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# The Effect of a Tuition Fee Reform on the Risk of Drop Out from University in the UK

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# The Effect of a Tuition Fee Reform on the Risk of Drop Out from University in the UK*

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**Abstract**

This paper investigates whether the increase in university tuition fees in 2006 changed student drop out behaviour. Using data on first year students who enrolled between 2003-2010 we show that the policy reform reduced the hazard of dropping out by 16%, but differences in the impact of the reform occur between income groups, for instance. The effect persisted beyond 2006 with a substantial additional effect arising from the 2008-10 recession. There is indirect evidence of a composition effect resulting in a fall in dropout rates, but debt aversion does not appear to determine drop out behaviour.

JEL Classification: I20, I22, I28
Keywords: Tuition fee reform, Dropouts, Duration analysis.

## 1 Introduction

Dropping out of education can be costly for individuals, especially if there is an increased risk of unemployment and associated lower lifetime earnings (Arulampalam et al., 2005), for universities insofar as income is reduced, and for society as a whole, especially when the state

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subsidy to education is high. Countries like the US and the UK have witnessed substantial increases in participation rates in higher education, and dropout rates have remained high as more marginal (in terms of ability) students have enrolled on university courses. With the increase in participation rates, and associated increased taxation to finance this expansion, it is no surprise that governments should look for alternative funding mechanisms. In recent years, successive UK governments have sought to reduce the subsidy to higher education and have sought to push more of these costs onto the beneficiaries of their education - the students.

A tuition fee was first introduced for students enrolling at universities in the UK in 1998/99 when they were required to pay approximately £1,000 per annum. The Higher Education Reform Act, approved in 2004, which was effective from the academic year 2006/07, raised the cap on fees to £3,000 per annum. From 2006 students could defer the payment of fees by taking a Tuition Fee Income Contingent Loan (TICL) up to the maximum amount of fees being charged. Repayment of the loan was linked to income obtained after graduation, at a 9 per cent fixed interest rate for everything earned above £15,000 and at a zero real interest rate. Hence, graduate students only repaid when they could afford it.[1] A further fee increase was introduced in 2012/13, which raised the fees to £6,000-£9,000.[2]

Students did receive financial support through both loans and grants. From 1999 support for living costs was entirely through Income Contingent Maintenance Loans (ICML), a quarter of which were means tested. Some students also received means tested tuition fee grants. In 2004/05, to help cover the cost of participating in higher education, the government introduced the Higher Education grant, and this was fully means tested and non-repayable. However, this grant was replaced from 2006/07 by the maintenance grant, which was also an income-assessed support.

Table 1 shows the evolution of fees and student support from 2003 to 2009. We note that the introduction of the tuition fee loans in 2006 drastically decreased the number of tuition fee grants.[3] In general, after 2006 although students could choose to pay fees up-front, the majority took out a tuition fee ICL and the total amount of debt (ICML + TICL) has therefore been increasing.

The 2006 reform represented a three-fold increase in tuition fees and was targeted at students whose nationality was English or Northern Irish.[4] Fees at Scottish universities were unchanged, but English, Welsh and Northern Irish students studying in Scotland were liable for the fee increase. Similarly, Scottish students choosing to study in English universities, for instance, were subjected to the fee increase as were students from the European Union (EU). Scottish students attending Scottish institutions did not have to pay increased tuition fees. However, if the reform affected the likelihood of studying outside Scotland, it is possible

[1] Before 1998/99 loans were repaid on mortgage style basis. Furthermore, from 2012/13 the government has added a tapered rate of interest which would rise to 3% depending on earnings, and the earnings threshold at which the loans start to be repaid has been increased from £15,000 to £21,000. The debt, however, will be written off after 30 years.

[2] It was hoped that the increase in 2012 would lead to a range of fees charged by universities, however, almost all universities chose to charge the highest fee.

[3] Tuition fee ICL were also available to pre-2006/07 entrants if they made a full or partial contribution to their fixed fees, but we observe in Table 1 that the number of these loans are now negligible.

[4] The tuition fee reform for students studying in Wales, mostly Welsh students, was introduced a year later and a substantial scholarship or bursary was made available to these students.

that the composition of the Scottish university student body changed, hence leading to an indirect effect of the tuition fee reform.

In this paper we investigate whether the tuition fee reform has affected the dropout behaviour of first year undergraduate students. The US literature on this topic suggests that higher student debt can generate a 'reluctance to borrow', either because students fear potential credit constraints after graduation or because they are 'debt averse', which consequently affects their risk of drop out (Stinebrickner and Stinebrickner, 2008; Rothstein and Rouse, 2011; Johnson, 2013). However, the levels of debt experienced by students in the US are likely to be substantially higher than the levels of debt experienced by students in the UK, especially for those groups of students affected by the 2006 tuition fee reform. It is therefore possible that other factors, apart from a reluctance to borrow, have influenced drop out behaviour. One such factor may be a compositional effect whereby 'marginal' students in terms of ability are discouraged from applying for university because the increased costs of a university education are perceived to be higher than the expected benefits, given their ability. Since less able students are more likely to drop out because of a higher probability of academic failure, it may be that the overall drop out rate decreases. A second argument is that increased tuition fees actually encourage greater effort on the part of students with respect to studying in an attempt to maximise the return on their investment, which therefore results in a lower risk of drop out. Finally, the tuition fee reform in 2006 was quickly followed in 2008 by the financial crisis and the so-called 'Great Recession'. As the labour market for youth became tight, job opportunities declined, which therefore reduced the opportunity costs of remaining at university. Hence, drop out rates fall.

It is difficult to measure and disentangle the underlying causes of drop out behaviour with available data. Nevertheless, we try to shed some light on these causes by addressing the following questions. First, has the tuition fee reform reduced the time to drop out once we allow for observable differences between students and unobserved heterogeneity? If students are observed to drop out earlier in the post reform period then one could conjecture that attitudes to debt accumulation is a possible cause. Second, how does drop out behaviour vary with the socio-economic background of students, their gender, the subject they studied and the type of university attended? Differences in the drop out behaviour by sub-groups of the student population is likely to give some insight into compositional effects. Third, are there heterogeneous policy effects, or more specifically, how does the impact of the tuition fee reform on dropout behaviour vary over time? Fourth, is there any evidence that the financial crisis and subsequent recession had an effect on drop out behaviour, and if so, was this effect larger or smaller than the effect of the tuition fee reform? Answers to the third and fourth questions should provide insights into the relative importance of tuiton fee reform versus recession effects. Fifth, did the reform have an indirect effect on the dropout behavior of those students who were ostensibly unaffected by the tuition fee increase, that is, Scottish students attending Scottish universities? Answers to this question are interesting insofar as it reflects a possible unintended consequence of the policy reform on the distribution of students between the home countries.

To answer these questions we use HESA data for the population of university students in the UK for the period 2002-2010. We employ duration modelling techniques, allowing for observed and unobserved heterogeneity. An alternative modelling strategy which we explored was the use of difference-in-difference analysis combined with matching models.

We abandoned this approach in favour of duration modelling simply because we could not identify a suitable control group (e.g. Scottish or non-EU international students) for whom the common trends condition held. In view of this we cannot claim that our findings on the effect of the tuition fee reform are causal.

Our findings suggest that the policy reform reduced the average hazard of dropping out by 16 percent for male and female students, however, this effect varies with the socio-economic background of the student, the subject they studied and by the type of university attended. Social science students and those attending Russell group universities had the greatest reductions in the risk of drop out following the tuition fee reform. We also show that the effect of the reform was not just a one off, persisting for a number of years after 2006, however, our analysis suggests that part of the reduction in the risk of drop out in the post-reform period is due to both the effects of the recession in 2008 and changes in the composition of the student population. There is little evidence that a reluctance to borrow affects student drop out behaviour. Finally, we show that the tuition fee reform also affected student drop out behaviour for Scottish students in Scottish universities. We, argue that Scottish students who would otherwise have studied at English universities chose to stay in Scotland. Our evidence raises some important issues regarding the 2011 tuition fee reforms.

In the next section of this paper we review the recent literature on dropout behaviour. This is followed by a detailed discussion of our data in Section 3, and in the proceeding section we outline our econometric modelling strategy. The results of our analysis are presented in Section 5 which is followed by our conclusions and policy implications.

