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Acknowledgments

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1 Introduction

Understanding how policy can affect university (college) participation is important for understanding how governments can promote human capital accumulation. The subject of how to finance higher education (HE) has been high on the agenda of successive UK governments since the 1960s. The UK has moved from a situation in which the taxpayer footed the entire bill for HE, to a system where HE participants contribute towards the cost. Since its inception, this so-called 'cost-sharing' has been plagued with controversy, with fears that it would lower university participation, particularly among individuals from less well-off backgrounds.

The UK has seen two dramatic changes to HE finance in recent years. The first arose out of the 1998 Teaching and Higher Education Act, whereby up-front tuition fees of £1,200 per year were introduced for degree courses for the first time ever, and maintenance grants, which are a non-repayable form of support, were abolished and replaced by higher maintenance loans (though grants were subsequently brought back in 2004). The second set of changes occurred some eight years later in 2006/07, with the introduction of fees of up to £3,000 per year for all students, regardless of background, and deferrable until after graduation using government-subsidised fee loans. Maintenance grants for the poorest students were also increased substantially at this time.

This paper exploits these important changes in fees and grants over time, along with some other variation occurring as a result of less-publicised policy decisions,[1] to estimate the causal impact of tuition fees and maintenance grants on university participation. This is an important contribution to an ongoing debate over this issue: despite years of debate and further major policy changes – see Barr and Crawford (2005) – there remains little evidence on the extent to which maintenance grants encourage students to participate in university, or tuition fees dissuade them from doing so. Yet the debate remains active and controversial: on the one hand, advocates of widening participation oppose tuition fees and the increasing emphasis on maintenance loans over grants,

[1] Means-tested maintenance grants were frozen in nominal terms during the period 1992–98, before being abolished in 1998/99. They were reintroduced at a maximum level of £1,040 in 2004/05. In addition, there have been a number of increases in means-tested maintenance loans throughout the period of analysis.

claiming that this deters youths from lower-income backgrounds from going to university (Sutton Trust, 2010; assorted media coverage[2]); on the other hand, many argue that requiring students to contribute to their HE costs is important for efficiency and equity reasons, and that the wage gains associated with a degree mean that youths are unlikely to be put off by increases in tuition fees (Greenaway and Haynes, 2003; Goodman and Kaplan, 2003). Most recently, following the Browne Review (an independent review of tuition fee policy in the UK which reported in October 2010),[3] the UK's coalition government increased the cap on tuition fees to £9,000 per year, to come into play in 2012. The increase was highly controversial and was met with mass student protests, but despite the ongoing controversy and debate associated with HE finance in the UK, there remains a lack of evidence on the causal effects of tuition fees and support on university participation. In the light of the new changes, it is of crucial importance to gain some understanding of the impacts of these policies on university participation, making this paper an important and timely contribution to the literature.

The paper uses 16 years of data (1992–2007) on the first-year-university participation decisions of young people from the UK Labour Force Survey (LFS). As discussed, during this period, up-front means-tested tuition fees were introduced and later replaced by higher deferred fees, and means-tested grants were abolished and subsequently reintroduced. We use these data to construct a pseudo panel data set, to deal with problems of multicollinearity and endogeneity. Our estimates suggest that tuition fees have a significant adverse effect on university participation, whilst maintenance grants have a positive impact. In particular, we find robust evidence that a £1,000 increase in fees results in a 3.9 percentage point decrease in university participation, while a £1,000 increase in grants results in a 2.6 percentage point increase in participation. These findings, which survive a battery of robustness checks, are comparable to, but of a slightly lower magnitude than, those reported in the US literature (Dynarski, 2000, 2003; Kane, 1995).

Understanding the link between university participation and HE finance is also important from a public spending perspective. Despite the increasing share of the financial burden borne by

[2] For a summary, see http://www.guardian.co.uk/education/2010/oct/12/high-fees-will-deter-poor-students.

[3] The Browne Review is formally titled 'Securing a Sustainable Future for Higher Education in England' and is available at http://hereview.independent.gov.uk/hereview/report/.

students, UK government spending on the HE system continues to grow – in 2009/10, the estimated spend was £1,050m on maintenance grants, £722m on student fee loans and £610m on maintenance loans[4] – and has reached 'unsustainable' levels according to the Browne Review (2010, p.56). But little evidence exists as to whether and to what extent these subsidies have an impact on university participation.

Separating out the effects of fees and grants on university participation is also important for policymakers going forward. Historically, policymakers in the UK have introduced packages of reforms affecting both major elements of HE finance – maintenance grants and tuition fees. However, if, as is currently the case, policymakers favour adjusting one element of HE finance more than others (the forthcoming changes to the system in 2012 will involve very large increases in tuition fees, but relatively small increases in grants), evidence on how this may affect university participation – which is what we provide in this paper – is of key importance. This sets the paper apart from previous work relating to the UK, which focuses on responses of university participation to an overall *set* of reforms, most notably the 1998 reforms, rather than to the separate elements of the reforms (fees and grants). Moreover, previous work tends to look more at the relationship between family background and participation around the time of the reforms, rather than at establishing a direct link between fees / grants and university participation, as we do in this paper. Blanden and Machin (2004), for instance, examine university participation and attainment by parental income before and after the 1998 reforms, and find that both participation in full-time education (at age 19) and degree attainment (at age 23) became more closely linked to family income as university participation expanded in the 1980s and 1990s. However, they find no evidence that these gaps in participation and attainment were related to the cost of HE. Subsequent work by Blanden and Machin (2008) indicates that the link between degree attainment and family income, while still strong, was static for those obtaining a degree between 1993 and 2003. We contribute to the debate by untangling the separate impacts of grants and fees on university participation..

[4] All in 2009 prices. 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.)

