Testing Means-Tested Aid

PRELIMINARY AND INCOMPLETE, PLEASE DO NOT CITE

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December 2015

Abstract: Billions of pounds per year is spent on aid for poor students in HE systems around the world, yet there remains limited evidence on the causal effect of these payments, particularly on the intensive margin. This is an empirical challenge since student aid is correlated with characteristics which influence both college enrolment and achievement. We overcome these challenges by studying a unique form of non-linear means tested financial aid which is unadvertised, varies substantially across institutions, and is subject to shifts in generosity across cohorts. Using student-level administrative data collected from 10 English universities, we study the effects of aid receipt on college completion rates, annual course scores, and degree class, using fixed effects and instrumental variables methods. Our findings suggest that each £1,000 of financial aid awarded increases the chances of gaining a good degree by around 3 percentage points, driven by completion of the final year and course scores.

JEL classification: I22, I23, I28

Keywords: higher education, financial aid, degree completion

Acknowledgements: We thank Susan Dynarski, Sarah Turner, Caroline Hoxby and Damon Clarke for their comments and suggestions. We would also like to thank participants of the AEFP 2014 Texas,RES 2014 and CESifo 2015 conferences, the Russell Sage Foundation and the CEP, LSE Education workshops. We also thank Steve Barnes, Prasanthi Ramakrishnan and Claudia Hupkau for their excellent assistance in collecting and cleaning the data. Wyness acknowledges ESRC funding (ES/L000105/1). All errors are our own.

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1. Introduction

Student aid is widely used around the world as a tool to promote access to university and to support disadvantaged students through their studies. England is no exception, where spending on student aid, in the form of government grants, subsidies on maintenance loans and university based financial aid reaches billions of pounds annually.[1]

To date, the majority of student aid research has focused on its effects on the extensive margin, specifically focusing on university participation decisions (see Kane 1999, Dynarski, 2003; 2003, Seftor and Turner 2002, Nielsen et al., 2010). However, there is surprisingly little research estimating the causal effect of aid on student outcomes whilst in college (degree completion, annual course scores and final degree classification). A likely reason for this is that many aid programs will impact both the extensive and intensive margins simultaneously. This set of outcomes is particularly important since aid-eligible students may be more likely to drop out of college or perform poorly in exams (Bettinger, 2004).

Yet, as is widely acknowledged in the literature (Dynarski, 2003) estimating the impact of student aid on educational attainment is an empirical challenge. There are three main issues at play. First, student aid tends to be correlated with many observable and unobservable factors that also affect an individuals' educational attainment. Aid recipients are more likely to be from poor backgrounds – and poor students are also more likely to drop out of college or fail exams for reasons unrelated to receipt of aid. A second problem is that aid is often related to student ability, either through the institution attended (since more able students congregate at better universities, who may in turn provide more generous financial packages), or directly through merit based aid programmes. Finally,

[1] In 2009/10, the UK government spend on was £1050m on maintenance grants, £722m on student fee loan subsidies and £610m on maintenance loan subsidies. Universities themselves spent £300m on bursaries. Sources: Student grant figures – Student Loans Company, Statistical First Release, 06/2009, Table 3. Maintenance loan and fee loan figures – DIUS Annual Report 2009, annex 1, Table 11. (This does not represent the amount of money lent to students, but the future cost of subsidising and writing off student loans issued in that year as well as management of the student loans stock).

the prospect of aid receipt at a university may be correlated with a students' likeliness to attend that particular college, making it difficult to separate the effects of aid receipt from enrolment effects.

In this paper we study a particular form of student aid – the English higher education bursary scheme – which we argue has unique features which help to overcome these problems, and establish the causal impact of this element of financial aid on student performance at university.

The English bursary scheme is different to other bursary schemes around the world, such as that in place in the US. The scheme is large-scale - around 44% of students receive a bursary, and over £300m is spent on bursaries every year[2] - meaning that the amount received by students is actually relatively small, averaging around £860 per bursary holder per year. This money is used for living expenses rather than as partial payment of tuition fees, which are deferred and do not require repayment until the student has graduated and is earning over £21,000 per year.

Bursaries were initially brought in in 2006, to allay fears that a significant increase in tuition fees (from £1,200 per year to £3,000 per year) would deter students from low income backgrounds from entering post-secondary education. The regulations on bursaries state that they are not merit based (scholarships), but solely determined by parental income. Moreover, it was mandated that universities spend a minimum of 10% of tuition fee income on bursaries.

However, universities were provided with no guidance or research with how to allocate these funds. Rather, they were given complete independence in how much they gave out and to whom. The upshot is universities designed their schemes on a somewhat arbitrary basis, and there is substantial variation in bursary generosity across institutions, with bursary amounts in our sample varying between £300 and £4,000 per year. Moreover, there is a large degree of cross-cohort variation within institution over time as universities experimented with their schemes from year to year.

[2] See OFFA (2015): Table 1e. Note that published figures do not provide a split of spending on bursaries and scholarships separately but it is widely known the bursary spending constitutes the vast majority of this spending.

This set up effectively solves the first of our key problems. Whilst poor students are more likely to receive financial aid under the English bursary scheme, the definition of a poor student, and how much they receive in bursary, varies across institution and within institution over time. In other words, whilst typically there would be no observable counterfactual to a poor student receiving aid (since all poor students receive aid), our data contain a range of counterfactuals at different levels of parental income. This is best illustrated by Figure 1. This shows average bursary paid over deciles of the parental income distribution of students that received bursary aid. Within each household income bracket, each point on the chart represents a university. As is evident, for students of similar income backgrounds, there is a substantial range of bursaries on offer. For example, students with parental incomes of less than £10,000 per year could receive as little as £350 and as much as £2,800 per year depending on the university attended.

A second concern is that aid can be related to student ability – itself driver of student outcomes – because high ability students attend certain institutions which may also offer higher bursaries. Our set up alleviates this issue by exploiting changes in the bursary schemes within universities over time. By way of example, Figure 2 shows how the bursary scheme of a single university changed between 2006 and 2011. During this time the maximum bursary that could be received increased from £3000 and then subsequently decreased to £1000, while the maximum parental income of eligible students increased from £15,000 to £25,000. Moreover the number of different levels of bursaries awarded and at this university decreased from three to two.[3] Thereby including university fixed effects along with controls for subject studied and enrolment test scores, we are ostensibly accounting for student ability and using the variation within a university across cohorts.

In our most preferred specification, we exploit the sharp changes in bursaries awarded for a small change in parental income within a university cohort. Again see Figure 2, which highlights the

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[3] In practise, for the majority of institutions, students are subject to the bursary rules in place upon year of entry to the course, so that policy change occurring during the duration of their course do not affect them, only new entry students. However, for some institutions, policy rule changes affect all students regardless of entry year.

discontinuities in bursary aid awarded within universities according to parental income. In this specification we include university-cohort fixed effects, whilst also accounting for up to a quadratic in parental income, entry test scores, a set of student characteristics and subject area studied. We also account for non-compliance by universities by instrumenting with the institutions' bursary rules. Here, the impact of aid is identified through imposing a smooth relationship of outcomes with parental income coinciding with sharp changes in aid eligibility.

A related issue concerns merit-based aid. Typically in other bursary schemes around the world, aid is more commonly awarded to students with higher entry test scores. Hence, we again might be concerned that students with high prior attainment also receive high amounts of aid. In this case our estimates of the effect of aid on student performance would be biased upwards. However the English scheme is non-merit based. So, conditional on parental income, bursary receipt is orthogonal to entry test scores. Moreover, as Figure 3 shows, whilst universities vary in quality, there is substantial overlap in entry test score requirements. This is driven by universities having different entry requirements for different subjects, particularly arising when a university has a strong reputation in a particular subject area. Hence, there is a high incidence of common support in test scores across institutions.