# 2 Theory and literature on drop out behaviour

Models of the decision to attend university or not, and the subsequent decision to drop out of education, are based on the solution to a series of optimization problems that are well known in the literature (Ben-Porath (1970); Heckman (1976) and Oreopoulos (2007)). Individuals maximise their expected lifetime utility by choosing their level of education, conditional on the present value of the expected lifetime wealth. Lifetime utility is a function of consumption which is affected by the individual's rate of time preference, risk aversion, the inter-temporal elasticity of substitution and the non-pecuniary benefits of education. Uncertainty is another important factor that may have an effect on drop out decisions. Students may be uncertain about their ability, the distribution of earnings in graduate and non-graduate jobs, as well as the possibility of short-term credit constraints during university attendance. As suggested in the Introduction, the financial crisis in 2008 which led to a severe recession is likely to have led to increased uncertainty amongst students with respect not only to reduced graduate and non-graduate job opportunities, but also with respect to the earnings distribution in those jobs. Existing students may therefore be less reluctant to drop out of university fearing a higher risk of becoming unemployed. Potential university students who are marginal in terms of their ability may also decide that university entrance is too risky and so do not enroll - the compositional effect. Another school of thought suggests that psychological factors can influence the participation and drop out decisions (Field, 2009), over and above the effect of rational economic decision making.

There are very few studies of the decision to drop out of higher education and almost

none that investigate the duration to dropping out. Many of the studies that do exist for the UK are largely descriptive and do not assess the impact of policy reforms on drop out behaviour. Smith and Naylor (2001) use data for a single cohort of HE students in the UK who enrolled in 1989-90 and find strong effects of prior attainment and local labour market conditions on the risk of dropping out. In addition, family background, personal characteristics and the subject studied at university had an effect on drop out behaviour. A further study by Johnes and McNabb (2004) focused on drop outs from UK HE institutions in 1993 and investigate the role of student-course matches and the effect of the students peers. Although it is difficult with this data to mitigate the reflection problem (Manski, 1993) they do provide some descriptive evidence that males with low ability peers are more likely to drop out. Students in higher quality universities are less likely to drop out. Arulampalam et al. (2005) analyse the effect of prior qualifications, following eight cohorts of university entrants over the period 1984-1992. Perhaps unsurprisingly, weaker students are more likely to drop out. Females were less likely to drop out. They confirm the negative effect of university quality on student drop out behaviour.

Vignoles and Powdthavee (2009) assess the effect of socio-economic background using administrative data for 1st year students who enrolled in a university in 2004-05. Students from families of higher socio-economic status are less likely to drop out; interestingly, students from an ethnic minority background were also less likely to drop out. Although of less relevance to our paper there are many more studies of drop out behaviour at the secondary school level. Lofstrom (2007), for instance, suggests that economic disadvantage, or family background, accounts for nearly 50% of the hispanics-whites gap in dropout rates. Studies that use more sophisticated econometric techniques, such as Ermish and Francesconi (2001) and Bratti (2007) find a limited effect of family income on high school dropout behaviour.

There are a number of studies that investigate the effect of policy reforms both for the UK and the US on the university participation decision. In particular, Dearden et al. (2013) evaluate the re-introduction of grants in the UK universities in 2004/05. Using a difference-in-differences approach they find that the increase in grants raised first-year degree participation (in 2005/06) by around 4 percentage points. By implication one might expect an increase in tuition fees to reduce university participation.

For the US Rothstein and Rouse (2011) show how student debt can affect graduates employment decisions. They evaluate, in a very selective US college, the effects of the replacement of students loans with a grant aid to students in financial need. They find that student debt reduces the probability of accepting low-paying jobs (e.g. in education, government, nonprofit) and an increased probability of accepting jobs with high starting salaries. Field (2009) offers a clear example of how psycho-social costs of debt can affect career decisions, by looking at the effects of an experiment run at the NYU School of Law. Students randomly selected in a lottery obtained income-contingent tuition fee waivers to be repaid only if after graduation the graduate obtains a high-paying (private sector) job. Students not selected obtained tuition loans which were repaid by NYU if after graduation they decided to work in low-paying (public sector) jobs. Thus the two packages of financial aid were equivalent in terms of net present values and, according to the standard economic theory, students should have been indifferent to the lottery outcomes. However, Field finds that graduates that received the tuition fee waiver were more willing to work in low-paying jobs. This can only be attributed to the different perception, and the associated psychological

costs, of the debt horizon between the two financial packages. Johnson (2013) extending the structural model of Keane and Wolpin (2001) and finds that changes in the size of government loans, which relax students' borrowing constraints, do not have important effects on degree completion rates. Johnson interprets these results as a consequence of the reluctance to borrow.

# 3 Data

We use administrative data which refers to the population of students who first enrolled at an institution of Higher Education in the UK between 2003-2010. The data were obtained from the Higher Education Statistics Agency (HESA) who had, in turn, obtained the data from each university and institute of higher education in the UK. There are several important features of these data. First, they record a students start date and end date and hence allow us to calculate the duration of stay in days. Second, the data contains personal information on age, ethnicity, gender, family information on parental occupation, which corresponds to broad income status, and there is information on the university attended and programme of study. Third, since the data refer to the population of students there are no problems of attrition which is common in survey data. Finally, we are able to make use of repeated cohort data for students who enrolled in HE prior to the reform (2003-2005) and post-reform (2006-2010) to investigate the hazard of exit from university.

The data refer to over 1.8 million students. However, there are various restrictions that we impose on the data. Students who enrol at a university between 2003 and 2010 are included in the analysis, however, we restrict our attention to drop out behaviour amongst 1st year undergraduate students. This is because we believe that the determinants of dropout behaviour are likely to vary by year of study and the first year is the period in which students learn about their ability and either adjust, or not, to studying away from home. Furthermore, if students dropped out before the end of December in the 1st year of enrolment they could avoid accumulating debt through the student loan. Insofar as students are aware of this rule then we should see a spike in the hazard of drop out during the first 3-4 months of study. Only full time students are considered since the dropout behaviour of part time students is likely to be very different. Students who have been registered for 6 years or more are excluded. We also exclude students who register for an undergraduate course but who have a prior postgraduate qualification. These could have been data errors and where they are not, then they are likely to be ineligible for student loans. Students aged 36 years or more are excluded from the analysis. Finally, we exclude non-EU international students since they are subject to different fee regimes and are not covered by the tuition fee reforms; students studying in Wales are excluded because the tuition reform started 1 year after that in England, that is, in 2007. In sum, we keep 'Home/EU' students studying in English and Northern Irish universities, and in a separate analysis we focus on Scottish students in Scottish universities.

The survival time to dropout is clearly discrete, since the event of interest can happen on any day of the year. The time students become at risk of dropping out coincides with the start of the observation period. Censoring occurs at the end of the first academic year, which we assume to be the 31st of August. We also restrict the enrolment period to a twelve

month time period and so the maximum length of our observation period is therefore 365 days.

In Figure 1 we divide the duration in days into 12 periods of equal length i.e. 'monthly' intervals, and plot the raw hazards, sub-divided by the pre- and post-reform cohorts. For both male and female students the hazard of drop out rises towards the end of the 1st year of study. The drop out hazard is slightly lower post-reform for all periods except 8 and 9 and there is a substantial reduction in the risk of drop out in period 12. This figure therefore suggests that the tuition fee reform may have influenced drop out behaviour during the first year of study, however, there is little evidence of a spike in drop outs in the first three months of study - recall that students who drop out in this time interval did not have to repay their tuition fees. Indeed, the hazard is lower in the post-reform period. These findings imply that students did not exhibit a reluctance to continue to borrow or debt aversion.

Table 2, Panel A, reports the actual dropout rates by year (cohort). It is clear that, on average, the drop out rate has remained fairly constant at around 8 per cent of the student population up to 2008 when the drop out rate began to fall, implying an effect from the financial crisis and consequent recession. Indeed, by 2010 the dropout rate was almost half of the rate of 2003. Comparing the pre- and post-reform periods, the drop out rate was around 1.7 percentage points lower in the post-reform period. Panel A also shows that there are differences in drop out behaviour between male and female students - in the post-reform period the drop out rate for males falls slightly more (1.9pp), compared to the pre-reform period, than for females (1.4pp), but the absolute drop out rate for males is still higher than females in the post-reform period.

Panel B disaggregates the dropout rate by the socio-economic background of the students' parents, where their occupation is collapsed into one of three groups - high, middle and low socio-economic groups.[5] These groups roughly correspond to high, middle and low income groups. What is clear from Panel B is that all groups exhibit a decline in the dropout rate following the tuition fee reform, however there is a ranking of dropout rates by socio-economic group for each year. The decrease in the dropout rate for the low income group is slightly higher from 2008, although this group still has the highest absolute dropout rate when compared with the middle and high income groups in the same period. The differences in drop out rates between income groups are between 1-2 percentage points.

