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The Impact of a Tuition Fee Policy in Scotland; Evidence from a Natural Experiment

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Abstract: In this paper I investigate the relationship between tuition fees and enrollment in higher education; in particular, the effect that the abolishment of upfront tuition fees (which were replaced by a graduate payment scheme) in Scotland for Scottish students had on their enrollment rate into universities in England. Several explanations have been offered as to why tuition response might be relatively large. Tuition is the most visible college price, and it is the one that is most inescapable. College tuitions are conspicuous, and students are unusually conscious of them. Annual increases generally are well publicized and often debated publicly. In this study, I look at two reasons why Scottish students may switch to Scottish universities after the up-front tuition was abolished. The first is that those who would have gone to university in England would switch to Scottish university as a result of the lower price. The second is that some who would not have participated prior to the reforms now do. This latter reason addresses the barriers to entry for students on the margin, which tuition fees create. I hypothesize that the abolishment of upfront fees in Scotland will increase participation of both the students and the possible students in Scottish universities in Scotland. I find that the tuition change had a small but significant effect on the switching students, a larger effect on the marginal student, and that both effects were strongly influenced by distance from Scottish border.

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1 Introduction

The last two decades have witnessed great change in higher education policy across OECD countries. Most prominent amongst these changes is a decline in public funding. Since the 1990s the share of private funds in higher education has risen in almost half of the OECD countries (Karkkainen, 2006) in an attempt to finance increased demand for higher education. Often, rising private contributions went along with the introduction of tuition fees, with countries frequently referencing the American system as a model (e.g. Australia in 1989 and Germany in 2007).

Contemporary observers have claimed that tuition fees raise barriers of entry into higher education and thus contradict the policy objective of increasing participation in higher education (Hirsch, 2008). Whether students are sensitive to prices however, remains unclear. Advocates of tuition fees, for instance, argue that if fees are implemented to improve the quality of universities, enrollment might even increase. Moreover, the introduction of tuition fees has often been accompanied by the creation of sizable subsidized loan schemes to mitigate potentially adverse effects on credit-constrained students. In some cases graduate endowment schemes, in which the tuition is paid only after the student receives a degree and earns a minimum income, have also been used. Therefore, whether tuition fees reduce enrollment probabilities remains an empirical question.

It is difficult to evaluate the impact of tuition fees on enrollment rates because they are frequently implemented nationwide (or across several countries) and concurrently. Many studies have tried to exploit cross-state and cross-time variations in tuition fees to estimate their impact on enrollment rates. In these instances, however, confounding variables will arise. On the one hand, estimates based on cross-sectional variations might be biased if there are unmeasurable

differences in students' preferences for higher education across states. In this case, observation of low tuition rates and high university enrollment need not reflect a causal relationship, but might simply result from higher preferences for education, as pointed out by Dynarski (2000). On the other hand, using variation across time it is possible to control for state fixed effects, such as preferences for education. However, this approach is vulnerable to changes in macro-aggregates or social norms over time for which it is, again, hard to control. This study will look at changes in fees over a short period of time so as to avoid the influence of long-term macroeconomic changes.

In both England and Scotland, tuition fees were paid for entirely by the state for all students admitted from 1977 to 1997. In 1998, however, following advice from a government committee, tuition fees were introduced. The initial charge was 1000 pounds per year ($1658 dollars at 1997 exchange rate.) Scottish student groups and many of the major Scottish political parties protested the decision and asked the Scottish government to reconsider. In 2000, loosely following the recommendations of another report, the Scottish government abolished upfront tuition fees for Scottish students studying at Scottish institutions and instituted a "graduate endowment" instead, a loan scheme which deferred payments until after the student graduated. The graduate endowment scheme was implemented in 2001- the post treatment year that I use. In this study I use the abolishment of upfront tuition fees in Scotland between 1999-2000 as a natural experiment to evaluate the impact of tuition fees on enrollment rates using difference-in-differences.

The following section is a literature review of seminal and recent works involving the discussion of the theory and models behind students' decision to enroll in university and the impact of tuition fee changes on these enrollment decisions. Section III briefly outlines the 1999

policy change and ensuing graduate endowment as well as the background of the higher education system in Scotland. A detailed description of the government's involvement of the policy change is included Appendix 1. Section IV outlines the theoretical model used in this study, including an individual's decision to enroll in university or not, and if so, in England or in Scotland, as well as reasons for a government to intervene in tuition policy. In Section V, I present my data and develop an econometric model, using the difference-in-difference methodology, to calculate the impact that the tuition change policy had on Scottish student's enrollment, netting out any other secular trends. Section VI discusses the results from my model. Section VII concludes with a summary of the major findings in the study and the implications for university funding policy.

2 Literature Review

Economists view the decision to enroll in university as an investment in human capital made by rational consumers. According to the human capital models of by Becker (1962) and Ben-Porath (1967), for example, a rational individual will choose years of schooling maximize the discounted present value of lifetime earnings, net of education costs. An individual faces the option each year of working or participating in higher education (investing in human capital.) Demand for education is higher the longer the period of accrual, the more productive is the time spent in education, and the smaller the relevant discount rate. For example, as expected unemployment rates increase, projected future earnings would decrease and students would demand less education. Also, as more students demand education, the skills premium or rate of return for college education go down and fewer students will dampen the demand for higher education. The individual

will attempt to maximize net wealth by equating the marginal cost of schooling to the marginal returns. The human capital model would suggest that implementing or increasing tuition fees raises costs of university and thus will decrease demand.

This model makes several predictions. Firstly, higher marginal costs of educational investment lead to a lower individually optimal level of education. This means that increases in direct costs, such as tuition fees are associated with lower investment in human capital. Equally, a reduction of marginal costs, caused for instance by loan subsidies or public grants would lead individuals to choose a higher level of education.

The predictions of this model have been discussed in a large body of empirical work. Leslie and Brinkman look at thirty empirical works, which consider the question of price and relationship to enrollment in the US and summarize the results. When prices are adjusted to 1982-1983, the mean response is about .7 percentage points. That is, for every $100 increase in tuition prices of $3,420 for tuition and room and board, one would expect an 18-24 year old participation rate drop of about three-quarters of a percentage point. Since the national higher education participation rate was about .33 in 1982, U.S. enrollments would decline by about 2.1 percent for each $100 price increase, all other factors equal. The 2.1 percent figure may be misleading because most studies show impacts upon freshman only. Upperclassmen are less price responsive. A more recent review is provided by Heller (1997), who reports that, for the studies that he looked at, an increase in tuition fees by $100 is consistent with a drop in enrollment between 0.5 and 1 percentage points. All of these studies look at U.S. data.

McPherson and Shapiro's study (1991) supports the claim that tuition fees affect enrollment. They use data from the Current Population Survey (CPS) between 1974 and 1984 to examine how aggregate enrollment rates of different population subgroups depend on the net costs of

higher education. As expected, an increase in the net costs of higher education by $100 is found to reduce enrollment rates of low-income youth by 0.68 percentage points. For middle and high-income groups this effect reverses sign. If costs rise by $100, enrollment rates of middle (high) income groups increase by 0.23 (0.87) percentage points.

Studies which use across-state variation in tuition fees or within-state variation over time to identify the effects of tuition fees on enrollment rates often implicitly assume that students are not mobile across state borders. Card and Lemieux (2000), for instance, fit the following equation

$$P_{it} = \beta X_{it} + \gamma_i + \nu_t + \quad _{it}$$

in which P_{kt} is the average enrollment rate for a specific age group in state k at time t, ν_t and γ_k are year and state fixed-effects and X_{kt} controls for time- and state-specific determinants of enrollment behavior. X_{kt} includes a measure of the average tuition costs in state k at time t. However, if we assume that some youth in state k has a strong preference for studying in another state j≠ k, then the decision to enroll at a university in state k will also depend on the tuition fees in state j. If, unlike in Card and Lemieux's model, students can move between states then the average enrollment rate in a state does not only depend on tuition levels in that state but also on average tuition levels in neighboring states.