Our estimates could still be biased if students select their institution based on its financial aid package, either in general, or knowing that they will eligible for certain amount of aid – the third of our identification problems. For example, students from poor backgrounds might choose a particular institution if doing so would mean they gain from a particularly generous aid package, and may also be more likely to graduate for unobservable reasons unrelated to the generosity of aid e.g. motivation. This would create an upward bias in our estimates. However, in our setting, students are unlikely to sort on parental income, conditional on entry test scores, because students have very little possibility of knowing what their bursary is likely to be ahead of enrolling in college. This arises in part because university bursary schemes are highly opaque, and in part because of the rather convoluted university application scheme in place in England. We argue that the relatively unknown status of this program means that we are estimating the impact on the intensive margin only, rather than the program also changing the student composition.

To explain in more depth, each university has its own unique bursary scheme in place. Bursary schemes are governed by complex means-testing rules, usually involving income thresholds and corresponding bursary amounts. Despite the generosity of such schemes they are rarely advertised in university prospectuses or included in aggregated university guides.[4] So, to understand what bursary they are entitled to, a student would have to navigate the finance pages of each institution they are interested in, understand the bursary schedule in place, and calculate their corresponding entitlement. Evidence that English bursaries do not influence enrolment choices of students has been provided by Corver (2010) who looks at the impact of bursaries on application to university using detailed administrative data. His study found no link between the amount of bursary on offer and likeliness to enrol in that particular university.

In addition to the lack of information, there is a large uncertainty at the time of application about which university they will eventually attend – and hence, which bursary they are going to receive. Students apply to university through the UCAS (Universities and Colleges Admissions Service) around nine months in advance. In the first stage of the application process, students make applications to up to 7 universities, with their application comprising of a personal statement and their predicted entry scores (generally A-level[5] grades). They then receive offers from each of the universities they have applied to, in each case conditional on entry scores. At this point, the student must rank these offers in order of preference. Finally, once the student has received their entry scores, they are obliged to attend the highest ranked university for which they meet the entry score criteria. The upshot of all of this is that i) students cannot know ahead of time what bursary they will end up

[4] To remedy this situation, Murphy and Wyness have recently collated the complete set of financial bursary rules for English universities and hosted a simplified version on the Guardian newspaper website for perspective students' use. This is available at http://www.theguardian.com/education/2015/jun/10/which-universities-offer-the-best-bursaries

[5] Entry requirements vary by institution but generally students are required to have a minimum of 2–3 A-levels (the academic qualification offered by educational institutions to students completing secondary or pre-university education)

with, since they do not know which university they will end up attending until they receive their final grades, ii) controlling the amount of bursary received by gaming the system (e.g. by mis-reporting parental income) would be near impossible since parental income thresholds vary by university, so students would not know which threshold to game. Thus, the institution students attend is likely to be unrelated to their financial aid package, and is more likely to be driven by idiosyncratic preferences, conditional on entry scores.

To examine the impact of bursary aid on college completion and degree performance we make use of a unique dataset collected from 10 higher education institutions in England. The dataset comprises individual-level data on UK and EU undergraduate students (i.e. those eligible for bursaries), comprising the institution and course attended, the bursary they are awarded each year (including zeros), their parental income and their college entry test scores, as well as basic demographics and background characteristics. These data also hold detailed information on their university performance, comprising their annual course scores, number of years of university completed, and their final degree classification. Such detailed data is largely unavailable in standard datasets.

Our preferred within university-year results suggest that each £1,000 of financial aid that students are eligible for in the first year increases the chances of obtaining a good degree by 2.9 percentage points. This is driven by both degree completion in the second and third year and higher course scores in the first and third year. For example, we find that at the mean each £1,000 of financial aid awarded in the first year increases the chances of completing the second year by 1.6 percentage points, and the third year by 1.8 percentage points (somewhat smaller than the effects found by Bettinger, 2004) and increases test scores by 0.055 standard deviations in the first year and by 0.045 in the third year.

The remainder of this paper proceeds as follows. Section 2 reviews the literature relevant to this paper, while Section 3 outlines the features of the UK student aid system. Section 4 describes our dataset. Section 5 goes on to outline the fixed effects and two stage least squares methodologies that will be employed, whilst Section 6 presents results and robustness checks. Section 7 concludes.

2. Literature Review

The majority of the research on the effects of financial aid are based in the US and focus on their impact on enrolment. In general, these studies have found a positive impact of easy to apply for aid programmes on enrolment. Dynarski (2000) finds that Georgia's HOPE Scholarship, a merit-aid programme, had a positive impact on students: a $1,000 increase in aid resulted in a 4 percentage point increase in HE participation. In a later paper (Dynarski, 2003) exploits a one-off policy change whereby financial aid was withdrawn from children with a deceased, disabled or retired father, finding that the reform reduced HE participation by 3.6 percentage points. Conversely, Kane (1995) looks at the impact of the Pell Grant aid system, finding no impact on participation, while Seftor and Turner (2002) find a small impact of Pell Grant eligibility of 0.7 percentage points per $1,000 of aid (although on a restricted sample of mature students).

Studies from the UK and Europe are rarer, possibly due to the paucity of 'clean' policy breaks and lack of large-scale data. Nielsen et al. (2010) exploit a change in aid in the Danish HE system which particularly benefitted higher income students, and find that a $1,000 increase in grants results in a 1.35 percentage point increase in HE participation. In the UK, Dearden et al (2014) study the impact of a policy reform which re-introduced grant aid to students from poor families in England, and find an impact on participation of 3.95 percentage points per £1,000.

A small number of papers from the US look at the impact of aid on both college enrolment and college completion or years of study. Turner and Bound (2002) focus on the impact of the G.I. Bill (which provided veterans of the Second World War funds for college education) on both college enrolment and completion, finding positive effects. Similarly Dynarski's 2003 paper examining the impact of the withdrawal of social security benefits, finds an effect on college completion of about 0.16 years per $1,000. Sjoquist and Winters (2012) examine the effects of state based merit-based aid programs on college attendance and completion, but find no evidence of a positive effect.

Closer in nature to our paper are those studies which look purely at college attainment (conditional on entry). There are a number of quasi-experimental papers which generally find financial aid to have negative impact on college drop-out and retention, and a positive impact on completion. These include Tuner and Bound, 2002; Dynarski, 2003; Bettinger, 2004. Also relevant are studies by Goodman (2008), Oreopoulos et al. (2009), Scott-Clayton (2011), DesJardins and McCall (2010), Garibaldi et al. (2012), and Joensen (2013) who demonstrate the potential effectiveness of providing incentives related to merit and timing in financial aid packages.

3. Institutional setup

The UK higher education system is characterised by high tuition fees (in 2012 they increased from £3,300 to £9,000[6] per year, meaning they are now the highest in Europe and on a par with many US institutions[7]) but a generous national system of financial support. This consists of means-tested fee and maintenance loans (the latter of up to £5,740 per year in 2015[8]), both repayable after graduation once the graduate is in employment and earning above £21,000 per year, and non-repayable means-tested maintenance grants of up to £3,387 per year for students with parental incomes less than £25,000.

However, maintenance grants will be abolished from September 2016 (with maintenance loans increased to make up the difference[9]), meaning higher education bursaries – the form of aid studied in this paper – will become the sole non-repayable form of student financial aid.[10] Bursaries

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[6] All figures expressed in this section are in nominal prices

[7] Whilst tuition fees are decided at the institution level, in practise the vast majority of universities charge the full £9,000 per year, and the average fee stood at £8,830 in 2015 (See OFFA (2015): Table 2)

[8] For full-time undergraduates living away from home and studying at English universities outside London. Different rates apply for those living at home or studying in London. See https://www.gov.uk/student-finance/loans-and-grants for full details.

[9] See http://www.ifs.org.uk/publications/7905 for more details

[10] There are other forms of non-repayable aid – mainly merit based scholarships and hardship funds, but these are generally restricted to a small number of students per institution; to the author's knowledge, no published data exist on the total value of these

also represent the sole form of aid which is governed at an *institutional* rather than a national level, giving rise to significant variation in eligibility across institutions, unlike the other national forms of aid.