The dropout rate for the broad type of university attended, classified here by the membership of various 'mission groups' is shown in Panel C. It is worth noting that UK HE is highly stratified and several 'mission' groups have emerged. The Russell Group of universities tend to be research intensive, are generally bigger in terms of student numbers and typically have a strong science base. Examples include Oxford, Cambridge, Imperial and UCL. The 1994 Group which disbanded in 2013, focus on teaching and research and include universities such as, Lancaster and Sussex. Post-1992 universities which converted from polytechnic or college of higher education status are essentially teaching focused, and these make up the majority of our 'Other' category.[6] Not surprisingly, the type of students who attend

[5]The high income group includes students whose parents have managerial and professional occupations. The middle income group includes students with parents in intermediate and technical occupations, small employers and self-employed. The low income groups includes student with parents in routine occupations and unemployed.

[6]This group of universities also includes some pre-1992 universities. Note that we also allow mission group

universities in each of the mission groups vary in terms of prior educational attainment (A level scores) and socio-economic background, the greatest overlap occurring between Russell and 1994 Group Universities. It is therefore important to allow for university type when trying to estimate the effect of the 2006 policy reform on dropout behaviour. We note that drop out rates are always higher in the 'Other' group of universities and lowest for Russell group universities. Nevertheless, the decrease in the dropout rate in the post-reform period is greatest for the 'Other' group of universities (i.e. 2.1pp) and changes marginally for 1994 group universities. Whether this effect survives once we control for covariates remains to be seen (see Section 5.2).

The results for the socio-economic and university mission group variables imply a change in the composition of the student post following the reform, evidence for which is in the larger decreases in the risk of drop out for low income and 'Other' universities imply that more marginal students in terms of ability did not enrol at university following the reform.

Panel D of Table 2 reports the raw drop out rates by subject of study. Data thinning meant that we were only able to disaggregate the data into five broad subject areas as shown in the Table. There is little vriation in the pre-reform drop out rates by subject. Following the reform drop out rates fall and there is also a slight increase in the variation in drop out rates by subject. Closer inspection of Panel D also shows the possible effect of the recession with a 1pp fall in the dropout rate for each subject from 2008 onwards which is greater than the fall in the drop out rates for each subject in the immediate aftermath of the tuition fee reform in 2006. Medical students continued to have the lowest drop out rates both before and after the tuition fee reform.

In Table 3 we show the dropout rates before the reform (2003-05) and in the first three years after the reform. As suggested above, there is very little evidence of a decrease in the dropout rate by 1pp after the reform, however, by the third year the drop out rates decrease substantially, with a larger effect for males (1.7pp) than for females (1.2pp).

Table A1, Appendix A, also provides some descriptive statistics for the covariates used in our econometric analysis.

# 4 Econometric Methodology

Let T be the time in months to dropout, which can take integer values $t = 1, \ldots, M$ and consider a sample of N students ($i = 1, \ldots, N$). Define $y_{it}$ as a dummy variable taking values 0 for all the periods if a student $i$ is censored at time $M$, and 1 in the period $t$ when dropout occurs and zero otherwise.

The conditional probability of dropping out for student $i$ at period $t$, given that event has not yet occurred, is the discrete-time hazard

$$h_{it} = P[T_i = t | T > t - 1, \mathbf{x_{it}}] \tag{1}$$

where $\mathbf{x_{it}}$ is a vector of observed explanatory variables, which can be time-variant or time-invariant.

Following Jenkins (1995) we expand the data to enable us to estimate discrete-time hazard models. More precisely, we reorganize our pooled cross-sectional data in order to

membership to be time varying since some universities shifted from the 1994 Group to the Russell Group.

have multiple rows of observations for each individual student with as many rows as the period at risk. Our final dataset has the format of an unbalanced panel. The likelihood for binary regression models based on the expanded data corresponds to the likelihood for the discrete-time hazard, and the predicted hazards are maximum likelihood estimates. We define the likelihood contribution for a student $i$ who is censored at time M as the probability

$$P[T_i > t] = \prod_{t=1}^{M}(1 - h_{it}) \tag{2}$$

The likelihood contribution of a student who drops out in period $M$ is

$$P[T_i = t] = h_{iM} \prod_{t=1}^{M-1}(1 - h_{it}) = \frac{h_{iM}}{1 - h_{iM}} \prod_{t=1}^{M}(1 - h_{it}) \tag{3}$$

From Equations (2) and (4) the corresponding log-likelihood is

$$logL = \sum_{i=1}^{N}\sum_{t=1}^{M} y_{it}\, log(\frac{h_{it}}{1 - h_{it}}) + \sum_{i=1}^{N}\sum_{t=1}^{M} log(1 - h_{it}) \tag{4}$$

We have to specify now the form of the hazard function. The most common method for modelling covariate effects for continuous-time hazard data assumes proportionality.[7] As demonstrated by Prentice and Gloeckler (1978) the discrete-time counterpart of the proportional hazards model is the complementary log-log hazard rate.

$$c \log\log(h_{it}) = \log(-\log(1 - h_{it})) = \mathbf{x_{it}}\beta + f(t) \tag{5}$$

where $f(t)$ is the baseline hazard. In our model we use a piecewise-constant function by including dummy variables for each period. Thus, within each month interval the duration dependence is assumed constant. This represents a semi-parametric, discrete-time, hazard model which can also be written as

$$h_{it} = 1 - \exp(-\exp(\mathbf{d_{it}}\alpha + \mathbf{x_{it}}\beta)) \tag{6}$$

In our analysis, we generalize this model to account for any unobserved individual-specific effects. Ignoring unobserved heterogeneity can generate misleading inference due to inconsistent parameter estimators (Lancaster (1992)). In Equation (6) we therefore include a random intercept $\eta_i$, which is uncorrelated with the vector of covariates, $\mathbf{x_{it}}$ (Narendranathan and Stewart, 1993).

$$h_{it} = 1 - \exp(-\exp(\mathbf{d_{it}}\alpha + \mathbf{x_{it}}\beta + \eta_i)) \tag{7}$$

This new specification requires an assumption on the the distribution of the unobservable individual-specific error term. Nicoletti and Rondinelli (2010) have provided Monte Carlo evidence that a misspecification of the random effect distribution does not bias either the duration dependence or the covariates included in our model.[8] We assume in all our estimations that the random intercept is normally distributed and constant over each time interval.

[7] This implies that the covariates act proportionally on the underlying hazard function.

[8] They also show more generally that discrete-time hazard models are robust to different form of misspecification of the unobserved heterogeneity.

# 5 Results

## 5.1 The Effect of the Tuition Fee Reform on the Incidence and Timing of Dropping Out

In Table 4 we report the point estimates of our base model, which include a full set of covariates together with the reform dummy variable. We compare the results for the homogenous and heterogeneous models, and for male and female students separately. We also include the p-value of the likelihood ratio test of the hypothesis of zero unobserved heterogeneity. Unobserved heterogeneity does not appear to be an issue in these models, indeed the coefficients of all explanatory variables are almost identical for both the homogenous and heterogenous models at three decimal places. The estimated effects on most of the covariates are signed appropriately and consistent with the existing literature. There are very few differences in the estimated effects for males and females, exceptions being the estimates for mature students and students from the Asian sub-group which suggest that female are less likely to drop out; for males the effects are positive. Females students studying creative subjects are more likely to drop out. For ease of interpretation we have expressed the estimated coefficient of the reform variable as a hazard ratio. This shows the proportional effect of the underlying hazard of dropping out for a change in the variable of interest. The hazard ratios imply that the tuition fee reform had the effect of reducing the risk of drop out by around 16-17 percent for males and females.

To investigate further the effect of the reform on the timing of the dropout decision we have re-estimated the models in Table 4 separately for the pre- and post-reform periods. Figure 2 plots the estimated baseline hazards for the homogenous and heterogenous models, pre- and post-reform and for females and males, respectively. What is immediately apparent is that there is very little difference between the estimated hazards in these two models.

Figure 3 compares only the heterogenous models pre-reform and post-reform. What is interesting is that the hazard of exit from university increases slightly in the first three periods of study and then flattens off until period 8 from which it begins to rise again, both before and after the reform. Thus, although students avoid the accumulation of debt if they leave university before December of the first semester, the tuition fee reform does not appear to have changed dropout behaviour in the early phase of a students undergraduate studies. A reluctance to continue borrowing does not seem to be driving our results. The risk of dropping out is slightly higher post-reform from period 8 to 11, and this is perhaps indicative of students receiving more information about their ability (e.g. through exam results) and then re-evaluating whether to return for a second year of study. The fact that there is a substantial reduction of the hazard of drop out in period 12, and especially for females, suggests that students take their decision to leave university earlier when compared to the pre-reform period. This could be because in the post-reform period students have to make decisions about loans for their second year of study earlier and so wish to avoid this commitment.

