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Does Offering More Science at School Increase the Supply of Scientists? The Impact of Offering Triple Science at GCSE on Subsequent Educational Choices and Outcomes

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I estimate the effects of an education policy (Triple Science) in England aimed at increasing the take-up and attainment of young people in science subjects. I identify the effect of the policy by comparing two adjacent cohorts of pupils in schools that offer Triple Science to one cohort, but not to the other. I find some large and significant effects on later subject choice and attainment, and these appear to be particularly strong for boys and pupils from more deprived backgrounds

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INTRODUCTION

In 2007, the Department for Children Schools and Families (DCSF) in England announced a new policy which would allow every pupil who had reached a certain standard in their science examinations at age 14 to continue to study Physics, Chemistry and Biology as three separate sciences at the ages of 15 and 16 (as opposed to studying them in a condensed manner, compressed into one or two subjects). This more intensive option for studying science is called "Triple Science" and is believed to provide young people with a better preparation for the study of science later on. The stated intention of the policy was to increase the number of young people taking Physics and Chemistry at A Level (the examination sat by most pupils in England at age 18) and their attainment in those subjects. Ultimately, the policy aims to increase the number of people taking science subjects in Higher Education, as well as the quality of the scientists supplied to the economy.

Despite the fact that some commentators are so convinced of the effectiveness of the policy that they have argued that it should be made compulsory for high achieving pupils (see Section I below), no evaluation of the policy has so far been carried out. In the absence of experimental data with well-defined treatment and control groups it is difficult to draw conclusions about the causal impact of Triple Science on later subject choice and attainment. This is a particular problem in the case of Triple Science, because the kinds of pupils who are offered Triple Science tend to be very different from those who are not. Although controlling for observable characteristics will help alleviate some of this problem, there are bound to be unobservable characteristics that the standard regression framework cannot control for, and which would bias the estimate of the effect of Triple Science on subject choice and attainment.

In this paper I shall argue that, in the absence of experimental data, a better estimate of the causal effect of Triple Science on later subject choice and attainment can be arrived at by exploiting the fact that over time some schools have dropped Triple Science and others have taken it on. Adjacent cohorts of young people going through these schools should be more comparable to each other, and they would have been subjected to a very similar school environment – but one cohort was offered Triple Science whereas the other was not. I argue that this strategy enables me to eliminate at least some of the unobservable characteristics associated with subject choice and attainment in science, and would provide a better estimate of the causal effect of Triple Science.

As far as I am aware, this is the first paper to attempt an estimate of the causal effect of Triple Science on later subject choice and attainment. More generally, I am not aware of any economic studies (particularly in the context of the UK) which have looked at the effect of curriculum structure and offer on later educational subject choice. In this sense, I believe the current study is the first of its kind.

My results indicate that pupils who are offered Triple Science are 8.3% more likely to take A Level Chemistry; 13.4% more likely to take A Level Mathematics; and 15.0% more likely to achieve a grade A in A Level Physics. In addition, I find that the effects of Triple Science are restricted to men only and that pupils from more deprived backgrounds appear to benefit most. In particular, more deprived pupils who were offered Triple Science were 13.7% more likely to choose Chemistry at A Level and 19.6% more likely to take Engineering and Technology in HE.

The remainder of this paper is set out as follows. Section I offers some background on the educational system in England and on the Triple Science policy. In Section II, I briefly review the economic literature on subject choice, and in Section III I describe the key features of my dataset. Section IV documents my empirical strategy and Section V contains the basic results. In Section VI I extend the analysis to certain sub-groups and check for heterogeneity in the treatment. Finally, Section VII offers some discussion and concluding remarks.

I. BACKGROUND

General Certificates of Secondary Education (GCSEs) are the most common qualification taken by 14-16 year olds in England. They are taken in a variety of subjects (usually around eight), which are chosen by the students themselves. However, if the student is in the state ("maintained") sector, he or she will be required to study at least English and Mathematics, as well as a science subject.

In terms of science, there are a number of options students can choose from, the main ones being Single, Double or Triple Science[1]. Single Award Science is the most basic option and combines Biology, Chemistry and Physics into one single GCSE. 13%[2] of pupils in England take this option, and they are not allowed to progress to an A Level in a science subject. Most students (53%) in England will take Double Science, which is the combined study of Biology, Chemistry and Physics that results in two GCSEs. Although students with this qualification are allowed to progress to science at A Level, Double Science is not as in-depth as studying the individual sciences separately (which is called Triple Science and leads to three separate science GCSEs). 10% of pupils in England take the latter option.[3]

Because it is the most in-depth option, Triple Science is considered by many in the scientific and business communities to be the best preparation for further study of science at both A Level and Higher Education, as well as for future careers in science. As a result, there have been various calls for the Government to increase the number of pupils taking Triple Science at GCSE. The Confederation of British Industry (CBI), for instance, has argued that bright pupils should be automatically entered for Triple Science GCSE, with the option to opt out of the exams (CBI, 2008). Similarly, Lord Sainsbury's Review of Science and Innovation (HMT, 2007) recommended that the Government should continue to increase the number of young people studying the three sciences as separate GCSEs, and that the school profile (which provides valuable information for parents) and the accompanying guidance should be amended to encourage schools to provide information about whether they offer Triple Science.

These calls come amidst claims from both the scientific and business communities that the HE system is not producing enough Science, Technology, Engineering and Mathematics (STEM) graduates[4], and that Britain's international competitiveness is being threatened by this shortage of STEM skills (see, for example: CBI, 2008 and BCC, 2008) – claims that have recently been given some substantiation when the Migration Advisory Committee (MAC - an independent body set up to advise the Government on where labour market shortages exist) produced its shortage occupation list, many of which were in the sciences.[5]

It is believed that increasing the number of youngsters taking the Triple Science option at GCSE is one way of improving the supply of scientists in the long run, via the impact it will have on take up of, and attainment in, science subjects both at A Level and in HE.

This lobbying by interest groups to put Triple Science at the forefront of the policy agenda has clearly been successful and, in 2007, the DCSF announced that, by September 2008: (i) all pupils achieving at least level 6 at Key Stage 3[6] (KS3) Science would be entitled to study Triple Science GCSE; and (ii) that all specialist science schools would offer Triple Science at least to all pupils achieving level 6+ in science at the end of KS3. In addition, the Government said it would encourage all schools to make Triple Science available to all pupils "who could benefit" (DCSF, 2007). The underlying aims of the policy were to increase the number of young people taking Physics and Chemistry A Levels (while maintaining the number taking Biology) and raise attainment in A Level science – but, as the title of the document suggests ("Nurturing Tomorrow's Scientists"), the ultimate goal of the programme is clearly to increase to number of young people who choose to study STEM in HE and, from there, the number of STEM graduates available to employers.

The announcement of the policy went hand-in-hand with the setting of a Government target to get 14% of all pupils in maintained schools in England studying Triple Science by 2014 - which was increased to 17% in 2009. In 2007, about 53,000 pupils took Triple Science and the target of 17% in maintained schools corresponds to approximately 100,000 pupils.

Although the DCSF does not support schools financially to offer Triple Science, they do contract with the Learning and Skills Network to support awareness and take-up of GCSE Triple Science through the Triple Science Support Programme[7]. Although the financial cost to a school of setting up a Triple Science programme is relatively minor, there are some barriers to provision which mean that some schools find it harder than others to offer Triple Science. These barriers might be: finding and recruiting specialist teachers willing to teach the subjects, revising the curriculum offer (as taking Triple Science means students don't do something else), adjusting careers advice and training to show students the benefits of taking three sciences in terms of job and career prospects, and additional expenditure on textbooks and materials. Although some schools might succeed in offering Triple Science to their pupils through collaborative arrangements with other schools, this is not possible for all schools (particularly those in rural areas with no other schools nearby).

If no financial support is available to offer Triple Science, why would any school make the switch to Triple Science? The answer, according to the DCSF, is simply that schools are keen to meet the learning needs of all their pupils, and Triple Science helps them do so. In addition, teaching staff tend to enjoy teaching the separate sciences, so job satisfaction plays a crucial role in the decision to offer Triple Science. Finally, for schools that have their own sixth form[8], Triple Science might support progression of pupils from GCSE to A Level, which is beneficial to the school.

II. DETERMINANTS OF SUBJECT CHOICE

As I mentioned in the introduction, I am not aware of any previous research which has attempted to estimate the causal effect of Triple Science on later subject choice and attainment. More generally, I don't know of any economic studies (particularly in the context of the UK) which have looked at the effect of curriculum structure and offer on later educational subject choice. In this sense, I believe the current study is the first of its kind.

Of some relevance, however, is the economic literature on subject choice in schools and HE, which I will briefly review in this section. This (limited) literature covers either: (i) the socio-demographic characteristics which are associated with the study of particular subjects; or (ii) the role of rates of return on subject choice. The former is predominantly descriptive in its nature, whereas the latter attempts to get at the intrinsic motivations behind pupils' choice of subject.

The present study probably fits in most with the first (descriptive) tradition – although it differs in an important respect from that literature to the extent that I am seeking to establish a causal relationship between curriculum on offer and later subject choice. However, even if I find that offering Triple Science at GCSE increases pupils' likelihood of studying STEM in HE, my results will say nothing about the underlying reasons why that may be the case. For instance – is it because Triple Science increases pupils' enjoyment of science? Or is it because it makes them better at science and hence more likely to continue to take the subject at a higher level (where generally it is considered to be a "tough" subject)? It is in this sense that my paper will be mostly "descriptive", and a good understanding of other "descriptive" factors which have been found to be associated with subject choice will thus be crucial for the specification of my regression models.

It is worth noting that a substantial amount has been written on the topic of subject choice in both the psychological and education literatures. In order to keep the present review manageable, I will try and restrict myself to the few studies which have been written in the field of economics.

Tackling the "descriptive" studies first, the most recent research in the UK context was carried out by Chowdry et al. (2008). The authors used a dataset similar to mine (consisting of matched school and Higher Education administrative records for young, English-domiciled students) and fitted both linear probability and multinomial logit models. They were particularly interested in which students were more/less likely to study: (i) STEM subjects; (ii) Law; and (iii) high-wage-return subjects. They found that a student's level of deprivation was not statistically associated with whether or not he/she chose to study a STEM subject and that, by and large, more deprived students were more likely to study subjects with clear economic returns in the labour market (including Law). They also found that ethnic minority groups were significantly less likely to enrol in a STEM subject than their White counterparts, but more likely to enrol in high-wage-return degrees, including Law. This appears to chime with earlier analysis by Connor et al. (2004) which looked at Higher Education Statistics Agency (HESA) records on students in HE and found a considerably higher concentration of minority ethnic students in Medicine/Dentistry, Computer Science and Law. By contrast, ethnic minority students were not well represented in the Physical Sciences, Languages, Art and Design, Humanities, Education, Veterinary Science and Agriculture.

The finding about socio-economic class is also confirmed in a 2006 study by Bratti, who uses data from the Universities' Statistical Record in the UK (a predecessor of HESA) for the period 1981-1991 and looks at young (<21) UK-domiciled students on full-time undergraduate courses. He investigates primarily whether there are any differences in the likelihood of studying three different subject groups: "quantitative subjects", "non-quantitative subjects", and "Law and Medicine". As explanatory variables, he includes gender, age at enrolment, secondary school type, A Level subjects taken, number of A Levels achieved, score in best three A Levels, region of residence prior to university enrolment, and social class. The study concludes that the latter has no effect on students' undergraduate degree subject choice. In fact, the author finds that the bulk of explanatory power of his models can be ascribed to A Level attainment and school type attended. Unfortunately, he does not discuss (or present the results for) the other explanatory variables he included in the model (e.g. gender and age).

One further study looking at tertiary level subject choice in Britain is by van de Werfhorst et al. (2003) who use longitudinal data from the 1958 National Child Development Study (NCDS). The authors use a multinomial regression model where the outcome variable is subject choice at university and which can take six different values: "Medicine and Law", "Engineering", "Science", "Economics", "Social studies" and "Arts". Contrary to the two previous studies cited, van de Werfhorst et al. (2003) find that children of the professional class were relatively more likely to choose Medicine and Law in university (although, as the authors themselves point out, this might be due to the specific characteristics of the cohort studied: at the time of the study only a very small minority of the working class entered HE, and this could be considered as a very particular and selected group (e.g., in terms of academic ability)). Van de Werfhorst et al. (2003) do find (consistent with the aforementioned studies) that ability/prior attainment plays a crucial role, as well young people's "comparative" advantage in certain subjects (i.e. young people choose to study subject that they are relatively good at). Finally, the authors also find a strong association between gender and subject choice.

The above studies are the only (economic) ones I am aware of which look at subject choice in Higher Education in the context of the UK. At secondary level, these are even fewer and further in between – and often tend to be more closely affiliated with the education literature than with the economics one (see, for instance, Ashworth and Evans, 2001; Davies et al., 2004; Bachan and Barrow, 2006; and Vidal Rodeiro, 2007). Mostly, these find similar effects of socio-demographic variables and prior attainment as I have already discussed in the context of Higher Education, although there are some interesting additional findings. For example, both Davies et al. (2004) and Ashworth and Evans (2001) find that the characteristics of the cohort of the students at the school (peer effects) are strongly associated with subject choice (e.g. proportion of students eligible for Free School Meals, the proportion of female students studying a particular subject, and the overall ability of fellow students).