Closely related to our work is the sizeable body of US literature estimating the causal effects of grants and fees on university participation. Kane (1994) exploits between- and within-state variation in US public spending on tuition fees to estimate the impact of tuition fees on university participation. He finds that a $1,000 increase in tuition fees results in a 3.7 percentage point decrease in attendance amongst black 18- to 19-year-olds. In a later paper (Kane, 1995), he again finds evidence of reductions in university participation for 18- to 19-year-olds due to increased fees, with a $1,000 increase in fees leading to a 2.4 percentage point decrease in participation. Hemelt and Marcotte (2008) exploit significant variation in tuition fees within US institutions and find estimates of a similar magnitude to Kane's 1995 finding.

Regarding the effects of financial support, 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 university participation. 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 reduces university participation by 3.6 percentage points. Kane (1995) also 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 of a restricted sample of mature students).

These results suggest an important role for tuition fees and grants in university participation decisions. However, they all relate to the US context, which is a unique setting in terms of the high levels of university fees; indeed, it is hard to think that they can be informative a priori about different, non-US, settings. In addition, these studies relate to specific groups of individuals, as seen above. Another feature is that they consider either the effect of fees or the effect of support, but not both in the same setting. In this paper, on the other hand, we can benchmark the effects of both grants and fees; moreover, we do this on a representative sample of individuals. Also, to our knowledge, our paper is the first to examine the role of fees and support in a different setting, the UK.

The paper proceeds as follows. Section 2 provides more background on the two main sets of HE finance reforms to take place in the UK, in 1998 and 2006. Section 3 describes the data used in the

analysis, while Section 4 describes the methodology used to estimate the separate effects of fees and grants on university participation. Section 5 presents the main findings of this analysis and includes a battery of robustness tests. Section 6 concludes.

2 HE Finance in the UK, 1960–2007

The UK HE sector has undergone a massive expansion in recent decades. Student volumes have increased dramatically, rising from around 50,000 full-time equivalent (FTE) students in the 1960s to 400,000 by 2007/08, as illustrated in Figure 1. This large increase in university attendance occurred intermittently and for various reasons, such as the conversion of 35 polytechnics to universities following the 1992 Higher Education Act, and the introduction of the General Certificate of Secondary Education (GCSE) which significantly improved school staying-on rates[5] – see Wyness (2010) and Blanden, Gregg & Machin (2003). It was, however, not matched by increases in university funding, so by 1997/98 the HE sector was in financial crisis: funding per FTE student had fallen to a historic low of £4,850[6] (from £8,000 per student at the end of the 1980s).[7] Moreover, the gap in university participation between rich and poor was very wide in comparison with other developed countries (Barr and Crawford, 1998), and there were concerns that it was growing even wider (Blanden, Gregg and Machin, 2005).

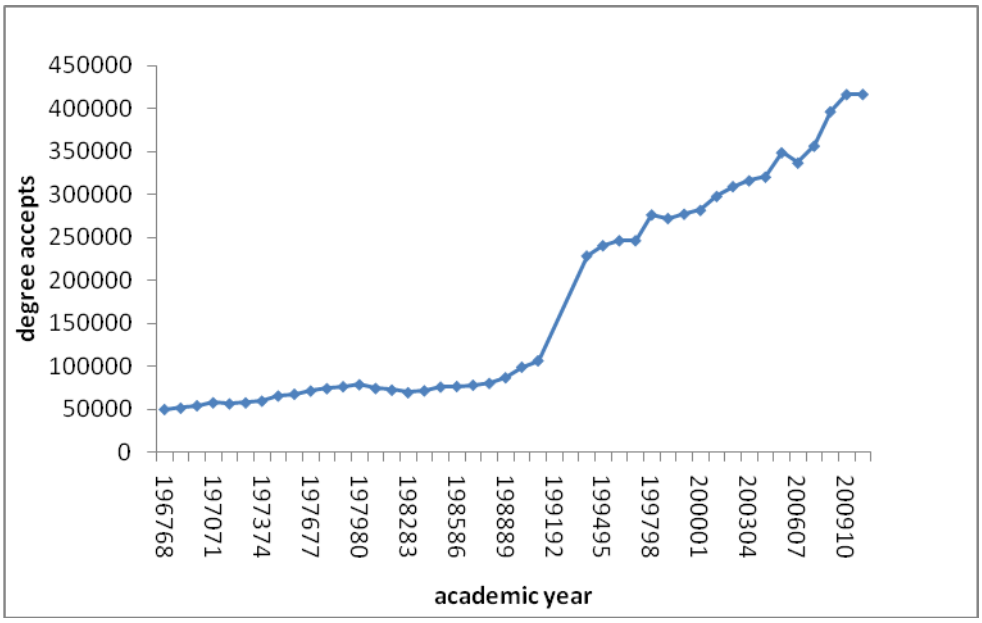
[5] The previous system of O levels tended to impose a cap on how many people could pass the exam, while the GCSE reform meant that anyone could achieve the top grade. The system moved away from pure examination assessment to a combination of exams and coursework, making top grades more accessible. It is generally agreed that this reform led to an increase in staying-on rates and, in turn, to an increase in university participation. For a full discussion, see Blanden, Gregg & Machin (2003).

[6] Note that all figures from this point on are expressed in 2006 prices unless otherwise stated.

[7] The authors are grateful to Vincent Carpentier, of the Institute of Education, University of London, for providing these figures.

This led to the first of two major policy reforms in the UK, 'the 1998 reforms'.[8] The second major policy reform followed some eight years on, in 2006.[9] The key changes in both reforms are now described.

Figure 1: Degree accepts (volume) by academic year



Source: All UK-domiciled HE students (Higher Education Statistics Agency – HESA). Full-time equivalent data represent the institution's assessment of the full-time equivalence of the student instance during the reporting academic year.

The 1998 reforms

These reforms saw the introduction, for the first time ever in the UK, of up-front means-tested tuition fees, of £1,200, affecting all but the least well-off students, or just over half of the student population as of 1998. They also resulted in the abolition of maintenance grants from 1999

[8] These were the result of the Dearing Report, formally known as 'The Report of the National Committee of Inquiry into Higher Education', available at https://bei.leeds.ac.uk/Partners/NCIHE/.

