Determinants of student's university choice

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Abstract

This paper studies the determinants of student's university choice. A wide range of economic research suggest high private and social benefits of higher education, as well as the variation of returns between institutions and degrees; however, not a lot of them focus on the aspects, which affect students' university choice. Therefore, we model the university choice of students who decide to participate in university education in Scotland, England and Wales. We explore variation in individual's location, their characteristics and tuition fees across the countries to identify preference towards choice of university. We use data from the Higher Education Statistical Agency (HESA) which include the population of British graduates between 2006 and 2010. Scottish students are the cohort of interest as they did not have to pay any tuition fees for most part of our sample. Our results suggest that not only socio-economic class, but also fees, are an important factor in university choice decision process, as we find Scottish students have a lower disutility of distance.

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1 Introduction

This paper investigates the determinants of university choice. Understanding the factors, which affect the university decisions, is crucial for better policy design and for example it could inform the discussion whether higher education should be subsidised and what is the most effective way of allocating resources in order to improve wide range of outcomes. Therefore, in the paper we will present a model of student's utility of university choice in order to learn what could be influencing the decision. We use home-university distance as the base utility. Distance in our model serves as approximation of moving costs. Students who are more sensitive to distance may have an actual smaller choice set of universities, if they are constraint by distance.

Many aspects can affect students' decisions regarding where to go to university. Some of them have been studied already. Arcidiacono (2005) looks at the importance of financial aid and affirmative action in students' decision making as well as how it affects their labour market outcomes. Gibbons and Vignoles (2012) focus on the importance of home/institution distance on participation and the utility of choice. We contribute to the literature as we are able to combine both the fees and the distance to institution, controlling for demographics of students.

As our paper focuses on modelling utility of choice we use a logit framework. The starting point in our analysis is a simple multinomial logit (McFadden 1974) following Gibbons and Vignoles (2012) specification but we use the full set of universities as the dependent variables. As the parameter space is large, and the estimation method is likely to suffer from unobserved location characteristics bias we contribute to the literature by expanding our methodology to alternative specific constant model of Bayer and Timmins (2007), which allows us to get informative results and include location information. Although independence of irrelevant alternatives could potentially be still a problem we do not expect it to be a problem. Finally, we exploit a policy design in the UK regarding application process and constraint the choice set to 6, which allows us to get very close to the real choice set.

In our analysis we use the Higher Education Agency Statistics (HESA) data, which includes the whole population of British graduates between 2006 and 2010. Since we are able to include the whole population of students, we can trust our results are representative as we do not need to worry about small sample problems of Arcidiacono (2005) or Fuller *et al* (1994). Specifically, we have demographic information on each student, ability approximated by final high school test scores, the chosen university, and the postcode sector of students at the time of enrolment. The individual level data is necessary to calculate distance and it allows us to model the decision process based on location. The HESA dataset is merged with university characteristics as well as the information on potential fees to be paid for each student, depending on university choice, and the country (England, Scotland or Wales) the university is in.

We would expect Scottish students to have the lowest disutility of distance, since they did not have to pay tuition fees in Scotland for the whole of our sample. Indeed, results from our preferred method show that English and Welsh students have a higher disutility of distance in comparison with Scottish. Moreover, the results suggest that fees have a negative effect on students' utility of choice. This result is stable between all estimation methods. We also find students from all of socio-economic backgrounds, apart from Professional and Managerial (the highest socioeconomic groups with the highest lifetime earnings) have a negative coefficient on interaction with distance. Russell Group[1] dummy

[1] Russell Group is similar in concept to Ivy League in North America

interacted with socio-economic background is negative for every interaction, which means all students have a disutility regarding attending Russell Group universities in comparison with students from Professional background. We run sensitivity checks to make sure we identify the origin of the effect correctly.

This paper progresses as follows. The following chapter discusses previous literature on the subject of student university choice and returns to education. It is followed by a short exposition on the British educational system. Subsequently we discuss our data. Part 5 and 6 discuss methodology and estimation results. Chapter 7 concludes.