Turning now to studies carried out outside the UK context, Smyth and Hannan's 2006 study of the take-up of Biology, Physics and Chemistry at the upper secondary level in the Republic of Ireland is worth mentioning, as it is the only study I am aware of which looks at how school factors (such as subject provision (including time-tabling), the timing of subject choice, and ability grouping) influence subject take-up. Unfortunately, the authors only look at the effect on immediate subject choice (i.e. whether the availability of one subject in the school has an effect on whether pupils take up other subjects or not), and not on later outcomes (which is the focus of my study). The authors have a very rich dataset at their disposal (which covers data from student questionnaires, detailed interviews with members of staff, as well as information on the prior attainment of students), and this allows them to look at the role of student perceptions (whether subjects are useful, interesting and/or difficult, career aspirations; academic self-image and gender role expectations) affect subject choice at the secondary level. They find that students are more likely to take science subjects if they find them interesting and useful, and if they do well in science. However, this study indicates that a focus on individual student attitudes is not sufficient to explain variation in take-up patterns since important differences are found between schools in the proportion of students taking science subjects at upper secondary level. The take-up of science subjects is found to reflect a school's decision about whether to provide a subject or not along with school organisation and process at both lower and upper secondary levels.

This brings us onto the studies which have tried to uncover some of the reasons behind subject choice (rather than just unveiling statistical associations between observable factors and subject studied). As I mentioned previously, in economics, these studies have tended to focus almost exclusively on the role of (expected) earnings on subject choice, as well as on people's attitudes towards risk. Moreover, nearly all of these studies have been carried out outside of the UK context.

Using Canadian data, Montmarquette et al. (2001) include an "expected earnings" variable in a model which otherwise includes most of the socio-demographic and other observable variables already discussed. These expected earnings are calculated at the individual level and draw on information about the student's perceived probability of success, the predicted earnings of graduates in all subjects, and the student's expected earnings if he (she) fails to complete a college degree. They find that expected earnings influence subject choice over and above all other factors they control for, and that the effect of this variable is twice as large for men as for women. The effect is also larger for the non-white population than for the white group, but does not vary by socio-economic class.

Using data on first year students in Belgium in the early 1990s, Rochat and Demeulemeester (2001) show that young people pay attention not only to the expected economic benefits, but also to the length of studies and the probability of succeeding in a chosen orientation. The authors use a three-step Heckman procedure to adjust for the potential self-selection associated with the fact that the probability of success will depend on the discipline chosen. Interestingly, they find that the richest students do not appear to be sensitive to either the expected chances of success or the economic benefits linked with their orientation choice.

Replicating the above methodology to the Italian context, Buonanno and Pozzoli (2007) also find that students take into account the a priori probability of success when choosing a college subject, and that students coming from a lower socio-economic background display more risk aversion. They believe that their findings can help explain an apparent paradox in the labour market where quantitative subjects are highly rewarded, yet the supply of suitable graduates does not appear to increase in response to those signals.

As I mentioned at the beginning of this section, my study probably fits in best with the "descriptive" tradition in the literature on subject choice. In the next two sections (which discuss the data used and the methodological approach, respectively) I will use the evidence presented in the first half of this section to construct my models of subject choice.

III. DATA AND DESCRIPTIVE STATISTICS

The data I use in this paper consists of matched administrative data: the National Pupil Database (NPD) for England matched to data from HESA.

The NPD is a longitudinal database of children in England holding detailed information on attainment (for pupils in both the maintained and independent sector) at all the Key Stages (KS2[9], KS3[10], KS4[11], and KS5[12]), as well as pupil characteristics (gender, ethnicity, mother tongue, Special Educational Needs (SEN), eligibility for Free School Meals (FSM), postcode deprivation indicators, and month of birth). Because pupil characteristics are generally not available for young people in the independent sector[13], I restrict my analysis to young people who were in the maintained sector at the time they sat their GCSEs.

These individual pupil records have recently been matched by the DCSF to HESA data which holds information on all people attending UK Higher Education Institutions (HEIs), including what subjects they study and which institutions they attend. HESA data matched to the NPD provides us with information on whether pupils entered Higher Education or not.

In addition, I merge in data from the Annual School Census (ASC) which contains some information on staffing resources available to each school in England. Although the ASC does not contain information about the subject specialisms of teachers, it does provide information on the number of qualified teachers, "other" teachers, technicians, as well as on the size of the school.

I have information on two cohorts: one consists of young people born in 1985 (who would have sat their GCSEs in 2001/02) and the other one of those born in 1986 (who would have sat their GCSEs in 2002/03). The 1985 cohort could have been in HE at the age of 18 in 2004/05 (19 in 2005/06), and the 1986 cohort could have been in HE at the age of 18 in 2005/06 (19 in 2006/07).

As mentioned before, I only keep young people who were in a maintained (state) Year 11 school (in order to have socio-demographic information for most pupils in my dataset). In addition, I only keep those pupils who were of the right academic age (i.e. those aged 15 at the end of KS4)[14]. This leaves me with 547,924 individuals in the 1985 cohort and 562,089 in the 1986 cohort – giving me a total of 1,110,013 observations in the entire dataset.

Table 1 provides some basic socio-demographic descriptive statistics for the pupils in this dataset. Just under half my sample is female, and almost 19% of pupils are from an ethnic minority background. Nearly 14% of pupils were on Free School Meals (FSM) at the age of 15, around 16% had special educational needs (SEN), and 9% had a mother tongue other than English. Table 1 also indicates some issues with both the ethnicity and SEN variables. Both of these were affected by a change in classification systems between 2002 and 2003 and, although in theory it should be possible to match one system up to another, teething problems with the introduction of the new classification clearly led to some inconsistencies in these variables between these two years. To deal with this problem in my econometric models, I shall include a list of dummies for all ethnicities and SEN, as well as interactions of these dummies with a cohort dummy.

[Table 1 here]

Tables 2 and 3 provide some information on the key measures of prior attainment I will be using throughout this analysis: attainment on the KS2 and KS3 tests in English, Mathematics and Science. In practice, young people are awarded a "level" (taking discrete integer values from 1-6 at KS2 and from 1-9 at KS3), depending upon the difficulty of the paper they sat ("tier") and the score they achieved in it. In order to obtain a more precise measure of prior attainment, however, I adopt the intrapolation method used by Chowdry et al. (2008) to transform these discrete levels into a continuous measure on a similar scale.[15] This allows me to use much more fine-grained measures of prior attainment, and to compare pupils who sat papers of different difficulties. Table 2 provides an idea of what these variables look like. The KS2 attainment variables tend to range from zero to a maximum of around seven, with a mean of just over four and a standard deviation ranging between 0.70 and 0.85. KS2 attainment information is missing for 9-10% of my sample. The KS3 attainment variables also have a minimum value of zero, but reach maxima of just under 10. Standard deviations range from 1.08 to 1.28 and attainment information is missing for 5-8% of the sample.[16]

[Table 2 here]

[Table 3 here]

In Panel B of Table 3, I show how attainment on these tests varies by: (i) whether or not the pupil took Triple Science at GCSE; and (ii) whether or not the pupil attended a school which offered Triple Science in that particular year. It is clear that: (i) pupils who took Triple Science had, on average, higher prior attainment than pupils who did not take Triple Science; and (ii) pupils attending schools where they were offered Triple Science had, on average, higher prior attainment than pupils whose schools did not offer Triple Science. As the p-values in this table show, these differences are all highly statistically significant.

Table 3 (Panel A) also provides information on the number of pupils who took Triple Science in both years of my dataset, as well as the number of pupils who attended schools where Triple Science was offered to them. Between 2002 and 2003, the proportion of pupils taking Triple Science increased from 4.3% of the cohort to 4.6% of the cohort – i.e. the equivalent of 23,423 young people in 2002, and 25,822 in 2003. The number of people who attended schools where they were offered Triple Science increased by 1.5 percentage points, from 142,321 in 2002 (or 26.0% of the cohort) to 154,399 in 2003 (or 27.5% of the cohort).

Table 4 summarises some key statistics for the schools in my dataset. There were 3,125 schools in 2002 and 3,103 in 2003. 24.2% of schools in 2002 offered Triple Science (n=755), compared to 25.8% of schools in 2003 (n=802) – an increase of 6.2%. As I will show later, however, there is considerable movement in both directions as a large number of schools apparently stop offering Triple Science over this two-year period. Table 4 also provides information on the size of the schools and on some of the resources available to schools (number of qualified teachers, number of other teachers, and technicians). As I will show in the next section, schools which offer Triple Science tend to have more qualified teachers, but also tend to be larger, so that their pupil-teacher ratio is not very different from that of schools that did not offer Triple Science.

[Table 4 here]

Finally, Table 5 summarises some of the key outcome variables that I will be looking at in this paper, including: proportion attaining two A Level passes; subject choice at A Level (proportion entering examinations in Biology, Chemistry, Physics and Mathematics A Levels - conditional on entering any A Level examinations at all); attainment in those subjects at A Level (i.e. proportion attaining a grade A – conditional on having entered an examination in that subject); the likelihood of being: in HE[17]; in a Russell Group institution[18] (conditional on being in HE); doing a STEM degree (conditional on being in HE); as well as the likelihood of studying certain STEM subjects in HE (conditional on being in HE).[19] The table breaks this down by whether: (i) pupils did Triple Science or not; and (ii) pupils attended a school which offered Triple Science or not. It is clear that students who took Triple Science at GCSE are much more likely to take science courses at both A Level and in HE, and they are more likely to do well at them. They are also more likely to achieve A Levels in the first place, to be in HE at the age of 19, and to be attending a Russell Group institution. Similarly, pupils who attended a school which offered Triple Science are more likely to have a positive outcome on all these variables than pupils who attended schools which did not offer Triple Science – except when it comes to studying Mathematics and Computer Science.[20]

[Table 5 here]

IV. EMPIRICAL STRATEGY

As was clear from Table 3, young people who attend schools that offer Triple Science are very different from young people who don't: they tend to have much higher prior attainment. Table 6 further demonstrates that young people who attend schools that offer Triple Science are slightly more likely to be male, less likely to be on Free School Meals, more likely to be White UK, and less likely to have either Special Educational Needs or English as a second language. Furthermore, as shown by Table 7, the outcomes of interest are correlated with the above student characteristics. Overall (although there are some exceptions), people who choose science subjects, etc... are more likely to be male, from an ethnic minority background, not on FSM, with no SEN and with English as foreign language. Finally, as indicated by Table 8, schools that offer Triple Science, although having more teachers, tend to be larger than schools that do not offer Triple Science.

[Table 6 here]

[Table 7 here]

[Table 8 here]

Any analysis looking at the relationship between being in a school that offers Triple Science and later outcomes will, at the very least, have to control for such confounding factors. Fortunately, my dataset is very rich in information on the prior attainment of pupils, as well as on their socio-demographic characteristics, so many selection issues will be dealt with by simply including detailed information on observable characteristics into the regression model. In addition, because I observe which schools young people attend, I can also eliminate any time-invariant unobserved heterogeneity at the school level by including school fixed effects. Finally, including a time dummy will control for any aggregate changes between the two cohorts which would have occurred in the absence of the programme. I estimate the following Linear Probability Model:

$$Y_i = \beta_0 + \beta_1 TS_i + \mathbf{PD}_i\gamma + \mathbf{PA}_i\delta + \mathbf{CD}_{gst}\theta + \mathbf{CA}_{gst}\rho + \mathbf{SR}_{st}\omega + \nu_t + \sigma_s + \varepsilon_i \qquad \text{(i)}$$

Where Y is the outcome of interest for pupil i and TS is a dummy variable indicating whether the pupil attended a school which offered Triple Science (so β_1 is the coefficient of interest). **PD** is a vector of pupil socio-demographic characteristics (including dummies for gender, ethnicity, Free School Meal status, Special Educational Needs, English as a foreign language, relative deprivation of the area the pupil lives in, and month of birth[21]) and **PA** is a vector measuring individual pupil attainment (continuous KS2 and KS3 scores in English, Mathematics and Science). Both **CD** and **CA** capture the make-up of the year group *g* that the pupil is in when taking his/her GCSE's: the socio-demographic composition of the year group (e.g. proportion female, proportion on FSM, etc...) and the average KS2 and KS3 attainment of pupils in the year group. Clearly these year group characteristics will not vary wildly over time within a school, and so will capture some of the school characteristics as well. **SR** is a vector of school resources in year t, and controls for the size of the school (number of Full-Time Equivalent pupils), the number of qualified (and other) teachers, and the number of technicians. ν_t is a dummy for the 1986 cohort and captures any time-specific effects, whereas σ_s represents a full set of school fixed effects. I estimate equation (i) by Ordinary Least Squares, adjusting for heteroscedasticity (as my outcomes are dichotomous) and allowing for clustering of the standard errors at the school level. In Appendix A, I provide more detail on each of the dependent and explanatory variables I included in my analysis.

Including school fixed effects means that the model summarised in equation (i) identifies the effect of being offered Triple Science by exploring variation within schools[22]. For such identification to be possible, it needs to be the case that some schools change their science curriculum on offer from one cohort to the next. This is indeed the case: I find that there are 192 schools that did not offer Triple Science in 2002, but did offer it in 2003, and there are a further 145 schools that offered Triple Science in 2002, but stopped offering it in 2003[23]. This compares to 610 schools which offered it in both years, and 2,149 schools which offered it in neither years. The attraction of this identification strategy is that I am comparing two adjacent cohorts of young people who went through the same school, but one of which was offered Triple Science, whereas the other was not. So, apart from the science curriculum offered to them, these two cohorts of young people should otherwise be very similar and be subjected to a very similar school environment. In addition, much of the variation that may exist between the two cohorts will be picked up by the detailed controls for prior attainment and socio-demographic characteristics included in the models, and some of the variation that may exist within schools over time will be captured by the controls for school characteristics.