## 5.2 The Effect of the Policy Reform on Sub-Groups of Students - Compositional Effects

Panel A of Table 5 report the estimates for different socio-economic groups of students to investigate whether the tuition fee reform has had a different effect on each sub-group. Our findings suggest that the reform did decrease the risk of dropout for all socio-economic groups. Interestingly, there is almost no difference between high and low income groups for females. However, male students from the low income groups are slightly more likely to drop out after the reform. The hazard ratio for the high income male students is 0.837, a 16.3% reduction in the risk of dropping out, whereas the equivalent figure for low income males is 0.875, a 12.5% reduction in the risk, a difference of around 4pp. Low ability people from low income background may be less reluctant to borrow, since they may be less informed of the consequences of debt default, or they may be protected by the funding system (i.e. they may get the maintenance grant introduced from 2006, see Table 1), thus most of them may still decide to enrol in the post-reform period. However, their risk of dropping out remains high, and this is reflected in the 4pp difference compared to their peers from high income background. For females there is very little evidence of differential effects by socio-economic background. Nevertheless, taken together with the descriptive evidence in Section 4 we argue that there has probably been a change in the composition of the student body and that this has influenced drop out behaviour as more marginal students do not enrol in the post reform period.

Table 5, Panel B shows the effect of the reform for students in different types of university, captured here by mission group membership. We compare students at Russell Group universities with those from the 'Other' category, that is, mostly the post 1992 universities. The differences in the effects of the tuition fee reform appear quite marked. Although students from both types of university are less likely to drop out after the reform, the effect for students at Russell Groups universities is much higher. The hazard ratio suggests that the risk of dropping out is reduced by 32-33 percent for males and females, which are substantial effects. The equivalent figures for students from 'Other' universities is approximately 12 percent for males and 15 percent for females. These differences between the two groups are substantial but note that we control for socio-economic background. It is the case that more able students tend to go to Russell Group universities, simply because they are far more selective with respect to prior academic attainment, and this is likely to be one reason for the difference in absolute drop out rates between the two groups of universities. The reason why students at Russell Group universities exhibit such a large decrease in the risk of drop out, relative to students at Other universities, in the post-reform period is most likely to be the result of differences in the composition of the student bodies in each type university . Higher ability students sort into the Russell Group universities and lower ability students sort into 'Other' universities.

Panel C of Table 5 reports the effects of the tuition reform disaggregated by the broad subject of study. The descriptive statistics suggested only a slight variation in the drop out rates by broad subject areas. However, after controlling for observed and unobserved heterogeneity amongst students, there is some evidence of variation in the response to the policy reform by subject of study with social science students exhibiting the largest decline in the risk of dropout and medical sciences the smallest decrease.

There has clearly been variation in the impact of the tuition fee reform between sub-groups of the student population. Our results confirm the effect arising from a change in the composition of the student body insofar as more marginal students may no longer enrol in university once fees had increased. However, those that enrol may be more motivated and put more effort in studies.

## 5.3 Persistence Effects of the Tuition Fee Reform and Recession

In this section we investigate whether the impact of the tuition fee reform persists over time - so-called 'heterogenous policy effects'. It could be that the tuition fee reform had a temporary effect on the early cohorts of students, and once the reality of the income contingent loan mechanism became more fully understood student behaviour returned to some pre-reform norm. To investigate this possibility we categorise the treated group of students into those enrolling 1, 2 and 3 years plus after the reform, rather than treat these as a homogenous group. The untreated group remains the same, that is, students who entered university in the period 2003-2005. Table 6 reports the point estimates which show a modest reduction in the risk of exit from university in the first and second year after the implementation of the reform for males, followed by a more substantial 13 percent decrease from year 3 onwards. There is also no statistically significant change for female students in the two years following the reform.

We investigted further the effects for 3 years or more. This is because it is likely that the very large estimates for 3 years or more pick up the effect of the tuition fee reform and the recession. Students may have stayed at university because the labour market had become very slack and there were few job opportunities, hence the opportunity costs of continued study fell. In an attempt to try and disentangle the effect of the reform from the effect of the recession, Panel B of Table 6 reports the effect of the financial crisis where the pre-recession period (post-reform) is taken as 2006-07 and the recession period following the financial crisis is 2008-10. It is clear that the recession had a substantial effect on drop out rates reducing them by 22 and 27 percentage points for males and females, respectively. Thus, roughly a quarter of the fall in the drop out rate for the post-reform/post-financial crisis period could be attributed to the effect of the recession. This is a rough calculation and one should not take it too literally, however, the important point is that although the financial crisis and subsequent recession had a substantial impact on drop out rates, it did not account for all of the reduction in the drop out rate in the post-reform sub period from 2008 onwards. Stated in another way, it is plausible to argue that the effect of the tuition fee reform persisted beyond three years, especially for males.

## 5.4 The Indirect Effects of the Tuition Fee Reform in Scotland

In this final section we speculate as to whether the tuition reform that impacted students studying in England and Northern Ireland could have affected the drop out behaviour of Scottish students studying at Scottish universities. We know from our previous work that the tuition fee reform in 2006 changed the distribution of students between the home countries, leading to an increase in the percentage of Scottish students choosing to stay in Scotland for their university education. This could have changed the composition of the student body in

Scottish universities and hence affected drop out rates. Table 7, Panel A shows that dropout rates vary over the period 2003 to 2010 for Scotland, and we notice a small decrease in the drop out rate in 2006. A subsequent decline in the dropout rate occurs after 2008 as the financial crisis unfolds. Panel B reports the estimated effects and it is clear that there is a reduction in the risk of drop out amongst Scottish students at Scottish universities, however, given the raw drop out rates in Panel A these effects are only partly to do with the tuition fee reform in the rest of the UK. The financial crisis played a substantial role in reducing drop out rates in Scotland.

# 6 Conclusion

In this paper we have investigated the impact of the 2006 tuition fee reform which simultaneously substantially increased the fee paid by English and Northern Irish students and introduced a tuition fee ICL. Theory suggests that this can lead to a variety of effects, such as increased uncertainty about net lifetime utility, or increased debt aversion, and may also lead students who have embarked on a university degree to re-evaluate their ability and hence expectations of success. Recent literature has also shown that student debt and reluctance to borrow may affect academic and early career decisions. This implies that students in the post-reform period may drop out of university earlier to avoid the accumulation of debt. It can also be argued that due to the prospect of higher fees and higher debt, students who are less able are less likely to enrol to universities in England and Northern Ireland. A change in the student body may therefore lead to lower dropout rates due to a composition effect. The post-reform period also witnessed the financial crisis and the onset of severe recession, leading to a reduction in job opportunities for young people including those who may have dropped out of university. Students who would have otherwise dropped out may therefore continue their studies because the opportunity costs of doing so have fallen. To investigate the impact of the 2006 reform we use HESA data for the period 2003-2010 and duration modelling techniques.

Our results suggest that the tuition fee reform did, in fact, reduce the hazard of dropping out of a university degree course in the first year of study. The effects are quite large insofar as in the post-reform period the risk of dropping out fell, on average, by 16 percent for male and female students. Moreover, there is a clear evidence of a change in the mechanism of revising students' expectations. Before the reform, students were dropping out more in the last month of the academic year whereas after the reform we observe a substantial decrease in the same period. We do not observe any particular increase in dropout rates in the initial 3 months of study, suggesting that a reluctance to borrow is not driving our findings.

There are also differences in the impact of the reform for sub-populations of students, which seem to confirm the hypothesis of a compositional change of the student body. For instance, we find that students from low income backgrounds (likely to be those students with lower prior attainment) experienced a smaller reduction in the hazard of dropping out when compared with students from high income backgrounds. Similarly, students who attended a Russell Group university experienced a substantial reduction in the hazard of drop out, especially in the case of males. An effect of the reform may have been to encourage students to exert greater effort, which increases the likelihood of academic success, in order to ensure

that they obtain a 'good' degree and hence improve their employment prospects.

A second major finding of our analysis is, however, that there are heterogenous policy effects. A simple comparison of student drop out behaviour before and after the introduction of the tuition fee reform conceals important variations. The major additional finding is that, for those students in the 1st and 2nd cohorts following the reform, the reduction in the risk of drop out is small or not significant. By the 3rd cohort of students the reduction of the hazard of exit is substantially higher. However, in the same period (2008-10) there was the financial crisis and the Great Recession, whose effect accounts for roughly 25 per cent of the reduction in the likelihood of drop out in that time period. Nevertheless, it is reasonable to argue that the effect of the tuition fee reform persisted beyond three years.

