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Filipa Sá

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Filipa Sá
King's College London
and IZA

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IZA

P.O. Box 7240
53072 Bonn
Germany

Phone: +49-228-3894-0
Fax: +49-228-3894-180
E-mail: iza@iza.org

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ABSTRACT

The Effect of Tuition Fees on University Applications: Evidence from the UK*

This article exploits variation in university tuition fees over time and across countries in the UK to examine the effect of fees on applications to higher education. It focuses on two policy changes: the removal of upfront tuition fees in Scotland in 2001 and the increase in fees in England in 2012. The findings suggest that the 2001 reform increased applications by 24.4%, while the 2012 reform reduced applications by 30.3%. The 2012 reform had a larger negative effect for applicants aged 20 and over and for courses with lower expected earnings after graduation.

JEL Classification: I21, J24

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Corresponding author:

Filipa Sá
Department of Management
King's College London
Franklin Wilkins Building
150 Stamford Street
London SE1 9NH
United Kingdom
E-mail: filipa.sa@kcl.ac.uk

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1 Introduction

The cost of a degree is an important determinant of the decision to apply to university. In the UK, there have been significant changes in tuition fee policy in recent years. Before 1998, the cost of a university degree was entirely supported by the government. Since then, students have been asked to pay part of the cost of higher education, but the level of tuition fees varies across UK countries.

This article exploits variation in tuition fees over time and across countries in the UK to study the effect of fees on the demand for higher education, attendance and course choice. I focus on two policy changes: the removal of upfront fees in Scotland in 2001 (2001 reform) and the increase in fees in England in 2012 (2012 reform). The 2001 reform replaced upfront fees of £1,000 per year with an endowment scheme in which students pay a total of £2,000 after graduation. This applied only to Scottish-domiciled students attending university in Scotland. The 2012 reform increased fees from £3,375 to a maximum of £9,000 per year for students at English universities.

Using difference-in-differences estimation, I find that the 2001 reform increased applications by 24.4%, while the 2012 reform reduced applications by 30.3%. The results imply an elasticity of applications with respect to fees between −0.23 and −0.33. The effect varies by age group. In particular, the increase in fees in England in 2012 reduced applications by more for applicants aged 20 and over than for younger applicants.

I use information on average expected salaries after graduation by subject and institution to test whether tuition fees have a different effect on applications at different points of the distribution of expected future earnings. The findings suggest that the 2001 reform increased applications by more for courses that offer higher expected salaries, while the 2012 reform reduced applications by more for courses that offer lower expected salaries after graduation. This suggests that applicants take expected future earnings into account when making their course choices.

In addition to applications, I look at the effect of tuition fees on the number of students who accept a place at a higher education institution. While applications capture the demand for higher education, acceptances are determined by demand and supply. I find that the reforms had no significant effect on acceptances, which is consistent with the fact that the number of places at universities and colleges in the UK is controlled by the government.

This article contributes to the literature on the effect of schooling costs on schooling outcomes.

The identification challenge in this literature is the fact that unobservable individual characteristics affect schooling outcomes. Therefore, a simple regression of schooling outcomes on schooling costs would suffer from an omitted variable bias.

A number of studies use quasi-experimental methods to get around this issue. Deming and Dynarski (2009) review this literature for the US and find that most studies provide evidence that reducing college costs can increase college entry and persistence. Most of these studies focus on young students, who have just graduated from high school. An exception is Seftor and Turner (2002), who use difference-in-differences estimation to study the effect of the means-tested federal Pell grant program on college enrollment of students aged 21 and over who are heads of household. They find that the Pell grant had a positive and significant effect on the probability of enrollment for these students. This contrasts with the findings for young high school graduates (18 and 19 year olds) reported in Kane (1995), which suggest that the Pell grant program had no effect on college enrollment. Garibaldi et al (2012) use a different methodology to establish causality and adopt a regression discontinuity design to exploit variation in the level of tuition paid by students at Bocconi University in Italy. They find that an increase in tuition fees reduces the probability of late graduation.

For the UK, there are some studies looking at the effect of tuition fees and student grants on university attendance. Dearden et al (2011) use data on university participation from the UK Labour Force Survey from 1992 to 2007 to estimate a fixed effects regression of participation rates on the level of tuition fees and grants. They find that fees have a significant adverse effect on university participation, while maintenance grants have a positive impact. Crowford and Dearden (2010) study the effect of the introduction of higher tuition fees in England in academic year 2006/07 on university participation. They use difference-in-differences estimation, comparing attendance rates of English students living near Scotland and English students living far from Scotland. The intuition for this identification strategy is that English students attending university in Scotland still have to pay fees, but at a lower level than if they were attending university in England. The results suggest that the reform did not have a significant effect on participation, although the authors attach little weight to these finding because participation trends prior to the reform appear different for the two groups of students.

Some policy reports use descriptive statistics to study the effect of the most recent increase in

fees in England in 2012 on university applications. The report of the Independent Commission on Fees (ICOF, 2012) shows that the number of applicants decreased significantly in 2012 compared with 2010. This reduction was mainly seen in England, with applications broadly constant in Scotland. When looking at differences by age group, the largest reduction in applications was for English applicants aged 20 and over. Similar findings are reported in UCAS (2012).

To my knowledge, this article is the first to evaluate the effect of the removal of upfront fees in Scotland in 2001 and the increase in fees in England in 2012 using quasi-experimental methods. It also adds to the existing academic literature by looking at applications as well as participation. The results from the two experiments are consistent and point to a negative effect of an increase in fees on applications to higher education.

The rest of the paper is organized as follows. The next section presents the institutional framework, summarizing the main changes in tuition fees across the UK and over time. Section 3 discusses the predictions of a simple schooling model for the effect of tuition fees on applications by younger and older students. Section 4 discusses the empirical methodology. Section 5 discussed the data and presents descriptive statistics. Empirical results are presented and discussed in Section 6 and Section 7 concludes.