However, despite my ability to control for time-invariant unobserved heterogeneity at the school level as well as detailed pupil characteristics, a few selection issues remain – some of which are easier to solve than others. One issue, as mentioned before, is that once Triple Science is offered, the selection of pupils into the programme is non-random. The way I deal with this is to estimate an “intention to treat” rather than the effect of “treatment on the treated”. So my interest is in whether or not a cohort that was offered Triple Science is more likely to choose and do well in science subjects later on, and not in whether pupils who actually take Triple Science are more likely to do so.

A slightly more difficult issue to address is whether pupils select into/out of schools once they know that Triple Science will be offered or taken off the curriculum in any particular year. Although there is not much I can do about this issue with the data available to me, there are a number of reasons to believe that this type of selection is not a major problem. First of all, there is very little movement of pupils in and out of schools between KS3 (which is when pupils start secondary school) and KS4 (which is when they sit their GCSEs) – fewer than 5% of pupils do so, and the proportion is very similar for schools that change their science curriculum and those that do not. In fact, the proportion is slightly lower for schools that drop/take on Triple Science (around 4% for both types of school). Re-running my analysis on the subset of pupils who remain in the same school between KS3 and KS4 does not alter the conclusions reached in this paper[24]. Most importantly, it is worth mentioning that, although pupils might move in and out of schools in search of a better school (or one with a better reputation), it is very unlikely to be the case that pupils select into and out of schools on the basis of whether or not they offer Triple Science. This is likely to be true particularly at the time when the pupils in my dataset were observed, when information about whether the school offered Triple Science was not included in the School Profile (which provides valuable information for parents picking schools). In addition, my datasets predate the big push by the Government and its stakeholders to get Triple Science on the curriculum, so much of the current publicity around Triple Science and its supposed benefits will not have existed.

A much more serious objection to my identification strategy, and one which I cannot really rule out, is that the decision at the school level to stop or start offering Triple Science is not entirely random, and that these unobserved factors which lead to a change in the science curriculum on offer might, in turn, be correlated with the outcomes of interest. Any such time-variant unobserved heterogeneity at the school level correlated with the outcome variables would bias my estimates of the impact of offering Triple Science on later subject choice and attainment. Although, by definition, I cannot assess how important this type of endogeneity is likely to be, I can demonstrate that any changes in the Triple Science offer are unrelated to changes in observable characteristics at the school level. A lack of relationship between such observable changes and a switch in the Triple Science offer is not final proof that there aren't any unobservable changes which might be driving my results. However it does at least provide some hope that there aren't major changes happening at the school level which would be driving my results.

Table 9 explores some of the observable changes at the school level which might have been correlated with changes in the science curriculum on offer. One possible reason for dropping Triple Science, for instance, might be staff turnover. However, the data suggest that the number of qualified teachers in schools which dropped Triple Science increased (from 63.3 to 64.0 full-time equivalents) rather than decreased between the two years I study. Unfortunately, there is no way of verifying the subject specialism of those teachers, so it still possible that science teachers left the school, and were substituted by non-science teachers (or, indeed, that a good science teacher was replaced by a bad one).

[Table 9 here]

Another possibility is that those schools that dropped Triple Science from their curriculum did so because they had been experiencing drops in the average ability of their student cohorts over time. However, as Table 9 shows, even though schools that dropped Triple Science saw a drop in attainment in KS2 Mathematics and Science, the same was true for schools that took on Triple Science in that year. And, even though schools that dropped Triple Science from their curriculum also saw a slight fall in KS3 English attainment between cohorts, it is hard to see why that would affect the science curriculum on offer (particularly since KS3 Science and Mathematics scores were higher for the second cohort than for the first).

Table 9 also shows that there was no drop in the average number of pupils who had achieved Level 6 on their KS3 Science tests in those schools that dropped Triple Science from their curriculum: the number went from 50 in the cohort that was offered Triple Science to 59 in the cohort that was not. This increase is comparable to the one that happened in schools which went from not offering Triple Science to offering it: 51 to 63 pupils.

Finally, Table 9 shows how changes in absolute cohort size are not driving the decision to drop or offer Triple Science either. In all school types, including those that stopped and those that started offering Triple Science, the cohort size increased from one year to the next. The data does suggest, however, that the likelihood of changing the science curriculum on offer is related to school size. Indeed, it appears that schools that never offer Triple Science are the smaller schools, on average, whereas schools that always offer Triple Science tend to be the larger ones. Schools that either drop or start offering Triple Science are somewhere in between these two extremes in terms of average cohort size, indicating that a school's ability to offer Triple Science may be related to total school resources and economies of scale in teaching.

The DCSF also kindly provided me with information on whether the schools in my dataset offered Triple Science in the two years following the ones I observe. Analysis of this data suggests that, for the majority of switching schools I identify in my dataset, the switch appears to be a permanent one. So of the schools that start offering Triple Science in my dataset, 52% continued to offer it in the next two years. Similarly, of the schools that stop offering Triple Science in my dataset, 79% do not offer it in the next two years. This suggests that, for most schools, the switch is a relatively permanent one and does not depend on the particular characteristics of the current cohort of students.

V. RESULTS

The basic results of my analysis are in Table 10, which presents the effect of attending a school which offers Triple Science on our outcomes of interest using variants of the LPM model specified in equation (i). I only present the coefficients on the "Triple School" variable (i.e. whether or not the student attended a school which offered Triple Science). Table 11 then translates these coefficients into percentage changes from the baseline probability for young people who were not offered Triple Science. Only a selection of specifications from Table 10 has been included in Table 11.

[Table 10 here]

[Table 11 here]

Column (1) in these tables presents the "raw" effect of attending a school which offers Triple Science and corresponds to the descriptive statistics presented in Table 5. These raw effects of attending a school which offers Triple Science are very large if compared to the baseline for young people who did not attend such schools. For example, it increases the likelihood that someone will: attain two A Level passes by 40.5%; take A Level Physics by 20.8%; attain a grade A in A Level Physics by 39.4%; be in HE at 19 by 40.5%; and study Physical Sciences in HE by 15.2%.

In subsequent columns, I add additional controls. Column (2) adds an indicator for which cohort the individual belonged to (v_t in equation (i)) as well as controls for individual socio-demographic characteristics (***PD$_i$***); column (3) adds individual prior attainment variables (***PA$_i$***); column (4) adds socio-demographic characteristics of the individual's year group (***CD$_{gst}$***); column (5) adds the average attainment of the year group (***CA$_{gst}$***); column (6) adds some information on school resources (***SR$_{st}$***); and, finally, column (7) adds school fixed effects (σ_s).

As column (3) shows, the addition of controls for individual prior attainment reduces the effects of attending a school which offers Triple Science considerably. To take the same examples as above, the effect on the likelihood of attaining two A Level passes is reduced from a "raw" 40.5% to 7.9%; the effect on the likelihood of taking A Level Physics is reduced to 3.7%; the effect on the likelihood of achieving a grade A in A Level Physics is reduced to 6.3%; and the effect on the likelihood of being in HE at 19 reduced to 9.1%. The effect on the likelihood of studying Physical Science in HE is now negative, and no longer statistically significant at conventional levels. Also note that some of the coefficients have now turned negative.

The inclusion of cohort and school characteristics (specification (6)) further reduces the effect of having attended a school which offered Triple Science. None of the effects on HE outcomes are now any longer statistically significant, and there have been further reductions in the effects on A Level outcomes. Individuals who attended schools that offered Triple Science are: 1.4% more likely to achieve 2 A Level passes; 3.8% more likely to choose A Level Physics; 6.4% more likely to choose A Level Biology; 9.1% more likely to achieve a grade A in A Level Chemistry and 5.4% more likely to achieve a grade A in A Level Physics.

Specification (7) adds in school fixed effects. So, whereas previously the effect of offering Triple Science was identified using variation across all schools, specification (8) relies on variation within schools to identify the Triple Science effect. This changes the results somewhat – suggesting that controlling for unobserved school characteristics is clearly important. According to this (preferred) model, offering Triple Science to pupils increases their likelihood of: taking A Level Chemistry by 8.3%; taking A Level Mathematics by 13.4%; and achieving a grade A in A Level Physics by 15.0%.[25]

VI. HETEROGENEOUS EFFECTS

In this section, I shall explore whether the effect of offering Triple Science varies depending on the characteristics of the pupils it is offered to. I shall explore the differential effects on: (i) pupils who were in schools that dropped Triple Science as opposed to those who were in schools that took on Triple Science; (ii) pupils who had and did not have high prior attainment in science; (iii) males v. females; (iv) more versus less deprived pupils; and, finally, (v) young people who attended schools with sixth forms, and those that did not. The results of this analysis are summarised in Table 12.

Columns (1) and (2) compare the effect of dropping Triple Science as opposed to taking it on. So far, I have been assuming that the effect of Triple Science is symmetrical – i.e. that it is the same in schools that drop it as in schools that take it on. However, there are reasons to believe that this effect may be asymmetrical. It may be the case that setting up a Triple Science programme is a costly investment and that it takes a while before it is up and running properly, so that effects may only start kicking in properly after the programme has been running for a couple of years. By contrast, taking Triple Science off the curriculum is a much more sudden and neat event, so one would expect the effect on pupil outcomes to be much more marked. Column (1) shows the coefficient on the Triple Science variable in a regression run on the subsample of schools that either never offered Triple Science, or those that started offering it in the second year of my dataset. So this column explores the effect of taking on Triple Science. Column (2), on the other hand, does the same on the subsample of schools that always offered Triple Science and those that initially offered it, but then dropped it. So here I look at the effect of discontinuing a Triple Science programme. The results suggest that there is no strong evidence for the asymmetry hypothesis.

In columns (3) and (4), I check whether the Triple Science effect varies depending on the aptitude for science of the pupils who are offered it. As mentioned in Section I (Background), DCSF's policy applies mainly to those young people who achieved Level 6 (or higher) on their KS3 Science test. So far, the analysis presented has covered all young people (regardless of their KS3 Science attainment). Here I re-run the analysis separately for young people who achieved Level 6 or higher on their KS3 science test, and those that did not. Of the 1985

(1986) cohort, 30% (34%) achieved Level 6 or higher in their KS3 Science test and, of these, 34% (35%) attended schools which offered Triple Science. Interestingly, the results suggest that there are positive effects of offering Triple Science for pupils who did not achieve Level 6, as well as for pupils who did achieve Level 6. This suggests that it might be useful to encourage take up of Triple Science even in lower attaining schools.

Columns (5) and (6) explore whether there are any gender differences in the effect of offering Triple Science. The results are striking, and suggest that the effect of Triple Science is restricted to men only. One possible explanation for this surprising result is that the later subject choice and attainment of women is simply not affected by Triple Science. However, a more convincing explanation for the lack of effect found for women probably lies in the fact that they are much less likely than men to take up Triple Science: in 1985 (1986), 5.0% (5.3%) of men took Triple Science, compared to 3.5% (3.9%) of women. These findings suggest that policy makers concerned about raising the proportion of women taking science in HE should think about other ways of making science more attractive and interesting to women.

In columns (7) and (8), I explore whether more deprived pupils stand to gain more from being offered Triple Science than less deprived pupils. Again, this is an important policy question, because there is now ample evidence to demonstrate that there is a labour market premium for holding a science degree[26]. To answer this question, I split my sample into two: the 50% most deprived pupils (as defined by the Income Deprivation Affecting Children Index (IDACI[27])) and the 50% least deprived pupils. I then re-run the regressions on the two samples separately. As in the case of gender, the results are striking: most of the effects of Triple Science are found for the 50% most deprived pupils. We can say with some confidence that deprived pupils who were offered Triple Science were 13.7% more likely to choose Chemistry at A Level and 19.6% more likely to take Engineering and Technology in HE. In addition, I find that pupils from more deprived backgrounds who were offered Triple Science are more likely to: take A Levels in Physics and Mathematics; achieve a grade A in A Level Mathematics and Chemistry; be in HE at 19; and be in a Russell Group institution at 19 – although all of these latter effects are only significant at the 10% confidence level. Clearly, these results are strongly supportive of the drive to try and make Triple Science available to all those pupils who could benefit, but are currently not offered it.

Finally, in columns (9) and (10), I explore whether or not the effects I found are restricted to schools which have their own sixth form. In those schools, the Triple Science effect might be caused simply because teachers and headmasters have an incentive to get pupils to progress to (science) A Levels and do well in them – regardless of whether Triple Science was offered or not. So one would worry if the Triple Science effect was found only in schools with sixth forms, and not in those without. In my dataset, out of 192 schools that took on Triple Science, 73 did not have their own sixth form. Similarly, out of 145 schools that dropped Triple Science, 55 did not have their own sixth form. The results in columns (9) and (10) of Table 12 suggest that the effect of Triple Science can be detected in both types of schools, supporting the evidence presented so far that offering Triple Science does indeed have a causal impact on pupils' subject choice and attainment.

VII. CONCLUSION

In this paper, I have tried to evaluate an English Government policy which aims to increase the number of pupils taking A Levels in Physics and Chemistry, their attainment in those subjects and, ultimately, the number of young people studying science in HE. The policy consists in offering pupils a more intense option of studying science when they are aged 15 (Triple Science), in the hope that this will better prepare them for the study of science at a higher level. I have argued that one can make use of the fact that some schools changed the intensity of their science offer to study the causal effect of offering Triple Science on pupil subject choice and attainment by exploring within-school variation.