Kane (1994), investigates college enrollment of 18-19 year-old high school graduates in the U.S. Using within- and between-state variation in tuition levels he finds that a $1000 increase in net direct college costs is associated with a five percentage point decline in the likelihood of college enrollment. This effect depends on race as well as parental income and is strongest for low-income youth. Dwenger, Storck, and Wrohlich's paper (2009), also investigates the affect that tuition fees have on mobile university applicants. They find a small but significant reaction:

the probability of applying for a university in the home state falls by 2 percentage points (baseline: 69%) for students who come from a state with newly introduced 1,000 euro tuition fees. Noorbaksh and Culp (2002) also look at enrollment and tuition changes. They look at the price elasticity of demand for Pennsylvania state universities for both nonresident and resident students. They conclude that the nonresident demand is price-elastic; after non-resident tuition fees were increased, the State System experienced an approximately 40% decline in nonresident enrollment.

There is in fact evidence that a significant proportion of students move across states and countries to attend university. Data from the National Center for Education Statistics show that student mobility in the U.S. is in fact sizable. In 1996 the percentage of college freshmen who attended an out-of-state public or private not-for-profit college was 26%. This figure remained fairly stable over time and was 25% in 2006 (Planty, Snyder, Provasnik, Kena, R., Ramani, and Kemp, 2008). My own sample of English and Scottish students suggests that there is some level of mobility between the two systems. In 1999, 2% of students from England were studying in Scotland and 6% of Scottish students were studying in England.

Although many of the studies discussed support the claim that changes in tuition fees impact enrollment rates, there are also a number of studies which find no significant influence of tuition costs on enrollment. Two of these studies use data from the Netherlands: Huijsman, Kloek, Kodde, and Ritzen (1986) find that enrollment rates of Dutch first-year students over the period from 1950 until 1982 were positively affected by financial aid but no significant influence was found for tuition fees. This result is reinforced by Canton and de Jong (2005) who study enrollment of students as a percentage of the number of qualified secondary school graduates over

the period 1950-1999. While financial support for students is shown to have a positive impact on enrollment rates, no significant influence is found for tuition.

This study is modeled after Hubner's (2007) which looks at the introduction of tuition fees in seven German states in 2007 as a natural experiment to identify the effects of tuition fees on enrollment probabilities of German high-school graduates. He finds a small but significant effect of tuition fees on enrollment behavior; an introduction of a 1000 Euro tuition fee reduces the probability of a student enrolling by 2.74%, slightly more than Dwenger, Storck, and Wrohlich's paper. In his difference-in-difference analysis, he allows for mobility between states. Because students are mobile, the increase in tuition in a fee-state can affect both that own state's high school graduates enrollment decision and those of the graduates from non-fee states (the control group). Mobile students from a non-fee state choose to attend their home university because of the relatively cheaper price of tuition.

3 Institutional Background

3.1 Scottish University Payment System

Beginning in 1977 all UK students were eligible for free university education; all fees were paid directly to the universities by the Scottish and English governments, respectively. As the UK university population rose during the 1980s the sums paid to universities became linked to their performance and efficiency, and by the mid 1990s funding per student had dropped by 40% since the mid-1970s, while numbers of full-time students had reached almost doubled. Following the lead of many of the OECD countries, who had been implementing a mixture of private and public funding, England and Scotland began to consider an abolishment of the universal free tuition and mandatory living grant system. The grant system, which had been in place for the duration of

the higher education system in the UK, provided university-associated living costs for years of university attendance. This grant was abolished in 1997 and reinstituted in 2005. The grant/loan system remains constant throughout the periods I examine.[1]

At the same time, the system of maintenance grants and loans was being questioned. In 1990, student loans were introduced in addition to maintenance grants, with the intention of gradually increasing the loan amount to represent 50% of the total maintenance package. The maintenance grant, including any parental contribution would provide the remaining 50%. At the same time, the value of the means-tested grant was frozen. By 1999, the maintenance grant was abolished and loans up to 4000 pounds could be taken out. The maintenance grants and loans system did not change during the period of my study.[2]

Following an investigation into the future of universities, the July 1997 report of the National Committee of Inquiry into Higher Education, chaired by the then Sir Ronald Dearing recommended the ending of universal free higher education, and that students should pay £1,000 per year towards the cost of their tuition fees. In response to this report, both Scotland and England set tuition fees to an upfront payment of £1,000, and the general consensus was that it would disproportionately affect disadvantaged individuals.

After a review of university funding by Dr Andrew Cubie,[3] the chair of the Independent Committee of Inquiry into Student Finance, tuition fees were abolished in Scotland in 2000. Scottish residents studying in Scottish universities would no longer be asked to pay the £1,000 annual tuition charged to other British students. However, the concession would not apply to students resident south of the border or to Scottish students who attend university in England or Wales. Scottish students were expected to eventually contribute £2,000 to a special

1 Appendix 1, Figure 6
2 As shown in Appendix 1.
3 See Appendix 1 for a more detailed description of the Scottish Executive's policy-making process.

"graduate endowment" fund. That sum is £1,000 less than students south of the border pay in fees (for three years), and payments would be due only when a graduate earned more than £17,000 a year. The graduate endowment applied to Scottish domiciled students and EU students from outside the UK who started their first full-time degree course at a Scottish institution on or after August 1, 2001. The committee stressed that most students would have less debt on graduation and that no student will have more debt on graduation than they would under the present arrangements.

4 Theoretical Model

4.1 Government and Tuition

With no intervention in the market for higher education, all students would bear the full costs of their higher education upfront and in full. Although there is clear evidence that individuals stand to gain from attending university – both from increased likelihood of employment and from higher earnings once in employment – there are a variety of problems which have been used to justify government intervention:

1.) Equity Concerns: Upfront tuition fees are inequitable. Wealthier families can pay charges directly; and even a middle-class parent who is low on liquid assets can borrow on good terms using the family home as security. Thus the options for borrowing are best for those who need them least. Capital markets may not develop to allow students to borrow enough money to cover the costs of their tuition and maintenance. This could lead to an inefficient number or mix of students participating in higher education.

2.) Efficiency Concerns: The ability to redistribute to oneself over the life cycle (what is called 'consumption smoothing') increases a person's welfare. It is efficient if people can choose

how to pay for education; equally, it is inefficient if people are forced to pay a significant part of the cost upfront. This is particularly true of tuition fees (other than minor charges), which tend to be (a) large and (b) 'lumpy', since the student normally has to pay a term's fees in a single chunk at the start of term.

3.) Asymmetric Information: People for whom access is most fragile tend to be those who are the least well-informed about higher education – about whether they are good enough to do well, and about the benefits of getting a degree. This could make them more risk averse. Students may lack the information they need to make rational, informed choices.

4.) Uncertainty: As a result of asymmetric information, there is a significant element of uncertainty about the returns to a degree. As with other uncertainties, these have the greatest effect on people who do not have the financial resources to self-insure.

Given these problems, the government might choose to alter who should pay, how much and when, so as to generate what it regards as the best level of investment in education for the individuals involved and for society as a whole. The Scottish Executive made it clear that widening access to higher education was a priority and a main objective of the 1999 policy initiative, and asserted that the introduction of the arrangement would lead to better results.

4.2 Graduate Endowment

The graduate endowment is a a direct approach to alleviate credit constraints in the credit market by allowing all fees to be deferred until later in life. This type of loan system can protect against the uncertainty involved with investment in higher education. Without some sort of protection against low future earnings, students may be deterred from taking out loans for the costs of their higher education even if loans were readily available. Depending on his/her degree of risk

aversion, an individual who stands to gain from university may choose not to borrow to cover the costs if he/she is sensitive to the possibility of not realising future financial benefits. To overcome this sort of market failure, it is necessary that some sort of mechanism is provided to smooth costs of higher education across individuals. One way of doing this is to make repayment of loans contingent on a certain level of realised income.