2 Previous literature

Even with increased participation levels in higher education, returns to university degree have continued being relatively stable in the UK (O'Leary and Sloane 2011) although some degrees like medicine or maths attract on average higher wages. However, returns vary not only by degree but also potentially by university attended. The literature suggests that students who attend a prestigious university are likely to have higher wages after graduation (Chevalier and Conlon 2003). Although Belfield and Fielding (2001) suggests only 1%-2% of wage differential can be explained by university resources; however the particularity of funding system in the UK means that universities receive same amount of funding per students per subject. The funds are not related to university teaching performance and on the other hand different teaching arrangements may reflect various university specific characteristics. More recent research of Hussain *et al* (2009) suggests a positive return to university quality, with results increasing non-lineary at the top of university quality distribution.

Some research has been dedicated to determinants of choice. The most notably research into choice of university in the UK, based on distance, is that of Gibbons and

Vignoles (2012). They show that distance to universities is an important factor for students from lower socio-economic backgrounds, who decide to participate in higher education.[2] We extend their analysis and deal with potential biases in their binomial estimations by running a multinomial McFadden logit (1974). It deals with the fact that any change in the distance to one university leads to changes in the distances to other universities. Ignoring the full choice set may bias estimates of the distance disutility upwards. Arcidiacono (2005) looks at how financial aid affects students' decision. He models all stages of choice starting with participation through university and course choice. He also includes labour market outcomes of students who would be affected by financial aid. He offers a very thorough analysis; however, in his discussion he does not control for distance and his sample size is also rather small and potentially non-representative. Nguyen and Taylor (2003) use multinomial logit of choice after high school graduation with choices varying between employment, unemployment, private four-year college, public four-year college, private two-year college, public two-year college. We do not model employment choices as Nguyen and Taylor (2003) do, or the choice to attend university, but we have the advantage of modelling the individual choice between all universities in the UK for each student, who decides to attend a higher education institution. This allows us not only to look at the utility of the choice but to analyse it in the context of the full choice set. Similar modelling approach to Nguyen and Taylor (2003) used in American context can be found in Fuller *et.al* (1982).

3 University Education in the UK

University education systems and subsidisation of tuition varies greatly between the 3 countries and over the time of our sample. We start our discussion with differences in the

[2] In previous versions of their paper they use a multinomial logit framework, but since their only focus in elasticity of distance, they decided to use only binomial framework for the published paper, as it worked better for their purpose.

systems themselves; bachelor with honours degree, which is a typical undergraduate degree, takes 4 years in Scotland, where it is 3 in the other two countries. The distribution of age varies slightly between countries, with Scotland having the highest proportion of younger students. This is a reflection of different educational system in general, where Scottish pupils can leave school and start attending university at the age of 16. The second most important difference is the way students are funded. The funding experienced a lot of changes over the time of our sample. Until 1997 the higher education in the UK has been free. In 1997 the Dearing report is published, which recommends introduction of means tested tuition fees. In 1998 the recommendation for fees is passed as law. Students entering university in autumn of 1998 are expected to pay upfront £1000 per year, inflation adjusted; it applies to all 3 countries. The payment was to be upfront, however means testing is introduced. Anyone whose parents earned above £35000 had to pay the fees. Students from families who earned between £23000 and £35000 had to pay a fraction of fees on a sliding scale. Finally students whose parents had total income below £23000 did not have to pay fees. Moreover, English, Welsh and Northern Irish students were to pay the fourth year at Scottish Universities. At the same time the Scotland Act (1998) comes in place, which gives Scotland independence in, amongst others, the area of higher education. In 2000 the tuition fees are abolished in Scotland. Year later the graduate endowment (one of payment to university after the graduation) has been introduced where students beginning university education after August 2001 would have to contribute to £2000 after 1 April 2005, that is 10 months after their graduation. The graduate endowment was increased to £2289 in 2006. It has been abolished the following year where all students who graduated after April 2007 would not have to pay it.

In England in 2006 the tuition fees are increased to £3000 per year. Means testing for fees disappears but all students are eligible for a student loan, which they do not have to repay until they graduate and earn at least £15000. Means testing is moved towards support packages, to help with the cost of living for example. With the increase of tuition fees in England, from 2006 Scottish students who want to study in England have to pay the fees, unless they could not study the subject in Scotland. Table 1, below, presents the variation in tuition fees over our sample. The fees vary by individual and the university i.e. students' choice set of fees depends on where they are from, what year they enrolled and the country the institutions are in.

