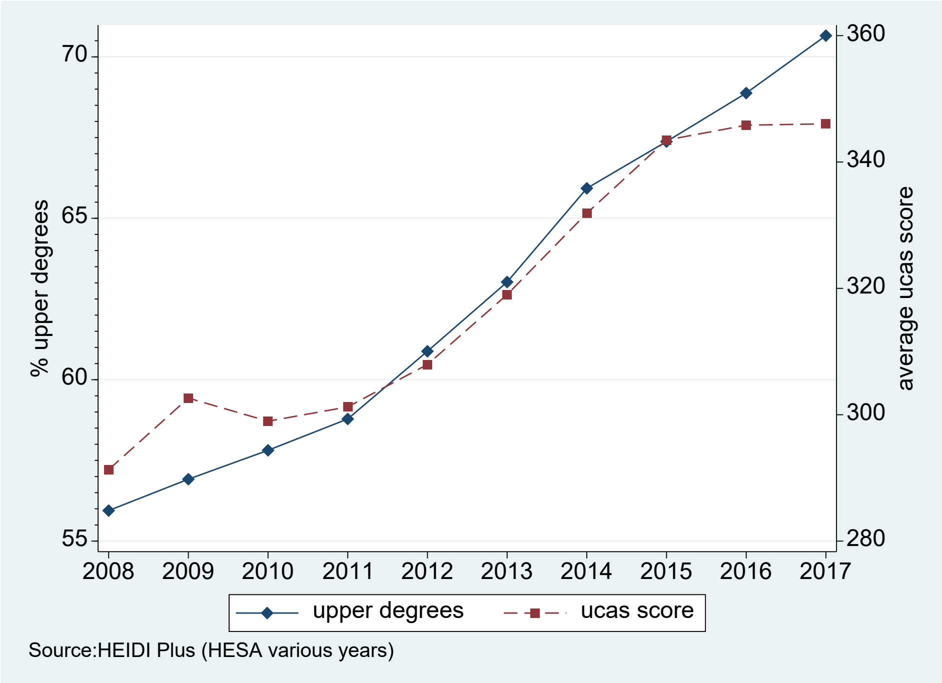
The relationships between the graduating cohort's UCAS score, the staff–student ratio, expenditure on educational services and upper degrees are depicted in Figures 3 to 6. Note that the percentage of upper degrees is measured on the left axis and the explanatory variable on the right.

UCAS score

In general, there is an upward trend in both average UCAS scores and upper degrees between 2008 and 2015, with both variables exhibiting a close *positive* relationship.[11] However, after 2015, the UCAS score shows little increase, although the upward trend in upper degrees continues (Figure 3).

[11] The strength of the relationship is measured by the correlation coefficient (ρ) that ranges from zero (no relationship/correlation) to 1 (perfectly related/correlated). In this case, ρ is significant and positive and moderately strong, ρ =0.65 [prob=0.00].

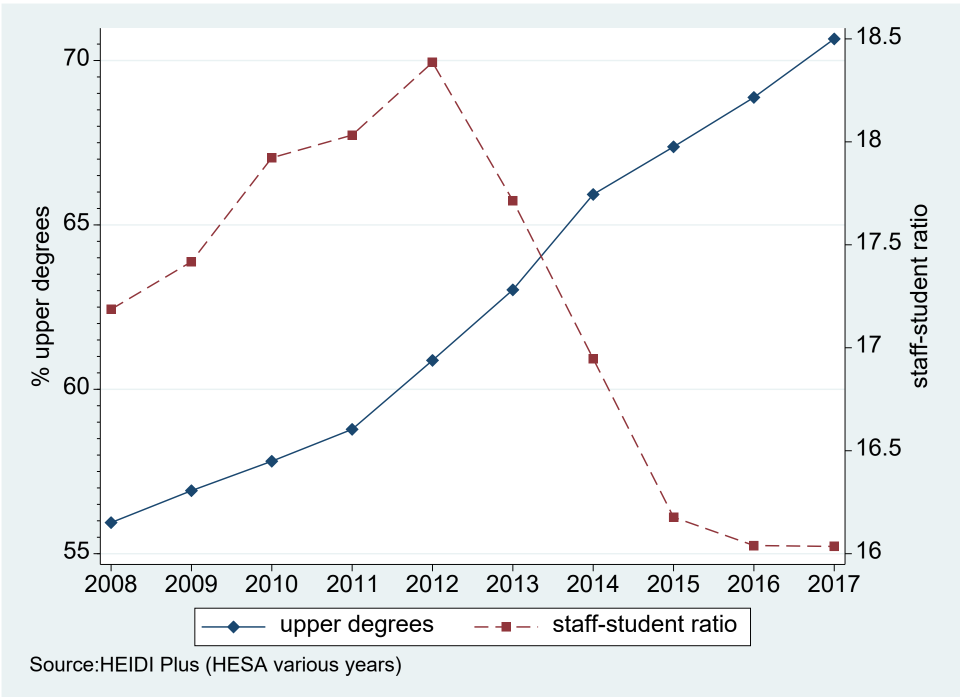
Figure 3: Upper degrees and average UCAS score, 2008–2017



Staff–student ratio

There appears to be little overall relationship between upper degrees and the staff–student ratio. However, both variables increased between 2008 and 2012. Thereafter, there is a significant fall in the ratio from around 18.5 to just over 16 (Figure 4).[12]

Figure 4: Upper degrees and staff–student ratio, 2008–2017

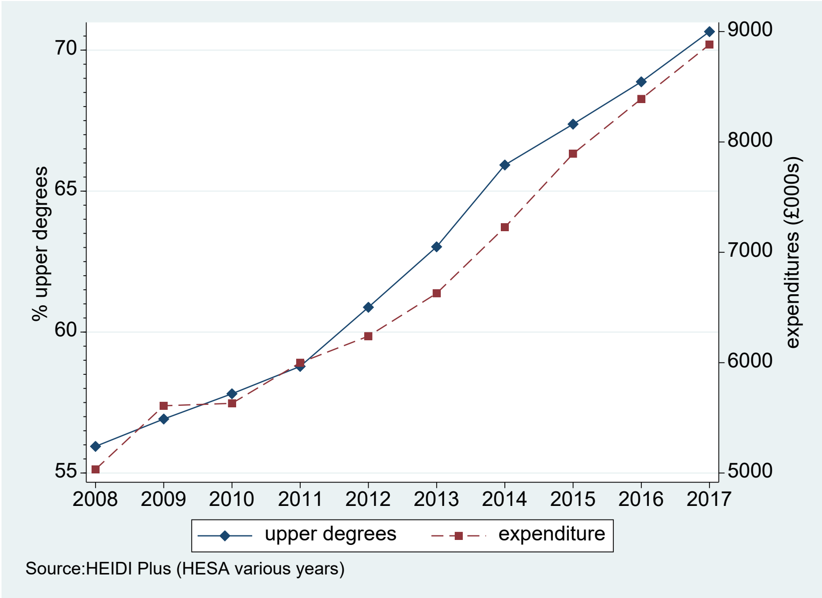


[12] These variables have a weak but significant negative correlation, ρ =–0.41 [prob=0.00].

Real expenditure on staff and student facilities

There is a *positive* relationship between university spending on staff and student facilities and upper degrees, with both variables increasing over time (Figure 5).[13]

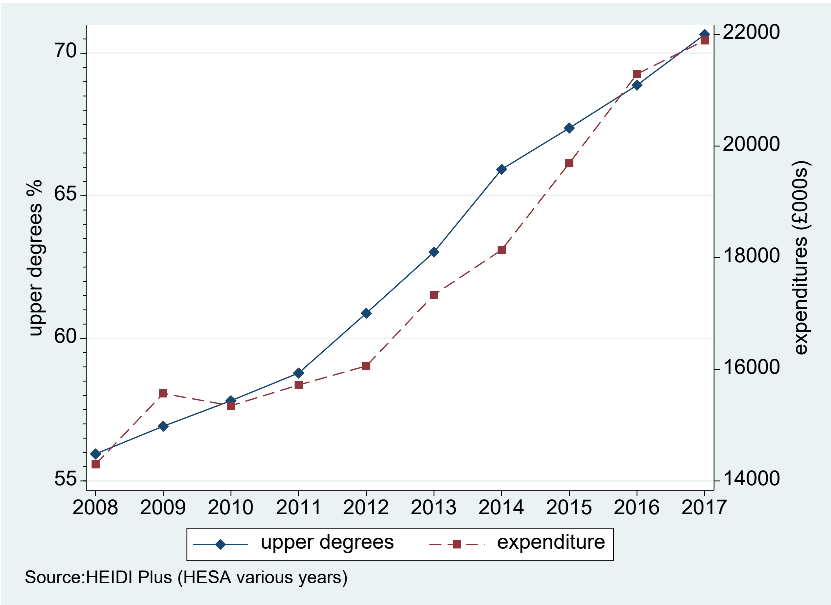
Figure 5: Upper degrees and real expenditure (2015=100) on staff and student facilities, 2008–2017



Expenditure on academic services

Both upper degrees and expenditures on academic services exhibit a *positive* relationship with both these variables increasing over time (Figure 6).[14]

Figure 6: Upper degrees and real expenditure (2015=100) on academic services, 20082017



[13] ρ = 0.40 [prob=0.00]
[14] ρ =0.43 [prob=0.00])

6: Results: primary analysis

The full set of results are reported in the tables found in Annexe D (upper degrees) and Annexe E (first-class degrees). The results for *all universities* in the sample are reported in column 2 in each table. The estimates for the four university groupings are reported in columns 3–6 in the tables. Those coefficients marked with asterisks are statistically significant and are those from which reasonable inferences can be drawn. The ones without an asterisk are interpreted as having no statistical association with either upper degrees or first-class degrees. We begin the discussion of results by first considering unexplained change in the upper-degree category, followed by a discussion of first-class degrees.

Upper degrees

The models for all universities (pre-1992, post-1992 and Scottish universities) are well specified according to the model diagnostics reported at the bottom of the table in Annexe D. However, the post-2003 specification is less well defined, so some caution must be exercised when interpreting the coefficients. We first consider the impact that raw material and input variables have on upper degrees before examining the unexplained component.

UCAS score

The estimated coefficient on the UCAS score, across all specifications, has the expected sign and exerts a positive influence on degree outcomes. However, for post-2003 universities, the coefficient is insignificant, suggesting that for these institutions, the UCAS score has no significant influence on upper degrees.

The sizes of the coefficients are intuitively plausible. Using the estimated coefficient for *all universities* (column 2, Annexe D), a 10% rise in the average UCAS score raises the proportion of upper degrees by around 1.5 percentage points.[15] The UCAS coefficient can be interpreted in a similar way across all other specifications. Thus, for the same increase in student quality, pre-1992 universities increase the proportion of upper degrees by about 0.6 points and for post-1992 universities, it has twice the impact, raising upper degrees by 1.2 points. These results, therefore, suggest differential treatment of students of similar quality.

Using the coefficient estimates from Annexe D and the mean percentage of upper degrees for each university grouping, it is possible to estimate the increase in upper degrees as the average UCAS entry score changes.[16] For instance, and for *all universities*, a university with an average UCAS entry score of 360 (eg, equivalent to three grade As at A-level) will award 2.7 percentage points more upper degrees than a university with students with an average entry score of 300, say (eg, equivalent to three grade Bs at A-level).[17] Similar calculations can be performed for other changes in the student entry profile across university groupings using A-level entry scores, as shown in Table 2.[18]

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[15] Percentage-point change = coefficient estimate × percentage change in UCAS points × average upper degrees = 0.242 × 0.1 × 62.62 = 1.51

[16] In this simulation, the UCAS scores for A-level grades are: A* = 140, A = 120, B= 100, C=80 and D = 60. The calculation used to estimate the percentage change in upper degrees is: percentage-point change = percentage change in UCAS points (mid-point average) × coefficient estimate × sample mean.

[17] Percentage-point change = 0.18×0.242×62.62 = 2.73

[18] It should be noted that, in general, most Scottish students will not take A-levels and their UCAS scores will be derived from Highers and Advanced Highers. They also tend to do more subjects at a slightly lower level of specialism than other UK students who have taken A-levels, which may explain the observed pattern for Scottish institutions in Table 2.

Table 2: Percentage-point increase in upper degrees by UCAS A-level entry score

UCAS grades	*All universities*	Pre-1992	Post-1992	Post-2003	Scottish universities
AAA to A*A*A*	2.27	0.87	1.76	1.09	5.19
BBB to AAA	2.73	1.05	2.11	1.31	6.22
CCC to BBB	3.33	1.28	2.58	1.60	7.61
DDD to CCC	4.39	1.69	3.40	2.11	10.03

It is evident from Table 2 that as the UCAS entry score increases, fewer upper degrees are awarded. This may reflect the possibility that to achieve three grade Cs rather than three grade Ds requires more effort on the part of the entrant than moving from three grade As to three grade A*s. The situation may also motivate students to strive harder for an upper degree, compared with students with higher entry scores.

