The Impact of Higher Education Finance on University Participation in the UK

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Abstract: In this paper we estimate the separate impacts of upfront fees, grants and maintenance loans on UK higher education participation. We use the panel data element of Labour Force Survey data on the university participation decisions of 18 year olds, covering the period 1992-2007, which saw great variation in HE finance, most importantly the introduction of up-front tuition fees and the abolition of student maintenance grants in 1998 and major reforms of 2004 in which maintenance grants were re-instated and up-front fees were replaced with deferred fees of £3000. We create a pseudo-panel of participation by UK region over time and test a number of specifications. Our findings show that tuition fees have a significant negative effect on participation, with a £1,000 increase resulting in a decrease in participation of 3.7ppt. Upfront non-repayable support in the form of grants has a positive effect on participation with a £1,000 increase in grants resulting in a 2.2ppt increase in participation. Repayable support in the form of loans also has a positive effect on participation of a similar magnitude to grants, with a £1,000 increase resulting in a 2.1ppt increase in participation. These findings are comparable, but of a slightly lower magnitude to those reported in the related US literature.

Keywords: Higher education participation, funding policies, fees, grants.

JEL classification:

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1. Introduction

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 where the taxpayer footed the entire bill for HE, to a system where HE participants contribute part of the cost. This so-called 'cost-sharing' has always been plagued with controversy, with fears that it would lower participation, particularly among youths from low income backgrounds.

The first most dramatic changes in UK student finances occurred as a result of the 1998 Teaching and Higher Education Act, whereby tuition fees were introduced for degree courses for the first time ever. Maintenance grants were reduced substantially and subsequently abolished and replaced by maintenance loans in 1999.[1] Eight years later, in 2006, another substantial policy change occurred as a result of the 2004 Higher Education Act: the introduction of deferred fees, considerably higher than before, for all students, regardless of background. These so called "top-up" fees were completely offset by an accompanying fee loan to be repaid after graduation, and so represented a further major shift. Maintenance grants, which were re-introduced for the poorest students in 2004, were also significantly increased in 2006.

Perhaps unsurprisingly, advocates of widening participation opposed the introduction of tuition fees and the increasing emphasis on maintenance loans over grants, claiming that this would only serve to deter youths from lower income backgrounds from going to university. On the other hand, many economists argued that requiring students to contribute to their higher education costs was important for efficiency and equity reasons (Greenaway and Haynes, 2003; Goodman and Kaplan, 2003) and that the wage gains associated with a degree would mean youths would be unlikely to be put off by the increase in upfront costs.

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[1] Eight years later, in 2006, another remarkable policy change occurred: the introduction of deferred fees, considerably higher than before, for *all* students, regardless of background. These so called "top-up" fees were completely offset by an accompanying fee loan to be repaid after graduation, and so represented a further major shift. Maintenance grants, which were re-introduced for the poorest students in 2004 were also significantly increased in 2006. We do not analyse these reforms in this paper.

However, despite years of debate and further major policy changes (for a summary, see Barr and Crawford, 2005), there remains little evidence on the extent to which maintenance grants encourage students towards higher education, or tuition fees dissuade them from it. This paper is the first UK study to provide evidence on the causal impact of maintenance grants and tuition fees on university participation in the UK. It exploits the exogenous variation in HE funding policies induced by these two reforms – along with some other variation occurring over time as a result of less-publicised policy choices – to estimate the effects. It uses Labour Force Survey (LFS) data from 1992-2007 – a period of great variation in higher education finance, particularly at the time of the major reforms in 1998 and 2006, described more fully in section 3. The main result of the paper comes from a model in which we pool fourteen years of data on the (first-year) university participation decisions of youths. During this period, upfront means-tested tuition fees were introduced and then replaced by deferred fees, and upfront means-tested grants were abolished and then re-introduced. We exploit differences in average loan, grant and fee levels by regionto form a pseudo-panel of participation by parental education and region over time and apply standard panel data techniques to obtain estimates of the impacts of grants and fees on participation. Our results indicate [g1] a £1,000 increase in fees results in a 4.8ppt decrease in university participation, while a £1,000 increase in grants results in a 3.2ppt increase in participation. These findings are comparable, but of a slightly lower magnitude to those reported in US literature.

Understanding the link between participation and HE finance is important from a financial perspective. Despite the increasing share of the financial burden being borne by students, UK government spending on the HE system continues to grow – in 2007, estimated spend was £918m on maintenance grants, £349m on student fee loans and £564 on maintenance loans, as well as a further £509m on loan administration.[2] But there is little evidence that these subsidies have any real impact on university attendance.

[2] All in 2007 prices. This does not represent the amount of money lent to students, but the future cost of subsidizing and writing off student loans issued in that year as well as management of the student loans stock (DfES departmental report 2007)

Separating out the effect of fees and grants is also important for policymakers going forward. Historically in the UK, HE policymakers have introduced packages of reforms, affecting both major elements of HE finance, grants and fees. However, if, as is likely, future policymakers adjust just one element of HE finance, then knowing how this may affect participation is of key importance. Previous related papers in the UK have focused on responses to a set of particular reforms, most notably the 1998 ones, rather than on the separate effects of the levels of fees and grants on participation over time. Blanden and Machin (2004) examine university participation rates by parental income before and after the 1998 reforms. They find that degree attainment became more closely linked to family income as participation in HE expanded between the 1980s and 1990s. However, they find no evidence that this gap in participation was related to the cost of HE. Evidence from a subsequent paper (Blanden and Machin, 2008) indicates that the link between degree participation and family income, while still strong, was static for those obtaining a degree between 1993-2003. Similar evidence of this nature comes from Galindo-Rueda et al (2004), who look at changes in university participation by parental income, over 1994-2001. Their results also highlight the large gap in participation by income background during the past decades, and they also conclude that this gap cannot be ascribed to the 1998 reforms.