Table 1

Years refer to enrolment years. Numbers in the table represent the cost of the whole degree. Welsh tuition fee costs are net of the Welsh Government grant. Years enrolment are the same for England and Wales.

	Scottish				English			Welsh		
Year	Scotland	England	Wales	Year	Scotland	England	Wales	Scotland	England	Wales
2002	£0	£0	£0	2003	£4400	£3300	£3300	£2510	£1410	£1410
2003	£0	£0	£0	2004	£4500	£3375	£3375	£2610	£1485	£1485
2004	£0	£0	£0	2005	£4600	£3450	£3450	£2710	£1560	£3450
2005	£0	£0	£0	2006	£4700	£9000	£3525	£2810	£7110	£3525
2006	£0	£9000	£3600	2007	£4800	£9000	£9000	£2910	£7110	£7110

4 The data

Our dataset is provided by Higher Education Statistical Agency (HESA) and it includes the total population of graduates in the UK, who graduated between 2006 and 2010. In this study, we only look at students who graduated with undergraduate degree and have a British address before enrolment. We focus on students who live in England, Scotland or Wales. Our dataset allows us to observe where students live before they started university at the level of postcode sector (e.g. AA11 1), we know their university of choice, as well as their demographic characteristics including age, gender, ability (approximated by UCAS tariff), socio-economic class based on their parents' occupational code and ethnicity. We merge university locations into our dataset to calculate the distance between each student and each university. In our subsample there are 146 institutions, from which 12 are in

Wales, 17 in Scotland, with the rest located in England.

The average distance students travelled to their university of choice, which we treat as moving costs, varies a lot with their socio-economic class Also, Scottish students chose universities closest to home, see Table 6, even though in first 4 years of our sample, Scottish students could study in England or Wales at the same level of tuition fees as in Scotland, which is £0. Nonetheless, just from looking at the descriptive statistic we observe otherwise. However, this statistic may be driven by the spatial distribution of universities, as Figure 1 is suggesting, therefore estimation methods are required. Figure 1 also suggests that some of the difference may be driven by the top of the distribution in distance to university of choice of British students.

Table 2

Students by country of residence.

	Total number	Percentage of total
England	207,455	90.19%
Scotland	11,704	5.09%
Wales	10,857	4.72%

Table 3

Summary of continuous variables.
Age is censored at 16 and 65.

Variable		Mean	Std..Dev	Min	Max
Tariff (ability)	230016	322.42	122.93	5	1080
Age	230016	18.72	2.20	16	65
Distance (km)	230016	136.56	171.60	.055	908.51

Table 4			
Distribution of distance to universities of choice between socio-economic groups in kilometres			
	Mean	Std. Dev.	Freq.
Professional	153.09	172.38	78383
Manager	144.11	171.71	46439
Admin	133.39	169.80	18238
Skilled trade	125.13	169.53	19844
Other	104.14	154.61	31850
No occupation	127.23	180.93	35270

Table 5			
Distribution of distance travelled to universities of choice between ethnic groups			
	Mean	Std. Dev.	Freq.
Asian	64.72	108.85	23054
Black	84.03	133.08	6015
Mixed	116.98	159.09	7335
Unknown	138.12	170.10	2752
White	147.62	176.81	190860

Table 6			
Mean distance travelled to university per country of residence			
	Mean	Std. Dev.	N
English	140.81	175.00	207455
Scottish	83.90	119.52	11704
Welsh	112.10	139.12	10857

Table 7			
Distribution of tariff between social groups			
	Mean	Std. Dev.	N
Professional	348.10283	121.52137	78383
Manager	335.06049	118.67891	46439
Admin	326.57829	121.14139	18238
Skilled trade	308.68729	115.00442	19844
Other	289.04571	119.22051	31850
No occupation	284.40387	122.83884	35270