Staff–student ratio

For *all universities* and post-1992 universities the estimated coefficient is negative and significant, suggesting that a higher staff–student ratio reduces the proportion of upper degrees. For *all universities,* a 10% increase in the staff–student ratio reduces 'good degrees' by just under 0.3 percentage-points.

Expenditure

For *all universities,* expenditure on academic services has a significant but small positive impact on upper degrees, suggesting that a 1% increase raises upper degrees by 0.7 of a percentage point. Spending on staff and student facilities exerts a significant influence on upper degrees across all specifications, except for post-1992 universities, but again the impact on upper degrees is relatively small.

Time dummies and 'unexplained' change

Across all specifications, the estimated coefficients on the time- and year dummies are highly significant and show an increasing trend from the academic year 2010/11 onwards, except those for post-2003 (and post-2012) universities, which are significant from 2011/12 onwards. These results imply a significant *increasing* unexplained component in awards that cannot be explained by the variables included in each model and changes in university efficiency. It suggests that institutions may need to look at the impact of internal practices and policies – beyond their students' entry-level tariffs and expenditure on staff, services and facilities – to understand their classification profiles.

The coefficients are re-expressed as percentage-point increases (relative to 2008) using the relevant sample mean for upper degrees from the first row of the table of summary statistics presented in Annexe B.[19] The 'unexplained' percentage-point increase for each grouping is presented in Table 3.

[19] Percentage point = year coefficient × sample mean

Table 3: 'Unexplained' percentage-point increase (upper degrees)

Academic year	*All universities*	Pre-1992	Post-1992	Post-2003	Scottish universities
2009	*n/a*	*n/a*	*n/a*	*n/a*	*n/a*
2010	1.06	*n/a*	*n/a*	*n/a*	*n/a*
2011	1.88	3.33	2.08	*n/a*	5.73
2012	3.82	4.75	4.64	4.66	6.13
2013	5.26	6.45	6.73	6.94	7.74
2014	7.14	6.52	8.69	9.68	8.39
2015	7.95	7.66	9.35	11.49	10.10
2016	9.33	8.37	11.01	11.89	10.70
2017	10.96	10.00	13.58	14.11	10.65

Note: n/a indicates an insignificant coefficient

Based on Table 3, the following inferences can be drawn:

- The 'unexplained' component shows an increasing trend, with the input variables and university efficiency each year explaining less of the change in the classification distribution each year.
- In 2011, and for *all universities* (column 2), 1.9 points of upper degrees awarded in that year (relative to 2008) cannot be explained by the controls included in the model and are therefore 'unexplained' grades
- By 2017, for *all universities*, the extent of the 'unexplained' component has risen to 11.0 points. This suggests that a significant share of upper degrees (16%)[20] awarded in 2017, relative to 2008, cannot be explained by changes in the model variables over the period.
- There are differences across the sector. In general, pre-1992 universities exhibit the lowest level of 'unexplained' increases and newer universities the highest.

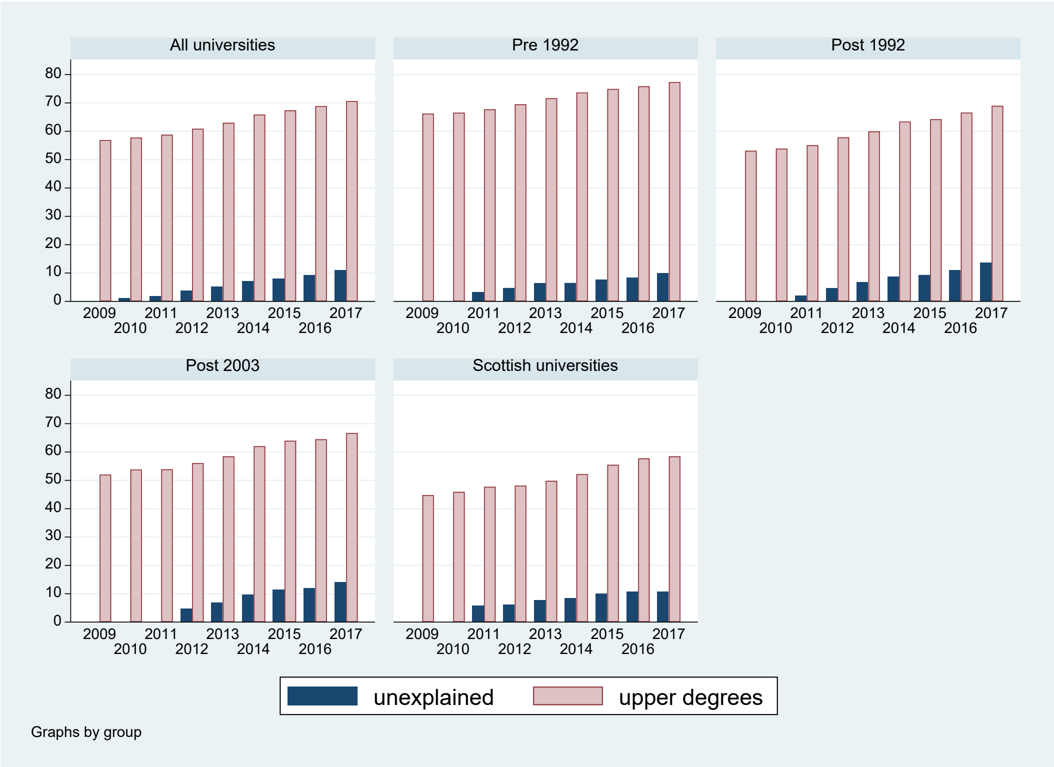
The 'unexplained' percentage-point increases from Table 3 are plotted against the actual proportion of upper degrees awarded in each year to arrive at a general picture of the possible extent of grade inflation (ie, where there are 'unexplained' patterns: see Figure 7). The dark bars represent the adjusted coefficient estimates (the figures in Table 3) and the light bars the actual percentage of upper degrees in each grouping. The following points are worth noting:

- Across *all universities,* there is an increasing trend in upper degrees accompanied by an increase in the 'unexplained' components.

[20] Transformed coefficient ÷ %good.

- From inspection of the graphs and comparing the height of each bar in each year, it appears that over time, 'unexplained' grades, those that are not connected to the input variables, and changes in university efficiency account for a greater share of upper degrees.
- The share of 'unexplained' grades is found to be higher in post-1992 and post-2003 universities than in pre-1992 universities.

Figure 7: 'Unexplained' increase: upper degrees, 2009–2017



The analysis carried out above is repeated for first-class degrees, which is now the dependent variable. The results are presented in Annexe E. All models are well specified according to the model diagnostics reported at the bottom of the table, but the Scottish specification is less well defined, so some caution must be exercised when interpreting the coefficients.

The input variables show variation in their significance across the specifications reported. For instance, the UCAS score is only significant in the general and pre-1992 models, and the staff–student ratio fails to maintain significance across the specifications reported.

Time dummies and 'unexplained' change

Across all specifications, the estimated coefficients on the year dummies are highly significant from 2009/10 onwards and increase over time. This result again implies a significant and increasing 'unexplained' component in awards that cannot be explained by the variables included in each model or by changes in university efficiency. There is, therefore, the possibility of grade inflation in the first-class category within this 'unexplained' component. The estimated 'unexplained' percentage-point changes are shown in Table 4.

Table 4: 'Unexplained' percentage-point increase (first-class degrees)

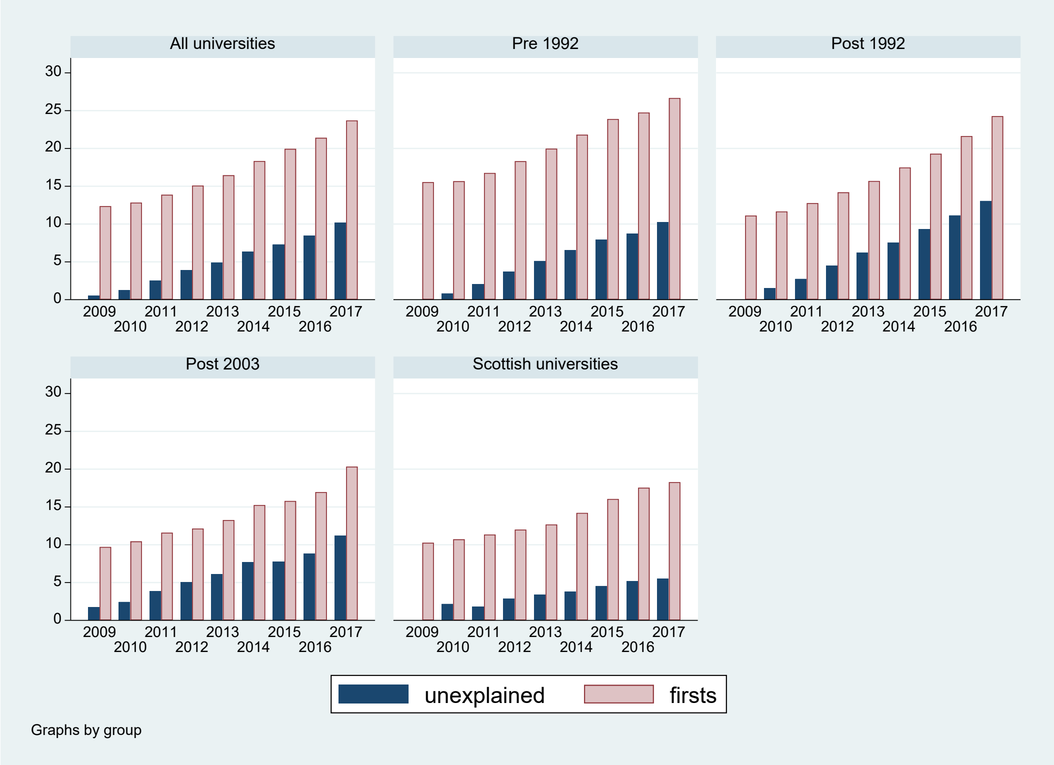
Academic year	*All universities*	Pre-1992	Post-1992	Post-2003	Scottish universities
2009	0.55	n/a	n/a	1.73	n/a
2010	1.26	0.83	1.51	2.44	2.18
2011	2.54	2.06	2.75	3.86	1.79
2012	3.88	3.69	4.51	5.06	2.89
2013	4.92	5.12	6.20	6.12	3.40
2014	6.33	6.53	7.56	7.69	3.82
2015	7.31	7.94	9.31	7.75	4.55
2016	8.45	8.71	11.15	8.85	5.19
2017	10.16	10.26	13.06	11.22	5.51

Note: n/a indicates an insignificant coefficient

- The 'unexplained' component shows an increasing trend, again suggesting increasing 'unexplained' changes in the classification distribution.
- For *all universities*, the 'unexplained' component of the increase from 2008 was 10.2 percentage points in 2017. This suggests a significant share of first-class degrees (43%) awarded in 2017 is 'unexplained' by changes in the model variables. Similar inferences can be drawn for other groupings.
- The 'unexplained' increase in the first-class degree category differs across groupings. Post-1992 universities exhibit the greatest grade inflation in this category and Scottish universities the least.
- The size of the 'unexplained' increases are similar to those reported in Table 3 (for upper degrees), except those relating to Scottish universities which are about half the size.

The unexplained percentage-point increases from Table 4 are plotted against the actual proportion of first-class degrees in each year in Figure 8.

Figure 8: 'Unexplained' increase: first-class degrees, 2009–2017



- Both the proportion of first-class degrees and the 'unexplained' component increase over time.
- Owing to the lower proportion of first-class degrees vis-à-vis upper degrees, the dark bars account for a greater share of the increasing trend, suggesting a greater challenge in the first-class category, with the potential for grade inflation possibly higher.
- This issue seems to be more pronounced in post-1992 and post-2003 groupings than in other university groupings.

