A Longitudinal Analysis of Degree Classifications at LSE: A Follow-up Study of OfS Report 2019.28

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Abstract

A recent publication from the Office for Students (OfS) revealed substantial increases in the proportion of first- and upper second-class degrees awarded by UK universities that are unexplained by changes in the graduate population over the years 2010-11 to 2017-18. This unexplained inflation in graduate attainment is interpreted as evidence of 'grade inflation' in the UK higher education sector.

The aim of this report is three-folds. First, the findings of the OfS report are replicated using both fixed- and mixed-effects logistic regression modelling based on student data from LSE between 2010-11 and 2017-18. Second, this report seeks to improve on their analyses by providing standard errors on the obtained estimates, as well as by suggesting an alternative measure of grade inflation, termed the 'grade inflation rate'. Third, this report provides results at the departmental level to enable the school to closely monitor grade inflation in the future. It then concludes with an evaluation of the methods used by OfS to model grade inflation.

This report reveals that grade inflation in LSE becomes noticeable starting in academic year 2014-15. It estimates a 6.2 percentage point unexplained increase in first- and upper second-class degrees awarded by LSE in academic year 2017-18 relative to 2010-11, with a standard error of 1.4 percentage points. The estimated unexplained increase for first-class degrees alone in 2017-18 relative to 2010-11 is 7.9 percentage points, with a standard error of 1.5 percentage points. Furthermore, the extent of grade inflation is heterogeneous among departments, with high within-department variation over time.

This report highlights that although these figures indicate grade inflation at LSE, they are substantially lower than the sector-level unexplained increases, which are 13.3 and 13.9 percentage points for upper degrees and first-class degrees, respectively, over the same time period. This analysis also shows that the proportion of first-class degrees awarded by LSE has been lower than the sector level in every year from 2010-11 to 2017-18. Procedures and computation codes for monitoring grade inflation at both the school level and the departmental level are provided to support the maintenance of a high degree classification standard at LSE.

Introduction

Overview of the OfS reports

In December 2018, the Office for Students published a report (OfS 2018.54) on changes in degree classifications over time across providers of higher education in the UK, focusing on the problem of *grade inflation*, 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). Using statistical modelling at the individual student level, the purpose of the report was to identify and quantify unexplained changes in the proportion of first- and upper second-class degrees awarded by UK universities between 2010-11 and 2016-17. These unexplained changes were then used to determine the amount of grade inflation over the period under consideration. Additionally, shortly after in July 2019, OfS published a new report (OfS 2019.28) updating their previous analysis to include a larger graduate population and the degree attainment results of the academic year 2017-18.

The 2019 OfS report includes only UK-domiciled first-degree graduates who studied full time, graduated in the academic years from 2010-11 to 2017-18, and were registered at higher education providers in England. They also received a classified honours degree (excluding Pass degrees). The providers considered in the report are universities that awarded at least 10 classified honours degrees in each of the seven academic years, for a total of 1,954,445 graduates from 148 providers. The following factors were taken into account in the OfS analysis to adjust for student population differences over the years:

- The provider at which the graduate was registered
- Year of graduation
- Subject studied
- Qualifications on entry
- Age
- Disability
- Ethnicity
- Gender
- Participation of Local Areas (POLAR4) quintile

To investigate grade inflation at the sector level, a mixed-effects logistic regression model was fitted to predict the probability of a single individual obtaining 1) a first- or upper second-class degree combined ("upper degree") or 2) a first-class degree only, using the above factors as

covariates.[1] In addition, the effects of individual universities across years are modelled as random effects rather than fixed effects. The specification of this regression model is given in Appendix A.

To quantify the effect of graduation year on degree classification, the above model was applied to the graduation population in each academic year from 2011-12 to 2017-18, but with the academic year of graduation changed to 2010-11. In other words, the model predicted the probability that a student obtains either an upper degree or a first-class degree *had the student graduated in 2010-11*. Once the predicted probabilities were calculated for all students who graduated in a particular academic year, the mean of these probabilities was taken as the *predicted proportion of graduates obtaining either an upper degree or a first-class degree in that academic year*. This predicted proportion was then compared to the observed value for that proportion in each academic year, and any difference between these two values was considered as 'unexplained' since they are not accounted for by the explanatory variables in the regression model.

A summary of unexplained changes in degree attainment at the sector level is given in **Tables 1 and 2** below.[2]

Table 1: Summary of observed and unexplained changes in upper degree attainment

Academic year	Observed proportion (%)	Change from 2010-11 (pp)	Unexplained change (pp)
2010-11 (ref.)	67.0	0.0	0.0
2011-12	69.3	2.3	2.4
2012-13	71.3	4.3	4.1
2013-14	73.9	6.9	6.4
2014-15	75.3	8.3	8.2
2015-16	76.4	9.4	9.8
2016-17	77.9	10.9	11.9
2017-18	79.0	12.0	13.3

[1] A fixed-effects logistic regression model was originally used in OfS 2018.54. This was changed to a mixed-effects model in OfS 2019.28.
[2] These tables are Tables 2 and 3 in OfS 2019.28.

Table 2: Summary of observed and unexplained changes in first-class degree attainment

Academic year	Observed proportion (%)	Change from 2010-11 (pp)	Unexplained change (pp)
2010-11 (ref.)	15.7	0.0	0.0
2011-12	17.4	1.7	1.6
2012-13	19.1	3.4	3.0
2013-14	21.0	5.3	4.7
2014-15	23.3	7.6	7.0
2015-16	24.7	9.0	8.8
2016-17	27.2	11.5	11.5
2017-18	29.3	13.6	13.9

Tables 1 and 2 show 1) the observed proportion of graduates who obtained either an upper degree or a first-class degree from 2010-11 to 2017-18, 2) the percentage point change in attainment relative to the base year of 2010-11, and 3) the percentage point change in attainment that is unexplained by the factors considered in the logistic regression model. It can be easily seen that for each academic year since 2011-12, most if not all of the increase in degree attainment is unexplained by changes in the graduate population. By 2017-18, 13.3 and 13.9 percentage points of the increase in upper degrees and first-class degrees respectively are unexplained.

It is worth noting that in the second and last three rows of **Table 1** corresponding to the academic years 2011-12, 2015-16, 2016-17, and 2017-18, the unexplained change in degree attainment is higher than the observed change from 2010-11. This shows that the model predicts that the overall proportion of graduates obtaining an upper degree in those years should be *lower* than that in 2010-11. For example, the predicted proportion of graduates obtaining an upper degree in 2017-18 is 65.7 percent, which is 13.3 percentage points lower than the observed proportion of 79.0 percent. This phenomenon is also observed in the row corresponding to the 2017-18 academic year as shown in **Table 2**. However, as the OfS report does not provide any measure of uncertainty for the estimates of the unexplained changes (e.g., standard error), it is difficult to draw conclusions based on these tables.

These results echo findings from previous studies of a similar nature, such as Bachan's (2018) analysis of grade inflation in UK universities between the academic years 2007-8 and 2016-17. Using a different set of variables including UCAS score, staff-student ratio, real expenditure on academic services, and real expenditure on student and staff facilities, Bachan calculated an unexplained percentage point increase of 11.0 and 10.2 points in upper degree and first-class degree attainment respectively in 2016-17. This is similar to the results in the OfS reports. Bachan

also noted that these unexplained changes have occurred only from the academic year 2010-11 onwards, relative to 2007-8. These findings highlight the severity of the grade inflation problem in the UK after 2010-11.

Grade Inflation at LSE

In addition to the sector-level findings, the OfS report investigated changes in degree classification at the individual university level relative to the sector as a whole in 2010-11 and to the same university in 2010-11. To do this, two statistical significance 'flags' were created under the mixed-effects model to indicate whether degree attainment at the university in a given academic year is significantly above, below, or not significantly different from 1) attainment in the sector in 2010-11, and 2) attainment at the same university in 2010-11, once all the explanatory variables are accounted for.[3] We point out that the way the statistical significance 'flags' were created is statistically flawed and thus these 'flags' may not be valid. This methodological issue of the OfS report is discussed at the end of this report.

The results show that for LSE, the observed proportion of upper degrees was not significantly different in 2010-11 from the 2010-11 sector level. However, there was a statistically significant increase in this proportion in 2017-18 relative to the 2010-11 sector level and to LSE's 2010-11 level. Furthermore, the results show that the proportion of first-class degrees awarded by LSE in 2010-11 was significantly *below* the sector in 2010-11: it awarded 15.5 percentage points *lower* first-class degrees than what the model predicts for the sector as a whole. In 2017-18, there was no significant difference in first-class degree attainment relative to the 2010-11 sector level, but there was a significant increase relative to LSE's 2010-11 level. However, it still awarded 6.4 percentage points lower first-class degrees relative to the 2010-11 sector level. In fact, the full results presented in Appendix B in this report show that LSE has been awarding a lower proportion of first-class degrees relative to the sector level *in every year* since 2010-11.

In other words, the OfS analysis suggests that some grade inflation does exist in LSE for upper degrees. Furthermore, whilst some grade inflation has been observed for first-class degrees *within LSE*, this inflation disappears when compared to the overall sector level in 2010-11. Although there has been an observed increase in the proportion of first-class degrees awarded by LSE, it had awarded a significantly lower proportion of first-class degrees than the rest of the sector to begin with back in 2010-11, and during the entire period from 2010-11 to 2017-18. On a whole, the results of the OfS report suggest that close monitoring of grade inflation within LSE is necessary over the next few years to ensure that degree attainment standards remain in line with the sector, though it is acknowledged that LSE has fared better than many other universities

[3] In OfS 2018.54, an additional mixed-effects model was fitted to investigate changes in degree attainment at the provider level. In OfS 2019.28, this analysis was based off the same mixed-effects model used to investigate changes at the sector level as mentioned above.

considered in the analysis. An evaluation of the validity of these results is provided later in this report.

Scope of the current analysis

In light of these findings, the purpose of this report is to replicate the OfS analysis using data from LSE in order to more accurately measure the rate of grade inflation from 2010-11 to 2017-18. This is achieved by calculating the unexplained change in upper degree or first-class degree attainment for each academic year since 2010-11, as well as a new measure of grade inflation called the 'Grade Inflation Rate'. Furthermore, this report determines the standard errors of these estimates, which were notably absent from the OfS report. It also provides a critical evaluation of the methodology employed by OfS, and identifies some of the shortcomings of its 2018 and 2019 reports. Lastly, the inclusion of the computation code in the statistical software R used for this analysis will support the school in closely monitoring potential grade inflation in the future.

Methodology

The current analysis adopts a similar method as the one employed by OfS. It considers only UK-domiciled, full-time students on Home (UK) fee status who graduated in the academic years from 2010-11 to 2017-18, amounting to a total of 5,015 students. However, unlike in the OfS analysis, students who graduated with a Pass degree were also included in the study population, whilst UK-domiciled students classified under Home (EU) or Overseas fee statuses were excluded.

Both fixed- and mixed-effects logistic regression models are used to predict expected degree classification attainment, taking the factors below into account. A detailed explanation of the variables is presented in Appendix C.