As described in the introduction, the system of higher education bursaries was introduced by the UK government in 2006. This coincided with the replacement of upfront means-tested tuition fees of £1,200 per year with a deferred tuition fee of up to £3,000 per year[11] backed by a tuition fee loan. As part of these changes English institutions were required to offer a bursary to all disadvantaged students (defined as those in receipt of a full maintenance grant, £2,700 at that time; note there are no other requirements, such as prior academic attainment or academic performance whilst at university, though the student has to be registered each year to receive their bursary). The minimum bursary that institutions could offer was set to be the difference between full fee charged and the maintenance grant received by the student. Thus, the minimum bursary at the time was £300 per year (£3,000 in fees minus £2,700 grants). From 2010 onwards, the rules were redefined so that the minimum bursary became 10% of fee charged. Since fees at the time were around £3,200 per year, the minimum bursary remained around £320 per year.[12] In practise, the bursary offered across institutions has varied considerably.

A notable feature of the bursaries system concerns their delivery. Although each individual institution designs its own bursary scheme (including the income thresholds for bursary receipt and the amount of bursary on offer), the Student Loans Company (SLC) administers the bursary payment

[11] Again the tuition fee was intended to be decided at institution level but in practise, all institutions charged £3,000 per year

[12] Since 2012, no minimum bursary requirement has been in place. The bursary system was supplanted by the National Scholarship Programme (NSP) in which universities were allocated a set amount of money to distribute among their disadvantaged students in the form of bursaries, fee waivers or other benefits. The NSP has since been disbanded.

for the majority of schemes.[13] The procedure for the first year of entry and every subsequent year a student attends university is as follows:[14]

i. Upon application to university (and each subsequent year) students complete a student finance form in order to apply for the national system of tuition fee loans, maintenance loans and maintenance grants. The latter two elements of the system are means tested, thus students must divulge their parental income. They also have to consent for this information to be shared with their institution (of which 98% do).

ii. The SLC then verify the students' parental income with the help of HMRC (the department of the UK Government responsible for the collection of taxes, the payment of some forms of state support, and the administration of other regulatory regimes including the national minimum wage).

iii. The university supplies the SLC with the bursary eligibility rules it has chosen for that year. The SLC thus calculate bursary due to every student based on their parental income.

iv. The SLC inform the university of which students will receive a bursary and how much they should be paid. The university then has to decide whether to approve, modify or cancel a student's bursary. The vast majority of bursaries are approved (some 98%). Students who do not take up their place, or who drop out of study before the bursary payment is due will not be approved for payment. Occasionally, modifications are made, such as if a student switches institutions, or their income changes.

v. Prior to their arrival at university that year, the SLC send every eligible student a letter which appears to be from the university informing them that they are eligible for a bursary, and the amount they are eligible for.

[13] Universities can opt to administer their own scheme but the majority choose to do so through the SLC

[14] The information that follows was provided to the author by the Student Loans Company in conversation – therefore no citations are available

vi. Finally, the SLC makes the payment to the student which is debited from the institutions' account. This payment occurs in the same transaction as the awarding of the student loan. This may have the impact of decreasing the salience of this form of student support.

A number of pertinent issues arise from this process. First, note that students do not have to apply for bursaries in order to receive them. Thus, there is no possibility of a student choosing not to take up their bursary (or forgetting to do so). As long as the student has applied for other forms of student support through the SLC (which include the £9,000 annual fee loan)[15] and choose to declare their parents' income, and are eligible for a bursary, they will receive it. The implication is that we will not have an issue with non-compliance on the part of the students, and our parameters do not represent intention to treat, as is common in financial aid literature (Dynarski, 2008, Dearden et al, 2012), but actually represent the impact of bursary aid receipt on outcomes.

However, despite this strict institutional setup, we do observe a degree of non-compliance in our data. This is illustrated in Figure 4, which plots household income and bursary receipt for every student within one particular university cohort in our sample. The horizontal and vertical lines show the different bursary levels stated by the university at each parental income level. As can be seen in this figure, the vast majority of students receive the bursary amount that corresponds with their observed household income. However in a small but significant number of cases, students receive more or less than they are entitled to. Across all our universities, we observe varying rates of non-compliance, with the average of around 5% of students receiving a bursary that is "too high" and around 7% receiving a bursary that is "too low".

One concern is that these issues are not simply random measurement error, but are arising from systematic issues that could generate biases. Administrators at these universities stated three situations where the amount of bursary received does not equal that which should be received for that level of parental income. First, a reassessment of parental income indicated that the student would be

[15] In 2011, 88% of eligible students took up maintenance loans (see www.parliament.uk/briefing-papers/sn01079.pfd)

eligible for a different student aid amount (either due to student error, or a sudden change in circumstances). Hence, the actual bursary paid by the institution differed from that expected according to their parental income records. Assuming that the measurement error may have overstated or understated parental income, this would downward bias the estimates. The second type of non-compliance concerns student pre-dropout. If students register for a course, but then withdraw from the course before arrival, they will not receive a bursary but may still be recorded in the administrative records. Typically, such students would have been removed from the data, but it is possible that could still appear in our data as having dropped out in year one. The result would be to bias our estimates upward.

The final example of non-compliance concerns the university using its discretion to award additional funds to some students. If it is the case that institutions are systematically awarding high ability students more than they are entitled to, this will again bias our estimates upwards.[16] In order to eliminate the biases caused by this non-compliance, we adopt an instrumental variables (IV) methodology for our preferred specification. This two-stage least squares approach, where the amount of grant aid an individual receives is predicted using the bursary rules set out by the institutions themselves, will provide an unbiased estimate of the local average treatment effect (LATE). Hence the 2SLS estimates will be based on the compliers only.

A further important implication of our institutional setup is that take-up of bursary each year is not endogenously related to eligibility in the previous year. For example, it may be the case that students who receive large bursaries in first year (and who may also be more likely to be low income) may be more likely to take up their bursaries the next year (and vice versa). As take-up is not governed by the students' wishes, our results do not suffer from this bias.

[16] Despite students' prior test scores being uncorrelated with indicators of whether the students received above or below their designated amount, one my still be concerned that those receiving more may have other unobservable positive abilities.

4. Data

This paper makes use of a unique administrative dataset collected from 10 UK universities. The data comprise the entire undergraduate population of UK and EU students for up to 6 cohorts of students beginning their studies between 2006 and 2011.

We begin with a sample of 325,418 students. As our estimation strategy relies on using the variation in financial aid for a given level of entry test scores to estimate the effect of bursaries on student outcomes, we first discard those students for whom we have no knowledge of parental income. As stated in Section 3, we only hold parental income information for students who received a bursary at some point. This means our sample consists only of bursary holders.

This reduces our sample substantially, to 63,719 students. We then discard those of non-traditional age, retaining only students aged 21 or below upon starting university. We also discard those students undertaking vocational courses or those above or below degree level. This leaves 34,026 students in the sample. Our sample is truncated, meaning we observe some students all the way through their studies (3 years), whilst we can only observe the first or second year of some students, since they would not have had the chance to complete their degrees at the time we obtained the data. Thus, in our preferred specifications, we use only the non-truncated sample of students, for whom we are able to observe their full transition through college, including dropouts. This is a total of 23,093 students. In a robustness check, looking only at completion in years 1 and 2, we include students for whom we only observe part of their transition through college – i.e. the full sample of 34,026 students.

University and course data

In each case our data contains information on the university attended (though for the purposes of this study, this is anonymised) and the subject studied. In the latter case data on some 2,200 courses was initially received. In the interests of simplicity, this was reduced to 22 different course types based on the widely-used JACS classifications See Appendix A).

Bursary/finance data

As described above, bursaries are administered through the Student Loans Company, then details of the bursaries paid out are returned to the university. The result is that the dataset contains full information on the bursary each student received each year, but parental income data only for those students in receipt of a bursary (since the Student Loans Company only returns data on those who were deemed eligible for a bursary).