7: Further analysis

Gender, previous schooling and subject mix

The model specifications used in the primary analysis are now augmented to include several variables that capture characteristics of the graduation cohort. These are:

- percentage of first degree female graduating students (full-person equivalent)
- percentage of first degree graduating students (full-person equivalent) who attended state schools or colleges prior to enrolling at university (UK students only)
- percentage of first degree graduating students (full-person equivalent) taking a science, engineering or technology (SET) subject, as classified by the Joint Academic Coding System (JACS). Broadly speaking, these subjects are: medicine and dentistry (and those allied to medicine); biological sciences; veterinary science; agriculture and related subjects; physical sciences; mathematical sciences; computer science; engineering and technology; and architecture, building and planning

To maintain a strongly balanced panel and thus taking account of missing variables, the sample is reduced to 1,240 observations on 124 institutions. The full set of descriptive statistics is presented in Annexe F and the relationship between these additional variables and upper degrees is described in Annexe G. The results for upper degrees are reported in the table in Annexe H. Owing to maximisation problems encountered with the Scottish specification, the model is not reported.[21] We refer to the models as 'extended models'.

The estimates for student–staff ratio suggest that a higher value of this variable reduces the proportion of upper degrees awarded. However, this effect is not detected for pre-1992 universities. Expenditure on academic services and staff and student facilities exerts little significant influence on upper degrees following the inclusion of the new variables.

Gender

The model results for upper degrees suggest a positive association between the proportion of female graduates and upper degrees, implying that females perform better than their male counterparts. However, the coefficient is only significant for *all universities* and for pre-1992 universities. In the case of *all universities,* a 10% rise in the percentage of females in the graduating cohort leads to a 1.2 percentage-point increase in upper degrees.

State schools and colleges

The estimates suggest that as the proportion of students from state schools and colleges increases, the proportion of upper degrees falls. The estimate for *all universities* suggests that a 10% increase in graduates from state institutions reduces upper degrees in the model by 2.8 percentage points. This effect is attenuated in the case of pre-1992 and post-1992 universities. There is no evidence that students from state schools affect upper degrees in post-2003 universities.

SET subjects

The estimated coefficient for subject mix suggests that as more students take a SET subject, the proportion of upper degrees falls. However, this effect is only significant for *all universities* and post-2003 universities. For *all universities,* a 10% increase in the proportion of SET subjects studied reduces upper degrees in the model by about 0.2 percentage points, suggesting the possibility that SET subjects are more harshly graded – although evidence suggests that while less likely to award a 2.1 classification, many SET subjects record higher proportions of first-class awards.

UCAS score

Across all specifications, the estimated coefficient on the UCAS score continues to have a significant and positive association with degree outcome except for post-2003 universities. Using the estimated coefficient for *all universities,* a 10% rise in the average UCAS score raises the proportion of upper degrees in the model by around 1.3 percentage points, which is very close to the estimate reported in Section 7. The UCAS coefficient again can be interpreted in a similar way across all specifications.

Time dummies and 'unexplained' change: upper degrees

Across all specifications, the estimated coefficients on the year dummies are highly significant and show an increasing trend around the academic year 2011/12 onwards (see

[21] This is because the log-likelihood function became very flat and the function failed to maximise.

Annexe H). This result again implies a significant and increasing 'unexplained' component in awards that cannot be explained by the variables now included in each model and changes in university efficiency.

The coefficients are re-expressed as percentage-point increases (relative to 2008) using the relevant sample mean for upper degrees from the first row of the table of summary statistics presented in Annexe F. The 'unexplained' percentage-point increases for each university grouping are presented in Table 5.

Table 5: 'Unexplained' percentage-point increase (upper degrees) (extended models)

Academic year	*All universities*	Pre-1992	Post-1992	Post-2003
2009	n/a	n/a	n/a	n/a
2010	1.32	n/a	n/a	n/a
2011	2.07	1.13	1.91	n/a
2012	4.02	3.04	4.41	4.60
2013	5.91	5.09	6.49	6.75
2014	8.26	7.36	8.28	9.38
2015	9.18	8.56	9.36	9.68
2016	10.62	9.48	10.30	9.44
2017	12.44	11.04	12.68	12.13

Note: n/a indicates an insignificant coefficient

- The 'unexplained' component again increases in size over time.
- For *all universities*, 1.3 percentage points of upper degrees awarded in 2010 cannot be explained by the controls included in the model and are therefore 'unexplained' grades.
- By 2017 and for *all universities*, the extent of the 'unexplained' component has risen to 12.4 percentage points.[22] This suggests that a significant share of upper degrees awarded in 2017 (17%, similar in magnitude to the estimate in the primary analysis), relative to 2008, cannot be explained by model variables.
- There are differences across the sector, with pre-1992 universities exhibiting the lowest 'unexplained' increases.

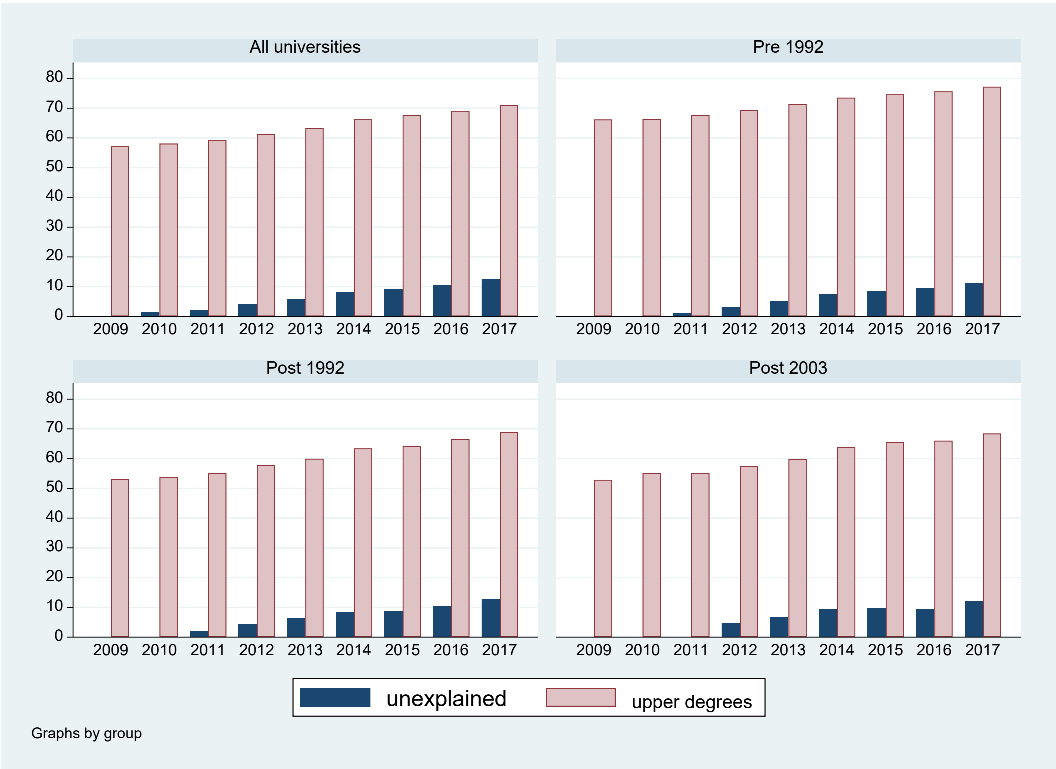
The 'unexplained' percentage-point increases from Table 5 are plotted against the actual proportion of upper degrees in Figure 9. The striking feature of the graphs is that the 'unexplained' patterns are very similar to those obtained in the primary analysis and that

[22] The estimates on the time dummies are now larger when compared with the estimates obtained in the primary analysis. This is due to the new model specification and the reduction in the sample size, which gives a larger average UCAS score. Part of this increase is due to the inclusion of the additional variables. These appear to negate the effect of the input variables used in the primary analysis (which increase over time), due to the new variables showing little increasing trends except for the 'school' variable. Given problems with estimation in regard to the Scottish specification, the models estimated in the primary analysis are preferred.

these kinds of student characteristics cannot explain all the trends being observed. The following points are worthy of note:

- Across all specifications there is an increasing trend in upper degrees, which is accompanied by an increase in the 'unexplained' component.
- From inspection of the graphs and comparing the height of each bar in each year, it appears that, over time, 'unexplained' grades (ie, those that are not connected to the input variables and additional variables) account for a greater share of upper degrees.
- The share of the 'unexplained' grades is very similar in significance and magnitude to those obtained in the primary analysis.
- The share of 'unexplained' grades is found to be higher in post-1992 and post-2003 universities than in pre-1992 universities, once again mirroring the findings reported in the primary analysis.
- The inclusion of additional variables relating to graduating students' characteristics has little impact on the extent and pattern of the 'unexplained' increase in upper degrees.

Figure 9: 'Unexplained' increase: upper degrees (extended model), 2009–2017



Time dummies and 'unexplained' change: first-class degrees

The analysis conducted above is repeated to examine 'unexplained' change within the first-class degree category. The results for the estimated models are reported in Annexe I. The percentage-point effects are shown in Table 6.

Table 6: 'Unexplained' percentage-point increase: first-class degrees (extended models)

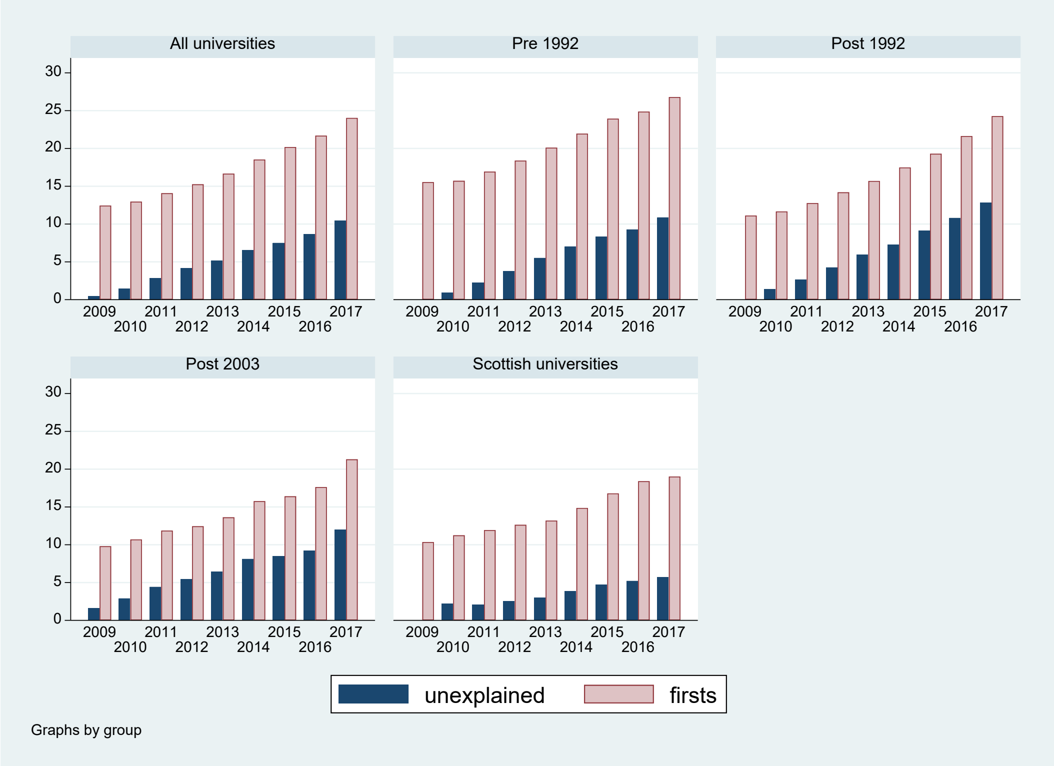
Academic year	*All universities*	Pre-1992	Post-1992	Post-2003	Scottish universities
2009	0.48	n/a	n/a	1.63	n/a
2010	1.47	0.90	1.41	2.91	2.22
2011	2.84	2.25	2.67	4.43	2.08
2012	3.91	3.77	4.27	5.44	2.55
2013	5.18	5.52	5.96	6.45	3.02
2014	6.57	7.04	7.26	8.13	3.86
2015	7.51	8.35	9.12	8.51	4.72
2016	8.68	9.29	10.81	9.24	5.22
2017	10.47	10.88	12.84	11.99	5.72

Note: n/a indicates an insignificant coefficient

- As in the primary analysis, the 'unexplained' increases are highly significant from 2009/10 onwards, indicating 'unexplained' increases, and the potential for grade inflation.
- The 'unexplained' percentage-point increase shows a general increasing trend, suggesting increasing 'unexplained' changes in the classification distribution.
- For *all universities*, the 'unexplained' component of the increase was 10.5 points in 2017. This suggests a significant share of first-class degrees (43%) awarded in 2017 is 'unexplained' and could be due to unaccounted factors and, potentially, inflated grades.
- The 'unexplained' increase in the first-degree category differs across university groupings. Post-1992 universities exhibit the greatest 'unexplained' component in this category and Scottish universities the least.