[9] As a robustness check, we limit the sample to pre-2006 in Section 5. We find no major differences in the parameter estimates.

onwards (preceded by their halving in 1998), also affecting just over half of all students.[10] In an implicit attempt by policymakers to offset these adverse changes, maintenance loans were increased: the increase in loans was of similar value to the reduction in the grant (for those formerly eligible for grants) and to the increase in fees (for those liable to the new fees).[11] This was an indirect attempt by policymakers to leave students no worse off in terms of up-front support than before the reforms, as these loans could be channelled towards fees or put towards living costs.

The 2006 reforms

By 2004, university participation had increased significantly, but there remained concern that representation of the lowest socio-economic groups had barely changed in relative terms (though it had risen in absolute terms – see Mayhew, Deer and Dua (2004)). There were also concerns that the student support package remained too low to cover the costs of university (Barr, 2004), and that UK universities were still underfunded compared with the rest of the OECD, compromising their quality and competitiveness (Greenaway and Haynes, 2003). A new set of reforms, arising out of the 2004 Higher Education Act, came into effect from the academic year 2006/07[12] to address these issues. This is the HE system that is in place at the time of writing.[13]

[10] However, grants had been frozen in nominal terms throughout the 1990s, so their real value had been eroding rapidly – so much so that in the period before their abolition they were, at a maximum of £980, too low to cover living costs (estimated at £6,890 per year excluding tuition fees, for a student living away from home and outside London (NUS, 2003)).

[11] Loans also moved from being mortgage-style to income-contingent, with this change fully phased in by 1999 (Goodman and Kaplan, 2003; Barr, 2004).

[12] As previously mentioned, maintenance grants were reintroduced in 2004/05 as part of this Act, though they were increased substantially in 2006/07.

[13] During writing the Government announced that the fee cap will be raised to £9,000 per year (in 2012 prices) in 2012/13, and the majority of universities that have announced their planned fees for 2012/13 have opted to charge the full £9,000 fee.

One important change concerned tuition fees: instead of being payable up front, all fees are now deferrable until after graduation, with loans available at a zero real interest rate, repayable according to income (at 9% above a threshold of £15,000). Unlike its predecessor, the current fee, which could be up to £3,000 per year,[14] is not means-tested – see Dearden, Fitzsimons and Goodman (2004) and Dearden et al. (2008) for more details. So, like the 1998 reforms, adverse changes to fees were offset by changes to loans, with the link being made more explicit through the introduction of fee loans. Another change to occur as a result of the 2004 Act was an increase in maintenance grants of up to £2,700 for the poorest students.[15] Maintenance loans remained pretty much unchanged, though they were reduced slightly for students who saw a grant increase.

These three elements of the HE finance system are shown in Tables 1–3, which set out the values of grants, fees and loans respectively, for the two major 'reform' years just discussed as well as for 1992/93 (the first year in our estimation period, and also during the time at which maintenance grants were being frozen) and 2004/05 (when maintenance grants were reintroduced after their abolition in 1999/00), for different parental income levels.

Table 1: Maintenance grant eligibility by parental income

GRANTS	Academic year			
Parental income	1992/93	1998/99	2004/05	2006/07
≤£10,000	2,989	949	1,040	2,700
£20,000	179	949	248	2,283
£30,000	0	569	0	832
£40,000	0	0	0	0
≥£50,000	0	0	0	0

[14] In practice, almost all universities charge the full fee. The fee cap will be raised to £9,000 (in 2012 prices) in 2012/13.(see footnote 13).

[15] Following their abolition in 1999/00, maintenance grants had been reintroduced in 2004/05 at £1,040 per year. Note too that the poorest students also benefit from bursaries under these reforms (at least £300 if the full fee is charged).

Table 2: Tuition fee levels by parental income

FEES	Academic year			
Parental income	1992/93	1998/99	2004/05	2006/07
≤£10,000	0	0	0	3,000
£20,000	0	373	0	3,000
£30,000	0	1,172	980	3,000
£40,000	0	1,172	1,196	3,000
≥£50,000	0	1,172	1,196	3,000

Table 3: Maintenance and fee loan eligibility by parental income

LOANS	Academic year			
Parental income	1992/93	1998/99	2004/05	2006/07[a]
≤£10,000	943	3,204	4,260	6,555
£20,000	943	3,204	4,260	6,555
£30,000	943	2,884	4,260	7,005
£40,000	943	2,403	3,262	6,549
≥£50,000	943	2,403	3,199	6,305

[a] Includes £3,000 fee loan (introduced in 2006/07). Maintenance loan amounts depend on whether the student is attending a London or non-London university, and whether (s)he is living at home or away from home; the figures in this table refer to non-home, outside London.

The two sets of reforms just discussed highlight two important features of the HE finance system. First, the three main elements of the system – grants, fees and loans – are all highly dependent on parental income.[16] Second, the three elements are highly interdependent. In particular, as we have seen, loans have commonly been used as a tool to offset adverse changes to grants and fees. These two features are clear from Figures 2–4, which show fee liability and grant and loan eligibility over time. First, each of these figures represents a different parental income group (for instance, Figure 2 covers individuals from low-income families, who were eligible for maximum grants in the 1990s and were not liable to means-tested tuition fees between 1998 and 2005).[17]

[16] The exception is deferred fees, which were introduced in 2006 and are payable by all students.

[17] For ease of illustration, we present these figures by income group. 'Low-income' students are those eligible for full grants, when in place, and not liable to means-tested fees, when in place (parental income less than approximately

Second, the interdependence is evident from the inverse relationship between grants and loans in Figures 2 and 3; and from the similar upward shifts in fees and loans from 1998 onwards in Figures 3 and 4 as loans are extended to cover fees. However, we should note that towards the end of the period, the three elements of the system move in the same direction, unlike in the pre-2006 period.