2 Institutional Framework

University tuition fees were first introduced in all UK countries in September 1998. Fees were set at £1,000 per year, with the expectation that means testing would imply that one third of students would not pay any fees.[1] Since then, there have been several changes in the level of tuition fees, with important variation across countries. In 1999, a devolution government was established in Scotland. The new Scottish Parliament received separate legislative powers in many areas, including tuition fees. From its creation, the Scottish Parliament adopted a distinctively different policy regarding tuition fees from that followed in the rest of the UK.

Figure 1 shows a time line with the evolution of tuition fees in England and Scotland. In Scotland, tuition fees were replaced with an endowment scheme in 2001. Instead of paying fees

[1] Students were exempt from fees if their families earned less than £23,000 per year and were charged reduced fees on a sliding scale if their families earned between £23,000 and £35,000. Students whose families earned more than £35,000 were charged full fees.

upfront, Scottish-domiciled students were required to pay a total of £2,000 after graduation if their annual earnings exceeded £10,000. In 2007, the Scottish government went one step further and eliminated fees altogether for Scottish-domiciled students graduating on or after April 2007. Students at Scottish universities qualify for no tuition only if they have been living in Scotland for at least three years by the time they start university or if they have moved to Scotland for a reason other than study.

England has also made changes to tuition fees since their first introduction in 1998. In 2004, it was announced that, from academic year 2006/07, upfront tuition fees of £1,000 per year would be replaced with variable fees to be paid after graduation if annual earnings exceeded £15,000. Universities had discretion over the amount of fees they charged, up to a maximum of £3,000 per year.[2] In 2010, the government announced that this cap would be raised to £9,000 per year for students entering university in academic year 2012/13. This announcement generated intense discontent among students and led to a number of public demonstrations.

Although universities have discretion over the amount of fees they charge, there is evidence that most universities in England have increased their fees substantially in response to increases in the maximum tuition limit. According to Universities UK (2009), almost all higher education institutions in England chose to set fees at the £3,000 cap from 2006/07. Regarding the most recent reform, evidence from HEFCE (2013) shows that, in 2012/13, 42 of 124 higher education institutions in England were charging the maximum level of fees of £9,000 and no institutions were charging less than £6,000. The sector average fee was £8,040 in 2012/13 and £8,507 in 2013/14.

In Wales, the cap on tuition fees was also increased to £9,000 in 2012, but the Welsh Assembly pays fee costs above £3,465 per year for Welsh students studying at any UK university. In Northern Ireland, fees were capped at £3,465 in 2012 for students from Northern Ireland, to rise in line with inflation in subsequent years. Fees for students from outside Northern Ireland were not capped, but were not expected to exceed £9,000.

This article exploits variation in tuition fees in Scotland and England to identify the causal effect of fees on schooling decisions. It focuses on two reforms:

- The replacement of tuition fees with an endowment scheme in Scotland in 2001 — 2001 reform

[2] This limit increased slightly every year in line with inflation and was at £3,375 in 2011/12.

- The increase in the cap on tuition fees in England in 2012 — 2012 reform

The 2006 reform in England is not analyzed because it would be difficult to separately identify its effect from the removal of fees in Scotland in 2007.

Both reforms analyzed in this article introduced significant changes in the amount of tuition fees paid by affected students. From the introduction of upfront fees in 1998 until the 2001 reform, Scottish students had to pay £1,000 per year, making the tuition cost of a degree equal to £3,000.[3] After the 2001 reform, the tuition cost of a degree for Scottish students attending university in Scotland fell to £2,000, with the added advantage of only being paid after graduation. In England, the 2012 reform increased the tuition cost of a degree from just over £10,000 to £27,000, for students at universities that charge maximum fees.

The increase in fees in England led to a significant change in the sources of funding used by students. Figure 2 reports the percentage of English-domiciled students studying full time at universities in England by funding source. Until the increase in fees in 2006, the fraction of students who borrowed to cover the cost of tuition was about the same as the fraction who did not receive any financial support. The increase in fees led to an increase in the fraction of students who fund their education with loans and a reduction in the fraction of self-funded students. This trend continued and in 2012 the vast majority of students (74%) were borrowing to pay tuition fees.

Student loans are provided by the Student Loans Company (SLC), which is owned by the government. The average amount of debt owed by students in England at the time when they start repaying their loans has been increasing steadily over time, according to data from the SLC. The amount of student debt on entry into repayment (including both tuition and maintenance loans) was just over £20,000 in 2014, which is about the same level as the average annual salary of English graduates six months after graduation.[4] This is expected to rise even further once students who pay fees at £9,000 start repaying their loans. By contrast, student debt in Scotland is much lower (at £7,600) because students do not have to pay fees and only borrow to cover maintenance costs.

[3] The typical duration of a university degree for full-time students is four years in Scotland and three years in England. However, fees for the final year of study in Scotland were waived to bring the total cost of a degree in line with the rest of the UK.

[4] According to data from the HESA Destinations of Leavers from Higher Education survey, the average annual salary of English-domiciled students who graduated in 2011/12 and were in full-time paid employment was £20,015 six months after graduation.

3 Theoretical Motivation

In the simple schooling model, first analyzed in Mincer (1958), high school graduates apply to university if the present value of their lifetime earnings with a university degree (net of direct costs of attending university) exceeds the present value of their lifetime earnings without a university degree. Specifically, suppose that a worker is employed for T years if he starts working after high school and is considering whether to go to university and postpone entry in the labour market by three years.

The present value of lifetime earnings if the worker does not go to university is:

$$PV_{HS} = \sum_{t=0}^{T} \frac{w_{HS}}{(1+r)^t}$$

where w_{HS} is the wage of a high school graduate and r is the discount rate.

The present value of lifetime earnings if the worker goes to university is:

$$PV_{Uni} = \sum_{t=3}^{T} \frac{w_{Uni}}{(1+r)^t} - \sum_{t=0}^{2} \frac{H}{(1+r)^t}$$

where w_{Uni} is the wage of a university graduate (with $w_{Uni} > w_{HS}$) and H is the direct cost of attending university (including tuition fees and maintenance costs).