My results indicate that pupils who are offered Triple Science are 8.3% more likely to take A Level Chemistry; 13.4% more likely to take A Level Mathematics; and 15.0% more likely to achieve a grade A in A Level Physics. In addition, I find that the effects of Triple Science are restricted to men only and that pupils from more deprived backgrounds appear to benefit most. In particular, more deprived pupils who were offered Triple Science were 13.7% more likely to choose Chemistry at A Level and 19.6% more likely to take Engineering and Technology in HE.

These effects appear very large, however one needs to remember that they are increases on a very small baseline. For example, the proportion taking A Level Mathematics was around 5.4% (or around 30,000 pupils a year). So, if Triple Science were made available to all pupils in my dataset achieving Level 6 at KS3 Science (i.e. an additional 145,000 students in the first cohort in my dataset and an additional 174,000 in the second cohort – over and above the 18,000 (19,000) who already received it in the first (second) cohort), then this would lead to an estimated increase in the number of young people with an A Level in Mathematics of around 2,150 in the first cohort of my dataset, and around 2,500 in the second cohort of my dataset. These represent increases in the number of young people with A Level Mathematics of 7.2% and 8.4%, respectively.

Given these small numbers, it is perhaps not surprising that I found only very few statistically significant effects of offering Triple Science on subject choice in HE. In addition, it is worth pointing out that there are a number of additional potential benefits of Triple Science I was not able to explore in this paper. For example, even if offering Triple Science does not have an enormous impact on subject choice in HE, it may still produce scientists of a “higher quality” – which could be reflected, for instance, in the proportion of graduates who achieve a 1^{st} class degree, or the proportion of students taking more difficult optional modules.

Table 1: Pupil Socio-Demographic Characteristics

	85 Cohort		86 Cohort		Total	
	#	%	#	%	#	%
Female	270,404	49.35	277,930	49.45	548,334	49.40
White, UK	452,403	82.57	450,438	80.14	902,841	81.34
White, Other	14,298	2.61	10,150	1.81	24,448	2.20
Asian, Indian	13,944	2.54	13,823	2.46	27,767	2.50
Asian, Pakistani	13,771	2.51	13,142	2.34	26,913	2.42
Asian, Bangladeshi	5,119	0.93	5,307	0.94	10,426	0.94
Asian, Other	115	0.02	2,970	0.53	3,085	0.28
Black, Caribbean	7,794	1.42	8,293	1.48	16,087	1.45
Black, African	6,962	1.27	7,673	1.37	14,635	1.32
Black, Other	4,352	0.79	2,367	0.42	6,719	0.61
Chinese	2,016	0.37	2,017	0.36	4,033	0.36
Mixed	266	0.05	9,879	1.76	10,145	0.91
Other, Unclassified, Missing	26,884	4.91	36,030	6.41	62,914	5.67
FSM	76,596	13.98	76,931	13.69	153,527	13.83
FSM Missing	1,177	0.21	0	0.00	1,177	0.11
SEN	95,896	17.50	82,214	14.63	178,110	16.05
Foreign Language	48,806	8.91	50,485	8.98	99,291	8.95
Language Missing	925	0.17	467	0.08	1,392	0.13

Notes: Table shows the number and proportion of each cohort with respective characteristic. E.g. 13.98% of the cohort born in 1985 was eligible for (and claimed). Free School Meals at the age of 15. FSM=Free School Meals. SEN=Special Educational Needs.

Table 2: Continuous Measures of KS2 and KS3 Attainment

	Mean	S.D.	Min.	Max.	% Missing
KS2 English Score	4.25	0.73	0.00	6.58	10
KS2 Mathematics Score	4.21	0.85	0.00	6.90	9
KS2 Science Score	4.33	0.70	0.00	6.89	9
KS3 English Score	5.40	1.15	0.00	9.73	8
KS3 Mathematics Score	5.71	1.28	0.00	9.95	5
KS3 Science Score	5.41	1.08	0.00	9.78	5

Notes: Table shows mean, standard deviation, minimum and maximum values, as well as % with_missing information for the key measures of prior attainment used in the paper. Figures are for both 1985 and 1986 cohorts pooled. KS=Key Stage.

Table 3: Number and Proportion of Pupils Taking and Being Offered Triple Science, as well as KS2 and KS3 Attainment for Each Group

PANEL A

	Took TS	Was Offered TS
N (1985 Cohort)	23,423	142,321
N (1986 Cohort)	25,822	154,399
N Total	49,245	296,720
% (1985 Cohort)	4.27	25.97
% (1986 Cohort)	4.59	27.47
% Total	4.44	26.73

PANEL B

	Did Not Take TS	Took TS	Difference (p value)	Was Not Offered TS	Was Offered TS	Difference (p value)
KS2 English Score	4.22	4.85	0.64	4.20	4.37	0.18
			(0.00)			(0.00)
KS2 Mathematics Score	4.17	5.04	0.87	4.15	4.36	0.21
			(0.00)			(0.00)
KS2 Science Score	4.30	4.97	0.67	4.28	4.45	0.17
			(0.00)			(0.00)
KS3 English Score	5.35	6.42	1.07	5.31	5.63	0.32
			(0.00)			(0.00)
KS3 Mathematics Score	5.63	7.26	1.63	5.60	6.00	0.40
			(0.00)			(0.00)
KS3 Science Score	5.34	6.75	1.41	5.31	5.66	0.35
			(0.00)			(0.00)

Notes: Panel A shows the number and percentage of pupils who (i) took Triple Science; and (ii) were offered Triple Science in both the 1985 and 1986 cohort, as well as the total for both cohorts together. Panel B shows the average Key Stage 2 and 3 attainment in English, Mathematics and Science for pupils who: (i) took Triple Science; and (ii) were offered Triple Science. Panel B also tests the statistical significance of the difference in prior attainment between these groups.

Table 4: School Characteristics

	No Triple Science (s.d.)	Triple Science (s.d.)
Average School Size	972	1,089
	(342.4)	(321.7)
Average Number of Qualified Teachers	57.7	64.7
	(20.1)	(19.5)
Average Number of Other Teachers	3.4	3.3
	(3.9)	(3.6)
Average Number of Technicians	5.2	5.7
	(2.2)	(2.3)

Notes: Table shows school characteristics at the end of KS4 for both the 1985 and 1986 cohorts (the relevant years being 2001/02 and 2002/03). Standard deviations (s.d.) in parentheses.

Table 5: Summary of Key Outcome Variables, by Triple Science Status

	Did Not Take TS		Took TS				Was Not Offered TS		Was Offered TS			
	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)	(viii)	(ix)	(x)	(xi)	(xii)
	#	%	#	%	Difference (iv)-(ii)	(p value)	#	%	#	%	Difference (x)-(viii)	(p value)
Two A Level Passes (1)	325,248	30.7	39,061	79.3	48.7	(0.00)	240,899	29.6	123,410	41.6	12.0	(0.00)
Took A Level Biology (2)	46,102	13.5	12,508	31.7	18.2	(0.00)	37,234	14.7	21,376	16.8	2.1	(0.00)
Took A Level Chemistry (2)	30,635	9.0	11,352	28.7	19.8	(0.00)	25,831	10.2	16,156	12.7	2.5	(0.00)
Took A Level Mathematics (2)	45,592	13.3	14,154	35.8	22.5	(0.00)	36,291	14.3	23,455	18.4	4.1	(0.00)
Took A Level Physics (2)	22,835	6.7	9,460	23.9	17.3	(0.00)	18,971	7.5	13,324	10.4	3.0	(0.00)
Grade A in A Level Biology (3)	7,757	16.8	3,965	31.7	14.9	(0.00)	6,498	17.4	5,224	24.4	7.0	(0.00)
Grade A in A Level Chemistry (3)	6,750	22.0	4,022	35.4	13.4	(0.00)	5,745	22.2	5,027	31.1	8.9	(0.00)
Grade A in A Level Physics (3)	4,681	20.5	3,313	35.0	14.5	(0.00)	4,040	21.3	3,954	29.7	8.4	(0.00)
Grade A in A Level Mathematics (3)	13,937	30.5	6,462	45.6	15.1	(0.00)	11,341	31.2	9,058	38.6	7.4	(0.00)
In HE at 19 (4)	275,162	25.9	34,512	70.1	44.1	(0.00)	204,718	25.2	104,956	35.4	10.2	(0.00)
In a Russell Group Institution at 19 (5) (6)	50,600	18.4	13,854	40.1	21.8	(0.00)	37,825	18.5	26,629	25.4	6.9	(0.00)
STEM in HE at 19 (5) (7)	101,507	36.9	18,467	53.5	16.6	(0.00)	78,728	38.5	41,246	39.3	0.8	(0.00)
Biological Sciences in HE at 19 (5)	25,936	9.4	3,873	11.2	1.8	(0.00)	19,724	9.6	10,085	9.6	0.0	(0.00)
Medicine, Dentistry and Veterinary Sciences in HE at 19 (5)	6,385	2.3	2,406	7.0	4.7	(0.00)	5,237	2.6	3,554	3.4	0.8	(0.00)
Physical Sciences in HE at 19 (5)	10,631	3.9	2,970	8.6	4.7	(0.00)	8,552	4.2	5,049	4.8	0.6	(0.00)
Engineering and Technology in HE at 19 (5)	10,270	3.7	2,465	7.1	3.4	(0.00)	8,109	4.0	4,626	4.4	0.4	(0.00)
Mathematics and Computer Science in HE at 19 (5)	16,383	6.0	2,474	7.2	1.2	(0.00)	12,768	6.2	6,089	5.8	-0.4	(0.00)

Notes: Table shows number and proportion achieving each outcome, by Triple Science (TS) status. For example: 31% of those who did not take TS achieved two A Level passes. (1) An "A Level Pass" is defined as obtaining a grade A-E. (2) Conditional on having been entered for A Level examinations (or equivalent). (3) Conditional on having been entered for examination in the subject. (4) "HE" includes 1st Degrees at Higher Education Institutions only. (5) Conditional on Being in HE at 19. (6) For list of Russell Group institutions see: www.russellgroup.ac.uk (7) STEM stands for Science, Technology, Engineering and Mathematics. Subject groupings at HE follow the JACS coding system.

Table 6: Characteristics of Pupils in Schools Offering Triple Science

	Was Not Offered TS	Was Offered TS		
	%	%	Difference	(p value)
Female	49.6	48.8	-0.8	0.00
FSM	14.3	3.9	-10.4	0.00
White, UK	81.3	82.4	1.1	0.00
White, Other	2.2	2.7	0.5	0.00
Asian, Indian	2.5	3.5	1.1	0.00
Asian, Pakistani	2.5	1.7	-0.8	0.00
Asian, Bangladeshi	1.0	0.3	-0.7	0.00
Asian, Other	0.3	0.5	0.2	0.00
Black, Caribbean	1.5	0.5	-1.0	0.00
Black, African	1.3	0.8	-0.6	0.00
Black, Other	0.6	0.3	-0.3	0.00
Chinese	0.3	0.9	0.5	0.00
Mixed	0.9	1.0	0.1	0.02
Other, Unclassified, Missing	5.7	5.5	-0.2	0.09
SEN	16.6	3.2	-13.5	0.00
Foreign Language	9.0	7.3	-1.8	0.00

Notes: Table shows the proportion of those who were and those who were not offered Triple Science with each characteristic. So, for example, 49.6% of those who were offered TS were female, compared to 48.8% of those who were not. The third column shows the difference between these proportions, and the fourth column shows the statistical significance of the difference.

Table 7: Selection of Outcomes by Student Characteristics

	Took A Level Biology	Took A Level Chemistry	Took A Level Physics	Took A Level Mathematics	HE at 19	Russell Group at 19	STEM at 19	ALL
Female	61.1	50.9	19.6	38.1	55.6	54.6	48.1	49.4
FSM	4.6	5.1	3.1	3.7	6.3	2.9	6.0	13.83
White, UK	75.9	71.0	80.8	76.1	76.4	80.0	76.3	81.34
SEN	2.4	2.9	3.7	2.6	4.3	2.4	4.5	16.05
Foreign Language	13.8	18.0	9.8	13.8	13.1	9.6	13.9	8.95

Note: Table shows proportion of those who achieve each outcome who are female, on FSM, etc... Last column shows proportions for entire sample (two cohorts combined).

Table 8: Characteristics of Schools Offering Triple Science

	2002		2003	
	Schools Offering TS	Schools Not Offering TS	Schools Offering TS	Schools Not Offering TS
Average Year Size	188	171	192	177
	(63.67)	(61.57)	(62.26)	(61.95)
Average School Size	1,097	968	1,103	990
	(319.93)	(339.65)	(319.19)	(342.03)
Average Number of Qualified Teachers	65.1	57.7	65.3	58.6
	(19.27)	(20.11)	(19.68)	(20.32)
Average Number of Other Teachers	3.4	3.3	3.8	4.1
	(3.60)	(3.75)	(4.69)	(2.60)
Average Number of Technicians	5.7	5.3	6.0	5.4
	(2.38)	(2.37)	(2.60)	(2.39)

Notes: Table shows school characteristics (size and number of staff) for those that offered and those that did not offer Triple Science (TS) in 2001/02 and in 2002/03. These years correspond to the year in which my cohorts sat their KS4 examinations.