Background information

The dataset holds information on the student background characteristics, such as their parental occupation, parental socio-economic status, their age at the point of entry, ethnic group, gender, disability status. Crucially, the dataset also contains information on the students' entry qualifications, in terms of their qualification types, subjects and grades. Again there were many hundreds of qualification types among the dataset. For simplicity we have therefore augmented the dataset with the corresponding UCAS (University and College Admissions Service) points assigned to this particular qualification. UCAS points scoring is the system used for students to meet the entry requirements for university admissions. All UK qualifications are awarded UCAS points, with the most common being A-Levels taken at the end of secondary school, which has a maximum points value of 140. Universities typically have entry requirements based on the best three A-Level equivalent scores. We calculated this corresponding score for each student.

Outcomes

The dataset tracks students throughout the course of their degree. Therefore we have information on each student's final outcome, including whether they dropped out, and their year of drop out, their annual course scores (generally this was provided as an annual average of all courses taken rather than individual scores per course. Since these scores are not comparable across universities, or individuals – since students take different courses – we standardize these to have a mean of zero and a standard deviation of 1), and their final degree classification.

In Table 1 we present some descriptive statistics on the individuals in our sample. The average bursary per bursary holder is £712[17], though there is variation over year of study. 43% of the sample are male, whilst the average age is 18.6 and 79.9% are white. According to the most recent Higher Education Statistics Agency (HESA) statistics (HESA, 2015: Table 6a), 45% of full-time undergraduates are male, 61% are under 22, and 60% are white. Therefore, our sample is representative in terms of gender, but is younger and whiter than the UK undergraduate population, which is expected given our sample restrictions. Students receive on average £1,800 per year in non-repayable grant aid from the government. This implies the average bursary received among our sample of students is substantial, representing an additional 40% on grant aid.

The university completion rate is almost 87% meaning that only 13% of students fail to complete university. This is compatible with the dropout rate from UK official statistics, of around 8% (HEFCE, 2014) bearing in mind our stricter (of traditional age, degree students) and poorer (bursary holder) sample. Drop out is highest in first year, at over 7%, and steadily declines. 62.6% of the entire sample obtain a good degree, defined here as a first or upper second class degree. Of those who complete their studies without dropping out, 72% obtain a good degree.

5. Estimation strategy

Estimating the impact of financial aid on student outcomes is typically fraught with issues due to the amount of aid received being highly correlated with factors that also impact on outcomes e.g. parental income and student ability. The institutional setting of the English bursary schemes allows us to disentangle these effects. We use three progressively more specific sources of variation in financial aid awarded to estimate the casual impact of aid on outcomes. Additionally, we instrument our financial aid awarded with aid eligibility to eliminate bias caused by non-compliance in the data.

[17] All prices are henceforth expressed in 2013 prices (RPI)

First, we exploit the variation in generosity in bursary awarded between institutions. Conditioning on parental income, this compares students from a given parental income background but receiving different amounts of aid dependent upon which university they attend (see Figure 1). We allow for non-linearities in the impact of amount awarded and parental income by including a squared term for each. To this basic specification we add a set of student characteristics, including entry qualification scores, and allow for differences in student outcomes across departments by including a set of indicators for each of the 22 subject areas. Effectively, we are comparing students with the same parental income, prior test scores and studying the same subject, but who are attending different universities due to idiosyncratic preferences. However, one should be concerned that even after controlling for these characteristics, student that attend high bursary institutions may attain better outcomes because these institutions are more 'productive'.

To account for this, the second source of variation we use is within university over time, through including university fixed effects. Since the enforced introduction of bursaries in 2006, there have been a considerable number of changes to bursary schemes within institutions (see Figure 2). We therefore exploit the variation in bursary awards within institution over time, effectively comparing two individuals of the same parental income background, but receiving different bursary awards due to their university entry year. Given the opaque nature of the student aid system for students applying to university it is unlikely that students delay or bring forward their enrolment at a specific institution in response to changes in bursary schemes.

The third source of variation is the most restrictive, exploiting the non-linear nature of the bursary schemes within an institution entry cohort, by including university-cohort fixed effects. All students entering a university in a given year are awarded financial aid based on the same set of rules relating to parental income. However due to the stepped nature of these schemes there are sharp discontinuities in the amount awarded for only small changes in parental income. For example, in Figure 2 we can see an individual with parental income of £15,000 in 2006 would have received a bursary of £3,000, but an individual with parental income of only £1 more would receive a bursary of £1,545. We only allow for the impact of parental income to change smoothly through the use of a quadratic term, and for the relationship between income and outcomes to be constant across all universities. The non-linearities in the means tested bursaries at universities over time at different points of parental income provide us with variation to identify the impact of aid on student outcomes.

As discussed in Section 3, we are concerned that our results may suffer from biases caused by non-compliance, which could bias our estimates upwards or downwards. To account for this, we adopt an instrumental variables approach. The estimation consists of two-stage least squares instrumenting the grant amount awarded using the amount of aid the student is eligible for, according to the university's own rules (bearing in mind their parental income and year of university entry). In the first stage, the size of the aid coefficient therefore represents the average increase in aid the student is eligible for, rather than that awarded. The second stage estimates the relationship between students' aid eligibility and the outcome of interest. Specifically we use the following equations:

$$A_{iucs} = \alpha + \beta_1 Z_{iucs} + \beta_3 Inc_{iucs} + \beta_4 Inc_{iucs}^2 + \beta' X_{iucs} + \alpha_s + \mu_{uc} + u_{iucs} \quad (1)$$

$$y_{iucs} = \beta_1 A_{iucs} + \beta_2 A_{iucs}^2 + \beta_3 Inc_{iucs} + \beta_4 Inc_{iucs}^2 + \beta' X_{iucs} + \alpha_s + \mu_{uc} + \varepsilon_{iucs} \quad (2)$$

where y is the outcome of student i attending university u, who started in year of entry cohort c . A is a continuous variable representing the amount of financial aid received by student i in thousands of pounds. Parental income *Inc* which the determinant of aid awarded is accounted for with a quadratic function. The instrument Z represents the amount of aid the student is eligible for, rather than the amount actually awarded, as discussed. The detailed nature of the data also allow us to condition on a large vector of background characteristics of all undergraduates in the study (X), such as university entry grades, age, ethnicity and gender. Included with these we additionally control for the national student financial aid award (which is means tested but differs from bursaries since it is awarded at the national rather than institutional level, hence has no across university variation, and means tested gradually so does not feature multiple discontinuities).[18] As described, we account for average differences across subjects (α_s). Finally we include a set of university-year effects (μ_{uc}), which will provide us with the parameters of interest β_1, and β_2 which will provide the impact of an additional £1000 of financial aid on student outcome y at different levels of aid.[19]

6. Empirical results

6.1 Main results

We begin the analysis by building up the specification from a raw correlation to our preferred specification, which uses the variation in aid within university cohorts. Table 2 presents estimates of having an additional £1,000 of bursary awarded in the first year on the probability of eventually gaining a good degree, assuming a linear probability model. The outcome variable is defined as equal to one if the student gains a first class honours degree or upper second and zero if the student obtains a lower second, third class honours degree, or if they drop out of university before completion. This uses the sample of students that could have completed their degree (i.e. excluding those students for whom we can only observe first or first and second years of study).

Panel A shows estimates of the impact assuming constant returns to financial aid, Panel B allows for decreasing marginal returns by adding a quadratic term in aid. Column 1 contains the raw correlation: an additional £1,000 of aid is associated with a 2.5 percentage point increase in students' chances of graduating with a good degree. There will be both positive and negative biases at play here. On the one hand, students from low income households are more likely to receive more financial aid, and are also less likely to achieve a good degree, generating a negative bias. On the other hand, students with high ability are likely to perform well at university, and are also more likely to attend

[18] Excluding the national grant scheme in the set of student characteristics does not significantly alter any of the results.

[19] All standard errors presented are robust and clustered at the university level.

prestigious richer institutions, which can afford to give out bigger bursaries; these factors would generate positive biases.