Rather than examining participation responses to a particular set of reforms, we advance on these studies by untangling the separate impact of grants and fees, and their direct relationship to HE participation. We accomplish this by constructing individuals' grant and fee obligations (which can be calculated using each respondent's parental income data and the year they are eligible for university) and using variation in tuition fee and grant policy over time through the changes in policy highlighted above, and across income group due to means-testing rules, for identification.

Closely related to our work is the sizeable body of US literature estimating the causal effects of grants and fees on HE participation. Kane (1994) exploits between- and within- state variation in US public spending on tuition fees to estimate the impact of tuition fee costs on university attendance. He finds that a $1000 increase in tuition fees ($1999) leads to a 3.7ppt decrease in attendance of black 18-19 year olds. Kane

(1995) also finds evidence of reductions in HE participation as a result of increased fees. His fixed effects methodology implies a $1000 increase in fees leading to a 2.4ppt decrease in participation.

Dynarksi (1999) exploits a policy change in 1982, whereby HE financial aid was withdrawn from children with a deceased, disabled or retired father. Using a difference-in-differences methodology to estimate the impact of aid on attendance, she finds that the effect of the reform is to reduce HE participation by 3.6 percentage points. Kane (1995) also looks at the impact of the Pell Grant aid system, but finds no impact on participation, while Sefton and Turner (2002) find a small impact of Pell Grant eligibility of 0.7 percentage points per $1000 of aid (although of a restricted sample of mature students) in their fixed-effects estimation.

Hemelt and Marcotte (2008) point out that little research of this nature has been carried out in recent years, making their paper a useful update. Their fixed effects methodology utilises significant variation in tuition fees within US institution. They find similar elastictities to Kane in the US.

ile these results relate to non-UK student aid and fee policies, the results all suggest that the levels of grants and fees set by the government play an important role in affecting HE participation decisions. Our paper consolidates this evidence even further in a different setting, the UK.

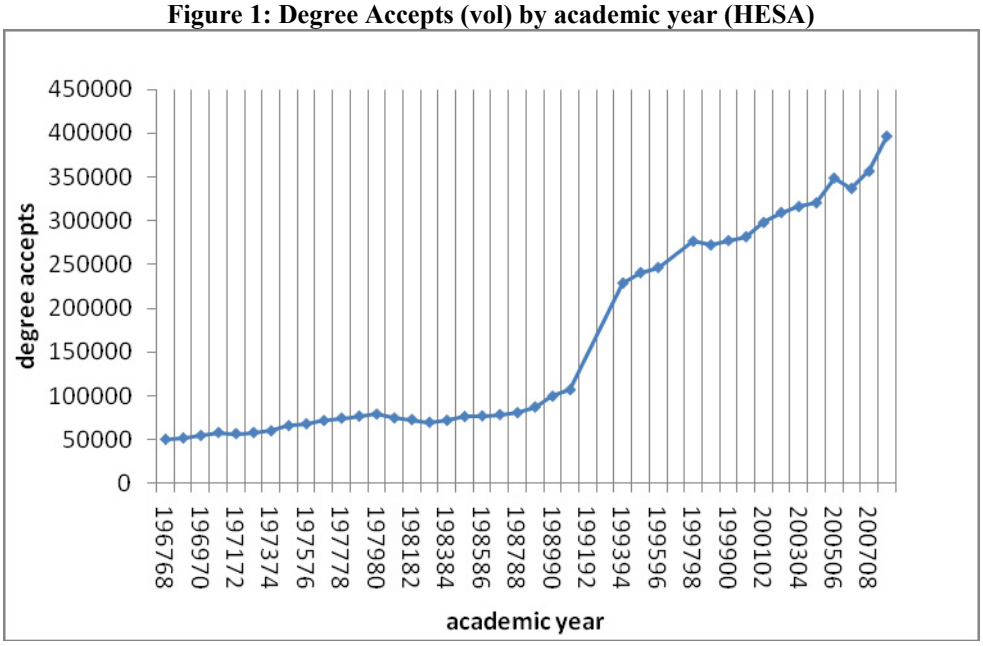
The paper proceeds as follows. In Section 2, we provide more background on the HE finance reforms that took place in 1998 and in particular which types of students were most affected and how. Section 3 describes the data that we use in the analysis. Section 4 describes our estimation strategy and 'pseudo panel' approach, while Section 5 presents the main findings of this analysis. Section 6 concludes with implications of the results for UK higher education funding policy. A number of robustness tests are presented in the Appendix.

2. HE Finance in the UK, 1960 – 2009[g3]

In this section we describe the evolution of HE Finance in the UK throughout the period 1960 through 2009. The UK HE sector has undergone a massive expansion in recent decades. Student volumes have more than quadrupled, rising from around

100,000 full-time equivalent (FTE) students in the 1960s to just under 450, [g4]by 2007, as illustrated in Figure 1.[3]

Figure 1: Degree Accepts (vol) by academic year (HESA)



This large increase in university attendance occurred intermittently and for various reasons (see Wyness (2010) and (Blanden et al, 2003) for details). However the large rises in participation were not matched with increases in university funding, so by 1997 the HE sector was in financial crisis: funding per FTE student had fallen to a historic low of £4,850[4] (from £8,000[5] per student at the end of the 1980s). The Dearing Report (2007)[6] was commissioned by the government to recommend ways to tackle the funding crisis as well as look at the issue of widening participation; despite the increases in enrolment, the gap between rich and poor was still very wide in comparison to other developed countries (Barr and Crawford, 1998), and rather than narrowing, it was widening (Blanden et al, 2005).