Table 9: Observable Changes at the School Level

		SCHOOL TREATMENT CATEGORY			
	Cohort	00	01	10	11
Year Group Size	1985	172	176	183	189
	1986	177	183	187	195
Number of FTE Qualified Teachers	1985	57.7	60.9	63.3	65.7
	1986	58.3	61.3	64.0	66.5
Average KS2 English Score	1985	4.15	4.23	4.23	4.43
	1986	4.19	4.28	4.25	4.45
Average KS2 Mathematics Score	1985	4.15	4.22	4.24	4.47
	1986	4.09	4.19	4.16	4.44
Average KS2 Science Score	1985	4.27	4.34	4.33	4.52
	1986	4.24	4.33	4.30	4.50
Average KS3 English Score	1985	5.24	5.38	5.37	5.69
	1986	5.27	5.44	5.35	5.78
Average KS3 Mathematics Score	1985	5.52	5.65	5.64	6.14
	1986	5.56	5.74	5.67	6.18
Average KS3 Science Score	1985	5.18	5.27	5.27	5.71
	1986	5.36	5.50	5.42	5.86
Number of Pupils Who Achieved Level 6 in KS3 Science	1985	46	51	50	79
	1986	54	63	59	90
Number of Schools in Category		2149	192	145	610

Notes: This table shows key school and cohort level characteristics, by cohort as well as by school treatment category. “00” indicates schools who never offered Triple Science; “01” indicates schools who did not offer it in the first year, but did in the second; “10” indicates schools who initially offered Triple Science, and then dropped it from the curriculum; and “11” schools are those that offered Triple Science to both cohorts. The bottom line of the table shows the number of schools in each treatment category.

Table 10: Effect of Being Offered Triple Science – Main Results

Notes: Each cell in the table on the following page reports the coefficient on the variable "Triple Science" (a dummy indicating whether the individual was offered Triple Science or not) from a different regression based on model (i) discussed in the main body of the paper. Each row is for a different outcome variable, and more and more explanatory variables are introduced as we move from left to right in each row. Specifically: Model (1) includes an indicator for being offered Triple Science only. Model (2) adds a cohort indicator and individual socio-demographic information. Model (3) adds individual attainment variables. Year group socio-economic information and attainment are added in Models (4) and (5), respectively. Model (6) further includes information about school resources and, finally, Model (7) adds school fixed effects.

		(1)	(2)	(3)	(4)	(5)	(6)	(7)
Two A Level Passes	Triple Science	0.120	0.0801	0.0235	0.0168	0.00694	0.00419	0.00180
	(s.e.)	(0.00678)***	(0.00511)***	(0.00241)***	(0.00233)***	(0.00214)***	(0.00212)**	(0.00260)
Took A Level Biology (1)	Triple Science	0.0209	0.0202	-0.00176	-0.00290	-0.00414	-0.00449	0.00536
	(s.e.)	(0.00327)***	(0.00317)***	(0.00257)	(0.00260)	(0.00263)	(0.00264)*	(0.00393)
Took A Level Chemistry (1)	Triple Science	0.0249	0.0244	0.00153	0.00118	-0.000309	-0.000156	0.00849
	(s.e.)	(0.00307)***	(0.00289)***	(0.00206)	(0.00205)	(0.00207)	(0.00209)	(0.00331)**
Took A Level Physics (1)	Triple Science	0.0297	0.0222	0.00522	0.00548	0.00540	0.00538	0.00452
	(s.e.)	(0.00272)***	(0.00222)***	(0.00167)***	(0.00165)***	(0.00163)***	(0.00165)***	(0.00267)*
Took A Level Mathematics (1)	Triple Science	0.0409	0.0333	-0.00116	0.000602	0.00367	0.00367	0.0100
	(s.e.)	(0.00400)***	(0.00341)***	(0.00234)	(0.00229)	(0.00225)	(0.00225)	(0.00348)***
Grade A in A Level Biology (2)	Triple Science	0.0698	0.0660	0.0112	0.0103	0.00999	0.0112	0.00654
	(s.e.)	(0.00762)***	(0.00720)***	(0.00501)**	(0.00488)**	(0.00475)**	(0.00482)**	(0.0101)
Grade A in A Level Chemistry (2)	Triple Science	0.0888	0.0799	0.0236	0.0224	0.0191	0.0202	0.0130
	(s.e.)	(0.00925)***	(0.00876)***	(0.00647)***	(0.00624)***	(0.00611)***	(0.00616)***	(0.0127)
Grade A in A Level Physics (2)	Triple Science	0.0839	0.0770	0.0133	0.0119	0.0105	0.0115	0.0319
	(s.e.)	(0.00908)***	(0.00881)***	(0.00591)**	(0.00597)**	(0.00585)*	(0.00584)**	(0.0143)**
Grade A in A Level Mathematics (2)	Triple Science	0.0737	0.0670	0.00536	0.00157	-0.000138	0.000406	-0.00177
	(s.e.)	(0.00858)***	(0.00813)***	(0.00554)	(0.00555)	(0.00569)	(0.00571)	(0.0115)
In HE at 19	Triple Science	0.102	0.0722	0.0245	0.0174	0.00439	0.00306	0.00373
	(s.e.)	(0.00620)***	(0.00476)***	(0.00239)***	(0.00223)***	(0.00188)**	(0.00188)	(0.00229)
In a Russell Group Institution at 19 (3)	Triple Science	0.0689	0.0567	0.0183	0.0111	0.00123	0.00140	0.00413
	(s.e.)	(0.00595)***	(0.00554)***	(0.00359)***	(0.00333)***	(0.00320)	(0.00318)	(0.00448)
STEM in HE at 19 (3)	Triple Science	0.00842	0.00258	-0.00887	-0.00386	-0.0000477	0.000764	0.00720
	(s.e.)	(0.00291)***	(0.00281)	(0.00279)***	(0.00274)	(0.00272)	(0.00273)	(0.00548)
Biological Sciences in HE at 19 (3)	Triple Science	-0.000259	-0.00127	-0.00316	-0.00200	-0.0000879	0.0000464	-0.00173
	(s.e.)	(0.00141)	(0.00138)	(0.00140)**	(0.00143)	(0.00146)	(0.00146)	(0.00343)
Medicine, Dentistry and Veterinary Sciences in HE at 19 (3)	Triple Science	0.00828	0.00802	0.00247	0.00121	-0.000788	-0.000522	-0.000421
	(s.e.)	(0.00121)***	(0.00117)***	(0.000933)***	(0.000897)	(0.000900)	(0.000902)	(0.00158)
Physical Sciences in HE at 19 (3)	Triple Science	0.00633	0.00271	-0.00167	-0.000704	0.000318	0.000395	0.00160
	(s.e.)	(0.00110)***	(0.000997)***	(0.000987)*	(0.000982)	(0.000979)	(0.000988)	(0.00232)
Engineering and Technology in HE at 19 (3)	Triple Science	0.00447	0.000914	-0.000995	-0.000187	0.000385	0.000594	0.00298
	(s.e.)	(0.00119)***	(0.000941)	(0.000925)	(0.000910)	(0.000914)	(0.000914)	(0.00210)
Mathematics and Computer Science in HE at 19 (3)	Triple Science	-0.00435	-0.00455	-0.00500	-0.00149	0.000680	0.000723	-0.000457
	(s.e.)	(0.00135)***	(0.00120)***	(0.00121)***	(0.00112)	(0.00113)	(0.00113)	(0.00291)

* p<0.10 **<0.05 ***<0.01 (1) Conditional on having been entered for A Level or equivalent qualifications; (2) Conditional on having been entered for examination in the subject; (3) Conditional on being in HE at 19.

Table 11: Effects of Being Offered Triple Science - Percentage Increase on Baseline

	Increased Likelihood According to Specification:			
	(1)	(3)	(6)	(7)
Two A Level Passes	40.5%	7.9%	1.4%	
Took A Level Biology	14.2%			
Took A Level Chemistry	24.5%			8.3%
Took A Level Physics	20.8%	3.7%	3.8%	
Took A Level Mathematics	54.7%			13.4%
Took A Level Biology	40.0%	6.4%	6.4%	
Grade A in A Level Chemistry	40.0%	10.6%	9.1%	
Grade A in A Level Physics	39.4%	6.3%	5.4%	15.0%
Grade A in A Level Mathematics	23.6%			
In HE at 19	40.5%	9.7%		
In a Russell Group Institution at 19	37.3%	9.9%		
STEM in HE at 19	2.2%	-2.3%		
Biological Sciences in HE at 19		-3.3%		
Medicine, Dentistry and Veterinary Sciences in HE at 19	32.4%	9.7%		
Physical Sciences in HE at 19	15.2%			
Engineering and Technology in HE at 19	11.3%			
Mathematics and Computer Science in HE at 19	-7.0%	-8.0%		

Notes: Table shows the percentage increase in the likelihood of achieving each outcome for young people who have been offered Triple Science. The baseline probabilities I used for these calculations are the ones reported in Column (viii) of Table 5. Each numbered column in the table above corresponds to the effect estimated in the corresponding specification in Table 10. Only the effects for specifications (1), (3), (6) and (7) are reported. So, for example, looking at the first row in specification (6): individuals who were offered Triple Science were 1.4% more likely to achieve two A Level passes compared to individuals who were not offered Triple Science. Blanks signify that the coefficient of the "Triple School" dummy was insignificant at the 5% level.

Table 12: Heterogeneity in the Effects of Being Offered Triple Science

Notes: Table shows coefficients on the "Triple Science" variable for variants of specification (7) in Table 10 where the sample has been restricted to: (1) young people in schools that never offer Triple Science and schools that take on Triple Science; (2) young people in schools that always offer Triple Science and schools that drop it; (3) young people who did not achieve Level 6 in their KS3 Science exams; and (4) young people who did; (5) males; (6) females; (7) the 50% most deprived pupils; and (8) the 50% least deprived; (9) young people in schools that do not have their own sixth form; and (10) young people who are in schools that do.

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
		Treatment Type		Level 6 in KS3 Science		Gender		Deprivation		Schools with Sixth Form	
		Take on TS	Drop TS	No	Yes	Male	Female	50% Most	50% Least	No	Yes
Two A Level Passes	Triple Science	0.00256	0.000404	0.00259	-0.000436	0.000446	0.00341	0.00189	0.00248	0.00356	0.000731
	(s.e.)	(0.00368)	(0.00445)	(0.00275)	(0.00483)	(0.00330)	(0.00370)	(0.00314)	(0.00384)	(0.00420)	(0.00330)
Took A Level Biology (1)	Triple Science	0.0101	0.00292	0.00354	0.00850	0.0150	-0.00155	0.00396	0.00626	0.00401	0.00482
	(s.e.)	(0.00553)*	(0.00639)	(0.00379)	(0.00576)	(0.00651)**	(0.00493)	(0.00608)	(0.00483)	(0.00676)	(0.00476)
Took A Level Chemistry (1)	Triple Science	0.0102	0.00462	0.00363	0.00953	0.0128	0.00445	0.0130	0.00633	0.00976	0.00743
	(s.e.)	(0.00431)**	(0.00571)	(0.00308)	(0.00493)*	(0.00520)**	(0.00393)	(0.00526)**	(0.00409)	(0.00681)	(0.00379)**
Took A Level Physics (1)	Triple Science	-0.000435	0.00687	0.00449	0.00310	0.00698	0.000163	0.00624	0.00458	0.000225	0.00576
	(s.e.)	(0.00340)	(0.00500)	(0.00193)**	(0.00410)	(0.00549)	(0.00221)	(0.00368)*	(0.00337)	(0.00447)	(0.00329)*
Took A Level Mathematics (1)	Triple Science	0.00866	0.0117	0.000934	0.0131	0.0173	0.00202	0.00974	0.0107	0.0104	0.0103
	(s.e.)	(0.00508)*	(0.00521)**	(0.00313)	(0.00508)***	(0.00549)***	(0.00417)	(0.00501)*	(0.00451)**	(0.00672)	(0.00401)**
Grade A in A Level Biology (2)	Triple Science	-0.00573	0.0227	0.0234	0.0000977	0.0309	-0.0107	0.0131	0.000093	0.0391	-0.00167
	(s.e.)	(0.0153)	(0.0152)	(0.0205)	(0.0109)	(0.0163)*	(0.0140)	(0.0160)	(0.0128)	(0.0182)**	(0.0120)
Grade A in A Level Chemistry (2)	Triple Science	-0.00586	0.0328	0.0211	0.00439	0.0396	-0.0192	0.0375	-0.0103	0.0488	0.00134
	(s.e.)	(0.0173)	(0.0226)	(0.0348)	(0.0134)	(0.0199)**	(0.0182)	(0.0227)*	(0.0157)	(0.0252)*	(0.0149)
Grade A in A Level Physics (2)	Triple Science	0.0182	0.0645	0.129	0.0173	0.0264	0.0688	0.0466	0.0281	0.000245	0.0377
	(s.e.)	(0.0192)	(0.0232)***	(0.0502)**	(0.0146)	(0.0151)*	(0.0419)	(0.0283)*	(0.0176)	(0.0290)	(0.0163)**
Grade A in A Level Mathematics (2)	Triple Science	-0.00307	0.00141	-0.0327	-0.00423	-0.00720	0.00103	0.00869	-0.00881	-0.00136	-0.00267
	(s.e.)	(0.0160)	(0.0186)	(0.0354)	(0.0126)	(0.0158)	(0.0197)	(0.0197)	(0.0146)	(0.0206)	(0.0139)
In HE at 19	Triple Science	0.00390	0.00475	0.00305	0.00574	0.00456	0.00304	0.00481	0.00353	0.00405	0.00316
	(s.e.)	(0.00322)	(0.00414)	(0.00242)	(0.00480)	(0.00304)	(0.00326)	(0.00281)*	(0.00356)	(0.00332)	(0.00304)
In a Russell Group Institution at 19 (3)	Triple Science	-0.0000133	0.0113	-0.00281	0.00806	0.00508	0.00286	0.0118	0.000945	0.0156	-0.000753
	(s.e.)	(0.00606)	(0.00745)	(0.00489)	(0.00646)	(0.00649)	(0.00601)	(0.00634)*	(0.00573)	(0.00761)**	(0.00538)
STEM in HE at 19 (3)	Triple Science	0.00799	0.00322	0.0106	0.00521	0.0171	-0.00125	0.0139	0.00515	-0.00488	0.0110
	(s.e.)	(0.00764)	(0.00908)	(0.00853)	(0.00701)	(0.00920)*	(0.00705)	(0.00966)	(0.00662)	(0.0112)	(0.00625)*
Biological Sciences in HE at 19 (3)	Triple Science	-0.000299	-0.00110	-0.00144	-0.00153	0.00777	-0.00894	0.00131	-0.00292	-0.00239	-0.00179
	(s.e.)	(0.00497)	(0.00576)	(0.00505)	(0.00448)	(0.00482)	(0.00497)*	(0.00520)	(0.00436)	(0.00602)	(0.00425)
Medicine, Dentistry and Veterinary Sciences in HE at 19 (3)	Triple Science	-0.00208	0.00281	0.0000207	-0.00128	0.00156	-0.00190	-0.00127	-0.0000883	0.00130	-0.00163
	(s.e.)	(0.00214)	(0.00287)	(0.00197)	(0.00234)	(0.00229)	(0.00241)	(0.00259)	(0.00208)	(0.00258)	(0.00195)
Physical Sciences in HE at 19 (3)	Triple Science	0.00277	0.00121	0.00333	-0.000659	0.000946	0.00178	0.00477	-0.000172	-0.0000220	0.00225
	(s.e.)	(0.00333)	(0.00375)	(0.00237)	(0.00336)	(0.00413)	(0.00261)	(0.00337)	(0.00296)	(0.00449)	(0.00270)
Engineering and Technology in HE at 19 (3)	Triple Science	0.00469	-0.00219	0.00584	0.000997	0.00572	0.000334	0.00727	0.000584	-0.00113	0.00452
	(s.e.)	(0.00287)	(0.00373)	(0.00315)*	(0.00283)	(0.00448)	(0.00122)	(0.00335)**	(0.00266)	(0.00406)	(0.00248)*
Mathematics and Computer Science in HE at 19 (3)	Triple Science	-0.00254	0.000833	0.000987	-0.000709	0.00000705	-0.000661	-0.00231	0.000678	-0.00553	0.00153
	(s.e.)	(0.00405)	(0.00473)	(0.00423)	(0.00349)	(0.00602)	(0.00212)	(0.00466)	(0.00343)	(0.00533)	(0.00341)