In column 2 we address the first of these issues by controlling for up to a quadratic in parental income, and also allowing for the effect of bursaries to change non-linearly with the amount awarded.[20] As expected, this raises the coefficient (since poorer students, who tend to have worse outcomes receive bigger bursaries). The linear estimate from Panel A shows for every £1000 students are 10% more likely to obtain a 'good degree'. The corresponding estimates allowing for decreasing returns are found below in Panel B. For ease of interpretation, beneath the estimated parameters for $\boldsymbol{\beta_1}$ and $\boldsymbol{\beta_2}$ (aid and aid squared) we present the marginal impact of £1000 of aid at the mean level of year 1 bursary aid (£862). Here the marginal impact of aid increases the likelihood of a student obtaining a good degree by 13.0 percentage points and is significant at 1%. The remainder of the results section will refer only to Panel B as the quadratic term is always significant and the marginal effect at mean follows the same pattern as the linear effects.

Students with higher prior test scores are likely to achieve good outcomes regardless and to the extent that they also attend institutions which give out larger bursaries, not controlling for them would bias up the estimate. In column 3 we additionally control for student characteristics (test scores, age, gender, ethnicity) which reduces the marginal impact to 0.115.

In column 4 we account for any differences across universities by including university fixed effects. The impact at the mean holds stable. Column 5 adds year effects accounting for any general increase in the probability of achieving a good degree over time, which significantly reduces the impact of aid to 0.101. The final column replaces the university and year effects with a set of indicators for each year university combination. This exploits the non-linear relationship between aid

[20] Including university-cohort fixed effects before parental income reduces the positive bias, with the marginal impact of aid being 0.006, and remains insignificant.

awarded and parental income. This shows that a £1,000 increase in bursary aid at the mean increases the probability of gaining a good degree by 8.4 percentage points.

This coefficient is comparable to the work of Bettinger (2004), bearing in mind exchange rates and inflation, who finds that a $1,000 (£660 aprox) increase in Pell aid corresponds to a 4 percent reduction in the likelihood that students withdraw from college in first year. However, as discussed we believe there are significant biases at play in these estimates, caused by non-compliance due to parental income reassessment, student pre-dropout, and through universities using discretionary payments. To remove these sources of bias we adopt a 2SLS approach, where in the first stage we predict students' aid awarded according to the aid that they were actually eligible for according to their parental income and university rules in their year of entry. The In the second stage we estimate the intention to treat effect, using this eligible aid amount as the instrument. The results for are contained in Table 3. Panel A recreates the results from Table 2, for reference. Panel B, meanwhile presents the reduced form results (i.e. regressing bursary rules on probability of obtaining a good degree) and the IV estimates. In each case the marginal effects at mean level of bursary are presented. As the results show, the coefficient arising from the instrumental variables estimators is significantly lower than that of the fixed effects; the coefficient on bursary aid drops from 8.4 to 2.9 percentage points. Note that the reduced form estimates show a very similar estimate of the impact of aid eligibility on degree performance of 2.3 percentage points. This is perhaps unsurprising, given that there is only a small degree of non-compliance in our data. Nevertheless, the difference in our fixed effects and IV estimators is of a significant degree for us to be concerned that there is a degree of bias caused by non-compliance in our data. Therefore the IV estimator is our preferred specification; we find a £1000 increase in bursary aid increases students' likeliness of obtaining a good degree by 2.9 percentage points.

What could be driving this increase in the chances of getting a good degree? We explore this in tables 4-5 by looking at the impact on completion of each academic year and annual course scores. All effects presented in these tables are the marginal impacts at the mean and are obtained from separate regressions. Table 4 first shows the impact of an additional £1,000 bursary award in first year on degree completion in the current and subsequent years. In each case, the full set of controls and a quadratic in bursaries is used, and we present the fixed effects, reduced form and IV results.

For our preferred IV estimator, we find some evidence that bursary aid has a positive impact on completion. We find a £1,000 increase in aid improves students' likeliness to complete their second year by 1.8 percentage points, and their third (final) year by 1.8 percentage points – though we find no effect for the concurrent year. It is interesting that the impact of aid on completion of final year is slightly lower than the impact of aid on obtaining a good degree – suggesting there may be some additional impact of aid coming through course scores.

This is examined more fully in Table 5, in which we present the results for an additional £1,000 of bursary on mean standardised course scores each year. Here we see a largely positive impact of bursaries – with the IV estimator showing an additional £1,000 of bursaries in the first year generating a 0.055 standard deviation increase in course scores in that year, and a 0.045 standard deviation in course scores in the third year. Thus, as hypothesised above, we do see a positive effect of bursary in year 1 on course scores in year 3.

In summary, our analysis shows a positive impact of bursary aid on degree performance, to the tune of 2.9 percentage points per £1,000. This positive impact appears to be driven by both an increased probability of completion (of as much as 1.8 percentage points) and improvements in test scores (of as much as 0.055 standard deviations). These impacts are relatively small (and smaller than those obtained by Bettinger (2009)). Around 62% of students in our sample currently obtain a good degree, whilst 86% complete their degrees.

6.2 Robustness Checks

We perform a series of robustness checks on our IV estimates to determine their stability. These are shown in Table 6. The first row presents the marginal effects of aid in the first year of study at the mean for both the fixed effects and IV models, with the outcome varying across the columns.

The outcomes are complete the 1st year, standardised 1st year course scores, and obtain good degree in columns one, two and three respectively.

Our main specification only uses students who could have potentially completed their course. However, we have data on all students that are currently studying at these ten universities. Therefore the second panel shows estimates includes additional cohorts, including all current students (i.e. those for whom we can only observe to the end of first or second year), this increases the sample size by around 10,000. Reassuringly the estimates do not change significantly for completing the 1st year or 1st year test scores. We do not present estimates for Good Degree as they would be the same as the row above.

One of the arguments that we put forward is that comparisons can be made across universities, which we support by showing that there is common support in the entry test scores of students (See Figure 3). Three universities appear to be exceptions to this, university one has test scores mostly below that of the others, and universities nine and ten appear to only enrol high ability students. Therefore in the third panel we re-estimate the results excluding these universities. Again this appears to have very little effect on the results.

Finally one may be concerned that the measure of prior ability that we condition on is also influenced by parental income. This would be a problem if students from low income backgrounds achieved lower test scores for a given ability compared to students from a high income background. This means when controlling for entry test scores we would effectively be comparing higher ability students from low income backgrounds to lower ability students from higher income backgrounds. To account for this potential issue we include an additional term where test scores are multiplied by log(1/(Income+1)). Once again this appears to have little impact on the estimate impact of financial aid on student outcomes.

6.3 Heterogeneity of aid impact

So far, we have shown that bursary aid improves students' degree performance by reducing dropout and improving test scores. In this section we explore whether certain students may benefit from bursaries more than others. Note that the results presented in this section are derived from the fixed effects estimations in Section 5.

In Figure 5 we plot the impact of bursary aid on degree performance across a range of bursary amounts. This figure is a graphical representation of the results presented in column 6 of Table 2, for a range of bursary amounts. Increasing aid improves performance, although there are decreasing marginal returns. The impact of aid peaks at £1,600 – where aid above this point in fact proves to worsen student outcomes, although not significantly.

Up to now, we have assumed that bursary aid has the same impact for all students. But of course it may be the case that some students benefit more from bursaries than others. To explore this we include additional terms allowing for the effect of aid to vary by parental income. We find no effects of varying the aid in this way (not shown). However, we examine the effect of bursaries across student ability levels (as proxied by entry test scores). A common argument in the literature (Dynarksi, 2003; Guryan, 2004) is that providing aid to marginal students may be inefficient. For example, if it was found that aid had the most impact on low ability students completing the first year of university, and negligible impacts on high ability students, one could argue that aid is simply subsidising marginal students. This would be problematic if such students derive less benefit from their studies, for example by experiencing lower returns to their degrees (Tobias, 2000). Alternatively, if high ability students gained the most from bursaries, regardless of income, then bursaries would be relieving the liquidity constraints of high ability students, allowing them to gain more from university. This would be an argument in favour of merit based financial aid. Through interacting the prior test scores with aid awarded, Figure 6 presents the marginal impact of aid over different entry test scores. Despite the wide confidence intervals, this is indicative evidence that bursary aid has a constant impact across all ability levels and implies that a means tested aid program is efficient.