Table 8

Distribution of tariff between Russell Group universities

	Mean	Std. Dev.	N
The University of Birmingham	388.32	89.23	4340
The University of Bristol	444.56	92.33	2945
The University of Cambridge	536.99	99.43	2488
The University of Leeds	390.88	90.49	5933
The University of Liverpool	369.60	90.71	3281
Imperial College London	464.40	97.18	790
King's College London	402.67	85.57	1946
London School of Economics	474.66	98.00	789
University College London	437.64	88.73	1851
The University of Newcastle	392.37	90.84	3461
The University of Nottingham	427.28	90.07	4637
The University of Oxford	518.60	91.98	2842
The University of Sheffield	408.14	86.90	4114
The University of Southampton	397.74	84.88	3082
The University of Warwick	462.24	95.74	2813
The University of Edinburgh	419.83	95.80	1903
The University of Glasgow	398.09	93.39	1624
Cardiff University	387.36	82.82	3752
The University of Manchester	411.48	91.35	5617

Table 9

Distribution of students in RG and non-RG universities by socio-economic group. Percentages represent the proportion of students from this particular socio-economic group per RG or non-RG universities

	Manager	Professional	Admin	Skilled Trade	Other	No Occupation
Non- Russell Group	19.39%	30.58%	7.82%	9.29%	15.50%	17.41%
Russell Group	22.53%	44.39%	8.24%	6.67%	8.96%	9.22%

We do observe that students from lower socio-economic background are underrepresented in the Russell Group (RG) of universities (similar Ivy League universities) (Table 9). However, Table 8 shows that amongst RG universities ability varies from 388 to 536 points were the difference between the highest and the lowest socio-economic class, as found in Table 7, is only around 60 points with students with parents from professional background averaging around 348. Even with one standard deviation an average student from professional background would not necessarily get accepted into University of Oxford or

Cambridge. We move onto estimation methods, which will help us in answering these differences.

5 Model and Methodology

In this paper we model students' university choice based on non-pecuniary determinants. The assumption is that a student i has a set of universities j=1,146 to choose from. Each student's utility of choice is driven by his socio-economic background, university characteristics, other demographics, fees and distance. We assume that students make a decision from the full set of universities first and then we constrain it to 6, which is the maximum number of institution to which students can actually apply[3]. We do not know the true application and acceptance pool, which is the limitation of the model, which cannot be overcome at the moment without using another dataset.

5.1 Multinomial logit

The model we present below allows us to see what determinants are important regarding university choice. Our methodology is based on multinomial (McFadden 1974) logit estimation with errors distributed Type 1 extreme value. This model allows us to calculate the utility of university choice based on the observed characteristics of students and universities, as well as the home-institution distances. In our analysis we look at England, Scotland and Wales. Student's i utility from attending a university j is

$$U_{ij} = \beta_1 lndist_{ij} + \beta_2 X_j + \beta_3 lndist_{ij} Z_i + \beta_4 X_j Z_i + \beta_5 lndist_{ij} X_j + \varepsilon_{ij} \qquad (1)$$

where $lndist_{ij}$ represents the natural logarithm of distance for each student i to university j. X_j are the observed characteristics of university j, Z_i are the observed characteristics of

[3] We exploit the fact that applications in the UK are done centrally, via one organisation, Universities and Colleges Application Services. They allowed 6 application per student over the time of our sample.

individual i. The interaction terms allows us to identify how observed individual characteristics affect the utility of choice . Given the information we hold about each student and each university the probability of a student to choose a university is

$$P_{ij} = \frac{exp(U_{ij})}{\sum exp(U_{ik})} \qquad (2)$$

We then maximise the log likelihood function

$$\text{LL}(\beta_1, \beta_2, \beta_3, \beta_4, \beta_5,) = \sum_{i=1}^{I} \sum_j y_{ij} \, lnP_{ij} \qquad (3)$$

where y_{ij}=1 if and individual i chose institution j, and 0 otherwise.

Although this estimation is an important extension of previous models applied to university choices it suffers from additional weakness. The 2 important caveats in this particular method are Independence of Irrelevant Alternatives (IIA) and unobserved characteristics of universities. Ignoring these issues may exaggerate the importance of distance in the (dis)utility of choice and it may cause the coefficient to be biased. We do not deal with the IIA problem at this stage as we believe it not to be a major issue; however, it is could be remedied with Random Parameters Model. We believe unobserved characteristics of location present a more serious problem in estimation of determinants of utility. Therefore, we focus our attention on extending our estimation strategy in order to include alternative specific constants, which is the solution to omitted variables bias.