- Department
- Year of graduation
- Qualifications on entry
- Age
- Disability
- Ethnicity
- Gender
- Participation of Local Areas (POLAR4) quintile

Following the original method used in OfS 2018.54, a fixed-effects logistic regression model is fitted to predict the probability of a single individual obtaining 1) a first- or upper second-class degree combined ("upper degree") or 2) a first-class degree only, using the above factors as covariates. The regression equation and the corresponding coefficient estimates are given in

Appendix D. Using a similar method, the unexplained change in degree attainment relative to 2010-11 is calculated by comparing the observed proportion of upper degrees or first-class degrees awarded to the proportion that is predicted by the model. In addition, a *grade inflation rate* is calculated as the ratio of the observed proportion to the predicted proportion for each academic year. In essence, this statistic tracks the *rate* at which the observed proportion has increased or decreased relative to the predicted proportion for each academic year relative to 2010-11. This thus provides an alternative measure of grade inflation to the unexplained change. Lastly, the standard errors and 95% confidence intervals for both the unexplained change and grade inflation rate statistics are computed using a non-parametric bootstrap method (Efron and Tibshirani, 1993) based on 1,000 bootstrap replications.

Next, two mixed-effects models containing 1) a random intercept for each department and 2) both a random department intercept and a random year coefficient for each department are fitted to predict the probability of an individual obtaining either an upper degree or a first-class degree. The regression equations for the two mixed-effects models are given in Appendix E. The estimates of the predicted proportions for each category of degree attainment obtained using the mixed-effects models are then compared to those generated using the fixed-effects model. It is found that for both upper and first-class degrees, the predicted proportions are nearly identical under the three models (i.e., one fixed-effects model and two mixed-effect models). Owing to the high computational burden of obtaining bootstrap standard errors under the mixed-effects models, results based on the fixed-effects model are presented in the main text as the final results. A comparison of the predicted grade inflation rates for all models are displayed in **Tables E1 and E2** in Appendix E.

In addition to the school-wide results, results at the departmental level are also reported. This is achieved by computing the observed proportion of graduates within each department who obtained either an upper degree or first-class degree, together with the predicted proportion for each department using the fixed-effects model, for each academic year. The grade inflation rate for each individual department per academic year is then calculated as the ratio of these observed and predicted proportions.

To compare grade inflation rates across departments, two different approaches are taken. The first approach is to identify the frequency that the department-specific grade inflation rate exceeds the school-wide rate for each academic year from 2011-12 to 2017-18. The departments whose grade inflation rates exceed the school-wide rate most frequently are taken to have larger grade inflation. The second approach is to obtain the observed proportion of graduates within each department who obtain either an upper degree or first-class degree *over the entire combined period* from 2011-12 to 2017-18. This is compared to the predicted proportion for each department

over the entire period using the fixed-effects model, to obtain an *aggregated grade inflation rate* for the years 2011-12 to 2017-18. The departments are then ranked based on their aggregated grade inflation rate. A summary of both ranking methods and their corresponding results are presented in Appendix G.

Results

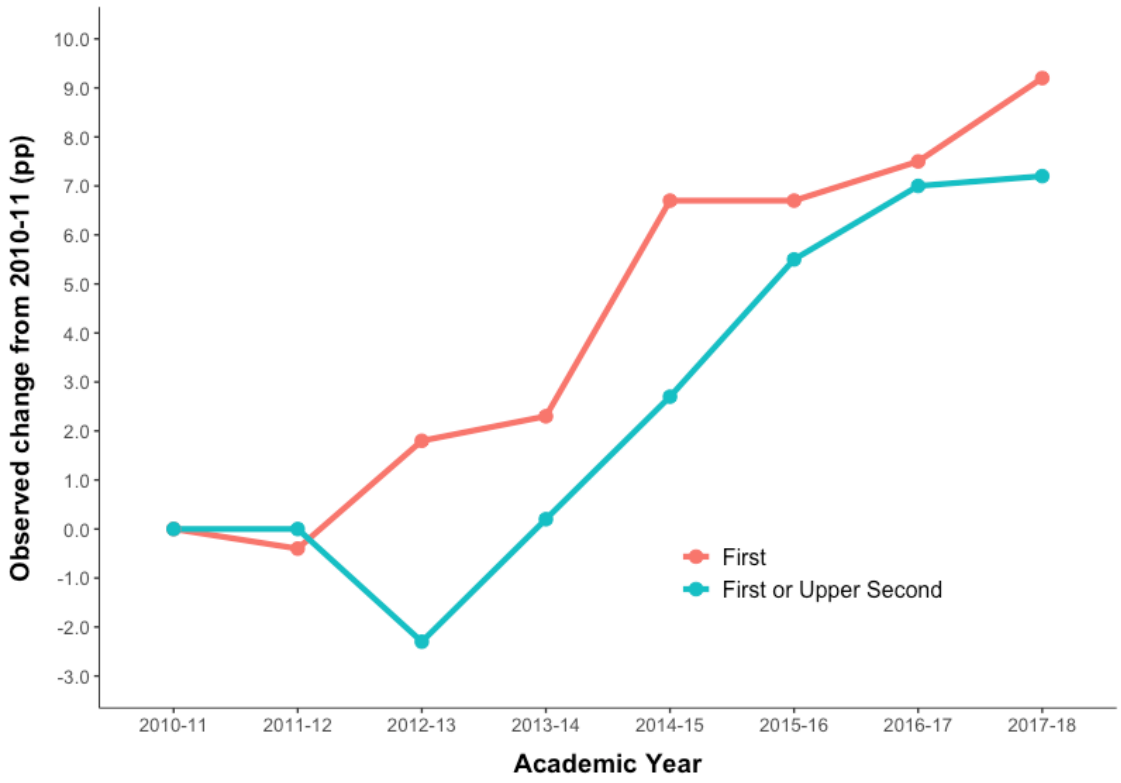
Descriptive analysis of degree attainment from 2010-11 to 2017-18

Table 3 below provides a summary of the percentage of graduates obtaining classified degrees, including passes, in the academic years 2010-11 and 2017-18. The proportion of graduates obtaining a first-class degree has risen by approximately 9 percentage points during this time period, whilst the proportion of those who obtained upper second-class degrees or lower has fallen. A full summary for each academic year from 2010-11 to 2017-18 is provided in Appendix F.

Table 3: Summary of degree classifications for academic years 2010-11 and 2017-18

	2010-11		2017-18	
Degree classification	**Number**	**Percentage**	**Number**	**Percentage**
First	115	19%	167	28%
Upper second	407	66%	384	64%
Other	96	15%	50	8%
Total	618	100%	601	100%

Figure 1: Observed changes in degree attainment in LSE relative to 2010-11



Next, the observed change in the proportion of graduates obtaining an upper degree or a first-class degree in each year relative to academic year 2010-11 is plotted in **Figure 1** above. The plot indicates that the observed proportion of graduates obtaining a first-class degree has increased since 2012-13, with a large jump in the 2014-15 academic year. By 2017-18, this change has risen to around 9.2 percentage points relative to 2010-11. Whilst the proportion of graduates obtaining an upper degree had remained around the same or lower from 2010-11 to 2013-14 relative to the base year, it started to rise in 2014-15, ending at a 6.9 percentage point increase by 2017-18.

Results from statistical modelling

Tables 4 and 5 below present the results from the fixed-effects logistic regression model for changes in the attainment of upper degrees and first-class degrees respectively, from 2010-11 to 2017-18. They show 1) the observed proportion of graduates who obtained either an upper degree or a first-class degree from 2010-11 to 2017-18, 2) the percentage point change in attainment relative to the base year of 2010-11, 3) the proportion of graduates obtaining either an upper degree or a first-class degree as predicted by the regression model after accounting for the explanatory variables and 4) the rounded percentage point change in attainment that is unexplained by the explanatory variables in the model.

Table 4: Summary of observed and unexplained changes in upper degree attainment combined in LSE

Academic year	Observed proportion (%)	Change from 2010-11 (pp)	Predicted proportion (%)	Unexplained change (pp)	S.E. of the unexplained change (pp)
2010-11 (ref.)	84.5	0.0	84.5	0.0	0.0
2011-12	84.5	0.0	83.7	0.8	1.4
2012-13	82.2	-2.3	84.3	-2.1	1.4
2013-14	84.7	0.2	83.2	1.4	1.4
2014-15	87.2	2.7	83.8	3.4	1.4
2015-16	90.0	5.5	84.3	5.8	1.4
2016-17	91.5	7.0	85.8	5.7	1.3
2017-18	91.7	7.2	85.4	6.2	1.4

Table 5: Summary of observed and unexplained changes in first-class degree attainment in LSE

Academic year	Observed proportion (%)	Change from 2010-11 (pp)	Predicted proportion (%)	Unexplained change (pp)	S.E. of the unexplained change (pp)
2010-11 (ref.)	18.6	0.0	18.6	0.0	0.0
2011-12	18.2	-0.4	18.9	-0.8	1.5
2012-13	20.4	1.8	19.0	1.4	1.5
2013-14	20.9	2.3	18.9	2.0	1.5
2014-15	25.3	6.7	19.0	6.3	1.5
2015-16	25.3	6.7	19.4	5.9	1.5
2016-17	26.1	7.5	19.9	6.2	1.6
2017-18	27.8	9.2	19.9	7.9	1.5

The plots of the unexplained change in each academic year relative to 2010-11 along with the 95% bootstrap confidence intervals are shown in **Figures 2 and 3** below:

Figure 2: Unexplained changes for upper degrees in LSE relative to 2010-11 (error bars indicate the bootstrap 95% confidence interval)