* p<0.10 **<0.05 ***<0.01 (1) Conditional on having been entered for A Level or equivalent qualifications; (2) Conditional on having been entered for examination in the subject; (3) Conditional on being in HE at 19.

ANNEX A: Identifying Schools That Offer Triple Science

The DCSF classifies a school as offering Triple Science if at least one pupil in the school is observed to enter the separate sciences. Although I use the same method as the DCSF throughout this paper, I cannot be sure that all schools in my dataset will be correctly labelled. In particular, I cannot be 100% certain that a school did not offer Triple Science. This is because a school might be offering Triple Science, but no pupil decides to take it on. So, in schools where I observe a switch from "not offering" to "offering" Triple Science, I may simply be observing pupil take-up of Triple Science rather than a change in the school's curriculum offer itself. In order to test the extent to which this affects my results, I run two robustness checks.

First, I verify whether, in schools that dropped Triple Science from their curriculum, there was an accompanying increase in the number of pupils taking Double Science (the next best alternative). Similarly, in schools which took on Triple Science after not at first having offered it, I check whether there was a sudden drop in the number of pupils taking Double Science. In the latter type of schools, I find that there was a simultaneous drop in the proportion of students attempting Double Science from 42.1% (prior to the introduction of the programme) to 39.0% after it. The proportion of pupils who take Triple Science in those schools is 4.6%. Similarly, in schools which initially offered Triple Science but then dropped it, I find an increase in the proportion of pupils who take Double Science from 37.1% to 41.2%. The original proportion of pupils taking Triple Science in those schools was 3.0%. These results suggest that there is indeed a change in the science curriculum on offer in the schools that I analyse and that changes in Triple Science status are not driven solely by measurement error.

As a second robustness check, I raise the threshold for identifying schools which offer and do not offer Triple Science. In effect, rather than classifying schools according to whether at least one pupil took Triple Science, I now classify them according to whether at least two/three/four/five/six pupils took Triple Science, and then re-run my analysis. So the schools which go from not offering to offering Triple Science will need to have zero pupils registered as taking Triple Science in the first year, and then two/three/four/five/six pupils in the second year. Similarly, in schools which initially offered Triple Science but subsequently dropped it, there would need to have been two/three/four/five/six pupils taking Triple Science in the first year, and none in the second year.

The results of this analysis can be found in Table A1, which shows the coefficients on the "Triple Science" variable from the a set of regressions where the threshold for identifying schools that offer Triple Science is gradually increased from one to six. These results are different from the main results presented in

Table 10 in the paper, and this was to be expected as the effect of Triple Science is now being identified using variation within a different set of schools (see number of schools in each treatment type at the bottom of the table). Not only will some schools have dropped out of the analysis, but some other ones might now be included as being "treatment" schools. Consider the case of a school which, in the first year, had 10 pupils taking Triple Science, but which only had 1 in the second year. Previously, this school would have been classified as a school that offered Triple Science in both years. However, by raising the threshold above 1, this school would now be classified as a school that offered Triple Science in the first year, but not in the second.

At some thresholds, the results suggest marginally significant effects on the likelihood of taking Biology, Chemistry, Physics and Mathematics at A Level; as well as on the likelihood of doing well in A Level Physics. Interestingly. I now find very strong effects of offering Triple Science on the likelihood that pupils will achieve A Levels, as well as on the likelihood of entering HE.

Table A1: Increasing the Threshold for Identifying Schools that Offer Triple Science

Notes: Table shows coefficients on the "Triple Science" variable for variants of specification (7) in Table 10 where the number of pupils doing Triple Science needed for the school to be classified as offering Triple Science is gradually increased from 1 to 6. Note that the results in the first column (1) correspond to those in column (7) in Table 10.

	Number of Pupils Required for the School to be Classified as Offering Triple Science					
	1	**2**	**3**	**4**	**5**	**6**
Two A Level Passes	0.00180	0.00431	0.00509	0.00649	0.00732	0.00926
	(0.00260)	(0.00322)	(0.00324)	(0.00326)**	(0.00329)**	(0.00328)***
Took A Level Biology (1)	0.00536	0.00697	0.00674	0.00803	0.00785	0.00671
	(0.00393)	(0.00464)	(0.00476)	(0.00474)*	(0.00482)	(0.00484)
Took A Level Chemistry (1)	0.00849	0.00682	0.00535	0.00540	0.00628	0.00658
	(0.00331)**	(0.00382)*	(0.00391)	(0.00390)	(0.00391)	(0.00382)*
Took A Level Physics (1)	0.00452	0.00360	0.00385	0.00421	0.00506	0.00378
	(0.00267)*	(0.00318)	(0.00323)	(0.00327)	(0.00329)	(0.00326)
Took A Level Mathematics (1)	0.0100	0.00720	0.00621	0.00629	0.00735	0.00616
	(0.00348)***	(0.00430)*	(0.00441)	(0.00439)	(0.00454)	(0.00448)
Grade A in A Level Biology (2)	0.00654	-0.00597	-0.00413	-0.00222	-0.00233	-0.00244
	(0.0101)	(0.0123)	(0.0129)	(0.0128)	(0.0131)	(0.0131)
Grade A in A Level Chemistry (2)	0.0130	0.0131	0.00945	0.0119	0.0133	0.0115
	(0.0127)	(0.0138)	(0.0143)	(0.0142)	(0.0146)	(0.0146)
Grade A in A Level Physics (2)	0.0319	0.0290	0.0224	0.0257	0.0255	0.0236
	(0.0143)**	(0.0170)*	(0.0176)	(0.0174)	(0.0177)	(0.0178)
Grade A in A Level Mathematics (2)	-0.00177	0.0112	0.0129	0.00949	0.00988	0.00798
	(0.0115)	(0.0136)	(0.0143)	(0.0148)	(0.0148)	(0.0146)
In HE at 19	0.00373	0.00689	0.00666	0.00712	0.00769	0.00899
	(0.00229)	(0.00282)**	(0.00290)**	(0.00288)**	(0.00292)***	(0.00295)***
In a Russell Group Institution at 19 (3)	0.00413	0.00330	0.00305	0.00407	0.00349	-0.000431
	(0.00448)	(0.00550)	(0.00568)	(0.00565)	(0.00571)	(0.00569)
STEM in HE at 19 (3)	0.00720	0.00515	0.00408	0.00328	0.00353	0.00307
	(0.00548)	(0.00634)	(0.00652)	(0.00647)	(0.00658)	(0.0064)
Biological Sciences in HE at 19 (3)	-0.00173	-0.00395	-0.00422	-0.00412	-0.00524	-0.00334
	(0.00343)	(0.00385)	(0.00398)	(0.00396)	(0.00403)	(0.00397)
Medicine, Dentistry and Veterinary Sciences in HE at 19 (3)	-0.000421	0.000212	0.0000591	-0.000770	-0.000622	-0.00113
	(0.00158)	(0.00184)	(0.00190)	(0.00189)	(0.00190)	(0.00188)
Physical Sciences in HE at 19 (3)	0.00160	0.000414	-0.000184	0.000921	0.00145	0.00137
	(0.00232)	(0.00275)	(0.00281)	(0.00283)	(0.00287)	(0.0028)
Engineering and Technology in HE at 19 (3)	0.00298	0.00428	0.00330	0.00274	0.00214	0.00174
	(0.00210)	(0.00237)*	(0.00244)	(0.00240)	(0.00245)	(0.00233)
Mathematics and Computer Science in HE at 19 (3)	-0.000457	-0.00152	-0.00120	-0.00200	-0.00236	-0.00272
	(0.00291)	(0.00324)	(0.00331)	(0.00328)	(0.00333)	(0.00335)
Number of Schools that Take on Triple Science	192	144	138	132	129	126
Number of Schools that Drop Triple Science	145	74	68	67	66	62

* p<0.10 **<0.05 ***<0.01

(1) Conditional on having been entered for A Level or equivalent qualifications; (2) Conditional on having been entered for examination in the subject; (3) Conditional on being in HE at 19.

ANNEX B: Description of Variables Included in Regressions

EXPLANATORY VARIABLES					
Individual Socio-Demographics					
Variable	Description	Unique Values	Mean	Min	Max
female	Dummy for whether individual is female.	2	0.494	0	1
fsm_reg	Dummy for whether individual was on Free School Meals at age 15. Missing values have been set to 0.	2	0.138	0	1
fsm_missing	Dummy for whether FSM information is missing.	2	0.001	0	1
quartile1	Dummy for whether individual lived in 25% most deprived areas. Omitted category is for individuals living in 25% least deprived areas.	2	0.248	0	1
quartile2	Dummy for whether individual lived in 25% second most deprived areas. Omitted category is for individuals living in 25% least deprived areas.	2	0.248	0	1
quartile3	Dummy for whether individual lived in 25% second least deprived areas. Omitted category is for individuals living in 25% least deprived areas.	2	0.248	0	1
quartilem	Dummy for whether area deprivation information was missing.	2	0.009	0	1
eth_w_oth	Dummy for whether individual belonged to White Other ethnic group. Omitted category is White UK.	2	0.022	0	1
eth_a_ind	Dummy for whether individual belonged to Asian Indian ethnic group. Omitted category is White UK.	2	0.025	0	1
eth_a_pak	Dummy for whether individual belonged to Asian Pakistani ethnic group. Omitted category is White UK.	2	0.024	0	1
eth_a_ban	Dummy for whether individual belonged to Asian Bangladeshi ethnic group. Omitted category is White UK.	2	0.009	0	1
eth_a_oth	Dummy for whether individual belonged to Asian Other ethnic group. Omitted category is White UK.	2	0.003	0	1
eth_b_car	Dummy for whether individual belonged to Black Caribbean ethnic group. Omitted category is White UK.	2	0.014	0	1
eth_b_afr	Dummy for whether individual belonged to Black African ethnic group. Omitted category is White UK.	2	0.013	0	1
eth_b_oth	Dummy for whether individual belonged to Black Other ethnic group. Omitted category is White UK.	2	0.006	0	1
eth_chi	Dummy for whether individual belonged to Chinese ethnic group. Omitted category is White UK.	2	0.004	0	1
eth_mix	Dummy for whether individual belonged to Mixed ethnic group. Omitted category is White UK.	2	0.009	0	1
eth_oth	Dummy for whether individual belonged to Other ethnic group. Omitted category is White UK.	2	0.057	0	1
eth_w_oth _86	Dummy for whether individual belonged to Other ethnic group AND to the 1986 cohort. Omitted category is White UK.	2	0.009	0	1
eth_a_ind _86	Dummy for whether individual belonged to Other ethnic group AND to the 1986 cohort. Omitted category is White UK.	2	0.012	0	1
eth_a_pak _86	Dummy for whether individual belonged to Other ethnic group AND to the 1986 cohort. Omitted category is White UK.	2	0.012	0	1
eth_a_ban _86	Dummy for whether individual belonged to Other ethnic group AND to the 1986 cohort. Omitted category is White UK.	2	0.005	0	1
eth_a_oth _86	Dummy for whether individual belonged to Other ethnic group AND to the 1986 cohort. Omitted category is White UK.	2	0.003	0	1
eth_b_car _86	Dummy for whether individual belonged to Other ethnic group AND to the 1986 cohort. Omitted category is White UK.	2	0.007	0	1
eth_b_afr _86	Dummy for whether individual belonged to Other ethnic group AND to the 1986 cohort. Omitted category is White UK.	2	0.007	0	1
eth_b_oth _86	Dummy for whether individual belonged to Other ethnic group AND to the 1986 cohort. Omitted category is White UK.	2	0.002	0	1
eth_chi _86	Dummy for whether individual belonged to Other ethnic group AND to the 1986 cohort. Omitted category is White UK.	2	0.002	0	1
eth_mix _86	Dummy for whether individual belonged to Other ethnic group AND to the 1986 cohort. Omitted category is White UK.	2	0.009	0	1
eth_oth _86	Dummy for whether individual belonged to Other ethnic group AND to the 1986 cohort. Omitted category is White UK.	2	0.032	0	1
sen	Dummy for wether individual had Special Educational Needs	2	0.160	0	1
sen_86	Dummy for wether individual had Special Educational Needs AND belonged to the 1986 cohort.	2	0.074	0	1
language_reg	Dummy for whether individual had a mother tongue other than English. Missing values set to zero.	2	0.089	0	1
language_missing	Dummy for whether information on the individual's mother tongue was missing.	2	0.001	0	1
_Imob_2	Dummy for being born in February. Omitted category is January.	2	0.081	0	1
_Imob_3	Dummy for being born in March. Omitted category is January.	2	0.087	0	1
_Imob_4	Dummy for being born in April. Omitted category is January.	2	0.084	0	1
_Imob_5	Dummy for being born in May. Omitted category is January.	2	0.087	0	1
_Imob_6	Dummy for being born in June. Omitted category is January.	2	0.080	0	1
_Imob_7	Dummy for being born in July. Omitted category is January.	2	0.084	0	1
_Imob_8	Dummy for being born in August. Omitted category is January.	2	0.084	0	1
_Imob_9	Dummy for being born in September. Omitted category is January.	2	0.081	0	1
_Imob_10	Dummy for being born in October. Omitted category is January.	2	0.083	0	1
_Imob_11	Dummy for being born in November. Omitted category is January.	2	0.081	0	1
_Imob_12	Dummy for being born in December. Omitted category is January.	2	0.082	0	1