A high school graduate applies to university if $PV_{Uni} > PV_{HS}$. This expression can be rewritten as:

$$\sum_{t=3}^{T} \frac{w_{Uni} - w_{HS}}{(1+r)^t} > \sum_{t=0}^{2} \frac{H + w_{HS}}{(1+r)^t}$$

This expression indicates that going to university involves two types of costs: the direct cost (H) and the opportunity cost (w_{HS}). Students apply to university if the present value of the wage differential they receive from having a university degree is large enough to cover the direct and opportunity costs of attending university. A direct result of this model is that an increase in tuition fees reduces the number of students who apply to university.

The model can also be used to study differences in schooling decisions by age. Assuming that wages increase with experience, the opportunity cost of going to university is larger for older workers. At the same time, older workers has fewer working years after graduation over which to

enjoy the higher earnings associated with a university degree. They are also likely to have a higher discount rate, reflecting the fact that they may be more financially constrained than young high school graduates.[5] All these factors imply that older workers are less likely to apply to university than young high school graduates. The difference in discount rates also implies that older workers are more sensitive to the level of tuition fees because they place a higher weight on present costs and a lower weight on future benefits of a university education. These differences by age group may explain why Seftor and Turner (2002) find that the Pell grant program in the US increased college enrollment of mature students, while Kane (1995) finds no effect for young high school graduates.

The schooling model explains the factors that determine the demand for higher education and is useful for understanding how tuition fees affect applications. However, when looking at the number of students who attend university, it is necessary to consider also the supply side, i.e., the number of places available at higher education institutions. In fact, while applications capture the demand side of the market, attendance is an equilibrium outcome, determined by demand and supply.

In England and Scotland, the number of places at universities and colleges is capped by the government. Each year, the funding councils in England and Scotland set the number of students that each institution may recruit, known as *student number control*. Controls on student numbers are based on guidance from the government and are justified by the need to limit the level of publicly-funded student loans and grants for fees and maintenance.

This policy implies that the supply of higher education in the UK is largely inelastic. Moreover, there is evidence that the number of places at universities and colleges has been consistently lower than the number of applicants, at least since the late 1990s. According to data from UCAS, reported in Figure 3, the ratio between the number of applicants and the number of acceptances at higher education institutions in the UK has been broadly constant at 1.3 to 1.4. In this context, an increase in tuition fees is expected to reduce applications, as predicted by the schooling model. However, it should not have any effect on acceptances, since universities are not able to respond to an increase in fees by recruiting more students.

[5] This may be the case because older workers are less likely to receive financial support from their parents and are more likely to have a family or other financial commitments.

4 Empirical Methodology

The identification challenge associated with estimating the effect of schooling costs on schooling decisions is discussed, for example, in Dynarski (2003). In principle, this effect could be captured by a reduced-form model with a measure of educational attainment as the dependent variable (for example, an indicator variable for whether an individual attends university or the number of university applications) and a measure of schooling costs as independent variable. The problem with this approach is that the cost of education is likely a function of omitted variables correlated with the demand for education. Institutional changes that introduce a discrete shift in the cost of education can induce variation that is uncorrelated with these unobserved determinants of schooling.

In the UK, the 2001 and 2012 reforms created variation in the cost of higher education that can be used to identify its effect on schooling decisions. I exploit variation in tuition fees over time and by country of domicile and estimate the following difference-in-differences (DD) model:

$$\ln(y_{djt}) = \gamma_d + \lambda_t + \delta D_{dt} + X_{djt}^{'}\beta + \varepsilon_{djt} \tag{1}$$

where d denotes country of domicile, j denotes gender, age group, institution and subject group (as described in the data section) and t denotes year. The dependent variable is the log of the number of university applications. The model includes country of domicile fixed effects (γ_d) and year fixed effects (λ_t). The vector of controls (X_{djt}) includes dummies for gender, age group, institution and subject; and the log of population living in country d, in gender and age group j in year t.

The regressor of interest is D_{dt} and indicates applications in the country affected by the change in tuition fees (treatment group) in the period after the change. When analyzing the removal of upfront fees in Scotland in 2001, this indicator is equal to one for Scottish-domiciled students in the period from 2001 to 2004 (the pre-treatment period goes from 1998 to 2000). The analysis stops in 2004 as this is the year when variable tuition fees where announced in England. When analyzing the increase in fees in England in 2012, the indicator D_{dt} takes the value one for English-domiciled students in 2012 and 2013. The pre-treatment period goes from 2008, after the removal of fees in Scotland, to 2010. I do not include 2011 in the analysis because applications in this year could have been affected by the announcement of a higher cap on fees in England in 2010. I focus on the

effect of the actual implementation of higher fees rather than the effect of the announcement.[6]

The causal effect of tuition fees on university applications is captured by δ and can be interpreted as the percentage change in the number of applications induced by the reforms. The specification controls for changes over time in average applications and for average differences in applications between students from Scotland and students from England. The key identifying assumption is that trends in applications would have been the same for English and Scottish students in the absence of the reforms. The reforms induce a deviation from this common trend, which is measured by the DD estimator. Although the level of applications in England and Scotland may be different, this difference should be captured by the country of domicile fixed effect (γ_d). To check the common trends assumption, I add country-specific time trends in equation (1) and estimate:

$$\ln(y_{djt}) = \gamma_{0d} + \gamma_{0d}t + \lambda_t + \delta D_{dt} + X'_{djt}\beta + \varepsilon_{djt} \tag{2}$$

where γ_{0d} is a country-specific intercept, as before, and γ_{0d} is a country-specific trend coefficient multiplying the time trend variable t.