7 Conclusion

Financial barriers to higher education have the potential to exacerbate existing earning inequalities. Our findings suggest that higher levels of bursary aid improve student performance. Students who have been awarded a bursary increase their likelihood of gaining a good degree by 2.9 percentage points for each additional £1,000 awarded. The effect is driven by both improvements in test scores and completion rates. Our results are robust to different specifications and samples.

The institutional set up we study means that we can also examine heterogeneity in our effects. Increasing aid improves performance, but we find some evidence of decreasing marginal returns to aid at higher levels. We also find that the returns to aid are constant across ability levels.

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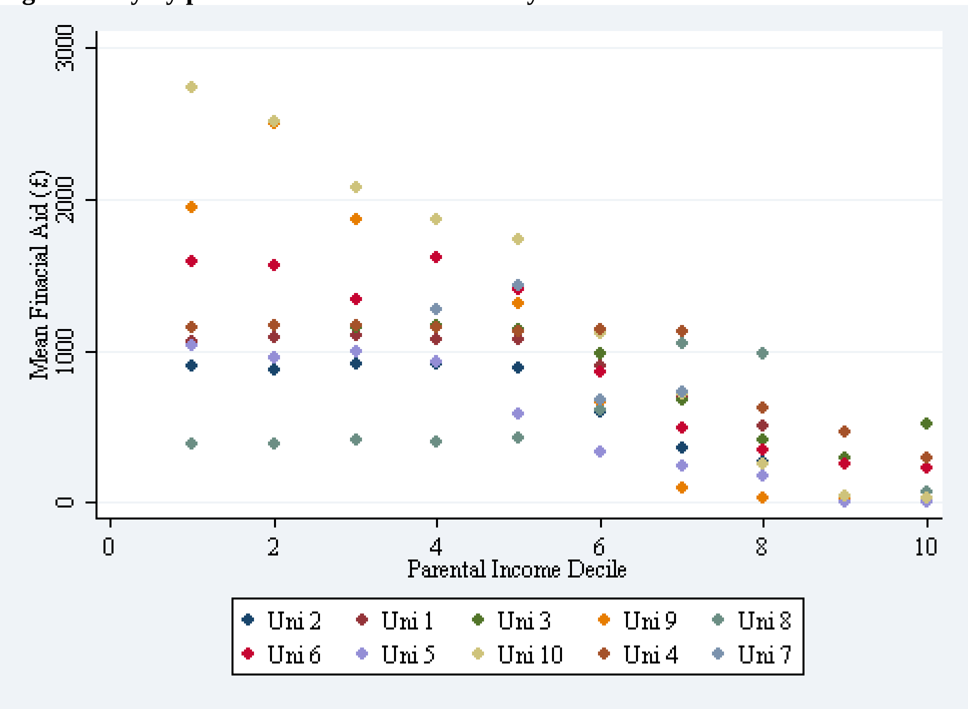
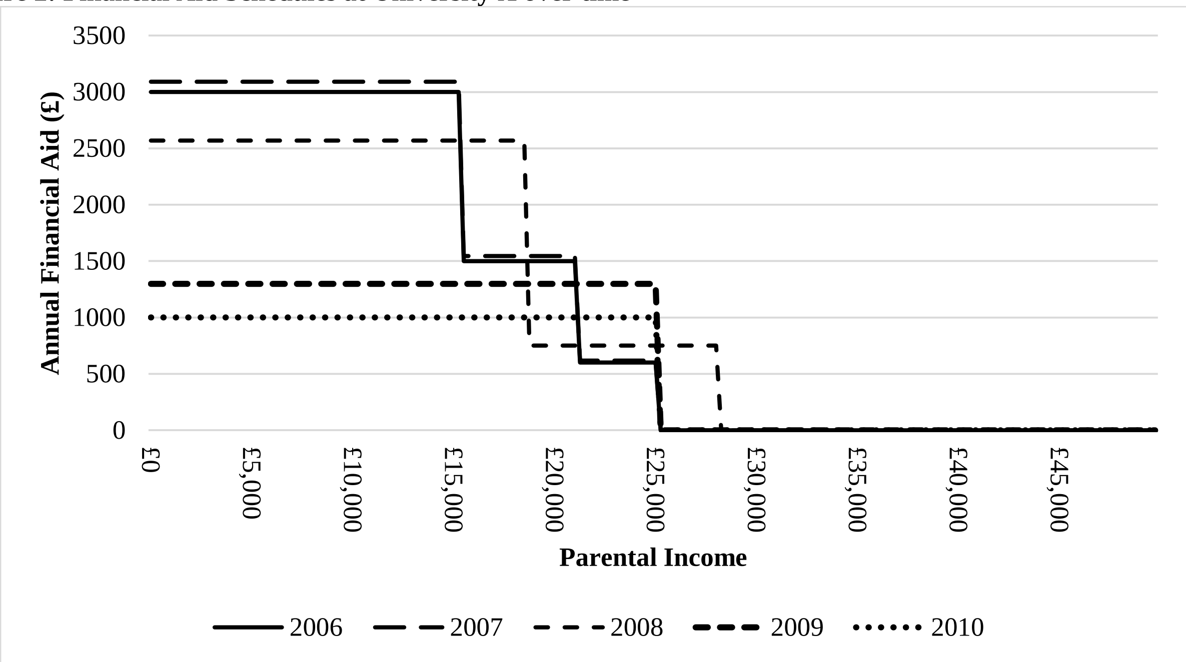
Figure 1: Average bursary by parental income and university



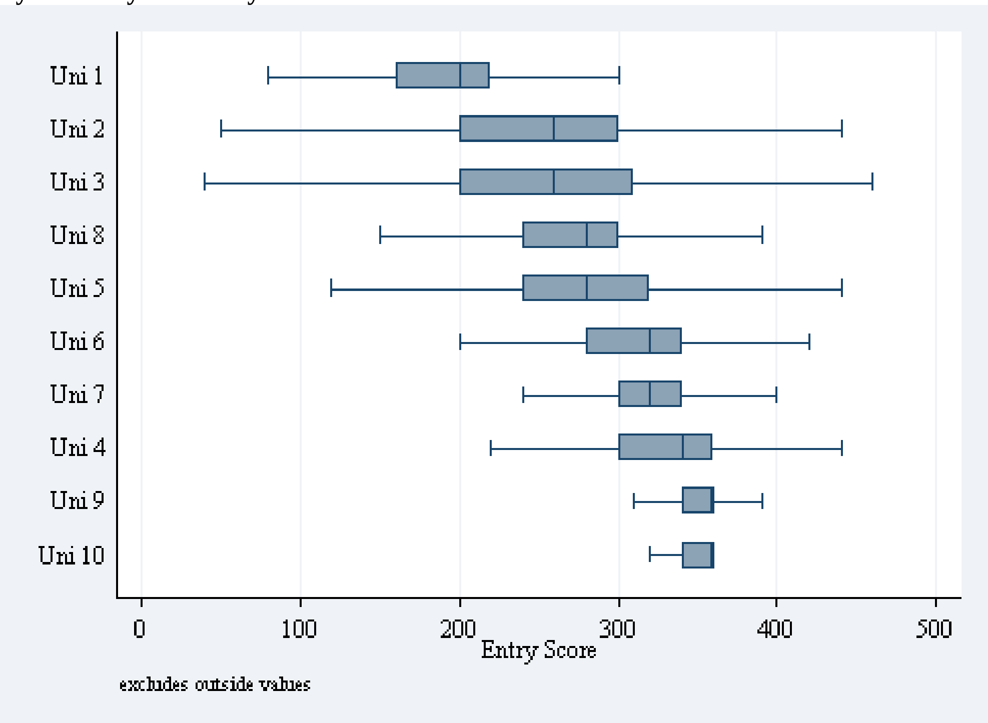
Notes: Each point represents the mean financial aid received at each university by parental income deciles of the estimation sample. Financial aid averaged over all academic years and cohorts. Source administrative data from the 10 universities.