4.3 A model for university enrollment

I use a simple theoretical model to analyze the university enrollment decisions of two groups, the "switchers" and the "either-ors", in two countries, country i and country j. I consider the decisions each of the groups make; the switchers deciding whether to enroll in country i or country j, and the either-ors who choose whether to enroll or obtain a job. I consider the utility functions of each group and the factors which may influence their decision.

Switchers

Expected utility for student i studying in country i may be expressed in terms of the empirical variables. Its general functional notation is:

$$E[U_i^i] = f(B_i^i, T_i^i, C_i^i, O_i^i) \quad (1)$$

where $E[U_i^i]$ is the expected utility of student i studying in their home country; B_i^i are the perceived and actual benefits of attending university in country i; T_i^i is the cost of tuition in country i; C_i^i are transportation costs associated with attending university in country i; and O_i^i are other existing opportunities and may add/ subtract from the opportunity cost of attending university.

The student also has the choice of studying in country j. In this case, the expected utility for student i may be expressed as

$$E\,[U_i^j] = f\,(B_i^j, T_i^j, C_i^j, O_i^i) \qquad (2)$$

where the utility now is a function of benefits and costs in country j, and other opportunities are still defined as local for the student. The student enrolls at university in country j if the utility of the decision exceeds the utility of the next best opportunity. If $E\,[U_i^i] \geq E\,[U_i^j]$ the student will choose to stay home, and if $E\,[U_i^i] \leq E\,[U_i^j]$ the student will choose to study abroad. This can be re-written as

$$E\,[U_i^i] - E\,[U_i^j] \geq 0 \qquad (3)$$

When the utility of studying in i minus that of studying in j is greater than 0, the student will choose to study in their home country. This decision is more likely the greater is B_i^i/B_i^j, the smaller is T_i^i/T_i^j, the smaller is C_i^i/C_i^j and the more desirable are O_i^i / O_i^j.

The relationship between transportation costs and enrollment in country i or j are expressed in Figure 3. The figure illustrates the role that transportation costs have on certain groups of individuals. On the vertical axis is the ratio of net cost between country i and country j and on the horizontal axis is the net distance for an student in country i to the closest university in country j. If the cost associated with attending university in i versus j are higher than the transportation costs to country j, then the student will choose to study in country j. If the cost associated with attending university in i versus j are less than the costs of transportation to country j, then the student will choose to remain at home. As the relative cost of studying in i decreases, those who choose to remain in country i increase. In this paper, this new group of individuals who formerly chose to study in country j (England) but after the tuition change choose to study in country i (Scotland) are the "switchers." All of these individuals would have entered university

regardless; their decision regarded whether or not to study in their home country. An example of a switcher would be an 18-year old Scottish high-school graduate whose parents studied at Oxford (in England) and was expecting to continue the legacy, but now decides to go to Edinburgh as a result of the fee decrease.

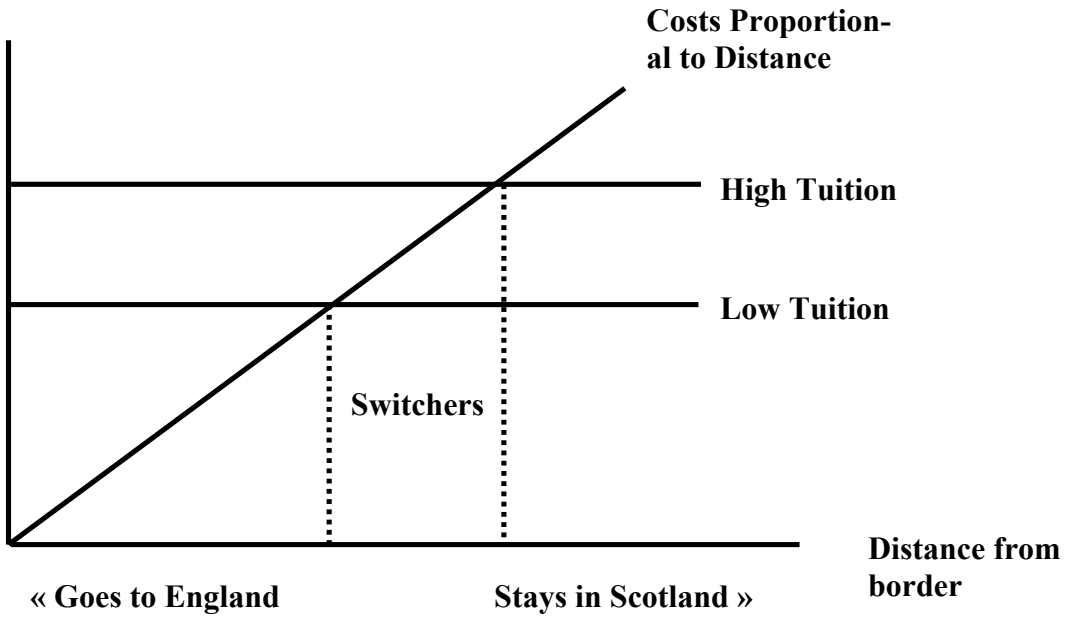

Figure 3

Either Ors

Now I consider the situation in which a high school graduate is faced with a decision of going on to university or entering the labor force. The student will decide to go on to university if the present value of the benefits associated with enrolling (discounted at the appropriate rate) are greater or equal to the present discounted value of both the direct and the opportunity costs of doing so. The present value of the benefits can be divided into two components: the expected value of the stream of increased earnings that accrue from a college education, and the value of any direct consumption benefits from undertaking this activity. The direct cost of going to college is the sum of several charges such as tuition and university life- living costs. The opportunity costs are defined by the wage that could have be earned at the best job alternatives during the time spent in university. An increase in the expected benefits should increase the percentage of individuals who find it desirable to pursue higher education. An increase in the cost of education, either in the form of increased direct educational charges or in the form of an increase in the opportunity cost of attending, will make pursuing a degree less desirable.

It is unclear how job availability affects school enrollment. On the one hand, if unemployment is low, students from poor families may be able to enroll in school, supporting themselves through part-time work. On the other hand, readily available employment opportunities for youth may simply raise the probability of dropping out of school or not choosing to enroll in the first place and working full-time. High unemployment may mean some families are unable to afford school expenditures and so their children may drop out, or it may mean that the opportunity cost of attending university is so low that it is beneficial to attend. The same argument can be made for wage. A high wage may draw individuals away from university or it might allow some families to pay for university.

This decision can be expressed be expressed in terms of utility functions. In this case, the utility of attending university is compared to the utility of getting a job:

$$E[U_i^U] = f(B_i, T_i, J_i, W_i) \quad (4)$$

where $E[U_i^U]$ is the expected utility of an individual from country i choosing to attend university, where B_i are the present value of the benefits associated with enrolling and where J_i is the level of local job availability and W_i is the available wage

$$E[U_i^N] = f(J_i, W_i) \quad (5)$$

where $E[U_i^N]$ is the expected utility of an individual from country i choosing not to attend university. When the utility for an individual in country i of attending university less the utility of not studying in university is greater than 0, the student will choose to attend university

$$E[U_i^U] - E[U_i^N] \geq 0 \quad (6)$$

This decision is more likely the greater is B_i^i, the smaller is T_i^i, the smaller is J_i^i, and the smaller is W_i^i. An example of an Either-Or would be an 18-year old, Scottish high-school graduate who might have been planning to take a job after high school, but in light of the tuition decrease, chose to attend a university.