Finally, we have found some evidence for an indirect effect of the reform on the composition of student body in Scotland. Indeed, more Scottish students, who without the fee increase would have studied in England, decided to stay in Scotland and pay zero tuition fees. This is reflected in a large reduction of dropout rates after 2006.

The evidence presented in this paper also has implications for policy and practice. From a policy perspective it is clear that the 2006 reform has had an effect on drop out behaviour, and hence it is likely that the 2011 reform, which increased fees further (to £6,000-£9,000) may have had a further effect. Whether this effect is of a similar, or greater magnitude, than the 2006 reform is a question that can only be addressed by further research. We can speculate that the 2011 reform is likely to have had a different effect because the magnitude of debt accumulation is much greater and hence debt aversion and uncertainty may have increased, hence leading to further change in student body and drop out rates.

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Table 1: The evolution of students financial support in the UK

| | *2003* | *2004* | *2005* | *2006* | *2007* | *2008* | *2009* |
|---|---|---|---|---|---|---|---|
| tuition fees | 1125 | 1150 | 1175 | 3000 | 3070 | 3145 | 3225 |
| *Loans* | | | | | | | |
| tuition fee loan | | | | | | | |
| | | | *students entering prior 2006/07* | | | | |
| number loans | na | na | na | 158 | 99 | 32 | 5.6 |
| | | | *students entering from 2006/07* | | | | |
| number loans | na | na | na | 234 | 455 | 666 | 780 |
| maintenance loan | | | | | | | |
| number eligible | 840 | 874 | 897 | 905 | 928 | 963 | 1004 |
| number loans | 682 | 693 | 719 | 728 | 746 | 772 | 820 |
| *Grants* | | | | | | | |
| tuition fee grant | | | | | | | |
| number full grants | 321 | 327 | 315 | 190 | 102 | 32 | 6.5 |
| number partial grants | 109 | 100 | 92 | 59 | 31 | 9 | 1.3 |
| maintenance grant | | | | | | | |
| full | na | na | na | 98 | 180 | 155 | 99 |
| partial | na | na | na | 68 | 122 | 98 | 54 |
| HE grants | | | | | | | |
| full | na | 83 | 160 | 127 | 77 | 24 | 5.2 |
| partial | na | 19 | 36 | 28 | 17 | 5 | 1 |

Source: Student Loans Company. Tuition fees are in GBP, other figures are in thousands.

na= not applicable.

Table 2: Changes in dropout rates, pre- and post-reform

*Panel A: Full sample*

| | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | before | after |
|---|---|---|---|---|---|---|---|---|---|---|
| all | 0.098 | 0.090 | 0.086 | 0.089 | 0.088 | 0.077 | 0.066 | 0.055 | 0.091 | 0.074 |
| males | 0.107 | 0.096 | 0.091 | 0.093 | 0.092 | 0.082 | 0.072 | 0.060 | 0.098 | 0.079 |
| females | 0.089 | 0.085 | 0.082 | 0.085 | 0.085 | 0.074 | 0.062 | 0.050 | 0.085 | 0.071 |
| N | 289922 | 250883 | 263903 | 252150 | 260869 | 277666 | 290684 | 289994 | 804708 | 1371363 |

*Panel B: Dropout rates by socio-economic background*

| | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | before | after |
|---|---|---|---|---|---|---|---|---|---|---|
| high income | 0.077 | 0.069 | 0.069 | 0.075 | 0.072 | 0.064 | 0.055 | 0.045 | 0.072 | 0.061 |
| N1 | 132814 | 117345 | 113443 | 105606 | 109835 | 111375 | 122211 | 125536 | 363771 | 574394 |
| middle income | 0.090 | 0.081 | 0.081 | 0.083 | 0.083 | 0.073 | 0.065 | 0.055 | 0.084 | 0.071 |
| N2 | 63584 | 54306 | 54676 | 51159 | 52732 | 56273 | 60423 | 60291 | 172720 | 280724 |
| low income | 0.106 | 0.098 | 0.095 | 0.100 | 0.102 | 0.088 | 0.079 | 0.069 | 0.100 | 0.086 |
| N3 | 40339 | 33840 | 36292 | 35101 | 37818 | 46075 | 42933 | 46391 | 110658 | 208131 |

*Panel C: Dropout rates by type of university*

| | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | before | after |
|---|---|---|---|---|---|---|---|---|---|---|
| Russell group | 0.057 | 0.052 | 0.046 | 0.049 | 0.046 | 0.040 | 0.028 | 0.021 | 0.052 | 0.036 |
| N1 | 66828 | 64663 | 64801 | 66064 | 68349 | 71074 | 71182 | 71144 | 196498 | 347607 |
| 1994 group | 0.074 | 0.072 | 0.064 | 0.075 | 0.074 | 0.062 | 0.052 | 0.044 | 0.070 | 0.061 |
| N2 | 36145 | 32840 | 33037 | 34960 | 37496 | 39914 | 40114 | 40818 | 102063 | 193261 |
| Others | 0.117 | 0.109 | 0.106 | 0.107 | 0.107 | 0.094 | 0.080 | 0.067 | 0.111 | 0.090 |
| N3 | 207923 | 176112 | 188862 | 180060 | 184395 | 199481 | 216376 | 220765 | 576103 | 997871 |

*Panel D: Dropout rates by subjects*

| | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | before | after |
|---|---|---|---|---|---|---|---|---|---|---|
| Medical sciences | 0.085 | 0.079 | 0.076 | 0.082 | 0.081 | 0.071 | 0.062 | 0.051 | 0.080 | 0.068 |
| N1 | 59902 | 55008 | 59192 | 57350 | 59715 | 62721 | 67397 | 69089 | 174102 | 316272 |
| Physical sciences | 0.111 | 0.101 | 0.091 | 0.094 | 0.095 | 0.083 | 0.071 | 0.058 | 0.102 | 0.079 |
| N2 | 55815 | 40546 | 40835 | 38957 | 41584 | 44516 | 46886 | 47311 | 137196 | 219254 |
| Social sciences | 0.104 | 0.096 | 0.092 | 0.095 | 0.090 | 0.078 | 0.066 | 0.054 | 0.098 | 0.075 |
| N3 | 62049 | 49321 | 50960 | 48441 | 53229 | 57870 | 59517 | 58878 | 162330 | 277935 |
| Humanities | 0.087 | 0.082 | 0.078 | 0.082 | 0.083 | 0.071 | 0.059 | 0.048 | 0.082 | 0.068 |
| N4 | 70923 | 68499 | 71646 | 68582 | 67125 | 71388 | 73851 | 73061 | 211068 | 354007 |
| Creative sciences | 0.101 | 0.097 | 0.097 | 0.094 | 0.096 | 0.089 | 0.081 | 0.068 | 0.098 | 0.085 |
| N3 | 38208 | 35491 | 39151 | 37177 | 37854 | 39765 | 41752 | 40740 | 112850 | 197288 |

First year entrants only.

Table 3: Changes in dropout rates, an investigation of heterogenous policy effects

| | *pre* | *1 year after* | *2 years after* | *3 years after* |
|---|---|---|---|---|
| all | 0.0913 | 0.0886 | 0.0881 | 0.0773 |
| males | 0.0985 | 0.0928 | 0.0920 | 0.0818 |
| females | 0.0854 | 0.0853 | 0.0850 | 0.0737 |
| N | 804708 | 252150 | 260869 | 277666 |

First year entrants only. Pre-reform 2003-2005.