An important feature of the UK reforms is that students at Scottish institutions only qualify for no tuition if they have been living in Scotland for at least three years by the time they start university or if they have moved to Scotland for a reason other than study. English students who move to Scotland to attend university still have to pay tuition fees. This is important because it reduces the potential for selection bias. If students were able to qualify for no fees simply by going to university in Scotland, we would probably observe that those who move to Scotland are more likely to apply to university, i.e. there would be a positive selection bias in the DD estimator for the 2001 reform and a negative bias for the 2012 reform. The requirement that a student must have lived in Scotland for at least three years to qualify for no tuition implies that membership of the treatment and control groups is arguably unrelated to individual choices.

Scottish-domiciled students still have to pay higher tuition fees if they decided to go to university in England. For the 2001 reform, this implies that the coefficient δ captures the effect of being eligible for reduced or no fees rather than the effect of actually paying reduced fees. For the 2012 reform, this implies that some students assigned to the control group actually receive treatment. In

[6] The results are qualitatively similar if 2011 is included in the post-treatment period.

the language of experiments, δ captures the intention-to-treat effect. In practice, however, the vast majority of Scottish-domiciled students apply to university in Scotland. In 2012, 96.5% of Scottish-domiciled applicants applied to university in Scotland (UCAS (2012)). Therefore, the coefficient δ is a close approximation to the effect of the treatment on the treated.

5 Data and Descriptive Statistics

Data on applications and acceptances were produced on request by the Universities and Colleges Admissions Service (UCAS), which manages all applications to undergraduate courses in the UK. The information provided is the number of applications and acceptances at English and Scottish universities by country of domicile (England and Scotland), institution (156 universities and colleges), gender, age group (18 years and under, 19, 20, and 21 and over), and subject (16 categories), for the period from 1998 to 2013.

Applicants are allowed to make more than one application to university. Until 2007, each applicant could apply to up to 6 courses. From 2008, the maximum number of choices was reduced to 5. Figure 3 plots the evolution of the number of applications per applicant since 1999. There is a marked reduction in this ratio in 2008, when the maximum number of choices was reduced. Apart from that year, the number of applications per applicant is broadly constant in the periods before and after 2008. This implies that the results that I obtain for applications should also provide information about the effect of tuition fees on the number of applicants. Acceptances measure the number of applicants that are offered and accept a place on a course. Unlike applications, there cannot be multiple acceptances per applicant, since applicants are only allowed to accept one offer.

Data on average salaries after graduation are from the Higher Education Statistics Agency (HESA) Destinations of Leavers from Higher Education (DLHE) survey. This survey covers the universe of all leavers who were UK domiciled prior to attaining higher education (with a response rate of 75%) and is conducted six months after graduation. The information provided is the average salary of first degree graduates on full-time paid employment (including self-employment) by gender, institution and subject. I combine this information with applications data to examine how changes in tuition fees affect applications along the distribution of expected future earnings.

The model controls for the log of population by country, year, gender, and age group (obtained

from the Office for National Statistics mid-year population estimates). Figure 4 plots the evolution of population aged 17 to 24 in England and Scotland. Population increased faster in England than in Scotland during the period of analysis. This should lead to a relative increase in applications by English-domiciled students, regardless of the level of tuition fees. I account for this by controlling for population in the model.

The common trends assumption is investigated in Figure 5, which shows the number of applications by country of domicile and age group. The figure shows that the number of applications was broadly constant in both countries before 2001. After the removal of upfront fees in Scotland in 2001, applications decreased slightly in England and increased slightly in Scotland. Between 2004 and 2007, applications followed a slight upward trend in both countries. In 2008, the number of applications fell in both countries because of the reduction in the number of choices that each applicant was allowed to make, from 6 to 5. In 2011, following the announcement of the increase in the cap on fees in England, applications still increased in both countries. However, in 2012 applications decreased in England, while continuing to increase in Scotland. This suggests that the effect of higher fees was felt when the increase in fees was actually implemented in 2012, rather than after the announcement in 2010. The most recent data for 2013 shows that applications have started to increase again in England. This graph supports the assumption of common trends and suggests that changes in fees have induced transitory deviations from the trend.

Table 1 reports means and standard deviations of the number of applications and acceptances, by country of domicile and age group, for the period before and after the 2001 and 2012 reforms. These summary statistics are calculated over cells defined by gender, age group, institution and subject. The numbers suggest that applications by English-domiciled students stayed broadly constant after the 2001 reform. By contrast, applications by Scottish-domiciled students increased by about 17%. The reform appears to have had a positive effect on applications for both age groups, but does not appear to have had a positive effect on acceptances. Turning to the 2012 reform, applications increased both for English and Scottish-domiciled students in 2012 and 2013. However, the increase was much larger (in percentage terms) in Scotland, especially for students aged 20 and over. The reform also seems to have had a negative effect on acceptances for older students, but the effect is smaller than for applications.

This table provides suggestive evidence that higher tuition fees discourage university applica-

tions, especially for older applicants. At the same time, changes in tuition fees do not appear to have a large effect on acceptances. I next use regression analysis and estimate model (1) to measure the effect of changes in tuition fees on applications and acceptances.

6 Results

6.1 Applications

Table 2 (top panel) reports the results of estimating model (1) with the log of university applications as the dependent variable. Standard errors are heteroskedasticity-robust and are clustered by institution to account for correlation in the error terms within groups.

The results suggest that the removal of upfront fees in Scotland in 2001 increased applications by 24.4%. This effect is even stronger (at 32.6%) in the model with country-specific time trends. The increase in tuition fees in England in 2012 reduced applications by 30.3% (34.5% in the model with country-specific time trends).

These results are not entirely comparable with previous estimates, because previous studies have focused on attendance rates rather than applications. Nonetheless, it is useful to benchmark them against previous estimates for attendance rates. Deming and Dynarski (2009) summarize the findings of a number of quasi-experimental studies conducted for the US. These studies find that an increase in student subsidies to higher education by $\$1,000$ increases the college attendance rate by about four percentage points. This is equivalent to an increase of about 6.9%, evaluated at an average attendance rate of 58% for 23 year olds in 2005.