5.2 Alternative specific constants model

The alternative specific constants model approach is an important extension of McFadden (1974) model. As we control for unobserved university characteristics we are able to recover estimates on (dis)utility of travel and other observed characteristics. The specific framework we use was first presented by Bayer and Timmins (2005, 2007) and applied in Murdock and Timmins (2007).

The model is applicable because it builds on the importance of taste (preference) in the choice of location, in our case university location, expressed as local spillovers, which are understood as location attributes conditional on other individuals who live in the area. As we do not know the application/acceptances pool, at the moment, the full application of the method is not available. The method is still an important extension as it deals with unobserved location characteristics bias.

Again, the model starts with describing student's utility. The framework we present below follows that of Bayer and Timmins (2007).

$$U_{ij} = \delta_j + \beta_1 X_j + \sigma_j(\beta_2 Z_i) + (\beta_0 + \beta_3 Z_i)dist_{ij} + \beta_4 X_j Z_i + \beta_5 dist_{ij} X_j + \varepsilon_{ij} \qquad (4)$$

$$\delta_j = \gamma X_j + \alpha\sigma_j + \xi_j \qquad (5)$$

The model from previous section has been extended with few important elements. First, in equation (4) we add δ_j, which is the choice specific constant. Another important component, which is required by the model is σ_j, which represents the expected share of students who chose university j (it is recovered from our data). Equation (5) shows the decomposition of the alternative specific constants. It includes observed characteristics of universities X_j and α is the coefficient on the share of students. At the moment σ_j is used as an observed location specific characteristic and we do not try to explain sorting on location with it[4]. Finally, ξ_j is the unobservable attribute of university choice, we assume it to be common across all students.

The estimation strategy is as follows. In the first step we recover δ_j by contraction mapping methods first developed by Berry *et al* (1995). The contraction mapping updates the guesses on the parameters until predicted share equals actual share.

$$P_{ij}^{m,q} = \frac{exp(U_{ij}^{m,q})}{\sum exp(U_{ik}^{m,q})} \qquad (7)$$

m is the number of iterations required to recover δ_j (the alternative specific constants) and *q* is the iterations needed to recover the rest of the parameters. Then, the predicted share of students who choose a specific university is equal to

$$\hat{\sigma}_j^{m,q} = \frac{1}{N}\sum_i P_{ij}^{mq} \qquad (8)$$

Finally, given the parameters estimated in equation (7) the contraction mapping iterates

$$\delta_j^{m+1,q} = \delta_j^{m,q} + (ln\sigma_j - ln\hat{\sigma}_j^{m,q}) \qquad (9)$$

until a vector of δ_j is recovered, which equalises the predicted shares to the actual shares σ_j (see Berry et al (1995) for the proof). In the second stage of the estimation we use the parameters and the predicted utilities from the contraction mapping to maximise the log

[4] In general application, its sign tells if the preference is for agglomeration (positive) or congestion (negative) towards the size of the university. As the data set we have now does not allows us to make assumption about sorting behaviour of students. Although, the extension to add more complex model of preference would not be straightforward; however it would add more power to the estimation of determinants of university choice

likelihood function, which this time includes the share of students at each university as the observed variables and the alternative specific constants as a parameter to be estimated[5].

$$LL(\delta^{*q}, \beta_0, \beta_1, \beta_2, \beta_3, \beta_4, \beta_5 | X, Z, dist, \sigma) = \sum_{i=1}^{I} \sum_j y_{ij} \, lnP_{ij}^* \quad (10)$$

6 Results

We first present the results from the multinomial logit without the alternative specific constants. In our estimation we include a set of interaction dummies, as well as distance on its own. The coefficient on the distance gives us the base utility. In our case the distance is in natural logs. Results are presented in Table 10. At the moment coefficients represent utils. We run two specifications . The disutility of distance is positive but insignificant in (1). The lack of significance in comparison with Gibbons and Vignoles (2012) study is potentially due to the fullness of our model, i.e. we include all socio-economic groups together. The insignificance implies that white male of professional background is indifferent regarding distance to university. The interactions of distance and socio-economic variable are significant in both in (1) and (2). There is a slight change in interaction of Manager*Ln(dist) in (2) as the coefficient loses significance. However the pattern stays the same for both models with all interactions being negative in significant in comparison with Professional socio-economic group. Russell Group dummy is also positive and significant in both models. Finally, females seem to have a lower disutility of distance in comparison to males in (1).