Figure 2: Fee liability and grant and loan eligibility: low-income individuals

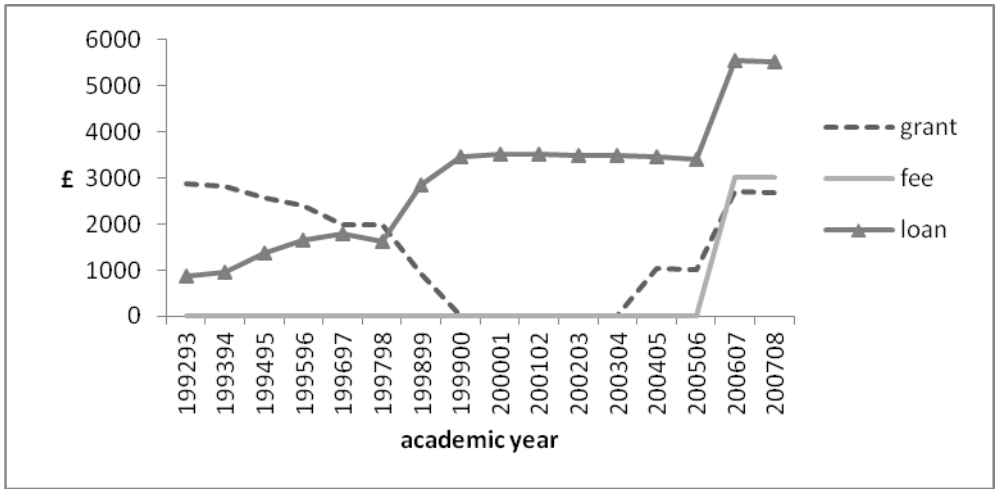
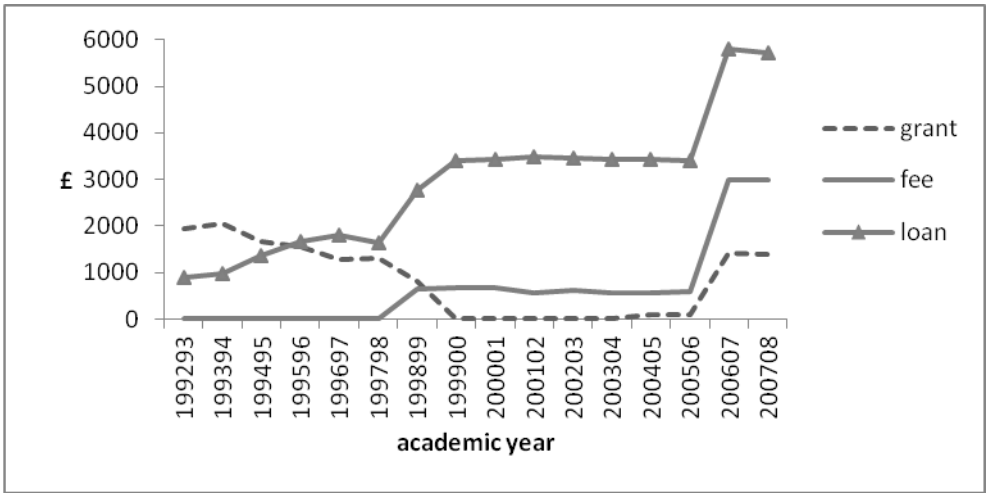
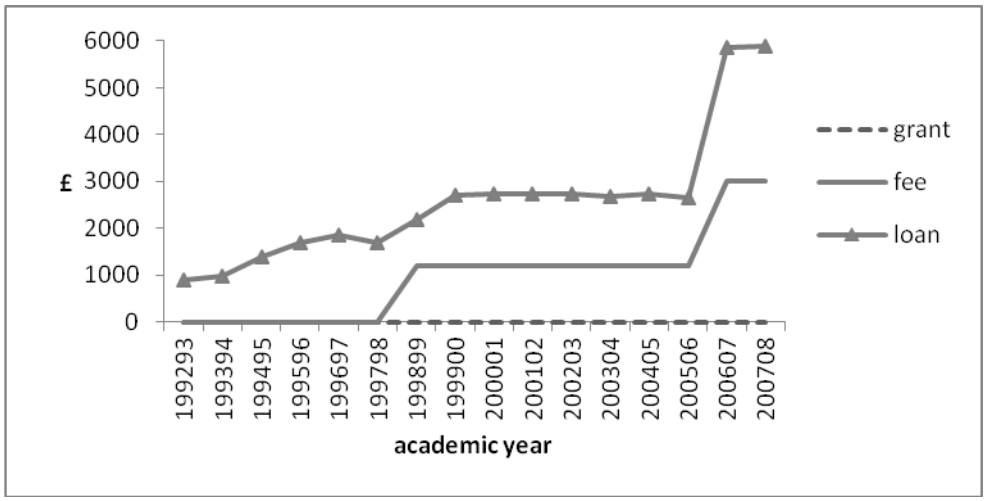


Figure 3: Fee liability and grant and loan eligibility: medium-income individuals



£17,500 p.a.). 'Medium-income' students are those eligible for partial grants and liable to partial means-tested fees, when in place (parental income between about £17,500 and £37,500). 'High-income' students are never eligible for grants, but always liable to means-tested fees, when in place (parental income above approximately £37,500 p.a.).

Figure 4: Fee liability and grant and loan eligibility: high-income individuals



This results in a high degree of collinearity between fees, grants and loans in all periods, making it difficult to separate out their effects within a standard regression framework. We instead estimate their effects by aggregating the data and converting them to a pseudo-panel – see Deaton (1985), Propper, Rees and Green (2001), Verbeek and Vella (2005) and Adda and Banks (2008). We come back to this in Section 4.