Figure 2: Financial Aid Schedules at University X over time



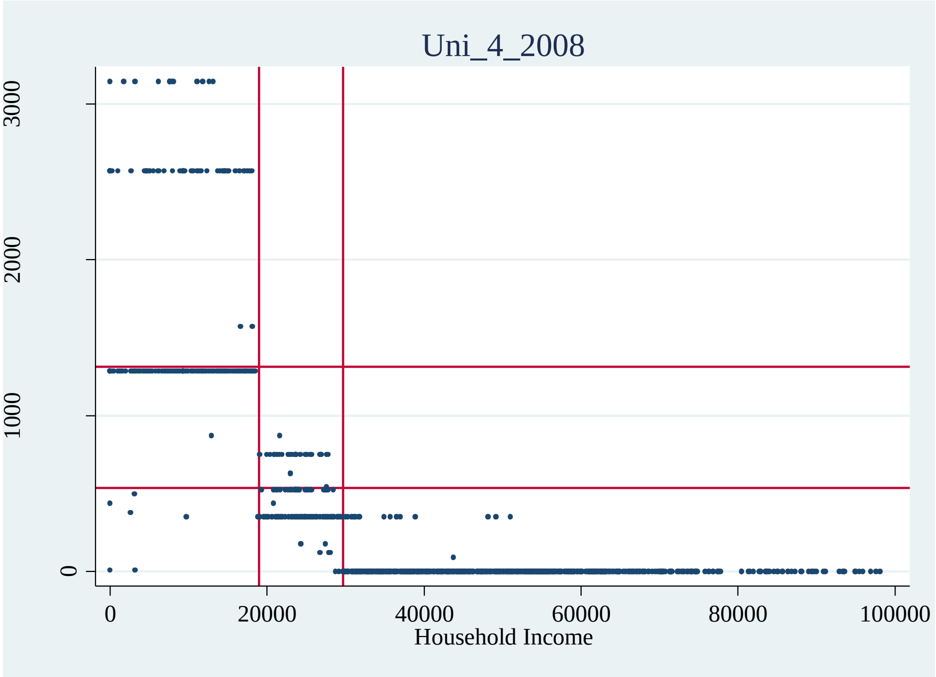
Notes: Figure 2 represents the financial aid schedules for first year students for an anonymous English university for students entering in the years 2006 through to 2010.

Figure 3: Entry scores by university



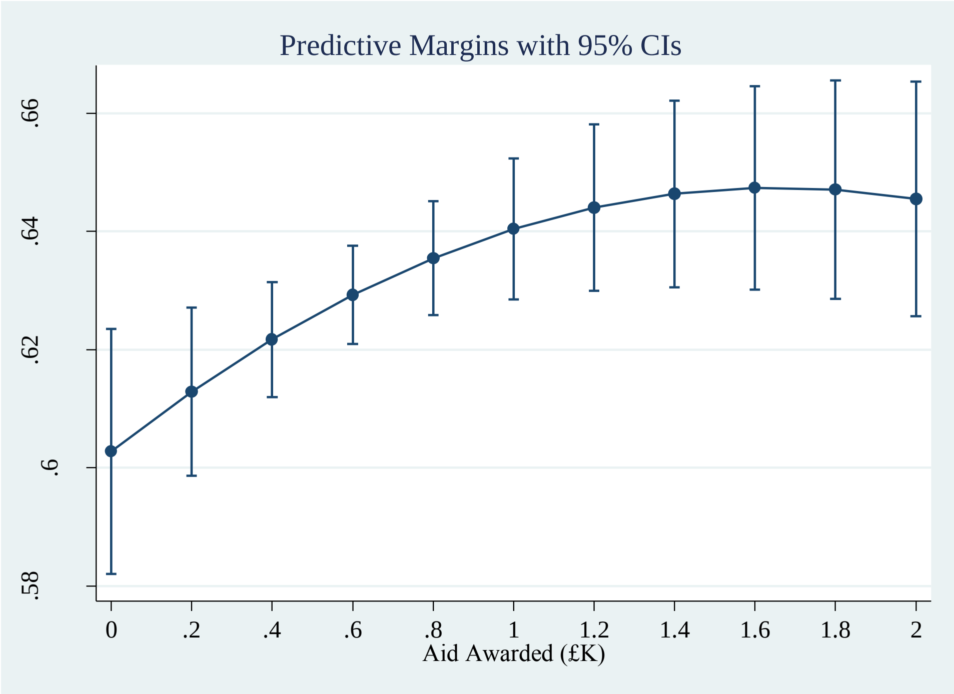
Notes: Figure 3 shows box plots of the entry qualification scores of students attending each university in the estimation sample. The ends of each box represent the 25th and 75th percentiles in entry qualification scores. Source administrative data from the 10 universities.

Figure 4: university aid rules and compliance at university 4, 2008



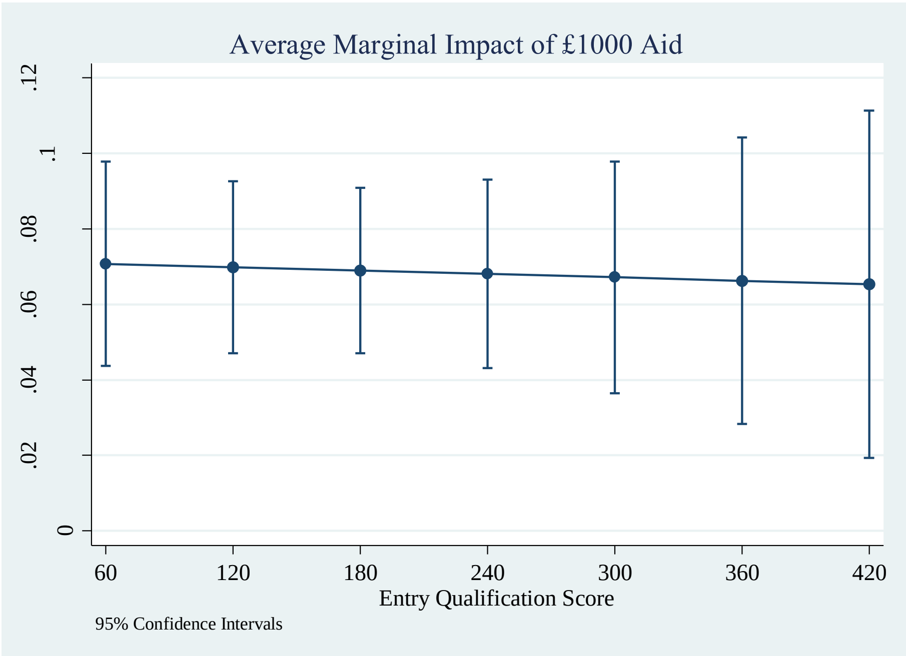
Notes: Figure 4 shows household income and bursary receipt for every first-year student within university 4, in 2008. The horizontal and vertical lines show the different bursary levels advertised by the university at each income level.