Individual Attainment					
Variable	Description	Unique Values	Mean	Min	Max
ks2_e_level_reg	Individual attainment in KS2 English test. Missing values set to zero.	259	3.818	0	6.58
ks2_e_level_miss	Dummy for whether individual attainment in KS2 English test is missing.	2	0.101	0	1
ks2_m_level_reg	Individual attainment in KS2 Mathematics test. Missing values set to zero.	271	3.821	0	6.90
ks2_m_level_miss	Dummy for whether individual attainment in KS2 Mathematics test is missing.	2	0.092	0	1
ks2_s_level_reg	Individual attainment in KS2 Science test. Missing values set to zero.	237	3.936	0	6.89
ks2_s_level_miss	Dummy for whether individual attainment in KS2 Science test is missing.	2	0.091	0	1
ks3_e_level_reg	Individual attainment in KS3 English test. Missing values set to zero.	240	4.954	0	9.73
ks3_e_level_miss	Dummy for whether individual attainment in KS3 English test is missing.	2	0.082	0	1
ks3_m_level_reg	Individual attainment in KS3 Mathematics test. Missing values set to zero.	1,122	5.407	0	9.95
ks3_m_level_miss	Dummy for whether individual attainment in KS3 Mathematics test is missing.	2	0.052	0	1
ks3_s_level_reg	Individual attainment in KS3 Science test. Missing values set to zero.	689	5.111	0	9.78
ks3_s_level_miss	Dummy for whether individual attainment in KS3 English test is missing.	2	0.055	0	1

Year Group Socio-Demographics					
Variable	Description	Unique Values	Mean	Min	Max
class_female	Proportion of year group who are female.	2,772	0.494	0	1.00
class_fsm_reg	Proportion of year group who are on Free School Meals. Missing values set to zero.	3,722	0.138	0	1.00
class_fsm_miss	Dummy if FSM information for entire year group is missing.	2	0.000	0	1
class_q1	Proportion of year group who come from 25% most deprived areas.	4,166	0.248	0	1.00
class_q2	Proportion of year group who come from 25% second most deprived areas.	4,216	0.248	0	1.00
class_q3	Proportion of year group who come from 25% second least deprived areas.	4,192	0.248	0	1.00
class_qm	Proportion of year group with missing information on area deprivation.	950	0.009	0	1.00
class_w_oth	Proportion of year group from White Other ethnic group.				
class_a_ind	Proportion of year group from Asian Indian ethnic group.	1,402	0.025	0	1.00
class_a_pak	Proportion of year group from Asian Pakistani ethnic group.	1,322	0.024	0	0.91
class_a_ban	Proportion of year group from Asian Bangladeshi ethnic group.	788	0.009	0	1.00
class_a_oth	Proportion of year group from Asian Other ethnic group.	540	0.003	0	0.29
class_b_car	Proportion of year group from Black Caribbean ethnic group.	1,193	0.014	0	0.82
class_b_afr	Proportion of year group from Black African ethnic group.	1,031	0.013	0	1.00
class_b_oth	Proportion of year group from Black Other ethnic group.	848	0.006	0	1.00
class_chi	Proportion of year group from Chinese ethnic group.	606	0.004	0	0.11
class_mix	Proportion of year group from Mixed ethnic group.	1,065	0.009	0	0.35
class_oth	Proportion of year group from Other ethnic group.	2,006	0.057	0	1.00
class_sen	Proportion of year group with Special Educational Needs.	3,731	0.160	0	0.86
class_language_reg	Proportion of year group with mother tongue other than English.	2,517	0.090	0	1.00
class_language_miss	Dummy if information on mother tongue us missing for entire year group.	2	0.000	0	1.00

Year Group Attainment					
Variable	Description	Unique Values	Mean	Min	Max
class_ks2_e_reg	Average KS2 English attainment of year group.	6,216	4.238	0	5.31
class_ks2_e_miss	Dummy for KS2 English attainment missing for entire year group.	2	0.000	0	1.00
class_ks2_m_reg	Average KS2 Mathematics attainment of year group.	6,219	4.201	0	5.71
class_ks2_m_miss	Dummy for KS2 Mathematics attainment missing for entire year group.	2	0.000	0	1.00
class_ks2_s_reg	Average KS2 Science attainment of year group.	6,213	4.322	0	5.29
class_ks2_s_miss	Dummy for KS2 Science attainment missing for entire year group.	2	0.000	0	1.00
class_ks3_e_reg	Average KS3 English attainment of year group.	6,220	5.377	0	7.78
class_ks3_e_miss	Dummy for KS3 English attainment missing for entire year group.	2	0.000	0	1.00
class_ks3_m_reg	Average KS3 Mathematics attainment of year group.	6,224	5.691	0	8.30
class_ks3_m_miss	Dummy for KS3 Mathematics attainment missing for entire year group.	2	0.000	0	1.00
class_ks3_s_reg	Average KS3 Science attainment of year group.	6,223	5.393	0	7.78
class_ks3_s_miss	Dummy for KS3 Science attainment missing for entire year group.	2	0.000	0	1.00

School Resources					
Variable	Description	Unique Values	Mean	Min	Max
yr11_fte_pupils_reg	Number of Full-Time Equivalent pupils in individual's school when s/he is in year 11.	1,543	1112.5	0	2624.0
yr11_fte_pupils_miss	Dummy if information on FTE pupils in individual's school is missing.	2	0.000	0	1.00
yr11_fte_qualteach_reg	Number of Full-Time Equivalent qualified teachers in individual's school when s/he is in year 11.	962	65.8	0	148.2
yr11_fte_qualteach_miss	Dummy if information on FTE qualified teachers in individual's school is missing.	2	0.000	0	1.00
yr11_fte_othteach_reg	Number of Full-Time Equivalent other teachers in individual's school when s/he is in year 11.	185	2.4	0	37.2
yr11_fte_othteach_miss	Dummy if information on FTE other teachers in individual's school is missing.	2	0.382	0	1.00
yr11_fte_tech_reg	Number of Full-Time Equivalent technicians in individual's school when s/he is in year 11.	146	5.1	0	21.8
yr11_fte_tech_miss	Dummy if information on FTE technicians in individual's school is missing.	2	0.146	0	1.00

DEPENDENT VARIABLES					
Variable	Description	Unique Values	Mean	Min	Max
out_alevel	Whether individual attained equivalent of 2 Vocational or Academic A Level passes.	2	0.328	0	1.00
out_l3_bio	Whether individual took A Level Biology.	2	0.050	0	1.00
out_l3_bio_a	Whether individual attained a grade A in A Level Biology.	2	0.011	0	1.00
out_l3_che	Whether individual took A Level Chemistry.	2	0.036	0	1.00
out_l3_che_a	Whether individual attained a grade A in A Level Chemistry.	2	0.010	0	1.00
out_l3_mat	Whether individual took A Level Mathematics.	2	0.052	0	1.00
out_l3_mat_a	Whether individual attained a grade A in A Level Mathematics.	2	0.018	0	1.00
out_l3_phy	Whether individual took A Level Physics.	2	0.028	0	1.00
out_l3_phy_a	Whether individual attained a grade A in A Level Physics.	2	0.007	0	1.00
out_he_19	Whether individual is doing a 1st Degree at the age of 19.	2	0.279	0	1.00
out_russell_19	Whether the individual is studying in a Russell Group institution at 19.	2	0.058	0	1.00
out_stem_19	Whether the individual is studying a STEM 1st Degree at 19.	2	0.108	0	1.00
out_he_bio_19	Whether the individual is studying a 1st Degree in Biological Sciences at 19.	2	0.027	0	1.00
out_he_eng_19	Whether the individual is studying a 1st Degree in Engineering and Technology at 19.	2	0.011	0	1.00
out_he_mat_19	Whether the individual is studing a 1st Degree in Mathematics and Computer Science.	2	0.017	0	1.00
out_he_med_19	Whether the individual is studying a 1st Degree in Medicine, Dentistry and Veterinary Science at 19.	2	0.008	0	1.00
out_he_phy_19	Whether the individual is studying a 1st Degree in Physical Sciences in HE at 19.	2	0.012	0	1.00

ANNEX C: Analysis on Sub-Sample of Pupils for Whom the KS3 and KS4 Establishments Were the Same

Notes: Table reproduces Table 10 on sub-sample of pupils for whom the KS3 and KS4 establishments were the same.

		(1)	(2)	(3)	(4)	(5)	(6)	(7)
Two A Level Passes	Triple Science	0.121	0.0806	0.0224	0.0161	0.00705	0.00416	0.00195
	(s.e.)	(0.00687)***	(0.00516)***	(0.00240)***	(0.00232)***	(0.00216)***	(0.00213)*	(0.00269)
Took A Level Biology (1)	Triple Science	0.0218	0.0209	-0.00204	-0.00299	-0.00398	-0.00429	0.00378
	(s.e.)	(0.00332)***	(0.00321)***	(0.00260)	(0.00264)	(0.00266)	(0.00267)	(0.00399)
Took A Level Chemistry (1)	Triple Science	0.0256	0.0247	0.000858	0.000736	-0.000373	-0.000186	0.00697
	(s.e.)	(0.00311)***	(0.00293)***	(0.00209)	(0.00208)	(0.00210)	(0.00212)	(0.00327)**
Took A Level Physics (1)	Triple Science	0.0301	0.0223	0.00461	0.00494	0.00513	0.00508	0.00409
	(s.e.)	(0.00278)***	(0.00227)***	(0.00171)***	(0.00169)***	(0.00167)***	(0.00169)***	(0.00269)
Took A Level Mathematics (1)	Triple Science	0.0417	0.0336	-0.00201	-0.0000842	0.00326	0.00327	0.00991
	(s.e.)	(0.00409)***	(0.00349)***	(0.00239)	(0.00234)	(0.00230)	(0.00229)	(0.00354)***
Grade A in A Level Biology (2)	Triple Science	0.0700	0.0662	0.00890	0.00855	0.00864	0.00994	0.00618
	(s.e.)	(0.00770)***	(0.00728)***	(0.00501)*	(0.00489)*	(0.00477)*	(0.00482)**	(0.0102)
Grade A in A Level Chemistry (2)	Triple Science	0.0889	0.0800	0.0209	0.0204	0.0181	0.0190	0.0112
	(s.e.)	(0.00943)***	(0.00892)***	(0.00659)***	(0.00635)***	(0.00620)***	(0.00625)***	(0.0131)
Grade A in A Level Physics (2)	Triple Science	0.0843	0.0775	0.0105	0.00962	0.00957	0.0107	0.0304
	(s.e.)	(0.00927)***	(0.00898)***	(0.00601)*	(0.00611)	(0.00597)	(0.00596)*	(0.0145)**
Grade A in A Level Mathematics (2)	Triple Science	0.0748	0.0682	0.00299	-0.000473	-0.000811	-0.000243	-0.00249
	(s.e.)	(0.00875)***	(0.00827)***	(0.00565)	(0.00569)	(0.00580)	(0.00583)	(0.0117)
In HE at 19	Triple Science	0.103	0.0725	0.0234	0.0167	0.00442	0.00303	0.00344
	(s.e.)	(0.00631)***	(0.00481)***	(0.00238)***	(0.00223)***	(0.00191)**	(0.00191)	(0.00242)
In a Russell Group Institution at 19 (3)	Triple Science	0.0696	0.0571	0.0172	0.0102	0.00105	0.00132	0.00382
	(s.e.)	(0.00605)***	(0.00564)***	(0.00364)***	(0.00339)***	(0.00329)	(0.00327)	(0.00454)
STEM in HE at 19 (3)	Triple Science	0.00882	0.00255	-0.00941	-0.00411	-0.000115	0.000837	0.00678
	(s.e.)	(0.00296)***	(0.00286)	(0.00285)***	(0.00279)	(0.00278)	(0.00278)	(0.00563)
Biological Sciences in HE at 19 (3)	Triple Science	-0.000369	-0.00124	-0.00312	-0.00187	-0.0000163	0.000177	-0.00185
	(s.e.)	(0.00143)	(0.00140)	(0.00142)**	(0.00145)	(0.00149)	(0.00149)	(0.00348)
Medicine, Dentistry and Veterinary Sciences in HE at 19 (3)	Triple Science	0.00825	0.00791	0.00207	0.000895	-0.000954	-0.000698	-0.000670
	(s.e.)	(0.00123)***	(0.00119)***	(0.000946)**	(0.000913)	(0.000919)	(0.000921)	(0.00158)
Physical Sciences in HE at 19 (3)	Triple Science	0.00617	0.00252	-0.00207	-0.00102	0.000126	0.000206	0.00166
	(s.e.)	(0.00113)***	(0.00102)**	(0.00101)**	(0.00100)	(0.000999)	(0.00101)	(0.00241)
Engineering and Technology in HE at 19 (3)	Triple Science	0.00482	0.00107	-0.000899	-0.000135	0.000472	0.000654	0.00304
	(s.e.)	(0.00120)***	(0.000952)	(0.000937)	(0.000923)	(0.000923)	(0.000924)	(0.00211)
Mathematics and Computer Science in HE at 19 (3)	Triple Science	-0.00455	-0.00485	-0.00531	-0.00172	0.000460	0.000506	-0.00112
	(s.e.)	(0.00138)***	(0.00122)***	(0.00123)***	(0.00114)	(0.00115)	(0.00115)	(0.00296)