2.1 1998 Reforms

[3] All UK domiciled Higher Education students (HESA). Full-time equivalent (FTE) data represents the institution's assessment of the full-time equivalence of the student instance during the reporting academic year. FTE data is based on the HESA session population, and includes writing-up students.

[4] All figures that follow are in 2006 prices unless otherwise stated

[5] Source: Carpentier, Institute of Education, University of London.

[6] Formally known as "*The National Committee of Inquiry into Higher Education*"

The most important policy change to come out of the Dearing Report was the introduction – for the first time ever in the UK - of upfront means-tested tuition fees of up to £1,200 in 1998, for all but the least well off students (just over half the student population as of 1998).

It also resulted in the abolition of grants from 1999 onwards (preceded by their halving in 1998), affecting just over half of all students. However, since 1990, the real value of grants had been eroding dramatically since they were frozen in real terms (see Figures 2-4, which illustrate the value of grants, fees and loans for students from different parental income backgrounds) so that in the period before their abolition they were extremely low, at a maximum of £810, in nominal terms. Finally, government-subsidised maintenance loans were increased. This latter reform was fully  sed [g5][EF6]in by 1999 (Goodman and Kaplan, 2003, Barr, 2004). Indeed, for those formerly eligible for grants, the increase was commensurate to the reduction in the grant, as is clear from Figures 2-4.

By 2004 UK participation had increased significantly, but despite Government declarations on the importance of widening participation, representation of the lowest socio-economic groups had barely changed, though in absolute terms it had risen (see Mayhew, Deer and Dua, 2004). There was also concern that the student support package was still too low to cover the costs of attending university (Barr, 2004). A further concern was that UK universities were still under funded compared with the rest of the OECD, compromising their quality and hence competitiveness (Greenaway and Haynes, 2003). To address these issues, the Government introduced the Higher Education Act in 2004.

2.2 2006 Reforms

This Act, fully in place by 2006, abolished upfront tuition fees and replaced them with a higher deferred fee, to be implemented in the 2006/07 academic year. Unlike its predecessor, the new fee was not means-tested, and could be up to £3,000 per year, with the amount at the discretion of each university (Dearden et al, 2004; 2008).[7] Fees

[7] In practice, **% of universities charged the full fee.

were deferrable until after graduation, using government subsidised income-contingent loans.

Another change to occur as a result of this act was the re-introduction of maintenance grants of up to £2,700 for the poorest students[8].

Maintenance loans were meanwhile reduced slightly for those students who qualified for the grant increase (those with parental income of below around £37,000)

The elements discussed above are summarised in Tables 1-3 below, where their precise relationship with parental income is shown for some example years.

Table 1: Maintenance grant eligibility by parental income (£2006)

GRANTS	year			
parental income	1992	1998	2004	2006
<£10,000	2989	949	1040	2700
£20,000	179	949	248	2283
£30,000	0	569	0	832
£40,000	0	0	0	0
£50,000	0	0	0	0
>£50,000	0	0	0	0

Table 2: Tuition fee eligibility by parental income (£2006)

FEES	year			
parental income	1992	1998	2004	2006
<£10,000	0	0	0	3000
£20,000	0	373	0	3000
£30,000	0	1172	980	3000
£40,000	0	1172	1196	3000
£50,000	0	1172	1196	3000
>£50,000	0	1172	1196	3000

Table 3: Maintenance and fee loan eligibility by parental income (£2006)

LOANS	year

[8] Maintenance grants had in fact been reintroduced in 2004/05 at £1,000 per year.

parental income	1992	1998	2004	2006[1]
<£10,000	943	3204	4260	6555
£20,000	943	3204	4260	6555
£30,000	943	2884	4260	7005
£40,000	943	2403	3262	6549
£50,000	943	2403	3199	6305
>£50,000	943	2403	3199	6305

[1]Includes £3000 fee loan (introduced in 2006)

As Tables 3-5 indicate, all elements of HE finance are means-tested (with the exception of deferred fees introduced in 2006, which are payable by all students). Thus parental income perfectly predicts the amount of fee, loan and grant a youth *would be* eligible for were (s)he to attend university the following year.

While the main policy changes in grants, fees and loans generate important variation over time, all three are highly correlated with each other, and with parental income, due to the means-testing criteria. This can be clearly seen from Figures 2-4, which show fee, grant and loan eligibility over time and by parental income.[9] They show in particular how loans have been used by policymakers to help offset adverse changes to grants and fees.

For instance, an inverse relationship between grants and loans is evident from Figures 2 and 3, in line with policymakers trying to offset grants reductions with loan increases, to leave students no worse off in terms of upfront costs.

Moreover, it is clear from Figures 3 and 4 that when fees were introduced for medium and high income students (1998/99), loans were extended considerably at the same time (so that by 1999 the increased cost in fees was fully covered by an increase in loans for those eligible for fees). Though not explicitly stated, the intention was that they cover the increased fees (indeed, anecdotal evidence suggests that students used their maintenance loans to pay for fees[g9][EF10]). Similarly, we see that in 2006/07, fees were increased, but were deferred and covered completely by a loan.

[9] For ease of illustration, we present these charts by income group – where "Low Income" students are those who will always be eligible for full grants, and never eligible for means-tested fees (parental income approx <£17,500pa); "Medium income" students are eligible for partial grants and partial means-tested fees (parental income approx >= £17,500 & <= £37,500); "High income" students are never eligible for fees, but always eligible for means-tested fees (parental income approx > £37,500).