Before proceeding, note that, as previously discussed, our parameters of interest are maintenance grants and tuition fees. Though the third element of HE finance – loans (for maintenance and, from 2006, for fees) – is important, we do not attempt to estimate its causal effects on university participation, though we do control for it throughout the analysis. One reason for this is that, as we see from Figures 2–4, there is considerably less variation in loans across income groups than in fees and grants, resulting in considerably less statistical power. Moreover, loan take-up is a complex decision-making process and its modelling is beyond the scope of this paper.[18] For

[18] The most recent government statistics show a take-up figure of 80% for maintenance loans (see Student Loans Company, Statistical First Release, 06/2009, table 4), despite them being a very attractive form of borrowing (debt is frozen at a zero real interest rate, and repayment is upon graduation and contingent on income, currently set at 9% of earnings above £15,000). Unfortunately, no information is available on the types of individuals who do or do not take up their loans.

simplicity, we control for the up-front value of loans in all specifications, implicitly assuming that individuals are present-oriented and discount the future completely, and we create one variable for loans, which includes just maintenance loans before 2006 and both fee and maintenance loans from 2006.[19]

A final point to make is that our period of interest (1992-2007) was one in which participation, whilst growing, was still relatively low, and in general there were no supply-side constraints: those who achieved the entry requirements for a degree were likely to secure a place at university. In more recent years however, demand has significantly exceeded supply, due in part to the economic crisis and resultant lack of jobs for school-leavers, meaning that any extension of our analysis to later years would have to take supply-side constraints into account.

3 Data

The objective of the paper is to estimate the effects of grants and fees on individuals' likelihood of entering university; our sample of interest is thus youths of university-entry age. More specifically, it consists of those eligible for *their first year* of university, who are subject to the HE finance policy in place at the time of their year of entry (as a rule, subsequent policy changes do not affect them). We take these to be people who are of the appropriate 'academic age' for the first year of university, as determined by date of birth, regardless of educational attainment to date. Our paper thus focuses on the effect of HE finance on entry to university rather than on the decision to continue at university.[20]

[19] For repayment purposes, fee and maintenance loans are treated as the same 'income-contingent repayment' loan by the Student Loan Company (indeed, they are treated as one loan on loan statements from the Student Loan Company).

[20] This is because we are unable to ascertain which HE policy individuals who have *already* left school are potentially subject to: for those in university, we do not know what year they began studying and hence what HE finance policies they fall under; for those not in education, it is more difficult to observe parental income, as they are less likely to be living at home in the previous period and thus we are less likely to observe their parents.

For these individuals, we require knowledge of parental income in order to calculate the amount of fees, grants and loans they *would be* liable to / eligible for were they to attend university; since we do not observe take-up of grants, we model individuals' behaviour based on what they are eligible for, i.e. 'intention to treat'.

The Labour Force Survey (LFS) is the only UK data set containing information on young people living at home in the year before they are eligible for university, along with their date of birth[21] and their parents' income, and their university decision a year later, as well as adequate sample sizes to allow for robust estimation.[22] This is a survey following around 60,000 households every quarter. It has both cross-sectional and longitudinal elements, with households interviewed for five consecutive quarters (i.e. waves 1–5, so wave 1 and wave 5 are one year apart) and then removed from the panel and replaced. We use LFS data from 1992 through 2007 in all that follows.

We use these data to create an accurate picture of university participation and potential HE finance for every individual in the following way. In order to calculate the levels of fees, grants and loans that all individuals are liable to / eligible for (regardless of whether they go to university or not), we need to observe parental income the year before the person is eligible to attend university (since this is how means-testing would be carried out), calculating an individual's liability to fees and eligibility for grants and loans from the government's means-testing formulae, which are based purely on parental income. The advantage of the LFS is that we observe households exactly one year apart (waves 1 and 5), so for people of university age in wave 5 (whether studying, working or not), we can observe parental income a year before (in wave 1). This is 25% of our sample. For people of university age in wave 1, or those of university age in wave 5 (again, whether studying, working or not) whose parental income in wave 1 is missing (the latter account for a significant proportion of our sample up to 1996 since until this time parental income data were only collected in wave 5), we only observe parental incomes in the current year,

[21] Note that, for some years, date of birth is only available in special-access versions of the LFS.

[22] For various reasons, neither the British Household Panel Survey (BHPS) nor the Family Resources Survey (FRS) fulfilled these criteria. The BHPS was found to have inadequate sample sizes, while the FRS does not collect information on those attending university but living outside the home (except those in halls of residence).

so we use these and adjust for inflation.[23] This is 54% of our sample. For people of university age but living away from home and not in a hall of residence (10%), we estimate fee liability and grant and loan eligibility on the basis of their own characteristics[24] and year of eligibility for university. There is a final group who do live at home but for whom parental income is missing (11%). We omit this group.

An important point to note here is that we actually only observe parental earnings, as opposed to parental income, since this is the only measure available in the LFS. We therefore use earnings as a proxy for income. This, combined with our imputation methods above, results in potential measurement error in our three elements of HE finance, as well as in our parental income variable itself. We will discuss our method of dealing with this possible measurement error in Section 4.

The sample is restricted to England, Wales and Northern Ireland, thus excluding Scotland. This is because Scotland experienced a significant departure from UK HE policy in 2000 and, as part of this, introduced an endowment of around £2,200 per student, to be paid upon graduation. This renders the Scottish system very different from the system that covers the rest of the UK.[25]

The outcome variable is 'attending first year of university, degrees only'. The average participation rate across the sample is 16.4% of 18- to 19-year-olds, though this varies considerably by parental income, as shown in Figure 5, with an average of 12.2% of individuals from low-income backgrounds studying for a degree compared with 30.4% from high-income backgrounds.[26] This is consistent with the findings of Blanden and Machin (2004), who examine participation by parental income in the period before and after the 1998 HE reforms and find significant differences in

[23] We test the robustness of this approach post-1996 by imputing lagged income in this way, for those whose income we observe in both waves, and measuring the correlation. We find the imputed and real incomes for wave 1 to be highly correlated, at around 0.85, so we are confident in this imputation method.

[24] Sex, ethnicity, GCSE attainment. Note that, obviously, we have no parental characteristics for these individuals.

[25] In 2000, Scotland abolished tuition fees. Ideally, this policy shift could be exploited to assess the impact of fees, using difference-in-difference analysis over time and country (England versus Scotland). However, as explained, at the same time Scotland introduced a number of other policy changes, such as the reintroduction of grants and the endowment fee, resulting in the lack of a 'clean' policy change.