The percentage-point increases from Table 6 are plotted against the actual proportion of first-class degrees awarded in each year and are depicted in Figure 10.

Figure 10: ‘Unexplained’ increase: first-class degrees (extended model), 2009–2017



- Both the proportion of first-class degrees and the ‘unexplained’ component increase over the time period.
- Owing to the lower proportion of first-class degrees vis-à-vis upper degrees, the dark bars account for a greater share of the increase, suggesting again a greater challenge in this category.
- This issue seems to be more pronounced in post-1992 and post-2003 universities than in other university groupings.
- The size, significance and pattern of the estimates presented in this section are very similar to those found in the primary analysis.

Domicile and ethnicity

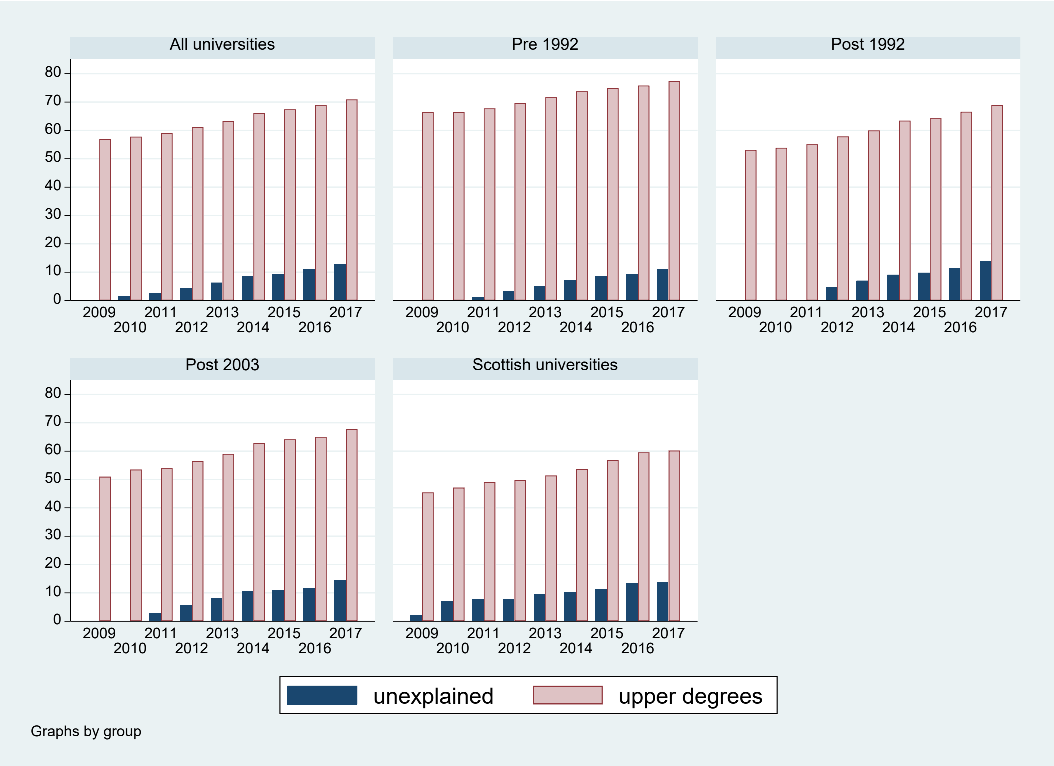
Upper degrees

The models estimated above are once again augmented to include two more variables that capture domicile and the ethnic background of the graduating cohort. While maintaining the extended model, we examine the impact on upper degrees for students who originate from outside the EU and consider the performance of UK graduating students from Black, Asian, Chinese and mixed-race backgrounds who are collectively referred to as ‘ethnic minority’ groups. In order to maintain a balanced panel, the sample is reduced to 1,180 observations containing 118 institutions. We refer to these models as ‘augmented models’.

The results for upper degrees are presented in Annexe J. There is no evidence to suggest that the proportion of students from minority ethnic groups affects the proportion of upper degrees. Domicile also has little impact on upper degrees in our model, except in the case of

Scottish universities, where an increase in the proportion of students from outside the EU reduces the proportion of upper degrees.

Figure 11: 'Unexplained' increase: upper degrees (augmented model), 2009–2017



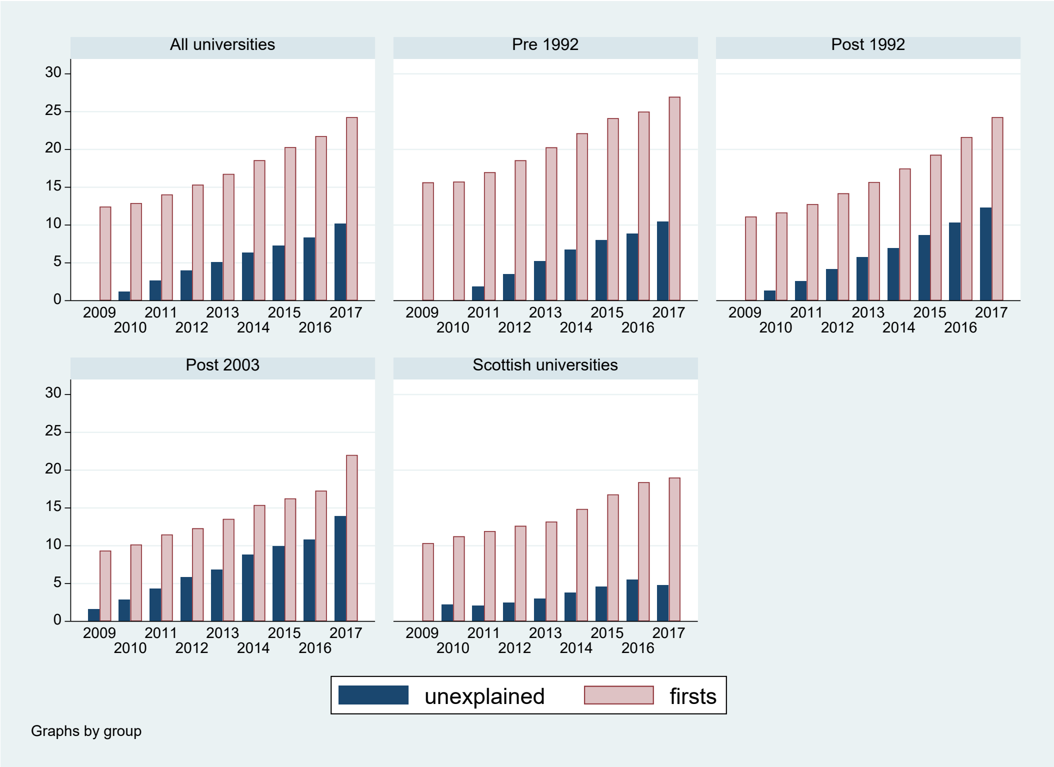
The time dummies show a similar pattern to those estimated in the primary analysis. They are again transformed to percentage-point increases and are presented in Figure 11. The important feature is that the extent of and size of the unexplained increase in upper degrees, relative to the actual proportion of upper degrees, reflect the pattern found in the primary analysis. This reinforces the possibility of grade inflation in upper degrees. Even with the inclusion of more variables, the change in upper degrees is still 'unexplained' – although there are still internal institutional factors, and student behaviours, which may also be driving much of the trend.

First-class degrees

In the first-class degree category, there is no evidence to suggest that increasing the proportion of non-EU students will affect the proportion of first-class degrees (see Annexe K). There is, however, some evidence to suggest that increasing the proportion of students from an ethnic minority background by 10% increases the proportion of first-class degrees by 0.1 points for *all universities* (mean percentage of firsts = 16.8%) and in Scottish universities by 0.3 points (mean=13.9%). Both of these effects are relatively small.

It should be noted that the inclusion of these variables in the analysis had little effect on the pattern and share of the 'unexplained' component relative to the proportion of first-class degrees awarded and observed previously (as shown in Figure 12).

Figure 12: ‘Unexplained’ increase: first-class degrees (augmented model), 2009–2017



Educational disadvantage: low participation areas and socio-economic group

The models estimated above are re-estimated to include variables for students from low-participation neighbourhoods (using the POLAR 3 classification) and from socio-economic groups NS-SEC 4–7. These variables replace the variables of ethnicity and domicile used in the previous analysis, while the original input variables alongside gender, SET subjects and school remain.

Low-participation neighbourhoods

Models that include the low-participation variable are only estimated for pre-1992 and post-1992 universities located in England, Wales and Northern Ireland due to the fact that very little data was published for Scottish universities. There was also a large amount of missing data associated with post-2003 universities. The results suggest that, taken together, graduating students from low-participation areas in the included universities are associated with a lower proportion of upper degrees, by about 1.4 percentage points. However, no significant influence is detected for students from low-participation neighbourhoods on upper degrees when taking each university individually (see Annexe L). Nevertheless, the patterns observed for the ‘unexplained’ increases are again similar to those found in the previous analysis, as demonstrated in Table 7 and Figure 13, further advancing the view that there are ‘unexplained’ changes in grade profiles to be interrogated.

Table 7: 'Unexplained' percentage-point increase: upper degrees

Academic year	Pre-1992 & Post 1992	Pre-1992	Post-1992
2009	*n/a*	*n/a*	*n/a*
2010	0.97	*n/a*	*n/a*
2011	1.84	*n/a*	*n/a*
2012	3.65	3.18	4.41
2013	5.78	5.31	6.47
2014	7.79	7.43	8.16
2015	8.61	8.77	8.63
2016	9.87	9.62	10.24
2017	11.94	10.97	12.68

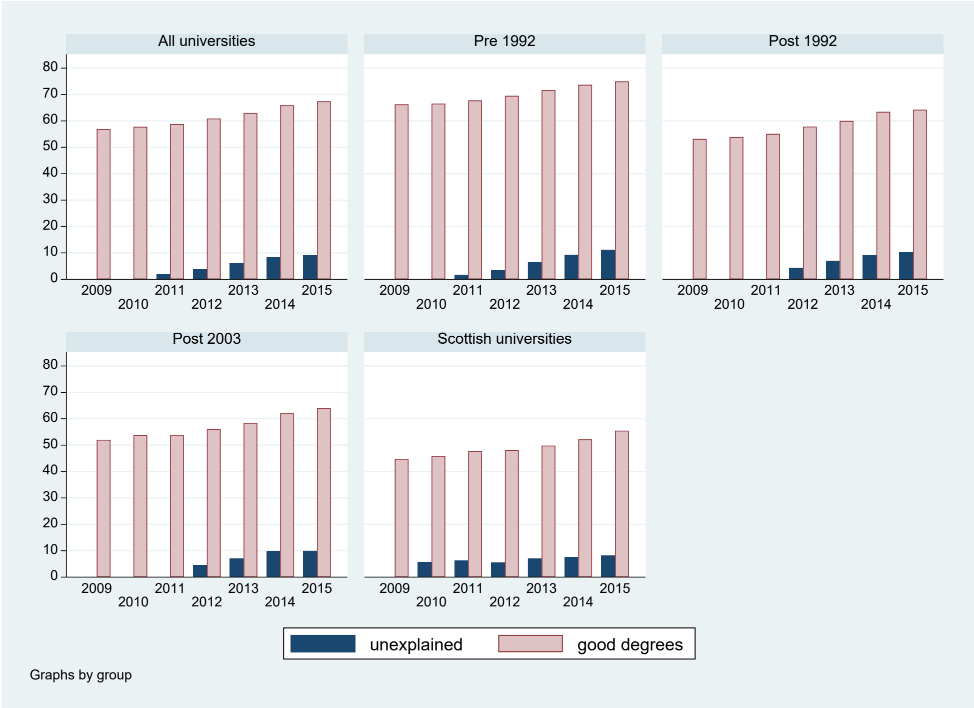
Note: n/a indicates an insignificant coefficient

Figure 13: 'Unexplained' increase: upper degrees (augmented model with low participation area), 2009–2017

Socio-economic grouping NS-SEC 4–7

Data was not available for socio-economic groups for the academic year 2015/16 and 2016/17. Models including students from socio-economic group 4–7 are reported in Annexe M. There were some problems in optimisation and the social class variable was not included in the post-1992 specification. In general, an increase in students belonging to socio-economic group 4–7 had the effect of reducing upper degrees for *all universities* and pre-1992 universities. They did not influence upper degrees in the post-2003 and Scottish specifications. Once again, the inclusion of the variable did not affect the pattern of upper degrees, as illustrated in Figure 14; nor did it affect the pattern of first-class classifications.