So, for each of the main policy changes, policy makers increased loans to offset increases in costs arising from falling grants and rising fees. This results in a high degree of collinearity between loans, grants and fees during the time of these policy shifts. As explained in section 4, we deal with this issue by converting our data into a pseudo panel, applying a fixed-effects transformation – a common method of dealing with linearity[g11].

Figure 2 Fee, Grant and Loan eligibility: Low income students

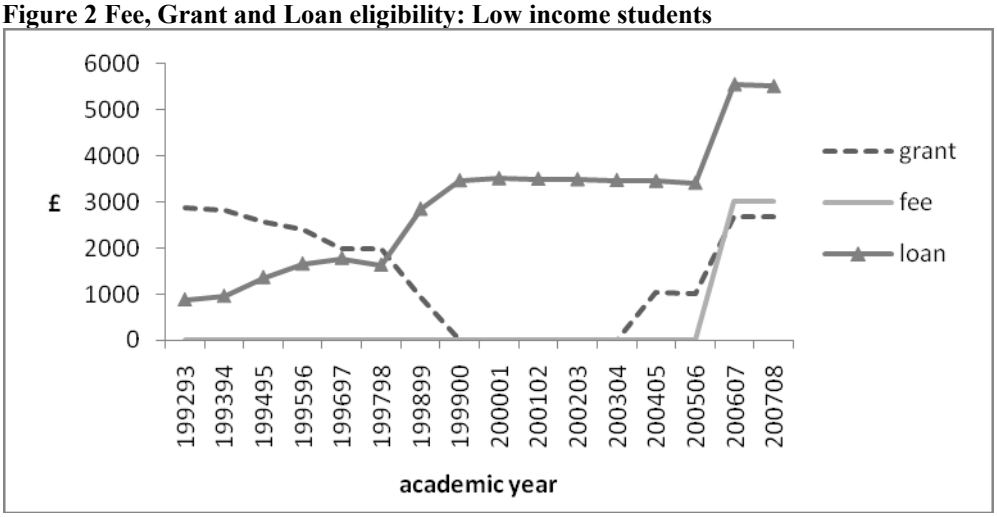


Figure 3 Fee, Grant and Loan eligibility: Medium income students

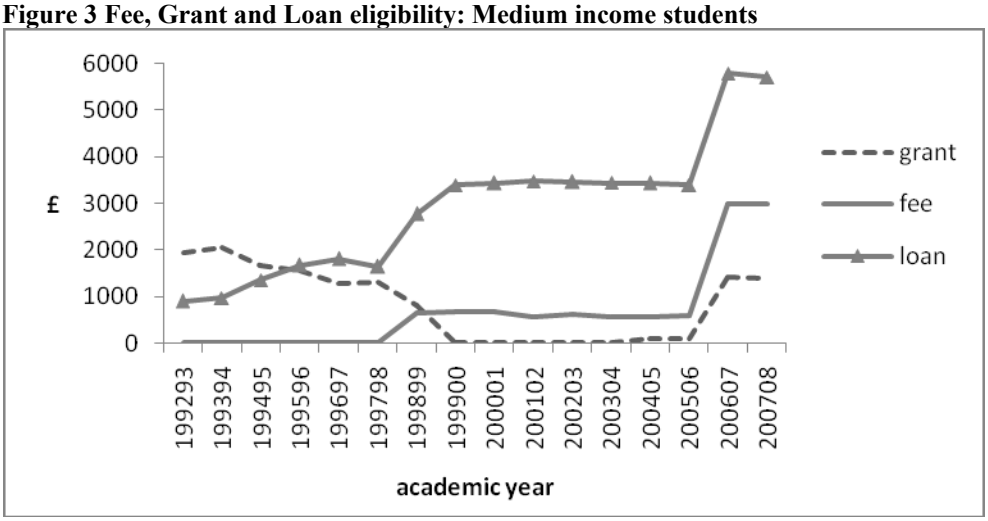
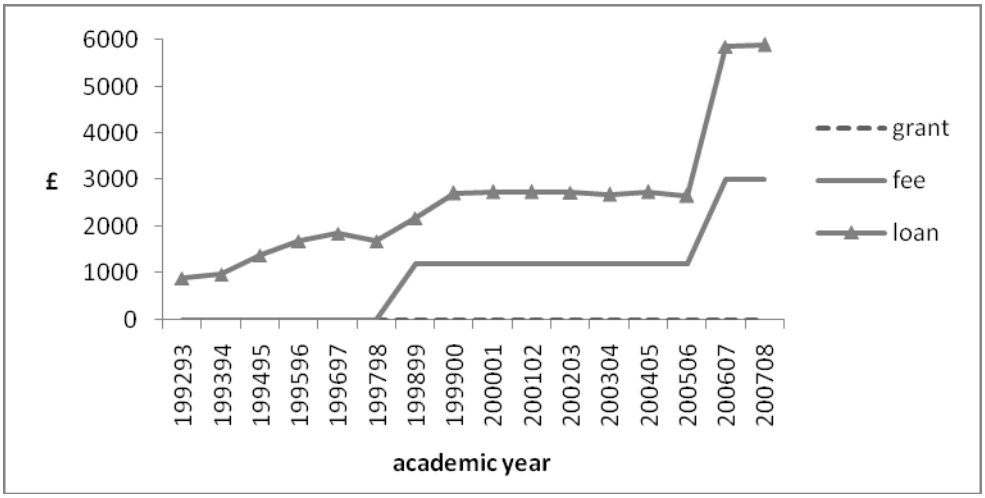