* p<0.10 **<0.05 ***<0.01 (1) Conditional on having been entered for A Level or equivalent qualifications; (2) Conditional on having been entered for examination in the subject; (3) Conditional on being in HE at 19.

ANNEX D: Effect of Triple Science on English

In this Annex, I look at what effect offering Triple Science has (if any) on the take-up of, and attainment in, English at A Level. I look at English, English Language and English Literature[xxviii]. Although intended as a falsification exercise, it is not a perfect one because the effects are not necessarily easy to predict – especially for attainment in English.

The effect on take-up of English is relatively straightforward to analyse from a theoretical perspective. If offering Triple Science makes pupils more likely to choose science subjects at A Level, than this will have to come at the expense of some other subject. This could be English (in which case we would expect the effect of offering Triple Science on the take-up of English to be negative) or some other, more "marginal" subjects like History, Geography, Economics or Psychology (in which case the effect on English should be zero). Either way, we would not expect the effect to be positive: it would be counter-intuitive if offering Triple Science increased the take-up of English at A Level, and this would throw some serious doubt on the results obtained so far. In this sense, re-running the analysis with as outcome variable the take-up of English at A Level serves as a nice falsification exercise which can be used as a further robustness check.

By contrast, the effect of offering Triple Science on attainment in English is more difficult to predict. This is because more intense study of the sciences may increase pupils' ability all-round, and have positive spill-over effects on other subjects outside Science and Mathematics as well. By contrast, it could also be the case that offering Triple Science leads the brightest students to go on to study science at A Level, leaving the slightly lesser able ones to go on and study English, in which case we would expect a negative effect of offering Triple Science on attainment in English at A Level. A negative effect of offering Triple Science on attainment in English is also compatible with the idea that offering Triple Science means pupils are less well-prepared for the study of other subjects (remember that offering Triple Science often means that some other subjects will have to taken off the curriculum in order to free some resources).

In Table D1 below, I present the coefficients on the "Triple Science" variable in regressions similar to specification (7) in Table 10, but where the outcome variables are now the likelihood of taking the various English A Levels, as well as attainment in those A Levels conditional on having taken them. The results which show the effect on the take-up of English are very encouraging: not a single one is statistically significant. The results on attainment in English mostly suggest no effect at all, although there is a marginally significant (10% confidence level) and negative effect on the likelihood of attaining a Grade A in English. Interestingly, abstracting away from the significance of the coefficients, it is worth noting that they are all negative.

Table D1: Effect of Triple Science on Take-up of, and Attainment in, English at A Level

Notes: Table shows coefficients on Triple Science for a series of regressions similar to those in specification (7) of Table 10, but where the outcome variables are now the likelihood of taking English A Levels, and of attaining a grade A in them.

Took A Level English (1)	Triple Science	-0.00114
	(s.e.)	(0.00323)
Took A Level English Literature (1)	Triple Science	-0.000593
	(s.e.)	(0.00459)
Took A Level English Language (1)	Triple Science	-0.000428
	(s.e.)	(0.00375)
Grade A in A Level English (2)	Triple Science	-0.0241
	(s.e.)	(0.0137)*
Grade A in A Level English Literature (2)	Triple Science	-0.0132
	(s.e.)	(0.00984)
Grade A in A Level Language (2)	Triple Science	-0.00140
	(s.e.)	(0.0110)

* p<0.10 **<0.05 ***<0.01

(1) Conditional on having been entered for A Level or equivalent qualifications.
(2) Conditional on having been entered for examination in the subject.

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Notes

[1] From 2006 onwards, these qualifications were replaced by "GCSE Science", "GCSE Additional Science" and "GCSE Separate Sciences" – but the concept of intensity of study still applies to these in the same way as it did to Single, Double and Triple Science.

[2] Latest figures are for 2008.

[3] Note that these figures are for all schools, including independent ones. Many independent school pupils will enter iGCSE science rather than a GCSE qualification. In addition, the figures are based on pupils achieving a grade in a science subject, and not all do. Together, these two categories account for around 7% of the cohort. The remaining 17% will take a variety of other science qualifications, mainly vocational ones like "Additional Applied", BTEC/OCR, Double Applied (VGCSE) and GNVQ.

[4] STEM covers the following subject groupings of the Joint Academic Coding System (JACS: Medicine and Dentistry, Subjects Allied to Medicine (which includes Nursing), Biological Sciences, Veterinary Sciences, Agriculture and Related Subjects, Physical Sciences, Mathematical and Computer Sciences, Engineering, Technologies, and Architecture, Building and Planning. For more information about the JACS, see http://www.hesa.ac.uk/index.php?option=com_content&task=view&id=158&Itemid=233.

[5] Although, according to OECD statistics, the UK fares rather well compared to most of its competitors when one looks at the number of science graduates per 100,000 25 to 34 year olds (OECD Education at a Glance 2008, Table A3.6) or the number proportion of the 20 to 64 year old population with Level 4 qualifications in Science, Engineering and Agriculture (OECD Education at a Glance 2008, Table A1.4).

[6] Key Stage 3 is the legal term for the three years of schooling in maintained schools in England and Wales, normally known as Year 7, Year 8 and Year 9, when pupils are aged between 11 and 14. At the end of this stage, pupils are assessed as part of the national programme of National Curriculum Assessment. Until 2008 this involved a series of externally-marked tests. However, from 2009, this will be based on on-going teacher assessment, with results for each school being published in performance tables.

[7] The DCSF spend around £3m per year to fund the Triple Science Support Programme (TSSP) delivered by the Learning and Skills Network (http://www.triplescience.org.uk/). The TSSP provides a range of support to schools wanting to deliver/access triple science learning.

[8] The sixth form (or Key Stage 5) is the final (optional) two years of secondary schooling when students are sixteen to eighteen years of age and normally prepare for their A Level examinations. The term is used to describe the final two years spent in a secondary school as opposed to a sixth form college where students start at age sixteen after leaving secondary school.

[9] Key Stage 2 refers to the four years of schooling in maintained schools in England, normally known as Year 3, Year 4, Year 5 and Year 6, when pupils are aged between 7 and 11. At the end of this stage, pupils are tested as part of the national programme of National Curriculum Tests, colloquially known as SATs. These tests cover English, Mathematics and Science.

[10] Key Stage 3 is the legal term for the three years of schooling in maintained schools in England, normally known as Year 7, Year 8 and Year 9, when pupils are aged between 11 and 14. At the end of this stage, pupils aged 14 - in Year 9 - are assessed as part of the national programme of National Curriculum assessment, including in English, Mathematics and Science.

[11] Key Stage 4 corresponds to the two final years of compulsory education when pupils are aged 15-16 and at the end of which they sit their GCSEs.

[12] The dataset holds detailed information on the Advanced Level General and Vocational Certificates of Education (GCE A Level and VCE A Level, respectively). These are the main qualifications sat by young people in England in Key Stage 5 (the two years of post-compulsory education for students aged 16-18. Unfortunately, the dataset does not hold any information on other, equivalent qualifications such as National Vocational Qualifications (NVQs), BTEC other vocational qualifications.

[13] Unless they have had a spell in the maintained sector. Around 7% of school children in England are educated in the independent sector.

[14] This gets rid of 144 observations in the 1985 cohort, and 227 observations in the 1986 cohort.

[15] I am grateful to the authors for providing me with the Stata syntax they used to derive these continuous KS2 and KS3 measures of prior attainment.

[16] Note that I have also experimented with standardising these prior attainment variables, and that this makes no substantial difference to the results presented in this paper. I have chosen to stick to non-standardised measures of prior attainment because of the implicit assumptions about changes in attainment between cohorts that are made by standardised measures of attainment.

[17] HE in this paper is defined as 1st Degree courses in Higher Education Institutions only. In other words, it excludes "other" undergraduate programmes such as Foundation Degrees, as well as 1st Degree courses at Further Education Colleges offering Higher Education courses. Note that 1st Degree courses are the main type of course taken at Undergraduate level, and are considered as the "traditional" form of HE.

[18] The Russell Group is an association of 20 major research-intensive universities of the United Kingdom. These include the universities of: Birmingham, Bristol, Cambridge, Cardiff, Edinburgh, Glasgow, Leeds, Liverpool, Manchester, Newcastle, Nottingham, Oxford, Sheffield, Southampton, as well as Imperial College London, King's College London, the London School of Economics and Political Science, Queen's University Belfast and University College London. For more information, visit: http://www.russellgroup.ac.uk/.

[19] Note that many of my outcome variables are conditional on having attained another outcome first. So, for example, when I look at the likelihood of attaining a grade A in A Level Physics, this is conditional on having entered an examination in that

subject. This means my analysis is open to the objection that there are possibly some selection issues at play which may lead to some bias in my results. The standard way to get around this issue would be to model the selection procedure separately and then adjust for selection in the outcome equation. However, this procedure relies on finding a credible exclusion restriction which should appear in the selection equation, but not in the outcome equation. Unfortunately, such variables were not available in my dataset.

[20] This is due to the fact that Computer Science is more likely to be taken by students from lower socio-economic backgrounds with lower prior attainment.

[21] Month of birth has been linked to various educational outcomes, including participation in HE. In the UK context, see HEFCE (2005), Crawford, Dearden and Meghir (2007) and Crawford and Dearden (2008).

[22] Note that, in effect, the estimation strategy is a difference-in-differences one, where changes in outcomes in the treatment schools are compared to changes in outcomes in non-treatment schools. The difference in these changes is attributed to the Triple Science programme.

[23] I use the same methodology as used by the DCSF to identify schools that offer Triple Science: i.e. as long as at least one pupil in the school enters exams in all three separate science subjects, then the school is considered to be offering Triple Science. Using this methodology, there is a slight problem in identifying schools that do not offer Triple Science, however. This is because a school might be offering Triple Science, but no pupil decides to take it on. In this case, a school would be wrongly classified as not offering Triple Science. In Annex A, I describe two robustness checks I carried out to test the extent to which the conclusions drawn in this paper are sensitive to how Triple Science schools are identified. First, I check whether in schools that start/stop offering Triple Science there is a simultaneous drop/increase in the number of pupils taking Double Science (the next best alternative to Triple Science). I find that this is indeed the case. Second, I increase the threshold for identifying schools that offer Triple Science from one pupil to two/three/four/five/six pupils, and re-run my analysis. The results of this analysis are slightly different from the main results presented in this paper – and one would expect them to be, as they are identified using a different set of schools. However, the overall conclusion that offering Triple Science has positive effects on later outcomes still holds.

[24] Results are shown in Annex C.

[25] Although not a perfect falsification exercise, I did look at the effect of offering Triple Science on English at A Level. The full analysis is presented in Annex D to this paper. In brief, the results are not counterintuitive, and I certainly do not find a positive effect of offering Triple Science on the likelihood of taking up English at A Level – which is what one would expect.

[26] See, for example, O'Leary and Sloane (2005), PWC (2005) and Chevalier (2009).

[27] IDACI measures the proportion of children under the age of 16 in an area living in low income households. It is a supplementary index to the Indices of Multiple Deprivation and is given at super output area level. Further information is available from http://www.communities.gov.uk/.

[xxviii] There are three different options available for studying English at A Level: English Literature, English Language, or English (which is a combination of English Language and English Literature into one subject).