Table 4: Estimates of the Base Model - All covariates

| | *Males* | | *Females* | |
|---|---|---|---|---|
| | *Homogenous* | *Heterogenous* | *Homogenous* | *Heterogenous* |
| Reform | -0.172*** | -0.172*** | -0.182*** | -0.182*** |
| | (0.008) | (0.008) | (0.008) | (0.008) |
| Hazard Ratio | 0.842 | 0.842 | 0.833 | 0.833 |
| *Country of origin* | | | | |
| Scotland | -0.047 | -0.047 | -0.024 | -0.024 |
| | (0.061) | (0.061) | (0.058) | (0.058) |
| Wales | 0.179*** | 0.179*** | 0.212*** | 0.212*** |
| | (0.028) | (0.028) | (0.025) | (0.025) |
| N.Ireland | 0.318*** | 0.318*** | 0.271*** | 0.271*** |
| | (0.039) | (0.039) | (0.037) | (0.037) |
| EU15 | -0.448*** | -0.449*** | -0.461*** | -0.461*** |
| | (0.027) | (0.027) | (0.028) | (0.028) |
| EU24 | -0.460*** | -0.460*** | -0.400*** | -0.400*** |
| | (0.050) | (0.050) | (0.041) | (0.041) |
| Middle income family | 0.069*** | 0.069*** | 0.071*** | 0.071*** |
| | (0.012) | (0.012) | (0.011) | (0.011) |
| Low income family | 0.193*** | 0.193*** | 0.179*** | 0.179*** |
| | (0.013) | (0.012) | (0.012) | (0.012) |
| Black | 0.220*** | 0.220*** | 0.065*** | 0.065*** |
| | (0.017) | (0.017) | (0.017) | (0.017) |
| Asian | 0.165*** | 0.165*** | -0.156*** | -0.156*** |
| | (0.012) | (0.012) | (0.014) | (0.014) |
| Other/Unknown | 0.245*** | 0.245*** | 0.150*** | 0.150*** |
| | (0.014) | (0.014) | (0.015) | (0.015) |
| NVQ Level 2 and below | 0.149*** | 0.149*** | 0.077*** | 0.077*** |
| | (0.016) | (0.015) | (0.015) | (0.015) |
| NVQ Level 4 | 0.032** | 0.032** | 0.066*** | 0.066*** |
| | (0.016) | (0.015) | (0.016) | (0.016) |
| Privately funded school | -0.135*** | -0.135*** | -0.160*** | -0.160*** |
| | (0.016) | (0.016) | (0.017) | (0.017) |
| Other school type | 0.211*** | 0.211*** | 0.182*** | 0.182*** |
| | (0.012) | (0.012) | (0.012) | (0.012) |
| Mature student | 0.115*** | 0.115*** | -0.018* | -0.018* |
| | (0.011) | (0.011) | (0.011) | (0.011) |
| 1994 group | 0.451*** | 0.451*** | 0.353*** | 0.353*** |
| | (0.016) | (0.016) | (0.016) | (0.016) |
| Others | 0.918*** | 0.919*** | 0.699*** | 0.699*** |
| | (0.013) | (0.013) | (0.013) | (0.013) |
| *Subject of study* | | | | |
| physical sciences | 0.232*** | 0.232*** | 0.173*** | 0.173*** |
| | (0.012) | (0.012) | (0.016) | (0.016) |
| social sciences | 0.016 | 0.016 | 0.090*** | 0.090*** |
| | (0.013) | (0.013) | (0.011) | (0.011) |
| humanities | -0.011 | -0.011 | 0.026** | 0.026** |
| | (0.013) | (0.013) | (0.010) | (0.010) |
| creative sciences | -0.067*** | -0.067*** | 0.079*** | 0.079*** |
| | (0.014) | (0.014) | (0.012) | (0.012) |
| N | 8026847 | 8026847 | 9950211 | 9950211 |
| LogL | -360009 | -360009.1 | -408912.8 | -408912.9 |
| $chi2^a$ | | 0.272 | | 0.179 |

First year entrants only, in English universities.
[a]LR test of model with Normal distributed heterogeneity against model without controlling for heterogeneity.
Base category subject: medical sciences.

Table 5: Estimates of the effect of the reform by subgroup of the student population

| | *Male* | | *Female* | |
|---|---|---|---|---|
| *Panel A: Socio-economic background* | | | | |
| | *High income* | *Low income* | *High income* | *low income* |
| reform | -0.178*** | -0.134*** | -0.176*** | -0.182*** |
| | (0.014) | (0.021) | (0.013) | (0.024) |
| Hazard Ratio | 0.837 | 0.875 | 0.838 | 0.833 |
| N | 3423335 | 1064380 | 4091157 | 1465708 |
| LogL | -123666.9 | -54530.27 | -143337.4 | -66546.58 |
| $chi2^a$ | 0.432 | 0.000 | 3.272** | 4.502** |
| *Panel B: Type of university* | | | | |
| | *Russell group* | *Others* | *Russell group* | *Others* |
| reform | -0.385*** | -0.129*** | -0.401*** | -0.157*** |
| | (0.023) | (0.009) | (0.029) | (0.009) |
| Hazard Ratio | 0.681 | 0.879 | 0.669 | 0.855 |
| N | 2030914 | 4704820 | 2116010 | 6376523 |
| LogL | -48343.21 | -265903.6 | -51791.58 | -307876 |
| $chi2^a$ | 0.915 | 0.049 | 1.167 | 2.488* |
| *Panel C: Subjects* | | | | |
| | *Medical sciences* | *Physical sciences* | *Social sciences* | *Humanities* | *Creative sciences* |
| reform | -0.159*** | -0.176*** | -0.202*** | -0.186*** | -0.163*** |
| | (0.013) | (0.013) | (0.012) | (0.011) | (0.014) |
| Hazard Ratio | 0.853 | 0.838 | 0.817 | 0.830 | 0.849 |
| N | 3927672 | 2801778 | 3679735 | 4842636 | 2725237 |
| LogL | -156381 | -128578.8 | -161082.7 | -192237.1 | -130420.6 |
| $chi2^a$ | 2.402 | 0.091 | 0.047 | 0.107 | 2.009 |

First year entrants only in English universities.
[a]LR test of model with Normal distributed
heterogeneity against model without controlling for heterogeneity.
All models contain the same control variables as in the base model.

Table 6: Persistence of the reform and effect of the crisis

*Panel A: Effect of the reform by year*

| | *Male* | | | *Female* | | |
|---|---|---|---|---|---|---|
| | *1 year after* | *2 years after* | *3 years after* | *1 year after* | *2 years after* | *3 years after* |
| reform | -0.039*** | -0.043*** | -0.144*** | 0.000 | -0.011 | -0.136*** |
| | (0.013) | (0.013) | (0.013) | (0.012) | (0.012) | (0.012) |
| Hazard Ratio | 0.962 | 0.958 | 0.866 | 1.000 | 0.989 | 0.873 |
| N | 3846410 | 3900009 | 3963052 | 4687341 | 4762488 | 4839834 |
| LogL | -191476.3 | -192750.6 | -191762.2 | -213155.7 | -215172.9 | -212823.9 |
| $chi2^a$ | 0.097 | 0.490 | 3.899 | 3.355 | 12.929 | 0.022 |

First year entrants only in English universities.
[a]LR test of model with Normal distributed heterogeneity
against model without controlling for heterogeneity.
All models contain the same control variables as in the base model.
Before reform: 2003/05. 1 year after: 2006/07.
2 years after: 2007/08. 3 years after: 2008/09/10.

*Panel B: Effect of the financial crisis*

| | *Male* | *Female* |
|---|---|---|
| crisis | -0.243*** | -0.316*** |
| | (0.011) | (0.010) |
| Hazard Ratio | 0.784 | 0.729 |
| N | 5081142 | 6395699 |
| LogL | -210307.4 | -246217 |
| $chi2^*$ | 0.057 | 0.009 |

Before crisis: 2006-07 and after crisis: 2008-10

Table 7: Estimates of the effect of the reform in Scotland

*Panel A: changes in dropout rates*

| | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | before | after |
|---|---|---|---|---|---|---|---|---|---|---|
| all | 0.104 | 0.095 | 0.094 | 0.089 | 0.098 | 0.082 | 0.056 | 0.042 | 0.090 | 0.067 |
| males | 0.117 | 0.103 | 0.100 | 0.097 | 0.109 | 0.091 | 0.062 | 0.043 | 0.107 | 0.079 |
| females | 0.093 | 0.088 | 0.089 | 0.083 | 0.090 | 0.076 | 0.052 | 0.041 | 0.090 | 0.067 |
| Nall | 23062 | 20930 | 20568 | 20530 | 20528 | 21417 | 24130 | 23059 | 64970 | 109254 |

*Panel B: base model estimates*

| | *Male* | | *Female* | |
|---|---|---|---|---|
| | *Homogenous* | *Heterogenous* | *Homogenous* | *Heterogenous* |
| reform | -0.308*** | -0.403*** | -0.277*** | -0.376*** |
| | (0.028) | (0.040) | (0.028) | (0.041) |
| Hazard Ratio | 0.735 | 0.668 | 0.758 | 0.687 |
| N | 635479 | 635479 | 778773 | 778773 |
| LogL | -29644.04 | -29636.43 | -30822.51 | -30803.07 |
| $chi2^a$ | | 15.208*** | | 38.889*** |

First year entrants only, Scottish students in Scottish University
[a]LR test of model with Normal distributed heterogeneity
against model without controlling for heterogeneity.
Same control variables as in the base model except for nationality.