The 2001 reform replaced upfront tuition costs of $£3,000$ for a degree with an endowment scheme in which students paid $£2,000$ after graduation. It is plausible that applicants viewed this reform a first step towards complete elimination of fees in Scotland. If the 2001 reform is treated as complete removal of fees, an increase in applications by 24.4% corresponds to an increase of 8.1% for a $£1,000$ reduction in fees. Converting to US dollars using the 2001 exchange rate, this implies an increase in applications of 5.6% for a $\$1,000$ reduction in fees. This is in line with the effects on attendance in the US literature, reported in Deming and Dynarski (2009). The 2012 reform increased the cost of a degree from $£10,395$ to about $£24,120$.[7] A reduction in applications by

[7] I assume that, if the cap on fees had not been increased, tuition fees in 2012/13 would have been set at $£3,465$

30.3% corresponds to a reduction of 2.2% for a £1,000 increase in fees or about 1.4% for a $1,000 increase in fees (at the 2012 exchange rate), a smaller effect than that found in the US literature for attendance.[8]

The results can also be expressed in terms of price elasticity of demand for higher education. Treating the 2001 reform as complete elimination of fees and the 2012 reform as an increase in fees from £10,395 to £24,120, the coefficients in Table 2 imply an elasticity of applications with respect to fees between −0.23 and −0.33.

6.2 Differences by Age Group

One of the implications of the simple human capital model discussed in Section 3 is that older students should be more sensitive to changes in tuition fees than younger students. To test this hypothesis, I estimate model (1) separately for applicants aged 19 and under and applicants aged 20 and over. The results, with and without country-specific trends, are reported in panels II and III of Table 2.

For the 2001 reform, there does not appear to be a significant difference by age group. Applications by candidates aged 19 and under increased by 18.5% (27.4% in the model with country-specific trends). This compares of an increase of 20.3% (22.8% with country-specific trends) for candidates aged 20 and over. However, for the 2012 reform, applications by older candidates decreased by a larger amount. Applications by candidates aged 20 and over fell by 38.6% (49.6% with country-specific trends), compared with a reduction of about 25% for younger applicants. This is consistent with the predictions of the simple human capital model discussed in Section 3.

6.3 Course Choice

The level of tuition fees may affect the choice of subject and institution made by applicants. It is possible that students respond to higher fees by applying to courses that offer higher expected earnings after graduation. On the other hand, the choice of course may be driven by individual preferences rather than expected future earnings. To test how changes in fees affect course choice,

(the same level as in 2011/12, adjusted for inflation). The level of fees after the reform (£24,120) is calculated assuming annual fees of £8,040 (the average level set by universities and colleges in 2012/13).

[8] I use the end of year spot exchange rates in 2001 and 2012, reported by the Bank of England.

I combine data on salaries after graduation with applications data and study the effect of the 2001 and 2012 reforms on applications at different quartiles of the distribution of expected future salaries.

Salary data are obtained from the HESA DLHE survey. The survey reports average salaries of first degree graduates in full-time paid employment (including self-employment) six months after graduation. When analyzing the 2001 reform, I use data for students who graduated in academic year 2002/03. For the 2012 reform, I use data for students who graduated in academic year 2011/12.

Table 3 reports average salaries by subject six months after graduation for students who graduated in academic year 2011/12. The sample is restricted to workers aged 20 to 30 earning less than £60,000 per year. The table reveals large heterogeneity in average salaries across subjects. Graduates in medicine and dentistry have the highest annual average salary (at almost £29,000), while those in creative arts and design have the lowest annual average salary (at just over £16,000).[9] There is also large variation across institutions within subject.

To test how changes in fees affect applications along the salary distribution, I first calculate the quartiles of the distribution of salaries by subject, institution and gender. I then combine this information with data on applications and estimate model (1) separately for applications to courses classified in each of these quartiles.

The results, reported in Table 4, suggest that the removal of upfront fees in Scotland in 2001 increased applications at all quartiles of the distribution of salaries. The increase was larger for courses with higher expected future earnings. Turning to the 2012 reform, the increase in fees in England reduced applications at all quartiles of the salary distribution, with a larger effect for courses with lower expected future earnings.

These findings suggest that students take expected future earnings into account when making their course choices. The effect is asymmetric: a reduction in fees appears to increase applications by more for courses that offer higher expected salaries, while an increase in fees appears to reduce applications by more for courses with lower expected salaries.

[9] The ranking of salaries across subjects is similar to the one reported in Chevalier (2011) for 2002/03 graduates. Average salaries are higher in Chevalier (2011) because he works with a version of the DLHE which is conducted three years after graduation.

6.4 Acceptances

The analysis so far has focused on applications, which capture the demand for higher education. I now turn to the effect of tuition fees on the number of students who accept a place at a higher education institution. Unlike applications, acceptances are an equilibrium outcome, determined both by demand for courses and by the number of vacancies supplied by universities and colleges.

To estimate the effect of changes in fees on the number of students who accept a place at a higher education institution, I estimate model (1) with the log of the number of acceptances as the dependent variable. Table 5 reports the results, which suggest that changes in tuition fees have a largely insignificant effect on acceptances. The only exception is acceptances by mature applicants which fell by 9.2% as a result of the increase in fees in 2012, although this effect is not robust to the inclusion of country-specific trends.

These findings for acceptances can be explained by the fact that the number of places at universities and colleges in England and Scotland is capped by the government and that in recent years demand for higher education has consistently exceeded supply. In this context, changes in tuition fees are expected to affect demand, but should have no effect on supply, which is largely inelastic. Because acceptances are an equilibrium outcome, determined by demand and supply, they should also be unaffected by changes in fees.

7 Conclusions

In the UK, changes in tuition fees have created large heterogeneity in the cost of higher education over time and across countries. However, few studies exploit these sources of variation to estimate the causal effect of tuition fees on schooling outcomes. This article studies the effect on applications and acceptances of two policy changes: the removal of upfront fees in Scotland in 2001 and the increase in fees in England in 2012.