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[5] Finally, we use the vector of δ^{*q} and substitute is as the dependent variables in equation (5) with an intercept term κ and using OLS we use this regression as the first step of Instrumental Variable method to recover the instrument for the share of students choosing university *j*. Specifically, we use the estimates of parameters from the OLS $(\hat{\kappa}, \hat{\alpha}, \hat{\gamma})$ and the maximised likelihood $(\beta_0, \beta_1, \beta_2, \beta_3, \beta_4, \beta_5)$ to calculate

$$\widehat{\sigma_J} = \frac{1}{N} \sum_i \frac{exp(\hat{\kappa} + \beta X_j + \gamma X_j Z_i + (\theta + \mu Z_i) dist_{ij} + \rho dist_{ij} X_j + \hat{\alpha} \sigma_j)}{\sum_{i=1}^{I} exp(\hat{\kappa} + \beta X_k + \gamma X_k Z_i + (\theta + \mu Z_i) dist_{ik} + \rho dist_{ij} X_k + \hat{\alpha} \sigma_j)} \quad (11)$$

which is then substituted into equation (5), which becomes the second stage of the Instrumental Variables estimated with OLS. In this way we recover the coefficients on the university characteristics.

In (2) we extend our model and include Russell Group dummy interacted with socio-economic group as well as ability, fees and nationality interacted with Ln(dist). The base utility is positive and significant from 0. This is not surprising as our reference group is a Scottish male from Professional background. Interaction between ability and distance is as we would expect positive and significant, which implies that more able students are more likely to travel further away to university of choice. Effect on female and distance is not statistically different from zero. Other important results are the negative and significant interactions between English and Welsh residency and distance. This result suggests Scottish students have a lower disutility of distance. However, a potential reason for this effect is the disproportionate number of good universities in Scotland[6]. However, this would not explain the negative effect on English and Welsh students' coefficient. The interaction dummy between distance and fees is negative and significant. Finally, the interaction of RG with Ln(dist) is significant and negative for all students in comparison to Professional background students. We find this pattern repeats through the paper and the potential reason for this result requires a bit attention. Although we assumed that distance is approximation of moving costs, there are other assumptions that can be made. Home-institution distance could be treated as a measure of risk-aversion and even more importantly information constraint[7]. Therefore, there are 3 potential interpretations of the results on interactions of RG dummy with socio-economic group. Firstly, it may be just students have a higher disutility of distance when RG universities are involved. This effect may also involve the fact it is harder to get enrolled to these universities or relatively small size of these universities. We run sensitivity checks in order to make sure this is not the case. Secondly, the negative coefficients may reflect lack of information of students from

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[6] [6] Both comments have been suggested by Jens Ruhose (ifo) and Prof. Nicholas Barr (LSE) respectively during CESifo summer institute

lower socio-economic background regarding the Russell Group universities. Finally, these students may have a higher risk aversion in general and in specific regarding the RG institution, in comparison the Professional Background students.