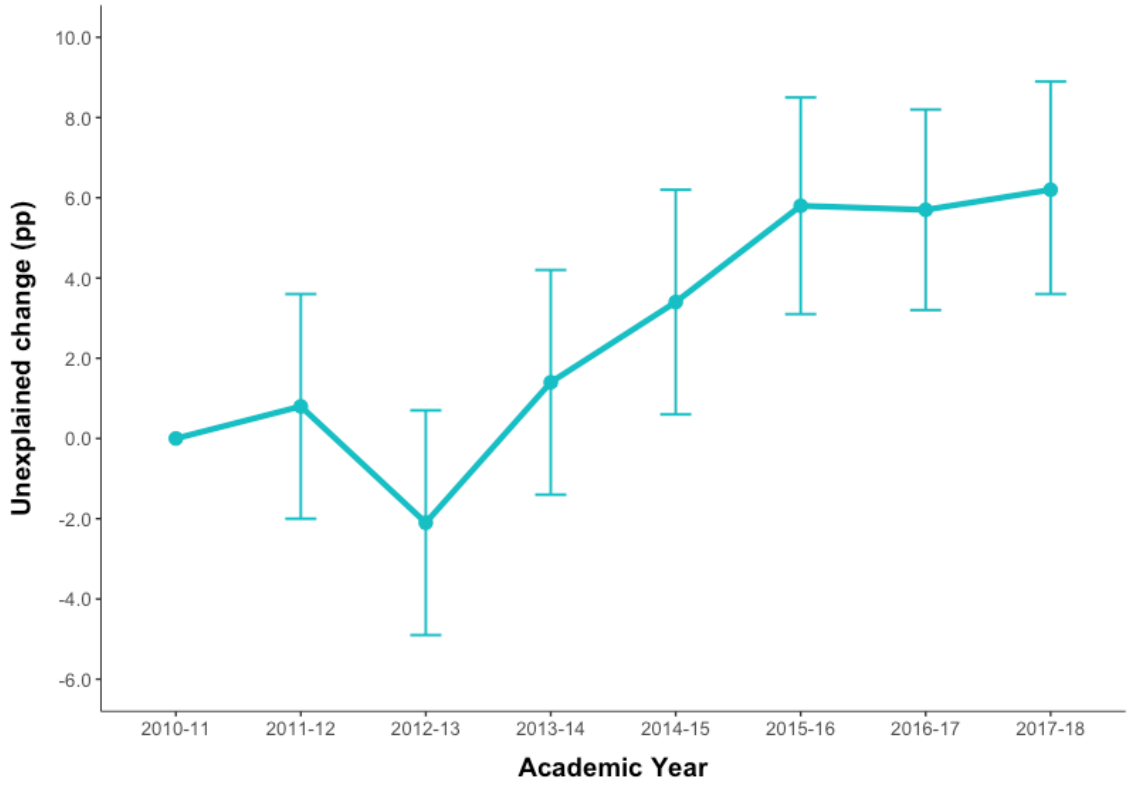
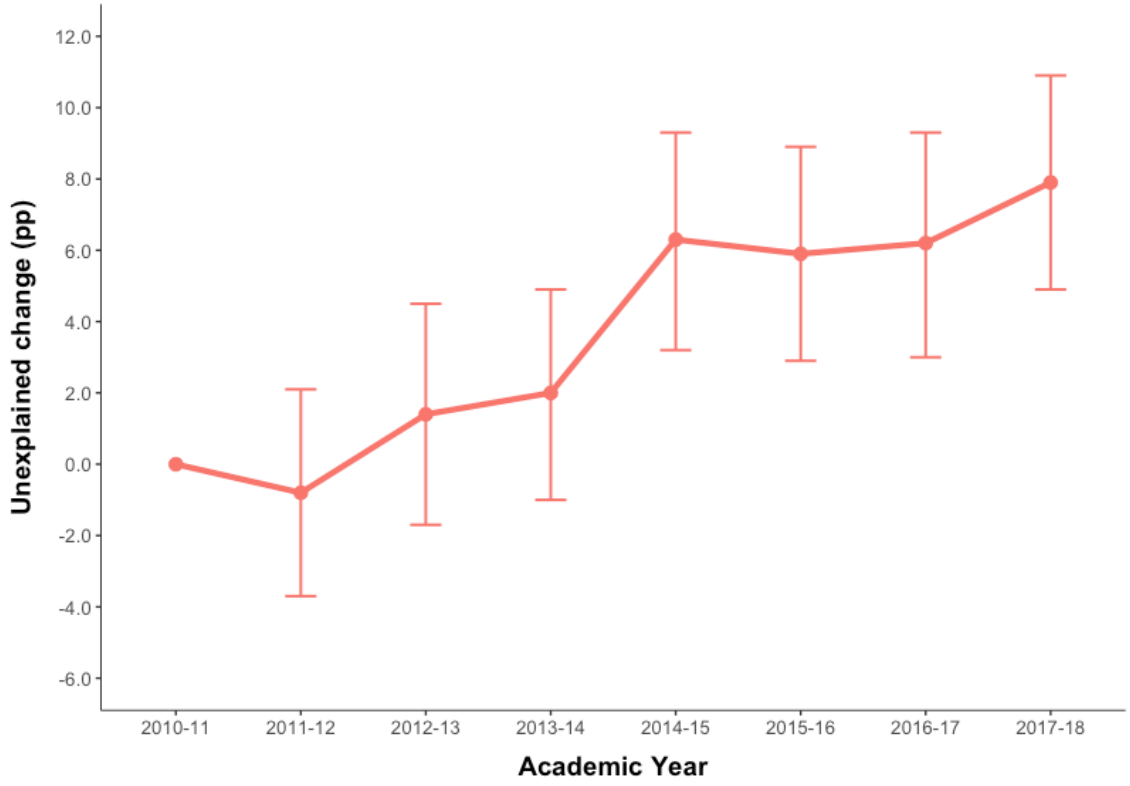


Figure 3: Unexplained changes for first-class degrees combined in LSE relative to 2010-11 (error bars indicate the bootstrap 95% confidence interval)



The results above suggest that there has been some grade inflation for both upper degrees and first-class degrees by 2017-18 relative to 2010-11, though this grade inflation seems to increase noticeably only around 2014-15. In addition, the model suggests that most of the grade inflation that has occurred since 2010-11 is unexplained by the explanatory variables. Two notable exceptions exist: in **Table 4**, the predicted proportion of upper degrees attained is *higher* than the observed proportion in 2012-13, and similarly in **Table 5** the predicted proportion of first-class degrees attained is again *higher* than the observed proportion in 2011-12. Overall, the results of this analysis generally corroborate the OfS results in both OfS 2018.54 and OfS 2019.28.

Figures 4 and 5 below show the grade inflation rate for each academic year, previously defined as the ratio of the observed proportion of graduates obtaining either an upper degree or a first-class degree to the predicted proportion from the regression model. Both figures also include 95% bootstrap confidence intervals for the grade inflation rate.

Figure 4: Grade inflation rate for upper degrees in LSE since 2010-11 (error bars indicate the 95% bootstrap confidence interval)

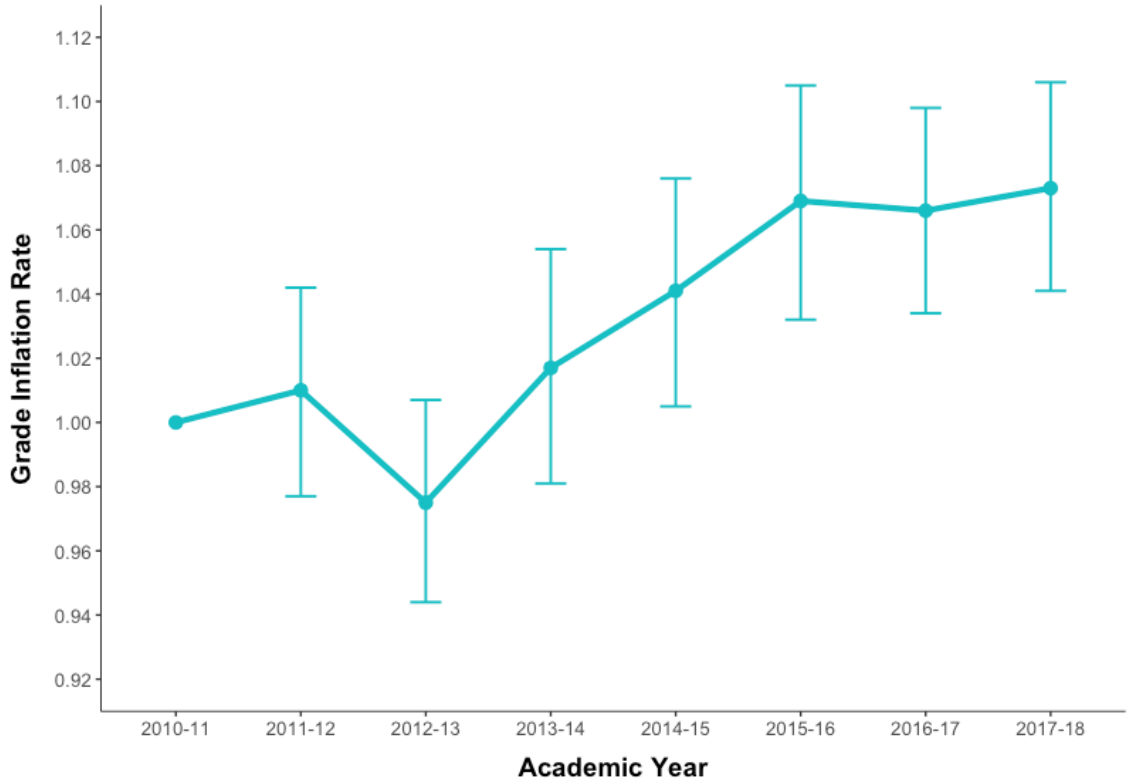
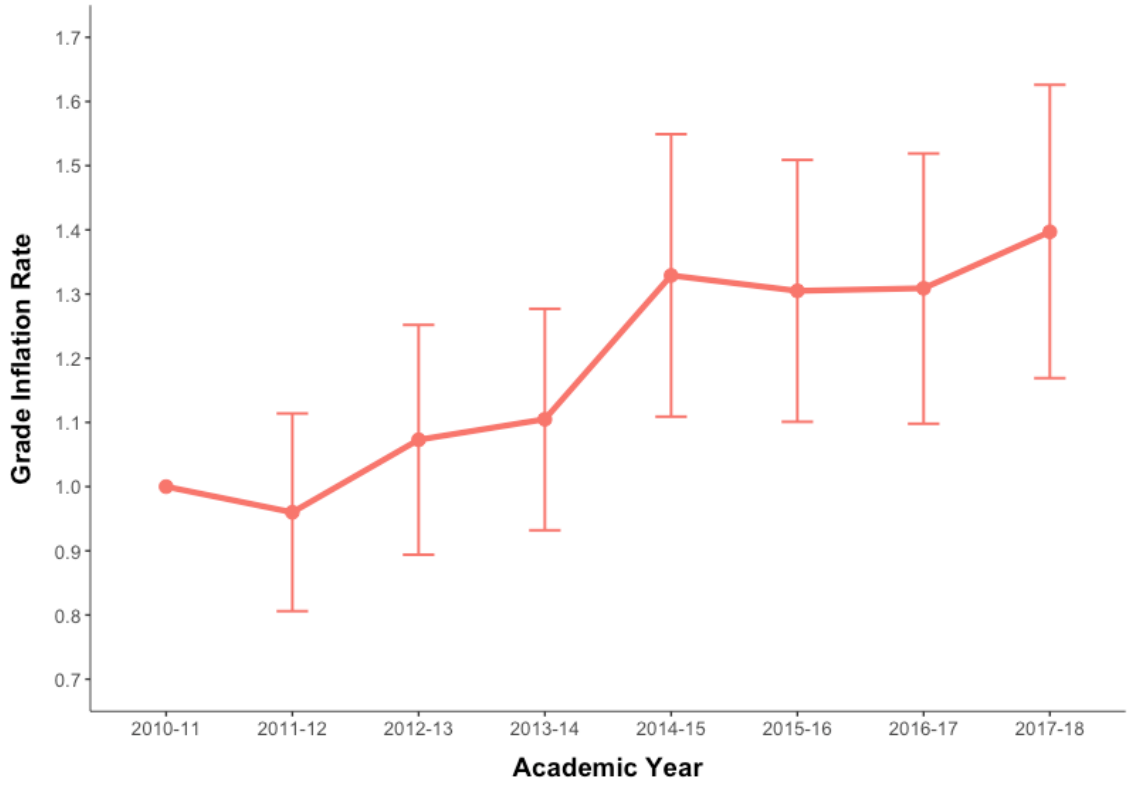


Figure 5: Grade inflation rate for first-class degrees in LSE since 2010-11 (error bars indicate the bootstrap 95% confidence interval)



The trends for the grade inflation rate in both plots closely mimic that of the unexplained change relative to 2010-11 in **Figures 2 and 3**, as is expected. **Figure 4** suggests that grade inflation for upper degrees has plateaued somewhat since 2015-16 at around 7%. In **Figure 5**, there is a large jump in grade inflation for first-class degrees in 2014-15, before remaining somewhat stable around 30-40%. Although this percentage seems exceptionally large, one must bear in mind that the observed proportion of first-class degrees awarded in 2010-11 was only 18.6%, which had risen by 9.2% to 27.8% in 2017-18 as indicated in **Table 5**.