5 Data and Estimation Strategy

5.1 Data Characteristics

My empirical analysis is based on county level, first year enrollment rates of UK residents in Scotland and England for the school years 1999-2000 and 2001-2002. The policy change impacted students entering university in autumn of 2000. The graduate endowment was instituted in

autumn of 2001. Thus, the dates I look at are the school year prior to the policy change (1999-2000) and the school year prior to the introduction of the graduate endowment (2001-2002.)

Data for county enrollment rates was collected through Higher Education Statistics Agency, HESA. This data specifies the county of residence and country of university for Scottish and English first-year undergraduates. Universities report the numbers used to construct these enrollment rates to HESA each year. Data for county specific average weekly household income as well as the 18-19 year old youth population by county was provided by the UK Office for National Statistics (ONS.) Data for county-level unemployment rates was provided by National Office Labour Market Statistics (NOMIS), a branch of the ONS. I compiled the distance data by calculating each county's distance from the nearest point to the Scottish/ English border.

UK cross-country university enrollment counts for first-year, full-time undergraduates is shown in Tables 1 and 2. I do not look at Northern Ireland and Wales in my study, but Tables 1 and 2 show that most of their mobility occurs within Scotland and England.

UK Cross-Country Enrollment Counts 1999-2000

Domicile	England	Scotland	N. Ireland/ Wales
All UK Domicile	266770	32220	7760
English	256080	4050	70
Scottish	2150	26600	20
N. Irish/ Welsh	8540	1570	7670

Table 1

UK Cross-Country Enrollment Counts 2001-2002

Domicile	England	Scotland	N. Ireland/ Wales
All UK Domicile	288125	37060	9220
English	277685	3980	85
Scottish	2090	31550	15
N. Irish/ Welsh	8350	1530	9120

Table 2

The individual characteristics of county i that I have measured are unemployment rates and average weekly income. These vary significantly within and between England and Scotland, and influence the calculation of opportunity costs. Descriptive statistics are presented in Table 3 and Table 4.

Unemployment rates and average weekly incomes: Pre/ Post Treatment

	English Income (£)		Scottish Income(£)		English Unemployment (%)		Scottish Unemployment (%)	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post
Mean	269.62	307.60	251.67	290.44	7.07	4.64	7.87	6.11
Standard Deviation	31.65	38.84	50.81	29.13	2.41	1.50	2.49	1.91
Sample Variance	1002.34	1508.75	2581.60	848.54	5.82	2.26	6.20	3.63
Maximum	376.61	437.10	296.36	345.90	13.10	8.60	14.30	9.50
Minimum	199.04	240.60	205.62	236.20	3.60	2.10	4.70	3.40

Table 3

Income has been inflation adjusted to 2002 dollars. Mean income is higher in England than in Scotland, both before and after the policy change. Mean income increased, for both countries, around 15% over the three year interval. Table 8 (in Appendix 2) shows the Scottish counties in order of highest to lowest mean income post-policy. Figures 1 and 2 are maps showing the location of the counties I look at for both England and Scotland.[4]

Enrollment rates: Scotland and England Pre and Post Treatment

	English Home/Total		Scottish Home/ Total		English Home/ Youth		Scottish Home/ Youth	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post
Mean (Cross-country)	0.98	0.98	0.92	0.91	0.24	0.22	0.23	0.26
Standard Deviation	0.01	0.01	0.04	0.10	0.19	0.05	0.10	0.06
Sample Variance	0.00	0.00	0.00	0.01	0.04	0.00	0.01	0.00

Table 4

In the next section I will discuss the difference-in-difference method I use to estimate the the causal effect of the policy on Scottish students, and then I will describe the model specification used to calculate the effect.

[4] Appendix 2.

5.2 Estimation Method

This paper's empirical model utilizes the tuition policy change in Scotland as a natural experiment. Analyzing changes in enrollment rates for Scottish students after the tuition change, I expect to find a discontinuity between the school year 1999-2000 and 2002-2003, before and after the policy was implemented. I use England as a control, to net out secular trends in enrollment behavior. In this way, although the treatment and control states differ in individual characteristics and enrollment rates, this difference is captured by the state fixed effect.

To execute this, I will employ the difference-in-difference strategy. It works as follows: outcomes are observed for two groups for two time periods. One of the groups is exposed to a treatment in the second period but not in the first period. The second group is not exposed to the treatment during either period. In the case where the same units within a group are observed in each time period, the average gain in the second (control) group is subtracted from the average gain in the first (treatment) group. This removes biases in second period comparisons between the treatment and control group that could be the result from permanent differences between those groups, as well as biases from comparisons over time in the treatment group that could be the result of trends. In this study, Scottish counties are the treatment group and English counties are the control.

Figure 4 shows the differences. Dif 3 is the difference which would have occurred had no policy been implemented, the counterfactual. Dif 1 is the actual difference, which occurred post-treatment, and Dif 2 is the change in the enrollment rate, which occurred as a result of the policy.

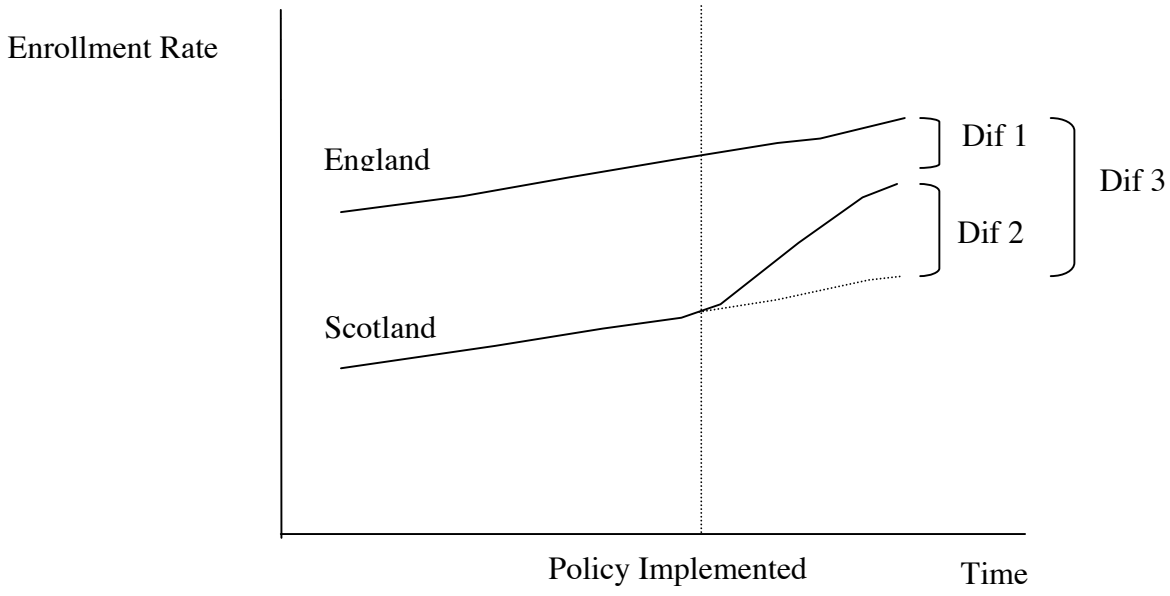

Figure 4

This methodology requires the assumption that in the absence of the policy change the expected value of enrollment in country i, at time t, is determined by the sum of time-invariant county and country effects (unemployment, income),γ, and time effects common across countries and countries, λ. This relationship is defined in (7).

$$E\,[Y_{st}|\ s,t] = \gamma_i + \lambda_t \qquad (7)$$

This assumption can also be explained as the need for the counterfactual enrollment trend behavior of the treatment and control groups to be the same. I established this by calculating English and Scottish home enrollment trends for the years 1994-1999. The trends are illustrated in Figure 5.