Figure 1: The raw hazard before and after reform by gender

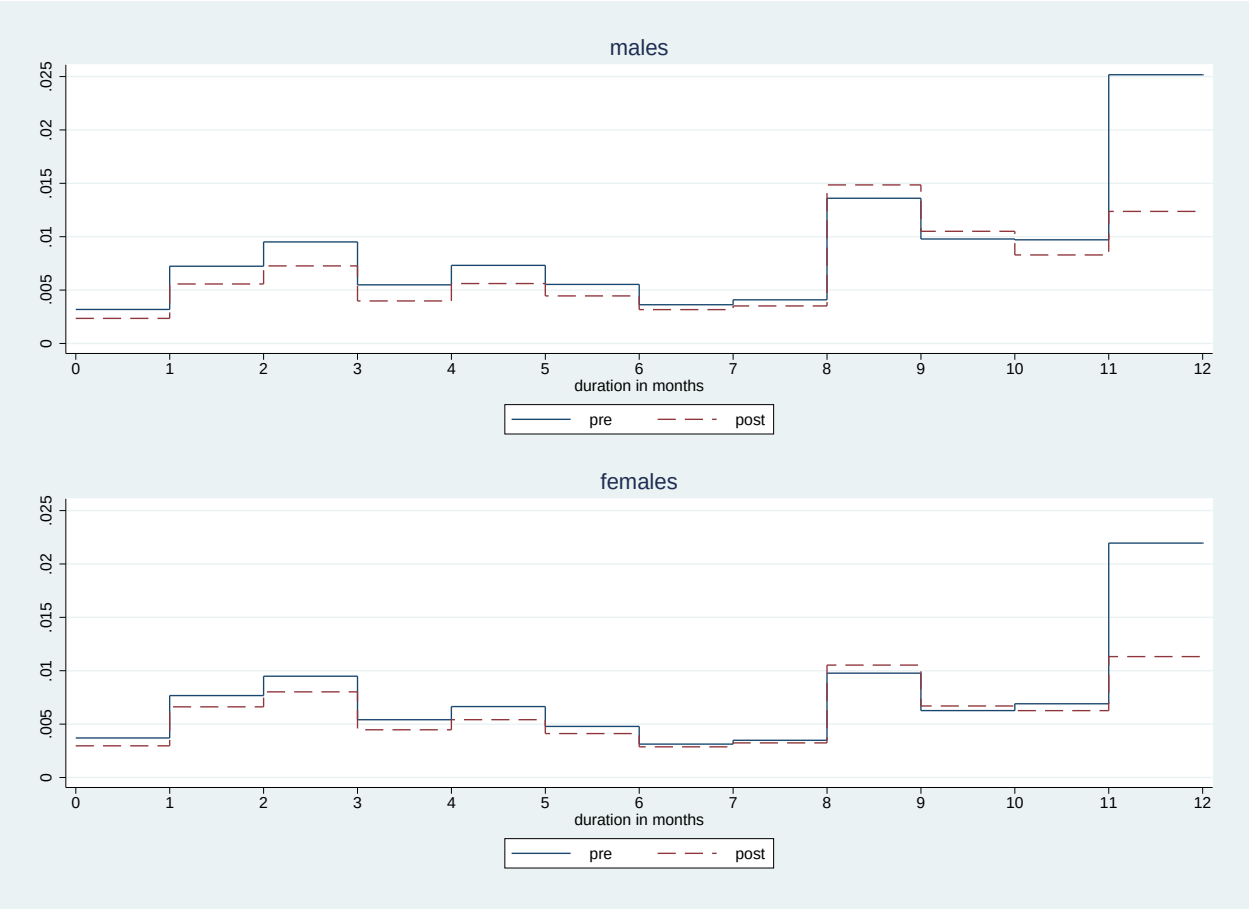


Figure 2: Estimated Hazard

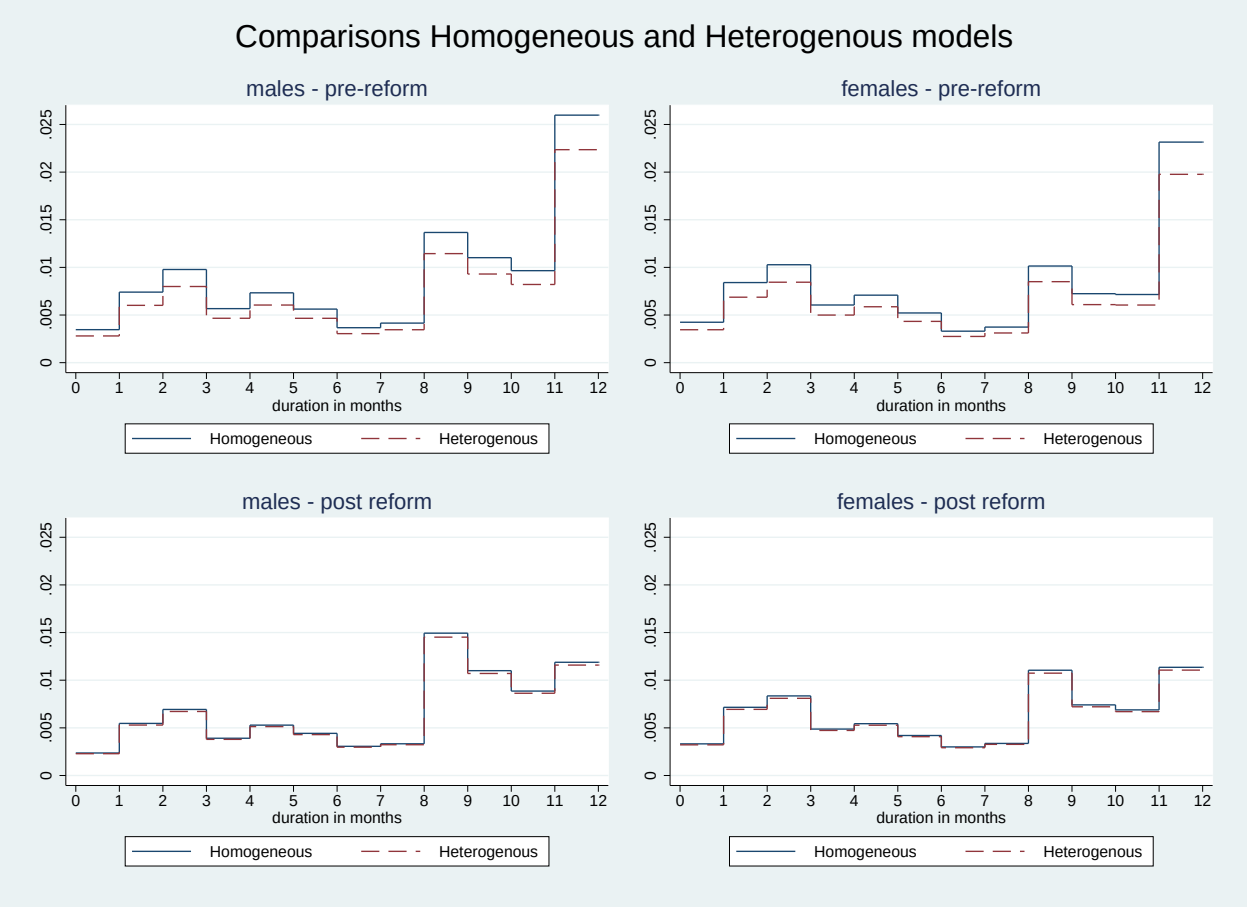


Figure 3: Estimated Hazard - Pre and Post reform

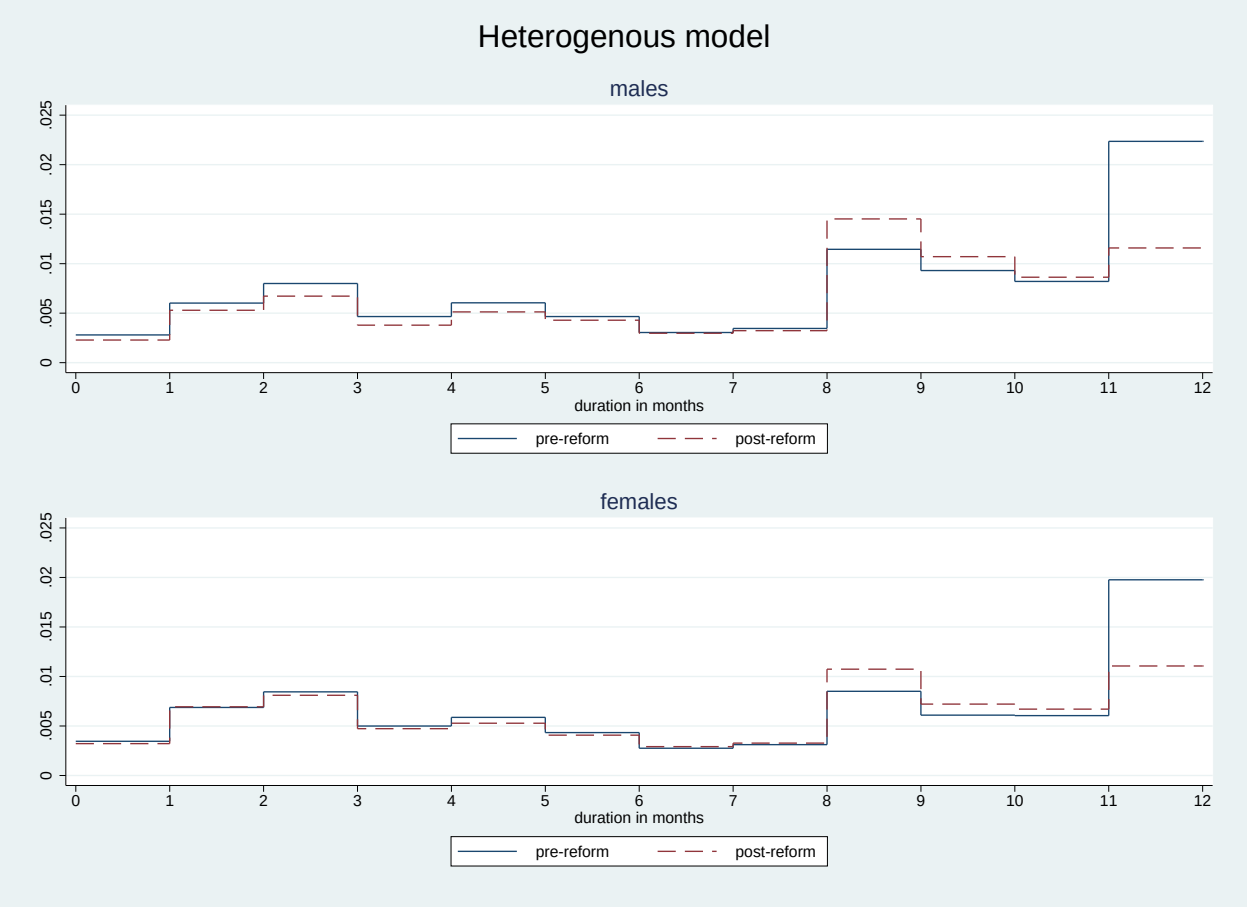
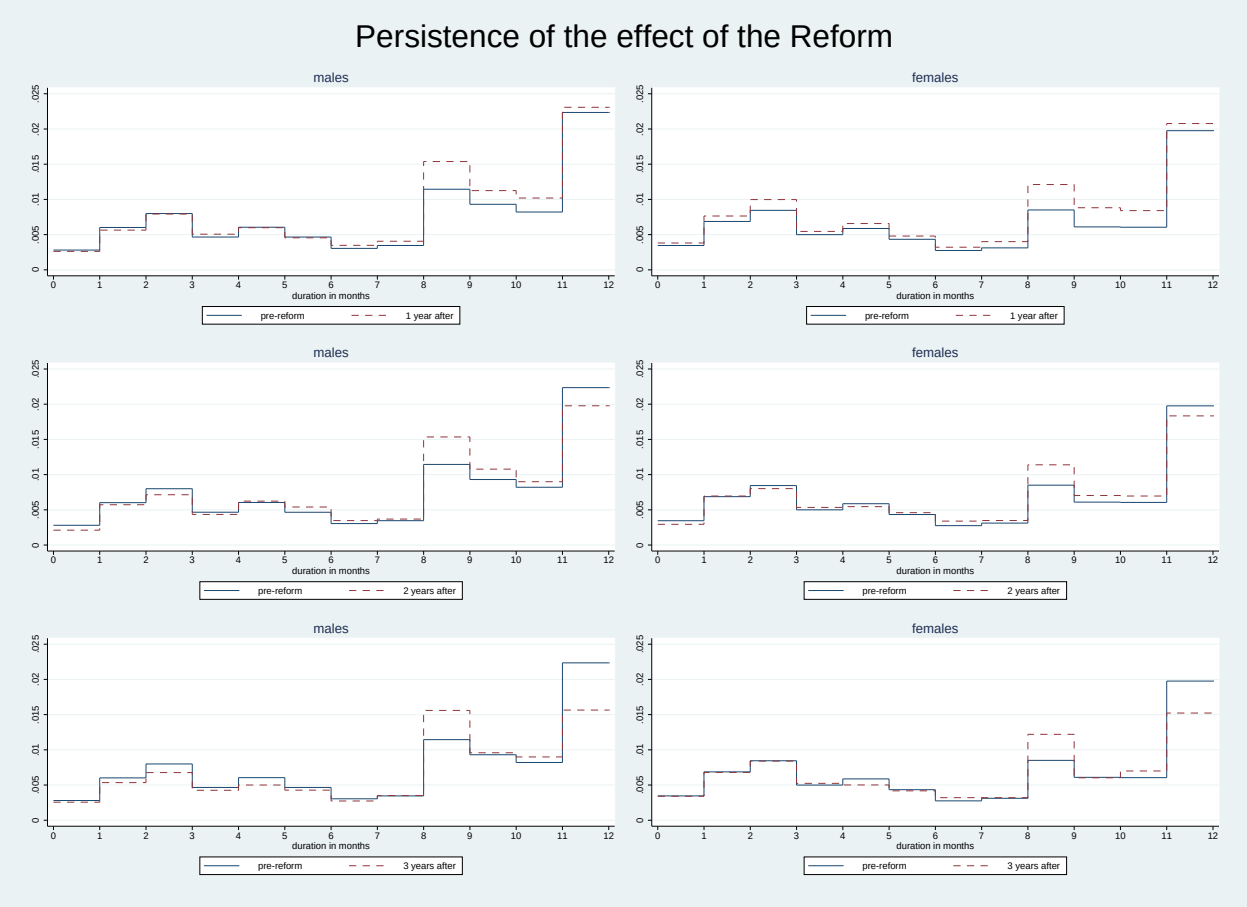


Figure 4: Analysis of heterogenous reform effects



# Appendix A

Table A1: Descriptive Statistics - Sample proportions

| | *Males* | | *Females* | |
|---|---|---|---|---|
| Reform | pre | post | pre | post |
| English | 0.926 | 0.927 | 0.927 | 0.927 |
| Scottish | 0.006 | 0.005 | 0.006 | 0.005 |
| Welsh | 0.023 | 0.019 | 0.023 | 0.019 |
| NorthIrel | 0.008 | 0.007 | 0.008 | 0.008 |
| EU15 | 0.033 | 0.031 | 0.029 | 0.028 |
| EU24entr | 0.004 | 0.010 | 0.006 | 0.013 |
| White | 0.653 | 0.638 | 0.697 | 0.672 |