Results at departmental level

Figures 6 and 7 below present only the results for the departments identified to have the largest grade inflation from 2010-11 to 2017-18, ranked by their aggregated grade inflation rates from 2011-12 to 2017-18 combined. For upper degree and first-class degree inflation, the top five and six departments are shown respectively. The grade inflation rates for all 15 departments for each year from 2010-11 to 2017-18, their aggregated grade inflation rates, along with the bootstrap standard errors, are displayed in Appendix G. **Tables G3 and G6** in Appendix G also present the full results for both methods of ranking the departments.

Figure 6: Grade inflation rate for upper degrees since 2010-11 by department (only top five departments in terms of aggregated grade inflation rate are shown)

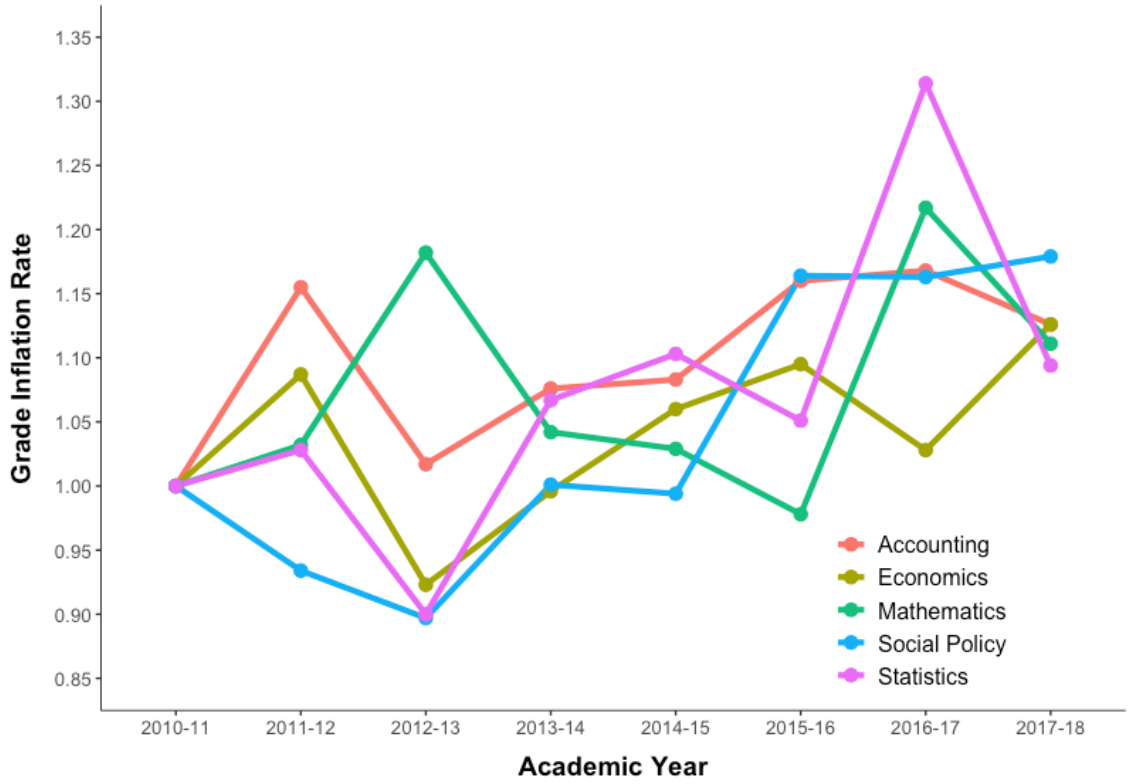
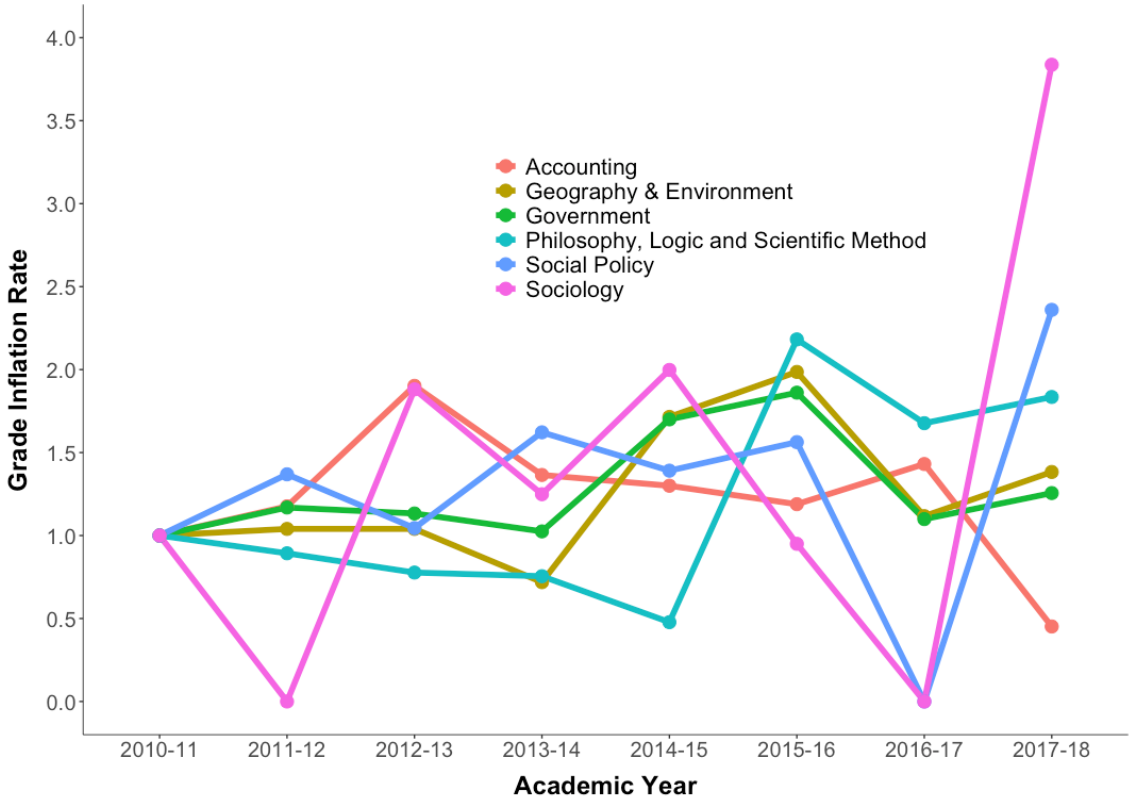


Figure 7: Grade inflation rate for first-class degrees since 2010-11 by department (only top six departments in terms of aggregated grade inflation rate are shown)



It can be seen that for both upper and first-class degree attainment, there is generally an upward trend for the departments that exhibited the largest grade inflation. Regarding upper degree attainment, the department-specific results in **Figure 6** roughly trace the pattern displayed by the school-wide results in **Figure 4**. A majority of the departments included in the plot showed a sharp fall in upper degree attainment in 2012-13 relative to their level in the previous year (2011-12) and to the base year (2010-11). This is followed by a general sustained increase in attainment from 2013-14 to 2017-18. This is also seen in the full results in **Table G1** in Appendix G. In contrast, any pattern in first-class degree attainment is much less discernible due to high within-department variation over time. For example, as shown in **Figure 7** above the Department of Sociology had a grade inflation rate for first-class degree attainment of 0 in both 2011-12 and 2016-17 (corresponding to zero students obtaining a first-class degree) and around 3.84 in 2017-18.

Although the two ranking methods produce different results, it can be seen that the Accounting and Economics departments consistently rank among the top departments for upper degree inflation, whilst the Department of Philosophy, Logic and Scientific Method consistently rank among the lowest. For first-class degree inflation, Accounting, Sociology, and Social Policy rank highly on both scales whilst Anthropology ranks low.

Discussion

Evaluating grade inflation at LSE

The results presented in the previous section suggest that a certain level of grade inflation exists at LSE for both upper degree and first-class degree attainment. Whilst the purpose of this report is not to determine the root causes of this grade inflation, several key observations can be made.

First, the unexplained increase of 6.2 and 7.9 percentage points in upper degree and first-class degree attainment respectively in LSE in 2017-18 relative to 2010-11 still lags behind the overall sector level unexplained increase of 13.3 and 13.9 percentage points for both categories respectively in 2017-18 relative to 2010-11 as presented in the OfS report. This suggests that the grade inflation at LSE is less severe than that experienced by the sector as a whole.

Second, grade inflation for first-class degrees has taken place against the backdrop of an unusually low baseline first-class degree attainment rate. As mentioned earlier in the introduction, it must be remembered that the OfS analysis suggests that LSE has been awarding a *lower proportion* of first-class degrees *in every year from 2010-11 to 2017-18* relative to the 2010-11 sector level, even with supposed grade inflation within the school. This implies that the school had been under-awarding first-class degrees to begin with. The statistical significance 'flags' adopted in the OfS report also indicate that despite a significant rise in first-class degree attainment in 2017-18 relative to LSE's original level in 2010-11, it is not significantly different relative to the 2010-11

sector level, indicating that this grade inflation still remains within an acceptable region. Although the methodological flaws with these 'flags' cast some doubt on the validity of its results, as discussed below, the percentage point figures in the last column of Appendix B remain reliable and so valid inferences can still be made. Hence, grade inflation for first-class degrees may not be considered a serious problem as long as LSE's first-class attainment rate remains close to the 2010-11 sector level. Further monitoring of future degree attainment will thus be necessary to maintain this high standard in degree attainment at LSE.

Third, it is possible that the increase in university tuition fees beginning in the 2012-13 academic year has had an impact on upper degree and first-class degree attainment – a conjecture also raised in Bachan (2018). The results above show a sudden and substantial increase in first-class degree attainment (and upper degree attainment to a smaller extent) in the 2014-15 academic year. This coincides with the academic year of graduation of the first batch of students who had their university tuition fees nearly trebled in 2012-13. It is possible that the rise in tuition fees has led to inflationary practices by universities attempting to attract fee-paying students, though this seems less likely in LSE considering that international students (who pay double the tuition fees of UK/EU students) comprise slightly over a third of the total undergraduate population – a proportion that has not changed since 2010-11. This might reduce the incentive for LSE to lower its academic standards to attract fee-paying UK students. Another explanation is that the rise in tuition fees has both incentivised students to be more selective of courses and motivated them to work harder. The desire to maximise the value of their degree may lead to improved academic performance, as may perceptions of an increasingly competitive job market (Stevens, 2018). Sá (2019) provides evidence of a link between tuition fees and choice of university and choice of course in the UK, suggesting that students take into account expected future earnings when selecting their university and subject. It would not be surprising then that a connection exists between tuition fees and degree attainment. Further research is thus necessary to confirm these potential causal relations.

The results also indicate that the extent of grade inflation appears to be heterogeneous across departments within LSE for both upper and first-class degree attainment. Despite this, the department-specific grade inflation rates generally follow an increasing trend as is expected from the earlier school-wide analysis. Furthermore, the ranking of the departments based on the two different approaches often yielded different results, though some departments such as Accounting and Social Policy were consistently deemed to have the highest amount of grade inflation for upper and first-class degrees respectively, as shown in **Tables G3 and G6** in Appendix G. The fact that high variation across the years exists within certain departments, such as Social Policy for first-class degree attainment, also implies that perhaps greater quality control needs to be exercised in those departments to prevent degree attainment from fluctuating so wildly.

Lastly, a possible extension of this study could include an investigation of grade inflation at the module ("course" in LSE terminology) level. Since module content and assessment policies are determined directly by individual departments, any form of quality control as mentioned earlier would likely have to be conducted at the module level. Such a study could thus provide an insight into the specific drivers of grade inflation at the most fundamental level. This could enable a targeted approach in combatting grade inflation.