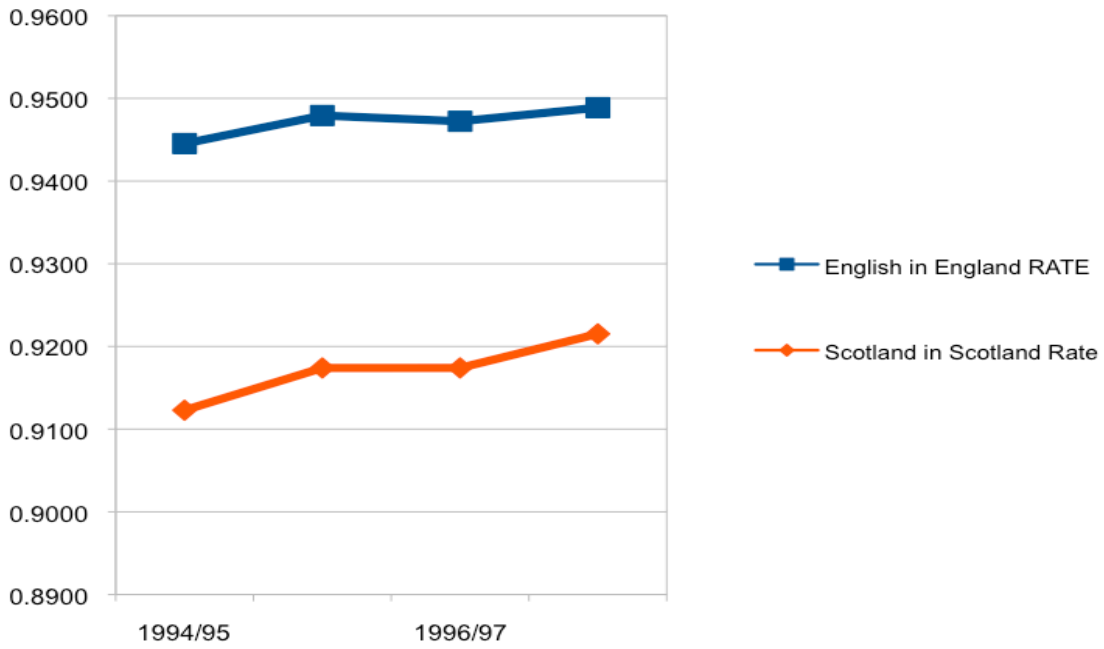

Figure 5

The impact of the policy can be estimated using simple differences in population means. Let d_{it} be a dummy for low-tuition counties and low-tuition period. Assuming $E\,[Y_{Scot,2001} - Y_{Scot,\,1999} \mid s,t\,]$ is a constant denoted δ, (where δ is the causal effect of interest,) Y_{st} can be written:

$$= Y_{it=}\,\gamma_i + \lambda_t + \delta\, d_{it} + \varepsilon_{it} \qquad (8)$$

$$\text{if } E(\varepsilon_{it} \mid i,t) = 0$$

Taking away the first difference, time-invariant state effects,

England $= \{\, E\,[\, Y_{it} \mid i=Eng,\, t=2001] - E\,[\, Y_{it} \mid i=Eng,\, t=1999] \qquad (9)$

$$= Y_{it2001} - Y_{i1999}$$

Scotland $= \{\, E\,[\, Y_{it} \mid i=Scot,\, t=2001] - E\,[\, Y_{it} \mid i=Scot,\, t=1999] \qquad (10)$

$$= Y_{i2001} - Y_{i1999} + \delta$$

My simple estimation results are illustrated in Table 6. Without controlling for any other variables, the change in enrollment rates after the policy change is larger for Scottish students studying in Scottish universities than for English students studying in English universities.

	Home Enroll 1999-2000	Home Enroll 2001-2002	Difference
English Student	0.986252321	0.987628934	0.001
Scottish Student	0.939201392	0.955748303	0.0165
β_3, δ			0.0155

Table 6

5.3 Model Specification

The methodology outlined above can also be used for regression analysis. Let R_i be a dummy variable, which takes on the value of 1 for Scottish counties and 0 for English counties and d_t a time dummy which takes on the value 1 for observations obtained in 2001 and 0 for observations obtained in 1999.

Then enrollment status can be described as

$$Y_{it} = \beta_0 + \beta_1 d_t + \beta_2 R_i + \beta_3 [d_t * R_i] + \Sigma X_k + e_{it} \qquad (11)$$

where Y_{it} =enrollment rate in home country, X's are characteristics of county i that influence enrollment; these may vary across counties, time, or both and where $E[\varepsilon_{it} \ d, R] = 0$

I look at two dependent variables, $Y_{it,}$ by using two different definitions of the enrollment rate; the first as local students enrolled in home country as a proportion of local college bound students and the second as local students enrolled in home country as a proportion of the total local 18-19 year old population. The first enrollment rate looks at the impact of tuition changes on first year, college-bound Scottish students who are deciding between Scottish and English universities ("switchers.") The second enrollment rate targets the impact of the tuition change on those youths who might or might not have attended a university ("either-ors.") By analyzing these two different enrollment rates, I am able to distinguish between the effect on switchers and either-ors.

The coefficient on $d_t R_i$, the interaction term, should be 0 in the absence of the policy change in Scotland, assuming there are no other "normal" differences between the two groups which would effect enrollment rates. The second assumption needed is that enrollment probabilities of the control groups- the counties in England- are not impacted by the change in tuition policy in Scotland.[5] In this regression equation, β_3 is the equivalent of the previously defined δ, the causal effect of interest, the "average treatment effect on the treated' (Imbens and Angrist, 1994). This parameter captures the impact that the change of tuition had on Scottish students studying in Scotland or Scottish youths studying in Scotland. In Hubner's paper, he qualifies that mobility of students between countries may undermine this estimation. In this paper, however, because only Scottish students experience a change in relative tuition rates, this assumption is valid. English students must continue to pay the same amount to attend Scottish universities. This allows us to interpret β_3 as the full effect of the treated.

5 This was established in Figure 5.

Instead of regressing enrollment rates on the levels in (11) , I regress differences in enrollment rates on differences of the right hand variables. Differencing (11) you get

$$(Y_{it} - Y_{it-1}) = \beta_0 + \beta_1 d_t + \beta_2 R_i + \beta_3 [d_t R_i] - \beta_0 - \beta_1 d_t - \beta_2 R_i - \beta_3 [d_t R_i] - \Sigma[X_{it} - X_{it-1}] \quad (12)$$

$$= \beta_1 [d_t - d_{t-1}] + \beta_2 [R_i - R_i] + \beta_3 [d_t R_i - d_{t-1} R_i] + \Sigma[X_{it} - X_{it-1}] \quad (13)$$

$$= \beta_1 [d_t - d_{t-1}] + \beta_3 [d_t R_i - d_{t-1} R_i] + \Sigma[X_{it} - X_{it-1}] \quad (14)$$

where $\Sigma [X_{it} - X_{it-1}]$ are all non-constant, county characteristics such as unemployment and income and β_3 is the coefficient on the differenced interaction term, which will only equal one for Scottish students, post-policy.

By taking differences, you don't see the influence of cross-sectional, county-specific variables (such as income and unemployment) on the impact of the policy. To make up for this, I reintroduce cross-sectional information that I differenced out, by reintroducing income/state and an unemployment/state interaction terms. My distance/state interaction indicates the relationship between distance and enrollment rates only on Scottish counties (which take the value 1.) My income/ state interaction term functions similarly for average weekly income in Scottish counties. I regress enrollment rate differences on these two terms and get an idea about whether areas with different income/ unemployment rates are impacted by the policy differently.