The results from both experiments are consistent and suggest that increases in tuition fees have a negative effect on applications to higher education. I find that the removal of upfront fees in Scotland in 2001 increased applications by 24.4%, while the increase in fees in England in 2012 reduced applications by 30.3%. These results imply an elasticity of demand for higher education with respect to fees between -0.23 and -0.33. Consistent with the predictions of a simple schooling

model, the most recent reform reduced applications by more for older applicants.

Looking at course choice, I find evidence that changes in tuition fees have a different effect on applications at different points of the distribution of expected earnings after graduation. The removal of upfront fees in Scotland in 2001 increased applications by more for subjects/institutions that offer higher expected salaries after graduation. At the same time, the increase in fees in England in 2012 had a larger negative effect on applications for subjects/institutions with lower expected salaries after graduation.

References

[1] Chevalier, A. (2011). 'Subject choice and earnings of UK graduates', *Economics of Education Review*, vol. 30, pp. 1187– 1201.

[2] Crowford, C. and Dearden, L. (2010). 'The impact of the 2006-07 HE finance reforms on HE participation', BIS Research Paper no. 13.

[3] Dearden, L., Fitzsimons, E. and Wyness, G. (2011). 'The impact of tuition fees and support on university participation in the UK', Centre for the Economics of Education DP 126.

[4] Deming D. J. and Dynarski, S. M. (2010). 'Into college, out of poverty? Policies to increase the postsecondary attainment of the poor', in *Targeting investments in children: fighting poverty when resources are limited*, University of Chicago Press.

[5] Dynarski, S. M. (2003). 'Does aid matter? Measuring the effect of student aid on college attendance and completion', *American Economic Review*, vol. 93(1), pp. 279-288.

[6] Garibaldi, P., Giavazzi, F., Ichino, A. and Rettore, E. (2012). 'College cost and time to complete a degree: evidence from tuition discontinuities', *Review of Economics and Statistics*, vol. 94(3), pp. 699-711.

[7] HEFCE (2013). 'Higher education in England: impact of the 2012 reforms', Higher Education Funding Council for England report 2013/03.

[8] Independent Commission on Fees (2012). 'Analysis of UCAS applications for 2012/13 admissions'.

[9] Kane, T. J. (1995). 'Rising public college tuition and college entry: how well do public subsidies promote access to college?" National Bureau of Economic Research Working Paper 5164.

[10] Mincer, J. (1958). 'Investment in human capital and personal income distribution', *Journal of Political Economy*, vol. 66(4), pp. 281-302.

[11] Seftor, N. S. and Turner, S. E. (2002). 'Back to school: federal student aid policy and adult college enrollment', *The Journal of Human Resources*, vol. 37(2), pp. 336-352

[12] UCAS (2012). 'How have applications for full-time undergraduate higher education in the UK changed in 2012?', UCAS Analysis and Research, July 2012.

[13] Universities UK (2009). 'Changing landscapes: future scenarios for variable tuition fees', research report March 2009.

Figure 1. Tuition fees in England and Scotland

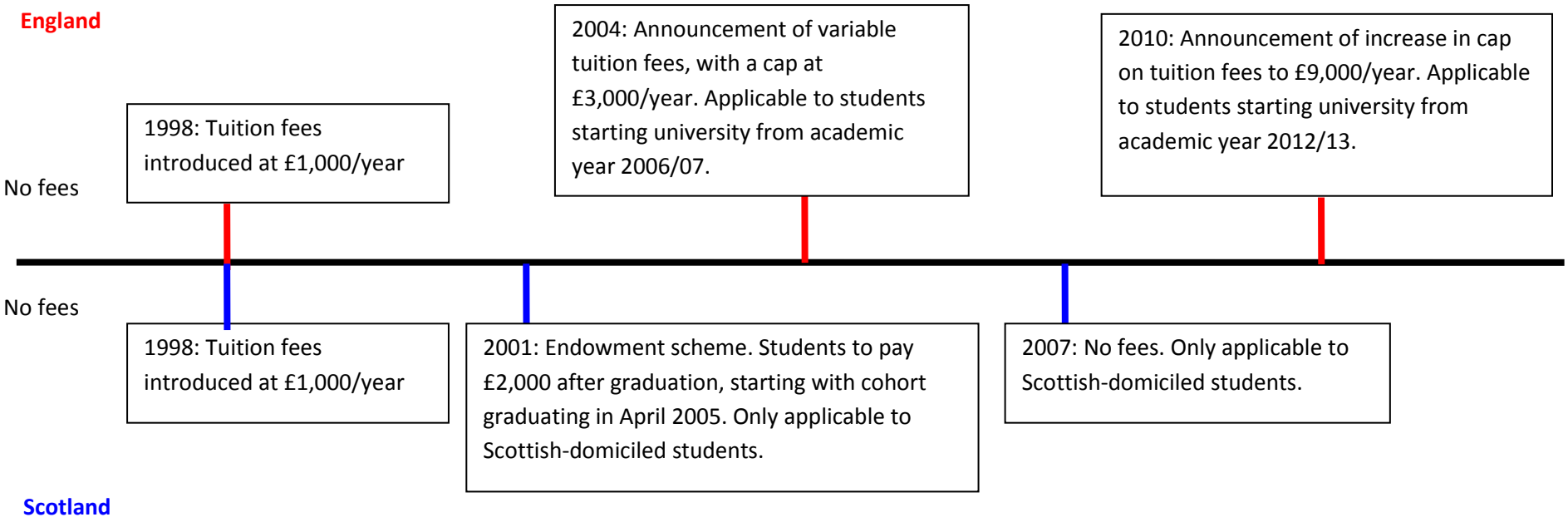
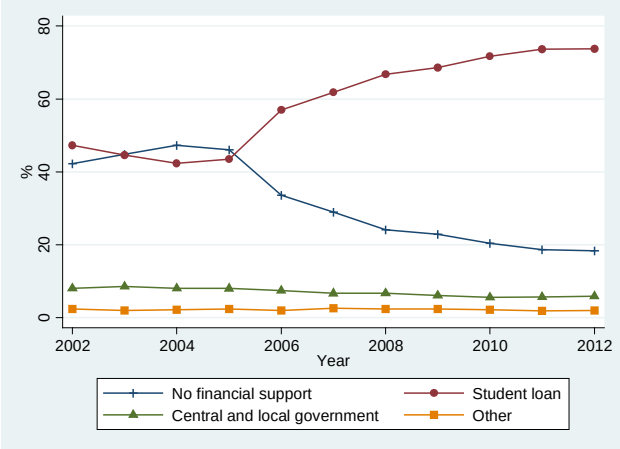
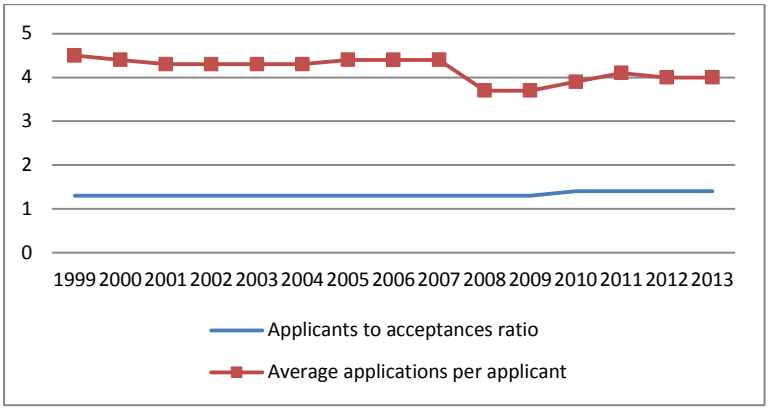