Caveats in the method used to analyse grade inflation

It is admittedly extremely difficult to distinguish between 'legitimate' rises in degree attainment and grade inflation in practice. However, the method of using a logistic regression on certain explanatory variables adopted by OfS (which is replicated in this report) assumes that any unexplained difference between observed and predicted degree attainment is *necessarily* the result of grade inflation. In reality, these unexplained changes may be due to variables that were not included in the models presented, or may not even be due to grade inflation at all. Some of the shortcomings of the method used to model grade inflation have been identified as follows.

According to Bachan (2018), factors such as "changes in marking and examination procedures, grading boundaries, and the treatment of borderline students may account for a substantial proportion of the unexplained change". Allen (2018) argues that a lack of consistency in degree classification algorithms across universities, as well changes in these algorithms over time, may be key drivers of grade inflation. Despite their importance in determining degree attainment, the complexities surrounding these grading rules and algorithms mean that they might be difficult to capture in a statistical model such as logistic regression. Fortunately for this report, however, this is not a major concern as the degree classification rules used by LSE have remained largely unchanged over the period considered in the analysis.

In addition to changes in the rules that govern the way degrees are awarded, it is also likely that improvements in academic support for students can have a tangible impact on degree attainment. Stevens (2018) notes that "over the last five years, support for disadvantaged and under-represented students at Russell Group universities to succeed on their courses has more than trebled," and a study by Murphy and Wyness (2016) from the LSE Centre for Economic Performance revealed that "each £1,000 of financial aid awarded increases the chances of gaining a good degree by around 3.7 percentage points". **Table 6** below indicates the amount of financial support (bursaries) for UK/EU LSE undergraduates awarded from 2010-11.

It can be seen that financial support per student for UK/EU undergraduates at LSE measured in real terms in 2017-18 was over two and a half times that of the 2010-11 figure. This, combined

with Murphy and Wyness' findings, suggests that some 'unexplained' rise in degree attainment since 2010-11 is indeed unsurprising. Thus, the LSE grade inflation figures presented in this report have to be evaluated in light of the increase in student financial support over time.

Table 6: Financial support (bursaries) awarded to UK/EU LSE undergraduates from 2010-11 to 2017-18

Academic year	LSE bursaries for UK/EU undergraduates (£)	No. of UK/EU students	Nominal value of financial support per student (£)	Standardised value of financial support per student (£)[4]
2010-11 (ref.)	1,276,000	777	1,642	1,642
2011-12	1,305,000	780	1,673	1,621
2012-13	2,024,730	781	2,592	2,437
2013-14	2,494,780	751	3,322	3,052
2014-15	3,682,399	781	4,715	4,289
2015-16	4,101,921	830	4,942	4,418
2016-17	4,320,674	907	4,764	4,112
2017-18	4,471,898	856	5,224	4,364

Finally, Firth (2019) provides a hypothetical extreme example of two universities that are deemed to demonstrate an unexplained increase in first-class degree attainment *despite both making it more difficult for all students to obtain a first-class degree*, which arises due to changes in the composition of both universities' student populations rather than because of inflationary practices. Despite the simplicity of his example, it suggests that shifts in the way students choose the universities they attend may conceal the true nature of degree attainment and lead to distorted results by solely relying on the OfS approach. That there is likely to be a causal relation between tuition fees and the choice of university and course (Sá, 2019) indeed suggests that the methods used by the OfS may not measure grade inflation accurately, especially from academic year 2014-15 onwards.

Future monitoring of grade inflation

The purpose of this report is not only to investigate the extent of grade inflation within LSE, but also to provide a framework for the school to monitor future grade inflation at both the school and department level. To that end, the computation code in the R statistical analysis software used for this study was kept well-documented, such that new analyses of a similar nature may be replicated every year once student and degree classification data for each graduating cohort are made

[4] The consumer price index is used to convert nominal values to standardised values, taking 2010 as the baseline year.

available. If grade inflation in certain departments reach unacceptable levels in the future based on the new results, for example, these departments can easily be identified and warned. This will thus enable the school to exercise greater control over potential grade inflation in the future.

Statistical methodological issue in the OfS analysis

As mentioned earlier, the way of creating the statistical significance 'flags' is statistically flawed. More precisely, statistical significance 'flags' were obtained based on the Z-statistics given in equations E1 and E2 in the OfS report (OfS 2019.28), under a mixed-effects logistic regression model. These two equations are repeated in the current report as equations B1 and B2 respectively in Appendix B. To recall, these 'flags' indicate whether degree attainment at a particular university in a given academic year is significantly above, below, or not significantly different from 1) attainment in the sector in 2010-11, and 2) attainment at the same university in 2010-11, once all the explanatory variables are accounted for. There are two flaws in this method.

First, statistical significance and p-values are defined under the Frequentist statistical framework exclusively, though there are Bayesian counterparts of them. That is, statistical significance and p-values come from the statistical testing of a hypothesis about a certain fixed parameter, for example, whether the fixed parameter is zero or not. However, under the mixed-effects logistic regression model adopted in the OfS report, the parameters of interest, for example $u_{0,j} + \beta_{year} + u_{year,j}$ in equation B1 and $\beta_{year} + u_{year,j} - u_{2010,j}$ in equation B2, are random variables, for which hypothesis testing is not suitable.[5]

Second, even if OfS changes their model to a fixed-effects model and replaces the random variables in equations B1 and B2 by their point estimates, the Z-statistics given in these equations are not asymptotically normal, and thus lead to statistically invalid p-values. This is because by ignoring the correlations between the estimates in the numerators of both equations, the terms in the denominators do not accurately estimate the standard deviations of the corresponding numerators.

Owing to these flaws, the Z-statistics and results of the two 'flags' based on the mixed-effects model in the OfS report should therefore be taken with caution, though this does not adversely impact the validity of the conclusions stated in this report.

[5] $u_{0,j}$ is the random intercept; $u_{year,j}$ is the provider random year effect; β_{year} is the sector fixed year effect.

Conclusion

The OfS reports on grade inflation in the UK higher education sector have brought to light concerns that university degrees may be losing their value especially in recent years. Their statistical analyses based on student data have revealed grade inflation at both the sector level and the individual university level. This report has taken their results a step further by examining the presence and extent of grade inflation within LSE (among departments) specifically.

The results indicate that although there has been some inflation in both upper degree and first-class degree attainment since 2010-11, LSE had been issuing a lower proportion of first-class degrees than expected in the first place. The sudden spike in first-class degree attainment in 2014-15 also coincides with graduation of the first batch of students who had their university tuition fees nearly trebled in 2012-13. Additional econometric analysis building upon the work of Sá (2019) could possibly draw a causal link between the increase in tuition fees and degree attainment. In addition, the grade inflation figures at LSE are substantially lower than the overall sector-level figures over the same time period, and it can be seen that grade inflation for upper degrees has plateaued somewhat since 2015-16. Further monitoring of grade inflation for both classes of degrees in the future is therefore necessary for more detailed conclusions to be drawn. The department-specific results also show significant variability in grade inflation both between and within individual departments since 2010-11, and have flagged certain high-inflation departments based on two different ranking methods.

A natural extension of this study would be to include all undergraduate students who graduated from LSE since 2010-11, rather than just the subset of students considered in this report. Furthermore, additional analysis of grade inflation at the module level could help paint a clearer picture of the grade inflation happening at LSE, and allow departments to focus their attention on specific high-inflation modules for review.

This report also highlights several of the shortcomings of the method used to study grade inflation, including the omission of important factors that may affect degree classification, as well as the inherent inability of the models to accurately measure grade inflation due to changes in the composition of the university student population. Moving ahead, it is important that future studies on grade inflation bear in mind these weaknesses before drawing definitive conclusions. In analysing an issue as complex as grade inflation, perhaps a more nuanced approach is necessary. Numbers alone indeed do not tell the whole story.

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Appendices

Appendix A: Mixed-effects Logistic Regression Model used in OfS 2019.28

A mixed-effects logistic regression model was used to model the probability of graduate i attaining an upper degree or first-class degree, from provider j, after accounting for the effect of the explanatory variables outlined in the report above. The model is given as follows:

Equation A1: 'Full' mixed-effects logistic regression model for graduate degree attainment

$$Attained\ an\ upper\ degree\ OR\ first\ class\ degree \sim Binomial(n_{ij}, \pi_{ij})$$

$$logit(\pi_{ij}) = \beta_{0,j} + u_{0,j} + \sum_{Year=1}^{8} (\beta_{Year} + u_{Year,j}) X_{Year,ij} + \sum_{Sub=9}^{25} \beta_{Sub} X_{Sub,ij} + \sum_{Qual=26}^{47} \beta_{Qual} X_{Qual,ij} + \sum_{Age=48}^{48} \beta_{Age} X_{Age,ij} + \sum_{(Qual*Age)=49}^{70} \beta_{(Qual*Age)} X_{(Qual*Age),ij} + \sum_{Disb=71}^{71} X_{Disb,ij} X_{Disb,ij} + \sum_{Sex=72}^{73} \beta_{Sex} X_{Sex,ij} + \sum_{Ethn=4}^{78} \beta_{Ethn} X_{Ethn,ij} + \sum_{POLAR=79}^{83} \beta_{POLAR} X_{POLAR,ij}$$

The βs represent the fixed effects coefficients that are common to individuals across all providers (the sector) and years. The Xs (0 or 1) are dummies representing whether or not an individual has the characteristics: (See Appendix C for the coding of each variable)

- $Year =$ academic year of graduation
- $Sub =$ subject of study
- $Qual =$ entry qualifications
- $Age =$ age
- $Qual * Age =$ interaction between entry qualification and age
- $Disb =$ disability
- $Sex =$ sex
- $Ethn =$ ethnicity
- $POLAR =$ POLAR4 quintile

$u_{0,j}$ is the random intercept for provider j and $u_{Year,j}$ represents the random coefficient for provider j in academic year $Year$ with $u_{0,j} \sim N(0, \sigma^2_{u_0})$ and $u_{Year,j} \sim N(0, \sigma^2_{u_{Year}})$.