6 Estimation Results

Table 7 shows the results from my regressions for both the switchers and the either-ors. The "Simple" column for both groups shows the regression results with just the policy interaction term, and the next two columns show the additions of first the distance/state and then the income/state terms. Column 1 results, thus, refer to the regression of differenced switcher enrolment rates on the policy interaction term, differenced unemployment rates, and differenced weekly incomes. This regression as a whole is not significant. When I add the distance/state interaction term (results in column 2) the regression becomes significant as a whole, with the policy interaction term significant at the 10% level and the distance/state interaction term significant at the 1% level. The policy interaction term has a coefficient of .045, indicating an increase of 1,330 students studying in Scotland as a result of the policy. The distance/state term shows that for as the county moves from the border by 100 kilometers, the likelihood of "switching" is decreased by 2 per cent. These results indicate that while the policy seemed to have had a negligible "average" effect on the counties as a whole, counties close to the border experienced a significant increase in Switchers enrollment rates as a result of the policy. These results are consistent with the arguments discussed earlier in the paper and with Figure 3; the closer an individual is to the border, the more likely they are to switch in the first place. When the net costs of Scottish universities relative to English universities declines (in this case as a result of the policy) I expect those closest to the border to "switch." My results confirm this theory. I introduce the income/state interaction term, in column 3, to see it any of this cross-county variation in enrollment rate changes can be attributed to county-specific income heterogeneity. The income/state

term is not found to be significant for this cohort, indicating that the level of income prior to the policy change has no relationship with the policy's impact.

I run the same series of regressions with the "Either-Ors." For the simple regression, I find that the interaction term is significant at the 1% level and has a coefficient of .04, indicating a 4% average increase in the enrollment rate of Scottish youth studying in Scotland. This translates to approximately 1,064 additional Scottish Either-Ors entering university as a result of the policy. In column 5, I introduce the distance/state interaction term and find that it is significant at a 5% level, whereas the policy interaction term, which was significant at the 1% level in the previous regression, is now insignificant. These results suggest that the policy change did not have a significant effect averaged across Scottish counties as a whole, but it did for counties further from the border (in direct contrast with the switchers who saw enrollment rates more likely decrease the further from the border.) The coefficient on this term is .03, indicating that as the county moves from the border by 100 kilometers, the likelihood of an Either-Or enrolling is increased by 3 per cent. In this paper, I do not theorize any direct relationship between distance from border and Either-Or enrollment, and thus I can only attribute this effect to individual-specific county heterogeneity.

Differenced income was also found to be significant at the 5% level. For a one-pound increase in average weekly income, a county was likely to experience an average increase in Either-Or enrollment of .01%; Finally, I include the income/state interaction term and find significance at a 5% level. The effect is positive, indicating that counties with higher income levels experienced larger Either-Or enrollment rate increases. The coefficient on this term is .002, indicating that counties where weekly income pre-treatment was higher by one pound, saw an associated increase of approximately .02% more Either-Or enrollees. This correlation may be due to a

	“Switchers”	**“Either-Ors”**

variety of things; it is possible that wealthier areas are more likely to advertise university access in their communities. Another possibility is that wealthier areas are generally areas with universities, and as students on the margin are more likely to enroll when transportation costs are low, this leads to higher Either-Or enrollment.

	Simple (1)	DistanceState (2)	IncomeState (3)	Simple (4)	DistanceState (5)	IncomeState (6)
Constant	-0.029 (-1.37)	-0.09 (-0.36)	-0.006 (-0.22)	-0.028 (-1.74)	-0.033* (-1.74)	-0.001 (-0.46)
Policy Interaction	-0.005 (-0.36)	0.045* (1.78)	0.038 (0.99)	0.037*** (3.49)	-0.002 (-0.1)	0.061* (2.15)
Distance/State		-0.2*** (-3.26)	-0.2** (-3.16)		0.03** (2.95)	0.03*** (3.46)
Income/State			0.0002 (0.24)			0.002** (2.78)
Distance		0.000 (0.52)	0.000 (0.49)		0.000 (0.25)	0.000 (0.01)
Income Δ	0.001* (1.88)	0.000 (1.18)	0.000 (0.73)	0.000 (1.66)	0.001** (2.43)	0.000 (0.09)
Unemployment Δ	-0.001 (-0.22)	-0.001 (-0.17)	-0.001 (-0.16)	-0.003 (-0.098)	-0.0032 (-1.01)	-0.003 (-0.96)
N	98	98	98	98	98	98
R^2	0.4	0.20	0.20	0.12	0.22	0.28
F	1.43	4.64	3.84	4.30	5.05	5.81

Table 7

(DistanceState in hundreds of kilometers, Incomestate in pounds)

7 Conclusion

In the last decade many countries have shifted higher education funding from public to private sources. Often, this trend went along with the introduction of tuition fees at public universities. This paper adds to the empirical literature by attempting to identify the impact of tuition fees on enrollment behavior by using the reduction in upfront tuition fee price in Scotland in 1999. While natural experiments have been used to identify the effect of student aid on enrollment behavior, this paper is one of the few to apply this strategy to estimate the effects of tuition fees.

This paper adds to the empirical literature trying to identity the impact of tuition fees on enrollment rates by using the asymmetric abolishment of upfront tuition fees in one country in the UK, namely Scotland. By exploiting the "natural experiment" character of the policy, I am able to utilize the difference-in-difference estimation strategy, which allows me to avoid some potential estimation problems from cross-country or across-time variation in tuition rates. This model has been used by various other authors, but my paper contributes to the small empirical literature by applying it to new countries and a new set of data. Knowing the size of applicants' reaction in different countries and in different cohorts is important from both a political and an academic point of view.

Using the difference-in-difference methodology, I found a small but significant increase in enrollment rates, consistent with much of the research done in the US, for both Scottish students studying choosing to study in Scotland and on 18-19 year olds who would otherwise have not enrolled. As hypothesized, the Switcher cohort responded differently depending on proximity to the Scottish/ English border; surprisingly, there was also a relationship for the Either-Ors. I do not examine the possible causes for this relationship, leaving room for more research regarding cross-county characteristics in Scotland, and the likelihood for increased access to university education for the individuals on the margin.

Although the results from my paper suggest that decreasing upfront tuition fees may help widen access to particular groups along with increase competitiveness for local universities, the ideal tuition policy design may not be of this variety. If, for instance, the Scottish Executive's priority is to widen access for primarily disadvantaged youth populations, they may consider using more narrow, possibly means-tested policy designs, as opposed to a flat tuition reduction across all incomes.

This paper finds a strong relationship between distance from the border and enrollment choices, for both cohorts. The government (local and national) should not ignore these type of effects, as they imply that the policy could be engineered with a consideration of cross-county heterogeneity. If the Either-Ors in this paper that chose to attend university came mainly from higher income areas, then it may be of interest to policy-makers to begin targeting poorer neighborhoods or neighborhoods that are not near universities. In any case, these heterogenous treatment effects, varying both across counties and across income levels, strongly suggest a much more narrow focus when designing tuition policy in the future.

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Appendix 1

The National Committee of Inquiry into Higher Education (also known as the Dearing Committee) was appointed in May 1996 with the support of the UK Secretary of State for Education. The Committee had 17 members, including Sir Ron Garrick who chaired the Scottish Committee. The Committee's purpose was: 'to make recommendations on how the purposes, shape, structure, size and funding of higher education, including support for students, should develop to meet the needs of the United Kingdom over the next 20 years, recognizing that higher education embraces teaching, learning, scholarship and research.'

In addition, the Committee was to take account of the broader context of higher education, including increased demand for higher education, increased diversity among students, the distinctive nature of higher education provision in different parts of the UK and the key role of higher education in economic, professional and social development in an increasingly competitive international context. The Committee published the Dearing Report in July 1997. The Report listed 93 recommendations covering the entire scope of its purpose. The Committee started by summarizing the changes in higher education over the previous 20 years:

• The number of students has 'much more than doubled'
• Public funding for higher education has increased by 45% in real terms
• Unit funding per student has decreased by 40%
• Public spending on higher education as a percentage of GDP has remained the same

The Committee concluded that some of the tuition would have to fall upon the students and parents : 'We recognize the need for new sources of finance for higher education…..We

therefore recommend that students enter into an obligation to make contributions to the cost of their higher education once they are in work.'