Figure 4: Fee, Grant and Loan eligibility: High income students



3. Data

We are interested in finding out whether grant, fee and loan eligibility affects an individual's likeliness to enter university. Therefore, our sample of interest is youths of university entry age. In particular our sample consists of those eligible for *their first year of* university, who are subject to the finance policy in place in their first year of entry (subsequent policy changes do not affect them). We take these to be people who are of the appropriate 'academic age' for first year of university (as determined by precise date of birth)[10], whatever their education background. We do not consider continuing university students in our analysis (i.e. those already in the HE system) since we are unable to tell which HE Finance policy they are subject to (this depends on year of entry into education – information we do not have – rather than current year of study) or whether they decided to enter university after a gap year or more to avoid an HE policy. Furthermore, our paper concentrates on the effect of HE Finance on entry to HE rather than on the decision to continue.

For this sample of individuals, we require access to their parental income in order to calculate the amount of fees, - grants and ns [g12]they *would be* eligible for were they to go to university. Note since we do not observe take-up of grants and loans, we model students' behaviour based on what they are eligible for – i.e. 'intention to treat', which is more at the heart of policy makers' concerns.

[10] For more information on the English school admissions entry criteria see http://www.teachernet.gov.uk/management/atoz/c/compulsoryschoolage/

However, few datasets observe people living at home in the year before they are eligible for university, along with their date of birth and their parents' income, which is what is used to determine grant and fee levels. Moreover, datasets that successfully follow that specific individual into university or otherwise, a year later, are even harder to come by! The Labour Force Survey (LFS) was the only one that fulfilled these criteria and contained adequate sample sizes to enable robust estimation.[11] This is a survey following around 60,000 households every quarter. It has both cross-sectional and longitudinal elements – households are interviewed for 5 consecutive quarters (i.e. waves 1 – 5) and then removed from the panel and replaced. We use LFS data from 1992 through 2007 in all that follows.

We use this data set to create an accurate picture of university participation in the following way. We assess whether an individual is of university age in wave 5 (using date of birth as previously described). If so, we obtain their parent's income in wave 1 and calculate their fee, loan, and grant levels. The dependent variable is whether the individual is participating in university in wave 5 or not. This method applies to all individuals living in either home or in halls of residence (89% of first year university participants). For the remaining 11% who live in private accommodation, we have no parental income information (since such individuals are in independent households). For these individuals we estimate fee, loan and grant eligibility on the basis of their own characteristics, using the year of university eligibility for identification. The sensitivity of this approach is tested by excluding them from the model completely and the results are found to be similar (see Section 6 for full details of this method and the results).

Another potential issue with our parental income data is that some individuals' parental incomes are observed only in the year in which they go to university, rather than the year before. This is true of all individuals in the LFS pre-1996, in which income information was only recorded in wave 5, as well as some individuals for whom the information is missing in wave 1 but not in wave 5. For these individuals,

[11] 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).

we impute their lagged parental income based on their current wave 5 income, adjusting for inflation. We test for 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.

In the analysis that follows, the sample is restricted to youths in England, Wales and Northern Ireland since Scotland experienced a significant departure from UK policy in 2000, and as part of this, introduced an endowment of £2289 per student, to be paid upon graduation. This renders the Scottish system very different to the English system, with no comparable series in the rest of the UK.

Our outcome variable is "studying for first degree" – the average participation rate of the sample is 16.1% though participation varies considerably by income group, as seen in Figure 5[12], with only 11.4% of individuals from low income backgrounds studying for a degree, versus 31.8% from high income kgrounds[g13]. The sample is evenly split between males and females, those with and without five good GCSEs and parental education types. Again it can be seen, unsurprisingly, that those with high parental incomes have very highly educated parents, and vice versa. The significant increase in participation in 1992/93 academic year arising from the 1992 HE act is also somewhat apparent in this chart[13].

Figure 5: Degree participation over time (LFS)