Appendix B: Results of provider-level analysis in OfS 2019.28 for the LSE

Tables B1 and B2 present the provider-level results by the Office of Students for upper degree and first-class degree attainment in the LSE. The table headings are as follows:

- **Observed attainment (%)**: The proportion of graduates attaining the specified degree classifications
- **Sector 2010-11 flag**: Whether attainment at the provider was statistically significantly above (1), below (-1), or no different from (0) the attainment in the sector in 2010-11, with the effect of all explanatory variables accounted for
- **Provider 2010-11 flag**: Whether attainment at the provider was statistically significantly above (1), below (-1), or no different from (0) the attainment at the same provider in 2010-11, with the effect of all explanatory variables accounted for
- **Unexplained attainment (pp)**: The unexplained attainment at the provider relative to the attainment in the sector in 2010-11 (calculated using only the fixed effects of the mixed-effects logistic regression model presented in Appendix A); a negative number indicates that attainment at the provider is beneath that of the average sector attainment in 2010-11 with the effect of explanatory variables accounted for

Table B1: Provider-level results for upper degree attainment in the LSE from 2010-11 to 2017-18

Academic year	Observed attainment (%)	Sector 2010-11 flag	Provider 2010-11 flag	Unexplained attainment (pp)
2010-11 (ref.)	83.0	0	0	-5.6
2011-12	82.7	0	0	-5.6
2012-13	80.0	0	0	-7.8
2013-14	83.0	0	0	-6.2
2014-15	87.6	0	0	-0.9
2015-16	89.1	0	1	0.3
2016-17	90.9	0	1	2.0
2017-18	91.6	1	1	3.7

Table B2: Provider-level results for first-class degree attainment in the LSE from 2010-11 to 2017-18

Academic year	Observed attainment (%)	Sector 2010-11 flag	Provider 2010-11 flag	Unexplained attainment (pp)
2010-11 (ref.)	18.5	-1	0	-15.5
2011-12	17.8	-1	0	-15.1
2012-13	19.2	-1	0	-15.3
2013-14	19.8	-1	0	-15.1
2014-15	24.1	0	0	-9.6
2015-16	25.8	0	0	-9.1
2016-17	25.9	0	1	-8.2
2017-18	27.3	0	1	-6.4

The two statistical significance flags are created for a provider where the following Z-scores are deemed significant at the $\alpha < 0.05$ level, or lie outside the limits -3.5844 (flag = -1) ≤ Z ≤ 3.5833 (flag = 1), as deduced by applying the Bonferroni correction method for multiple comparisons. Since the results of 148 providers are compared in OfS 2019.28, the Z-score threshold is set at 0.05/148 = 0.0003, which corresponds to ± 3.5844 standard deviations from the mean (zero). The Z-scores for the sector 2010-11 and provider 2010-11 flags are calculated using equations B1 and B2 respectively, where each value of j corresponds to a provider.[6]

Equation B1: Sector in 2010-11 flag

$$Z_{Sector,j,2010} = \begin{cases} \dfrac{u_{0,j} + u_{year,j}}{\sqrt{s.e.(u_{0,j})^2 + s.e.(u_{year,j})^2}} & , year = 2010 \\ \dfrac{u_{0,j} + \beta_{year} + u_{year,j}}{\sqrt{s.e.(u_{0,j})^2 + s.e.(\beta_{year})^2 + s.e.(u_{year,j})^2}} & , year \neq 2010 \end{cases}$$

Equation B2: Provider in 2010-11 flag

$$Z_{Provider,j,2010} = \begin{cases} 0 & , year = 2010 \\ \dfrac{\beta_{year} + u_{year,j} - u_{2010,j}}{\sqrt{s.e.(\beta_{year})^2 + s.e.(u_{year,j})^2 + s.e.(u_{2010,j})^2}} & , year \neq 2010 \end{cases}$$

[6] These equations correspond to equations E1 and E2 respectively in OfS 2019.28

Appendix C: Full description of the variables used in the models in this report

Table C1: Variables used in the fixed- and mixed-effects logistic regression models in this report (all categorical)

Model variable name	Description
Year of graduation (Year)	Academic year of graduation: 2010-11 (ref.) 2011-12 2012-13 2013-14 2014-15 2015-16 2016-17 2017-18
Department (Dpt)	Department graduate is registered under: Accounting Anthropology Economics (ref.) Economic History Geography & Environment Government International History International Relations Law Management Mathematics Philosophy, Logic and Scientific Method Social Policy Sociology Statistics
Qualifications on entry (Qual)	Entry qualifications of graduate: AAA (ref.) AAB Below AAB International Baccalaureate Other A Levels

Participation of Local Areas (POLAR4) quintile[7] (POLAR)	Young participation quintile of graduate: Quintile 1 Quintile 2 Quintile 3 Quintile 4 Quintile 5 (ref.)
Ethnicity (Ethn)	Ethnicity of graduate: White (ref.) Black Asian Other Unknown
Disability (Disb)	Declared disability status of graduate: No disability (ref.) Disability
Gender[8] (Gend)	Sex of graduate: Male (ref.) Female
Age (Age)	Age on entry into university: Under 21 (Young) (ref.) Over 21 (Mature)

[7] Students with no reported POLAR4 quintiles (85 in total) are excluded from the analysis.
[8] Students with missing gender information (12 in total) are excluded from the analysis.

Appendix D: Fixed-effects logistic regression model for the analysis of LSE data

For the analysis of LSE data in this report, a fixed-effects logistic regression model was used to model the probability of graduate i attaining an upper degree or first-class degree, after accounting for the effect of the explanatory variables in Appendix C above. The full model is given below:

Equation D1: Fixed-effects logistic regression model for graduate degree attainment

$$Attained\ an\ upper\ degree\ OR\ first\ class\ degree \sim Binomial(n_i, \pi_i)$$

$$logit(\pi_i) = \beta_0 + \sum_{Year=1}^{7} \beta_{Year}\, X_{Year,i} + \sum_{Dpt=8}^{21} \beta_{Dpt}\, X_{Dpt,i} + \sum_{Qual=22}^{25} \beta_{Qual}\, X_{Qual,i} + \sum_{POLAR=26}^{29} \beta_{POLAR}\, X_{POLAR,i} + \sum_{Ethn=30}^{33} \beta_{Ethn}\, X_{Ethn,i} + \sum_{Disb=34}^{34} \beta_{Disb}\, X_{Disb,i} + \sum_{Gend=35}^{35} \beta_{Gend}\, X_{Gend,i} + \sum_{Age=36}^{36} \beta_{Age}\, X_{Age,i}$$

The βs represent the fixed-effects coefficients for the categorical variables in the model, and the Xs (0 or 1) are dummies for categories of the following individual characteristics:

- $Year =$ academic year of graduation
- $Dpt =$ department
- $Qual =$ entry qualifications
- $POLAR =$ POLAR4 quintile
- $Ethn =$ ethnicity
- $Disb =$ disability
- $Gend =$ gender
- $Age =$ age

Table D1: Variable coefficient estimates of the model for upper degree attainment

Effect		Estimate	Standard Error	p-value
Intercept		2.02	0.18	<0.0001
Year	2010-11 (ref.)	-	-	-
	2011-12	0.07	0.17	0.68
	2012-13	-0.17	0.17	0.30
	2013-14	0.12	0.17	0.47
	2014-15	0.31	0.18	0.08
	2015-16	0.58	0.18	<0.01
	2016-17	0.64	0.19	<0.001
	2017-18	0.70	0.20	<0.001
Dpt	Economics (ref.)	-	-	-
	Accounting	-0.86	0.17	<0.0001
	Anthropology	1.35	0.31	<0.0001
	Economic History	0.96	0.28	<0.001
	Geography & Environment	0.46	0.22	0.04
	Government	1.01	0.24	<0.0001
	International History	1.64	0.32	<0.0001
	International Relations	1.48	0.54	<0.01
	Law	0.95	0.21	<0.0001
	Management	0.40	0.22	0.07
	Mathematics	-0.68	0.16	<0.0001
	Philosophy, Logic and Scientific Method	1.30	0.36	<0.001
	Social Policy	0.56	0.25	0.03
	Sociology	1.22	0.33	<0.001
	Statistics	-0.42	0.19	0.03
Qual	AAA (ref.)	-	-	-
	AAB	-0.77	0.13	<0.0001
	Below AAB	-1.45	0.21	<0.0001
	International Baccalaureate	1.05	0.73	0.15
	Other A Levels	0.02	0.30	0.94
POLAR	Quintile 5 (ref.)	-	-	-
	Quintile 1	0.30	0.28	0.27
	Quintile 2	-0.05	0.18	0.78
	Quintile 3	0.18	0.15	0.22
	Quintile 4	-0.01	0.11	0.91

Ethn	White (ref.)	-	-	-
	Black	-1.18	0.19	<0.0001
	Asian	-0.73	0.11	<0.0001
	Other	-0.29	0.18	0.11
	Unknown	-0.06	0.42	0.89
Disb	No disability (ref.)	-	-	-
	Disability	-0.25	0.14	0.07
Gend	Male (ref.)	-	-	-
	Female	0.03	0.10	0.79
Age	Under 21 (Young) (ref.)	-	-	-
	Over 21 (Mature)	-0.99	0.35	<0.01

Table D2: Analysis of Variance results for the model for upper degree attainment

Variable	Degrees of Freedom	Deviance	Residual df.	Residual Deviance	p-value (chi-square test)
Null model	-	-	5014	3856.6	-
Year	7	53.59	5007	3803.0	<0.0001
Dpt	14	339.66	4993	3463.3	<0.0001
Qual	4	73.71	4989	3389.6	<0.0001
POLAR	4	3.53	4985	3386.1	0.47
Ethn	4	64.08	4981	3322.0	<0.0001
Disb	1	3.62	4980	3318.4	0.06
Gend	1	0.11	4979	3318.3	0.74
Age	1	7.11	4978	3311.2	<0.01

Table D3: Variable coefficient estimates of the model for first-class degree attainment

Effect		Estimate	Standard Error	p-value
Intercept		-0.07	0.14	0.60
Year	2010-11 (ref.)	-	-	-
	2011-12	-0.05	0.15	0.72
	2012-13	0.09	0.15	0.53
	2013-14	0.14	0.15	0.37
	2014-15	0.40	0.15	<0.01
	2015-16	0.37	0.14	0.01
	2016-17	0.38	0.14	<0.01
	2017-18	0.48	0.14	<0.001
Dpt	Economics (ref.)	-	-	-
	Accounting	-1.13	0.17	<0.0001
	Anthropology	-1.16	0.21	<0.0001
	Economic History	-0.89	0.18	<0.0001
	Geography & Environment	-1.01	0.16	<0.0001
	Government	-1.16	0.14	<0.0001
	International History	-1.10	0.16	<0.0001
	International Relations	-1.24	0.25	<0.0001
	Law	-1.27	0.14	<0.0001
	Management	-0.94	0.20	<0.0001
	Mathematics	-0.27	0.13	0.05
	Philosophy, Logic and Scientific Method	-0.81	0.18	<0.0001
	Social Policy	-1.69	0.28	<0.0001
	Sociology	-1.44	0.30	<0.0001
	Statistics	-0.28	0.16	0.07
Qual	AAA (ref.)	-	-	-
	AAB	-0.92	0.14	<0.0001
	Below AAB	-1.27	0.32	<0.0001
	International Baccalaureate	-0.02	0.28	0.93
	Other A Levels	-0.07	0.20	0.71
POLAR	Quintile 5 (ref.)	-	-	-
	Quintile 1	-0.02	0.19	0.92
	Quintile 2	0.06	0.14	0.65
	Quintile 3	0.01	0.11	0.94
	Quintile 4	-0.18	0.09	0.05

Ethn	White (ref.)	-	-	-
	Black	-0.94	0.23	<0.0001
	Asian	-0.18	0.09	<0.0001
	Other	-0.19	0.13	0.14
	Unknown	-0.79	0.31	<0.01
Disb	No disability (ref.)	-	-	-
	Disability	-0.23	0.12	0.05
Gend	Male (ref.)	-	-	-
	Female	-0.14	0.08	0.07
Age	Under 21 (Young) (ref.)	-	-	-
	Over 21 (Mature)	0.12	0.29	0.68

Table D4: Analysis of Variance results for the model for first-class degree attainment

Variable	Degrees of Freedom	Deviance	Residual df.	Residual Deviance	p-value (chi-square test)
Null model	-	-	5014	3856.6	-
Year	7	53.59	5007	3803.0	<0.0001
Dpt	14	339.66	4993	3463.3	<0.0001
Qual	4	73.71	4989	3389.6	<0.0001
POLAR	4	3.53	4985	3386.1	0.47
Ethn	4	64.08	4981	3322.0	<0.0001
Disb	1	3.62	4980	3318.4	0.06
Gend	1	0.11	4979	3318.3	0.74
Age	1	7.11	4978	3311.2	<0.01