Figure 5: Average marginal impact of £1,000 aid on degree performance



*Notes: Figure 5 shows the predicted outcome of good degree over the range of bursary aid amounts awarded Estimates come from the fixed effects estimators, which can be found in Column 6 of Table 2. Standard errors clustered at the university*year*subject level. Source administrative data from the 10 universities.*

Figure 6: Average marginal impact of £1,000 aid on degree performance, across ability of student



*Notes: Figure 8 shows the marginal impact of an additional £1,000 of for the mean student at different levels of entry qualification. Estimates obtained from specification 1 additionally with the entry test scores and finical aid terms interacted. Calculated using the margins command. Standard errors clustered at the university*year*subject level. Source administrative data from the 10 universities.*

Table 1: Characteristics and student outcomes

	Mean	Std dev.
Average bursary (£)	712.808	(611.137)
Bursary aid in year 1 (£)	862.269	(748.792)
Bursary aid in year 2 (£)	788.614	(749.033)
Bursary aid in year 3 (£)	780.989	(757.647)
Male (%)	0.427	(0.495)
Age on entry	18.626	(0.837)
White (%)	0.797	(0.402)
Household income (£)	28,000	(21000)
Entry test scores	283.637	(79.257)
Government aid (£)	1814.65	(1188.752)
Dropped out year 1 (%)	0.072	(0.258)
Dropped out year 2 (%)	0.034	(0.182)
Dropped out year 3 (%)	0.018	(0.133)
Dropped out year 4 (%)	0.005	(0.072)
Dropped out year>4 (%)	0.002	(0.044)
Course scores year 1	0	(1)
Course scores year 2	0	(1)
Course scores year 3	0	(1)
Completed degree (%)	0.869	(0.338)
Obtained good degree (% of all students)	0.626	(0.484)
Obtained good degree (as % of those completing)	0.720	(0.449)
N	23,093	

Notes: sample consists of those who have had a bursary at some point during university. Also sample consists only of those students whose final outcome can be observed

Table 2: Impact of financial aid on probability of obtaining a good degree

P(Good Degree)	(1)	(2)	(3)	(4)	(5)	(6)
Panel A						
1st year financial aid awarded	0.025***	0.102***	0.076***	0.060***	0.052***	0.043***
	(0.006)	(0.008)	(0.007)	(0.007)	(0.007)	(0.007)
Panel B						
1st year financial aid	0.017	0.177***	0.179***	0.201***	0.184***	0.158***
	(0.018)	(0.018)	(0.015)	(0.015)	(0.015)	(0.014)
1st year financial aid squared	0.003	-0.029***	-0.040***	-0.056***	-0.052***	-0.047***
	(0.007)	(0.007)	(0.006)	(0.006)	(0.005)	(0.005)
Marginal effect at mean	0.022**	0.130***	0.115***	0.112***	0.101***	0.084***
	(0.008)	(0.009)	(0.008)	(0.008)	(0.008)	(0.008)
Parental Income		✓	✓	✓	✓	✓
Student Characteristics			✓	✓	✓	✓
University Effects				✓	✓	
Year Effects					✓	
University*Year Effects						✓

Notes: All coefficients show marginal effect at mean bursary amount. Good degree defined as being equal to 1 for those students obtaining a first class or upper second class degree, and 0 for all other outcomes, including drop out. Sample consists only of those students whose final outcome can be observed. Standard errors are in parenthesis, and are clustered at institution*year level.* $p < 0.1$. ** $p < 0.05$. *** $p < 0.01$

Table 3: Impact of financial aid on probability of obtaining a good degree

P(Good Degree)	(1)	(2)	(3)	(4)	(5)	(6)
Panel A						
1st year financial aid awarded	0.022***	0.130***	0.115***	0.112***	0.101***	0.084***
	(0.008)	(0.009)	(0.008)	(0.008)	(0.008)	(0.008)
Panel B						
Reduced form – 1st year financial rules	-0.036***	0.081***	0.060***	0.033***	0.022**	0.023**
	(0.009)	(0.013)	(0.011)	(0.010)	(0.010)	(0.010)
IV- 1st year Financial Aid Awarded	-0.041***	0.090***	0.068***	0.041***	0.028**	0.029**
	(0.009)	(0.014)	(0.013)	(0.013)	(0.012)	(0.012)
Parental Income		✓	✓	✓	✓	✓
Student Characteristics			✓	✓	✓	✓
University Effects				✓	✓	
Year Effects					✓	
University*Year Effects						✓

Notes: All coefficients show marginal effect at mean bursary amount. Good degree defined as being equal to 1 for those students obtaining a first class or upper second class degree, and 0 for all other outcomes, including drop out. Sample consists only of those students whose final outcome can be observed. Standard errors are in parenthesis, and are clustered at institution*year level.* $p < 0.1$. ** $p < 0.05$. *** $p < 0.01$

Table 4: Impact of financial aid on probability of completion

P(Complete)	Complete 1st year	Complete 2nd year	Complete 3rd year	Good degree
	(1)	(2)	(3)	(4)
Panel A				
1st year financial aid awarded	0.099***	0.098***	0.099***	0.084***
	(0.017)	(0.015)	(0.015)	(0.008)
Panel B				
Reduced form – 1st year financial rules	0.009	0.012	0.012	0.021**
	(0.007)	(0.008)	(0.010)	(0.009)
IV- 1st year Financial Aid Awarded	0.009	0.016**	0.018**	0.023**
	(0.007)	(0.007)	(0.007)	(0.010)
Parental Income	✓	✓	✓	✓
Student Characteristics	✓	✓	✓	✓
University*Year Effects	✓	✓	✓	✓

Notes: Coefficients presented are of marginal effects at mean bursary amount. Sample sizes vary by year as students drop out. Sample consists only of those students whose final outcome can be observed. Sample consists only of those students whose final outcome can be observed. Standard errors are in parenthesis, and are clustered at institution*year level.* $p < 0.1$. ** $p < 0.05$. *** $p < 0.01$

Table 5: Impact of financial aid on course scores

P(Course Scores)	Course scores 1st year	Course scores 2nd year	Course scores 3rd year	Good degree
	(1)	(2)	(3)	(4)
Panel A				
1st year financial aid awarded	0.166***	0.134***	0.131***	0.084***
	(0.019)	(0.020)	(0.020)	(0.008)
Panel B				
Reduced form – 1st year financial rules	0.046**	0.028	0.037	0.023**
	(0.023)	(0.022)	(0.023)	(0.010)
IV- 1st year Financial Aid Awarded	0.055**	0.035	0.045*	0.029**
	(0.027)	(0.026)	(0.026)	(0.012)
Parental Income	✓	✓	✓	✓
Student Characteristics	✓	✓	✓	✓
University*Year Effects	✓	✓	✓	✓

Notes: Coefficients presented are of marginal effects at mean bursary amount. Sample sizes vary by year as students drop out. Sample consists only of those students whose final outcome can be observed. Sample consists only of those students whose final outcome can be observed. Standard errors are in parenthesis, and are clustered at institution*year level.* $p < 0.1$. ** $p < 0.05$. *** $p < 0.01$

Table 6: Robustness Checks

	Financial Aid Awarded			IV Financial Aid Rules		
	Complete 1st Year	Course Scores 1st Year	Good Degree	Complete 1st Year	Course Scores 1st Year	Good Degree
Specification	(1)	(2)	(3)	(1)	(2)	(3)
Main Specification	0.099***	0.166***	0.090***	0.009	0.055**	0.028**
	(0.008)	(0.019)	(0.007)	(0.007)	(0.027)	(0.011)
Include Current Students	0.085***	0.185***		0.005	0.060**	
	(0.006)	(0.017)		(0.006)	(0.024)	
Exclude Outlying Entry Score Universities (1, 9, 10)	0.091***	0.202***	0.096***	0.007	0.053*	0.022*
	(0.006)	(0.022)	(0.008)	(0.011)	(0.032)	(0.011)
Condition on Prior Test Scores by Income	0.100***	0.164***	0.089***	0.007	0.037	0.031*
	(0.008)	(0.020)	(0.007)	(0.007)	(0.025)	(0.017)

Notes: Sample sizes vary by year as students drop out. Sample consists only of those students whose final outcome can be observed. Coefficients presented are of marginal effects at mean bursary amount. Outlying Universities based on the lack of overlap in prior test scores with other universities. Accounting for test scores reflecting different ability by test scores, additionally controls for test scores multiplied by log(1/(Income+1)). Standard errors are in parenthesis, and are clustered at institution level. * $p < 0.1$. ** $p < 0.05$. *** $p < 0.01$