[26] We use the income groups defined in Section 2.2 (see footnote 17) in the descriptive statistics.

participation between those from low- and high-income backgrounds.[27] Their analysis also shows that the gap in degree attainment between individuals from low- and high-income backgrounds widened between the early 1980s and late 1990s (earlier than the timescale of this analysis), though later work (Blanden and Machin, 2008) suggests the decline in social mobility may have flattened out. Indeed, Figure 5 clearly illustrates that the gap in university participation between those from low- and high-income households (and particularly between low- and medium-income households) has been narrowing since the mid-1990s. The figure also emphasises that those from different parental income backgrounds have differing trends in participation over time, meaning that it will be important to control for this in our modelling.

Figure 5: University participation over time by parental income group

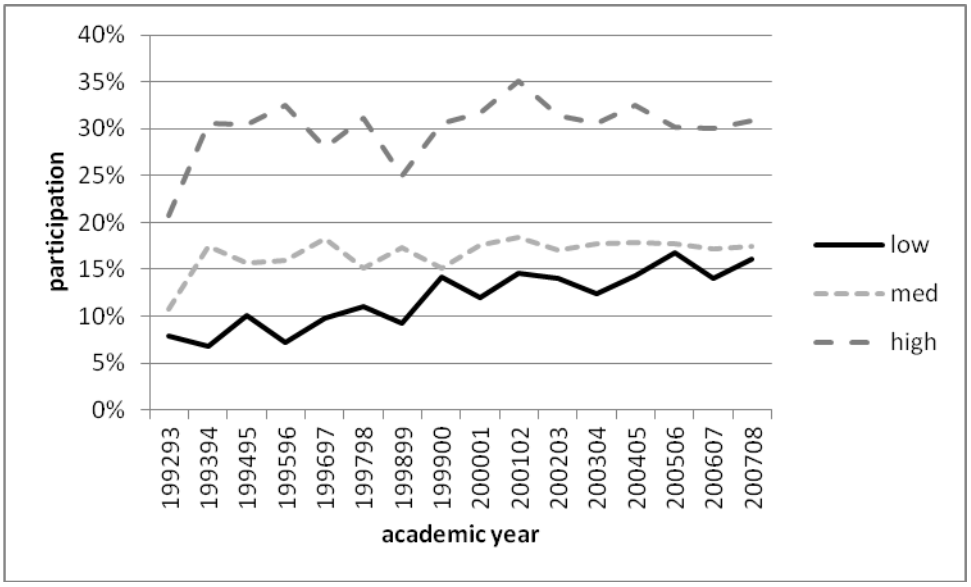


Table 4 shows summary statistics and sample means for the outcome variable and control variables used in the analysis (at the individual, rather than aggregate level). The control variables include ethnicity (a binary variable taking the value 1 if the individual is white and 0 otherwise), youth's prior educational attainment (measured as having 5 or more good GCSEs, less than 5

[27] Their analysis focuses on degree acquisition at age 23, and controls for background characteristics, so is not directly comparable to Figure 5.

GCSEs or no GCSEs),[28] education level of the more highly educated parent (measured in four categories of attainment using the National Qualification Framework of both educational and vocational qualifications), current parental income (this is the sum of both parents' annual income in the *current* year, i.e. when the youth is eligible for university at age 18–19) and region (18 regional dummies in total, representing the 16 major regions of England and one for each of Wales and Northern Ireland). Note that region represents the region of home domicile of the individual.[29]

The final sample size is 27,485 youths aged 18–19. Note that the sample is evenly split between males and females, around 50% of the sample have attained five or more good (A*–C grades) GCSEs[30] and the level of parental education is quite diverse.

4 Estimation

The analysis uses 16 years of repeated cross-sections from 1992 through 2007. The overall sample size is 27,485 individuals. To estimate the parameters of the model, we aggregate university participation by region of residence, sex, level of parental education and time, to create a pseudo-panel. This helps overcome problems of multicollinearity as well as endogeneity. Regarding the former, we saw from Section 2 that the three main elements of the HE finance package – fees, loans and grants – are all highly collinear with each other and with parental income. This results in

[28] A variable measuring number of A levels is available in the LFS data set, but only from 1993 onwards, and it is limited in granularity to zero, or one or more. Furthermore, A-level attainment can be considered endogenous to the university participation decision. For these reasons, GCSE or equivalent is chosen as a more robust measure of prior educational attainment.

[29] So students and non-students living in a region away from home have their home domicile as their region, rather than the region of the institution they are attending / place they are working. Note, in this respect, that HE finance is dependent on country of *domicile* rather than on country of institution.

[30] This is the expected level of attainment at the end of compulsory education in the UK.

Table 4: Summary statistics (LFS 1992–2007)[a]

	Mean	Standard deviation
University participation	16.36	36.99
Sex		
Male	0.5073	0.50
Female	0.4927	0.50
Ethnicity		
White	86.19	34.50
Non-white	9.09	28.75
Missing	4.72	21.20
Youth's education		
5 or more GCSEs (A*–C)[b]	50.10	50.00
1–4 GCSEs (A*–C)	26.69	44.23
No GCSEs	21.19	40.86
Missing	2.02	14.08
Parental education[c]		
NVQ level 4 or above	26.29	44.02
NVQ level 3	22.11	41.50
NVQ level 2	12.27	32.81
NVQ level 1 or below	27.04	44.42
Missing	12.29	32.84
Current parental income (£)	21,602	23,730
Region		
England	88.91	31.40
Wales	5.76	23.30
Northern Ireland	5.33	22.46
Grant (£)	1,114	1,153
Fee (£)	585	1,008
Sample size	27,485	

Notes: Data in this table are based on the individual-level sample of 27,485 individuals.
[a] Sample shown is all those eligible for first year of university.
[b] This is the expected level of attainment by the end of compulsory education in the UK.
[c] This is the education level of the more highly educated parent.