Appendix E: Mixed-effects logistic regression model for the analysis of LSE data

In addition to the fixed-effects model, two mixed-effects logistic regression models were used to model the probability of graduate i attaining an upper degree or first-class degree, from department j, after accounting for the effect of the explanatory variables in Appendix C. The models are given as follows:

Equation E1: Mixed-effects Model 1 – Mixed-effects logistic regression model for graduate degree attainment (random intercept)

$$Attained\ an\ upper\ degree\ OR\ first\ class\ degree \sim Binomial(n_{ij}, \pi_{ij})$$

$$logit(\pi_{ij}) = \beta_{0,j} + u_{0,j} + \sum_{Year=1}^{7} \beta_{Year} X_{Year,ij} + \sum_{Dpt=8}^{21} \beta_{Dpt} X_{Dpt,ij} + \sum_{Qual=22}^{25} \beta_{Qual} X_{Qual,ij} + \sum_{POLAR=26}^{29} \beta_{POLAR} X_{POLAR,ij} + \sum_{Ethn=30}^{33} \beta_{Ethn} X_{Ethn,ij} + \sum_{Disb=34}^{34} \beta_{Disb} X_{Disb,ij} + \sum_{Gend=35}^{35} \beta_{Gend} X_{Gend,ij} + \sum_{Age=36}^{36} \beta_{Age} X_{Age,ij}$$

Equation E2: Mixed-effects Model 2 – Mixed-effects logistic regression model for graduate degree attainment (random intercept and random year coefficient)

$$Attained\ an\ upper\ degree\ OR\ first\ class\ degree \sim Binomial(n_{ij}, \pi_{ij})$$

$$logit(\pi_{ij}) = \beta_{0,j} + u_{0,j} + \sum_{Year=1}^{7} (\beta_{Year} + u_{Year,j}) X_{Year,ij} + \sum_{Dpt=8}^{21} \beta_{Dpt} X_{Dpt,ij} + \sum_{Qual=22}^{25} \beta_{Qual} X_{Qual,ij} + \sum_{POLAR=26}^{29} \beta_{POLAR} X_{POLAR,ij} + \sum_{Ethn=30}^{33} \beta_{Ethn} X_{Ethn,ij} + \sum_{Disb=34}^{34} \beta_{Disb} X_{Disb,ij} + \sum_{Gend=35}^{35} \beta_{Gend} X_{Gend,ij} + \sum_{Age=36}^{36} \beta_{Age} X_{Age,ij}$$

The βs represent the fixed-effects coefficients for the categorical variables in the model, and the Xs (0 or 1) are dummies representing whether or not an individual has the characteristics:

- $Year =$ academic year of graduation
- $Dpt =$ department
- $Qual =$ entry qualifications
- $POLAR =$ POLAR4 quintile
- $Ethn =$ ethnicity
- $Disb =$ disability
- $Gend =$ gender

- $Age =$ age

$u_{0,j}$ is the random intercept for department j and $u_{Year,j}$ represents the random coefficient for department j in academic year $Year$ with $u_{0,j} \sim N(0, \sigma^2_{u_0})$ and $u_{Year,j} \sim N(0, \sigma^2_{u_{Year}})$.

Table E1: Comparison of grade inflation rates for good degrees for fixed- and mixed-effects models

Academic year	Grade inflation rate (Fixed effects model)	Grade inflation rate (Mixed-effects model 1)	Grade inflation rate (Mixed-effects model 2)
2010-11 (ref.)	1.000	1.000	1.000
2011-12	1.010	1.009	1.009
2012-13	0.975	0.975	0.974
2013-14	1.017	1.017	1.017
2014-15	1.041	1.040	1.040
2015-16	1.069	1.069	1.068
2016-17	1.066	1.067	1.067
2017-18	1.073	1.073	1.073

Table E2: Comparison of grade inflation rates for first-class degrees for fixed- and mixed-effects models

Academic year	Grade inflation rate (Fixed effects model)	Grade inflation rate (Mixed-effects model 1)	Grade inflation rate (Mixed-effects model 2)
2010-11 (ref.)	1.000	1.001	1.001
2011-12	0.960	0.961	0.960
2012-13	1.073	1.074	1.076
2013-14	1.105	1.103	1.103
2014-15	1.329	1.331	1.330
2015-16	1.305	1.303	1.303
2016-17	1.309	1.306	1.308
2017-18	1.397	1.400	1.400

Table E3: Fixed-effects coefficient estimates for Mixed-effects Model 1 for upper degree attainment

Effect		Estimate	Standard Error	p-value
Intercept		2.61	0.25	<0.0001
Year	2010-11 (ref.)	-	-	-
	2011-12	0.07	0.17	0.69
	2012-13	-0.18	0.16	0.29
	2013-14	0.12	0.17	0.48
	2014-15	0.31	0.18	0.07
	2015-16	0.58	0.18	<0.01
	2016-17	0.64	0.18	<0.001
	2017-18	0.70	0.19	<0.001
Qual	AAA (ref.)	-	-	-
	AAB	-0.75	0.13	<0.0001
	Below AAB	-1.40	0.21	<0.0001
	International Baccalaureate	1.07	0.73	0.14
	Other A Levels	0.04	0.30	0.88
POLAR	Quintile 5 (ref.)	-	-	-
	Quintile 1	0.30	0.28	0.27
	Quintile 2	-0.05	0.18	0.77
	Quintile 3	0.18	0.15	0.22
	Quintile 4	-0.01	0.11	0.91
Ethn	White (ref.)	-	-	-
	Black	-1.19	0.19	<0.0001
	Asian	-0.76	0.11	<0.0001
	Other	-0.29	0.18	0.11
	Unknown	-0.05	0.42	0.90
Disb	No disability (ref.)	-	-	-
	Disability	-0.25	0.14	0.08
Gend	Male (ref.)	-	-	-
	Female	0.04	0.09	0.66
Age	Under 21 (Young) (ref.)	-	-	-
	Over 21 (Mature)	-0.97	0.34	<0.01

Table E4: Fixed-effects coefficient estimates for Mixed-effects Model 1 for first-class degree attainment

Effect		Estimate	Standard Error	p-value
Intercept		-1.00	0.16	<0.0001
Year	2010-11 (ref.)	-	-	-
	2011-12	-0.05	0.15	0.72
	2012-13	0.09	0.15	0.53
	2013-14	0.13	0.15	0.38
	2014-15	0.39	0.15	<0.01
	2015-16	0.37	0.14	0.01
	2016-17	0.37	0.14	<0.01
	2017-18	0.48	0.14	<0.001
Qual	AAA (ref.)	-	-	-
	AAB	-0.95	0.13	<0.0001
	Below AAB	-1.39	0.31	<0.0001
	International Baccalaureate	-0.04	0.28	0.89
	Other A Levels	-0.10	0.20	0.62
POLAR	Quintile 5 (ref.)	-	-	-
	Quintile 1	-0.03	0.19	0.88
	Quintile 2	0.06	0.14	0.66
	Quintile 3	0.01	0.11	0.96
	Quintile 4	-0.18	0.09	0.05
Ethn	White (ref.)	-	-	-
	Black	-0.92	0.23	<0.0001
	Asian	-0.73	0.09	<0.0001
	Other	-0.18	0.13	0.15
	Unknown	-0.78	0.30	0.01
Disb	No disability (ref.)	-	-	-
	Disability	-0.24	0.12	0.04
Gend	Male (ref.)	-	-	-
	Female	-0.16	0.08	0.03
Age	Under 21 (Young) (ref.)	-	-	-
	Over 21 (Mature)	0.11	0.29	0.70

Table E5: Fixed-effects coefficient estimates for Mixed-effects Model 2 for upper degree attainment

Effect		Estimate	Standard Error	p-value
Intercept		2.61	0.25	<0.0001
Year	2010-11 (ref.)	-	-	-
	2011-12	0.06	0.17	0.73
	2012-13	-0.18	0.17	0.29
	2013-14	0.12	0.17	0.49
	2014-15	0.31	0.18	0.08
	2015-16	0.59	0.19	<0.01
	2016-17	0.65	0.19	<0.001
	2017-18	0.71	0.20	<0.001
Qual	AAA (ref.)	-	-	-
	AAB	-0.75	0.13	<0.0001
	Below AAB	-1.40	0.21	<0.0001
	International Baccalaureate	1.07	0.73	0.14
	Other A Levels	0.04	0.30	0.88
POLAR	Quintile 5 (ref.)	-	-	-
	Quintile 1	0.31	0.28	0.27
	Quintile 2	-0.05	0.18	0.77
	Quintile 3	0.18	0.15	0.22
	Quintile 4	-0.01	0.11	0.91
Ethn	White (ref.)	-	-	-
	Black	-1.19	0.19	<0.0001
	Asian	-0.76	0.11	<0.0001
	Other	-0.29	0.18	0.11
	Unknown	-0.05	0.42	0.90
Disb	No disability (ref.)	-	-	-
	Disability	-0.25	0.14	0.08
Gend	Male (ref.)	-	-	-
	Female	0.04	0.09	0.67
Age	Under 21 (Young) (ref.)	-	-	-
	Over 21 (Mature)	-0.97	0.34	<0.01

Table E6: Fixed-effects coefficient estimates for Mixed-effects Model 2 for first-class degree attainment

Effect		Estimate	Standard Error	p-value
Intercept		-1.01	0.17	<0.0001
Year	2010-11 (ref.)	-	-	-
	2011-12	-0.05	0.16	0.77
	2012-13	0.10	0.16	0.53
	2013-14	0.13	0.16	0.40
	2014-15	0.40	0.15	<0.01
	2015-16	0.37	0.15	0.01
	2016-17	0.37	0.15	0.01
	2017-18	0.48	0.15	<0.01
Qual	AAA (ref.)	-	-	-
	AAB	-0.95	0.13	<0.0001
	Below AAB	-1.39	0.31	<0.0001
	International Baccalaureate	-0.04	0.28	0.89
	Other A Levels	-0.10	0.20	0.62
POLAR	Quintile 5 (ref.)	-	-	-
	Quintile 1	-0.03	0.19	0.88
	Quintile 2	0.06	0.14	0.66
	Quintile 3	0.01	0.11	0.96
	Quintile 4	-0.18	0.09	0.05
Ethn	White (ref.)	-	-	-
	Black	-0.92	0.23	<0.0001
	Asian	-0.73	0.09	<0.0001
	Other	-0.18	0.13	0.15
	Unknown	-0.78	0.30	0.01
Disb	No disability (ref.)	-	-	-
	Disability	-0.24	0.12	0.04
Gend	Male (ref.)	-	-	-
	Female	-0.16	0.08	0.04
Age	Under 21 (Young) (ref.)	-	-	-
	Over 21 (Mature)	0.11	0.29	0.70

Table E7: Variance component estimates for the mixed-effects models for upper and first-class degree attainment (standard errors in parentheses)

		Mixed-effects Model 1		Mixed-effects Model 2	
	Random effect	**Upper degrees**	**First-class degrees**	**Upper degrees**	**First-class degrees**
Intercept	$\sigma^2_{u_0}$	0.553 (0.149)	0.168 (0.087)	0.554 (0.150)	0.168 (0.087)
Year	$\sigma^2_{u_{Year}}$	-	-	0.007 (0.171)	0.008 (0.108)

Appendix F: Degree classifications summary for academic years 2010-11 to 2017-18 in LSE

Table F1 shows the breakdown of the degree classifications of the graduate population considered in the model from 2010-11.