| Black | 0.043 | 0.052 | 0.047 | 0.058 |
| Asian | 0.113 | 0.107 | 0.095 | 0.094 |
| Other/Unknown | 0.064 | 0.058 | 0.058 | 0.056 |
| Non UK | 0.127 | 0.146 | 0.103 | 0.120 |
| high income family | 0.401 | 0.371 | 0.405 | 0.363 |
| middle income family | 0.178 | 0.170 | 0.193 | 0.182 |
| low income family | 0.116 | 0.124 | 0.128 | 0.142 |
| NVQ Level 3 | 0.791 | 0.818 | 0.810 | 0.834 |
| NVQ Level 2 and below | 0.119 | 0.095 | 0.107 | 0.088 |
| NVQ Level 4 | 0.090 | 0.088 | 0.084 | 0.078 |
| State-funded school or college | 0.650 | 0.687 | 0.705 | 0.738 |
| Privately funded school | 0.121 | 0.110 | 0.097 | 0.086 |
| mature | 0.208 | 0.172 | 0.192 | 0.162 |
| Rusell group | 0.239 | 0.247 | 0.209 | 0.210 |
| 1994 Group | 0.146 | 0.158 | 0.136 | 0.145 |
| Others | 0.615 | 0.594 | 0.655 | 0.645 |
| N | 342,853 | 580,419 | 404,272 | 713,863 |