Figure 14: 'Unexplained' increase: upper degrees (augmented model with low-participation area and socio-economic group 4–7), 2009–2017



8: University efficiency

The stochastic frontier framework employed also allows university-specific variation in efficiency to be estimated, that is, how efficient a university is at turning its 'raw materials' using its 'inputs' into graduates with upper degrees. The models presented in Annexe D are used to predict the level of efficiency for pre-1992, post-1992 and Scottish universities.[23] The results are presented in the box plots in Figure 15.

The y-axis measures the level of university efficiency, which ranges from zero (not at all efficient) to 1 (100% efficient). We notice several outliers which influence mean efficiency. However, median efficiency (as indicated by the horizontal line in each box) in each university grouping has been relatively high in each year (for pre-1992 median efficiency = 94% on average, and for post-1992 = 93% and for Scottish universities = 92%, in 2017). Although median efficiency shows no discernible trend, there is evidence to suggest that efficiency has become more compressed over time, with less variation across institutions. In general, the figure shows that UK universities are relatively efficient in their use of the raw material and inputs into the educational process. That being the case, even a high level of efficiency is unable to explain the trends we see occurring.

[23] The model for post-2003 universities was less well specified with the noise to signal ratio λ being insignificant and therefore the efficiency term may be biased.

Figure 15: University efficiency scores, 2008–2017

9: Conclusion

The analysis presented in this report examined the extent of 'unexplained' change in grade profiles in UK higher education from 2007/08 to 2016/17 to investigate the potential for grade inflation. The data used in the analysis included several variables assumed to affect upper degrees and includes 128 institutions in total. The modelling technique adopted allows for university efficiency in converting 'raw 'materials' (students) and 'inputs' (facilities and services) into 'outputs' (graduates with particular degree classifications) to enter the analysis. This is some improvement over other techniques, used in this context, that do not control for efficiency, and often conflate it with grade inflation. The results also suggest that most UK universities operate at a high level of efficiency in teaching and use of resources.

Several models were estimated, and based on model specification, the most austere models, estimated in the primary analysis, provide the most reliable estimates of the 'unexplained' influence on degree classification across specifications. The results from the primary analysis confirm the importance of entry qualifications (average UCAS score) and spending on learning facilities in determining degree outcomes. However, their significance and impact on degree success vary across universities. Moreover, the analysis finds a growing unexplained component since 2010/11 that accounts for a significant proportion of the overall increase in upper degrees.

For instance, in 2016/17 this 'unexplained' component is estimated at 10.97 percentage points, which suggests that the actual proportion of upper degrees awarded in that year (76%) should be reduced by about 11 points on average to account for this 'unexplained' component, but there is variation across universities. This result remains robust in subsequent analysis when the models presented in the primary analysis are augmented to include other dimensions of student characteristics, such as socio-economic class.

There is evidence of similar ‘unexplained’ components in the first-class category since 2008/09, which is greater in extent to that observed for upper degrees. Overall, these results suggest that a large part of the rise in the proportion of upper degrees could be due to grade inflation in the first-class category.

These results will prove controversial where there is strong evidence to support the notion that student quality and characteristics and institutional efficiency alone cannot explain the trends we are seeing. Therefore, other factors, including potentially inflationary practices – or policies that have inadvertent inflationary outcomes – exist in UK higher education. The results do not suggest that the sector return to norm referencing, but it would appear that the sector may need to review its marking and grading processes to ensure they can continue to protect the value of qualifications and that we can be confident in the academic standards that underpin them.

Moreover, this report does not seek to explain why these ‘unexplained’ increases exist. There are many reasons why the proportion of first-class and upper degrees have increased over time, which may not be due to the variables included in the models presented, nor to grade inflation. These reasons may include improvements in student motivation, ability and diligence, marking and examination procedures, grading boundaries, and the treatment of borderline students, which may account for a substantial proportion of the ‘unexplained’ component. These issues have been raised in the literature. For example, Bloxham and Price (2015) question the effectiveness of the external examination system, Allen (2017) and Sinclair et al (2017) consider the degree algorithms used to classify degrees, Universities UK (2007) and Sadler (2009) question whether the degree classification system fulfills its purpose, given changes in the higher education landscape over the past two decades. Other factors that may contribute to inflationary practices are the nature of summative assessements and their contribution to the final mark.

The government, or more specifically government policy on performance monitoring, and the use to which the resultant league tables are put, could also have a perverse impact on grading and hence grade inflation and standards. It may be the case that upper degree outcomes should be removed from league table rankings altogether, but this would most likely be met with objection in a ‘consumerised’ higher education system where student information is central. The evidence also shows that this unexplained component has been present in UK higher education from around the academic year 2010/11, and it may be the case that the increase in tuition fees in 2012 may have also contributed the rise in upper and first-class degrees as universities attempt to attract fee-paying students. Government policy therefore needs to be given more consideration before it is put into force as it too may be seen as encouraging inflationary practice.

The analysis presented here was conducted at the level of the university and helps to identify the extent of possible grade inflation, as existing within a wider ‘unexplained’ change in degree award distributions over time. Further research is clearly warranted that considers the grade inflation at the course and student level so that standards across universities can be explored in finer detail.

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Annexe A: UK universities included in the dataset

Pre-1992 universities [a]	Aberystwyth, Aston, Bangor, Bath, Birmingham†, Bradford, Bristol†, Brunel, Cambridge†, Cardiff†, City, Durham†, East Anglia, Essex, Exeter†, Goldsmith's, Hull, Imperial College†, Keele, Kent, King's College†, Lancaster, Leeds†, Leicester, Liverpool†, London School of Economics (LSE)†, Manchester†, Newcastle†, Nottingham†, Oxford†, Reading, Royal Holloway, Queen Mary†, Loughborough, Queen's Belfast†, Salford, School of Oriental and African Studies (SOAS), Sheffield†, Southampton†, Surrey, Sussex, Swansea, Trinity St David, Ulster, University College London (UCL)†, Warwick†, York†.
Post-1992 universities [b]	Anglia Ruskin, Bath Spa, Bedfordshire, Birmingham City, Bournemouth, Brighton, Cardiff Met, Central Lancashire, Coventry, De Montfort, Derby, East London, Gloucestershire, Greenwich, Hertfordshire, Huddersfield, Kingston, Leeds Beckett, Lincoln, Liverpool John Moores, London Metropolitan, Manchester Met, Middlesex, Northumbria, Nottingham Trent, Oxford Brookes, Plymouth, Portsmouth, Sheffield Hallam, South Bank, South Wales, Staffordshire, Sunderland, Teesside, West of England, West London, Westminster, Wolverhampton.
Post-2003 universities	Bolton, Bishop Grosseteste, Buckinghamshire New, Canterbury Christ Church, Chester, Chichester, Cumbria, Edge Hill, Falmouth, Glyndwr, Harper Adams, Leeds Trinity, Liverpool Hope, Newman, Northampton, Roehampton, Royal Agricultural University, St Mary's Twickenham, Southampton Solent, St Mark and St John Plymouth, Suffolk, University College Birmingham, Winchester, Writtle College, Worcester, York St John.
Scottish universities	Aberdeen, Abertay, Dundee, Edinburgh, Glasgow, Glasgow Caledonian, Heriot-Watt, Highlands and Islands, Napier, Queen Margaret, Robert Gordon, St Andrews, Stirling, Strathclyde, Stranmills, West of Scotland.
Excluded institutions	
Medical schools	Brighton and Sussex Medical School, Institute of Cancer Research (PG), York Medical School, London School of Hygiene and Tropical Medicine (PG), Royal College of Nursing, Royal Veterinary College, School of Pharmacy, St George's Hospital Medical School, College of Medicine and Integrated Health.

Colleges of art, music or drama	Arts Bournemouth, Arts London, Conservatoire for Dance and Drama, Courtauld Institute, Creative Arts, Edinburgh College of Art†, Glasgow School of Art†, Guildhall School of Music and Drama, Leeds Arts, Liverpool Institute for the Performing Arts, Norwich Arts, Plymouth Arts, Ravensbourne, Rose Bruford, Royal Academy of Music, Royal College of Music, Royal Central School of Speech and Drama, Royal College of Art (PG), Royal Conservatoire of Scotland†, Royal Northern College of Music, Trinity Laban Conservatoire of Music and Dance.
Miscellaneous institutions	UCL Institute of Education, Birkbeck, Open University, University of Buckingham, Institutes of the University of London (eg advanced legal studies, Commonwealth studies, Germanic studies, Historical Research, Latin American studies, Marine Biological station, Warburg Institute), London Business School (PG), Royal Scottish Agricultural College, Scotland's Rural College.

Notes to table:
(a) The classification 'pre-1992' is used in the text to refer to the following institution types: ancient, civic and red brick, and the 1960s universities. Civic universities are those established between the late 19th century and the late 1950s. 1960s universities are those created just before and as a result of the Robbins Report 1963.
(b) Post-1992 universities include former polytechnics and higher education institutions that were granted university status shortly after the passing of Further and Higher Education Act 1992.
† Russell Group Universities
(PG) denotes postgraduate institution

Annexe B: Descriptive statistics, primary analysis

Variable	*All universities*	Pre-1992	Post-1992	Post-2003	Scottish universities
% good	62.62 (12.38)	70.91 (8.85)	59.54 (8.06)	58.30 (11.47)	50.25 (16.74)
% firsts	16.57 (6.38)	19.84 (6.02)	15.89 (5.39)	13.39 (5.77)	13.27 (6.26)
Average UCAS score	318.84 (83.13)	384.89 (76.50)	262.09 (38.30)	261.39 (34.53)	352.33 (74.83)
Staff–student ratio	17.19 (3.63)	14.82 (2.46)	18.84 (2.37)	18.78 (4.53)	16.73 (4.07)
Real expenditure on academic services (£000s)	17534.37 (13116.94)	24395.88 (15032.09)	18319.39 (8058.31)	5449.39 (4525.4)	15404.92 (11150.98)
Real expenditure on staff student facilities (£000s)	6753.769 (4787.90)	8899.635 (4779.81)	7604.18 (4084.15)	2539.54 (2500.62)	5254.54 (4475.31)
Number of universities	128	48	38	27	15
Number of observations	1280	480	380	270	150

Note: Standard deviations are in parentheses.

Annexe C: Methodology, technical description

Given the nature of the data set, grade inflation is examined using panel data techniques. The empirical literature on grade inflation often uses educational production functions, but fails to control for changes in university efficiency regarding improving student degree performance. Thus the grade inflation observed in many studies may be a result of universities becoming more technically efficient in teaching and learning. To account for changes in efficiency, we use a stochastic production frontier framework. A 'true' (university) random effects estimator (TRE) is used, in that it allows for time-varying university inefficiency to be separated from cross-section university heterogeneity (see Greene 2005; Belotti et al 2012 for details). The basic model can be expressed as:

$$g_{it} = (\alpha + \omega_i) + \beta' \mathbf{X}_{it} + \sum_{t=2}^{T} \gamma_t D_t + \mathbf{v}_{it} - \mathbf{u}_{it} \qquad i = 1,2,\ldots,N \qquad t = 1,2,\ldots,T$$

$$\mathbf{v}_{it} \sim \text{NID}(0,\sigma_v^2) \qquad \text{and} \qquad \mathbf{u}_{it} \geq 0 \text{ where } \mathbf{u}_{it} \sim N^+(0,\sigma_u^2)$$

where: g_{it} is the natural logarithm of the percentage of upper degrees awarded by the i^{th} institution at time *t*; and $\mathbf{X}_{it}$ is a k×1 vector of performance-determining variables. Specifically, the vector $\mathbf{X}_{it}$ includes variables that describe graduate- and institution-specific characteristics in the i^{th} university at time *t*, as described in Section 4 of the report. A set of time-specific dummies (D_t) are used to capture exogenous factors that affect *all universities* in their award of 'good' degrees that are independent from changes in university efficiency (eg, a general fall in standards or grade inflation). The unknown parameters α, ω_i, β, and γ_t are estimated using simulated maximum likelihood techniques. In this specification, ω_i, is a random effect and captures variation due to unobserved university-specific heterogeneity not associated with university-specific variation in efficiency.

The error term $\mathbf{v}_{it} - \mathbf{u}_{it}$ is a composed error term and comprises of two elements. The first term $\mathbf{v}_{it}$ is symmetrically distributed and captures conventional exogenous random shocks (ie, effects not under the control of the institution) that vary across universities. The second term $\mathbf{u}_{it}$ is one-sided, assumed to have a half normal distribution that captures changes in university (technical) inefficiency over time. The method suggested by Jondrow et al (1982) is used to estimate university-specific efficiency using the information contained in the composed error, ie $\mathbf{E}(\mathbf{u}_{it} \mid \mathbf{v}_{it} - \mathbf{u}_{it})$.