Table 10

Multinomial logit – dependent variable university choice

		No alt. specific constants		Alt. specific constants	
Individual Attribute	University Attribute	Estimate (std.error) (1)	Estimate (std.error) (2)	Estimate (std.error) (3)	Estimate (std.error) (4)
1.Professional	Russell		Reference Cat		Reference Cat
2 Manager	Russell		-0.22*(0.012)		-0.225*(0.012)
3 Admin	Russell		-0.32*(0.018)		-0.329*(0.018)
4 Skilled Trade	Russell		-0.69*(0.019)		-0.711*(0.019)
5 Other	Russell		-0.89*(0.017)		-0.934*(0.017)
6 No occupation	Russell		-0.96*(0.016)		-1.016*(0.016)
1.Professional	Ln(dist)	Reference Cat	Reference Cat	Reference Cat	Reference Cat
2 Manager	Ln(dist)	-0.013***(0.006)	-0.008(0.007)	-0.015*(0.003)	-0.008**(0.00 4)
3 Admin	Ln(dist)	-0.037*(0.009)	-0.036*(0.009)	-0.053*(0.005)	-0.051*(0.004)
4 Skilled Trade	Ln(dist)	-0.021**(0.009)	-0.040*(0.009)	-0.029*(0.005)	-0.044*(0.005)
5 Other	Ln(dist)	-0.07*(0.007)	-0.082*(0.008)	-0.087*(0.004)	-0.094*(0.004)
6 No occupation	Ln(dist)	-0.019*(0.007)	-0.044*(0.007)	-0.045*(0.004)	-0.062*(0.004)
Ability (Tariff)	Ln(dist)		0.08*(0.025)		0.191*(0.01)
Scottish	Ln(dist)		Reference Cat		Reference Cat
English	Ln(dist)		-1.12*(0.009)		-1.216*(0.004)
Welsh	Ln(dist)		-0.63*(0.020)		-0.705*(0.007)
Female	Ln(dist)	0.47*(0.0048)	-0.0005(0.005)	-0.023*(0.002)	-0.027*(0.002)
	Ln(dist)*Russell		-0.003(0.005)		0.004(0.003)
	Ln(dist)*Fees		-0.05*(0.001)		-0.004*(0.001)
	Russell	0.85*(0.004)	1.21*(0.008)		
	Ln(dist)	0.012(0.022)	1.04*(0.028)	0.0071 (0.01)	1.050*(0.016)
Age	Ln(dist)	-Yes*	Yes	-Yes***	Yes*
		220653	220653	220653	220653

* significant at 1%, ** significant at 5%, ***significant at 10%

Second strategy is to include alternative specific constants into a McFadden choice model framework. The results are presented in Table 10 models (3) and (4). We calculate same models as (1) and (2) but we drop the main effect on RG dummy, as here it is included in the alternative specific constant. Model (3) still shows that distance is insignificantly different from 0 although the sign have continues to be positive. We also find a clearly negative result of distance on all socio-economic groups in comparison with students from Professional background in (3) and (4). The coefficients on distance-socio-economic interactions stay very similar between (3) and (4) although there is not statistical difference between professional and managerial group regarding distance in the latter. The Russell Group dummies are negative for all groups in comparison to professional socio-economic group.

As in (2), students with higher ability have a lower disutility of distance. However, coefficient on female changes sign to negative. The results also suggest that Scottish students indeed have a lower disutility of travel, which would imply that subsidisation of higher education may have a positive effect on their university choices. The size of the effect is not very different from (2). Interestingly, the interaction of Russell Group dummy with distance is positive but not significant. A notable result is the fact that both in (2) and (4) the size and the sign of the interaction of fees with distance stays very similar and continuous to be negative, which suggests that fees have a negative effect on student's utility of university choice irrespective of model used.

To make sure we attribute the results from Russell Group dummy we run sensitivity checks. We generate a random dummy variable, we call it Dummy, and use it in estimation instead of the Russell Group dummy, making sure that the number of students attending these chosen at random universities is similar to Russell Group universities. The results are presented in Table 11. The results show positive coefficients on a random dummy interaction.

Table 11
Sensitivity Check
Multinomial logit – dependent variable university choice

		Alt. specific constants	
Individual Attributes	University Attribute	Estimate (Std.Error) (5)	Estimate (Std.Error) (6)
1.Professional	Dummy		Reference Category
2 Manager	Dummy		0.0849*(0.015)
3 Admin	Dummy		0.1417*(0.021)
4 Skilled Trade	Dummy		0.1796*(0.021)
5 Other	Dummy		0.2600*(0.017)
6 No occupation	Dummy		-0.0501*(0.018)
1.Professional	Ln(dist)	Reference Category	Reference Category
2 Manager	Ln(dist)	-0.0139** (0.007)	0.0014 (0.0071)
3 Admin	Ln(dist)	-0.0543*(0.009)	-0.0351*(0.009)
4 Skilled Trade	Ln(dist)	-0.0298*(0.009)	-0.0223*(0.009)
5 Other	Ln(dist)	-0.0861*(0.007)	-0.0693**(0.008)
6 No occupation	Ln(dist)	-0.0449*(0.007)	-0.0245*(0.007)
Ability (Tariff)	Ln(dist)		0.161*(0.023)
Scottish	Ln(dist)		Reference Category
English	Ln(dist)		-1.211*(0.009)
Welsh	Ln(dist)		-0.725*(0.020)
Female	Ln(dist)	-0.0232*(0.005)	-0.0303*(0.005)
	Ln(dist)*Dummy		0.0889*(0.007)
	Ln(dist)*Fees		-0.0044*(0.001)
	Ln(dist)	0.0166 (0.023)	1.050*(0.028)
Age		Yes	Yes
Observation		220653	220653