The Government welcomed the Report and accepted many of its recommendations, such as the one that students themselves contribute to tuition fees, a practice which was duly introduced in 1998/99. However, the model of student support recommended in the Dearing Report, known as maintenance finance, was not accepted. The Report has suggested maintenance grants and loans should be split evenly to cover the remaining tuition after students contributions, but instead, student loans, repayable on graduation on an income contingent basis, came to be the main form of public support for students and from 1999/2000 maintenance grants would no longer be available for most new students or those who entered higher education in 1998/99.

The decision to introduce tuition fees was also strongly opposed by opposition parties and eventually became a key issue in the 1999 Scottish Parliamentary elections. All parties – with the exception of Labour - were committed to the abolition of tuition fees. This included the Liberal Democrats, the Scottish Conservatives and the Scottish National Party. Labour won the most seats at the election, and together with the Liberal Democrats, formed a coalition government.

Inevitably, the reform of funding arrangements for Scottish students in further and higher education institutions was one of the dominant issues in the first year of the Scottish Parliament. The debate initially focused on the issue of tuition fees, but later broadened to encompass student finance as a whole (grants, loans.) The debate in the Scottish Parliament reflected a lengthier, UK-wide debate over the best means of providing financial support for students. As a response to the high levels of interest and opposition to change, a new body, chaired by Andrew Cubie,

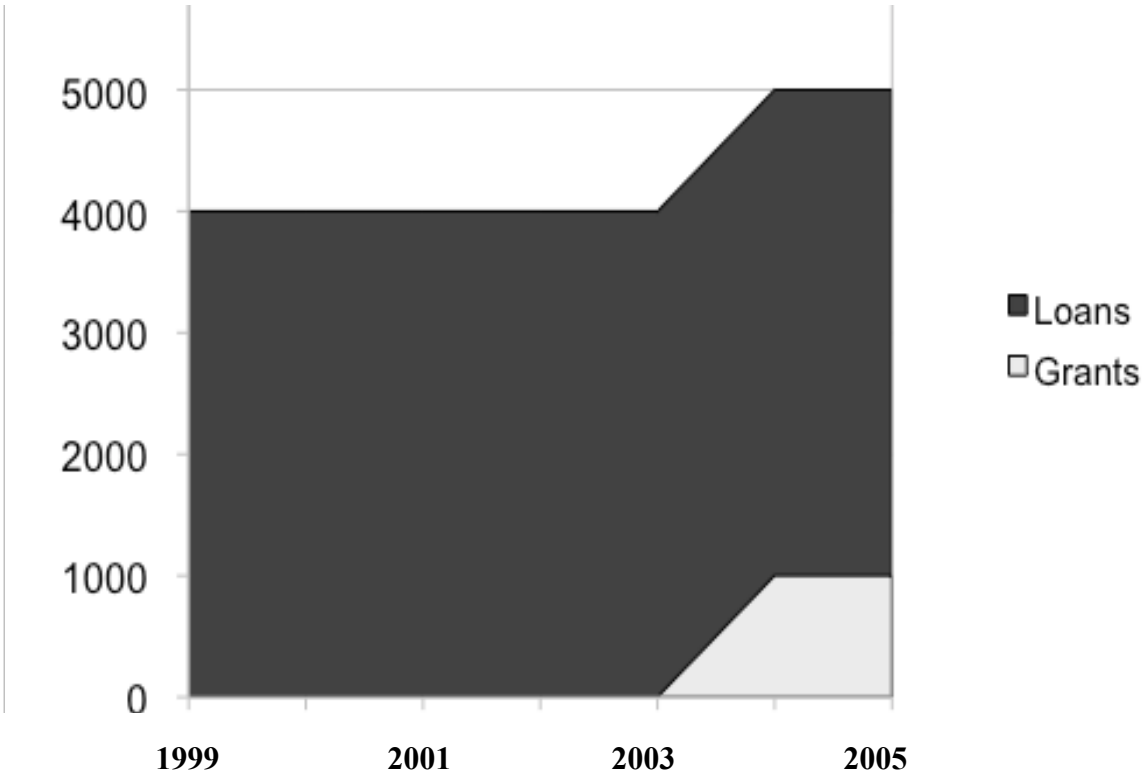
known as the Cubie Committee, was established on July 2, 1999 to readdress student finance in Scotland. The Committee was given the following goals:

- To conduct a comprehensive review of tuition fees and financial support for students normally resident in Scotland participating, part-time or full-time, in further and higher education courses anywhere in the UK
- To consider how best to promote access to further and higher education, particularly for those groups currently under-represented, while taking account of the need to maintain and to develop quality and standards, and the position of Scottish further and higher education in the wider UK system.
- To make recommendations for any changes to the current system, and to explain how these changes would be funded if they required additional resources.

The Committee presented the report to the Scottish Executive on the December 21,1999 after it had carried out a comprehensive analysis of public opinion on the future of student finance: two separate consultation documents were sent out to more than 100,000 people; 13 public hearings were undertaken at venues across the whole country, while oral evidence was heard from groups such as student bodies, trade unions and political parties. The Committee also commissioned academic research. In its final report: 'Student Finance: Fairness for the future', a total of 52 recommendations were made. In summary, the main recommendations were:

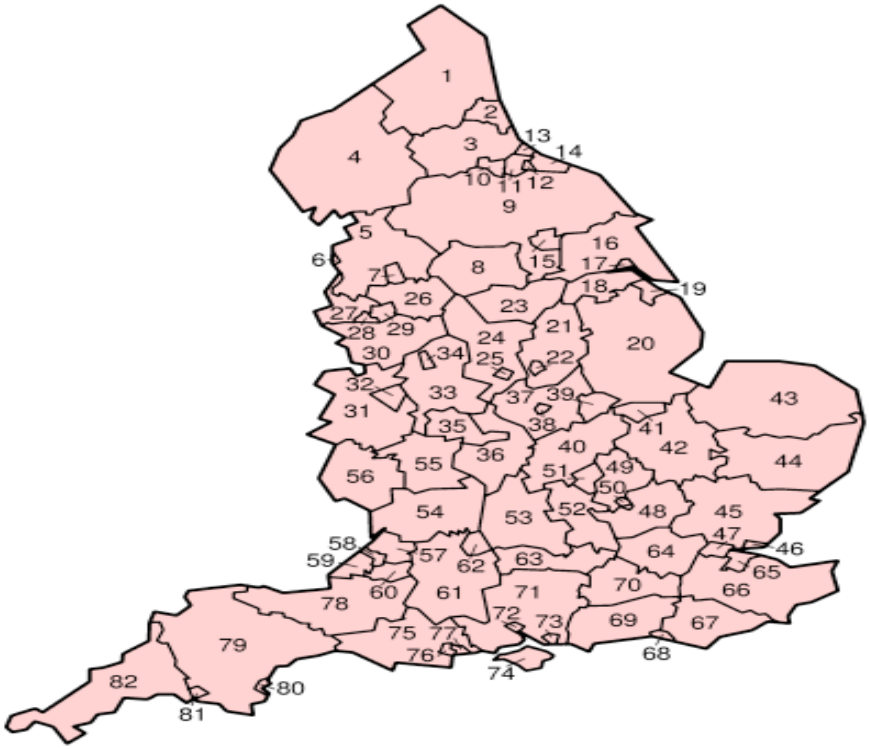
- Abolition of tuition fees for all Scottish students enrolled in Scottish universities.
- Continuation of non-repayable grants for further education students .
- Re-introduction of maintenance grants for students from low income backgrounds set at 50% of the total amount of financial support available .