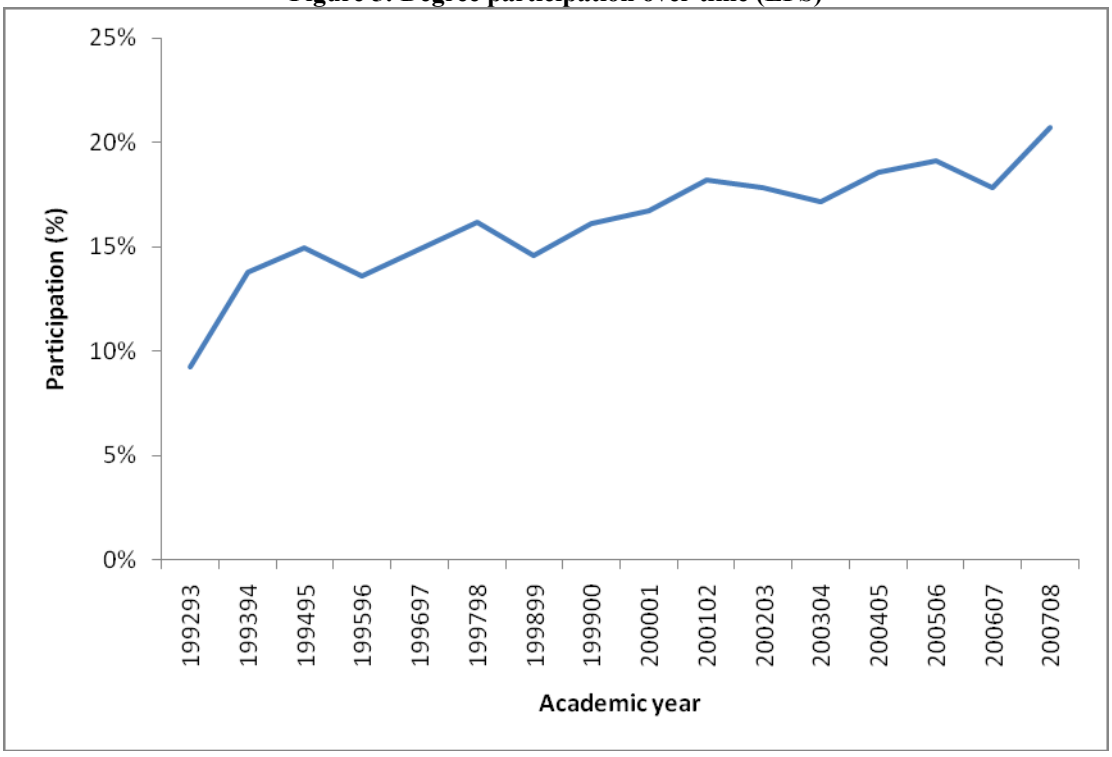


Table 4 shows summary statistics and sample means, including the selection of control variables which will be used throughout the remainder of this analysis. These

[12] We use the income groups defined in Section 2.2 (see footnote 12) in the descriptive statistics

[13] In a sensitivity testing stage, all models are re-estimated excluding 1992/93, with little effect on the results.

are ethnicity (a binary variable taking the value of one if the individual is white and zero otherwise)[14], youth's prior attainment (a binary variable taking the value of one if the youth has five or more good GCSEs and zero if the youth has less than five)[15], parents education (this is available for each parent and is measured in 3 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 (using 18 regional dummies in total, representing the 16 major regions of England, and one each for Wales and Northern Ireland). Note that region represents the region of home domicile of the individual. This means that those living at home or in halls of residence will have their home domicile as their region, rather than the region of the institution they are attending. This is in fact preferable, since HE finance is dependent on country of domicile rather than location of institution. For example, English, Welsh and Northern Irish students studying in Scotland would still have to pay fees even though they were abolished for Scottish students, so knowing the location of their institution is irrelevant.

Thus, the final sample size, including those living away from home and not in halls of residence for whom parental income is imputed, but excluding those with missing parental income for other reasons, is  486 [g14]youths of age 18-19.

[14] While a number of ethnic groupings are available in the LFS dataset, white represents the majority with the others spread throughout several smaller categories, so for simplicity a binary variable is created

[15] A variable measuring number of A-levels is available in the LFS dataset, but only from 1993 onwards, and is limited in granularity to less than 1 or 1 or more. For these reasons GCSE or equivalent is chosen as a more robust measure of prior attainment.

Table 4: Summary Statistics (LFS, 1992-2005)[1]

		parental income:				sex:	
	all	g15]	medium	high	missing	male	female
% all sample	-	45.6	28.1	15.0	11.3	51.4	48.6
% of participants	15.9	11.4	16.6	31.0	12.9	14.1	17.9
% of non-participants	83.9	88.7	83.3	68.2	87.1	85.9	82.2
ethnicity							
white (%)	84.8	80.6	90.0	92.0	79.2	84.8	84.8
non-white (%)	8.5	12.7	4.8	3.9	10.9	9.0	9.0
missing (%)	6.7	6.7	5.2	4.1	9.9	6.3	6.2
youth's education							
GCSEs >=5 (%)	46.9	41.2	51.1	69.2	30.0	43.2	50.9
GCSES < 5 (%)	49.9	55.7	46.3	29.1	63.7	53.4	47.6
missing (%)	3.2	3.1	2.6	1.7	6.4	3.4	1.5
parent's education [1]							
NVQ level 4 +(%)	34.2	24.0	43.7	73.1	-	35.2	33.1
NVQ level 2 or 3(%)	22.4	25.8	29.6	15.7	-	23.3	21.5
NVQ level <2(%)	27.6	44.7	21.6	7.5	-	29.5	25.7
missing (%)	15.8	5.5	5.1	3.7	100	12.0	19.8
parental inc £	22,227	6,315	27,914	57,449	-	21,872	22,649
region							
England (%)	88.4	86.2	90.0	92.1	88.8	88.7	88.2
Scotland (%)	-	-	-	-	-	-	-
Wales (%)	5.8	6.0	5.8	5.2	5.9	5.7	6.0
Northern Ireland (%)	5.8	7.8	4.2	2.7	5.3	5.7	5.8
sample size	22,486	10,264	6,308	3,380	2,534	11,567	10,919

[1] Sample below is all those first year eligibles, with known parental incomes or, for those living independently, but of eligibility age, imputed parental incomes

[2] This is the education level of the more educated parent.

4. Estimation

Our basic model is as follows:

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

for i=1,…N; t=1992,…,2007, where

$P_{i,t}$=1 if individual i participates in HE in year t, =0 otherwise

$F_{i,t}$ is the HE fee level for individual i were (s)he to participate in HE in year t

$G_{i,t}$ is the HE grant level for individual i were (s)he to participate in HE in year t

$L_{i,t}$ is the HE loan level for individual i were (s)he to participate in HE [GaS16]year t[16]

$X_{i,t}$ are background characteristics affecting choices, including GCSE attainment (a binary variable which takes the value of 1 if the individual has 5 or more GCSEs at A*-C), parental education (defined as education level of the most highly educated parent), ethnicity, parental income in year t and gender

τ_t is a time trend

ρ_r is a set of regional dummies

$u_{i,t}$ is an iid error term

Beyond 2006 we create a composite loan series which incorporates both fee and maintenance loans in order to be able to extend this series beyond 2005. Thus, we treat fee and maintenance loans as a single entity. We believe this is plausible since, as we have described, loans were extended in 1998 as upfront fees were brought in, and anecdotal evidence suggests that while there were no explicit fee loans, individuals did in fact use their maintenance loan to pay for cover fees (since the fee was upfront, it effectively reduced upfront benefits to those students who were eligible for it).