Standard errors in parentheses
* p<0.01, ** p<0.05, *** p<0.1

Table 12

Multinomial logit – constraint choice

Individual Attribute	University Attribute	Alt. specific constants Estimate (std.error) (5)	Estimate (std.error) (6)
1.Professional	Russell		Results pending
2 Manager	Russell		
3 Admin	Russell		
4 Skilled Trade	Russell		
5 Other	Russell		
6 No ccupation	Russell		
1.Professional	Ln(dist)	Reference Cat	
2 Manager	Ln(dist)	-0.017**(0.008)	
3 Admin	Ln(dist)	-0.052*(0.01)	
4 Skilled Trade	Ln(dist)	-0.020 ***(0.01)	
5 Other	Ln(dist)	-0.084* (0.009)	
6 No occupation	Ln(dist)	-0.021** (0.008)	
Ability (Tariff)	Ln(dist)		
Scottish	Ln(dist)		
English	Ln(dist)		
Welsh	Ln(dist)		
Female	Ln(dist)	-0.029* (0.005)	
	Ln(dist)*Russell		
	Ln(dist)*Fees		
	Russell		
	Ln(dist)	0.067*(0.02)	
Age	Ln(dist)	-Yes*	Yes*
		220653	220653

* significant at 1%, ** significant at 5%, ***significant at 10%

We finally run 2 more models using a random set of 6 universities for each student. The choice set include the university of choice as well as the 5 other universities based on students ability and subject studied. We find that the results are very similar to (3) and (4) although the significance slightly falls for some of the results.

7 Conclusions

Our results suggest that Scottish students have a lower disutility of distance than their Welsh or English counterparts. This result, amongst many things, could be contributed to by the fact Scottish students have to pay the lowest fees. It means pricing higher education at £0 could have a significant effect on students' choices towards where they study, conditional on their participation. However, we find that coefficients on RG*distance interactions for socio-economic groups but Professional are negative, which means students from non-Professional backgrounds have a disutility of attending Russell Group universities. If correctly specified, this result is could have important implications since we can attribute higher wages to students who graduate from these universities. Finally, though our results are an important improvement over previous research, we recognise that we do not know students application sets, and more research needs to be dedicated towards student's determinants of university choice especially if subsidisation of higher education is to improve outcomes of students from lower socio-economic groups.

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Appendix A

Calculation of the distance matrix

We use the eastings and northings for each postcode in the country provided by UKBorders. Easting refers to the eastward-measured distance (or the x-coordinate), while northing refers to the northward-measured distance (or the y-coordinate). The geography we have is on postcode sector level. In our sample we have close to 9000. In order to estimate the distance we first need to find the centre of each postcode. We do it by taking the minimum and the maximum of both eastings and northings from the group of postcodes, which belong to our postcode sector. The shape below presents a simplification of the exercise. Each corner represents easing or northing. The dashed lines represent where we would expect the centre of the postcode sector to be. We achieve this by calculating the mean of each minimum maximum pair. Once we calculate the easing and northing for centre of each postcode sector in order to calculate the distance we apply the Pythagoras rule.

Home-university distance =

$$sqrt\ \left(\left(university_{easting} - mean_{easting}\right)^2 + \left(university_{northing} - mean_{northing}\right)^2\right) \qquad \text{(A1)}$$

We then calculate the distance matrix, i.e. distance between every postcode sector and every university. Using distance matrix allows us to condition the utility not only on the distance to every university of choice but the whole choice set of universities. For more details also see:

http://www.ordnancesurvey.co.uk/oswebsite/docs/maps/national-grid-map-with-numbering.pdf