All variables are converted to natural logarithms for estimation to ease interpretation of the results. The estimates of γ_t are converted to percentage-point increases by multiplying them by the sample mean for upper degrees.

Annexe D: Primary results, upper degrees

Variable	*All universities*	Pre-1992	Post-1992	Post-2003	Scottish universities
Ln (UCAS score)	0.242*** (0.068)	0.082** (0.038)	0.197** (0.101)	0.125 (0.103)	0.688*** (0.063)
Ln (staff–student ratio)	-0.040* (0.025)	-0.064 (0.059)	-0.065* (0.037)	- 0.046 (0.048)	0.023 (0.047)
Ln (academic services)	0.012*** (0.005)	-0.001 (0.008)	-0.009 (0.065)	0.011* (0.007)	-0.001 (0.006)
Ln (staff and student facilities)	0.016*** (0.004)	0.019*** (0.005)	-0.021 (0.023)	0.016*** (0.006)	0.052*** (0.009)
University dummies					
Scottish	*base*				
Pre-1992	0.380*** (0.018)				
Post-1992	0.332*** (0.032)				
Post-2003	0.393*** (0.028)				
Time dummies					
2008	*base*	*base*	*base*	*base*	*base*
2009	-0.002 (0.007)	-0.001 (0.006)	0.002 (0.010)	0.007 (0.023)	0.070 (0.068)
2010	0.017** (0.009)	0.011 (0.007)	0.019 (0.013)	0.031 (0.026)	0.125 (0.131)
2011	0.030*** (0.012)	0.047*** (0.009)	0.035*** (0.013)	0.036 (0.024)	0.114*** (0.026)
2012	0.061*** (0.012)	0.067*** (0.010)	0.078*** (0.017)	0.080*** (0.027)	0.122*** (0.026)
2013	0.084*** (0.016)	0.091*** (0.011)	0.113*** (0.020)	0.119*** (0.027)	0.154*** (0.034)
2014	0.114*** (0.023)	0.092*** (0.011)	0.146*** (0.026)	0.166*** (0.035)	0.167*** (0.039)
2015	0.127*** (0.028)	0.108*** (0.013)	0.157*** (0.031)	0.197*** (0.034)	0.201*** (0.042)
2016	0.149***	0.118***	0.185***	0.204***	0.213***

	(0.025)	(0.011)	(0.036)	(0.036)	(0.034)
2017	0.175***	0.141***	0.228***	0.242***	0.212***
	(0.027)	(0.012)	(0.034)	(0.035)	(0.038)
N	1280	480	380	270	150
Universities	128	48	38	27	15
Loglikelihood	1381.74	709.14	471.35	262.39	128.61
σ_u	0.084***	0.073***	0.085***	0.001***	0.0921***
	(0.015)	(0.016)	(0.010)	(0.00001)	(0.0293)
σ_v	0.045**	0.020**	0.019***	0.080***	0.0621***
	(0.009)	(0.010)	(0.006)	(0.007)	(0.010)
$\lambda = \sigma_u / \sigma_v$	1.837***	3.625***	4.484***	0.0099	1.483***
	(0.023)	(0.018)	(0.015)	(0.0071)	(0.033)
Θ	0.217***	0.0835***	0.066*	0.149***	0.262***
	(0.016)	(0.006)	0.043	(0.013)	(0.015)

Note: Robust standard errors adjusted for clustering by university are reported in parentheses.
**significant at 0.10, **significant at 0.05 and ***significant at 0.01*
Ln denotes the natural logarithm operator.

Annexe E: Primary results, first-class degrees

Variable	*All universities*	Pre-1992	Post-1992	Post-2003	Scottish universities
Ln (UCAS score)	0.444*** (0.086)	0.302*** (0.087)	0.022 (0.137)	0.025 (0.168)	1.407 (0.162
Ln (staff–student ratio)	-0.047 (0.058)	-0.254 (0.159)	-0.199 (0.120)	0.013 (0.098)	-0.065 (0.068)
Ln (academic services)	0.044*** (0.012)	0.112 (0.034)	-0.006 (0.042)	0.047*** (0.012)	0.005 (0.019)
Ln (staff and student facilities)	0.028** (0.013)	0.030*** (0.022)	-0.068 (0.058)	0.025** (0.011)	0.088*** (0.019)
University dummies					
Scottish	*base*				
Pre-1992	0.440*** (0.018)				
Post-1992	0.3691*** (0.032)				
Post-2003	0.2783*** (0.028)				
Time dummies					
2008	*base*	*base*	*base*	*base*	*base*
2009	0.033** (0.016)	0.016 (0.015)	0.032 (0.024)	0.129*** (0.047)	0.092 (0.075)
2010	0.076*** (0.016)	0.042** (0.019)	0.095*** (0.031)	0.182*** (0.042)	0.164** (0.079)
2011	0.153*** (0.018)	0.104*** (0.024)	0.173*** (0.027)	0.288*** (0.043)	0.135** (0.070)
2012	0.234*** (0.022)	0.186*** (0.028)	0.284*** (0.039)	0.378*** (0.045)	0.218*** (0.052)
2013	0.297*** (0.025)	0.258*** (0.030)	0.390*** (0.053)	0.457*** (0.056)	0.256*** (0.055)
2014	0.382*** (0.027)	0.329*** (0.033)	0.476*** (0.062)	0.574*** (0.056)	0.288*** (0.057)
2015	0.441*** (0.030)	0.400*** (0.040)	0.586*** (0.084)	0.597*** (0.075)	0.343*** (0.078)
2016	0.510***	0.439***	0.702***	0.661***	0.391***

	(0.028)	(0.034)	(0.083)	(0.073)	(0.072)
2017	0.613***	0.517***	0.822***	0.838***	0.415***
	(0.033)	(0.035)	(0.087)	(0.092)	(0.067)
N	1280	480	380	270	150
Universities	128	48	38	27	15
Loglikelihood	1381.74	261.03	170.21	111.060	117.883
σ_u	0.084***	0.108*	0.196***	0.182**	0.0015***
	(0.015)	(0.058)	(0.039)	(0.093)	(0.0002)
σ_v	0.045**	0.106**	0.073***	0.171***	0.191***
	(0.009)	(0.024)	(0.024)	(0.040)	(0.031)
$\lambda = \sigma_u / \sigma_v$	1.837***	1.026***	2.648***	1.067***	0.008
	(0.023)	(0.078)	(0.062)	(0.129)	(0.031)
Theta	0.204***	0.130***	0.019***	0.218***	0.200***
	(0.023)	(0.020)	(0.007)	(0.014)	(0.35)

Note: Robust standard errors adjusted for clustering by university are reported in parentheses.
**significant at 0.10, **significant at 0.05 and ***significant at 0.01*
Ln denotes the natural logarithm operator.

Annexe F: Descriptive statistics, extended model

Variable	*All universities*	Pre-1992	Post-1992	Post-2003	Scottish universities
% good	62.85 (12.02)	70.75 (8.82)	59.54 (8.06)	59.767 (10.20)	51.658 (16.41)
% firsts	16.72 (6.34)	19.93 (6.02)	15.89 (5.39)	13.81 (5.71)	13.85 (6.06)
Average UCAS score	319.96 (83.43)	386.08 (76.80)	262.09 (38.30)	262.80 (34.17)	360.25 (70.30)
Staff–student ratio	17.38 (3.41)	14.86 (2.52)	18.84 (2.37)	19.71 (3.22)	17.42 (3.24)
Real expenditure on academic services (£000s)	17918.1 (13031.75)	24906.21 (14773.41)	18319.39 (8058.31)	5716.28 (4568.67)	16321.45 (10960.08)
Real expenditure on staff and student facilities (£000s)	6914.13 (4730.35)	9085.86 (4654.60)	7604.18 (4084.15)	2739.94 (2492.12)	5625.003 (4404.02)
% female	56.28 (8.39)	52.67 (5.75)	54.60 (4.91)	65.32 (10.35)	57.04 (7.86)
% SET subjects	44.30 (37.22)	49.40 (17.46)	40.81 (10.37)	29.54 (19.24)	60.89 (98.05)
% students from state schools and colleges	90.048 (11.34)	83.22 (11.67)	95.66 (6.32)	96.94 (3.22)	88.26 (10.94)
Number of universities	124	47	38	25	14

Number of observations	1240	470	380	250	140

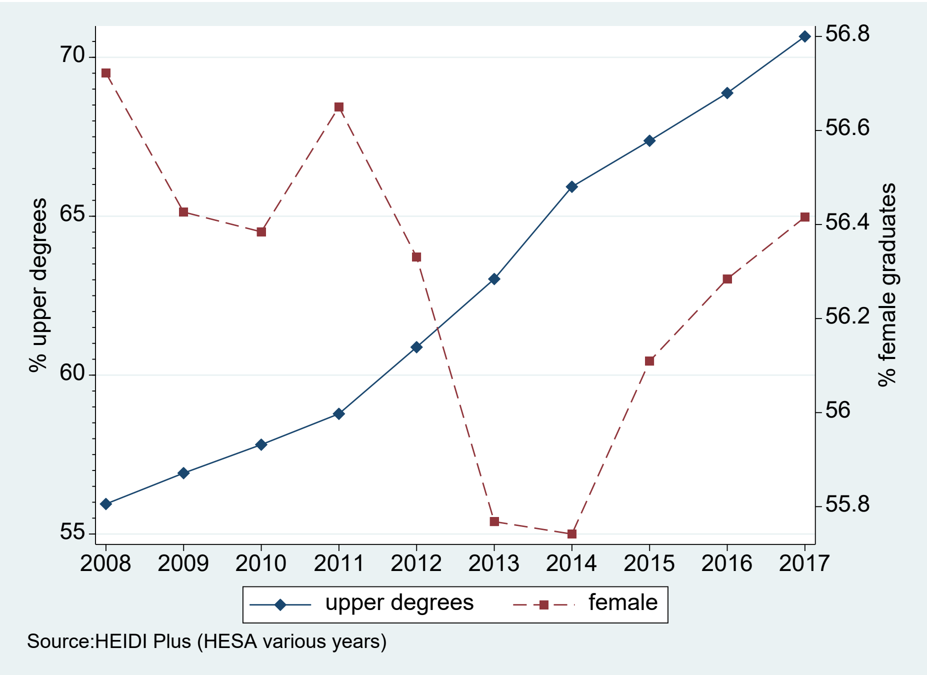
Note: Standard deviations are in parentheses.

Annexe G: Female graduates, state-school entrants, SET subjects and upper degrees

Female students and upper degrees

Female students account for a greater proportion of graduating students than male students in all years, although there was a slight fall between 2011 and 2013. There appears to be no obvious relationship between the proportion of female graduating students and upper degrees, except that between 2014 and 2017, there was an increase both in upper degrees and female graduates. However, the data suggests a significant, but small, negative correlation between these variables (ρ =-0.11 [prob=0.0001]). See Figure G1.

Figure G1: Female graduates and upper degrees, all universities, 2008–2017

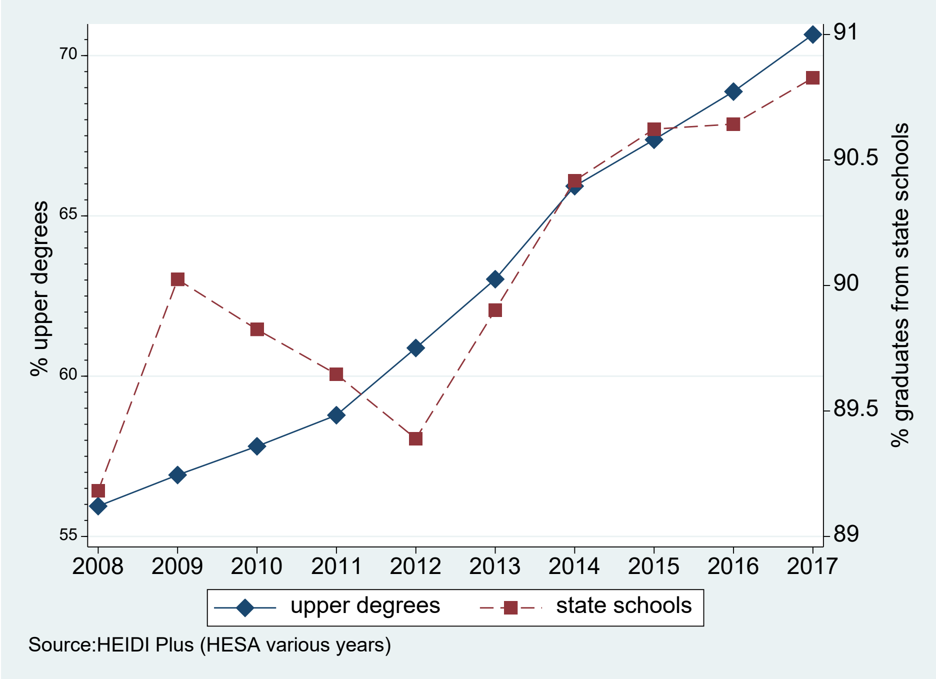


Note: Excludes postgraduate institutions, medical schools, universities of the arts and the Open University.