Ideally, we would estimate the model using OLS on our pooled cross-sectional data. However, our set of explanatory variables of interest (fee, grant and loan eligibility) are highly collinear, meaning it is difficult to identify their separate effects, and the parameter estimates are very sensitive to the inclusion or exclusion of variables[17]. .

Figures 2-4 illustrated that the three elements of the HE finance package are very closely related, indeed policy is specifically designed so that students are no worse off

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[16] Note that this is the upfront value of the loan and thus we are testing an individuals' response to the upfront value rather than the loans' true value, which will depend on how much the individual eventually repays. Since loans are income contingent the amount repaid will depend on the individual's labour market outcome and therefore will vary across individuals. The worth of the loan to an individual will also depend on his/her discount rate. In Section 6 we transform the loan's value by applying a discount rate (standard across individuals) and thus estimate the response to a truer approximation to the loans worth.

[17] In an initial testing stage we experimented with a number of specifications on our individual level data, and found the coefficients to be highly sensitive to the inclusion and exclusion of different variables.

upfront than previously, through the Government's policy of using increases in loans to offset decreases in grants and increases in fees. Tables 5 and 6 illustrate this offsetting more clearly, for two example periods before and after the major reforms:

Table 5: Change in overall costs of university attendance as result of 1998 reforms (£[g17])

	Low income		Medium income		High income	
	1997	1999	1997	1999	1997	1999
Grants	2097	0	1107	0	0	0
Fees	0	0	0	856	0	1177
Loans	2014	4175	2014	4175	2014	3130
net costs[1]	-4111	-4175	-3121	-3319	-2014	-1953
change in net costs		-64		-198		61

[1] Net costs defined as fee-loan-grant; see for example Kane(1995)

Table 6: Change in overall costs of university attendance as result of 2006 reforms (£[g18])

	LOW INCOME		MEDIUM INCOME		HIGH INCOME	
	2005	2006	2005	2006	2005	2006
Grants	1020	2700	0	0	0	0
Fees	0	3000	367	3000	1199	3000
Loans	4177	6555	4177	6555	3137	6305
net costs[1]	-5197	-6255	-3810	-3555	-1938	-3305
change in net costs		-1058		255		-1367

[1] Net costs defined as fee-loan-grant; see for example Kane(1995)

As table 5 shows, low income students experienced a large decrease in their grants between 1997 and 1999 – but this was almost exactly offset by an increase in their loan eligibility so that they were no worse off upfront. Similarly, high income students were around £1200 worse off from the introduction of fees – but they too received loan increases of around the same amount.

Moreover, as illustrated in Tables 1-3, loans, grants and fees are perfectly related to lagged parental income, and thus closely related to current parental income, another regressor. Indeed, only some kinks in the formulae for grants, fees and loans render their relationship with parental income non-lar[GaS19][18].

[18] Another possible modelling strategy would be regression discontinuity since the means testing rules generate discontinuities in grants and fees in particular, in certain years. However, our sample sizes are not large enough at the discontinuities (which vary by parental income) to produce robust analysis of this nature.

A common method used to deal with this problem is to transform the data. The idea is to transform the data in such a way that the resulting variables are not collinear. For example, it may be the case that while two variables at time t are highly collinear, they may not be so related at time t-1, and therefore a first-difference model solves the problem of collinearity. Following this type of strategy would require longitudinal panel data following an individual over time, however, and as discussed our data are repeated cross-sections (in fact, since university decision making is a one-off choice which occurs at a particular (school-leaving) age, a standard panel set-up is infeasible in our context). Instead, we adopt a pseudo-panel approach to estimate the model.

seminal paper, Deaton (1985) suggests the use of cohorts to estimate a fixed effects model from repeated cross-sections. Individuals sharing common characteristics, such as year of birth, are grouped into cohorts, after which the averages within these cohorts are treated as observations in a pseudo panel.

We define groups on the basis of region, gender and parental education.[22] So in practical terms, we aggregate HE participation by region, sex, level of parental education and time: for example, we take all males whose most highly educated parent is educated to Level 4 or above in region r in 1992 and compute their average HE participation; we do exactly the same for females. This grouping is natural: as Verbeek (2007) discusses, cohorts should be defined as groups whose explanatory variables change differentially over time. This is certainly the case for a key explanatory variable in our model – GCSE results – which varies markedly over time by parental education background, region and gender.

Thus our equation of interest becomes:

$$P_{rgyt} = \alpha + \beta_1 F_{rgyt} + \beta_2 G_{rgyt} + \beta_3 L_{rgyt} + \gamma X_{rgyt} + \tau_t + f_{rgy} + v_{rgyt} \qquad (2)$$

[21] Note, regions pertain to an individuals home rather than where they attend university. So those individuals whose normal residence is in England but who attend university in Scotland will be recorded in English regions. This is preferable, since grant and fee amounts are calculated according to home domicile.

[22] Note, regions pertain to an individuals home rather than where they attend university. So those individuals whose normal residence is in England but who attend university in Scotland will be recorded in English regions. This is preferable, since grant and fee amounts are calculated according to home domicile.