over-sensitivity of the coefficient estimates to small changes in the model, making it econometrically difficult to identify their separate effects using a framework such as equation (1), where university participation of individual *i* in period *t*, P_{it}, is modelled as a function of fees (*F*),

grants (*G*), loans (*L*), background characteristics (*X*), regional dummies, an individual-specific effect and a time trend.[31]

$$P_{it} = \alpha + \beta_1 F_{it} + \beta_2 G_{it} + \beta_3 L_{it} + \gamma X_{it} + \rho_r + \tau_t + f_i + \upsilon_{it} \quad (1)$$

A common method for dealing with this problem is to transform the data in such a way as to remove the high degree of collinearity amongst the variables, which is what the aggregation does. Regarding endogeneity, a concern is that unobserved individual-specific effects are correlated with explanatory variables of interest – in particular, with parental income, and thus fees, loans and grants – and also affect the outcome of interest. For this reason, we group individuals into cells, or 'cohorts' (defined below), which tends to homogenise the individual effects among individuals grouped in the same cell, thus creating a pseudo-panel of groups of individuals sharing common characteristics. The averages within these cells are treated as observations in a pseudo-panel to which standard panel-data techniques can be applied (Deaton, 1985). This procedure also reduces the biasing effects of measurement error, which, as we saw in Section 3, is a concern regarding parental income. A further advantage is that since a new sample of individuals is taken in each period, the use of a pseudo-panel greatly reduces the effect of attrition on parameter estimates.

In order to construct cells for the pseudo-panels, we aggregate university participation by region, sex, level of parental education and time. Specifically, we have: (i) 18 regions;[32] (ii) two sexes; (iii) five levels of education of the more highly educated parent: level 4 or above, level 3, level 2, level 1 or below, missing[33]; and (iv) 16 years. So, for example, we take all 18- to 19-year-old males whose more highly educated parent is level 4 or above in Merseyside in 1992, and compute average university participation amongst them. So we use 18 regions, two sexes and five parental

[31] In an initial stage, we experimented with a number of specifications, and found the coefficients to be highly sensitive to small changes in the model specification and to the inclusion or exclusion of particular variables.

[32] 1 Tyne and Wear, 2 rest of North East, 3 Greater Manchester, 4 Merseyside, 5 rest of North West, 6 South Yorkshire, 7 West Yorkshire, 8 rest of Yorkshire & Humberside, 9 East Midlands, 10 West Midlands metropolitan county, 11 rest of West Midlands, 12 Eastern, 13 Inner London, 14 Outer London, 15 South East, 16 South West, 17 Wales, 18 Northern Ireland.

[33] Those with 'missing parental education' are living independently and thus have no parental information.

education groups to form cells, or cohorts, that we follow over time. As Verbeek (2007) discusses, cells should be defined as groups whose explanatory variables change differentially over time: this is the case for a key explanatory variable in our model – GCSE results – which varies markedly over time by parental education background, region and sex. The cell sizes, which are shown in Table 5, vary from 1,566 to 4,020 households, with a mean of 2,749, and result in a balanced panel of 10 groups, in 18 regions, over 16 years, or 2,880 cells in total. We treat the averages within these cells as observations in a panel.

The equation we estimate is

$$P_{ct} = \alpha + \beta_1 F_{ct} + \beta_2 G_{ct} + \beta_3 L_{ct} + \gamma X_{ct} + g(\tau_t) + f_c + \upsilon_{ct} \quad (2)$$

where P_{ct} represents the mean university participation rate in each of the cells. F_{ct}, G_{ct} and L_{ct} denote respectively the average fee, grant and loan of that cell in period t, for t = 1992,...,2007. The remaining explanatory variables are contained in X_{ct} and are as shown in Table 4, again at their mean levels by cell. The presence of cell-specific unobserved heterogeneity that is fixed over time is captured by f_c, while υ_{ct} represents an iid error term. Note also that a linear time trend is allowed for in the model, $g(\tau_t)$, which varies by parental education group.

Table 5: Pseudo-panel number of cells

Group	Description	Frequency
1	male, parental education level 4 or above	3,795
2	male, parental education level 3	3,199
3	male, parental education level 2	1,806
4	male, parental education level 1 or below	4,020
5	male, missing parental education	1,124
6	female, parental education level 4 or above	3,432
7	female, parental education level 3	2,877
8	female, parental education level 2	1,566
9	female, parental education level 1 or below	3,411
10	female, missing parental education	2,255
Total		27,485

5 Findings

In this section, we present the results of our preferred specification, accompanied by a number of robustness tests. As a reminder, our parameters of interest are tuition fees and grants, although, as previously described, we also control for maintenance and fee loans in all specifications.

Main specification

In our preferred specification, we aggregate the data into cells on the basis of parental education, sex, region and time (see Section 4) to create a pseudo-panel, and estimate a fixed-effects model on it. This is to allow for time-invariant unobserved heterogeneity within cells that is potentially correlated with the outcome variable of interest. We control for all of the background variables listed in Table 4, at their average value per cell, along with a linear time trend that we allow to vary by cell-average parental education (see Figure 5 for evidence of differing trends in university participation over time – in that case by parental income). Our results are presented in Table 6.

Table 6: Probability of university participation at age 18–19

Cells created by parental education group, region, sex and time

Dependent variable →	University participation
Grant	0.0262 [0.010]**
Fee	–0.039 [0.015]**
Number of cells	2,802

Notes: Dependent variable is participation in first year of university (degrees only) at age 18–19.
All regressions control for the socio-economic variables listed in Table 4. We also control for a linear time trend interacted with parental income level.
Numbers in square brackets are standard errors.
* Denotes statistical significance at the 10% level.
** Denotes statistical significance at the 5% level.
** Denotes statistical significance at the 1% level or less.

The findings show that a £1,000 increase in fees results in a 3.9 percentage point decrease in first-year-university participation, whilst a £1,000 increase in grants leads to a 2.6 percentage point

increase in participation. These coefficients are in line with, but slightly smaller than, the findings of Dynarski (2000, 2003) and Kane (1995), as described in Section 1, bearing in mind inflation and exchange rates. These coefficients translate to average elasticities of –0.14 and 0.18 for fees and grants respectively.