Table F1: Degree classifications summary for academic years 2010-11 to 2017-18

Academic year	No. of firsts	First (%)	No. of upper second	Upper second (%)	No. of other degree	Other degree (%)	Total
2010-11	115	19%	407	66%	96	15%	618
2011-12	117	18%	427	66%	100	16%	644
2012-13	124	20%	375	62%	108	18%	607
2013-14	128	21%	391	64%	94	15%	613
2014-15	150	25%	368	62%	76	13%	594
2015-16	160	25%	410	65%	63	10%	633
2016-17	184	26%	461	65%	60	9%	705
2017-18	167	28%	384	64%	50	8%	601

Appendix G: Department-specific results from statistical modelling

Table G1: Grade inflation rates for upper degrees for all departments from 2010-11 to 2017-18 (standard errors in parentheses)

Department	2010-11 (ref.)	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	Mean (2011-12 to 2017-18)
Accounting	1.000	1.155	1.017	1.076	1.083	1.160	1.168	1.126	1.112
		(0.068)	(0.063)	(0.068)	(0.071)	(0.070)	(0.071)	(0.072)	
Anthropology	1.000	0.909	1.050	0.980	1.011	1.069	1.041	1.071	1.019
		(0.024)	(0.024)	(0.021)	(0.021)	(0.020)	(0.022)	(0.021)	
Economics	1.000	1.087	0.923	0.996	1.060	1.095	1.028	1.126	1.045
		(0.028)	(0.025)	(0.027)	(0.031)	(0.031)	(0.029)	(0.030)	
Economic History	1.000	1.073	0.933	1.039	1.043	1.033	0.998	1.038	1.022
		(0.027)	(0.023)	(0.024)	(0.029)	(0.029)	(0.028)	(0.024)	
Geography &	1.000	0.932	0.966	1.091	1.019	1.058	1.052	1.024	1.020
Environment		(0.026)	(0.023)	(0.031)	(0.029)	(0.026)	(0.024)	(0.023)	
Government	1.000	0.953	0.972	1.032	1.065	1.064	1.065	1.026	1.025
		(0.013)	(0.013)	(0.019)	(0.016)	(0.016)	(0.015)	(0.017)	
International History	1.000	0.935	0.985	0.973	1.013	1.036	1.034	1.048	1.003
		(0.012)	(0.012)	(0.014)	(0.011)	(0.011)	(0.011)	(0.016)	
International Relations	1.000	0.971	1.033	0.935	1.035	1.046	1.044	1.045	1.016
		(0.020)	(0.018)	(0.029)	(0.019)	(0.025)	(0.023)	(0.022)	
Law	1.000	0.997	0.923	1.022	1.051	1.049	1.041	1.059	1.020
		(0.017)	(0.015)	(0.016)	(0.015)	(0.016)	(0.017)	(0.016)	
Management	1.000	1.169	0.833	0.948	1.067	1.136	1.036	1.113	1.043
		(0.049)	(0.035)	(0.038)	(0.038)	(0.039)	(0.034)	(0.036)	
Mathematics	1.000	1.032	1.182	1.042	1.029	0.978	1.217	1.111	1.084
		(0.055)	(0.061)	(0.053)	(0.053)	(0.050)	(0.060)	(0.054)	
Philosophy, Logic and	1.000	1.057	1.057	1.005	0.970	1.027	0.984	1.021	1.017
Scientific Method		(0.021)	(0.020)	(0.018)	(0.022)	(0.024)	(0.020)	(0.023)	
Social Policy	1.000	0.934	0.897	1.001	0.994	1.164	1.163	1.179	1.047
		(0.040)	(0.038)	(0.042)	(0.039)	(0.050)	(0.047)	(0.051)	
Sociology	1.000	0.878	1.065	1.004	0.988	1.097	1.093	1.123	1.035
		(0.033)	(0.033)	(0.035)	(0.037)	(0.046)	(0.027)	(0.037)	
Statistics	1.000	1.028	0.900	1.067	1.103	1.051	1.314	1.094	1.080
		(0.055)	(0.046)	(0.054)	(0.061)	(0.058)	(0.080)	(0.056)	
Mean	1.000	1.007	0.982	1.014	1.035	1.071	1.085	1.080	
School-wide GIR	1.000	1.010	0.975	1.017	1.041	1.069	1.066	1.073	

Table G2: Aggregated grade inflation rate for upper degrees for all departments from 2011-12 to 2017-18 (standard errors in parentheses)

Department	Aggregated grade inflation rate from 2011-12 to 2017-18
Accounting	1.111 (0.066)
Anthropology	1.017 (0.021)
Economics	1.047 (0.029)
Economic History	1.022 (0.027)
Geography & Environment	1.021 (0.025)
Government	1.025 (0.016)
International History	1.009 (0.012)
International Relations	1.018 (0.024)
Law	1.023 (0.017)
Management	1.032 (0.039)
Mathematics	1.087 (0.055)
Philosophy, Logic and Scientific Method	1.016 (0.021)
Social Policy	1.039 (0.043)
Sociology	1.032 (0.036)
Statistics	1.067 (0.057)

Table G3: Ranking of departments based on grade inflation rate for upper degrees

- **Ranking 1**: Departments are ranked based on the number of times their grade inflation rate exceeds the school-wide grade inflation rate for each year between 2011-12 and 2017-18
- **Ranking 2**: Departments are ranked based on their aggregated grade inflation rate from 2011-12 to 2017-18 combined

Ranking 1	Count	Ranking 2	Aggregated grade inflation rate
Accounting	7	Accounting	1.111
Anthropology	5	Mathematics	1.087
Economics	5	Statistics	1.067
Economic History	4	Economics	1.047
Geography & Environment	4	Social Policy	1.039
Government	3	Management	1.032
International History	3	Sociology	1.032
International Relations	3	Government	1.025
Law	3	Law	1.023

Management	2	Economic History	1.022
Mathematics	2	Geography & Environment	1.021
Philosophy, Logic and Scientific Method	1	International Relations	1.018
Social Policy	1	Anthropology	1.017
Sociology	1	Philosophy, Logic and Scientific Method	1.016
Statistics	1	International History	1.009

Table G4: Grade inflation rates for first-class degrees for all departments from 2010-11 to 2017-18 (standard errors in parentheses)

Department	2010-11 (ref.)	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	Mean (2011-12 to 2017-18)
Accounting	1.000	1.176	1.902	1.365	1.300	1.189	1.431	0.452	1.259
		(0.189)	(0.302)	(0.218)	(0.213)	(0.193)	(0.224)	(0.074)	
Anthropology	1.000	1.127	1.092	0.883	1.835	1.105	1.154	1.092	1.184
		(0.221)	(0.217)	(0.164)	(0.360)	(0.219)	(0.215)	(0.207)	
Economics	1.000	0.738	0.962	1.158	1.365	1.285	1.197	1.454	1.166
		(0.061)	(0.081)	(0.094)	(0.115)	(0.109)	(0.099)	(0.119)	
Economic History	1.000	0.977	0.612	1.464	1.215	1.416	0.968	1.792	1.206
		(0.159)	(0.099)	(0.237)	(0.199)	(0.250)	(0.167)	(0.308)	
Geography &	1.000	1.040	1.040	0.719	1.715	1.986	1.117	1.383	1.286
Environment		(0.148)	(0.143)	(0.104)	(0.245)	(0.296)	(0.154)	(0.197)	
Government	1.000	1.169	1.133	1.025	1.700	1.861	1.099	1.256	1.320
		(0.152)	(0.144)	(0.132)	(0.232)	(0.244)	(0.145)	(0.160)	
International History	1.000	0.599	0.558	0.882	1.493	1.007	1.727	2.025	1.184
		(0.084)	(0.078)	(0.126)	(0.206)	(0.140)	(0.246)	(0.292)	
International Relations	1.000	1.177	1.196	0.871	1.129	0.819	1.417	1.665	1.182
		(0.275)	(0.304)	(0.206)	(0.270)	(0.190)	(0.354)	(0.395)	
Law	1.000	1.202	1.174	1.018	0.991	1.360	1.321	1.468	1.219
		(0.159)	(0.153)	(0.139)	(0.131)	(0.184)	(0.176)	(0.200)	
Management	1.000	0.842	0.773	0.943	1.829	1.039	1.651	1.898	1.282
		(0.149)	(0.134)	(0.165)	(0.340)	(0.191)	(0.306)	(0.345)	
Mathematics	1.000	1.070	1.240	1.465	1.072	1.000	1.423	0.877	1.164
		(0.113)	(0.137)	(0.157)	(0.116)	(0.102)	(0.157)	(0.093)	
Philosophy, Logic and	1.000	0.893	0.777	0.755	0.478	2.182	1.677	1.835	1.228
Scientific Method		(0.135)	(0.118)	(0.111)	(0.077)	(0.333)	(0.250)	(0.278)	
Social Policy	1.000	1.369	1.045	1.622	1.391	1.563	0.000	2.360	1.336
		(0.445)	(0.324)	(0.533)	(0.421)	(0.486)	(0.000	(0.780)	
Sociology	1.000	0.000	1.881	1.249	1.998	0.950	0.000	3.837	1.416
		(0.000)	(0.703)	(0.453)	(0.731)	(0.323)	(0.000)	(1.277)	
Statistics	1.000	1.219	1.396	0.957	1.346	0.718	1.789	1.149	1.224
		(0.162)	(0.179)	(0.125)	(0.183)	(0.097)	(0.259)	(0.156)	
Mean	1.000	0.973	1.119	1.092	1.390	1.299	1.198	1.636	
School-wide GIR	1.000	0.960	1.073	1.105	1.329	1.305	1.309	1.397	

Table G5: Aggregated grade inflation rate for first-class degrees for all departments from 2011-12 to 2017-18 (standard errors in parentheses)

Department	Aggregated grade inflation rate from 2011-12 to 2017-18
Accounting	1.291 (0.067)
Anthropology	1.172 (0.022)
Economics	1.216 (0.028)
Economic History	1.165 (0.025)
Geography & Environment	1.283 (0.026)
Government	1.293 (0.015)
International History	1.246 (0.012)
International Relations	1.226 (0.023)
Law	1.214 (0.017)
Management	1.233 (0.037)
Mathematics	1.166 (0.054)
Philosophy, Logic and Scientific Method	1.288 (0.021)
Social Policy	1.367 (0.043)
Sociology	1.282 (0.035)
Statistics	1.150 (0.055)

Table G6: Ranking of departments based on grade inflation rate for first-class degrees

- **Ranking 1**: Departments are ranked based on the number of times their grade inflation rate exceeds the school-wide grade inflation rate for each year between 2011-12 and 2017-18
- **Ranking 2**: Departments are ranked based on their aggregated grade inflation rate from 2011-12 to 2017-18 combined

Ranking 1	Count	Ranking 2	Aggregated grade inflation rate
Law	5	Social Policy	1.367
Social Policy	5	Government	1.293
Accounting	4	Accounting	1.291
Economics	4	Philosophy, Logic and Scientific Method	1.288
Economic History	4	Geography & Environment	1.283
Government	4	Sociology	1.282
International Relations	4	International History	1.246

Mathematics	4	Management	1.233
Sociology	4	International Relations	1.226
Statistics	4	Economic History	1.216
Geography & Environment	3	Law	1.214
International History	3	Anthropology	1.172
Management	3	Mathematics	1.166
Philosophy, Logic and Scientific Method	3	Economics	1.165
Anthropology	2	Statistics	1.150