- Introduction of an endowment scheme for post-graduation contributions of £3,075 towards tuition costs, payable (once annual salary is above £25,000) at a rate of 2% of income per year .
- Abolition of student loan entitlement for students with parents earning more than £47,000 per year.
- Scottish-domiciled students studying at Scottish universities would contribute to the Graduate Endowment scheme, to be introduced in academic session 2001-02.



Maintenance Grants and Loans Over Treatment Period
Figure 6

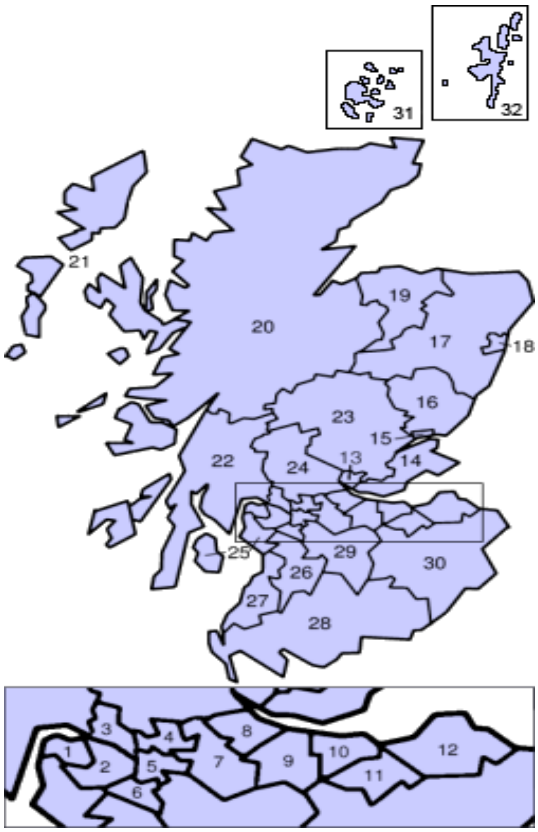
Appendix 2



Map of England

Figure 7

1.	Northumberland	21.	Nottinghamshire	41.	Cambridgeshire	61.	Berkshire
2.	Tyne and Wear	22.	Nottingham	42.	Norfolk	62.	Greater London
3.	Durham	23.	South Yorkshire	43.	Suffolk	63.	Medway
4.	Cumbria	24.	Derbyshire	44.	Essex	64.	Kent
5.	Lancashire	25.	City of Derby	45.	Southend-on-Sea	65.	East Sussex
6.	Blackpool	26.	Greater Manchester	46.	Thurrock	66.	Brighton & Hove
7.	Blackburn with Darwen	27.	Merseyside	47.	Hertfordshire	67.	West Sussex
8.	West Yorkshire	28.	HaltonWarrington	48.	Bedfordshire	68.	Surrey
9.	North Yorkshire	29.	Cheshire	49.	Luton	69.	Hampshire
10.	Darlington	30.	Shropshire	50.	Milton Keynes	70.	City of Southampton
11.	Stockton-on-Tees	31.	Telford and Wrekin	51.	Buckinghamshire	71.	City of Portsmouth
12.	Middlesbrough	32.	Staffordshire	52.	Oxfordshire	72.	Isle of Wight
13.	Hartlepool	33.	City of Stoke-on-Trent	53.	GloucestershireWorcestershire	73.	Dorset
14.	Redcar and Cleveland	34.	West Midlands	54.	Herefordshire	74.	Poole
15.	York	35.	Warwickshire	55.	South Gloucestershire	75.	Bournemouth
16.	East Riding of Yorkshire	36.	Leicestershire	56.	City of Bristol	76.	Somerset
17.	Kingston upon Hull	37.	City of Leicester	57.	North Somerset	77.	Devon
18.	North Lincolnshire	38.	Rutland	58.	Bath and North East Somerset	78.	Torbay
19.	North East Lincolnshire	39.	Northamptonshire	59.	Wiltshire	79.	Plymouth
20.	Lincolnshire	40.	Peterborough	60.	Swindon	80.	Cornwall



Map of Scotland

Figure 8

1. Inverclyde
2. Renfrewshire
3. West Dunbartonshire
4. East Dunbartonshire
5. Glasgow City
6. East Renfrewshire
7. North Lanarkshire
8. Falkirk
9. West Lothian
10. City of Edinburgh
11. Midlothian
12. East Lothian
13. Clackmannanshire
14. Fife
15. Dundee City
16. Angus
17. Aberdeenshire
18. Aberdeen City
19. Moray
20. Highland
21. Outer Hebredies
22. Argyll and Bute
23. Perth and Kinross
24. Stirling
25. North Ayrshire
26. East Ayrshire
27. South Ayrshire
28. Dumfries and Calloway
29. South Lanarkshire
30. Scottish Borders
31. Orkney
32. Shetland

Countries	I_i (high to low)	U_i (low to high)	H/T_i (high to low)	H/Y_i (high to low)
City of Edinburgh	345.9	7.5 (16)	0.96 (13)	0.28 (9)
East Lothian	342.2	6.3 (11)	0.89 (24)	0.2 (25)
City of Aberdeen	337.4	5.7 (7)	0.98 (3)	0.31 (3)
Renfrewshire	332.8	5.7 (7)	0.92 (22)	0.26 (13)
South Ayrshire	330	9.5 (24)	0.93 (21)	0.31 (3)
West Lothian	317.3	6.7 (13)	0.96 (13)	0.2 (25)
City of Dundee	313	11 (28)	0.68 (30)	0.23 (17)
City of Glasgow	310.4	14.3 (31)	0.99 (1)	0.18 (31)
North Lanarkshire	308.4	10.9 (27)	0.99 (1)	0.2 (25)
Clackmannanshire	308	10.7 (26)	0.68 (29)	0.22 (19)
South Lanarkshire	306.3	8 (18)	0.97 (8)	0.26 (13)
Argyll and Bute	304.5	8.6 (21)	0.87 (26)	0.28 (9)
Falkirk	288.4	8 (18)	0.84 (27)	0.2 (25)
Midiothian	288.3	6.1 (10)	0.89 (24)	0.19 (30)
East Ayrshire	286.1	11.8 (29)	0.92 (22)	0.21 (23)
Fife	286	9.4 (23)	0.96 (13)	0.22 (19)
Highland	283.5	8.7 (22)	0.98 (3)	0.27 (11)
East Dunbartonshire	282.5	5.5 (6)	0.94 (17)	0.41 (2)
Stirling	282.2	6.7 (13)	0.98 (3)	0.26 (13)
Shetland	281.9	5 (2)	0.75 (28)	0.27 (11)
Perth and Kinross	280.6	5.7 (7)	0.97 (8)	0.31 (3)
Aberdeenshire	271.1	4.7 (1)	0.98 (3)	0.31 (3)
Inverclyde	269.4	8 (18)	0.94 (17)	0.21 (23)
Moray	265.8	6.4 (12)	0.94 (17)	0.23 (17)
Dumfris and Galloway	262.7	7.6 (17)	0.97 (8)	0.22 (19)
Angus	262.3	6.9 (15)	0.94 (17)	0.31 (3)
North Ayrshire	261	10.3 (25)	0.96 (13)	0.22 (19)
East Renfrewshire	259.7	5.4 (5)	0.97 (8)	0.44 (1)
West Dunbartonshire	251.6	12.4 (30)	0.97 (8)	0.2 (25)
Orkney	248.2	5.3 (4)	0.57 (31)	0.3 (8)
Scottish Borders	236.2	5.2 (3)	0.98 (3)	0.26 (13)

Ranked Incomes and Unemployment Rates by County

Table 8