The coefficient on loans, 2.5 percentage points (not shown in the table), is also of statistical significance at 5%, though note that we are controlling in this specification for the up-front, non-discounted value of loans, thus assuming that individuals discount the future completely.[34]

It is also reassuring to note that the explanatory variables all have the expected signs and are generally significant (see Table A1 in the appendix). Children of well educated parents (NVQ Levels 3 and 4) are significantly more likely to attend university than children of parents with no qualifications, while youths own prior attainment is a key driver of university participation, in line with widely accepted theory and evidence (Heckman and Carneiro, 2003; Gorard, 2006). GCSE attainment has a strong positive impact on participation – an increase from fewer than five good GCSEs to five or more good GCSEs results in a 25.6 percentage point increase in the probability of attending university, while whites are less likely than non-whites to go to university a well-known feature of UK HE participation, in contrast with countries such as the US – see Chowdry et al. (2010).

Robustness

To assess the robustness of this finding, we next estimate four different specifications of the model. In the first, we allow for a quadratic as well as a linear time trend, and we continue to allow it to vary by cell-average parental education. In the second, we omit the years in which deferred fees were in force (post 2005). In the third, we omit 1992, a year in which there was a sharp increase in university participation; and in the fourth, we omit the missing parental

[34] We believe that controlling for loans is important, as they have been an intrinsic part of successive governments' HE finance packages. But, as previously described, we are reluctant to attach a causal interpretation to this parameter.

education group, just under 17% of the sample. The main findings remain robust to these changes in the model specification. The estimates are shown in columns (1) through (4) of Table 7.

Table 7: Probability of university participation at age 18–19

	Quadratic time trend	Specification up to 2005	Drop 1992	Missing parental education group omitted
	(1)	(2)	(3)	(4)
grant	0.0217	0.0316	0.0253	0.0199
	[0.010]**	[0.013]**	[0.010]**	[0.012]*
fee	-0.0378	-0.0412	-0.0376	-0.0323
	[0.015]**	[0.025]*	[0.015]**	[0.018]*
No of cells	2802	2444	2629	2268

Notes: Dependent variable is participation in first year of university (degrees only) at age 18–19.
All regressions control for the socio-economic variables listed in Table 4. We also control for a linear time trend interacted with parental education level.
Numbers in square brackets are standard errors.
* Denotes statistical significance at the 10% level.
** Denotes statistical significance at the 5% level.
*** Denotes statistical significance at the 1% level or less.

Column (1) of the Table shows estimates from the first robustness exercise, in which we allow for a more flexible time trend. In particular, in addition to a linear time trend, varying across parental education group, as in our preferred specification, we allow a quadratic time trend, again varying across parental education group. The results change very little.

In the second robustness exercise, shown in column (2), we include data only up to 2005, the year before higher, deferred tuition fees came into effect. This is because by pooling years before and after the 2006 reforms, we are pooling together different types of fees, both up-front and deferred (though see the discussion on offsetting up-front fees with loans in Section 2.1). So in this specification we include only up-front fees in the analysis. The coefficient on fees remains very similar, and is significant at the 10% level. We also find the coefficient on grants to be similar.

In our third robustness exercise, we omit data from 1992, a year in which participation rose rapidly due to the 1992 Further and Higher Education Act. This Act made changes in the funding and administration of further education and higher education within the United Kingdom, most dramatically by granting university status to 35 polytechnics, and a number of other further

education institutions, thus significantly increasing the volume of university participants. Again the results change very little.

Finally, we estimate the model using four rather than five parental education groups (level 4 or above, level 3, level 2, level 1 or below), thus omitting the group whose parental education is missing due to them living away from home (12% of the sample), to see whether results are sensitive to this. The estimates are of similar magnitude and are significant at the 10% level.

6 Conclusion

Understanding how policy can affect university education is important for understanding how governments can promote human capital accumulation. This paper exploits historic changes to university funding policies in the UK to estimate the impact of tuition fees and maintenance grants on university participation. Previous work on this, which largely relates to the US, considers either the effect of fees or the effect of support, but not both in the same setting; moreover it considers specific sub-samples of individuals. In this paper on the other hand, we benchmark the effects of both grants *and* fees, and furthermore, we do this on a representative sample of individuals. Using a pseudo panel data set constructed from 16 years of data on first-year university participation, our results suggest an important role for tuition fees and grants in university participation decisions: we find robust evidence that a £1,000 increase in tuition fees reduces university participation by 3.9 percentage points, while a £1,000 increase in maintenance grants increases participation by 2.6 percentage points. These figures equate to an elasticity of –0.14 for fees and 0.18 for grants. These results are in line with those estimated in the US in a number of studies, such as Kane (1995), Dynarski (2003) and Hemelt and Marcotte (2008).

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Appendix A1

Table A1: Probability of university participation at age 18–19

	Marginal Effects
Grant	0.0262
	[0.010]**
Fee	-0.039
	[0.015]**
Loan	0.0253
	[0.011]**
Current parental income	-0.0001
	[0.001]
White	-0.1049
	[0.025]***
GCSE / O level	0.2617
	[0.019]***
Parental income quartile 1 (omitted)	
Parental income quartile 2	0.0139
	[0.024]
Parental income quartile 3	0.0591
	[0.033]*
Parental income quartile 4	0.1114
	[0.054]**
Parental education quartile 1 × Time	-0.0007
	0.0018]
Parental education quartile 2 × Time	0.0015
	[0.002]
Parental education quartile 3 × Time	-0.0006
	[0.002]
Parental education quartile 4 × Time	0.0008
	[0.001]
Unemployment rate	0.0081
	[0.003]***
constant	-0.273
	[0.008]***
No of cells	2802

Notes: Dependent variable is participation in first year of university (degrees only) at age 18–19.
Numbers in square brackets are standard errors.
* Denotes statistical significance at the 10% level.
** Denotes statistical significance at the 5% level.
*** Denotes statistical significance at the 1% level or less.