State schools and colleges and upper degrees

Graduates from state schools or colleges account for around 90% of all graduates on average. There was a slight fall in the number of students who enter university from state institutions between 2009 and 2012, after which there has been a continual increase. The data suggests a significant negative correlation between these variables (ρ =-0.44 [prob=0.000]). See Figure G2.

Figure G2: State school students and upper degrees, all universities, 2008–2017

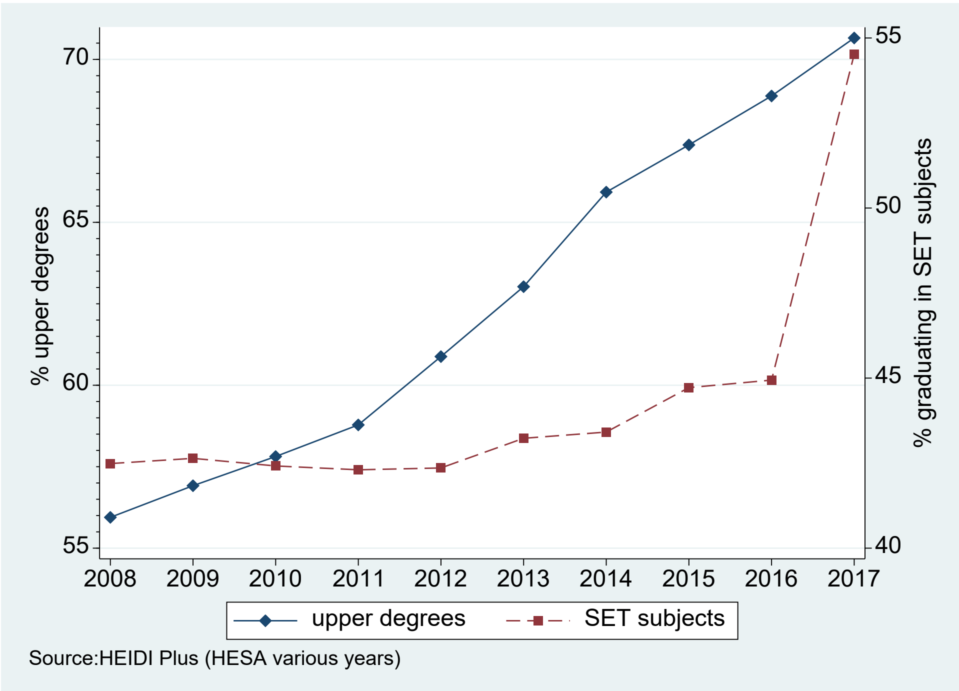


Note: Excludes postgraduate institutions, medical schools, universities of the arts and the Open University.

SET subjects and upper degrees

There appears to be little overall relationship between the proportion of graduates in SET subjects and upper degrees, but we do note a large increase in students graduating in SET subjects in 2017. The data suggests no significant association between these variables (ρ =-0.011 [prob=0.69]). See Figure G3.

Figure G3: Graduates in SET subjects and upper degrees, 2008–2017



Note: Excludes postgraduate institutions, medical schools, universities of the arts and the Open University

Annexe H: Upper degrees, extended model

Variable	*All universities*	Pre-1992	Post-1992	Post-2003
Ln (UCAS score)	0.203***	0.043**	0.225***	0.218
	(0.080)	(0.023)	(0.078)	(0.157)
Ln (% female)	0.186***	0.131*	0.077	0.080
	(0.066)	(0.076)	(0.113)	(0.075)
Ln (% state schools or colleges)	-0.449***	-0.332***	-0.311***	0.335
	(0.099)	(0.058)	(0.102)	(0.284)
Ln (% SET subjects)	-0.033*	-0.010	-0.009	-0.068***
	(0.019)	(0.010)	(0.034)	(0.012)
Ln (staff–student ratio)	-0.078**	-0.021	-0.071**	-0.138*
	(0.039)	(0.071)	(0.032)	(0.079)
Ln (academic services)	0.005	0.003	-0.002	0.012*
	(0.006)	(0.013)	(0.028)	(0.007)
Ln (staff and student facilities)	0.004	0.021	-0.015	0.0002
	(0.008)	(0.013)	(0.016)	(0.008)
University dummies				
Scottish	***Base***			
Pre-1992	0.419***	n/a	n/a	n/a
	(0.034)			
Post-1992	0.416***	n/a	n/a	n/a
	(0.040)			
Post-2003	0.380***	n/a	n/a	n/a
	(0.058)			
Time dummies				
2008	***base***	***base***	***base***	***base***
2009	-0.001	-0.002	0.000	-0.016
	(0.006)	(0.006)	(0.010)	(0.016)
2010	0.021**	0.008	0.017	0.024
	(0.009)	(0.008)	(0.012)	(0.026)
2011	0.033***	0.016*	0.032***	0.034
	(0.009)	(0.009)	(0.013)	(0.026)
2012	0.064***	0.043***	0.074***	0.077***
	(0.010)	(0.009)	(0.016)	(0.030)
2013	0.094***	0.072***	0.109***	0.113***
	(0.011)	(0.011)	(0.019)	(0.031)
2014	0.131***	0.104***	0.139***	0.157***
	(0.013)	(0.016)	(0.023)	(0.033)

2015	0.146***	0.121***	0.146***	0.162***
	(0.015)	(0.018)	(0.027)	(0.037)
2016	0.169***	0.134***	0.173***	0.158***
	(0.016)	(0.016)	(0.026)	(0.045)
2017	0.198***	0.156***	0.213***	0.203***
	(0.016)	(0.016)	(0.026)	(0.034)
N	1240	470	380	250
Universities	124	47	38	25
Loglikelihood	1338.90	712.30	535.44	263.92
Θ	0.168***	0.068***	0.063***	0.053***
	(0.014)	(0.006)	(0.011)	(0.009)
σ_u	0.089***	0.073***	0.084***	0.001***
	(0.018)	(0.016)	(0.009)	(0.00001)
σ_v	0.041**	0.020**	0.020***	0.080***
	(0.012)	(0.010)	(0.004)	(0.007)
$\lambda = \sigma_u / \sigma_v$	2.139***	3.625***	4.219***	0.010
	(0.029)	(0.018)	(0.012)	(0.0071)

Note: Robust standard errors are reported in parentheses.
**significant at 0.10, **significant at 0.05 and ***significant at 0.01*
Ln denotes the natural logarithm operator.

Annexe I: First-class degrees, extended model

Variable	*All universities*	Pre-1992	Post-1992	Post-2003	Scottish universities
Ln (UCAS score)	0.417***	0.196*	0.044	0.046	1.106***
	(0.115)	(0.113)	(0.121)	(0.230)	(0.331)
Ln (% female)	-0.107	0.062	-0.146	-0.341*	-0.329*
	(0.112)	(0.233)	(0.189)	(0.167)	(0.192)
Ln (% state schools or colleges)	-0.149	-0.359***	-0.289	3.285***	-0.381
	(0.186)	(0.146)	(0.226)	(0.924)	(0.485)
Ln (% SET subjects)	0.006	0.069**	0.211**	-0.060**	0.123*
	(0.026)	(0.033)	(0.091)	(0.026)	(0.067)
Ln (staff–student ratio)	-0.234	-0.270	-0.121	-0.129	-0.023
	(0.093)	(0.174)	(0.116)	(0.209)	(0.206)
Ln (academic services)	0.042***	0.069	-0.009	0.036***	-0.126
	(0.014)	(0.034)	(0.040)	(0.012)	(0.100)
Ln (staff and student facilities)	0.005	-0.011***	-0.067	0.007	0.196***
	(0.018)	(0.022)	(0.051)	(0.016)	(0.053)
University dummies					
Scottish	*base*				
Pre-1992	0.396***				
	(0.072)				
Post-1992	0.400***				
	(0.075)				
Post-2003	0.350***				
	(0.082)				
Time dummies					
2008	*base*	*base*	*base*	*base*	*base*
2009	0.029*	0.023	0.022	0.118***	0.018
	(0.016)	(0.016)	(0.025)	(0.038)	(0.078)
2010	0.088***	0.045**	0.089***	0.211***	0.160**
	(0.017)	(0.019)	(0.030)	(0.038)	(0.087)
2011	0.170***	0.113***	0.168***	0.321***	0.150*
	(0.019)	(0.023)	(0.029)	(0.043)	(0.082)
2012	0.249***	0.189***	0.269***	0.394***	0.184***
	(0.024)	(0.029)	(0.039)	(0.062)	(0.074)
2013	0.310***	0.277***	0.375***	0.467***	0.218***
	(0.029)	(0.032)	(0.048)	(0.070)	(0.057)
2014	0.393***	0.353***	0.457***	0.589***	0.279***
	(0.033)	(0.039)	(0.054)	(0.069)	(0.067)

2015	0.449***	0.419***	0.574***	0.616***	0.341***
	(0.039)	(0.045)	(0.070)	(0.087)	(0.081)
2016	0.519***	0.466***	0.680***	0.669***	0.377***
	(0.038)	(0.042)	(0.063)	(0.089)	(0.052)
2017	0.626***	0.546***	0.808***	0.868***	0.413***
	(0.043)	(0.044)	(0.067)	(0.104)	(0.075)
N	1240	470	380	250	140
Universities	124	47	38	25	14
Loglikelihood	378.55	261.03	175.27	32.294	29.53
σ_u	0.148***	0.108*	0.216***	0.195**	0.216***
	(0.051)	(0.058)	(0.030)	(0.073)	(0.093)
σ_v	0.129**	0.106**	0.056***	0.149***	0.116***
	(0.022)	(0.024)	(0.019)	(0.037)	(0.032)
$\lambda = \sigma_u / \sigma_v$	1.143***	1.026***	3.850***	1.297***	1.860
	(0.072)	(0.078)	(0.046)	(0.105)	(0.113)
θ	0.186***	0.130***	-0.136***	0.185***	0.177***
	(0.015)	(0.020)	(0.014)	(0.022)	(0.041)

Note Robust standard errors adjusted for clustering by university are reported in parentheses.
**significant at 0.10, **significant at 0.05 and ***significant at 0.01*
Ln denotes the natural logarithm operator.

Annexe J: Upper degrees, augmented model

Variable	*All universities*	Pre-1992	Post-1992	Post-2003	Scottish universities
Ln (UCAS score)	0.217**	0.035	0.184	0.189	0.506***
	(0.094)	(0.039)	(0.191)	(0.188)	(0.169)
Ln (% female)	0.028	0.147*	0.071	0.105	-0.834**
	(0.066)	(0.082)	(0.126)	(0.113)	(0.099)
Ln (% state schools or colleges)	-0.465**	-0.261***	-0.481	-0.104	-0.186
	(0.207)	(0.051)	(0.416)	(0.834)	(0.073)
Ln (% SET subjects)	-0.029***	-0.018	-0.018	-0.058***	-0.005
	(0.018)	(0.011)	(0.073)	(0.011)	(0.012)
ln (staff–student ratio)	-0.065*	-0.044	-0.065	-0.049	-0.131
	(0.038)	(0.086)	(0.054)	(0.081)	(0.104)
Ln (academic services)	0.005	-0.001	-0.005	0.020	0.017
	(0.006)	(0.014)	(0.039)	(0.013)	(0.032)
Ln (staff and student facilities)	0.006	0.026	-0.015	0.007	0.098***
	(0.006)	(0.014)	(0.018)	(0.011)	(0.027)
Ln (non-EU students)	-0.019	0.006	0.005	-0.008	-0.081***
	(0.015)	(0.012)	(0.023)	(0.026)	(0.031)
Ln (ethnic minority)	-0.002	-0.001	-0.020	-0.012	-0.021
	(0.012)	(0.009)	(0.052)	(0.020)	(0.042)
University dummies					
Scottish	***base***				
Pre-1992	0.438***	n/a	n/a	n/a	n/a
	(0.057)				
Post-1992	0.483***	n/a	n/a	n/a	n/a
	(0.083)				
Post-2003	0.462***	n/a	n/a	n/a	n/a
	(0.061)				
Time dummies					
2008	***base***	***base***	***base***	***base***	***base***
2009	0.002	0.001	0.005	-0.007	0.044**
	(0.007)	(0.006)	(0.023)	(0.017)	(0.014)
2010	0.025***	0.009	0.023	0.030	0.134***
	(0.008)	(0.009)	(0.026)	(0.028)	(0.029)
2011	0.041***	0.017*	0.037	0.048*	0.153**
	(0.008)	(0.009)	(0.029)	(0.027)	(0.032)
2012	0.071***	0.047***	0.079**	0.096***	0.149**
	(0.009)	(0.012)	(0.041)	(0.033)	(0.033)