Figure 2. Percentage of students by major source of tuition fees



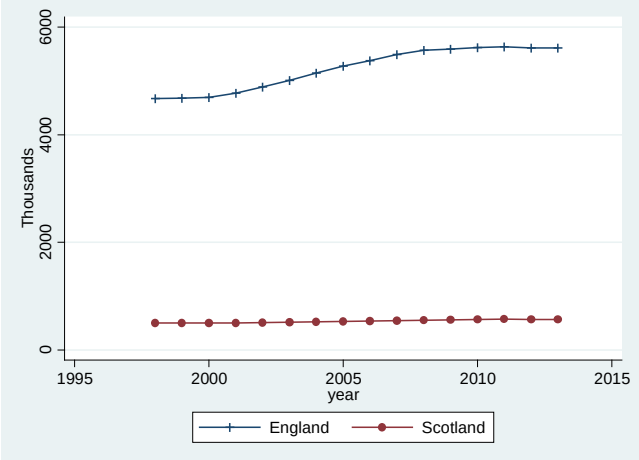
Source: HESA student database. Note: Percentages calculated for students with domicile in England attending English institutions

Figure 3. Application ratios



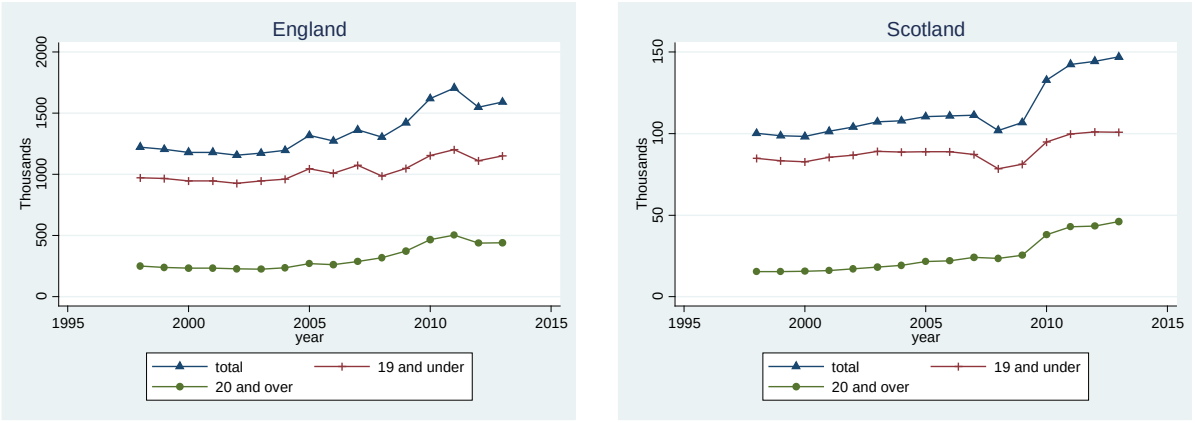
Source: UCAS. Note: The number of applications that each applicant is allowed to make was reduced from 6 to 5 in 2008.

Figure 4. Population trends in England and Scotland, age 17-24



Source: ONS mid-year population estimates.

Figure 5. Number of applications by country of domicile and age group



Source: UCAS.

Table 1. Descriptive statistics, by country and age group, before and after the reforms

	2001 Reform					
	England			Scotland		
	1998-2000	2001-2004	% Change	1998-2000	2001-2004	% Change
I. Overall						
Number of applications	124.369	122.551	-1.5%	45.462	53.173	17.0%
	(203.701)	(202.906)		(121.984)	(131.825)	
Number of acceptances	26.459	28.302	7.0%	21.657	22.224	2.6%
	(34.022)	(36.752)		(32.731)	(32.652)	
II. Age 19 and under						
Number of applications	185.911	184.891	-0.5%	57.896	69.965	20.8%
	(252.774)	(251.507)		(146.206)	(160.741)	
Number of acceptances	33.429	36.182	8.2%	26.774	27.549	2.9%
	(39.175)	(42.330)		(38.736)	(38.765)	
III. Age 20 and over						
Number of applications	53.595	51.492	-3.9%	21.030	24.270	15.4%
	(79.818)	(80.739)		(34.895)	(38.728)	
Number of acceptances	16.037	17.249	7.6%	13.489	14.514	7.6%
	(20.303)	(22.868)		(16.687)	(18.278)	
	2012 Reform					
	England			Scotland		
	2005-2010	2012-2013	% Change	2005-2010	2012-2013	% Change
I. Overall						
Number of applications	143.141	151.379	5.8%	60.760	77.983	28.3%
	(241.608)	(276.045)		(132.391)	(159.078)	
Number of acceptances	34.122	34.402	0.8%	23.919	26.059	8.9%
	(47.940)	(47.224)		(35.220)	(39.256)	
II. Age 19 and under						
Number of applications	200.891	208.417	3.7%	78.986	97.644	23.6%
	(266.657)	(276.874)		(159.098)	(183.723)	
Number of acceptances	41.731	42.376	1.5%	28.027	29.279	4.5%
	(49.202)	(49.073)		(37.947)	(38.710)	
III. Age 20 and over						
Number of applications	79.833	88.805	11.2%	36.235	53.565	47.8%
	(191.721)	(261.190)		(77.524)	(117.265)	
Number of acceptances	23.745	23.051	-2.9%	18.348	21.514	17.3%
	(44.098)	(41.924)		(30.279)	(39.596)	