Where p_{rgyt} represents the mean participation rate in Higher Education in the 144 regional groupings (18 English, Northern Irish and Welsh regions split by gender *g* (male or female) and education group y (of which there are 4 education groups – NVQ Level 4 or above, NVQ Level 3, NVQ Level 2 and NVQ Level 1 or below; this is defined as the education level of the most highly educated parent) at time *t* (between 1992 and 2007). The remaining variables, aside from the error terms, are as found in equation 1, again at their mean levels within region, for each education and gender group, by year.

Now, the presence of unobserved heterogeneity that is fixed over time is allowed for by group (f_{rgy}), while v_{rgyt} represents the usual random error component.

As discussed, our main reason for using this approach is to transform our data to deal with the high degree of collinearity of our explanatory variables. The pseudo-panel transformation helps in the following way: while an individuals grant is directly related to his fee in time t due to his parental income, the average grant for region r and gender g (which is the average of all grants in that region, which will be a wide range of values) is less directly related to the average fee for region r and gender g (again, an average of a number of fee levels). The panel set up breaks the direct link between the HE finance variables and parental income (and hence their direct link to each other) since the average grant in region r is not a linear transformation of average income in region r, rather it is the average of all grants in region r. Indeed our fixed effects methodology transforms the data even further.

It is well-known, in building a pseudo-panel data set, there is a trade-off between the size and number of cohorts. Small cohorts imply less precise estimates of the cohort means and thus the trade-off is essentially between the number of 'artificial' observations and the accuracy of these observations - the narrower the groups chosen, the greater the number of data points, but the smaller the number of observations per cell and hence the greater the potential error in the estimate of the group mean. Our

choice of groups gives a balanced panel of 10 groups, in 18 regions, over 16 years, or 2880 cells in total. The size distribution of each group is given in Table 7.

Table 7 Pseudo-panel group [g24]

Group	Description	Freq.
1	male, parental education level 4 or above	4,398
2	male, parental education level 3	3,744
3	male, parental education level 2	2,097
4	male, parental education below level 1 or below	4,596
5	male, missing parental education	1,118
6	female, parental education level 4 or above	3,956
7	female, parental education level 3	3,339
8	female, parental education level 2	1,842
9	female, parental education below level 1 or below	3,957
10	female, missing parental education	2,359
Total		31,476

To estimate the model, the averages within groups are treated as observations in a pseudo-panel to which standard techniques for panel data estimation are applied. So we treat the pseudo panel as if it were a genuine panel and estimate the model using fixed effects. Note that grouping into cells tends to homogenise the individual effects among individuals grouped in the same cell, so that the average specific effect is approximately invariant between periods and can be removed by within or first difference transformations.

5. Findings

The set of findings from the pseudo-panel approach, in which we estimated a Fixed Effects model are presented in Table 8.

Table 8 Probability of Attending a University Degree Course [GaS25] **£1000 of grants and fees; Pseudo-panel Fixed Effects Model**

	(2) FE
Grant	0.022
	(0.010)**
Fee	-0.037
	(0.014)**
Loan	0.021
	(0.011)*
parental income	0.005
	(0.000)

White	-0.099
	(0.02)**
GCSE	0.255
	(0.017)***
Low income	0.090
	(0.084)
Medium income	0.132
	(0.085)
High income	0.160
	(0.952)
unemployment rate	0.008
	(0.003)**
Constant	-0.291
	(0.107)**
Time trend (lin & n-lin)	Y
Observations	2806
R-squared	0.19
Number of groups	180

The results imply that a £1000 increase in fees results in a 3.7 percentage point decrease in participation, whilst a £1000 increase in grants leads to a 2.2 percentage point increase in participation and a £1000 increase in loans leads to a 2.1 percentage point increase in participation. These coefficients are in-line with the findings of Dynarski (2004) and Kane (1995), as described in Section 1, bearing in mind inflation and exchange rates. A somewhat counter-intuitive result is that the coefficient on loans is not found to be significantly different from the coefficient on loans (bearing in mind that as previously described, we are testing the impact of the upfront value of loans on participation and do not take into account discount rates, or knowledge and uptake of loans and grants). Under these simple assumptions these results imply that individuals place the same value on loans as they do on grants.

The set of explanatory variables is highly significant. Prior attainment is a key driver of participation, in line with widely accepted theory (Heckman and Carneiro, 2003; Gorard, 2006). GCSE attainment has a strong positive impact on participation – an increase from less than 5 good GCSEs to 5 or more good GCSEs results in a 25 percentage point increase in the probability of attending university – and whites are less likely than non-whites to go to university.

Conclusions

In this paper we have estimated the impact of tuition fees, loans and grants on HE participation using a pseudo-panel technique which helped us to overcome problems associated with collinearity among our variables of interest. The use of pseudo-panel techniques meant that this estimation problemcould be dealt with using fixed effects, since observations were then observed in more than one time period.

Our main finding is that a £1,000 increase in upfront tuition fees *reduces* degree participation by 3.7 percentage points, while a £1,000 increase in maintenance grants *increases* participation by 2.2 percentage points, and a £1,000 increase in maintenance loans *increases* participation by 2.1 percentage points. These results are in line with, but of a slightly lower magnitude, than those estimated in the US in a number of studies such as Kane (1995), Dynarksi (1999) and Helemt and Marcotte (2008).

These results are highly relevant for policy makers, who ought to be aware of the negative impact of fees and the positive impact of aid on participation. Maintenance grants and loans can potentially be used to offset the negative influence of fee increases, given their opposing influences on participation. Policy makers should also be aware of particularly vulnerable groups when setting levels of fees and grants, and may need to target specific groups with more generous aid to counteract any increases in tuition fees.

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