2013	0.101***	0.072***	0.118**	0.136***	0.182***
	(0.013)	(0.014)	(0.051)	(0.031)	(0.043)
2014	0.137***	0.102***	0.153***	0.183***	0.198***
	(0.017)	(0.018)	(0.063)	(0.036)	(0.059)
2015	0.149***	0.120***	0.165***	0.189***	0.219***
	(0.020)	(0.019)	(0.078)	(0.043)	(0.049)
2016	0.175***	0.132***	0.194***	0.202***	0.257***
	(0.021)	(0.018)	(0.084)	(0.048)	(0.054)
2017	0.205***	0.155***	0.235***	0.245***	0.266***
	(0.022)	(0.018)	(0.089)	(0.039)	(0.057)
N	1180	450	380	210	140
Universities	118	45	38	21	14
Loglikelihood	1312.64	675.17	533.39	221.74	138.53
θ	0.223***	0.072***	0.053***	0.042***	0.309***
	(0.028)	(0.005)	(0.011)	(0.013)	(0.022)
σ_u	0.081***	0.076***	0.084***	0.001***	0.074***
	(0.015)	(0.014)	(0.011)	(0.0001)	(0.021)
σ_v	0.043**	0.017*	0.020***	0.078***	0.054***
	(0.009)	(0.010)	(0.007)	(0.009)	(0.009)
$\lambda = \sigma_u / \sigma_v$	1.849***	4.520***	4.315***	0.008	1.363***
	(0.023)	(0.023)	(0.012)	(0.009)	(0.026)

Note: Robust standard errors are reported in parentheses.
**significant at 0.10, **significant at 0.05 and ***significant at 0.01*
Ln denotes the natural logarithm operator.

Annexe K: First-class degrees, augmented model

Variable	*All universities*	Pre-1992	Post-1992	Post-2003	Scottish universities
Ln (UCAS score)	0.457***	0.225*	0.100	-0.267	1.021*
	(0.120)	(0.135)	(0.189)	(0.262)	(0.581)
Ln (% female)	-0.111	0.157	-0.092	0.035	-0.350
	(0.126)	(0.205)	(0.205)	(0.178)	(0.304)
Ln (% state schools or colleges)	-0.408***	-0.401*	-0.150	5.078***	-0.332
	(0.156)	(0.222)	(0.524)	(1.862)	(0.762)
Ln (%SET subjects)	0.012	0.103***	0.219**	-0.083***	0.122*
	(0.032)	(0.025)	(0.097)	(0.022)	(0.070)
ln (staff–student ratio)	-0.209**	-0.248	-0.143	0.155	-0.036
	(0.100)	(0.193)	(0.114)	(0.216)	(0.287)
Ln (academic services)	0.040***	0.060**	0.005	0.042**	-0.088
	(0.013)	(0.072)	(0.041)	(0.017)	(0.188)
Ln (staff and student facilities)	0.003	-0.007	-0.070	0.019*	0.165***
	(0.017)	(0.036)	(0.057)	(0.018)	(0.049)
Ln (non-EU students)	-0.019	-0.021	-0.006	0.047	-0.071
	(0.023)	(0.033)	(0.029)	(0.028)	(0.128)
Ln (ethnic minority)	0.061**	0.023	0.021	-0.032	0.192**
	(0.024)	(0.027)	(0.052)	(0.030)	(0.084)
University dummies					
Scottish	*base*				
Pre-1992	0.384***				
	(0.100)				
Post-1992	0.434***				
	(0.101)				
Post-2003	0.412***				
	(0.097)				
Time dummies					
2008	*base*	*base*	*base*	*base*	*base*
2009	0.021	0.015	0.014	0.117***	0.016
	(0.015)	(0.017)	(0.034)	(0.034)	(0.040)
2010	0.071***	0.028	0.083**	0.210***	0.162***
	(0.017)	(0.022)	(0.036)	(0.043)	(0.055)
2011	0.159***	0.094***	0.163***	0.318***	0.151**
	(0.020)	(0.024)	(0.031)	(0.045)	(0.068)
2012	0.238***	0.174***	0.262***	0.429***	0.180***
	(0.025)	(0.031)	(0.039)	(0.070)	(0.067)
2013	0.301***	0.259***	0.363***	0.501***	0.215**

	(0.030)	(0.037)	(0.062)	(0.067)	(0.100)
2014	0.376***	0.335***	0.437***	0.649***	0.273**
	(0.035)	(0.042)	(0.069)	(0.072)	(0.145)
2015	0.431***	0.400***	0.545***	0.730***	0.331**
	(0.038)	(0.048)	(0.113)	(0.082)	(0.140)
2016	0.497***	0.441***	0.649***	0.796***	0.397**
	(0.037)	(0.046)	(0.102)	(0.094)	(0.157)
2017	0.606***	0.522***	0.775**	1.024***	0.345**
	(0.041)	(0.050)	(0.050)	(0.106)	(0.146)
N	1180	450	380	210	140
Universities	180	45	38	21	14
Loglikelihood	367.466	251.337	176.040	37.587	31.193
σ_u	0.128***	0.080	0.216***	0.200**	0.233***
	(0.069)	(0.158)	(0.028)	(0.098)	(0.074)
σ_v	0.135**	0.112**	0.057***	0.143***	0.097***
	(0.025)	(0.045)	(0.015)	(0.044)	(0.023)
$\lambda = \sigma_u / \sigma_v$	0.946***	0.716***	3.758***	1.395***	2.409***
	(0.092)	(0.202)	(0.041)	(0.136)	(0.085)
θ	0.189***	0.130***	0.125***	0.119***	0.222*
	(0.033)	(0.017)	(0.027)	(0.032)	(0.118)

Note: Robust standard errors adjusted for clustering by university are reported in parentheses.
**significant at 0.10, **significant at 0.05 and ***significant at 0.01*
Ln denotes the natural logarithm operator.

Annexe L: Upper degrees, augmented model (low-participation area)

Variable	*All universities*	Pre-1992	Post-1992
Ln (UCAS score)	0.202***	0.028	0.222**
	(0.076)	(0.035)	(0.106)
Ln (% female)	0.087**	0.128	0.078
	(0.046)	(0.303)	(0.093)
Ln (% state schools or colleges)	-0.190**	-0.276***	0.197**
	(0.087)	(0.057)	(0.101)
Ln (%SET subjects)	-0.053***	-0.007	0.014
	(0.008)	(0.049)	(0.040)
ln (staff–student ratio)	-0.096***	-0.041	-0.084
	(0.032)	(0.077)	(0.039)
Ln (academic services)	0.009*	0.002	-0.007
	(0.005)	(0.048)	(0.019)
Ln (staff and student facilities)	0.003	0.023	-0.013
	(0.005)	(0.036)	(0.012)
Ln (low-participation areas)	-0.023*	-0.029	-0.045
	(0.015)	(0.025)	(0.045)
Pre-1992 university	0.045**	*n/a*	*n/a*
	(0.024)		
Time dummies			
2008	***base***	***base***	***base***
2009	-0.004	0.002	-0.002
	(0.005)	(0.011)	(0.013)
2010	0.015*	0.009	0.018
	(0.008)	(0.012)	(0.015)
2011	0.028***	0.019	0.035
	(0.007)	(0.014)	(0.013)
2012	0.061***	0.045***	0.074**
	(0.009)	(0.018)	(0.020)
2013	0.088***	0.075***	0.108**
	(0.013)	(0.024)	(0.024)
2014	0.121***	0.105***	0.137***
	(0.014)	(0.033)	(0.030)
2015	0.137***	0.124***	0.145***
	(0.017)	(0.038)	(0.034)
2016	0.157***	0.136***	0.172***
	(0.016)	(0.044)	(0.034)
2017	0.181***	0.155***	0.213***
	(0.017)	(0.042)	(0.035)

N	850	470	380
Universities	85	47	38
Loglikelihood	1406.72	713.57	535.933
σ_u	0.070***	0.074***	0.083***
	(0.016)	(0.158)	(0.009)
σ_v	0.042***	0.018*	0.020***
	(0.009)	(0.045)	(0.005)
$\lambda = \sigma_u / \sigma_v$	1.164***	4.205***	4.146***
	(0.026)	(0.202)	(0.012)
θ	0.063***	0.076**	0.074***
	(0.005)	(0.035)	(0.012)

Note: Robust standard errors adjusted for clustering by university are reported in parentheses.
**significant at 0.10, **significant at 0.05 and ***significant at 0.01*
Ln denotes the natural logarithm operator.

Annexe M: Upper degrees, augmented model (socio-economic group)

Variable	*All universities*	Pre-1992	Post-1992	Post-2003	Scottish universities
Ln (UCAS score)	0.204*** (0.075)	0.027 (0.033)	0.186 (0.119)	0.216 (0.184)	0.593*** (0.162)
Ln (% female)	-0.069 (0.043)	0.125* (0.076)	0.060 (0.104)	0.124 (0.090)	-0.950 (0.598)
Ln (% state schools or colleges)	-0.071 (0.119)	-0.410*** (0.131)	-0.169** (0.078)	-0.297 (0.404)	-0.788*** (0.235)
Ln (%SET subjects)	-0.045*** (0.007)	-0.029** (0.012)	-0.036 (0.031)	-0.056*** (0.014)	-0.072 (0.150)
Ln (staff–student ratio)	-0.075*** (0.031)	-0.012 (0.080)	-0.049 (0.073)	-0.171** (0.078)	-0.131 (0.104)
Ln (academic services)	0.009** (0.005)	-0.010 (0.016)	-0.007 (0.020)	0.011 (0.007)	0.091 (0.219)
Ln (staff and student facilities)	0.001 (0.006)	-0.004 (0.022)	-0.016 (0.011)	-0.007 (0.007)	0.125*** (0.036)
Ln (low-participation)	-0.034*** (0.013)	-0.022 (0.027)	-0.045 (0.049)	n/a	n/a
Ln (socio-economic group)	-0.092*** (0.33)	-0.044** (0.022)	n/a	-0.164 (0.075)	-0.077 (0.186)
Time Dummies					
2008	***base***	***base***	***base***	***base***	***base***
2009	0.004 (0.007)	0.010 (0.007)	0.001 (0.015)	-0.004 (0.018)	0.024 (0.036)
2010	0.013 (0.009)	0.011 (0.007)	0.017 (0.013)	0.021 (0.027)	0.115*** (0.035)
2011	0.029*** (0.007)	0.023* (0.009)	0.034 (0.018)	0.034 (0.027)	0.125*** (0.034)
2012	0.061*** (0.010)	0.048*** (0.010)	0.073** (0.018)	0.079*** (0.031)	0.111*** (0.031)
2013	0.095*** (0.011)	0.090*** (0.011)	0.117** (0.025)	0.120*** (0.035)	0.140*** (0.039)
2014	0.132*** (0.014)	0.131*** (0.018)	0.151*** (0.033)	0.170*** (0.040)	0.152*** (0.045)
2015	0.144*** (0.016)	0.158*** (0.022)	0.170*** (0.042)	0.171*** (0.044)	0.164*** (0.039)

N	879	376	303	200	111
Universities	110	47	38	25	14
Loglikelihood	1119.82	568.89	418.42	219.48	138.53
θ	0.065***	0.082***	0.066***	0.054***	0.309***
	(0.007)	(0.007)	(0.006)	(0.010)	(0.022)
σ_u	0.063***	0.071***	0.092***	0.001***	0.074***
	(0.017)	(0.017)	(0.011)	(0.0001)	(0.021)
σ_v	0.044***	0.018*	0.008	0.072***	0.054***
	(0.009)	(0.011)	(0.017)	(0.007)	(0.009)
$\lambda = \sigma_u / \sigma_v$	1.426***	4.027***	11.129***	0.007	1.363***
	(0.025)	(0.041)	(0.012)	(0.007)	(0.026)

Note: Robust standard errors are reported in parentheses.
**significant at 0.10, **significant at 0.05 and ***significant at 0.01*
Ln denotes the natural logarithm operator.

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