Note: Summary statistics are calculated over cells defined by gender, age, institution and subject. Standard deviations in parentheses.

Table 2. Effect on applications

	ln(applications)			
	2001 reform		2012 reform	
	(1)	(2)	(3)	(4)
I. Overall				
Treatment group × post treatment	0.244***	0.326***	-0.303***	-0.345***
	(0.042)	(0.059)	(0.046)	(0.049)
Observations	81,826	81,826	60,411	60,411
R-squared	0.380	0.380	0.369	0.369
II. Age 19 and under				
Treatment group × post treatment	0.185***	0.274***	-0.250***	-0.254***
	(0.053)	(0.075)	(0.051)	(0.058)
Observations	45,290	45,290	31,999	31,999
R-squared	0.366	0.366	0.355	0.356
III. Age 20 and over				
Treatment group × post treatment	0.203***	0.228***	-0.386***	-0.496***
	(0.042)	(0.065)	(0.050)	(0.056)
Observations	36,536	36,536	28,412	28,412
R-squared	0.339	0.339	0.336	0.336
Country-specific trends	No	Yes	No	Yes

Notes. Robust standard errors clustered by institution in parentheses. Regressions include year and country of domicile fixed effects, the log of population, and indicators for gender, age group, institution and subject. *** significant at 1%, ** significant at 5%, * significant at 10%.

Table 3. Average salaries across subjects for graduates in 2011/12

Subject	Average salary (£)	Standard deviation across institutions
Medicine and dentistry	28,988	1,623
Subjects allied to medicine	20,728	1,764
Biological sciences	17,021	2,145
Veterinary science and agricultural and related studies	19,090	4,776
Physical sciences	19,123	2,799
Mathematical and computer sciences	21,922	3,109
Engineering and technology	24,028	3,149
Architecture, building and planning	21,451	4,236
Social studies	19,765	2,790
Law	17,926	2,583
Business and admin. studies	19,804	3,093
Mass communications and documentation	16,581	1,899
Languages	17,266	2,046
Historical and philosophical studies	17,323	2,322
Creative arts and design	16,051	1,858
Education	19,403	2,278

Source: HESA DLHE survey. Note: Average salaries calculated for workers earning less than £60,000 per year. The sample is restricted to graduates between age 20 and 30, in full-time paid employment six months after graduation.

Table 4. Effect on course choice

	Quartile 1		Quartile 2		Quartile 3		Quartile 4	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
I. 2001 reform								
Treatment group × post treatment	0.215***	0.320***	0.274***	0.365***	0.304***	0.476***	0.370***	0.492***
	(0.075)	(0.115)	(0.089)	(0.117)	(0.092)	(0.121)	(0.084)	(0.108)
Observations	10,966	10,966	10,931	10,931	10,596	10,596	11,131	11,131
R-squared	0.455	0.455	0.550	0.551	0.542	0.543	0.574	0.575
II. 2012 reform								
Treatment group × post treatment	-0.367***	-0.540***	-0.367***	-0.505***	-0.339***	-0.378***	-0.287***	-0.288***
	(0.101)	(0.128)	(0.095)	(0.121)	(0.081)	(0.106)	(0.069)	(0.067)
Observations	10,167	10,167	10,259	10,259	10,485	10,485	10,764	10,764
R-squared	0.553	0.553	0.496	0.496	0.426	0.427	0.410	0.410
Country-specific trends	No	Yes	No	Yes	No	Yes	No	Yes

Notes. Robust standard errors clustered by institution in parentheses. Regressions include year and country of domicile fixed effects, the log of population, and indicators for gender, age group, institution and subject. Separate regressions are estimated for each quartile of the distribution of expected average salaries of graduates in full-time paid employment six months after graduation. *** significant at 1%, ** significant at 5%, * significant at 10%.

Table 5. Effect on acceptances

	ln(acceptances)			
	2001 reform		2012 reform	
	(1)	(2)	(3)	(4)
I. Overall				
Treatment group × post treatment	-0.001	-0.004	-0.079**	-0.062
	(0.029)	(0.041)	(0.036)	(0.052)
Observations	55,026	55,026	43,859	43,859
R-squared	0.320	0.320	0.343	0.343
II. Age 19 and under				
Treatment group × post treatment	-0.050	-0.094	-0.052	-0.037
	(0.041)	(0.060)	(0.051)	(0.075)
Observations	32,549	32,549	25,480	25,480
R-squared	0.288	0.288	0.336	0.336
III. Age 20 and over				
Treatment group × post treatment	-0.024	0.002	-0.092**	-0.052
	(0.037)	(0.052)	(0.046)	(0.060)
Observations	22,477	22,477	18,379	18,379
R-squared	0.380	0.381	0.400	0.400
Country-specific time trends	No	Yes	No	Yes

Notes. Robust standard errors clustered by institution in parentheses. Regressions include year and country of domicile fixed effects, the log of population, and indicators for gender, age group, institution and subject. *** significant at 1%, ** significant at 5%, * significant at 10%.